QUEANBEYAN-PALERANG REGIONAL COUNCIL

Council Meeting Attachment

27 FEBRUARY 2019

ITEM 12.7 IWCM STRATEGY - PALERANG COMMUNITIES

ATTACHMENT 2 INTEGRATED WATER CYCLE MANAGEMENT STRATEGY - PALERANG COMMUNITIES

NSW GOVERNMENT | Public Works Advisory

Queanbeyan-Palerang Regional Council

Integrated Water Cycle Management Strategy

Palerang Communities

Report Number: WSR - 18058

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QPRC

A division of the Department of Finance, Services and Innovation

Queanbeyan-Palerang Regional Council

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Version	Author	Reviewer	Approved for Issue	
			Name	Date
1.0	Glenn Fernandes	M Sundar	Glenn Fernandes	28/09/2018
2.0	Glenn Fernandes	M Sundar	Glenn Fernandes	11/10/2018

Glenn Fernandes

Principal Engineer – Planning (Water Utilities)

Level 3 Foreshore Building

66 Harrington Street

The Rocks NSW 2000

T: 02 9240 8751

E: glenn.fernandes@finance.nsw.gov.au

W: www.publicworksadvisory.nsw.gov.au

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Executive Summary

Introduction

The Integrated Water Cycle Management (IWCM) Strategy addresses six elements of the Best-Practice Management of the Water Supply and Sewerage Framework. It is a local water utility's (LWU's) 30-year strategy for the provision of appropriate, affordable, cost-effective and sustainable urban water services that meet community needs and protect public health and the environment. Preparation of an IWCM Strategy will also enable Council to comply with the NSW Government's Best-Practice Management of the Water Supply and Sewerage Framework.

The development of Council's IWCM has followed the Department of Industry - Water (DI Water) methodology outlined in the IWCM Strategy Check List (July 2014). The following studies have been completed to date.

- **IWCM Issues Paper** – identifying the IWCM Issues
- **IWCM Options and Scenario Analysis Paper** – assessing the options to address the issues and evaluating the IWCM scenarios.

This IWCM Strategy report contains a summary of all the outcomes. It outlines the adopted IWCM Scenario and includes a Total Asset Management Plan (TAMP) and a Financial Plan (FP).

Water Supply and Sewerage Schemes

Palerang community sits within three catchments namely Murrumbidgee Catchment, Shoalhaven Catchment and Lake George Catchment. All three of the major townships are within different catchments. There are three water supply schemes in the former Palerang LGA, servicing Braidwood, Bungendore and Captains Flat. Together the three schemes supply treated water to an estimated serviced population of over 5,700. Two of the schemes source their water from surface based supplies while the other is sourced from groundwater.

Palerang has three sewerage schemes servicing townships of Bungendore, Braidwood and Captains Flat. The other much smaller rural villages, as well as the considerable rural residential and rural areas in Palerang are serviced by on-site sewage management systems.

Population and Demographic Projections

The major factor contributing to growth in the former Palerang LGA are proposed major Greenfield developments at Bungendore which is expected to more than double the population of Bungendore over the next 10 years. The dwelling growth rates nominated by Council for Braidwood and Captains Flat are 1.2 and 0.2 percent respectively. Dwelling growth in Bungendore is estimated to currently be 10.0 percent, which is expected to decrease exponentially to around 1.1 percent by 2046.

Table S.1 shows the population projection for each service area.

Table S.1: Population projection for each service area

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Water	3,148	5,039	6,905	8,554	9,904	10,952	11,734
	Sewerage	3,130	5,022	6,887	8,536	9,887	10,934	11,717
Braidwood	Water	1,062	1,129	1,200	1,276	1,356	1,441	1,532
	Sewerage	965	1,032	1,103	1,179	1,259	1,344	1,434
Captains Flat	Water	426	431	436	440	445	450	455
	Sewerage	402	407	411	416	421	426	431

The IWCM Issues

The key issues impacting on the Palerang Communities' water supply schemes are outlined in **Table S.2**, **Table S.3** and.

Table S.2: General IWCM System Issues

Issue Type	Target for Compliance	Issue
Work Health and Safety (WHS)	Management System	Council does not have a documented Work and Health and Safety system. Council undertakes periodic WHS reviews but these are not documented
Levels of Service	Description and performance	There is no centralised data management system in place to monitor and measure the system performance against the levels of service (LOS) The LOS need to be reviewed for the newly formed Queanbeyan-Palerang Regional Council.
Best Practice	Pricing	Council currently has a two tier inclining block tariff structure for water supply. Council should consider moving towards a fixed rate tariff structure.

Table S.3: Water Supply System Issues

Issue Type	Target for Compliance	Issue
General water supply issues		
Level of Service	Minimum pressure with firefighting capability	Council have nominated 'positive residual head' as the target for compliance, the current performance needs to be better understood through modelling.
Regulatory	Fluoridation of Public Water Supplies	The requirement for periodic auditing of the fluoridation systems is not always being met.
Regulatory	Drinking Water Management System	Several of the nominated CCPs in the DWMS are not considered CCPs like free chlorine in the reticulation. The turbidity alert limit corrective action for Captains Flat WTP needs to include a membrane integrity test.
Bungendore water supply issues		
Performance	Non-revenue water	Non-revenue water at Bungendore has been fairly constant at 125 L/connection/ day. This is higher than the state wide median of 92 L/connection/day for 2015/16.
Water security	Licensed allocation	It is estimated that Bungendore water supply dry year extraction will exceed its licensed extraction limit from the Bungendore and Currandooly bores by 2018.
Level of Service	Headworks capacity	The peak day demand will exceed the combined capacity of the Bungendore and Currandooly WTPs around 2025. The WTP, and reservoir capacity would need to be reviewed to ensure that the required pressure can be maintained in the system.
Braidwood water supply issues		
Performance	Non-revenue water	Non-revenue water at Braidwood is on average 280 L/connection/ day. This is higher than the state wide median of 92 L/connection/day for 2015/16.

Issue Type	Target for Compliance	Issue
Captains Flat water supply system		
Performance	Non-revenue water	Seasonal variations in the NRW for the Captains Flat system have been noticed which are due to a faulty meter at the Captains Flat swimming pool and the neighbouring fields which share a meter. This meter recently been replaced.

Table S.4: Sewerage System Issues

Issue Type	Target for Compliance	Issue
General sewerage system issues		
Unserviced communities	On-site sewage management systems	Village of Majors Creek – potential issue due to the following reasons: • Small lot sizes (some around 3,000 & several around 1,000 m^2) • Inadequate buffer distance from Majors Creek • Moderately well to imperfectly drained soil Village of Nerriga – potential issue due to the following reasons: • Small lot sizes (various sizes below 3,000 m^2) • Some properties may have inadequate buffer distance from Bindi Brook Village of Araluen – potential issue due to the following reasons: • Small lot sizes (several properties less than 1,500 m^2 bordering each other) • Moderately permeable, imperfectly drained soil.
Bungendore sewerage system issues		
Best Practice	Section 60 approval	Effluent from the Bungendore STP is reused on-site, for road works (truck filling) and for watering Bungendore oval. Council does not have a Recycled Water Management Plan and Section 60 approval for the off-site effluent reuse.
		The Log Reduction Value (LRV) required for effluent reuse may not be achieved through the current STP process. This will be reviewed during the preparation of the Recycled Water Management System (RWMS) for Section 60 approval.
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit in 2016, 2014, 2012 and 2011. Council needs to consider undertaking an inflow/infiltration study.
Performance	Effluent reuse flow balance	There is a mismatch in the effluent reuse flow balance. Potential reasons for the discrepancy could include uncalibrated meters, and on-site flows which may not be metered.
Sewer catchment performance	Pump sizing @ PWWF	The PWWF at catchment #2, 8 and 9 exceeds the capacity of a single pump. The PWWF at catchments #4 will exceed the capacity of a single pump by 2021. This is based on a PWWF calculated from the storm allowance which is twice the maximum flow recorded during the highest rainfall event in the last five years. Hence this is a conservative assessment.
	Odour/septicity potential	Catchment #7 and 8 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. This risk is expected to continue over the 30 year planning period.

Issue Type	Target for Compliance	Issue
Capacity	Sewage Treatment Plant	The EP load currently exceeds the 3,000 EP STP capacity, and is expected to exceed the 5,000 EP capacity by 2020. For the assessed hydraulic loading of 200 L/EP/day in this study, the plant hydraulic and capacity will be exceeded by: • 2018 for the 3,000 EP STP, or 2023 when capacity is increased to 5,000 EP by commissioning the second IDEA reactor.
Braidwood sewerage system issues		
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.
Sewer catchment performance	Pump sizing	The PWWF at catchment #1 will exceed the capacity of a single pump by 2021.Council has funded for an upgrade.
	Odour/septicity potential	Catchment #3, and 5 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. The risk for Catchment #5 is expected to drop to low risk by 2020, however Catchment #3 is expected to remain at medium risk.
Captains Flat sewerage system issues		
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.
Sewer catchment performance	Pump sizing	The PWWF at catchment #1 is expected to exceed the duty pump capacity.
Performance	Sewage Treatment Plant	The plant needs to be upgraded to improve replace ageing infrastructure, improve treatment and enable enhanced phosphorus removal, enable screening and grit removal, improve sludge and sludge drying components and improve amenity and WHS.

Shire-Wide IWCM Scenarios

Feasible options to address the IWCM issues were evaluated and assessed. The shortlisted options were combined in to three Shire-wide IWCM Scenarios (Table S1). The scenarios address all the identified issues.

All the scenarios have common management system measures which relate to data and information management. The scenarios may be modified to reflect the priorities and preferences of individual communities and as a result of additional information and knowledge becoming available from ongoing investigations.

Table S1 provides a summary of the measures included in each scenario.

Target for compliance	Issue	Option	Scenario 1	Scenario 2	Scenario 3
Water Security and headworks capacity Level of Service	The dry year demands exceed the current licensed entitlement. The peak day demand will exceed the combined capacity of the Bungendore and Currandooly WTPs around 2025.	**Water Supply Option 1** – Extraction from Lachlan Fold Belt source followed by Bungendore alluvial source.	✓ Stage 1 2019 Stage 2 2032	-	-
		Water Supply Option 2 – Extraction from Lachlan Fold Belt source only.	-	✓ Stage 1 2019 Stage 2 2032	-
		Water Supply Option 3 – Bulk supply from ICON Water	-	-	✓ 2019
Capacity – Sewage Treatment Plant	Bungendore STP hydraulic capacity will be exceeded by around 2024 for the existing 6,000 EP STP (@200 L/EP/d).	**STP Option 1** – 6,000 EP STP Upgrade (@200 L/EP/d)	✓ 2024	✓ 2024	✓ 2024

Figure S1 presents the forecast combined water supply and sewerage typical residential bills for the three IWCM scenarios.

For the purpose of Triple Bottom Line (TBL) analysis, a total of seven environmental and social targets have been used to score the IWCM Scenarios as to how they address the IWCM Issues. Suitable weightings were assigned to the criteria. Table S2 shows the outcome of the TBL analysis for each IWCM Scenario. Refer to Section 12.4 for more details.

Table S2: IWCM Scoring Ranking

	Scenario 1	Scenario 2	Scenario 3
Total Present Value @ 7% ($M)	28.6	29.6	59.9
Environmental and Social Scores (ESS)	7.1	6.3	4.8
ESS/$M	0.25	0.21	0.08
Ranking	**1**	**2**	**3**

Whilst Scenario 1 has the highest score on a TBL assessment basis, due to the risks and uncertainties in obtaining additional water licence entitlement for alluvial groundwater source in this scenario, IWCM Scenario 2 is recommended for adoption. The structure of the Scenarios provides Council with a 10-year timeframe before a decision on the Stage 2 augmentation is made and this is within the 8-year review cycle of the IWCM Strategy.

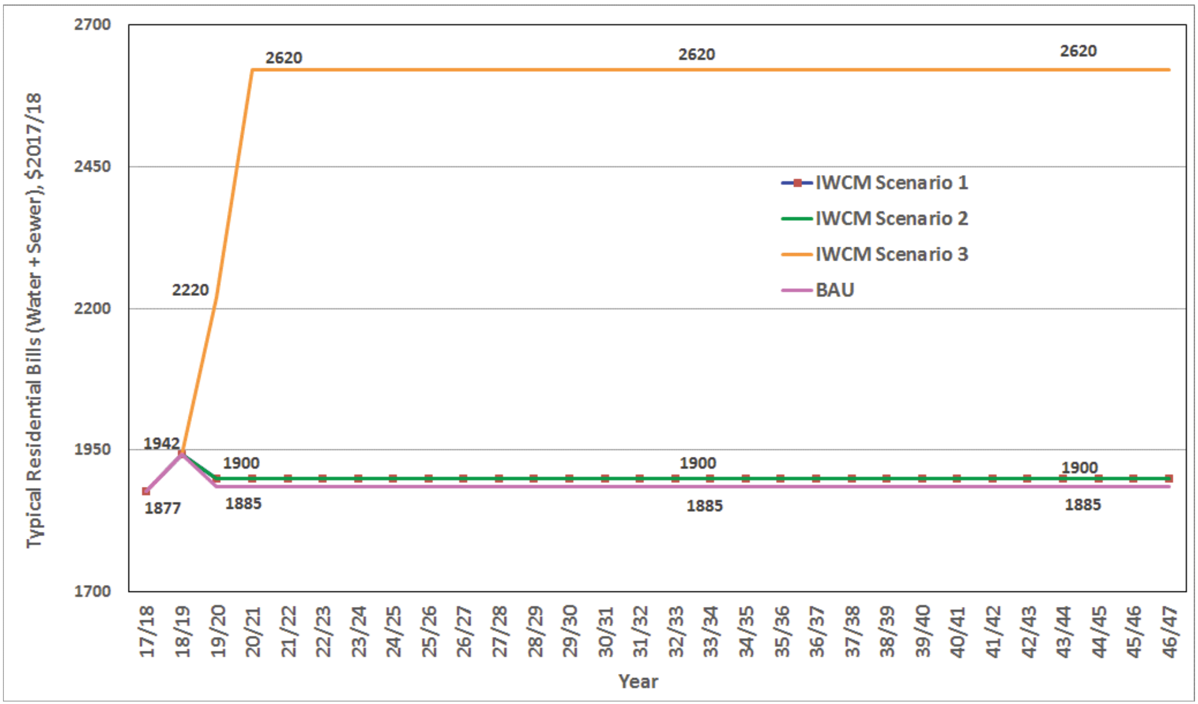

Figure S1: Combined Water + Sewerage TRBs for IWCM Scenarios

Long-term Financial Plans

Financial models for the water and sewer funds of the Palerang Community for the adopted IWCM strategy have been developed to forecast the lowest, sustainable price path for the water supply and sewerage services on which to base Council's tariff structure. All costs and revenues in the input data and the model outcomes are in 2017/18 dollars unless stated otherwise.

The adopted IWCM scenario does not consider government grant or subsidy for any of the planned capital works for the financial modelling purposes. The financial projections need to be reviewed annually with respect to material changes to the proposed capital works program and/or changes to any of the underlying assumptions.

The 2017/18 water supply TRB of $855 p.a. has been increased to $920 (inflated $945 p.a.) for the year 2018/19 as per the adopted Revenue Policy. The water fund financial model has demonstrated that the 2018/19 TRB needs to be increased to $1,000 p.a. (inflated $1050 p.a.) from 2019/20 onwards and can be maintained at that level for the remaining forecast years with ongoing annual adjustments for CPI / inflation. The levels of TRB, cash and borrowing outstanding during the forecast period for the water fund are depicted in Figure S2 below. More detailed discussions on the water fund financial model forecasts are presented in Section 14.5.

The 2017/18 sewerage TRB of $1,022 p.a. has been adjusted for CPI to $1,045 and adopted for 2018/19. The sewer fund financial model for the adopted IWCM scenario shows that the sewerage TRB can be can be reduced to $900 p.a.(inflated $945) from 2019/20 onwards and maintained at that level for the remainder of the forecast period. The levels of TRB, cash and borrowing outstanding during the forecast period for the sewer fund are depicted in the Figure S3. More detailed discussions on the sewer fund financial model forecasts are presented in Section 14.6.

Strategy Review Cycle

The IWCM Strategy is developed for a planning period of 30 years and is subject to a 4-yearly review cycle. The key assumptions and the renewals plan is reviewed during the 4-year mid-term review. A new strategy is developed after 8 years.

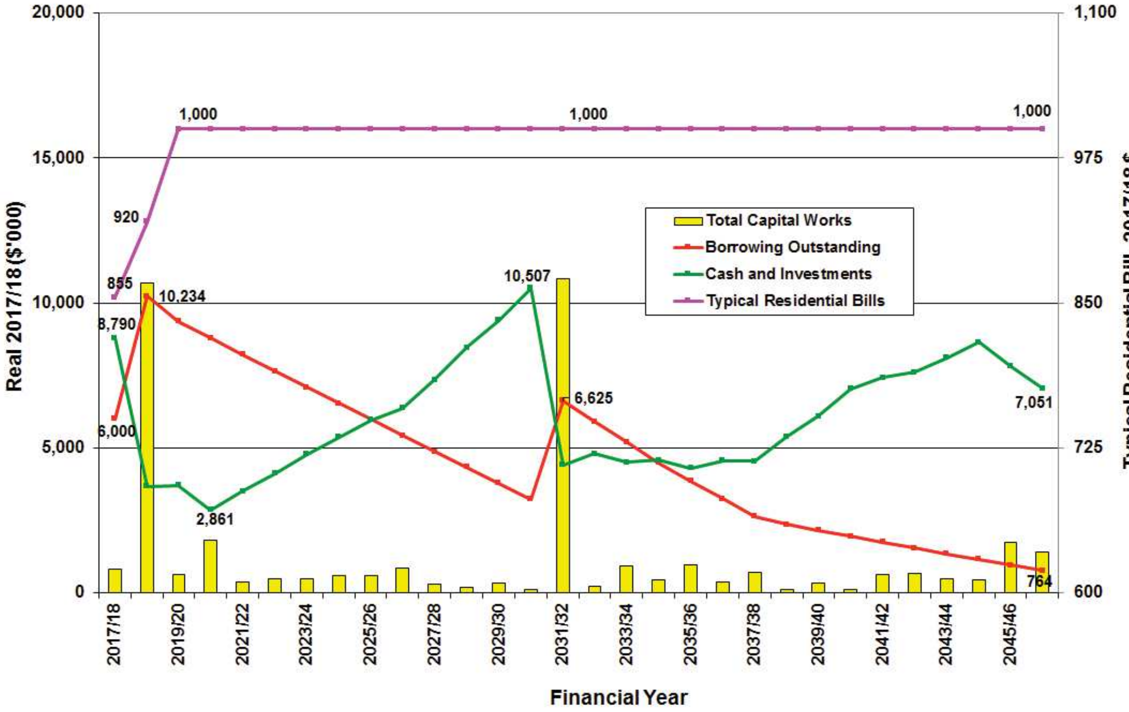

Figure S2: Water Fund Financial Model Forecasts for the adopted IWCM Scenario

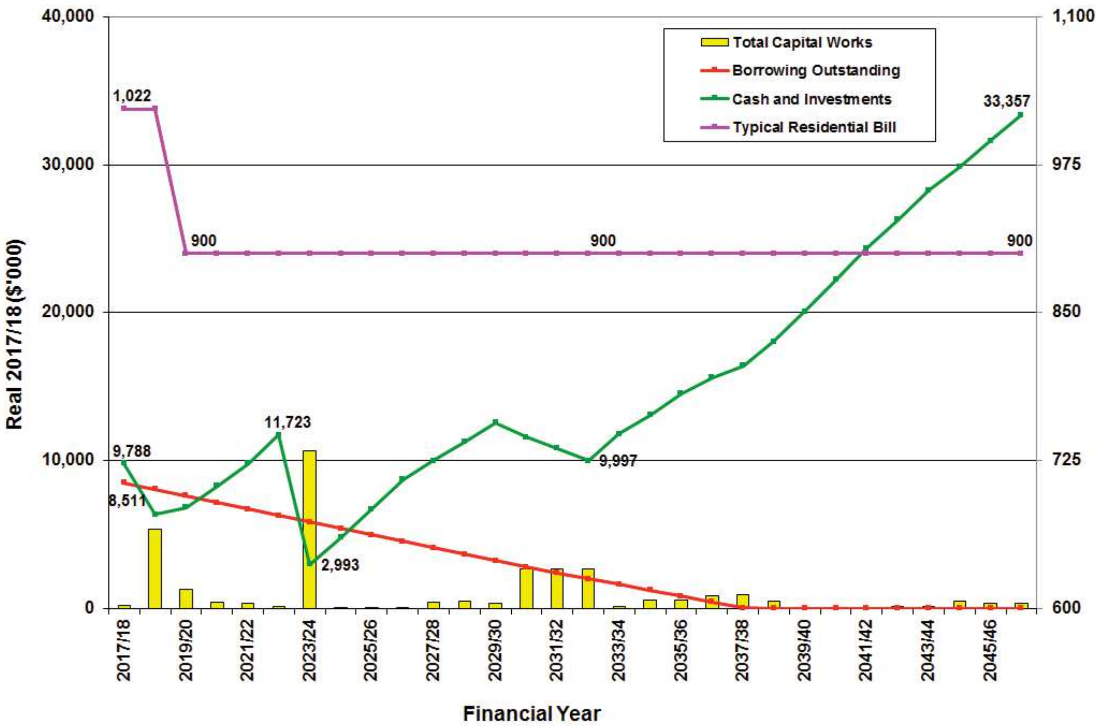

Figure S3: Sewer Fund Financial Model Forecasts for the adopted IWCM Scenario

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1 Context

The Office of Local Government's Integrated Planning and Reporting (IP&R) framework allows NSW councils to draw their various plans together, understand how they interact and get the maximum leverage from their efforts by planning holistically and sustainably for the future. The IP&R Framework requires Councils to have a long-term Resourcing Strategy for the provision of resources required to implement the strategies established by the Community Strategic Plan. The strategy must include provisions for:

- Long term financial planning
- Workforce management planning and
- Asset management planning

Councils that have responsibility for water supply and sewerage infrastructure need to comply with the requirements and timeframes of the NSW Government's Best Practice Management of Water Supply and Sewerage framework set by the Department of Industry (DoI) Water. Accordingly, a Local Water Utility's (LWU's) peak planning documents for its water supply and sewerage businesses are its current Integrated Water Cycle Management (IWCM) Strategy and its current Strategic Business Plan (SBP). The IWCM Strategy and SBP need to be prepared every 8 years on a rotation of every 4 years. The outputs of an IWCM Strategy are the Total Asset Management Plan (TAMP) and the 30-year Financial Plan (FP). Council's IWCM Strategy therefore becomes its Resourcing Strategy for Water Supply and Sewerage. The interaction between the IP&R Framework and the IWCM process is shown in Figure 1.1.

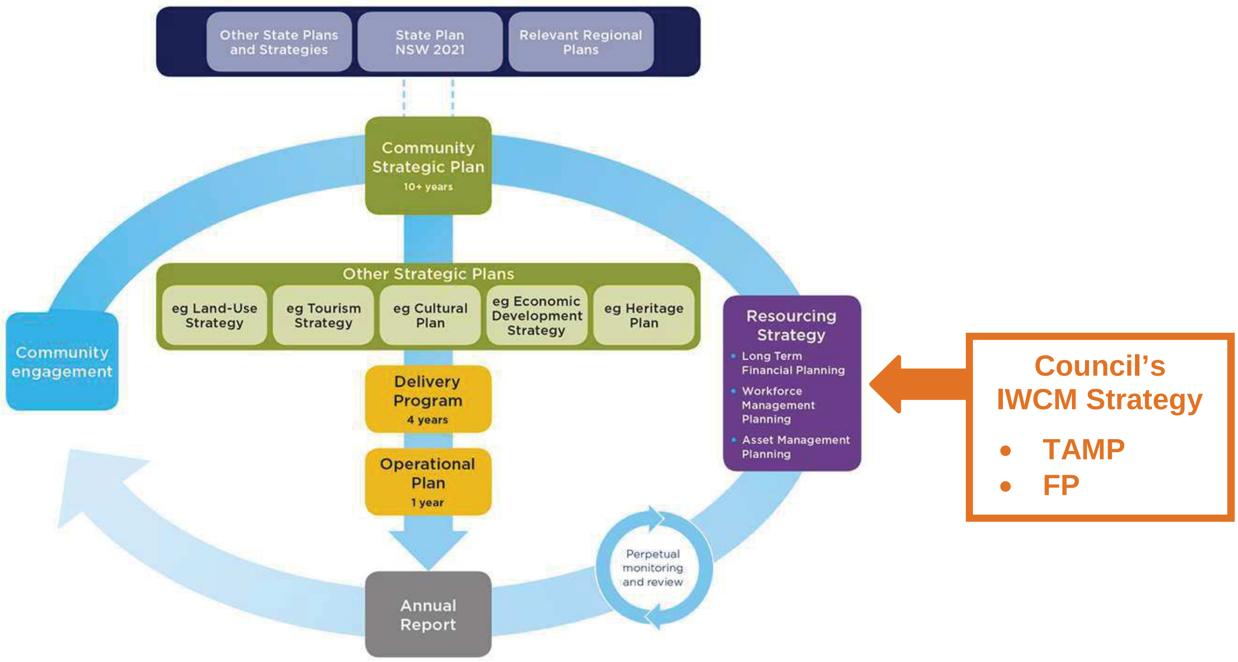

Figure 1.1: Interaction of IWCM Strategy with IP&R Framework

2 Introduction

2.1 Overview

The Integrated Water Cycle Management (IWCM) Strategy addresses six elements of the Best-Practice Management of Water Supply and Sewerage Framework and is a local water utility's (LWU's) 30-year strategy for the provision of appropriate, affordable, cost-effective and sustainable urban water services that meet community needs and protect public health and the environment.

The IWCM Strategy:

- Sets the objectives and performance indicators for the Water & Sewer business
- Identifies the needs
- Right sizes' infrastructure
- Determines the priority
- Identifies the best-value 30-year IWCM scenario on a triple bottom line basis.

2.2 Background to Queanbeyan-Palerang Regional Council's IWCM Strategy

In May 2016, Palerang Council amalgamated with Queanbeyan City Council to form the Queanbeyan-Palerang Regional Council (QPRC). The former Palerang Council commissioned the preparation of an IWCM Strategy to cover the water supply and sewerage areas of the Palerang Community. There is potential for significant growth in the town of Bungendore if the water supply and sewerage infrastructure can be augmented to service this growth.

2.3 Progress

The development of Council's IWCM has followed the DI Water methodology outlined in the IWCM Strategy Check List (July 2014). The following studies have been completed to date.

- **IWCM Issues Paper**

  This report identified and outlined the current and 30-year projected issues relating to Council's regulatory requirements, growth, levels of service (LOS), and performance of Council's water supply and sewerage services. The Issues paper addresses Tasks 1 to 8 of the IWCM Check List and is provided in Appendix A.

- **IWCM Options and Scenario Analysis Paper**

  This report assessed options to address the issues identified in the Issues Paper, and used the Triple Bottom Line (TBL) criteria to evaluate and shortlist the individual options for subsequent bundling into scenarios.

  Following the evaluation and shortlisting of options IWCM Scenarios were created using a mix of options that together, address the urban water service issues. The Scenarios were evaluated to identify the scenario which provides the best value for money taking full account of the social, environmental and economic considerations.

  The Options Review and Scenario Analysis Paper addresses Tasks 9, 10, 11 and 12 of the IWCM Check List and is provided in Appendix B.

This IWCM Strategy report contains a summary of all the outcomes. It outlines the adopted IWCM Scenario and includes a Total Asset Management Plan (TAMP) and a Financial Plan (FP).

3 Description

3.1 Overview

Palerang is located in south-eastern New South Wales, immediately to the east of Canberra. The area is predominantly rural, with some rural-residential areas and a number of small towns and villages. Palerang, with a population of 15,897 (2015 Estimated Residential Population), encompasses an area of 5,140 square kilometres. The major town is Bungendore, followed by Braidwood and then Captains Flat. The rural land is used mainly for cattle and sheep grazing, forestry, orchards and vineyards. Tourism is also an important industry (Source: Palerang Asset Management Plan, September 2013).

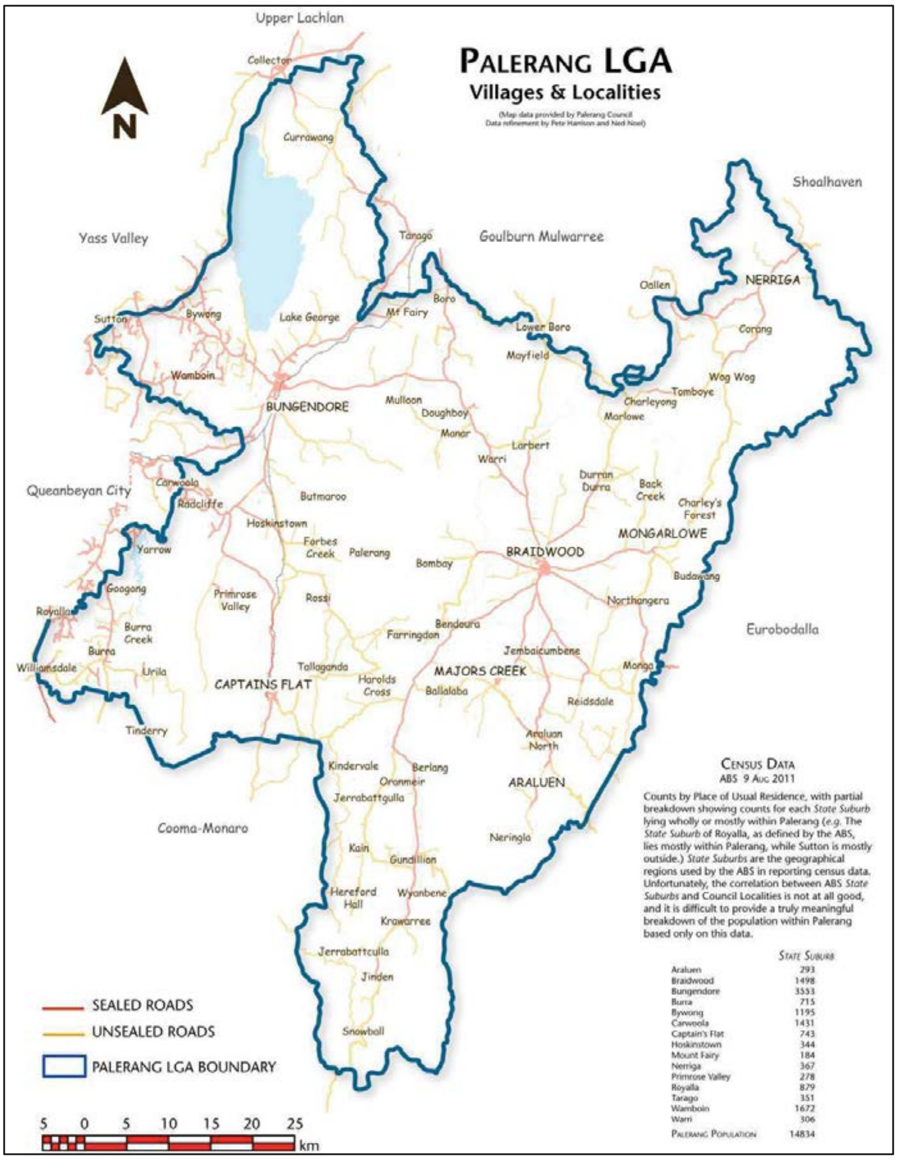

Figure 3.1: Palerang community LGA map

3.2 Water Catchments

The Palerang community sits within three catchments namely Murrumbidgee Catchment, Shoalhaven Catchment and Lake George Catchment. All three of the major townships are within different catchments.

3.2.1 Lake George catchment

The town of Bungendore is located within the southern parts of the Lake George Catchment. The catchment has an area of 950 square kilometres, with the lake itself occupying 16 per cent of this area. Grazing accounts for 76 per cent of all land use in the catchment, which is also home to tourism and wine growing industries. Lake George catchment is labelled as area number 5 in Figure 3.2

3.2.1 Murrumbidgee catchment

The Murrumbidgee catchment in southern NSW has many significant wetland habitats of international ecological importance and a diverse climate, ranging from the alpine conditions of the Snowy Mountains to the semi-arid conditions of the Riverina Plains.

The catchment is 84,000 square kilometres, with land use dominated by extensive agriculture and grazing occupying 64 per cent of the catchment. Major water users include local councils and water utilities, forestry, tourism, and agriculture, including rice, dairy, wool, wheat, beef, lamb, grapes and citrus.

The only town within the Palerang community that is within the Murrumbidgee catchment is Captains Flat located in the far-east of the catchment. The Murrumbidgee catchment is shown in Figure 3.2

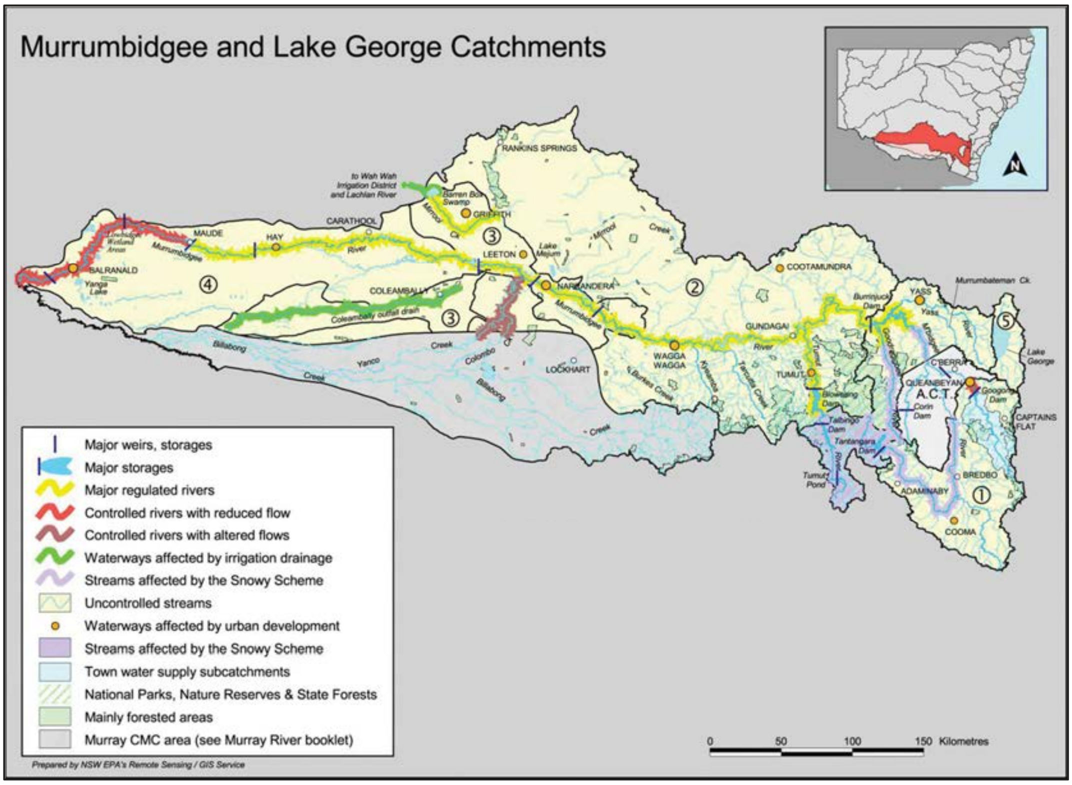

Figure 3.2: Murrumbidgee and Lake George catchments

3.2.1 Shoalhaven catchment

The Shoalhaven catchment is located in the New South Wales upper South Coast and has an area of 7,300 square kilometres. The region is well known for its fresh produce sourced from local farms and dairies, and for its beef cattle, wool and other agriculture essential to the NSW economy.

Cattle and sheep grazing is the largest single land use. The catchment also supports horse studs, piggeries, dairies and poultry production as well as vineyards, olive groves, and canola and cereal crops. Cleared grazing land covers 36 per cent of the catchment, along with large areas of national parks (31 per cent) and forests (27 per cent). Rainfall generally increases from the south-west near Cooma to the north-east near Robertson.

The upper Shoalhaven catchment had been modified substantially which resulted in degradation in both aquatic and terrestrial systems. Agriculture and mining have contributed to this process particularly through the removal of timber to drive steam engines and for construction. The Shoalhaven catchment covers 5,640 square kilometres - more than one-third of Sydney's drinking water catchment. The Shoalhaven Catchment is shown in Figure 3.3.

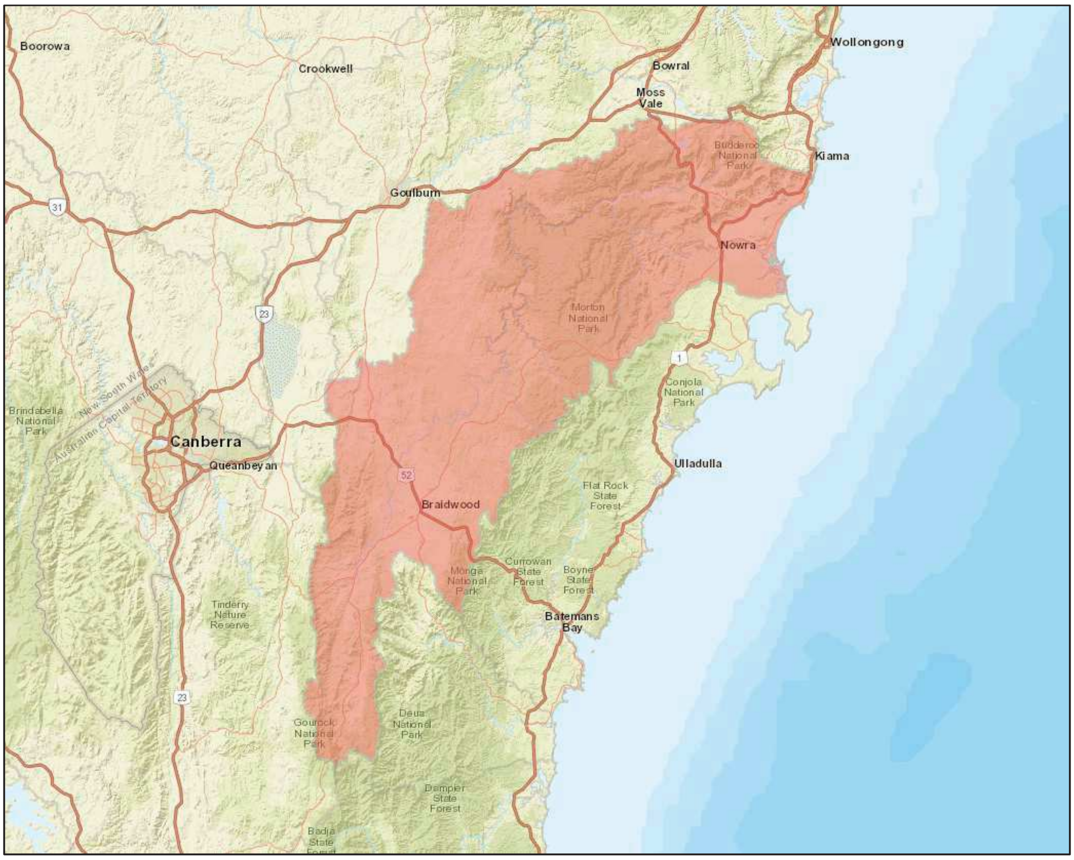

Figure 3.3: Shoalhaven catchment

4 Description of Urban Water Services

4.1 Water Supply System

There are three water supply schemes in the former Palerang LGA, servicing Braidwood, Bungendore and Captains Flat. Together the three schemes supply treated water to an estimated serviced population of over 5,700. Two of the schemes source their water from surface based supplies while the other is sourced from groundwater.

4.1.1 Water access licenses

The Water Access Licences (WAL) held by Council issued under the Water Management Act 2000 given in Table 4.1. All Nominated works have the use purpose of “Town Water Supply”.

Table 4.1: Water Access Licence Details

Licence Number	Water Source	Nominated Works	Allocation	Expiration Date
WAL 32742	Bungendore Alluvial Groundwater Source **Turallo Borefield**	40CA412631 4 x Bores	272 ML/year	15-Aug-2022
WAL 36260	Bungendore Alluvial Groundwater Source **Currandooly Borefield**	40CA415918 1 x Bore	200 ML/year	13-Aug-2037
WAL 25376	Shoalhaven River Water Source **Braidwood**	10CA102425 2 x 100 mm Centrifugal Pump 1 x Overshot Dam	360 ML/year	30-Jun-2021
WAL 36281	Molonglo Water Source **Captains Flat**	40CA415962 1 x Diversion Pipe 1 x 80 mm Centrifugal Pump 1 x Overshot Dam	250 ML/year	22-May-2028

4.1.2 Bungendore Water Supply Scheme

The current Bungendore water supply scheme consists of the original water supply scheme at Bungendore and a recently commissioned supplementary water supply scheme at Currandooly. The Bungendore water supply scheme draws water from the Bungendore Alluvial ground water source and comprises of:

- Four bores with a total extraction capacity of 4.5 ML/d on a 22-hour basis
- A raw water intake at the Bungendore Alluvial ground water source.
- An aeration tower at the Bungendore WTP with a collection tank and fluoride dosing
- Chlorination for disinfection.
- A clear water pumping station that pumps water to the Bungendore township prior to storage in three reservoirs.

The Currandooly water supply scheme draws water from a bore source and comprises of:

- A raw water intake at the Currandooly bore.

- A conventional clarifier and sand filter system WTP with a clear water transfer system and chemical dosing facilities consisting of caustic soda, potassium permanganate, alum and fluoride dosing.
- Chlorination for disinfection.
- A clear water pumping station that pumps water to the Days Hill reservoir and Turallo reservoirs 1 and 2 after reticulation through the Elmslea Estate and Bungendore township.

4.1.3 Braidwood Water Supply Scheme

The Braidwood water supply scheme draws water from an off-stream storage dam filled by the Shoalhaven River and comprises of:

- River intake pumps with a capacity of 1.38 ML/d (24-hour operation)
- A raw water intake pumped from the off-stream dam with a provision for PAC dosing when required.
- A dissolved air flotation (DAF) and dual media gravity filtration WTP with a clear water tank and chemical dosing facilities consisting of alum, caustic soda and fluoride dosing.
- Chlorination for disinfection.
- A clear water pumping station that pumps water to three reservoirs at the WTP site prior to distribution to the Braidwood township.

4.1.4 Captains Flat Water Supply Scheme

The Captains Flat water supply scheme draws water from a dam on the Molonglo River and comprises of:

- A raw water intake pumped from the Captains Flat dam
- An ultra-membrane filtration WTP with a clear water tank and chemical dosing facilities consisting of caustic soda, polyaluminium chloride and fluoride dosing.
- Chlorination for disinfection.
- A clear water pumping station that pumps water to Keating's reservoirs 1 and 2 prior to distribution to Captains Flat and Beverly Hills townships.

Design capacities for Bungendore, Braidwood and Captains Flat water supply schemes are given in Table 4.2.

Table 4.2: Water supply scheme capacities

Unit	Bungendore Water Supply [1]		Braidwood Water Supply		Captains Flat Water Supply	
	Design Flow	Design Capacity	Design Flow	Design Capacity	Design Flow	Design Capacity
Raw Water Intake	75 L/s[1]	-	16 L/s	-	8 L/s	-
Raw Water Pumping Station	75 L/s[1]	-	16 L/s	-	8 L/s	-
Water Treatment Plant	-	5.2 ML/d	-	2 ML/d	-	0.7 ML/d
Clear Water Pump	65 L/s	-	-	-	-	-

Reservoir storage	-	4.56 ML	-	2.6 ML	-	0.88 ML

1 – Combined capacities from Bungendore and Currandooly bores within the Bungendore water supply scheme

4.2 Sewerage Schemes

Queanbeyan-Palerang Regional Council operates three sewage collection and treatment schemes in the former Palerang Shire: Bungendore, Braidwood and Captains Flat.

4.2.1 Bungendore Sewerage Scheme

The Bungendore sewerage scheme has a gravity reticulation system, incorporating a series of 10 sewage pumping stations (SPS) serving small areas within the catchment. The STP receives sewage flows through a series of rising mains from SPSs within the Bungendore township.

Bungendore STP is a 5,000 EP capacity STP that utilises two IDEA reactors for secondary treatment and chemical liquid alum to treat sewage. Effluent is disinfected by UV prior to discharge into Mill Post Creek. Effluent that is not discharged is chlorinated and used at the STP for on-site purposes and for off-site purposes at the truck fill station and potential irrigation of the Bungendore oval.

The SPS hierarchy diagram and pump rates are shown in Figure 4.1. A schematic diagram of Bungendore Sewerage Scheme is provided in Figure 4.2.

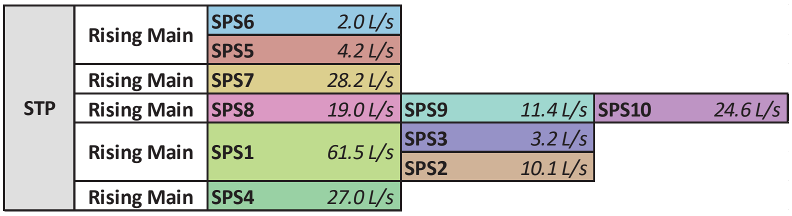

Figure 4.1 Bungendore SPS Hierarchy

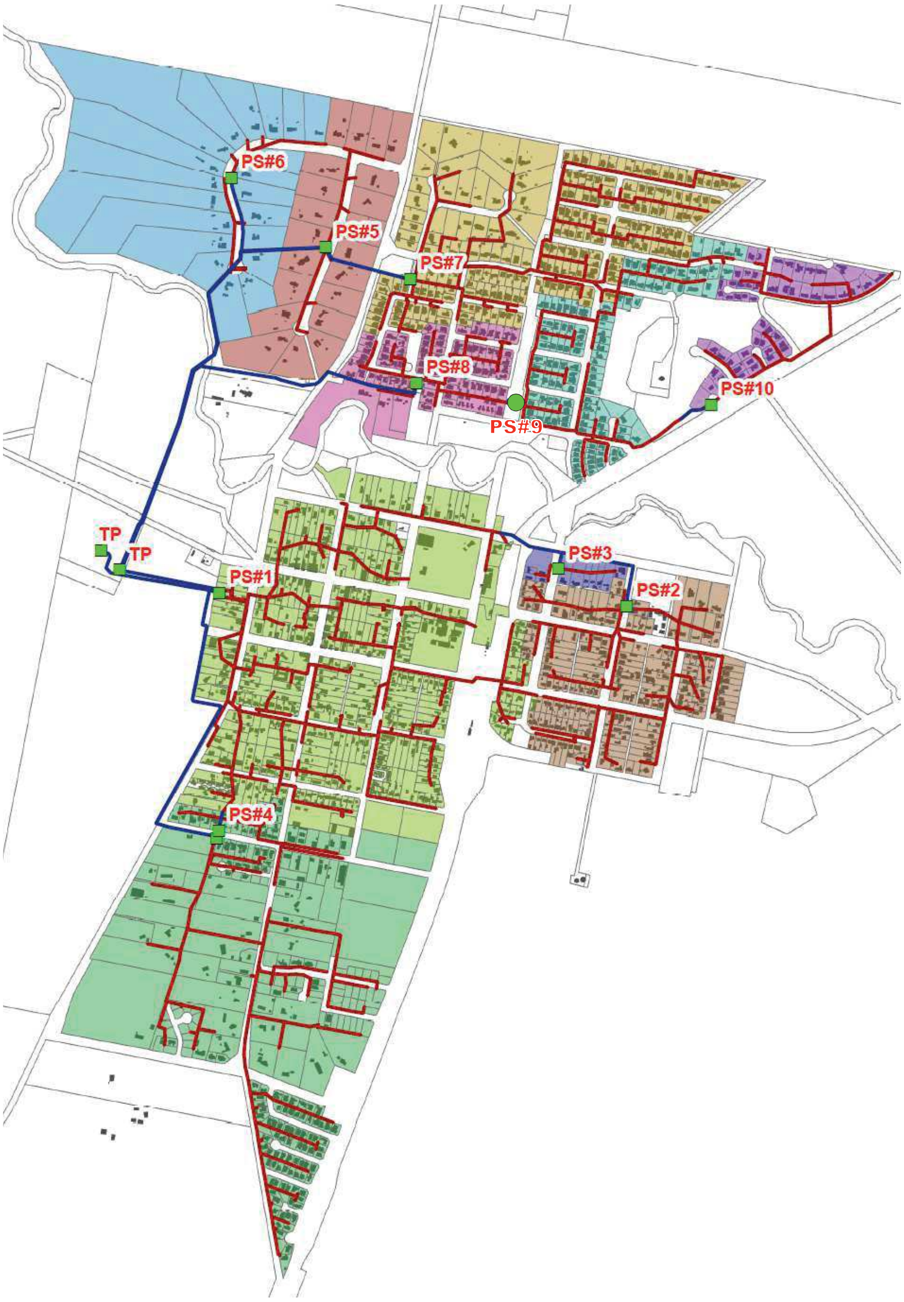

Figure 4.2 Bungendore Sewerage Schematic

4.2.2 Braidwood Sewerage Scheme

The Braidwood sewage collection system is a conventional gravity sewerage system comprising seven pumping stations. The STP receives sewage flows through a rising main from SPS 1.

The plant inflows are directed to the Inlet works via a rising main from SPS 1. Sewage flows greater than the Inlet works capacity overflows to the emergency storage pond.

Braidwood STP utilises one IDEA reactor for secondary treatment and chemical phosphorus removal to treat sewage. The STP has a civil and hydraulic capacity of 3,000 EP and electrical and mechanical equipment capacity for 2,000 EP. The effluent is disinfected via a UV unit prior to discharge to Flood Creek.

The Braidwood sewerage scheme with SPS pump rates are shown in Figure 4.3, and the SPS hierarchy is presented in Figure 4.4 with flow direction from left to right.

Figure 4.3: Braidwood sewerage scheme with SPS pump rates

<table>
<tr><td>SPS 3
4.0 L/s</td><td>SPS 2
20.0 L/s</td><td rowspan="4">SPS 1
38.0 L/s</td><td rowspan="4">Rising Main</td><td rowspan="4">STP</td></tr>
<tr><td></td><td>SPS 4
2.8 L/s</td></tr>
<tr><td>SPS 6
7.5 L/s</td><td>SPS 5
8.6 L/s</td></tr>
<tr><td></td><td>SPS 7
6.5 L/s</td></tr>
</table>

Figure 4.4: Braidwood SPS hierarchy

4.2.3 Captains Flat Sewerage Scheme

Captains Flat has a gravity reticulation system. All the sewage from the township gravity flows to the Captains Flat pump station. This pump station transfers raw sewage to the Captains Flat STP.

Captains Flat STP has a design capacity of 500 EP and is comprised of a Pasveer channel for secondary treatment. Treated effluent is discharged to the maturation ponds and then to the Molonglo River.

The Captains Flat sewerage scheme with SPS pump rates are shown in Figure 4.5, and the SPS hierarchy is presented in Figure 4.6 with flow direction from left to right.

Figure 4.5: Captains Flat sewerage scheme with SPS pump rates

SPS 1 *13.2 L/s*	**Rising Main**	**STP**

Figure 4.6: Captains Flat SPS hierarchy

4.3 Unserviced Areas

Council provided On-Site Sewage Management Systems (OSSMS) records from their internal Health and Building Department. Most of the areas listed are rural localities with large rural lots. Council staff advised there are few villages in the former Palerang LGA that are not connected to the town water supply or sewerage - Nerriga, Majors Creek and Araluen.

Of Council’s 4,538 registered OSSM systems, approximately 3,000 are septic tanks, 1,250 are Aerated wastewater treatment systems (AWTS), with the remainder being cesspits, dry or wet composting, greywater treatment or other. Approximately 250 received High Risk – two year approval, 3,900 received Medium Risk – five year approval, and 385 failed inspection. These failures could pose a serious environmental and public health threat. Almost all of the former Palerang area is part of a catchment supplying drinking water to Sydney, Canberra and local towns.

The OSSMS in Majors Creek and Araluen are performing well, with only 4 out of 114 OSSMs in Araluen and 9 out of 143 failing inspection. However, in Nerriga 16 out of 65 OSSMS (25%) are failing. In Captains Flat there are 66 OSSMS, 12 of which are failing. Some of these may be in the area known locally as Beverly Hills, which is supplied by water but not sewerage services.

5 Population and Demographic Projection

5.1 Overview

To develop a coherent IWCM strategy it is necessary to consider the rate at which the population is expected to grow, areas of potential growth, and the timing and rate of uptake of future developments. The town of Bungendore is expected to experience significant growth due to its proximity to Canberra. The major factor contributing to growth in the former Palerang LGA are proposed major Greenfield developments at Bungendore, which in addition to significant infill are expected to more than double the population of Bungendore over the next ten years.

Development is likely to initially occur in the approved Elmslea North and Bungendore East developments, with additional Greenfield land required in the future. The estimated dwelling growth distribution and timing for Bungendore is provided in Figure 5.1.

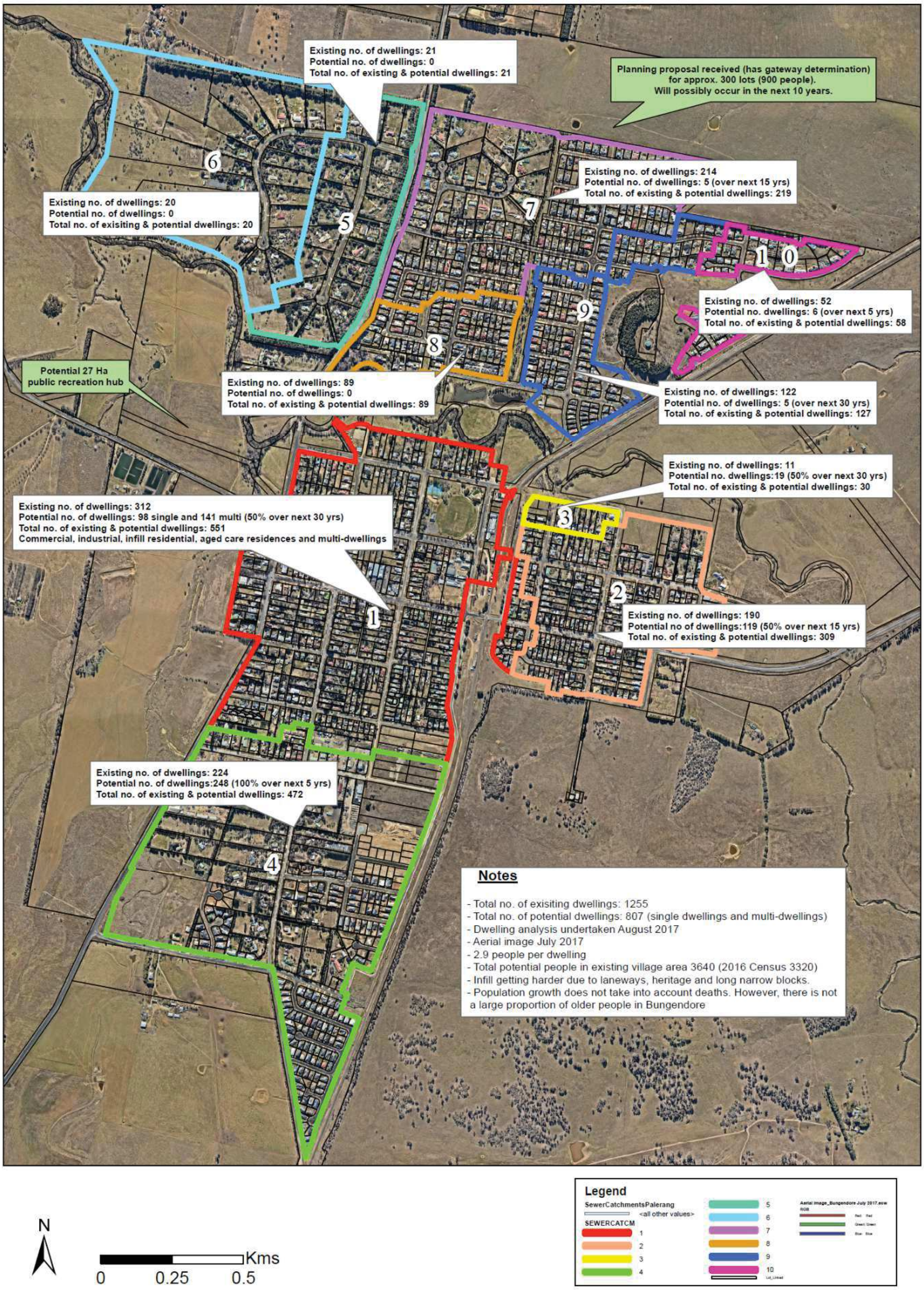

Figure 5.1: Growth Distribution in Bungendore

5.2 Population projections

The occupied residential property projection for each town is shown in Table 5.1, and the serviced population projection for each water supply and sewerage scheme is provided in Table 5.2.

Table 5.1: Occupied residential property projections

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Water	1,074	1,719	2,356	2,918	3,379	3,737	4,004
	Sewerage	1,068	1,713	2,350	2,912	3,373	3,731	3,998
Braidwood	Water	469	499	530	563	599	636	676
	Sewerage	426	456	487	520	556	593	633
Captains Flat	Water	193	195	197	199	202	204	206
	Sewerage	182	184	186	188	191	193	195

Table 5.2: Serviced residential population projections

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Water	3,148	5,039	6,905	8,554	9,904	10,952	11,734
	Sewerage	3,130	5,022	6,887	8,536	9,887	10,934	11,717
Braidwood	Water	1,062	1,129	1,200	1,276	1,356	1,441	1,532
	Sewerage	965	1,032	1,103	1,179	1,259	1,344	1,434
Captains Flat	Water	426	431	436	440	445	450	455
	Sewerage	402	407	411	416	421	426	431

6 Water Service Objectives

A list of objectives relevant to the management of the urban water services has been provided in Table 6.1 and Table 6.2 for consideration by Council staff. Each objective has one or more Service Standard (or Design Basis) drawn from legislation, best practice guidelines, and industry practice.

It should be noted that the objectives and targets would have a direct and significant influence on the future direction and management of the urban water services, hence allowing the identification of issues. Further it is noted that meeting agreed objectives and targets incurs cost, which needs to be recovered through typical residential bills and developer charges, and hence needs to be considered in the context of the community's preferences and ability to pay (i.e., affordability). Thus, it is expected that QPRC would use the draft list in its consultation with the PRG to establish through the consultation process an agreed set of objectives and the associated Key Performance Indicators (KPIs) and targets.

Table 6.1: Palerang Community – Water Supply Service Objectives and Targets – Draft

Objective	Service Standard (Design Basis)	Performance Indicator	Target
Water supply security			
Adequate potable water for current and future generations with reasonable level of restrictions	Surface Water - 5/10/10 rule based on 95th percentile dry year demands: • Water restrictions are in place for no more than 5% of the time • Water restrictions occur on average once every 10 years • During water restrictions, demand is reduced by 10%	• Frequency of restrictions • Total percentage duration of drought related restrictions • Average number of drought related Level 3 restrictions.	Not more often than once in 10 years To be finalised by Council To be finalised by Council
Water extraction licence limits not exceeded	Projected town water supply extraction is within the upper limit of the water extraction licence and meets any license conditions.	• Annual volume of water extracted (ML/year).	Captains Flat: 250 Braidwood: 360 Bungendore: 472
Drinking water quality			
Protects public health	• 100% compliance with the ADWG for health based parameters. • Compliance with the DWMS	• Number of boil water alerts • Non-compliances reported in annual DWMS audit.	Zero Zero
Aesthetically fit for purpose	% compliance with the ADWG for aesthetic parameters	Number of customer complaints: • Discoloured water complaints • Complaints of taste • Complaints of odour	 Zero Zero Zero
Reliability of supply infrastructure			
Limit supply interruptions	Asset condition rating (default rating 2)	Number of service interruptions due to asset failure – no/year/1000 tenements • Planned • Unplanned	 8 10

Objective	Service Standard (Design Basis)	Performance Indicator	Target
Maintain Continuous Service Availability	Workforce resourcing	Response time to incidents for 95% of occasions (hours) • During working hours • Out of working hours	 1. 2
Maintain adequate pressure	Treatment and distribution system capacity designed to supply 95th percentile Peak Day Demand. Minimum pressure at customer tap of 12 m when delivering 0.1 L/s and meeting the Peak Day Demand.	Number of incidents causing complaints about pressure.	To be finalised by Council
Provide adequate firefighting capability	System can supply 10 L/s for 4 hours when supplying peak day demands while maintaining adequate pressure.	Percentage of urban area with firefighting facilities. Percentage of system capable of meeting fire engine requirements.	100%

Table 6.2: Palerang Community – Sewerage Service Objectives and Targets – Draft

Objective	Service Standard (Design Basis)	Performance Indicator	Target
Reliability of collection and treatment infrastructure			
Maintain Continuous Service Availability	Asset condition rating (default rating 2)	Number of unplanned service interruptions due to asset failure (number/year): • Backup of sewage into properties • Overflow due to pump failure • Main blockage/collapse	 Zero Zero 4
	Workforce resourcing	Response time to incidents • Major spill • Moderate • Minor	 0.5 hour during hours and 1 hour after hours. 0.5 hour during hours and 1 hour after hours. 1 hour during hours and 1.5 hour after hours.
Protect the Environment and Receiving waters			
System Performance	• Compliance with the EPL • Contain 8 hours sewage load @ADWF within each SPS • Rainfall event with a 20% AEP • Compliance with biosolids guidelines • Minimise odours	• Non-compliances with EPL • Non-compliance with the RWMS • Number of overflows @ADWF • Number of overflows for the selected rainfall event • Non-compliances • Number of odour complaints	To be finalised by Council TBA from modelling TBA from modelling Unknown STP - 2, SPS - 2, reticulation - 2
Community Wellbeing			
Public open spaces	Greener parks, ovals and open spaces.	Greener parks, ovals and open spaces.	Green parks and ovals

7 Water Demand Projection and Capacity Issues

7.1 Historical data

The historical water production for Bungendore, Braidwood and Captains Flat is shown in Figure 7.1 to Figure 7.3.

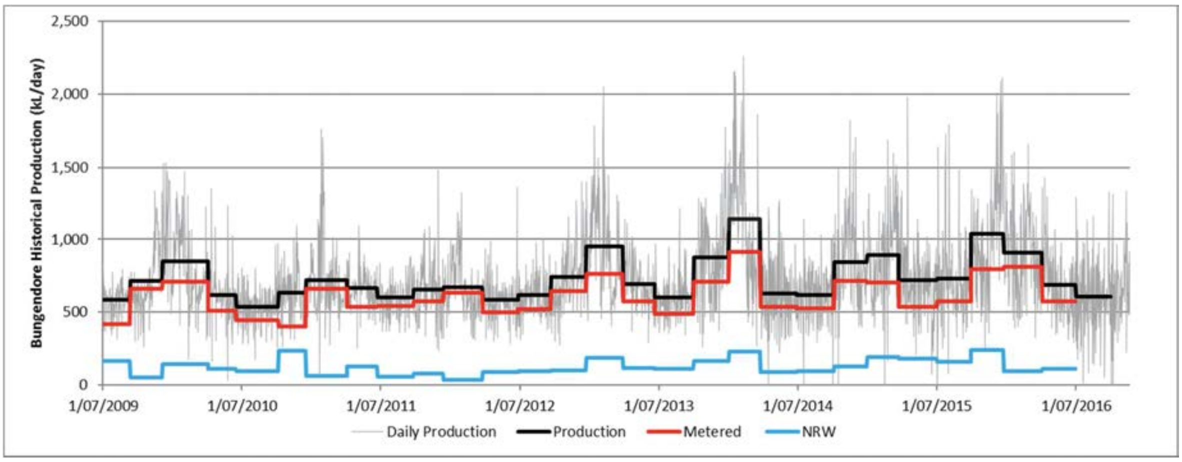

Figure 7.1: Bungendore historical daily production showing quarterly averages

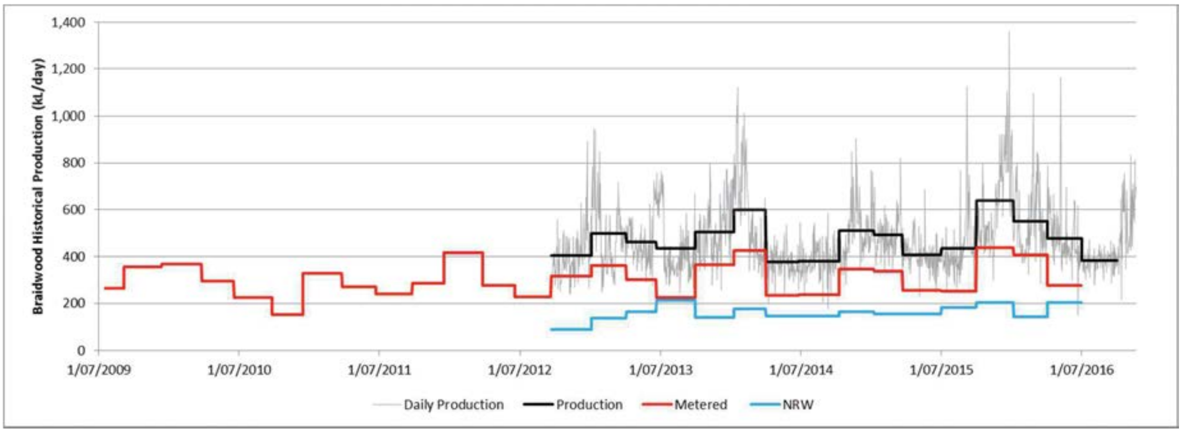

Figure 7.2: Braidwood historical daily production showing quarterly averages

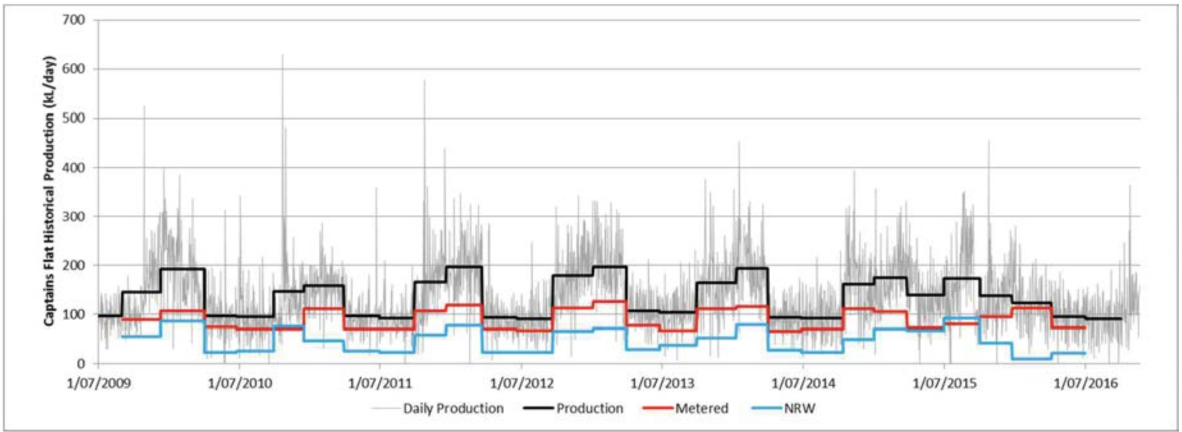

Figure 7.3: Captains Flat daily production showing quarterly averages

7.2 Water consumption

The average day demands for each scheme split by user class and showing major non-residential users are shown in Figure 7.4 to Figure 7.6.

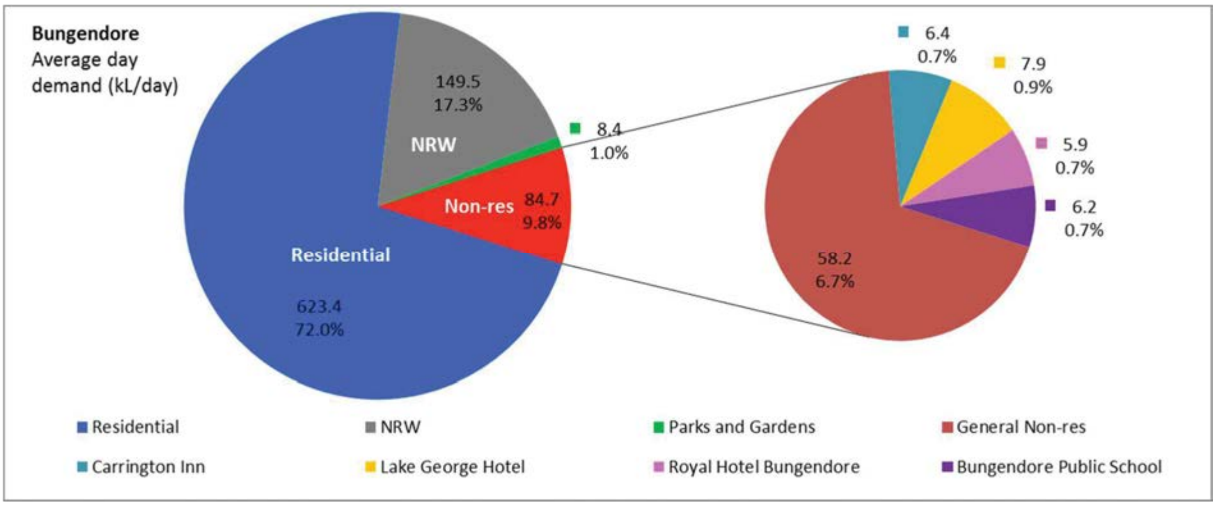

Figure 7.4: Bungendore user class split – average day demand

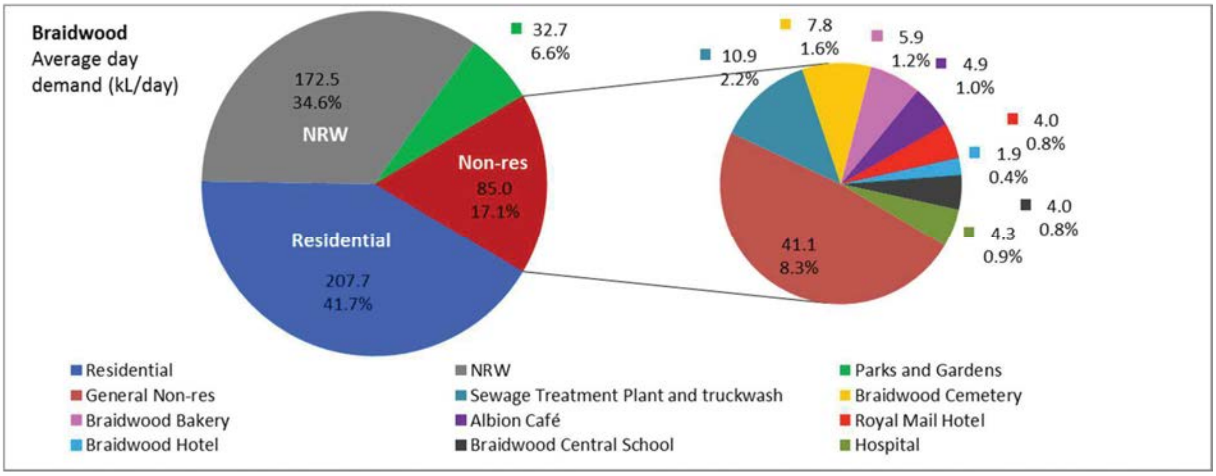

Figure 7.5: Braidwood user class split – average day demand

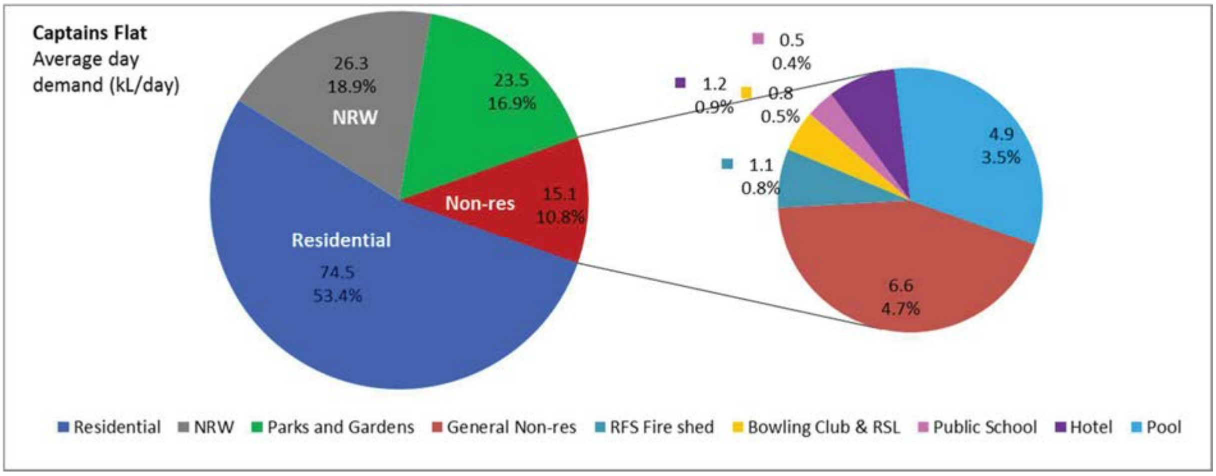

Figure 7.6: Captains Flat user class split – average day demand

7.3 Non-revenue water

Non-revenue water (NRW) is made up of a number of components including:

- unbilled authorised consumption which includes water used for fire-fighting and operational uses for example mains flushing
- apparent losses including illegal connections and metering inaccuracies
- real losses, mostly leakage from the network.

NRW at Bungendore and Braidwood have remained fairly constant around 125 and 280 L/connection/day respectively. These values are used in future projections. Braidwood has highest NRW as it is the oldest network, has the highest number of main breaks. The trunk main from the WTP to town frequently broke and was recently replaced.

Council has indicated that the seasonal variation in Captain's Flat NRW is due to a leak and faulty meter at Captain's Flat pool and the neighbouring fields, which share a meter. Council recently installed a new mag-flow meter and have advised that it is measuring flow well.

7.4 Impact of BASIX

The former Palerang LGA is in the 40% BASIX water target zone, meaning that the BASIX water target requires up to a 40% reduction in mains-supplied potable water consumption, compared to the average 'pre-BASIX' home benchmark of 90.34 kL/person/year.

As the projected demands at Bungendore will be significantly impacted by the BASIX demand due to the high number of new developments, these demands were modelled and compared with the climate corrected demands for houses within the "Elmslea Estate" which have been constructed to comply with BASIX requirements. Based on this analysis and comparison with the actual demands at Elmslea Estate, an average year unit demand of 180 kL/dwelling/year and a dry year unit demand of 240 kL/dwelling/year were adopted for new dwellings in the projections. The BASIX dwelling unit demands are summarised in **Table 7.1**

Table 7.1: Estimated BASIX unit demands for average active connected residential property

	Current dwelling average year	Current dwelling dry	BASIX average year demand @ 40% reduction	Modelled BASIX average year	Modelled BASIX dry

	demand (kL/prop/yr)	year demand (kL/prop/yr)	on benchmark (kL/prop/yr)	demand (kL/prop/yr)	year demand (kL/prop/yr)
Bungendore	212	260	157	180	240
Braidwood	149	179	125	51	108
Captains Flat [1]	144	187	125	51	108

7.5 Water supply projections

The water supply projections for the individual schemes are shown in Table 7.2 and Table 7.3

Table 7.2: Water production forecast

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Average year (ML/year)	316	463	633	761	866	948	1,010
	Dry year (ML/year)	379	564	787	949	1,082	1,185	1,263
	Peak day (ML/day)	2.8	4.1	5.7	6.8	7.8	8.5	9.0
Braidwood	Average year (ML/year)	182	191	200	210	221	232	244
	Dry year (ML/year)	223	234	245	257	270	283	298
	Peak day (ML/day)	1.5	1.5	1.6	1.7	1.8	1.9	2.0
Captains Flat	Average year (ML/year)	51	52	52	53	53	54	54
	Dry year (ML/year)	64	65	66	66	67	67	68
	Peak day (ML/day)	0.7	0.7	0.7	0.7	0.7	0.7	0.7

Water extraction has been estimated at 107% of the WTP production to account for waste during the treatment process (such as in filter backwash, sludge production.)

Table 7.3: Water extraction forecast

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Average year (ML/year)	338	495	677	814	927	1,014	1,080
	Dry year (ML/year)	405	604	842	1,015	1,157	1,268	1,351
	Peak day (ML/day)	3.0	4.4	6.1	7.3	8.3	9.1	9.7
Braidwood	Average year (ML/year)	195	204	214	225	236	248	261
	Dry year (ML/year)	239	250	263	275	289	303	319
	Peak day (ML/day)	1.6	1.6	1.7	1.8	1.9	2.0	2.1
Captains Flat	Average year (ML/year)	55	55	56	56	57	57	58
	Dry year (ML/year)	69	69	70	71	71	72	73
	Peak day (ML/day)	0.7	0.7	0.7	0.7	0.7	0.7	0.8

7.6 Secure Yield and drought reliability

7.6.1 Bungendore water supply

The projected dry extraction along with the licensed entitlement for the Bungendore water supply scheme is shown in Figure 7.7. The dashed line shows the projected dry year extraction without the demand from the Bungendore West recreation areas if it is irrigated using STP effluent.

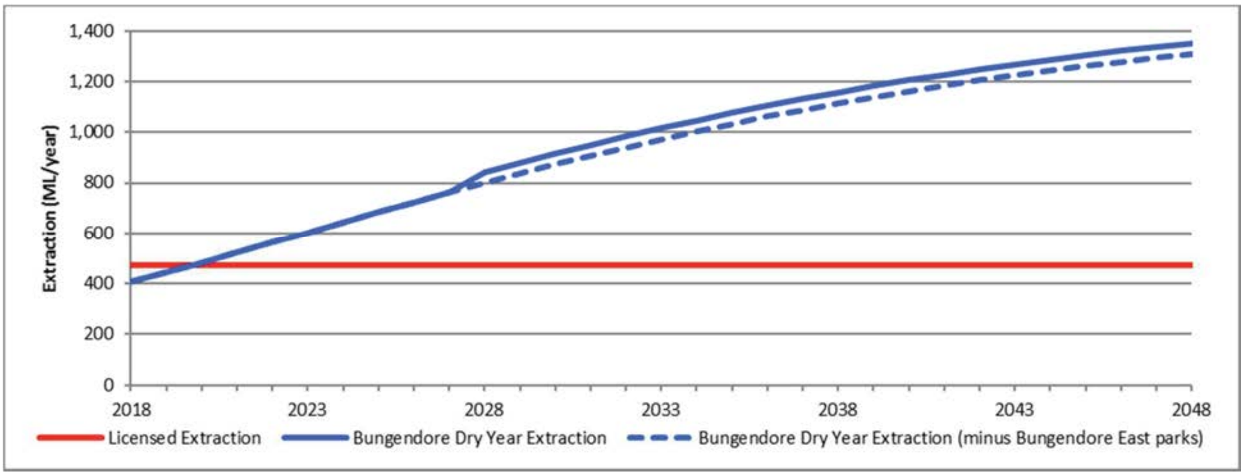

Figure 7.7: Projected dry year extraction – Bungendore

It is estimated that Bungendore water supply extraction will exceed its licensed entitlement **in a dry year** by 2020, if the Greenfields developments were to proceed.

An analysis was undertaken to determine the impact on the extraction if STP effluent were reused as a third pipe for the Greenfields developments. However Council is not keen to consider this option due to complexity of managing water supply systems with a third pipe, and the high risk of cross contamination.

7.6.2 Braidwood and Captains Flat Secure Yield

A secure yield analysis was undertaken for the Braidwood and Captains Flat headworks system in accordance with the requirements of DoI Water's draft guidelines for *"Assuring future urban water security – Assessment and adaption guidelines for NSW local water utilities"*.

Under the NSW Security of Supply basis 'Secure Yield' is defined as the highest annual water demand that can be supplied from a water supply headworks system while meeting the above '5/10/10' rule. The key aspects of the 5/10/10 rule are:

1. Water restrictions are in place for no more than 5% of the time
2. Water restrictions occur on average once every 10 years
3. During water restrictions, demand is reduced by 10%

The secure yield estimate for the Braidwood and Captains Flat Headworks Systems are provided in Table 7.4.

Table 7.4: Braidwood and Captains Flat secure yield outcome

Case	Secure Yield (5/10/10) ML/a		Comment
	Braidwood	Captains Flat	
Historic climate 1890 -2015 stream flows	394 [1]	235	Existing off-stream storage at Braidwood – 73 ML
1^0C warming	357	183	Existing onstream storage Captains Flat – 820 ML

1 – Potential estimate as limited to 360 based on licence conditions

The projected dry year extraction and the secure yield estimates for the Braidwood and Captains Flat water supply schemes is shown in Figure 7.8 and Figure 7.9 respectively.

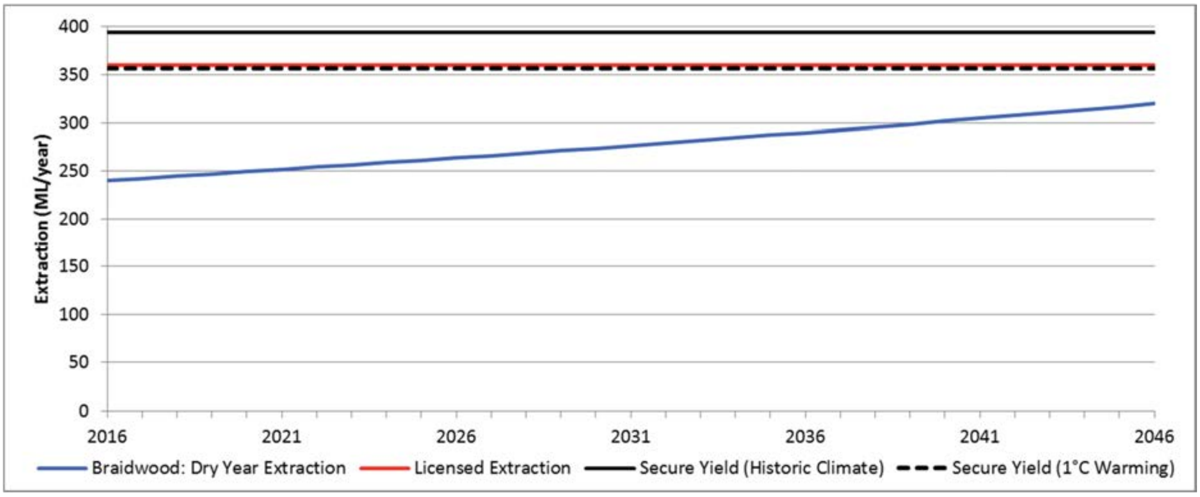

Figure 7.8: Braidwood licenced extraction

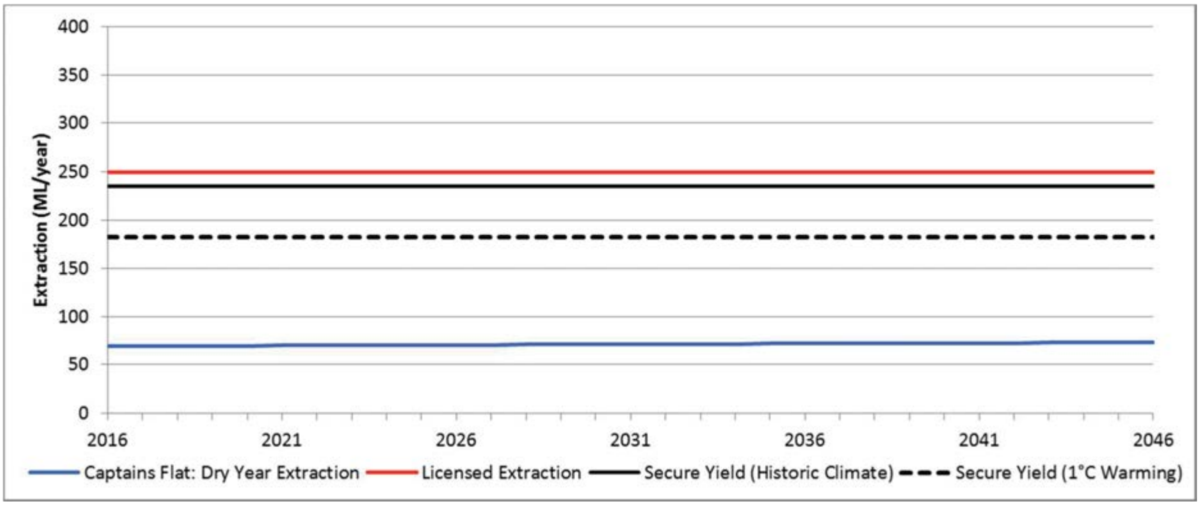

Figure 7.9: Captains Flat licenced extraction

It is noted that for both Braidwood and Captains Flat the secure yield of the water supply under the current license condition and headworks capacity is sufficient to meet the unrestricted dry year demands for the 30 year planning horizon.

7.7 Headworks Capacity assessment

The assessment is used to check the capacity of the scheme to meet the levels of service when supplying the peak day demands. The forecast peak day water production is compared to WTP capacity and total reservoir capacity for each scheme in Figure 7.10 to Figure 7.12.

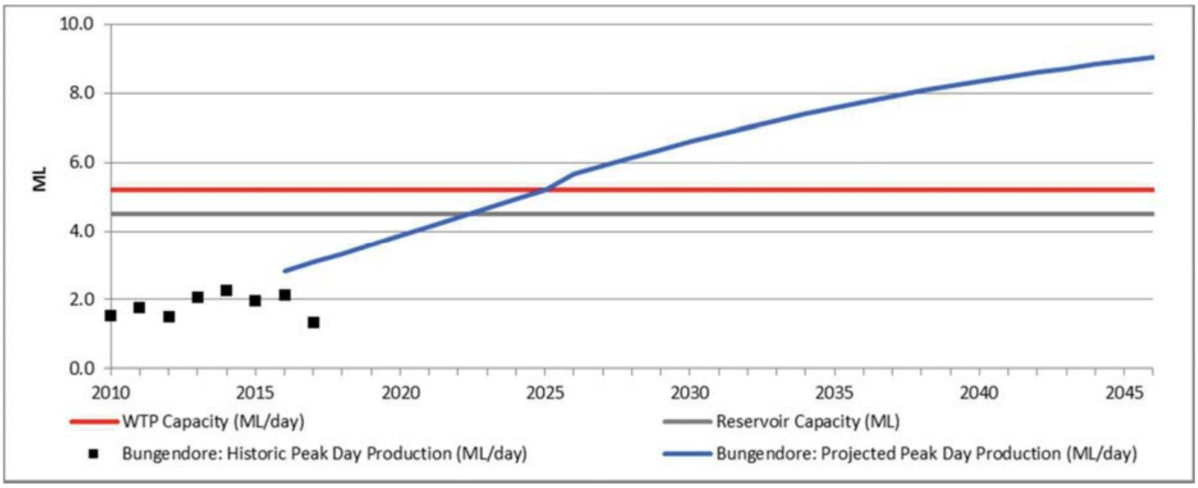

Figure 7.10: Bungendore current headworks capacity and peak day demand

The Bungendore WTP capacity is the sum of the Bungendore and Currandooly WTPs. If the Greenfields development progresses as predicted, the total WTP capacity will be exceeded around 2025. The reservoir capacity will need to be reviewed to ensure that the required pressure can be maintained in the system with the addition of the Greenfields demand.

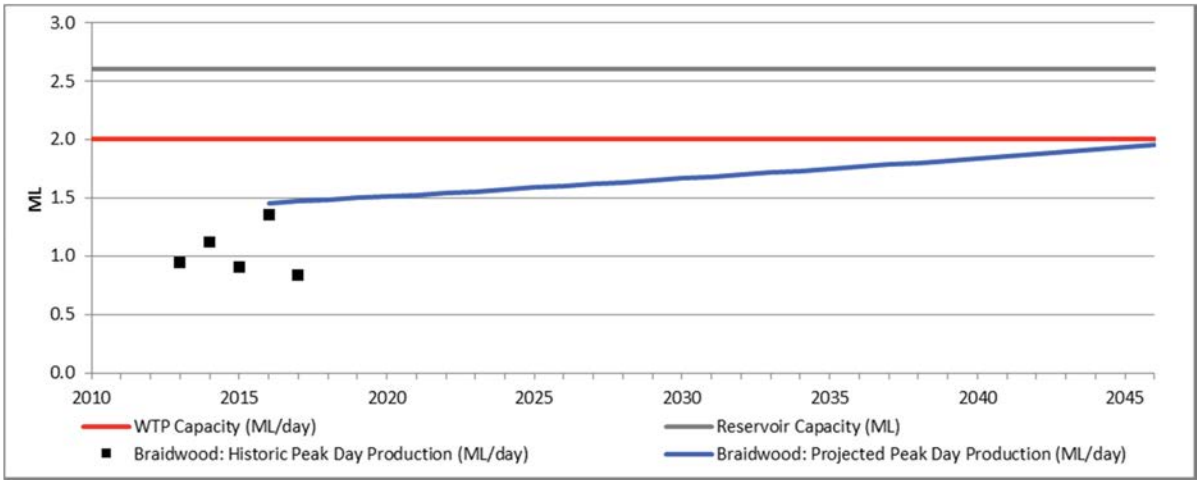

Figure 7.11: Braidwood current headworks capacity and peak day demand

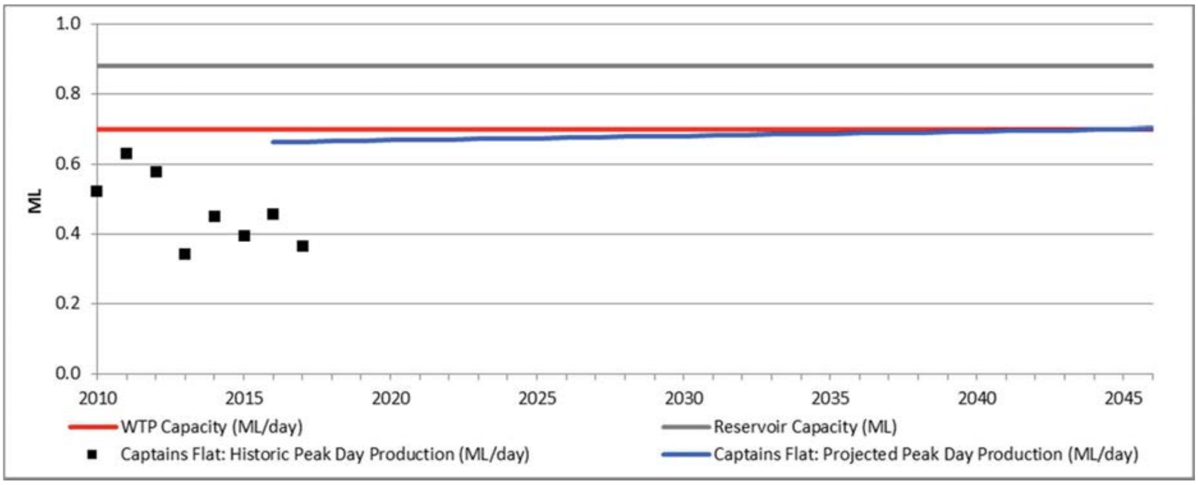

Figure 7.12: Captains Flat current headworks capacity and peak day demand

The peak day production at Braidwood and Captains Flat is expected to exceed WTP capacity around 2046.

7.8 Water distribution issues

Council is in the process of engaging Public Works Advisory to build hydraulic models of the water distribution schemes, to assess the current performance and the upgrades required to cater for future growth. The Bungendore scheme will be modelled first as it will be experiencing the highest growth rate.

8 Sewage Load Projection and Capacity Issues

8.1 Historical data

The historical daily inflows for all STPs in conjunction with site rainfall records are presented in Figure 8.1 to Figure 8.3 below.

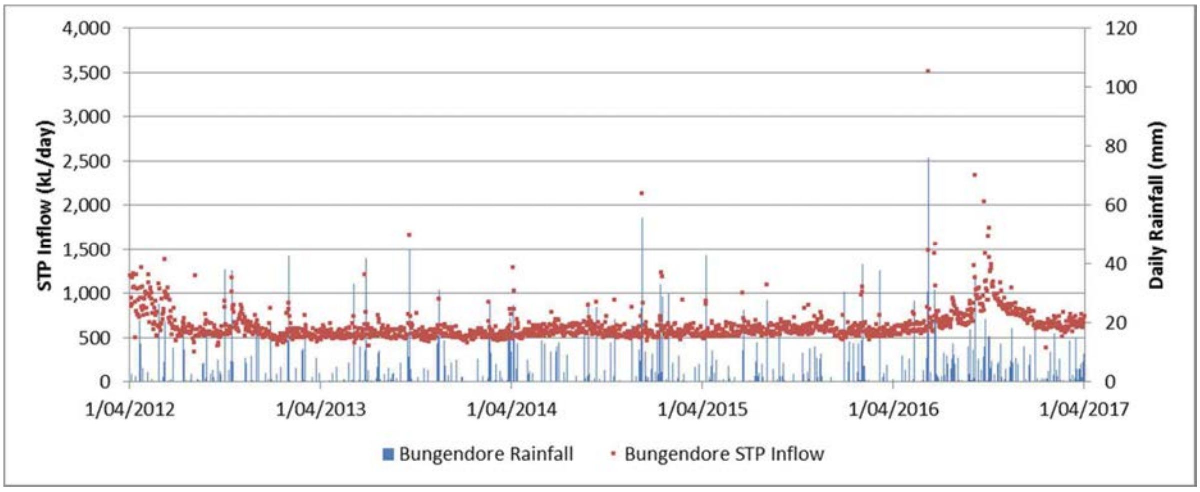

Figure 8.1: Daily STP Inflow and rainfall for Bungendore STP

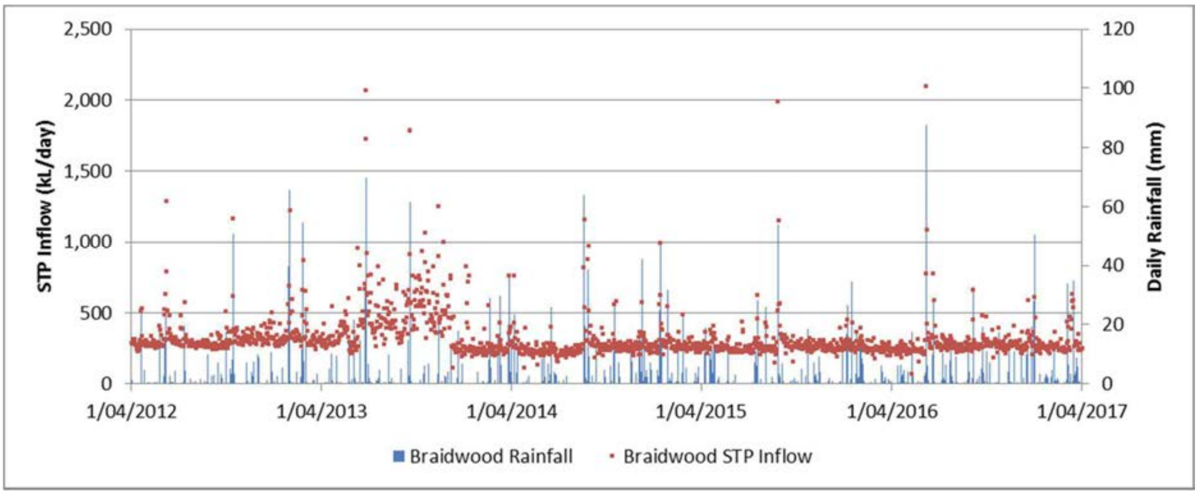

Figure 8.2: Daily STP Inflow and rainfall for Braidwood STP

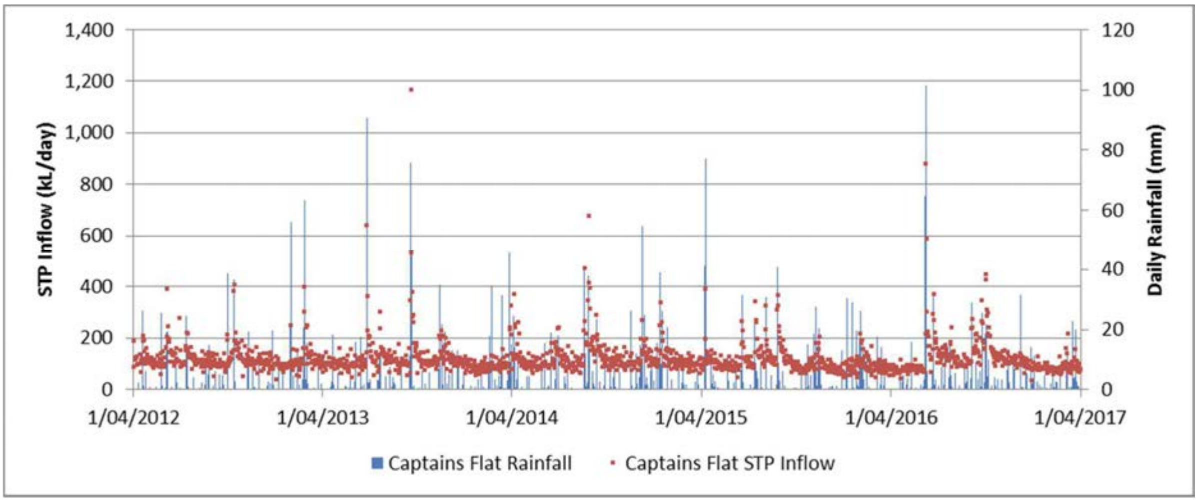

Figure 8.3: Daily STP Inflow and rainfall for Captains Flat STP

8.2 Sewer Flows and Projections

The historical data was analysed to determine Average Dry Weather Flow (ADWF). The assessed 2016 ADWF is shown in Table 8.1. The estimated hydraulic loading rate for all the STPs is also shown.

Table 8.1: Assessed ADWF, Hydraulic, Biological and Nutrient Loadings

	Bungendore	Braidwood	Captains Flat
2016 ADWF (kL/day)	650	260	100
Assessed hydraulic Loading (L/EP/day)	194	189	235
Design Hydraulic Loading (L/EP/day)	200	200	240
PWWF/ADWF	11.5	14.3	14.6
Biological loading (BOD), g/EP/day	70	70	70
Total Kjeldahl Nitrogen (TKN), g/EP/day	12	12	12.5
Total Phosphorus (TP), g/EP/day	2.6	2.0	2.7

This is based on the storm allowance and may be a conservative number. The future STP sewage loading projections are shown in Table 8.2.

Table 8.2: Projected ADWF and PDWF

Scheme		2016	2021	2026	2031	2036	2041	2046
Bungendore STP	ADWF (kL/d)	650	1,030	1,404	1,735	2,007	2,218	2,377
	PDWF (L/s)	17	25	33	40	45	49	52
Braidwood STP	ADWF (kL/d)	260	274	290	306	323	341	360
	PDWF (L/s)	7	8	8	9	9	9	10
Captains Flat STP	ADWF (kL/d)	100	101	102	103	105	106	107
	PDWF (L/s)	3	3	3	3	4	4	4

8.3 Sewage Treatment Plant Capacity Assessments

Time series graphs showing the projected EP growth and biological loadings, with the STP design capacity are provided for each STP. All STPs were designed using typical design hydraulic loadings of 240 L/EP/day. The hydraulic capacity of the plants has been evaluated against the adopted design loading rates from the assessment in this study (Table 8.1).

8.3.1 Bungendore Sewage Treatment Plant

An assessment of the STP capacity against the projected EP growth for the Bungendore STP is presented in Figure 8.4.

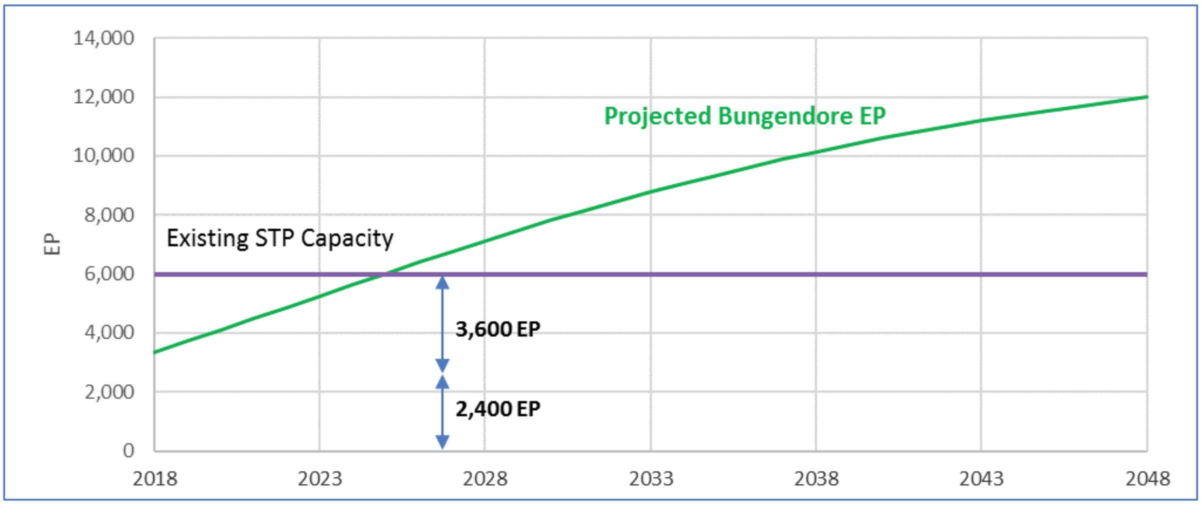

Figure 8.4: Bungendore STP - projected EP growth and STP design capacity @ 200 L/EP/day

At the projected growth and the assessed hydraulic loading of 200 L/EP/day, the hydraulic capacity of the STP is estimated to be exceeded around 2024. The biological capacity of the STP needs to be assessed.

8.3.2 Braidwood Sewage Treatment Plant

Figure 8.5 below provides an assessment of the STP capacity against the projected EP growth for the Braidwood STP. The Braidwood STP has a civil and hydraulic capacity of 3,000 EP and electrical and mechanical equipment capacity for 2,000 EP.

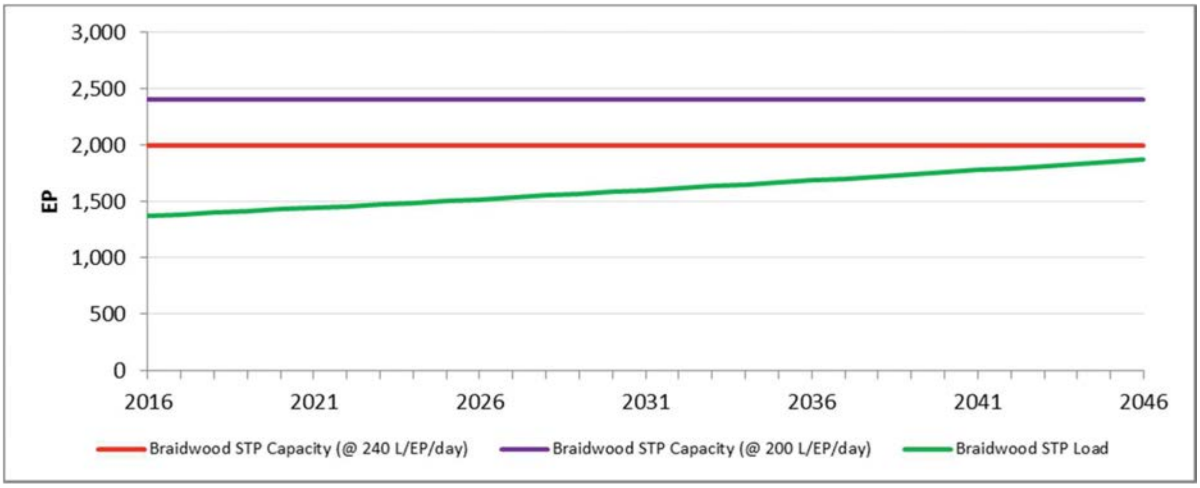

Figure 8.5: Braidwood STP - projected EP growth and STP design capacity

It is estimated the electrical and mechanical capacity of 2,000 EP of the Braidwood STP will not be exceeded in the 30-year planning period for the design hydraulic loading or the assessed loading of

200 L/EP/day. The actual influent BOD concentrations at Braidwood were measured to be above the STP design unit loading of 70 g/EP/day. It is recommended that Council continue to monitor BOD to ensure the plant biological capacity is not exceeded.

8.3.3 Captains Flat Sewage Treatment Plant

Figure 8.6 below provides an assessment of the STP capacity against the projected EP growth for the Captains Flat STP.

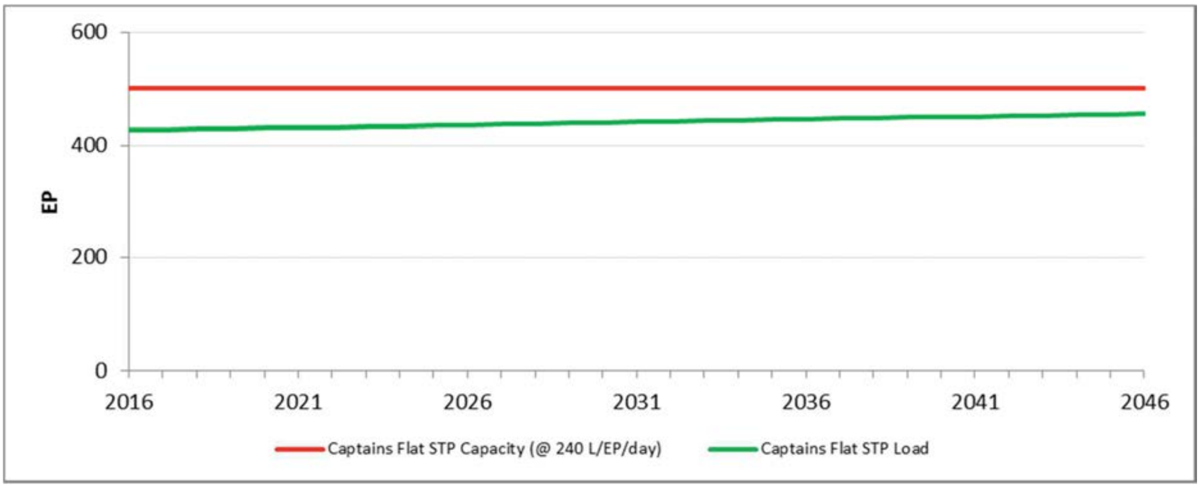

Figure 8.6: Captains Flat STP - projected EP growth and STP design capacity

It is estimated the capacity of 500 EP of the Captains Flat STP will be not be exceeded in the 30-year planning period. An upgrade to Captains Flat STP is currently in progress to replace ageing infrastructure, improve treatment and enable enhanced phosphorus removal, enable screening and grit removal, improve sludge and sludge drying components and improve amenity and WHS.

8.4 Collection and transfer system

Council is in the process of engaging Public Works Advisory to build hydraulic models of the sewage collection and transfer system, to assess the current performance and the upgrades required to cater for future growth. The Bungendore scheme will be modelled first as it will be experiencing the highest growth rate.

9 Business and Infrastructure Performance Issues

The infrastructure performance issues were classified under the following categories:

- Legislative compliance issues
- Levels of Service issues

9.1 Water supply scheme issues

9.1.1 Legislative compliance issues

The legislative compliance issues are summarised below:

- The requirement for periodic auditing of the fluoridation systems is not always being met.
- Several of the nominated CCPs in the DWMS are not considered CCPs like free chlorine in the reticulation. The turbidity alert limit corrective action for Captains Flat WTP needs to include a membrane integrity test.

9.1.2 Levels of Service (LOS) issues

The LOS issues are summarised below:

Minimum pressure with firefighting capability

- Council have nominated ‘positive residual head’ as the target for compliance, the current performance needs to be better understood through modelling.

Bungendore

- Non-revenue water at Bungendore has been fairly constant at 125 L/connection/day. This is higher than the state wide median of 92 L/connection/day for 2015/16.
- It is estimated that Bungendore water supply dry year extraction will exceed its licensed extraction limit from the Bungendore and Currandooly bores after 2020.

Braidwood

- Non-revenue water at Braidwood is on average 280 L/connection/day. This is higher than the state wide median of 92 L/connection/day for 2015/16.

Captains Flat

- Seasonal variations in the NRW for the Captains Flat system have been noticed which are due to a faulty meter at the Captains Flat swimming pool and the neighbouring fields which share a meter. This meter recently been replaced.

9.2 Sewerage scheme issues

9.2.1 Legislative compliance issues

The legislative compliance issues are summarised below:

Bungendore STP

- Effluent from the Bungendore STP is reused on-site, for road works (truck filling) and for watering Bungendore oval. Council does not have a Recycled Water Management Plan and Section 60 approval for the off-site effluent reuse.
- The Log Reduction Value (LRV) required for effluent reuse may not be achieved through the current STP process. This will be reviewed during the preparation of the Recycled Water Management System (RWMS) for Section 60 approval.
- The plant exceeded the volumetric discharge limit in 2011, 2012, 2014 and 2016. Council needs to consider undertaking an inflow/infiltration study.

Braidwood STP

- The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.

Captains Flat STP

- The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.

9.2.2 Levels of Service issues

The LOS issues are summarised below:

- Council needs to review and redefine its nominated level of service for response times.

Bungendore STP

- There is a mismatch in the effluent reuse flow balance. Potential reasons for the discrepancy could include uncalibrated meters, and on-site flows which may not be metered.
- The peak wet weather flow (PWWF) at catchment no. 2, 8 and 9 exceeds the capacity of a single pump. The PWWF at catchment no. 4 will exceed the capacity of a single pump by 2021. This is based on a PWWF calculated from the storm allowance which is twice the maximum flow recorded during the highest rainfall event in the last five years. Hence this is a conservative assessment.
- Catchment no. 7 and 8 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. This risk is expected to continue over the 30 year planning period.

Braidwood STP

- The PWWF at catchment no. 1 will exceed the capacity of a single pump by 2021.
- Catchment no. 3, and 5 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. The risk for catchment no. 5 is expected to drop to low risk by 2020, however catchment no. 3 is expected to remain at medium risk.

Captains Flat STP

- The PWWF at catchment no. 1 is expected to exceed the duty pump capacity.
- The plant needs to be upgraded to replace ageing infrastructure, improve treatment and enable enhanced phosphorus removal, enable screening and grit removal, improve sludge and sludge drying components and improve amenity and WHS.

9.2.3 Unserviced communities

There are several rural communities in the former Palerang LGA that are not supplied with water or sewerage services. These included the villages of Araluen, Majors Creek, Mongarlowe and Nerriga and the rural residential areas of Wamboin, Bywong, Burra, Urila, Hoskinstown, Rossi, Carwoola, Royalla, and Sutton.

10 Work being done by Council

There are several initiatives and projects that Council is either currently undertaken or have been included in the 'Business as Usual' capital works program. These are:

General Works

- Seeking ISO accreditation for a Health, Safety, Environment and Quality system (HSEQ).
- Investigating different centralised data management system softwares available in the market to suit their operational requirements.
- Setting up hydraulic models for the water distribution and sewer networks, starting with the Bungendore system.
- Following measures to reduce the non-revenue water in the Braidwood system
    - Replacing an old 2.2 km trunk main from the reservoirs to the town has been replaced
    - A program to replace all the galvanised pipes and old reticulation mains
    - A program for the replacement of water meters.

Bungendore Sewerage scheme

- Council has engaged PWA to develop a path to obtain Section 60 approval for the Bungendore effluent reuse scheme. Council's objective is to have the required effluent treatment in place for the current 5,000 EP plant capacity, within the next two years.
- An amount has been included in the 2018/19 budget to clean and camera a selection of the reticulation mains with a view to condition rating. It is also proposed to inspect a selection of manholes and smoke test private connections. The results of this study will form the basis of any relining works/mains refurbishment to be conducted in 2019/20.
- Pumping station #4 is planned to be upgraded with new pumps and a rising main in the 2019/20 financial year.

Braidwood Sewerage scheme

- Council has completed an inflow/infiltration study this year whereby all mains were cleaned, CCTV inspected and rated. All the manholes were also inspected and property lines smoke tested. The following renewal works have been budgeted for the next two years:
    - Relining of mains identified
    - Manhole surround and lid replacement
    - Smoke test rectification works
- New pumps with a capacity of 60 L/s will be installed at SPS1.

Captains Flat Sewerage scheme

- An inflow/infiltration study was conducted in the 17/18 year for Captains Flat which included some significant pipe relining.
- An overhaul of SPS1 is planned for 2018/19 but mostly aimed at refurbishing the station lid and SCA. The pumps will also be upgraded.
- Council is in the process of constructing a new plant. This work will be completed by 30th June 2019 and will resolve all the above issues.

11 Options Evaluation

This section provides a summary of the Bungendore water supply source, headworks capacity and the sewerage scheme options that were considered to address the IWCM issues that were identified. The present value cost estimates for the options are provided in Appendix D.

11.1 Bungendore water security options

Three water sources have been identified from which Council could obtain the 1 GL/year of additional water required to secure the water supply for the 30-year planning horizon. These are:

- Bungendore Alluvial Groundwater Source
- Fractured rock source from the Lachlan Fold Belt (LFB)
- Bulk supply from Icon Water in Queanbeyan

Council would need to apply for this additional entitlement due to growth under Section 66(4) of the Water Management Act.

Obtaining additional entitlement from the Bungendore Alluvial Groundwater Source, will likely be more difficult, as this water source is close to fully allocated and would require entitlements to be purchased or loaned from other users, or even a compulsory acquisition by the Minister. The additional entitlement from this source will still not satisfy the 1 GL/year of additional water that Council will require in the 30-year planning horizon, and therefore Council will need to supplement this entitlement with an entitlement from the LFB water source.

Connecting to Icon Water supply and purchasing of bulk water will require a connection between Bungendore and Queanbeyan, however this will guarantee that a high quality water source is always available to Council.

The triple bottom line assessment of the options is summarised in Table 11.1.

Table 11.1: Triple bottom line assessment of water source options

TBL Category	Criteria	Bungendore Alluvial source	Lachlan Fold Belt source	Bulk water supply from ICON Water
Social	Community is burdened with infrastructure	Two stage construction provides flexibility to cater for growth and reduces risk of overcapitalising.	Two stage construction provides flexibility to cater for growth and reduces risk of overcapitalising.	Pipeline is sized for ultimate capacity and hence there is a risk of overcapitalising.
	Long-term water security of supply	Obtaining additional entitlements may require compulsory acquisition by the Minister for which there is no precedent.	The water source is under allocated. However, the location and sustainable yield of potential future bores is unknown.	No issue with long-term water security as this can be included in a Service Level Agreement (SLA).
	Employment /tourism	Additional employment is generated within Council for operating the new infrastructure.	Additional employment is generated within Council for operating the new infrastructure	Opportunity for additional employment is reduced. However, the pipeline provides opportunity for servicing new development along the alignment.

TBL Category	Criteria	Bungendore Alluvial source	Lachlan Fold Belt source	Bulk water supply from ICON Water
	Local ownership	Maintains local ownership of the complete supply train. Council is in control of the asset condition.	Maintains local ownership of the complete supply train. Council is in control of the asset condition.	Headworks for the scheme is not owned by Council.
	Reliability	Council is in control of the scheme and can assure reliability.	Council is in control of the scheme and can assure reliability.	Supply reliability is outside of Council's control and will need to be established in the SLA.
Environmental	Construction environmental impact	Minimum due to smallest plant footprint	Higher due to increased plant footprint	Greatest impact along the entire length of the pipeline.
	Operational environmental impact	Minimum sludge generated due to good quality of the water.	Increased environmental impact due to greater sludge generation from treating poor quality water.	No impact within Bungendore and minimum impact at the source WTP.
	Energy consumption	Minimum energy consumption due to simple treatment required as the water quality is good.	Higher energy consumption due to more advanced treatment required as the water quality is poor.	Highest energy consumption required for pumping the water from Queanbeyan to Bungendore.
Economic	Capital cost	Lowest capital cost	Intermediate capital cost	Highest capital cost
	Operating cost	Lowest operating cost due to simplified treatment process.	High operating cost due to increased complexity of treatment.	Highest operating cost due to the access and usage charges imposed by ICON Water

In formulating the Bungendore water supply source options, the following factors have been taken into consideration:

- An additional entitlement of 1 GL is required to service growth for the next 30 years
- There is an immediate need of about 0.5 GL to service the population growth at least for the next 10 years.
- Obtaining any additional entitlement from the Bungendore alluvial source may require a compulsory acquisition for which there is no precedent, and which may therefore be a long drawn out process.
- The understanding that Council has drilled production bores in the Lachlan Fold Belt water source that can reliably supply at least 0.5 GL/year.

On this basis, the following options have been formulated:

<u>Option 1</u>: Obtain an additional entitlement of 0.5 GL/year from the LFB to service the immediate need. Supplement this entitlement with an entitlement from the Bungendore Alluvial source.

Option 2: Obtain an additional entitlement of 0.5 GL/year from the LFB to service the immediate need. Increase this entitlement to 1 GL/year if additional entitlements from the Bungendore alluvial cannot be obtained.

Option 3: Connect to the ICON Water supply at Queanbeyan.

Options 1 and 2 are shown in Figure 11-1.

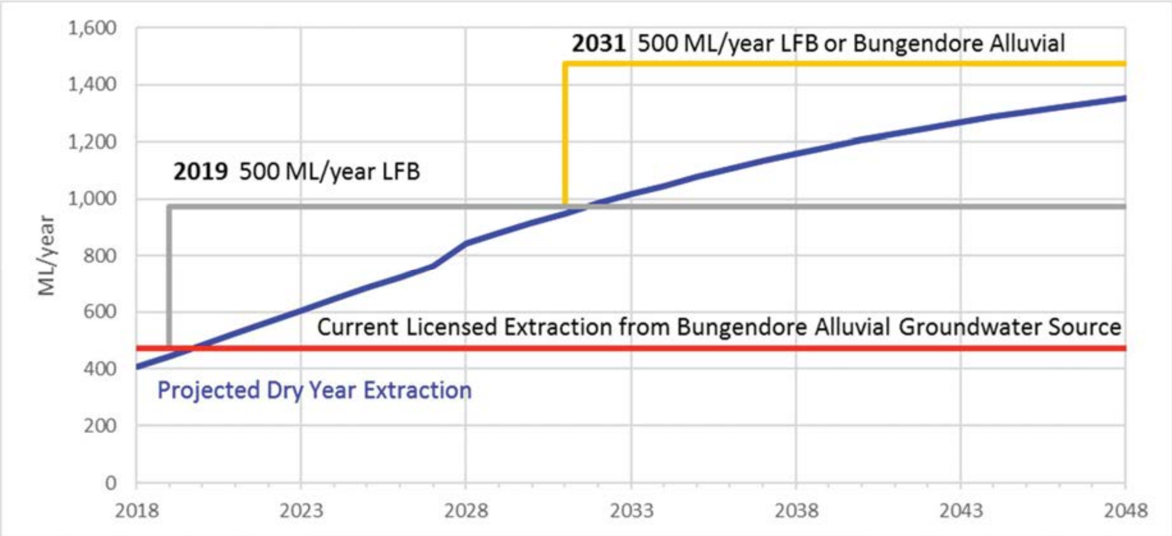

Figure 11-1: Groundwater source options from Bungendore Alluvial and LFB

11.2 Bungendore Headworks capacity options

Three water sources, for the supply of this additional water, have been evaluated. These are:

- Bungendore Alluvial Groundwater Source
- Fractured rock source from the Lachlan Fold Belt (LFB)
- Bulk supply from Icon Water in Queanbeyan
-

The long-term average annual extraction limit (LTAAEL) for the Bungendore Alluvial Groundwater Source is 1,268 ML/year. The current entitlements total 1,243 ML/year, or 98% of the LTAAEL. The LTAAEL for the LFB MDB Groundwater Source is 875,652 ML/year. The current entitlements total 148,896 ML/year, or 17% of the LTAAEL.

The water quality from the Bungendore Alluvial source would be similar to that being received and treated at the Bungendore WTP. Bore water is aerated at the existing Bungendore WTP for the removal of carbon dioxide. It then gravitates to a collection tank where chlorine and fluoride are added before being distributed to the town. The water from the LFB source has iron and manganese and will need more treatment process units than just aeration, chlorination and fluoridation.

A stage augmentation of the WTP is proposed. The Stage 1 capacity of 1.5 ML/day followed by a Stage 2 augmentation of 3.0 ML/day (total 4.5 ML/d) allows for easier augmentation by adding two additional treatment trains. The staged capacity augmentation ensures that the community does not end up paying for infrastructure that is provided for growth that does not eventuate.

The staging of the Bungendore WTP upgrades is shown in Figure 11.2.

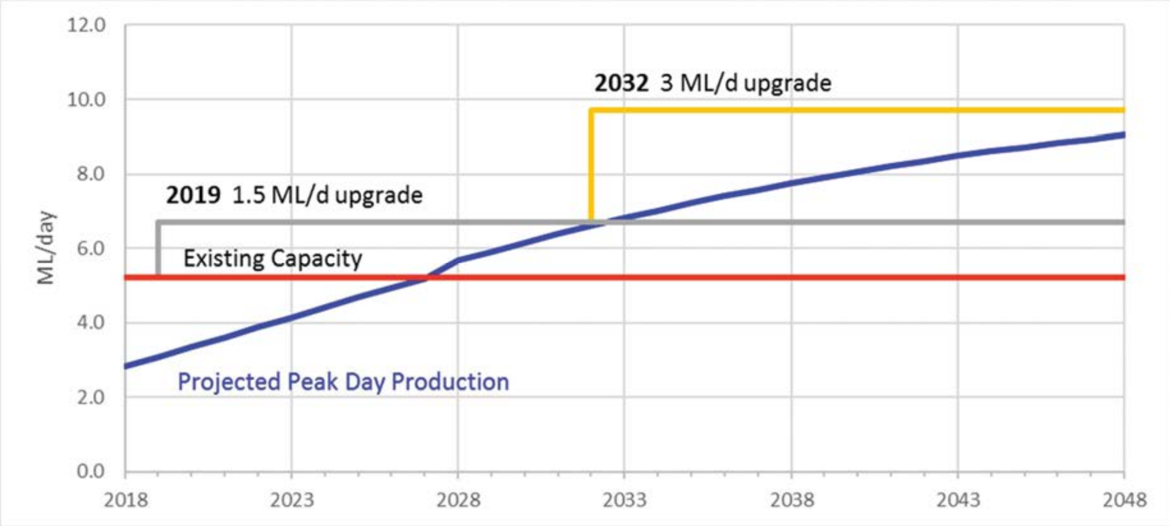

Figure 11.2: Bungendore WTP upgrade staging

Option 1 – Extraction from Lachlan Fold Belt followed by Bungendore alluvial water source

- Stage 1: Commission the Jim Gray and East Bungendore LFB bores (combined capacity 2.3 ML/day) and construct a 1.5 ML/day WTP to treat the bore water
- Stage 2: Augment the WTP capacity by 3 ML/d by 2032, to treat Bungendore alluvial water

Stage 2: Two 17.5 L/s alluvial bores (combined capacity 2.7 ML/day) will be developed and the Bungendore WTP capacity is augmented with an additional 3 ML/day capacity to treat this water.

Option 2 – Extraction from Lachlan Fold Belt only

- Stage 1: Commission the Jim Gray and East Bungendore LFB bores (combined capacity 2.3 ML/day) and construct a 1.5 ML/day WTP to treat the bore water
- Stage 2: Augment the WTP capacity by 3 ML/d by 2032, to treat water from the LFB (fractured rock).

Stage 2 – Construct additional 25 L/s bores (capacity 2 ML/day) (location currently unknown).

Option 3 – Supply of bulk treated water from Icon Water

- Water supply to Bungendore by connecting to the Icon Water supply offtake at Queanbeyan through a bulk water supply agreement.

The summary of the three options that were assessed and the outcomes of the assessment is provided in Table 11.2.

Table 11.2: Water supply feasible options

Option	Bore capacity		Bungendore WTP augmentation		Total Capital Cost ($K)	30-year Total PV ($K)
	Stage 1	Stage 2	Stage 1	Stage 2		
1	2.3 ML/d (existing LFB)	2.7 ML/d from alluvial source	1.5 ML/d (2019)	3.0 ML/d (2032)	17,562	18,124

Option	Bore capacity		Bungendore WTP augmentation		Total Capital Cost ($K)	30-year Total PV ($K)
	Stage 1	Stage 2	Stage 1	Stage 2		
2	2.3 ML/d (existing LFB)	2.0 ML/d (in LFB)	1.5 ML/d (2019)	3.0 ML/d (2032)	18,600	19,139
3	Bulk water supply from Icon Water		No	No	26,961	49,384

11.3 Sewerage options

The current Bungendore STP arrangement is one 2,000 EP and one 3,000 EP IDEA tanks, which were designed for 240 L/EP/day. The STP inflow analysis in the Issues Paper assessed the current hydraulic loading at around 200 L/EP/day, which brings the adjusted STP capacity to 6,000 EP. The biological capacity has not been assessed.

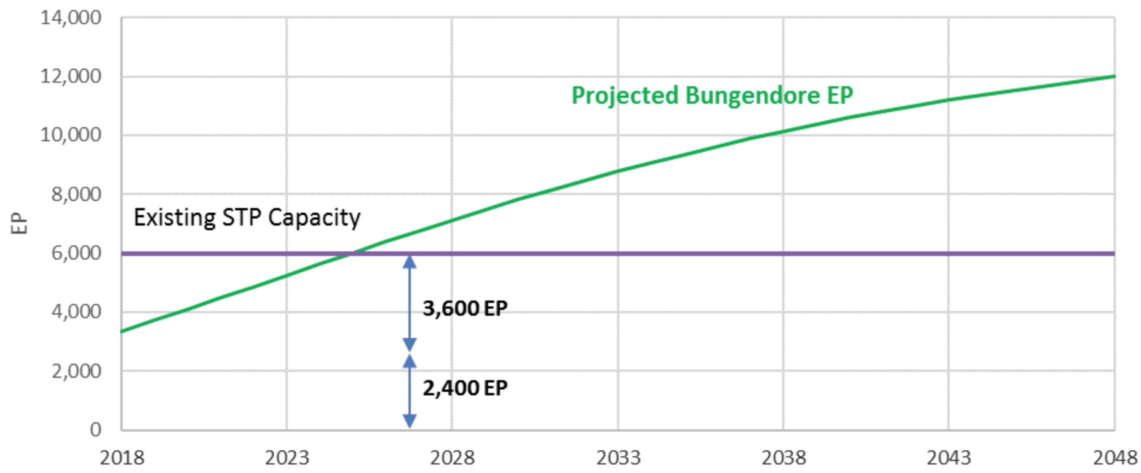

Figure 11.3: Bungendore STP projections

As Figure 11.3 shows, the Bungendore STP will require an additional capacity of about 6,000 EP (at 200 L/EP/day) from the existing STP capacity to provide sufficient treatment capacity for the 30-year planning period as shown. Two augmentations options are proposed and presented below.

STP Option 1: 6,000 EP STP upgrade

A single 6,000 EP STP upgrade in 2024 will increase the STP Capacity to 12,000 EP, which is estimated to be sufficient to service the 30-year planning horizon. Construction of the 6,000 EP reactor would also allow for the existing 3,600 EP tank to be mothballed and later recommissioned when the capacity is needed. This is shown in Figure 11.4.

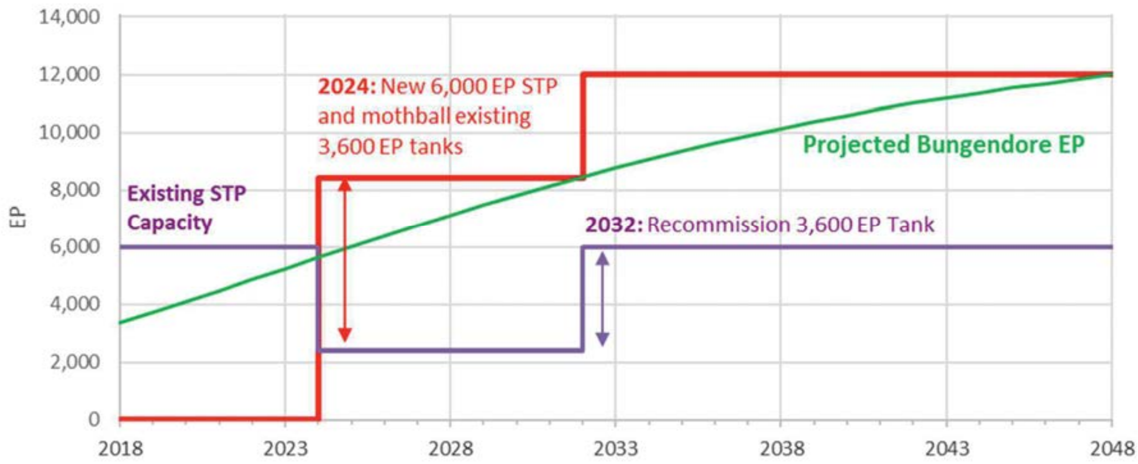

Figure 11.4: STP Option 1 - 6,000 EP (at 210 L/EP/day) STP upgrade

STP Option 2: Staged development of two 3,000 EP STP upgrades

In this option, two 3,000 EP tanks would be constructed over two stages. It is estimated that the first upgrade will be required around 2024, and the second upgrade in 2033. This is shown in Figure 11.5.

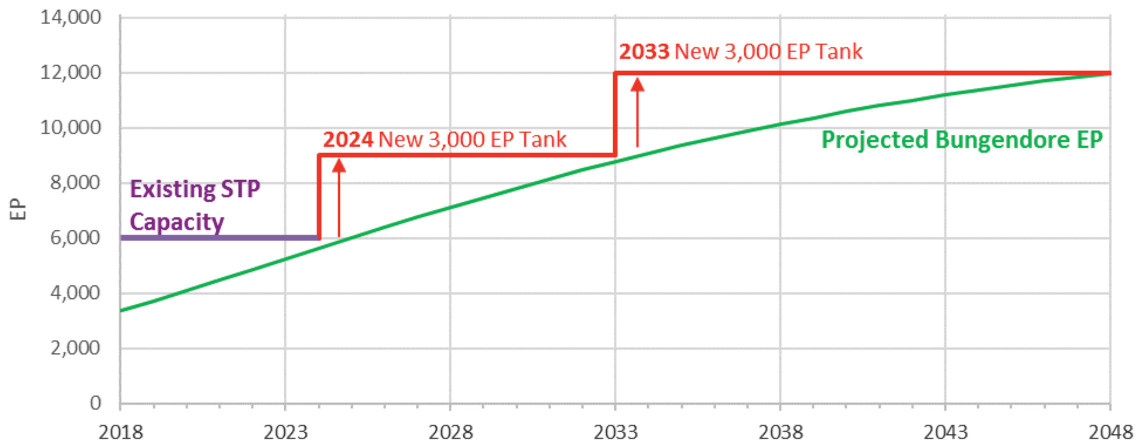

Figure 11.5: STP Option 2 - Staged development of two 3,000 EP tank STP upgrades

The advantage of this option is that if anticipated growth does not occur, the second tank many not be needed. The summary of the two options that were assessed and the outcomes of the assessment is provided in Table 11.3.

Table 11.3: Sewerage options

Option	Upgrade description	Total Capital Cost ($K)	30-year Total PV ($K)
1	Construct new 6,000 EP tank and mothball existing tanks in 2024. Recommission tanks as needed.	10,080	10,466
2	Construct new 3,000 EP tank in 2024. Construct new 3,000 EP tank in 2033.	10,080	9,087

However, construction of two tanks may not be accommodated at the current site and a new site may have to be investigated. The cost of land acquisition and transport of the sewage to the new site has not been included. This cost would increase the cost of option 2 further and hence it has not been considered further.

12 IWCM Scenarios

After evaluating and shortlisting all the available options, the shortlisted opportunities/options have been combined into three IWCM scenarios using the bundling process.

12.1 Measures and works common to all IWCM Scenarios

The issues associated with data, information and asset management needs which could be done using common management systems across the water and sewerage services for all the scenarios are provided in Table 12.1.

Table 12.1: Common Management System Measures for IWCM Scenarios

Issue Type	Target for Compliance	Action
General		
Work Health and Safety (WHS)	Management System	Obtain ISO accreditation for a Health, Safety, Environment and Quality system (HSEQ).
Levels of Service (LOS)	Description and performance	Investigate different database softwares available in the market to suit the operational requirements, with a view to purchasing a suitable software system.
Best Practice	Pricing	Council have adopted a best practice tariff structure for water pricing.
General water supply issues		
Level of Service	Minimum pressure with firefighting capability	Complete network modelling of the distribution system, to understand the firefighting capability of the system, starting with Bungendore.
Regulatory	Fluoridation of Public Water Supplies	Implement the following process: • An annual independent review as part of the HSEQ system • A quarterly or six-monthly internal review.
Regulatory	Drinking Water Management System	Add membrane integrity testing to the weekly operational report for the Captains Flat WTP to require say monthly testing and reporting of the result.
Bungendore water supply issues		
Performance	Non-revenue water	Consider the following initiatives to deal with the non-revenue water in the Bungendore system: • A water loss study • Better monitoring of flushing/operational water usage • Water meter replacement program.
Braidwood water supply issues		
Performance	Non-revenue water	Council has already undertaken the following: • An old 2.2 km trunk main from the reservoirs to the town has been replaced

Issue Type	Target for Compliance	Action
		• Council has spent $50,000 replacing old galvanised water mains in town Consider the following measures to deal with the non-revenue water in the Braidwood system: • Continue the program of mains replacement until all the galvanised pipes are replaced • Following the replacement of galvanised pipes, replace all old reticulation mains. • Continue the program for the replacement of water meters.
Captains Flat water supply system		
Performance	Non-revenue water	Seasonal variations in the NRW for the Captains Flat system have been noticed which are due to a faulty meter at the Captains Flat swimming pool and the neighbouring fields which share a meter. This meter recently been replaced.
Bungendore sewerage system issues		
Best Practice	Section 60 approval	Continue the currently initiated process to have the required effluent treatment and the RWMS in place for the current 5,000 EP plant capacity, within the next two years.
Regulatory	EPA License non-compliance	The following works are to be undertaken: • Clean and camera all mains with a view to condition rating them. • Inspect all manholes and smoke test private connections. • Use the results of this study to form the basis of any relining works/mains refurbishment to be conducted in 2019/20.
Performance	Effluent reuse flow balance	Council proposes to have all streams metered.
Sewer catchment performance	Pump sizing @ PWWF	Carry out the planned upgrade to pumping station #4, with new pumps and a rising main in the 2019/20 financial year. Determine the upgrade required for pumping stations #2, 8 and 9 through the sewer network modelling that Council plans to undertake.
	Odour/septicity potential	Council to investigate this issue further.
Braidwood sewerage system issues		
Regulatory	EPA License non-compliance	Carry out the following renewal works that have been budgeted for the next two years: • Relining of mains identified • Manhole surround and lid replacement • Smoke test rectification works

Issue Type	Target for Compliance	Action
Sewer catchment performance	Pump sizing	Investigate this issue further.
	Odour/septicity potential	
Captains Flat sewerage system issues		
Regulatory	EPA License non-compliance	Undertake the planned inflow/infiltration study.
Sewer catchment performance	Pump sizing	Carry out the overhaul of the station planned for 18/19 but mostly aimed at refurbishing the station lid and SCA. Also upgrade the pumps as a result of this issue.

12.2 Description of the IWCM Scenarios

The Bungendore Water Security Options and Water Supply Headworks options are combined to give three possible scenarios. As mentioned earlier, only STP Option 1 is practical given the site limitations of the existing STP, and therefore this option is included in all three scenarios.

Table 12.2 shows the bundled scenarios and the issues that are being addressed by each option are also listed.

Table 12.2: Palerang IWCM scenarios

Target for compliance	Issue	Option	Scenario		
			1	2	3
Water Security and headworks capacity Level of Service	The dry year demands exceed the current licensed entitlement. The peak day demand will exceed the combined capacity of the Bungendore and Currandooly WTPs around 2025.	**Water Supply Option 1** – Extraction from Lachlan Fold Belt source followed by Bungendore alluvial source.	✓ Stage 1 2019 Stage 2 2032	-	-
		Water Supply Option 2 – Extraction from Lachlan Fold Belt source only.	-	✓ Stage 1 2019 Stage 2 2032	-
		Water Supply Option 3 – Bulk supply from ICON Water	-	-	✓ 2019
Capacity – Sewage Treatment Plant	Bungendore STP hydraulic capacity will be exceeded by around 2024 for the existing 6,000 EP STP (@200 L/EP/d).	**STP Option 1** – 6,000 EP STP Upgrade (@200 L/EP/d)	✓ 2024	✓ 2024	✓ 2024

12.3 Present Value Analysis of IWCM Scenarios

12.3.1 Water supply Service

Table 12.3 presents the summary of the estimated total cost of capital outlay and the present value of the capital, and the operating and maintenance (O&M) cost estimates over the 30 years of the water supply service for each IWCM Scenario based on 2018 dollars.

Table 12.3: Summary of Capital and Present Value Costs for the IWCM Scenarios – Water Supply

	Scenario 1	Scenario 2	Scenario 3
Total Capital Cost over 30 years ($M)	17.6	18.6	27.0
Present Value of Capital Cost @ 7% ($M)	12.8	13.2	27.0
Present Value of O&M Cost ($M)	5.3	5.9	22.4
Total Present Value @ 7% ($M)	**18.1**	**19.1**	**49.4**

12.3.1 Sewerage Service

Table 12.4 presents the summary of the estimated total cost of capital outlay and the present value of the capital, and the O&M cost estimates over the 30 years of the sewerage service for each IWCM Scenario based on 2018 dollars.

Table 12.4: Summary of Capital and Present Value Costs for the IWCM Scenarios – Sewerage

	Scenario 1	Scenario 2	Scenario 3
Total Capital Cost over 30 years ($M)	10.1	10.1	10.1
Present Value of Capital Cost @ 7% ($M)	7.2	7.2	7.2
Present Value of O&M Cost ($M)	3.3	3.3	3.3
Total Present Value @ 7% ($M)	**10.5**	**10.5**	**10.5**

12.4 Triple Bottom Line Assessment of Scenarios

A total of seven environmental and social targets have been used to score the IWCM Scenarios as to how they address the IWCM Issues. Suitable weightings were assigned to the criteria. The criteria and their objectives are shown in Table 12.5.

Table 12.5: Social and Environmental Performance Criteria and weightings

TBL Category	Criteria	Weighting
ENVIRONMENTAL	Minimises construction environmental footprint	0.4
	Reduces operational energy consumption	0.4
	Reduces operational generation of waste	0.2
	Total weighted environmental score	**1.0**
SOCIAL	Community is burdened with infrastructure if growth does not eventuate	0.2
	Provides for greater long-term security of supply	0.2

TBL Category	Criteria	Weighting
	Promotes local employment	0.3
	Maintains local control of complete supply train	0.3
	Total weighted social score	**1.0**

The scoring of the scenarios against the criteria was based on the TBL assessment provided in Table 11.1. The outcome of the environmental and social scoring for each IWCM Scenario across the 7 criteria is shown in Table 12.6. Detailed scoring is given in Appendix E.

Table 12.6: Summary of triple bottom line score for IWCM scenarios

	Scenario 1 (LFB and Alluvial)	Scenario 2 (LFB only)	Scenario 3 (ICON Water)
Environmental Score	3.8	2.8	2.4
Social Score	3.3	3.5	2.4
Environmental and Social Score (ESS)	**7.1**	**6.3**	**4.8**

Table 12.7 presents the ranking of the IWCM Scenarios following the DPI Water ranking methodology.

Table 12.7: IWCM scoring ranking

	Scenario 1	Scenario 2	Scenario 3
Total Present Value @ 7% ($M)	28.6	29.6	59.9
Environmental and Social Scores (ESS)	7.1	6.3	4.8
ESS/$M	0.25	0.21	0.08
Ranking	**1**	**2**	**3**

According to the assessment and ranking criteria used above, Scenario 1, which includes the extraction from the Lachlan Fold Belt followed by extraction from the Bungendore alluvial source, is the preferred Scenario.

12.5 Analysis of Risks

Whilst each scenario can address the water security and headworks capacity issues, there are risks associated with the project delivery for each of these scenarios. These are outlined in Table 12.8.

Table 12.8: Project delivery of scenarios

Scenario	Delivery Risk
Scenario 1 – LFB and Bungendore alluvial	• Relies on obtaining an entitlement from Bungendore Alluvial Groundwater Source most likely by compulsory acquisition. • There is no precedent for this and therefore the process is unknown. • Depends on the appetite of the Minister and the political climate at the time. • It is also unknown how much of the entitlement would become available and what the actual compensation might be.
Scenario 2 – LFB only	• Only two bores have been drilled. It is unclear where the other bores, required to access additional water will be located, and what their water quality might be. • It is unknown what the sustainable capacity of these bores would be.
Scenario 3 – Supply from ICON Water	• Will require negotiation of a cross-state water supply arrangement – possible difficulties with different regulations over interstate jurisdiction • Any future changes to water supply scheme will require negotiation and agreement with ICON Water. • Will require cross-state land negotiation/acquisition.

Whilst Scenario 1 is the preferred Scenario on a TBL assessment basis, it has a higher risk in terms of project delivery and this needs to be considered by Council before adopting a preferred scenario. However, the structure of the options provides Council with a 10-year timeframe before a decision on the Stage 2 augmentation is made which is within the 8-year review cycle of the IWCM Strategy.

12.6 Preferred Scenario

In addition to the common measures and works listed in Table 12.1, the preferred IWCM Scenario consists of the following major water supply and sewerage works.

- Obtain an additional entitlement of 0.5 GL/year from the LFB to meet the water requirements up to 2031.
- Supplement this entitlement with an additional entitlement of about 0.5 GL/year from the Bungendore Alluvial source to meet the water requirements up to 2048.
- Construct a 1.5 ML/d water treatment plant (WTP) in 2020 to treat water from the Lachlan Fold Belt groundwater source.
- Augment the water treatment plant capacity by constructing a 3.0 ML/d (WTP) in 2032 to treat water from the Bungendore alluvial groundwater water source.
- Assess the biological treatment capacity of the Bungendore STP
- Augment the capacity of the Bungendore STP by 6,000 EP in 2024 and mothball the existing reactors.
- Recommission the mothballed reactors to meet the treatment capacity as and when required.

13 Total Asset Management Plan

This total asset management plan presents the details of the projected capital works and recurrent (operation, maintenance and management – OMA) expenditure schedules for the next 30 years, which are significant parameters for financial planning.

The capital works and the OMA details used in the financial models ensure forecasting funds required to implement the scheduled capital works as planned and help develop effective funding/financing strategies to moderate any adverse financial impact on customers and the Council.

13.1 Capital Works

The adopted IWCM strategy enables Council to develop a schedule of expected capital works into the future to satisfy the forecast service demands in terms of growth, improved levels of service and replacement of existing assets.

Growth works	Works required to increase the capacity of facilities, to service new release areas/ subdivisions.
Improved level of service works - ILOS (including backlog works)	Works to provide better public health and environmental standards, better service, higher reliability, or an extension of services to unserviced existing development. Works in this category may be eligible for Government grants.
Asset renewal	Renewal/ replacement of existing assets, which have aged and reached the end of their economic service life

The adopted IWCM strategy develops the growth and ILOS capital works over the planning horizon based on the adopted options to address the identified IWCM issues for the water supply and sewerage services. Additionally, anticipating the need and timing for asset renewal/ replacement is vital given the significant capital investment requirements and the need to ensure availability of funds.

Prioritising and planning for renewal and replacement capital works is then undertaken in consideration of meeting service level objectives and minimising infrastructure service risks based on the current hierarchy of critical assets so identified. Council typically undertakes asset renewal to either:

- ensure the reliability of the existing infrastructure to deliver the service it was constructed to facilitate, or
- ensure the infrastructure is of sufficient quality to meet the service requirements

Council's asset management plan (Appendix F) identifies the estimated maintenance and capital expenditure required by matching the projected asset renewals to provide an agreed level of service to the community with the planned renewal works program. The levels of renewal expenditure are based on current data maintained up to date in the asset register (TechOne Asset Management System). The asset register is continually reviewed and refined for the useful lives and remaining lives of asset components that improves the confidence level of the assessment of the renewal expenditure requirement.

The 30-year water supply and sewerage capital works programs including for the adopted IWCM strategy are presented in Table 13.1 to Table 13.4 and Figure 13-1 and Figure 13-2.

13.2 Recurrent Costs

Administration/ Management costs	Reflects true overheads associated with providing this service. Any cross subsidies with General Fund should be eliminated or explicitly disclosed in the Annual Accounts.
Operations and Maintenance (O&M) costs	It is assumed that the current level of costs shown in the Financial Statements reflects a realistic level of expenditure for the current schemes. The projections assume costs increased in proportion to the growth
Model cost overrides	Additional costs are included where specific activities have been identified for future years. This includes new initiatives plus additional costs associated with new capital works identified as part of the adopted IWCM scenario. For details of overrides used in the model, refer to the next section (Financial Plan).

Details of overrides for recurrent expenditure are as follows:

- Administration – as estimated and adopted by the Council
- Engineering & Supervision – as estimated and adopted by the Council
- Operation and Maintenance expenses – includes additional cost estimates for IWCM initiatives
- Energy costs – includes additional cost estimates for IWCM initiatives
- Chemical costs – includes additional cost estimates for IWCM initiatives
- Other expenses – as estimated and adopted by the Council
- Other revenue, grants and contributions – as estimated based on adopted assessment growth rate

The recurrent O&M costs for the adopted water supply and sewerage IWCM scenario are presented in Table 13.5and Table 13.6.

Table 13.1: 30-Year Capital Works Schedule for Water Supply – Preferred IWCM Scenario

Palerang - Water Services Capital Works Program - Adopted IWCM Scenario

WATER - 30-Year Capital Works Program

Current Year 2017 /18

CAPITAL WORKS IN 2017 ($'000)

ITEMS	ILOS	GROWTH	RENEW	Total	1 2017/18	2 2018/19	3 2019/20	4 2020/21	5 2021/22	6 2022/23	7 2023/24	8 2024/25	9 2025/26	10 2026/27	11 2027/28	12 2028/29	13 2029/30	14 2030/31	15 2031/32
A - NEW WORKS - BACKLOG																			
	100%			0															
B - NEW WORKS - GROWTH																			
B'dore WTP Upgrade (1.5 ML) - LF Belt Bores - Stage1		100%		9,439		9439													
B'dore WTP Upgrade (3 ML) - LF Belt Bores - Stage2		100%		9,160															9160
Private works, connections, extensions		100%		1,490	30	60	50	50	50	50	50	50	50	50	50	50	50	50	50
New Meters and Connections		100%		560			20	20	20	20	20	20	20	20	20	20	20	20	20
Council's Capital Proj Mgmt Charge		100%		831	1	380	3	3	3	3	3	3	3	3	3	3	3	3	369
C - NEW WORKS - SERVICE IMPROVEMENT / OTHER																			
Bungendore - Water Bores	100%			500		500													
Dams (Component) upgrade	100%			0															
Braidwood W.T.P. - Improvements	100%			900							300								
Bungendore W.T.P. - Improvements	100%			900								300							
Currandooly W.T.P. - Improvements	100%			400			150	250											
Captains Flat W.T.P. - Improvements	100%			300													150		
Pump Station - (Component) upgrade - Braidwood	100%			200	100	100													
Reservoirs - (Component) upgrade	100%			15	15														
Telemetry System upgrade	100%			465	65										100				
Council's Capital Proj Mgmt Charge	100%			131	7	24					12	12			4		6		
E - ASSET / COMPONENT RENEWAL																			
Based on Asset Register																			
Dams			100%	500									250						
Water Treatment Plants			100%	4,500										700					1000
Pump Stations			100%	840			10	10	10	10	10	150	150	10	10	10	10	10	10
Replace Cap Flat Steel Reservoir			100%	650	500	150													
Water Mains			100%	2,080	30	450													400
Service Connections			100%	900	60		60		60		60		60		60		60		60
Captains Flat Dam 10 yearly post stressing lift off test			100%	360					120										120
Replace Braidwood rising main			100%	1,600				1600											
Paint Days Hill reservoir			100%	700						350									
Turallo Reservoirs retaining wall and leak repair			100%	200			200												
Establish Hydraulic model (all three schemes)	100%			105			75	30											
Replace membranes Captains Flat WTP			100%	280					70							70			
Chemical storage shed Captains Flat WTP			100%	200			200												
Water loss studies	100%			150			150												
Water Meters			100%	840			30	30	30	30	30	30	30	30	30	30	30	30	30
Telemetry System			100%	510			10	10	10	10	10	10	10	10	10	10	10	10	10
Council's Capital Proj Mgmt Charge			100%	573	24	24	29	67	12	16	4	8	20	30	4	5	4	2	65
GRAND TOTAL				40,279	832	11,127	987	2,070	385	489	499	583	593	853	291	198	343	125	11,294

ITEMS	16 2032/33	17 2033/34	18 2034/35	19 2035/36	20 2036/37	21 2037/38	22 2038/39	23 2039/40	24 2040/41	25 2041/42	26 2042/43	27 2043/44	28 2044/45	29 2045/46	30 2046/47
A - NEW WORKS - BACKLOG															
B - NEW WORKS - GROWTH															
B'dore WTP Upgrade (1.5 ML) - LF Belt Bores - Stage1															
B'dore WTP Upgrade (3 ML) - LF Belt Bores - Stage2															
Private works, connections, extensions	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
New Meters and Connections	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Council's Capital Proj Mgmt Charge	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
C - NEW WORKS - SERVICE IMPROVEMENT / OTHER															
Bungendore - Water Bores															
Dams (Component) upgrade															
Braidwood W.T.P. - Improvements		300										300			
Bungendore W.T.P. - Improvements			300										300		
Currandooly W.T.P. - Improvements															
Captains Flat W.T.P. - Improvements								150							
Pump Station - (Component) upgrade - Braidwood															
Reservoirs - (Component) upgrade															
Telemetry System upgrade	100					100					100				
Council's Capital Proj Mgmt Charge	4	12	12			4		6			4	12	12		
E - ASSET / COMPONENT RENEWAL															
Based on Asset Register															
Dams														250	
Water Treatment Plants										300				1250	1250
Pump Stations	10	10	10	150	150	10	10	10	10	10	10	10	10	10	10
Replace Cap Flat Steel Reservoir															
Water Mains		400		400		400									
Service Connections		60		60		60		60		60		60		60	
Captains Flat Dam 10 yearly post stressing lift off test										120					
Replace Braidwood rising main															
Paint Days Hill reservoir											350				
Turallo Reservoirs retaining wall and leak repair															
Establish Hydraulic model (all three schemes)															
Replace membranes Captains Flat WTP				70							70				
Chemical storage shed Captains Flat WTP															
Water loss studies															
Water Meters	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Telemetry System	10	10	10	150	100	10	10	10	10	10	10	10	10	10	10
Council's Capital Proj Mgmt Charge	2	20	2	34	11	20	2	4	2	21	19	4	2	64	52
GRAND TOTAL	229	915	437	967	364	707	125	343	125	624	666	499	437	1,747	1,425

Table 13.2: 30-Year Capital Works Schedule for Sewerage – Preferred IWCM Scenario

Palerang - Sewerage Services Capital Works Program - Adopted IWCM Scenario

SEWER - 30-Year Capital Works Program

Current Year 2017 /18

CAPITAL WORKS IN 2017 $('000)

ITEMS	ILOS	GROWTH	RENEW	Total	1 2017/18	2 2018/19	3 2019/20	4 2020/21	5 2021/22	6 2022/23	7 2023/24	8 2024/25	9 2025/26	10 2026/27	11 2027/28	12 2028/29	13 2029/30	14 2030/31	15 2031/32
A - NEW WORKS - BACKLOG																			
	100%			0															
B - NEW WORKS - GROWTH																			
Bungendore effluent reuse system	100%	0%		570	25	45	500												
Bungendore STP upgrade 2023/24		100%		10,080			-				10,080								
Replace rising main and pumps B'dore SPS#2	50%	50%		260		260													
Upgrade pumps at SPS#4 Bungendore		100%		80		80													
Private Works - Extension & connection (infill)		100%		580		20	20	20	20	20	20	20	20	20	20	20	20	20	20
Council's Capital Proj Mgmt Charge		100%		468	1	16	21	1	1	1	404	1	1	1	1	1	1	1	1
C - NEW WORKS - OTHER (Performance improvement)																			
Upgrade pumps at SPS#1 Braidwood to meet PWWF	100%			30		30													
Captains Flat STP upgrade	100%			3,595	95	3500													
Upgrade SPS2 & 7 Bungendore			100%	250	0	250													
Upgrade SPS5 at Bungendore			100%	200		200													
Upgrade SPS1 at Captains Flat			100%	200		200													
Pump Station upgrades / improvements			100%	250	0					50					50				
Telemetry System upgrade	100%			600		100					100					100			
Council's Capital Proj Mgmt Charge	100%			205	4	171	0	0	0	2	4	0	0	0	2	4	0	0	0
D - RENEWALS																			
Based on Asset Register																			
STP Assets renewal/ Majoar refurbishments			100%	7,650														2,500	2,500
Pump station asset renewal			100%	3,300			-	300	300						300	300	300		
Pump replacements			100%	450	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Inflow study Braidwood - main relining			100%	250		250													
Inflow study Bungendore - initial study/works			100%	350			350												
Replace rising main SPS#3 Braidwood			100%	300			300												
Reticulation - Mains / Service Lines		50%	50%	2,000		-													
Telemetry component renewal			100%	280			10	10	10	10	10	10	10	10	10	10	10	10	10
Sewer Manhole Renewals			100%	355	25	230	50	50											
Council's Capital Proj Mgmt Charge			100%	598	2	20	29	15	13	1	1	1	1	1	13	13	13	101	101
GRAND TOTAL				32,901	167	5,387	1,295	411	359	99	10,634	47	47	47	411	463	359	2,647	2,647

ITEMS	16 2032/33	17 2033/34	18 2034/35	19 2035/36	20 2036/37	21 2037/38	22 2038/39	23 2039/40	24 2040/41	25 2041/42	26 2042/43	27 2043/44	28 2044/45	29 2045/46	30 2046/47
A - NEW WORKS - BACKLOG															
B - NEW WORKS - GROWTH															
Bungendore effluent reuse system															
Bungendore STP upgrade 2023/24															
Replace rising main and pumps B'dore SPS#2															
Upgrade pumps at SPS#4 Bungendore															
Private Works - Extension & connection (infill)	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Council's Capital Proj Mgmt Charge	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C - NEW WORKS - OTHER (Performance improvement)															
Upgrade pumps at SPS#1 Braidwood to meet PWWF															
Captains Flat STP upgrade															
Upgrade SPS2 & 7 Bungendore															
Upgrade SPS5 at Bungendore															
Upgrade SPS1 at Captains Flat															
Pump Station upgrades / improvements	50					50					50				
Telemetry System upgrade		100					100					100			
Council's Capital Proj Mgmt Charge	2	4	0	0	0	2	4	0	0	0	2	4	0	0	0
D - RENEWALS															
Based on Asset Register															
STP Assets renewal/ Majoar refurbishments	2,500												150		
Pump station asset renewal					300	300	300						300	300	300
Pump replacements	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Inflow study Braidwood - main relining															
Inflow study Bungendore - initial study/works															
Replace rising main SPS#3 Braidwood															
Reticulation - Mains / Service Lines			500	500	500	500									
Telemetry component renewal	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Sewer Manhole Renewals															
Council's Capital Proj Mgmt Charge	101	1	21	21	33	33	13	1	1	1	1	1	19	13	13
GRAND TOTAL	2,699	151	567	567	879	931	463	47	47	47	99	151	515	359	359

Table 13.3: Capital Works Summary for Water Supply ($'000)

2017/18 ($'000)	Growth and Minor Works	Improved Levels of Service	Asset Renewals	Total Capital Works	Expected Subsidy	Cost to Council
2017/18	31	187	614	832	0	832
2018/19	9,879	624	624	11,127	0	11,127
2019/20	73	375	539	987	0	987
2020/21	73	280	1,717	2,070	0	2,070
2021/22	73	0	312	385	0	385
2022/23	73	0	416	489	0	489
2023/24	73	312	114	499	0	499
2024/25	73	312	198	583	0	583
2025/26	73	0	520	593	0	593
2026/27	73	0	780	853	0	853
2027/28	73	104	114	291	0	291
2028/29	73	0	125	198	0	198
2029/30	73	156	114	343	0	343
2030/31	73	0	52	125	0	125
2031/32	9,599	0	1,695	11,294	0	11,294
2032/33	73	104	52	229	0	229
2033/34	73	312	530	915	0	915
2034/35	73	312	52	437	0	437
2035/36	73	0	894	967	0	967
2036/37	73	0	291	364	0	364
2037/38	73	104	530	707	0	707
2038/39	73	0	52	125	0	125
2039/40	73	156	114	343	0	343
2040/41	73	0	52	125	0	125
2041/42	73	0	551	624	0	624
2042/43	73	104	489	666	0	666
2043/44	73	312	114	499	0	499
2044/45	73	312	52	437	0	437
2045/46	73	0	1,674	1,747	0	1,747
2046/47	73	0	1,352	1,425	0	1,425
Total	**21,480**	**4,066**	**14,733**	**40,279**	**0**	**40,279**

Table 13.4: Capital Works Summary for Sewerage ($’000)

2017/18 ($'000)	Growth and Minor Works	Improved Levels of Service	Asset Renewals	Total Capital Works	Expected Subsidy	Cost to Council
2017/18	1	124	42	167	0	167
2018/19	246	3,976	1,165	5,387	0	5,387
2019/20	41	500	754	1,295	0	1,295
2020/21	21	0	390	411	0	411
2021/22	21	0	338	359	0	359
2022/23	21	2	76	99	0	99
2023/24	10,504	104	26	10,634	0	10,634
2024/25	21	0	26	47	0	47
2025/26	21	0	26	47	0	47
2026/27	21	0	26	47	0	47
2027/28	21	2	388	411	0	411
2028/29	21	104	338	463	0	463
2029/30	21	0	338	359	0	359
2030/31	21	0	2,626	2,647	0	2,647
2031/32	21	0	2,626	2,647	0	2,647
2032/33	21	2	2,676	2,699	0	2,699
2033/34	21	104	26	151	0	151
2034/35	271	0	296	567	0	567
2035/36	271	0	296	567	0	567
2036/37	271	0	608	879	0	879
2037/38	271	2	658	931	0	931
2038/39	21	104	338	463	0	463
2039/40	21	0	26	47	0	47
2040/41	21	0	26	47	0	47
2041/42	21	0	26	47	0	47
2042/43	21	2	76	99	0	99
2043/44	21	104	26	151	0	151
2044/45	21	0	494	515	0	515
2045/46	21	0	338	359	0	359
2046/47	21	0	338	359	0	359
Total	**12,338**	**5,130**	**15,433**	**32,901**	**0**	**32,901**

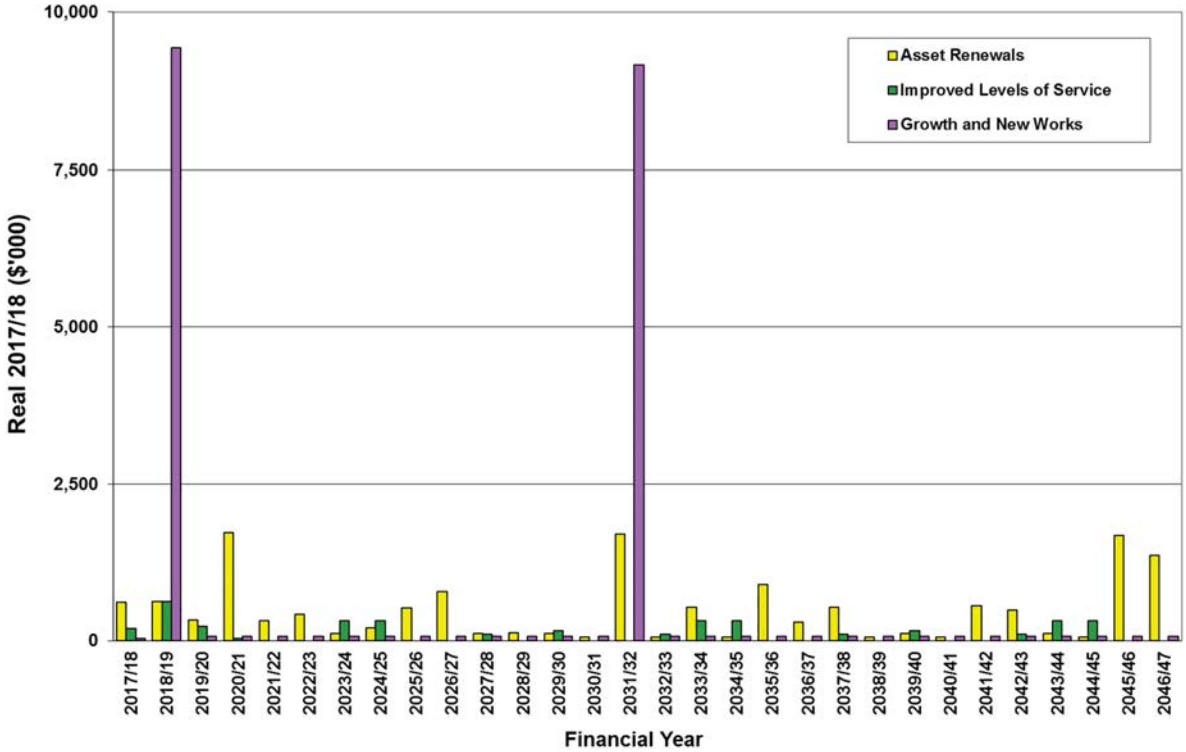

Figure 13-1: 30-year Capital Works Program - Water Supply

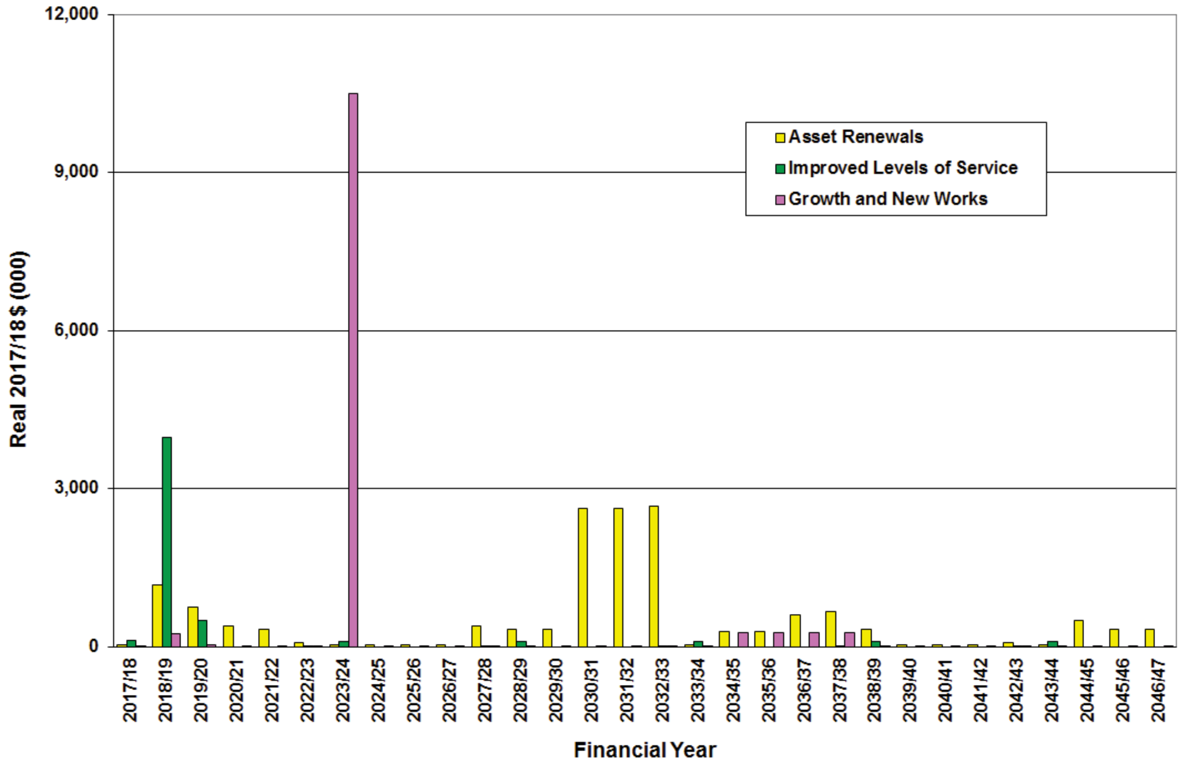

Figure 13-2: 30-year Capital Works Program - Sewerage

Table 13.5: Recurrent O&M Expenditure Summary for Water Supply ($'000)

2017/18 ($'000)	Management	Operation & Maintenance	Depreciation (Non-Cash)
2017/18	432	1,160	625
2018/19	501	1,220	758
2019/20	449	1,643	760
2020/21	471	1,717	760
2021/22	525	1,790	759
2022/23	514	1,862	758
2023/24	535	1,934	761
2024/25	591	2,004	765
2025/26	635	2,072	764
2026/27	597	2,139	764
2027/28	617	2,202	765
2028/29	636	2,272	764
2029/30	654	2,331	766
2030/31	757	2,390	765
2031/32	689	2,616	886
2032/33	706	2,955	887
2033/34	721	3,015	891
2034/35	811	3,074	894
2035/36	751	3,129	894
2036/37	813	3,181	895
2037/38	778	3,232	896
2038/39	840	3,279	895
2039/40	803	3,323	897
2040/41	815	3,366	898
2041/42	825	3,406	898
2042/43	972	3,445	899
2043/44	846	3,483	903
2044/45	855	3,518	907
2045/46	864	3,550	908
2046/47	928	3,814	907

Table 13.6: Recurrent O&M Expenditure Summary for Sewerage ($'000)

2017/18 ($'000)	Management	Operations & Maintenance	Depreciation
2017/18	453	844	918
2018/19	452	972	975
2019/20	491	938	979
2020/21	471	1,021	976
2021/22	525	1,033	973
2022/23	518	1,081	970
2023/24	541	1,129	1,118
2024/25	653	1,346	1,115
2025/26	645	1,399	1,112
2026/27	608	1,449	1,109
2027/28	629	1,499	1,106
2028/29	650	1,549	1,105
2029/30	735	1,597	1,102
2030/31	777	1,643	1,100
2031/32	708	1,689	1,098
2032/33	727	1,731	1,095
2033/34	744	1,772	1,095
2034/35	910	1,813	1,096
2035/36	777	1,850	1,098
2036/37	842	1,888	1,099
2037/38	808	1,922	1,100
2038/39	873	1,955	1,100
2039/40	914	1,985	1,098
2040/41	848	2,016	1,097
2041/42	860	2,045	1,095
2042/43	1,013	2,072	1,094
2043/44	883	2,097	1,094
2044/45	979	2,123	1,093
2045/46	904	2,146	1,091
2046/47	970	2,168	1,055

14 Financial Plan

14.1 Overview

This section presents the details of the long-term financial plans for the water supply and sewerage services of the Palerang Community for the adopted IWCM strategy. The water and sewer funds for this purpose are consolidated funds across the community and are not based on individual schemes or catchments. The overall goal of financial planning is to determine the lowest, sustainable price path for the water supply and sewerage services on which to base Council's tariff structure. The details of assumptions, input data and output financial forecasts for the adopted IWCM strategy are presented in this plan. The plan also presents the sensitivity of financial forecasts to possible changes in key model variables.

14.2 Financial Modelling Methodology

FINMOD 4.0, the software developed by the DPI Water was used to develop the financial models. For a particular Level of Service (LOS), FINMOD enables an examination of a range of funding options to determine the best mix of borrowing and internal funding.

A stable level of annual residential charges for water supply and sewerage services has been achieved using Finmod by optimising the long-term funding strategy in meeting the demands of the capital works program and day-to-day operations, while ensuring a minimum level of cash liquidity. The financial models have been developed for a 30-year planning horizon.

The financial model balances the forecast income and expenditure for each service delivery option over the projected modelling period. (Figure 14.1) illustrates the main elements, which affect the financial modelling.

The goals of the financial modelling task are to:

- optimise long term funding strategy
- meet the demands of the capital works programme and other life cycle costs of the system assets
- ensure a minimum level of cash liquidity
- provide a forecast of the average residential annual charges over the long term.

The long-term financial plans demonstrate the sustainability of future actions and also to show the sensitivity of model outcomes to some of the key assumptions made.

Funding is usually from a mix of borrowing and direct revenue and can also be offset by receiving Government subsidies where applicable. Renewal campaigns would usually be funded from revenue, and some cash would be accumulated in anticipation of major projects, to reduce the need for borrowing.

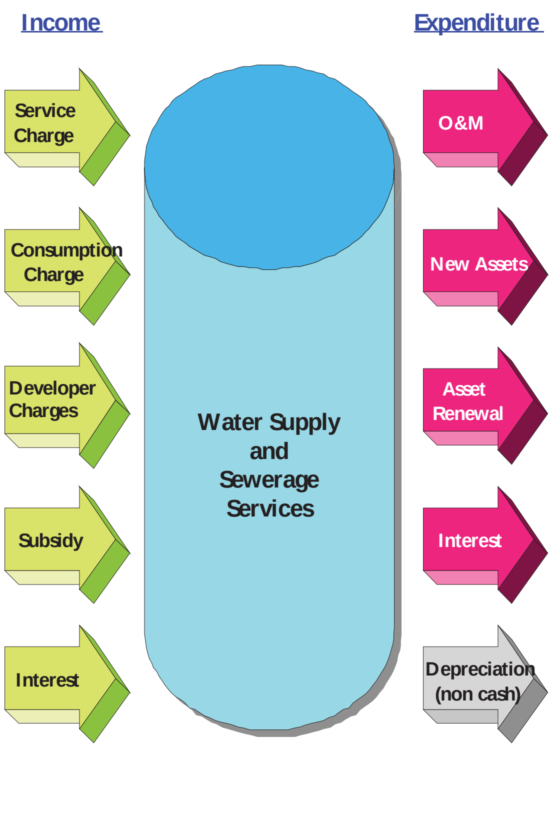

Figure 14.1 – Elements of Financial Modelling

The DI Water encourages the use of long-term loans because they support the idea of intergenerational equity and this will reduce the demand for funds in the short term

If the resulting annual charges are considered unacceptable or unaffordable, some input variables (levels of service) can be adjusted to arrive at a satisfactory projection of annual charges. For example, to reduce the level of annual charges, Council may delay some of the capital works, may increase developer charges, or may take long-term or structured loans.

While the preferred model reflects the expected performance of the systems, it does not give any indication of the sensitivity of the proposed solution should the basic assumptions used prove significantly different in practice.

For this reason, a sensitivity analysis is carried out if it is perceived that a variable may change significantly in the future. The value of a sensitivity analysis is that it shows:

- The sensitivity of the results to assumptions (uncontrollable variables); and
- The impact of changing controllable variables.

The DPI Water Guidelines suggest that a number of sensitivities should be carried out to test the robustness of the plan. With regard to the controllable variables such as the loan structure and the developer charges, the model enables Council to make decisions to establish the right management policies.

With uncontrollable variables, Council is at the mercy of change. The down side risk of an increase in interest rates, or lower than expected growth rates, or rise in energy costs, may be significant.

Council's charging (pricing) policies will also take into account corporate policies, approach to risk and the acceptability of charges to the community. Some of these risks are evident from the sensitivities presented in this Plan.

On-going Review

Over time, changes in model variables can have a significant impact on the model's accuracy and this has implications for Palerang Community's forward planning. It is recommended that the models be reviewed annually, and the financial plan revised regularly preferably on a 3-yearly basis. Where Councils have an active capital works program that requires government grant/ subsidy, then annual updates are recommended by DPI Water.

14.3 Financial Model Inputs

Several variables and assumptions have been used in the development of the base cases of the water and sewer fund financial models (Appendix G and Appendix H) and are summarised in Table 14.1. The model assumptions have been first agreed to by the Council based on a representative view on the impact of a number of factors. They have been grouped into five main policy areas and are discussed below:

- Charges
- Revenues and Expenditures
- Service Provision
- Funding/ Financing Capital Works
- Performance Measures

Table 14.1: Key Input Parameters for the Financial Models

	Input Data/ Assumption/ Source	
	Water Supply	**Sewerage**
Historical Data	Palerang Community special schedules 3,4,5 and 6 for years 2014/15 and 2015/16 and the Revenue Policies for 2017/18 and 2018/19 considered for typical income and expenditure	
Financial Data	Average annual long-term inflation rate: 2.5% p.a. Annual Borrowing Interest Rate: 4.5% p.a. Annual Investment Interest Rate: 3.0% p.a.	
Demographic Base Data (2017/18)	No. of Resi. Assessments: 2,155 (Vacant - 56) No. of Non-Resi. Assessments: 260 (Vacant - 41) Pensioner Assessments: 229 Assessment growth rate: 2.7% p.a. (Long-term average)	No. of Resi. Assessments: 2,094 (Vacant - 244) No. of Non-Resi. Assessments: 222 (Vacant - 134) Pensioner Assessments: 249 Assessment growth rate: 2.9% p.a. (Long-term average)
Current Charges (from Revenue Policy 2017/18)	All customers: Access Charge*: $440 p.a. (20 mm) Usage Charge+: $2.31/ Kl (up to 200 KL) $3.63/ KL (above 200 KL) Typical Residential Bill: $855 p.a. Residential Revenue: 81.1% Non-residential Revenue: 18.9% Sec.64 Developer Charges: $10,150/ET	Residential Charges: $1022 p.a. Non-Residential: Access Charge* (20mm): $1,171 p.a. Usage Charge: $2.74/ Kl Residential Revenue: 81.9% Non-residential Revenue: 18.1% Sec.64 Developer Charges: $12,180/ET
Opening Balances (June 2017)	Outstanding Loan: $4,366 K Cash and Investments: $ 9,597 K Minimum operating cash: $1,000 K	Outstanding Loan: $ 8,748 K Cash and Investments: $ 11,831 K Minimum operating cash: $1,000 K

* - For larger than 20 mm meter size connections, the annual access charges increase by the square of the proportion of larger meter sizes to 20 mm; + - Council has adopted single tier usage charge from 2018/19 onwards. Refer to the Revenue Policy 2018/19

14.3.1 Charges

Charging Structure

The projection of typical residential bills (TRBs) for water supply and sewerage is made in 2017/18 dollars and demonstrates the lowest long-term practical price path that can be achieved based on assumptions made. Where feasible the price path is maintained level in real terms and it is assumed that on an annual basis these charges are increased in line with the inflation/ CPI (consumer price index).

Typical residential bills calculated by the model are higher than the average bills because the model considers account revenue losses due to unoccupied tenements and pensioner rebates. Council can use this information in fixing its service tariffs. These are to be reviewed at least every 5 years and indexed in the interim.

Developer Charges

Current (2017/18) Sec.64 developer charges for the new developments are $ 10,150/ET and $12,180/ET for water supply and sewerage services, respectively, based on the Palerang Section 64 Plans for Water Supply and Sewerage, 2011. These charges have been adopted for the financial modelling. Council is planning to review and update of the developer charges and the Development Servicing Plans following the completion of IWCM Strategy in accordance with the 2016 Developer Charges Guidelines.

Cash and Investments

Minimum cash levels of $ 1,000,000 each for water fund and the sewerage fund have been considered.

14.3.2 Revenues and Expenditures

Inflation

Average long-term inflation rate of 2.5% p.a. for general and capital works financial activities has been adopted for both water supply and sewerage models.

Interest Rates

The interest rates adopted in this analysis are 4.5% p.a. for all new borrowing from 2018/19 onwards and 3.0% p.a. for all investments.

Capital Works

The capital work expenses form a significant component of the inputs. The capital works program adopted for financial modelling includes all the capital works identified for IWCM Scenario 2 and in the Council's asset renewal program.

Recurrent Costs

The financial models for water supply and sewerage consider a number of ongoing recurrent costs from historic input details. By default, the modelling increases historical operation and maintenance expenses on a pro-rata basis with respect to growth. This has been overridden where Council has provided revised estimates, i.e. where the IWCM action plan requires new initiatives or where new works require additional operating resources as described in Section 13.

14.3.3 Service Provision

Growth Projections

A long-term average residential assessment growth rate of 2.7% p.a. for water supply (5.3% p.a. for the first 5 year) and 2.9% p.a. for sewerage (5.8% p.a. for first 5-years) as forecast for the development of IWCM strategy has been adopted for the financial models. In line with Council's adopted development policy, the growth has been assumed to occur in all the serviced towns. Same growth rates have been adopted for water supply and sewerage models.

Expected life of assets

The default average life of the system assets is based on the weighted average of long-lived structures and shorter-lived mechanical plant. These average lives are currently estimated by Council to be 75 years for water assets and 70 years for sewerage assets.

Depreciation is a non-cash expense, which is dependent upon asset lives. The age of assets directly affects the level of future asset renewal works, which are part of the capital works program.

14.3.4 Funding Capital Works

Some, or all, capital works can be funded directly from accumulated cash reserves. To overcome intergenerational equity issues, it is general practice to fully fund renewals programs out of internally generated cash (where practical) and to borrow against capital acquisitions.

Funds, which are surplus to requirements, can be used to further reduce or eliminate borrowing requirements and reduce interest payments.

Loans are taken out as required to finance the capital works and to maintain the adopted minimum cash level of $1,000,000 in each of water and sewer funds.

Revenue – Typical Residential Bills maintained at constant level in real terms, unless where an increase is required for the long term financial viability.

Subsidies/Grants for Capital Works

Financial assistance in the form of grants for capital works may be received under various funding programs by the State and Federal Governments such as the Restart NSW or the National Stronger Regions Fund (NSRF). The Program's guidelines, published by the Department of Industries and Infrastructure NSW at the State level and Commonwealth Department of Infrastructure and Regional Development, define the extent of the available grants/ subsidies.

The financial models for both the water and sewer fund assume that no government grant/ subsidy for any of the planned capital works.

14.4 Assumptions and Limitations of the Model

The projections of the financial models are mainly based on the previous two years (historical) financial records. Allowance is made for new initiatives, future rate forecasts, and maintenance of sustainable Levels of Service (LOS) as identified and adopted by Council through the IWCM process.

The net operating results and other financial performance indicators such as the economic real rate of return (ERRR) etc., in the financial projections should be seen in light of the fact that the depreciation of existing assets shown in the operating statement is not a cash item. FINMOD specifically models Council's asset renewal program as the fully internally funded component of the capital works program. A modest negative operating result is often sustainable as conventional depreciation of assets is conservative in comparison with an asset renewal program that has been rigorously evaluated and adopted for the financial projections.

The financial model manages the cash flow and keeps a running tally of the cumulative depreciation so that the Council can appreciate the potential future liability for maintaining the value in the system and the LOS. By planning ahead and making optimum use of existing assets, a more cost effective and efficient service should result.

Typical Residential Bills are used as the performance indicators representing overall revenue requirements from residential customers. This should not be confused with pricing structure. Pricing, i.e. distribution of the charges according to consumption or special customer groups, is the subject of a separate revenue planning exercise. Tariff structure for the services will need to take into account corporate policies, approach to risks such as lower than adopted growth rates, increase in interest rates and the acceptability of charges to the community.

The financial model is not a substitute for normal budgeting, (i.e. short-term financial planning). The model assumes that all expenses and income occur at the beginning of the year and is therefore not appropriate to track cash flow throughout the year. It is important, however, that the budgeting process is carried out within the framework of the long-term financial plan.

The TAM Plan (refer to Section 13) shows the expenditure based on the current estimates for the long-term capital, operational and maintenance and are used in the models for projecting the financial position over the next 30 years. Models will require updating as more accurate expenditure schedules become available. Annual update and 3 to 4 yearly review of the model projections with the up to date level of expenditure is recommended.

14.5 Financial Model Outcomes – Water Supply

14.5.1 Projected Financial Position

All costs and revenues in the input data and the model outcomes are in 2017/18 dollars unless stated otherwise. The first year of model projections is 2017/18 and CPI should be applied accordingly. The financial projections need to be reviewed annually with respect to material changes to the proposed capital works program and/or changes to any of the underlying assumptions.

The 2017/18 water supply TRB of $855 p.a. has been increased to $920 (inflated $945 p.a.) for the year 2018/19 as per the adopted Revenue Policy. The adopted IWCM scenario of the water fund financial model does not consider any government grant or subsidy for any of the planned capital works. Accordingly, the TRB forecasts by the model for the next 30-years is presented in Figure 14.2.

The model demonstrated that the 2018/19 TRB needs to be increased to $1,000 p.a. (inflated $1050 p.a.) from 2019/20 onwards and can be maintained at that level for the remaining forecast years with ongoing annual adjustments for CPI / inflation.

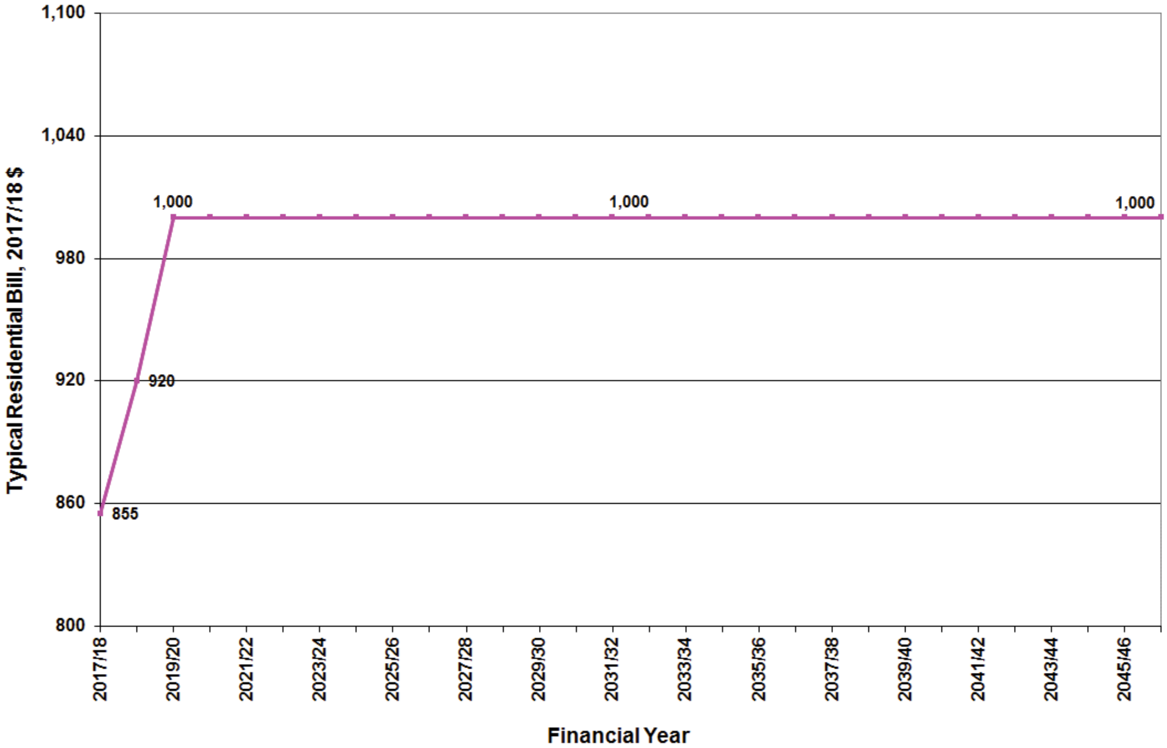

Figure 14.2: Typical Residential Bill for Water Supply

The projected level of charges is sufficient to maintain liquidity with a minimum of $1,000 K of cash in hand over the period.

The model forecasts demonstrate that with the adopted price path, the stage 1 and stage 2 WTP upgrade works need to be funded through a mix of cash reserves and external borrowing and there will not be any need for external borrowing for other planned capital works throughout the forecast period. The outstanding loan for water fund will reach a maximum of $10,234 K in 2018/19 (assuming the stage 1 WTP upgrade work is completed as planned in the adopted 30-year capital works program) and will be gradually retired during the remaining forecast period. The levels of cash and borrowing outstanding during the forecast period are depicted in Figure 14.3.

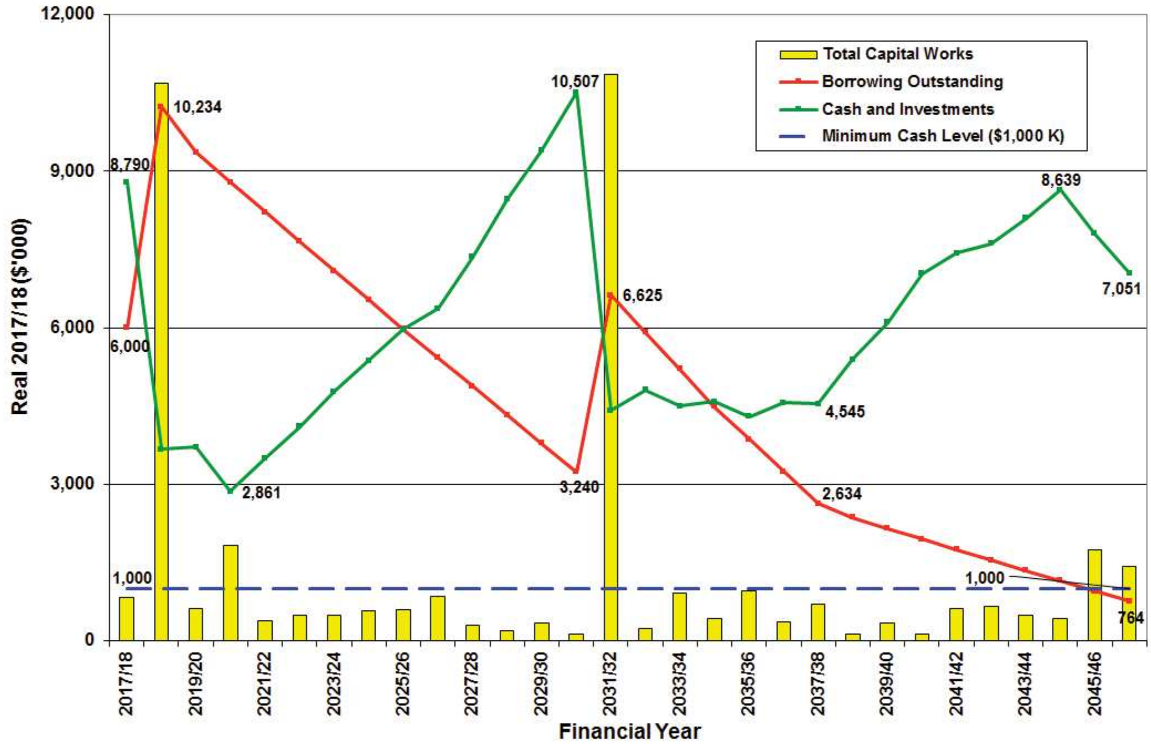

Figure 14.3: Cash & Borrowing Projections for Water Supply

Projected financial results for the water fund are presented in Table 14.2. Note that all the projected financial figures are in current (2017/18) dollars and need indexing for CPI/Inflation for future years. More detailed financial output statements are as presented in Appendix G.

14.5.2 Sensitivity of Financial Projections

The water fund financial model does not involve any grant/ subsidy, hence, does not warrant sensitivity analysis for a 'no subsidy scenario'. Sensitivity of the model forecasts were analysed for higher capex estimates and lower growth rates and the impact of these variables on the water supply TRB forecasts are summarised in Table 14.3 and presented in Figure 14.4 and Figure 14.5.

Table 14.2: Projected Financial Results – Water Fund

2017/18 ($'000)	Revenue and Expenses			Capital Transactions		Financial Position					System Assets			
Financial Year	Total Revenue	Total Expenses	Operating Result (Before Grants)	Acquisition of Assets	Principal Loan Payments	Cash and Investments	Borrowings	Total Assets	Total Liabilities	Net Assets Committed	Current Replacement Cost	Less: Accumulated Depreciation	Written Down Current Cost	Typical Residential Bills
2017/18	7,451	2,978	4,473	832	466	8,790	6,000	37,809	6,315	31,494	40,985	16,667	24,318	855
2018/19	4,148	3,472	676	10,688	620	3,676	10,234	42,472	10,567	31,905	51,049	16,728	34,321	920
2019/20	4,483	3,842	642	629	621	3,711	9,364	42,228	9,714	32,514	51,347	17,086	34,261	1,000
2020/21	4,607	3,932	675	1,820	346	2,861	8,789	42,359	9,157	33,202	51,450	16,059	35,391	1,000
2021/22	4,781	4,055	726	385	356	3,507	8,219	42,456	8,605	33,851	51,523	16,438	35,085	1,000
2022/23	4,924	4,111	813	490	364	4,111	7,654	42,596	8,057	34,539	51,597	16,715	34,882	1,000
2023/24	5,114	4,204	911	499	374	4,781	7,094	42,779	7,515	35,264	51,982	17,298	34,684	1,000
2024/25	5,260	4,319	941	583	384	5,372	6,537	42,954	6,975	35,979	52,367	17,802	34,565	1,000
2025/26	5,391	4,417	974	593	395	5,962	5,982	43,120	6,437	36,683	52,440	17,984	34,456	1,000
2026/27	5,523	4,444	1,079	853	407	6,371	5,430	43,381	5,901	37,480	52,513	17,908	34,604	1,000
2027/28	5,644	4,525	1,119	291	418	7,361	4,879	43,524	5,366	38,158	52,689	18,500	34,189	1,000
2028/29	5,777	4,609	1,168	198	428	8,459	4,332	43,623	4,834	38,789	52,763	19,083	33,680	1,000
2029/30	5,879	4,684	1,195	343	441	9,401	3,785	43,714	4,302	39,412	52,992	19,679	33,313	1,000
2030/31	6,017	4,839	1,178	125	453	10,507	3,240	43,679	3,771	39,908	53,065	20,337	32,728	1,000
2031/32	5,992	5,291	701	10,855	536	4,418	6,625	49,127	7,170	41,957	62,225	19,475	42,750	1,000
2032/33	6,050	5,634	416	229	548	4,808	5,916	48,638	6,474	42,164	62,403	20,258	42,145	1,000
2033/34	6,127	5,699	428	915	561	4,505	5,210	48,354	5,782	42,572	62,787	20,568	42,219	1,000
2034/35	6,187	5,834	354	437	594	4,584	4,489	47,853	5,073	42,780	63,172	21,361	41,811	1,000
2035/36	6,250	5,815	435	967	512	4,296	3,868	47,647	4,464	43,183	63,245	21,314	41,931	1,000
2036/37	6,315	5,917	398	364	524	4,568	3,250	47,200	3,856	43,344	63,318	21,871	41,447	1,000
2037/38	6,385	5,921	464	707	536	4,545	2,634	46,910	3,252	43,658	63,496	22,191	41,304	1,000
2038/39	6,439	6,020	419	125	207	5,391	2,362	46,559	2,991	43,568	63,569	22,990	40,579	1,000
2039/40	6,496	6,031	465	343	148	6,104	2,157	46,325	2,795	43,530	63,798	23,730	40,068	1,000
2040/41	6,579	6,091	487	125	151	7,037	1,953	45,980	2,600	43,380	63,871	24,533	39,338	1,000
2041/42	6,614	6,143	471	624	154	7,429	1,751	45,812	2,407	43,405	63,944	24,838	39,107	1,000
2042/43	6,647	6,334	313	666	158	7,610	1,550	45,564	2,214	43,350	64,121	25,207	38,914	1,000
2043/44	6,717	6,252	465	499	161	8,106	1,351	45,310	2,023	43,287	64,506	25,957	38,550	1,000
2044/45	6,754	6,304	451	437	164	8,639	1,154	44,998	1,834	43,164	64,892	26,773	38,118	1,000
2045/46	6,759	6,346	413	1,747	167	7,809	959	45,303	1,645	43,658	64,965	25,970	38,995	1,000
2046/47	6,822	6,675	147	1,425	171	7,051	764	45,346	1,458	43,888	65,038	25,488	39,550	1,000

Table 14.3: Sensitivity Analysis – Water Fund

Sensitivity	Values of Variables for Analysis	Effect on TRB compared to the adopted IWCM Scenario
Lower than expected assessment growth rate	50% of the adopted assessment growth rate for IWCM Strategy.	TRB increase in 2019/20 will be higher at $230 compared to the increase of $80 for the adopted scenario. Also, the TRB will require another increase of $150 during the Stage 2 WTP upgrade
Higher Capital expenditure	Cost estimates for adopted capital works program increase by 20%	TRB increase in 2019/20 will be higher at $180 compared to the increase of $80 for the adopted scenario.

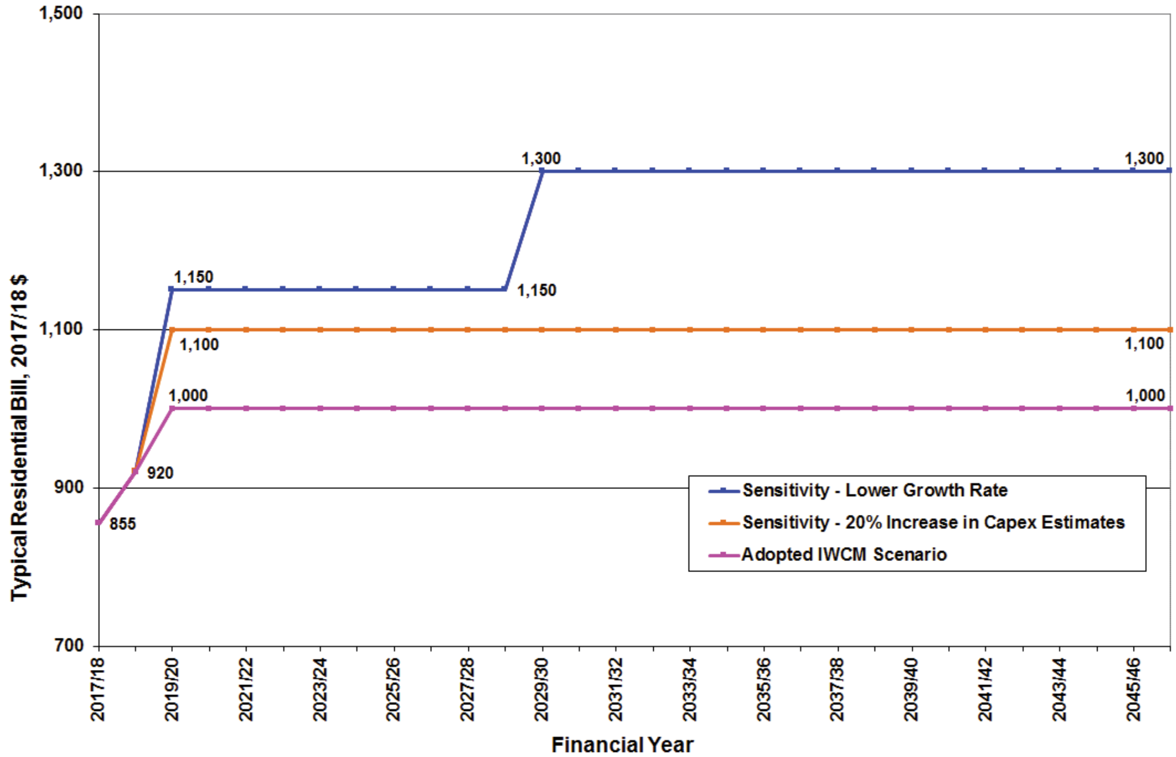

Figure 14.4: Sensitivity of Typical Residential Bill for Water Supply

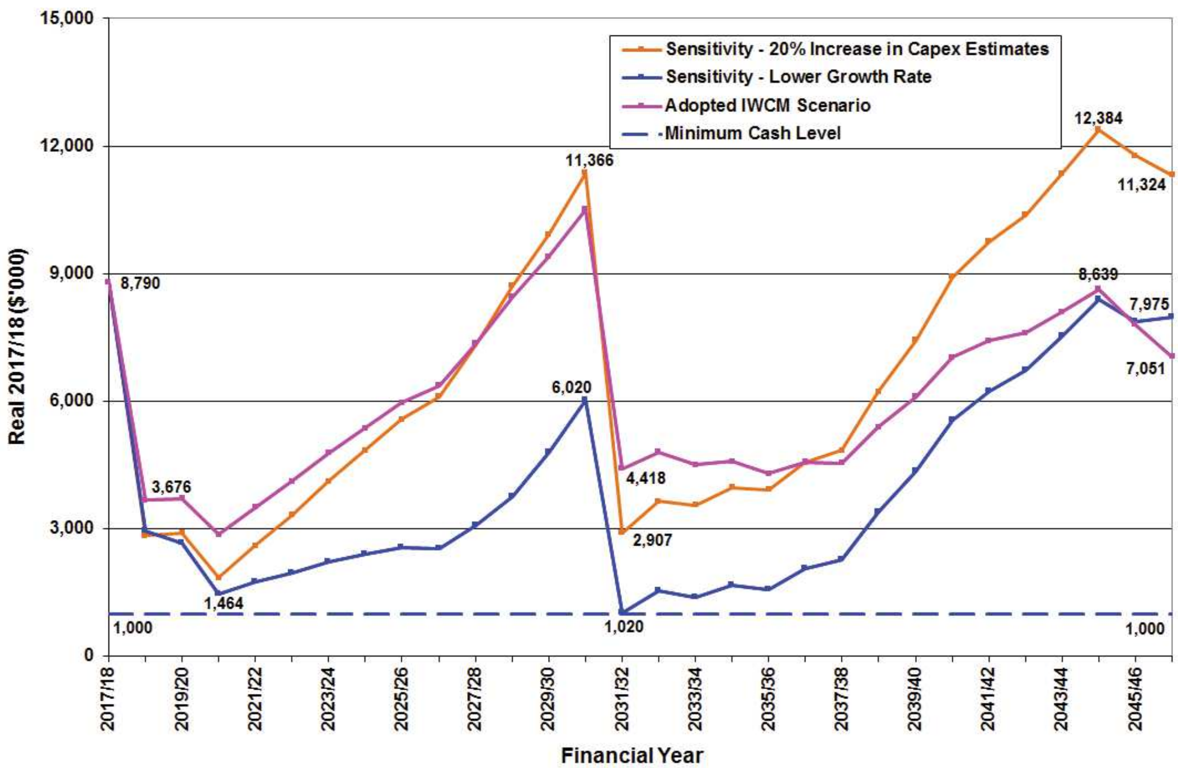

Figure 14.5: Sensitivity of Cash and Investment Levels for Water Supply

14.6 Financial Model Outcomes – Sewerage

14.6.1 Projected Financial Position

The first year of model projections is 2017/18 and CPI should be applied accordingly. All costs and revenues in the input data and the model outcomes also are in 2017/18 dollars unless stated otherwise. The financial projections need to be reviewed annually with respect to material changes to the proposed capital works program and/or changes to any of the underlying assumptions.

The 2017/18 sewerage TRB of $1,022 p.a. has been adjusted for CPI to $1,045 and adopted for 2018/19. The adopted IWCM scenario of the sewer fund financial model does not consider any government grant or subsidy for any of the planned capital works. Accordingly, the TRB forecasts determined by the model for the next 30-years is presented in Figure 14.6.

The model forecasts demonstrate that the sewerage TRB can be reduced to $900 p.a.(inflated $945) from 2019/20 onwards and maintained at that level for the remainder of the forecast period. In terms of inflated dollars after adjustments for CPI, this represents a reduction in TRB of $100 in 2019/20.

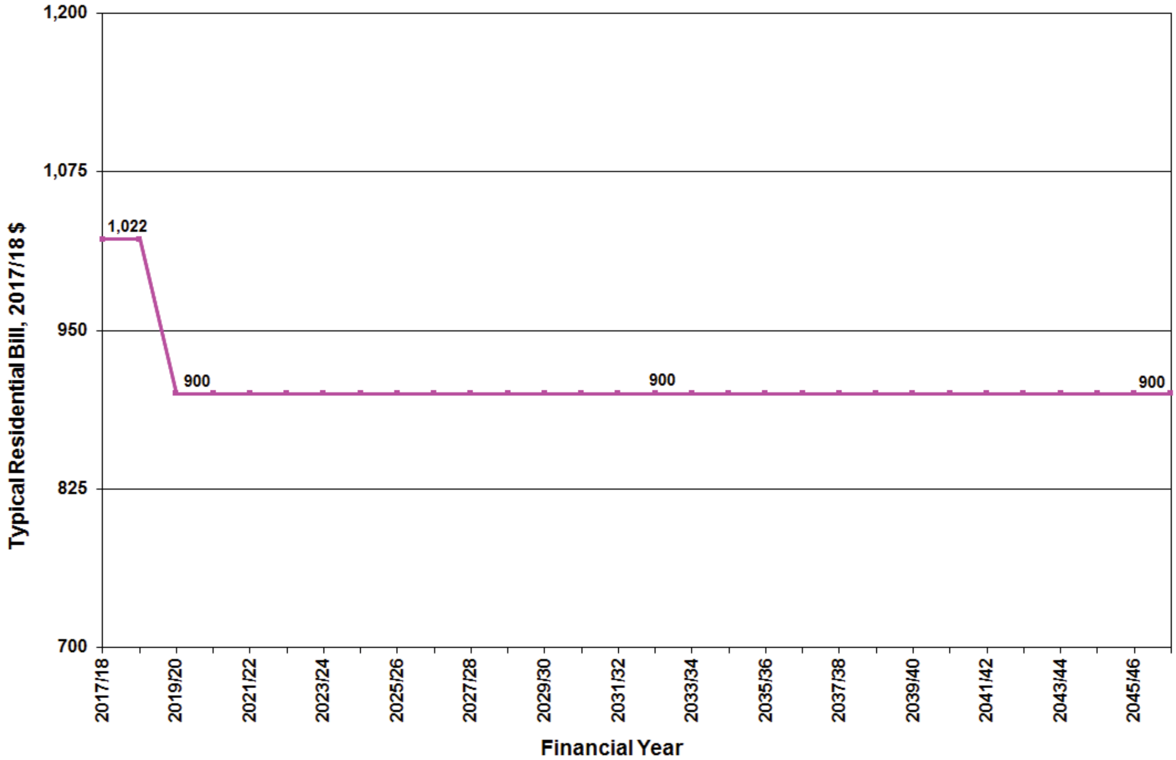

Figure 14.6: Typical Residential Bill for Sewerage

The projected level of charges is sufficient to maintain liquidity with a minimum of $1,000 K of cash and investments in the sewer fund over the forecast period.

The model forecast demonstrates that with the adopted price path, all the planned capital works can be fully funded through a mix of internal cash reserves and revenues without the need for any new external borrowings during the forecast period. The outstanding loan for sewer fund was $8,748 K as at 30 June 2017 which will be paid off according to the current repayment schedule. The levels of cash and borrowing outstanding during the forecast period are depicted in the Figure 14.7.

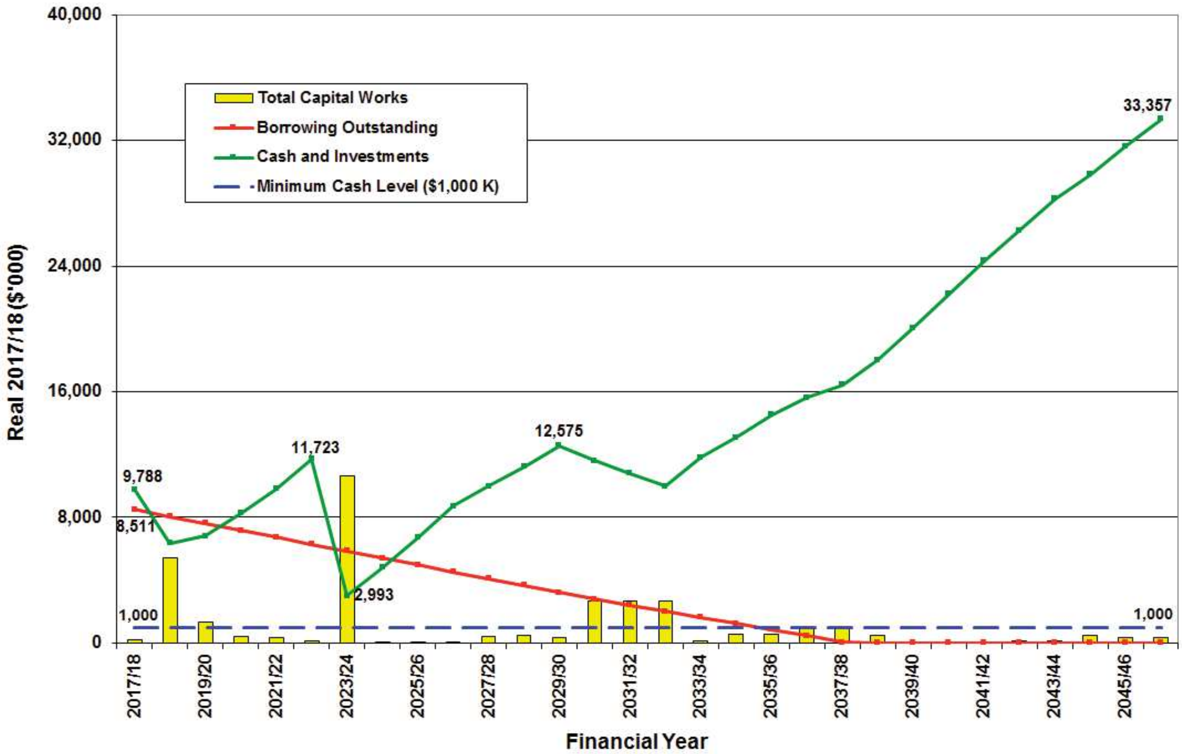

Figure 14.7: Cash & Borrowing Projections for Sewerage

Projected financial results for the sewer fund are presented in Table 14.4 next page. Note that all the projected financial figures are in current (2017/18) dollars and need indexing for CPI/Inflation for future years. More detailed financial output statements are as presented in Appendix H.

14.6.2 Sensitivity of Financial Projections Results

Sensitivity of the sewer fund model forecasts were analysed for higher capex estimates and lower growth rates and the impact of these variables on the sewerage TRB forecasts are summarised in Table 14.5 and presented in Figure 14.8 and Figure 14.9.

Table 14.4: Projected Financial Results for Sewer Fund

2017/18 ($'000)	Revenue and Expenses			Capital Transactions		Financial Position					System Assets			
Financial Year	Total Revenue	Total Expenses	Operating Result (Before Grants)	Acquisition of Assets	Principal Loan Payments	Cash and Investments	Borrowings	Total Assets	Total Liabilities	Net Assets Committed	Current Replacement Cost	Less: Accumulated Depreciation	Written Down Current Cost	Typical Residential Bills
2017/18	3,580	2,820	760	167	237	9,788	8,511	43,585	8,826	34,759	46,684	17,625	29,059	1,022
2018/19	4,567	3,084	1,483	5,386	243	6,354	8,060	44,497	8,394	36,103	50,905	17,294	33,612	1,022
2019/20	4,298	3,080	1,218	1,294	249	6,829	7,615	45,226	7,967	37,259	51,446	17,381	34,064	900
2020/21	4,448	3,126	1,322	411	259	8,265	7,170	46,044	7,540	38,504	51,467	17,833	33,634	900
2021/22	4,609	3,177	1,431	359	268	9,816	6,727	46,932	7,115	39,817	51,488	18,336	33,151	900
2022/23	4,781	3,203	1,578	99	277	11,723	6,286	47,925	6,693	41,232	51,511	19,102	32,409	900
2023/24	4,794	3,411	1,383	10,634	285	2,993	5,847	48,673	6,273	42,400	62,119	20,069	42,050	900
2024/25	4,850	3,715	1,135	47	295	4,800	5,409	49,380	5,854	43,526	62,140	21,036	41,104	900
2025/26	5,022	3,737	1,285	48	304	6,702	4,973	50,188	5,435	44,753	62,162	22,003	40,159	900
2026/27	5,184	3,737	1,447	46	315	8,707	4,537	51,104	5,017	46,087	62,182	22,970	39,212	900
2027/28	4,936	3,794	1,141	412	325	9,979	4,101	51,659	4,598	47,061	62,205	23,574	38,631	900
2028/29	5,076	3,853	1,223	463	336	11,239	3,665	52,258	4,179	48,079	62,330	24,231	38,100	900
2029/30	5,211	3,971	1,240	359	347	12,575	3,229	52,835	3,759	49,076	62,352	24,887	37,465	900
2030/31	5,309	4,044	1,265	2,647	359	11,601	2,791	53,394	3,336	50,058	62,372	23,256	39,117	900
2031/32	5,392	4,007	1,385	2,647	319	10,808	2,403	54,140	2,964	51,176	62,394	21,625	40,769	900
2032/33	5,465	4,054	1,411	2,699	329	9,997	2,015	54,924	2,591	52,333	62,417	19,943	42,473	900
2033/34	5,582	4,100	1,481	151	340	11,813	1,627	55,790	2,216	53,574	62,541	20,914	41,627	900
2034/35	5,697	4,298	1,399	567	350	13,078	1,237	56,522	1,840	54,682	62,812	21,619	41,193	900
2035/36	5,812	4,192	1,620	567	362	14,522	845	57,434	1,461	55,973	63,083	22,327	40,756	900
2036/37	5,911	4,283	1,628	879	373	15,619	452	58,310	1,080	57,230	63,354	22,728	40,626	900
2037/38	5,704	4,273	1,431	931	384	16,429	56	58,952	696	58,256	63,627	23,082	40,545	900
2038/39	5,804	4,361	1,443	463	55	18,028	0	59,918	651	59,267	63,752	23,758	39,994	900
2039/40	5,904	4,435	1,468	47	0	20,084	0	60,927	662	60,265	63,773	24,746	39,027	900
2040/41	6,004	4,406	1,599	47	0	22,218	0	62,018	672	61,346	63,794	25,734	38,060	900
2041/42	6,103	4,451	1,652	47	0	24,353	0	63,112	682	62,430	63,815	26,723	37,092	900
2042/43	6,192	4,636	1,556	99	0	26,286	0	64,060	691	63,369	63,838	27,663	36,176	900
2043/44	6,272	4,537	1,735	151	0	28,299	0	65,140	700	64,440	63,964	28,654	35,310	900
2044/45	6,349	4,663	1,686	515	0	29,849	0	66,125	709	65,416	63,985	29,178	34,807	900
2045/46	6,422	4,614	1,808	359	0	31,638	0	67,195	717	66,478	64,006	29,859	34,147	900
2046/47	6,488	4,671	1,818	359	0	33,357	0	68,232	725	67,507	64,027	30,540	33,487	900

Table 14.5: Sensitivity Analysis – Sewer Fund

Sensitivity	Values of Variables for Analysis	Effect on TRB compared to the Preferred Scenario
Lower than expected assessment growth rate	50% of the adopted assessment growth rate for IWCM Strategy.	TRB in 2019/20 will need to be increased by $78 instead of the decrease in TRB by the same amount for the adopted scenario.
Higher Works Capital expenditure	Cost estimates for adopted capital works program increase by 20%	TRB in 2019/20 will need to be maintained at the current level instead of the decrease in TRB by $78 for the adopted scenario.

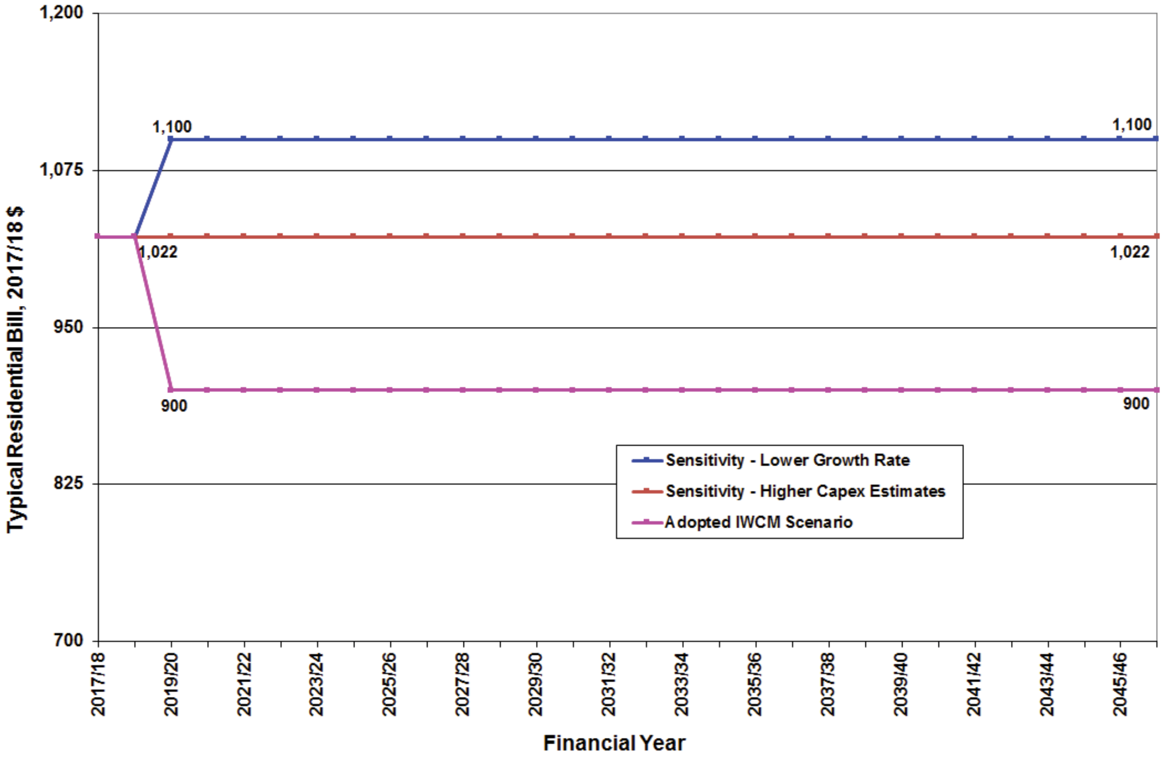

Figure 14.8: Sensitivity of Typical Residential Bill for Sewerage

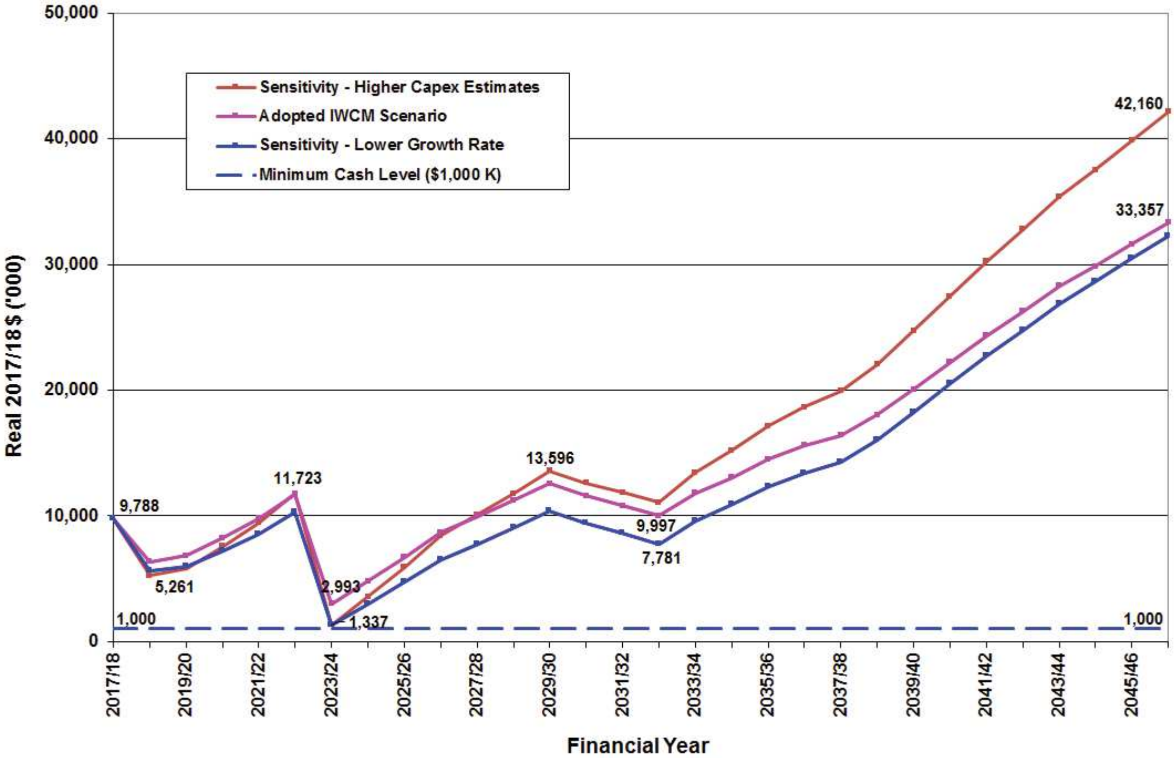

Figure 14.9: Sensitivity of Cash and Investment Levels for Sewerage

Appendices

List of Appendices

Appendix A IWCM Issues Paper

Queanbeyan-Palerang Regional Council

Palerang Community
Integrated Water Cycle Management
Issues Paper

Report Number: WSR - 16082

Date: July 2018

A division of the Department of Finance, Services and Innovation

Queanbeyan-Palerang Regional Council

Palerang Community
Integrated Water Cycle Management
Issues Paper

Report Number: WSR - 16082

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Glenn Fernandes

Principal Engineer – Planning (Water Utilities)

Level 4 Foreshore House

66 Harrington Street, The Rocks

Sydney NSW 2000

T: 02 9240 8751

E: glenn.fernandes@finance.nsw.gov.au

W: www.publicworks.nsw.gov.au

Executive Summary

Palerang is located in south-eastern New South Wales, immediately to the east of Canberra. With a population of 14,350 (2011census), Palerang encompasses an area of 5,140 square kilometres. The major town is Bungendore, followed by Braidwood and then Captains Flat. The rural land is used mainly for cattle and sheep grazing, forestry, orchards and vineyards. Tourism is also an important industry.

In May 2016 Palerang Council (PC) amalgamated with Queanbeyan City Council (QCC) to form Queanbeyan-Palerang Regional Council (QPRC). The former Palerang Council commissioned the preparation of an IWCM Strategy to cover the water supply and sewerage areas serviced by the former Palerang Community.

This report provides a summary of the issues and all the outcomes from items 2 to 7 of DPI Water's July 2014, IWCM checklist.

Water Supply and Sewerage Schemes

Palerang community sits within three catchments namely Murrumbidgee Catchment, Shoalhaven Catchment and Lake George Catchment. All three of the major townships are within different catchments. There are three water supply schemes in the former Palerang LGA, servicing Braidwood, Bungendore and Captains Flat. Together the three schemes supply treated water to an estimated serviced population of over 5,700.Two of the schemes source their water from surface based supplies while the other is sourced from groundwater.

Palerang has three sewerage schemes servicing townships of Bungendore, Braidwood and Captains Flat. The other much smaller rural villages, as well as the considerable rural residential and rural areas in Palerang are serviced by on-site sewage management systems.

Population and Demographic Projections

The major factor contributing to growth in the former Palerang LGA are proposed major Greenfield developments at Bungendore which is expected to more than double the population of Bungendore over the next 10 years. The dwelling growth rates nominated by Council for Braidwood and Captains Flat are 1.2 and 0.2 percent respectively. Dwelling growth in Bungendore is estimated to currently be 10.0 percent, which is expected to decrease exponentially to around 1.1 percent by 2046.

Table S.1 shows the population projection for each service area.

Table S.1: Population projection for each service area

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Water	3,148	5,039	6,905	8,554	9,904	10,952	11,734
	Sewerage	3,130	5,022	6,887	8,536	9,887	10,934	11,717
Braidwood	Water	1,062	1,129	1,200	1,276	1,356	1,441	1,532
	Sewerage	965	1,032	1,103	1,179	1,259	1,344	1,434
Captains Flat	Water	426	431	436	440	445	450	455
	Sewerage	402	407	411	416	421	426	431

Water Demand Analysis and Projection

The historical water production and metered data was modelled to understand the impact of climate dependency, increase in number of active connections, price increase and water restrictions.

Non-Revenue Water (NRW) at Bungendore and Braidwood has remained fairly constant around 125 and 280 L/connection/day respectively. The average NRW at Captains Flat was estimated at 110 L/connection/day. The residential unit water demands are summarised in Table S.2.

Table S.2: Unit demand per active connected residential standard properties

System	Average year demand (kL/prop/year)	Dry year demand (kL/prop/year)	Dry year to average year ratio	Average day demand (L/prop/day)	Peak day demand (L/prop/day)	Peak day to average day ratio
Bungendore	212	260	122%	581	1,650	284%
Braidwood	149	179	120%	409	1,389	339%
Captains Flat	144	187	129%	395	1,919	486%

Current and projected average year, dry year, and peak day demands for the water supply scheme is provided in Table S.3**.**

Table S.3: Water extraction forecast

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Average year (ML/year)	316	463	633	761	866	948	1,010
	Dry year (ML/year)	379	564	787	949	1,082	1,185	1,263
	Peak day (ML/day)	2.8	4.1	5.7	6.8	7.8	8.5	9.0
Braidwood	Average year (ML/year)	182	191	200	210	221	232	244
	Dry year (ML/year)	223	234	245	257	270	283	298
	Peak day (ML/day)	1.5	1.5	1.6	1.7	1.8	1.9	2.0
Captains Flat	Average year (ML/year)	51	52	52	53	53	54	54
	Dry year (ML/year)	64	65	66	66	67	67	68
	Peak day (ML/day)	0.7	0.7	0.7	0.7	0.7	0.7	0.7

The model was tested for the impact of climate change using CSIRO data for evapotranspiration. The model showed that under climate change scenarios the average year and dry year production would increase by about 4 to 5 percent.

Sewer Load Analysis and Projection

The estimated Sewer EP Projection is given in Table S.4.

Table S.4: Sewer EP Projections

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Residential	3,130	5,022	6,887	8,536	9,887	10,934	11,717
	Non-residential	220	226	233	240	248	257	266
	Total	3,350	5,248	7,120	8,777	10,135	11,191	11,982

		2016	2021	2026	2031	2036	2041	2046
Braidwood	Residential	965	1,032	1,103	1,179	1,259	1,344	1,434
	Non-residential	408	413	418	423	428	433	439
	Total	1,373	1,445	1,521	1,601	1,687	1,777	1,873
Captains Flat	Residential	402	407	411	416	421	426	431
	Non-residential	24	24	24	24	24	24	24
	Total	426	431	436	441	445	450	455

The historical daily STP inflows were analysed for Bungendore, Braidwood and Captains Flat STPs. The average dry weather flows (ADWF) for each sewerage scheme are provided in Table S.5.

Table S.5: Adopted 2016 ADWF and Unit Loading

STP	Adopted 2016 ADWF (kL/day)	2016 EP [1]	Unit loading (L/EP/day)	Adopted Unit loading (L/EP/day)
Bungendore	650	3,350	194	200
Braidwood	260	1,373	189	200
Captains Flat	100	426	235	240

Historical wet weather STP inflows were compared with theoretically calculated Storm Allowances to understand the peak wet weather flows. For this assessment the instantaneous PWWF is assumed to be 12 times ADWF for Bungendore STP and 14 times ADWF for Braidwood and Captains Flat STPs. The current and projected sewer system loads for each sewerage scheme is provided in Table S.6.

Table S.6: Projected STP flows

		2016	2021	2026	2031	2036	2041	2046
Bungendore STP	ADWF (kL/day)	650	1,030	1,404	1,735	2,007	2,218	2,377
	PDWF (L/s)	17	25	33	40	45	49	52
	PWWF (L/s)	90	143	195	241	279	308	330
Braidwood STP	ADWF (kL/day)	260	274	290	306	323	341	360
	PDWF (L/s)	7	8	8	9	9	9	10
	PWWF (L/s)	42	44	47	50	52	55	58
Captains Flat STP	ADWF (kL/day)	100	101	102	103	105	106	107
	PDWF (L/s)	3	3	3	3	4	4	4
	PWWF (L/s)	16	16	17	17	17	17	17

IWCM Issues

The Palerang water and sewerage system issues that have been identified through the analyses are outlined in Table S.7, Table S.8 and Table S.9.

Table S.7: General IWCM System Issues

Issue Type	Target for Compliance	Issue
Work Health and Safety (WHS)	Management System	Council does not have a documented Work and Health and Safety system. Council undertakes periodic WHS reviews but these are not documented
Levels of Service	Description and performance	There is no centralised data management system in place to monitor and measure the system performance against the levels of service (LOS) The LOS need to be reviewed for the newly formed Queanbeyan-Palerang Regional Council.
Best Practice	Pricing	Council currently has a two tier inclining block tariff structure for water supply. Council should consider moving towards a fixed rate tariff structure.

Table S.8: Water Supply System Issues

Issue Type	Target for Compliance	Issue
General water supply issues		
Level of Service	Minimum pressure with firefighting capability	Council have nominated 'positive residual head' as the target for compliance, the current performance needs to be better understood through modelling.
Regulatory	Fluoridation of Public Water Supplies	The requirement for periodic auditing of the fluoridation systems is not always being met.
Regulatory	Drinking Water Management System	Several of the nominated CCPs in the DWMS are not considered CCPs like free chlorine in the reticulation. The turbidity alert limit corrective action for Captains Flat WTP needs to include a membrane integrity test.
Bungendore water supply issues		
Performance	Non-revenue water	Non-revenue water at Bungendore has been fairly constant at 125 L/connection/ day. This is higher than the state wide median of 92 L/connection/day for 2015/16.
Water security	Licensed allocation	It is estimated that Bungendore water supply dry year extraction will exceed its licensed extraction limit from the Bungendore and Currandooly bores by 2018.
Level of Service	Headworks capacity	The peak day demand will exceed the combined capacity of the Bungendore and Currandooly WTPs around 2025. The WTP, and reservoir capacity would need to be reviewed to ensure that the required pressure can be maintained in the system.
Braidwood water supply issues		
Performance	Non-revenue water	Non-revenue water at Braidwood is on average 280 L/connection/ day. This is higher than the state wide median of 92 L/connection/day for 2015/16.

Issue Type	Target for Compliance	Issue
Captains Flat water supply system		
Performance	Non-revenue water	Seasonal variations in the NRW for the Captains Flat system have been noticed which are due to a faulty meter at the Captains Flat swimming pool and the neighbouring fields which share a meter. This meter recently been replaced.

Table S.9: Sewerage System Issues

Issue Type	Target for Compliance	Issue
General sewerage system issues		
Unserviced communities	On-site sewage management systems	Village of Majors Creek – potential issue due to the following reasons: • Small lot sizes (some around 3,000 & several around 1,000 m^2) • Inadequate buffer distance from Majors Creek • Moderately well to imperfectly drained soil Village of Nerriga – potential issue due to the following reasons: • Small lot sizes (various sizes below 3,000 m^2) • Some properties may have inadequate buffer distance from Bindi Brook Village of Araluen – potential issue due to the following reasons: • Small lot sizes (several properties less than 1,500 m^2 bordering each other) • Moderately permeable, imperfectly drained soil.
Bungendore sewerage system issues		
Best Practice	Section 60 approval	Effluent from the Bungendore STP is reused on-site, for road works (truck filling) and for watering Bungendore oval. Council does not have a Recycled Water Management Plan and Section 60 approval for the off-site effluent reuse.
		The Log Reduction Value (LRV) required for effluent reuse may not be achieved through the current STP process. This will be reviewed during the preparation of the Recycled Water Management System (RWMS) for Section 60 approval.
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit in 2016, 2014, 2012 and 2011. Council needs to consider undertaking an inflow/infiltration study.
Performance	Effluent reuse flow balance	There is a mismatch in the effluent reuse flow balance. Potential reasons for the discrepancy could include uncalibrated meters, and on-site flows which may not be metered.
Sewer catchment performance	Pump sizing @ PWWF	The PWWF at catchment #2, 8 and 9 exceeds the capacity of a single pump. The PWWF at catchments #4 will exceed the capacity of a single pump by 2021. This is based on a PWWF calculated from the storm allowance which is twice the maximum flow recorded during the highest rainfall event in the last five years. Hence this is a conservative assessment.
	Odour/septicity potential	Catchment #7 and 8 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. This risk is expected to continue over the 30 year planning period.

Issue Type	Target for Compliance	Issue
Capacity	Sewage Treatment Plant	The EP load currently exceeds the 3,000 EP STP capacity, and is expected to exceed the 5,000 EP capacity by 2020. For the assessed hydraulic loading of 200 L/EP/day in this study, the plant hydraulic and capacity will be exceeded by: • 2018 for the 3,000 EP STP, or 2023 when capacity is increased to 5,000 EP by commissioning the second IDEA reactor.
Braidwood sewerage system issues		
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.
Sewer catchment performance	Pump sizing	The PWWF at catchment #1 will exceed the capacity of a single pump by 2021.Council has funded for an upgrade.
	Odour/septicity potential	Catchment #3, and 5 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. The risk for Catchment #5 is expected to drop to low risk by 2020, however Catchment #3 is expected to remain at medium risk.
Captains Flat sewerage system issues		
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.
Sewer catchment performance	Pump sizing	The PWWF at catchment #1 is expected to exceed the duty pump capacity.
Performance	Sewage Treatment Plant	The plant needs to be upgraded to improve replace ageing infrastructure, improve treatment and enable enhanced phosphorus removal, enable screening and grit removal, improve sludge and sludge drying components and improve amenity and WHS.

Contents

Figures

Tables

1 Introduction

1.1 Palerang Community LGA

Palerang is located in south-eastern New South Wales, immediately to the east of Canberra. The area is predominantly rural, with some rural-residential areas and a number of small towns and villages. Palerang, with a population of 14,350 (2011census), encompasses an area of 5,140 square kilometres. The major town is Bungendore, followed by Braidwood and then Captains Flat. The rural land is used mainly for cattle and sheep grazing, forestry, orchards and vineyards. Tourism is also an important industry (Source: Palerang Asset Management Plan, September 2013).

In May 2016 Palerang Council (PC) amalgamated with Queanbeyan City Council (QCC) to form Queanbeyan-Palerang Regional Council (QPRC). This IWCM Strategy covers the water supply and sewerage areas serviced by the former Palerang Community.

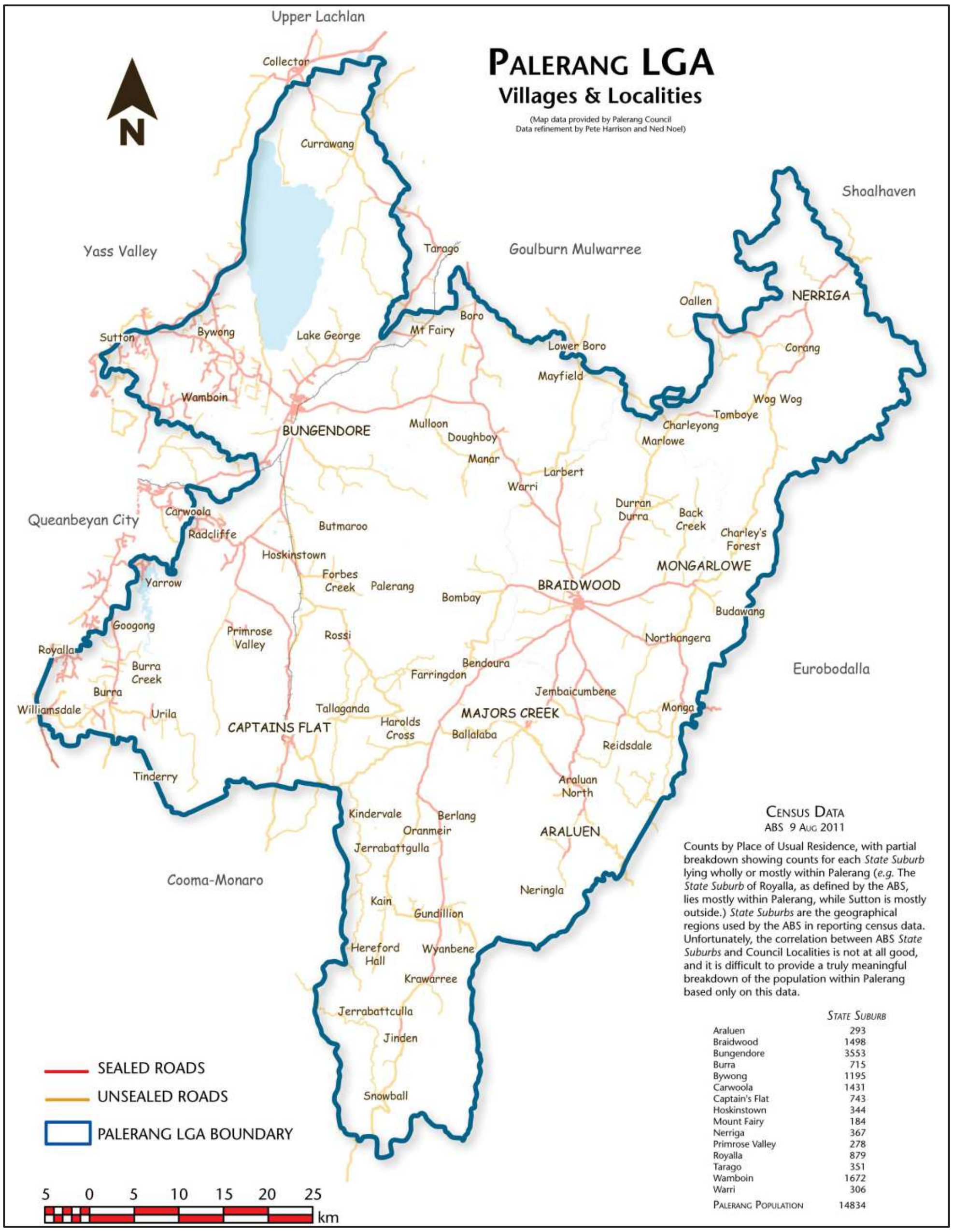

Figure 1.1 Palerang Community LGA Map

In Palerang there are three potable water supplies and three sewerage schemes servicing the townships of Braidwood, Bungendore and Captains Flat (see Figure 1.1). A summary of Palerang's water supply and sewerage schemes is included in Table 1.1.

1.2 Serviced Communities

The population of the serviced communities within the former Palerang LGA are included in Table 1.1.

Table 1.1 2016 Population in main urban centres

Suburbs	2016 Urban Centre Population [1]	Water Supply	Sewerage System
Bungendore	3,317	Bungendore and Currandooly Water Supply Schemes	Bungendore Sewerage Scheme
Braidwood	1,273	Braidwood Water Supply Schemes	Braidwood Sewerage Scheme
Captains Flat	449	Captains Flat Water Supply Schemes	Captains Flat Sewerage Scheme

1 – Source: ABS 2016 Census Quickstats

1.3 Un-serviced Communities

There are several rural communities in the former Palerang LGA that are not supplied with water or sewerage services. These included the villages of Araluen, Majors Creek, Mongarlowe and Nerriga and the rural residential areas of Wamboin, Bywong, Burra, Urila, Hoskinstown, Rossi, Carwoola, Royalla, and Sutton.

Residents in these areas predominantly rely on roof rainwater and/or groundwater bores for water supply, and during period of extended drought have water tanked o their homes. These residents treat wastewater using onsite sewage management systems (OSSMS – for example septic tanks).

2 Operating environment and levels of service

2.1 Operating environment

The delivery of urban water services including water supply, sewerage and stormwater services is subject to a number of legislative and regulatory requirements, guidelines, contractual obligations for delivery of services and other external and internal factors, collectively referred to as the operating environment. An IWCM issue will arise if there is a failure to meet the legal obligations or agreed levels of service regarding provision of water supply and sewerage services including the following:

- Legislative and regulatory requirements (health requirements, WHS, EPA Licence)
- Levels of service targets (as agreed with customers)
- Contractual and agreed arrangements (for example Memorandum of Understanding (MoU))
- Best Practice Management criteria

The operating environment compliance situation is analysed in this Section to identify the IWCM issues.

The Local Government Act and a number of other pieces of legislation influence the way in which Council can provide the urban water and wastewater services and have specific implications for the operation of the schemes. Table 2.1 provides the details of Council's current compliance with the legislative and regulatory requirements.

Table 2.1: Palerang Community Council Legislative requirements

Key Legislative Framework and their main purposes	Council current performance and future targets
Local Government Act (1993)	
This Act aims to provide the legal framework for an effective, efficient, environmentally responsible, and open system of Local Government including the provision, management and operation of water supply and sewerage works and facilities. It covers: • Section 60 - proposal approvals for water or sewage treatment works construction and for effluent and bio-solids reuse • Section 61 - inspections of water and sewage treatment works • Section 64 - developer charges • Section 68 - provide an approval for users to discharge trade waste to Council's sewerage system or do works to water and sewerage infrastructure with Council approval. • Section 90 (2) – concurrence on liquid trade waste approvals • Section 428 – annual reporting	These Legislative and regulatory targets are generally met by Council. • Council has Section 60 approval for its water and wastewater system operations. • Council does **not** have a RWMP or Section 60 approval for the Bungendore reuse scheme • Council has indicated they will update the existing DSP after the IWCM is finalised • Council has implemented a trade waste policy and charges. See Section 3.7
Environmental Planning and Assessment Act (1979) (incl. the EPA Regulation 2000).	
This Act aims to encourage proper management of resources, the orderly use of land, the provision of services, and the protection of the environment. It covers: Local Environmental Plans (LEP), Environmental Impact Statement (EIS), Reviews of Environmental Factors (REF)	These Legislative and regulatory requirements are generally met by Council.

Key Legislative Framework and their main purposes	Council current performance and future targets
Public Health Act (2010)	
This Act aims to promote, protect and improve public health; by providing safe drinking water to the community. It requires a Local Water Utility to have a Drinking Water Management Plan (DWMP) in place. Councils performance against the DWMP was checked by: - Reviewing the raw water quality received at the plant - The performance of the plant against the critical control points - Review of the reticulated water quality	Refer Section 8.3 for Council's performance against their DWMP.
Local Government Amendment (Planning and Reporting) Act 2009	
Sets out the integrated reporting requirements for local government in NSW, including the need to develop a Long-term Community Strategic Plan and Resourcing Strategy (which must include long-term financial planning, workforce management planning and asset management planning).	
Seat of Government Acceptance Act 1909 – First Schedule	
The State shall not pollute and shall protect from pollution the waters of the Queanbeyan and Molonglo Rivers throughout their whole course above the Territory.	Council has an EPA licence for the Captains Flat STP which discharges to waters upstream of the Territory
Water Management Act (2000) Section 66	
This Act promotes the sharing of responsibility for the sustainable and efficient use of water between the NSW Government and water users and provides a legal basis to manage NSW water planning, allocation of water resources and water access entitlements. Section 66 of the Water Management Act 2000 states that: *the Minister may at any time increase the utility's entitlement to water under a local water utility licence so as to reflect any rapid growth of population within the utility's area requiring an immediate increase in the availability of water for supply by that utility.*	Council has several water access licences issued under the Water Management Act 2000. See Section 3.2.1. Section 8.1.1 shows that Council the licensed allocation for Bungendore could be exceeded in the next 3 years and Council would need to negotiate for an increase in entitlement.
Protection of the Environment Operations Act (1997)	
This Act introduces an approach to protect the environment. It is a powerful tool for regulating sewerage and trade waste by local water utilities and facilitating compliance with the utility's conditions of approval for liquid trade waste discharges to the sewerage system.	Council has EPA licences for the three STPs at Bungendore, Braidwood and Captains Flat; licence numbers 201, 1733 and 1929 respectively. Licence requirements and recent non-compliances are given in Section 3.3.2., 3.3.3 and 3.3.4. Council has a Pollution Incident Response Management Plan (PIRMP) for each STP.
Dam Safety Act 1978	
Under this act, the owner of any dam listed as a prescribed dam must meet the requirements of the NSW Dams Safety Committee (DSC). The DSC assigns dams a consequence category relative to their dam failure consequence, and this determines the level of reporting and type of actions required by the dam owner as part of their Safety Management System (SMS).	Captains Flat Dam is a prescribed dam owned by Council. Council has engaged Public Works Advisory (PWA) to undertake a Dam Surveillance Report and PWA

Key Legislative Framework and their main purposes	Council current performance and future targets
	are also Council's nominated dam experts.
Work Health and Safety Act 2011 and WHS Regulation 2011	
This Act has an objective to provide a consistent framework to secure the health and safety of workers and workplaces.	Council does currently undertake regular WHS audits at the plants, but these are not documented **Issue**
Fluoridation of Public Water Supplies Act (1957)	
This Act covers the addition of fluoride to public water supply under the NSW Fluoridation Code of Practises	The fluoridation systems at all water supply schemes comply with the code. Council advises that the requirement for period auditing is not always being met **Issue**

2.2 Levels of Service

Levels of Service (LOS) are defined by local water utilities as the standards required from the water and sewerage systems from the perspective of the individual customer. The LOS are targets which the Council aims to meet and are not intended as a formal customer contract.

The provision of the agreed levels of service to customers is dependent upon the efficient and effective running of the water supply and sewerage operations. To this end, Council implements a program of works and appropriate operation and maintenance procedures to meet the levels of service for the current and future customers. Council also identifies additional works required to bridge any gap between the existing and desired services.

The LOS described below have been prepared with assistance of former PC staff and with reference to the DPI Water Strategic Business Planning Guidelines for Water and Sewerage (July 2011)., The LWU collects the data required to monitor the performance against the LOS, however there is no centralised system in place to managing the data appropriately **Issue**.

Table 2.2 Water Supply LOS Targets & Current Performance

DESCRIPTION	UNIT	LEVEL OF SERVICE	
		Target	Current Performance assessed by Council
Pressure:			
Minimum pressure when delivering 0.15L/s/tenement PID	Metres Head	12	Bungendore - 12 Braidwood - 40 Captains Flat - 40
Minimum pressure when delivering 0.10L/s/tenement with firefighting capability	Metres Head	Positive residual head throughout network	Bungendore - 12 Braidwood - 12 Captains Flat - 12
Max. static pressure	Metres head	90	90
Fire-Fighting:			
Compliance with The Water Supply Investigation Manual	% area served	95	100

DESCRIPTION	UNIT	LEVEL OF SERVICE	
		Target	Current Performance assessed by Council
Supply Interruptions to Consumers:			
Planned (95% of time):			
Notice given to domestic customers	Working Days	1	1
Notice given to commercial customers	Working Days	2	3
Notice given to industrial customers	Working Days	2	3
Maximum duration of interruption	Hours	8	2
Total number of interruptions	No./year/1000 tenements	8	5
Unplanned:			
Maximum duration	Hours	6	3
Total number of interruptions	No./year/1000 tenements	10	8
Response Times (Defined as time to have staff on-site to rectify problem) Supply Failure: Note: Times apply for 95% of occasions			
All Customers:			
During working hours	Hours	1	1
Out of working hours	Hours	2	2
Minor Problems & General Inquiries:			
Oral inquiry	Working Days	2	2
Written inquiry	Working Days	10	15
Service Provided			
Time to provide an individual connection to water supply in serviced area (90% of times)	Working days	5	5
Water Quality			
Number of boil water alerts	No./year	0	
Taste/odour complaints	No./year	0	

Table 2.3 Sewerage LOS Targets & Current Performance

DESCRIPTION	UNIT	LEVEL OF SERVICE	
		Target	Current Performance assessed by Council
Frequency Of System Failures			
Category 1: Failure due to rainfall and deficient capacity (overflows)	Number/year	0	0
Category 2: Failures due to pump or other breakdown including power failure (overflows)	Number/year	0	0
Category 3: Failures due to main blockages and collapses (overflows)	Number/year	4	2
Response Times System Failure: (Defined as the maximum time to have staff on site to commence rectification after notification)			
Priority 1: (Major spill, significant environmental or health impact, or affecting large number of consumers i.e. a major main)			
During working hours	Hours	0.5	0.5
After hours	Hours	1	1
Priority 2: (Moderate spill, some environmental or health impact, or affecting small number of consumers i.e. other mains)			
During working hours	Hours	0.5	0.5
After hours	Hours	1	1
Priority 3: (Minor spill, little environmental or health impact, or affecting a couple of consumers)			
During working hours	Working Day	1	1
After hours	Working Day	1.5	1.5
Customer Complaints			
General Complaints and Inquiries: Note: Applies for 95% of complaints			
Oral complaints	Working Day	2	2
Written complaints	Working Day	10	15
Odour Complaints:			
Treatment works (outside designated buffer zone)	Number/year	2	1
Pumping Stations	Number/year	2	0
Reticulation system	Number/year	2	0

3 Urban water services

3.1 Water catchments

Palerang community sits within three catchments namely Murrumbidgee Catchment, Shoalhaven Catchment and Lake George Catchment. All three of the major townships are within different catchments.

3.1.1 Lake George Catchment

The town of Bungendore is located within the southern parts of the Lake George Catchment. The catchment has an area of 950 square kilometres, with the lake itself occupying 16 per cent of this area. Grazing accounts for 76 per cent of all land use in the catchment, which is also home to tourism and wine growing industries. Lake George Catchment is labelled as area ⑤ in Figure 3.1.

3.1.2 Murrumbidgee Catchment

The Murrumbidgee catchment in southern NSW has many significant wetland habitats of international ecological importance and a diverse climate, ranging from the alpine conditions of the Snowy Mountains to the semi-arid conditions of the Riverina Plains.

The catchment is 84,000 square kilometres, with land use dominated by extensive agriculture and grazing occupying 64 per cent of the catchment. Major water users include local councils and water utilities, forestry, tourism, and agriculture, including rice, dairy, wool, wheat, beef, lamb, grapes and citrus.

The only town within the Palerang community that is within the Murrumbidgee catchment is Captains Flat located in the far-east of the catchment. The Murrumbidgee catchment is shown in Figure 3.1

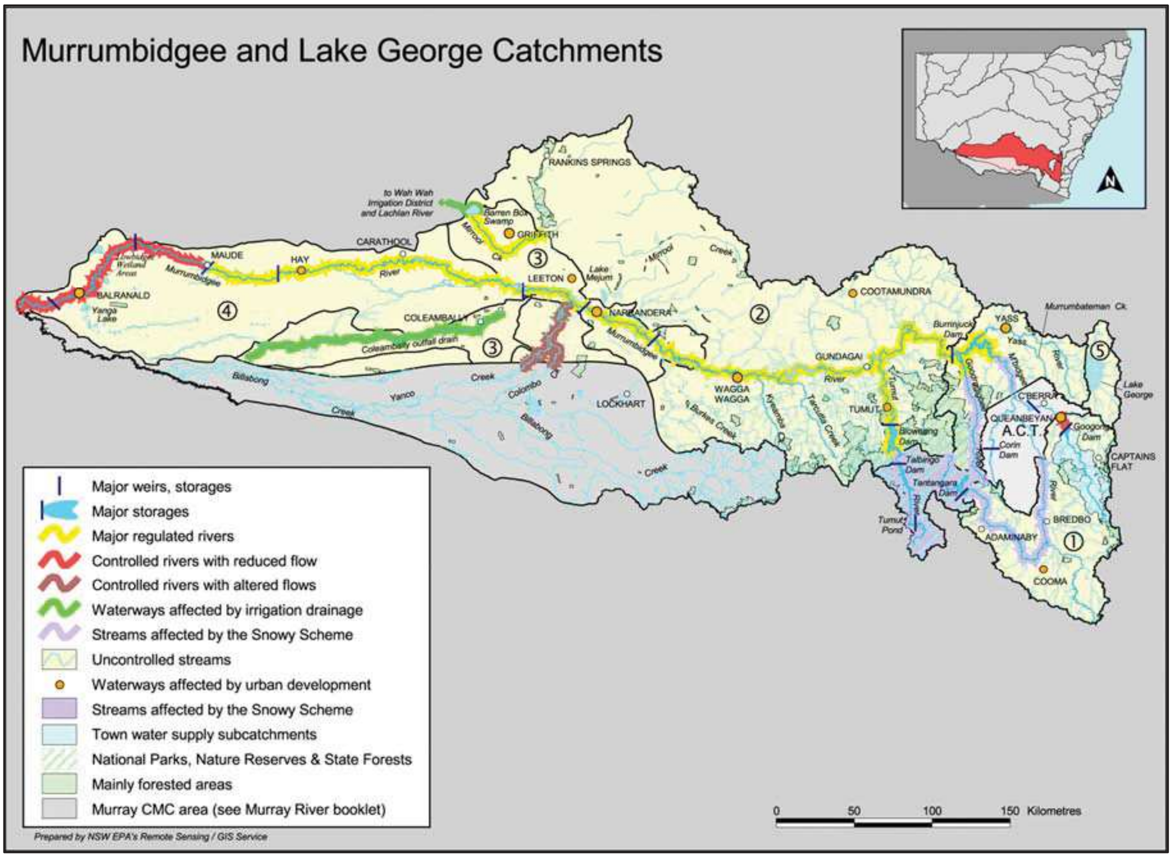

Figure 3.1 Murrumbidgee and Lake George Catchments

3.1.3 Shoalhaven Catchment

The Shoalhaven catchment is located in the New South Wales upper South Coast and has an area of 7,300 square kilometres. The region is well known for its fresh produce sourced from local farms and dairies, and for its beef cattle, wool and other agriculture essential to the NSW economy.

Cattle and sheep grazing is the largest single land use. The catchment also supports horse studs, piggeries, dairies and poultry production as well as vineyards, olive groves, and canola and cereal crops. Cleared grazing land covers 36 per cent of the catchment, along with large areas of national parks (31 per cent) and forests (27 per cent). Rainfall generally increases from the south-west near Cooma to the north-east near Robertson.

The upper Shoalhaven catchment had been modified substantially which resulted in degradation in both aquatic and terrestrial systems. Agriculture and mining have contributed to this process particularly through the removal of timber to drive steam engines and for construction.

Shoalhaven Catchment is shown in Figure 3.2.

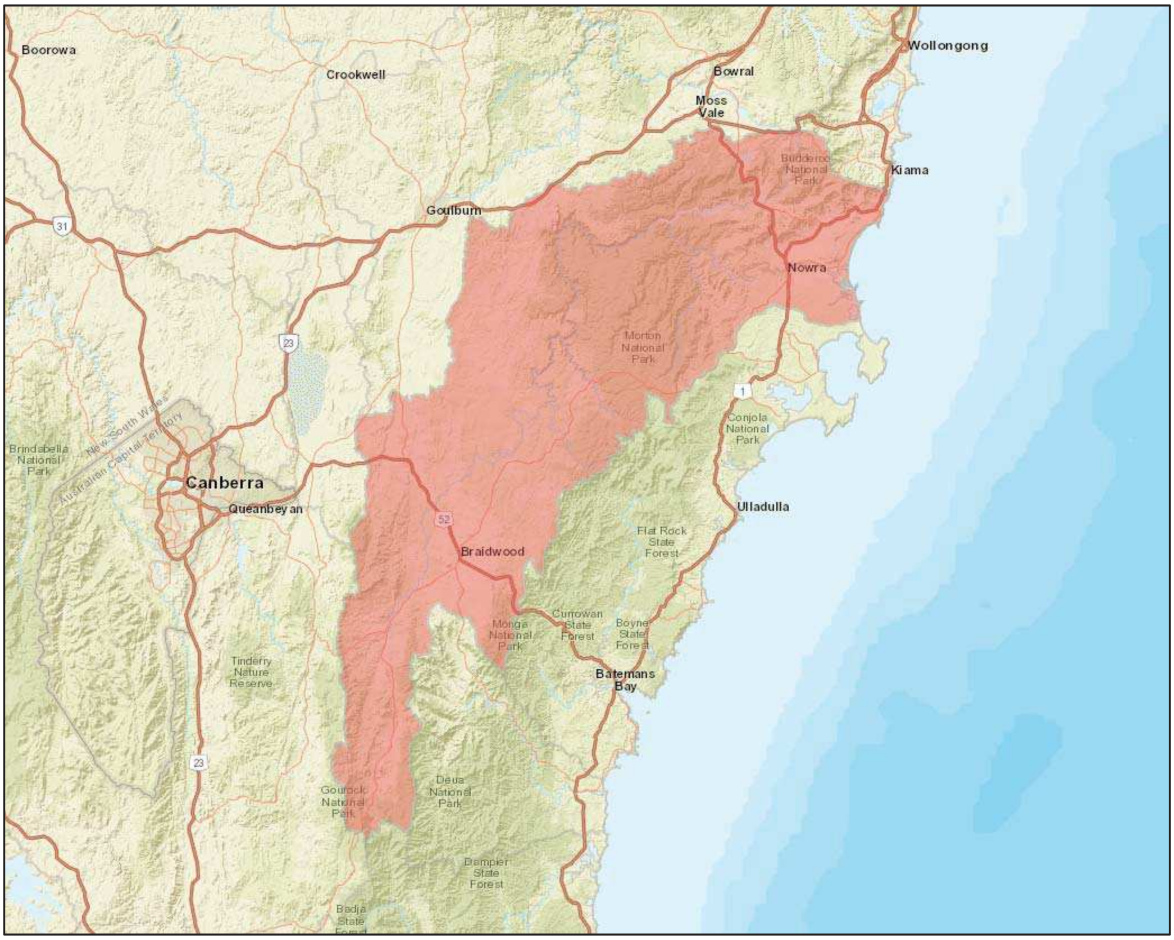

Figure 3.2 Shoalhaven Catchment

3.2 Water Supply Schemes

3.2.1 Overview

There are three water supply schemes in the former Palerang LGA, servicing Braidwood, Bungendore and Captains Flat. Together the three schemes supply treated water to an estimated serviced population of over 5,700.Two of the schemes source their water from surface based supplies while the other is sourced from groundwater.

An overview of Palerang Community's Water Supply System is given in Table 3.1

Table 3.1 Summary of Palerang Community's Water Supply Systems

Town/Service Areas	Bungendore	Braidwood	Captains Flat
Water Supply Source	Alluvial ground water	Shoalhaven River	Molonglo River
Water Extraction Licence Allowance (ML/year)	322 and 150	360	250
Treatment works type	Aeration (Bungendore) & Conventional clarifier and sand filter system (Currandooly). Both have chlorine and fluoride dosing	DAFF treatment with Chlorine and Fluoride dosing	Ultrafiltration with chlorine and fluoride dosing
Treatment works capacity (ML/day)	3.5 (Bungendore) & 2 (Currandooly)	2	0.7
Reservoirs Capacity (ML)	4.56	2.60	0.88

Palerang Community holds the Water Access Licences (WAL) issued under the Water Management Act 2000 given in Table 3.2. All Nominated works have the use purpose of "Town Water Supply".

Table 3.2: Water Access Licence Details

Licence Number	Water Source	Nominated Works	Allocation	Expiration Date
WAL 32742	Bungendore Alluvial Groundwater Source **Bungendore Bores**	40CA412631 4 x Bores	322 ML/year [1]	15-Aug-2022
WAL 36260	Bungendore Alluvial Groundwater Source **Currandooly Bores**	40CA415918 1 x Bore	150 ML/year [1]	13-Aug-2037
WAL 25376	Shoalhaven River Water Source **Braidwood**	10CA102425 2 x 100 mm Centrifugal Pump 1 x Overshot Dam	360 ML/year	30-Jun-2021
WAL 36281	Molonglo Water Source **Captains Flat**	40CA415962 1 x Diversion Pipe 1 x 80 mm Centrifugal Pump 1 x Overshot Dam	250 ML/year	22-May-2018

1 - Clause 58 of the Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources 2012 says the annual allocation for Bungendore and Currandooly bores are 272 ML and 200 ML respectively. DPI Water has indicated that the WAL is the prevailing document.

3.2.2 Bungendore Water Supply Scheme

Raw Water Source

Bungendore is located south of Lake George, and is dependent on the Bungendore Alluvial ground water source for town water supplies and irrigation. Groundwater systems are primarily recharged by rainfall and river leakage. However, river regulation has substantially modified flooding and flow regimes, influencing groundwater level behaviour in adjoining connected groundwater systems.

WTP Description

The current Bungendore Water Supply Scheme consists of the original water supply scheme (WSS) at Bungendore and a recently commissioned supplementary WSS at Currandooly.

The original Bungendore scheme consists of four bores located around the town with a total extraction capacity of approximately 4.5 ML/day on a 22-hour basis. Bore water is aerated at the existing Bungendore Water Treatment Plant (WTP) for the removal of carbon dioxide. It then gravitates to a 100 kL collection tank. Chlorine and fluoride are added to the collection tank before being distributed to town. The capacity of the aeration plant is approximately 3.2 ML/day.

The Currandooly WSS was commissioned in 2013 to supplement the Bungendore Scheme. The Currandooly scheme consists of a bore, a 1.8 km raw water rising main, a water treatment plant located on the Tarago Road about 5 km north of Bungendore, and a clear water transfer system to transfer the water to town. The Currandooly bore supply is capable of producing 2 ML/day over 22 hours. The WTP is a conventional clarifier and sand filter system consisting of the following processes:

- Aeration
- Potassium permanganate to oxidise soluble manganese
- Coagulation and flocculation
- Sand filtration
- Disinfection using chlorine gas
- pH correction using caustic soda
- Fluoridation with sodium fluoride

The schematic for the treatment system is provided in Figure 3.3.

Distribution

The treated water from Bungendore Water Supply scheme is distributed and stored in a collection tank before supply through the Bungendore Township prior to storage in the 3 reservoirs. The transfer pump station can process about 3.2 ML/day over 22 hours.

Turallo Reservoirs 1 and 2 (capacities of 0.91 ML and 1.45 ML respectively) store the surplus treated water which is reticulated back to town as required. These reservoirs are connected to the Days Hill Reservoir (capacity of 2.2 ML) where treated water is reticulated to the Elmslea Estate. Under normal operation the Days Hill Reservoir only supplies the Elmslea Estate although options exist to interconnect all the reservoirs. The Turallo Reservoirs can solely or concurrently supply the whole town as can Days Hill if required. Due to the nature of the reservoirs system this is considered an open reservoir system.

The treated water from the Currandooly WTP is transferred to the Days Hill Reservoir and Turallo Reservoirs 1 and 2 after reticulation through the Elmslea Estate and Bungendore Township. The three reservoirs are roofed with locked access ladders and hatches.

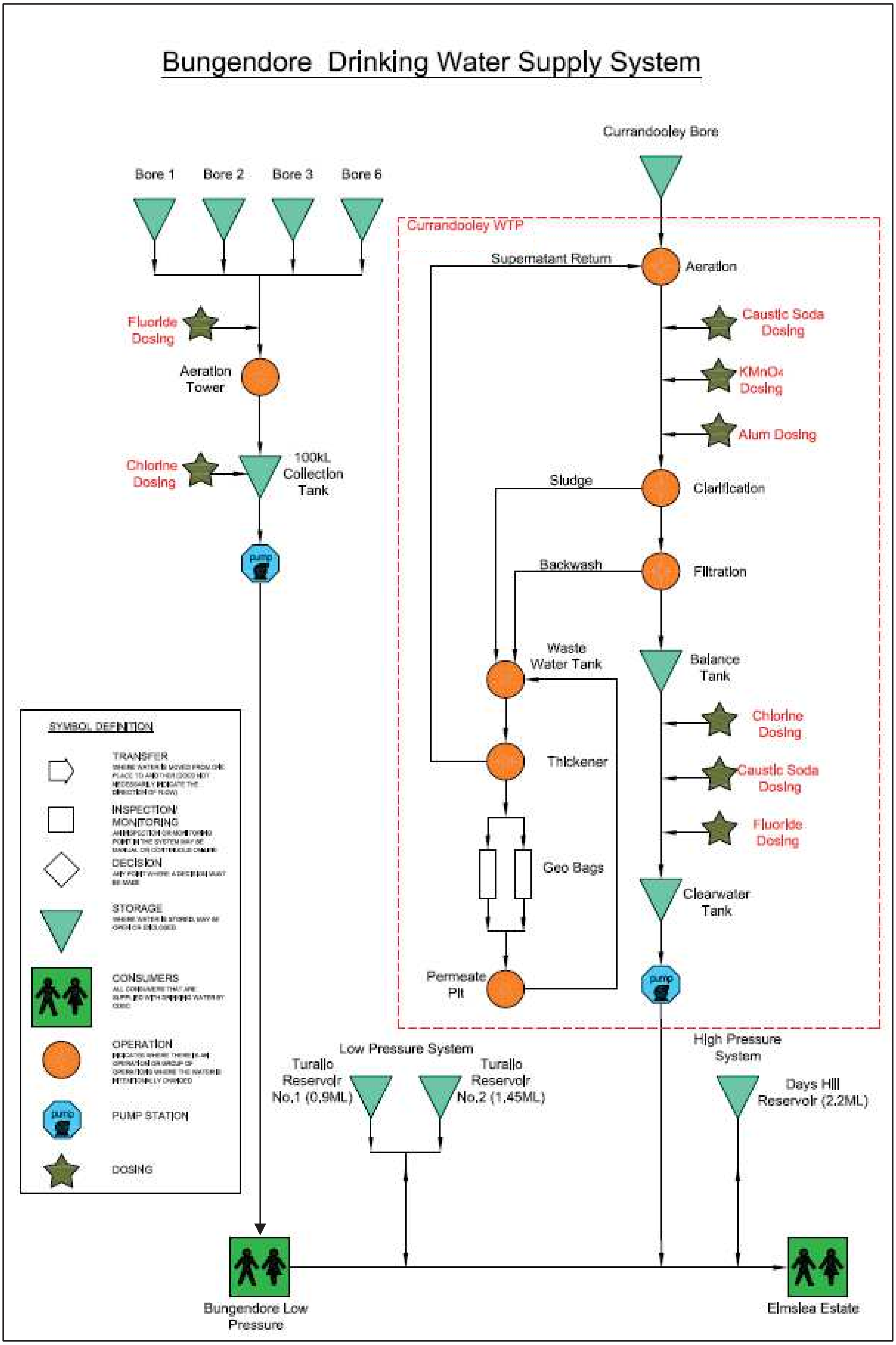

Figure 3.3 Bungendore Water Treatment Plant Schematic

3.2.3 Braidwood Water Supply Scheme

Raw Water Source

The Braidwood Water Supply Scheme sources raw water from an 80 ML off-stream dam built in the mid-1980s. The storage dam is filled from the Shoalhaven River which lies within the upper region of the Southern Rivers Catchment area and forms the upper regions of the Sydney Drinking Water Catchment. The river intake pumps are operated manually as required. When in operation they run 24 hours per day at 1.38 ML/day.

The upper Shoalhaven Catchment had been modified substantially which resulted in degradation in both aquatic and terrestrial systems. Agriculture and gold mining have contributed to this process particularly through the removal of timber to drive steam engines and for construction. Although fifty years have passed since significant gold mining ceased, the catchment remains in a highly modified state.

WTP Description

Braidwood WTP was commissioned in March 2013. Raw water is pumped from a submerged pipe in the off-stream dam to the Braidwood WTP. The WTP has a 2 ML/day capacity and consists of the following processes:

- Powder activated carbon (PAC) (used periodically)
- Coagulation and flocculation with aluminium sulphate
- Dissolved air flotation and filtration via a dual media gravity filter
- Disinfection using chlorine gas
- pH correction with caustic soda (when required)
- Fluoridation with sodium fluoride

The backwash waste water and sludge is also treated on-site with supernatant recycled to the 80 ML off-stream storage dam. The clear water from the WTP is stored in three reservoirs with a combined capacity of 2.6 ML (2 x 0.55 ML and one new 1.5 ML reservoir) at the WTP site. All are roofed with locked access ladders and hatches.

Distribution

Treated water stored at the reservoirs supply Braidwood via a 2.3 kilometre 300mm diameter DICL trunk main. This main was entirely replaced in 2016/2017 and is accompanied by a parallel 150mm diameter UPVC raw water main for future non potable applications. The potable 300 mm trunk main connects with the reticulation at Saleyards Lane where gravity mains service the township.

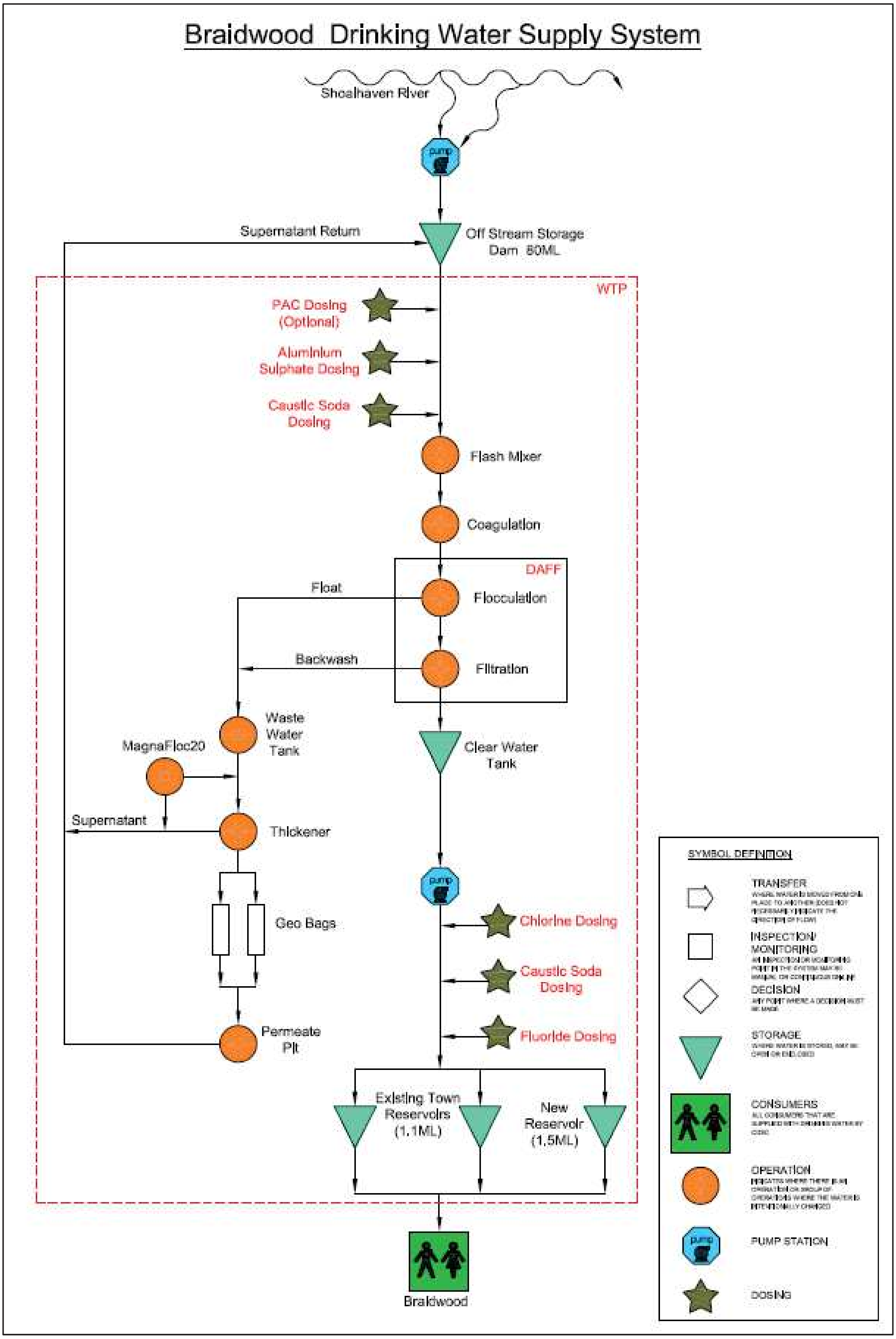

Figure 3.4 Braidwood Water Treatment Plant Schematic

3.2.4 Captains Flat Water Supply Scheme

Raw Water Source

The Captains Flat Water Supply Scheme sources raw water from an 820 ML dam on the Molonglo River. The capacity of the booster pump is equivalent to the WTP capacity of 0.7 ML/day.

WTP Description

The Captains Flat WTP is a 0.7 ML/day ultrafiltration plant which was commissioned in 2002. The WTP includes the following process:

- Coarse screen filtration
- pH correction with caustic soda
- Polyaluminium chloride (PACl) for coagulation
- Ultra-membrane filtration
- Disinfection using liquid chlorine
- Fluoridation using sodium fluoride
- Standard Backwash (every 25 min running time) to recycled water tank
- Chemical backwash using 1) Nitric acid and 2) Caustic soda / sodium hypochlorite (every 90 standard backwashes) to chemical backwash tank prior to recycled water tank
- Backwash/chemical backwash alternated through Lamella separator supernatant to raw water tank
- Sludge concentrate periodically gravitates to sludge drying beds
- Supernatant is filtered through GAC prior to feed water tank

Council has relocated the PACl dosing point which has increased the filter run times. Council also replaced the membranes two years ago.

The schematic for the treatment system is provided in Figure 3.5.

Distribution

Treated water is pumped to Keating's Reservoirs 1 and 2 (capacities 0.33 ML and 0.55 ML respectively) before being distributed via gravity to Captains Flat Village and Beverly Hills. The 0.55 ML reservoir is a steel reservoir originally constructed by the mine. This reservoir has been condemned and is scheduled for replacement with a concrete structure in 2017/18. The other is a concrete tank built in the mid-1980s and had its roof replaced recently. Treated water from both reservoirs can be distributed to both reticulated systems; therefore, this is considered an open reservoir system.

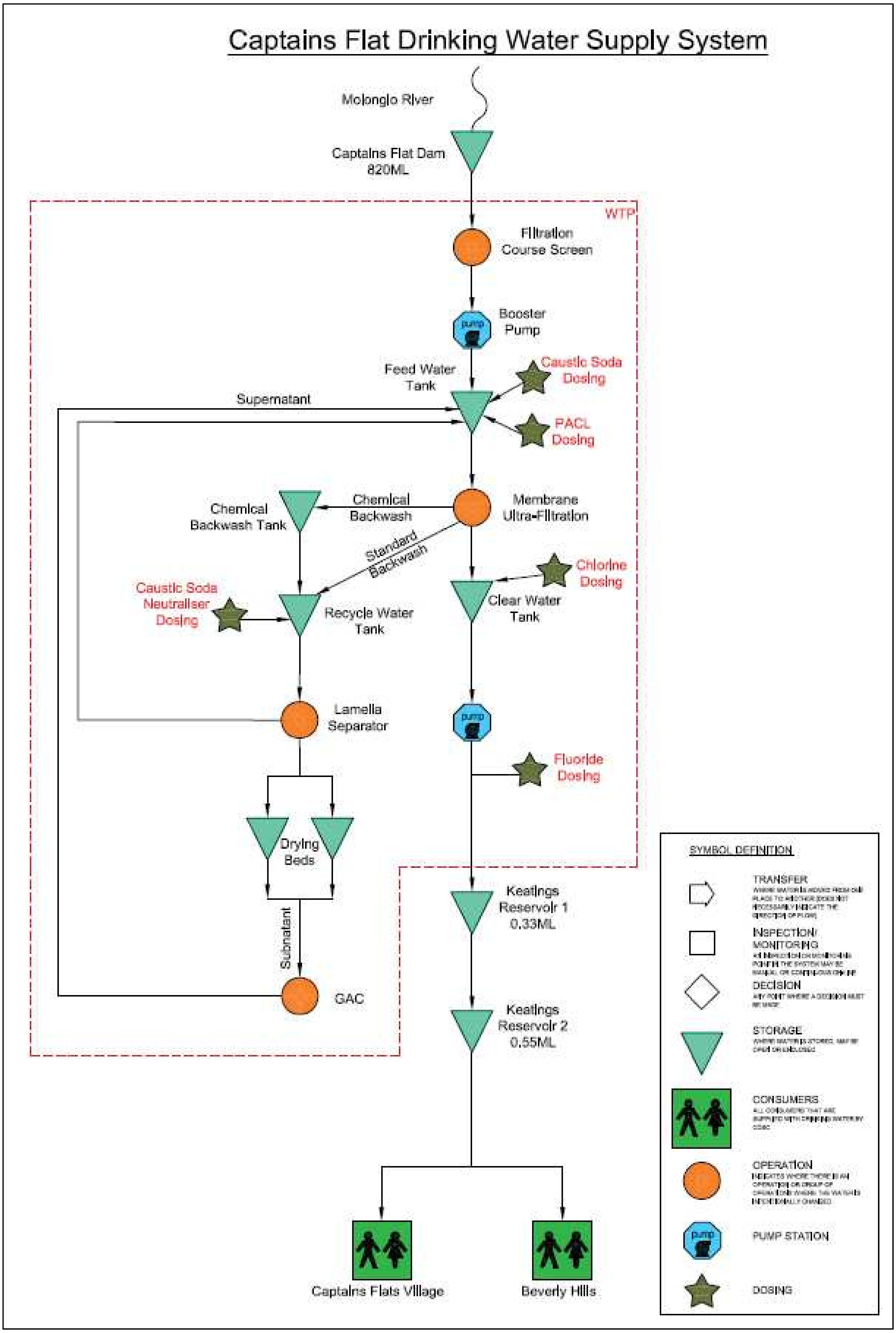

Figure 3.5: Captains Flat Water Treatment Plant Schematic

3.2.5 Drinking Water Management System Findings

Several high and very high risk hazards were identified as part of the DWMS Risk Assessment (1), and of these many were still classified as high risk after mitigation measures. Based on the water quality issues identified throughout the Drinking Water Management System risk assessment, an improvement plan was developed for Council and is subject to an annual review by the Executive Management team.

For all water supply schemes the risk from pathogens, either in the catchment, dam storage, WTP, service reservoirs or reticulation remained high after mitigation measures. For the Captains Flat water supply scheme the risks from contamination in the service reservoirs due to unauthorised access, and the risk from loss of trained operators both remained high even after mitigation measures. All risks identified can be found in A.7.

3.3 Sewerage Schemes

3.3.1 Overview

Palerang has three sewerage schemes servicing townships of Bungendore, Braidwood and Captains Flat. The other much smaller rural villages, as well as the considerable rural residential and rural areas in Palerang are serviced by on-site sewage management systems.

Palerang's asset management plan states that Council is not expecting that any of the unserviced villages will be sewered in the next decade, and that the current arrangements with the use of septic tanks and other on-site sewage management systems will prevail until then (2).

3.3.2 Bungendore Sewerage Scheme

Sewage collection and transfer

Bungendore has a gravity reticulation system, incorporating a series of 10 sewage pumping stations serving small areas within the catchment. The flows from the part of the town south of Turallo Creek discharge to Sewage Pumping Station 1 (SPS1) and are then transferred to Bungendore Sewage Treatment Plant (STP) through a dedicated 200 mm diameter DICL rising main. Future arrangements exist however for the direct transfer of sewage from that part of Bungendore south of King Street to the STP. This area is serviced by SPS4. In 2015 a dedicated 150 mm DICL rising main was constructed to join with the 200 mm main from SPS1. Once ADWFs at SPS4 reach a predefined tipping point, this main will be commissioned, effectively taking catchment 4 out of the load currently borne by SPS1.

The areas to the north of Turallo Creek are variously serviced by a series of other pumping stations. Some have their own rising mains to the STP whilst others work in series. SPS5 and SPS6 share a common rising main to the STP. SPS7 has its own rising main to the STP as does SPS8. SPS9 and SPS10 both pump to catchment 8 and therefore make use of that rising main.

A schematic diagram of Bungendore Sewerage Scheme is provided in Figure 3.7. The SPS hierarchy diagram and pump rates are shown in Figure 3.6, showing SPS4 pumping directly to the STP.

STP	**Rising Main**	**SPS6**	*2.0 L/s*				
		SPS5	*4.2 L/s*				
	Rising Main	**SPS7**	*28.2 L/s*				
	Rising Main	**SPS8**	*19.0 L/s*	**SPS9**	*11.4 L/s*	**SPS10**	*24.6 L/s*
	Rising Main	**SPS1**	*61.5 L/s*	**SPS3**	*3.2 L/s*		
				SPS2	*10.1 L/s*		
	Rising Main	**SPS4**	*27.0 L/s*				

Figure 3.6 Bungendore SPS Hierarchy

There is an imbalance in SPS10 pumping to SPS9 which has a lower duty. Issue

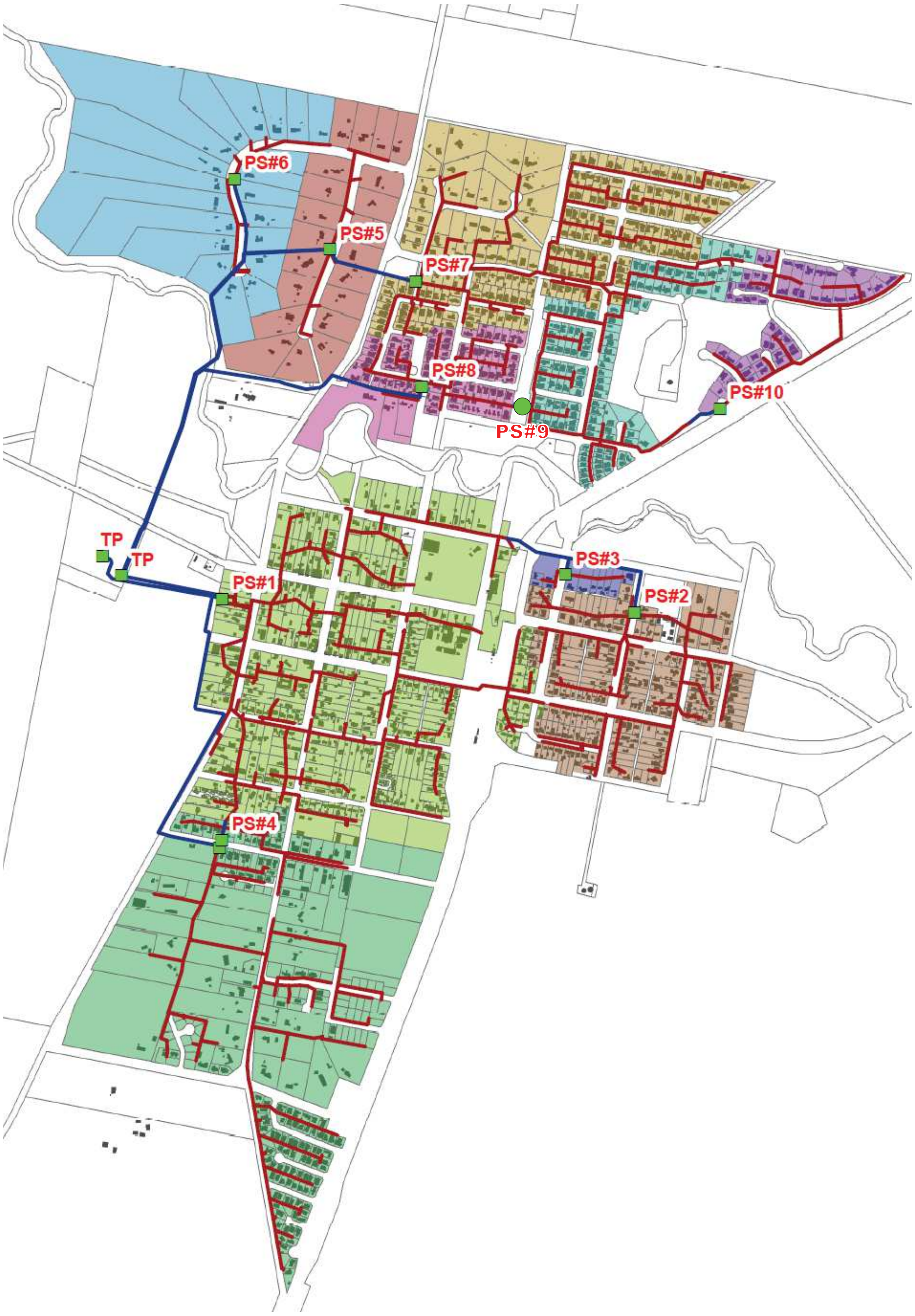

Figure 3.7 Bungendore Sewerage Schematic

STP Description

Bungendore STP was first constructed in 1976 with a 1,000 EP Pasveer Channel, and in 1993 a 2,000 EP capacity IDEA tank was constructed. The STP was re-augmented in 2012 with the demolition of the Pasveer channel and the construction of a new 3,000 EP IDEA reactor on the same footprint. Due to the high growth rates expected in Bungendore, the 1993 IDEA tank has been refurbished and is now ready for recommissioning when required (bringing the total capacity to 5,000 EP).

A summary of Bungendore STP's process units and their capacities is given in Table 3.3 and a process flow diagram is provided in Figure 3.8.

Table 3.3 Bungendore STP Description

Process	Design Criteria	Capacity
STP Design Capacity		
Average Dry Weather Flow (ADWF)	240 L/EP/day 3,000 EP IDEA Tank 2,000 EP IDEA Tank when required	 720 kL/day 480 kL/day Total: 1,200 kL/day
Peak Wet Weather Flow (PWWF)	7 x ADWF 3,000 EP 5,000 EP	 58.3 L/s 97.3 L/s
Process Units Capacities		
Primary Treatment		
Inlet works (including screening and grit removal)	5,000 EP	Bypass inflows in excess of PWWF
Emergency Overflow Storage		
None		
Secondary Treatment		
2 x IDEA tank	1 x 3,000 EP (in use) 1 x 2,000 EP (ready to commission)	
BOD_5	70 g/EP/day[1] 3,000 EP 5,000 EP	 210 kg/day 350 kg/day
TKN	12 g/EP/day[1] 3,000 EP 5,000 EP	 36 kg/day 60 kg/day
Chemical Dosing		
1 x Liquid alum storage tank	*For P removal*	25 kL
Sludge Management		
4 x Sludge lagoons	5,000 EP	2 x 929 m^3 Total 2 x 2,150 m^3 Total
7 x Sludge drying beds	5,000 EP	Not available
Disinfection		
Ultraviolet disinfection system	5,000 EP	42 L/s for full disinfection
Effluent Management	**Discharge to Mill Post Creek**	
3 x Effluent storage ponds	Not available	
1 x Reuse storage tank	For on-site and off-site use	Pump max capacity 25 L/s

1 – Drawing No 0800035-4A Bungendore STP Augmentation, NSW Public Works;

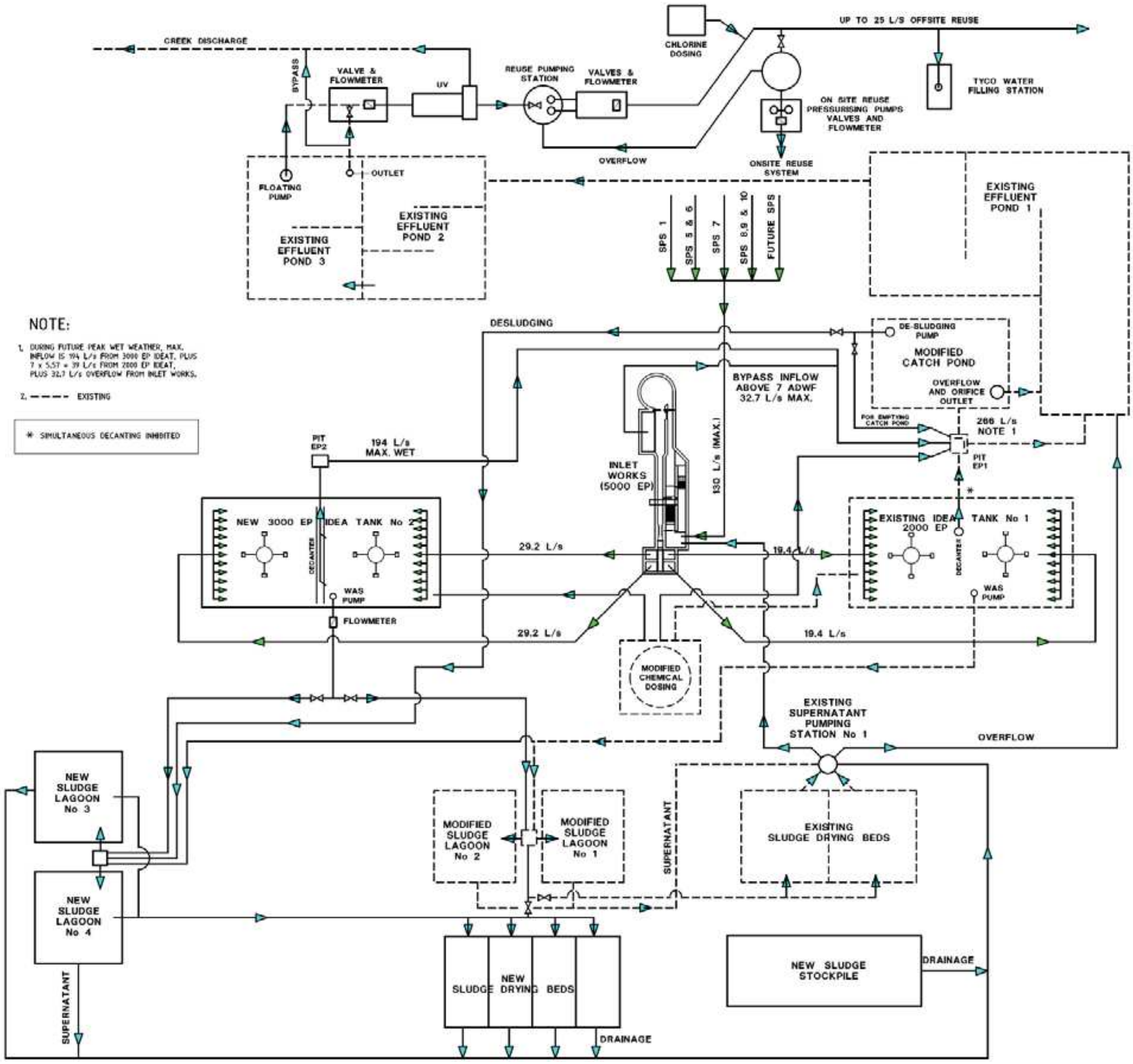

Figure 3.8 Bungendore STP Process Flow Diagram

Effluent Management

Part of the effluent is discharged into Mill Post Creek as allowed under the EPA Licence for the STP (Licence Number 201) and this is monitored and tested for compliance with the licence limits. Effluent is disinfected by UV prior to environmental discharge.

Effluent that is not discharged is used at the STP for onsite purposes (wash down and onsite irrigation), and for off-site purposes at the truck fill station and irrigation of the Bungendore oval and parks. For offsite and onsite reuses only chlorine is added before it is transferred to the end users. Reuse pumps and transfer system have a maximum capacity of 25 L/s (3). According to the last two years of data, 23 ML/year, or approximately 17% of the total STP effluent, was used for reuse purposes. Council has advised that from the total reuse volumes, approximately 5% is used for onsite purposes, 35% used for road work (truck filling) and 60% used for watering Bungendore oval.

Council has advised that plans exist to substantially expand the use of recycled water from the Bungendore facility, most notably for further municipal purposes. Interest, however, has also been shown for other commercial use. No plans exist at this stage to expand supply for a "third pipe" residential non potable system.

At present, Council does not have Section 60 approval for operating the Bungendore off-site reuse system. Issue. An assessment of the log reduction values for the effluent reuse scheme is given in Section 9.4.2.

Biosolids Management

Sludge is stabilised in sludge lagoons prior to drying on sand beds. Dried solids are stored on open ground within the STP grounds for ultimate disposal to landfill.

Licence requirements

The EPA licence for this site (number 201) specifies monitoring at the following EPA identification points:

1. Volumetric monitoring – Influent monitoring at inlet works prior to treatment and eventual discharge to Millpost Creek.
2. Effluent Quality Monitoring – at modified Catch Pond and eventual discharge to Millpost Creek.
3. Effluent Quality Monitoring and Volumetric Monitoring – Discharge to Millpost Creek, post UV disinfection.

Points 2 and 3 are monitored monthly by grab sample for the pollutants given in Table 3.4. The 100 percentile concentration limits in Table 3.4 apply to Point 3.

Table 3.4: Bungendore STP – Pollution Concentration and Load Limits

Pollutant	90 percentile concentration limit	100 percentile concentration limit	Load Limit (kg)
Ammonia	None	10 mg/L	None
BOD	None	10 mg/L	7,384
Faecal Coliforms	None	200 CFU / 100 mL	None
Nitrogen (total)	None	10 mg/L	7,384
Oil and Grease[1]	None	10 mg/L	3,692
pH	None	6.5-8.5	None
Phosphorus (total)	None	0.5 mg/L	369
Total suspended solids	None	15 mg/L	11,077

1 – Oil and Grease is only required to be monitored quarterly, all other pollutants are monitored on a four-weekly basis

Flow is monitored daily at Point 1 by a level sensor and hydraulic flume, and at Point 3 by an electromagnetic flow meter. The volumetric flow at either point must not exceed 2,160 kL/day.

3.3.3 Braidwood Sewerage Scheme

Sewage collection and transfer

Braidwood SPS1, SPS2 and SPS3 pump wells and the rising mains of SPS1 and SPS2 were replaced as a part of Braidwood's sewer scheme upgrading project in 2007/08. The old wet/dry well style SPSs were replaced with wet well based duty/standby submersible pumps. The system upgrades undertaken with the STP augmentation are summarised below:

- Replacement of old STP in 2010
- Upgrade SPS#1 – 3.2 m diameter concrete well with duty and standby submersible pumps, 18 – 50 L/s variable speed drive (VSD) controlled pumps

- Upgrade SPS#2 - 2.25 m diameter concrete well with duty and standby submersible pumps, 9 – 24 L/s VSD controlled pumps
- Upgrade SPS#3 - 1.8 m concrete well with duty and standby submersible pumps, 5 L/s
- Upgrade Rising Main 1 (rising main from SPS#1 to STP) - replaced old 150 mm AC rising main with a 200 mm PN35 DICL rising main
- Upgrade Rising Main 2 (rising main from SPS#2 to manhole AD5) – replaced old 100mm AC rising main with a new 150mm uPVC rising main

Catchments 4, 5 and 6 have all been added to the scheme progressively since the above works. These have all addressed previously unserviced areas of Braidwood. SPS#7 is a new SPS that services an Aged Care facility in the east of Braidwood.

All raw sewage collected from the pumping/gravity catchments is transferred to SPS#1 and then pumped to Braidwood STP.A schematic diagram of Braidwood sewerage scheme is presented in Figure 3.10. The SPS hierarchy diagram and pump rates are shown in Figure 3.9.

STP	**Rising Main**	**SPS1**	*38.0 L/s*	**SPS2**	*20.0 L/s*	**SPS3**	*4.5 L/s*
				SPS4	*2.8 L/s*		
				SPS5	*8.6 L/s*	**SPS6**	*7.5 L/s*
				SPS7	*6.5 L/s*		

Figure 3.9: Braidwood SPS Hierarchy

Figure 3.10: Braidwood Sewerage Schematic

STP Description

Braidwood sewage treatment plant was commissioned in 2010. This was an entire replacement of the old trickling filter plant (1966). The new treatment plant has a civil and hydraulic capacity of 3,000 equivalent persons (EP) and electrical and mechanical equipment capacity for 2,000 EP.

A summary of Braidwood STP's process units and their capacities is given in Table 3.5. The process flow of Braidwood STP is provided in Figure 3.11

Table 3.5 Braidwood STP Description

Process	Design Criteria	Capacity
STP Design Capacity		
Average Dry Weather Flow (ADWF)	2,000 EP @ 240 L/EP/day	480 kL/day
Peak Wet Weather Flow (PWWF)	7 x ADWF	39 L/s
Process Units Capacities		
Primary Treatment		
Inlet works (including screening and grit removal)	2,000 EP	Receive inflows up to 64 L/s Bypass flows in excess of 39 L/s during wet weather
Vortex Grit Arrestor	2,000 EP	Max 120 m^3/m^2/hour
Emergency Overflow Storage		
Emergency overflow storage pond	28 days at ADWF 4 days at PWWF	13.8 ML
Secondary Treatment		
1 x IDEA tank BOD_5 NH_3 TP	Treatment of flows up to PWWF 70 g/EP/day[1] 12 g/EP/day[1] 2 g/EP/day	 140 kg/day 24 kg/day 4 kg/day
1 x Catch / balance pond		101 m^3
Chemical Dosing		
1 x Liquid alum storage tank	*For P removal*	20 kL
Sludge Management		
2 x Sludge lagoons	Detention time 7 month	1,150 m^3 per lagoon
2 x Sludge drying beds		440 m^2 per bed
Disinfection		
Ultraviolet disinfection system	2,000 EP	25 L/s for full disinfection
Effluent Management	Discharge to Flood Creek	
1 x Reuse storage tank	For on-site use	

1 - Drawing No. 0601355-4, Braidwood STP Augmentation, NSW Public Works;

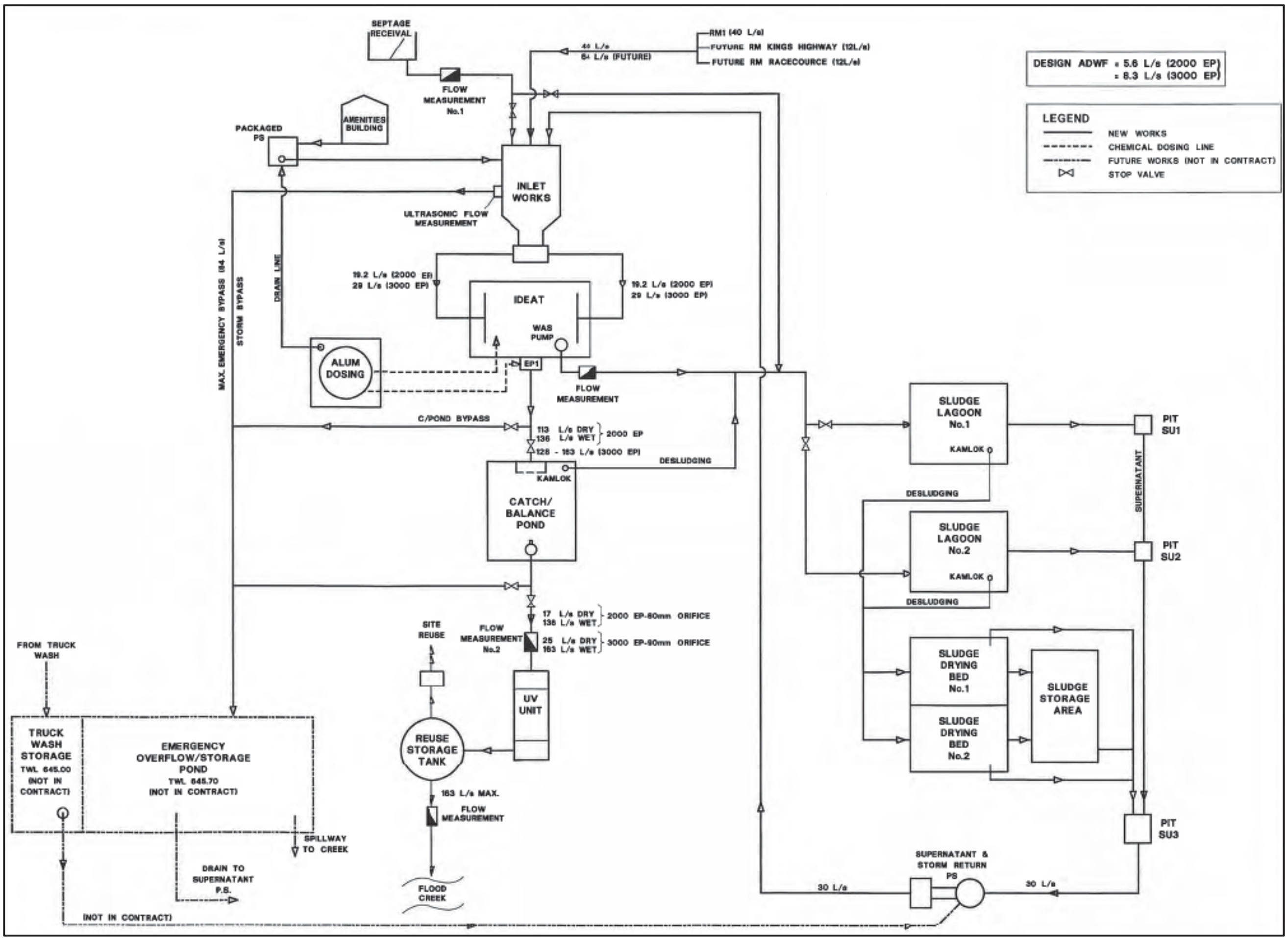

Figure 3.11 Braidwood STP Process Flow Diagram

Effluent Management

The treated effluent from the STP is discharged to Flood Creek. The EPA licence (Licence Number 1733) allows Braidwood STP to discharge into surface waters at a maximum daily limit of 1,440 kL/day. The effluent is monitored and tested for compliance with licence limits.

Over the years, the local Braidwood Golf Course has approached Council for advice in respect of the potential for reuse options from the STP. Council advised that, if Braidwood Golf Course agreed to use effluent from the STP, the average effluent reuse is 150 kL/day that is approximately 50% of the effluent discharge from the STP. Council will need to obtain S60 approval for this reuse option. In considering these matters Council has previously resolved that the Club would need to substantially contribute financially toward the capital cost of such a venture as well as ongoing operating costs into the future. Interest from the Golf Club has dropped off in recent years and the matter has not progressed much beyond these initial discussions.

An assessment of the log reduction values for the effluent reuse scheme is given in Section 9.4.2.

Biosolids Management

Sludge is stabilised in the sludge lagoons prior to drying on sand beds. Dried solids are stored onsite and eventually disposed of at landfill.

Licence requirements

The EPA licence for this site (number 1733) specifies monitoring at the following EPA identification points:

1. Discharge to waters, effluent quality monitoring – Measurement pit adjoining Site Reuse Storage Tank, marked "Flow measurement pit".
2. Volume Monitoring – "Inlet works" shown on "New works and layout coordinates". Flow is monitored daily using flow meter and continuous logger.

Points 1 is monitored by grab sample for the pollutants given in Table 3.6.

Table 3.6: Braidwood STP – Pollution Concentration and Load Limits

Pollutant	90 percentile concentration limit	100 percentile concentration limit	Load Limit (kg)
Ammonia	2 mg/L	None	None
BOD	10 mg/L	20 mg/L	2,200
Faecal Coliforms	200 CFU / 100 mL	None	None
Nitrogen (total)	10 mg/L	None	1,650
Oil and Grease[1]	2 mg/L	10 mg/L	1,100
pH	6.5-8.5	None	None
Phosphorus (total)	0.5 mg/L	None	110
Total suspended solids	15 mg/L	30 mg/L	3,300

Point 2 is monitored for daily flow by level sensor and hydraulic flume supported by a continuous logger. The volumetric flow must not exceed 1,440 kL/day.

NorBE requirement

Unlike Bungendore and Captains Flat, the town of Braidwood lies in the Sydney Drinking Water Catchment area.

The State Environmental Planning Policy (SEPP) requires that all proposed development in the Greater Sydney drinking water catchment to have a neutral or beneficial effect on water quality (NorBE) which requires much more stringent effluent quality requirements for Council's STPs. For example, if the plant flow volumes were to double (due to increased plant loads from new development) then the nutrient concentrations in the effluent would need to be halved from its current value in order to maintain (neutral) or reduce (beneficial) the current impact (evaluated in term of mass of nutrient) on the receiving waters.

If Council is planning an upgrade of the Braidwood STP they will have to ensure it is NorBE compliant.

3.3.4 Captains Flat Sewerage Scheme

Sewage collection and transfer

Captains Flat has a gravity reticulation system. All the sewage from the township gravity flows to the Captains Flat pump station. This pump station transfers raw sewage to the Captains Flat STP.

A schematic diagram of Captains Flat Sewerage Scheme is provided in Figure 3.7. The SPS hierarchy diagram and pump rates are shown in Figure 3.12.

Figure 3.12: Captains Flat SPS Hierarchy

Figure 3.13 Captains Flat Sewerage Schematic

STP Description

Captains Flat STP is the oldest STP in Palerang Sewerage Systems. This STP was built in mid 1980s and it has a capacity of 500 EP.

A summary of Captains Flat STP's process units and their capacities is given in Table 3.7.

Table 3.7 Captains Flat STP Description

Process	Design Criteria	Capacity
STP Design Capacity		
Average Dry Weather Flow (ADWF)	500 EP @ 240 L/EP/day	120 kL/day
Peak Wet Weather Flow (PWWF)	7 x ADWF	9.7 L/s
Process Units Capacities		
Primary Treatment		
None		
Emergency Overflow Storage		
None		

Process	Design Criteria	Capacity
Secondary Treatment		
1 x Pasveer Channel BOD_5 NH_3 TP	1 x 500 EP 70 g/EP/day[1] 12.5 g/EP/day[1] 2.7 g/EP/day	 210 kg/day 36 kg/day 6 kg/day
Chemical Dosing		
None		
Sludge Management		
2 x Sludge lagoons	Unknown	143 m^3 total
1 x Sludge drying bed	Unknown	Unknown
Disinfection		
None		
Effluent Management	**Discharge to Molongolo River**	
2 x Effluent Ponds	Unknown	900 m^3 total

1 - Schematic Flow Diagram, Captains Flat STP Augmentation, NSW Public Works
2 – Public Works Department NSW – Contract drawings #79166 Captains Flat STW

Effluent Management

Treated effluent from the STP is discharged to the effluent storage ponds and then to the Molonglo River. The EPA licence for Captains Flat STP allows discharge to surface waters at a maximum daily limit of 240 kL/day. The effluent is monitored and tested for compliance with the licence limits.

Biosolids Management

Sludge is stabilised in sludge lagoons prior to drying on sand beds. Dried solids are stored in on-site sludge storage area.

Licence requirements

The EPA licence for this site (number 1929) specifies monitoring at the following EPA identification points:

1. Discharge to waters, total volume monitoring and effluent quality monitoring – the tertiary lagoon outlet pipe to Molonglo River.
2. Environmental Monitoring - In Molonglo River, 500 metres upstream of Discharge Point 1
3. Environmental Monitoring - In Molonglo River, 500 metres downstream of Discharge Point 1

Points 1 is monitored quarterly by grab sample for the pollutants given in Table 3.8. No load based limits apply to these pollutants.

Table 3.8: Captains Flat STP – Pollution Concentration and Load Limits

Pollutant	90 percentile concentration limit	100 percentile concentration limit	Load Limit (kg)
BOD	None	20 mg/L	None
Oil and Grease	None	10 mg/L	None
Total suspended solids	None	30 mg/L	None

Points 2 and 3 are monitored quarterly by grab sample for BOD, oil and grease, TSS, Nitrogen (total and ammonia), pH and Phosphorus (total). No concentration or load based limits apply to these pollutants.

Point 1 is monitored for daily flow by an electronic meter and continuous logger. The volumetric flow must not exceed 240 kL/day.

Planned Upgrade

Council have planned an upgrade to Captains Flat STP. A detailed design has been developed together with appropriate contractual and commercial clauses and it is proposed that the project be tendered in 2017/18. The upgrade will not increase the capacity of the STP.

The existing STP is around 35 years old, and Council have identified the following issues which justify the planned upgrade:

1. The amenities building does not have adequate crib facilities for the operator. The lab serves as the operator’s meal room which is a health issue.
2. The switchgear is old and the PLC is obsolete. There is no SCADA capability at the plant.
3. The sludge lagoons are unlined and do not have safety fencing. In addition to this, there are hydraulic issues with one of the lagoons that means it is often unused. The lagoons are difficult to properly de-sludge and are prone to excessive grass and vegetation growth.
4. The drying bed is largely unformed as has very poor under bed drainage. The supernatant return pump station is makeshift (it is a modified sewer manhole chamber). The bed is very ineffective.
5. The tertiary ponds are fairly ineffective and do not provide much natural UV stabilisation for the treated effluent as is evidenced by the presence of FC in the discharge. The ponds are prone to some sludge settlement which is difficult to extract.
6. The Pasveer Channel is not supported by safety fencing. It does not include any chemical phosphorus treatment. There are no facilities for grit and / or rag removal as there is no dedicated inlet works.

3.4 Urban stormwater

QPRC is responsible for kerb and gutter and drainage assets in Braidwood, Bungendore and Captains Flat. Council does not operate any stormwater harvesting system or water sensitive urban design projects in Palerang.

3.4.1 Kerb and Gutter

Council is currently responsible for approximately 47 km of kerb and gutter in Braidwood, Bungendore and Captains Flat. There is insufficient kerb and gutter in the urban areas causing ponding, which in turn accelerates pavement condition deterioration and reduces level of service (e.g. nuisance, reduced safety and other asset failures).

The asset condition provided in the Palerang Asset Management Plan (AMP) states that approximately 6% of kerb and gutter are in poor or very poor condition. The AMP also states that there are insufficient kerb and gutters in the urban areas and that maintenance of these assets is predominantly reactive.

The level of service for kerb and gutters is to provide assets to ensure efficient disposal of stormwater run-off and that no flooding of properties occur under normal rainfall conditions. Council has a renewal and new works expenditure plan in place for kerbs and gutters in order to achieve its levels of services.

3.4.2 Drainage

Council's drainage assets consist of pipes, pits, manholes, culverts and headwalls. The Palerang AMP states that there is insufficient drainage in both urban and rural areas. There is open drainage in the urban areas which needs to be placed underground for safety and aesthetics reasons.

The collection of data for rural culverts (for the purposes of the AMP preparation) provided condition information for about 70% of the assets. That information was used to estimate the condition for all rural culverts. There is a large gap in condition data for drainage in the urban areas. In 2010 an estimate of the condition of pipes for Braidwood was prepared and an estimated construction date was allocated to the remaining urban drainage assets in order to estimate a remaining useful life and hence the timing for renewal.

Maintenance of drainage is predominantly reactive. Due to the importance of drainage in urban areas and the impact of any issues with poor condition any problems are attended to as a matter of priority. Council has prepared a renewal and new works expenditure plan for kerbs and gutters in order to achieve its levels of services, which is to provide kerb and gutter to ensure efficient disposal of stormwater run-off and that no flooding of properties occur under normal rainfall conditions.

Council has a renewal and new works expenditure plan in place for drainage assets in order to achieve its levels of services. The level of service for drainage is to provide assets to ensure efficient disposal of stormwater run-off and that no flooding of properties occur under normal rainfall conditions. (Source: Palerang Council Asset Management Plan, September 2013)

3.5 Asset Management

Council has developed and continuously updates its asset register. Council also recently prepared a Palerang asset management plan (September 2013) (2), which identified the adequacy of existing assets for delivering future demand. Council is monitoring its deteriorated assets and progressively replacing assets according to priority.

Table 3.9 provides an overview of Palerang's water supply and sewerage schemes assets valuation, obtained from *2014/15 Water Supply and Sewerage Special Schedules 3 to 6.* Public Works Advisory has reviewed the Current Replacement Costs and they're found to be reasonable.

Table 3.9 Total Asset Valuation Summary (2015/16 $'000)

	Water Supply	Sewerage
Current Replacement Cost (CRC)	41,822	43,117
Written Down Current Cost (WDCC)	25,416	29,030
WDCC/CRC	61%	67%
2014/15 Assets Depreciation	592	848
30 year Forecast Depreciation	17,760	25,440

3.6 Current price signals

Palerang Council's recent pricing details for water and sewerage are summarised in Table 3.10. Council will complete an update of its Development Servicing Plan following the finalisation of the IWCM.

Table 3.10: Palerang Community water supply and sewerage fees and charges

	2013/14	2014/15	2015/16
Water Supply			
Usage Charge Tier 1<200KL ($/kL)	2.08	2.14	2.22
Usage Charge Tier 2>200KL ($/kL)	3.28	3.37	3.49
Access charge (20mm service size)	397	407	422
Typical Residential Bill ($/Property)	732	745	773
OMA Cost per Property ($/Property)	595	573	586
Revenue per Property ($/Property)	950	1,020	964
Sewerage			
Annual Residential Charge ($)	922	946	982
Non-Residential Charge ($) ▪ Access Charge (20mm water service) ▪ Usage Charge ($/kL)	 N/A 2.62	 1,086 2.69	 1,126 2.69
Typical Residential Bill ($/Property)	922	946	982
Trade Waste Charges	Appropriate charges are applied		
OMA Cost per Property* ($/Property)	498	512	514
Revenue per Property* ($/Property)	1,140	1,300	1058

3.7 Liquid Trade Waste Policy

Palerang Community has adopted a Liquid Trade Waste Policy in June 2011.This policy outlines how Palerang will regulate liquid trade waste discharges to its sewerage scheme in accordance with NSW Framework for Regulation of Sewerage.

Some of the 2015/16 LTW fees are given in Table 3.11

Table 3.11 Palerang Community Council 2015/16 Liquid Trade Waste Fees and Charges

Application Fees	
Existing dischargers	$0.00
Classification A	$64.00
Classification B	$127.50
Classification S	$190.50
Classification C	$381.50
Annual Charges	
Category 1 Discharger	$95.00
Category 2 Discharger	$190.50
Category 3 Discharger	$637.00
Industrial Discharger- fee based on waste	$183.50 - $614.00
Re-Inspection Fee	$90.00

Trade Waste Usage Charge	
Category 1 Discharger with appropriate equipment	$0.00
Category 1 Discharger without appropriate pre-treatment, R1 (per kL)	$2.50
Category 2 Discharger with appropriate pre-treatment, R1 (per kL)	$2.50
Category 2 Discharger without appropriate pre-treatment, R2 (per kL)	$18.00
Food Waste Disposal Charge, UF (per bed)	$32.50

4 Population and development

4.1 Historical Population

4.1.1 Shire and Urban Centre Populations

The historical population of the Palerang LGA and the three main urban centres of Braidwood, Bungendore and Captains Flat have been obtained from the Australian Bureau of Statistics (ABS) Census data.

The historical Estimated Resident Population (ERP) for the Palerang LGA is presented in Table 4.1. The ABS ERP is released every year and uses data from several sources, including the Census, which has been corrected for several factors. The most recent estimates are from 30 March 2016.

Table 4.1: Historical Palerang LGA Estimated Resident Population

	1991	1996	2001	2006	2011	2015
Palerang LGA	8,810	9,674	10,805	12,703	14,857	15,897

The historical population for the Urban Centres is presented in Table 4.2. These populations are obtained from ABS Census Quickstats data.

Table 4.2 Historical Urban Centre Population of Serviced Areas

Area	Population				Growth Rate (per year)			Historical Average Annual Growth Rate
	2001	2006	2011	2016	2001 to 2006	2006 to 2011	2011 to 2016	
Bungendore	1,685	2,183	2,754	3,317	5.32%	4.76%	3.79%	4.62%
Braidwood	996	1,108	1,158	1,273	2.15%	0.89%	1.91%	1.65%
Captains Flat	419	447	436	449	1.30%	-0.50%	0.59%	0.46%

Table 4.3 outlines the historical household size and occupancy ratio recorded by ABS in the past four Censuses. Household size is expressed in terms of occupied dwellings i.e. people per household. The Household size in the former Palerang LGA's main townships has not changed from 2001 to 2011. It is expected these ratios will remain for the 30 year planning horizon.

Table 4.3 Historical Household Size and Occupancy Ratio

Area	Household Size				Occupancy Ratio			
	2001	2006	2011	2016	2001	2006	2011	2016
Bungendore	2.9	2.9	2.9	2.9	0.94	0.92	0.93	0.95
Braidwood	2.3	2.3	2.3	2.3	0.80	0.83	0.84	0.88
Captains Flat	2.3	2.3	2.3	2.2	0.83	0.96	0.88	0.87

Source: Australian Bureau of Statistics Census, QuickStats

4.1.2 Serviced Population

The estimated serviced population is shown in Table 4.4. These numbers are taken from Council's 2016 billing data. Population estimates are calculated by multiplying the number of occupied properties with a water / sewer connection by the 2016 household size for each service area, given in Table 4.3. An occupied property is defined as one that uses more than 110 L/day on average.

Table 4.4: 2016 Serviced Properties and Population from Billing Data

	Bungendore	Braidwood	Captains Flat	Total
Total Residential Properties				
On water supply	1,129	530	224	1,883
On sewerage	1,117	482	212	1,811
On water but not sewerage	12	48	12	72
Occupied Residential Properties				
On water supply	1,074	469	193	1,736
On sewerage	1,068	426	182	1,676
On water but not sewerage	6	43	11	60
Population				
On water supply	3,148	1,062	426	4,636
On sewerage	3,130	965	402	4,497
On water but not sewerage	18	97	24	139

All residential properties that are serviced with sewerage are also in the water service area. Residential properties that are serviced with water supply but not sewerage tend to be larger rural type properties in all schemes, and in Captains Flat this includes several smaller residential properties in the area known locally as Beverley Hills.

DPI Water planning data

Table 4.5 summarises the Palerang historical number of water supply and sewerage connected properties, assessments and serviced population which is obtained from DPI Water (formerly NSW Office of Water) planning data.

Table 4.5: Summary of DPI Water Planning Data

	1995/96	2000/01	2005/06	2010/11	2014/15
Water Supply					
Residential Connected Properties	No data	No data	1,740	1,840	2,038
Non-Residential Connected Properties	No data	No data	50	190	202
Total Connected Properties	1,320	1,540	1,790	2,030	2,240
Total Assessments	1,464	1,640	1,880	2,140	2,360
Serviced Population	2,900	3,000	3,800	4,700	5,300
Sewerage					
Residential Connected Properties	No data	No data	1,600	1,736	1,920
Non-Residential Connected Properties	No data	No data	180	161	190
Total Connected Properties	1,330	1,350	1,780	1,897	2,110
Total Assessments	1,400	1,440	1,870	2,000	2,220
Serviced Population	2,750	2,900	3,800	4,400	5,100

Source: DPI Water Historical Planning Data for Palerang

4.2 Visitor Contribution

4.2.1 Major Tourist Events

Bungendore

The main tourist events held in Bungendore are the annual Country Muster held in early February, the annual Bungendore Quilt Event in late November and the annual Wine Expo in mid-December.

Daily sewage data records to the Bungendore STP and daily water production records from the Bungendore WTP show no noticeable increases in the daily sewage loadings and water demand due to the above tourist events. The majority of tourists are day visitors, who only make a small impact on sewage loads and water demand. This is because day visitors do not undertake the activities that have the biggest impact on sewage volumes and water consumption (laundry and showering), and they do not impact the external water use (garden watering).Thus no extra allowance is required for holiday demand or loading in the systems.

Braidwood

The Braidwood Cup is the main tourist event held annually in mid-February. Braidwood annual agricultural show is held in early March at the Braidwood Showground. The Music at the Creek Folk Festival occurs in November as does the annual Braidwood Quilt Event and the Open Gardens. Due to its location between Canberra and South Coast, Braidwood is also a convenient stopping point for visitors travelling between the two areas (Source: Braidwood Sewerage Scheme Concept Development of Augmentation, January 2006).

Similar to Bungendore, these events do not cause a noticeable increase in the water demand and sewage volumes.

Captains Flat

There are no major events in Captains Flat and no significant impact on the water demand and sewage volumes associated with tourist events.

4.2.2 Tourist Premises

The majority of tourists in the Palerang are day visitors, who only make a small impact on sewage volumes and water demand. The number of existing tourist premises in each town is outlined in Table 4.6.

Table 4.6: Tourist Accommodation

Community	Type of accommodation	Number of rooms/unit
Bungendore	B&B	4
	Inn	26
	Hotel	6
	Hotel	6
	B&B	4
	Motel	8
Braidwood	Motel	11
	Eco Motel	4
	Hotel	15
	B&B	4
	Motel	10
Captains Flat	Hotel	21

4.3 Major development

The major factor contributing to growth in the former Palerang LGA are proposed major Greenfield developments at Bungendore, which in addition to significant infill are expected to more than double the population of Bungendore over the next ten years. Development will initially occur in the approved Elmslea North and Bungendore East developments, with additional Greenfield land required in the future.

To meet this growth, it is anticipated that Council will need to construct additional education facilities (one primary school and one high school is expected) as well as additional land for public recreation, such as sports fields and parks.

Currently a large proportion of the town commutes to Canberra for work and school, but Council expects that as Bungendore develops, more residents will be staying in Bungendore during the day.

4.4 Projections

4.4.1 Nominated Growth Rate

Table 4.7 summarises the growth rates nominated by Council. These were used in this IWCM study's water and sewerage demand analyses to determine the 30 year growth projections for residential and non-residential customers. It is assumed that there is no growth in other non-residential user classes.

Table 4.7 Residential and Non-residential Properties Annual Growth Rates

Scheme	Residential	Commercial	Education
Bungendore	10% decreasing exponentially to 1.1% (average growth rate of 4.1%)	1.20%	2.00% [1]
Braidwood	1.20%	0.60%	0.00%
Captains Flat	0.20%	0.10%	0.00%

1 - assumed one new primary school and one new high school in Bungendore

Council provided their estimated dwelling growth distribution and timing by sewer catchment for Bungendore, which is provided in Figure 4.1. This planning data also gives the estimated uptake of development in Greenfields areas.

In Braidwood the majority of growth occurred in SPS1, SPS2 and SPS3 sewer catchments which grew at 1.0% per annum. The remainder of growth was split between SPS4, SPS5 and SPS6 sewer catchments. In Captains Flat all growth occurred in the SPS1 sewer catchment. A new Aged Care facility has also been built and will be serviced by a new, developer constructed, sewer pumping station SPS#7.

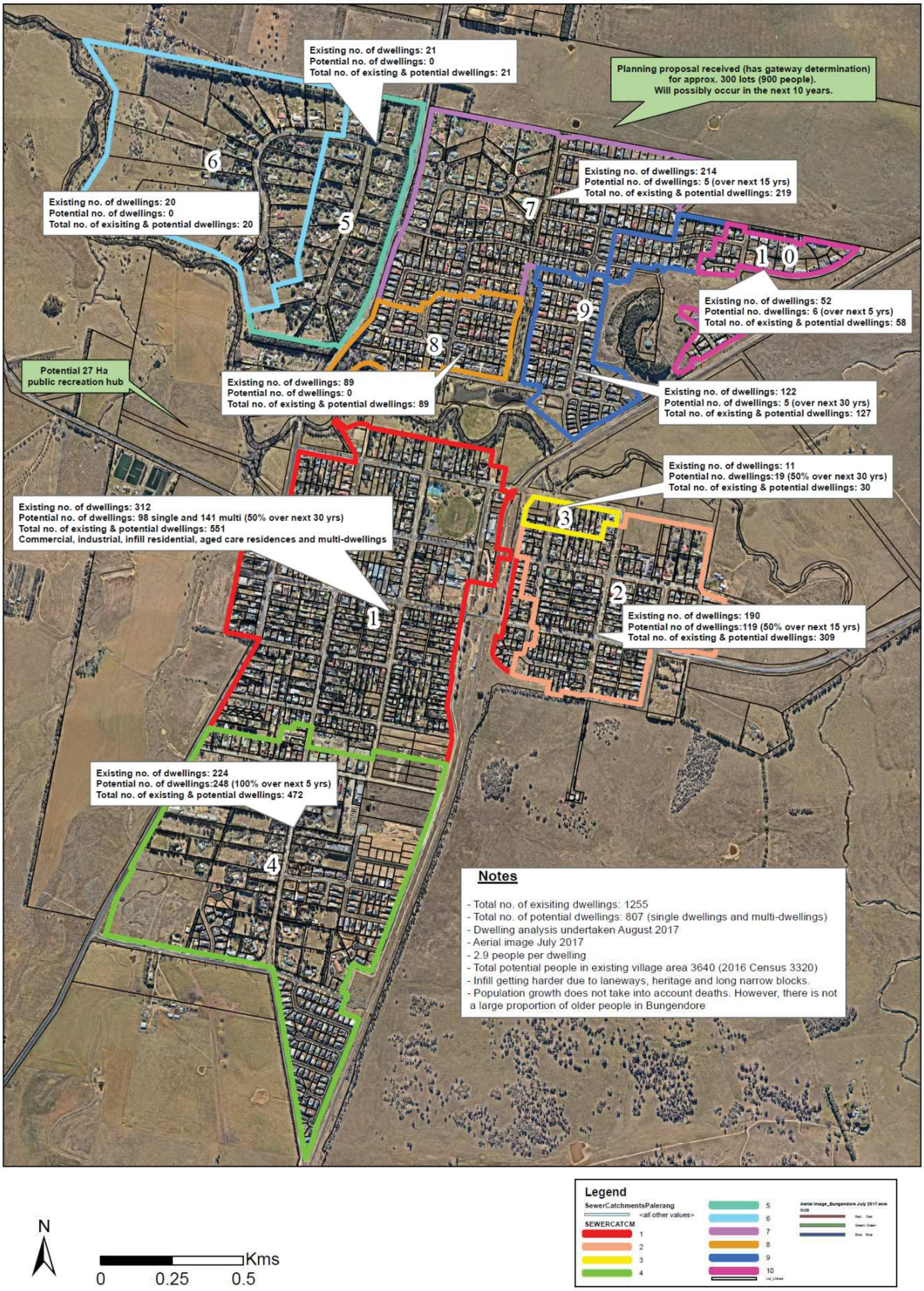

Figure 4.1: Growth Distribution in Bungendore

4.4.1 Population and dwelling projection

Table 4.8 shows the residential dwelling projection for each scheme. It is assumed that all new dwellings are connected to water and sewerage.

Table 4.8: Residential Dwelling Projections

		2016	2021	2026	2031	2036	2041	2046
Bungendore	BU SPS1	312	330	348	368	388	410	432
	BU SPS2	190	208	227	248	250	250	250
	BU SPS3	11	12	14	15	17	19	21
	BU SPS4	224	472	472	472	472	472	472
	BU SPS5	21	21	21	21	21	21	21
	BU SPS6	20	20	20	20	20	20	20
	BU SPS7	214	216	218	219	219	219	219
	BU SPS8	89	89	89	89	89	89	89
	BU SPS9	122	123	124	126	127	128	130
	BU SPS10	52	58	58	58	58	58	58
	Elmslea North	0	132	300	300	300	300	300
	Bungendore East	0	220	591	700	700	700	700
	Extra Possible	0	0	54	464	899	1,231	1,473
	Not on sewer	12	12	12	12	12	12	12
	Total on water	**1,267**	**1,912**	**2,549**	**3,111**	**3,572**	**3,930**	**4,197**
	Total on sewer	**1,255**	**1,900**	**2,537**	**3,099**	**3,560**	**3,918**	**4,185**
Braidwood	BR SPS1	316	332	349	367	386	405	426
	BR SPS2	119	125	131	138	145	153	160
	BR SPS3	14	15	15	16	17	18	19
	BR SPS4	15	16	18	19	21	23	24
	BR SPS5	4	6	8	10	12	15	17
	BR SPS6	14	18	22	26	31	37	42
	Not on sewer	48	48	48	48	48	48	48
	Total on water	**530**	**560**	**591**	**624**	**660**	**697**	**737**
	Total on sewer	**482**	**512**	**543**	**576**	**612**	**649**	**689**
Captains Flat	CF SPS1	212	214	216	218	221	223	225
	Not on sewer	12	12	12	12	12	12	12
	Total on water	**224**	**226**	**228**	**230**	**233**	**235**	**237**
	Total on sewer	**212**	**214**	**216**	**218**	**221**	**223**	**225**

Note: the dwelling projection starting point for Bungendore is based off the values in Figure 4.1 provided by Council, which is why they do not exactly match the number of dwellings obtained from billing data in Table 4.4.

Table 4.9 shows the occupied residential property projection for each scheme. Full projections by sewer catchment are given in Appendix A.2.

Table 4.9: Occupied Residential Property Projections

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Water	1,074	1,719	2,356	2,918	3,379	3,737	4,004
	Sewerage	1,068	1,713	2,350	2,912	3,373	3,731	3,998
Braidwood	Water	469	499	530	563	599	636	676
	Sewerage	426	456	487	520	556	593	633
Captains Flat	Water	193	195	197	199	202	204	206
	Sewerage	182	184	186	188	191	193	195

Table 4.10 shows the population projection for each scheme. Full projections by sewer catchment are given in Appendix A.3.

It is assumed that the 2016 household sizes in Table 4.2 remain constant over the next 30 years, and all new dwellings are occupied.

Table 4.10: Serviced Residential Population Projections

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Water	3,148	5,039	6,905	8,554	9,904	10,952	11,734
	Sewerage	3,130	5,022	6,887	8,536	9,887	10,934	11,717
Braidwood	Water	1,062	1,129	1,200	1,276	1,356	1,441	1,532
	Sewerage	965	1,032	1,103	1,179	1,259	1,344	1,434
Captains Flat	Water	426	431	436	440	445	450	455
	Sewerage	402	407	411	416	421	426	431

5 Water demands

Council provided approximately seven years of daily production data, from 1 July 2009 to 18 November 2016. These volumes were read daily off mag-meters located after each WTP.

Water meter billing data was provided by Council for the duration of the 2009/10 financial year to the 2015/16 financial year. Water meters are read quarterly around the end of the months of June, September, December and March, with the read date for each meter recorded by Council. The historical number of connections is given in Table 5.1.

Analysis identified that the production data for Braidwood before the second quarter of the 2012/13 financial year did not match with the water billing data, and for this reason it was not used in water demand analysis.

Table 5.1: Number of connections

	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Bungendore							
Residential	910	911	974	1026	1058	1085	1128
Non-residential	67	63	67	66	69	68	71
Total	977	974	1041	1092	1127	1153	1199
Braidwood							
Residential	508	491	493	507	510	510	510
Total Non-res	77	76	82	84	82	80	85
Total	585	567	575	591	592	590	595
Captains Flat							
Residential	202	214	213	212	214	216	220
Total Non-res	13	13	13	13	12	14	13
Total	215	227	226	225	226	230	233

5.1 Historical Water Demand Analysis

The historical water production for Bungendore, Braidwood and Captains Flat is shown in Figure 5.1 to Figure 5.3.

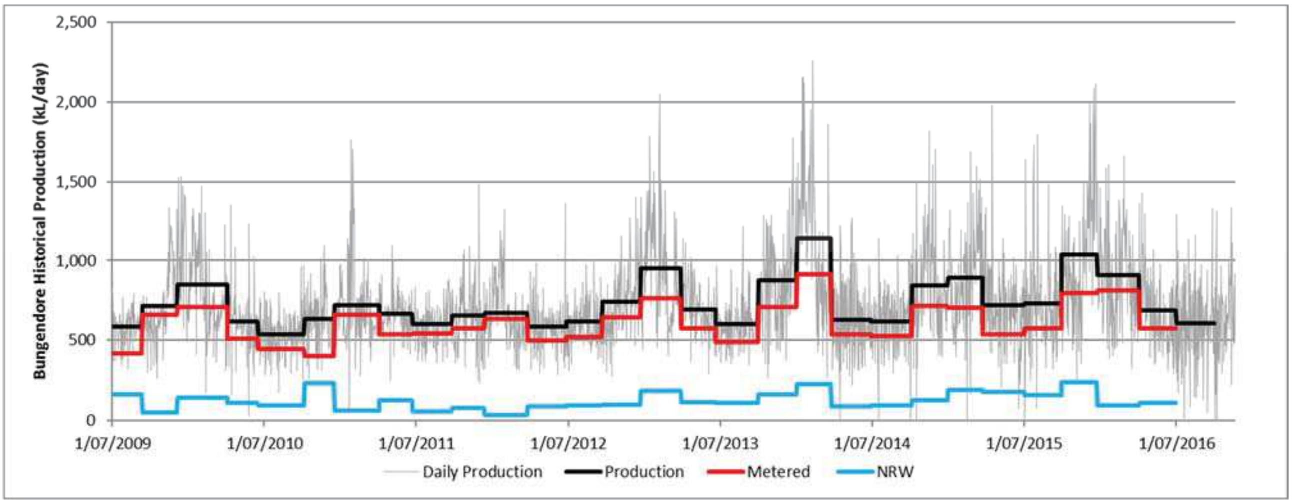

Figure 5.1 Bungendore Historical daily production showing quarterly averages

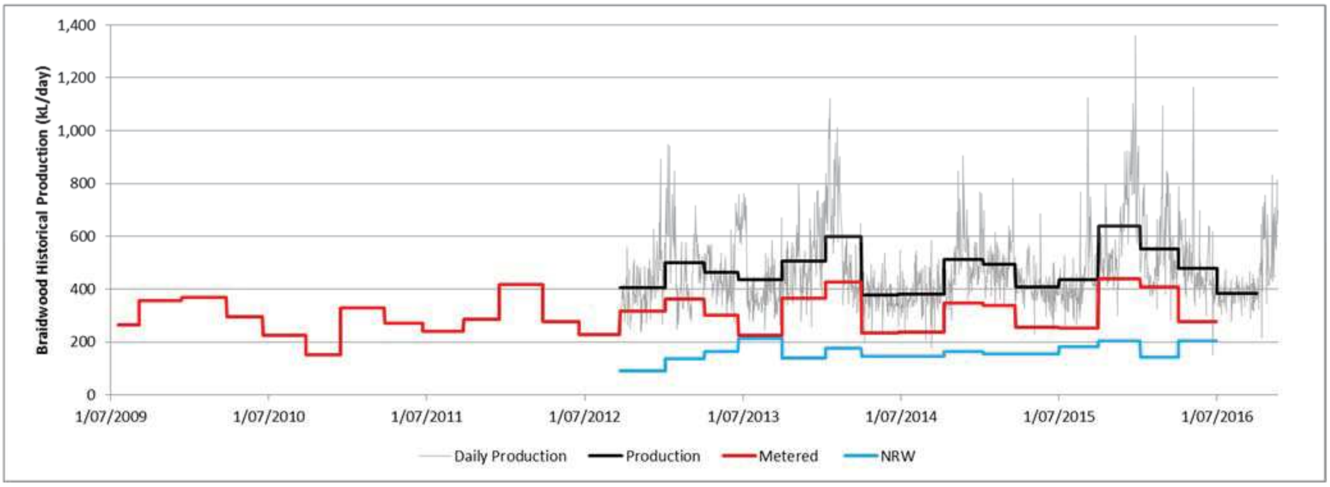

Figure 5.2 Braidwood Historical daily production showing quarterly averages

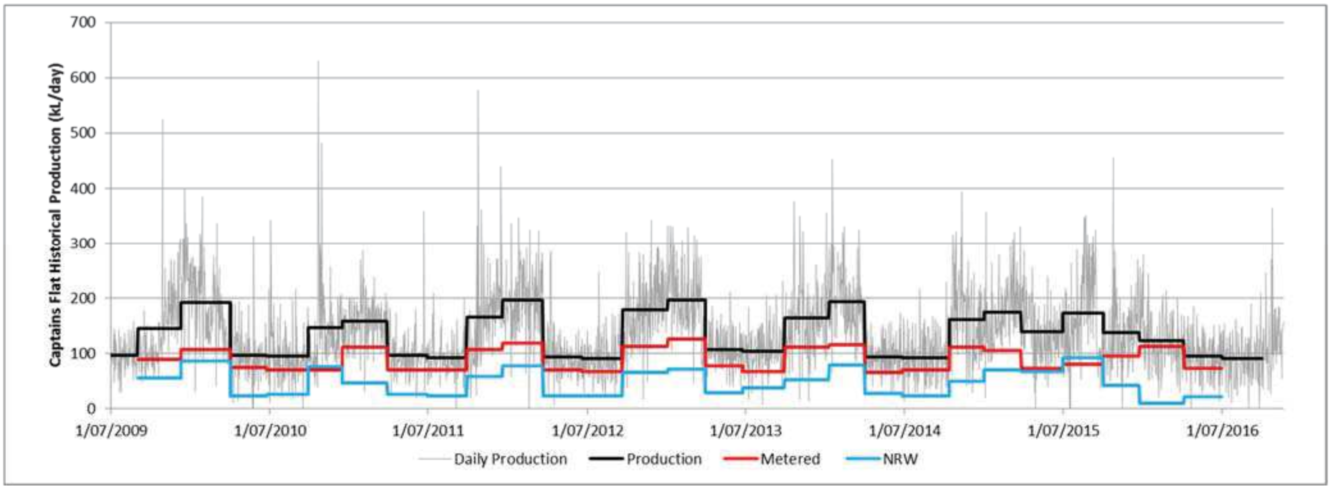

Figure 5.3 Captains Flat Historical daily production showing quarterly averages

Council has indicated that the seasonal variation in Captain's Flat NRW is due to a leak and faulty meter at Captain's Flat pool and the neighbouring fields, which share a meter. Council replaced the meter in February 2016, which later failed. The meter was replaced again in February 2017 but has failed again. Council recently installed a new mag-flow meter and have advised that it is measuring flow well.

The average daily production and metered demand for each quarter are provided with the NRW analysis in Section 5.6 Figure 5.4.

5.2 Factors and Trends

5.2.1 Historical factors and trends

There are many factors that may influence the production and consumption of potable water.

For the three water schemes in Palerang LGA, the impacts of the following factors and trends were assessed:

- Climate dependency
- Increase in number of active connections
- Price increases as per Local Water Utilities Circular 11 (LWU11)
- Water restrictions

Climate dependency

The impact of climate was analysed by comparing the modelled 'lawn grade irrigation' demand with the metered water production. The model used historical daily rainfall and evaporation data for weather station at Braidwood and estimates a lawn grade irrigation demand per hectare plus a climate independent demand. It was found that adding the historical NRW calculated from the billing data to the modelled demand improved the fit with the historical production.

The historical metered demand from each user class was also assessed using the same method to determine climate dependence. This was used to obtain the climate dependent demand from park and gardens, and from residential properties defined as "standard" (less than 0.5 Ha) and "large" (greater than 0.5 Ha).

Bungendore

The best fit production model estimated that 17.9 Ha is irrigated by the Bungendore water supply scheme. Prior to the 2013/14 FY, Council was irrigating approximately 3.7 Ha of parks and gardens in Bungendore, however since the reuse irrigation scheme has been implemented, the area irrigated off the potable water supply has reduced to approximately 0.6 Ha. Almost all the area irrigated is from dwellings (approximately 136 m^2 and 362 m^2 per standard and large property respectively).

Braidwood

The best fit model estimated that 12.0 Ha is irrigated by the Braidwood water supply scheme. The irrigated area for parks and gardens is approximately 2.2 Ha and approximately 4.6 Ha is irrigated by dwellings (approximately 84 m^2 and 222 m^2 per standard and large property respectively). The remainder is assumed to be split between the various non-residential users.

Captains Flat

Due to the faulty meter at Captains Flat Pool and neighbouring parks, and because of the large volumes of water both of these use on a seasonal pattern, the demand from this meter was included in the NRW that was added to the climate model.

The best fit model estimated that 2.4 Ha is irrigated by the Captains Flat water supply scheme, excluding the parks bordering the swimming pool. Of this, approximately 1.1 Ha is occupied by dwellings (approximately 122 m^2 irrigated per standard property) with the remainder is assumed to be split between the various non-residential users. As explained in Section 5.3.1, the parks bordering the pool make up approximately 2.3 Ha of lawn irrigated by the water supply scheme; however they are only irrigated during the months October to March.

Number of connections

Bungendore experienced a significant increase in number of active connections over the period of available data, from around 980 to 1180. This was due primarily to population growth and was found to have a significant impact on the production at Bungendore.

Braidwood and Captains Flat did not experience significant increase in number of connections.

Pricing

Prior to 2011/12 FY Bungendore, Braidwood and Captains Flat were charged different prices for water consumption. Starting in the 2011/12 FY all three schemes were charged the same price, with a significant price increase occurring in Bungendore from \$1.23/kL to \$1.95/kL. The effect of this increase on water production was analysed using price elasticity factors obtained from LWU Circular 11 – Pricing Information Sheet 2.

Water Restrictions and WaterWise incentives – not assessed

Since 2008 Council has offered incentives through the WaterWise program to home owners in all three water supply schemes. As part of the program customers are offered a number of retrofit rebate incentive schemes to save water involving cash payments to install rainwater tanks, replace single flush with dual flush toilets, and replace inefficient water appliances. The WaterWise Program will continue in 2017/18. (Source: Draft QPRC budget documents).

Palerang Council changed from Level 3 Water Restrictions to water conservation measures on 20 March 2010.

As production data is only available from 1 July 2009 there was not enough data to assess the impact of water restrictions and the WaterWise program on demand.

5.3 Non-revenue water

Non-revenue water (NRW) is made up of a number of components including:

- unbilled authorised consumption which includes water used for fire-fighting and operational uses for example mains flushing
- apparent losses including illegal connections and metering inaccuracies
- real losses, mostly leakage from the network.

The NRW for the three schemes is given in Table 5.2. For all schemes, NRW is higher than the 2014-15 state-wide median of 92 L/connection/day for Local Water Utilities with 1,501 to 3,000 Properties (4).

Table 5.2: NRW Summary

	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Bungendore							
Average NRW (kL/day)	103	120	65	125	144	148	[1] 149
Number of connections	979	974	1043	1093	1128	1154	1200
Average NRW (L/connection/day)	105	123	63	115	128	128	124
Braidwood							
Average NRW (kL/day)					168	154	183
Number of connections	588	569	577	593	593	591	596
Average NRW (L/connection/day)					283	261	307
Captains Flat							
Average NRW (kL/day)	53	42	45	48	49	51	41
Number of connections	216	228	228	226	227	232	235
Average NRW (L/connection/day)	245	185	198	211	215	218	175

The average daily non-revenue water by quarter is displayed in Figure 5.4.

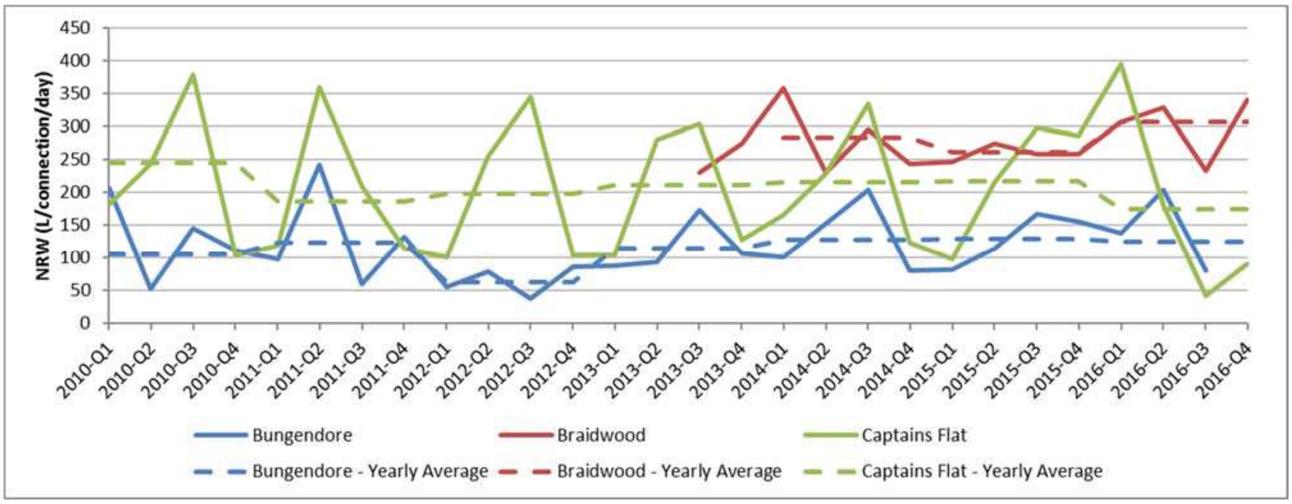

Figure 5.4: Historical non-revenue water

Braidwood has highest NRW as it is the oldest network, has the highest number of main breaks. The trunk main from the WTP to town frequently broke and was recently replaced. **ISSUE**

NRW at Bungendore and Braidwood have remained fairly constant around 125 and 280 L/connection/day respectively. These values are used in future projections.

5.3.1 Demand from Captains Flat pool and neighbouring parks

It is noted that NRW at Captains Flat has large seasonal variation which was found to be climate independent after analysis. Council advised that this large volume of NRW is likely due to the Pool which had a leak and a faulty meter which meters both the pool and the surrounding parks. This has recently been rectified and it is expected that NRW will be lower in the future.

Due to the faulty meter, historical metered demand from the pool and parks was unreliable and therefore was added to the NRW volumes. In other words, NRW volume was calculated as metered production minus all metered demands except for the demand from the pool and parks meter.

By doing this it was found that the NRW was increasing by a volume of approximately 60 kL/day for the six months of the year, October to March. It is assumed that this volume is coming from the pool and parks, which is backed up by the fact that there is frequently no metered volumes for the pool and parks for Q1 (July to September) and Q4 (April to June) of each financial years. Council has indicated that the average daily use by the pool when in operation is approximately 13 kL/day, which leaves the remaining 47 kL/day to be attributed to use from the parks. Using the climate model, it was found that during October to March of a year with an average climate, an area of 2.3 Ha would use approximately 47 kL/day. The area of the parks was measured on satellite map to be approximately 2.5 Ha.

Thus, excluding the approximately 60 kL/day of use by the pool and parks during October to March reduces the average NRW by around 30 kL/d over one year. The average NRW at Captains Flat would reduce to around 25 kL/day which equates to around 110 L/connection/day. This is approximately what is achieved during the winter quarters (Q1 and Q4) as seen in Figure 5.4. This value is used in future projections.

5.3.2 DPI Water Benchmarking

DPI Water planning data for the last four years also shows that Palerang water leaks and NRW have increased over the last four years (see Figure 5.5).

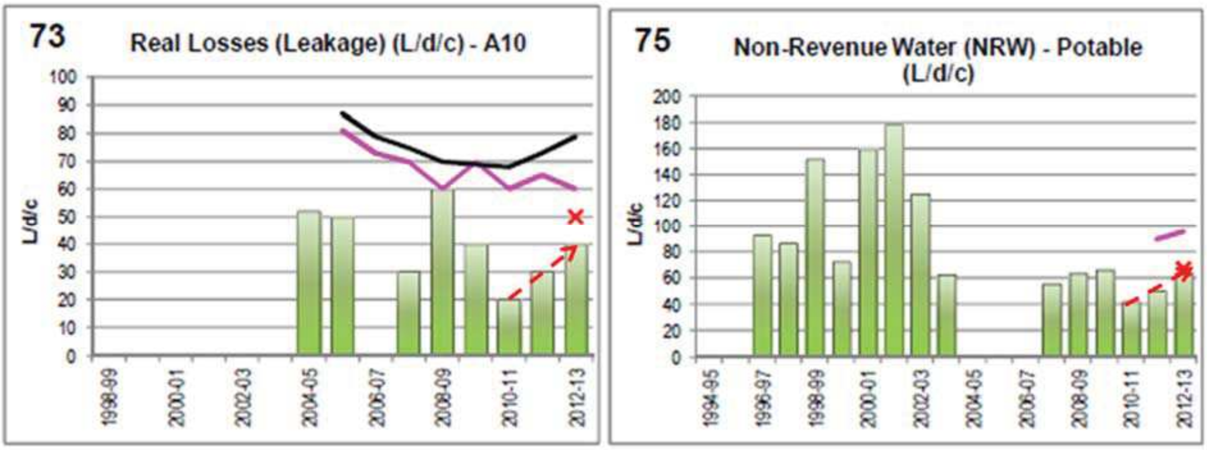

Figure 5.5: DPI Water Benchmarking – (73) Water Leakage per Connection and (75) Non-Revenue Water per Connection

A discrepancy has been identified between the total NRW reported to DPI Water for benchmarking purposes and the actual volumes calculated in this report and used for projections.

It is recommended that Council investigate as to what is causing this discrepancy in reporting.

5.4 System Demand Splits

The average day and peak day demands for each scheme split by user class and showing major non-residential users are shown in Figure 5.6 to Figure 5.11.

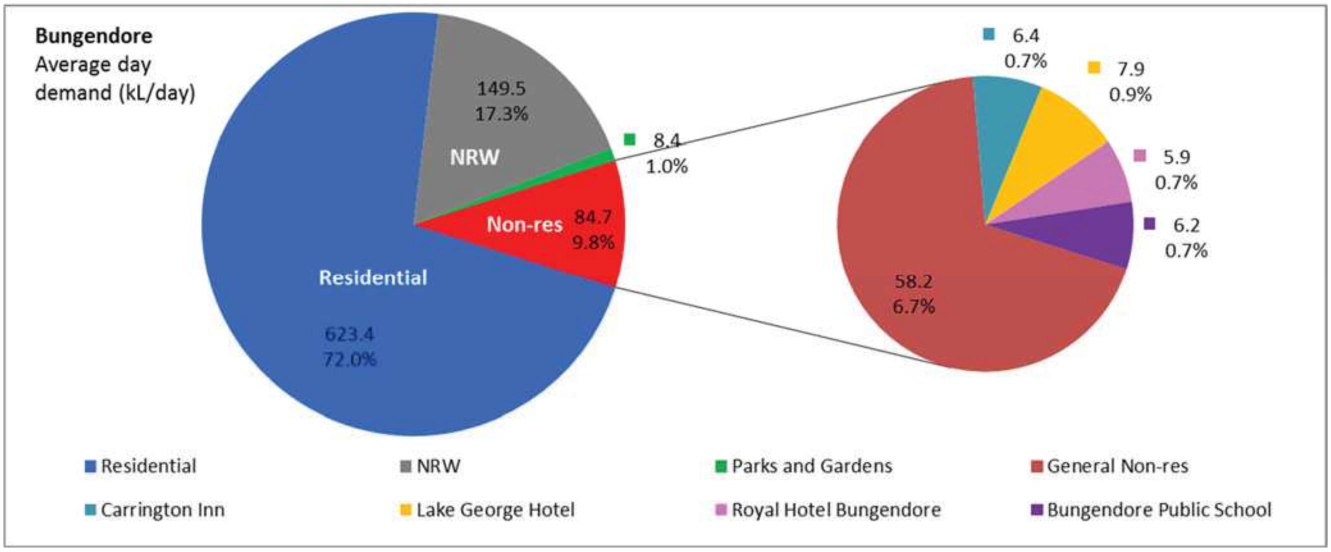

Figure 5.6: Bungendore user class split – average day demand

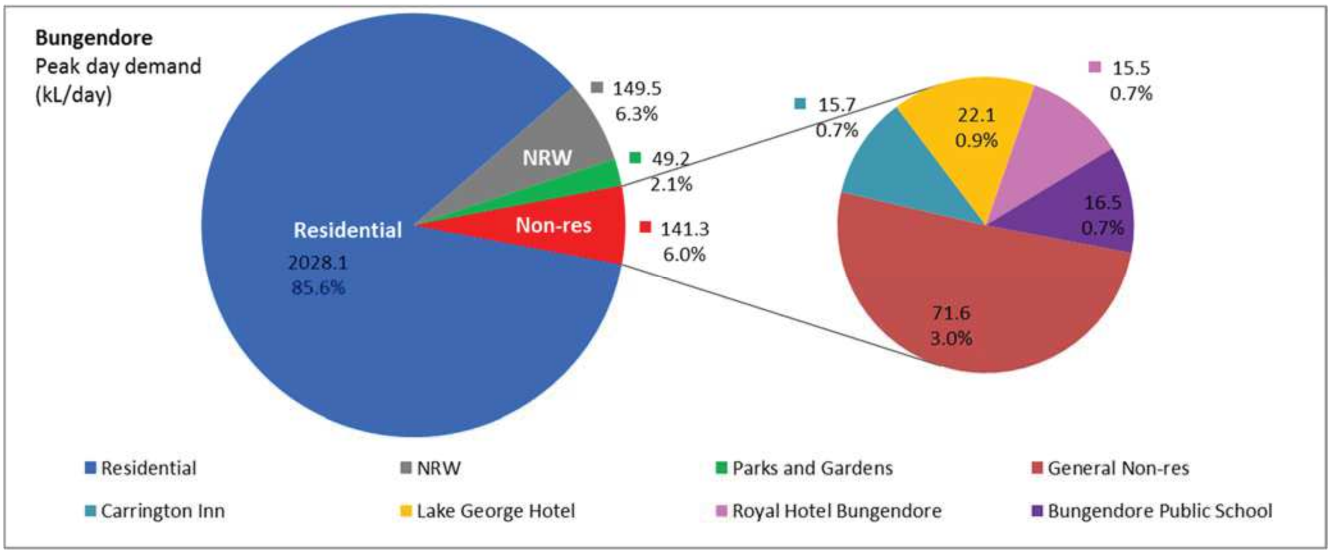

Figure 5.7: Bungendore user class split – peak day demand

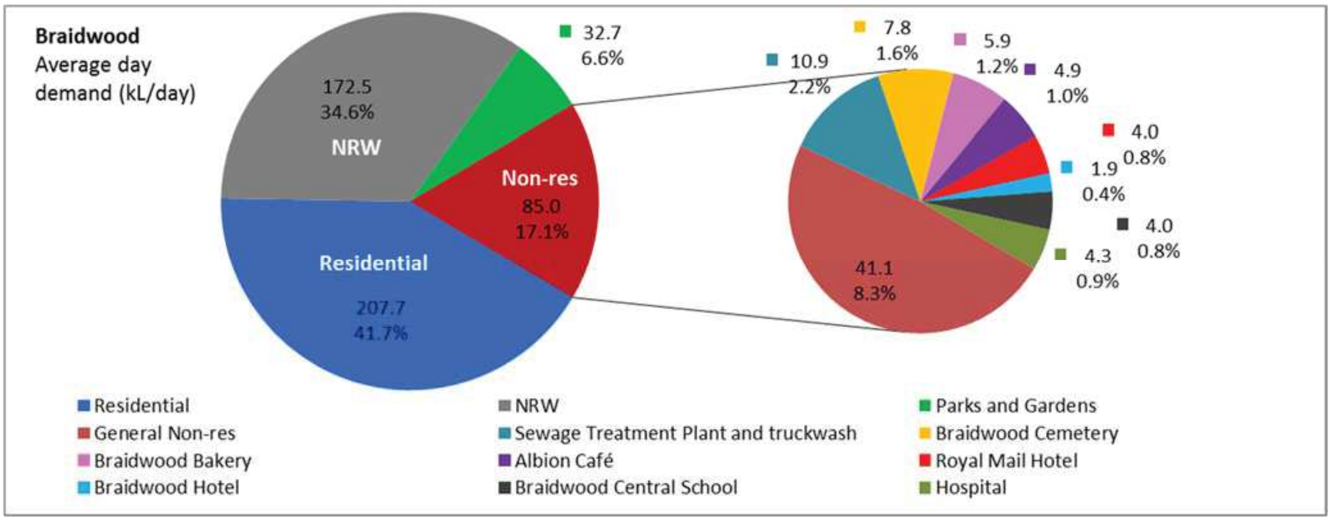

Figure 5.8: Braidwood user class split – average day demand

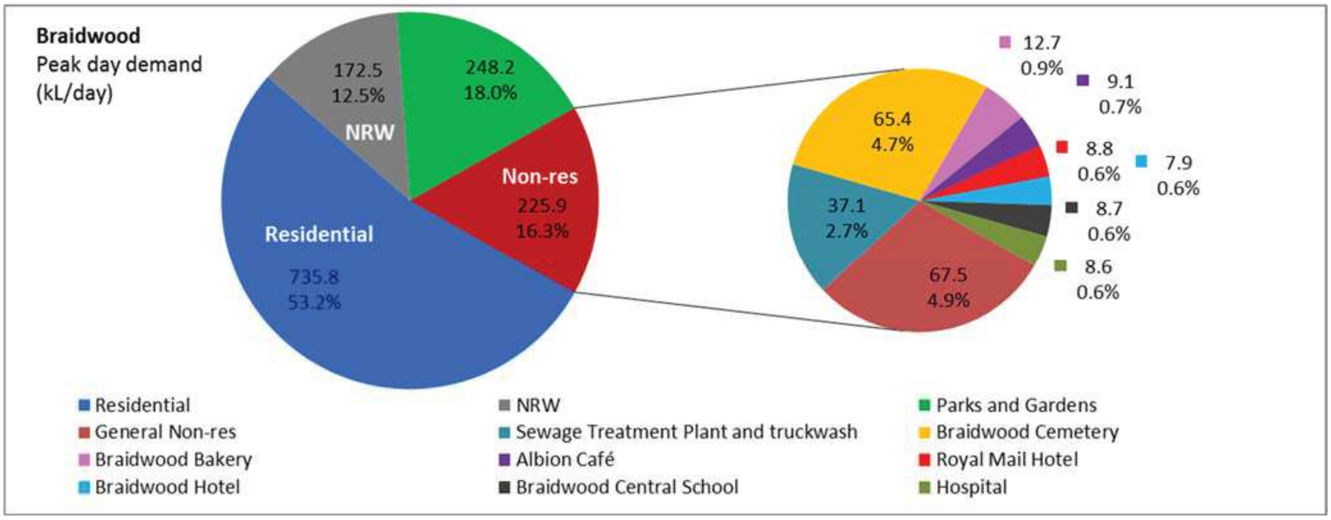

Figure 5.9: Braidwood user class split – peak day demand

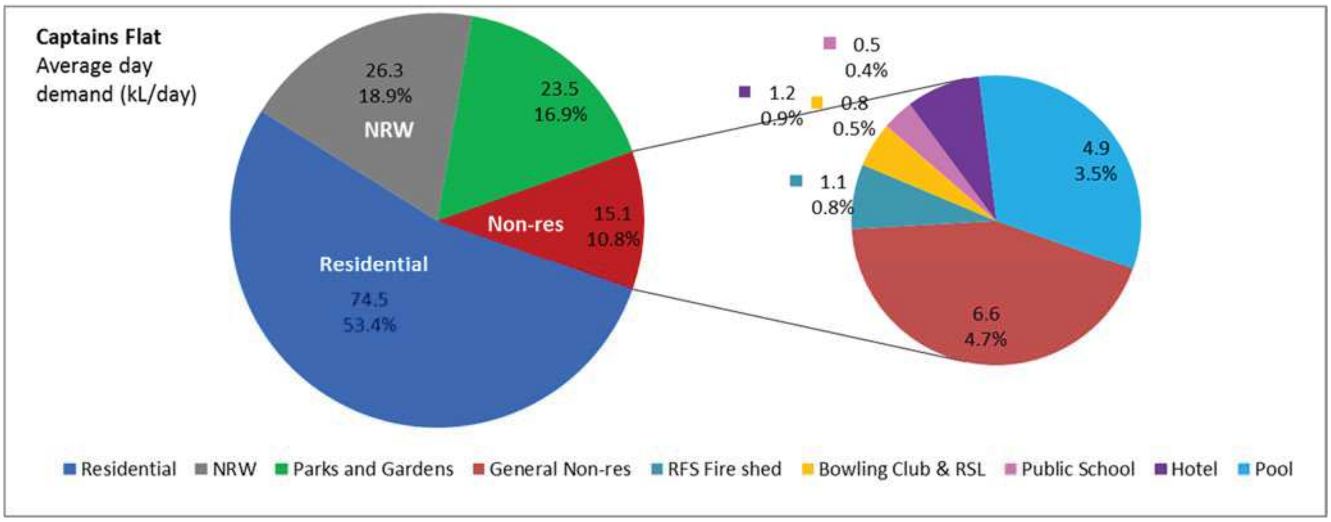

Figure 5.10: Captains Flat user class split – average day demand

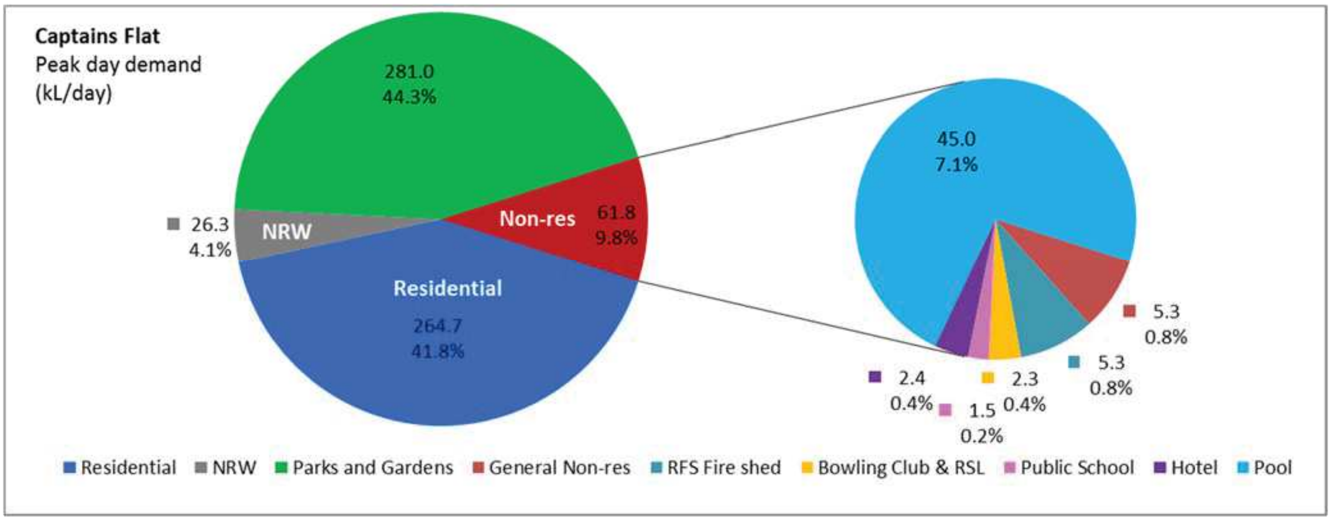

Figure 5.11: Captains Flat user class split – peak day demand

5.5 Metered Demand Assessment

Billing data was supplied for all customers. The analysis was undertaken by:

1. Splitting the users by water supply area and user category
2. Assessing the climate dependence of the usage pattern for each user class
3. Estimating the annual average year demand
   a) for users that showed significant climate dependent demand, the average year demand was calculated using the historical average year irrigation demand.
   b) for users that did not show significant climate dependent demand, the average year demand was calculated as the average demand of all years for which data is available.
4. Estimating the annual dry year demand
   a) for users that showed significant climate dependent demand, the *dry* year demand was calculated using the historical highest year irrigation demand
   b) for users that did not show significant climate dependent demand, the “dry” year was calculated as the highest demand of all years for which data is available
5. Using the following peaking factors to estimate peak day demand:
   a. For Bungendore, the lawn grade irrigation peaking factor was based on the ratio of average day to peak week-average day irrigation demand (6.0). For Braidwood and Captains Flat which have more parks and gardens, the irrigation peaking factor was based on the ratio of average day to peak week-peak day irrigation demand (8.4).
   b. A non-irrigation demand peaking factor was determined to be 1.4, 1.6 and 2.4 for Bungendore, Braidwood and Captains Flat respectively. It is expected that the peaking factor increases with decreasing population, as there is a greater chance of simultaneous use.

5.5.1 Residential metered water use

The metered demand analysis for residential users was undertaken using the same method that was used for the assessment of the climate dependence of the production data.

The model determined that standard sized residential properties (less than 0.5 Ha) in Bungendore, Braidwood and Captains Flat, the estimated area of irrigated “lawn” was 137, 85 and 122 m^2 respectively, and the estimated internal demand was 399, 297 and 233 kL/day respectively. The residential unit water demands are summarised in Table 5.3.

Table 5.3: Unit demand for active connected residential standard properties

System	Average year demand (kL/prop/year)	Dry year demand (kL/prop/year)	Dry year to average year ratio	Average day demand (L/prop/day)	Peak day demand (L/prop/day)	Peak day to average day ratio
Bungendore	212	260	122%	581	1,650	284%
Braidwood	149	179	120%	409	1,389	339%
Captains Flat	144	187	129%	395	1,919	486%

5.5.2 Non-residential metered water use

The historical average daily demands for each non-residential user class are shown in Figure 5.12 to Figure 5.14.

It can be seen that during the summer quarters (Q2 and Q3) parks and garden are the dominant non-residential users in Braidwood and Captains Flat.

The effluent reuse to water Bungendore's playing fields began operation 2013/14 and since then has reduced parks and gardens consumption by approximately 80%.

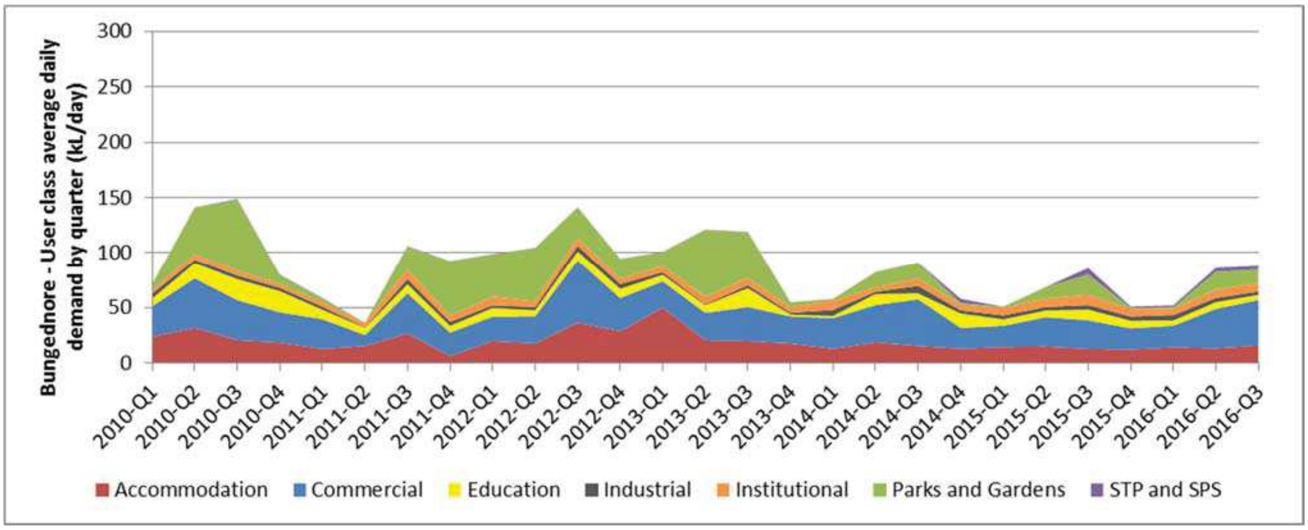

Figure 5.12: Bungendore– metered demand by non-residential user class

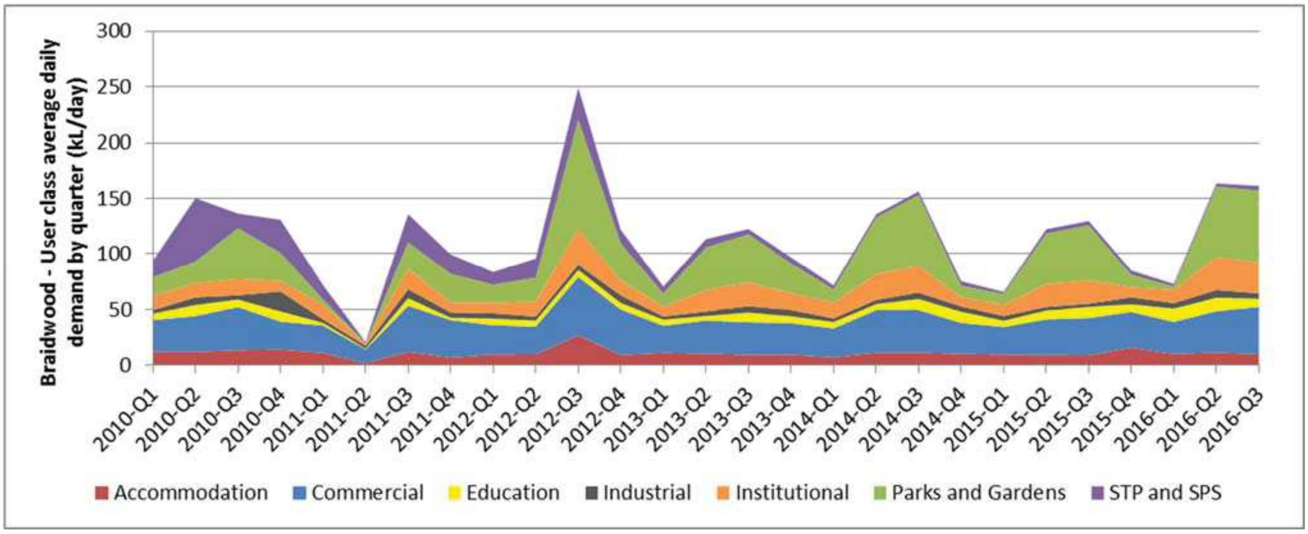

Figure 5.13: Braidwood– metered demand by non-residential user class

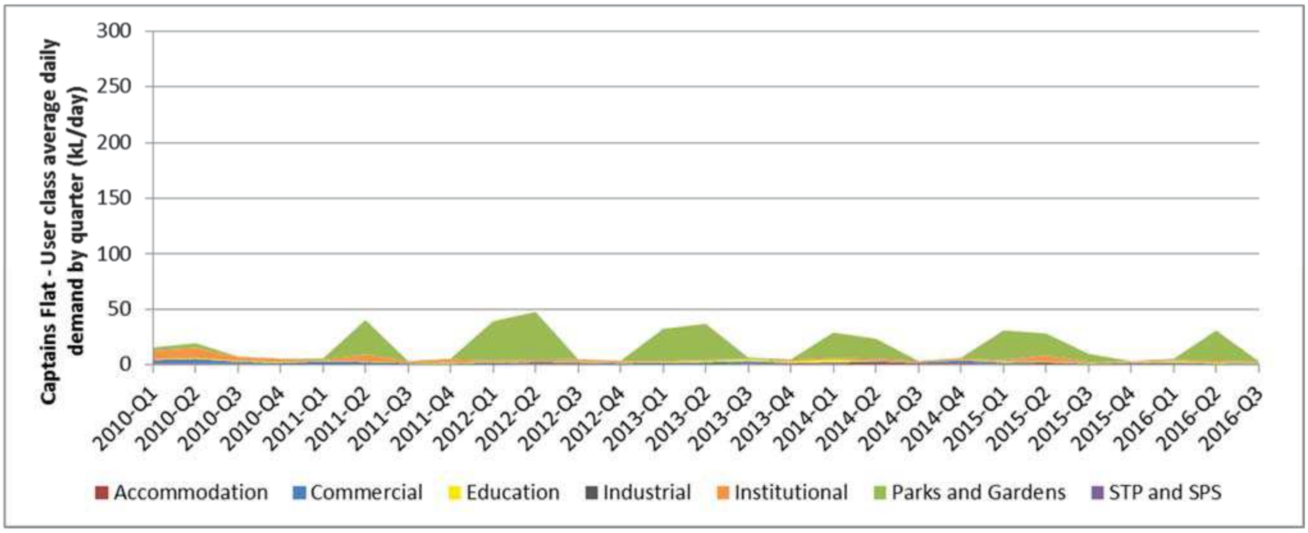

Figure 5.14: Captains Flat – metered demand by non-residential user class

Each non-residential user class and major user was assessed for climate dependence using the same method used for the assessment of production data. It was found that Parks and Gardens use was climate dependent for all schemes, as was the use by Braidwood cemetery (classified as Institutional). The modelled demands are summarized in Table 5.4. The demand for Captains Flat Parks and Gardens was estimated using the method described in Section 5.3.1.

Table 5.4: Climate dependent non-residential demands

	Average year demand (ML/year)	Dry year demand (ML/year)	Dry year to average year ratio	Average day demand (kL/day)	Peak day demand (kL/day)	Peak day to average day ratio
Bungendore – Parks and Gardens	3.1	4.4	145%	8.4	49.2	587%
Braidwood – Parks and Gardens	11.9	16.8	141%	32.7	248.3	759%
Captains Flat – Parks and Gardens	8.6	13.2	154%	23.5	281.0	1196%
Braidwood Cemetery	2.9	4.2	146%	7.8	65.4	837%

The water demands for other major consumers vary significantly, although with little climate dependence. Therefore demands are based on:

- Average year demand is the average annual recorded demand over the period of record for each user
- Dry year demand is the 95%ile annual demand based on the users record
- Average day demand is one 365th of the annual average
- Peak day demand is 120% of the 95th%ile of the individual meter reads

The estimated demands are summarized in Table 5.5.

Table 5.5: Climate independent non-residential demands

	Average year demand (ML/year)	Dry year demand (ML/year)	Dry year to average year ratio	Average day demand (kL/day)	Peak day demand (kL/day)	Peak day to average day ratio
Bungendore						
Carrington Inn	2.3	3.12	134%	6.4	15.6	245%
Lake George Hotel	2.9	5.35	185%	7.9	22.2	280%
Royal Hotel Bungendore	2.1	3.92	185%	5.8	15.4	264%
Bungendore Public School	2.3	2.47	108%	6.2	16.5	264%
Braidwood						
Sewage Treatment Plant and truckwash	4.0	6.05	152%	10.9	37.0	340%
Braidwood Bakery	2.2	3.10	143%	5.9	12.8	216%
Albion Café	1.8	2.16	120%	4.9	9.1	185%
Royal Mail Hotel	1.5	1.85	126%	4.0	8.8	219%
Braidwood Hotel	0.7	2.96	424%	1.9	7.9	414%
Braidwood Central School	1.4	2.76	191%	4.0	8.7	220%

	Average year demand (ML/year)	Dry year demand (ML/year)	Dry year to average year ratio	Average day demand (kL/day)	Peak day demand (kL/day)	Peak day to average day ratio
Hospital	1.6	1.85	117%	4.3	8.6	198%
Captains Flat						
RFS Fire shed	0.4	0.60	152%	1.1	5.3	493%
Bowling Club & RSL	0.3	0.32	117%	0.8	2.3	300%
Public School	0.2	0.43	225%	0.5	1.5	283%
Hotel	0.5	0.65	144%	1.2	2.4	194%
Pool [1]	1.8	2.14	120%	4.9	45.0	923%

1 – The pool only operates 4.5 months of the year at an average flow rate of 13 kL/day during this period. The average daily flow rate over the whole year is 4.9 kL/day. The peak day demand of 45.0 kL assumes that 15% of the estimated pool volume is used during periodic backwashing of filters. Dry year demand is estimated at 120% average year demand.

It is recommended that, where possible, water connections for mixed use be separately metered e.g. where there is currently one meter for a residential and commercial premises, or one meter for pool and surrounding sports fields.

5.6 Climate corrected demand

Because NRW was subtracted from production data during modelling, the output from the model is essentially the metered demand for each scheme, which was found to be climate dependent. The NRW pattern was found to have low climate dependence; however Captains Flat exhibits an NRW that is very seasonally variable, as can be seen in Figure 5.3. This was due to the faulty meter at the Swimming Pool which has been replaced. NRW is now expected to be more constant.

The climate corrected metered demand for the water supply schemes as calculated by the model are given in Table 5.6.

Table 5.6: Average and dry year metered demand from model

System	Average year demand (ML/year)	Dry year demand (ML/year)	Dry year to average year ratio
Bungendore	262	324	124%
Braidwood	119	160	135%
Captains Flat	42	55	132%

5.7 Peak Day Analysis

The historical peak day persistence for each water supply scheme is shown in Figure 5.15 to Figure 5.17, as well as the average and 95 percentile persistence pattern. The values for the average and 95 percentile persistence pattern are given in Table 5.7.

For Bungendore, Braidwood and Captains Flat, the average peak day production was 251%, 219% and 348% the average day production, respectively.

Table 5.7: Percent of peak day demand

Days around peak day	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7
Bungendore															
Average	134	150	138	123	122	133	146	251	115	141	139	162	138	120	115
95% ile	229	266	292	239	200	215	275	327	224	216	237	263	243	179	181
Braidwood															
Average	135	141	133	147	147	150	164	219	145	139	131	152	137	139	130
95% ile	195	223	228	223	220	222	246	293	208	175	143	201	199	193	198
Captains Flat															
Average	116	102	82	100	141	119	84	348	147	137	121	121	125	145	145
95% ile	184	181	143	185	262	231	155	473	325	207	201	196	220	212	240

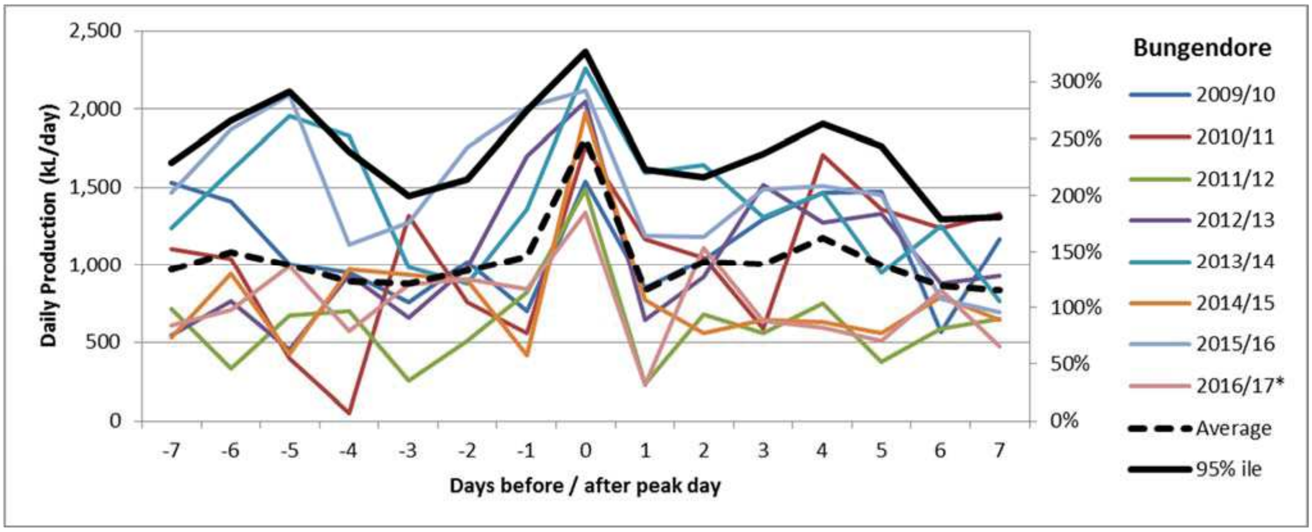

Figure 5.15: Bungendore Peak Demand Pattern

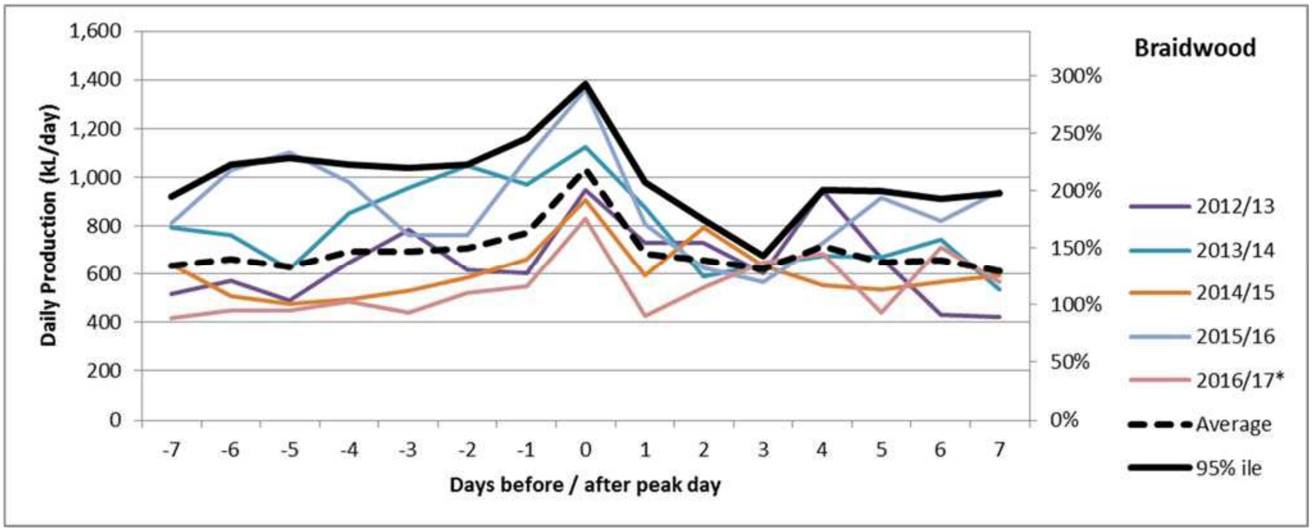

Figure 5.16: Braidwood Peak Demand Pattern

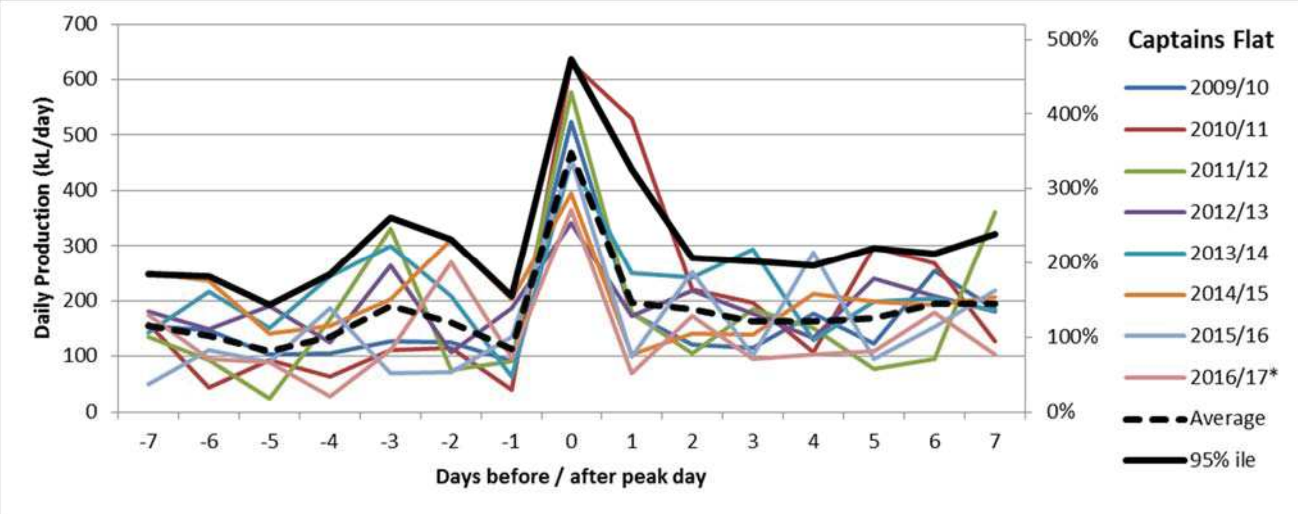

Figure 5.17: Captains Flat Peak Demand Pattern

5.8 Impact of BASIX

The former Palerang LGA is in the 40% BASIX water target zone, meaning that the BASIX water target requires up to a 40% reduction in mains-supplied potable water consumption, compared to the average 'pre-BASIX' home benchmark of 90.34 kL/person/year. All new dwellings are built following BASIX, and therefore the average annual water demands in the residential sector are expected to decrease for new dwellings.

The primary aim of BASIX is to reduce the annual average demand, it is less effective in reducing peak day and dry year demands as BASIX dwellings often rely on relatively small rain water tanks with potable top ups to augment their water supply.

A rainwater tank model was run using the median properties of existing BASIX houses in Bungendore and Braidwood. Properties of existing BASIX dwellings were obtained off the BASIX public database, which showed that the majority of properties for both schemes used rainwater for toilet flushing, garden and lawn watering and laundry (washing machines). The median rainwater tank size and roof area was 15 kL and 245 m^2 for Bungendore and 44 kL and 210 m^2 for Braidwood. The rainwater tank model also used the climate dependent and climate independent demands for residential properties calculated in Section 5.5.1.

The BASIX dwelling unit demands are summarized in Table 5.8.

Table 5.8: Estimated BASIX unit demands for average active connected residential property

	Current dwelling average year demand (kL/prop/yr)	Current dwelling dry year demand (kL/prop/yr)	BASIX average year demand @ 40% reduction on benchmark (kL/prop/yr)	Modelled BASIX average year demand (kL/prop/yr)	Modelled BASIX dry year demand (kL/prop/yr)
Bungendore	212	260	157	93	156
Braidwood	149	179	125	51	108
Captains Flat [1]	144	187	125	51	108

1 – Captains Flat modelled BASIX demands have been assumed to be the same as Braidwood due to similar demands for existing properties and household size

At PRG1, the concern was raised that the modelled BASIX demands were very low compared to the current demands. It was identified that many existing houses already have rainwater tanks, and thus the internal demands and irrigated lawn area for an average house calculated in Section 5.5.1 may already be accounting for some water savings and would be double counted by adopting these internal demands and lawn areas in the Modelled BASIX demands.

Since the projected demands will be significantly impacted by the BASIX demand due to the high growth rate, it is important that these demands be carefully considered and be based on sound analysis.

The BASIX demands were reviewed by running the rainwater tank model using internal demands for a three bedroom BASIX house obtained from the *Technical Memorandum Water Smart Growth Design Parameters* (5),:

- Internal demand of 258 L/day on town water
- Internal demand of 60 L/day on rain water (for toilet flushing)
- Roof area of 300 m^2 and irrigated lawn area of 250 m^2 – typical values obtained from satellite imagery of Bungendore

The model was run using climate data from 1970 and tested the sensitivity to different tank sizes. In order to check if the modelled demands were achievable they were compared with the climate corrected demands for houses within the “Elmslea Estate” which have been constructed to comply with BASIX requirements. The results are summarized in Table 5.9.

Table 5.9: Modelled unit demands for BASIX properties with rainwater tanks

System	Average year demand (kL/dw/yr)	Dry year demand (kL/dw/yr)
Modelled BASIX household demand		
Modelled House (no tank)	237	319
Modelled House (5 kL tank)	182	271
Modelled House (10 kL tank)	164	253
Modelled House (22 kL tank) [1]	142	233
Modelled BASIX household demand		
Elmslea Estate	172	233

1 – In Council’s DCP (6), 22.5 kL is the minimum required tank size for a three bedroom house where reticulated town water supply is available

Based on the above information, an average year unit demand of 180 kL/dwelling/year and a dry year unit demand of 240 kL/dwelling/year were adopted for new dwellings for use in projections.

5.9 Forecast water production and extraction

The forecast water production provided in Table 5.10 is calculated from the estimated 2016 water demands plus the adopted unit demand for each additional dwelling given in Table 4.8. The production estimates allows for the non-revenue water estimated in Section 5.3.

Council has plans to develop two new public recreation areas consisting of several parks and sports fields. The Bungendore West recreation area is estimated to be developed in 2020 and contribute approximately 10 Ha of irrigated lawn. This area is across the road from Bungendore STP and it is expected to be irrigated by STP effluent. The Bungendore East recreation area is estimated to be developed in 2026 and contribute approximately 8 Ha of lawn which will be irrigated by town water. See A.7 for more details.

Table 5.10: Water production forecast

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Average year (ML/year)	316	463	633	761	866	948	1,010
	Dry year (ML/year)	379	564	787	949	1,082	1,185	1,263
	Peak day (ML/day)	2.8	4.1	5.7	6.8	7.8	8.5	9.0
Braidwood	Average year (ML/year)	182	191	200	210	221	232	244
	Dry year (ML/year)	223	234	245	257	270	283	298
	Peak day (ML/day)	1.5	1.5	1.6	1.7	1.8	1.9	2.0
Captains Flat	Average year (ML/year)	51	52	52	53	53	54	54
	Dry year (ML/year)	64	65	66	66	67	67	68
	Peak day (ML/day)	0.7	0.7	0.7	0.7	0.7	0.7	0.7

Water extraction has been estimated at 107% of the WTP production to account for waste during the treatment process (such as in filter backwash, sludge production.)

Table 5.11: Water extraction forecast

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Average year (ML/year)	338	495	677	814	927	1,014	1,080
	Dry year (ML/year)	405	604	842	1,015	1,157	1,268	1,351
	Peak day (ML/day)	3.0	4.4	6.1	7.3	8.3	9.1	9.7
Braidwood	Average year (ML/year)	195	204	214	225	236	248	261
	Dry year (ML/year)	239	250	263	275	289	303	319
	Peak day (ML/day)	1.6	1.6	1.7	1.8	1.9	2.0	2.1
Captains Flat	Average year (ML/year)	55	55	56	56	57	57	58
	Dry year (ML/year)	69	69	70	71	71	72	73
	Peak day (ML/day)	0.7	0.7	0.7	0.7	0.7	0.7	0.8

5.10 Impact of climate variability

Climate variability is expected to increase in the future due to changes to the composition of the atmosphere. The NSW and ACT Regional Climate Modelling (NARCliM) project is a multi-agency research partnership between the NSW and ACT governments and the Climate Change Research Centre at the University of NSW. The NARCliM project has produced regional climate projections for south-east Australia spanning the range of likely future changes in climate. The following data was obtained from the NARCliM project for the South East and Tablelands area

Table 5.12: Change in average rainfall (7)

Season	2020-2039	2060-2079
Summer	0% to 5%	+5% to +10%
Autumn	+5% to +10%	+5% to +10%
Winter	0% to -5%	0% to -5%
Spring	-5% to -10%	-5% to -10%

Table 5.13: Change in average max temperature (7)

	2020-2039	2060-2079
Yearly average	1.0 to 1.5 °C	2.0 to 2.5 °C

The NSW Office of Environment and Heritage commissioned the CSIRO to investigate the likely change in rainfall and fire danger in NSW. The CSIRO Climate Change in Australia report includes expected changes in evapotranspiration. The results are summarised in Table 5.14.

Table 5.14: Change in Evapotranspiration (8)

Season	2030	2050
Summer	1% to 6%	3% to 15%
Autumn	1% to 6%	3% to 15%
Winter	1% to 10%	3% to 25%
Spring	1% to 10%	3% to 25%
Annual	1% to 6%	3% to 15%

The model described in Section 5.2 was run using historical climate data from 1970 to 2016, and again using a second climate change corrected series. In the climate change scenario, rainfall and evaporation were adjusted for each season by the average of the ranges in Table 5.12 and Table 5.14 respectively. The maximum temperature increased by 1.75°C.

The overall change in demand is summarised in Table 5.15.

Table 5.15: Change in demand under climate change scenario

	Average Year Metered Demand (ML/year)			Dry Year Metered Demand (ML/year)		
	Present Climate	Climate Change Scenario	% increase demand	Present Climate	Climate Change Scenario	% increase demand
Bungendore	262	271	104%	324	340	105%
Braidwood	119	125	105%	160	171	107%
Captains Flat	31.2	32	104%	40	41.9	105%

6 Sewer loadings

6.1 Historical Sewage Flow Analysis

The historical daily STP inflows were analysed for Bungendore, Braidwood, and Captains Flat STPs.

The historical daily and monthly average STP influent flows in conjunction with rainfall records obtained from the Bureau of Meteorology are shown in Figure 6.1 to Figure 6.9.

6.2 Sewer system flow forecast

The following capacity assessment uses STP inflow data from 01 April 2012 to 01 March 2017 supplied by Council. All rainfall data was obtained from the Bureau of Meteorology for each community.

Actual Average Dry Weather Flow (ADWF)

The daily flow data was analysed to estimate the average dry weather flow and maximum flow on a wet day. To estimate ADWF a dry day was taken as a day with no rainfall on that day, the five preceding days and one day following. A wet day was any day with >2 mm rainfall. Historical ADWF is presented in Table 6.1.

Table 6.1: Historical ADWF

STP	2012	2013	2014	2015	2016
Bungendore [1]	693	569	596	626	666
Braidwood	291	412	254	257	255
Captains Flat	113	107	99	99	92

1 – Because many residents in Bungendore work or go to school in Canberra during the week and thus not contributing to sewer flows, the ADWF was taken for weekends only

Bungendore ADWF has been slowly increasing, likely caused by the increase in population. Council advised the high recorded ADWF in 2012 is likely due to a faulty meter on the inlet flume of the old inlet works which was later replaced.

Over the last three years Braidwood ADWF has remained relatively constant around 255 kL/day. The high value of 392 kL/day in 2013 was likely caused by a period of persistently high inflow, as can be seen in Figure 6.4. The effect of rainfall on STP inflow seems to be most persistent at Braidwood STP, with some instances of inflow not returning to normal ADWF levels until two weeks after a high rainfall event. To address this Council are in the process of developing an inflow/infiltration study due in 2017.

Captains Flat ADWF has remained relatively constant around 100 kL/day.

The adopted 2016 ADWF and unit loading is presented in Table 6.2.

Table 6.2: Adopted 2016 ADWF and Unit Loading

STP	Adopted 2016 ADWF (kL/day)	2016 EP [1]	Unit loading (L/EP/day)	Adopted Unit loading (L/EP/day)
Bungendore	650	3,350	194	200
Braidwood	260	1,373	189	200
Captains Flat	100	426	235	240

1 – the 2016 EP is given in Table 6.7.

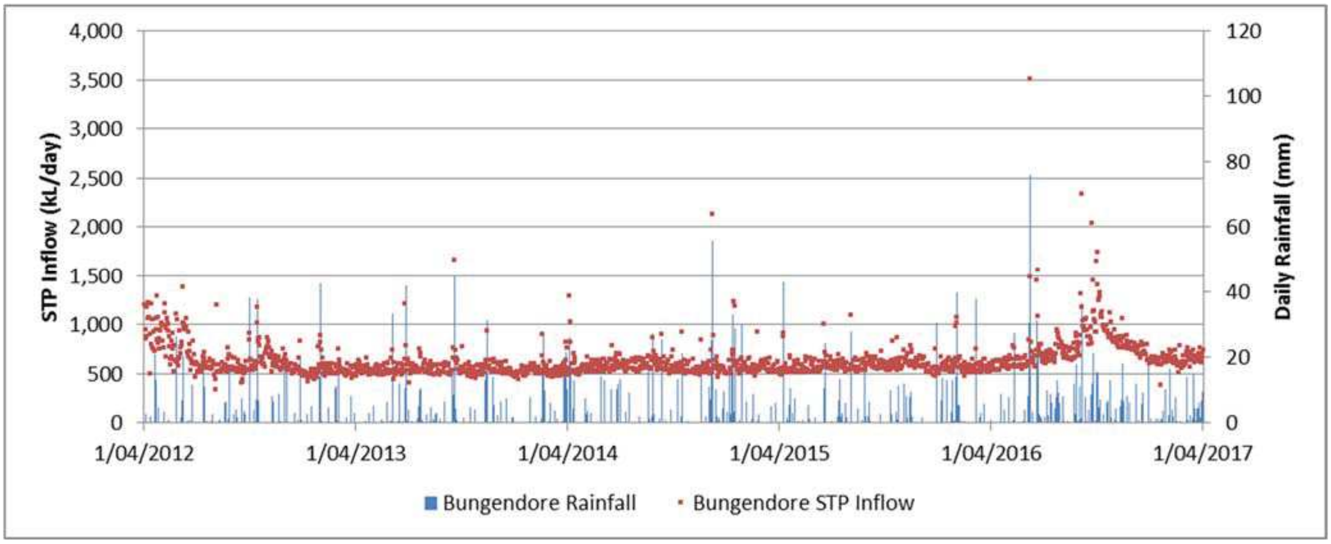

Figure 6.1: Daily STP Inflow and Rainfall for Bungendore STP

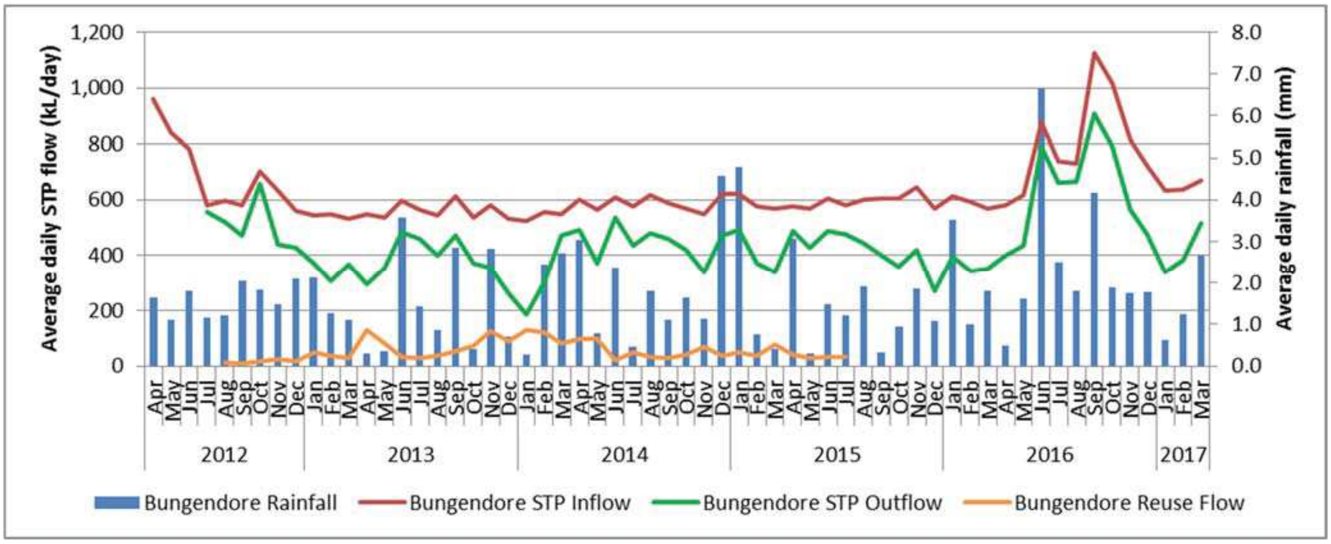

Figure 6.2: Average Daily STP Inflow, Outflow and rainfall per month for Bungendore STP

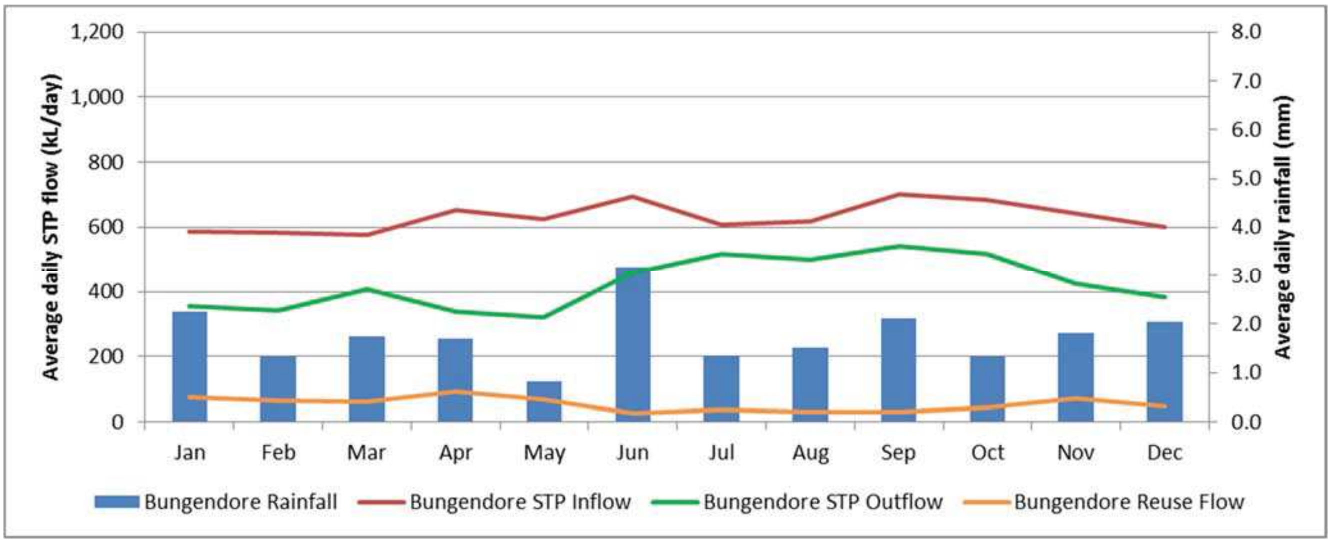

Figure 6.3: Average Daily STP Inflow, Outflow and rainfall by month for Bungendore STP

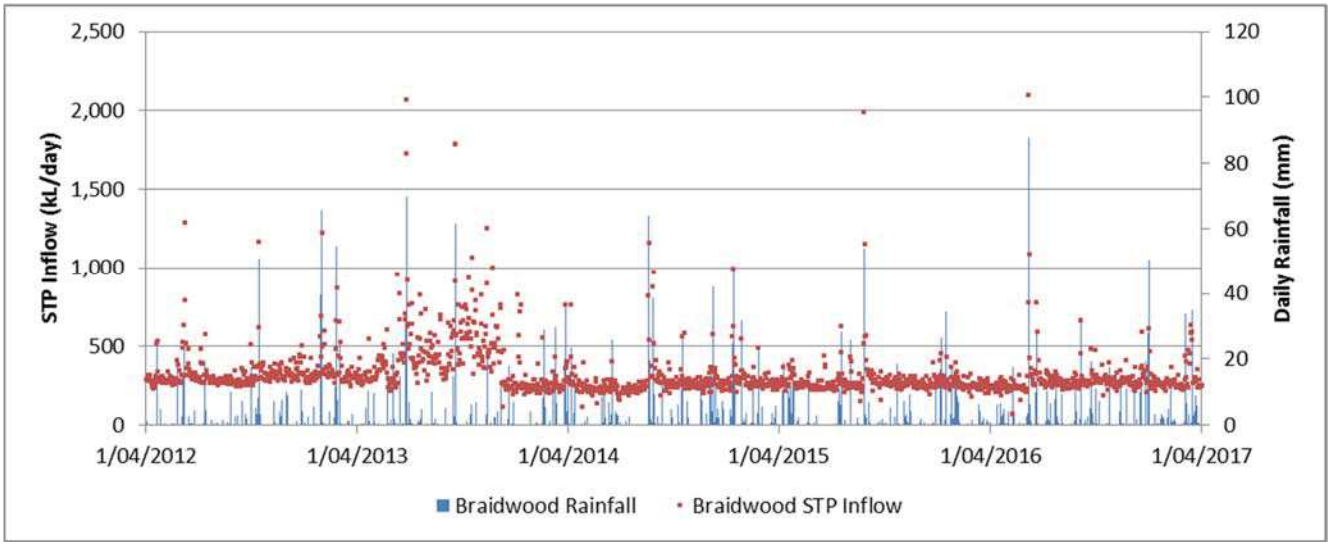

Figure 6.4: Daily STP Inflow and Rainfall for Braidwood STP

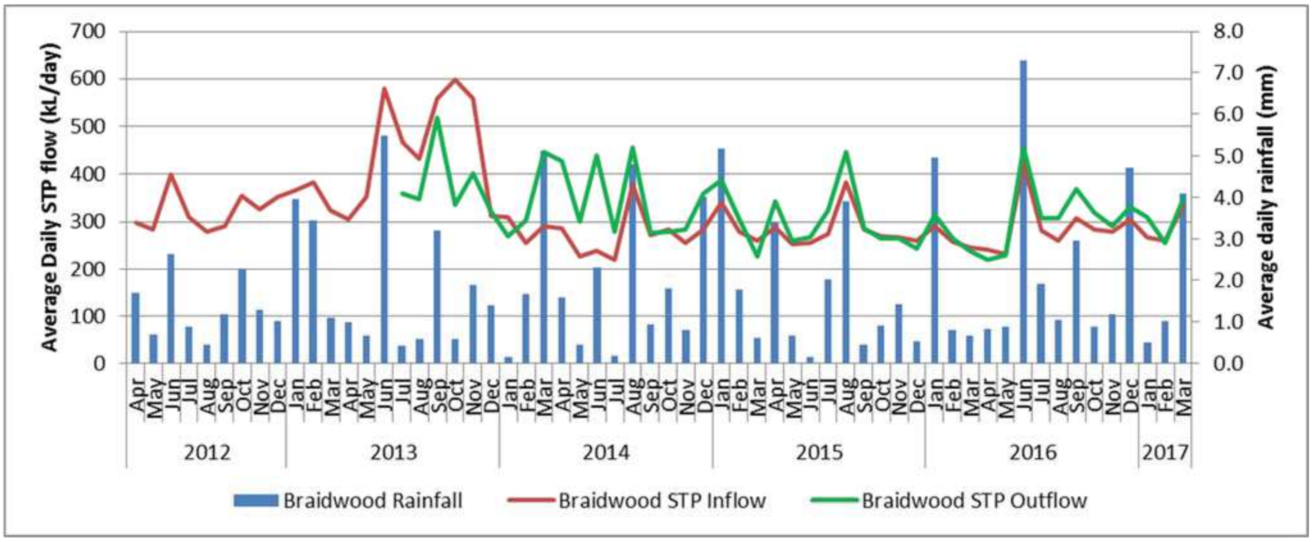

Figure 6.5: Average Daily STP Inflow, Outflow and rainfall per month for Braidwood STP

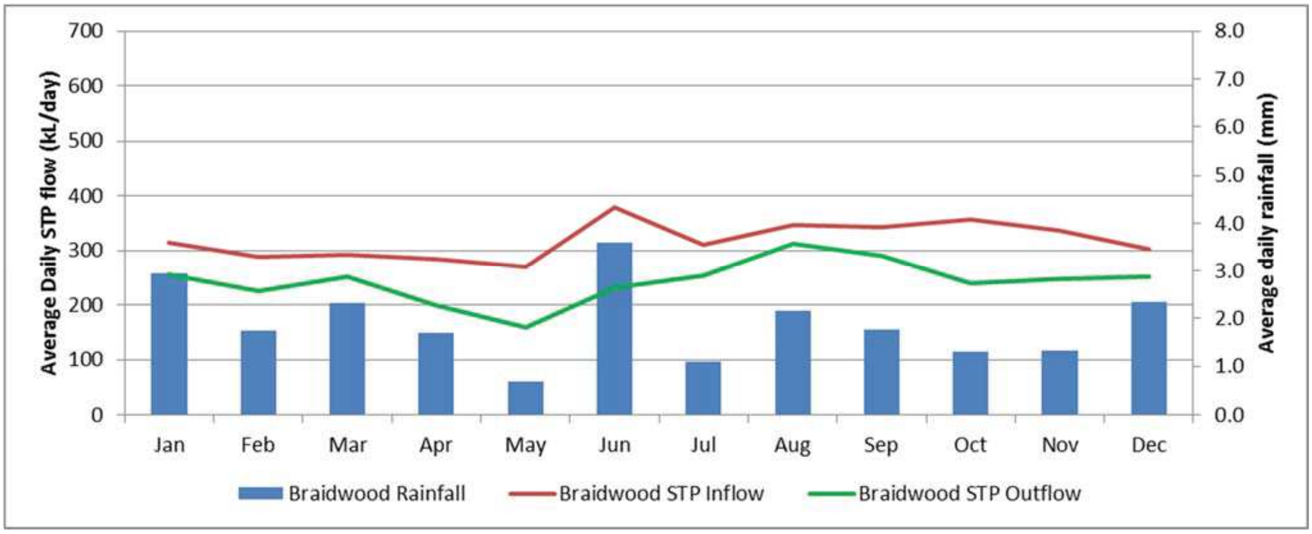

Figure 6.6: Average Daily STP Inflow, Outflow and rainfall by month for Braidwood STP

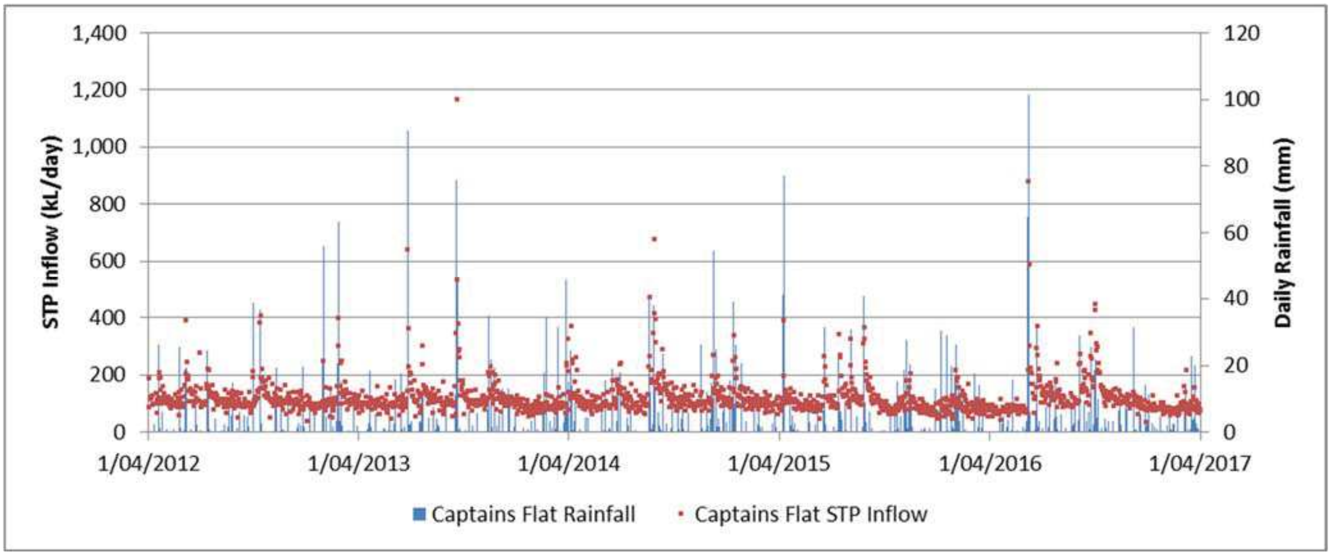

Figure 6.7: Daily STP Inflow and Rainfall for Captains Flat STP

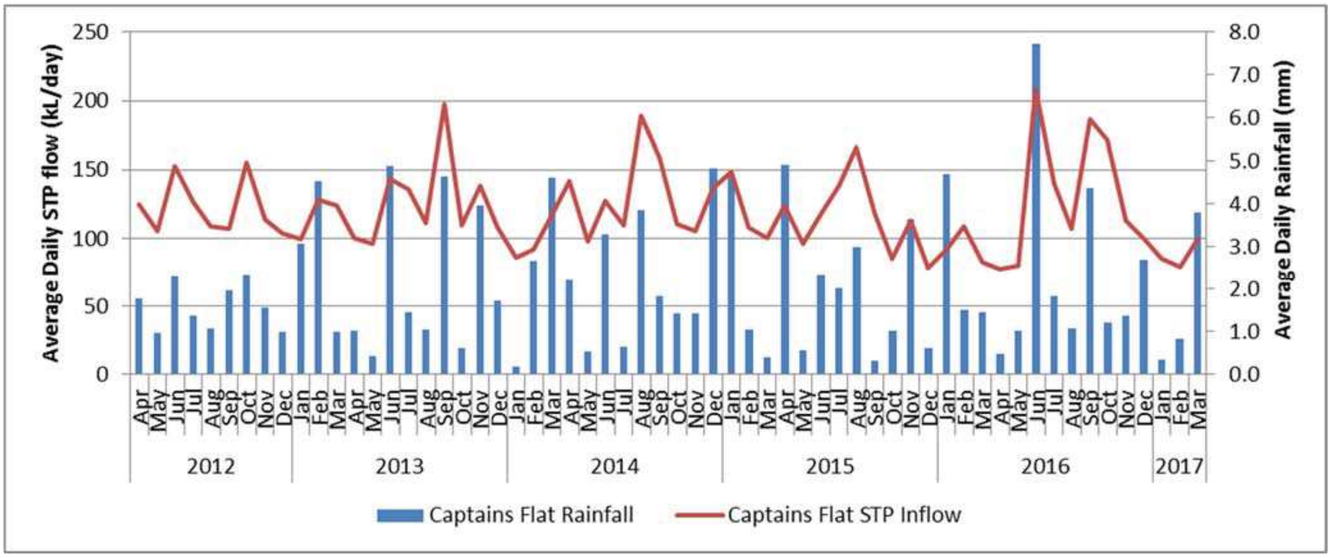

Figure 6.8: Average Daily STP Inflow, Outflow and rainfall per month for Captains Flat STP

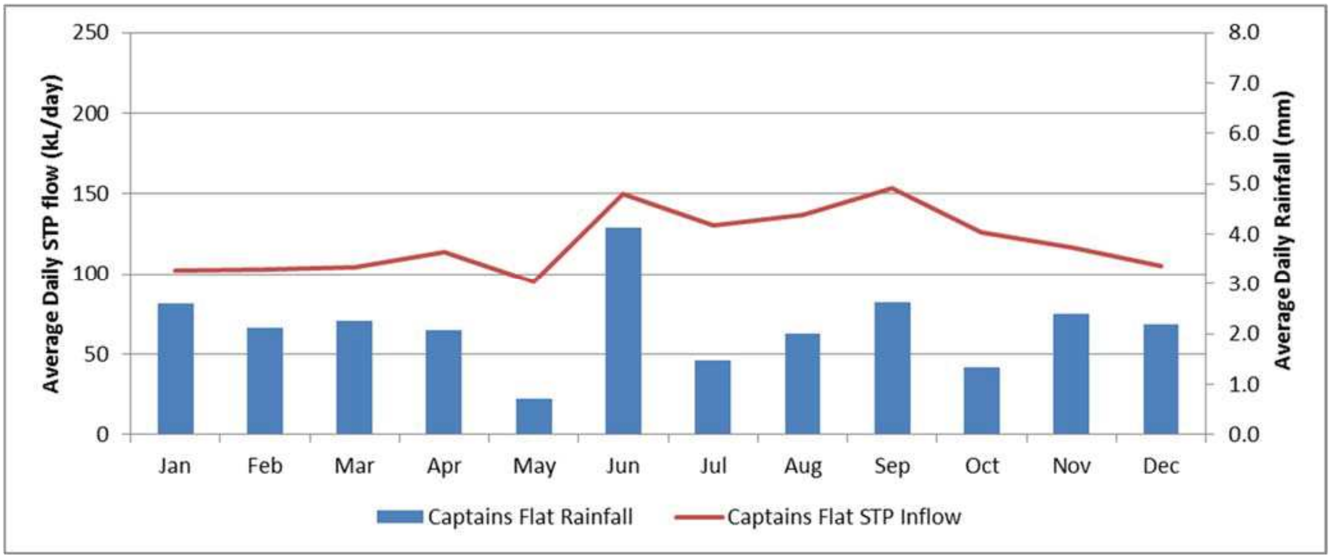

Figure 6.9: Average Daily STP Inflow, Outflow and rainfall by month for Captains Flat STP

Peak Dry Weather Flow

For all STPs the adopted peak dry weather flows (PDWFs) are based on calculation in the sewer design manual and are provided in Table 6.3.

Instantaneous influent flow is available for Braidwood STP from a 72 hour influent monitoring assessment undertaken in June 2011 (9). For the three 24 hour periods, the ratios between maximum recorded flow rate and average flow rate (the peaking factor) were 2.0, 1.9 and 1.7. A figure showing the recorded flow rates is provided in Appendix E.

The calculated peaking factor of 2.5 for Braidwood is slightly higher than the ratios observed during the 72 hour monitoring, however it is adopted as a conservative estimate, because conditions may have changed since when the test was undertaken in 2011.

Table 6.3: Former Palerang LGA sewerage schemes calculated PDWF

STP	Calculated peaking factor 'r'	Adopted ADWF (L/s)	Calculated PDWF (L/s)
Bungendore	2.2	7.5	16.9
Braidwood	2.5	3.0	7.4
Captains Flat	2.8	1.2	3.3

Peak Wet Weather Flow

Between 1 April 2012 and 1 March 2017, the maximum recorded daily flows at Bungendore, Braidwood and Captains Flat STPs was 3,522 kL, 2,100 kL and 1,168 kL respectively. These events occurred on 5 June 2016, 6 June 2016 and 18 September 2013 respectively. Rainfall during all three high flow events was approximately equal to a 1-in-5 year 48-hour rainfall event.

Formulas in the sewer design manual provide a method to calculate instantaneous Storm Allowance (SA) and subsequently PWWF from ET.

$$PWWF = PDWF + SA, \qquad \text{where } SA = 0.058\, L/s * ET$$

A summary of PWWF flow data is shown in Table 6.4.

Table 6.4: Former Palerang LGA sewerage schemes calculated PWWF

STP	Calculated Storm Allowance (L/s)	Calculated PWWF (L/s)	Calculated PWWF/ADWF	Historical Max Flow/ADWF
Bungendore	69	86	11.5	5.4
Braidwood	36	43	14.3	8.1
Captains Flat	14	17	14.6	11.7

It is noted that the storm allowance does not relate to a specific ARI rainfall event whereas the historical high rainfall event was approximately a 1 in 5 year 48 hour event. For this assessment the instantaneous PWWF is assumed to be 12 times ADWF for Bungendore STP and 14 times for Braidwood and Captains Flat STP. This is based on the storm allowance and may be a conservative number.

It was noted during PRG1 that to reduce inflow into sewers located within flood zones, Council are planning to replace manhole lids with bolt down lids in these areas. All SPS wells are above 1 in 100 year flood level.

6.3 Historical Effluent Reuse Flows

Historical effluent reuse flows for Bungendore STP are shown in Figure 6.2 and Figure 6.3. Reuse flows are only available from 1 August 2012 to 17 July 2015, and only a total flow was provided by Council. Council has advised that from the total reuse volumes, approximately 5% is used for onsite purposes, 35% used for road work (truck filling) and 60% used for watering Bungendore oval.

For Bungendore STP, the sum of outlet and reuse metered volumes does not equal the metered inflow volume. The calculated difference between inflow and outflow is on average 19% the inflow volume. The historical inflow and outflows and the calculated difference are given in Appendix C. Council has advised that approximately 38 kL/day of waste activated sludge (WAS) is pumped to the sludge lagoons from the IDEA Tanks, and the supernatant is then returned to the inlet works, possibly double-counting this inflow. Other potential reasons for the discrepancy include by evaporative losses, uncalibrated meters, or on-site reuse flows which may not have been included in the reused metered flow.

6.4 Tourist Population Effects

As mentioned in Section 4.2.1, visitors do not impact the sewage flows in any of the three schemes.

6.5 Biological and Nutrient Loading Analysis

Council does not have data on current influent biological (BOD) and nutrient (Nitrogen (N) and Phosphorus (P)) loads. Palerang Shire STP's design biological and nutrient parameters are summarised in Table 6.5, taken from the STP Description tables in Section 3.3.

Table 6.5 Design Parameters of BOD, Nitrogen and Phosphorus

Parameter	Bungendore	Braidwood	Captains Flat
Biological Oxygen Demand, BOD (g/EP/day)	70	70	70
Total Nitrogen, N (g/EP/day)	12	12	12.5
Total Phosphorus, P (g/EP/day)	2.6	2.0	2.7

The 2011 Braidwood 72 hour monitoring report (9) identified that the average BOD, COD and SS concentrations to the plant exceed (by approximately 30%) the design load to the plant. In contrast, the measured soluble BOD concentrations were well within expected levels, which indicated, according to the report, that some trade wastes (e.g. septage) containing highly active and insoluble materials were being discharged into the reticulation system. The average unit loading was approximately 97 g BOD /EP/day compared to the design value of 70 g BOD/EP/day. Nitrogen was equivalent to its design load and Phosphorus slightly less than the design loads.

No actual biological or nutrient loading concentrations were available for Bungendore or Captains Flat STPs. The normal range for BOD load in small communities is 55 to 65 g/EP/day. Where specific data is not available a BOD loading of 65 g/EP/day is considered.

6.6 Sewer ET and EP Projections

The residential sewer ET in each sewer catchment is equal to the number of occupied residential properties. Non-residential users have been given an ET based on their expected sewage loading.

The 30 year sewer ET projection for each sewerage scheme split by residential and non-residential ET are given in Table 6.6. Full details are given in Appendix A.3.

Table 6.6: Sewer ET Projections

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Residential	1,068	1,713	2,350	2,912	3,373	3,731	3,998
	Non-residential	75	77	80	82	85	88	91
	Total	1,143	1,790	2,429	2,995	3,458	3,818	4,088
Braidwood	Residential	426	456	487	520	556	593	633
	Non-residential	180	182	184	187	189	191	194
	Total	606	638	672	707	745	785	827
Captains Flat	Residential	182	184	186	188	191	193	195
	Non-residential	11	11	11	11	11	11	11
	Total	193	195	197	199	202	204	206

The number of ETs was converted in to EPs by using the 2016 Census data household size (see Table 4.3). These values are approximately 2.9, 2.3 and 2.2 people per household for Bungendore, Braidwood and Captains Flat respectively. Council staff proposed that since most of the Bungendore residents are working or at school in nearby Canberra, a reduced household size of 2.3 be adopted for Bungendore, however since these residents are expected to be home on weekends and holidays, 2.9 is still adopted to assess STP and SPS capacities under these circumstances.

The 30 year sewer ET projection for each sewerage scheme split by residential and non-residential ET are given in Table 6.7. Full details are given in Appendix A.5

Table 6.7: Sewer EP Projections

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Residential	3,130	5,022	6,887	8,536	9,887	10,934	11,717
	Non-residential	220	226	233	240	248	257	266
	Total	3,350	5,248	7,120	8,777	10,135	11,191	11,982
Braidwood	Residential	965	1,032	1,103	1,179	1,259	1,344	1,434
	Non-residential	408	413	418	423	428	433	439
	Total	1,373	1,445	1,521	1,601	1,687	1,777	1,873
Captains Flat	Residential	402	407	411	416	421	426	431
	Non-residential	24	24	24	24	24	24	24
	Total	426	431	436	441	445	450	455

6.7 Projected sewer system flow projection

Future ADWF, PDWF and PWWF were estimated by using a unit loading for future growth of 200 L/EP/day for Bungendore and Braidwood STP and 240 L/EP/day for Captains Flat STP. The future STP sewage loading projections are shown in Table 6.8.

Table 6.8: Projected STP flows

		2016	2021	2026	2031	2036	2041	2046
Bungendore STP	ADWF (kL/day)	650	1,030	1,404	1,735	2,007	2,218	2,377
	r	2.3	2.1	2.1	2.0	2.0	1.9	1.9
	PDWF (L/s)	17	25	33	40	45	49	52
	PWWF (L/s)	90	143	195	241	279	308	330
Braidwood STP	ADWF (kL/day)	260	274	290	306	323	341	360
	r	2.5	2.4	2.4	2.4	2.4	2.4	2.4
	PDWF (L/s)	7	8	8	9	9	9	10
	PWWF (L/s)	42	44	47	50	52	55	58
Captains Flat STP	ADWF (kL/day)	100	101	102	103	105	106	107
	r	2.9	2.9	2.9	2.9	2.9	2.9	2.9
	PDWF (L/s)	3	3	3	3	4	4	4
	PWWF (L/s)	16	16	17	17	17	17	17

7 Design Parameters for Water Supply and Sewerage Scheme

Based on the outcomes of the analyses discussed in Sections 5 and 6, the following tables summarise the design parameters and unit loadings that are used for the capacity assessment of existing infrastructure. They are also used for projections that determine capacity and staging of future upgrades and augmentations for water supply and sewerage infrastructure.

7.1 Water Supply

Metered Demand Analysis

The 2016 average and dry year demands were obtained by climate correcting historical data in Section 5.6. These demands are used as the starting point for demand projections.

Table 7.1: Average and dry year metered demand from model

System	Average year demand (ML/year)	Dry year demand (ML/year)	Dry year to average year ratio
Bungendore	212	260	122%
Braidwood	149	179	120%
Captains Flat	144	187	129%

Impact of BASIX

From the assessment in Section 5.8, climate corrected residential unit demands were compared to an BASIX dwellings requirements and the results of rain water tank modelling. An average year unit demand of 180 kL/dwelling/year and a dry year unit demand of 240 kL/dwelling/year were adopted for new dwellings, for use in projections.

Non-revenue water

From the NRW analysis in Section 5.3, an NRW allowance of 125 and 280 L/connection/day were adopted for Bungendore and Braidwood respectively. Captains Flat has been experiencing high seasonal NRW which has been attributed to a faulty meter at the pool and surrounding parks. Council has now fixed this, and an NRW of 110 L/connection/day has been adopted.

Peak Day Analysis

From the peak day analysis in Section 5.7, an average day to peak day factor was adopted for Bungendore, Braidwood and Captains Flat of 2.51, 2.19 and 3.48 respectively. This was passed on the 95th percentile peak day production.

Forecast water production and extraction

The below forecast water production and extraction are provided in Table 7.2. These projections are used to determine license requirements, assess water security and headworks capacity.

Table 7.2: Water extraction forecast

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Average year (ML/year)	338	495	677	814	927	1,014	1,080
	Dry year (ML/year)	405	604	842	1,015	1,157	1,268	1,351
	Peak day (ML/day)	3.0	4.4	6.1	7.3	8.3	9.1	9.7

		2016	2021	2026	2031	2036	2041	2046
Braidwood	Average year (ML/year)	195	204	214	225	236	248	261
	Dry year (ML/year)	239	250	263	275	289	303	319
	Peak day (ML/day)	1.6	1.6	1.7	1.8	1.9	2.0	2.1
Captains Flat	Average year (ML/year)	55	55	56	56	57	57	58
	Dry year (ML/year)	69	69	70	71	71	72	73
	Peak day (ML/day)	0.7	0.7	0.7	0.7	0.7	0.7	0.8

7.2 Sewerage

The projected sewer EP for each sewer catchment is provided in Table 7.3. The projection for each SPS is used to assess the pumping station capacity, emergency storage and septicity potential, and the total EP is used to assess the capacity of the sewage treatment plants.

Table 7.3: STP Equivalent Population (EP) Projections

		2016	2021	2026	2031	2036	2041	2046
Bungendore	BU SPS1	977	1,034	1,094	1,157	1,224	1,295	1,366
	BU SPS2	475	527	584	646	651	651	651
	BU SPS3	32	36	40	45	50	56	62
	BU SPS4	427	1,155	1,156	1,158	1,159	1,161	1,162
	BU SPS5	56	56	56	56	56	56	56
	BU SPS6	59	59	59	59	59	59	59
	BU SPS7	595	601	608	610	610	610	610
	BU SPS8	255	255	255	255	255	255	255
	BU SPS9	340	344	347	351	355	358	362
	BU SPS10	135	152	152	152	152	152	152
	Elmslea North	0	386	879	879	879	879	879
	Bungendore East	0	644	1,731	2,052	2,052	2,052	2,052
	Extra Greenfields	0	0	160	1,359	2,635	3,609	4,317
	Total	3,350	5,248	7,120	8,777	10,135	11,191	11,982
Braidwood	BR SPS1	842	883	925	970	1,017	1,066	1,118
	BR SPS2	425	439	454	470	487	504	522
	BR SPS3	35	37	39	40	42	44	46
	BR SPS4	29	32	35	39	42	46	51
	BR SPS5	14	18	22	27	32	38	45
	BR SPS6	27	36	45	55	66	78	92
	Total	1,373	1,445	1,521	1,601	1,687	1,777	1,873
Captains Flat	CF SPS1	426	431	436	441	445	450	455
	Total	426	431	436	441	445	450	455

The unit hydraulic loading for each sewerage scheme is provided in Table 7.4.

Table 7.4: Adopted 2016 ADWF and Unit Loading

STP	Adopted 2016 ADWF (kL/day)	Adopted Unit loading (L/EP/day)
Bungendore	650	200
Braidwood	260	200
Captains Flat	100	240

Design parameters for sewage influent quality are provided in Table 7.5.

Table 7.5: Design Parameters of BOD, Nitrogen and Phosphorus

Parameter	Bungendore	Braidwood	Captains Flat
Biological Oxygen Demand, BOD (g/EP/day)	70	70	70
Total Nitrogen, N (g/EP/day)	12	12	12.5
Total Phosphorus, P (g/EP/day)	2.6	2.0	2.7

No actual biological or nutrient loading concentrations were available for Bungendore or Captains Flat STPs. The normal range for BOD load in small communities is 55 to 65 g/EP/day. Where specific data is not available a BOD loading of 65 g/EP/day is considered.

8 Water System Capacity and Performance Assessment

8.1 Security of Supply

8.1.1 Bungendore Secure Yield

The projected dry extraction from Table 5.11 along with the licensed allocation from Table 3.2 for the Bungendore water supply schemes is shown in Figure 8.1. Bungendore is supplied from the Bungendore and Currandooly borefields, with a total licensed allocation of 472 ML/year. Another line also shows the projected dry year extraction without the demand from the Bungendore East recreation areas if it is also irrigated using STP effluent.

It is estimated that Bungendore will exceed its licensed extraction by 2018.

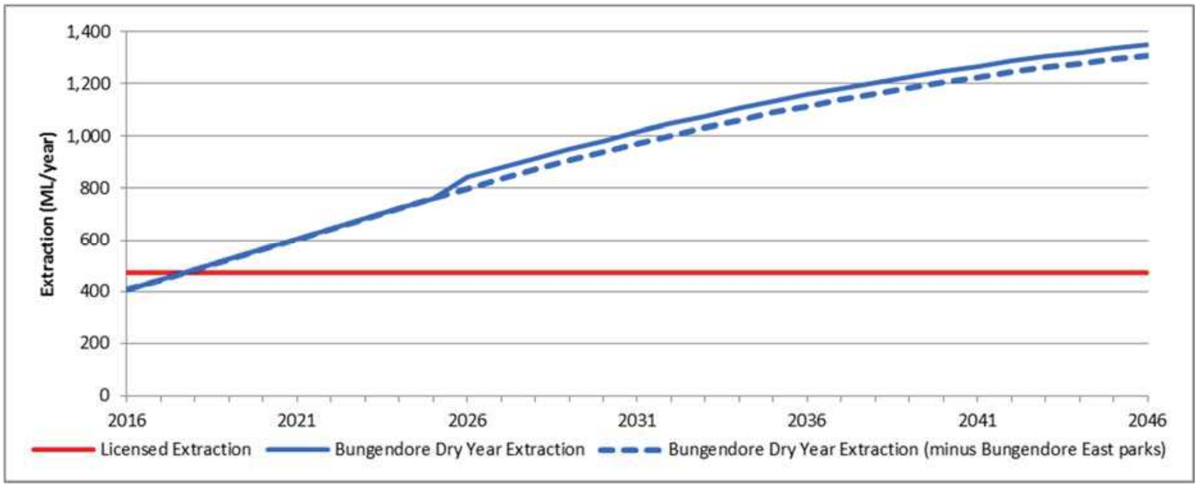

Figure 8.1: Projected Dry Year Extraction - Bungendore

An analysis was undertaken to determine the impact on the extraction if STP effluent were reused as a third pipe for the Greenfields developments. The provision of a third pipe removes the need to have a rainwater tank to meet BASIX requirements. If a third pipe were considered, the 2046 estimated dry year extraction could drop from around 1,600 ML/year to 1,100 ML/year if effluent is reused for lawn and garden watering only, or to 1,000 ML/year if effluent is also reused for toilet flushing and laundry. This is shown in Figure 8.2.

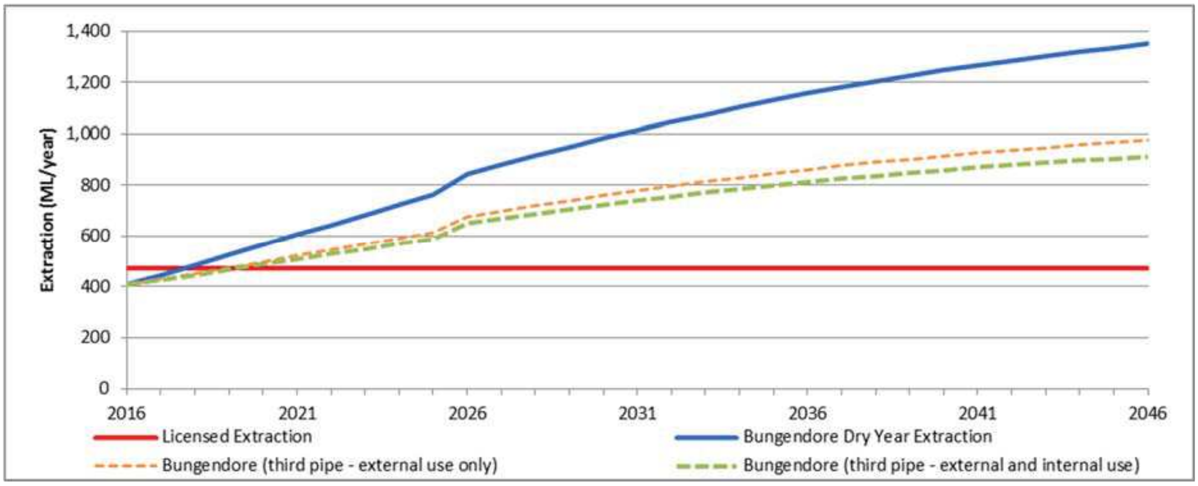

Figure 8.2: Projected Dry Year Extraction – Bungendore with Third Pipe

Long-term average annual extraction limit (LTAAEL)

The LTAAEL for the Bungendore Alluvial Groundwater Source is 1,268 ML/year (10). Currently there are a total of six licenses (including two held by Council) with a total allocation of 1,238 ML/year.

Council may be able to obtain an increase in Licensed Allocation under Section 66 of the Water Management Act 2000, which states that:

the Minister may at any time increase the utility's entitlement to water under a local water utility licence so as to reflect any rapid growth of population within the utility's area requiring an immediate increase in the availability of water for supply by that utility.

8.1.2 Braidwood and Captains Flat Secure Yield

A secure yield analysis (11) was undertaken for the Braidwood and Captains Flat headworks system in accordance with the requirements of DPI Water's draft guidelines for *"Assuring future urban water security – Assessment and adaption guidelines for NSW local water utilities"*.

Under the NSW Security of Supply basis 'Secure Yield' is defined as the highest annual water demand that can be supplied from a water supply headworks system while meeting the above '5/10/10' rule.

The key aspects of the 5/10/10 rule are:

1. Water restrictions are in place for no more than 5% of the time
2. Water restrictions occur on average once every 10 years
3. During water restrictions, demand is reduced by 10%

The secure yield estimate for the Braidwood and Captains Flat Headworks Systems are provided in Table 8.1.

Table 8.1 Braidwood and Captains Flat Secure Yield Outcome

Case	Secure Yield (5/10/10) ML/a		Comment
	Braidwood	Captains Flat	
Historic climate 1890 -2015 stream flows	394 [1]	235	Existing offstream storage at Braidwood – 73 ML
1^0C climate warming	357	183	Existing onstream storage Captains Flat – 820 ML

1 - Potential estimate as limited to 360 based on licence conditions

The projected dry extraction from Table 5.11 along with the licensed allocation from Table 3.2 and the secure yields from Table 8.1 for the Braidwood and Captains Flat water supply schemes is shown in Figure 8.3 and Figure 8.4.

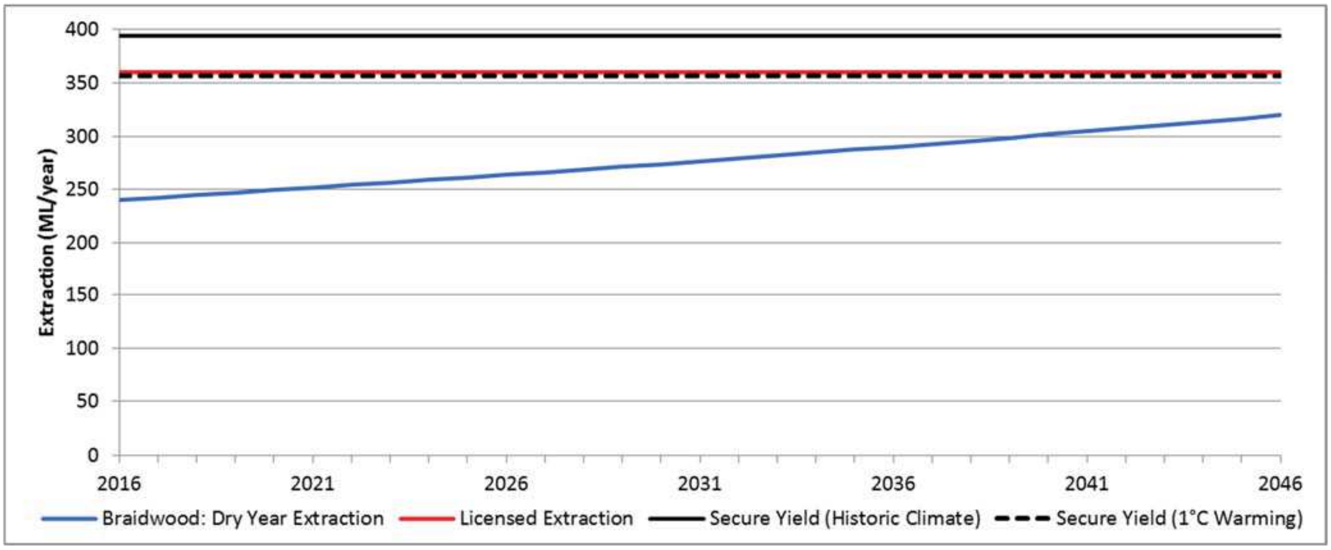

Figure 8.3: Braidwood Licenced Extraction

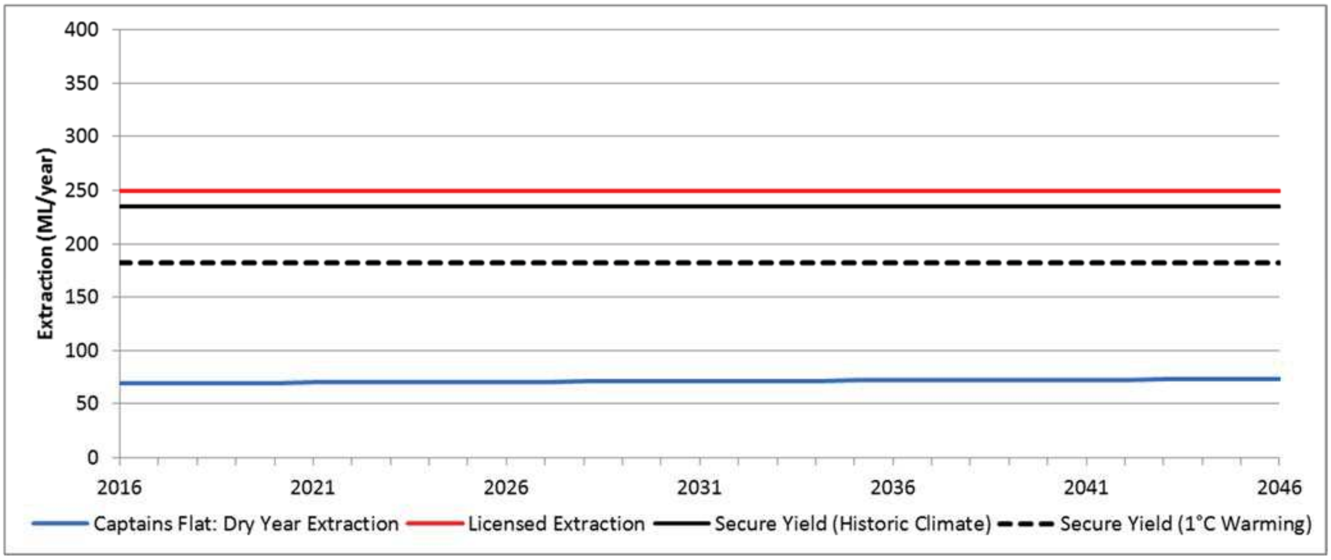

Figure 8.4: Captains Flat Licenced Extraction

It is noted that for both Braidwood and Captains Flat the secure yield of the water supply under the current license condition and headworks capacity is sufficient to meet the unrestricted dry year demands for the 30 year planning horizon.

8.2 Headworks Capacity

The headworks capacity is used to check the capacity to provide peak day demands. The forecast peak day water production is compared to WTP capacity and total reservoir capacity for each scheme in Figure 8.5 to Figure 8.7.

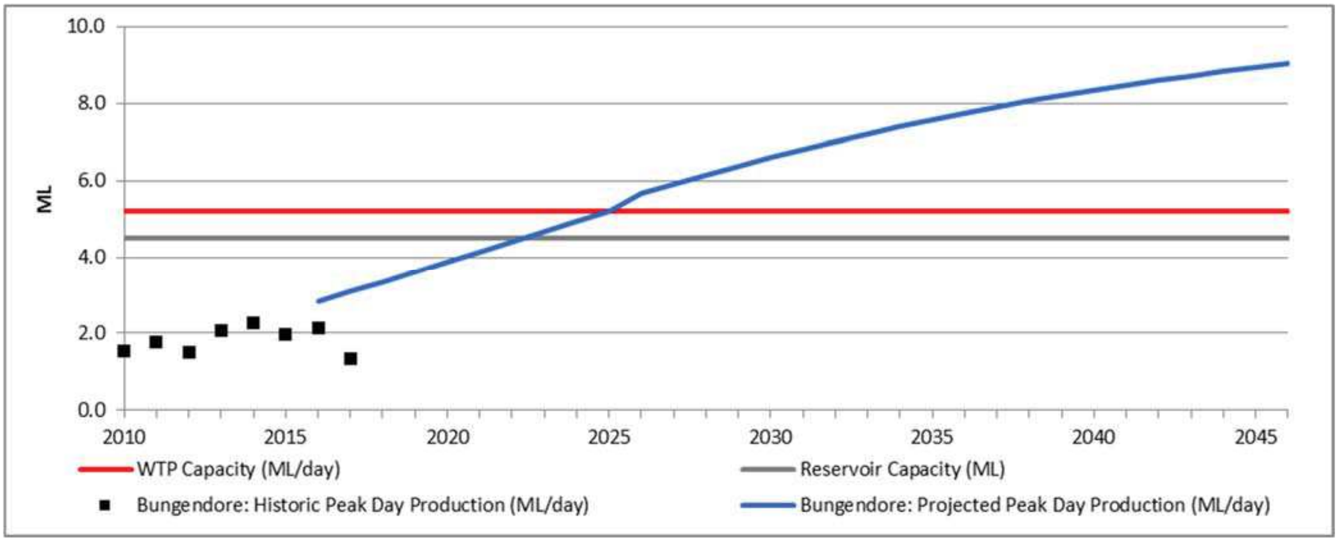

Figure 8.5: Bungendore current headworks capacity and projected peak day demand

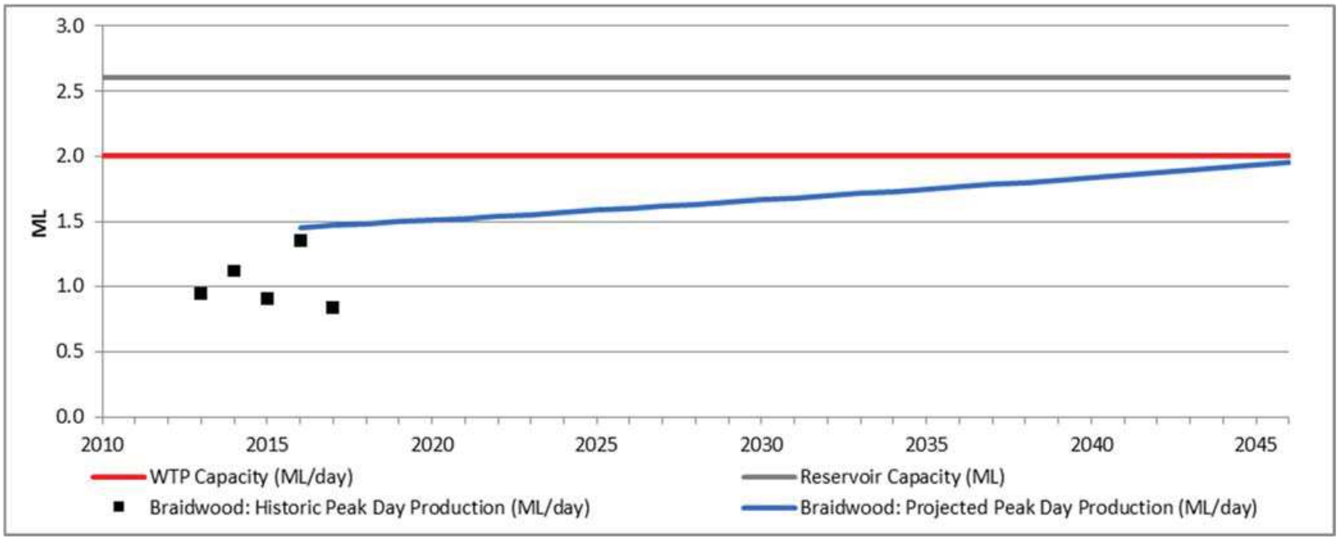

Figure 8.6: Braidwood current headworks capacity and projected peak day demand

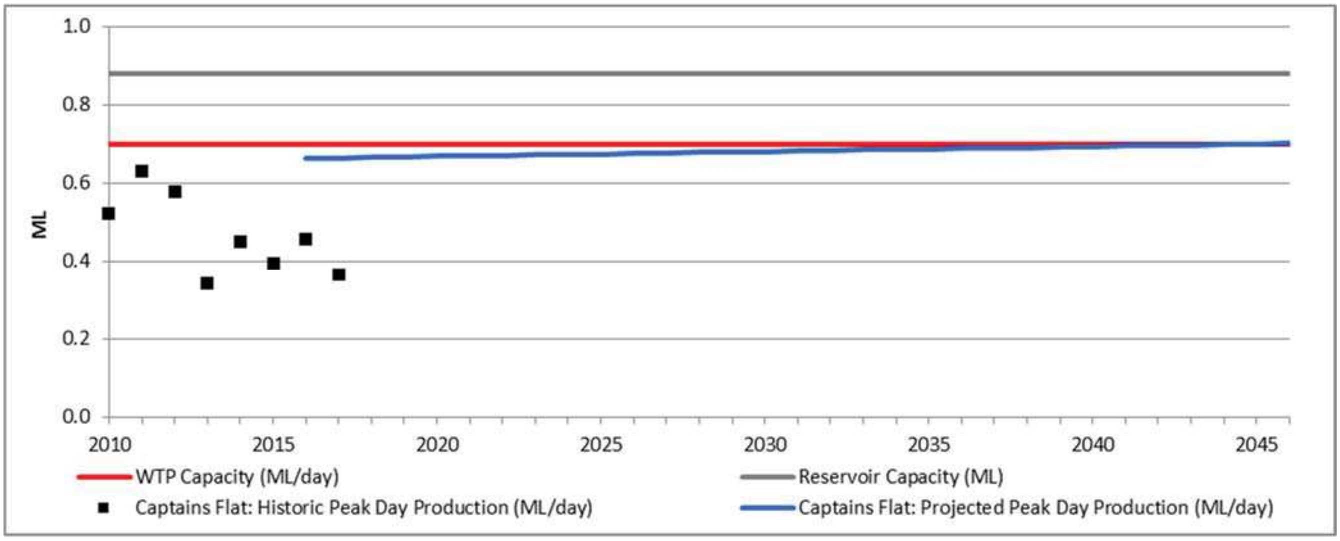

Figure 8.7: Captains Flat current headworks capacity and projected peak day demand

The Bungendore WTP capacity is the sum of the Bungendore and Currandooly WTPs. If the Greenfields development progresses as predicted, the total WTP capacity will be exceeded around 2025. The reservoir capacity will need to be reviewed to ensure that the required pressure can be maintained in the system with the addition of the Greenfields demand.

The peak day production at Braidwood and Captains Flat is expected to exceed WTP capacity around 2046.

8.3 Water Quality Performance

8.3.1 Drinking Water Management System

Council has a Drinking Water Management System adopted in 2014 (1) which defines the Critical Control Points (CCPs) used to control treated water quality. A review of CCPs was undertaken by Atom Consulting in 2016 (12) and new CCPs have been adopted in October 2017 following a revision of the DWMS by Viridis Consultants.

The current CCPs and their limits are given in Table 8.2.

Table 8.2: Palerang Shire – Critical Control Point Summary

CCP			Target Criteria	Adjustment Limit	Critical Limit
Bungendore	CCP1	Chlorination	1.2 mg/L Clearwater tank	< 0.9 mg/L or > 2.0 mg/L Clearwater tank	< 0.7 mg/L or > 5.0 mg/L Clearwater tank
			> 0.4 mg/L Reticulation	< 0.3 mg/L Reticulation	< 0.2 mg/L or > 5 mg/L Reticulation
	CCP2	Fluoridation	0.95 - 1.05 mg/L	0.9 - 0.95 mg/L or 1.05 - 1.35 mg/L	< 0.9 mg/L for 72 hrs or > 1.5 mg/L
	CCP3	Reservoir	No gaps, vermin proof, secure, enclosed, locked	Breach of reservoir integrity	Evidence of vermin
Currandooly	CCP1	Filtration	< 0.2 NTU	> 0.3 NTU	> 1.0 NTU
	CCP2	Chlorination	1.0 to 1.5 mg/L Clearwater tank	< 1.0 mg/L or > 2.0 mg/L Clearwater tank	< 0.5 mg/L or > 5.0 mg/L Clearwater tank
			> 0.4 mg/L Reticulation	< 0.3 mg/L Reticulation	< 0.2 mg/L or > 5.0 mg/L Reticulation
	CCP3	Fluoridation	0.95 - 1.05 mg/L	0.9 - 0.95 mg/L or 1.05 - 1.35 mg/L	< 0.9 mg/L for 72 hrs or > 1.5 mg/L
	CCP4	Reservoir	No gaps, vermin proof, secure, enclosed, locked	Breach of reservoir integrity	Evidence of vermin
Braidwood	CCP1	Filtration	< 0.1 NTU	> 0.3 NTU	> 0.5 NTU
	CCP2	Chlorination	1.0 to 2.0 mg/L Clearwater tank	< 0.8 mg/L or > 2.0 mg/L Clearwater tank	< 0.5 mg/L or > 5.0 mg/L Clearwater tank
			> 0.4 mg/L Reticulation	< 0.3 mg/L Reticulation	< 0.2 mg/L or > 5.0 mg/L Reticulation
	CCP3	Fluoridation	0.95 - 1.05 mg/L	0.9 - 0.95 mg/L or 1.05 - 1.35 mg/L	< 0.9 mg/L for 72 hrs or > 1.5 mg/L
	CCP4	Reservoir	No gaps, vermin proof, secure, enclosed, locked	Breach of reservoir integrity	Evidence of vermin

	CCP		Target Criteria	Adjustment Limit	Critical Limit
Captains Flat	CCP1	Filtration	< 0.2 NTU	> 0.5 NTU	> 1.0 NTU
	Interim CCP2**	Chlorination	5.0 – 8.0 mg/L WTP	< 4.0 mg/L or > 8.8mg/L WTP	< 3.0 mg/L or > 10 mg/L WTP
			> 1.0 mg/L Reservoir outlet	< 0.8mg/L or > 3.0 mg/L Reservoir outlet	< 0.2 mg/L or > 5.0 mg/L Reservoir outlet
			> 0.3 mg/L Reticulation	< 0.3mg/L Reticulation	< 0.2 mg/L or > 5.0 mg/L Reticulation
	CCP3	Fluoridation	0.95 - 1.05 mg/L	0.9 - 0.95 mg/L or 1.05 - 1.35 mg/L	< 0.9 mg/L for 72 hrs or > 1.5 mg/L
	CCP4	Reservoir	No gaps, vermin proof, secure, enclosed, locked	Breach of reservoir integrity	Evidence of vermin

**Note: Limits are based on the high chlorine demand from the corroding reservoir. Limits to be reviewed following replacement of reservoir.

Several of Council's adopted CCPs should not be considered CCPs e.g reservoir integrity and free chlorine in reticulation are covered by LWU Circular 18.

It is noted that for CCP1 - Filtration at Captains Flat WTP, the alert actions described in the DWMS if the turbidity breaches the alert limit of 0.5 NTU include backwashing and cleaning the membrane and performing jar testing. Public Works Advisory advises that an increase in turbidity is likely due to a membrane integrity issue, and thus an integrity test should be performed.

8.3.2 Bungendore Water Supply Scheme

Raw Water Quality

Bungendore Bores - operators monitor raw water pH and natural fluoride daily in the bore water entering the plant. The Bungendore bores have fluctuating levels of natural fluoride, with Bore 2 known to maintain the highest level of fluoride, and WTP fluoride dosing levels are adjusted according to the measured raw water fluoride. Raw water turbidity is not measured at the Bungendore bores,

Currandooly Bore - operators monitor raw water turbidity, pH, iron and manganese daily. The Currandooly bore is known to be high in iron and manganese.

Water Treatment – CCP Analysis

Council provided CCP monitoring data and operation limits from 1 January 2015 to 6 January 2017 for all WTPs. CCP limits were adopted from Council's Drinking Water Management System (1).

Graphs of the CCP monitoring data can be found in Appendix D.1.

Analysis of the Bungendore WTP performance against the CCPs identified the following:

- The DWMS review (12) recommended the limits for fluoride concentration be changed slightly to bring them in line with the *NSW Code of Practice for Fluoridation* of Public Water Supplies. It is recommended the lower critical limit be changed from < 0.7 mg/L to <0.9 mg/L for 72 hours, and the upper critical limit be changed from >1.2 mg/L to >1.5 mg/L. There have been no exceedances of these limits over the sampling period.
- Chlorine residual in reticulation is not considered a CCP. It is recommended that free chlorine be monitored in the 100 kL Collection Tank at the WTP (see Figure 3.3). Residual chlorine in the system is covered under the DPI Water LWU Circular 18.

Analysis of the Currandooly WTP performance against the CCPs identified the following:

- The pH measured at the aerator is used as a CCP but this is technically an operational control point to optimize manganese removal. The pH was frequently above the alert limit and critical limit, however since April 2016 this parameter has consistently been within limits. The DWMS review (12) recommended a higher target pH of 8.0 – 8.5 be used to improve manganese removal.
- Two out of 457 samples were above the critical limit of 2 NTU for turbidity measured after filtration
- Under the fluoride CCP limits recommended in the DWMS review and taken from the *NSW Code of Practice for Fluoridation*, there have been no breaches of critical limits out of 617 samples.
- Free chlorine at the Clearwater tanks was below the critical CCP limit of 0.5 mg/L in 16 out of 360 samples. The DWMS review (12) recommended a stricter CCP alert limit of < 1.0 mg/L be used to improve operation control, as currently more than 12% of samples fall below the current CCP alert limit of 0.75 mg/L.

Water Treatment – NSW Health Water Quality Monitoring Analysis

In addition to the monitoring of CCPs, treated water is also monitored four times a year for Microbial, Physical, Chemical, Disinfection residual, Fluoridation, Radiological and Disinfection by-products parameters, as required by the NSW Health Water Quality Monitoring Program 2005.

Analysis of six years of NSW Health Water Quality Monitoring (2011 – 2016) identified the following:

- No presence of E. coli has been observed in either the source water or the treated water from Bungendore and Currandooly bores.
- The source water has low turbidity as expected in groundwater supplies and slightly increases through reticulation. pH is optimal
- Results from the most recent radiological analysis (May 2017) found radiological levels in the samples taken from the Bungendore and Currandooly bores to be within the ADWG recommended levels of gross alpha activity (0.5 Bq/L) and gross beta activity (0.5 Bq/L).
- Trihalomethanes (disinfection by-products) were within the ADWG recommended limits.

8.3.1 Braidwood Water Supply Scheme

Raw Water Quality

Raw water is monitored daily for turbidity and pH. Council has not indicated that there are any raw water issues.

Water Treatment – CCP Analysis

Graphs of the CCP monitoring data can be found in Appendix D.1.

Analysis of the Braidwood WTP performance against the CCPs identified the following:

- Turbidity after filtration has consistently been achieved within the target limits more than 99% of the time. The DWMS review (12) recommended a stricter alert and critical limit of 0.3 NTU and 0.5 NTU respectively be adopted for effective filtration of Cryptosporidium and Giardia.
- Free chlorine at the Clearwater tanks was below the critical CCP limit of 0.5 mg/L in one out of 360 samples.
- Under the fluoride CCP limits recommended in the DWMS review and taken from the *NSW Code of Practice for Fluoridation*, there have been no breaches of critical limits out of 737 samples.
- Chlorine residual in reticulation has been within targeted limits more than 99% of the time.

Water Treatment – NSW Health Water Quality Monitoring Analysis

Analysis of six years of NSW Health Water Quality Monitoring (2011 – 2016) identified the following:

- E.coli is present in the water in Braidwood off-stream dam, with a maximum of 410 MPN/100mL recorded on 23 February 2012. Prior to 2013, E.coli was observed to be carrying through into the treated water, with a maximum of 440 MPN/100 mL E.Coli detected in WTP product water on 13 November 2012 (possibly an error) and a maximum of 3 MPN/100 mL E.Coli detected in reticulated water on 18 May 2011. Since 2013 there has been no recorded microbiological contamination in the treated water from the WTP or in the reticulation
- Turbidity is reduced through the treatment process, although still marginally higher than optimal after filtration. Council have noted that there has been some concern about disparity in some water quality results for the new plant (primarily between onsite turbidity loggers and ALS turbidity results). The contractor has approached ALS to review. Council regularly observes the in line turbidity monitors, with results showing < 0.1 NTU.
- Results from the most recent radiological analysis (May 2017) found radiological levels in the samples taken from Braidwood off-stream dam to be within the ADWG recommended levels of gross alpha activity (0.5 Bq/L) and gross beta activity (0.5 Bq/L).
- Trihalomethanes (disinfection by-products) were within the ADWG recommended limits.

8.3.2 Captains Flat Water Supply Scheme

Raw Water Quality

Raw water is monitored daily for turbidity, pH and temperature. Turbidity meters were installed in the raw water and clear water tanks in around March 2017. Tthere is not yet significant amounts of data to properly assess raw water turbidity, however it has been observed to reach as high as 32 NTU. Council has not indicated that there are any raw water issues.

Water Treatment – CCP Analysis

Graphs of the CCP monitoring data can be found in Appendix D.1.

Analysis of the Captains Flat WTP performance against the CCPs identified the following:

- The product water breaches the lower critical limit of 6.9 for pH in 5 out of 728 samples, and the upper critical limit of 8.5 for pH in 33 out of 728 samples
- One out of 579 samples were above the critical limit of 1 NTU for turbidity measured after filtration, likely occurring during a period of ripening after chemical backwash
- Free chlorine at the WTP was below the critical CCP limit of 0.5 mg/L in one out of 728 samples.
- Under the fluoride CCP limits recommended in the DWMS review and taken from the *NSW Code of Practice for Fluoridation*, there have been no breaches of critical limits out of 737 samples.

The DWMS review (12) identified a high chlorine demand at the reservoir. Following this review Council cleaned the reservoir in 2016 and are planning to replace the reservoir.

Water Treatment – NSW Health Water Quality Monitoring Analysis

Treated water is monitored four times a year for Microbial, Physical, Chemical, Disinfection residual, Fluoridation, Radiological and Disinfection by-products parameters, as required by the NSW Health Water Quality Monitoring Program 2005.

Analysis of six years of NSW Health Water Quality Monitoring (2011 – 2016) identified the following:

- E.coli is present in the raw water in Captains Flat Dam, with a maximum of 390 MPN/100mL recorded on 9 December 2014. However this does not carry through after treatment as there has been no recorded microbiological contamination in the treated water from the WTP or in the reticulation. This was a serious issue with the water supply prior to construction of the WTP.

- Turbidity is reduced through the treatment process. Council has advised that prior to the installation of higher accuracy on-line WTS turbidity meters there was an issue with high turbidity following filtration.
- Results from the most recent radiological analysis (May 2017) found radiological levels in the samples taken from Captains Flat Dam to be within the ADWG recommended levels of gross alpha activity (0.5 Bq/L) and gross beta activity (0.5 Bq/L).
- Trihalomethanes (disinfection by-products) were within the ADWG recommended limits.

8.4 Compliance with LWU Circular 18

Council has addressed most of the requirements of LWU Circular 18. The Circular specifies the requirements for the following three barriers are assessed to assure integrity and safety of the water supply system.

8.4.1 Barrier 1: Effective Disinfection

Monitoring of factors which affect disinfection

The CCPs developed in the DWMS are implemented to ensure that water leaving the WTPs consistently achieves effective disinfection. The adjustment and critical limits have also been set so that the chlorine residual in water leaving the plant will satisfy the requirements of the ADWG at the point of use.

Achieve minimum chlorine contact time (C.t.)

Council's DWMS (1) states that the Bungendore, Currandooly, Braidwood and Captains Flat WTPs achieve the required chlorine contact time (C.t. time) of 0.5 mg/L free chlorine after 30 minutes contact time or a minimum of 15 mg/L/min. A desktop calculation of C.t. times confirms this.

8.4.2 Barrier 2: Distribution System Integrity

Council's reservoirs are inspected each week which requires a check of perimeter security and a walk-around inspection and top inspection of the reservoir. Council uses Reservoir Integrity as a CCP in all three water supply schemes, however technically it is not a CCP.

Council provided the inspection reports from January 2017 and December 2016 for each reservoir. As of the last inspection no issues were identified and no actions were required at any of the eight reservoirs.

8.4.3 Barrier 3: Maintain a Free Chlorine Residual in the Water in the Distribution System

Council monitors free chlorine daily in the reticulation of each of the water supply schemes.

Bungendore Water Supply Scheme

Reticulated water quality is monitored daily at the supply and the sample points "Gibraltar St", "Works Depot", "Simms Drive" and "Trucking Yard Lane". Reticulated water free chlorine records were assessed from a period of four weeks (11 March 2017 – 7 April 2017).

The free chlorine at Simms Drive was found to be low; eight out of 28 samples were below 0.2 mg/L, and more than half of the samples were less than 0.3 mg/L. In comparison, the lowest free chlorine sampled at all other points was 0.36 mg/L.

Braidwood Water Supply Scheme

Reticulated water quality is monitored daily at the supply and the sample point at STP, and five days a week at the sample points “Church”, “Centennial Park” and “Barry’s House”. Reticulated water free chlorine records were assessed from a period of four weeks (31 December 2016 – 27 January 2017).

The free chlorine at all sample points was within acceptable limits, with a minimum and maximum free chlorine of 0.33 mg/L and 1.47 mg/L respectively.

Captains Flat Water Supply Scheme

Reticulated water is monitored daily at the supply and the sample points “Park”, “Depot” and “Foxlow St” and once a week at the sample points “Beazley St” and “George St”. Reticulated water free chlorine records were assessed from a period of four weeks (31 December 2016 – 27 January 2017).

It was identified that there were two consecutive days where the free chlorine at the “Depot” sample points dropped below 0.2 mg/L, and the “Park” and “Foxlow St” sample points also had very low free chlorine measurements close to 0.2 mg/L.

8.5 Performance in latest WHS Audit

Council does not have a formal Work Health and Safety Management system**. Issue**

9 Sewerage Scheme Capacity and Performance Assessment

9.1 Sewer Catchment Performance

Council's sewerage system includes ten SPS at Bungendore, seven SPS at Braidwood and one SPS at Captains Flat. A summary is given in Table 9.1.

Table 9.1: Council sewage pumping stations

Scheme	SPS	Pump station pumps to	Duty (L/s)	Standby (L/s)
Bungendore	SPS#1	**Bungendore STP**	61.5	61.5
	SPS#2	SPS#3 catchment	10.1	10.0
	SPS#3	SPS#1 catchment	3.2	3.2
	SPS#4	SPS#1 catchment (lift pump station) [1]	27.0	27.0
	SPS#5	**Bungendore STP** (combined RM with SPS#6)	4.2	4.2
	SPS#6	**Bungendore STP** (combined RM with SPS#5)	2.0	2.0
	SPS#7	**Bungendore STP**	28.2	28.2
	SPS#8	**Bungendore STP**	19.0	19.0
	SPS#9	SPS#8 catchment (lift pump station)	11.4	11.4
	SPS#10	PS#9 catchment	24.6	24.6
Braidwood	SPS#1	**Braidwood STP**	38.0	38.0
	SPS#2	PS#1 catchment	20.0	20.0
	SPS#3	PS#2 catchment	4.5	4.5
	SPS#4	PS#1 catchment	2.8	2.8
	SPS#5	PS#1 catchment	8.6	8.6
	SPS#6	PS#5 catchment	7.5	7.5
	SPS#7	PS#1 catchment	6.5	6.5
Captains Flat	SPS#1	**Captains Flat STP**	13.2	13.2

1 – Bungendore SPS#4 will be switched over to a direct line to the STP once ADWF into SPS#4 reaches 1.67 L/s (143.8 kL/day). This is estimated to occur around 2019.

Performance is not assessed for the new SPS#7 as it has been sized specifically for the retirement village. SPS#7 pumps to the catchment of SPS#1 which is assessed, and the population growth is included in the SPS#1 catchment (see Table 4.8).

9.1.1 Pump Capacity Assessment

The flow to each pump station was calculated by multiplying the projected EP in the direct gravity catchment of each SPS (see Table 6.7) by the adopted hydraulic loadings given in Section 6.7.

The calculated ADWF run time for each SPS is given in Table 9.2, with instances where the pump run time at ADWF exceeds three hours highlighted in red.

Table 9.2: Hours run at ADWF for selected sewage pumping stations

Scheme	SPS	SPS Pump rate (L/s)	Hours Run per day at ADWF						
			2016	2021	2026	2031	2036	2041	2046
Bungendore	1	61.51	1.3	1.4	1.5	1.6	1.7	1.8	1.8
	2	10.1	2.5	2.8	3.1	3.5	3.5	3.5	3.5
	3	3.2	0.5	0.6	0.7	0.8	0.8	0.9	1.1
	4	27	0.9	2.4	2.4	2.4	2.4	2.4	2.4
	5	4.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	6	2	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	7	28.2	1.1	1.1	1.2	1.2	1.2	1.2	1.2
	8	19	2.1	2.1	2.1	2.2	2.2	2.2	2.2
	9	11.4	2.2	2.3	2.4	2.4	2.4	2.4	2.4
	10	24.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Braidwood	1	38	1.9	2.0	2.1	2.2	2.4	2.5	2.6
	2	20	1.2	1.3	1.3	1.4	1.4	1.5	1.5
	3	4.5	0.4	0.4	0.5	0.5	0.5	0.5	0.5
	4	2.75	0.6	0.6	0.7	0.8	0.8	0.9	1.0
	5	8.63	0.2	0.3	0.4	0.5	0.6	0.7	0.9
	6	7.5	0.2	0.3	0.3	0.4	0.5	0.6	0.7
Captains Flat	1	13.2	2.1	2.1	2.1	2.2	2.2	2.2	2.2

The PWWF to each SPS was calculated using the methodology in the sewer design manual for the current and projected EP loading. The results are given in Table 9.3, with Peak Wet Weather Flows that exceed the pump capacity highlighted in red.

Table 9.3: Calculated Peak Wet Weather Flows for selected sewage pumping stations

Scheme	SPS	SPS Pump rate (L/s)	PWWF to SPS (L/s)						
			2016	2021	2026	2031	2036	2041	2046
Bungendore	1	61.5	40.0	43.1	46.5	50.1	52.2	54.4	56.5
	2	10.1	12.8	14.2	15.8	17.5	17.7	17.7	17.7
	3	3.2	0.9	1.0	1.1	1.2	1.4	1.5	1.7
	4	27.0	11.5	31.7	31.8	31.8	31.8	31.9	31.9
	5	4.2	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	6	2.0	1.6	1.6	1.6	1.6	1.6	1.6	1.6
	7	28.2	16.0	16.2	16.4	16.4	16.4	16.4	16.4
	8	19.0	19.7	20.3	20.4	20.5	20.6	20.7	20.8
	9	11.4	12.8	13.4	13.5	13.6	13.7	13.8	13.9
	10	24.6	3.6	4.1	4.1	4.1	4.1	4.1	4.1
Braidwood	1	38.0	36.1	38.1	40.2	42.5	44.8	47.3	50.0

Scheme	SPS	SPS Pump rate (L/s)	PWWF to SPS (L/s)						
			2016	2021	2026	2031	2036	2041	2046
	2	20.0	12.1	12.6	13.0	13.5	14.0	14.5	15.1
	3	4.5	0.9	1.0	1.0	1.1	1.1	1.2	1.2
	4	2.8	0.8	0.9	0.9	1.0	1.1	1.2	1.4
	5	8.6	1.1	1.4	1.8	2.2	2.7	3.2	3.7
	6	7.5	0.7	0.9	1.2	1.5	1.8	2.1	2.5
Captains Flat	1	13.2	13.9	14.0	14.2	14.3	14.4	14.6	14.7

Several SPS are currently at risk of wet weather overflows, as the calculated PWWF is greater than the maximum pump rate. It should be noted that this assessment is based on PWWF estimated from the storm allowance. For Braidwood and Bungendore this is almost double the actual inflow received during the highest rainfall event in the last five years. Hence this assessment is based on a very conservative number.

It is recommended that council assess the pump station performance in wet weather events to determine whether an upgrade to pump capacity is required.

9.1.2 Emergency Storage Capacity

The available emergency storage volumes within the pumping stations under current and future projected sewer loads are provided in Table 9.4.

Table 9.4: Emergency storage volume in sewage pumping stations

Scheme	SPS	Pump Well Emergency Storage (kL)	Gravity sewer storage (kL)	Total storage (kL) [1]	ADWF from Gravity (L/s)		Hours storage at ADWF	
					2016	2046	2016	2046
Bungendore	1	40.1	124.7	179.1	2.2	3.1	23	16
	2	7.6	46.6	54.2	1.1	1.5	14	10
	3	3.6	9.7	13.3	0.1	0.1	51	26
	4	24.9	72.4	104.4	1.0	2.7	30	11
	5	8.4	18.1	26.4	0.1	0.1	59	59
	6	8.6	28.3	36.9	0.1	0.1	78	78
	7	9.3	58.0	67.3	1.3	1.4	14	14
	8	14.3	69.4	83.7	0.6	0.6	41	41
	9	15.1	50.0	65.1	0.8	0.8	24	22
	10	25.3	12.1	37.4	0.3	0.3	34	30
Braidwood	1	22.5	50.0	151.5	1.8	2.5	23	17
	2	10.9	0.0	87.0	0.9	1.2	26	21
	3	5.1	10.0	15.1	0.1	0.1	54	41
	4	5.4	7.0	12.4	0.1	0.1	54	30
	5	9.1	3.1	12.2	0.0	0.1	113	33
	6	9.1	3.8	12.9	0.1	0.2	60	17
Captains Flat	1	7.6	10.9	18.5	1.2	1.2	4	4

1 – total storage includes gravity storage from valve pits and old wet wells, provided by Council

In Council's current Levels of Service (see Table 2.3), the response time to have staff on-site for sewage system failures is half an hour during working hours and one hour after working hours. All SPS in Bungendore and Braidwood have much greater than one hour's storage at current and future sewer loads. Captains Flat SPS#1 currently has an estimated 4 hours emergency storage time which meets Council's LOS target could be an issue if the pump fails during a high rainfall event.

9.1.3 Odour/Septicity Potential

Septicity potential is generally assessed by reviewing sewage detention times in pump rising mains According to WSA Guidelines, sewage with a detention time between 4 and 8 hours has a medium risk of septicity, and above 8 hours has a high risk of septicity (13).

The current and future (2046) available storage volumes within the pumping stations are provided in Table 9.5. Detention times greater than 4 hours are highlighted in red. It is recommended that Council investigate these pump stations for septicity issues.

Table 9.5: Detention time in sewer rising mains

Scheme	SPS	Rising main length (m)	Rising main diameter (mm)	SPS Pump rate (L/s)	Cumulative ADWF (L/s)		Detention time at ADWF (hours)	
					2016	2046	2016	2046
Bungendore	1	471	200	61.5	3.3	4.7	1.2	0.9
	2	540	100	10.1	1.1	1.5	1.1	0.8
	3	54	100	3.2	0.1	0.1	1.6	0.8
	4	30	100	27.0	1.0	2.7	0.1	0.0
	5	268	50	4.2	0.1	0.1	1.2	1.2
	6	241	50	2.0	0.1	0.1	1.0	1.0
	7	1,740	150	28.2	1.3	1.4	6.4	6.2
	8	1,445	150	19.0	1.6	1.7	4.3	4.1
	9 [1]	N/A	N/A	11.4	1.1	1.2	NA	NA
	10	110	150	24.6	0.3	0.3	1.8	1.6
Braidwood	1	1271	200	38.0	3.0	4.2	3.7	2.7
	2	590	150	20.0	1.0	1.3	2.9	2.3
	3	189	100	4.5	0.1	0.1	5.3	4.0
	4	215	50	2.8	0.1	0.1	1.8	1.0
	5	228	93	8.6	0.1	0.3	4.8	1.4
	6	80	93	7.5	0.1	0.2	2.5	0.7
Captains Flat	1	230	150	13.2	1.2	1.2	1.0	0.9

1 – Bungendore PS#9 is a lift PS and does not have a rising main

In Bungendore SPS7 and SPS8 are estimated to be at medium risk of odour/septicity issues, due to their relatively long rising mains. These areas are not expected to experience much or any population growth, so odour/septicity issues are not expected to decrease in the 30 year planning period Issue.

In Braidwood, detention times in SPS5 is predicted to fall below four hours detention time by 2020, however SPS3 is expected to remain a medium risk of odour/septicity issues for the next 30 years Issue.

9.2 STP Performance

Time series graphs showing the projected EP growth with the STP design capacity are provided for each STP. All three STPs were designed using typical design hydraulic loadings of 240 L/EP/day.

9.2.1 Bungendore Sewerage Scheme

Bungendore STP can be upgraded from 3,000 EP to 5,000 EP capacity by recommissioning the refurbished 1993 vintage IDEA tank.

Figure 9.1 shows the projected EP growth in Bungendore. At the projected growth and the hydraulic loading of 240 L/EP/day the capacity of 3,000 EP is already exceed. After the commissioning of the second IDEA tank, the STP capacity will increase to 5,000 EP, and this capacity is expected to be exceeded in 2020.

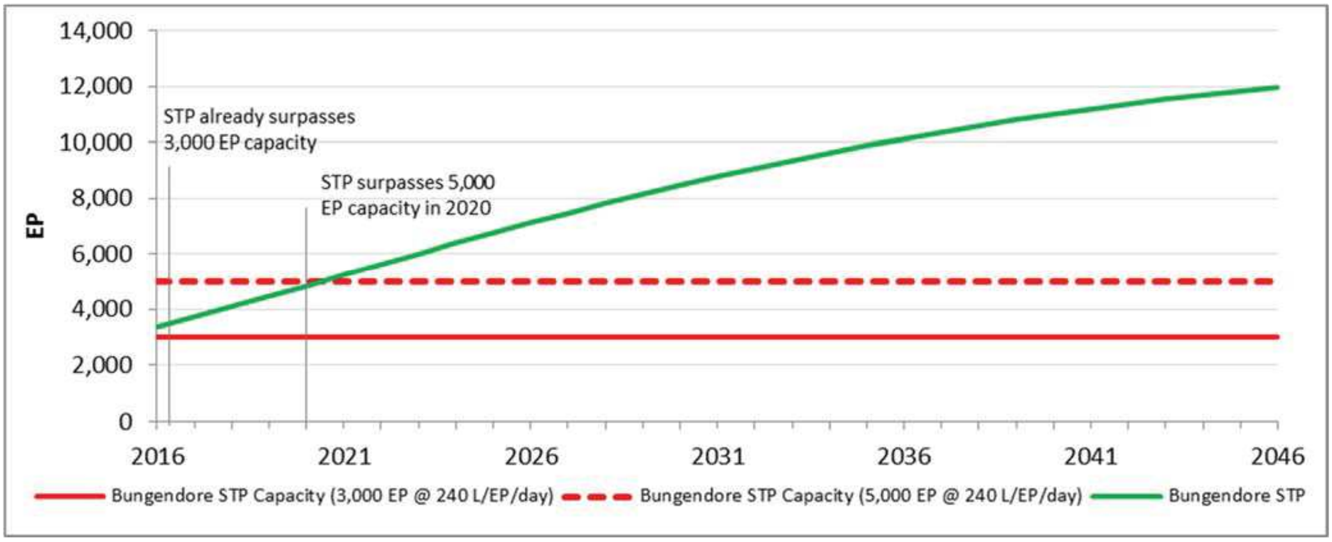

Figure 9.1: Bungendore STP - projected EP growth and STP design capacity @ 240 L/EP/day

For the assessed hydraulic loading of 200 L/EP/day in this study (see Table 6.1), the functional hydraulic capacity of the STP is increased to 3,600 EP. At this capacity the STP hydraulic capacity will is estimated to be exceeded by 2017. See Figure 9.2.

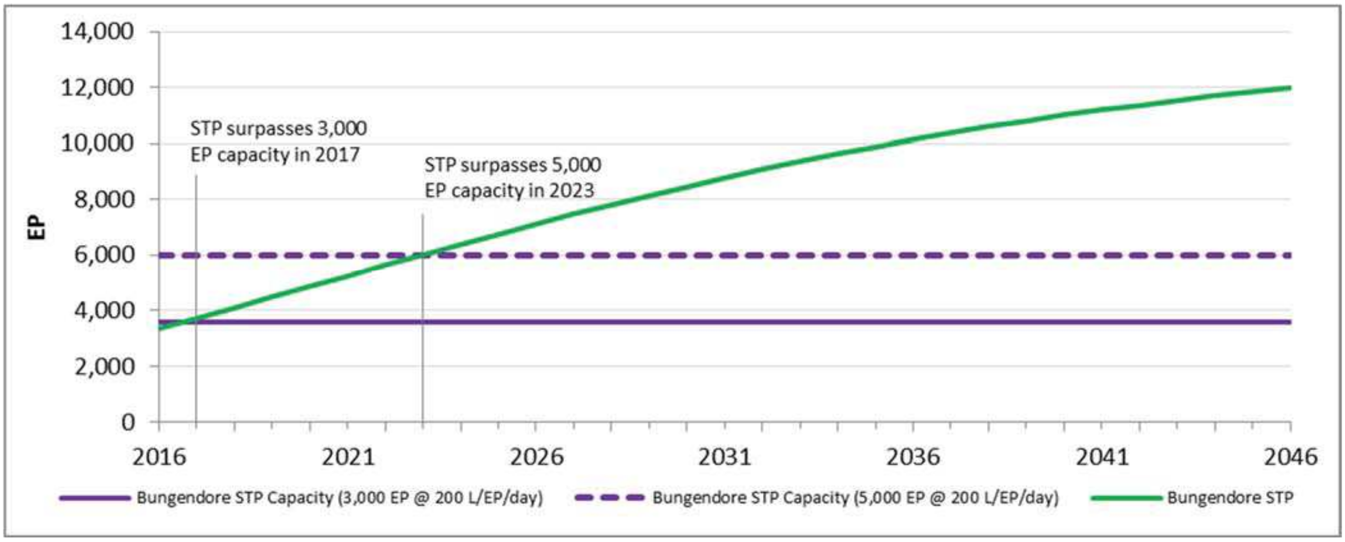

Figure 9.2: Bungendore STP - projected EP growth and STP design capacity @ 210 L/EP/day

9.2.2 Braidwood Sewerage Scheme

Figure 9.3 shows the projected EP growth in Braidwood. It is estimated the capacity of 2,000 EP of the Braidwood STP will be not be exceeded in the 30 year planning period.

The actual influent BOD concentrations at Braidwood were measured to be above the STP design unit loading of 70 g/EP/day (see Section 6.5). It is recommended that Council continue to monitor BOD to ensure the plant biological capacity is not exceeded.

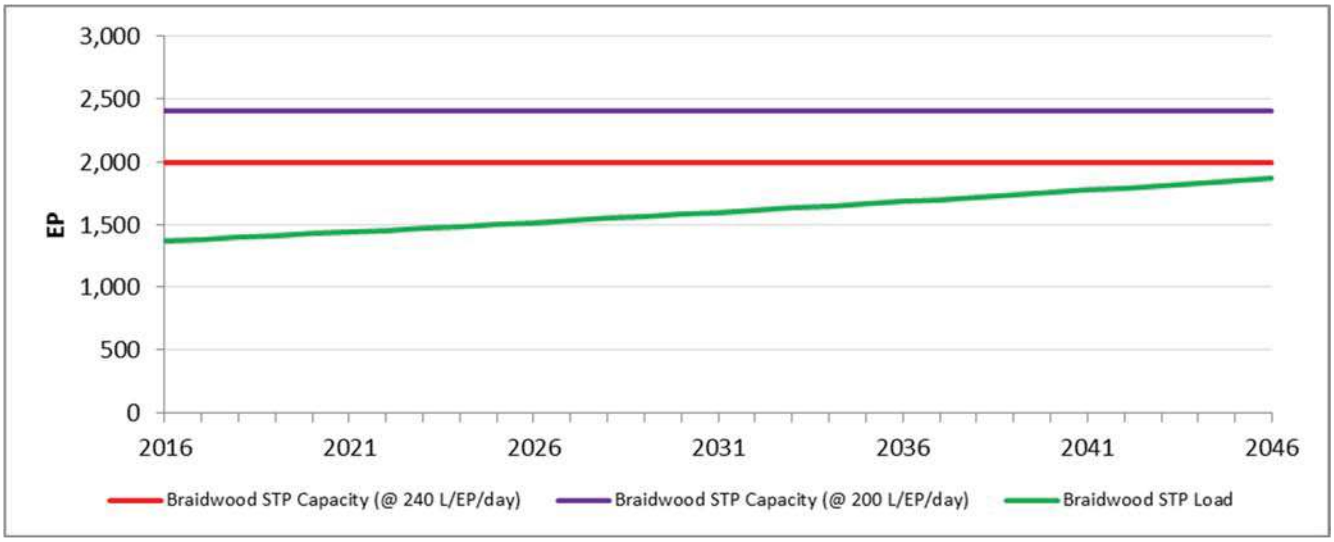

Figure 9.3: Braidwood STP - projected EP growth and STP design capacity

9.2.3 Captains Flat Sewerage Scheme

Figure 9.4 shows the projected EP growth in Captains Flat. It is estimated the capacity of 500 EP of the Captains Flat STP will be not be exceeded in the 30 year planning period.

As described in Section 3.3.4, Council are planning an upgrade to Captains Flat STP over the next 2 years. This upgrade will improve replace ageing infrastructure, improve treatment and enable enhanced phosphorus removal, enable screening and grit removal, improve sludge and sludge drying components and improve amenity and WHS. No additional capacity is being sought.

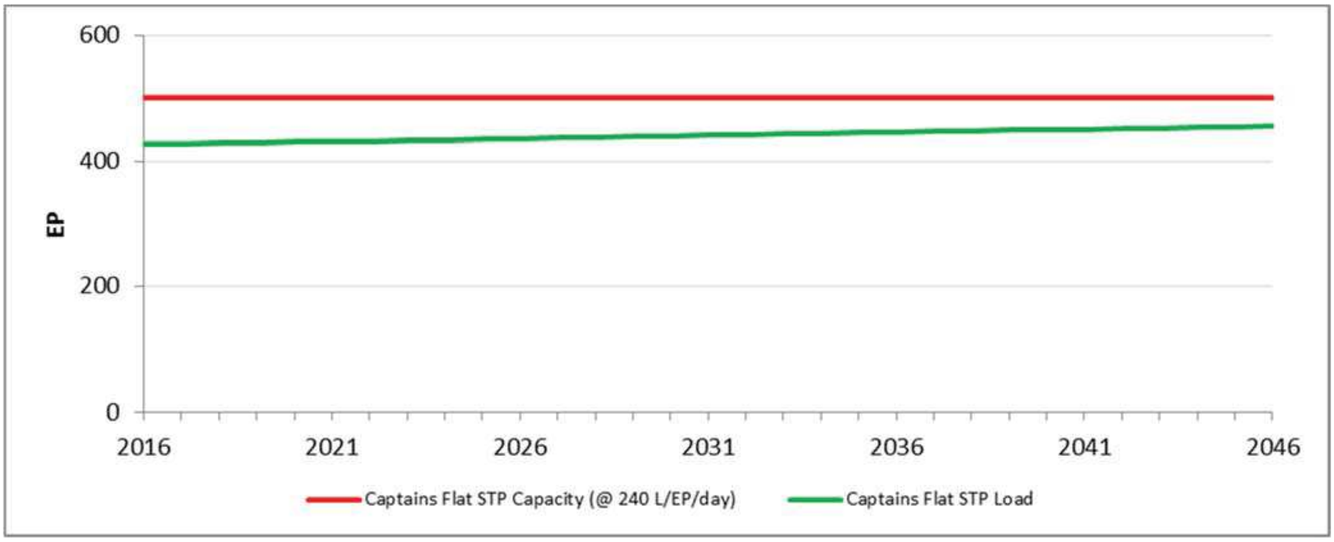

Figure 9.4: Captains Flat STP - projected EP growth and STP design capacity

9.3 Performance against LOS Targets

Council received 6 odour complaints for the treatment works in 2014/15 which is higher than the LOS target of 3 complaints per year. Council has advised this was due to an issue at the sludge ponds which has seen been rectified. Otherwise Council has been operating within LOS Targets.

9.4 Performance against Regulatory Requirements

9.4.1 Performance against EPA Licence Conditions

Bungendore STP

Recent non-compliances with EPA license conditions are summarised in Table 9.6.

Bungendore STP has had two recorded exceedances of phosphorus concentration limits over the last three reporting periods, with unknown causes. It is noted that on occasion algae in the effluent ponds degrades effluent quality.

In their 2016/17 annual return, Council did not have to pay an LBL pollutant fee for Bungendore STP.

Table 9.6 Bungendore Sewerage Non-compliances

Year ending	Type of non-compliance	No. of times occurred
30 June 2016	Phosphorus limit exceeded, cause unknown	1
	Exceeded volumetric limit of 2160kL/day at inlet (Point 1). Heavy rainfall. Coincided with natural disaster declaration from LGA. Monitor into the future. Consider whether an inflow / infiltration study is required	1
30 June 2015	No non-compliances	
30 June 2014	Exceeded discharge volumetric limit once due to wet weather.	1
	Fail pH limit on 2 occasions, suspended solids limit 3 times, phosphorus 4 times. Cause unknown. pH from catch pond consistently good, possibly wildlife activity in tertiary pond. Continue to monitor.	9
30 June 2013	Fail to take required number of samples for points 2 & 3. Licence varied to include new requirement for 4 weekly tests. System implemented from then.	2
	Fail Phosphorous, pH and TSS limit at point 3. Plant commissioned in June/July 2012, including chemical dosing, phosphorous removal. Improved water quality migrating through tertiary pond system.	1
30 June 2012	Continuous logger non-functional during commissioning of new plant. Old inlet works decommissioned as part of commissioning of new plant. New measurement SCADA commence 30 June 2012.	1
	Exceed volumetric inflow on 69 occasions. Caused by heavy rain. Inflows/Infiltration. Measure at outlet done. Alternate through tertiary ponds done.	69
	Exceed BOD & suspended solids once. Cause Algal ref chlorophyll 'a' of 560mg/L. Incidence may be reduced with commissioning of new plant. Nutrients will be reduced with new plant so issue may be less in future.	1
30 June 2011	Exceeded volumetric limit on 50 occasions. Predominately rainfall and associated inflow/infiltration. Construction of 3000 EP plant to supplement existing 2000 EP plant is currently underway due for completion early 2012.	50
	Electronic volume measurement failed. Failure of ultrasonic sensor. New plant being constructed. This will include dedicated outflow measurement as well as inflow.	98

Year ending	Type of non-compliance	No. of times occurred
	No environmental flows at point 2.	4
	Exceed suspended solids limit once, BOD twice. Algal bloom in tertiary ponds. Not strictly an exceedance given condition L3.5.	1
	No environmental flows at Point 2	4

Braidwood STP

Recent non-compliances with EPA license conditions are summarised in Table 9.7

Braidwood STP has exceeded the limit for phosphorus during the last three reporting periods, suspected to be due to under-dosing of Aluminium Sulphate. Operators have increased the frequency of operational testing.

In their 2016/17 annual return, Council did not have to pay an LBL pollutant fee for Braidwood STP.

Braidwood STP has also regularly breached the licence conditions for daily flow. The EPA Licences requires completion of a "Pollution Study: Infiltration Investigation" to address exceedances of the daily volume limit that have occurred over the 2013 - 2014 and 2014 - 2015 annual return reporting periods. The infiltration investigation must use a range of methods, including smoke testing, dye testing and camera work to identify any sources of infiltration in the reticulation system and must be completed by 30 June 2018 and a report is due four months after the infiltration investigation is due.

Table 9.7 Braidwood Sewerage Non-compliance

Year ending	Type of non-compliance	No. of times occurred
30 June 2016	90 percentile phosphorus result exceeded limit of 0.5mg/L. Cause was possibly under-dosing of Aluminium Sulphate. Increased frequency of operational testing. Maintain increase frequency of operational testing	2
	Exceeded volumetric discharge from Point 1, twice. Cause was heavy rain - inflow/infiltration. Council has negotiated with EPA in development of PRP U1.1. Requirement sees study being undertaken in next reporting period	2
30 June 2015	Exceeded 90 percentile limits for phosphorus due to fine tuning of aluminium sulphate dosing. Staff training and elevated monitoring regimen to prevent recurrence	1
	Exceedance of daily volume limit (1,440 kL) – Max recorded 1,725 kL	1
30 June 2014	Fail limit for suspended solids on 2 occasions, nitrogen once, phosphorus twice, and ammonia 3 times, faecal coliforms once.	2
	Exceeded discharge limit once due to heavy rain. Potentially inflow/infiltration study in future.	1
30 June 2013	Limit exceeded for Ammonia, Nitrogen, TSS and pH. Possibly seasonal/high rainfall. Monitor and modify as required.	1
	Exceed volumetric limit twice. Rainfall and resultant inflow/infiltration.	2
30 June 2012	Exceed 90%ile for Ammonia, Nitrogen (total), total Phosphorus caused by alum dosing set too high at commissioning. Dose corrected. TSS exceeded due to inadequate catch pond clean regime. Pond now routinely cleaned monthly.	1

Year ending	Type of non-compliance	No. of times occurred
	Exceed daily volumetric limit at ADP001 due to significant rainfall. Inflow study required in future.	3
	Failed to measure conductivity as criteria inadvertently removed from regime in consideration of draft licence referring to condition L3.3. Parameter reinstated after 23/8/12	1
30 June 2011	Volumetric limit exceeded on 54 occasions due to high influent flows. Revised licence for new plant together with appropriate volumetric limit (pending with OEH).	54
	Failed to test for specific conductance on 2 occasions due to being omitted from test schedule. New licence for issue (pending with OEH). Reinstated for testing in light of delay.	2
	Suspended Solids limit exceeded on 3 occasions due to high algae. New plant commissioned.	3
	Failure of biological process in new Extended Aeration Tank due to suspected biological toxins from raw sewage influent. Plant re-seeded on 2 occasions subsequently.	1

Captains Flat STP

Recent non-compliances with EPA license conditions are summarised in Table 9.8.

Captains Flat STP has also regularly breached the licence conditions for daily flow. The EPA Licence requires completion of a “Pollution Study: Infiltration Investigation” which had to be completed by 30 June 2017. Council has advised that this study has been completed by Interflow and some rectification works have already been done, with more rectification works planned. The Infiltration Investigation and recommendations report is due on September 30 2017, and all recommendations must be implemented by 30 June 2018.

Table 9.8 Captains Flat Sewerage Non-compliances

Year starting	Type of non-compliance	No. of times occurred
30 June 2016	Inflow to plant exceeded the volumetric threshold on 240kL/day on 14 occasions. Cause was rainfall - suspected inflow/infiltration into reticulation network. Development of PRP U1.1 of the licence. PRP to address non-compliance(s) issued **Issue**	14
30 June 2015	Exceeded daily volume limit due to inflow/infiltration in reticulation network. Future inflow/infiltration study to be undertaken.	15
30 June 2014	Missed one quarterly test in May 2014, as operator missed calendar notification. Special supplementary test taken in August 2014. Fiver planned for 14/15 instead of four. Improved calendar notification to prevent recurrence.	1
	Exceed maximum inflow of 240kL/day on 14 occasions. Future inflow/infiltration study and associated works to prevent recurrence	14
30 June 2013	Exceeded maximum daily volumetric limit nine times due to excess rainfall – inflow/infiltration. Future inflow/infiltration study to be conducted.	5
30 June 2012	Exceed volumetric limit, caused by rainfall/ inflow/ infiltration. Action taken will be an inflow study.	34
30 June 2011	Exceed volumetric limit due to rainfall.	30
	Suspended solids limit exceeded on 2 occasions. Algae in tertiary ponds.	2

9.4.2 Performance of effluent reuse schemes

Bungendore STP

A preliminary assessment of the LRV values for the Bungendore effluent reuse application and the LRV achieved by the treatment process was undertaken using DPI Water's RWMS Guidance Document (14). The results are presented in Table 9.9.

It should be noted that the treatment process may not meet the minimum required LRV for viruses, depending on the effectiveness of the treatment processes.

Table 9.9: Bungendore LRV targets and minimum values achieved from treatment

End User	Log Reduction Values		
	Protozoa	Virus	Bacteria
LRV Targets			
Municipal Use – open spaces, sports grounds, golf courses, public gardens, dust suppression or unrestricted access and application	3.7	5.2	4.0
Indicative LRV for treatment processes			
Primary Treatment	0.0 – 0.5	0.0 – 0.1	0.0 – 0.5
Secondary Treatment	0.5 – 2.0	0.5 – 2.0	1.0 – 3.0
Lagoon Storage	1.0 – 3.5	1.0 – 4.0	3.0 – 5.0
Chlorination	0 – 0.5	1.0 – 4.0	2.0 – 4.0
UV Disinfection	3.0 – 4.0	Adenovirus 1.0 – 4.0 Other 3.0 – 4.0	2.0 – 4.0
Total	**4.5 – 10.5**	**Adenovirus 3.5 – 14.1 Other 5.5 – 14.1**	**8.0 – 16.5**

Braidwood STP

A preliminary assessment of the LRV values for the Braidwood effluent reuse application and the LRV achieved by the treatment process was undertaken using DPI Water's RWMS Guidance Document (14). The results are presented in Table 3.7.

It should be noted that the treatment process may not meet the minimum required LRV for Protozoa, Virus and Bacteria depending on the effectiveness of the treatment processes.

Table 9.10: Braidwood LRV targets and minimum values achieved from treatment

End User	Log Reduction Values		
	Protozoa	Virus	Bacteria
LRV Targets			
Municipal Use – open spaces, sports grounds, golf courses, public gardens, dust suppression or unrestricted access and application	3.7	5.2	4.0
Indicative LRV for treatment processes			
Primary Treatment	0.0 – 0.5	0.0 – 0.1	0.0 – 0.5
Secondary Treatment	0.5 – 2.0	0.5 – 2.0	1.0 – 3.0
UV Disinfection	3.0 – 4.0	Adenovirus 1.0 – 4.0 Other 3.0 – 4.0	2.0 – 4.0
Total	**3.5 – 6.5**	**Adenovirus 1.5 – 6.1 Other 3.5 – 6.1**	**3.0 – 7.5**

9.4.3 Performance in latest WHS Audit

Council does not have a formal Work Health and Safety Management system. **Issue**

10 Unserviced communities

Council provided On-site Sewage Management Systems (OSSMS) records from their internal Health and Building Department. The records can be found in Appendix G. Most of the areas listed are rural localities with large rural lots. Council staff advised there are few villages in the former Palerang LGA that are not connected to the town water supply or sewerage - Nerriga, Majors Creek and Araluen.

Of Council's 4,538 registered OSSM systems, approximately 3,000 are septic tanks, 1,250 are Aerated wastewater treatment systems (AWTS), with the remainder being Cess Pits, Dry or Wet composting, Grey Water treatment or other. Approximately 250 received High Risk – two year approval, 3,900 received Medium Risk – five year approval, and 385 failed inspection. These failures could pose a serious environmental and public health threat. Almost all of the former Palerang area is part of a catchment supplying drinking water to Sydney, Canberra and local towns.

The OSSMS in Majors Creek and Araluen are performing well, with only 4 out of 114 OSSMs in Araluen and 9 out of 143 failing inspection. However in Nerriga 16 out of 65 OSSMS (25%) are failing. In Captains Flat there are 66 OSSMS, 12 of which are failing. Some of these may be in the area known locally as Beverly Hills, which is supplied by water but not sewerage services.

A preliminary assessment of the operating environment at the villages of Majors Creek, Nerriga and Araluen, and the large rural residential area of Wamboin were undertaken in accordance with the Department of Local Government document "On-site sewage management for single households", Jan 1998. The issues are identified in Table 10.1.

Table 10.1: OSSMS Assessment

Parameter	Lot Size	Buffer distance to permanent surface water	Site Drainage
OSSMS Requirements			
Requirement	Minimum 4,000 to 5,000 m2	Minimum 100 m	Well drained
Risk if requirement not met	Public health risk (human contact), Environmental contamination (insufficient area for sustainable disposal)	Contamination of surface water	Resurfacing hazard - Public health risk (human contact)
Village Assessment			
Village of Majors Creek	Many properties around 3,000 m^2. Several smaller properties around 1000 m^2. Area zoned as RU5 Village, surrounded by RU1 Primary Production **Potential issue**	Some properties are < 60 m from back of property to Majors Creek **Potential issue**	Red Kurosol, Brown Kurosol. Moderately well drained to imperfectly drained [1] **Potential issue**
Village of Nerriga	Village properties of various sizes below 3,000 m^2 Area zoned as RU5 Village, surrounded by RU1 Primary Production **Potential issue**	Properties near Nerriga Historical Museum are close to Bindi Brook. Buffer distance could be 70 to 180 m depending on location of OSSM system on property. **Potential issue**	Rudosol, Leptic, Lithic, Basic, very gravelly, clay loamy, very shallow Highly permeable, well drained, [2] **Likely no issue.**

Parameter	Lot Size	Buffer distance to permanent surface water	Site Drainage
Village of Araluen	Several properties less than 1,500 m^2 bordering each other. Area zoned as RU5 Village and E4 Environmental Living, surrounded by RU1 Primary Production **Potential issue**	Several properties less than 100 m to Araluen Creek which has been known to flood. **Likely no issue.**	Tenosol, Yellow Podzolic Soil. Imperfectly drained, slight erosion hazard [3] **Potential issue**
Village of Wamboin	Large 1.8 Ha – 8 Ha lots (measured from satellite maps). Area zoned as E4 Environmental Living. **No issue**	Several large properties border the Yass River. Buffer distance could be 0 to >500 m depending on location of OSSM system on property. **Likely no issue.**	Solodic Soil. Moderately permeable, imperfectly drained [4] **Potential issue**
Village of Carwoola	Large 1.8 Ha – 8 Ha lots (measured from satellite maps). Area zoned as E4 Environmental Living. **No issue**	Several large properties border the Molonglo River. Buffer distance could be 0 to >500 m depending on location of OSSM system on property. **Likely no issue.**	Alluvium Soil, Siltstone/ mudstone. Very slowly permeable, imperfectly drained [5] **Potential issue**

1 - Soil Technical Report, *OBSCRAS - ARALUEN (1003635) Prof 109*, © Office of Environment and Heritage
2 - Soil Technical Report, Sydney Catchment Authority reconnaissance soil survey – Ulladulla (1004270) Prof 92 © Office of Environment and Heritage
3 - Soil Technical Report, *OBSCRAS - ARALUEN (1003635) Prof 110*, © Office of Environment and Heritage
4 - Soil Technical Report, Soil Landscapes of the Canberra 1:100 000 Sheet (1000464) Prof 7, © Office of Environment and Heritage
5 - Soil Technical Report, Soil Landscapes of the Canberra 1:100 000 Sheet (1000464) Prof 33, © Office of Environment and Heritage

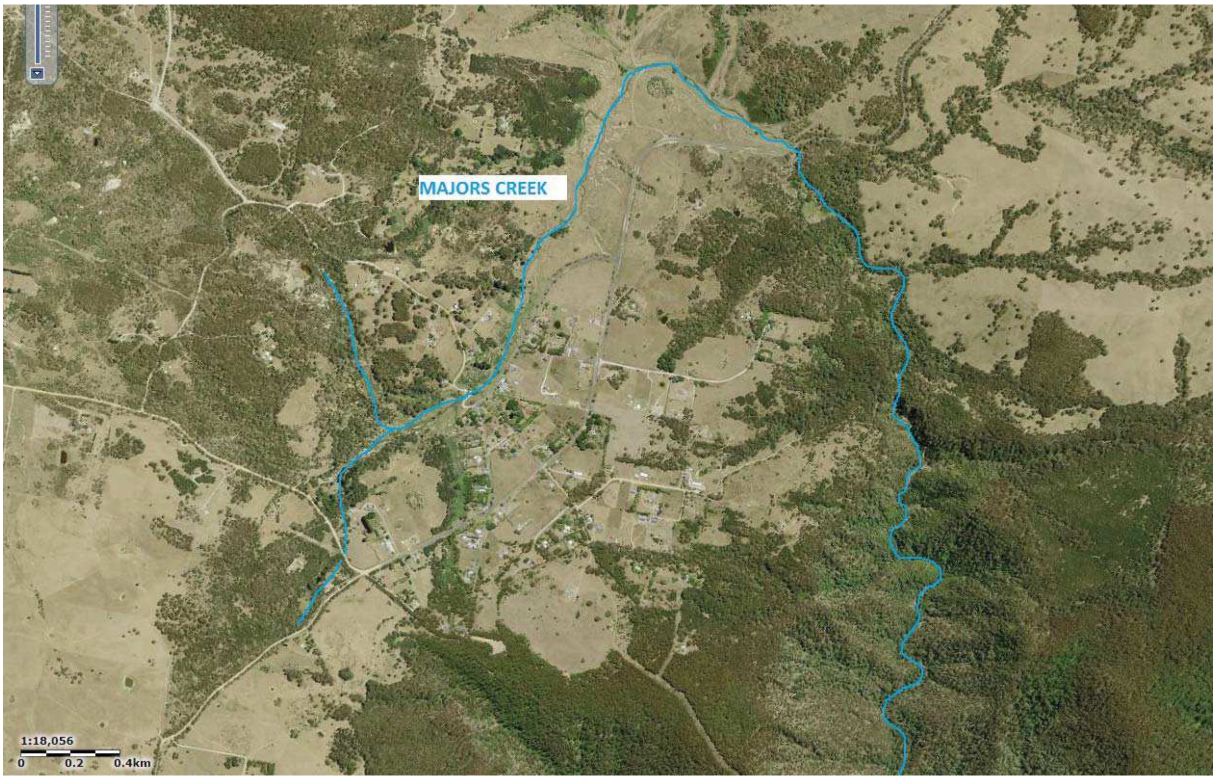

Figure 10.1: Unserviced Area - Majors Creek

Figure 10.2: Unserviced Area - Nerriga

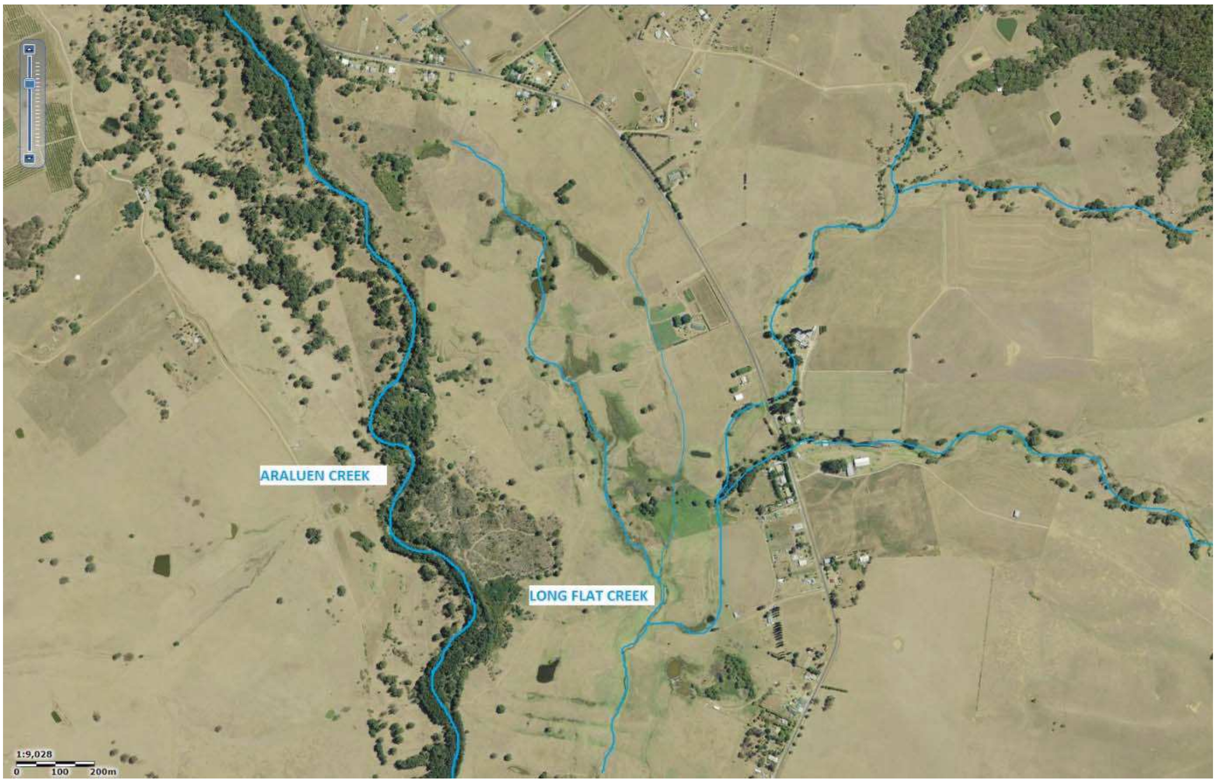

Figure 10.3: Unserviced Area - Araluen

Figure 10.4: Unserviced Area - Wamboin

Figure 10.5: Unserviced Area - Carwoola

11 IWCM Issues

The general IWCM issues are listed in Table 11.1.

Table 11.1: General IWCM System Issues

Issue Type	Target for Compliance	Issue
Work Health and Safety (WHS)	Management System	Council does not have a documented Work and Health and Safety system. Council undertakes periodic WHS reviews but these are not documented
Levels of Service	Description and performance	There is no centralised data management system in place to monitor and measure the system performance against the levels of service (LOS) The LOS need to be reviewed for the newly formed Queanbeyan-Palerang Regional Council.
Best Practice	Pricing	Council currently has a two tier inclining block tariff structure for water supply. Council should consider moving towards a fixed rate tariff structure.

The water supply system issues are outlined in Table 11.2.

Table 11.2: Water Supply System Issues

Issue Type	Target for Compliance	Issue
General water supply issues		
Level of Service	Minimum pressure with firefighting capability	Council have nominated 'positive residual head' as the target for compliance, the current performance needs to be better understood through modelling.
Regulatory	Fluoridation of Public Water Supplies	The requirement for periodic auditing of the fluoridation systems is not always being met.
Regulatory	Drinking Water Management System	Several of the nominated CCPs in the DWMS are not considered CCPs like free chlorine in the reticulation. The turbidity alert limit corrective action for Captains Flat WTP needs to include a membrane integrity test.
Bungendore water supply issues		
Performance	Non-revenue water	Non-revenue water at Bungendore has been fairly constant at 125 L/connection/ day. This is higher than the state wide median of 92 L/connection/day for 2015/16.
Water security	Licensed allocation	It is estimated that Bungendore water supply dry year extraction will exceed its licensed extraction limit from the Bungendore and Currandooly bores by 2018.
Level of Service	Headworks capacity	The peak day demand will exceed the combined capacity of the Bungendore and Currandooly WTPs around 2025. The WTP, and reservoir capacity would need to be reviewed to ensure that the required pressure can be maintained in the system.
Braidwood water supply issues		
Performance	Non-revenue water	Non-revenue water at Braidwood is on average 280 L/connection/ day. This is higher than the state wide median of 92 L/connection/day for 2015/16.

Issue Type	Target for Compliance	Issue
Captains Flat water supply system		
Performance	Non-revenue water	Seasonal variations in the NRW for the Captains Flat system have been noticed which are due to a faulty meter at the Captains Flat swimming pool and the neighbouring fields which share a meter. This meter recently been replaced.

The water supply system issues are outlined in Table 11.3.

Table 11.3: Sewerage System Issues

Issue Type	Target for Compliance	Issue
General sewerage system issues		
Unserviced communities	On-site sewage management systems	Village of Majors Creek – potential issue due to the following reasons: • Small lot sizes (some around 3,000 & several around 1,000 m^2) • Inadequate buffer distance from Majors Creek • Moderately well to imperfectly drained soil Village of Nerriga – potential issue due to the following reasons: • Small lot sizes (various sizes below 3,000 m^2) • Some properties may have inadequate buffer distance from Bindi Brook Village of Araluen – potential issue due to the following reasons: • Small lot sizes (several properties less than 1,500 m^2 bordering each other) • Moderately permeable, imperfectly drained soil.
Bungendore sewerage system issues		
Best Practice	Section 60 approval	Effluent from the Bungendore STP is reused on-site, for road works (truck filling) and for watering Bungendore oval. Council does not have a Recycled Water Management Plan and Section 60 approval for the off-site effluent reuse.
		The Log Reduction Value (LRV) required for effluent reuse may not be achieved through the current STP process. This will be reviewed during the preparation of the Recycled Water Management System (RWMS) for Section 60 approval.
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit in 2016, 2014, 2012 and 2011. Council needs to consider undertaking an inflow/infiltration study.
Performance	Effluent reuse flow balance	There is a mismatch in the effluent reuse flow balance. Potential reasons for the discrepancy could include uncalibrated meters, and on-site flows which may not be metered.
Sewer catchment performance	Pump sizing @ PWWF	The PWWF at catchment #2, 8 and 9 exceeds the capacity of a single pump. The PWWF at catchments #4 will exceed the capacity of a single pump by 2021. This is based on a PWWF calculated from the storm allowance which is twice the maximum flow recorded during the highest rainfall event in the last five years. Hence this is a conservative assessment.

Issue Type	Target for Compliance	Issue
	Odour/septicity potential	Catchment #7 and 8 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. This risk is expected to continue over the 30 year planning period.
Capacity	Sewage Treatment Plant	The EP load currently exceeds the 3,000 EP STP capacity, and is expected to exceed the 5,000 EP capacity by 2020. For the assessed hydraulic loading of 200 L/EP/day in this study, the plant hydraulic and capacity will be exceeded by: • 2018 for the 3,000 EP STP, or 2023 when capacity is increased to 5,000 EP by commissioning the second IDEA reactor.
Braidwood sewerage system issues		
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.
Sewer catchment performance	Pump sizing	The PWWF at catchment #1 will exceed the capacity of a single pump by 2021.Council has funded for an upgrade.
	Odour/septicity potential	Catchment #3, and 5 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. The risk for Catchment #5 is expected to drop to low risk by 2020, however Catchment #3 is expected to remain at medium risk.
Captains Flat sewerage system issues		
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.
Sewer catchment performance	Pump sizing	The PWWF at catchment #1 is expected to exceed the duty pump capacity.
Performance	Sewage Treatment Plant	The plant needs to be upgraded to improve replace ageing infrastructure, improve treatment and enable enhanced phosphorus removal, enable screening and grit removal, improve sludge and sludge drying components and improve amenity and WHS.

12 Bibliography

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Appendices

Appendix A Projections

A.1 Total Residential Properties

Number of residential properties (from Council map)	2016	2021	2026	2031	2036	2041	2046
BU SPS1	312	330	348	368	388	410	432
BU SPS2	190	208	227	248	250	250	250
BU SPS3	11	12	14	15	17	19	21
BU SPS4	224	472	472	472	472	472	472
BU SPS5	21	21	21	21	21	21	21
BU SPS6	20	20	20	20	20	20	20
BU SPS7	214	216	218	219	219	219	219
BU SPS8	89	89	89	89	89	89	89
BU SPS9	122	123	124	126	127	128	130
BU SPS10	52	58	58	58	58	58	58
Elmslea North	0	132	300	300	300	300	300
Bungendore East	0	220	591	700	700	700	700
Extra Possible	0	0	54	464	899	1,231	1,473
Not on sewer	12	12	12	12	12	12	12
Total on water	**1,267**	**1,912**	**2,549**	**3,111**	**3,572**	**3,930**	**4,197**
Total on sewer	**1,255**	**1,900**	**2,537**	**3,099**	**3,560**	**3,918**	**4,185**

Number of residential properties (>0)	2016	2021	2026	2031	2036	2041	2046
BR SPS1	316	332	349	367	386	405	426
BR SPS2	119	125	131	138	145	153	160
BR SPS3	14	15	15	16	17	18	19
BR SPS4	15	16	18	19	21	23	24
BR SPS5	4	6	8	10	12	15	17
BR SPS6	14	18	22	26	31	37	42
Not on sewer	48	48	48	48	48	48	48
Total on water	**530**	**560**	**591**	**624**	**660**	**697**	**737**
Total on sewer	**482**	**512**	**543**	**576**	**612**	**649**	**689**

Number of residential properties (>0)	2016	2021	2026	2031	2036	2041	2046
CF SPS1	212	214	216	218	221	223	225
Not on sewer	12	12	12	12	12	12	12
Total on water	**224**	**226**	**228**	**230**	**233**	**235**	**237**
Total on sewer	**212**	**214**	**216**	**218**	**221**	**223**	**225**

A.2 Total Occupied Residential Properties

The 2016 estimated occupied residential properties were identified from billing data as properties using over 110 L/day on average.

The occupied residential properties increase for each new residential property in Appendix A.1.

Number of occupied residential properties (>110)	2016	2021	2026	2031	2036	2041	2046
BU SPS1	269	287	305	325	345	367	389
BU SPS2	162	180	199	220	222	222	222
BU SPS3	11	12	14	15	17	19	21

BU SPS4	135	383	383	383	383	383	383
BU SPS5	19	19	19	19	19	19	19
BU SPS6	20	20	20	20	20	20	20
BU SPS7	203	205	207	208	208	208	208
BU SPS8	87	87	87	87	87	87	87
BU SPS9	116	117	118	120	121	122	124
BU SPS10	46	52	52	52	52	52	52
Elmslea North	0	132	300	300	300	300	300
Bungendore East	0	220	591	700	700	700	700
Extra Possible	0	0	54	464	899	1231	1473
Not on sewer	6	6	6	6	6	6	6
Total on water	**1,074**	**1,719**	**2,356**	**2,918**	**3,379**	**3,737**	**4,004**
Total on sewer	**1,068**	**1,713**	**2,350**	**2,912**	**3,373**	**3,731**	**3,998**

Number of occupied residential properties (>110)	2016	2021	2026	2031	2036	2041	2046
BR SPS1	278	294	311	329	348	367	388
BR SPS2	107	113	119	126	133	141	148
BR SPS3	12	13	13	14	15	16	17
BR SPS4	13	14	16	17	19	21	22
BR SPS5	4	6	8	10	12	15	17
BR SPS6	12	16	20	24	29	35	40
Not on sewer	43	43	43	43	43	43	43
Total on water	**469**	**499**	**530**	**563**	**599**	**636**	**676**
Total on sewer	**426**	**456**	**487**	**520**	**556**	**593**	**633**

Number of occupied residential properties (>110)	2016	2021	2026	2031	2036	2041	2046
CF SPS1	182	184	186	188	191	193	195
Not on sewer	11	11	11	11	11	11	11
Total on water	**193**	**195**	**197**	**199**	**202**	**204**	**206**
Total on sewer	**182**	**184**	**186**	**188**	**191**	**193**	**195**

A.3 Population Projection

Population	2016	2021	2026	2031	2036	2041	2046
BU SPS1	788	840	894	951	1,012	1,076	1,140
BU SPS2	475	527	584	646	651	651	651
BU SPS3	32	36	40	45	50	56	62
BU SPS4	396	1,123	1,123	1,123	1,123	1,123	1,123
BU SPS5	56	56	56	56	56	56	56
BU SPS6	59	59	59	59	59	59	59
BU SPS7	595	601	608	610	610	610	610
BU SPS8	255	255	255	255	255	255	255
BU SPS9	340	344	347	351	355	358	362
BU SPS10	135	152	152	152	152	152	152
Elmslea North	0	386	879	879	879	879	879

Bungendore East	0	644	1,731	2,052	2,052	2,052	2,052
Extra Possible	0	0	160	1,359	2,635	3,609	4,317
Not on sewer	18	18	18	18	18	18	18
Total on water	**3,148**	**5,039**	**6,905**	**8,554**	**9,904**	**10,952**	**11,734**
Total on sewer	**3,130**	**5,022**	**6,887**	**8,536**	**9,887**	**10,934**	**11,717**

Population	2016	2021	2026	2031	2036	2041	2046
BR SPS1	630	666	704	745	787	832	879
BR SPS2	242.3172	256	271	286	302	318	336
BR SPS3	27.17576	29	30	32	34	36	38
BR SPS4	29.4404	32	35	39	42	46	51
BR SPS5	9.058586	13	17	22	27	33	39
BR SPS6	27.17576	36	45	55	66	78	92
Not on sewer	97.3798	97	97	97	97	97	97
Total on water	**1,062**	**1,129**	**1,200**	**1,276**	**1,356**	**1,441**	**1,532**
Total on sewer	**965**	**1,032**	**1,103**	**1,179**	**1,259**	**1,344**	**1,434**

Population	2016	2021	2026	2031	2036	2041	2046
CF SPS1	402	407	411	416	421	426	431
Not on sewer	24.29412	24	24	24	24	24	24
Total on water	**426**	**431**	**436**	**440**	**445**	**450**	**455**
Total on sewer	**402**	**407**	**411**	**416**	**421**	**426**	**431**

A.4 Sewer ET Projections

A.4.1 Bungendore

Res ET	2016	2021	2026	2031	2036	2041	2046
BU SPS1	269	287	305	325	345	367	389
BU SPS2	162	180	199	220	222	222	222
BU SPS3	11	12	14	15	17	19	21
BU SPS4	135	383	383	383	383	383	383
BU SPS5	19	19	19	19	19	19	19
BU SPS6	20	20	20	20	20	20	20
BU SPS7	203	205	207	208	208	208	208
BU SPS8	87	87	87	87	87	87	87
BU SPS9	116	117	118	120	121	122	124
BU SPS10	46	52	52	52	52	52	52
Elmslea North	0	132	300	300	300	300	300
Bungendore East	0	220	591	700	700	700	700
Extra Greenfields	0	0	54	464	899	1231	1473
Total	1068	1713	2350	2912	3373	3731	3998

Non-res ET	2016	2021	2026	2031	2036	2041	2046
BU SPS1	64	66	68	70	72	75	77
BU SPS2	0	0	0	0	0	0	0

BU SPS3	0	0	0	0	0	0	0
BU SPS4	11	11	11	12	12	13	14
BU SPS5	0	0	0	0	0	0	0
BU SPS6	0	0	0	0	0	0	0
BU SPS7	0	0	0	0	0	0	0
BU SPS8	0	0	0	0	0	0	0
BU SPS9	0	0	0	0	0	0	0
BU SPS10	0	0	0	0	0	0	0
Elmslea North	0	0	0	0	0	0	0
Bungendore East	0	0	0	0	0	0	0
Extra Greenfields	0	0	0	0	0	0	0
Total	75	77	80	82	85	88	91

Total Sewer ET	2016	2021	2026	2031	2036	2041	2046
BU SPS1	333	353	373	395	418	442	466
BU SPS2	162	180	199	220	222	222	222
BU SPS3	11	12	14	15	17	19	21
BU SPS4	146	394	394	395	395	396	397
BU SPS5	19	19	19	19	19	19	19
BU SPS6	20	20	20	20	20	20	20
BU SPS7	203	205	207	208	208	208	208
BU SPS8	87	87	87	87	87	87	87
BU SPS9	116	117	118	120	121	122	124
BU SPS10	46	52	52	52	52	52	52
Elmslea North	0	132	300	300	300	300	300
Bungendore East	0	220	591	700	700	700	700
Extra Greenfields	0	0	54	464	899	1231	1473
Total	1143	1790	2429	2995	3458	3818	4088

A.4.2 Braidwood

Res ET	2016	2021	2026	2031	2036	2041	2046
BR SPS1	278	294	311	329	348	367	388
BR SPS2	107	113	119	126	133	141	148
BR SPS3	12	13	13	14	15	16	17
BR SPS4	13	14	16	17	19	21	22
BR SPS5	4	6	8	10	12	15	17
BR SPS6	12	16	20	24	29	35	40
Total	426	456	487	520	556	593	633

Non-res ET	2016	2021	2026	2031	2036	2041	2046
BR SPS1	94	96	98	99	101	103	106
BR SPS2	81	81	81	81	82	82	82
BR SPS3	4	4	4	4	4	4	4
BR SPS4	0	0	0	0	0	0	0
BR SPS5	2	2	2	2	2	2	2

BR SPS6	0	0	0	0	0	0	0
Total	180	182	184	187	189	191	194

Total Sewer ET	2016	2021	2026	2031	2036	2041	2046
BR SPS1	372	390	409	428	449	471	493
BR SPS2	188	194	201	208	215	223	231
BR SPS3	16	16	17	18	19	20	20
BR SPS4	13	14	16	17	19	21	22
BR SPS5	6	8	10	12	14	17	20
BR SPS6	12	16	20	24	29	35	40
Total	606	638	672	707	745	785	827

A.4.3 Captains Flat

Res ET	2016	2021	2026	2031	2036	2041	2046
CF SPS1	182	184	186	188	191	193	195
Total	182	184	186	188	191	193	195

Non-res ET	2016	2021	2026	2031	2036	2041	2046
CF SPS1	11	11	11	11	11	11	11
Total	11	11	11	11	11	11	11

Total Sewer ET	2016	2021	2026	2031	2036	2041	2046
CF SPS1	193	195	197	199	202	204	206
Total	193	195	197	199	202	204	206

A.5 Sewer EP Projections

A.5.1 Bungendore

Res EP	2016	2021	2026	2031	2036	2041	2046
BU SPS1	788	840	894	951	1,012	1,076	1,140
BU SPS2	475	527	584	646	651	651	651
BU SPS3	32	36	40	45	50	56	62
BU SPS4	396	1,123	1,123	1,123	1,123	1,123	1,123
BU SPS5	56	56	56	56	56	56	56
BU SPS6	59	59	59	59	59	59	59
BU SPS7	595	601	608	610	610	610	610
BU SPS8	255	255	255	255	255	255	255
BU SPS9	340	344	347	351	355	358	362
BU SPS10	135	152	152	152	152	152	152
Elmslea North	0	386	879	879	879	879	879
Bungendore East	0	644	1,731	2,052	2,052	2,052	2,052
Extra Greenfields	0	0	160	1,359	2,635	3,609	4,317
Total	3,130	5,022	6,887	8,536	9,887	10,934	11,717

Non-res EP	2016	2021	2026	2031	2036	2041	2046
BU SPS1	189	194	199	205	212	219	226
BU SPS2	0	0	0	0	0	0	0
BU SPS3	0	0	0	0	0	0	0
BU SPS4	31	32	34	35	36	38	40
BU SPS5	0	0	0	0	0	0	0
BU SPS6	0	0	0	0	0	0	0
BU SPS7	0	0	0	0	0	0	0
BU SPS8	0	0	0	0	0	0	0
BU SPS9	0	0	0	0	0	0	0
BU SPS10	0	0	0	0	0	0	0
Elmslea North	0	0	0	0	0	0	0
Bungendore East	0	0	0	0	0	0	0
Extra Greenfields	0	0	0	0	0	0	0
Total	220	226	233	240	248	257	266

Total Sewer EP	2016	2021	2026	2031	2036	2041	2046
BU SPS1	977	1,034	1,094	1,157	1,224	1,295	1,366
BU SPS2	475	527	584	646	651	651	651
BU SPS3	32	36	40	45	50	56	62
BU SPS4	427	1,155	1,156	1,158	1,159	1,161	1,162
BU SPS5	56	56	56	56	56	56	56
BU SPS6	59	59	59	59	59	59	59
BU SPS7	595	601	608	610	610	610	610
BU SPS8	255	255	255	255	255	255	255
BU SPS9	340	344	347	351	355	358	362
BU SPS10	135	152	152	152	152	152	152
Elmslea North	0	386	879	879	879	879	879
Bungendore East	0	644	1,731	2,052	2,052	2,052	2,052
Extra Greenfields	0	0	160	1,359	2,635	3,609	4,317
Total	3,350	5,248	7,120	8,777	10,135	11,191	11,982

A.5.2 Braidwood

Res EP	2016	2016	2016	2016	2016	2016	2016
BR SPS1	630	666	704	745	787	832	879
BR SPS2	242	256	271	286	302	318	336
BR SPS3	27	29	30	32	34	36	38
BR SPS4	29	32	35	39	42	46	51
BR SPS5	9	13	17	22	27	33	39
BR SPS6	27	36	45	55	66	78	92
Total	965	1,032	1,103	1,179	1,259	1,344	1,434

Non-res EP	2016	2016	2016	2016	2016	2016	2016
BR SPS1	213	217	221	225	230	234	239

BR SPS2	183	183	184	184	185	185	186
BR SPS3	8	8	8	8	8	8	8
BR SPS4	0	0	0	0	0	0	0
BR SPS5	5	5	5	5	5	5	5
BR SPS6	0	0	0	0	0	0	0
Total	408	413	418	423	428	433	439

Total Sewer EP	2016	2016	2016	2016	2016	2016	2016
BR SPS1	842	883	925	970	1,017	1,066	1,118
BR SPS2	425	439	454	470	487	504	522
BR SPS3	35	37	39	40	42	44	46
BR SPS4	29	32	35	39	42	46	51
BR SPS5	14	18	22	27	32	38	45
BR SPS6	27	36	45	55	66	78	92
Total	1,373	1,445	1,521	1,601	1,687	1,777	1,873

A.5.3 Captains Flat

Res EP	2016	2021	2026	2031	2036	2041	2046
CF SPS1	402	407	411	416	421	426	431
Total	402	407	411	416	421	426	431

Non-res EP	2016	2021	2026	2031	2036	2041	2046
CF SPS1	24	24	24	24	24	24	24
Total	24	24	24	24	24	24	24

Total Sewer EP	2016	2021	2026	2031	2036	2041	2046
CF SPS1	426	431	436	441	445	450	455
Total	426	431	436	441	445	450	455

A.6 Water Projections

A.6.1 Average Year Demands

New Residential	2016	2021	2026	2031	2036	2041	2046
Bungendore	0	116	231	332	415	479	527
Braidwood	0	5	11	17	23	30	37
Captains Flat	0	0	1	1	2	2	2
Bungendore (third pipe - external use only)	0	77	154	221	277	320	352
Bungendore (third pipe - external and internal use)	0	65	128	184	231	266	293

New Commercial	2016	2021	2026	2031	2036	2041	2046

Bungendore	**0.0**	0.6	1.3	2.0	2.7	3.5	4.3
Braidwood	**0.0**	0.4	0.7	1.1	1.5	1.9	2.3
Captains Flat	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0

New Education

	2016	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Bungendore	0.0	0.2	0.5	0.8	1.1	1.4	1.8
Braidwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Captains Flat	0.0	0.0	0.0	0.0	0.0	0.0	0.0

New Park and Gardens

	2016	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Bungendore	0.0	0.0	25.0	25.0	25.0	25.0	25.0
Braidwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Captains Flat	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bungendore (new parks on reuse)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Total

	2016	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Bungendore	262	379	519	621	705	771	820
Braidwood	119	125	131	137	144	151	158
Captains Flat	42	42	42	43	43	44	44
Bungendore (third pipe - external use only)	262	340	442	511	567	611	644
Bungendore (third pipe - external and internal use)	262	327	417	474	521	558	586
Bungendore (new Parks on reuse)	262	379	494	596	680	746	795

A.6.2 Dry Year Demands

New Residential

	2016	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Bungendore	0	155	308	443	553	639	703
Braidwood	0	7	15	23	31	40	50
Captains Flat	0	1	1	2	2	3	3
Bungendore (third pipe - external use only)	0	77	154	221	277	320	352
Bungendore (third pipe - external and internal use)	0	65	128	184	231	266	293

New Commercial

Same as average year	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2046**
Bungendore	**0**	1	1	2	3	4	4
Braidwood	**0**	0	1	1	1	2	2
Captains Flat	**0**	0	0	0	0	0	0

New Education

Same as average year	2016	2021	2026	2031	2036	2041	2046
Bungendore	0	0	0	1	1	1	2
Braidwood	0	0	0	0	0	0	0
Captains Flat	0	0	0	0	0	0	0

New Park and Gardens	2016	2021	2026	2031	2036	2041	2046
Bungendore	0	0	40	40	40	40	40
Braidwood	0	0	0	0	0	0	0
Captains Flat	0	0	0	0	0	0	0
Bungendore (new parks on reuse)	0	0	0	0	0	0	0

Total	2016	2021	2026	2031	2036	2041	2046
Bungendore	324	480	674	810	921	1,008	1,073
Braidwood	160	168	176	184	193	203	213
Captains Flat	55	55	56	56	57	57	58
Bungendore (third pipe - external use only)	324	402	520	588	645	689	722
Bungendore (third pipe - external and internal use)	324	390	494	551	598	635	663
Bungendore (new Parks on reuse)	324	480	634	770	881	968	1,033

A.6.3 Average Day Demands

Average Day Demand (kL/day)	2016	2021	2026	2031	2036	2041	2046
Bungendore	716	1,037	1,421	1,701	1,931	2,111	2,246
Braidwood	325	341	357	375	393	413	434
Captains Flat	114	115	116	117	118	119	120
Bungendore (third pipe - external use only)	716	931	1,211	1,398	1,553	1,673	1,764
Bungendore (third pipe - external and internal use)	716	895	1,141	1,297	1,426	1,527	1,604
Bungendore (new Parks on reuse)	716	1,037	1,353	1,633	1,863	2,042	2,177

A.6.4 Peak Day Demands

Average Day Demand (kL/day)	2016	2021	2026	2031	2036	2041	2046
Bungendore	2,343	3,391	4,649	5,565	6,318	6,904	7,345
Braidwood	952	998	1,046	1,097	1,151	1,209	1,270
Captains Flat	539	544	549	554	559	565	570
Bungendore (third pipe - external use only)	2,343	3,045	3,961	4,574	5,079	5,473	5,771
Bungendore (third pipe - external and internal use)	2,343	2,929	3,731	4,244	4,666	4,996	5,246
Bungendore (new Parks on reuse)	2,343	3,391	4,426	5,341	6,094	6,680	7,121

A.6.5 NRW

Total connections	2016	2021	2026	2031	2036	2041	2046
Bungendore	1,196	1,845	2,486	3,051	3,515	3,876	4,147
Braidwood	616	647	680	715	752	791	833
Captains Flat	239	241	243	245	248	250	252

NRW (ML/year)	2016	2021	2026	2031	2036	2041	2046
Bungendore	55	84	113	139	161	177	189
Braidwood	63	66	70	73	77	81	85
Captains Flat	10	10	10	10	10	10	10

A.6.6 Production

Average Year Production (ML/year)	2016	2021	2026	2031	2036	2041	2046
Bungendore	316	463	633	761	866	948	1,010
Braidwood	182	191	200	210	221	232	244
Captains Flat	51	52	52	53	53	54	54
Bungendore (third pipe - external use only)	316	424	556	650	728	788	834
Bungendore (third pipe - external and internal use)	316	411	530	613	681	735	775
Bungendore (new Parks on reuse)	316	463	608	736	841	923	985

Dry Year Production (ML/year)	2016	2021	2026	2031	2036	2041	2046
Bungendore	379	564	787	949	1,082	1,185	1,263
Braidwood	223	234	245	257	270	283	298
Captains Flat	64	65	66	66	67	67	68
Bungendore (third pipe - external use only)	379	487	633	728	805	866	911
Bungendore (third pipe - external and internal use)	379	474	608	691	759	812	853
Bungendore (new Parks on reuse)	379	564	747	909	1,042	1,145	1,223

Average Day Production (kL/day)	2016	2021	2026	2031	2036	2041	2046
Bungendore	866	1,267	1,732	2,083	2,371	2,595	2,764
Braidwood	498	522	548	575	604	635	667
Captains Flat	140	141	143	144	145	147	148
Bungendore (third pipe - external use only)	866	1,161	1,522	1,780	1,992	2,158	2,283
Bungendore (third pipe - external and internal use)	866	1,126	1,451	1,679	1,866	2,012	2,122
Bungendore (new Parks on reuse)	866	1,267	1,664	2,014	2,302	2,527	2,695

Peak Day Production (kL/day)	2016	2021	2026	2031	2036	2041	2046
Bungendore	2,832	4,146	5,666	6,813	7,755	8,489	9,041

Braidwood	1,457	1,528	1,603	1,683	1,768	1,857	1,952
Captains Flat	664	670	676	682	688	695	701
Bungendore (third pipe - external use only)	2,832	3,799	4,977	5,822	6,516	7,058	7,467
Bungendore (third pipe - external and internal use)	2,832	3,683	4,747	5,492	6,103	6,581	6,942
Bungendore (new Parks on reuse)	2,832	4,146	5,442	6,589	7,531	8,265	8,817

A.6.7 Extraction

Average Year Extraction (ML/year)	2016	2021	2026	2031	2036	2041	2046
Bungendore	338	495	677	814	927	1,014	1,080
Braidwood	195	204	214	225	236	248	261
Captains Flat	55	55	56	56	57	57	58
Bungendore (third pipe - external use only)	338	454	595	696	779	843	892
Bungendore (third pipe - external and internal use)	338	440	567	656	729	786	829
Bungendore (new Parks on reuse)	338	495	650	787	900	987	1,053

Dry Year Extraction (ML/year)	2016	2021	2026	2031	2036	2041	2046
Bungendore	405	604	842	1,015	1,157	1,268	1,351
Braidwood	239	250	263	275	289	303	319
Captains Flat	69	69	70	71	71	72	73
Bungendore (third pipe - external use only)	405	521	678	778	861	926	975
Bungendore (third pipe - external and internal use)	405	507	650	739	812	869	912
Bungendore (new Parks on reuse)	405	604	799	973	1,115	1,225	1,308

Average Day Extraction (kL/day)	2016	2021	2026	2031	2036	2041	2046
Bungendore	927	1,356	1,853	2,229	2,537	2,777	2,957
Braidwood	533	559	586	615	646	679	714
Captains Flat	150	151	153	154	156	157	158
Bungendore (third pipe - external use only)	927	1,243	1,628	1,904	2,132	2,309	2,442
Bungendore (third pipe - external and internal use)	927	1,205	1,553	1,796	1,996	2,153	2,271
Bungendore (new Parks on reuse)	927	1,356	1,780	2,155	2,463	2,704	2,884

Peak Day Extraction (kL/day)	2016	2021	2026	2031	2036	2041	2046
Bungendore	3,031	4,436	6,062	7,290	8,298	9,083	9,674
Braidwood	1,559	1,635	1,715	1,801	1,891	1,987	2,089
Captains Flat	710	717	723	730	737	743	750
Bungendore (third pipe - external use only)	3,031	4,065	5,325	6,229	6,972	7,552	7,989
Bungendore (third pipe - external and internal use)	3,031	3,941	5,080	5,876	6,531	7,042	7,428

	Bungendore (new Parks on reuse)	3,031	4,436	5,823	7,050	8,058	8,843	9,434

A.7 Water ET Projections

The 30 year water equivalent tenements (ET) projection is given in Table 12.1.The water ET for each scheme was calculated by dividing the average daily water demand for each user class by the average daily active residential water demand for that scheme (see Table 5.3) The adopted 2016 water ET was based on the most recent year of available billing data.

Residential water ET growth follows projected dwelling growth derived in Section 4.4.1, with each new dwelling equal to 1 water ET. Education and commercial ET increases at the rate given in Table 4.7.

Council has plans to develop two new public recreation areas consisting of several parks and sports fields. The Bungendore West recreation area will be supplied by STP effluent and thus will contribute zero Water ET. The Bungendore East development is estimated to occur in 2026 and will account for approximately 100 ET.

Table 12.1: Water ET projection by user class

		2016	2021	2026	2031	2036	2041	2046
Bungendore	Residential	1,030	1,675	2,312	2,874	3,335	3,693	3,960
	Accommodation	30	30	30	30	30	30	30
	Commercial	50	53	56	60	63	67	72
	Education	14	15	17	19	21	23	25
	Industrial	7	7	7	7	7	7	7
	Institutional	12	12	12	12	12	12	12
	Parks and Gardens	15	15	115	115	115	115	115
	STP and SPS	2	2	2	2	2	2	2
	Total	1,160	1,810	2,551	3,119	3,585	3,949	4,222
Braidwood	Residential	500	530	561	594	630	667	707
	Accommodation	30	30	30	30	30	30	30
	Commercial	80	82	85	88	90	93	96
	Education	20	20	20	20	20	20	20
	Industrial	15	15	15	15	15	15	15
	Institutional	45	45	45	45	45	45	45
	Parks and Gardens	80	80	80	80	80	80	80
	STP and SPS	10	10	10	10	10	10	10
	Total	780	812	846	882	920	960	1,003
Captains Flat	Residential	200	202	204	206	209	211	213
	Accommodation	4	4	4	4	4	4	4
	Commercial	4	4	4	4	4	4	4
	Education	2	2	2	2	2	2	2
	Industrial	0	0	0	0	0	0	0
	Institutional	5	5	5	5	5	5	5
	Parks and Gardens	30	30	30	30	30	30	30
	STP and SPS	0	0	0	0	0	0	0
	Total	245	247	249	251	254	256	258

Appendix B Bungendore Recreation Areas

B.1 Bungendore East Recreation Area

Extract from Bungendore East Planning Proposal, 2015

Estimated Lawn Area

Irrigated Area	Number	Area (Ha)	Area (Ha)
Soccer Field	5	0.6	3
Rugby Field	2	0.84	1.68
Football / Cricket Pitch	1	2	2
Park	1	1	1
Total			**7.7**

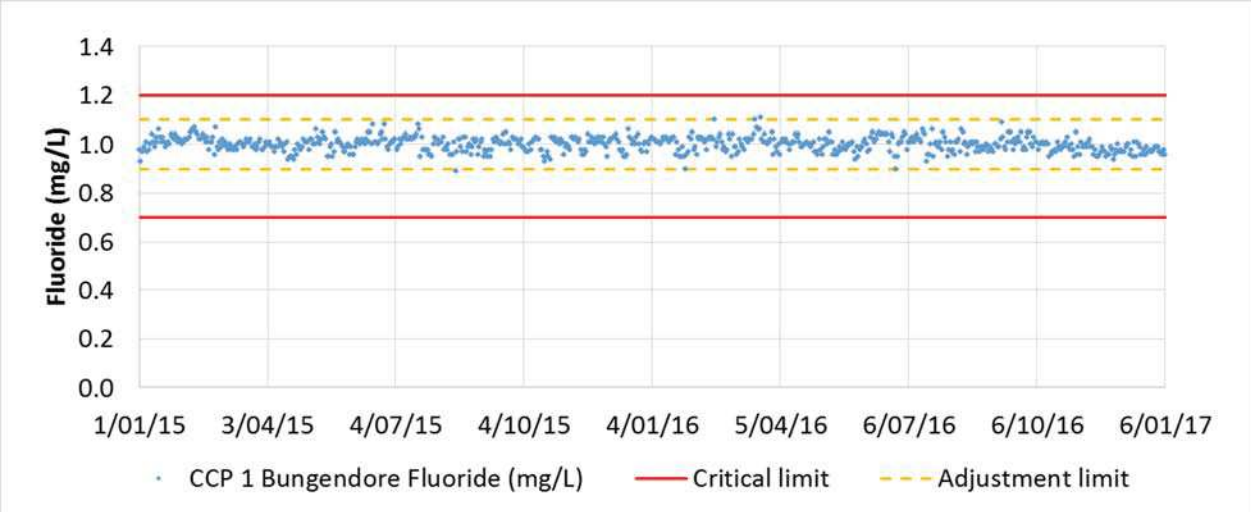
Appendix C Bungendore STP Historical Inflow and Outflow

Bungendore STP historical inflow and outflow (kL/month)

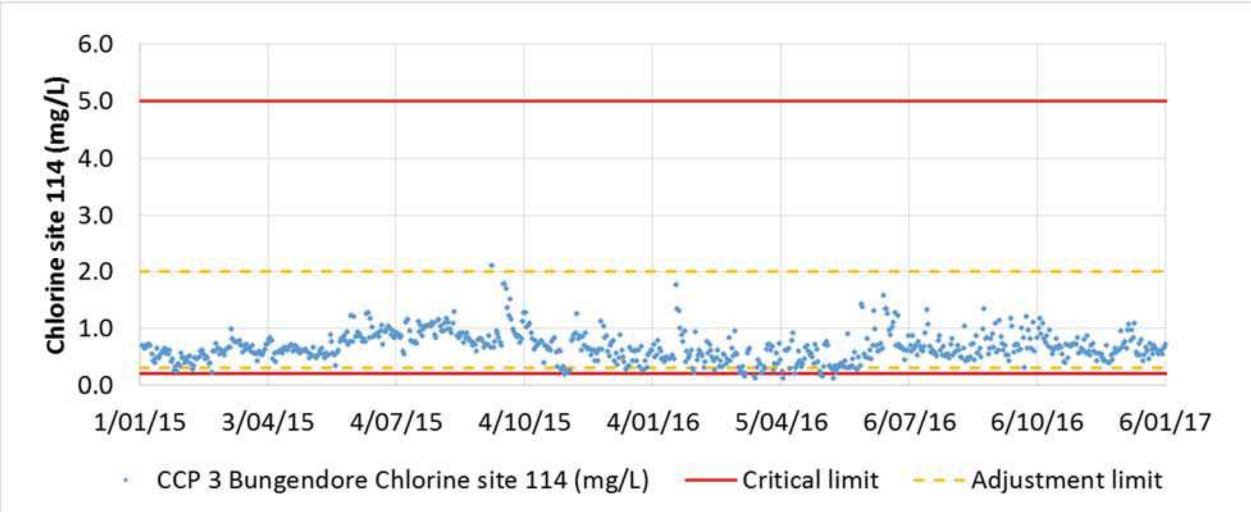
Month	Inflow (metered)	Outflow		
		Discharge (metered)	Reuse (metered)	Remainder (calculated)
Aug-12	18,492	16,165	417	1,910
Sep-12	17,391	14,166	206	3,019
Oct-12	21,697	20,358	512	827
Nov-12	18,981	13,166	746	5,069
Dec-12	17,324	13,196	482	3,646
Jan-13	16,819	11,479	1,452	3,888
Feb-13	15,412	8,567	1,037	5,808
Mar-13	16,502	11,384	816	4,302
Apr-13	16,450	8,839	3,913	3,698
May-13	16,608	11,067	2,473	3,068
Jun-13	17,891	14,568	941	2,382
Jul-13	17,504	14,209	819	2,476
Aug-13	16,855	12,367	1,128	3,360
Sep-13	18,435	14,179	1,595	2,661
Oct-13	16,660	11,548	2,190	2,922
Nov-13	17,385	10,644	3,701	3,040
Dec-13	16,523	8,135	2,724	5,664
Jan-14	16,254	5,790	4,057	6,407
Feb-14	15,546	8,417	3,441	3,688
Mar-14	17,013	14,598	2,495	-80
Apr-14	17,989	14,795	2,947	247
May-14	17,562	11,567	2,960	3,035
Jun-14	18,215	16,108	624	1,483
Jul-14	17,875	13,469	1,447	2,959
Aug-14	19,135	14,919	1,048	3,168
Sep-14	17,728	13,789	849	3,090
Oct-14	17,688	13,035	1,313	3,340
Nov-14	16,485	10,207	2,086	4,192
Dec-14	19,274	14,676	1,167	3,431
Jan-15	19,262	15,300	1,452	2,510
Feb-15	16,132	10,342	1,046	4,744
Mar-15	17,595	10,498	2,323	4,774
Apr-15	17,283	14,599	1,268	1,416
May-15	17,655	13,275	910	3,470
Jun-15	18,178	14,618	930	2,630

Appendix D CCP Monitoring Data

D.1 Bungendore CCPs

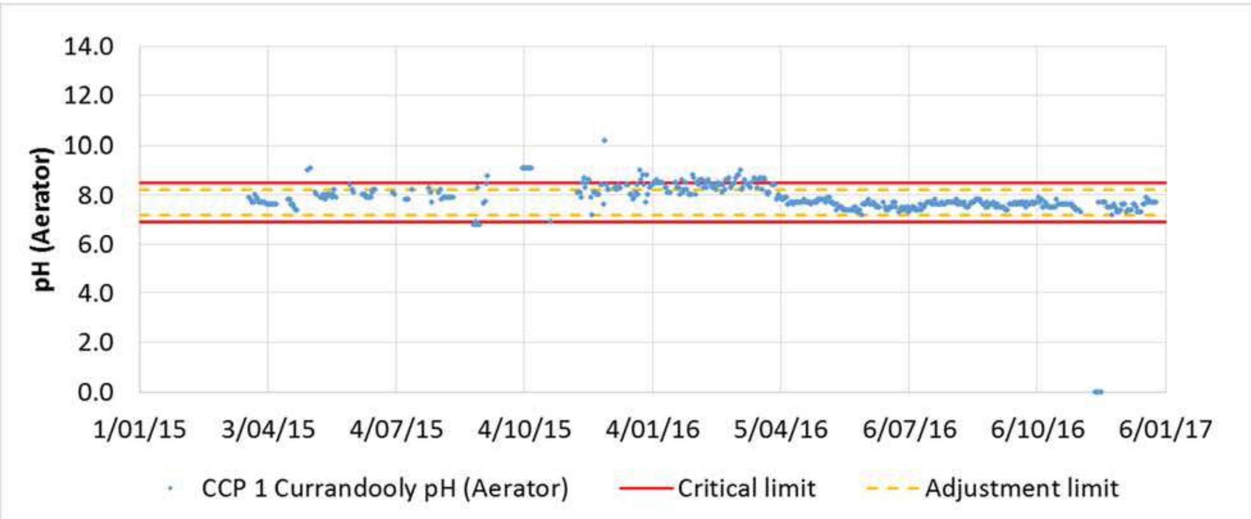


Appendix Figure D.1: Bungendore CCP1

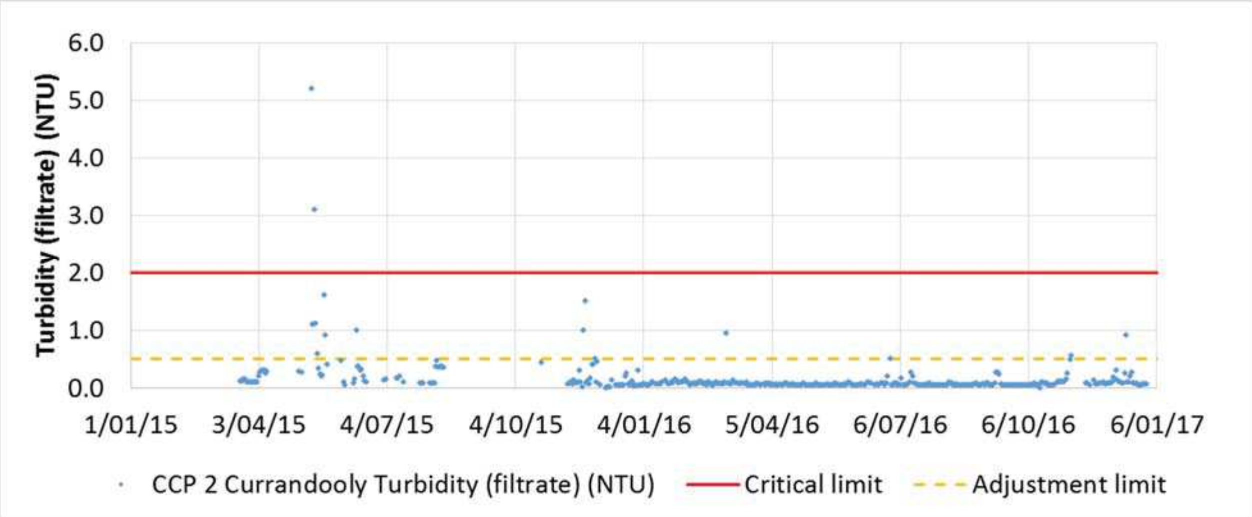


Appendix Figure D.2: Bungendore CCP2

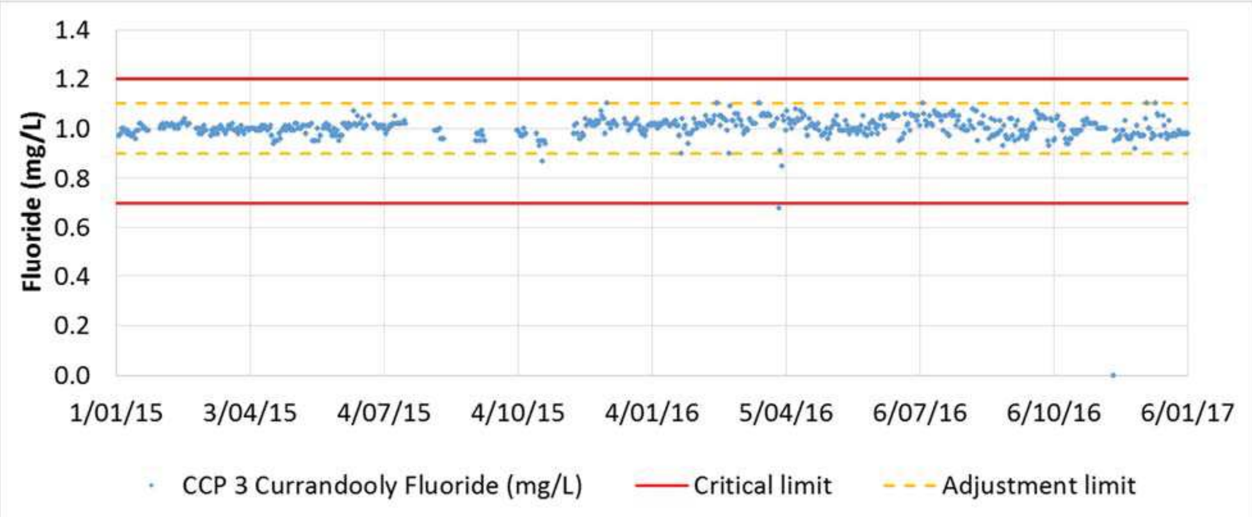
D.2 Currandooly CCPs



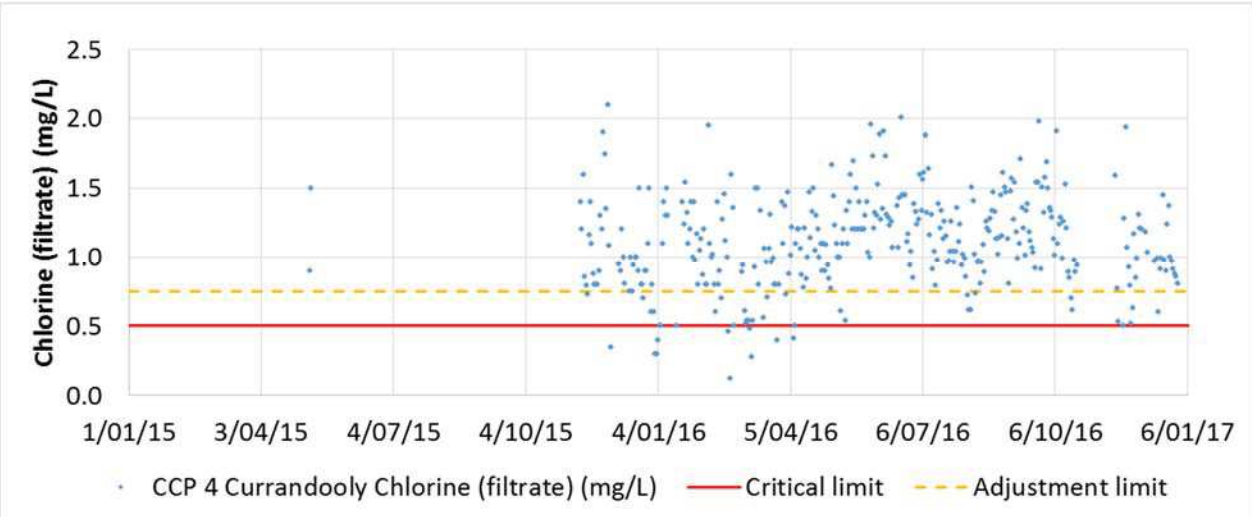
Appendix Figure D.3: Currandooly CCP1



Appendix Figure D.4: Currandooly CCP2

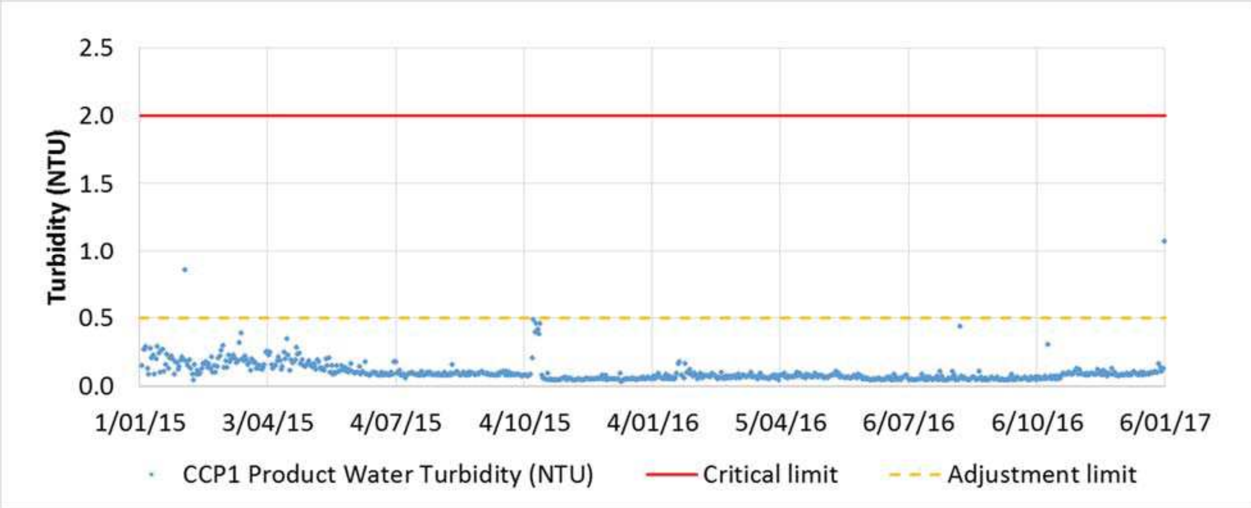


Appendix Figure D.5: Currandooly CCP3

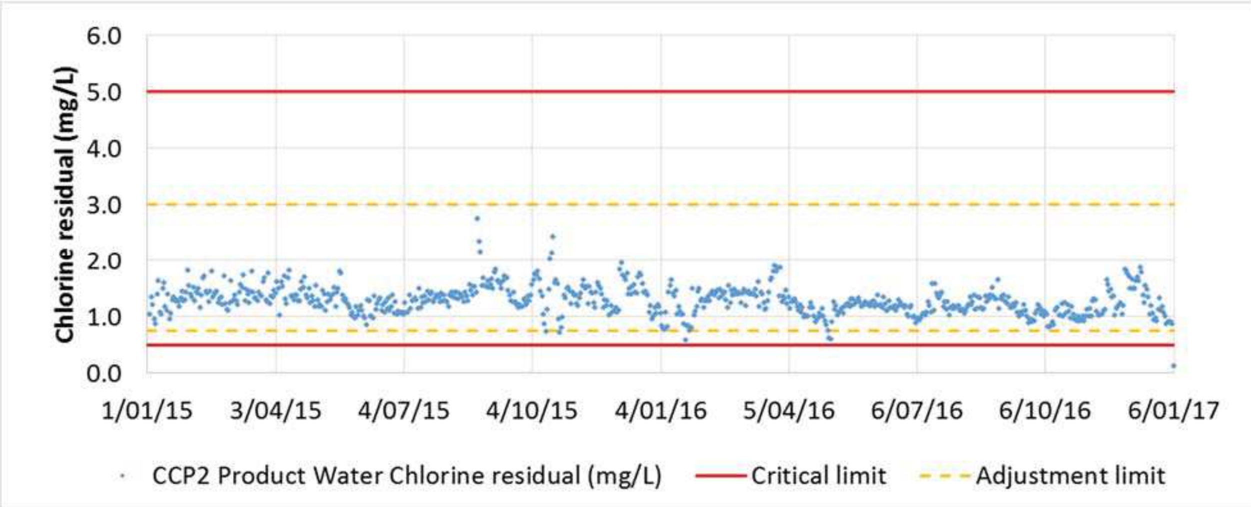


Appendix Figure D.6: Currandooly CCP4

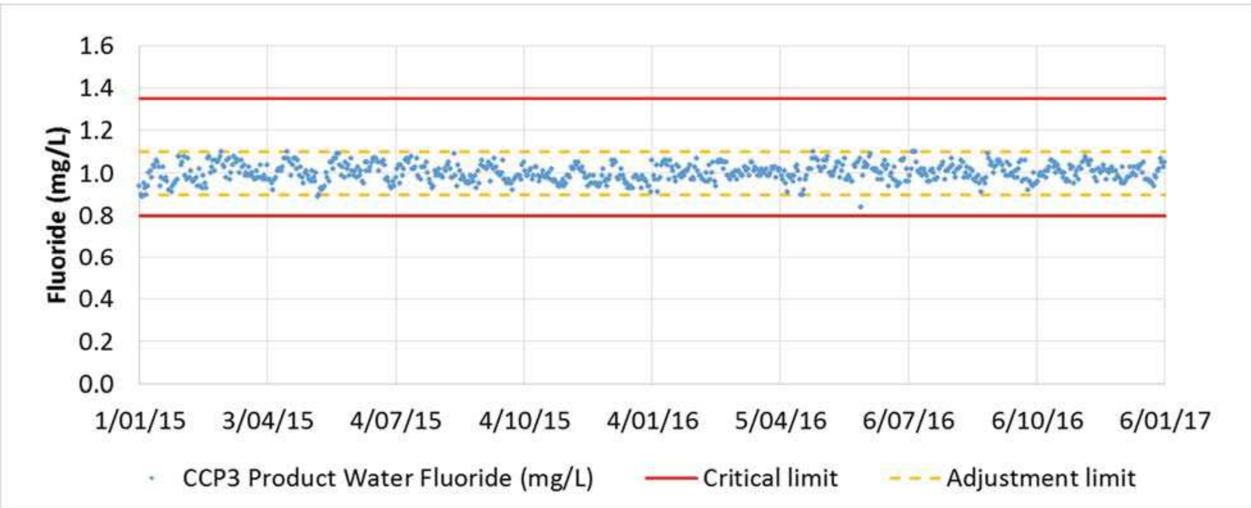
D.3 Braidwood CCPs



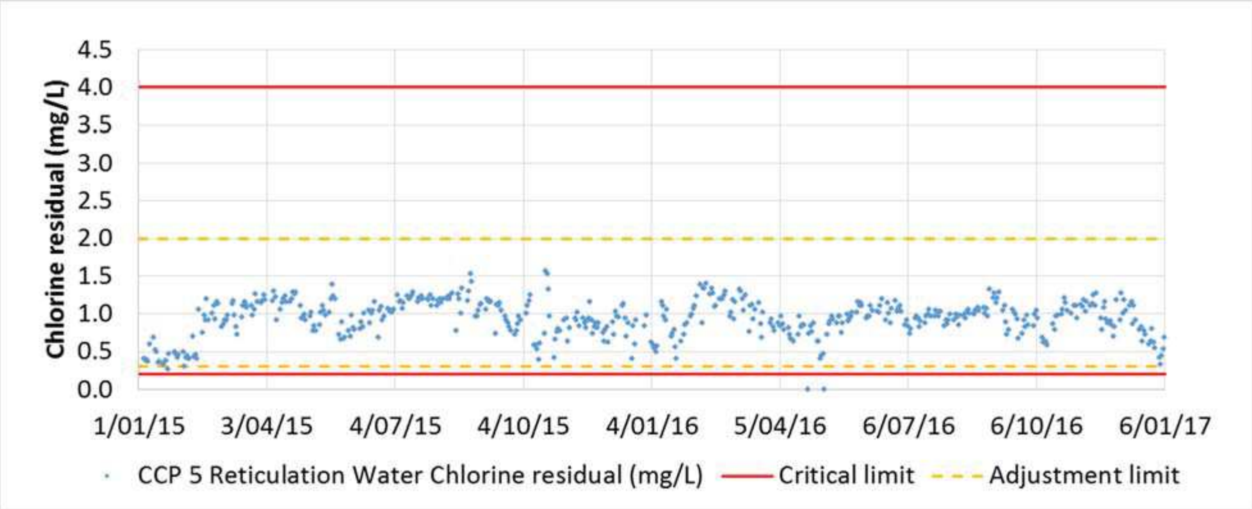
Appendix Figure D.7: Braidwood CCP1



Appendix Figure D.8: Braidwood CCP2

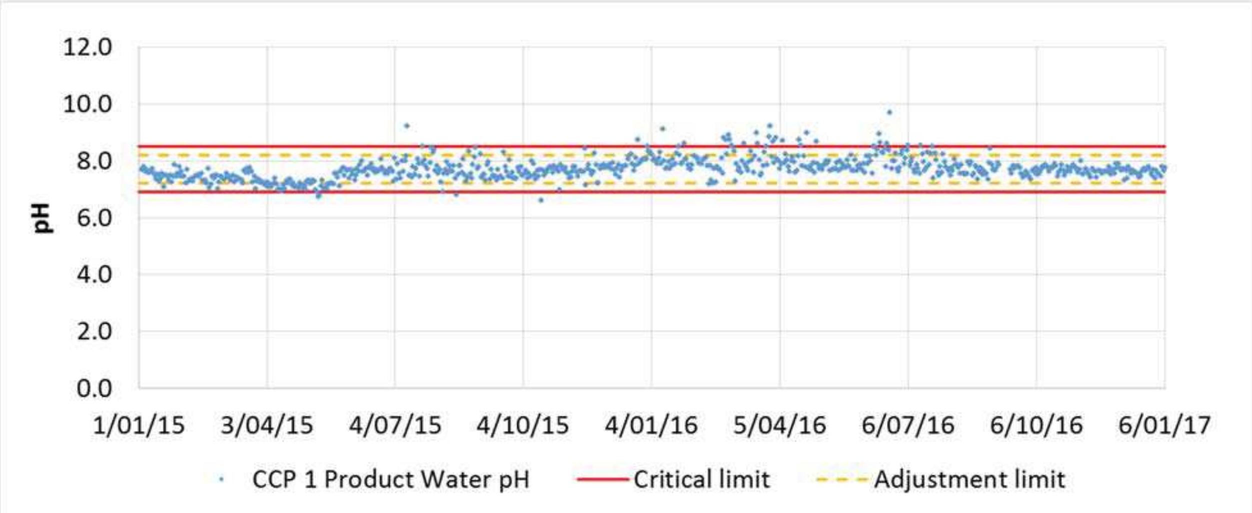


Appendix Figure D.9: Braidwood CCP3

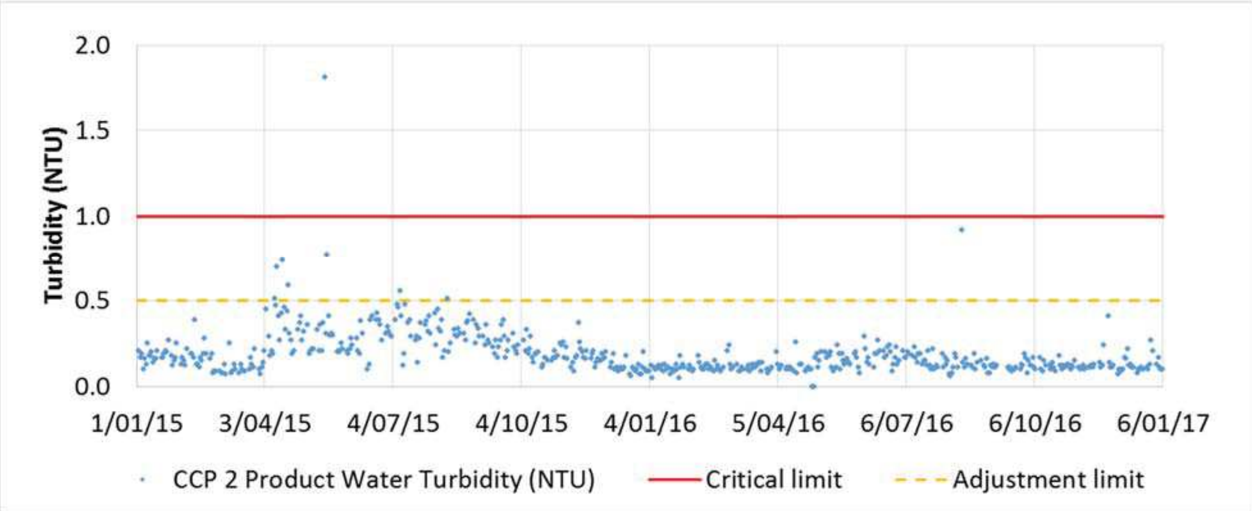


Appendix Figure D.10: Braidwood CCP5

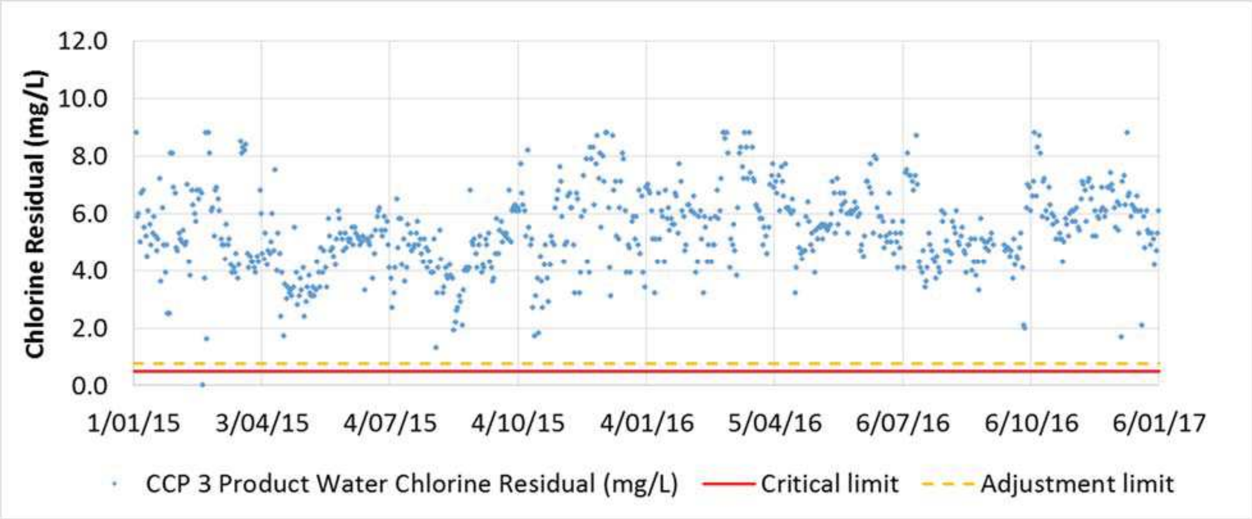
D.4 Captains Flat CCPs



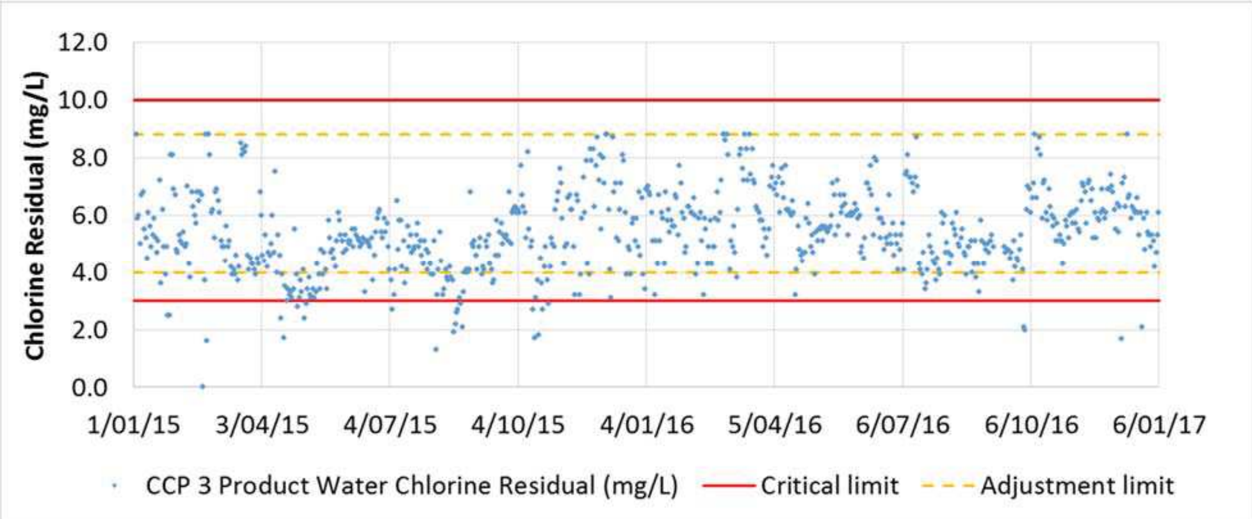
Appendix Figure D.11: Captains Flat CCP1



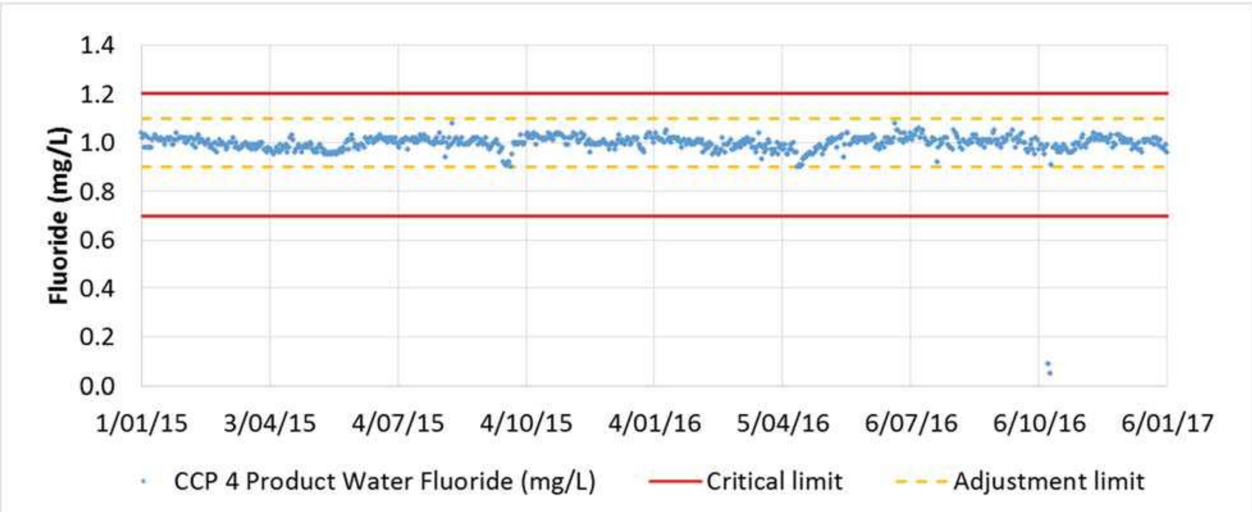
Appendix Figure D.12: Captains Flat CCP2



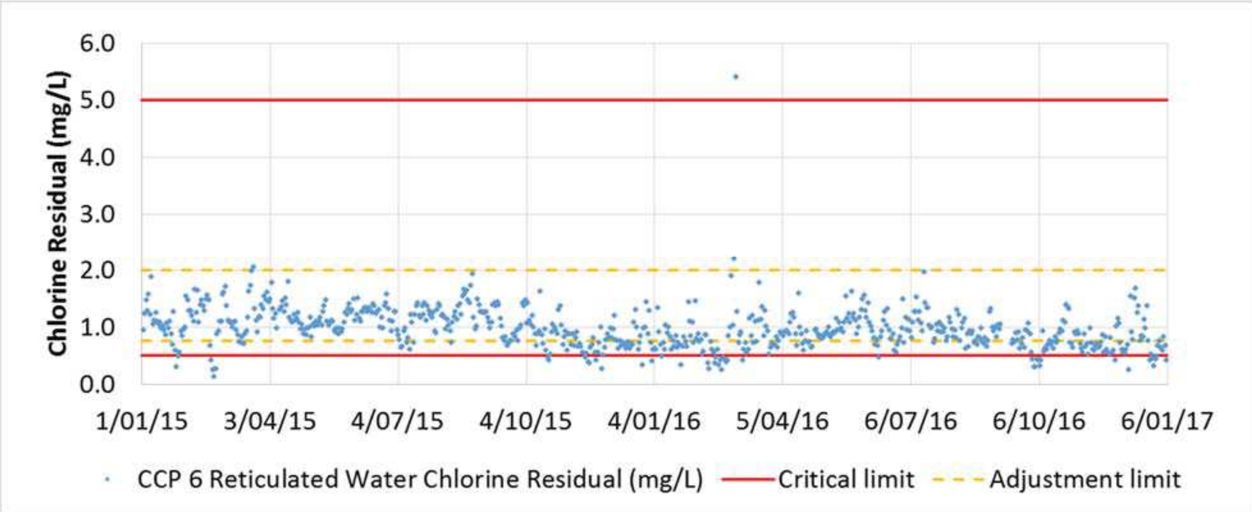
Appendix Figure D.13: Captains Flat CCP3



Appendix Figure D.14: Captains Flat CCP3 [revised CCP limits]

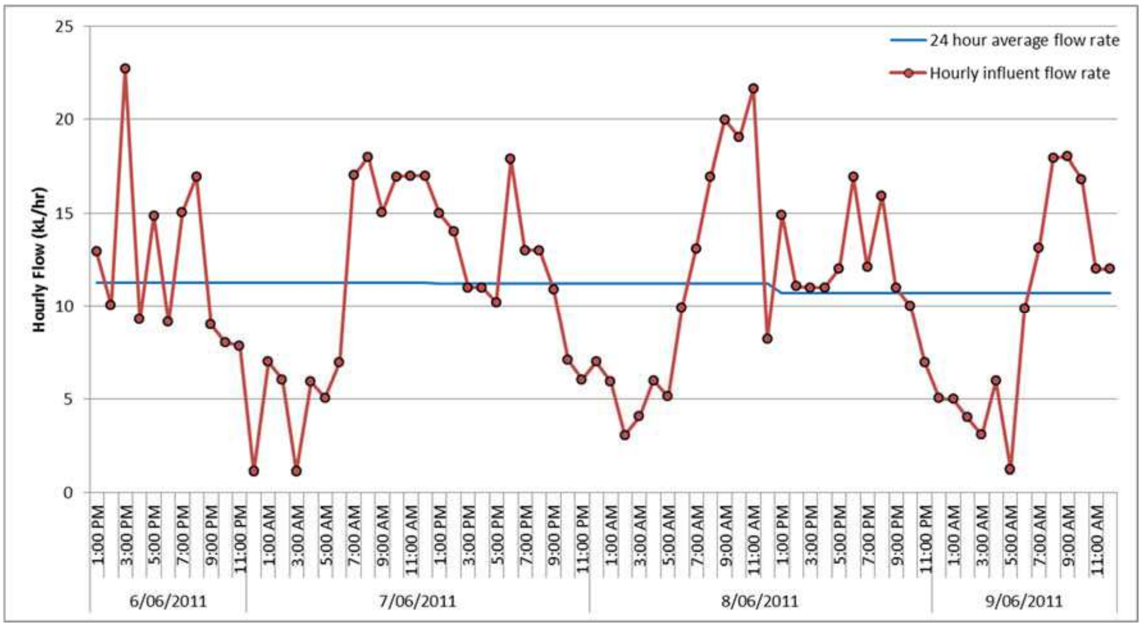


Appendix Figure D.15: Captains Flat CCP4

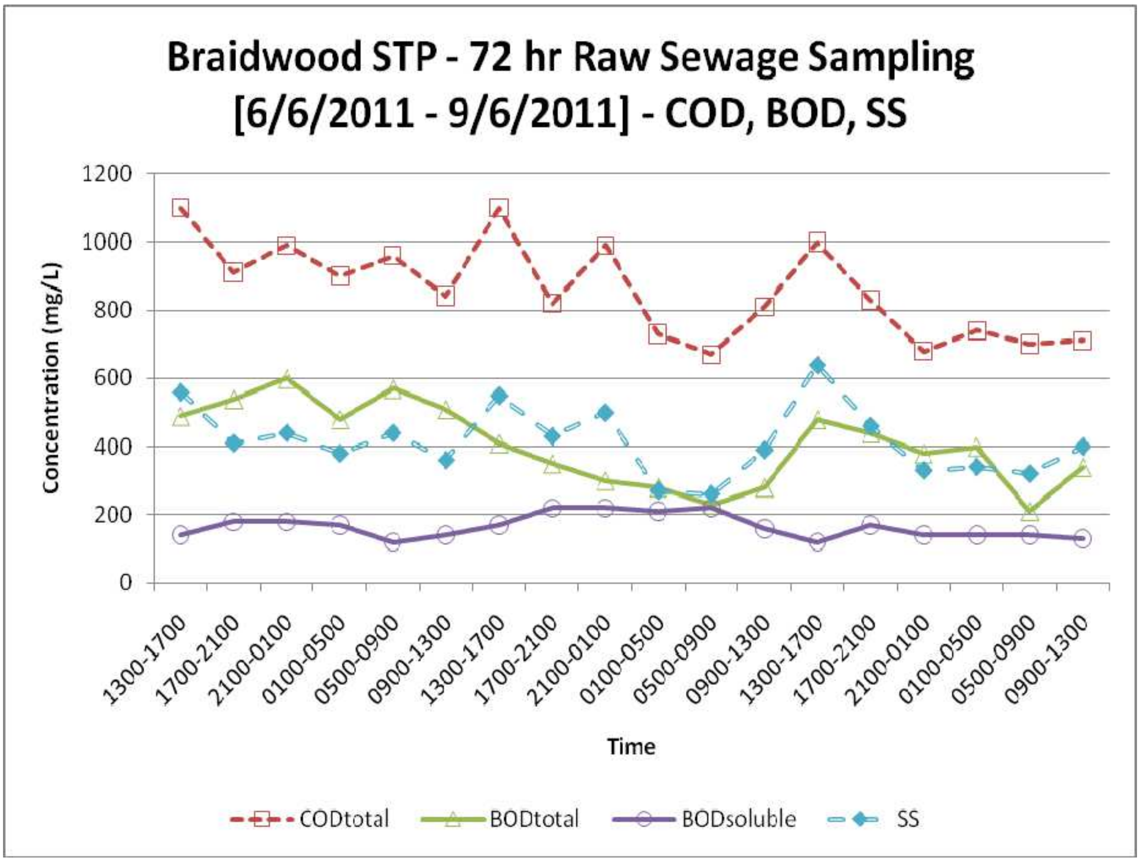


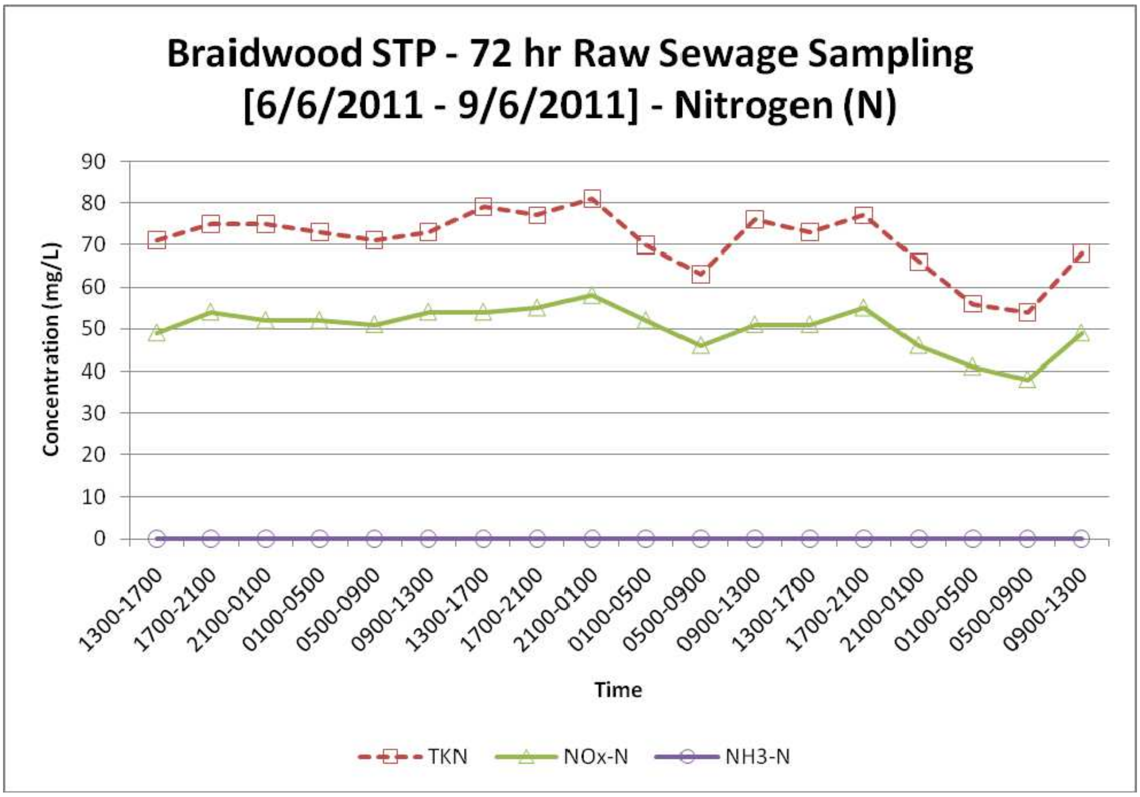
Appendix Figure D.16: Captains Flat CCP6

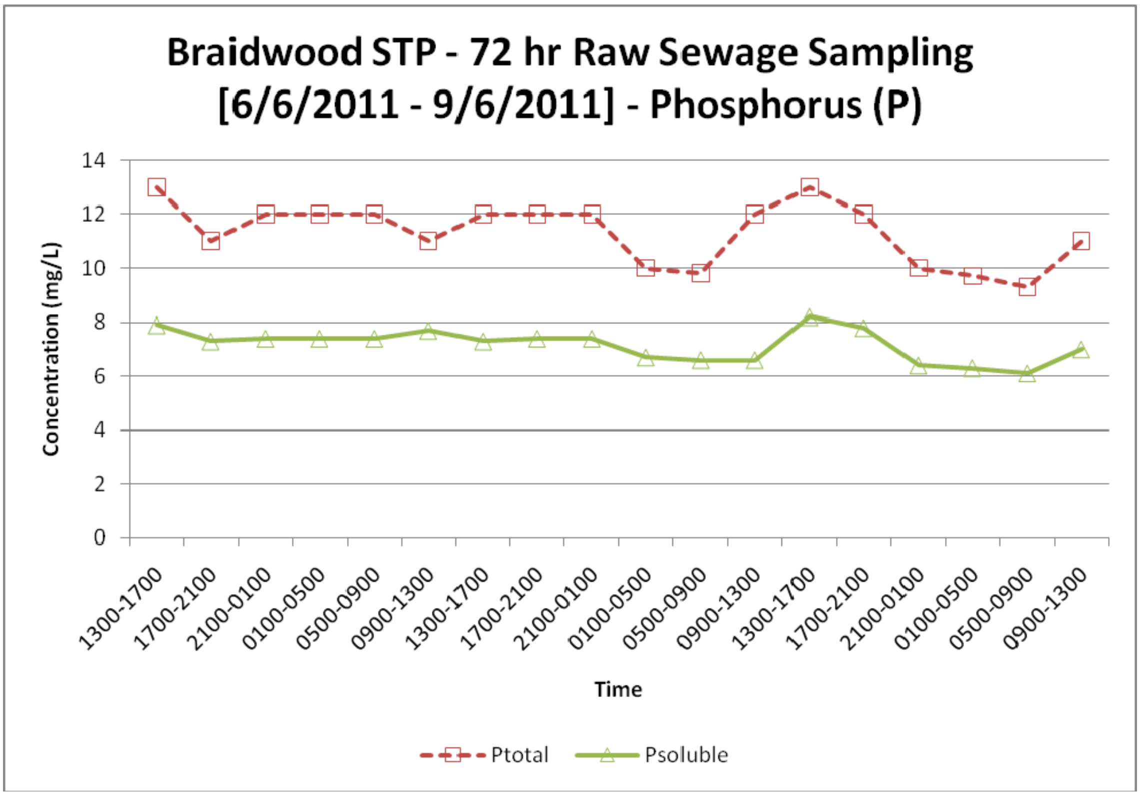
Appendix E Braidwood 72 Hour Monitoring Results



Appendix Figure E.1: 72 hour monitoring influent flowrate




Braidwood STP - 72 hr Raw Sewage Sampling
[6/6/2011 - 9/6/2011] - Nitrogen (N)
Concentration (mg/L)
90
80
70
60
50
40
30
20
10
0
1300-1700
1700-2100
2100-0100
0100-0500
0500-0900
0900-1300
1300-1700
1700-2100
2100-0100
0100-0500
0500-0900
0900-1300
1300-1700
1700-2100
2100-0100
0100-0500
0500-0900
0900-1300
Time
TKN
NOx-N
NH3-N


Braidwood STP - 72 hr Raw Sewage Sampling
[6/6/2011 - 9/6/2011] - Phosphorus (P)
Concentration (mg/L)
14
12
10
8
6
4
2
0
1300-1700
1700-2100
2100-0100
0100-0500
0500-0900
0900-1300
1300-1700
1700-2100
2100-0100
0100-0500
0500-0900
0900-1300
1300-1700
1700-2100
2100-0100
0100-0500
0500-0900
0900-1300
Time
Ptotal
Psoluble

Appendix F NSW Health Drinking Water Monitoring Program data (2003 – 2013)

Appendix Table F.1: Bungendore reticulation

Parameters	ADWG Value	Number Samples	Min	Mean	95%ile	Max	Non Compliances
E. coli (cfu/100 ml)	< 1	558	< 1	< 1	< 1	10	1
Total Coliform (cfu/100 ml)	< 1	557	< 1	5	1	> 200	32
pH (pH units)	6.5 – 8.5	251	6.6	7.8	8.1	8.4	0
True Colour (HU)	15	16	1	1	2	3	0
Turbidity (NTU)	5	20	0	0.3	0.9	1.6	0
Hardness (as $CaCO_3$) (mg/L)	200	17	23	132	157	157	0
Free Chlorine (mg/L)	0.2 - 0 5	267	0.11	0.50	0.80	8.80	1 exceed 7 low res.
Total Chlorine (mg/L)	5	259	0.25	0.68	1.04	8.80	1
Aluminium (mg/L)	0.2	17	0.01	0.03	0.10	0.31	1

Appendix Table F.2: Captains Flat reticulation

Parameters	ADWG Value	Number Samples	Min	Mean	95%ile	Max	Non Compliance
E. coli (cfu/100 ml)	< 1	303	< 1	< 1	< 1	1	1
Total Coliform (cfu/100 ml)	< 1	303	< 1	2	2	> 200	22
pH (pH units)	6.5 – 8.5	133	6.8	7.7	8.3	9.0	3
True Colour (HU)	15	16	1	3	7	7	0
Turbidity (NTU)	5	20	0.0	1.1	3.9	8.6	1
Hardness (as $CaCO_3$) (mg/L)	200	16	19	41	145	150	0
Free Chlorine (mg/L)	0.2 - 5	20	46	88	319	324	0
Total Chlorine (mg/L)	5	133	0.01	2.37	8.48	8.84	31 exceed 30 low res
Fluoride	0.9 – 1.5	50	0.05	0.68	1.12	1.22	Dosing commenced 24/5/2010
Iron (mg/L)	0.3	129	0.02	2.71	8.80	8.84	33

Appendix G OSSM Register

Locality	Number of Systems	System Type							Number of Approvals		Number of Failing Systems
		AWTS	Cess Pit	Dry Composting	Wet Composting	Septic	Grey Water Treatment	Other	High Risk (2yr)	Medium Risk (5yr)	
Araluen	114	11	2	6	0	95	0	0	5	105	4
Back Creek	8	0	2	0	0	6	0	0	0	6	2
Ballalaba	20	0	1	0	0	19	0	0	3	14	3
Bendoura	40	7	2	1	1	29	0	0	2	33	5
Berlang	3	0	0	0	0	3	0	0	0	2	1
Bombay	77	10	11	3	0	52	1	0	12	48	17
Boro	45	6	6	2	0	31	0	0	2	37	6
Braidwood	231	21	5	1	2	201	1	0	14	198	19
Budawang	28	3	0	2	1	21	0	0	1	25	2
Bungendore	282	97	3	0	2	180	0	0	11	254	17
Burra	282	97	1	3	4	177	0	0	12	262	8
Bywong	435	168	1	4	2	260	0	0	18	403	14
Captains Flat	66	12	2	0	0	51	0	0	5	48	12
Carwoola	339	103	0	4	0	231	0	1	29	300	10
Charleys Forest	66	3	6	2	0	54	1	0	7	47	12
Collector	6	1	0	0	0	5	0	0	1	5	0
Corang	16	0	4	1	0	11	0	0	1	12	3
Currawang	57	14	0	1	0	42	0	0	2	45	10
Durran Durra	46	3	5	4	0	34	0	0	2	38	6
Farringdon	14	1	1	0	0	12	0	0	4	10	0
Forbes Creek	30	6	1	1	0	22	0	0	0	26	4
Googong	3	2	0	0	0	1	0	0	0	3	0
Harolds Cross	43	4	4	3	0	28	4	0	7	35	1
Hereford Hall	23	2	1	1	0	20	0	0	0	21	2
Hoskinstown	71	13	1	0	3	54	0	0	3	66	2
Jembaicumbene	23	3	0	0	1	18	1	0	2	19	2
Jerrabatgulla	13	0	0	1	0	12	0	0	1	10	2
Jinden	24	0	1	0	0	23	0	0	2	18	4
Kindervale	16	0	2	0	0	14	0	0	2	9	5
Krawaree	46	1	3	3	0	39	0	0	2	36	8
Lake George	51	13	0	1	0	37	0	0	1	19	11
Larbert	24	1	1	1		21	0	0	1	22	1
Majors Creek	143	17	8	6	1	109	0	2	4	131	9

Locality	Number of Systems	System Type							Number of Approvals		Number of Failing Systems
		AWTS	Cess Pit	Dry Composting	Wet Composting	Septic	Grey Water Treatment	Other	High Risk (2yr)	Medium Risk (5yr)	
Manar	60	17	1	0	0	42	0	0	3	52	5
Marlowe	13	0	1	2	0	10	0	0	1	4	8
Mayfield	20	3	1	0	0	16	0	0	1	16	3
Monga	24	0	2	1	0	21	0	0	5	16	3
Mongarlowe	75	8	6	2	0	59	0	0	12	57	6
Mount Fairy	94	25	2	3	0	64	0	0	1	86	7
Mulloon	47	9	0	2	0	35	1	0	1	38	8
Neringla	19	0	2	1	0	16	0	0	1	15	4
Nerriga	65	2	13	5	1	44	0	0	1	48	16
Northangera	23	1	2	0	0	20	0	0	0	22	1
Oallen	90	5	11	10	0	64	0	0	3	62	25
Primrose Valley	55	11	0	0	1	43	0	0	8	41	6
Reidsdale	62	3	1	1	3	53	0	0	5	46	11
Rossi	27	13	1	0	0	13	0	0	0	25	2
Royalla	177	172	0	0	0	5	0	0	0	173	4
Snowball	6	0	0	0	0	6	0	0	0	5	1
Sutton	168	96	0	0	0	72	0	0	5	153	10
Tarago	29	2				27	0	0	1	24	4
Tinderry	17	1	0	0	0	16	0	0	2	11	4
Tomboye	50	1	9	7	0	33	0	0	2	42	16
Urila	49	10	0	0	0	39	0	0	3	42	4
Wamboin	555	235	0	4	9	306	1	0	36	505	14
Warri	42	16	0	2	0	21	1	0	0	38	4
Williamsdale	17	3	0	0	0	14	0	0	3	12	2
Wog Wog	26	1	5	2	0	18	0	0	1	19	6
Wyanbene	32	0	9	1	0	22	0	0	0	24	8
Yarrow	11	1	0	0	0	10	0	0	0	10	1
Total	**4538**	**1254**	**140**	**94**	**31**	**3001**	**11**	**3**	**251**	**3893**	**385**

Level 4 Foreshore House
66 Harrington Street
Sydney NSW 2000

www.publicworks.nsw.gov.au

Appendix B Options Assessment and Scenario Analysis

Palerang Communities IWCM – Options Assessment & Scenario Analysis

For

QPRC

Report No: PWA-IS 18010

Date: August 2018

Palerang Communities IWCM – Options Assessment

Queanbeyan-Palerang Regional Council

Report Number: PWA-IS 18010

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Glenn Fernandes

Principal Engineer – Planning (Water Utilities)

Level 3, 66 Harrington Street

THE ROCKS NSW 2000

T | 02 9240 8751

M | 0421 487 408

E | glenn.fernandes@finance.nsw.gov.au

W | www.publicworksadvisory.nsw.gov.au

Cover image: Lake George, NSW

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1 Introduction

This Options Assessment forms part of the wider Palerang Integrated Water Cycle Management (IWCM) Strategy. The objectives of this paper are to evaluate the water and sewerage options to address the issues identified in the IWCM Issues Paper.

IWCM Issues

The water and sewerage system issues for the Palerang communities that have been identified through the analyses in the Issues Paper are outlined in Table 1-1, Table 1-2 and Table 1-3.

Table 1-1~~1.1~~: General IWCM System Issues

Issue Type	Target for Compliance	Issue
Work Health and Safety (WHS)	Management System	Council does not have a documented Work Health and Safety system. Council undertakes periodic WHS reviews but these are not documented.
Levels of Service (LOS)	Description and performance	There is no centralised data management system in place to monitor and measure the system performance against the LOS. The LOS need to be reviewed for the newly formed Queanbeyan-Palerang Regional Council.

Table 1-2~~1.2~~: Water Supply System Issues

Issue Type	Target for Compliance	Issue
General water supply issues		
Level of Service	Minimum pressure with firefighting capability	Council have nominated ‘positive residual head’ as the target for compliance, the current performance needs to be better understood through modelling.
Regulatory	Fluoridation of Public Water Supplies	The requirement for periodic auditing of the fluoridation systems is not always being met.
Regulatory	Drinking Water Management System	Several of the nominated CCPs in the DWMS are not considered CCPs like free chlorine in the reticulation. The turbidity alert limit corrective action for Captains Flat WTP needs to include a membrane integrity test.
Bungendore water supply issues		
Performance	Non-revenue water	Non-revenue water at Bungendore has been fairly constant at 125 L/connection/day. This is higher than the state wide median of 92 L/connection/day for 2015/16.
Water security	Licensed allocation	It is estimated that Bungendore water supply dry year extraction will exceed its licensed extraction limit from the Bungendore and Currandooly bores after 2020.
Level of Service	Headworks capacity	The peak day demand will exceed the combined capacity of the Bungendore and Currandooly WTPs around 2025. The WTP, and reservoir capacity would need to be reviewed to ensure that the required pressure can be maintained in the system.

Issue Type	Target for Compliance	Issue
Braidwood water supply issues		
Performance	Non-revenue water	Non-revenue water at Braidwood is on average 280 L/connection/ day. This is higher than the state wide median of 92 L/connection/day for 2015/16.
Captains Flat water supply system		
Performance	Non-revenue water	Seasonal variations in the NRW for the Captains Flat system have been noticed which are due to a faulty meter at the Captains Flat swimming pool and the neighbouring fields which share a meter. This meter recently been replaced.

Table 1-3~~1.3~~: Sewerage System Issues

Issue Type	Target for Compliance	Issue
General sewerage system issues		
Levels of Service	Response times	Council needs to review and redefine its nominated level of service for response times.
Unserviced communities	On-site sewage management systems	Village of Majors Creek – potential issue due to the following reasons: • Small lot sizes (some around 3,000 m^2 and several around 1,000 m^2) • Inadequate buffer distance from Majors Creek • Moderately well to imperfectly drained soil Village of Nerriga – potential issue due to the following reasons: • Small lot sizes (various sizes below 3,000 m^2) • Some properties may have inadequate buffer distance from Bindi Brook Village of Araluen – potential issue due to the following reasons: • Small lot sizes (several properties less than 1,500 m^2 bordering each other) • Moderately permeable, imperfectly drained soil.
Bungendore sewerage system issues		
Best Practice	Section 60 approval	Effluent from the Bungendore STP is reused on-site, for road works (truck filling) and for watering Bungendore oval. Council does not have a Recycled Water Management Plan and Section 60 approval for the off-site effluent reuse.
		The Log Reduction Value (LRV) required for effluent reuse may not be achieved through the current STP process. This will be reviewed during the preparation of the Recycled Water Management System (RWMS) for Section 60 approval.
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit in 2011, 2012, 2014 and 2016. Council needs to consider undertaking an inflow/infiltration study.
Performance	Effluent reuse flow balance	There is a mismatch in the effluent reuse flow balance. Potential reasons for the discrepancy could include uncalibrated meters, and on-site flows which may not be metered.

Issue Type	Target for Compliance	Issue
Sewer catchment performance	Pump sizing @ PWWF	The peak wet weather flow (PWWF) at catchment no. 2, 8 and 9 exceeds the capacity of a single pump. The PWWF at catchment no. 4 will exceed the capacity of a single pump by 2021. This is based on a PWWF calculated from the storm allowance which is twice the maximum flow recorded during the highest rainfall event in the last five years. Hence this is a conservative assessment.
	Odour/septicity potential	Catchment no. 7 and 8 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. This risk is expected to continue over the 30 year planning period.
Capacity	Sewage Treatment Plant	The EP load currently exceeds the 3,000 EP STP capacity, and is expected to exceed the 5,000 EP capacity by 2020. For the assessed hydraulic loading of 200 L/EP/day in this study, the plant hydraulic and capacity will be exceeded by: • 2018 for the 3,000 EP STP, or 2023 when capacity is increased to 5,000 EP by commissioning the second IDEA reactor.
Braidwood sewerage system issues		
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.
Sewer catchment performance	Pump sizing	The PWWF at catchment no. 1 will exceed the capacity of a single pump by 2021.Council has funded for an upgrade.
	Odour/septicity potential	Catchment no. 3, and 5 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. The risk for catchment no. 5 is expected to drop to low risk by 2020, however catchment no. 3 is expected to remain at medium risk.
Captains Flat sewerage system issues		
Regulatory	EPA License non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.
Sewer catchment performance	Pump sizing	The PWWF at catchment no. 1 is expected to exceed the duty pump capacity.
Performance	Sewage Treatment Plant	The plant needs to be upgraded to improve replace ageing infrastructure, improve treatment and enable enhanced phosphorus removal, enable screening and grit removal, improve sludge and sludge drying components and improve amenity and WHS.

2 General IWCM Issues

This section discusses what management measures will be taken to address the general IWCM Issues.

Issue: Work Health and Safety – Management System

Council does not have a documented Work Health and Safety system. Council undertakes periodic WHS reviews but these are not documented.

Council is seeking ISO accreditation for a Health, Safety, Environment and Quality system (HSEQ). An audit is scheduled for June 2018.

Issue: Levels of Service – Description and performance

There is no centralised data management system in place to monitor and measure the system performance against the levels of service (LOS).

The LOS need to be reviewed for the newly formed Queanbeyan-Palerang Regional Council.

Council needs to investigate different database softwares available in the market to suit their operational requirements.

3 General Water Supply System Issues

This section discusses what measures will be taken to address the general water supply system issues.

Issue: Level of Service – Minimum pressure with firefighting capability

Council have nominated 'positive residual head' as the target for compliance, the current performance needs to be better understood through modelling.

Council has committed to setting up network models of the distribution system, starting with the Bungendore system.

Issue: Regulatory – Fluoridation of Public Water Supplies

The requirement for periodic auditing of the fluoridation systems is not always being met.

This issue is proposed to be addressed as follows:

- An annual independent review as part of the HSEQ system
- A quarterly or six-monthly internal review.

Issue: Regulatory – Drinking Water Management System (DWMS)

Several of the nominated CCPs in the DWMS are not considered CCPs like free chlorine in the reticulation.

The turbidity alert limit corrective action for Captains Flat WTP needs to include a membrane integrity test.

The DWMS has been reviewed and the Critical Control Points modified. Membrane integrity testing will be added to the weekly operational report to require say monthly testing and reporting of the result.

Issue: Performance – Non-revenue water

Non-revenue water at Bungendore and Braidwood are higher than the state wide median.

Bungendore

The following initiatives will be considered to deal with the non-revenue water in the Bungendore system:

- A water loss study
- Better monitoring of flushing/operational water usage
- Water meter replacement program.

Braidwood

The current and proposed measures to deal with the non-revenue water in the Braidwood system are listed below:

- An old 2.2 km trunk main from the reservoirs to the town has been replaced
- Council has spent $50,000 replacing old galvanised water mains in town
- This program of mains replacement will continue until all the galvanised pipes are replaced
- Following the replacement of galvanised pipes, old reticulation mains will be replaced
- Council also has a program for the replacement of water meters.

4 Bungendore Water Security Issue

4.1 Background

Issue: Water Security – Licensed allocation

It is estimated that Bungendore water supply dry year extraction will exceed its licensed extraction limit from the Bungendore and Currandooly bores by 2020.

The projected dry extraction along with the licensed entitlement for the Bungendore water supply scheme is shown in Figure 4-1.

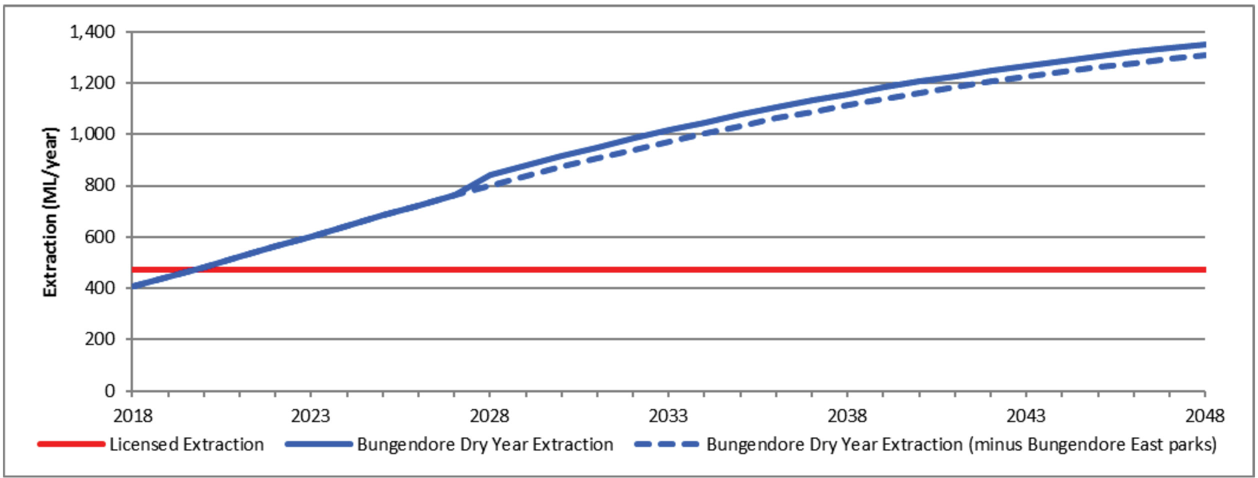


Figure 4-1: Projected dry year extraction – Bungendore water supply

Details of the Water Access Licenses (WAL) that Council holds for the Bungendore water supply are provided in Table 4-1.

Table 4-1: Details of Water Access Licenses for Bungendore water supply

WAL	Water Sharing Plan	Water Source	Management Zone	Share Component	Borefield	Category
32742	Murrumbidgee unregulated and alluvial water sources	Bungendore Alluvial Groundwater	Whole water source	272 ML/y	Turallo	Local Water Utility
36260				200 ML/y	Currandooly	

It is noted that the share components specified in the license certificate correspond to the first water year of the Water Sharing Plan (the Plan). The share components listed in Table 4-1 applies to each water year after the first year in which the Plan has effect.

Three water sources, for the supply of this additional water, have been evaluated. These are:

- Bungendore Alluvial Groundwater Source
- Fractured rock source from the Lachlan Fold Belt
- Bulk supply from Icon Water in Queanbeyan

Council would therefore require an additional entitlement of **1 GL/year** to meet the 30-year extraction requirements for Bungendore water supply due to growth.

Section 66(4) of the Water Management Act states that:

…… the Minister may at any time increase the utility's entitlement to water under a local water utility licence so as to reflect any rapid growth of population within the utility's area requiring an immediate increase in the availability of water for supply by that utility.

4.2 Bungendore Alluvial Groundwater Source

4.2.1 Availability of water

The long-term average annual extraction limit (LTAAEL) for the Bungendore Alluvial Groundwater Source is 1,268 ML/year. The water requirements within the Bungendore Alluvial Groundwater Source are listed in Table 4-2 which shows current entitlements total 1,243 ML/year, or 98% of the LTAAEL.

Table 4-2: Water requirements in the Bungendore Alluvial Groundwater Source

Water requirement	ML/year
Requirement for basic landholder rights	
Domestic and stock rights	25
Native title rights	0
Requirement for extraction under access licenses	
Domestic and stock	0
Local water utility	472
Unregulated river	0
Unregulated river (high flow)	0
Aquifer	746
TOTAL	**1,243**

The current licensed entitlements within this water source are provided in Table 4-3.

Table 4-3: Current licensed entitlements within the Bungendore Alluvial water source

WAL	Category	Tenure type	Share component (ML)
32742	Local Water Utility	Specific purpose	272
32743	Aquifer	Continuing	29
32744	Aquifer	Continuous	705
36132	Aquifer	Continuous	2
36178	Aquifer	Continuous	30
36260	Local Water Utility	Specific Purpose	200
TOTAL ENTITLEMENT			**1,238**

4.2.2 Obtaining additional entitlements

As the unallocated amount within the water source is only 30 ML, in reviewing an application from Council for additional entitlements the Minister may consider:

- The historical usage under WAL 32744.
- The category, and therefore the priority of the licenses.
- A review of the SDL limit for the water source.
- A part increase to the entitlement of say 500 ML to cover Council's short-term need.
- The alternate options available to Council to obtain the additional entitlement.
- Compulsory acquisition of access licenses.

Compulsory acquisition of access licenses

Section 79 of the Water Management Act states that:

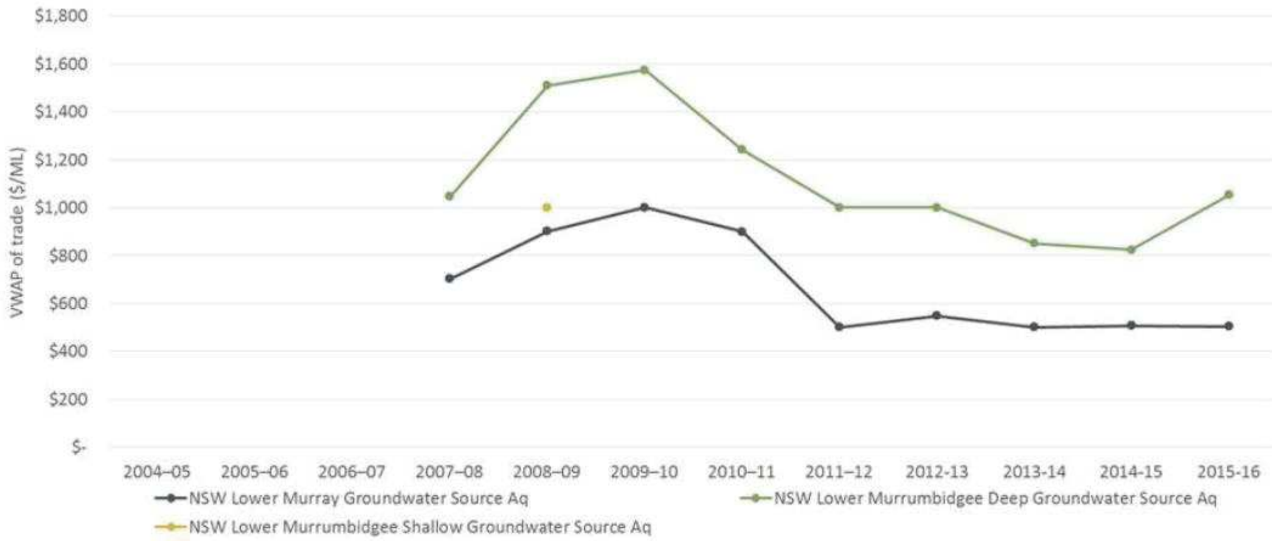
(1) *The Minister may, by notice in writing served on their holders, compulsorily acquire access licences if of the opinion that, in the special circumstances of the case, the public interest requires their compulsory acquisition.*
(2) *A person from whom an access licence is compulsorily acquired under subsection (1) is entitled to compensation from the State for the market value of the licence as at the time it was compulsorily acquired.*

Market Value of License

Reference is made to a report prepared for DPI Water in 2017, **Aither 2017, *Water markets in New South Wales: market outcomes, trends and drivers*, Aither Pty Ltd.**

The report provides the following information regarding changes in entitlement trade prices for groundwater sources in the southern MDB.

"Figure 21 shows changes in entitlement trade prices for groundwater sources in the southern MDB. The trend for groundwater entitlement prices is broadly similar to surface water entitlements, with increasing prices during drought periods, and a small increase in prices (for Murrumbidgee Deep) from 2014–15 to 2015–16 (when actual and expectations about water availability declined). An upward trend towards the end of the period may have been driven by concerns about declining long term water availability outlooks, as groundwater may be seen as a tool to mitigate against surface water availability risk."



Source: Aither 2016. Based on information provided by NSW DPI Water.
Note: All $0 trades are removed when calculating prices, however in some cases outlier prices may still be present. Prices reported are volume weighted average prices (VWAP).

Figure 4-2: Southern Murray-Darling Basin groundwater entitlement prices, 2004-05 to 2015-16 (Aither, 2017)

Based on the information in Figure 4-2, an amount of $1,200 per ML could be considered as the market value for trading in groundwater entitlements. For the permanent transfer of entitlement an amount of $3,000 per ML has been considered following discussions during the PRG Workshop.

It is understood that Council has attempted to negotiate with the owner of WAL 32744 to buy out the licence in full (or part thereof) but the owner has not shown any willingness to do so. Council may consider negotiating a lease arrangement, in lieu of a complete buy-out.

4.2.3 Water quality

The water quality from the Turallo borefield would be similar to that being received and treated at the Bungendore WTP. Bore water is aerated at the existing Bungendore WTP for the removal of carbon dioxide. It then gravitates to a collection tank where chlorine and fluoride are added before being distributed to the town.

4.2.4 Infrastructure requirements

The following works would be involved in augmenting the Bungendore water supply scheme from the Bungendore alluvial water source:

- four bores to a depth of around 50 metres including power supply (possible land acquisition);
- rising mains from the bores to the WTP (incorporating routes along road reserve and some private easements); and
- augmenting the Bungendore WTP capacity, which includes land acquisition and a power supply upgrade.

Water from the alluvial bores will be treated at the existing 3.2 ML/day Bungendore WTP which will need to be augmented with additional capacity to meet increased peak day demand.

4.3 Lachlan Fold Belt

4.3.1 Availability of water

Council undertook investigations as to the possibility of securing additional entitlements from the fractured rock aquifers in the Lachlan Fold Belt (LFB) which is included in the Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011.

The LTAAEL for the LFB MDB Groundwater Source is 875,652 ML/year. The water requirements within the LFB Groundwater Source are listed in Table 4-4 which shows current entitlements total 148,896 ML/year, or 17% of the LTAAEL.

Table 4-4: Water requirements in the Lachlan Fold Belt MDB groundwater source

Water requirement	ML/year
Requirement for basic landholder rights	
Domestic and stock rights	74,311
Native title rights	0
Requirement for extraction under access licenses	
Domestic and stock	0
Local water utility	5,101
Aquifer	69,248
Salinity and water table management	236
TOTAL	**148,896**

For the purposes of the plan, the Lachlan Fold Belt MDB Groundwater Source is divided into the following management zones:

(a) Lachlan Fold Belt MDB (Mudgee) Management Zone, and
(b) Lachlan Fold Belt MDB (Other) Management Zone.

The town of Bungendore lies within the ‘Other’ Management Zone of the groundwater source.

4.3.2 Obtaining additional entitlements

As there is a large amount of unallocated water within this Water Source, Council will be able to obtain an entitlement under Section 66(4) of the Water Management Act.

4.3.3 Water quality

Council has investigated a total of nine test sites with varying results. Two of the sites were identified for development to production bore status these being bores at Elmslea Estate and East Bungendore. In summary, around 735 ML/a was identified as being possible from these two sites. The water from these two sources has iron and manganese and will need more treatment process units than just aeration, chlorination and fluoridation.

4.3.4 Infrastructure requirements

Council set about determining targets for exploratory drilling of LFB fractured rock bore sites in and around the village of Bungendore. Council investigated a total of nine test sites out of which two were developed to production bore status, with these being bores at Elmslea Estate (Jim Gray) and East Bungendore.

Council engaged Hydroliex to undertake the bore testing. The Hydroilex report concluded that the East Bungendore production bore was capable of delivering about 500 ML/year at 80% duty or 630 ML/ year at 100% based on a pump rate of up to **20 L/s**. For the Jim Gray site, the recommendation was 135 ML/year at 50% duty and **8.5 L/s**. In summary, around 735 ML/year was identified as being possible from these two sources subject to the issue of an appropriate entitlement and subsequent works approval.

The work involved in sourcing the water from the Lachlan Fold Belt includes:

- equipping the Jim Gray and East Bungendore Bore with pumping equipment, associated electrical equipment and a power supply
- rising main to transfer water from the East Bungendore and Jim Gray bores to the WTP
- construction of a new WTP to treat iron and manganese, similar to the Currandooly WTP;
- land acquisition.

The water from the East Bungendore bore is slightly more saline than from the alluvium and the Jim Gray bore. The East Bungendore bore water has a total dissolved solids (TDS) of approximately 527 mg/L whilst the TDS of the water from the Jim Gray bore is approximately 226 mg/L. East Bungendore bore water also has some issues with slight exceedances in the screening value for radionuclides.

A new WTP will need to be constructed which can treat the iron and manganese from LFB water source, similar to the Currandooly WTP. The water could be shandied with alluvial water to reduce the TDS of the treated water.

4.4 Supply of bulk treated water from ICON Water

This option would include water supply to Bungendore by connecting to the ICON Water supply at Queanbeyan through a bulk water supply agreement.

This option will involve connecting to the ICON Water supply at Queanbeyan. The proposed connection is at the existing ICON Water Offtake No. 2, where Queanbeyan draws water off for East Queanbeyan. It is a 1,800 mm diameter trunk main that joins Stromlo WTP and Googong WTP.

4.5 Assessment of Water Source Options

Obtaining additional entitlement from the LFB water source, will likely be straight-forward, as this water source is currently under-allocated. Water from this aquifer in the Bungendore area has proven to be high in iron and manganese, and thus will require more treatment process units than just aeration, chlorination and fluoridation.

Obtaining additional entitlement from the Bungendore Alluvial Groundwater Source, will likely be more difficult, as this water source is close to fully allocated and would require entitlements to be purchased or loaned from other users or even a compulsory acquisition by the Minister. The additional entitlement from this source will still not satisfy the 1 GL/year of additional water that Council will require in the 30-year planning horizon, and therefore Council will need to supplement this entitlement with an entitlement from the LFB water source.

Connecting to ICON Water supply and purchasing of bulk water will require a connection between Bungendore and Queanbeyan, however this will guarantee a high quality water source is always available to Council.

The triple bottom line assessment of the options is summarised in

Table 4-5: Triple bottom line assessment of water source options

TBL Category	Criteria	Bungendore Alluvial source	Lachlan Fold Belt source	Bulk water supply from ICON Water
Social	Flexibility	Two stage construction provides flexibility to cater for growth and reduces risk of overcapitalising.	Two stage construction provides flexibility to cater for growth and reduces risk of overcapitalising.	Pipeline is sized for ultimate capacity and hence there is a risk of overcapitalising.
	Long-term water security	Obtaining additional entitlements may require compulsory acquisition by the Minister for which there is no precedent.	The water source is under allocated. However, the location and sustainable yield of potential future bores is unknown.	No issue with long-term water security as this can be included in a Service Level Agreement (SLA).
	Employment /tourism	Additional employment is generated within Council for operating the new infrastructure.	Additional employment is generated within Council for operating the new infrastructure	Opportunity for additional employment is reduced. However the pipeline provides opportunity for servicing new development along the alignment.
	Ownership	Maintains local ownership of the complete supply train. Council is in control of the asset condition.	Maintains local ownership of the complete supply train. Council is in control of the asset condition.	Headworks for the scheme is not owned by Council.
	Reliability	Council is in control of the scheme and can assure reliability.	Council is in control of the scheme and can assure reliability.	Supply reliability is outside of Council's control and will need to be established in the SLA.
Environmental	Construction environmental impact	Minimum due to smallest plant footprint	Higher due to increased plant footprint	Greatest impact along the entire

TBL Category	Criteria	Bungendore Alluvial source	Lachlan Fold Belt source	Bulk water supply from ICON Water
				length of the pipeline.
	Operational environmental impact	Minimum sludge generated due to good quality of the water.	Increased environmental impact due to greater sludge generation from treating poor quality water.	No impact within Bungendore and minimum impact at the source WTP.
	Energy consumption	Minimum energy consumption due to simple treatment required as the water quality is good.	Higher energy consumption due to more advanced treatment required as the water quality is poor.	Highest energy consumption required for pumping the water from Queanbeyan to Bungendore.
Economic	Capital cost	Lowest capital cost	Intermediate capital cost	Highest capital cost
	Operating cost	Lowest operating cost due to simplified treatment process.	High operating cost due to increased complexity of treatment.	Highest operating cost due to the access and usage charges imposed by ICON Water

4.6 Formulation of options

In formulating the Bungendore water supply source options, the following factors have been taken into consideration:

- An additional entitlement of 1 GL is required to service growth for the next 30 years
- There is an immediate need of 0.5 GL to service the population growth at least for the next 10 years.
- Obtaining any additional entitlement from the Bungendore alluvial source may require a compulsory acquisition for which there is no precedent, which may therefore be a long drawn out process.
- The understanding that Council production bores ready in the Lachlan Fold Belt water source can reliably supply at least 0.5 GL/year..

On this basis, the following options have been formulated:

Option 1: Obtain an additional entitlement of 0.5 GL/year from the LFB to service the immediate need. Supplement this entitlement with an entitlement from the Bungendore Alluvial source.

Option 2: Obtain an additional entitlement of 0.5 GL/year from the LFB to service the immediate need. Increase this entitlement to 1 GL/year if additional entitlements from the Bungendore alluvial cannot be obtained.

Option 3: Connect to the ICON Water supply at Queanbeyan.

Options 1 and 2 are shown in Figure 4-3.

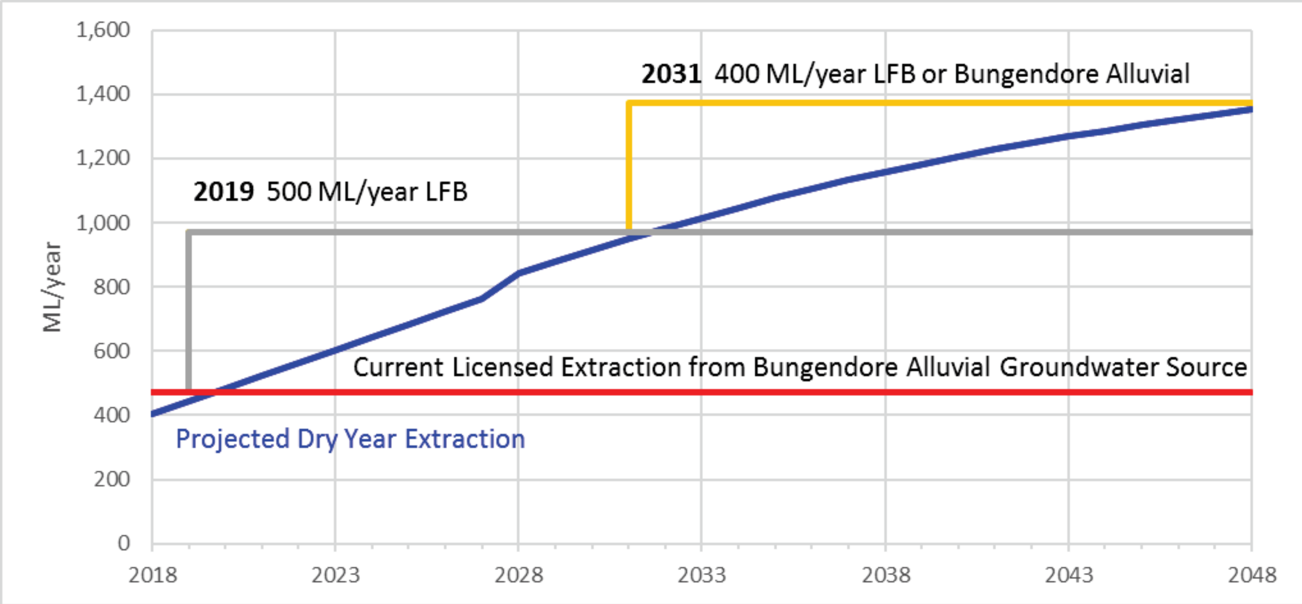


Figure 4-3: Groundwater source options from Bungendore Alluvial and LFB

5 Bungendore Water Supply Headworks Issue

5.1 Background

Issue: Level of Service – Headworks capacity

The peak day demand will exceed the combined capacity of the Bungendore and Currandooly WTPs around 2027. The existing Bungendore WTP, and reservoir capacity would need to be reviewed to ensure that the required the required levels of service can be maintained in the system on a peak day.

The forecast peak day water production is compared to the total WTP capacity and total reservoir capacity for each scheme in Figure 5-1.

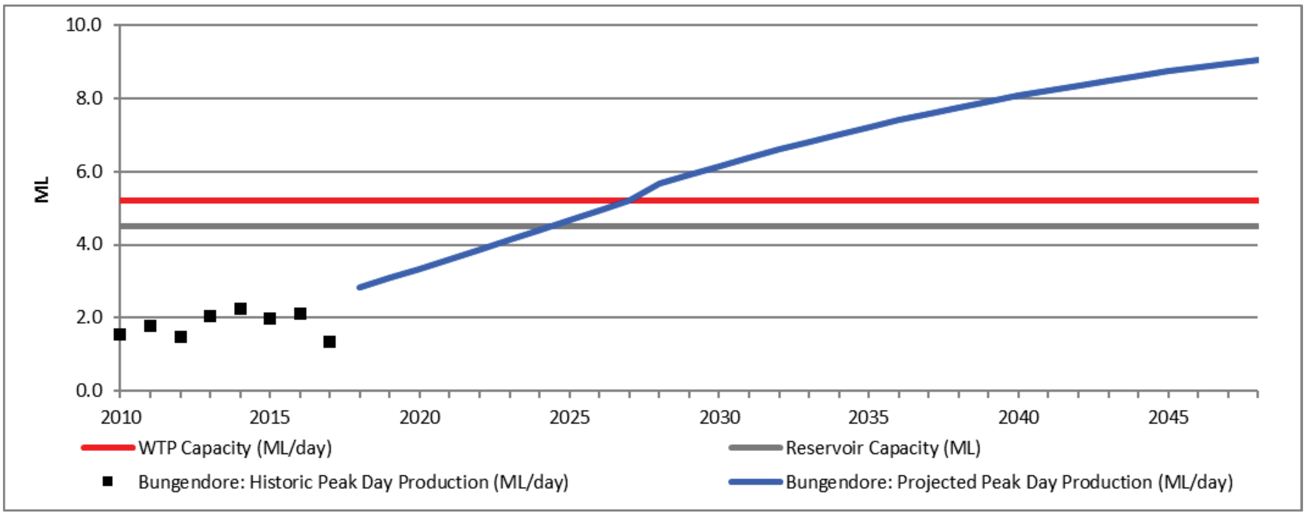


Figure 5-1: Bungendore current headworks capacity and projected peak day demand

The existing Bungendore WTP (3.2 ML/day capacity) sources water from four **alluvial** bores with a total extraction capacity of approximately 4.5 ML/day on a 22-hour basis. The existing Currandooly WTP and bore has a 2.0 ML/day capacity.

The capacities are given in Table 5-1.

Table 5-1~~5.1~~: Extraction rates from existing bores in Bungendore

Bore Number	Extraction rate (L/s)	Extraction rate (ML/day) 22-hour basis
Bore 1 (Bungendore alluvial)	11.5	0.9
Bore 2 (Bungendore alluvial)	15.0	1.2
Bore 3 (Bungendore alluvial)	14.0	1.1
Bore 6 (Bungendore alluvial)	16.0	1.3
Currandooly (Currandooly)	25.0	2.0
Total	**81.5**	**6.5**

The Bungendore peak day demand is estimated to reach around 9.0 ML/day by 2048. This means that additional WTP capacity of about **4.0 ML/day** and additional bore capacity of **2.5 ML/day** will need to be constructed to meet the 2047 peak day demand.

5.2 Formulation of options

Based on the groundwater source options discussed in Section 4.6, the following capacity augmentation options are proposed:

- Stage 1: Commission the Jim Gray and East Bungendore LFB bores (combined capacity 2.3 ML/day) and construct a new 1.5 ML/day WTP to treat the bore water
- Stage 2: Augment the WTP capacity by 3 ML/d by 2032, to treat Bungendore alluvial water, or to treat water from the LFB (fractured rock) if an entitlement from the Bungendore alluvial cannot be obtained.

The staged capacity augmentation ensures that the community does not end up paying for infrastructure that is provided for growth that does not eventuate.

The Stage 1 capacity of 1.5 ML/day followed by a Stage 2 augmentation of 3.0 ML/day (total 4.5 ML/d) allows for easier augmentation by adding two additional treatment trains.

The staging of the WTP upgrades is shown in Figure 5-2.

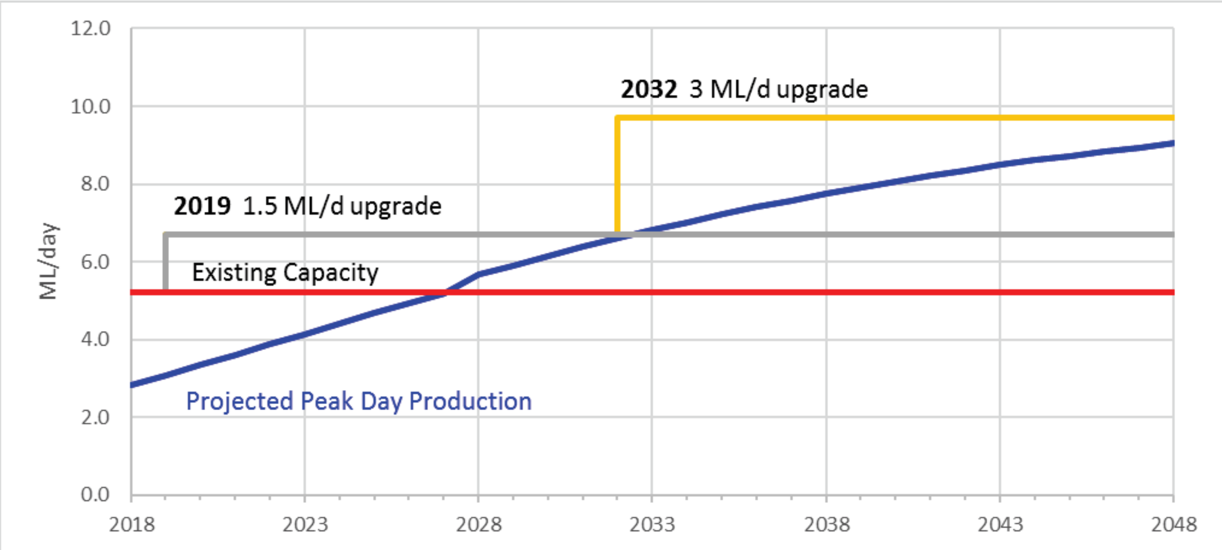


Figure 5-2: Bungendore WTP Upgrade Staging

The infrastructure works required to access the water from the LFB and the Bungendore alluvial water sources are discussed in the Sections below.

5.3 Water Supply Option 1 – Extraction from Lachlan Fold Belt followed by Bungendore alluvial water source

- Stage 1: Commission the Jim Gray and East Bungendore LFB bores (combined capacity 2.3 ML/day) and construct a 1.5 ML/day WTP to treat the bore water
- Stage 2: By 2032, two 17.5 L/s alluvial bores (combined capacity 2.7 ML/day) will be developed and the Bungendore WTP capacity is augmented with an additional 3 ML/day capacity to treat this water.

A desktop hydraulic analysis was undertaken to size the components of the transfer system from the bores to the WTP – the resulting hydraulic profiles are given in Appendix A.2 The location of the existing and proposed infrastructure for this option is shown in Figure 5-3.

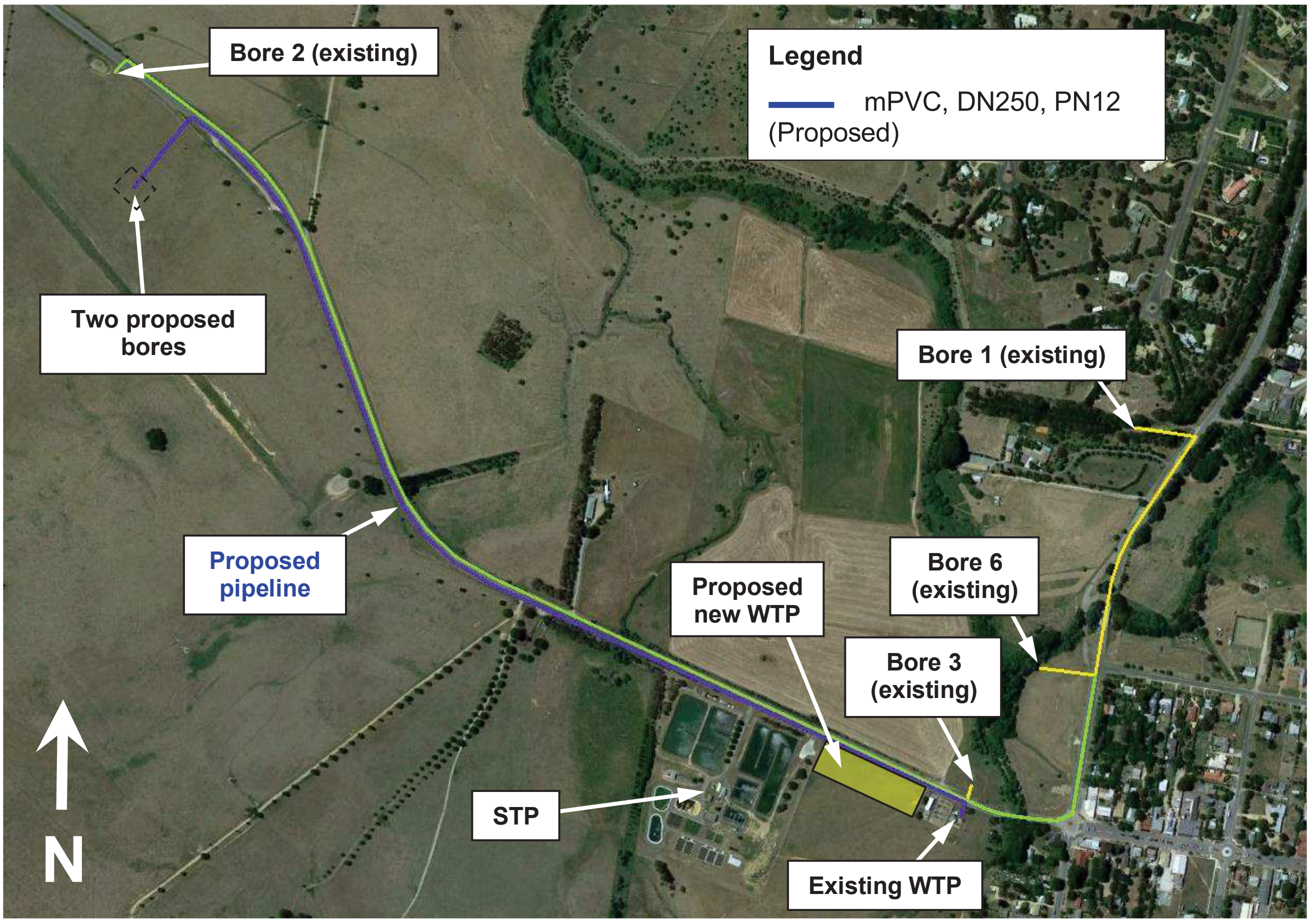


Figure 5-3: Existing and proposed infrastructure for supplying water from the Bungendore alluvial water source

A summary of the cost estimate for this option is provided in Table 5-2. A detailed cost estimate for this option is provided in Appendix B.2. The cost estimate does not include the land acquisition for easements.

Table 5-2: Cost Estimate for Option 1 – Extraction from the Lachlan Fold Belt followed by Bungendore alluvial

Item	Capital Cost ($K)	NPV@7% ($K)
Stage 1 – Lachlan Fold Belt Source		
Pipe Cost (supply and lay, crossings and valves)	$1,186	$1,186
Bores and pump stations	$365	$365
Water Treatment Plant (1.5 ML/day)	$4,000	$4,000
Power Supply	$500	$500
Sub Total	**$6,051**	**$6,051**
Stage 2 – Bungendore Alluvial Source		
Pipe Cost (supply and lay including crossings)	$477	$198
Bores and pump stations	$680	$282
Water Treatment Plant (3.0 ML/day)	$3,000	$1,245
Private alluvial allocation acquisition (350 ML/a)	$1,050	$436
Sub Total	**$5,207**	**$2,161**
Total Prime Cost	**$11,258**	**$8,212**

Item	Capital Cost ($K)	NPV@7% ($K)
General Contingency (% 30 of Prime Cost)	$11,258	$8,212
Direct Cost	**$3,377**	**$2,463**
Design & Preconstruction Activities (10% of Direct Cost)	$14,635	$10,675
Construction Activities (10% of Direct Cost)	$1,464	$1,068
Total Capital Cost	**$17,562**	**$12,810**
Pumping Costs	$1,501	$524
Operating Costs WTP	$5,818	$2,173
Maintenance Costs	$7,108	$2,793
Total Operation and Maintenance Costs	**$14,427**	**$5,314**
Total Present Value	**$31,989**	**$18,124**

5.4 Water Supply Option 2 – Extraction from Lachlan Fold Belt only

- Stage 1: Commission the Jim Gray and East Bungendore LFB bores (combined capacity 2.3 ML/day) and construct a 1.5 ML/day WTP to treat the bore water
- Stage 2: Augment the WTP capacity by 3 ML/d by 2032, to treat water from the LFB (fractured rock).

Stage 2 – Construct an additional 25 L/s bore or bores (capacity 2 ML/day), the location of which is currently unknown.

A desktop hydraulic analysis was undertaken to size the components of the transfer system from the bores to the WTP – the resulting hydraulic profiles are given in Appendix A.1.The location of the existing and proposed infrastructure for this option is shown in Figure 5-4.

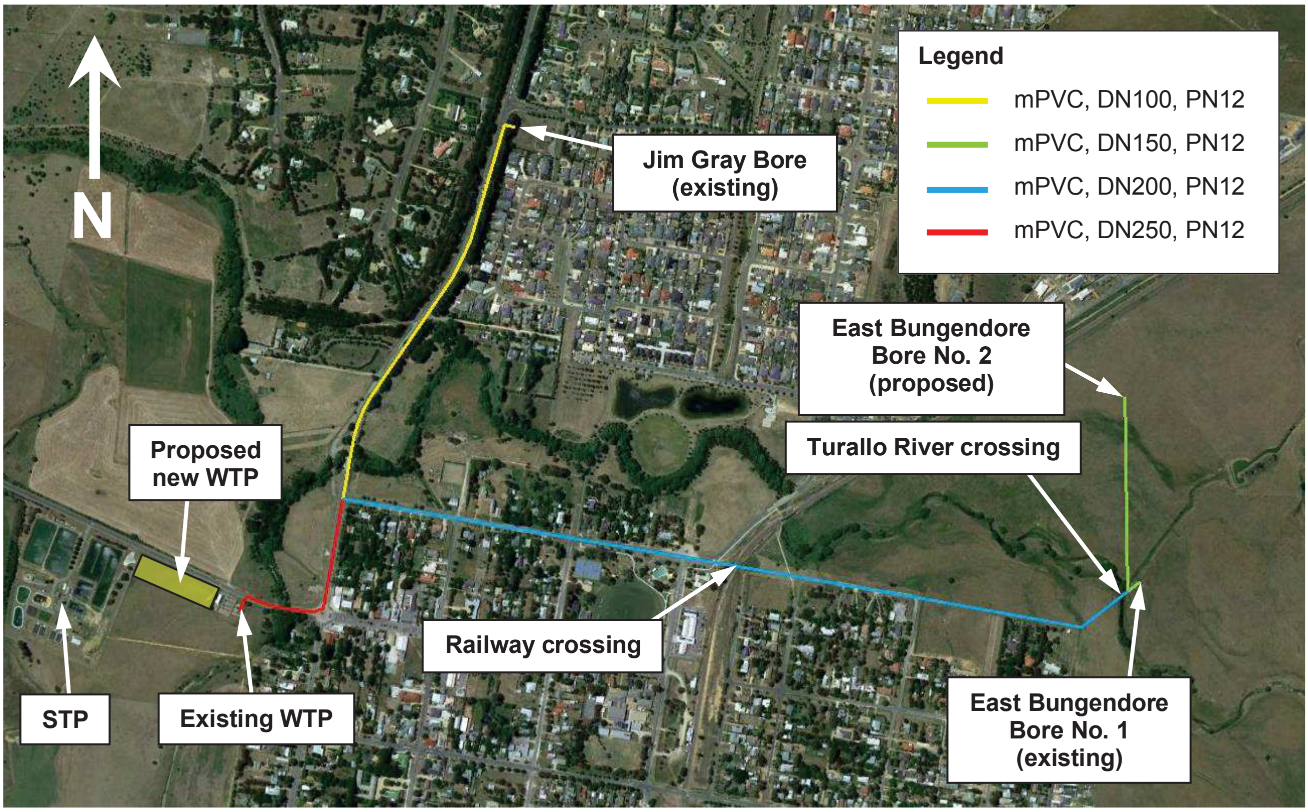


Figure 5-4: Proposed infrastructure for supplying water from the Lachlan Fold Belt source

A summary of the cost estimate for the proposed Bungendore Alluvial Groundwater Source option is provided in Table 5-3. A detailed cost estimate for this option is provided in Appendix B.1. The cost estimate does not include the land acquisition for easements.

Table 5-3: Cost Estimate for Option 2 – Extraction from LFB only

Item	Capital Cost ($K)	NPV@7% ($K)
Stage 1		
Pipe Cost (supply and lay, crossings and valves)	$1,181	$1,181
Bores and pump stations	$365	$365
Water Treatment Plant (1.5 ML/day)	$4,000	$4,000
Power Supply	$500	$500
Sub Total	**$6,046**	**$6,046**
Stage 2		
Pipe Cost (supply and lay including crossings)	$202	$85
Bores and pump stations	$670	$278
Water Treatment Plant (3.0 ML/day)	$5,000	$2,075
Sub Total	**$5,872**	**$2,438**
Total Prime Cost	**$11,923**	**$8,488**
General Contingency (% 30 of Prime Cost)	$3,577	$2,546
Direct Cost	**$15,500**	**$11,034**
Design & Preconstruction Activities (10% of Direct Cost)	$1,550	$1,103
Construction Activities (10% of Direct Cost)	$1,550	$1,103
Total Capital Cost	**$18,600**	**$13,241**
Pumping Costs	$1,685	$588
Operating Costs WTP	$7,096	$2,489
Maintenance Costs	$7,968	$2,998
Total Operation and Maintenance Costs	**$16,750**	**$5,899**
Total Present Value	**$35,350**	**$19,139**

5.5 Water Supply Option 3 – Bulk supply from ICON Water

A desktop hydraulic analysis was undertaken to size the components of the transfer. The resulting hydraulic profiles are given in Appendix A.3. The proposed pipeline alignment from Queanbeyan to Bungendore is shown in Figure 5-5.

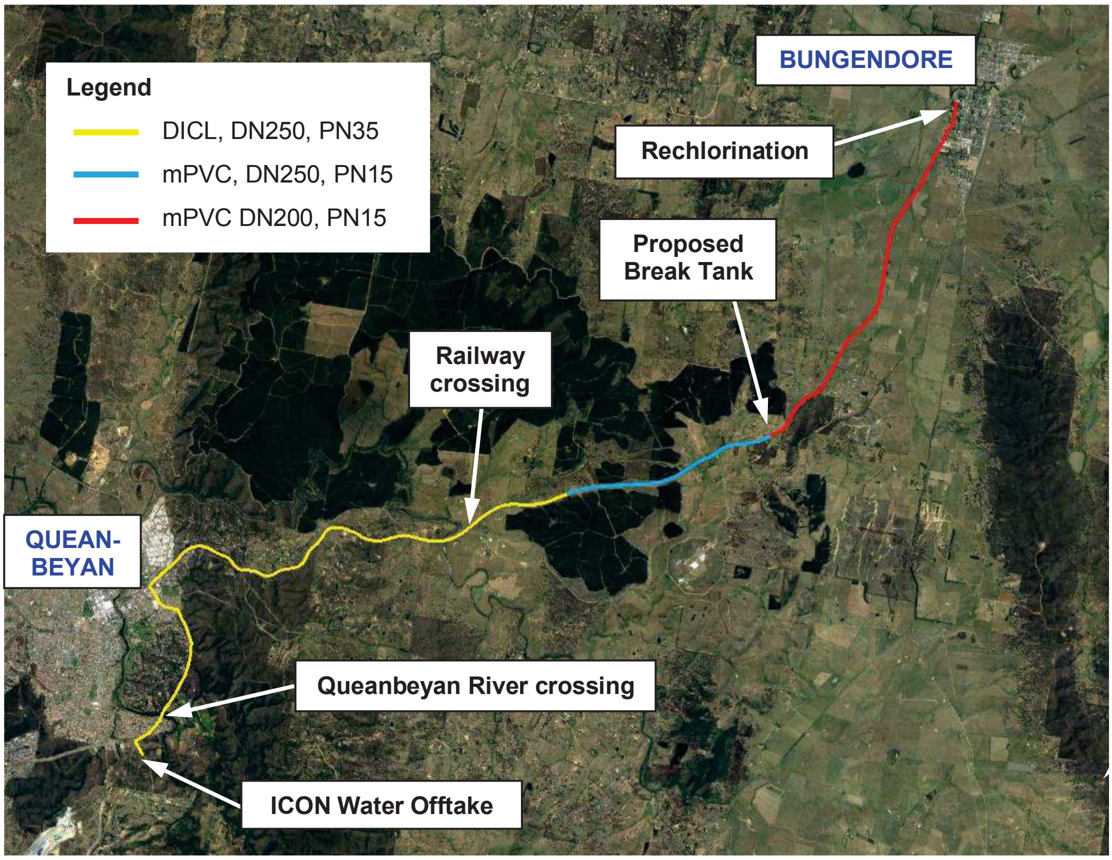


Figure 5-5: Proposed pipeline alignment from Queanbeyan to Bungendore

A summary of the cost estimate for this option is provided in Table 5-4. A detailed cost estimate for this option is provided in Appendix B.3. The cost estimate does not include the land acquisition for easements - approximately 8,400 m^2 area.

Table 5-4: Cost Estimate for Water Supply Option 3 – Bulk supply from ICON Water

Item	Capital Cost ($K)	NPV@7% ($K)
Pipe Cost (supply and lay, crossings and valves)	$12,663	$12,663
Pumping Station	$1,020	$1,020
5 ML Break Tank	$3,500	$3,500
Power Supply	$100	$100
Sub Total	**$17,283**	**$17,283**
Total Prime Cost	**$17,283**	**$17,283**
General Contingency (% 30 of Prime Cost)	$5,185	$5,185
Direct Cost	**$22,468**	**$22,468**
Design & Preconstruction Activities (10% of Direct Cost)	$2,247	$2,247
Construction Activities (10% of Direct Cost)	$2,247	$2,247
Total Capital Cost	**$26,961**	**$26,961**
Pumping Costs	$6,137	$2,199
Operating Costs WTP	$146	$52
Maintenance Costs	$2,793	$1,155
Total Operation and Maintenance Costs	**$61,709**	**$22,423**
Total Present Value	**$88,670**	**$49,384**

6 General Sewerage Issues

This section discusses what measures will be taken to address the sewerage issues.

6.1 Bungendore General Sewerage Issues

Issue: Best Practice – Section 60 approval

Effluent from the Bungendore STP is reused on-site, for road works (truck filling) and for watering Bungendore oval. Council does not have a Recycled Water Management Plan and Section 60 approval for the off-site effluent reuse.

The Log Reduction Value (LRV) required for effluent reuse may not be achieved through the current STP process. This will be reviewed during the preparation of the Recycled Water Management System (RWMS) for Section 60 approval.

Council has engaged PWA to develop a path to obtain Section 60 approval for the effluent reuse scheme. This process includes the assessment of LRV's required for the specific reuse application. Council's objective is to have the required effluent treatment in place for the current 5,000 EP plant capacity, within the next two years.

Issue: Regulatory – EPA License non-compliance

The plant exceeded the volumetric discharge limit in 2011, 2012, 2014 and 2016. Council needs to consider undertaking an inflow/infiltration study.

An amount has been included in the 2018/19 budget to clean and camera a selection of the reticulation mains with a view to condition rating. It is also proposed to inspect a selection of manholes and smoke test private connections. The results of this study will form the basis of any relining works/mains refurbishment to be conducted in 2019/20.

Issue: Performance – Effluent reuse flow balance

There is a mismatch in the effluent reuse flow balance. Potential reasons for the discrepancy could include uncalibrated meters, and on-site flows which may not be metered.

Council proposes to have all streams metered.

Issue: Sewer catchment performance – Pump sizing @ PWWF

The peak wet weather flow (PWWF) at catchment no. 2, 8 and 9 exceeds the capacity of a single pump. The PWWF at catchment no. 4 will exceed the capacity of a single pump by 2021. This is based on a PWWF calculated from the storm allowance which is twice the maximum flow recorded during the highest rainfall event in the last five years. Hence this is a conservative assessment.

Pumping station #4 is planned to be upgraded with new pumps and a rising main in the 2019/20 financial year.

The upgrade required for pumping stations 8 and 9 will be determined through the sewer network modelling that Council plans to undertake.

Issue: Odour/septicity potential

Catchment no. 7 and 8 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. This risk is expected to continue over the 30 year planning period.

Council will investigate this issue further.

Issue: Capacity – Sewage Treatment Plant

The EP load currently exceeds the 3,000 EP STP capacity, and is expected to exceed the 5,000 EP capacity by 2020.

For the assessed hydraulic loading of 200 L/EP/day in this study, the plant hydraulic and capacity will be exceeded by 2018 for the 3,000 EP STP, or 2023 when capacity is increased to 5,000 EP by commissioning the second IDEA reactor.

Council has developed a concept design to augment the plant capacity to 12,000 EP.

6.2 Braidwood General Sewerage Issues

Issue: Regulatory – EPA License non-compliance

The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.

For the Braidwood scheme Council has completed an inflow/infiltration study this year whereby all mains were cleaned, CCTV inspected and rated. All the manholes were also inspected and property lines smoke tested. The following renewal works have been budgeted for the next two years:

- Relining of mains identified
- Manhole surround and lid replacement
- Smoke test rectification works

Issue: Sewer catchment performance – Pump sizing

The PWWF at catchment no. 1 will exceed the capacity of a single pump by 2021. Council has funded for an upgrade.

Installation of new pumps with a capacity of 60 L/s has been allowed for in the current budget.

Issue: Sewer catchment performance – Odour/septicity potential

Catchment no. 3, and 5 have a medium risk for odour/septicity potential with a detention time greater than 4 hours. The risk for Catchment no. 5 is expected to drop to low risk by 2020, however Catchment no. 3 is expected to remain at medium risk.

Council will investigate this issue further.

6.3 Captains Flat General Sewerage Issues

Issue: Regulatory – EPA License non-compliance

The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.

An inflow/infiltration study was conducted in the 17/18 year for Captains Flat which included some significant pipe relining.

Issue: Sewer catchment performance – Pump sizing

The PWWF at catchment no. 1 is expected to exceed the duty pump capacity.

An overhaul of the station is planned for 18/19 but mostly aimed at refurbishing the station lid and SCA. The pumps will also be upgraded as a result of this issue

Issue: Performance – Sewage Treatment Plant

The plant needs to be upgraded to improve replace ageing infrastructure, improve treatment and enable enhanced phosphorus removal, enable screening and grit removal, improve sludge and sludge drying components and improve amenity and WHS.

Council is in the process of constructing a new plant. The tender closes on 1st May 2018. This work will be completed by 30th June 2019 and will resolve all the above issues.

6.4 Unserviced Communities issues

Issue: Unserviced communities – On-site sewage management systems

Systems at the Village of Majors Creek, Nerriga and Araluen have potential issues mainly due to the following reasons:

- *Small lot sizes (some around 3,000 m^2 and several around 1,000 m^2)*
- *Inadequate buffer distance from Majors Creek*
- *Moderately well to imperfectly drained soil*
- *Some properties may have inadequate buffer distance from Bindi Brook*
- *Moderately permeable, imperfectly drained soil.*

Council has a well implemented On-Site Sewage System Management (OSSMS) program where all private systems within the shire are inspected on a regular basis, and those at higher risk are inspected more frequently. The inspection reports do not suggest that any of the systems in these villages are at a risk of non-performance.

7 Bungendore STP Capacity Issue

Issue: Capacity – Sewage Treatment Plant

For the assessed hydraulic loading of 200 L/EP/day in the Issues Paper, the plant hydraulic capacity will be exceeded by around 2024 for the existing 5,000 EP STP.

The current STP arrangement is one 2,000 EP and one 3,000 EP IDEA tanks, which were designed for 240 L/EP/day. The STP inflow analysis in the Issues Paper assessed that current hydraulic loading at around 200 L/EP/day, which brings the adjusted STP hydraulic capacity to 6,000 EP. The biological capacity needs to be assessed.

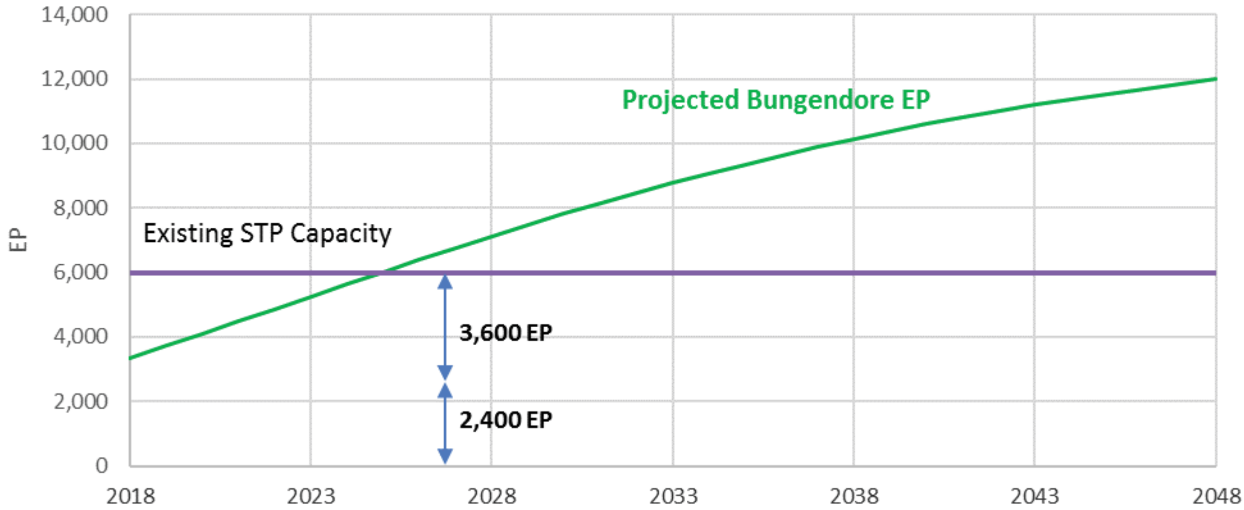


Figure 7-1: Bungendore STP Projections

An additional capacity of about 6,000 EP (at 200 L/EP/day) will be required to provide sufficient treatment capacity for the 30-year planning period. Two augmentation options are proposed.

7.1 STP Option 1 – 6,000 EP STP Upgrade

A single 6,000 EP STP upgrade in 2024 will increase the STP Capacity to 12,000 EP, which is estimated to be sufficient to service the 30-year planning horizon. Construction of the 6,000 EP reactor would also allow for the existing 3,600 EP tank to be mothballed and later recommissioned when the capacity is needed. This is shown in Figure 7-2.

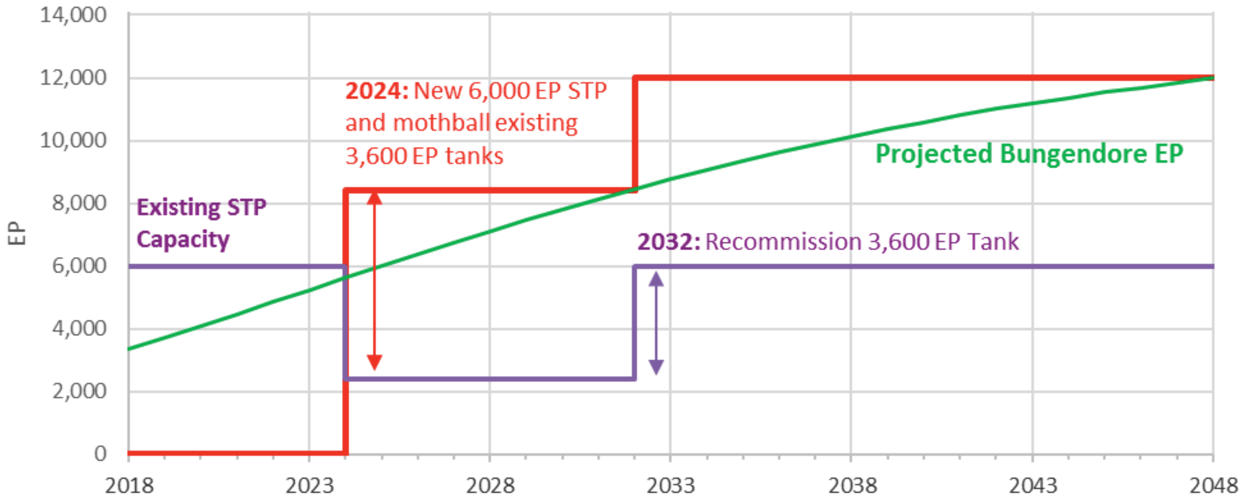


Figure 7-2: STP Option 1 – 6,000 EP (at 200 L/EP/day) STP Upgrade

A summary of the cost estimate for this option is provided in Table 7-1. A detailed cost estimate for this option is provided in Appendix B.4

Table 7-1: Cost Estimate for STP Option 1 – 6,000 EP STP Upgrade

Item	Capital ($K)	NPV@7% ($K)
STP Upgrade (6,000 EP)	$7,000	$4,991
Total Prime Cost	**$7,000**	**$4,991**
General Contingency (% 20 of Prime Cost)	$1,400	$998
Direct Cost	**$8,400**	**$5,989**
Design & Preconstruction Activities (10% of Direct Cost)	$840	$599
Construction Activities (10% of Direct Cost)	$840	$599
Total Capital Cost	**$10,080**	**$7,187**
Additional Operating Costs		$2,299
Maintenance Costs		$997
Total Operation and Maintenance Costs		**$3,279**
Total Present Value		**$10,466**

7.2 STP Option 2 – Staged development of two 3,000 EP STP upgrades

In this option, two 3,000 EP tanks would be constructed over two stages. It is estimated that the first upgrade will be required around 2024, and the second upgrade in 2033. This will increase the STP capacity to 12,000 EP, which is estimated to be enough to treat all sewage in Bungendore beyond the 30-year horizon. This is shown in Figure 7-3.

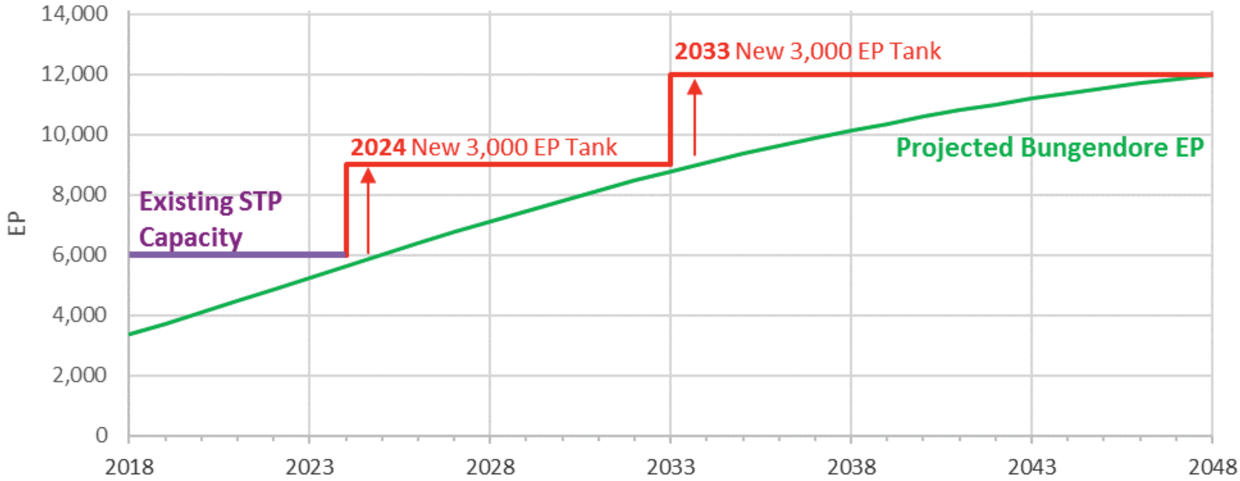


Figure 7-3: STP Option 2 – Staged development of two 3,000 EP tank STP upgrades

The advantage of this option is that if anticipated growth doesn't occur, the second tank many not need to be constructed. However, construction of two tanks cannot be accommodated at the current site and a new site would have to be investigated.

A summary of the cost estimate for this option is provided in Table 7-2. A detailed cost estimate for this option is provided in Appendix B.5

Table 7-2: Cost Estimate for STP Option 2 - staged development of two 3,000 EP tank STP upgrades

Item	Capital ($K)	NPV@7% ($K)
Stage 1 STP Upgrade (3,000 EP)	$4,200	$2,995
Stage 2 STP Upgrade (3,000 EP)	$2,800	$1,086
Total Prime Cost	**$7,000**	**$4,080**
General Contingency (% 20 of Prime Cost)	$1,400	$816
Direct Cost	**$8,400**	**$4,897**
Design & Preconstruction Activities (10% of Direct Cost)	$840	$490
Construction Activities (10% of Direct Cost)	$840	$490
Total Capital Cost	**$10,080**	**$5,876**
Additional Operating Costs		$2,299
Maintenance Costs		$929
Total Operation and Maintenance Costs		**$3,211**
Total Present Value		**$9,087**

Council had indicated that there is not enough room at the current STP site to construct two IDEA tanks, and the site would be problematic to expand. Therefore Option 2 is not considered further.

8 IWCM Scenarios

The Bungendore Water Security options and Water Supply Headworks options are combined to give three possible scenarios. As mentioned earlier, only STP Option 1 is practical given the site limitations of the existing STP, and therefore this option is included in all three scenarios.

Table 8-1 shows the bundled scenarios and the issues that are being addressed by each option are also listed.

Table 8-1: Palerang IWCM Scenarios

Target for Compliance	Issue	Option	Scenario 1	Scenario 2	Scenario 3
Water Security and headworks capacity Level of Service	The dry year demands exceed the current licensed entitlement. The peak day demand will exceed the combined capacity of the Bungendore and Currandooly WTPs around 2025.	**Water Supply Option 1** – Extraction from Lachlan Fold Belt source followed by Bungendore alluvial source.	✓ Stage 1 2019 Stage 2 2032		-
		Water Supply Option 2 – Extraction from Lachlan Fold Belt source only.		✓ Stage 1 2019 Stage 2 2032	-
		Water Supply Option 3 – Bulk supply from ICON Water	-	-	✓ 2019
Capacity – Sewage Treatment Plant	Bungendore STP hydraulic capacity will be exceeded by around 2024 for the existing 5,000 EP STP.	**STP Option 1** – 6,000 EP STP Upgrade	✓ 2024	✓ 2024	✓ 2024

8.1 Present Value Analysis of IWCM Scenarios

Table 8-2 presents the summary of the estimated total cost of capital outlay and the present value of the capital, and the operating and maintenance (O&M) cost estimates over the 30 years of the water supply service for each IWCM Scenario based on 2018 dollars.

Table 8-2: Capital and Present Value Costs for the IWCM Scenarios – Water Supply

	Scenario 1	Scenario 2	Scenario 3
Total Capital Cost over 30 years ($M)	17.6	18.6	27.0
Present Value of Capital Cost @ 7% ($M)	12.8	13.2	27.0
Present Value of O&M Cost ($M)	5.3	5.9	22.4
Total Present Value @ 7% ($M)	**18.1**	**19.1**	**49.4**

Table 8-3 presents the summary of the estimated total cost of capital outlay and the present value of the capital, and the O&M cost estimates over the 30 years of the sewerage service for each IWCM Scenario based on 2018 dollars.

Table 8-3: Capital and Present Value Costs for the IWCM Scenarios – Sewerage

	Scenario 1	Scenario 2	Scenario 3
Total Capital Cost over 30 years ($M)	10.1	10.1	10.1
Present Value of Capital Cost @ 7% ($M)	7.2	7.2	7.2
Present Value of O&M Cost ($M)	3.3	3.3	3.3
Total Present Value @ 7% ($M)	**10.5**	**10.5**	**10.5**

8.2 Triple Bottom Line Assessment of Scenarios

A total of seven environmental and social targets have been used to score the IWCM Scenarios as to how they address the IWCM Issues. Suitable weightings were assigned to the criteria. The criteria and their objectives are shown in Table 8-4.

Table 8-4: Social and Environmental Performance Criteria and weightings

TBL Category	Criteria	Weighting
ENVIRONMENTAL	Minimises construction environmental footprint	0.4
	Reduces operational energy consumption	0.4
	Reduces operational generation of waste	0.1
	Total weighted environmental score	**1.0**
SOCIAL	Community is burdened with infrastructure if growth does not eventuate	0.2
	Provides for greater long-term security of supply	0.2
	Promotes local employment	0.3
	Maintains local control of complete supply train	0.3
	Total weighted social score	**1.0**

The outcome of the environmental and social scoring for each IWCM Scenario across the 7 criteria is shown in Table 8-5. Detailed scoring is given in Appendix C. The scoring is based on the TBL assessment of the options presented in Table 4-5

Table 8-5: Summary of TBL Score for IWCM Scenarios

	Scenario 1 (LFB and Alluvial)	Scenario 2 (LFB Only)	Scenario 3 (ICON Water)
Environmental Score	3.8	2.8	2.4
Social Score	3.3	3.5	2.4
Environmental and Social Score (ESS)	7.1	6.3	4.8

Table 8-6 presents the ranking of the IWCM Scenarios following the DPI Water ranking methodology.

Table 8-6: IWCM Scoring Ranking

	Scenario 1	Scenario 2	Scenario 3
Total Present Value @ 7% ($M)	28.9	29.6	59.9
Environmental and Social Scores (ESS)	7.1	6.3	4.8
ESS/$M	0.25	0.21	0.08
Ranking	**1**	**2**	**3**

According to the assessment and ranking criteria used above, Scenario 1, which includes the extraction from the Lachlan Fold Belt followed by extraction from the Bungendore alluvial source, is the preferred Scenario.

8.3 Analysis of Risks

Whilst each scenario can address the water security and headworks capacity issues, there are risks associated with the project delivery for each of these scenarios. These are outlined in Table 8-7.

Table 8-7: Project delivery of Scenarios

	Delivery risk
Scenario 1 – LFB and Bungendore alluvial	- Relies on obtaining an entitlement from Bungendore Alluvial Groundwater Source most likely by compulsory acquisition. - There is no precedent for this and therefore the process is unknown. - Depends on the appetite of the Minister and the political climate at the time. - It is also unknown how much of the entitlement would become available.
Scenario 2 – LFB only	- Only two bores have been drilled. It is unclear where the other bores, required to access additional water, will be located. - It is unknown what the sustainable capacity of these bores would be.
Scenario 3 – Supply from ICON Water	- Will require negotiation of a cross-state water supply arrangement – possible difficulties with different regulations over interstate jurisdiction - Any future changes to water supply scheme will require negotiation and agreement with ICON Water. - Will require cross-state land negotiation/acquisition.

Whilst Scenario 1 is the preferred Scenario on a TBL assessment basis, it has a higher risk in terms of project delivery and this needs to be considered by Council before adopting a preferred scenario. However, the structure of the options provides Council with a 10-year timeframe before a decision on the Stage 2 augmentation is made which is within the 8-year review cycle of the IWCM Strategy.

Appendices

Appendix A Hydraulic Profile for proposed bore transfer systems

A.1 Hydraulic analysis for pipelines from Lachlan Fold Belt bores

The results of the hydraulic analysis for the transfer systems from each bore are provided in Figure 8-1 and Figure 8-3.

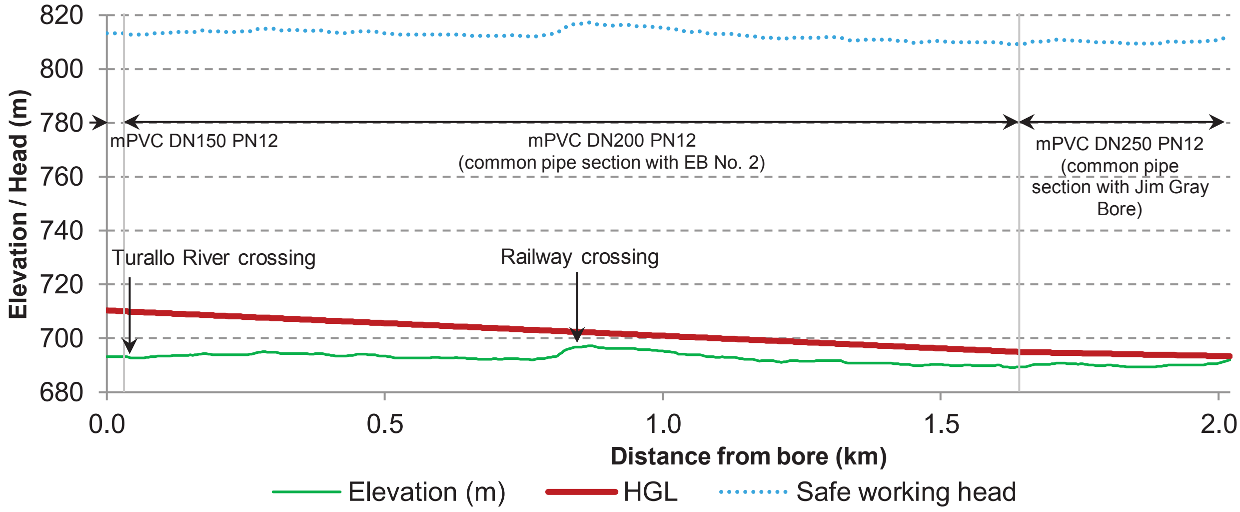


Figure 8-1: Hydraulic analysis for transfer from existing East Bungendore Bore No. 1

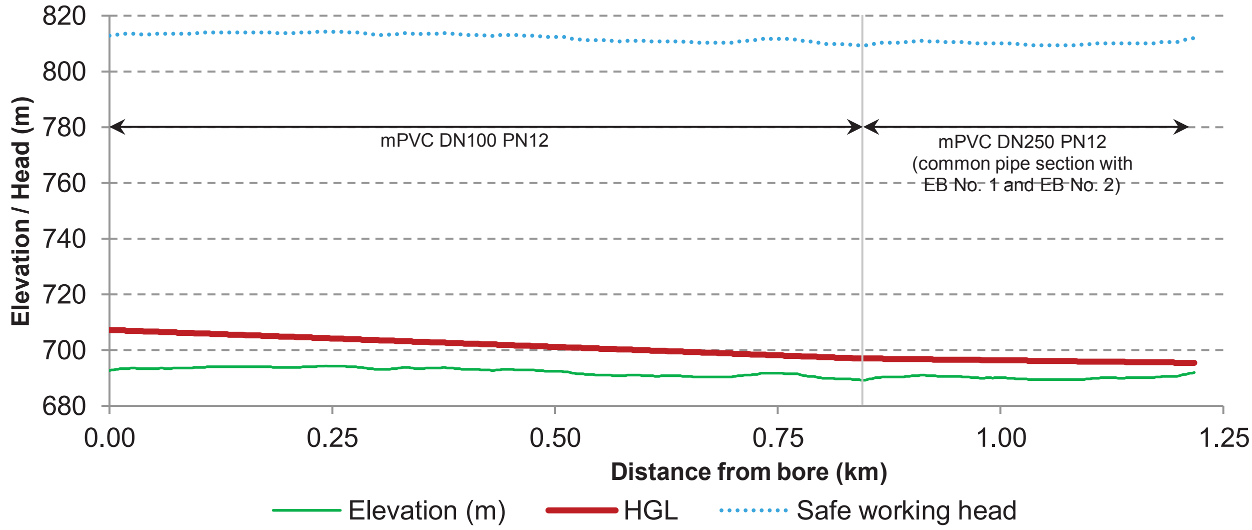


Figure 8-2: Hydraulic analysis for transfer from existing Jim Gray Bore

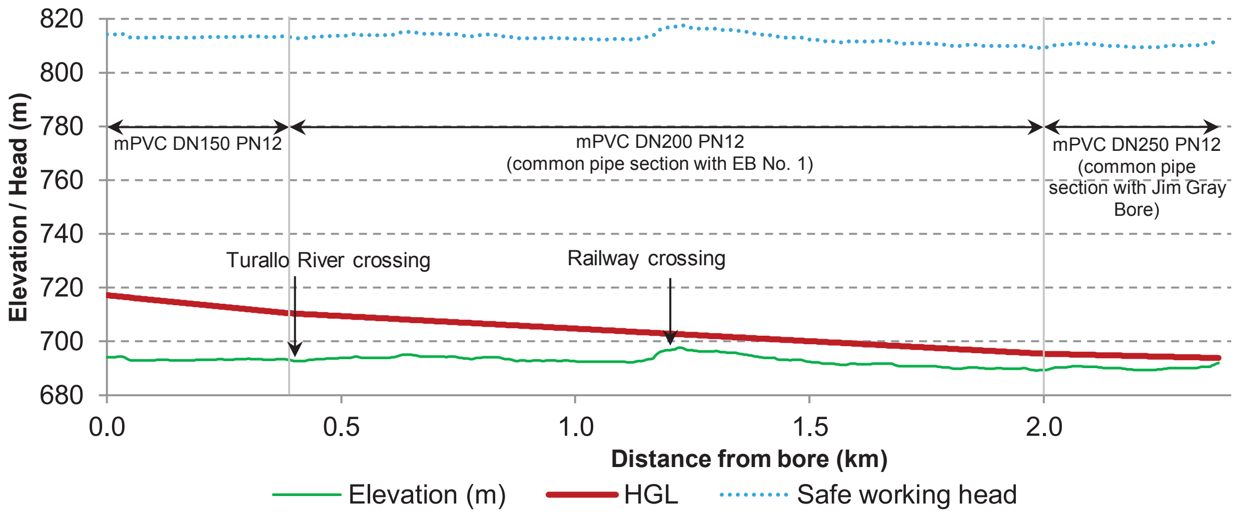


Figure 8-3: Hydraulic analysis for transfer from East Bungendore Bore No. 2

A.2 Hydraulic analysis for pipelines from alluvial bores

The hydraulic analysis for the transfer system from the two proposed bores is provided in Figure 8-4.

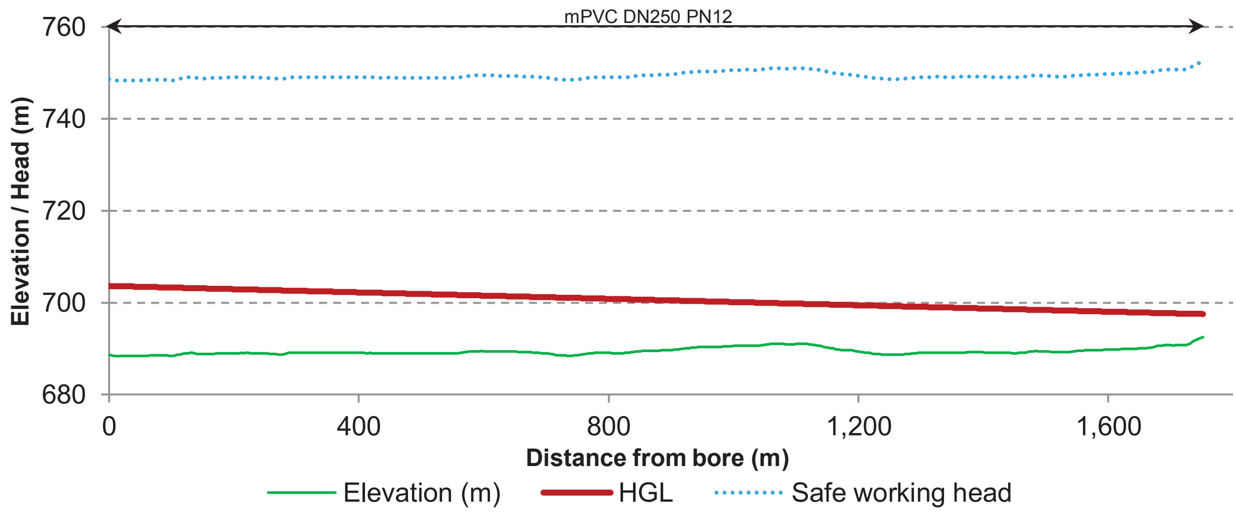


Figure 8-4: Hydraulic analysis for transfer from the proposed bores

A.3 Hydraulic analysis for pipeline from Queanbeyan to Bungendore

The results of the hydraulic assessment are shown in Figure 8-5.

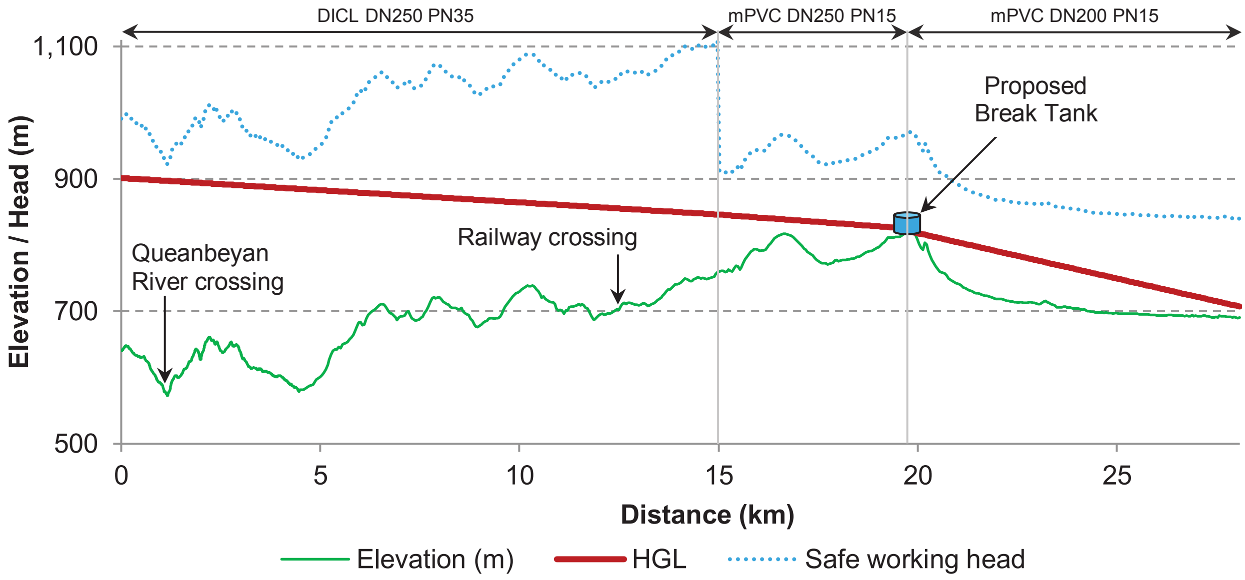


Figure 8-5: Hydraulic analysis for transfer system from Queanbeyan to Bungendore

Appendix B Detailed Cost Estimates

B.1 Cost estimate for Water Supply Option 1 - Implementation of LFB bores followed by alluvial bores

Water Supply Option 2 – Implementation of Lachlan Fold Belt bores followed by alluvial bores

ITEM	DESCRIPTION	[UNIT]	[QTY]	[RATE]	AMT	PRESENT WORTH ($'000)																																	
				$ / Unit	$K	4%	7%	10%	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
	Pumping Station - Bore to Bungendore WTP	m head	65					Average Year Production (ML/year)	262	284	308	331	355	379	402	426	449	472	519	541	562	583	602	621	640	657	674	690	705	720	734	747	759	771	782	792	802	811	820
CAPITAL COSTS																																							
Pipe cost (supply and lay)																																							
Stage 1	mPVC DN100 (existing fractured rock bore)	m	844	$ 100	$ 84	$84	$84	$84	$84																														
Stage 1	mPVC DN200 (existing fractured rock bore)	m	1,612	$ 186	$ 300	$300	$300	$300	$300																														
Stage 1	mPVC DN250 (existing fractured rock bore)	m	376	$ 233	$ 88	$88	$88	$88	$88																														
Stage 2	mPVC DN250 (Alluvial source)	m	1,752	$ 233	$ 408	$245	$169	$118	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$408																	
Additional costs for construction																																							
Stage 1	Allow for hard difficulty (for mPVC DN200, OTR)	m	680	$ 170	$ 116	$116	$116	$116	$116																														
Stage 1	Additional cost for rock (mPVC DN100)	m	253	$ 6	$ 2	$2	$2	$2	$2																														
Stage 1	Additional cost for rock (mPVC DN200)	m	484	$ 8	$ 4	$4	$4	$4	$4																														
Stage 1	Additional cost for rock (mPVC DN250)	m	113	$ 9	$ 1	$1	$1	$1	$1																														
Stage 2	Additional cost for rock (mPVC DN250 Alluvial)	m	526	$ 9	$ 5	$3	$2	$1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5																	
Pipeline crossings for Stage 1: Fractured rock																																							
Stage 1	Thrust boring	m	40	$ 5,000	$ 200	$200	$200	$200	$200																														
Stage 1	Directional Drilling	m	25	$ 5,000	$ 125	$125	$125	$125	$125																														
Stage 1	Open cut trenching	m	20	$ 5,000	$ 100	$100	$100	$100	$100																														
Pumping Station - Bores to WTP																																							
Stage 1	Pump and associated pipework (18.5 kW @ 8.5 L/s)	Item	1	$ 45,000	$ 45	$45	$45	$45	$45																														
Stage 1	Pump and associated pipework (30 kW @ 20 L/s)	Item	1	$ 60,000	$ 60	$60	$60	$60	$60																														
Stage 1	Building works (Stage 1)	Item	2	$ 30,000	$ 60	$60	$60	$60	$60																														
Stage 1	Electrical works (switchroom, switchboard & switchgear)	Item	2	$ 100,000	$ 200	$200	$200	$200	$200																														
Stage 2	Bore drilling (2 bores)	Item	2	$ 150,000	$ 300	$180	$124	$87	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$300																	
Stage 2	New Pumps (2 x 30 kW @ 12.5 L/s) and associated pipew	Item	2	$ 70,000	$ 140	$84	$58	$41	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$140																	
Stage 2	Building works (Stage 2)	Item	2	$ 20,000	$ 40	$24	$17	$12	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$40																	
Stage 2	Electrical works (switchroom, switchboard & switchgear)	Item	2	$ 100,000	$ 200	$120	$83	$58	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$200																	
Water Treatment Plant																																							
Stage 1	Stage 1: 1.5 ML/day WTP (Lachlan Fold)	Item	1	$ 4,000,000	$ 4,000	$4,000	$4,000	$4,000	$4,000																														
Stage 2	Stage 2: 3.0 ML/day WTP (Alluvial)	Item	1	$ 3,000,000	$ 3,000	$1,802	$1,245	$869	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,000																	
Valves																																							
Stage 1	Air valves	Item	15	$ 3,906	$ 59	$59	$59	$59	$59																														
Stage 1	Scour valves	Item	14	$ 3,195	$ 45	$45	$45	$45	$45																														
Stage 1	Isolation valves	Item	2	$ 4,586	$ 9	$9	$9	$9	$9																														
Stage 1	Motorised valve	Item	2	$ 12,000	$ 24	$24	$24	$24	$24																														
Stage 1	Pressure-sustaining valve	Item	2	$ 15,000	$ 30	$30	$30	$30	$30																														
Stage 2	Air valves	Item	5	$ 3,906	$ 20	$12	$8	$6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$20																	
Stage 2	Scour valves	Item	4	$ 3,195	$ 13	$8	$5	$4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$13																	
Stage 2	Isolation valves	Item	1	$ 4,586	$ 5	$3	$2	$1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5																	
Stage 2	Motorised valve	Item	1	$ 12,000	$ 12	$7	$5	$3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12																	
Stage 2	Pressure-sustaining valve	Item	1	$ 15,000	$ 15	$9	$6	$4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15																	
Licence Acquisition																																							
Stage 2	Private alluvial allocation acquisition (350 ML/a)	Item	350	$ 3,000	$ 1,050	$631	$436	$304	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,050																	
Easement Costs																																							
	Easements (private land)	sq m	1,302		$ -	$0	$0	$0																															
	Easements (road reserve)	sq m	14,952		$ -	$0	$0	$0																															
Power Supply																																							
Stage 1	High Voltage Power Supply	Item	1	$ 500,000	$ 500	$500	$500	$500	$500																														
Prime Costs					**$11,258**	**$9,178**	**$8,212**	**$7,559**	**$6,051**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$5,207**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	General Contingency	% of Prime Cost	30%		$3,377	$2,753	$2,463	$2,268	$1,815	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,562	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Direct Costs					**$14,635**	**$11,931**	**$10,675**	**$9,827**	**$7,866**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$6,769**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Design & Preconstruction Activities	% of Direct Cost	10%		$1,464	$1,193	$1,068	$983	$787	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$677	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Construction Activities	% of Direct Cost	10%		$1,464	$1,193	$1,068	$983	$787	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$677	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL CAPITAL COST					**$17,562**	**$14,318**	**$12,810**	**$11,792**	**$9,439**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$8,123**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OPERATION & MAINTENANCE COSTS																																							
	Electrical Costs																																						
	Cost electricity	c per kWh	33																																				
	Pumping Costs																																						
	Pumping Station - Bore 2 to Bungendore WTP	$/ML per m head	1.287		$1,501	$784	$524	$372		$24	$26	$28	$30	$32	$34	$36	$38	$39	$43	$45	$47	$49	$50	$52	$54	$55	$56	$58	$59	$60	$61	$62	$64	$64	$65	$66	$67	$68	$69
	Operating Costs																																						
	Chemical Costs (Stage 1 - LFB)	$ per year	$ 100,000		$3,000	$1,729	$1,241	$943		$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
	Chemical Costs (Stage 2 - Alluvial)	$ per year	$ 30,000		$540	$237	$134	$78		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
	Chlorination System (water treatment)	mg/L	2	$ 4	$144	$75	$50	$36		$2	$2	$3	$3	$3	$3	$3	$4	$4	$4	$4	$4	$5	$5	$5	$5	$5	$5	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$7
	Energy costs for WTP	$ per ML	$ 120		$2,134	$1,119	$748	$532		$34	$37	$40	$43	$45	$48	$51	$54	$57	$62	$65	$67	$70	$72	$75	$77	$79	$81	$83	$85	$86	$88	$90	$91	$93	$93	$93	$93	$93	$93
	Maintenance Costs																																						
	Maintenance Civil	% of Capital Cost	0.50%		$460	$255	$176	$130		$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19
	Maintenance Mech + Elec	% of Capital Cost	4.00%		$5,748	$3,199	$2,214	$1,639		$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235
	Pigging	Item	$ 30,000		$900	$549	$402	$313		$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
TOTAL OPERATION & MAINTENANCE COSTS					**$ 14,427**	**$7,772**	**$5,314**	**$3,867**	**$0**	**$336**	**$341**	**$346**	**$351**	**$356**	**$361**	**$366**	**$371**	**$375**	**$385**	**$390**	**$394**	**$429**	**$541**	**$545**	**$549**	**$553**	**$557**	**$560**	**$563**	**$566**	**$569**	**$572**	**$575**	**$577**	**$578**	**$579**	**$580**	**$581**	**$582**
TOTAL PRESENT VALUE					**$ 31,989**	**$22,090**	**$18,124**	**$15,660**	**$9,439**	**$336**	**$341**	**$346**	**$351**	**$356**	**$361**	**$366**	**$371**	**$375**	**$385**	**$390**	**$394**	**$8,552**	**$541**	**$545**	**$549**	**$553**	**$557**	**$560**	**$563**	**$566**	**$569**	**$572**	**$575**	**$577**	**$578**	**$579**	**$580**	**$581**	**$582**

B.2 Cost estimate for Water Supply Option 2 – Two stage implementation of Lachlan Fold Belt bores

Water Supply Option 1 - Two stage implementation of Lachlan Fold Belt bores

ITEM	DESCRIPTION	[UNIT]	[QTY]	[RATE] $ / Unit	AMT $K	PRESENT WORTH ($'000) 4%	7%	10%	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
	Pumping Station - Bore to Bungendore WTP	m head	73						262	284	308	331	355	379	402	426	449	472	519	541	562	583
CAPITAL COSTS																						
Pipe cost (supply and lay)																						
Stage 1	mPVC DN100 (existing fractured rock bore)	m	844	$ 100	$ 84	$84	$84	$84	$84													
Stage 1	mPVC DN200 (existing fractured rock bore)	m	1,612	$ 186	$ 300	$300	$300	$300	$300													
Stage 1	mPVC DN250 (existing fractured rock bore)	m	376	$ 233	$ 88	$88	$88	$88	$88													
Stage 2	mPVC DN150 (proposed fractured rock bore)	m	1,000	$ 136	$ 136	$82	$56	$39	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$136
Difficult Construction																						
Stage 1	Allow for hard difficulty (for mPVC DN200, OTR)	m	680	$ 170	$ 116	$116	$116	$116	$116													
Stage 1	Additional cost for rock (mPVC DN100)	m	253	$ 6	$ 2	$2	$2	$2	$2													
Stage 1	Additional cost for rock (mPVC DN200)	m	484	$ 8	$ 4	$4	$4	$4	$4													
Stage 1	Additional cost for rock (mPVC DN250)	m	113	$ 9	$ 1	$1	$1	$1	$1													
Stage 2	Additional cost for rock (mPVC DN150)	m	300	$ 7	$ 2	$2	$2	$2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2
Pipeline crossings for Stage 1: Fractured rock																						
Stage 1	Thrust boring	m	40	$ 5,000	$ 200	$200	$200	$200	$200													
Stage 1	Directional Drilling	m	25	$ 5,000	$ 125	$125	$125	$125	$125													
Stage 1	Open cut trenching	m	20	$ 5,000	$ 100	$100	$100	$100	$100													
Pumping Station - Bore to WTP																						
Stage 1	Pump and associated pipework (18.5 kW @ 8.5 L/s)	Item	1	$ 45,000	$ 45	$45	$45	$45	$45													
Stage 1	Pump and associated pipework (30 kW @ 20 L/s)	Item	1	$ 60,000	$ 60	$60	$60	$60	$60													
Stage 1	Building works (Stage 1)	Item	2	$ 30,000	$ 60	$60	$60	$60	$60													
Stage 1	Electrical works (switchroom, switchboard & switchgear)	Item	2	$ 100,000	$ 200	$200	$200	$200	$200													
Stage 2	Drilling Bores (1 bores)	Item	1	$ 150,000	$ 150	$90	$62	$43	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$150
Stage 2	Monitoring Bores (4 bores)	Item	4	$ 75,000	$ 300	$180	$124	$87	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$300
Stage 2	New Pumps (1 x 30 kW @ 25 L/s) and associated pipewor	Item	1	$ 90,000	$ 90	$54	$37	$26	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$90
Stage 2	Building works (Stage 2)	Item	1	$ 30,000	$ 30	$18	$12	$9	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30
Stage 2	Electrical works (switchroom, switchboard & switchgear)	Item	1	$ 100,000	$ 100	$60	$41	$29	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$100
Water Treatment Plant																						
Stage 1	Stage 1: 1.5 ML/day WTP	Item	1	$ 4,000,000	$ 4,000	$4,000	$4,000	$4,000	$4,000													
Stage 2	Stage 2: 3.0 ML/day WTP	Item	1	$ 5,000,000	$ 5,000	$3,003	$2,075	$1,448	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5,000
Valves																						
Stage 1	Air valves	Item	15	$ 3,906	$ 59	$59	$59	$59	$59													
Stage 1	Scour valves	Item	14	$ 3,195	$ 45	$45	$45	$45	$45													
Stage 1	Isolation valves	Item	2	$ 4,586	$ 9	$9	$9	$9	$9													
Stage 1	Motorised valve	Item	2	$ 12,000	$ 24	$24	$24	$24	$24													
Stage 1	Pressure-sustaining valve	Item	2	$ 15,000	$ 30	$30	$30	$30	$30													
Stage 2	Air valves	Item	5	$ 3,906	$ 20	$12	$8	$6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$20
Stage 2	Scour valves	Item	4	$ 3,195	$ 13	$8	$5	$4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$13
Stage 2	Isolation valves	Item	1	$ 4,586	$ 5	$3	$2	$1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5
Stage 2	Motorised valve	Item	1	$ 12,000	$ 12	$7	$5	$3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12
Stage 2	Pressure-sustaining valve	Item	1	$ 15,000	$ 15	$9	$6	$4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15
Easement Costs																						
	Easements (private land)	sq m	3,288		$ -	$0	$0	$0														
	Easements (road reserve)	sq m	15,906		$ -	$0	$0	$0														
	Railway easement and allowance	sq m	96		$ -	$0	$0	$0														
Power Supply																						
Stage 1	High Voltage Power Supply	Item	1	$ 500,000	$ 500	$500	$500	$500	$500													
Prime Costs					**$11,923**	**$9,577**	**$8,488**	**$7,752**	**$6,051**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$5,872**
	General Contingency	% of Prime Cost	30%		$3,577	$2,873	$2,546	$2,326	$1,815	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,762
Direct Costs					**$15,500**	**$12,451**	**$11,034**	**$10,077**	**$7,866**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$7,634**
	Design & Preconstruction Activities	% of Direct Cost	10%		$1,550	$1,245	$1,103	$1,008	$787	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$763
	Construction Activities	% of Direct Cost	10%		$1,550	$1,245	$1,103	$1,008	$787	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$763
TOTAL CAPITAL COST					**$18,600**	**$14,941**	**$13,241**	**$12,093**	**$9,439**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**$0**	**$0**	**$9,160**
OPERATION & MAINTENANCE COSTS																						
	Electrical Costs																					
	Cost electricity	c per kWh	33																			
	Pumping Costs																					
	Pumping Station - Bore to Bungendore WTP	$ per ML/m head	1.287		$1,685	$881	$588	$418		$27	$29	$31	$33	$36	$38	$40	$42	$44	$49	$51	$53	$55
	Operating Costs																					
	Chemical Costs (Stage 1 - LFB)	$ per year	$ 100,000		$3,000	$1,729	$1,241	$943		$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
	Chemical Costs (Stage 2 - LFB)	$ per year	$ 100,000		$1,800	$791	$447	$261		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$100
	Chlorination System (water treatment)	mg/L	2	$ 4	$144	$75	$50	$36		$2	$2	$3	$3	$3	$3	$3	$4	$4	$4	$4	$4	$5
	Energy costs for WTP	$ per ML	$ 120		$2,153	$1,125	$751	$534		$34	$37	$40	$43	$45	$48	$51	$54	$57	$62	$65	$67	$70
	Maintenance Costs																					
	Maintenance Civil	% of Capital Cost	0.50%		$504	$274	$187	$136		$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11
	Maintenance Mech + Elec	% of Capital Cost	4.00%		$6,564	$3,549	$2,409	$1,750		$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135
	Pigging	Item	$ 30,000		$900	$549	$402	$313		$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
TOTAL OPERATION & MAINTENANCE COSTS					$16,750	$8,798	$5,899	$4,215	**$0**	**$339**	**$344**	**$349**	**$354**	**$360**	**$365**	**$370**	**$375**	**$380**	**$391**	**$396**	**$400**	**$505**
TOTAL PRESENT VALUE					**$35,350**	**$23,739**	**$19,139**	**$16,308**	**$9,439**	**$339**	**$344**	**$349**	**$354**	**$360**	**$365**	**$370**	**$375**	**$380**	**$391**	**$396**	**$400**	**$9,665**

DESCRIPTION	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
Pumping Station - Bore to Bungendore WTP (m head)	602	621	640	657	674	690	705	720	734	747	759	771	782	792	802	811	820
Prime Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
General Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Direct Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Design & Preconstruction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL CAPITAL COST	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pumping Station - Bore to Bungendore WTP	$57	$58	$60	$62	$63	$65	$66	$68	$69	$70	$71	$72	$73	$74	$75	$76	$77
Chemical Costs (Stage 1 - LFB)	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
Chemical Costs (Stage 2 - LFB)	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
Chlorination System (water treatment)	$5	$5	$5	$5	$5	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$7
Energy costs for WTP	$72	$75	$77	$79	$81	$83	$85	$86	$88	$90	$91	$93	$94	$95	$96	$97	$98
Maintenance Civil	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21
Maintenance Mech + Elec	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283
Pigging	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
TOTAL OPERATION & MAINTENANCE COSTS	**$668**	**$672**	**$676**	**$680**	**$684**	**$688**	**$691**	**$694**	**$697**	**$700**	**$703**	**$706**	**$708**	**$710**	**$713**	**$715**	**$717**
TOTAL PRESENT VALUE	**$668**	**$672**	**$676**	**$680**	**$684**	**$688**	**$691**	**$694**	**$697**	**$700**	**$703**	**$706**	**$708**	**$710**	**$713**	**$715**	**$717**

B.3 Cost estimate for Water Supply Option 3 – Bulk supply from ICON Water

Water Supply Option 3 – Bulk supply from ICON Water

ITEM	DESCRIPTION	[UNIT]	[QTY]	[RATE]	AMT	PRESENT WORTH ($'000)			
	Pumping Station - Offtake to Bungendore WTP	m head	262			Average Year Production (ML/year)			262
	Total pipeline length	m	28,086						
				$ / Unit	$K	4%	7%	10%	2019
CAPITAL COSTS									
Pipe cost (supply and lay)									
	DICL DN250	m	14,041	$ 261	$ 3,665	$3,665	$3,665	$3,665	$3,665
	mPVC DN250	m	4,783	$ 233	$ 1,114	$1,114	$1,114	$1,114	$1,114
	mPVC DN200	m	7,864	$ 186	$ 1,463	$1,463	$1,463	$1,463	$1,463
Difficult Construction									
	Allow for hard difficulty (for DICL DN250, OTR)	m	938	$ 474	$ 445	$445	$445	$445	$445
	Allow for hard difficulty (for mPVC DN200, OTR)	m	460	$ 356	$ 164	$164	$164	$164	$164
	Additional cost for rock	m	8,426	$ 26	$ 219	$219	$219	$219	$219
Road Crossings									
	Open Trenching (minor roads)	m	25	$ 1,000	$ 25	$25	$25	$25	$25
Rail Crossings									
	Thrust boring	m	60	$ 70,000	$ 4,200	$4,200	$4,200	$4,200	$4,200
River Crossings									
	Directional Drilling	m	100	$ 5,000	$ 500	$500	$500	$500	$500
Creek Crossings									
	Thrust boring	m	60	$ 5,000	$ 300	$300	$300	$300	$300
Drainage Crossings									
	Thrust boring	m	6	$ 60,000	$ 360	$360	$360	$360	$360
Pumping Station - Offtake to Bungendore WTP									
	Pump at Offtake (260 kW @ 52 L/s)	Item	1	$ 300,000	$ 300	$300	$300	$300	$300
	Associated pipework/machinery for pump	Item	1	$ 170,000	$ 170	$170	$170	$170	$170
	Building works	Item	1	$ 250,000	$ 250	$250	$250	$250	$250
	Electrical works (switchroom, switchboard & switchgear)	Item	1	$ 300,000	$ 300	$300	$300	$300	$300
Break Tank									
	5 ML Concrete Reservoir	Item	1	$ 3,500,000	$ 3,500	$3,500	$3,500	$3,500	$3,500
Valves									
	Air valves	Item	20	$ 3,906	$ 78	$78	$78	$78	$78
	Scour valves	Item	18	$ 3,195	$ 58	$58	$58	$58	$58
	Isolation valves	Item	10	$ 4,586	$ 46	$46	$46	$46	$46
	Motorised valve	Item	1	$ 12,000	$ 12	$12	$12	$12	$12
	Pressure-sustaining valve	Item	1	$ 15,000	$ 15	$15	$15	$15	$15
Easement Costs									
	Easements	sq m	8,388		$ -	$0	$0	$0	$0
Power Supply									
	High Voltage Power Supply	Item	1	$ 100,000	$ 100	$100	$100	$100	$100
Prime Costs					**$17,283**	**$17,283**	**$17,283**	**$17,283**	**$17,283**
	General Contingency	% of Prime Cost	30%		$5,185	$5,185	$5,185	$5,185	$5,185
Direct Costs					**$22,468**	**$22,468**	**$22,468**	**$22,468**	**$22,468**
	Design & Preconstruction Activities	% of Direct Cost	10%		$2,247	$2,247	$2,247	$2,247	$2,247
	Construction Activities	% of Direct Cost	10%		$2,247	$2,247	$2,247	$2,247	$2,247
TOTAL CAPITAL COST					**$26,961**	**$26,961**	**$26,961**	**$26,961**	**$26,961**
OPERATION & MAINTENANCE COSTS									
	Electrical Costs								
	Cost electricity	c per kWh	33						
	Pumping Costs								
	Pumping Station - Offtake to Bungendore WTP	$ per ML/m head	1.287		$6,137	$3,250	$2,199	$1,588	$88
	Operating Costs								
	Chlorination System (water treatment)	mg/L	2	$ 4	$146	$77	$52	$38	$2
	Bulk Water Supply (ICON Water)								
	ICON Headworks Costs (supplying to Qbyn)	$ per year	$336,054			$6,147	$4,506	$3,504	
	ACT Govt Utilities Water Network Tax	$ per year	$1,130			$21	$15	$12	
	ACT Govt Water Extraction Charge	$ per kL	$0.58			$5,603	$3,795	$2,744	
	Usage Charge	$ per kL	$1.79			$17,293	$11,712	$8,468	
	Maintenance Costs								
	Maintenance Civil	% of Capital Cost	0.50%		$1,499	$864	$620	$471	
	Maintenance Mech + Elec	% of Capital Cost	4.00%		$1,294	$746	$535	$407	
TOTAL OPERATION & MAINTENANCE COSTS					$61,709	$32,990	$22,423	$16,220	**$90**
TOTAL PRESENT VALUE					**$88,670**	**$59,952**	**$49,384**	**$43,181**	**$27,051**

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
Average Year Production (ML/year)	284	308	331	355	379	402	426	449	472	519	541	562	583	602	621	640	657	674	690	705	720	734	747	759	771	782	792	802	811	820
Prime Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
General Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Direct Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design & Preconstruction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL CAPITAL COST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pumping Station - Offtake to Bungendore WTP	$96	$104	$112	$120	$128	$136	$144	$151	$159	$175	$182	$190	$196	$203	$210	$216	$222	$227	$233	$238	$243	$247	$252	$256	$260	$264	$267	$270	$274	$277
Chlorination System (water treatment)	$2	$2	$3	$3	$3	$3	$3	$4	$4	$4	$4	$4	$5	$5	$5	$5	$5	$5	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$7
ICON Headworks Costs (supplying to Qbyn)	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336
ACT Govt Utilities Water Network Tax	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1
ACT Govt Water Extraction Charge	$165	$178	$192	$206	$220	$233	$247	$260	$274	$301	$314	$326	$338	$349	$360	$371	$381	$391	$400	$409	$418	$426	$433	$440	$447	$454	$460	$465	$471	$476
Usage Charge	$509	$551	$593	$635	$678	$720	$762	$804	$845	$929	$968	$1,006	$1,043	$1,078	$1,112	$1,145	$1,177	$1,207	$1,235	$1,263	$1,289	$1,313	$1,337	$1,359	$1,380	$1,400	$1,418	$1,436	$1,453	$1,468
Maintenance Civil	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50
Maintenance Mech + Elec	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
TOTAL OPERATION & MAINTENANCE COSTS	$1,203	$1,266	$1,330	$1,394	$1,458	$1,523	$1,587	$1,650	$1,711	$1,840	$1,899	$1,956	$2,012	$2,066	$2,118	$2,167	$2,215	$2,261	$2,304	$2,346	$2,385	$2,422	$2,458	$2,492	$2,523	$2,553	$2,582	$2,608	$2,634	$2,657
TOTAL PRESENT VALUE	$1,203	$1,266	$1,330	$1,394	$1,458	$1,523	$1,587	$1,650	$1,711	$1,840	$1,899	$1,956	$2,012	$2,066	$2,118	$2,167	$2,215	$2,261	$2,304	$2,346	$2,385	$2,422	$2,458	$2,492	$2,523	$2,553	$2,582	$2,608	$2,634	$2,657

B.4 Cost estimate for STP Option 1 – 6,000 EP STP Upgrade

STP Option 1 – 6,000 EP STP Upgrade

ITEM	DESCRIPTION	[UNIT]	[QTY]	[RATE] $ / Unit	AMT $K	PRESENT WORTH ($'000) 4%	7%	10%
CAPITAL COSTS								
	Total cost to construct a new 6,000 EP plant (Convert 2016 price to 2018 by ι		1	$ 7,000,000	$ 7,000	$5,753	$4,991	$4,346
Prime Costs					**$ 7,000**	**$5,753**	**$4,991**	**$4,346**
	General Contingency	% of Prime Cost	20%		$ 1,400	$1,151	$998	$869
Direct Costs					**$ 8,400**	**$6,904**	**$5,989**	**$5,216**
	Design & Preconstruction Activities	% of Direct Cost	10%		$ 840	$690	$599	$522
	Construction Activities	% of Direct Cost	10%		$ 840	$690	$599	$522
TOTAL CAPITAL COST					**$ 10,080**	**$8,285**	**$7,187**	**$6,259**
OPERATION & MAINTENANCE COSTS								
	Additional Operating Costs	$/EP	45	$ 50	$7,329	$3,619	$2,299	$1,552
	Maintenance Costs							
	Maintenance Civil	% of Capital Cost	0.50%	$ 4,000,000	$500	$257	$166	$113
	Maintenance Mech + Elec	% of Capital Cost	4.00%	$ 2,500,000	$2,500	$1,284	$831	$564
TOTAL OPERATION & MAINTENANCE COSTS					**$ 10,329**	**$5,143**	**$3,279**	**$2,212**
TOTAL PRESENT VALUE					**$ 20,409**	**$13,428**	**$10,466**	**$8,470**
New EP								

Item	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Total cost to construct a new 6,000 EP plant	$0	$0	$0	$0	$0	$7,000										
Prime Costs	$0	$0	$0	$0	$0	$7,000										
General Contingency	$0	$0	$0	$0	$0	$1,400										
Direct Costs	$0	$0	$0	$0	$0	$8,400										
Design & Preconstruction Activities	$0	$0	$0	$0	$0	$840										
Construction Activities	$0	$0	$0	$0	$0	$840										
TOTAL CAPITAL COST	$0	$0	$0	$0	$0	$10,080	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Additional Operating Costs	$17	$34	$51	$68	$85	$103	$120	$137	$153	$170	$186	$201	$216	$230	$244	$258
Maintenance Civil	$0	$0	$0	$0	$0	$0	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20
Maintenance Mech + Elec	$0	$0	$0	$0	$0	$0	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
TOTAL OPERATION & MAINTENANCE COSTS	$17	$34	$51	$68	$85	$103	$240	$257	$273	$290	$306	$321	$336	$350	$364	$378
TOTAL PRESENT VALUE	$17	$34	$51	$68	$85	$10,183	$240	$257	$273	$290	$306	$321	$336	$350	$364	$378
New EP	369	746	1128	1512	1898	2282	2663	3039	3409	3770	4123	4466	4798	5118	5427	5723

Item	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
TOTAL CAPITAL COST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Additional Operating Costs	$270	$283	$294	$305	$316	$326	$335	$344	$353	$361	$368	$375	$375	$375	$375
Maintenance Civil	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20
Maintenance Mech + Elec	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
TOTAL OPERATION & MAINTENANCE COSTS	$390	$403	$414	$425	$436	$446	$455	$464	$473	$481	$488	$495	$495	$495	$495
TOTAL PRESENT VALUE	$390	$403	$414	$425	$436	$446	$455	$464	$473	$481	$488	$495	$495	$495	$495
New EP	6007	6279	6538	6785	7019	7242	7453	7652	7841	8019	8186	8344	8493	8633	8772

B.5 Cost estimate for STP Option 2 – Staged development of two 3,000 EP tank STP upgrades

STP Option 2 – Staged development of two 3,000 EP tank STP upgrades

ITEM	DESCRIPTION	[UNIT]	[QTY]	[RATE] $ / Unit	AMT $K	PRESENT WORTH ($'000) 4%	7%	10%
CAPITAL COSTS								
	Stage 1 3,000 EP		1	$ 4,800,000	$ 4,200	$3,452	$2,995	$2,608
	Stage 2 3,000 EP		1	$ 3,200,000	$ 2,800	$1,617	$1,086	$737
Prime Costs					**$ 7,000**	**$5,069**	**$4,080**	**$3,345**
	General Contingency	% of Prime Cost	20%		$ 1,400	$1,014	$816	$669
Direct Costs					**$ 8,400**	**$6,083**	**$4,897**	**$4,014**
	Design & Preconstruction Activities	% of Direct Cost	10%		$ 840	$608	$490	$401
	Construction Activities	% of Direct Cost	10%		$ 840	$608	$490	$401
TOTAL CAPITAL COST					**$ 10,080**	**$7,299**	**$5,876**	**$4,817**
OPERATION & MAINTENANCE COSTS								
	Additional Operating Costs	$/EP	45	$ 50	$7,329	$3,619	$2,299	$1,552
	Maintenance Costs							
	Maintenance Civil	% of Capital Cost	0.50%	$ 4,500,000	$475	$234	$147	$97
	Maintenance Mech + Elec	% of Capital Cost	4.00%	$ 3,000,000	$2,532	$1,245	$783	$518
TOTAL OPERATION & MAINTENANCE COSTS					**$ 10,336**	**$5,081**	**$3,211**	**$2,150**
TOTAL PRESENT VALUE					**$ 20,416**	**$12,380**	**$9,087**	**$6,967**
New EP								

Item	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Stage 1 3,000 EP	$0	$0	$0	$0	$0	$4,200										
Stage 2 3,000 EP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,800	
Prime Costs	$0	$0	$0	$0	$0	$4,200	$0	$0	$0	$0	$0	$0	$0	$0	$2,800	
General Contingency	$0	$0	$0	$0	$0	$840	$0	$0	$0	$0	$0	$0	$0	$0	$560	
Direct Costs	$0	$0	$0	$0	$0	$5,040	$0	$0	$0	$0	$0	$0	$0	$0	$3,360	
Design & Preconstruction Activities	$0	$0	$0	$0	$0	$504	$0	$0	$0	$0	$0	$0	$0	$0	$336	
Construction Activities	$0	$0	$0	$0	$0	$504	$0	$0	$0	$0	$0	$0	$0	$0	$336	
TOTAL CAPITAL COST	$0	$0	$0	$0	$0	$6,048	$0	$0	$0	$0	$0	$0	$0	$0	$4,032	$0
Additional Operating Costs	$17	$34	$51	$68	$85	$103	$120	$137	$153	$170	$186	$201	$216	$230	$244	$258
Maintenance Civil	$0	$0	$0	$0	$0	$0	$16	$16	$16	$16	$16	$16	$16	$16	$16	$16
Maintenance Mech + Elec	$0	$0	$0	$0	$0	$0	$84	$84	$84	$84	$84	$84	$84	$84	$84	$84
TOTAL OPERATION & MAINTENANCE COSTS	$17	$34	$51	$68	$85	$103	$220	$237	$253	$269	$285	$301	$316	$330	$344	$357
TOTAL PRESENT VALUE	$17	$34	$51	$68	$85	$6,151	$220	$237	$253	$269	$285	$301	$316	$330	$4,376	$357
New EP	369	746	1128	1512	1898	2282	2663	3039	3409	3770	4123	4466	4798	5118	5427	5723

Item	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
TOTAL CAPITAL COST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Additional Operating Costs	$270	$283	$294	$305	$316	$326	$335	$344	$353	$361	$368	$375	$375	$375	$375
Maintenance Civil	$16	$16	$16	$23	$23	$23	$23	$23	$23	$23	$23	$23	$23	$23	$23
Maintenance Mech + Elec	$84	$84	$84	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120
TOTAL OPERATION & MAINTENANCE COSTS	$370	$382	$394	$448	$458	$468	$478	$487	$495	$503	$511	$518	$518	$518	$518
TOTAL PRESENT VALUE	$370	$382	$394	$448	$458	$468	$478	$487	$495	$503	$511	$518	$518	$518	$518
New EP	6007	6279	6538	6785	7019	7242	7453	7652	7841	8019	8186	8344	8493	8633	8772

Appendix C Ranking of Social and Environmental Performance of Scenarios

Council to Review

TBL Category	Criteria	Weighting	Scenario 1	Scenario 2	Scenario 3
ENVIRONMENTAL	Minimises construction environmental footprint	0.4	4	3	2
	Reduces operational energy consumption	0.4	4	3	2
	Reduces operational generation of waste	0.2	3	2	4
	Total weighted environmental score	1.0	3.8	2.8	2.4
SOCIAL	Community is burdened with infrastructure if growth does not eventuate	0.2	4	4	2
	Provides for greater long-term security of supply	0.2	2	3	4
	Promotes local employment	0.3	3	3	2
	Maintains local control of complete supply train	0.3	4	4	2
	Total weighted social score	1.0	3.3	3.5	2.4
	Total Environmental and Social Scores (ESS)		7.1	6.3	4.8

% Of Target Met	Score
<25%	1
25%-49%	2
50%-74%	3
75%-99%	4
>99%	5

Level 3, 66 Harrington Street
THE ROCKS NSW 2000

www.publicworksadvisory.nsw.gov.au

Appendix C Secure Yield Analysis Report for Braidwood Dam

NUWS

PALERANG COUNCIL WATER SUPPLY

Captains Flat and Braidwood
Yield Study Report

Prepared for Palerang Council

Report No. 14013
December 2015
NSW Urban Water Services Pty Ltd

Summary

This report provides updated *secure yield* estimates for Palerang Councils water supply headworks systems for Captains Flat and Braidwood estimated in accordance with NSW Office of Water's Draft *"Assuring future urban water security, Assessment and Adaption guidelines for NSW local water utilities"* (Ref 1).

It is noted '*secure yield*' is a defined term (see section 1.7) based on accepted methodology.

Table S1 provides the secure yields estimated for Captains Flat and Table S2 provides the secure yields estimated for Braidwood.

Table S1: Captains Flat Secure Yield Estimates

System	Secure Yield (5/10/10) ML/a	Case
Existing *(820 ML onstream storage)*	**235**	Historic Climate 1890 -2015 streamflows
Existing *(820 ML onstream storage)*	**183**	1°C climate warming

Table S2: Braidwood Secure Yield Estimates

System	Secure Yield (5/10/10) ML/a	Case
Existing *(73 ML offstream storage)*	**394***	Historic Climate 1890 -2015 streamflows
Existing *(73 ML offstream storage)*	**357**	1°C climate warming

**Note potential estimate as limited to 360 based on licence conditions*

It is noted the secure yield estimates are dependent on the operating rules data and assumptions as discussed in detail in the main body of this Report.

Contents

Tables

Figures

1. Introduction

1.1 Background

Captain Flat's water supply headworks system consists of Captains Flat Dam on the Molonglo River from which water is transferred to supply. The Dam has a storage capacity of 820 ML. The catchment area of the Dam is some 34 km^2.

Braidwood water supply headworks consist of an offtake on the Shoalhaven River from which water is transferred to a 73 ML offstream storage from which water is transferred to supply. The catchment area of the river offtake is some 1100 km^2.

A *secure yield* assessment of the Captains Flat system was undertaken in 1999 as part of Captains Flat water supply augmentation investigations (Ref 2). However there appears to be no records of any *yield* assessments having been undertaken for Braidwood water supply.

To satisfy NSW Office of Water (NOW) guidelines for *Best Practice Management of Water Supply and Sewerage* local water utilities are required to develop Integrated Water Cycle Management (IWCM) plans. One of the inputs to the IWCM studies is to provide secure yield estimates of the existing water system determined in accordance with NSW Office of Water's (NOW) draft guidelines for "*Assuring future urban water security*".

Council thus required updated estimates of *secure yield* in accordance with NOW's guidelines to assist with assessing their water supply systems to meet their future demands.

1.2 Scope of Work

Palerang Council commissioned HydroScience Consulting (HC) to undertake IWCM studies with NSW Urban Water Services (NUWS) engaged as specialist sub consultants to:

- Estimate the *Secure Yield* of the existing Captains Flat and Braidwood water supply headworks system.
- Assess the impacts of climate change on the *Secure Yield*.

It is noted *Secure Yield* is a defined term as provided by NSW Office of Water (NOW) *Best-Practice Management of Water Supply and Sewerage Guidelines* (Ref 3) and the *NSW Water Supply Investigation Manual* (Ref 4) and more recently by NOW's Draft *"Assuring future urban water security, Assessment and Adaption guidelines for NSW local water utilities"* (Ref 1). Use of Secure Yield provides a practical consistent basis for assessing the yield of a system on a security of supply basis. Details of Secure Yield are provided in Section 1.7 and Appendix A.

1.3 Objectives

This report contains a summary of the modelling undertaken to provide secure yield estimates for specified operating and streamflow conditions for Captains Flat and Braidwood's water supply headworks system.

The outcomes from this modelling were required to assist with planning to meet future water demand.

1.4 Methodology

Estimating the yield of a headworks system involves two important stages:

- Streamflow estimation:

  Developing an appropriate sequence of streamflows

- System Behaviour Modelling:

  Modelling the behaviour of the headworks system subject to operating constraints using the streamflows to assess what demand subject to reliability or security criteria can be satisfied.

For this study the required streamflows were obtained using the AWBM rainfall runoff model (Ref 5).

For the behaviour modelling a purposely developed system behaviour model to determine yield in terms of 'secure yield' for water supply headworks system was used. The underlying methodology used in the model arises from the definition of *Secure Yield* and has been successfully used on many other water supply headworks systems. The model logic has been developed and tested through many uses over the years.

1.5 Climate Change

While secure yield allows for meeting demand with restrictions through a much worse drought than has occurred since about 1890, consideration needs to be given to possible changes from Climate Change.

For this study additional consideration was given by using the approach proposed in NSW Office of Water's (NOW) Draft Proposed Policy[1] for assessing the impact of climate change on non-metropolitan water supplies as informed by (Samra & Cloke, 2010) and provided in Appendix A.

1.6 Qualifications

The work contained in this Report is considered valid within the context of the study purposes, but caution should be exercised if aspects of this report, including data and estimates, are abstracted out of context or are to be used for some other purpose. Hydrology is not an exact science and necessarily involves some uncertainty and the results should be regarded as estimates within the limitations of the study and available data to be used as indications in a much larger decision making process.

1. *The draft Policy is now also given by way of NOWs Draft Guidelines (Ref 1).*

The yield of a headworks system is dependent on the assumed streamflows and operating constraints. For this study observed streamflows were provided by others and the operating constraints are as specified. While the yield estimates are based on established methodology, NSW Urban Water Services Pty Ltd does not warrant or accept any liability in relation to the quality or accuracy of the yield estimates which are reliant on provided information and no responsibility is accepted by NSW Urban Water Services Pty Ltd for the accuracy, currency, reliability and correctness of any information in this publication provided by the client or third parties.

1.7 Yield Model

Secure Yield

For the past 25 years or so most urban water supply headworks in country NSW have been sized on a robust Security of Supply basis. This security of supply basis was developed to cost-effectively provide sufficient dam storage capacity to allow the water utility to effectively manage its water supply in future droughts of greater severity than experienced over the past 100 or more years. '*Secure Yield*' is the water demand that can be expected to be supplied with only moderate restrictions during a significantly more severe drought than has been experienced since about 1895 (from when generally reliable rainfall records are available). The required water restrictions must not be too severe, not too frequent, nor of excessive duration. It has been argued that the definition of *Secure Yield* in effect allows meeting demand with moderate restrictions through a severe drought akin to a '1 in 1000 year' drought[2].

Under the NSW Security of Supply basis (commonly referred to as the '5/10/20 rule'), water supply headworks system were normally sized so that:

a) Duration of restrictions does not exceed 5% of the time; and
b) Frequency of restrictions does not exceed 10% of years (ie 1 year in 10 on average)
c) Severity of restrictions does not exceed 20%. Systems must be able to meet 80% of the unrestricted water demand (ie 20% average reduction in consumption due to water restrictions) through a repetition of the worst recorded drought, commencing with the storage drawn down to the level at which restrictions need to be imposed to satisfy a) and b) above.

'Secure Yield' was defined as the highest annual water demand that can be supplied from a water supply headworks system while meeting the above '5/10/20' rule.

Over the last 20 years there has been a significant reduction in residential water consumption per property and thus it is considered it will be difficult to achieve a 20% reduction in consumption as implied by the earlier '5/10/20'rule . Consequently NSW Office of Water (NOW) recommends that future planning should be based on a 10% reduction in consumption through a repetition of the worst drought commencing with the storage already drawn down to satisfy the 5% duration and 10% frequency criteria. Thus the '5/10/20'rule has now become a '5/10/10'rule.

2 *It is noted that '1 in 1000 year drought' does not mean it only occurs once every thousand years but means it has a 0.1% probability of occurring any year.*

It is also noted that more recently the 10% frequency rule has been slightly refined by NOW from frequency of restrictions occurring 1 in 10 years on average to only being applied in 10% of years. For a sample of test cases this was of little consequence, and was desired to fit in with NOWs requirements for Performance Reporting of restrictions and thus was also based on the financial year.

The current procedures to determine secure yield are illustrated in Figures 1 and 2 which have been taken from material provided by NOW.

Model

Essentially the model is a computer program that balances continuity equations between all the water sources and demands while incorporating the procedures (as illustrated in Figures 1 and 2) to determine secure yield. The model simulates the behaviour of the system by accounting for and balancing the available water. The hydrological cycle is modelled external to the model and the required hydrometeorological data is provided as input to the system behaviour model. In essence the system model is driven by operating conditions such as the need to meet a particular demand while satisfying constraints and available flow.

2. Hydrometeorological Data

2.1 Introduction

In general estimates of daily rainfalls, streamflows and daily evaporation and evapotranspiration for as long a historical period as possible is desirable.

Satisfying the '5,10,10' rule for determining secure yield requires more than 100 years of daily streamflows to be a sufficiently long data sample for testing the rules and so as to include the significant Federation drought (1895-1903) and other known significant droughts.

In addition to daily streamflows, accompanying daily rainfalls and evaporation are required for input to the system behaviour model for determining the net loss or gain from or to storage's water surface area due to evaporation or rainfall.

The daily rainfalls are also required as input to the AWBM rainfall runoff model as well as daily evapotranspiration to obtain streamflows when no observed streamflows are available. The details of the model are provided in Ref 5 and illustrated in Figure 3.

For this study historic data series were developed to cover the period January 1890 to April 2015.

2.2 Data

Meteorological

The daily rainfall and daily evapotranspiration data were obtained from the SILO Data Drill for selected grid points. The SILO Data Drill is a service provided by the Science Delivery Division of Queensland Department of Science, Information Technology, Innovation and the Arts (DSITIA). The Data Drill accesses grids of data derived from interpolation of point Bureau of Meteorology station records. Interpolations are calculated by Splinning and Kriging techniques. Further details of the processes are given in Ref 6.

For Captains Flat up to 4 grid points as given in Table 2.1 and shown in Figure 4 were used to cover the gauging stations and storage catchments.

For Braidwood 56 grid points as given in Table 2.2 and shown in Figure 5 were used to cover the gauging station catchment and 41 point to cover the river offtake catchment.

Daily evaporation and rainfall data to represent losses from the storages was also obtained from the SILO Data Drill. For this purpose data from the closest Grid Point was used.

Table 2.1: Captains Flat SILO Grid Points

Grid Point	Longitude °	Latitude °
1	149.40	35.60
2	149.45	35.60
3	149.45	35.65
4	149.50	35.65
1 to 4 to gauging station 410757; 2 to 4 to gauging station 41000208 and to dam, 2 for storage		

Table 2.2: Braidwood SILO Grid Points

Grid Point	Longitude °	Latitude °
1	149.50	35.60
2	149.50	35.85
3	149.55	35.55
4	149.55	35.60
5	149.55	35.65
6	149.55	35.70
7	149.55	35.75
8	149.55	35.80
9	149.55	35.85
10	149.55	35.90
11	149.55	35.95
12*	149.60	35.40
13*	149.60	35.45
14	149.60	35.50
15	149.60	35.55
16	149.60	35.60
17	149.60	35.65
18	149.60	35.70
19	149.60	35.75
20	149.60	35.80
21	149.60	35.85
22	149.60	35.90
23	149.60	35.95
24*	149.65	35.35
25*	149.65	35.40
26*	149.65	35.45
27	149.65	35.50
28	149.65	35.55
29	149.65	35.60
30	149.65	35.65
31	149.65	35.70
32	149.65	35.75
33	149.65	35.80
34	149.65	35.85
35	149.65	35.90
36	149.65	35.95
37*	149.70	35.35
38*	149.70	35.40
39*	149.70	35.45
40	149.70	35.50
41	149.70	35.55
42	149.70	35.60
43*	149.75	35.35
44*	149.75	35.40
45*	149.75	35.45
46	149.75	35.50
47*	149.80	35.40
48*	149.80	35.45
49	149.80	35.50
50	149.80	35.55
51*	149.85	35.45
52*	149.85	35.50
53	149.85	35.55
54	149.85	35.60
55	149.90	35.55
56	149.90	35.60
*1 to 56 to gauging station; *excluded for offtake; 45 for storage*		

Streamflow

Two AWBM models were set up:

- One for determining inflows to Captains Flat Dam
- One for determining streamflows at the Braidwood Shoalhaven River offtake.

Captains Flat Dam

The AWBM model parameter values were estimated by calibration with the available observed data for the gauging stations:

- Molongo River at Kobada (41000208), catchment area 23.5 km^2, records available from June 2004.

- Molongo River at Copper Creek, catchment area 47 km^2, records available from December 1972 to August 1997.

The Kobada gauging station was upstream of the Dam and thus its flows would not be affected by the Dam operations. However examination of the flows showed long periods of *unnatural* low flow behaviour[3]. Thus the flow records of the downstream Cooper Creek gauging station were also tested. While these flows were for a longer period, they would have affected by the operations of the upstream dam.

Three calibration cases were thus examined:

1 Using the full period of record (2004-2015) for the Kobada gauging station. (*Molong02*)

2 Using the period of record without the *unnatura*l low flows (2010-2015) for the Kobada gauging station.(*Molong04*)

3 Using the full period of record (1972-1997) for the Cooper Creek gauging station (*Molong06*).

Daily rainfall and daily evapotranspiration data from the nominated SILO Grid Points were used to represent the gauging stations.

Reasonable calibration was judged to have been achieved for all 3 cases for the purposes in-hand (*apart from the low flows*) as shown by Figures 6 and 7 comparing modelled flows with observed flows on a flow duration basis. Thus it was decided to examine the three calibration cases impact on the secure yield.

The selected parameter values for the three cases were used with the AWBM model to the Dam to transform the long historic series of daily rainfall and daily evapotranspiration from the 3 SILO Grid Points (*Nos 3 to 5*) to corresponding modelled historic daily dam inflows. When the historic daily flow series was input into the headworks system model, when *observed* daily flows at the gauging stations were available these were factored to allow for the differences in dam catchment area to the gauging stations catchment area and used in preference to modelled flows.

3. The reasons for the unnatural behaviour was unknown and is discussed further in section 6.4.

Braidwood

The AWBM model was set up for the Shoalhaven River catchment upstream of the river offtake. The AWBM model parameters were estimated by calibration with the available observed data for the gauging station (215002) Shoalhaven River at Warri.

The gauging station has been in operation since August 1914 and has a catchment area of 1450 km^2. The river offtake has a catchment area of 1100 km^2.

Daily rainfall and daily evapotranspiration data from the 56 SILO Grid Points were used to represent the gauging station..

Good calibration was judged to have been achieved for the purposes in-hand as shown by Figure 8 comparing modelled flows with observed flows on a flow duration basis. Thus the resulting model parameter values were selected.

The selected parameter values were used with the AWBM model to the river offtake to transform the long historic series of daily rainfall and daily evapotranspiration from the 41 SILO Grid Points (see Table 2.2) to corresponding modelled historic daily flows. When the historic daily flow series was input into the headworks system model, when *observed* daily flows at the gauging station were available these were factored to allow for the smaller catchment area to the offtake and used in preference to modelled flows.

3. System Behaviour Modelling

3.1 Introduction

Modelling of the behaviour of the water supply headworks system is required to determine the *secure yield* of that system. The aim of the modelling is to determine the maximum annual demand that satisfies the '5/10/10' rules. This is done using a computer storage and system behaviour model using an iterative process to satisfy all the requirements implied by the rules and available water from the various sources.

System behaviour models were set up for the two headworks systems using model logic developed and tested over many years and incorporating refinements to reflect current requirements.

The model is essentially driven by operating conditions such as the need to meet a specified demand whilst satisfying constraints such as available water from streamflows.

In addition to the hydrometeorological data that has to be input into the computer simulation model, other data has to be incorporated into the model. These additional data are detailed in the following sections.

3.2 Headworks System

The existing headworks systems modelled are shown in Figures 4 and 5.

Captains Flat headworks essentially consists of the on-stream Dam storage from which water is transferred to the WTP.

Braidwood essentially consists of the offtake on the Shoalhaven River with water transferred to the off stream storage and then onto to supply.

3.3 Demand Pattern

Whilst secure yield provides the system annual demand that can be met, the annual demand needs to be broken down into monthly patterns to reflect seasonality. The demand patterns used are given in Table 3.1.

Table 3.1: Demand Patterns

	% of Annual Demand											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Captains Flat	12.2	10.6	10.1	6.6	6.3	6.4	6.4	6.5	6.3	8.1	9.3	11.2
Braidwood	11.3	8.8	9.5	8.1	7.5	6.5	6.2	7.1	7.3	9.3	9.1	9.3

Provided by HC based on Councils monthly average consumption data for 2003 to 2014. It was judged the secure yields would not be sensitive to the variation in the individual year's monthly patterns.

3.4 Storage

Details of storage sizes modelled based on the provided information are as given in Table 3.2.

Table 3.2: Storage Data

Storage	Full Storage ML	Dead Storage ML	Assumed Leakage ML/d
Captains Flat Dam storage	820	120	0
Braidwood offstream storage	72.88	10.2	0

3.5 Storage Area

Evaporation losses (or rainfall gain) from the storages water surface areas were modelled as the volume of water in the storage changed.

For the Captains Flat Dam storage there was no recent survey data so the relation used for the 1999 yield study (Ref 2) (*which it is understood was based on the available survey data at the time*) was used:

$$\mathbf{A = 0.003\ V^{0.405}}$$

where A = water surface area in km^2 and V =storage volume in ML

For the Braidwood offstream storage Council had a survey undertaken for this study from which the data in Table 3.3 was obtained and used.

Table 3.3: Braidwood Storage Area Data

Depth m	Storage ML	Storage Area m^2
8.500	72.88	13291
8.075	67.33	12819
7.650	61.98	12348
7.225	56.84	11876
6.800	51.89	11404
6.375	47.14	10933
5.950	42.60	10461
5.525	38.25	9989
5.100	34.10	9518
4.675	30.16	9046
4.250	26.42	8574
3.825	22.87	8102
3.400	19.53	7631
2.975	16.39	7159
2.550	13.44	6687
2.125	10.70	6216
1.700	8.16	5744
1.275	5.82	5272
0.850	3.70	4800
0.425	1.74	4329
0.000	0	3857

3.6 Environmental Flows

Captains Flat

Currently and in accordance with their licence conditions and approvals for Captains Flat the water supply headworks is operated without any requirements for environmental flows (EFR) or irrigation but with a riparian release of up to the lesser of *2 cusecs* (ie 4.8932 ML/d) and the actual inflow. Thus only the riparian release requirements were included in the modelling.

Braidwood

Currently and in accordance with their licence conditions and approvals for Braidwood the water supply headworks is operated without any requirements for environmental flows (EFR) or irrigation and riparian releases. Thus no releases requirements were included in the modelling.

3.7 Operating Rules

Captains Flat

The general rule modelled for transferring water from the existing headworks system was:

- Water was simply extracted from the Dam storage subject to availability to the WTP to meet demand. Initially a transfer rate of 0.7 ML/d was used as this was the capacity of the WTP. However this was subsequently found to be limiting the yield and thus the transfer capacity was increased so that it was not a constraint on the secure yield.

Braidwood

The general rule modelled for transferring water from the existing headworks system was:

- Water was simply extracted from the river subject to availability to keep the off stream storage (*2 cases*) either full or 90% full. A transfer rate of 1.51 ML/d was used from the river to the offstream storage. A transfer rate of 2 ML/d from the storage to supply was used. Demand was met by transferring from the offstream storage.

4. Modelling Results

4.1 Introduction

The secure yield estimates determined from the behaviour modelling for the requested specified cases are presented in this chapter.

Secure Yield determination is based on a defined methodology (see Appendix A) and uses historic climate data and allows for supply to be met through a much more severe drought than has occurred in the last 120 years or so. The results presented in this chapter are based on historic climate. Adjustments to these results can be made to allow for projected climate change scenarios using defined methodology and these results are presented in Chapter 5.

While secure yield is reliant on the available streamflows, it is also dependent on transfer capacities, environmental flow conditions, annual demands and their monthly distribution, level of security expected and the schemes operating rules. The conditions used have been described in Chapter 3.

The expected level of security arises from the 5/10/10 rules which provides for 10% restrictions occurring in 10% of the years for 5% of the time.

4.2 Results

Captains Flat

The secure yield results are provided in Table 4.1 for the existing system for Captains Flat Dam for the three flow series and with and without including the WTP transfer capacity. The results show that the secure yield is limited by the WTP capacity.

For the case of being unconstrained by the WTP capacity then the secure yield varies quite markedly with the flow series. From a consideration of the results and the basis of the flows it was judged appropriate to adopt the results based on using all the observed data (ie Molong02) from the upstream gauging station to calibrate the AWBM model.

*Braidwoo*d

The secure yield results are provided in Table 4.2 for the existing system for Braidwood for the two cases of transferring water from the river to keep the storage (1) full as possible and (2) 90% full. While keeping the storage full as possible maximises the secure yield for this system there is little difference in secure yield from only transferring water from the river to keep the storage 90% full.

Table 4.1: Captains Flat Water Supply Headworks Existing System Results

Run No.	Flow Series	On Stream Storage Size ML	WTP Transfer Rate ML/d	Riparian Release ML/d	Secure Yield (ML/a)	Restrictions			Critical Drought	
						Applied at storage (% full)	Duration (%)	% of Years	From	To
His21	Molong02	820	**0.7**	4.89	**175**	75	2.66	7.20	17/05/1979	03/04/1981
His41	Molong04	820	**0.7**	4.89	**175**	80	0.01	0.80	03/05/1982	20/03/1983
His61	Molong06	820	**0.7**	4.89	**175**	80	0.81	4.00	22/10/1894	12/05/1896
His21x	Molong02	820	*unconstrained*	4.89	**235**	65	2.28	6.40	17/05/1979	03/04/1981
His41x	Molong04	820	*unconstrained*	4.89	**445**	70	1.94	9.60	10/11/1894	12/05/1896
His61x	Molong06	820	*unconstrained*	4.89	**320**	65	1.47	4.80	20/10/1894	12/05/1896

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Table 4.2: Braidwood Water Supply Headworks Existing System Results

Run No.	Flow Series	Off Stream Storage Size ML	Transfer to keep storage % Full	Releases ML/d	Secure Yield (ML/a)	Restrictions			Critical Drought	
						Applied at storage (% full)	Duration (%)	% of Years	From	To
Run 210	BRWOOD2	72.9	**100**	0	**423**	80	1.04	3.97	03/12/2006	11/02/2007
Run 212	BRWOOD2	72.9	**90**	0	**394**	80	0.85	3.97	04/12/2006	17/01/2007

5. Climate Change

5.1 Background

While secure yield allows for meeting demand with restrictions through a much worse drought than has occurred since about 1890, consideration needs to be given to possible changes from Climate Change.

For this study additional consideration was given by using the approach[4] proposed in NSW Office of Water's (NOW) Draft Proposed Policy for assessing the impact of climate change on non-metropolitan water supplies as given in (Samra & Cloke, 2010) and provided in Appendix B. However for this study data for projections based on 1°C warming scenario, about Year 2030 for A1B mid-range emissions, were used. The Pilot Study was based on 0.9°C warming, for A1B mid-range emissions scenario, at the time thought to be about a Year 2030 projection but now considered to be some years earlier.

5.2 Data

The required Climate Change data to follow the proposed approach were provided by NOW. Daily values of rainfall and evapotranspiration were provided by NOW using the methodology developed for their 2008 data sets (Vaze et al, 2008) (Ref 7) for the 15 global climate models (GCMs) and the corresponding historic data for the nominated catchment representative SILO grid points *(3 for Captains Flat, 41 for Braidwood*). The climate change data are for projected ~2030 and were obtained by Vaze et al (Ref 7) by scaling the historical 1894-2008 daily rainfall and evapotranspiration data using the methods detailed in Chiew et al, 2008 (Ref 8). The climate change data were based on the Years 2030 A1B warming scenarios, mid-range emissions scenarios.

The daily data from the 15 GCMs and the corresponding historic base data were input into the calibrated AWBM rainfall runoff models to produce 16 series of:

- flows at the Shoalhaven River offtake for Braidwood and
- inflows to Captains Flat Dam

for the 1°C warming scenario.

5.3 Modelling

The modelling essentially involved:

- The 16 series of daily flows, (and daily rainfalls and daily evaporation) for Braidwood and Captains Flat were respectfully input into their headworks storage behaviour models to determine 16 corresponding secure yield estimates. (*The required daily evaporation data for the storages were obtained from relations developed between historic evapotranspiration and historic evaporation and then applied to the climate change evapotranspiration daily values*).

4. This complies with NOWS draft guidelines "Assuring future urban water security" (Ref 1).

It is noted the modelling period due to data availability was 1/1/1895 to 31/12/2008 which was slightly shorter to that used for the secure yield modelling without climate change.

5.4 Results

Captains Flat

Table 5.1 summarises the key results for determining the factors to apply to the *traditional* secure yield estimates for the Captain Flats cases modelled to allow for Climate Change using the same approach[5] as provided by NOWs draft policy as given in "NSW Response for Addressing the Impact of Climate Change on the Water Supply Security of Country Towns", (Samra & Cloke, 2010).

Table 5.1: Captains Flat Climate Change Factors

Case for 1°C warming	Secure Yield Estimates ML/a				Relevant Case in terms of NOW Draft Policy	Adopted Factor to be Applied for Climate Change
	Historic from Climate Change data Base	Median from GCMs (5/10/10)	Lowest from GCMs (5/10/10)	Lowest from GCMs rerun with (10/15/25)*		
	A	B	C	D		
Existing storage 820 ML Unconstrained transfer to WTP	205	170	140	160	D/A	0.7805
(Based on AWBM calibration for Molong02 flow series) *Other GCM results provided in Appendix A*						

** Subsequent to Samra & Cloke, 2010, the Technical Steering Committee revised 5/10/25 to 10/15/25*

It is noted that the secure yields in column A are different than the original historic secure yields. This was a common finding of the pilot study due to differences in data sets including period of data.

Table 5.2 provides the secure yield estimates adjusted for climate change in accordance with the above proposed approach.

Table 5.2: Captains Flat Secure Yield Adjusted for Climate Change

Case	Secure Yield Estimates ML/a			
	Run No for Original Historic Case*	Original Historic (5/10/10)	Adjustment factor for Climate Change	With Climate Change
Existing storage 820 ML Unconstrained transfer to WTP	His22	235	0.7805	183
(Based on AWBM calibration for Molong02 flow series) ** see Table 4.1*				

5. This complies with NOWs draft guidelines "Assuring future urban water security" (Ref 1).

Braidwood

Table 5.3 summarises the key results for determining the factors to apply to the *traditional* secure yield estimates for the Braidwood cases modelled to allow for Climate Change using the same approach[6] as provided by NOWs draft policy as given in "NSW Response for Addressing the Impact of Climate Change on the Water Supply Security of Country Towns", (Samra & Cloke, 2010).

Table 5.3: Braidwood Flat Climate Change Factors

Case for 1°C warming	Secure Yield Estimates ML/a				Relevant Case in terms of NOW Draft Policy	Adopted Factor to be Applied for Climate Change
	Historic from Climate Change data Base	Median from GCMs (5/10/10)	Lowest from GCMs (5/10/10)	Lowest from GCMs rerun with (10/15/25)*		
	A	B	C	D		
Offstream storage 72.9 ML Transfer River water to keep 90% full	486	441	390	468	B/A	0.9074
Other GCM results provided in Appendix A						

** Subsequent to Samra & Cloke, 2010, the Technical Steering Committee revised 5/10/25 to 10/15/25*

It is noted that the secure yields in column A are different than the original historic secure yields. This was a common finding of the pilot study due to differences in data sets including period of data.

Table 5.4 provides the secure yield estimates adjusted for climate change in accordance with the above proposed approach.

Table 5.4: Braidwood Secure Yield Adjusted for Climate Change

Case	Secure Yield Estimates ML/a			
	Run No for Original Historic Case*	Original Historic (5/10/10)	Adjustment factor for Climate Change	With Climate Change
Offstream storage 72.9 ML Transfer River water to keep 90% full	Run 212	394	0.9074	357
* *see Table 4.2*				

6. This complies with NOWs draft guidelines "Assuring future urban water security" (Ref 1).

6. Discussion

6.1 Previous Study

Captains Flat

Table 6.1 compares the secure yield estimated for this study with the comparable 1999 study (Ref 2) estimates for the existing system.

Table 6.1: Captains Flat Secure Yield Comparison

Study	Case/Basis	Climate	Security Criteria	Secure Yield ML/a
1999[1]	Monthly Flows. Non parametric correlation of Molonglo River flows at Copper Creek g/s (410757)(d/s of dam) with monthly rainfalls. Dead Storage 280 ML	Historic	5/10/20	130
2015	Daily flows. AWBM rainfall runoff model calibrated with Molonglo River flows at Kobada g/s (412000208) (u/s of dam). Dead Storage 120 ML	Historic	5/10/10	235
2015	Daily flows. AWBM rainfall runoff model calibrated with Molonglo River flows at Molongo River at Kobada g/s (412000208) (u/s of dam). Dead Storage 120 ML	1°C warming	5/10/10	183

1. Provided as Appendix C in Ref 2

The current secure yield estimate is higher than the preliminary estimate reported in the for the 1999 study (Ref 2). Rainfall-runoff modelling to provide the required daily flows would be expected to be more reliable for determining secure yield than the previous technique of using monthly flows extended by non parametric correlation with rainfalls. It is noted the 1999 study showed (Appendix C, Figure 7) the use of monthly flows produced about twice as much drawdown during the 1981 drought compared to the limited available daily flows. Also the 1999 study had an additional 160 ML of dead storage.

Braidwood

There do not appear to be any previous studies with estimates of *secure yield* for Braidwood that can be compared with the current study estimates.

6.2 Consumption

Captains Flat

Table 6.2 provides the annual water usage for the last 11 years met from Captains Flat water supply headworks system based on Councils data provided by HS.

Table 6.2: Captains Flat Annual Water Usage

Financial Year	Annual Usage ML/a
2003/04	57.5
2004/05	47.5
2005/06	46.0
2006/07	56.2
2007/08	50.8
2008/09	51.5
2009/10	50.9
2010/11	45.2
2011/12	49.4
2012/13	53.9
2013/14	49.1

Captains Flat usage over the last years has been much less than their estimated secure yields of 235 ML/a for historic climate and 183 ML/a with 1 ^{o}C warming. The Captains Flat licence allows diversion of up to 250 ML for town water supply per financial year.

Braidwood

Table 6.3 provides the annual water usage for the last 10 years met from Braidwood's water supply headworks system based on Councils data provided by HS.

Table 6.3: Braidwood Annual Water Usage

Financial Year	Annual Usage ML/a
2004/05	160.7
2005/06	172.1
2006/07	157.5
2007/08	119.7
2008/09	151.9
2009/10	145.7
2010/11	94.1
2011/12	120.3
2012/13	155.3
2013/14	171.9

Braidwood's usage over the last years has been much less than their estimated secure yields of 440 ML/a for historic climate and 427 ML/a with 1 ^{o}C warming. Braidwood's Shoalhaven River allows diversion of up to 360 ML for town water supply per year.

6.3 Storage Behaviour

Figures 9 and 10 show the modelled storage behaviour diagrams for a repeat of the historic climate supplying annual demands (*with restrictions applied in accordance with 5/10/10 rules*) that equate to both the secure yield and the maximum annual demands taken from the annual usage tables in section 6.2.

If operational records of the storage levels had been available, these could be compared with the storage behaviour plots for the historic annual demands to provide further validation of the reasonableness of the estimated secure yields.

For the Captains Flat case, the adopted *Molong02* historic inflow series was used.

6.4 Considerations

Both systems have relatively high secure yields compared to past usage.

Captains Flat benefits from a relatively large onstream storage although this is somewhat offset by the storage being supplied by a relatively small catchment area.

Braidwood benefits from water being supplied by a relatively large river catchment area although this is somewhat offset by a relatively small offstream storage.

The Captains Flat secure yield is more sensitive to the 1 ^{o}C warming than the Braidwood secure yield estimate as although the Braidwood low flows are reduced they are still relatively high compared to demand.

Extractions from the river upstream of the Braidwood water supply offtake would reduce the flow at the river offtake and thus potentially may reduce the secure yield. However due to how the inflows were modelled it is implicitly assumed that future upstream extractions by users will be similar to the past as reflected in the observed daily flow data from 1914 to 2015.

Considerations to adopt the *Molong02* inflow series for Captains Flat Dam inflow included the following:

- Resulted in conservative secure yield estimates relative to the other flow series.
- Due to the low flow calibration performance of all three cases it was appropriate to err conservatively.
- Removal of the *unnatural* low flows limited the flow range for the AWBM calibration and thus resulted in significantly higher flows when using the upstream gauging station data for calibration. (see Figure 11) that compares the 3 flow series on a flow duration curve basis).
- The *unnatura*l low flow behaviour was attributed to the rating curve for transforming recorded low river levels to *observed* low flows not being well established or stable. Thus it provided a record that periods of very low flows occurred albeit perhaps the actual daily values were not captured with high accuracy.
- Use of the upstream gauging station records for calibration removed the uncertainty of any effects of the Dam on the downstream observed flows.
- The critical drought for *Molong02* was 5/1979 to 4/1981 which was covered by observed flows at the downstream gauging station and use of these (*Molong06*) resulted in higher secure yield estimates.

7. Recommendations

The results presented in this report should be used keeping in mind the assumptions on which the estimates are based.

8. References

1. NSW Department of Primary Industries, Office of Water (2013), “Assuring future urban water security, Assessment and adaption guidelines for NSW local water utilities”, Draft-December 2013.
2. NSW Department of Public Works and Services (2000), “Captains Flat Water Supply Augmentation Specification Synopsis”, Report No: DC99119-WT,June 2000, prepared for Yarrowlumla Shire Council and Department of Land and Water Conservation..
3. NSW Department of Water and Energy (2007), “Best-Practice Management of Water Supply and Sewerage, Guidelines”, August 2007.
4. NSW Public Works (1986), “Water Supply Investigation Manual” (Amended 1990).
5. CRC for Catchment Hydrology (2004), “Rainfall Runoff Library V1.05, AWBM Catchment Water Balance Model”
6. Jeffrey, S.J., Carter,J.O.,Moudie, K.M., and Beswick, A.R.(2001), “Using Spatial Interpolation to construct a Comprehensive archive of Australian Climatic data”, Environmental Modelling and Software, Vol 16/4 pp309-330,2001.
7. Vaze, J., Post D., Chiew F., Perraud J-M. and Kirono D. (2008), “Future climate and runoff projections (~2030) for New South Wales and Australian Capital Territory, NSW Department of Water and Energy, Sydney.
8. Chiew F., Teng J., Kirono D., Frost A.J., Bathols J.M., Vaze J., Viney N.R., Young W.J., Hennessy K.J., and Cai W.J., (2008), “Climate data for hydrologic scenario modelling across the Murray-Darling Basin”, A report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project. CSIRO, Sydney.

9. Figures

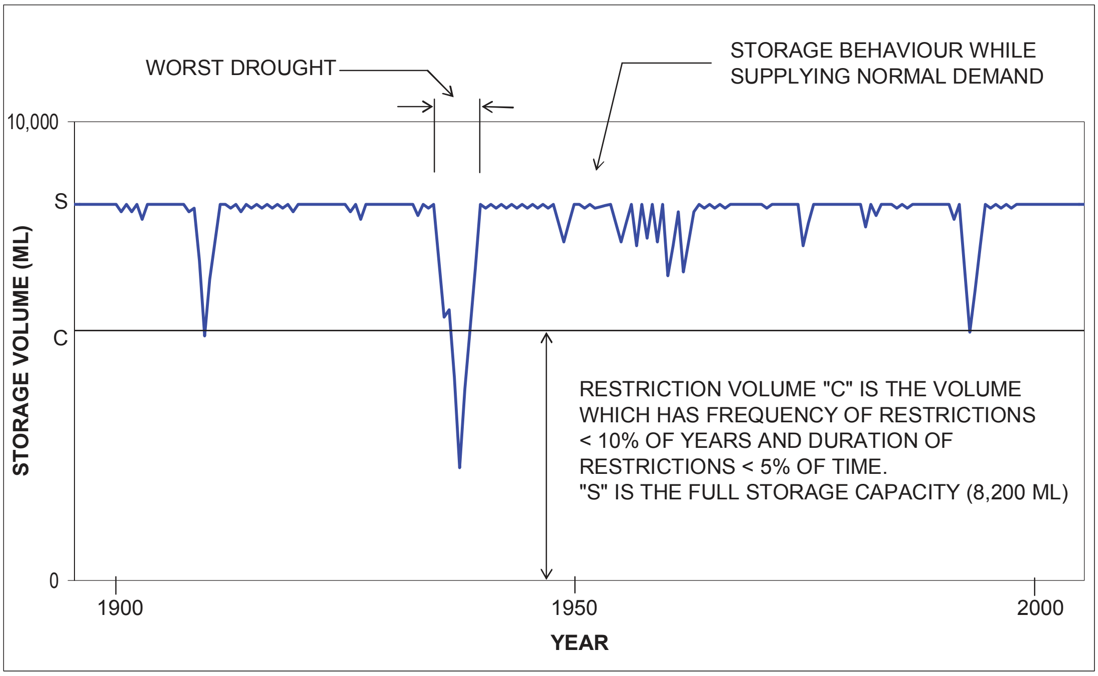


Figure 1: Duration and Frequency of Restrictions

Figure 1 shows the results of simulating an example utility's storage behavior for 120 years of daily streamflow, rainfall and evaporation data and shows that:

- Unrestricted water demand can be supplied for over 95% of the time and over 90% of years (ie. whenever the storage volume is above the **restriction volume C**). In order to satisfy the 5/10/10 rule, restrictions must be imposed whenever the volume of water in storage falls below the **restriction volume C**.
- A 10% reduction in demand is applied when the storage falls below **restriction volume C**
- The worst drought shown in Figure 1 is for approximately the 5-year period January 1939 to December 1943
- The minimum simulated storage volume is approximately 30% of the full storage capacity.

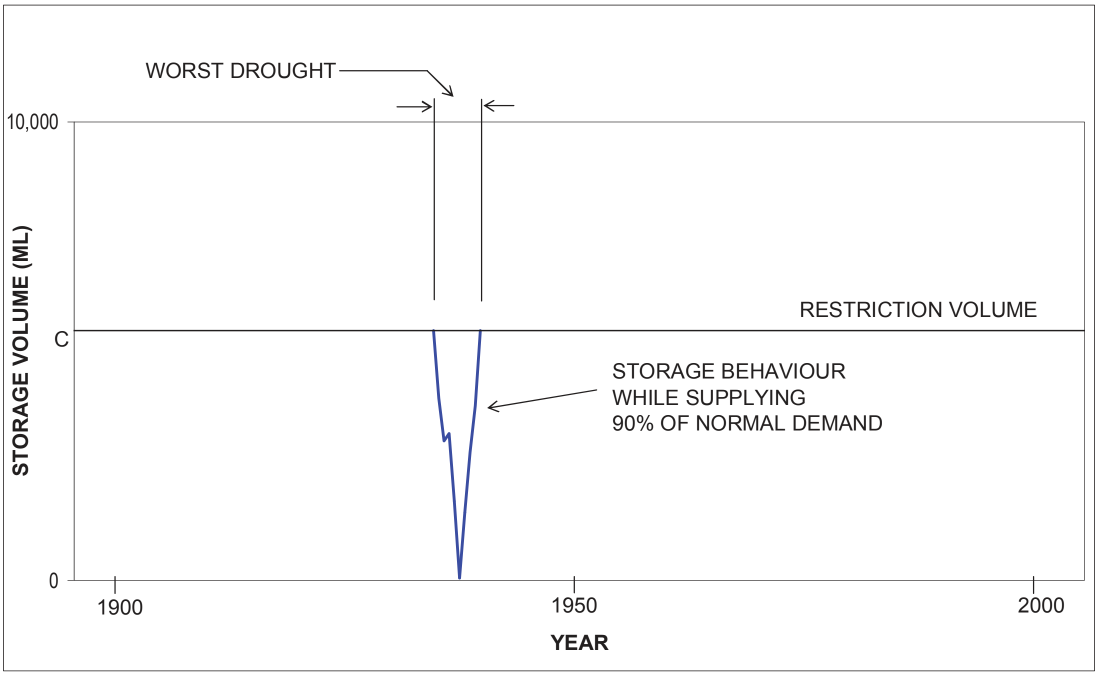


Figure 2: Severity of Restrictions

Figure 2 shows the results of simulating storage behaviour for the worst drought identified in Figure 1 (5-year drought from January 1939 to December 1943) on the following basis:

- A 10% reduction in demand for the full 5-year drought as the storage volume is below the Restriction volume C
- The commencing storage volume for this simulation is the **restriction volume C** and the resulting minimum simulated storage volume is approximately 2% of the full storage capacity.

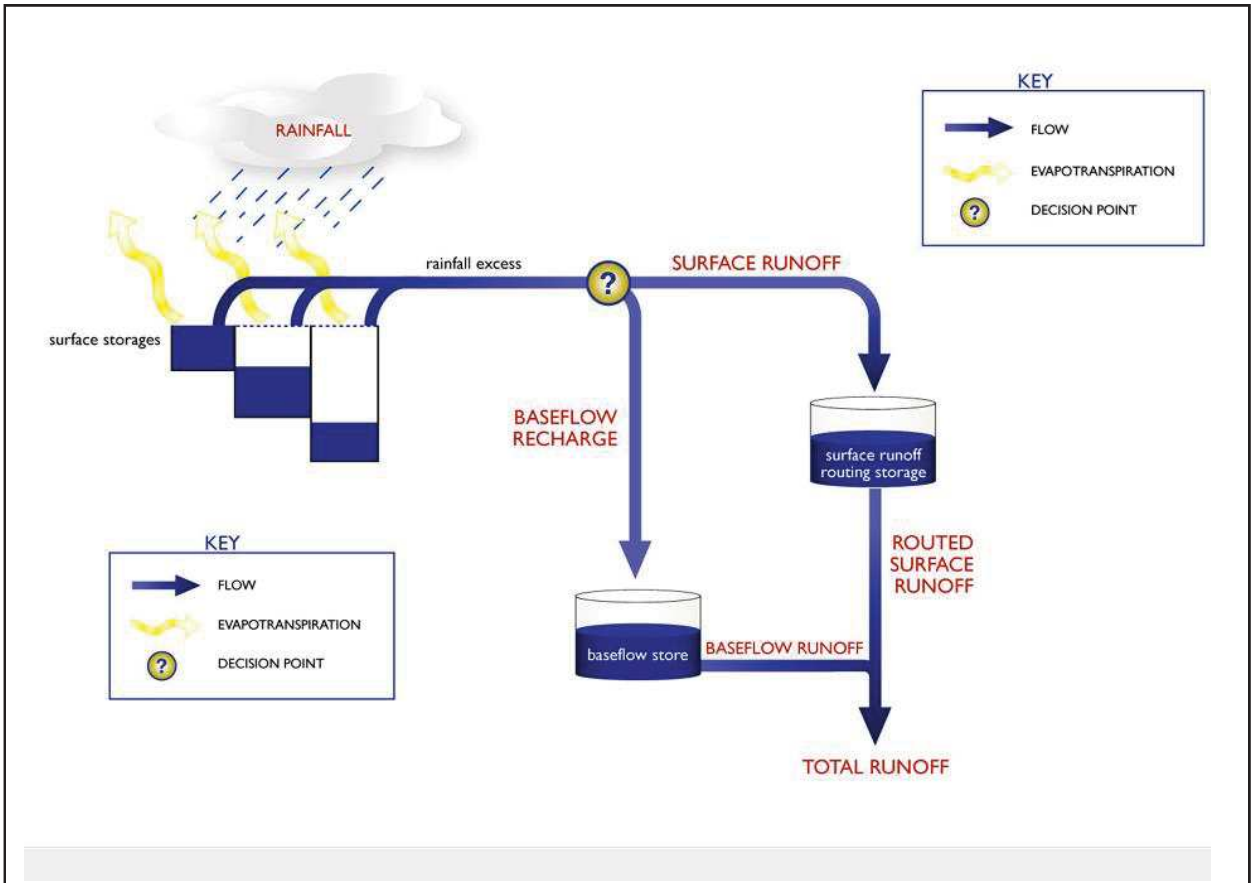
Comment

Imposition of the requirements of the 5/10/10 rule approximates the severity of a '1 in 1000 year' drought and is necessary in order to enable a utility to manage its system in a drought more severe than the worst drought in the 120 year historical record, with only moderate drought water restrictions.

As the first year of the worst drought for this example utility is simulated in **both Figure 1 and Figure 2**, the water supply system must be able to cope with effectively a 6-year drought, rather than the 5-year worst drought in Figure 1 as it takes about 1-year to drawdown to **restriction volume C.**

It is important to note that the analytical process for the 5/10/10 rule is iterative and that a solution is identified only when all 3 requirements have been met.

A refinement that the NUWS model undertakes and as practiced by the former NSW Public Works Hydrology Group is to test all droughts for criticality when testing the critical drought with the storage already drawdown at the start of the drought. This is done as it was occasionally found in previous studies that the drought that is critical for the full storage was not necessarily the drought that was critical for in effect a smaller (ie drawdown) storage. This is achieved by modelling the full flow series with the reduced storage size and the restricted demand. This also arises from the "1 in 1000 year" security concept.



Source Reference 5

Figure 3: AWBM Model

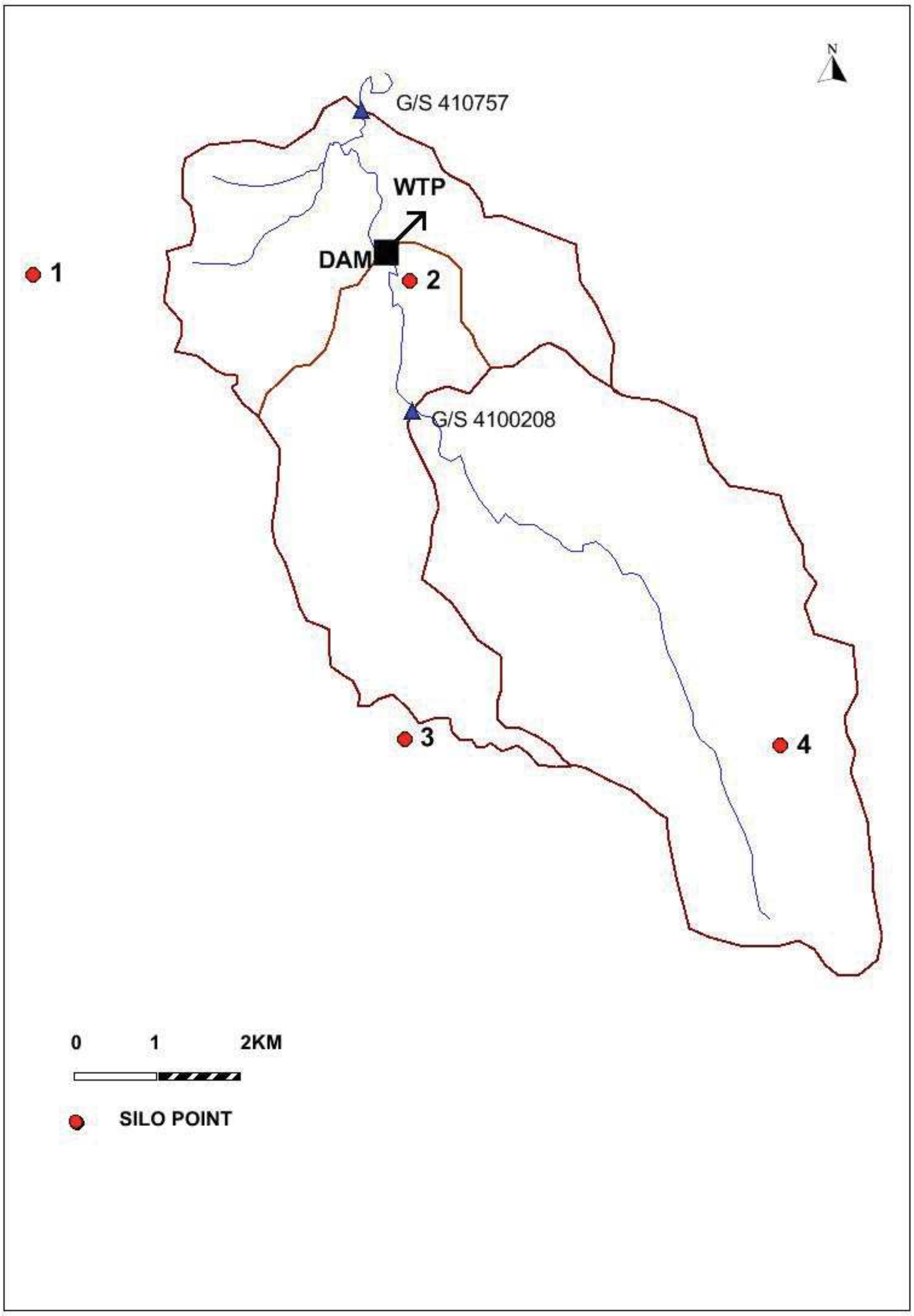


Figure 4: Captains Flat Model Catchments and Water Supply Scheme

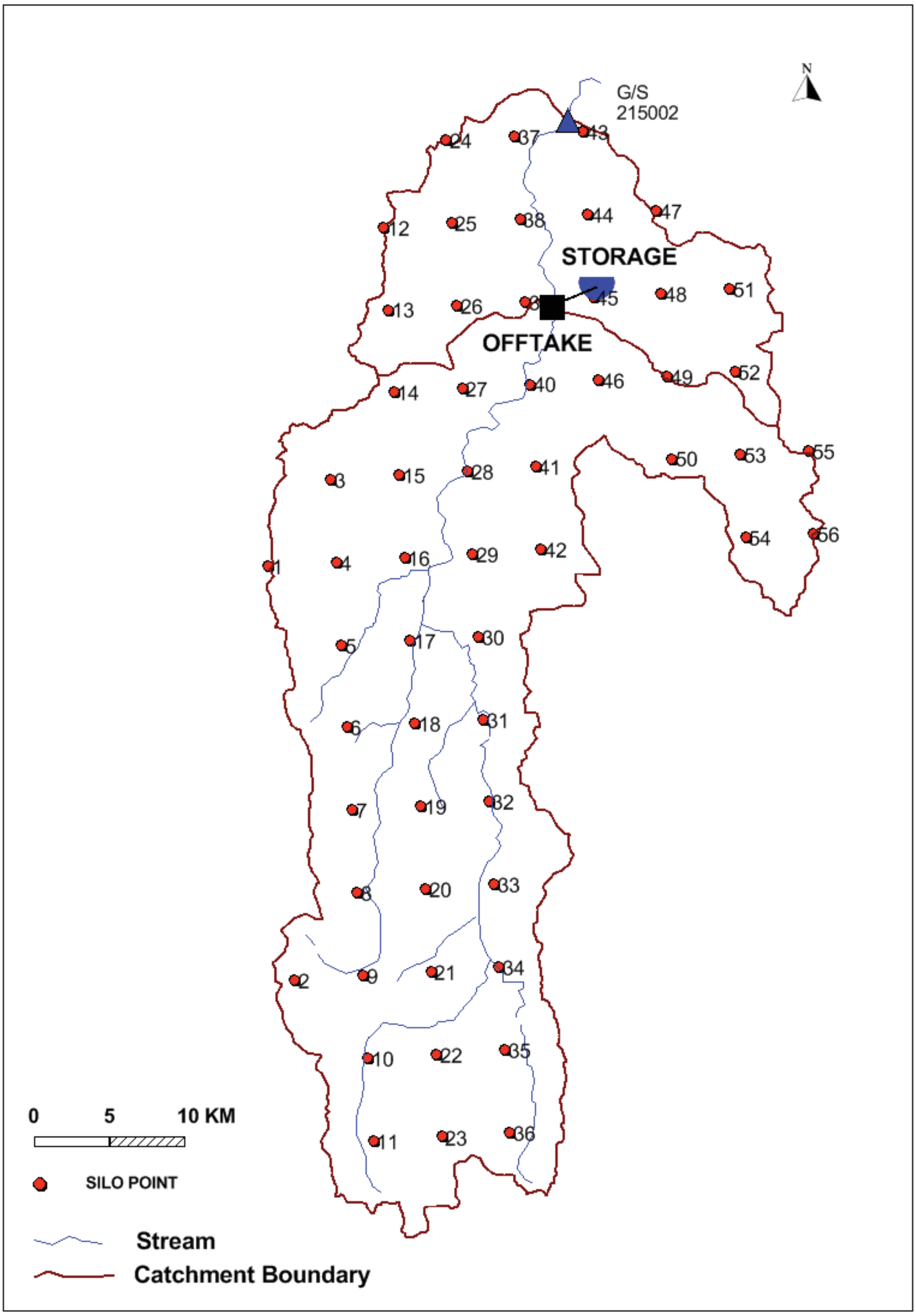
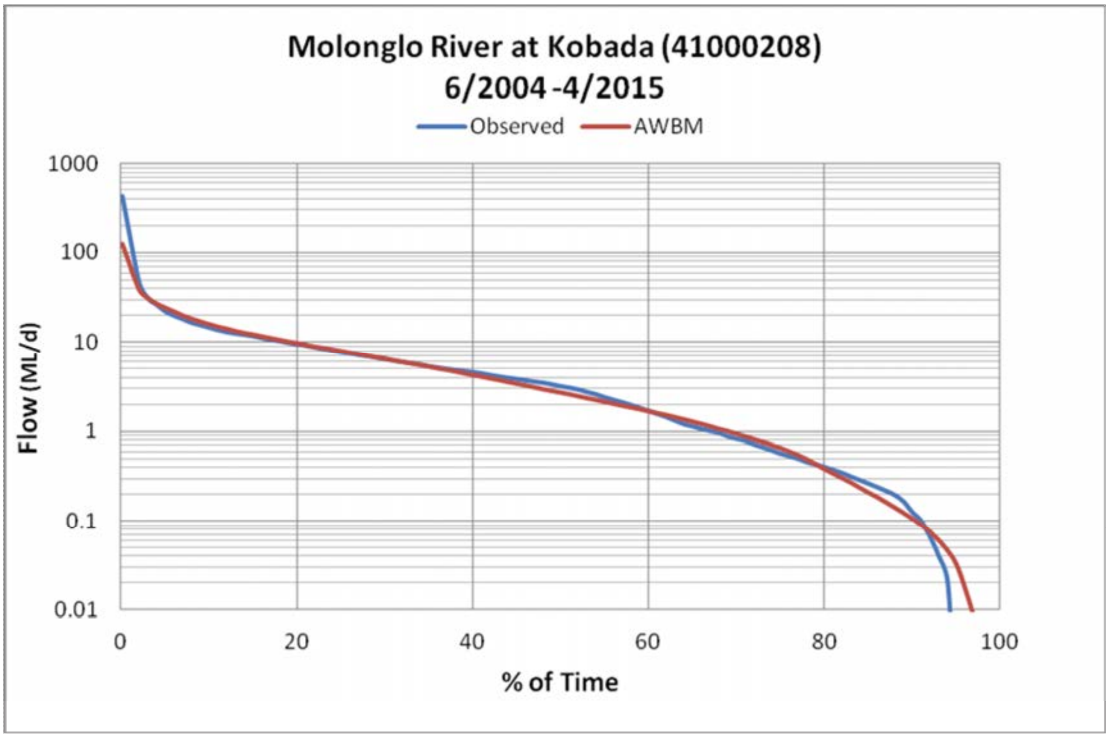


Figure 5: Braidwood Model Catchments and Water Supply Scheme



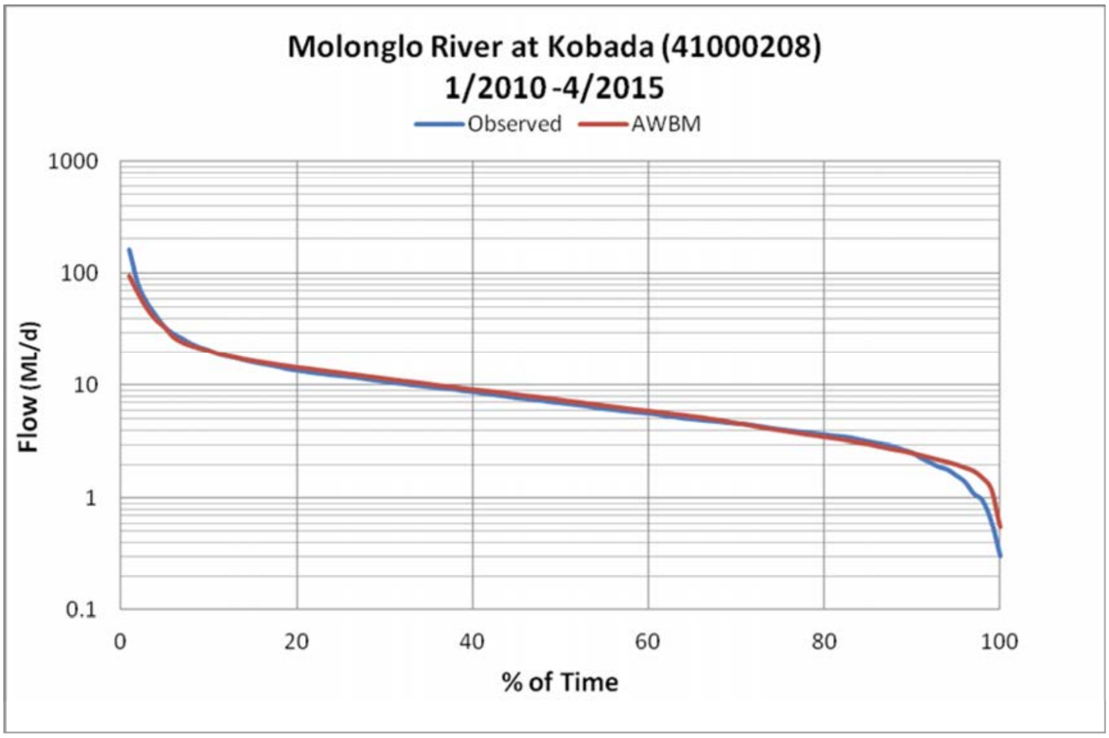


Figure 6: Captains Flat (u/s g/s) Modelled and Observed Flow Duration Curves

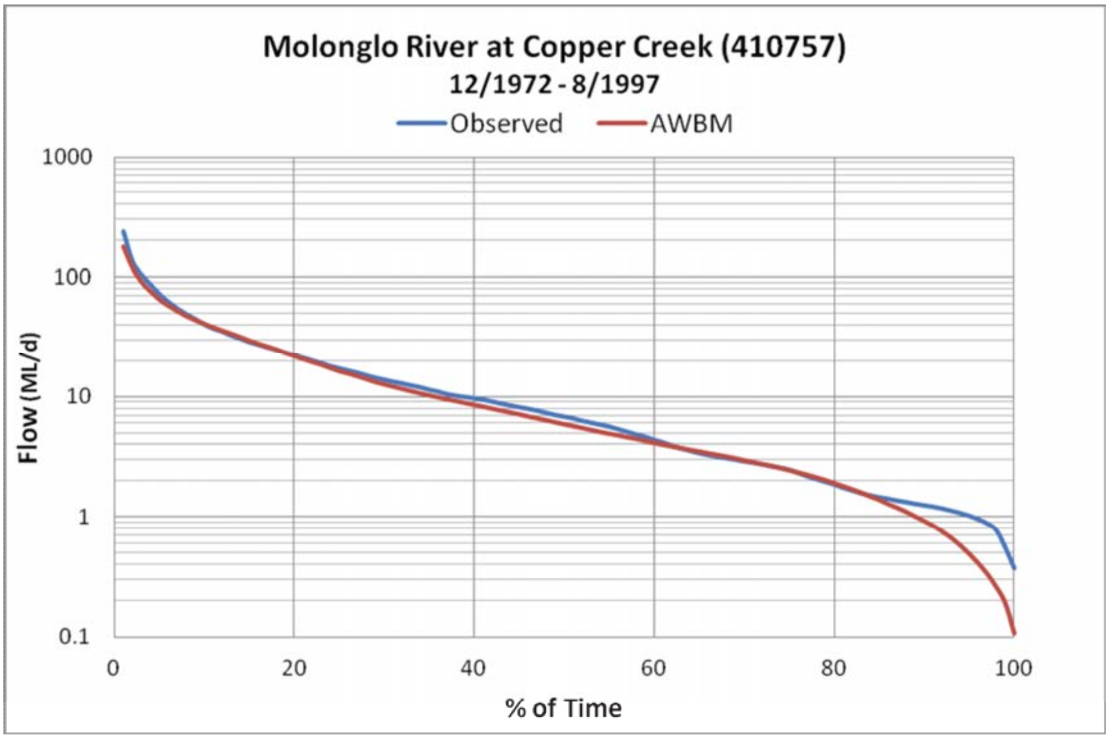


Figure 7: Captains Flat (d/s g/s) Modelled and Observed Flow Duration Curves

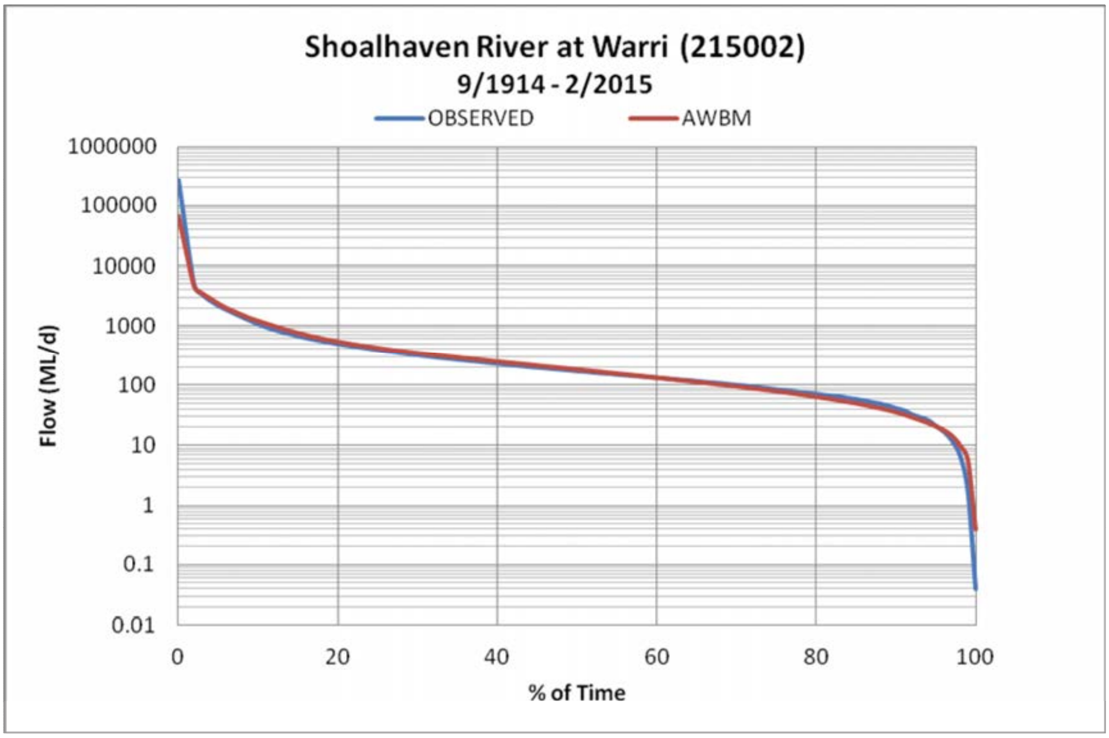
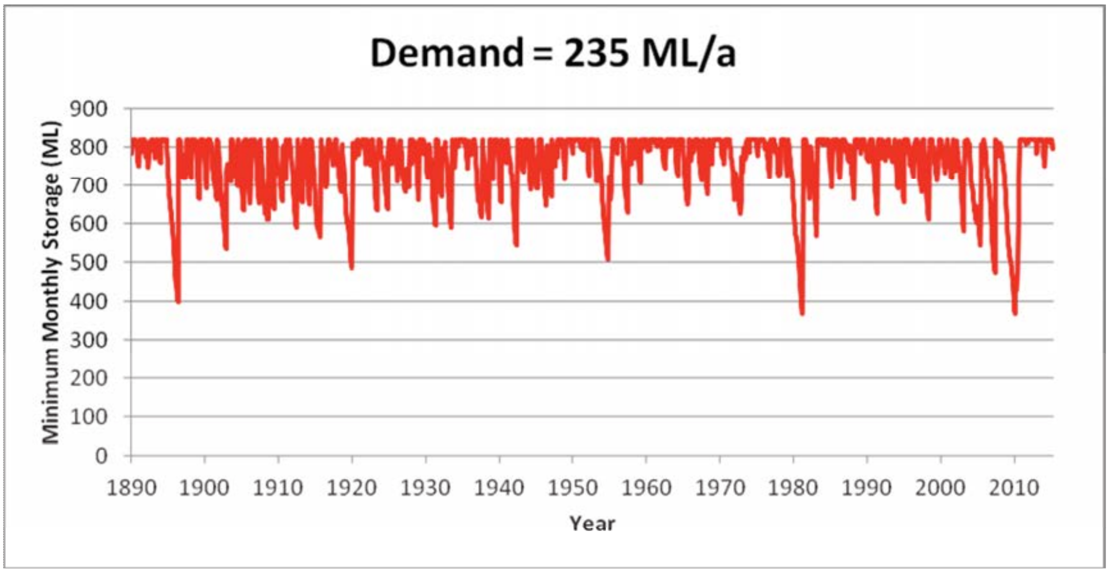
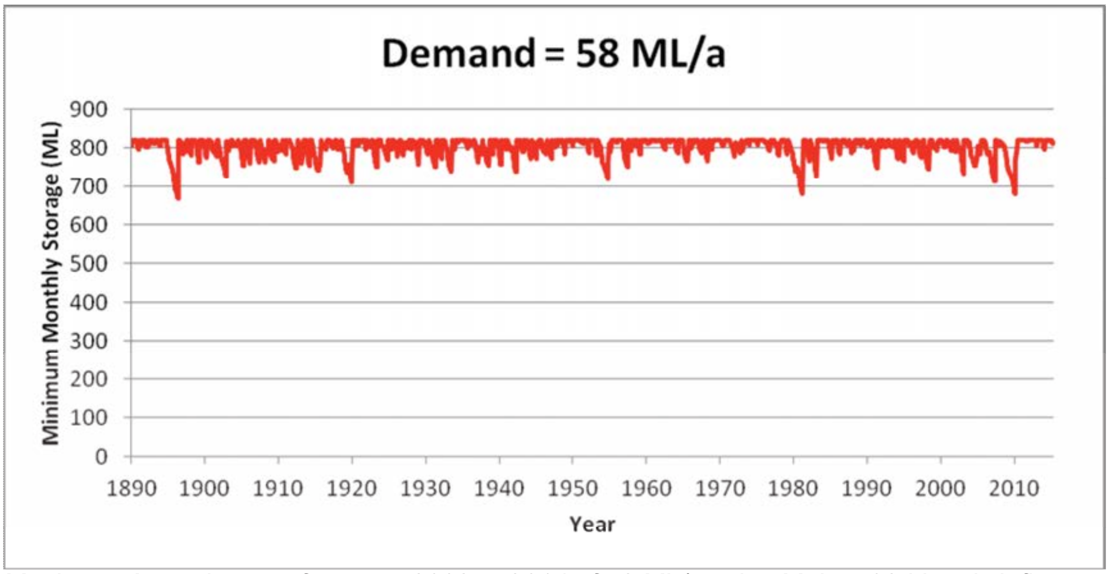


Figure 8: Braidwood Modelled and Observed Flow Duration Curves

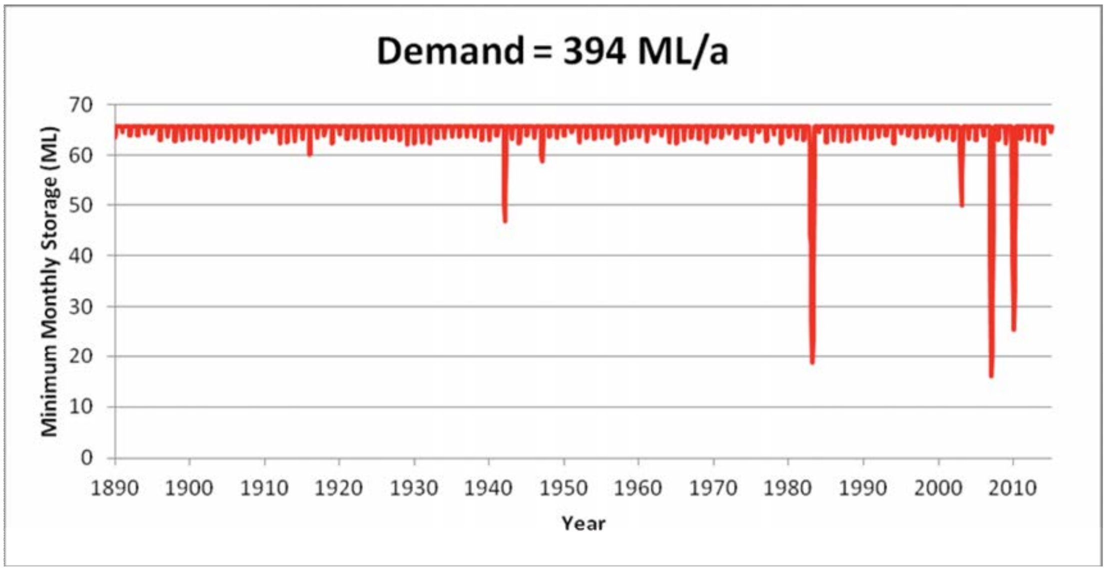


Secure Yield 235 ML/a for historic climate using Molong02 historic inflows

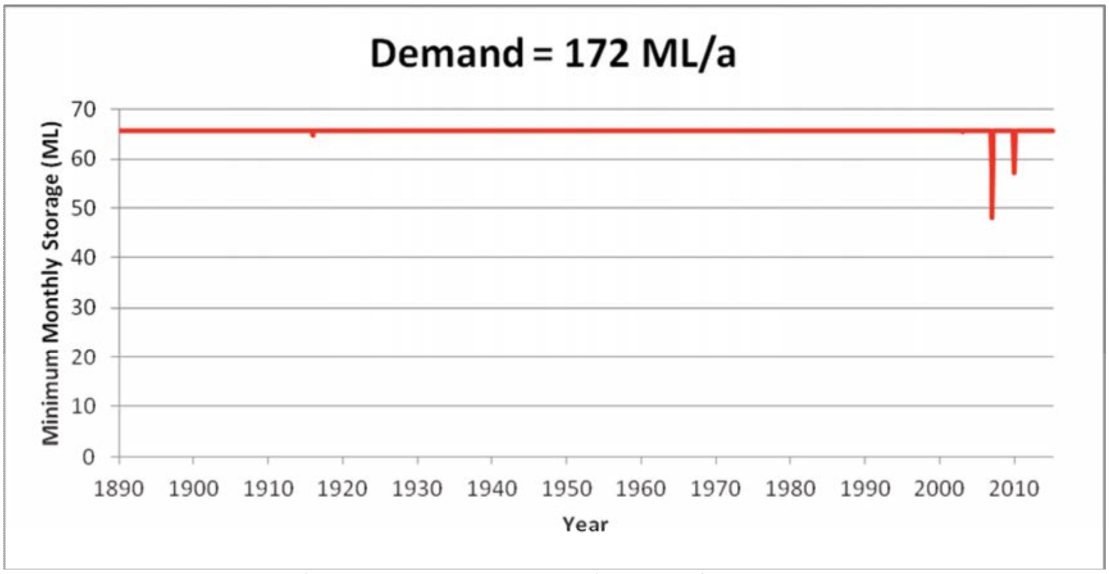


Maximum Annual usage for years 2003 to 2014 of 58 ML/a using Molong02 historic inflows

Figure 9: Captains Flat Storage Behaviour Diagrams

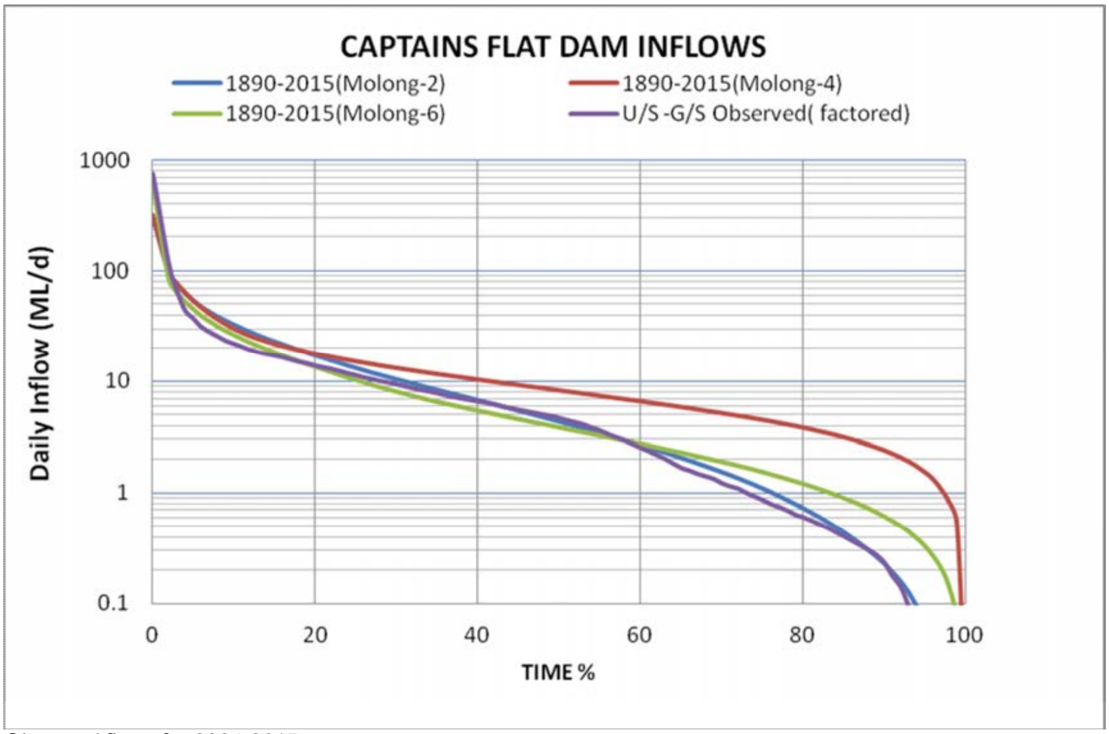


Secure Yield 394 ML/a for historic climate



Maximum Annual usage for years 2004 to 2014 of 172 ML/a

Figure 10: Braidwood Storage Behaviour Diagrams



Observed flows for 2004-2015
Modelled flows 1890-2015 pre merging with observed flows

Figure 11: Captains Flat Dam Modelled Inflow Duration Curves

10 Appendices

Appendix A – GCM Modelling Results

Data Set		Secure Yield ML/a	
		Captains Flat	Braidwood
Historical Data from NSW Database based on 5/10/10 design rule		205	486
15 GCMs based on 5/10/10 design rule			
	GCM1	200	479
	GCM2	195	457
	GCM3	150	390 (Lowest)
	GCM4	140 (Lowest)	405
	GCM5	160	415
	GCM6	165	441 (Median)
	GCM7	180	445
	GCM8	150	408
	GCM9	170 (Median)	456
	GCM10	195	446
	GCM11	205	437
	GCM12	160	402
	GCM13	160	422
	GCM14	185	485
	GCM15	195	465
Lowest GCM based on 10/15/25 design rule		160	468

Appendix B – Climate Change Paper

Paper from ‘Practical Responses to Climate Change’, National Conference 2010, Melbourne, Institution of Engineers Australia.

NSW RESPONSE FOR ADDRESSING THE IMPACT OF CLIMATE CHANGE ON THE WATER SUPPLY SECURITY OF COUNTRY TOWNS

Sam Samra [1], Peter Cloke [2]
1. Senior Manager, Water Utility Performance, NSW Office of Water
Sydney, NSW 2000
Sam.Samra@water.nsw.gov.au
2. Principal Hydrologist, NSW Water Solutions, NSW Public Works
Sydney, NSW 2000
Peter.Cloke@services.nsw.gov.au

ABSTRACT
Under the NSW Government's *Best-Practice Management of Water Supply and Sewerage Guidelines*, local water utilities in non-metropolitan NSW are required to prepare and implement a comprehensive 30-year integrated water cycle management (IWCM) strategy. The IWCM strategy is prepared for the utility's water supply, sewerage and stormwater businesses, including the water supply headworks, and is effectively a 30-year rolling strategy, which must be reviewed and updated by each utility every 6 years.

For the past 25 years most urban water supply headworks in country NSW have been sized on a robust Security of Supply basis. This security of supply basis has been designed to cost-effectively provide sufficient dam storage capacity to allow the water utility to effectively manage its water supply in future droughts of greater severity than experienced over the past 100 or more years. 'Secure Yield' is the water demand that can be expected to be supplied with only moderate water restrictions during a significantly more severe drought than had been experienced historically. The required water restrictions must not be too severe, not too frequent, nor of excessive duration. Recent analysis for the severe 2001-2007 drought has confirmed the continuing robustness of the NSW Security of Supply basis.

To understand the potential impact of climate change on the security of urban water supplies, results are presented from a pilot study for 11 non-metropolitan NSW water supplies utilising 112 years of downscaled daily hydrometeorological data from 15 global climate models for climate change projections for the year 2030 using the A1B medium warming emissions scenario. This analysis enabled determination of the impact of climate change on the Year 2030 secure yield for each water supply.

Future 30-year IWCM strategies in NSW will need to include assessment of the secure yield of the utility's water supply in accordance with the analysis reported for the pilot study. Implementation of these strategies, together with the required 6-yearly updates, will address future water security.

INTRODUCTION
The NSW Government is tackling the challenge of the impact of climate change on non-metropolitan urban water utilities in a multi-pronged approach through comprehensive best practice management requirements, as noted below.

The key element of the NSW response to climate change is that the utilities will be required to determine their urban water supply security along the lines of the analysis reported in this paper for the pilot study for 11 NSW water supplies. Reporting of such water supply security analysis will need to be documented in each utility's 30-year IWCM strategy.

Background
The NSW Government's *Best-Practice Management of Water Supply and Sewerage Guidelines* (Dept Water and Energy, 2007) is the key driver for reform of planning and management and performance improvement in non-metropolitan NSW. 106 NSW local water utilities provide piped water supply and sewerage services to the 1.8 million people in NSW country towns (97.9% water supply coverage). The 19 requirements of the guidelines include:

- Annual performance monitoring by each utility;
- Current 20 year strategic business plan and financial plan;
- Regulation of water supply, sewerage and trade waste (including pay-for-use water pricing, full cost recovery, commercial sewer usage, trade waste and developer charges, trade waste approvals for all dischargers and a sound trade waste regulation policy by each utility);
- Demand management;
- Drought management ; and

- Integrated Water Cycle Management (IWCM) - comprehensive 30 year strategy required for the utility's water supply, including headworks, sewerage, and where cost-effective, stormwater businesses. A full range of scenarios must be evaluated on a rigorous triple bottom line (TBL) basis, with extensive community involvement. The IWCM Strategy is effectively a 30-year rolling strategy, which must be reviewed and updated by each utility every 6 years.

The non-metropolitan NSW utilities have annual revenue of $950 million and an asset base with a current replacement cost of almost $20 billion (NSW Office of Water, 2010 (1) : vii). Overall, the utilities had met 82% of the requirements of the *Best-Practice Management Guidelines* by June 2009. The Best-Practice Management Guidelines, the IWCM Guidelines, the 7 IWCM Information Sheets and the annual NSW Water Supply and Sewerage Performance Monitoring Reports and Benchmarking Reports are available on the NSW Office of Water website (www.water.nsw.gov.au).

NSW Security of Supply Basis

45 local water utilities have surface water supplies with storage dams in non-metropolitan NSW. Such utility storages have in the main been sized on the NSW Security of Supply basis since the mid–1980s (NSW Public Works, 1986; Samra & French, 1988 and Cloke, 1995).

The purpose of the NSW Security of Supply basis is to determine the cost-effective storage volume and transfer capacities required to enable each water utility to operate its system with only moderate water restrictions in the event of occurrence of droughts of similar severity to those in the historical record, generally back to at least 1895. The utility would also be able to cope with significantly more severe droughts albeit with more severe water restrictions. Effectively, each water supply system would be able to cope with approximately a '1 in 1000 year drought' (Cloke & Samra, 2009 :13).

Under the NSW Security of Supply basis (commonly referred to as the '5/10/20 rule'), water supply headworks systems are normally sized so that:

a) Duration of restrictions does not exceed 5% of the time; and

b) Frequency of restrictions does not exceed 10% of years (ie. 1 year in 10 on average); and

c) Severity of restrictions does not exceed 20%. Systems must be able to meet 80% of the unrestricted water demand (ie. 20% average reduction in consumption due to water restrictions) through a repetition of the worst recorded drought, commencing with the storage drawn down to the level at which restrictions need to be imposed to satisfy a) and b) above.

This enables the utilities to operate their systems without restrictions until the volume of stored water approaches the trigger level determined by a) and b) above (typically about 50% to 60% of the storage capacity). If at this trigger level, the utility imposes drought water restrictions which reduce demand by 20%, the system would be able to cope with a repeat of the worst recorded drought, commencing at that time, without emptying the storage.

'Secure yield' is defined as the highest annual water demand that can be supplied from a water supply headworks system while meeting the above '5/10/20 rule[1]'.

The robustness of the NSW Security of Supply basis has been demonstrated by Cloke & Samra (2009 :7) who showed that for the 10 NSW urban water supplies studied, the very severe 2001 to 2007 drought resulted in a reduction in the secure yield of up to 7% for 7 of the water supplies and a reduction of about 15% for the other 3 supplies.

The first paragraph in footnote 2 below[2], which is a quote from page 3 of the *2008-09 NSW Water Supply and Sewerage Performance Monitoring Report* shows that for the 15 years from 1986, the frequency of drought water restrictions by the non-metropolitan NSW water utilities was consistent with the implied target of no restrictions in 90% of years in b) above.

The *2008-09 NSW Water Supply and Sewerage Benchmarking Report* shows each utility's drought water restrictions over each of the last 6 years (page 56).

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1 As noted at the top of page 3, this has been superseded by a '5/10/10 rule' since February 2009.

2 'For the 15 years from 1986 to 2000/01, on average, the NSW utilities did not apply any drought water restrictions for 87% of the years, which include the severe 1993 to 1994 drought. This is consistent with the implied target of no restrictions in 90% of years in the NSW Security of Supply basis (commonly referred to as the '5/10/10 rule').

For the 23 years from 1986 to 2008/09, on average, the NSW utilities did not apply any drought water restrictions for 75% of the years. However, this period includes both the above 1993 to 1994 drought and the very severe 2001 to 2008/09 drought.'

The *2008-09 Performance Monitoring Report* (page 8) also shows 'there has been a 47% reduction in the volume of average annual residential water supplied per property in non-metropolitan NSW over the last 18 years (from 330 to 175kL per connected property)'. It is therefore considered that it will now be much more difficult to achieve a 20% reduction in consumption than it was 20 years ago as there has been a large reduction in outdoor water use. Accordingly, in February 2009 the NSW Office of Water agreed to basing future planning in non-metropolitan NSW on being able to achieve an average of only a 10% reduction in consumption through a repetition of the worst drought commencing with the storage already drawn down to satisfy the restriction duration and frequency criteria in a) and b) on page 2. Thus the NSW '5/10/20 rule' has been superseded by a '5/10/10 rule'.

Accordingly, a pilot study has been undertaken to examine the impacts climate changed hydrometeorological data has on water security for 11 surface water supplies and to develop a methodology suitable for application for this purpose by the other NSW water utilities.

PILOT STUDY

A Climate Change Steering Group has been formed to oversee a climate change pilot study for 11 urban NSW water supplies and development of NSW guidelines for local water utilities on assessing the impact of climate change on the secure yield of their water supplies. The Steering Group members are:

- Peter McLoughlin (National Water Commission)
- Jai Vaze (NSW Office of Water/CSIRO)
- Peter Cloke (NSW Public Works - commissioned to carry out the pilot study)
- Sascha Moege (Local Government and Shires Associations)
- Wayne Franklin (NSW Water Directorate)
- Sam Samra, Mike Partlin, Peter Ledwos (NSW Office of Water)

As indicated above, the purpose of the pilot study was to provide insights on the impacts of climate changed hydrometeorological data on the water security of the 11 water supplies in the pilot study and to then develop a suitable methodology and guidelines for application by the other NSW water utilities.

The pilot study (Samra & Cloke, 2010 :10) involved undertaking hydrological and system modelling to determine the impact of climate change on secure yield. The pilot study incorporates the scientific logic of the CSIRO's Murray Darling Basin Sustainable Yields Project (Chiew et al, 2008), which used daily historical data from 1895 to 2006 and applied the relevant global climate models (GCMs) to provide projected (~2030) climate changed data for each GCM for this period.

The pilot study uses daily values of rainfall and evapotranspiration from the NSW Office of Water's 2008 data sets[3] (Vaze et al, 2008) for 15 GCMs. These future climate change series for ~2030 were obtained by Vaze et al by scaling the historical 1895-2006 daily rainfall and evapotranspiration data using the methods detailed in Chiew et al ,2008.. These data sets involve extension of the CSIRO data for the Murray Darling basin to cover all of NSW and are based on the Year 2030 A1B warming scenario[4]; a mid range emissions scenario.

The study essentially involved two modelling steps:

- Daily rainfall and evapotranspiration data were inputted into existing calibrated rainfall-runoff models to produce climate changed daily streamflows[5]
- The daily climate changed streamflows, rainfall and evapotranspiration were inputted into water supply system simulation models[6] to determine climate changed secure yields.

The climate changed secure yields were compared with the secure yields for a repeat of the historical data set as noted on page 5.

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[3] This comprehensive data set provides projections of down scaled daily climate changed data for the Year 2030 for all of NSW. It is the best such data set available at present, and was therefore used for the pilot study. As noted on page 10 this data set now covers all of NSW, Victoria and the Murray Darling Basin, including Adelaide. As noted on page 10 improved and longer term projections of climate changed data are expected to be developed in the future and these should be applied by water utilities when they become available.

[4] It is noted that there is little difference in the impacts of the various warming scenarios considered by the IPCC for the Year 2030. Such impacts diverge in longer term projections such as for the Year 2050 or 2070.

[5] Use of a locally calibrated daily rainfall-runoff model for each water supply is essential. The analysis carried out in the pilot study demonstrated that use of generalised streamflow estimates available from the NSW Office of Water data sets is inappropriate for security of water supply analysis. In NSW, such a local daily rainfall-runoff model is routinely developed for any water supply secure yield study.

[6] Similarly, a suitable system simulation model is routinely developed in NSW for any water supply secure yield study.

Table 1 lists the 15 GCMs that were used to produce the data sets

Table 1: The 15 Global Climate Models

Climate Data Series	GCM	Modelling Group	Country
1	CCCMA T47	Canadian Climate Centre	Canada
2	CCCMA T63	Canadian Climate Centre	Canada
3	CNRM	Meteo-France	France
4	CSIRO-MK3.0	CSIRO	Australia
5	GFDL 2.0	Geophysical Fluid Dynamics Lab	USA
6	GISS-AOM	NASA/Goddard Institute for Space Studies	USA
7	IAP	LASG/Institute of Atmospheric Physics	China
8	INMCM	Institute of Numerical Mathematics	Russia
9	IPSL	Institut Pierre Simon Laplace	France
10	MIROC-M	Centre for Climate Research	Japan
11	MIUB	Meteorological Institute of the University of Bonn,	Germany
		Meteorological Institute of KMA	Korea
12	MPI-ECHAMS	Max Planck Institute for Meteorology, DKRZ	Japan
13	MRI	Meteorological Research Institute	Japan
14	NCAR-CCSM	National Center for Atmospheric Research	USA
15	NCAR-PCMI	National Center for Atmospheric Research	USA

It is noted that to maintain relativity and ensure consistency in the pilot study, modelled streamflow data was used throughout. However in practice in determining 'historical' secure yield, best use is made of the observed data for each utility. Thus the historical estimates in Table 2 differ slightly from the current best estimates of secure yield, which include consideration of the observed data. Thus the Steering Group recommends applying the percentage change in secure yield in column (9) of Table 2 to the utility's current best estimate of secure yield in order to obtain the climate changed secure yield estimate.

Table 2: Comparison of Secure Yield Estimates#

Water Utility	Estimated Secure Yield (ML)				% Change in Secure Yield From Historical Data Set			
	Historical Data Set*	Median of 15 Global Climate Models (GCMs)	Lowest GCM	Lowest GCM with 25% severity	Median of 15 GCMs [(3) – (2)]×100 / (2)	Lowest GCM [(4) – (2)]×100 / (2)	Lowest GCM with severity of 25% [(5) – (2)]x100 / (2)	Adopted % Change in Year 2030 Secure Yield due to Climate Change [lesser of (6) & (8)] (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	21,500	20,000[14]	17,500 [9]	19,500	-7%	-19%	-9%	**-9%**
2	3,400	3,500 [1]	3,200 [9]	3,600	+3%	-6%	+6%	**+3%**
3	12,400	12,200 [1]	11,400 [6]	12,600	-2%	-8%	+2%	**-2%**
4	7,700	7,200 [13]	6,700 [3]	7,200	-6%	-13%	-6%	**-6%**
5	5,200	4,900 [4]	4,500 [9]	4,800	-4%	-13%	-8%	**-8%**
6	495	450 [12]	400 [3]	435	-9%	-19%	-12%	**-12%**
7	4,850	4,150 [4]	3,250 [3]	3,600	-14%	-33%	-26%	**-26%**
8	3,600	3,600 [8]	2,900 [3]	3,400	0%	-19%	-6%	**-6%**
9	480	360 [8]	220 [4]	240	-25%	-54%	-50%	**-50%**
9+	1500	1260 [7]	880 [4]	1060	-16%	-41%	-29%	**-29%**
10	185	175 [4]	115 [9]	135	-5%	-38%	-27%	**-27%**
11	16,900	15,300 [4]	14,300 [13]	15,700	-9%	-15%	-7%	**-9%**

On the basis of '5/10/10 rule' in ML/a, except for columns (5) and (8), which involve a severity of 25% (ie. a '5/10/25 rule').
* 111 years of data (1896 to 2006) from the "Future climate and runoff projections (in 2030) for NSW and ACT" Database.
+ Enlarged storage for proposed augmentation.
In columns (3) and (4), the relevant GCM is shown within square brackets, eg. for Utility 10 the secure yield shown in column (3) is based on GCM 4.

Figure 1 shows the general location of the 11 NSW water supply systems examined which covered a range of attributes: large, small, on-stream storage, off-stream storage, coastal, inland and multi-sources.`

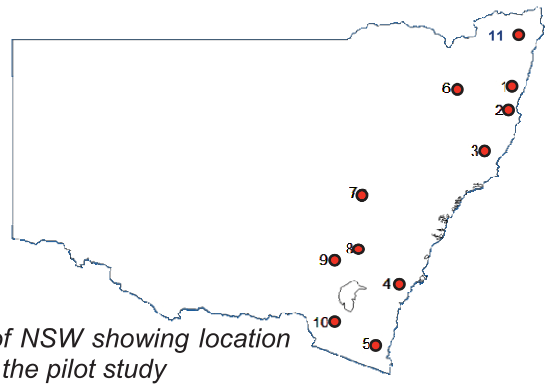

Figure 1: Map of NSW showing location of the utilities in the pilot study

RESULTS OF THE PILOT STUDY

Climate Change

The projected impacts of climate change in ~2030 on the average annual rainfall, streamflow and evapotranspiration for each utility's water supply, in comparison with the historical data sets are shown in Figures 2, 3 and 4 respectively. Note that there is a tendency towards drying in NSW.

Following determination of the average annual rainfall for each of the 15 GCMs for each utility, the GCM with the highest average annual rainfall is shown as 'Highest' in Figure 2, expressed as a percentage change in comparison with the historical average annual rainfall. Similarly, the GCM with the lowest average annual rainfall for a utility is shown as 'Lowest' and the GCM with the median average annual rainfall from the 15 GCMs is shown as 'Median' in Figure 2.

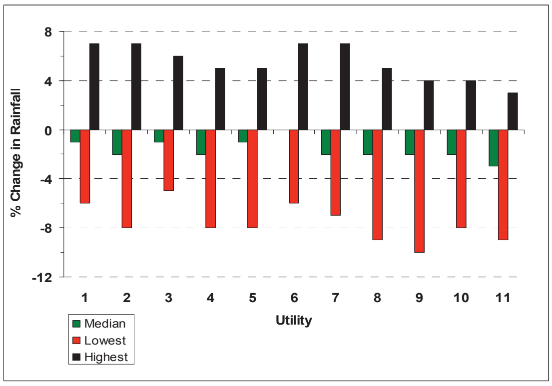

Figure 2: % Change in the Average Annual Rainfall for the Global Climate Models (GCMs) shown compared with the result for the Historical Data Set

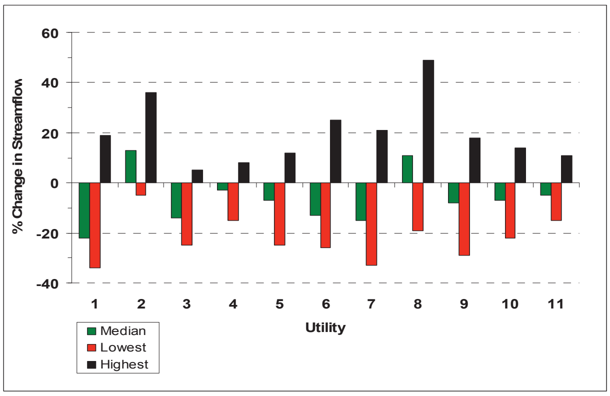

Figure 3: % Change in the Average Annual Streamflow for the Global Climate Models (GCMs) shown compared with the result for the Historical Data Set

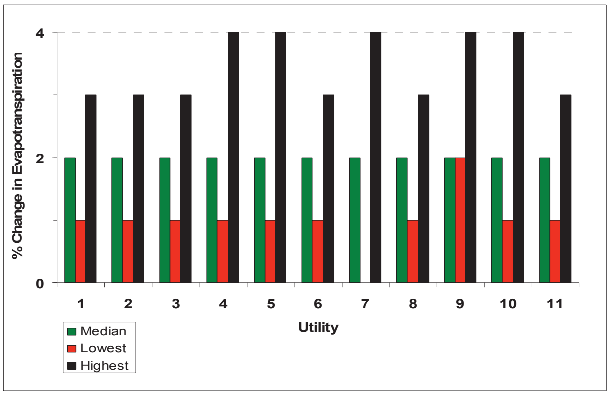

Figure 4: % Change in the Average Annual Evapotranspiration for the Global Climate Models (GCMs) shown compared with the result for the Historical Data Set

Figure 2 shows that the changes in the average annual rainfall for the GCM with the median change range from no change (Utility 6) to a reduction of 3% (Utility 11) (median is a 2% reduction). For the GCM with the lowest change, the range is reductions of 5% (Utility 3) to 10% (Utility 9) (median is an 8% reduction). For the GCM with the highest change, the range is increases of 3% (Utility 11) to 7% (Utilities 1, 2, 6 and 7) (median is a 5% increase).

Figure 3 shows that the changes in the average annual streamflow for the GCM with the median change range from an increase of 13% to a reduction of 22% (median is a 7% reduction). For the GCM with the lowest change, the range is reductions of 5% to 34% (median is a 25% reduction). For the GCM with the highest change, the range is increases of 5% to 49% (median is an 18% increase).

Figure 4 shows that for the GCM with the median change, the change in the average annual evapotranspiration is a 2% increase in each case. For the GCM with the lowest change, the range is increases of nil to 2% (median is a 1% increase). For the GCM with the highest change, the range is increases of 3% to 4% (median is a 3% increase).

Secure Yield

The results of the pilot study with respect to secure yield are shown in Table 2. Columns (2), (3) and (4) show the secure yield for each of the 11 utilities in the pilot study for the historical data, the median of 15 GCMs and the lowest GCM on the basis of the '5/10/10 rule'.

Columns (6) and (7) show the changes in secure yield for the median of 15 GCMs and the lowest GCM in percentage terms. For the median GCM (column (6)) the change in secure yield varies from an increase of 3% (Utility 2) to a reduction of 25% (Utility 9). For the lowest GCM (column (7)) the change in secure yield varies from a 6% reduction (Utility 2) to a reduction of 54% (Utility 9).

As discussed in Samra & Cloke (2010 :5) the Steering Group considers that a balanced approach to determining the secure yield after climate change would be to adopt the lesser of:

a) secure yield for the median of 15 GCMs on the basis of the ‘5/10/10 rule’
b) secure yield for the GCM with the lowest secure yield on the basis of a ‘5/10/25 rule’; the 25% severity of restrictions under this rule amounts to being able to ‘survive’ occurrence of the lowest GCM, albeit with relatively harsh water restrictions to cope with the reduced availability of water.

Thus a utility’s core planning under a) above would be on the basis of the ‘5/10/10 rule’. However, under b) above, the utility would also need to ensure its system would be able to survive the lowest GCM under the severe restrictions involved in a ‘5/10/25 rule’.

Column (5) of Table 2 shows the secure yield of the lowest GCM on the basis of 25% severity of restrictions (ie. a ‘5/10/25 rule’). For comparison purposes, the percentage change in secure yield is shown in column (8).

The above approach is considered to provide a reasonable balance between avoiding excessive capital expenditure by the utilities and avoiding very harsh future drought water restrictions. The 25% severity for the GCM with the lowest secure yield is considered to be acceptable in view of the low probability of occurrence of such a GCM and is informed by the outcomes of at least 35% reduction in consumption achieved by several NSW utilities in the current drought, including Goulburn, Orange and the Central Coast (Samra & Cloke, 2010: 5).

The adopted change in the Year 2030 secure yield due to climate change for each utility is shown in column (9) of Table 2 and Figure 5. This is identical with the values shown in column (6), for 4 utilities (2, 3, 4 *and 11). The adopted changes for the other 7 utilities are on the basis of 25% severity of restrictions for the* lowest GCM, and are up to 25 percentage points lower than for the median GCM.

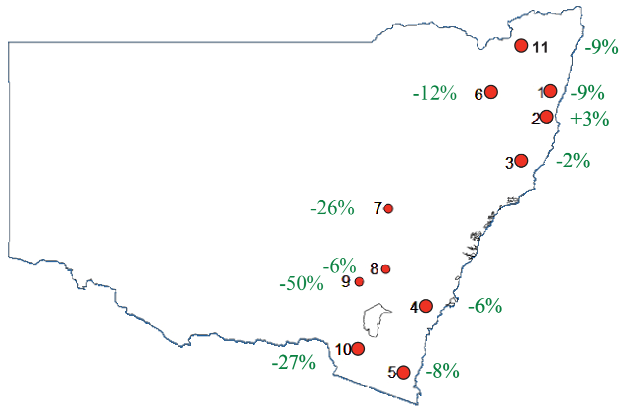

Figure 5: Map of NSW showing adopted % change in Year 2030 Secure Yield due to climate change for each utility in the pilot study

Note:
For Utility 9, the changes in secure yield for the existing small storage dam and for the proposed enlargement of the dam were -50% and -29% respectively.

The 3 utilities with a reduction in the adopted secure yield of over 25% are inland utilities in mid and southern NSW. This finding is consistent with the Victorian expectation of increasing drought severities.

Storage behaviour diagrams for each utility are shown in Figures A1 to A12 in Appendix A on page 11. These show the storage behaviour (expressed as % of full storage capacity) while delivering an annual demand[7] equivalent to the secure yield determined for the historical data for a repeat of:

- the historical climate conditions and
- for a repeat of the climate changed conditions that produced the
    - highest,
    - median and
    - lowest climate changed secure yield for each utility.

Using the climate changed inflows, Figures A1 to A12 show that except for Utility 10 (Figure A11), the storages did not empty while supplying a demand equivalent to the historic secure yield for each utility. This includes the results in Figures A9 and A10 for Utility 9 which had the largest reduction in secure yield. It is important to note that the existing small storage capacity for Utility 9 results in a 50% reduction in secure yield (column 9 of Table 2). However after the proposed augmentation of the storage dam, there would be only a 29% reduction in the secure yield, which demonstrates that the impact of climate change is system dependent.

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[7] Unrestricted demand was supplied until the storage volume fell to the restriction volume for each utility (typically about 50% to 60% of full capacity). Thereafter 90% of the demand was supplied until there was a significant recovery in the storage volume, when the unrestricted demand was resumed. As it was necessary to use the first year of each dataset to initialise the daily rainfall-runoff models, each simulation was generally carried out with the remaining 111 years of daily hydroclimate data.

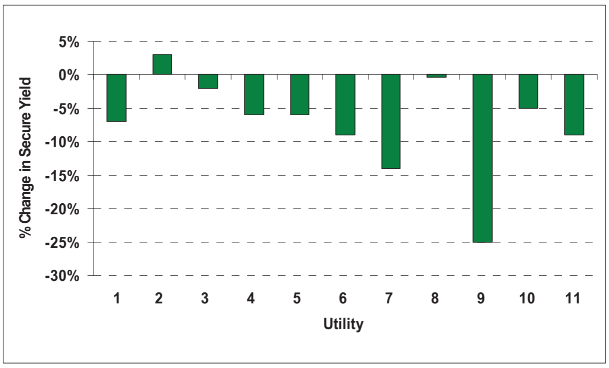

Figure 6: Median % Change in the Secure Yield from the 15 Global Climate Models compared with the result for the Historical Data Set

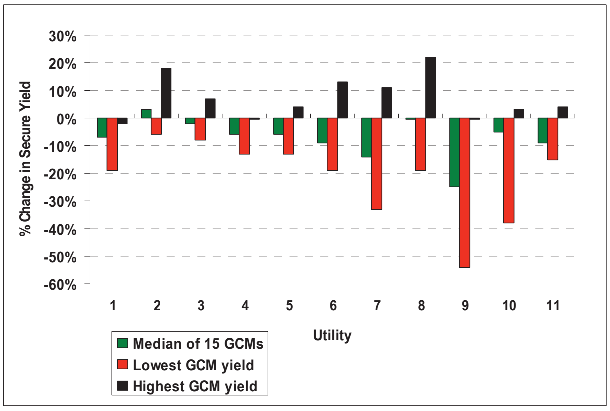

Figure 7: % Change in the Secure Yield for the Global Climate Models (GCMs) shown compared with the result for the Historical Data Set

Figure 6 provides a graphical representation of the percentage change in secure yield for the GCM with the median secure yield, in comparison with the historical data set. These results are as shown in column (6) of Table 2 and range from an increase of 3% to a reduction of 25%.

Figure 7 also provides a graphical representation of this percentage change for the GCM with the lowest secure yield (from column (7) of Table 2) and that for the GCM with the highest secure yield, in comparison with the historical data set. As also noted above, the results for the GCM with the lowest secure yield range from a reduction of 6% to a reduction of 54% (column (7) of Table 2). The results for the GCM with the highest secure yield range from an increase of 22% to a reduction of 2%.

The GCMs which provided the median, lowest and highest changes in the average annual rainfall, streamflow and evapotranspiration[8] (refer to Figures 2 to 4) are not necessarily those which resulted in the median, lowest and highest changes in secure yield (refer to Figure 7).

A report on the pilot study will be published on the NSW Office of Water website in 2010 in order to disseminate the results and findings of the study.

Tables 3 and 4 show the key characteristics of the 4 simulations shown for each utility in Figures A1 to A12 on page 12, Table 3 provides a comparison of the resulting minimum storage volume for each simulation and indicates that the minimum storage volume for the historical data set ranges from 31% to 49% of the full storage capacity (column (3)). For the median of GCMs, the minimum storage volume ranges from 23% to 49%, with 3 utilities having a minimum storage volume of 23% to 25% of capacity (column (4)). However, for the lowest GCM, 4 utilities have a minimum storage of under 15% of capacity (Utilities 7, 9, 10 and 11), with the storage volume for the small Utility 10 emptying for a period of 6 months (column (5)). For the highest GCM, the minimum storage volume ranges from 32% to 51% of capacity (column (6)).

Table 3: Comparison of Minimum Storage Volumes

Water Utility	Storage Capacity (ML)	**Minimum Storage Volume (%) while supplying the Historical Secure Yield**			
		Historical Data Set	Median of 15 Global Climate Models (GCMs)	Lowest GCM	Highest GCM
(1)	(2)	(3)	(4)	(5)	(6)
1	35,600	39	30	20	40
2	5,500	31	33	27	41
3	4,500	43	49	31	51
4	4,900	46	44	42	46
5	3,780	49	34	24	37
6	460	34	31	22	42
7	22,500	37	23	10	43
8	15,500	38	38	23	46
9	850	37	25	9	37
9+	2,470	37	30	14	42
10	100	31	29	0 for 6 months	32
11	14,800	33	23	14	39

+ Enlarged storage

[8] Eg. for Utility 1, the median rainfall, streamflow, evapotranspiration and secure yield resulted from GCMs 5, 5 , 9 and 14 respectively.

Table 4: Comparison of Storage Drawdowns

Water Utility (1)	% of the time storage is drawn down below volumes shown while supplying the Historical Secure Yield											
	Historical Data Set (2)			Median of 15 Global Climate Models (GCMs) (3)			Lowest GCM (4)			Highest GCM (5)		
	60%	**40%**	**20%**	**60%**	**40%**	**20%**	**60%**	**40%**	**20%**	**60%**	**40%**	**20%**
1	1.4	0.1	0.0	1.5	0.5	0.0	3.1	0.7	0.1	1.2	0.0	0.0
2	3.7	0.8	0.0	2.8	0.7	0.0	5.0	0.8	0.0	1.1	0.0	0.0
3	0.7	0.0	0.0	0.8	0.0	0.0	1.3	0.1	0.0	0.5	0.0	0.0
4	1.5	0.0	0.0	2.1	0.0	0.0	2.9	0.0	0.0	1.6	0.0	0.0
5	0.2	0.0	0.0	1.1	0.2	0.0	2.1	0.3	0.0	0.7	0.0	0.0
6	1.4	0.2	0.0	1.1	0.2	0.0	2.3	0.4	0.0	0.7	0.0	0.0
7	5.0	0.4	0.0	9.5	1.4	0.0	18	5.2	0.8	2.5	0.0	0.0
8	7.0	0.2	0.0	6.1	0.3	0.0	16	2.9	0.0	1.0	0.0	0.0
9	1.4	0.2	0.0	1.7	0.6	0.0	2.5	0.8	0.2	0.8	0.1	0.0
9+	1.4	0.2	0.0	1.5	0.4	0.0	2.4	0.5	0.1	1.0	0.0	0.0
10	2.0	0.5	0.0	2.7	0.8	0.0	4.3	1.4	0.7	1.5	0.4	0.0
11	1.5	0.3	0.0	3.4	0.7	0.0	4.9	1.3	0.4	1.6	0.1	0.0

+ Enlarged storage

In summary, Table 3 shows that for the median GCM, the minimum resulting storage volume for most of the utilities is a little lower than that for the historical data, indicating slightly more severe droughts than had been experienced historically. For the lowest GCM, all the minimum storage volumes are much lower than the historical data set. This indicates the occurrence of much more severe droughts, with 5 of the utilities experiencing a minimum storage volume of under 15% of full capacity, in comparison with the historical data set, where the minimum storage volume was 31% of full capacity.

For the 4 simulations for each utility discussed in Table 3 above, Table 4 provides a comparison of the percentage of time each storage is drawn down below 60%, 40% and 20% of full capacity. These draw downs indicate the relative vulnerability of each water supply to supply failure due to emptying of the storage. For the historical data set (column (2)) of Table 4 shows that the percentage of time the storage volume falls below 60% of full capacity exceeds 5% only for Utility 8, where restrictions are implemented at a storage capacity of 55% under the '5/10/10 rule'. Column (3) of Table 4 shows that for the median of GCMs, 2 utilities (Utilities 7 & 8) have storage volumes under 60% of capacity for more than 5% of the time. Only these 2 utilities have such storage volumes for more than 5% of the time for the lowest GCM, but the duration now extends to 16% to 18% of the time for this GCM (column (4)). For the highest GCM, the duration of such storage volumes does not exceed 2.5% of the time for any utility (column (5)).

Table 4 also shows that for the historical data set (column (2)), the percentage of time the storage volume falls below 40% of full capacity, which could be expected in a severe drought, does not exceed 0.8% for all the utilities. Column (3) of Table 4 shows that for the median of GCMs, only Utility 7 has such storage volumes exceeding 0.8% of the time. However, for the lowest GCM only 7 utilities have such storage volumes not exceeding 0.8% of the time, with the other 4 utilities (Utilities 7, 8, 10 and 11)) experiencing durations of 1.3% to 5.2% of the time (column (4)). For the highest GCM, the duration of such storage volumes does not exceed 0.4% of the time (column (5)).

In addition, Table 4 shows that for the historical data set (column (2)), the median of GCMs (column (3)) and the highest GCM (column (5)), the storage volume never falls below 20% of full capacity, which could be expected to occur only in an extreme drought. However, for the lowest GCM, 5 utilities (Utilities 1, 7, 9, 10 and 11) have a storage volume below 20% of capacity for at least 0.1% of the time (column (4)).

As previously noted, the *Best-Practice Management Guidelines* require each NSW water utility to prepare a comprehensive 30-year IWCM Strategy. The IWCM strategies will need to include assessment of the secure yield of the utility's water supply on the basis of new NSW guidelines proposed for release in late 2010. The utilities will be able to soundly plan for the security of their water supply for climate change by developing and implementing their 30-year IWCM strategy on the basis of the climate changed secure yield determined along the lines of the pilot study for 11 NSW water supplies.

As noted on page 3, the pilot study has focused on climate change projections for the Year 2030 based on predictions for the A1B mid range warming emissions scenario. This is not only due to the availability of the daily database but because there is only a small difference in the climate change projections between different emissions scenarios for the year 2030. These differences will be magnified for longer-term projections, such as year for the year 2050 or 2070.

DISCUSSION

The 1895-1902 Federation Drought

The severe 2001-2007 drought has been claimed as the worst drought since records began in Australia and has resulted in questioning of the reliability of several major water supplies in Australia. Fortunately NSW country town water supplies that had been planned on the basis of the NSW security of supply basis (ie. 5/10/20 rule) have been able to maintain the expected supply. It is hypothesised that this is because the 5/10/20 rule incorporates the very severe Federation drought of 1895-1902 and allows for maintaining a 20% restricted supply through in effect a '1 in 1000 year' drought (Cloke & Samra, 2009 :13).

It is understood consideration of Perth's and Melbourne's water supply reliability was until recently based on flow records post the Federation drought, as shown in their plots of inflows (*from 1911 for Perth and from 1913 for Melbourne*) (Gill, 2008 and Rhodes et al, 2010). The plot of inflows to Perth's water supply headworks has been repeatedly shown as an example of a shifting climate.

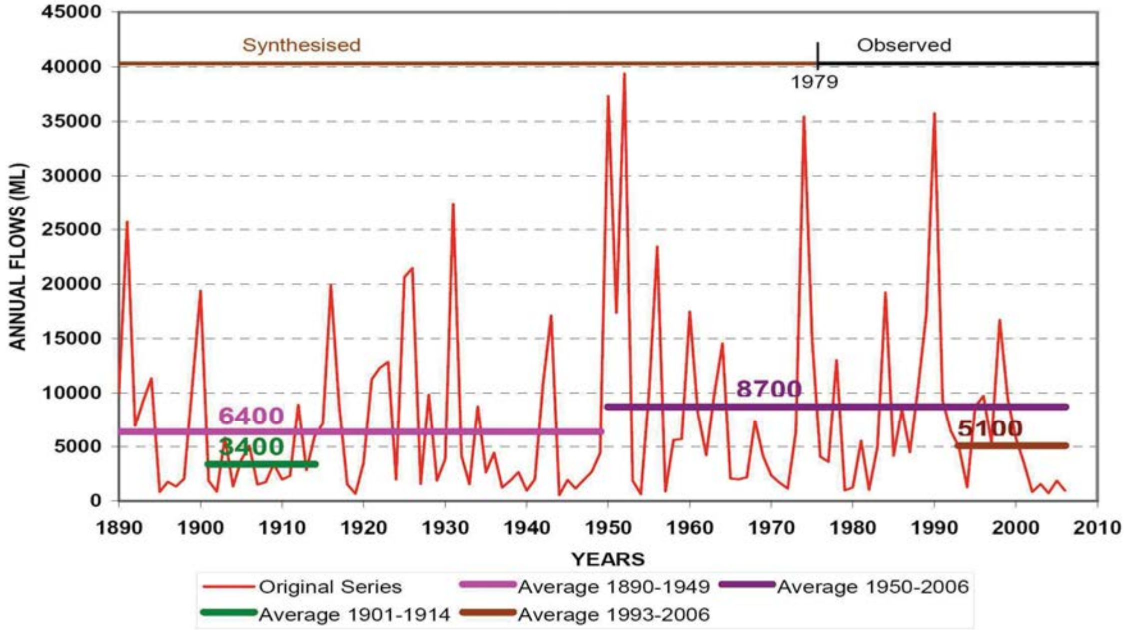

Figure 8: Annual Historic Flows Periodic Comparison

An equivalent plot of inflows for a Tablelands water utility in central NSW [catchment area 100 km^2] is shown in Figure 8. With the inclusion of the Federation drought it suggests that the 2001-2007 drought was more likely to be due to climate variability rather than climate change and in terms of water supply headworks was not the worst drought on record.

If the Federation drought and pre 1915 droughts had not been incorporated in the water supply planning, secure yields for many NSW water supplies would have been determined to have been much higher and may have then been impacted by the 2001-2007 drought. **For example for Utility 7, post the Federation drought, the secure yield would have been determined as some 25% higher and post 1915, some 50% higher than the historical secure yield.** This highlights the importance of including the Federation Drought in any security of supply simulation studies to avoid such over-estimation of secure yield.

Accordingly, it is considered that the robustness of the NSW security of supply basis, combined with analysis for climate change as developed in the pilot study, will continue to provide reliable and cost-effective water supply security for NSW country towns.

Reducing uncertainty in climate models

The overall summary of the **Ozwater '10 Workshop on Climate Change Impacts on the Water Sector** (Claydon, et al., 2010: 3) includes:

> 'Reducing uncertainty in climate models is an active area of research – in particular coupled ocean-atmosphere general circulation models (GCMs). There have already been (published) steps made to provide this more refined (downscaled) output in Bureau of Meteorology and CSIRO climate projections, especially for drought. However, the core aspects of how best to apply these various models using sophisticated integrated modelling procedures remains an ongoing interesting research and operational issue.'

It is acknowledged that reducing uncertainty in climate models and how best to apply them is an area of ongoing research.

However, water supply planning and decision making requires assessment of the impact of climate change on water supply security. At present, the best available downscaled daily hydrometeorological data in Australia is for 15 GCMs along the lines developed by the Murray Darling Basin Sustainable Yields Project. Such data is now available for all of NSW and Victoria, as well as for all of the Murray Darling Basin, including Adelaide. It is therefore considered that the analysis carried out in this pilot study could be used to assess the Year 2030 climate change impacts for urban water utilities in the areas with such downscaled data which have surface water supplies with storage dams.

In addition, there are some major research activities such as the research in SEACI[9] Theme 2 which focus on improving hydroclimate change projections for south-eastern Australia. They are specifically investigating

(i) GCM assessment and selection for hydrological application and

(ii) assessing the relative merits of different downscaling methods and relative uncertainties in various components in estimating climate change impact on runoff (GCM projections, downscaling methods and hydrological modelling) (Vaze J., 2010).

The above research includes consideration of dynamic downscaling, which has the potential to improve the projections of drought persistence for severe droughts.

Accordingly, as such better hydroclimate change data becomes available in the future, it should be applied in future planning. In this regard, where a utility has sufficient supply capacity to enable it to defer a major capital investment decision for additional surface water supplies for 5 or more years, it should do so, as the better hydroclimate change data likely to be available by that time would enable the utility to make a more robust investment decision.

CONCLUSIONS

1 A sound basis has been developed for non-metropolitan urban water utilities to assess the impact of climate change for the Year 2030 on the secure yield of their urban water supply. This is an adaptive management approach which enables utilities to carry out sound climate change planning and decision making immediately, using the existing 112 years of downscaled daily hydrometeorological data sets for 15 GCMs. As better hydroclimate change projections become available in the future, these will need to be applied in future planning by the utilities.

2 The results for the 11 utilities in the pilot study are shown in Figure 5 on page 6. These indicate that the main impacts on Year 2030 secure yield are:

- no greater than a reduction of 9% for the 7 coastal and tablelands utilities
- reductions of almost 30% for the 3 inland utilities in mid and southern NSW, after allowing for the proposed augmentation of the existing small storage capacity for Utility 9.

3 Future utility 30-year IWCM strategies in NSW will need to include assessment of the secure yield of the utility's water supply in accordance with the analysis reported for the pilot study. Implementation of these strategies, together with the required 6-yearly updates, will address the future water security of these utilities.

ACKNOWLEDGMENTS

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Chee Chen and Dr Liz Chen of NSW Public Works Hydrology Group who carried out the detailed modelling required to produce the results provided in the pilot study.

The many NSW Councils which have engaged NSW Public Works over the years to carry out yield studies, thus enabling use of the study models for the analysis reported in the pilot study.

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APPENDIX A

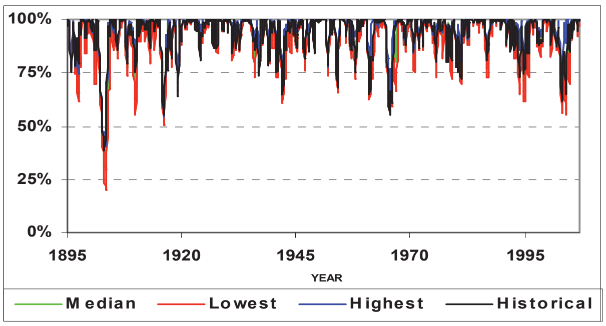

Figure A1: Storage Behaviour Diagram for repeat of years 1895 to 2006 for different climate conditions for Utility 1

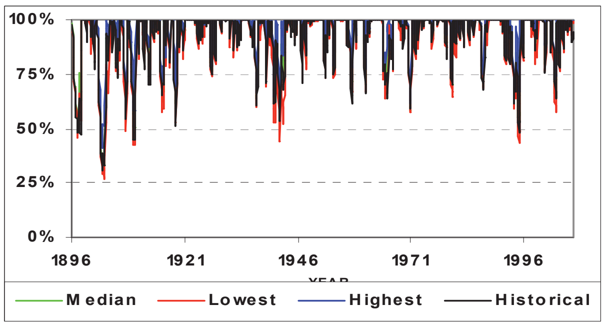

Figure A2: Storage Behaviour Diagram for repeat of years 1896 to 2006 for different climate conditions for Utility 2

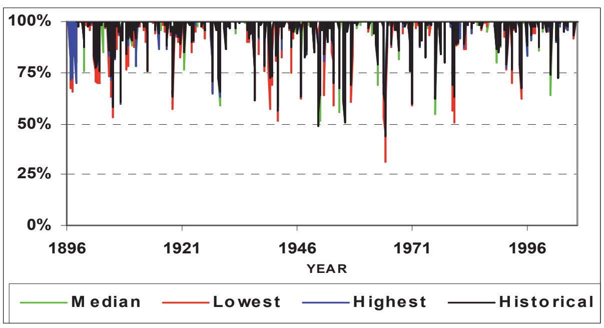

Figure A3: Storage Behaviour Diagram for repeat of years 1896 to 2006 for different climate conditions for Utility 3

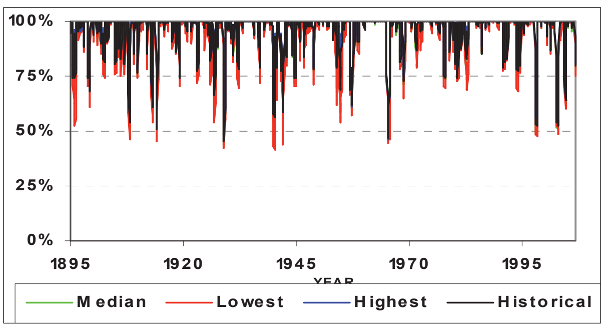

Figure A4: Storage Behaviour Diagram for repeat of years 1895 to 2006 for different climate conditions for Utility 4

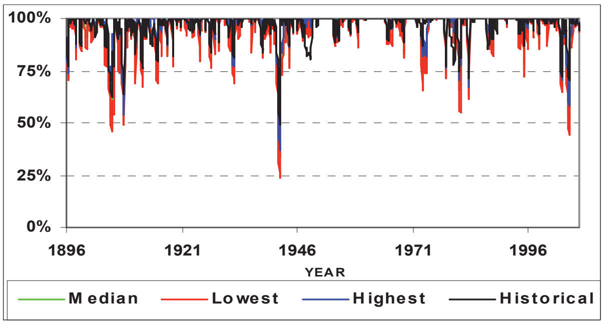

Figure A5: Storage Behaviour Diagram for repeat of years 1896 to 2006 for different climate conditions for Utility 5

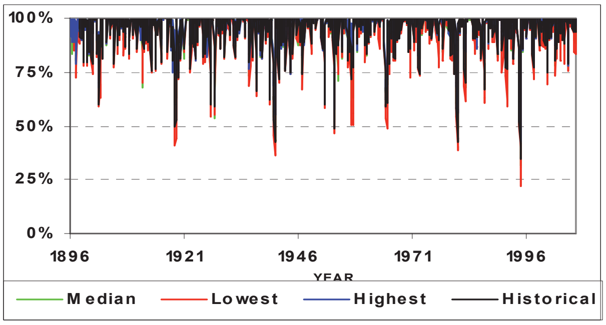

Figure A6: Storage Behaviour Diagram for repeat of years 1896 to 2006 for different climate conditions for Utility 6

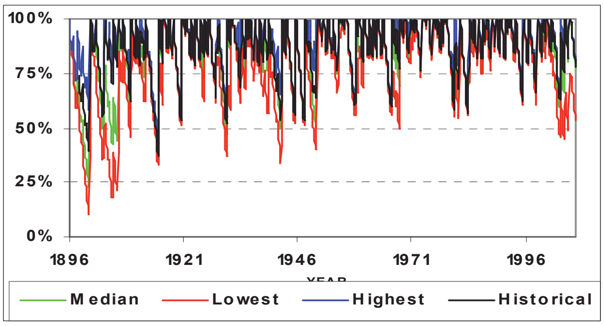

Figure A7: Storage Behaviour Diagram for repeat of years 1896 to 2006 for different climate conditions for Utility 7

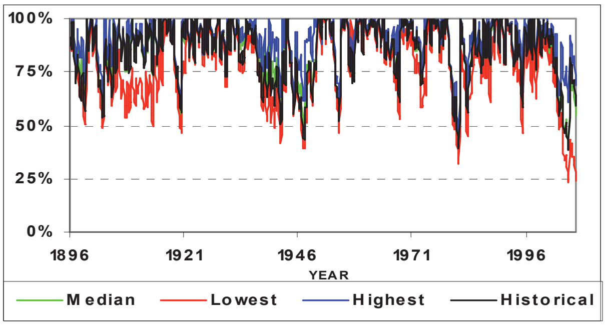

Figure A8: Storage Behaviour Diagram for repeat of years 1896 to 2006 for different climate conditions for Utility 8

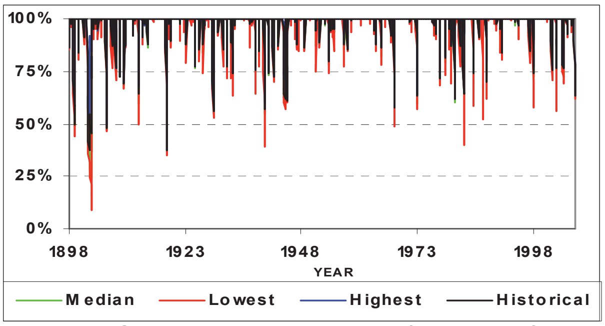

Figure A9: Storage Behaviour Diagram for repeat of years 1898 to 2006 for different climate conditions for Utility 9 – Existing Storage

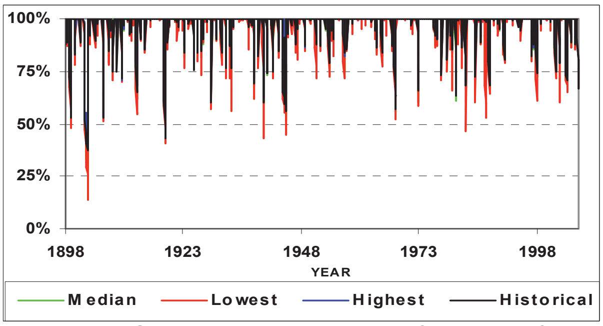

Figure A10: Storage Behaviour Diagram for repeat of years 1898 to 2006 for different climate conditions for Utility 9 – Enlarged Storage

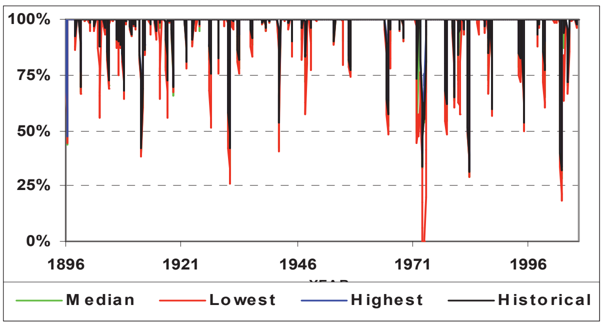

Figure A11: Storage Behaviour Diagram for repeat of years 1896 to 2006 for different climate conditions for Utility 10

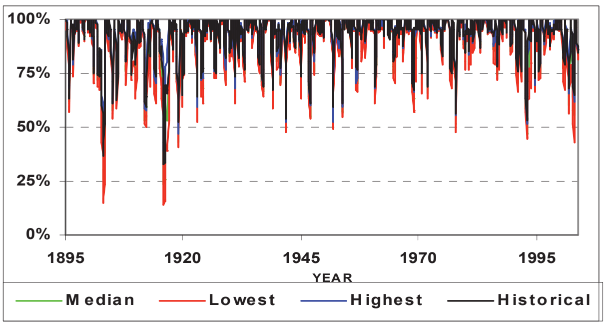

Figure A12: Storage Behaviour Diagram for repeat of years 1895 to 2003 for different climate conditions for Utility 11

Appendix D Present Value Cost Estimates for Water and Sewer Options

Stage 1 - Source from Lachlan Fold Belt followed by Stage 2 from Bungendore alluvia

ITEM	DESCRIPTION	[UNIT]	[QTY]	[RATE]	AMT	PRESENT WORTH ($'000)																
	Pumping Station - Bore to Bungendore WTP	m head	65		Additional Average Year Production (ML/year)				262	284	308	331	355	379	402	426	449	472	519	541	562	583
				$ / Unit	$K	4%	7%	10%	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CAPITAL COSTS																						
Pipe cost (supply and lay)																						
Stage 1	mPVC DN100 (existing fractured rock bore)	m	844	$ 100	$ 84	$84	$84	$84	$84													
Stage 1	mPVC DN200 (existing fractured rock bore)	m	1,612	$ 186	$ 300	$300	$300	$300	$300													
Stage 1	mPVC DN250 (existing fractured rock bore)	m	376	$ 233	$ 88	$88	$88	$88	$88													
Stage 2	mPVC DN250 (Alluvial source)	m	1,752	$ 233	$ 408	$245	$169	$118	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$408
Additional costs for construction																						
Stage 1	Allow for hard difficulty (for mPVC DN200, OTR)	m	680	$ 170	$ 116	$116	$116	$116	$116													
Stage 1	Additional cost for rock (mPVC DN100)	m	253	$ 6	$ 2	$2	$2	$2	$2													
Stage 1	Additional cost for rock (mPVC DN200)	m	484	$ 8	$ 4	$4	$4	$4	$4													
Stage 1	Additional cost for rock (mPVC DN250)	m	113	$ 9	$ 1	$1	$1	$1	$1													
Stage 2	Additional cost for rock (mPVC DN250 Alluvial)	m	526	$ 9	$ 5	$3	$2	$1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5
Pipeline crossings for Stage 1: Fractured rock																						
Stage 1	Thrust boring	m	40	$ 5,000	$ 200	$200	$200	$200	$200													
Stage 1	Directional Drilling	m	25	$ 5,000	$ 125	$125	$125	$125	$125													
Stage 1	Open cut trenching	m	20	$ 5,000	$ 100	$100	$100	$100	$100													
Pumping Station - Bores to WTP																						
Stage 1	Pump and associated pipework (18.5 kW @ 8.5 L/s)	Item	1	$ 45,000	$ 45	$45	$45	$45	$45													
Stage 1	Pump and associated pipework (30 kW @ 20 L/s)	Item	1	$ 60,000	$ 60	$60	$60	$60	$60													
Stage 1	Building works (Stage 1)	Item	2	$ 30,000	$ 60	$60	$60	$60	$60													
Stage 1	Electrical works (switchroom, switchboard & switchgear)	Item	2	$ 100,000	$ 200	$200	$200	$200	$200													
Stage 2	Bore drilling (2 bores)	Item	2	$ 150,000	$ 300	$180	$124	$87	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$300
Stage 2	New Pumps (2 x 30 kW @ 12.5 L/s) and associated pipe	Item	2	$ 70,000	$ 140	$84	$58	$41	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$140
Stage 2	Building works (Stage 2)	Item	2	$ 20,000	$ 40	$24	$17	$12	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$40
Stage 2	Electrical works (switchroom, switchboard & switchgear)	Item	2	$ 100,000	$ 200	$120	$83	$58	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$200
Water Treatment Plant																						
Stage 1	Stage 1: 1.5 ML/day WTP (Lachlan Fold)	Item	1	$4,000,000	$ 4,000	$4,000	$4,000	$4,000	$4,000													
Stage 2	Stage 2: 3.0 ML/day WTP (Alluvial)	Item	1	$3,000,000	$ 3,000	$1,802	$1,245	$869	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,000
Valves																						
Stage 1	Air valves	Item	15	$ 3,906	$ 59	$59	$59	$59	$59													
Stage 1	Scour valves	Item	14	$ 3,195	$ 45	$45	$45	$45	$45													
Stage 1	Isolation valves	Item	2	$ 4,586	$ 9	$9	$9	$9	$9													
Stage 1	Motorised valve	Item	2	$ 12,000	$ 24	$24	$24	$24	$24													
Stage 1	Pressure-sustaining valve	Item	2	$ 15,000	$ 30	$30	$30	$30	$30													
Stage 2	Air valves	Item	5	$ 3,906	$ 20	$12	$8	$6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$20
Stage 2	Scour valves	Item	4	$ 3,195	$ 13	$8	$5	$4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$13
Stage 2	Isolation valves	Item	1	$ 4,586	$ 5	$3	$2	$1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5
Stage 2	Motorised valve	Item	1	$ 12,000	$ 12	$7	$5	$3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12
Stage 2	Pressure-sustaining valve	Item	1	$ 15,000	$ 15	$9	$6	$4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15
Licence Acquisition																						
Stage 2	Private alluvial allocation acquisition (350 ML/a)	Item	350	$ 3,000	$ 1,050	$631	$436	$304	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,050
Easement Costs																						
	Easements (private land)	sq m	1,302		$ -	$0	$0	$0														
	Easements (road reserve)	sq m	14,952		$ -	$0	$0	$0														
Power Supply																						
Stage 1	High Voltage Power Supply	Item	1	$ 500,000	$ 500	$500	$500	$500	$500													
Prime Costs					**$11,258**	**$9,178**	**$8,212**	**$7,559**	**$6,051**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$5,207**
	General Contingency	% of Prime Cost	30%		$3,377	$2,753	$2,463	$2,268	$1,815	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,562
Direct Costs					**$14,635**	**$11,931**	**$10,675**	**$9,827**	**$7,866**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$6,769**
	Design & Preconstruction Activities	% of Direct Cost	10%		$1,464	$1,193	$1,068	$983	$787	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$677
	Construction Activities	% of Direct Cost	10%		$1,464	$1,193	$1,068	$983	$787	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$677
TOTAL CAPITAL COST					**$17,562**	**$14,318**	**$12,810**	**$11,792**	**$9,439**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**$0**	**$0**	**$8,123**
OPERATION & MAINTENANCE COSTS																						
	Electrical Costs																					
	Cost electricity	c per kWh	33																			
	Additional Pumping Costs																					
	Pumping Station - Bore 2 to Bungendore WTP	$/ML per m head	1.287		$1,501	$784	$524	$372		$24	$26	$28	$30	$32	$34	$36	$38	$39	$43	$45	$47	$49
	Additional Operating Costs																					
	Chemical Costs (Stage 1 - LFB)	$ per year	$100,000		$3,000	$1,729	$1,241	$943		$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
	Chemical Costs (Stage 2 - Alluvial)	$ per year	$ 30,000		$540	$237	$134	$78		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30
	Chlorination System (water treatment)	mg/L	2	$ 4	$144	$75	$50	$36		$2	$2	$3	$3	$3	$3	$3	$4	$4	$4	$4	$4	$5
	Energy costs for WTP	$ per ML	$ 120		$2,134	$1,119	$748	$532		$34	$37	$40	$43	$45	$48	$51	$54	$57	$62	$65	$67	$70
	Maintenance Costs																					
	Maintenance Civil	% of Capital Cost	0.50%		$460	$255	$176	$130		$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11
	Maintenance Mech + Elec	% of Capital Cost	4.00%		$5,748	$3,199	$2,214	$1,639		$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135
	Pigging	Item	$ 30,000		$900	$549	$402	$313		$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
TOTAL OPERATION & MAINTENANCE COSTS					**$ 14,427**	**$7,772**	**$5,314**	**$3,867**	**$0**	**$336**	**$341**	**$346**	**$351**	**$356**	**$361**	**$366**	**$371**	**$375**	**$385**	**$390**	**$394**	**$429**
TOTAL PRESENT VALUE					**$ 31,989**	**$22,090**	**$18,124**	**$15,660**	**$9,439**	**$336**	**$341**	**$346**	**$351**	**$356**	**$361**	**$366**	**$371**	**$375**	**$385**	**$390**	**$394**	**$8,552**

DESCRIPTION	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
Average Year Production (ML/year)	602	621	640	657	674	690	705	720	734	747	759	771	782	792	802	811	820
Prime Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
General Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Direct Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Design & Preconstruction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL CAPITAL COST	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pumping Station - Bore 2 to Bungendore WTP	$50	$52	$54	$55	$56	$58	$59	$60	$61	$62	$64	$64	$65	$66	$67	$68	$69
Chemical Costs (Stage 1 - LFB)	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
Chemical Costs (Stage 2 - Alluvial)	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
Chlorination System (water treatment)	$5	$5	$5	$5	$5	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$7
Energy costs for WTP	$72	$75	$77	$79	$81	$83	$85	$86	$88	$90	$91	$93	$93	$93	$93	$93	$93
Maintenance Civil	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19	$19
Maintenance Mech + Elec	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235	$235
Pigging	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
TOTAL OPERATION & MAINTENANCE COSTS	**$541**	**$545**	**$549**	**$553**	**$557**	**$560**	**$563**	**$566**	**$569**	**$572**	**$575**	**$577**	**$578**	**$579**	**$580**	**$581**	**$582**
TOTAL PRESENT VALUE	**$541**	**$545**	**$549**	**$553**	**$557**	**$560**	**$563**	**$566**	**$569**	**$572**	**$575**	**$577**	**$578**	**$579**	**$580**	**$581**	**$582**

O&M costs for WTP: 40% civil, 60% mech/elec

40%	Civil
60%	Mech/Elec

Stage 2 - Source from Bungendore alluvial source followed by Stage 2 from Lachlan Fold belt source

Pumping Station - Bore to Bungendore WTP m head 73 Additional Average Year Production (ML/year)

ITEM	DESCRIPTION	[UNIT]	[QTY]	[RATE]	AMT	PRESENT WORTH ($'000)		
				$ / Unit	$K	4%	7%	10%
CAPITAL COSTS								
Pipe cost (supply and lay)								
Stage 1	mPVC DN100 (existing fractured rock bore)	m	844	$ 100	$ 84	$84	$84	$84
Stage 1	mPVC DN200 (existing fractured rock bore)	m	1,612	$ 186	$ 300	$300	$300	$300
Stage 1	mPVC DN250 (existing fractured rock bore)	m	376	$ 233	$ 88	$88	$88	$88
Stage 2	mPVC DN150 (proposed fractured rock bore)	m	1,000	$ 136	$ 136	$82	$56	$39
Difficult Construction								
Stage 1	Allow for hard difficulty (for mPVC DN200, OTR)	m	680	$ 170	$ 116	$116	$116	$116
Stage 1	Additional cost for rock (mPVC DN100)	m	253	$ 6	$ 2	$2	$2	$2
Stage 1	Additional cost for rock (mPVC DN200)	m	484	$ 8	$ 4	$4	$4	$4
Stage 1	Additional cost for rock (mPVC DN250)	m	113	$ 9	$ 1	$1	$1	$1
Stage 2	Additional cost for rock (mPVC DN150)	m	300	$ 7	$ 2	$2	$2	$2
Pipeline crossings for Stage 1: Fractured rock								
Stage 1	Thrust boring	m	40	$ 5,000	$ 200	$200	$200	$200
Stage 1	Directional Drilling	m	25	$ 5,000	$ 125	$125	$125	$125
Stage 1	Open cut trenching	m	20	$ 5,000	$ 100	$100	$100	$100
Pumping Station - Bore to WTP								
Stage 1	Pump and associated pipework (18.5 kW @ 8.5 L/s)	Item	1	$ 45,000	$ 45	$45	$45	$45
Stage 1	Pump and associated pipework (30 kW @ 20 L/s)	Item	1	$ 60,000	$ 60	$60	$60	$60
Stage 1	Building works (Stage 1)	Item	2	$ 30,000	$ 60	$60	$60	$60
Stage 1	Electrical works (switchroom, switchboard & switchgear)	Item	2	$ 100,000	$ 200	$200	$200	$200
Stage 2	Drilling Bores (1 bores)	Item	1	$ 150,000	$ 150	$90	$62	$43
Stage 2	Monitoring Bores (4 bores)	Item	4	$ 75,000	$ 300	$180	$124	$87
Stage 2	New Pumps (1 x 30 kW @ 25 L/s) and associated pipework	Item	1	$ 90,000	$ 90	$54	$37	$26
Stage 2	Building works (Stage 2)	Item	1	$ 30,000	$ 30	$18	$12	$9
Stage 2	Electrical works (switchroom, switchboard & switchgear)	Item	1	$ 100,000	$ 100	$60	$41	$29
Water Treatment Plant								
Stage 1	Stage 1: 1.5 ML/day WTP	Item	1	$ 4,000,000	$ 4,000	$4,000	$4,000	$4,000
Stage 2	Stage 2: 3.0 ML/day WTP	Item	1	$ 5,000,000	$ 5,000	$3,003	$2,075	$1,448
Valves								
Stage 1	Air valves	Item	15	$ 3,906	$ 59	$59	$59	$59
Stage 1	Scour valves	Item	14	$ 3,195	$ 45	$45	$45	$45
Stage 1	Isolation valves	Item	2	$ 4,586	$ 9	$9	$9	$9
Stage 1	Motorised valve	Item	2	$ 12,000	$ 24	$24	$24	$24
Stage 1	Pressure-sustaining valve	Item	2	$ 15,000	$ 30	$30	$30	$30
Stage 2	Air valves	Item	5	$ 3,906	$ 20	$12	$8	$6
Stage 2	Scour valves	Item	4	$ 3,195	$ 13	$8	$5	$4
Stage 2	Isolation valves	Item	1	$ 4,586	$ 5	$3	$2	$1
Stage 2	Motorised valve	Item	1	$ 12,000	$ 12	$7	$5	$3
Stage 2	Pressure-sustaining valve	Item	1	$ 15,000	$ 15	$9	$6	$4
Easement Costs								
	Easements (private land)	sq m	3,288		$ -	$0	$0	$0
	Easements (road reserve)	sq m	15,906		$ -	$0	$0	$0
	Railway easement and allowance	sq m	96		$ -	$0	$0	$0
Power Supply								
Stage 1	High Voltage Power Supply	Item	1	$ 500,000	$ 500	$500	$500	$500
Prime Costs					**$11,923**	**$9,577**	**$8,488**	**$7,752**
	General Contingency	% of Prime Cost	30%		$3,577	$2,873	$2,546	$2,326
Direct Costs					**$15,500**	**$12,451**	**$11,034**	**$10,077**
	Design & Preconstruction Activities	% of Direct Cost	10%		$1,550	$1,245	$1,103	$1,008
	Construction Activities	% of Direct Cost	10%		$1,550	$1,245	$1,103	$1,008
TOTAL CAPITAL COST					**$18,600**	**$14,941**	**$13,241**	**$12,093**
OPERATION & MAINTENANCE COSTS								
	Electrical Costs							
	Cost electricity	c per kWh	33					
	Additional Pumping Costs							
	Pumping Station - Bore to Bungendore WTP	$ per ML/m head	1.287		$1,685	$881	$588	$418
	Additional Operating Costs							
	Chemical Costs (Stage 1 - LFB)	$ per year	$ 100,000		$3,000	$1,729	$1,241	$943
	Chemical Costs (Stage 2 - LFB)	$ per year	$ 100,000		$1,800	$791	$447	$261
	Chlorination System (water treatment)	mg/L	2	$ 4	$144	$75	$50	$36
	Energy costs for WTP	$ per ML	$ 120		$2,153	$1,125	$751	$534
	Maintenance Costs							
	Maintenance Civil	% of Capital Cost	0.50%		$504	$274	$187	$136
	Maintenance Mech + Elec	% of Capital Cost	4.00%		$6,564	$3,549	$2,409	$1,750
	Pigging	Item	$ 30,000		$900	$549	$402	$313
TOTAL OPERATION & MAINTENANCE COSTS					$16,750	$8,798	$5,899	$4,215
TOTAL PRESENT VALUE					**$35,350**	**$23,739**	**$19,139**	**$16,308**

ITEM	DESCRIPTION	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
	Additional Average Year Production (ML/year)	262	284	308	331	355	379	402	426	449	472	519	541	562	583	602	621	640	657	674	690	705	720	734	747	759	771	782	792	802	811	820
CAPITAL COSTS																																
Pipe cost (supply and lay)																																
Stage 1	mPVC DN100 (existing fractured rock bore)	$84																														
Stage 1	mPVC DN200 (existing fractured rock bore)	$300																														
Stage 1	mPVC DN250 (existing fractured rock bore)	$88																														
Stage 2	mPVC DN150 (proposed fractured rock bore)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$136																	
Difficult Construction																																
Stage 1	Allow for hard difficulty (for mPVC DN200, OTR)	$116																														
Stage 1	Additional cost for rock (mPVC DN100)	$2																														
Stage 1	Additional cost for rock (mPVC DN200)	$4																														
Stage 1	Additional cost for rock (mPVC DN250)	$1																														
Stage 2	Additional cost for rock (mPVC DN150)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2																	
Pipeline crossings for Stage 1: Fractured rock																																
Stage 1	Thrust boring	$200																														
Stage 1	Directional Drilling	$125																														
Stage 1	Open cut trenching	$100																														
Pumping Station - Bore to WTP																																
Stage 1	Pump and associated pipework (18.5 kW @ 8.5 L/s)	$45																														
Stage 1	Pump and associated pipework (30 kW @ 20 L/s)	$60																														
Stage 1	Building works (Stage 1)	$60																														
Stage 1	Electrical works (switchroom, switchboard & switchgear)	$200																														
Stage 2	Drilling Bores (1 bores)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$150																	
Stage 2	Monitoring Bores (4 bores)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$300																	
Stage 2	New Pumps (1 x 30 kW @ 25 L/s) and associated pipework	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$90																	
Stage 2	Building works (Stage 2)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30																	
Stage 2	Electrical works (switchroom, switchboard & switchgear)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$100																	
Water Treatment Plant																																
Stage 1	Stage 1: 1.5 ML/day WTP	$4,000																														
Stage 2	Stage 2: 3.0 ML/day WTP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5,000																	
Valves																																
Stage 1	Air valves	$59																														
Stage 1	Scour valves	$45																														
Stage 1	Isolation valves	$9																														
Stage 1	Motorised valve	$24																														
Stage 1	Pressure-sustaining valve	$30																														
Stage 2	Air valves	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$20																	
Stage 2	Scour valves	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$13																	
Stage 2	Isolation valves	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5																	
Stage 2	Motorised valve	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$12																	
Stage 2	Pressure-sustaining valve	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15																	
Power Supply																																
Stage 1	High Voltage Power Supply	$500																														
Prime Costs		**$6,051**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$5,872**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	General Contingency	$1,815	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,762	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Direct Costs		**$7,866**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$7,634**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Design & Preconstruction Activities	$787	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$763	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Construction Activities	$787	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$763	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL CAPITAL COST		**$9,439**	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**	**$0**	**$0**	**$9,160**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OPERATION & MAINTENANCE COSTS																																
	Pumping Station - Bore to Bungendore WTP		$27	$29	$31	$33	$36	$38	$40	$42	$44	$49	$51	$53	$55	$57	$58	$60	$62	$63	$65	$66	$68	$69	$70	$71	$72	$73	$74	$75	$76	$77
	Chemical Costs (Stage 1 - LFB)		$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
	Chemical Costs (Stage 2 - LFB)		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
	Chlorination System (water treatment)		$2	$2	$3	$3	$3	$3	$3	$4	$4	$4	$4	$4	$5	$5	$5	$5	$5	$5	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$7
	Energy costs for WTP		$34	$37	$40	$43	$45	$48	$51	$54	$57	$62	$65	$67	$70	$72	$75	$77	$79	$81	$83	$85	$86	$88	$90	$91	$93	$94	$95	$96	$97	$98
	Maintenance Civil		$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$11	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21	$21
	Maintenance Mech + Elec		$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$135	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283	$283
	Pigging		$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
TOTAL OPERATION & MAINTENANCE COSTS		**$0**	**$339**	**$344**	**$349**	**$354**	**$360**	**$365**	**$370**	**$375**	**$380**	**$391**	**$396**	**$400**	**$505**	**$668**	**$672**	**$676**	**$680**	**$684**	**$688**	**$691**	**$694**	**$697**	**$700**	**$703**	**$706**	**$708**	**$710**	**$713**	**$715**	**$717**
TOTAL PRESENT VALUE		**$9,439**	**$339**	**$344**	**$349**	**$354**	**$360**	**$365**	**$370**	**$375**	**$380**	**$391**	**$396**	**$400**	**$9,665**	**$668**	**$672**	**$676**	**$680**	**$684**	**$688**	**$691**	**$694**	**$697**	**$700**	**$703**	**$706**	**$708**	**$710**	**$713**	**$715**	**$717**

O&M costs for WTP: 40% civil, 60% mech/elec

40% Civil
60% Mech/Elec

ITEM	DESCRIPTION	[UNIT]	[QTY]	[RATE] $ / Unit	AMT $K	PRESENT WORTH ($'000) 4%	7%	10%	2019
Water Supply Option 3 – Bulk supply from ICON Water									
	Pumping Station - Offtake to Bungendore WTP	m head	262					Average Year Production (ML/year)	262
	Total pipeline length	m	28,086						
CAPITAL COSTS									
Pipe cost (supply and lay)									
	DICL DN250	m	14,041	$ 261	$ 3,665	$3,665	$3,665	$3,665	$3,665
	mPVC DN250	m	4,783	$ 233	$ 1,114	$1,114	$1,114	$1,114	$1,114
	mPVC DN200	m	7,864	$ 186	$ 1,463	$1,463	$1,463	$1,463	$1,463
Difficult Construction									
	Allow for hard difficulty (for DICL DN250, OTR)	m	938	$ 474	$ 445	$445	$445	$445	$445
	Allow for hard difficulty (for mPVC DN200, OTR)	m	460	$ 356	$ 164	$164	$164	$164	$164
	Additional cost for rock	m	8,426	$ 26	$ 219	$219	$219	$219	$219
Road Crossings									
	Open Trenching (minor roads)	m	25	$ 1,000	$ 25	$25	$25	$25	$25
Rail Crossings									
	Thrust boring	m	60	$ 70,000	$ 4,200	$4,200	$4,200	$4,200	$4,200
River Crossings									
	Directional Drilling	m	100	$ 5,000	$ 500	$500	$500	$500	$500
Creek Crossings									
	Thrust boring	m	60	$ 5,000	$ 300	$300	$300	$300	$300
Drainage Crossings									
	Thrust boring	m	6	$ 60,000	$ 360	$360	$360	$360	$360
Pumping Station - Offtake to Bungendore WTP									
	Pump at Offtake (260 kW @ 52 L/s)	Item	1	$ 300,000	$ 300	$300	$300	$300	$300
	Associated pipework/machinery for pump	Item	1	$ 170,000	$ 170	$170	$170	$170	$170
	Building works	Item	1	$ 250,000	$ 250	$250	$250	$250	$250
	Electrical works (switchroom, switchboard & switchgear)	Item	1	$ 300,000	$ 300	$300	$300	$300	$300
Break Tank									
	5 ML Concrete Reservoir	Item	1	$ 3,500,000	$ 3,500	$3,500	$3,500	$3,500	$3,500
Valves									
	Air valves	Item	20	$ 3,906	$ 78	$78	$78	$78	$78
	Scour valves	Item	18	$ 3,195	$ 58	$58	$58	$58	$58
	Isolation valves	Item	10	$ 4,586	$ 46	$46	$46	$46	$46
	Motorised valve	Item	1	$ 12,000	$ 12	$12	$12	$12	$12
	Pressure-sustaining valve	Item	1	$ 15,000	$ 15	$15	$15	$15	$15
Easement Costs									
	Easements	sq m	8,388		$ -	$0	$0	$0	$0
Power Supply									
	High Voltage Power Supply	Item	1	$ 100,000	$ 100	$100	$100	$100	$100
Prime Costs					**$17,283**	**$17,283**	**$17,283**	**$17,283**	**$17,283**
	General Contingency	% of Prime Cost	30%		$5,185	$5,185	$5,185	$5,185	$5,185
Direct Costs					**$22,468**	**$22,468**	**$22,468**	**$22,468**	**$22,468**
	Design & Preconstruction Activities	% of Direct Cost	10%		$2,247	$2,247	$2,247	$2,247	$2,247
	Construction Activities	% of Direct Cost	10%		$2,247	$2,247	$2,247	$2,247	$2,247
TOTAL CAPITAL COST					**$26,961**	**$26,961**	**$26,961**	**$26,961**	**$26,961**
OPERATION & MAINTENANCE COSTS									
	Electrical Costs								
	Cost electricity	c per kWh	33						
	Pumping Costs								
	Pumping Station - Offtake to Bungendore WTP	$ per ML/m head	1.287		$6,137	$3,250	$2,199	$1,588	$88
	Operating Costs								
	Chlorination System (water treatment)	mg/L	2	$ 4	$146	$77	$52	$38	$2
	Bulk Water Supply (ICON Water)								
	ICON Headworks Costs (supplying to Qbyn)	$ per year	$336,054			$6,147	$4,506	$3,504	
	ACT Govt Utilities Water Network Tax	$ per year	$1,130			$21	$15	$12	
	ACT Govt Water Extraction Charge	$ per kL	$0.58			$5,603	$3,795	$2,744	
	Usage Charge	$ per kL	$1.79			$17,293	$11,712	$8,468	
	Maintenance Costs								
	Maintenance Civil	% of Capital Cost	0.50%		$1,499	$864	$620	$471	
	Maintenance Mech + Elec	% of Capital Cost	4.00%		$1,294	$746	$535	$407	
TOTAL OPERATION & MAINTENANCE COSTS					$61,709	$32,990	$22,423	$16,220	**$90**
TOTAL PRESENT VALUE					**$88,670**	**$59,952**	**$49,384**	**$43,181**	**$27,051**

Row	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Average Year Production (ML/year)	284	308	331	355	379	402	426	449	472	519	541	562	583	602	621
Prime Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
General Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Direct Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design & Preconstruction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL CAPITAL COST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pumping Station - Offtake to Bungendore WTP	$96	$104	$112	$120	$128	$136	$144	$151	$159	$175	$182	$190	$196	$203	$210
Chlorination System (water treatment)	$2	$2	$3	$3	$3	$3	$3	$4	$4	$4	$4	$4	$5	$5	$5
ICON Headworks Costs (supplying to Qbyn)	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336
ACT Govt Utilities Water Network Tax	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1
ACT Govt Water Extraction Charge	$165	$178	$192	$206	$220	$233	$247	$260	$274	$301	$314	$326	$338	$349	$360
Usage Charge	$509	$551	$593	$635	$678	$720	$762	$804	$845	$929	$968	$1,006	$1,043	$1,078	$1,112
Maintenance Civil	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50
Maintenance Mech + Elec	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
TOTAL OPERATION & MAINTENANCE COSTS	**$1,203**	**$1,266**	**$1,330**	**$1,394**	**$1,458**	**$1,523**	**$1,587**	**$1,650**	**$1,711**	**$1,840**	**$1,899**	**$1,956**	**$2,012**	**$2,066**	**$2,118**
TOTAL PRESENT VALUE	**$1,203**	**$1,266**	**$1,330**	**$1,394**	**$1,458**	**$1,523**	**$1,587**	**$1,650**	**$1,711**	**$1,840**	**$1,899**	**$1,956**	**$2,012**	**$2,066**	**$2,118**

Row	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
Average Year Production (ML/year)	640	657	674	690	705	720	734	747	759	771	782	792	802	811	820
Prime Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
General Contingency	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Direct Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Design & Preconstruction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Construction Activities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL CAPITAL COST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Pumping Station - Offtake to Bungendore WTP	$216	$222	$227	$233	$238	$243	$247	$252	$256	$260	$264	$267	$270	$274	$277
Chlorination System (water treatment)	$5	$5	$5	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$6	$7
ICON Headworks Costs (supplying to Qbyn)	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336	$336
ACT Govt Utilities Water Network Tax	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1
ACT Govt Water Extraction Charge	$371	$381	$391	$400	$409	$418	$426	$433	$440	$447	$454	$460	$465	$471	$476
Usage Charge	$1,145	$1,177	$1,207	$1,235	$1,263	$1,289	$1,313	$1,337	$1,359	$1,380	$1,400	$1,418	$1,436	$1,453	$1,468
Maintenance Civil	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50
Maintenance Mech + Elec	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43	$43
TOTAL OPERATION & MAINTENANCE COSTS	**$2,167**	**$2,215**	**$2,261**	**$2,304**	**$2,346**	**$2,385**	**$2,422**	**$2,458**	**$2,492**	**$2,523**	**$2,553**	**$2,582**	**$2,608**	**$2,634**	**$2,657**
TOTAL PRESENT VALUE	**$2,167**	**$2,215**	**$2,261**	**$2,304**	**$2,346**	**$2,385**	**$2,422**	**$2,458**	**$2,492**	**$2,523**	**$2,553**	**$2,582**	**$2,608**	**$2,634**	**$2,657**

STP Option 1 – 6,000 EP STP Upgrade

ITEM / DESCRIPTION	[UNIT]	[QTY]	[RATE] $ / Unit	AMT $K	PRESENT WORTH ($'000) 4%	7%	10%
CAPITAL COSTS							
Total cost to construct a new 6,000 EP plant (Convert 2016 price to 2018 by u		1	$ 7,000,000	$ 7,000	$5,753	$4,991	$4,346
Prime Costs				**$ 7,000**	**$5,753**	**$4,991**	**$4,346**
General Contingency	% of Prime Cost	20%		$ 1,400	$1,151	$998	$869
Direct Costs				**$ 8,400**	**$6,904**	**$5,989**	**$5,216**
Design & Preconstruction Activities	% of Direct Cost	10%		$ 840	$690	$599	$522
Construction Activities	% of Direct Cost	10%		$ 840	$690	$599	$522
TOTAL CAPITAL COST				**$ 10,080**	**$8,285**	**$7,187**	**$6,259**
OPERATION & MAINTENANCE COSTS							
Additional Operating Costs	$/EP	45	$ 50	$7,329	$3,619	$2,299	$1,552
Maintenance Costs							
Maintenance Civil	% of Capital Cost	0.50%	$ 4,000,000	$500	$257	$166	$113
Maintenance Mech + Elec	% of Capital Cost	4.00%	$ 2,500,000	$2,500	$1,284	$831	$564
TOTAL OPERATION & MAINTENANCE COSTS				**$ 10,329**	**$5,143**	**$3,279**	**$2,212**
TOTAL PRESENT VALUE				**$ 20,409**	**$13,428**	**$10,466**	**$8,470**
New EP							

ITEM / DESCRIPTION	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Total cost to construct a new 6,000 EP plant	$0	$0	$0	$0	$0	$7,000									
Prime Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$7,000**									
General Contingency	$0	$0	$0	$0	$0	$1,400									
Direct Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$8,400**									
Design & Preconstruction Activities	$0	$0	$0	$0	$0	$840									
Construction Activities	$0	$0	$0	$0	$0	$840									
TOTAL CAPITAL COST	**$0**	**$0**	**$0**	**$0**	**$0**	**$10,080**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Additional Operating Costs	$17	$34	$51	$68	$85	$103	$120	$137	$153	$170	$186	$201	$216	$230	$244
Maintenance Civil	$0	$0	$0	$0	$0	$0	$20	$20	$20	$20	$20	$20	$20	$20	$20
Maintenance Mech + Elec	$0	$0	$0	$0	$0	$0	$100	$100	$100	$100	$100	$100	$100	$100	$100
TOTAL OPERATION & MAINTENANCE COSTS	**$17**	**$34**	**$51**	**$68**	**$85**	**$103**	**$240**	**$257**	**$273**	**$290**	**$306**	**$321**	**$336**	**$350**	**$364**
TOTAL PRESENT VALUE	**$17**	**$34**	**$51**	**$68**	**$85**	**$10,183**	**$240**	**$257**	**$273**	**$290**	**$306**	**$321**	**$336**	**$350**	**$364**
New EP	369	746	1128	1512	1898	2282	2663	3039	3409	3770	4123	4466	4798	5118	5427

ITEM / DESCRIPTION	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
TOTAL CAPITAL COST	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Additional Operating Costs	$258	$270	$283	$294	$305	$316	$326	$335	$344	$353	$361	$368	$375	$375	$375	$375
Maintenance Civil	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20	$20
Maintenance Mech + Elec	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
TOTAL OPERATION & MAINTENANCE COSTS	**$378**	**$390**	**$403**	**$414**	**$425**	**$436**	**$446**	**$455**	**$464**	**$473**	**$481**	**$488**	**$495**	**$495**	**$495**	**$495**
TOTAL PRESENT VALUE	**$378**	**$390**	**$403**	**$414**	**$425**	**$436**	**$446**	**$455**	**$464**	**$473**	**$481**	**$488**	**$495**	**$495**	**$495**	**$495**
New EP	5723	6007	6279	6538	6785	7019	7242	7453	7652	7841	8019	8186	8344	8493	8633	8772

STP Option 2 – Staged development of two 3,000 EP tank STP upgrades

ITEM / DESCRIPTION	[UNIT]	[QTY]	[RATE] $ / Unit	AMT $K	PRESENT WORTH ($'000) 4%	7%	10%
CAPITAL COSTS							
Stage 1 3,000 EP		1	$ 4,800,000	$ 4,200	$3,452	$2,995	$2,608
Stage 2 3,000 EP		1	$ 3,200,000	$ 2,800	$1,617	$1,086	$737
Prime Costs				**$ 7,000**	**$5,069**	**$4,080**	**$3,345**
General Contingency	% of Prime Cost	20%		$ 1,400	$1,014	$816	$669
Direct Costs				**$ 8,400**	**$6,083**	**$4,897**	**$4,014**
Design & Preconstruction Activities	% of Direct Cost	10%		$ 840	$608	$490	$401
Construction Activities	% of Direct Cost	10%		$ 840	$608	$490	$401
TOTAL CAPITAL COST				**$ 10,080**	**$7,299**	**$5,876**	**$4,817**
OPERATION & MAINTENANCE COSTS							
Additional Operating Costs	$/EP	45	$ 50	$7,329	$3,619	$2,299	$1,552
Maintenance Costs							
Maintenance Civil	% of Capital Cost	0.50%	$ 4,500,000	$475	$234	$147	$97
Maintenance Mech + Elec	% of Capital Cost	4.00%	$ 3,000,000	$2,532	$1,245	$783	$518
TOTAL OPERATION & MAINTENANCE COSTS				**$ 10,336**	**$5,081**	**$3,211**	**$2,150**
TOTAL PRESENT VALUE				**$ 20,416**	**$12,380**	**$9,087**	**$6,967**
New EP							

ITEM / DESCRIPTION	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Stage 1 3,000 EP	$0	$0	$0	$0	$0	$4,200									
Stage 2 3,000 EP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,800
Prime Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$4,200**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$2,800**
General Contingency	$0	$0	$0	$0	$0	$840	$0	$0	$0	$0	$0	$0	$0	$0	$560
Direct Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$5,040**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$3,360**
Design & Preconstruction Activities	$0	$0	$0	$0	$0	$504	$0	$0	$0	$0	$0	$0	$0	$0	$336
Construction Activities	$0	$0	$0	$0	$0	$504	$0	$0	$0	$0	$0	$0	$0	$0	$336
TOTAL CAPITAL COST	**$0**	**$0**	**$0**	**$0**	**$0**	**$6,048**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$4,032**
Additional Operating Costs	$17	$34	$51	$68	$85	$103	$120	$137	$153	$170	$186	$201	$216	$230	$244
Maintenance Civil	$0	$0	$0	$0	$0	$0	$16	$16	$16	$16	$16	$16	$16	$16	$16
Maintenance Mech + Elec	$0	$0	$0	$0	$0	$0	$84	$84	$84	$84	$84	$84	$84	$84	$84
TOTAL OPERATION & MAINTENANCE COSTS	**$17**	**$34**	**$51**	**$68**	**$85**	**$103**	**$220**	**$237**	**$253**	**$269**	**$285**	**$301**	**$316**	**$330**	**$344**
TOTAL PRESENT VALUE	**$17**	**$34**	**$51**	**$68**	**$85**	**$6,151**	**$220**	**$237**	**$253**	**$269**	**$285**	**$301**	**$316**	**$330**	**$4,376**
New EP	369	746	1128	1512	1898	2282	2663	3039	3409	3770	4123	4466	4798	5118	5427

ITEM / DESCRIPTION	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
TOTAL CAPITAL COST	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Additional Operating Costs	$258	$270	$283	$294	$305	$316	$326	$335	$344	$353	$361	$368	$375	$375	$375	$375
Maintenance Civil	$16	$16	$16	$16	$23	$23	$23	$23	$23	$23	$23	$23	$23	$23	$23	$23
Maintenance Mech + Elec	$84	$84	$84	$84	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120
TOTAL OPERATION & MAINTENANCE COSTS	**$357**	**$370**	**$382**	**$394**	**$448**	**$458**	**$468**	**$478**	**$487**	**$495**	**$503**	**$511**	**$518**	**$518**	**$518**	**$518**
TOTAL PRESENT VALUE	**$357**	**$370**	**$382**	**$394**	**$448**	**$458**	**$468**	**$478**	**$487**	**$495**	**$503**	**$511**	**$518**	**$518**	**$518**	**$518**
New EP	5723	6007	6279	6538	6785	7019	7242	7453	7652	7841	8019	8186	8344	8493	8633	8772

Appendix E Triple Bottom Line Assessment of Scenarios

TBL Category	Criteria	Weighting	Scenario 1	Scenario 2	Scenario 3
ENVIRONMENTAL	Minimises construction environmental footprint	0.4	4	3	2
	Reduces operational energy consumption	0.4	4	3	2
	Reduces operational generation of waste	0.2	3	2	4
	Total weighted environmental score	1.0	3.8	2.8	2.4
SOCIAL	Community is burdened with infrastructure if growth does not eventuate	0.2	4	4	2
	Provides for greater long-term security of supply	0.2	2	3	4
	Promotes local employment	0.3	3	3	2
	Maintains local control of complete supply train	0.3	4	4	2
	Total weighted social score	1.0	3.3	3.5	2.4
	Total Environmental and Social Scores (ESS)		7.1	6.3	4.8

% Of Target Met	Score
<25%	1
25%-49%	2
50%-74%	3
75%-99%	4
>99%	5

Appendix F Water Supply and Sewerage Asset Management Plans

PALERANG
COUNCIL

ASSET MANAGEMENT PLAN

Version 3.2 - September 2013

Document Control

Version	Date	Revision Details	Author	Reviewer
1.0	20/08/2010	Roads and Drainage Asset Management Plan adopted by Council at an Ordinary Meeting on 2 September 2010	Adam Hassan	
1.1	21/12/2012	Periodic update to reflect more up to date inputs and to expand plan to include other assets categories in addition to Roads & Drainage	Bill Ellison	
1.2 – 1.8	3/02/2013 – 21/05/2013	Update of asset data and values and predictive modelling of funding requirements, updated formatting	Kevin Ward	Bill Ellison
2.0	21/05/2013	Updated Version submitted to Council Meeting for adoption	Kevin Ward	Bill Ellison
2.1	28/05/2013	Includes refinement and further explanation of tabulated figures in Executive Summary	Kevin Ward	Bill Ellison
3.0	27/06/2013	Adopted by Council	Kevin Ward	Bill Ellison
3.1	9/08/2013	Re-definition and re-assessment of Infrastructure Backlog and consequent amendments to section 1.2.4 and Attachment B (Capital Works Needed table) where columns indicating Renewal Component (Infrastructure Backlog) and Growth & Enhancement Component have been added	Bill Ellison	
3.2	11/09/2013	Update of Charts and figures in Sections 5 and 7 for re-definition and re-assessment of Infrastructure Backlog	Kevin Ward	

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ABBREVIATIONS

AAAC	Average annual asset consumption
AMP	Asset management plan
ARI	Average recurrence interval
BOD	Biochemical (biological) oxygen demand
CRC	Current replacement cost
CWMS	Community wastewater management systems
DA	Depreciable amount
DoH	Department of Health
EF	Earthworks/formation
IRMP	Infrastructure risk management plan
LCC	Life Cycle cost
LCE	Life cycle expenditure
MMS	Maintenance management system
PCI	Pavement condition index
RV	Residual value
SS	Suspended solids
vph	Vehicles per hour
vpd	Vehicles per day

1 EXECUTIVE SUMMARY

This asset management plan forms part of Council's Resource Strategy and supports the Integrated Reporting Framework being implemented by Council in keeping with the Local Government Amendment (Planning and Reporting) Act 2009. The plan is a living document and will continue to be updated as gaps in asset information are filled and methods of assessing this information are improved. "Best assumptions" have been made based on the best available information at the time and this is stated in the plan where applicable.

Since the adoption of the Asset Management Strategy (2006) and Roads and Drainage Asset Management Plan 2010, Council has made considerable progress in implementation of an integrated Asset management System, including data verification and audit of some classes of assets. The data and predictions from this system have been used in the development of this asset management plan.

1.1 What Council Provides

Council owns and manages a wide range of public infrastructure assets to enable associated services to be provided to the community. The services are provided via the following asset classes and asset groups and sub-groups under the asset classes:

Asset Class	Asset Group and Sub Group
Roads and Drainage (Section 5)	• Sealed Pavements; • Kerb and Gutter; • Unsealed Pavements; • Paths; • Drainage; • Bridges and Major Culverts; and • Transport and Traffic Facilities.
Recreational Facilities (Section 6)	• Public Reserves and Parks • Playing Fields and Sports Facilities • Swimming Pools
General Fund Properties (Section 7)	• Public Buildings including o halls, o community centres, o amenities buildings o public toilets • Council Offices and Depots • Other Property Entities o Cemeteries o Saleyards o Showgrounds
Waste Facilities (Section 8)	• Landfills • Waste Transfer Stations
Water Supply Systems (Section 9)	• Water Supply Headworks • Water Supply Mains & Services

Asset Class	Asset Group and Sub Group
Sewerage Systems (Section 10)	• Sewage Treatment Plants • Sewage Pumping Stations • Sewer Mains
Plant, Equipment and Other Items (Section 11)	• Plant, Vehicles and Works Equipment • Office Equipment (IT and office machines), Furniture and Fittings • Library Books

1.2 What does the plan tell us?

1.2.1 How many assets?

Council is currently responsible for the following assets

Asset Class	Assets Details
Roads & Drainage (includes Local and Regional Roads)	584 km sealed roads 748 km unsealed roads 47 km Kerb & Gutter 24.3 km paved footpaths 18.1 km urban drainage pipes 38.7 km rural culverts with 6740 headwalls 26 timber bridges, 48 concrete bridges, 2 iron bridges and 43 major culverts (over 6 m span) 3465 signs 26 bus shelters 24,500 guide posts
Recreational Facilities	101 public reserves mostly in rural areas. It is also responsible of 8 parks in mainly urban areas. There are also 9 children's playgrounds throughout our LGA. Sports and recreation grounds at Bungendore, Braidwood, Captains Flat, Araluen, Majors Creek and Nerriga The Bungendore Skateboard Park
General Fund Properties	Approximately 22 public buildings, including 7 public hall, 5 public toilet buildings, 3 amenities buildings at sports grounds and 4 Community Centres Council offices and works depots at Bungendore and Braidwood.
Waste Facilities	Landfills at Bungendore, Macs Reef, Braidwood, Araluen, Majors Creek, Nerriga and a waste Transfer Station at Captains Flat
Water Supply Systems	21.7 km bulk mains 59.1 km reticulation mains 2 dams 7 reservoirs 5 bores 3 pump stations Water treatment facilities at Bungendore, Braidwood and Captains Flat

Asset Class	Assets Details
Sewerage Systems	7.7 km rising mains 55.1 km sewers 16 pump stations Sewage treatment plants at Bungendore, Braidwood and Captains Flat
Plant, Equipment and Miscellaneous Items	Over 200 Plant and Equipment assets, including 60 vehicles, 71 plant items (trucks, road plant, mowers and construction plant)

1.2.2 What are the assets worth?

The Replacement Cost, Depreciated Replacement Cost and Annual Depreciation Expense for the Council assets are as follows and are detailed under the Asset Valuations Section for the relevant Asset Class.

Asset Class	Gross Replacement Cost ($)	Depreciated Replacement Cost ($)	Annual Depreciation Expense ($)
Roads & Drainage (includes Local and Regional Roads)	636,022,000	564,562,000	7,114,400
Recreational Facilities	13,693,000	11,395,000	88,100
General Fund Properties	20,162,000	9,355,000	412,700
Waste Facilities (Landfill values included under land values and building values in General Fund Properties)	550,000	495,000	11,000
Water Supply Systems	29,041,000	15,552,000	393,300
Sewerage Systems	38,991,000	29,023,000	810,800
Plant, Equipment and Miscellaneous Items	12,794,000	5,746,000	1,870,000
Totals:	**751,253,000**	**636,128,000**	**10,744,800**

Notes: The Gross Replacement Costs in the above table are based on June 2012 construction costs for asset management estimating and prediction purposes.

Roads and drainage values include $439,000,000 for road formation which is deemed to have infinite life.

1.2.3 What does it Cost?

The forecast expenditure need for the assets over the 10 year timeframe of this plan (in 2012 dollars) is:

Asset Class	Predicted Operations & Maintenance	Predicted Renewals	Needed Upgrades & Capital Works	Developer Funded New Works
Roads & Drainage (Section 5)	$16,739,000	$92,352,000	$43,456,000	$76,460,000
Recreational Facilities (Section 6)	$6,142,000	$1,995,000	$9,920,000	$32,000
General Fund Properties (Section 7)	$7,506,000	$3,930,000	$4,372,000	0
Waste Facilities (Section 8)	$21,791,500	$2,640,000	$9,360,000	0
Water Supply Systems (Section 9)	$6,678,000	$1,442,000	$2,400,000	$1,154,000
Sewerage Systems (Section 10)	$7,277,000	$2,770,000	$7,968,000	$1,899,000
Plant, Equipment and Miscellaneous Items (Section 11)	N/A	$15,330,000	Nil	N/A
	$66,133,500	$120,459,000	$77,476,000	$79,545,000

NOTES:

1. The Upgrades & Capital Works for $43,453,000 for Roads & Drainage comprises the following works

Road Asset Type	Needed Upgrades & Capital Works
Widen & Strengthen Sealed Roads (Excludes 50 % of cost for renewal component of the works)	$15,056,000
Sealing of unsealed Roads	$21,602,000
Unsealed Road Improvements	$500,000
K&G and Road Safety	$1,345,000
Footpaths	$1,235,000
Drainage	$550,000
Public Carparks	$2,200,000
Other (Traffic facilities, Street lighting, Bus Bays)	$968,000
Total:	$43,456,000

2. The Predicted Renewals and Needed Upgrades & Capital Works includes $51,713,000 for renewal and upgrade of existing sealed roads and for the sealing of higher traffic gravel roads, as shown below. This work is required to provide a satisfactory standard to meet growth, increased traffic load and more modern standards to address safety concerns. Bitumen sealing of gravel roads is cost effective generally when traffic counts exceed 150 vpd AADT. About $13,000,000 is needed for Nerriga Road alone to seal the remaining 17 kms of gravel sections on this regional road (MR92). Traffic counts have reached 400-600 vpd following the sealing of MR 92 from Nowra to Nerriga in 2010.

Environs	Renew Sealed Roads to Adequate Standard		Seal Gravel Roads to Provide Adequate Standard	
	Length (km)	Cost	Length (km)	Cost
Braidwood	36.3	$15,585,000	19.8	$13,380,000
Bungendore	23.6	$12,069,000	15.8	$4,897,000
Burra/Urila/Royalla	3.2	$1,725,000	9.1	$2,785,000
Captains Flat	2.8	$732,000	1.4	$540,000
Totals	**65.9**	**30,111,000**	**46.3**	**21,602,000**

3. Renewal and upgrading of failed and deficient pavements are required on Burra Rd, Captains Flat Road, Tarago Road, Hoskinstown Rd, Park Lane, Cooma Rd, Majors Creek Rd and Nerriga Rd in particular.
4. $555,000 is required to provide key missing links in the piped urban drainage systems.
5. $1,235,000 is required to construct of required missing path links in our towns.
6. $8,175,000 is required for replacement of timber bridges
7. Expenditure of $9,920,000 is required on Recreation Facilities, which includes $4,000,000 for replacement of the Bungendore swimming pool, $3,000,000 for new Bungendore recreation grounds and $1,300,000 for upgrade of the Braidwood recreation grounds
8. The Shoalhaven River pump station and equipment require replacement within the next decade at an estimated cost of $360,000
9. Replacement of AC water mains in Captains Flat, Braidwood and Bungendore, amounting to $990,000, is required over the next 10 years. Provision of an extra clearwater storage reservoir is needed in Braidwood to cater for peak day demands.
10. Further expansion of the Bungendore Sewage Treatment Plant by 3000-5000 EP will be required towards the end of the 10 year period at a present day cost between $6,000,000 to $8,000,000
11. Sewerage works renewals of $2,772,000, includes $1,155,000 - Treatment Works (Captains Flat), $863,000 - Pump Stations, $754,000 – Sewer Mains
12. The relatively high amount $15,330,000 for renewal of Plant, Equipment and Miscellaneous, compared with the Replacement Cost, results from the short useful life of these assets compared with other infrastructure. In some cases (e.g. Motor vehicles), there will be several renewals of an asset over the next 10 years.

The most urgent General Fund projects, that virtually need to be constructed now, are indicated in Attachment B in the column with heading “Needed Now Projects’. These works total $59,820,000 and include Council’s Infrastructure backlog as discussed in the next section, as well as new and enhancement projects to cater for growth.

1.2.4 Does Council have an Infrastructure Backlog?

Assessment of Infrastructure Backlog

The definition adopted by Council to determine its Infrastructure Backlog is as follows:

The level of funds that are needed at current date to do the necessary works required to return existing assets to a satisfactory condition at their existing capacity. ‘Satisfactory’ is assumed to *be the level of service provided by the asset when it was originally provided and by inference was acceptable to its users at the time.*

This definition is in keeping with the NSW Local Government Act's Annual Statement of Accounts note (1) under Special Schedule No 7 which indicates that these works do not include any planned enhancements to the existing asset.

In Palerang, roads and bridges are the main asset classes where there is a substantial backlog of renewal works to return failing sections/components to satisfactory standard. While supplementary enhancement works may be desirable (and in practice will occur) to take a failing asset to a higher standard to cater for increased growth and latest standards, the scope of works required to solely address infrastructure backlog has been assessed based on undertaking the following, only:

1. For load limited bridges – the repair/refurbishment of the bridge structure to reinstate the structural capacity of the bridge to take general mass limit vehicles such as laden semi-trailers without any increase in existing lane widths.

2. For failing sealed roads that are becoming dangerous to users and may cause serious damage to vehicles as a result of their roughness – heavy patching and pavement rehabilitation to reinstate the travelling surface of pavements and replacement of failed culverts to the same dimensions as the original.

3. For sealed roads that need on-time renewal re-seals to preserve seal coat and thus pavement integrity – Re-seal on an average 15 year return period.

4. For unsealed roads where a lack of gravel sheeting causes slippery and/or boggy surfaces that may make them impassable during wet weather – gravel re-sheeting works

5. For paths and kerb & gutter – replacement of broken and uneven sections that are unserviceable and /or dangerous.

For other assets, infrastructure backlog works are typically those works required to ensure assets are provided in a safe and serviceable condition at the original level of service.

With reference to Attachment B, it has been estimated that Council's Infrastructure Backlog for its General Fund was $15,437,000 at 30 June 2013. The table below summaries the infrastructure backlog for all of the asset groups which totals $16,737,000:

Asset Group	Infrastructure Backlog At 30/06/2013
Sealed Roads	$8,511,000
Unsealed Roads	$1,500,000
Timber bridges	$3,455,000
Other Bridges	$375,000
Kerb & Gutter	$46,000
Urban Drainage	-
Paths	$40,000
Recreation Facilities	$300,000
General Fund Properties	$1,210,000
Sub-total for General Fund	$15,437,000
Water Supply	$1,300,000
Sewerage	-
Waste Facilities	-
Total Infrastructure Backlog	$16,737,000

More specifically, the works required to return assets to a satisfactory condition are as follows:

- Renewal of failing and rough pavements on Burra Rd, Captains Flat Road, Tarago Road, Collector Road, Hoskinstown Rd, Park Lane, Cooma Rd, Majors Creek Rd and Nerriga Rd.
- A catch-up program of re-sealing on sealed roads to preserve the running surfaces to avoid an escalation of maintenance required to keep roads in an operational condition.
- A catch-up program of gravel re-sheeting on unsealed roads in rural areas to avoid dangerous surfaces especially during wet weather.
- Refurbishment/replacement of failed/failing timber bridge and failed large culverts. The problem bridges are at timber bridge at St Omers Creek on Nerriga Rd, the timber deck of the concrete/timber bridge over the Molonglo River on the Captains Flat Road, the Allen-truss bridge over the Molonglo River at Foxlow on Hoskinstown Rd, the timber bridge over Back Creek on Cooma Rd, the timber bridge over Bedding Ground Creek on Reidsdale Rd and the failing multicell culvert over Burra Creek on Williamsdale Rd.
- Repair of failed sections of the kerb and gutter in the towns.
- Repair of failed sections of the path network in the towns.
- Refurbishment of deficient/deteriorated amenities buildings at Braidwood Recreation Grounds.
- Refurbishment of Council's Braidwood works depot which no longer provides the level of service required.
- Replacement of the Captains Flat Community Health Centre and refurbishment of a number of halls that have deteriorated over the years.
- Replacement of the remaining un-replaced sections of the water supply delivery main serving Braidwood from the water treatment plant; and provision of adequate clearwater storage to cater for the town now that the previous storage arrangement involving the off-stream dam is no longer fit for the purpose.

1.2.5 What has Council been doing about its Infrastructure Backlog?

Since the formation of Palerang Council in 2004 to present date Council has expended over $40 million on asset renewals and infrastructure capital projects with an objective of providing assets at a satisfactory standard for our community.

Most notably it has expended (with state & federal government financial assistance) over $18 million on replacement of old and deficient sewerage headworks and on new projects to upgrade the capacity and quality of its water supply systems. These systems are now in new condition and with adequate capacity to cater for population growth for the next decade. There remains a smaller backlog of old asbestos mains that need replacement but these are catered for by ongoing renewal programs funded by water and sewer charges. There is also a relatively urgent need for an extra clear water storage reservoir for Braidwood.

Council has also commenced a program which has been funded by a special waste charge to close and restore landfills that are full and to replace them with waste transfer stations.

While Council has expended over $22 million towards addressing its general fund infrastructure backlog as detailed below, the backlog remains high at current date, due to many more of our road, bridge, buildings and recreational facilities assets reaching the end of their serviceable life.

Works that have been undertaken include:

- Road rehabilitation projects on Bungendore Rd, Macs Reef Rd, Norton Rd, Captains Flat Rd, Hoskinstown Rd, Ellendon St, Tarago Rd, Molonglo St, Cooma Rd, Araluen Rd, Ryrie St and Little River Rd.
- Re-construction and bitumen sealing of higher trafficked gravel roads, including Williamsdale Rd, Urila Rd, Woolshed Lane, Mathews Lane, Briars-Sharrow Rd, Captains Flat Rd, Hill Street, Cooma Rd, Nerriga Rd and Charlie Forest Rd.
- Replacement of timber bridges with concrete structures on Tarago Rd (Turallo Ck), Cooma Rd (Jembaicumbene Ck), Neringla Rd (Araluen Ck), Majors Ck- Mountain Rd (Araluen Ck) and Stewarts Crossing Road (Pipeclay Ck). Major timber bridge refurbishments have also been undertaken on the Mongarlowe Ck Bridge at Mongarlowe, Tantuleun Ck on little River Rd and Majors Creek Rd Bridge.
- Gravel road re-sheeting and sealed road re-sealing programs
- New recreation facilities have been provided including the Bungendore Skatepark, Braidwood Gymnasium and at Mick Sherd Oval new amenities, car parking, underground watering and floodlighting.
- New WTS at Captains flat and re-instatement of landfill site.
- New Council Chambers and offices at Bungendore and refurbishment to the Braidwood Council offices and provision of new Braidwood library facility.
- New path links including new shared path linking Bungendore public school to Elmslea.

However, it is obvious that under existing funding arrangements, Council does not have the financial capacity to fund enough of the general fund infrastructure backlog and to also meet the need for necessary enhancements that are almost always required with these works in our fast growing LGA.

1.3 Plans for the Future

Council plans to operate and maintain all of its assets to achieve the following strategic objectives.

1. Ensure infrastructure assets are maintained at a safe standard.
2. Ensure that infrastructure assets provide the functions sought by the community.
3. Ensure that assets provide services at the standard that the community agrees to and can afford.

1.4 Measuring our Performance

Quality

All of Council's infrastructure assets will be maintained in a reasonably usable condition. Defects found or reported that are outside our service standard will be scheduled for repair commensurate with available funding.

Function

Our intent is that appropriate range of infrastructure is provided and maintained in partnership with other levels of government and stakeholders to meet the needs of the community. These assets will be maintained at a safe and functional standard as set out in this asset management plan within the constraints of our resource capacity.

Safety

We will inspect all infrastructure assets commensurate with available funding. Inspections will be carried out, with defects identified and repaired in accordance with adopted servicing regimes and schedules to ensure they are safe.

1.5 Ongoing Refinement of Asset Management Plan

Ongoing actions as listed below will improve the accuracy of asset knowledge and reliability of the AM plan to predict trends and allow asset management decisions to be optimised:

- Verify the value of unfunded renewals and investigate options to close the gap.
- Maintain and verify unit / renewal rates and useful lives across all asset groups.
- Regularly audit the condition of the Road infrastructure.
- Complete the establishment of a single asset register that is suitable for financial reporting and technical asset management. Develop formal processes for maintaining the asset register. Close the gaps in asset register data.
- Formalise condition inspection frameworks and establish process for on-going condition assessment (in particular, regularly audit the condition of the Road infrastructure). Close gaps in condition data.
- Pilot the inspection frequencies and maintenance response times as detailed in draft roads risk management policy. Expand the draft roads risk policy to cover all asset groups.
- Integrate the asset management system with other Council systems.
- Develop and implement monitoring and reporting processes for current service levels.
- Carryout a risk assessment to identify credible risks and develop a risk treatment plan for non-acceptable risks.
- Formalise methodologies for establishing future capital works programmes for undertaking necessary Council funded asset upgrade projects, including setting priorities for each group of assets. This will involve transfer of data into Long Term Financial Plans.

2 INTRODUCTION AND FRAMEWORK

2.1 Background

This asset management plan has been prepared to demonstrate responsive management of assets (and services provided from assets), compliance with regulatory requirements, and to communicate funding required to provide the required levels of service.

The ongoing periodic update of the plan will enable Council to review the performance of its infrastructure in relation to desired objectives for infrastructure management and funding.

The asset management plan is to be read with the following associated planning documents:

- Palerang Community Strategic Plan 2012-2016
- Asset Management Policy (2006);
- Asset Management Strategy (2006);
- Roads and Drainage Asset Management Plan 2010; and
- Draft Risk Management Policy for Roads (2008).

The scope of assets covered by this plan includes the following classes of assets:

- Roads and Drainage;
- Recreational Facilities;
- General Fund Properties;
- Waste Facilities;
- Water Supply Systems;
- Sewerage Systems; and
- Plant, Equipment and Miscellaneous Items.

Key stakeholders in the preparation and implementation of this asset management plan are:

- Government – State government having responsibility for Local Government. State and Federal Governments fund infrastructure developments;
- Councillors – As stewards of Council's infrastructure assets;
- Community – As users of services that rely on sound asset management;
- Visitors - As temporary users of services that rely on sound asset management;
- Utilities/Developers – As infrastructure providers;
- Employees/Volunteers – Having responsibilities for construction, operation and management of infrastructure and implementation of asset management plans;
- Contractors/Suppliers – As providers of services required in the implementation of asset management plans;
- Other Partners sharing asset management responsibility (including the Crown) ; and
- Insurers – Integral to risk management strategies that require sound asset management practice.

2.2 Goals and Objectives of Asset Management

The Council exists to provide services to its community in accordance with its charter under the Local Government Act 1993. Some of these services are provided by infrastructure assets. Council has acquired infrastructure assets by 'purchase', by contract, construction by Council staff and by donation of assets constructed by developers and others to meet increased levels of service.

This plan has been developed in accordance with actions outlined in the Asset Management Strategy and the Asset Management Policy previously adopted by Council, and will provide the framework under which all assets classes will be managed.

Council's goal in managing infrastructure assets is to meet the required level of service in the most cost effective manner for present and future consumers. The key elements of infrastructure asset management are:

- Taking a lifecycle approach;
- Developing cost-effective management strategies for the long term;
- Providing a defined level of service and monitoring performance;
- Understanding and meeting the demands of growth through demand management and infrastructure investment;
- Managing risks associated with asset failures;
- Sustainable use of physical resources; and
- Continuous improvement in asset management practices.[1]

2.3 Integrated Planning & Reporting Legislation

The primary aim of Council's Asset Management Plan (AMP) is to communicate information about assets, including the actions required, to provide a defined level of service in the most cost effective manner. It also demonstrates Council's compliance with regulatory requirements in accordance with NSW Division of Local Government's Integrated Planning & Reporting Legislation.

Compliance with IP&R guidelines requires adoption of a strategic, corporate and organisational planning framework that takes an integrated approach to long and short term planning, providing clear linkages between Council's strategies and plans at all levels. Asset Management is part of this framework and this Asset Management Plan is to be read with reference to the following plans:

- **Community Strategic Plan (CSP) -** Peak plan providing Council, community and other stakeholders with priority issues for address and goals for achievement in the longer term.
- **Delivery Program -** Plan documenting Council activities, projects and initiatives during each Council term, to achieve long term goals and targets described in CSP.
- **Operational Plan -** Annual Management Plan programming ongoing activities, projects and initiatives to achieve Delivery Program goals and targets.

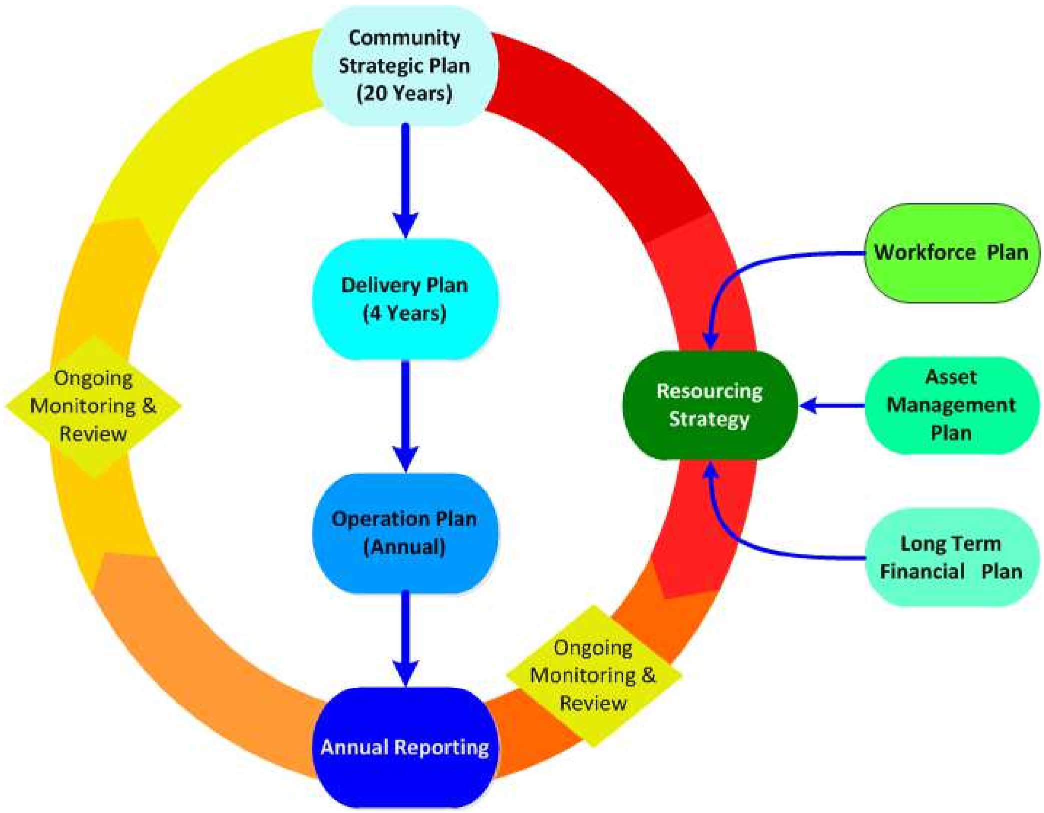
[1] International Infrastructure Management Manual 2006 Sec 1.1.3, p 1.3

These plans are supported by a **Resourcing Strategy** which comprises three sub-plans to ensure Council is able to adequately resource its ongoing activities, initiatives and long term goals. These consist of:

- This **Asset Management Plan** providing a comprehensive listing of Council's assets and outlining and communicating forecast demand, levels of service, lifecycle management strategies and activities and capital works programmes for the sustainable management of assets into the future over a 10 year period.
- **Long Term Financial Plan** documenting Council's projected income and expenditure and modelling to ensure financial sustainability over a 10 year period; and
- **Workforce Plan** identifying Council's anticipated human resource requirements to meet the goals and targets of the 4 year Delivery Program.

Council is also required to produce an **Annual Report** which documents Council activities in relation to its statutory responsibilities and reporting on progress of projects and initiatives outlined in the Operational Plan.

The inter-relationship between all these plans and the annual report is as depicted in the following diagram and together they form Councils Integrated Planning and Reporting framework in keeping with legislative requirements.



Strategic Statements contained in the Community Strategic Plan reinforce the goals of the asset management plan and vice versa:

Table 1 – Key Council Strategic Statements and how these are addressed in this Plan

CSP Focus Area.	Strategic Statements	How Strategic Statement is addressed in this Plan
Infrastructure and Transport	**Goal:** Palerang enjoys safe, functional, accessible and well-maintained infrastructure and comprehensive local and regional transport networks.	The asset management plan outlines and communicates forecast demand, levels of service, lifecycle management strategies and activities and capital works programmes for the sustainable management of assets into the future. It provides a framework for identifying, communicating and managing risks associated with infrastructure assets.
	The cost of providing adequate infrastructure for our existing and expanding community requires additional financial support.	The asset management plan provides a platform for financial planning and management of assets and can be used to inform and develop funding strategies and initiatives and advocacy for increased funding in the future.

2.4 *Plan Framework*

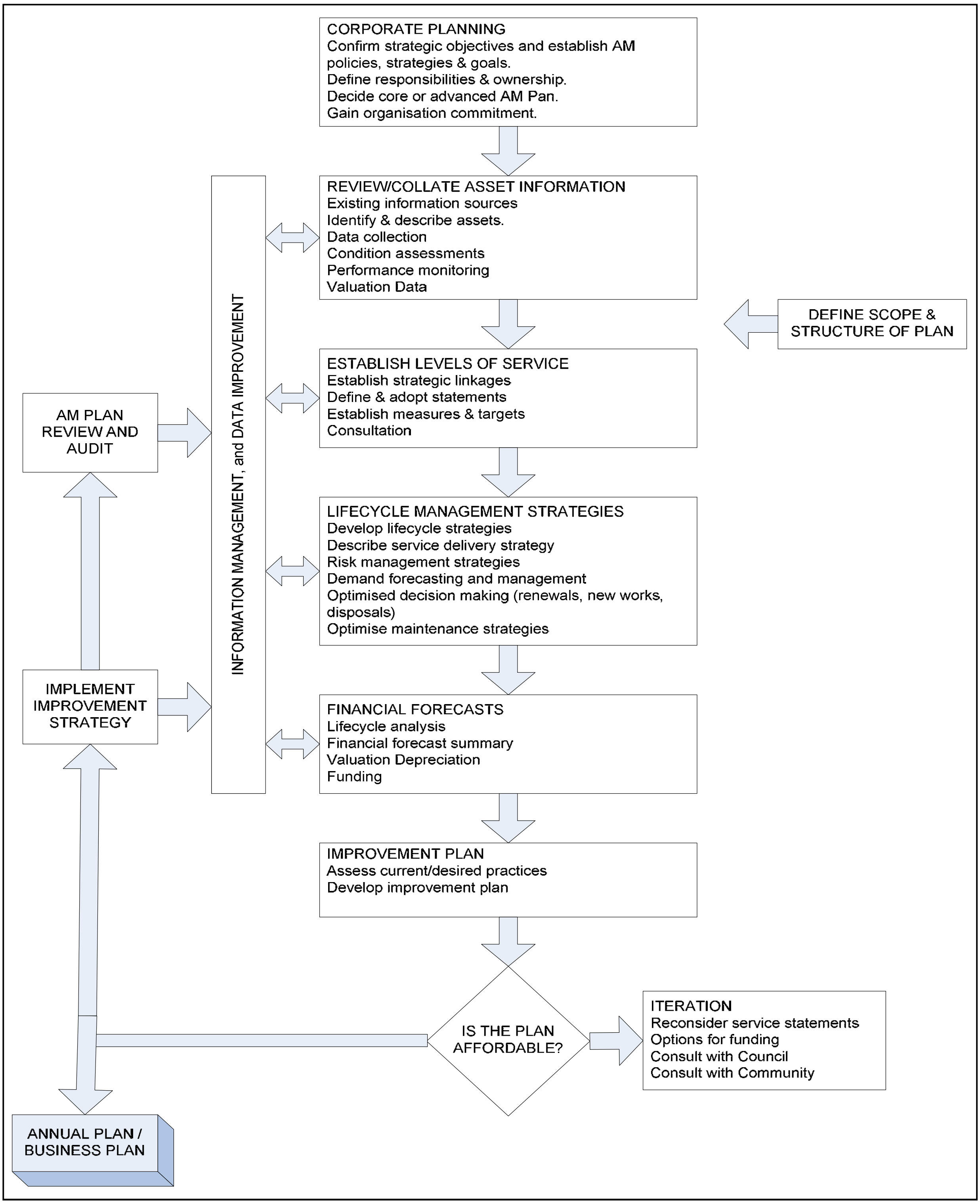
Based on the key elements of infrastructure asset management listed in Section 2.2, the key headings within each section of the plan (covering individual asset classes) are:

- Levels of service – specifies the services and levels of service to be provided by council;
- Future demand – how this will impact on future service delivery and how this is to be met;
- Life cycle management – how Council will manage its existing and future assets to provide the required services;
- Financial summary – what funds are required to provide the required services;
- Asset management practices;
- Monitoring – how the plan will be monitored to ensure it is meeting Council's objectives; and
- Asset management improvement plan.

A road map for preparing an asset management plan is shown in *Figure 1* below.

Figure 1 – Road Map for preparing an Asset Management Plan

Source: International Infrastructure Management Manual 2006 Fig 1.5.1, p 1.11



2.5 *Core and Advanced Asset Management*

The previous version of the asset management plan was prepared as a ‘core’ asset management plan in accordance with the International Infrastructure Management Manual. It was prepared to meet minimum legislative and organisational requirements for sustainable service delivery and long term financial planning and reporting. Core asset management is a ‘top down’ approach where analysis is applied at the ‘system’ or ‘network’ level.

This asset management plan moves towards ‘advanced’ asset management using a ‘bottom up’ approach for gathering asset information for individual assets to support the optimisation of activities and programs to meet agreed service levels.

This approach will continue as the Councils asset management system is further developed and integrated with other information systems and becomes utilised as part of the ongoing management of the assets.

2.6 *Key Assumptions made in Financial Forecasts*

This section details the key assumptions made in presenting the information contained in this asset management plan and in preparing forecasts of required operating and capital expenditure and asset values, depreciation expense and carrying amount estimates. It is presented to enable readers to gain an understanding of the levels of confidence in the data behind the financial forecasts.

Key assumptions made in this asset management plan are:

- All figures are shown in June 2012 dollar values with no adjustment being made for CPI.
- All figures have been developed with the best available information at the time.
- Required maintenance expenditure for Year 1 of the plan (2013 /14) has been set as the average maintenance expenditure that was incurred over the 2010/11, 2011/12 and the budgeted expenditure for the 2012/13 financial years.
- Future maintenance expenditure is forecast to trend in line with the quantity of the asset stock.
- Replacement Cost, Depreciated Replacement Cost and Annual Depreciation are calculated for the 10 year period. The following formulae, which relate to values at the end of each period, have been used:
  - ⇒ Replacement Cost: RC (2013/14) = RC (2012/13) + New Works (20013/14)
  - ⇒ Depreciated Replacement Cost: DRC (2013/14) = DRC (2012/13) + New Works (2013/14) + Renewals (2013/14) – Depreciation (2013/14).

Accuracy of future financial forecasts may be improved in future revisions of this asset management plan by the following actions.

- Continued improvement of the asset register data (in particular drainage assets).
- On-going maintenance of the asset registers.
- Integration of the asset register with other Council information systems (GIS, Finance, Records Management and Customer Requests).
- Regular condition audits of sealed pavements, unsealed pavements and drainage assets.
- Monitoring and confirmation of actual useful lives across the asset groups.

- Comparison of unit rates for renewal costs with actual cost of renewals across the asset groups.

2.7 *Asset Data Confidence Levels*

The confidence in the asset data used as a basis for the financial forecasts has been assessed using the grading system in *Table 2* detailed below.

Table 2 – Confidence Level Ratings

Confidence Grade	General Meaning
A	**Highly Reliable** Data based on sound records, procedure, investigations and analysis which is properly documented and recognised as the best method of assessment
B	**Reliable** Data based on sound records, procedures, investigations and analysis, documented properly but has minor shortcomings, for example the data are old, some documentation is missing and reliance is placed on unconfirmed reports or some extrapolation
C	**Uncertain** Data based on sound records, procedures, investigations and analysis which is incomplete or unsupported, or extrapolated from a limited sample for which grade A or B data are available
D	**Very Uncertain** Data based on unconfirmed verbal reports and/or cursory inspection and analysis.

The confidence levels for the data for each asset class are shown in ***Table 3*** below.

Table 3 – Confidence Levels in Data

Asset Class	Asset Sub Class	Data Confidence Level
Roads and Drainage	Sealed Pavements	A
	Kerb and Gutter	A
	Unsealed Pavement	A-B
	Paths	A-B
	Drainage	B-C
	Bridges and Major Culverts	A-B
	Transport and Traffic Facilities	A-B
Recreational Facilities	Public Reserves and Parks	A-B
	Playing Fields and Sports Facilities	A-B
	Swimming Pools	A
General Fund Properties	Public Buildings including halls, community centres, amenities buildings, public toilets	A-B

Asset Class	Asset Sub Class	Data Confidence Level
	Council Offices and Depots	A
	Other Property Entities (Cemeteries, Saleyards, Showgrounds)	A
Waste Facilities	Landfills	A-B
	Waste Transfer Stations	A-B
Water Supply Systems	Headworks, Treatment Works, Water Mains and Services	A-B
Sewerage Systems	Treatment Plants, Pumping Stations and Sewer Mains	A-B
Plant, Equipment and Other Items	Plant, Vehicles and Works Equipment	A
	Office Equipment (IT and office machines), Furniture and Fittings	A
	Library Books	B

3 LEVELS OF SERVICE & LIFECYCLE MANAGEMENT PLANS

3.1 Customer Research and Expectations

A community survey was undertaken by Winston Sustainable Research Strategies Pty Ltd for Council during August 2011 and compares the results with an earlier survey in April 2005 by Artcraft Research. The study involved administration by telephone of a structured questionnaire of around 15 minutes duration to a stratified random sample of 1,100 people (aged 18 years and over), drawn from throughout the Palerang Council area. The objective of the survey was to collect information on a broad range of matters, for example, the Local Environment Plan (LEP), possible special rates/rate increases and satisfaction levels with Council's services; amongst other topics.

A summary of the results that are applicable to road and other infrastructure assets are detailed in **Table 4** - **Table 6** below.

Table 4 – Summary of Customer Survey Results

What's not so good about the area you live in?	All %		Location					
			Braidwood %	Bungendore %	Captains Flat %	Villages %	Rural Resid'l %	Farms %
Roads / poor upkeep / potholed	2011	33.4	26.7	30.1	44.2	35.2	36.4	30.3
	2005	18.7	2.2	6.7	40.0	23.2	21.5	26.5
Garbage collection, none / infrequent /unreliable	2011	7.4	2.2	0.0	5.2	13.0	11.3	9.1
	2005	2.5	0.0	0.0	10.0	2.1	5.0	0.0
House Recycling none / infrequent /unreliable	2011	3.4	0.0	0.0	3.9	5.6	5.0	4.5
	2005	1.8	0.0	2.6	7.1	0.0	3.0	0.0

Table 5 – Summary of Customer Survey Results

Satisfaction Levels with:		Not at all satisfied	Not very satisfied	Quite satisfied	Very satisfied	Completely satisfied	Total Q+V+C	Mean
Garbage tip/transfer station	2011	9.3	15.8	38.1	20.9	15.9	74.9	3.2
	2005	12.9	10.6	32.1	32.1	12.4	76.6	3.2
Town water supply	2011	8.5	21.0	46.8	12.5	11.2	70.5	3.0
	2005	12.8	12.3	29.7	23.3	22.0	75.0	3.3
Local Roads	2011	7.4	28.3	46.0	13.8	4.4	64.2	2.8
	2005	8.7	19.0	32.7	29.7	9.9	72.3	3.1
Main roads through area	2011	9.9	30.8	35.6	15.5	8.1	59.2	2.8
	2005	10.7	18.2	24.7	30.5	15.8	71.0	3.2

Table 6 – Summary of Customer Survey Results

What changes would you most like to see that would make Palerang a better place? (1100 surveyed - responses relevant to assets listed only)	%
Upgrade all roads/road improvement generally	14.9
Upgrade Captains Flat Road	3.9
Build swimming pool in area	3.7
Upgrade Macs Reef Road	3.2

What changes would you most like to see that would make Palerang a better place? (1100 surveyed - responses relevant to assets listed only)	%
Upgrade Kings Highway	2.7

The surveys did not cover the full range of Council's assets, however it can be deduced from the above information that:

a) Councils residents are less satisfied with the standard of our roads in 2011 than in 2005, however about 65% of respondents rated them satisfactory.

b) There is a slightly lower satisfaction level with water supply services when comparing 2011 to 2005, however 70% still rated them satisfactory. A better result can be expected for the next survey as a new water treatment plant recently commissioned for Braidwood will produce high quality water to replace the pre-existing unfiltered supply arrangements that were very problematic.

c) Satisfaction levels with waste services are about the same when comparing 2011 to 2005.

The survey also highlights some specific projects that are considered important by a proportion of the respondents

3.2 Legislative Requirements

Council has to meet many legislative requirements including Australian and State legislation and State regulations. These are detailed in **Table 7**

Table 7 – Legislative Requirements

Legislation	Requirement
Local Government Act 1993	Sets out the role, purpose, responsibilities and powers of Local Governments in New South Wales. Also sets out the legal framework for an effective, efficient, environmentally responsible and open system of local government in New South Wales and, to regulate the relationships between the people and bodies comprising the system, and, to encourage and assist the effective participation of local communities in the affairs of local government.
Local Government Amendment (Planning and Reporting) Act 2009	Sets out the integrated reporting requirements for local government in New South Wales, including the need to develop a Long-term Community Strategic Plan and Resourcing Strategy (which must include long-term financial planning, workforce management planning and asset management planning).
Environment Planning and Assessment Act 1979	Set out to encourage the proper management, development and conservation of natural and artificial resources for the purpose of promoting the social and economic welfare of the community and a better environment and the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.

Legislation	Requirement
Road Act 1993	Sets out the rights of members of the public to pass along public roads, the rights of persons who own land adjoining a public road to have access to the public road, and to establish the procedures for the opening and closing of a public road, to provide for the classification of roads, to provide for the declaration of public authorities as roads authorities for both classified and unclassified roads, to confer certain functions (in particular, the function of carrying out road work), and to regulate the carrying out of various activities on public roads.
Water Management Act 2000	The object of this Act is the sustainable and integrated management of the State's water for the benefit of both present and future generations.
Public Health Act 1991	The objectives of this Act are to protect the public health of the community.
Waste Avoidance and Resource Recovery Act 2001	The objects of this Act are to encourage the most efficient use of resources, to provide for the continual reduction in waste generation, to minimise the consumption of natural resources, to ensure efficient funding of waste and resource management planning and to assist with the achievement of the objectives of the Protection of Environment Operations Act
Protection of Environment Operations Act 1977	Sets out to protect, restore and enhance the quality of the environment in NSW, having regard to the need to maintain ecologically sustainable development, pollution prevention, the elimination of harmful wastes, the reduction in the use of materials and the re-use, recovery or recycling of materials.
Protection of Environment (Administration) Act 1991	The objects of this Act is to constitute the Environment Protection Authority (now the DECC), to provide integrated administration for environment protection and to require the Authority to perform particular tasks in relation to the quality of the environment, environmental audit and reports on the state of the environment.
Occupational Safety and Health Act 2000	Sets out roles and responsibilities of secure the health and safety and welfare of people at work.
Workers Compensation Act 1987	Set out to provide for the compensation and rehabilitation of workers in respect of work related injuries.
Civil Liability Act 2002	Sets out to make provision in relation to the recovery of damages for death or personal injury caused by the fault or negligent of a person or organisation.
Other relevant Legislation	As required

3.3 Levels of Service

Council has defined service levels in two terms; Community Levels of Service and Technical Levels of Service.

Community Levels of Service relate to the function of the service provided and how the customer receives the service and are often best measured by customer research and surveys.

Supporting the community service levels are Technical Levels of Service which are measures of performance developed to ensure that the minimum community levels of service are met. These technical measures relate to service criteria such as:

- Condition;
- Function;
- Safety;
- Responsiveness; and
- Quality

Council's current service levels are defined under each class of asset in following Sections 5 to 11 of this plan.

In the previous Road Asset Management Plan 2010 the Community and Technical levels of service was related to numbers of Customer Requests and other measures that were not currently measured. In reviewing many of the Asset Management plans for other Council it has also been noted that current performance is not currently measured.

At present Council does not have a computerised Customer Request System to enable it to readily report on customer requests. In any case it is considered that customer requests may not give an accurate indication of asset condition across the full extent of the assets.

In this plan a practical approach has been taken to include performance targets and measures that Council is in a position to measure and achieve.

This takes into account the following:

- The relative size and quantity of assets compared with larger councils
- The detailed knowledge of staff and managers of the status, performance and maintenance of existing assets
- Regular contact and information exchange between Councillors/Staff and local residents
- Customer surveys
- Weekly Works Planning meetings that cover issues and actions across the full range of infrastructure
- Proposed regular (annual) audit of the condition of Roads, Kerb and Gutter and Footpaths, which will enable Council to measure changes in condition between audits
- The limited resources available to undertake detailed recording and monitoring of customer requests. The shortage of funds available to maintain assets in a condition that meet high levels of performance targets or unachievable customer expectations. For example, the plan indicates that additional funding of $900,000 per annum for sealed road renewal is required to avoid decline in condition
- Regularly repeated phone surveys (say every 4 years) will give the best indication of overall satisfaction levels with Councils services and facilities.

3.4 Lifecycle Management Plans

3.4.1 Introduction

The lifecycle management plans detail how Council plans to manage and operate the assets (at the agreed levels of service) while optimising lifecycle costs.

3.4.2 Asset Groups

Lifecycle management plans are defined for each of the key asset groups under each class of assets in Sections 5 to 11 that follow.

The lifecycle management plan outlines for each asset group:

- Background data – a description of the assets, capacity, performance and condition.
- Management tactics to achieve the identified levels of service for each asset group as included at the start of the Sections that cover each asset class. The management tactics are divided into the work categories defined under the next heading.

A summary of expenditure and changes to the asset base over the 10 year period is provided at the end of the section for each asset group. A complete financial summary is included in each Section.

3.4.3 Work Category Definitions

The work categories used for the lifecycle plans are defined below.

3.4.4 Maintenance and Operations

Maintenance is the day to day work that is necessary to keep assets operating, including instances where portions of the asset fail and need immediate repair to make the asset operational again. Appropriate levels of maintenance ensure that assets attain their full operational life expectancy.

Maintenance includes reactive, planned and cyclic maintenance work activities.

Reactive maintenance is unplanned repair work carried out in response to service requests and management/supervisory directions.

Planned maintenance is repair work that is identified and managed via a management system (not necessarily an information management system). Activities include inspection, assessing the condition against failure/breakdown experience, prioritising, scheduling, actioning the work and reporting what was done to develop a maintenance history and improve maintenance and service delivery performance. Local knowledge of Council Maintenance Supervisors and staff plays an important part in the identification and programming of repair work.

Cyclic maintenance is replacement of higher value components/sub-components of assets that is undertaken on a regular cycle including repainting, building roof replacement, etc. This work generally falls below the capital/maintenance threshold.

Operations are more applicable to provision of utility services including the operation of water supply, sewerage and waste assets. Typically, operations involves additional cost items beyond maintenance such as power use, chemical purchases, routine sampling and testing, staffing of facilities, meter reading and general monitoring of services.

3.4.5 Renewals

Renewal is major work which does not increase the asset's design capacity but restores, rehabilitates, replaces or renews an existing asset to its original service potential. Work over and above restoring an asset to original service potential is upgrade/expansion or new works expenditure.

3.4.6 New Works

New works are those works that create a new asset that did not previously exist, or works which upgrade or improve an existing asset beyond its existing capacity. They may result from growth, social or environmental needs. Assets may also be acquired at no cost to the Council from land development. These assets from growth are considered in each of Sections 5 to 11.

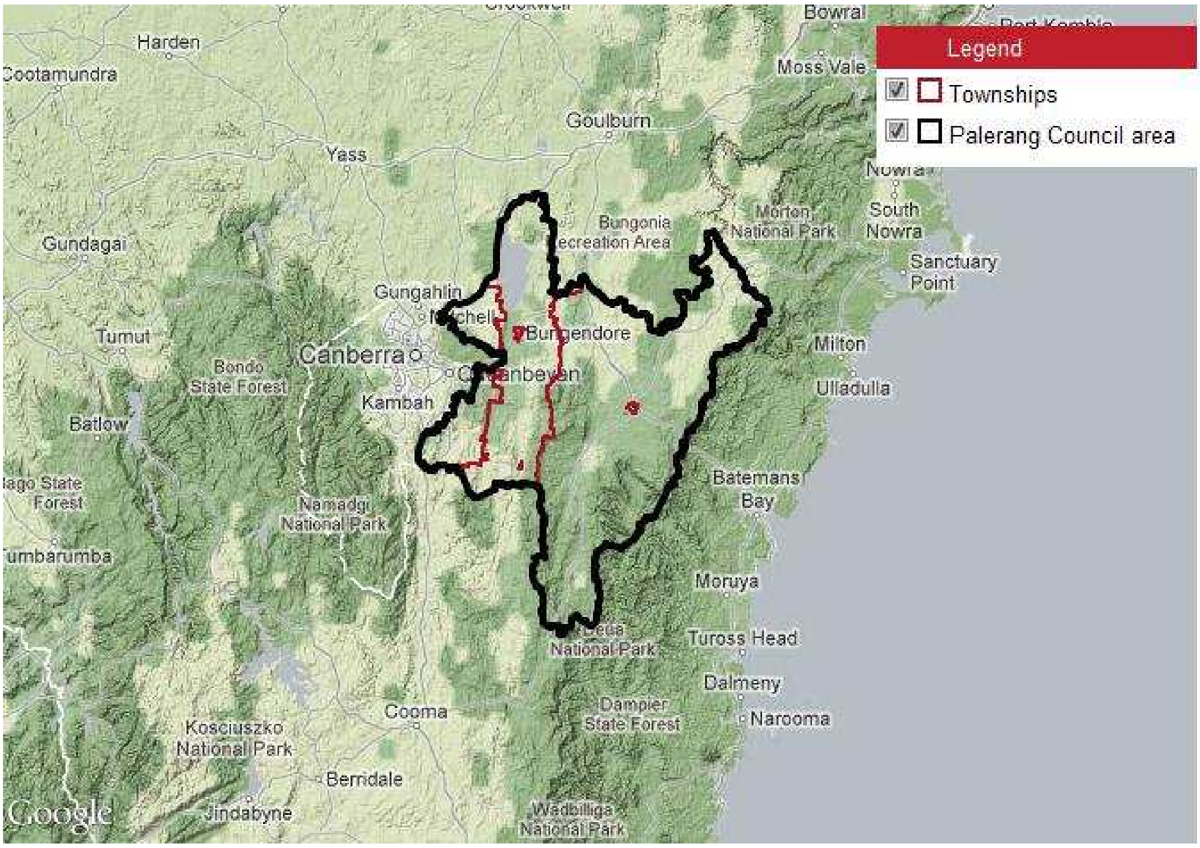
3.4.7 Disposals

Disposal includes any activity associated with disposal of a decommissioned asset including sale, demolition or relocation.

4 CATERING FOR PALERANG'S GROWTH

4.1 The Palerang Area

Palerang Council area is located in south-eastern New South Wales, immediately to the east of Canberra. Our Council area is predominantly rural, with some rural-residential areas and a number of small towns and villages. The Council area, with a population of 14,350 (2011 census), encompasses 5,140 square kilometres. The major town is Bungendore, followed by Braidwood and Captains Flat, with several smaller townships. Rural land is used mainly for cattle and sheep grazing, forestry, orchards and vineyards. Tourism is also an important industry. With an average population density of only 0.03 persons per ha, significant road length is required to provide vehicular access to our relevantly dispersed community.



The population of Palerang increased between 2006 and 2011 by 16.52% which is equivalent to 3.1% pa. This high growth is due to its close proximity to Canberra and its desirable topography and location between the ACT and the NSW South Coast.

A similar continuing growth rate is expected throughout the next decade and a further 1,400 - 1,600 extra building lots are expected to be created. This Asset Management Plan needs to consider future developments, their locations, the resulting higher populations and the new infrastructure assets that Council will acquire/need to provide as a consequence. In addition to population growth, other factors may also affect the demand for new infrastructure assets including changes in demographics, seasonal factors, consumer preferences and expectations, economic factors, agricultural practices and environmental awareness.

Over the next decade the new assets acquired will include new roads, bridges, drainage systems, water supply systems, sewerage systems, waste facilities, parks, playing fields, buildings and other community facilities.

Section 94 (Planning & Assessment Act) Development Plans will be applied to collect contributions from developments towards the upgrading and provision of new general fund assets and Section 64 (Local Government Act) Development Plans will be applied to collect developer contributions towards new water supply and sewerage assets and upgrades required as a result of developments.

For the purposes of analysing what demand there will be for new and upgraded assets, the Palerang LGA has been broken up into four separate localities that have different characteristics and drivers for growth. As discussed below the separate localities are as follows:

- Bungendore and Environs
- Braidwood and Environs
- Captains Flat and Environs
- Burra/Urila/Royalla

4.2 Bungendore and Environs

Over the next decade about 500 new lots are expected at Bungendore. In this time, the population will continue to grow at around 5% per annum from the current 2,800 to about 4,500 persons.

Bungendore is very popular as a place to live and to visit. It is within easy commuting distance of the ACT and Queanbeyan and provides a pleasant, friendly and safe country town atmosphere. House and land packages on larger lots at competitive prices have been attractive to new families who want to move to the town. Other families will also continue to move to Bungendore to be near their workplace at the new Defence Headquarters (HQJOC) which is only 10 kms south of the town.

There continues to be much interest from developers to develop extra lots and medium density housing.

Under the current planning scheme proposals, new development that will occur at Bungendore over the next 5 years is likely to be within the existing town boundaries where existing road infrastructure and utility services will be supplemented by a few new roads and utility service extensions within subdivisions of the existing larger town blocks.

Provided the 'soon to be' commissioned supplementary Currandooly Water Supply System proves to be sustainable to support a larger population, it can be expected that in the latter part of the decade some of the growth will be in 'greenfields' sites on the edge of the town. Under these circumstances extended road, drainage, water supply, sewerage and path networks will be required as well as additional parks and children's play grounds to serve these

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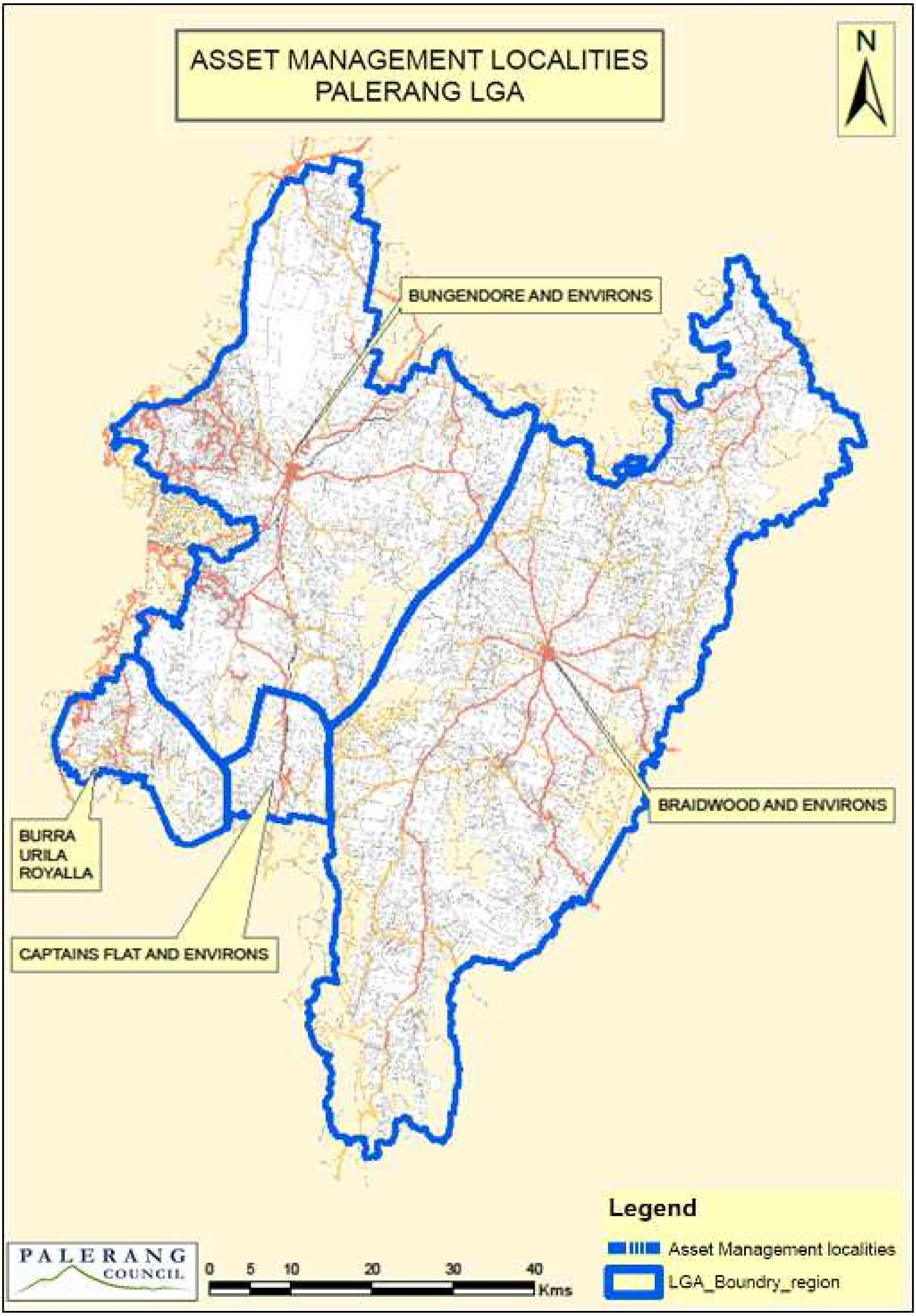

ASSET MANAGEMENT LOCALITIES
PALERANG LGA
N
BUNGENDORE AND ENVIRONS
BRAIDWOOD AND ENVIRONS
BURRA
URILA
ROYALLA
CAPTAINS FLAT AND ENVIRONS
Legend
Asset Management localities
LGA_Boundry_region
PALERANG COUNCIL
0 5 10 20 30 40
Kms

Provided the 'soon to be' commissioned supplementary Currandooly Water Supply System proves to be sustainable to support a larger population, it can be expected that in the latter part of the decade some of the growth will be in 'greenfields' sites on the edge of the town. Under these circumstances extended road, drainage, water supply, sewerage and path networks will be required as well as additional parks and children's play grounds to serve these developments. These will be provided as part of these developments and handed over to Council as subdivisions are released. This will occur prior to the new population that is being catered for, being in place. It is expected that there will be no new playing fields in these areas as a centralised playing field/sports complex is planned for the land on the western edge of town between Bungendore Road and Turallo Creek.

The Bungendore swimming pool has reached capacity for the current population and a larger pool is required to serve the future population of the catchment which can be expected to be over 8000 people within 10 years.

The area has reached a population where an ambulance station and town fire brigade should ideally be located with Council providing suitable land.

A steady but modest level of subdivisions is also expected to occur over the next decade within the Bungendore environs in the rural residential areas of Wamboin, Bywong, Sutton East and Carwoola. However, the rezoning of further significant areas as rural residential is unlikely as NSW Planning regional planning documents encourage new development in or close to existing towns where lots are more readily serviced and where reticulated water supply and sewerage are available.

About 70 % of a total potential yield of 500 extra lots is expected to occur in these areas over the next decade. Further rural subdivisions can be expected in the rural Mulloon and the Fairy Meadow parish areas where 40ha lots can be created.

There will be a few larger subdivisions that will create new roads but there will also many 2-3 lot subdivisions along existing sealed and unsealed roads. These latter subdivisions will add to traffic flows without adding new road assets. These will pay a S94 contribution to assist in upgrading the road network utilised.

The rural and rural residential subdivisions will also increase the demands for playing fields and other sporting and recreational facilities which will be provided for the district in Bungendore.

Many sections of the most used sealed roads have aging and failing pavements that will need continuing rehabilitation and widening to cater for increased traffic generation. These include Captains Flat Road, Macs Reef Road, Norton Road, the Federal Highway end of Bungendore Road, Tarago Road and Hoskinstown Road.

There are also a number of existing gravel roads with relatively high traffic counts that are expected to experience moderate increases in traffic due to extra but dispersed subdivisions away from Bungendore. Ideally, to provide the appropriate level of service and to address safety and dust impacts, some of these roads warrant bitumen sealing. These include Gidleigh Lane, Hoskinstown Road between Briars-Sharrow Road and Hoskinstown and Woolcara Lane.

4.3 Braidwood and Environs

Braidwood has not grown significantly over the last 2 decades and remains at about 1,200. It is expected that new lots will be created by modest levels of subdivision.

The staged 'greenfields' subdivision ('Braidwood Ridge') on the southern outskirts of the town is likely to be the main source of new lots and place of population growth in Braidwood for the next decade and longer. This development will add some new roads, drainage, water supply, sewerage and path assets and place demands for a children's playground and passive park space in this area. Along with a number of other small subdivisions of mainly 2-3 lots in the town and development of other rural subdivisions in the surrounding district it can be expected that there will be a higher level of demand on the town's playing fields at the Recreation Ground in Keder Street. These need to be upgraded to replace old and deficient amenities and under-sized playing fields at this ground.

Some of the new lots that are created may take some time to be occupied with a residence. Consequently there is likely to be a faster growth in the creation of new infrastructure assets than there will be growth in population. On past trends the population growth would be less than 1% however the expected opening of the new Dargues Reef Gold Mine at Majors Creek, employing about 60 employees, may add some impetus for growth.

Further rural subdivisions will also occur mainly in the old Tallaganda Shire areas, where concessional lot and 40 ha lot subdivisions have been allowed.

The boarder rural areas and the villages at Nerriga, Mongarlowe, Majors Creek and Araluen will experience continued slow development of rural subdivisions and some building activity in the village areas. The low employment prospects of the area restrict the population growth rate, especially in areas away from Braidwood. The sealing of MR 92 from Nowra towards Braidwood may make subdivision of 40ha lots and previously approved concessional lot subdivisions north of Braidwood more viable where new owners could commute the less than 1 hour trip to Nowra which is a larger commercial and industrial centre. The rural residential 1 (C) precinct on the eastern side of Mongarlowe is also likely to be developed with approvals having been given in recent years for lifestyle lots.

There are many sections of old and inadequate sealed pavements that are distressed and will require continuing rehabilitation to keep them in serviceable condition. The most distressed pavements are along Cooma Road, Nerriga Road, Majors Creek Road, Araluen Road and Little River Road.

There is also a need to upgrade and seal some unsealed Braidwood town streets serving multiple residences. These include Station St, Saleyards Lane/Gladys St and Hawthorne Lane.

The Nerriga Road needs to be bitumen sealed urgently over its 17 kms of gravel road to cater for the 400-600 vpd now travelling this road following the completion of the sealing of the Nowra to Nerriga section located mainly in Shoalhaven City Council's LGA in 2010.

Bridges at Back Creek and St Omers Creek need to be replaced as soon as possible, as they have reached the end of their life.

A growth rate in Braidwood and district of about 1% per annum is expected over the next decade.

4.4 Captains Flat and Environs

There is very little potential for new residential subdivisions at Captains Flat due to the surrounding steep topography and the rehabilitated but restricted old mine working areas. In fact, there has been a small decrease in population between the 2006 census and 2011 census to 437, even though there was an increase of 6 occupied dwellings.

There is also limited potential for future subdivisions in the surrounding areas apart from the possible creation of a few 80ha rural lots that may be approved. With 'averaging' allowed in the old Yarrowlumla Shire area the lot entitlements can be clustered thus reducing the length of new roads required to service them. One or two low standard access roads could be constructed as part of this activity but no other new infrastructure is expected.

Based on a no growth situation it can be accepted that there will be very little increase in demand for new infrastructure assets in Captains Flat and district, however the timber bridges over the Molonglo River will need replacement/refurbishment in the short term and the old community health centre building needs to be replaced with modern facilities

The Captains Flat Road, Wattle Avenue and sections of Jerangle Road, among other deteriorating sealed roads, are in urgent need of rehabilitation to maintain their serviceability.

4.5 Burra/Urila/Royalla

The potential for extra new large subdivisions on the western side the of Palerang LGA in these areas is becoming more limited as most of the larger properties in the Rural Residential 1(D) zones have already been subdivided.

Notwithstanding, there is some potential for some extra lots in the areas currently zoned rural residential 1(D).

A growth rate of less than 0.5% pa is expected where it is possible that 1 or 2 short new roads could be created to service the modest development levels.

The relatively high traffic counts of Urila Road and Williamsdale Road warrant that these roads should be upgraded and bitumen sealed in stages.

Many sealed sections of Burra Road already need rehabilitation and widening to ensure their serviceability into the future and the existing culvert over Burra Creek on Williamsdale Road needs to be replaced with a new, larger structure to improve the level of service especially during times of flood.

The Section 355 Committee responsible for the Royalla Reserve is planning to develop a community hall and recreational facilities on the site to meet community needs.

4.6 Tabulated Summaries of Future Asset Demand

The results of the above analyses are summarised in Attachment B under **Capital Works Needed** and **New Assets From Growth - Developer Funded Works**

5 ROADS AND DRAINAGE ASSETS

5.1 Current Levels of Service

Current levels of service for road and drainage assets are detailed in *Table 8* to *Table 14 below.* As stated in Section 3.1, Council residents are less satisfied with the standard of our roads in 2011 than in 2005. Due to the relatively small size of the Palerang Council, staff have a detailed knowledge of the condition of the road and drainage assets and where maintenance renewal work is required.

In Section 5.5 - Lifecycle Management for Road Asset Groups, it is demonstrated that additional funding is required to improve the service levels of Sealed and Unsealed roads.

It is proposed that regular condition audits of roads, kerb & Gutter and footpaths will be conducted. These audits, along with customer surveys, extensive local staff knowledge of asset condition and information from weekly Works Planning meetings, will be used to measure the ongoing performance.

Table 8 – Current Levels of Service (Sealed Pavements)

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
COMMUNITY LEVELS OF SERVICE				
Quality	Provide a smooth ride.	Customer surveys	Improved customer satisfaction	Reduced satisfaction from 2005 to 2011. To be compared against next survey
Function	Meet user requirements for travel time and accessibility.	Customer surveys	Improved customer satisfaction	Reduced satisfaction from 2005 to 2011. To be compared against next survey
Safety	Provide safe useable roads free from hazards.	Customer surveys	Improved customer satisfaction	Reduced satisfaction from 2005 to 2011. To be compared against next survey
TECHNICAL LEVELS OF SERVICE				
Condition	Adequately maintained sealed roads	Condition rating	Improvement in condition rating of bitumen seals	To be measured at next audit
Function	Roads are adequate to carry the required vehicles and loadings	Road inspection	Reduction in length of sealed pavement where posted pavement strength restricts loading demand.	To be measured at next audit
Safety	Defects are responded to as per the Draft Risk Management Policy for Roads.	Compliance against the Draft Policy.	X% compliance	Defects and actions are reported at weekly Works Planning meetings Review of Traffic accident data (Refer Attachment E)

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
	Routine inspections are carried out as per the Draft Risk Management Policy for Roads.	Compliance against the Draft Policy.	X% compliance	Regular audits are to be conducted. Council staff have a detailed knowledge of road safety condition through daily work activities and customer contact

Table 9 – Current Levels of Service (Kerb and Gutter)

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
COMMUNITY LEVELS OF SERVICE				
Function	Provide adequate kerb and gutter to ensure efficient disposal of stormwater run-off.	Flooding of properties	No flooding of properties under normal rainfall conditions	There is insufficient kerb and gutter in the urban areas
Safety	Provide safe useable roads free from hazards.	Ponding on roads.	No ponding on roads under normal rainfall conditions	There is insufficient kerb and gutter in the urban areas
	Provide a safe kerb and gutter free from hazards.	Unsafe kerb and gutter.	Improvement in condition between audits	To be measured at next audit
TECHNICAL LEVELS OF SERVICE				
Condition	Maintain kerb and gutter.	Condition rating.	Improvement in condition between audits	To be measured at next audit

Table 10 – Current Levels of Service (Unsealed Pavements)

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
COMMUNITY LEVELS OF SERVICE				
Quality	Provide a smooth ride.	Customer surveys	Improved customer satisfaction	Reduced satisfaction from 2005 to 2011. To be compared against next survey
Function	Meet user requirements for travel time and accessibility.	Customer surveys	Improved customer satisfaction	Reduced satisfaction from 2005 to 2011. To be compared against next survey

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
Safety	Provide safe useable roads free from hazards.	Customer surveys	Improved customer satisfaction	Reduced satisfaction from 2005 to 2011. To be compared against next survey
TECHNICAL LEVELS OF SERVICE				
Condition	Carryout routine grading as per documented frequencies for unsealed pavements.	Compliance against the grading schedule	Roads graded within + or – 10% of their grading frequency.	80%
Function	Provide all weather access by providing adequate cover of gravel on unsealed roads. Subject to available funding, upgrade gravel roads to seal road standard, once traffic count has reached 150 vpd AADT.	Occurrences and duration of roads being inaccessible. Length of gravel road sealed.	Maintain roads in condition that provides all weather access and seal gravel roads when traffic count threshold reached.	Next audit to measure any change in condition and length of gravel roads sealed.
Safety	Defects are responded to as per the Draft Risk Management Policy for Roads.	Compliance against the Draft Policy	Full compliance	Defects and actions are reported at weekly Works Planning meetings
	Routine inspections are carried out as per the Draft Risk Management Policy for Roads.	Compliance against the Draft Policy	Full compliance	Regular audits are to be conducted. Council staff have a detailed knowledge of road safety condition through daily work activities and customer contact

Table 11 – Current Levels of Service (Paths)

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
COMMUNITY LEVELS OF SERVICE				
Quality	Provide footpaths that are wide enough and in good condition	Regular audit of condition.	Maintain good condition	To be measured at next audit
Function	Meet user requirements for pedestrians, bike riders and people with disabilities.	Regular audit of condition.	Maintain good condition	To be measured at next audit

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
Safety	Provide safe useable footpaths free from trip and other hazards.	Regular audit of condition.	Maintain good condition	To be measured at next audit
TECHNICAL LEVELS OF SERVICE				
Condition	Provide and maintain paths.	Condition rating.	Improvement in condition between audits.	To be measured at next audit

Table 12 – Current Levels of Service (Drainage)

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
COMMUNITY LEVELS OF SERVICE				
Function	Provide adequate drainage to ensure efficient disposal of stormwater run-off.	Instances of flooding of properties.	No flooding of properties under normal rainfall conditions	Audit of drainage assets in progress
Safety	Provide safe useable roads free from hazards.	Instances of ponding on roads.	No ponding on roads under normal rainfall conditions	Audit of drainage assets in progress
	Provide a safe drainage system free from hazards.	Instances of unsafe drainage assets.	Maintain assets in good condition	Audit of drainage assets in progress
TECHNICAL LEVELS OF SERVICE				
Condition	Maintain drainage assets.	Condition rating.	Maintain drainage assets in good condition	Audit of drainage assets in progress

Table 13 – Current Levels of Service (Bridges and Major Culverts)

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
COMMUNITY LEVELS OF SERVICE				
Function	Meet user requirements for accessibility.	Instances of issues of accessibility	Issuers with access attended to promptly	Defects and actions are reported at weekly Works Planning meetings
Safety	Provide safe useable roads free from hazards.	Instances of issues relating to hazards on bridges and major culverts.	Issuers with hazards attended to promptly	Defects and actions are reported at weekly Works Planning meetings

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
TECHNICAL LEVELS OF SERVICE				
Condition	Maintain bridges and major culverts.	Condition rating.	Maintain bridges in good condition	25% of bridges (mainly timber) in poor to very poor condition
Function	Bridges are adequate to carry the required vehicles and loadings.	Bridge inspection.	Minimise number of bridges with loading or dimension restrictions	2

Table 14 – Current Levels of Service (Traffic and Transport Facilities)

Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
COMMUNITY LEVELS OF SERVICE				
Function	Meet user requirements for ease of navigation by providing adequate signage.	Signage provided in accordance with RTA guidelines	Signage provided and maintained in good condition	Issues and actions are reported at weekly Works Planning meetings
Safety	Provide safe conditions for night driving by providing adequate guide posts on rural roads.	Signage provided in accordance with RTA guidelines	Signage provided and maintained in good condition	Issues and actions are reported at weekly Works Planning meetings
TECHNICAL LEVELS OF SERVICE				
Function	Defects are responded to as per the Draft Risk Management Policy for Roads.	Compliance against the Draft Policy	Signage provided and maintained in compliance with Draft Policy	Issues and actions are reported at weekly Works Planning meetings
	Routine inspections are carried out as per the Draft Risk Management Policy for Roads.	Compliance against the Draft Policy	Signage provided and maintained in compliance with Draft Policy	Issues and actions are reported at weekly Works Planning meetings

5.2 Desired Levels of Service for Roads

At present, indications of desired levels of service are obtained from various sources including feedback from residents to Councillors and staff, service requests and correspondence. Council has yet to quantify desired levels of service. This will be done in future revisions of this asset management plan.

5.3 Future Demand for Road and Drainage Assets

5.3.1 Demand Forecast

A description of the expected demand for extra road assets is included in Section 5.4.

5.3.2 Changes in Technology

Technology changes may affect the delivery of services covered by this plan in the areas detailed in *Table 15* below. These changes in technology will need to be reflected in the financial forecasts of future versions of this plan as and when these technologies are introduced at Council.

Table 15 - Changes in Technology and Forecast Effect on Service Delivery

Technology Change	Effect on Service Delivery
Change in road construction methods	Use of existing road pavement materials for insitu stabilisation reducing construction and disposal costs.
Relining of pipes	Renewal of pipelines by relining reduces the impact and cost of work, whilst still extending the useful life of the pipeline.
Improvement of information systems and asset knowledge	Improvements in monitoring condition, capturing and analysing data, planning works and making information available to Council staff to enable more efficient service delivery Timely identification of maintenance and repair work to ensure achievement of asset life expectancy.

5.3.3 Demand Management Plan (Roads & Drainage)

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand and demand management. Demand management practices include non-asset solutions, insuring against risks and managing failures.

Opportunities identified to date for demand management are shown in *Table 16*. Further opportunities will be developed in future revisions of this asset management plan.

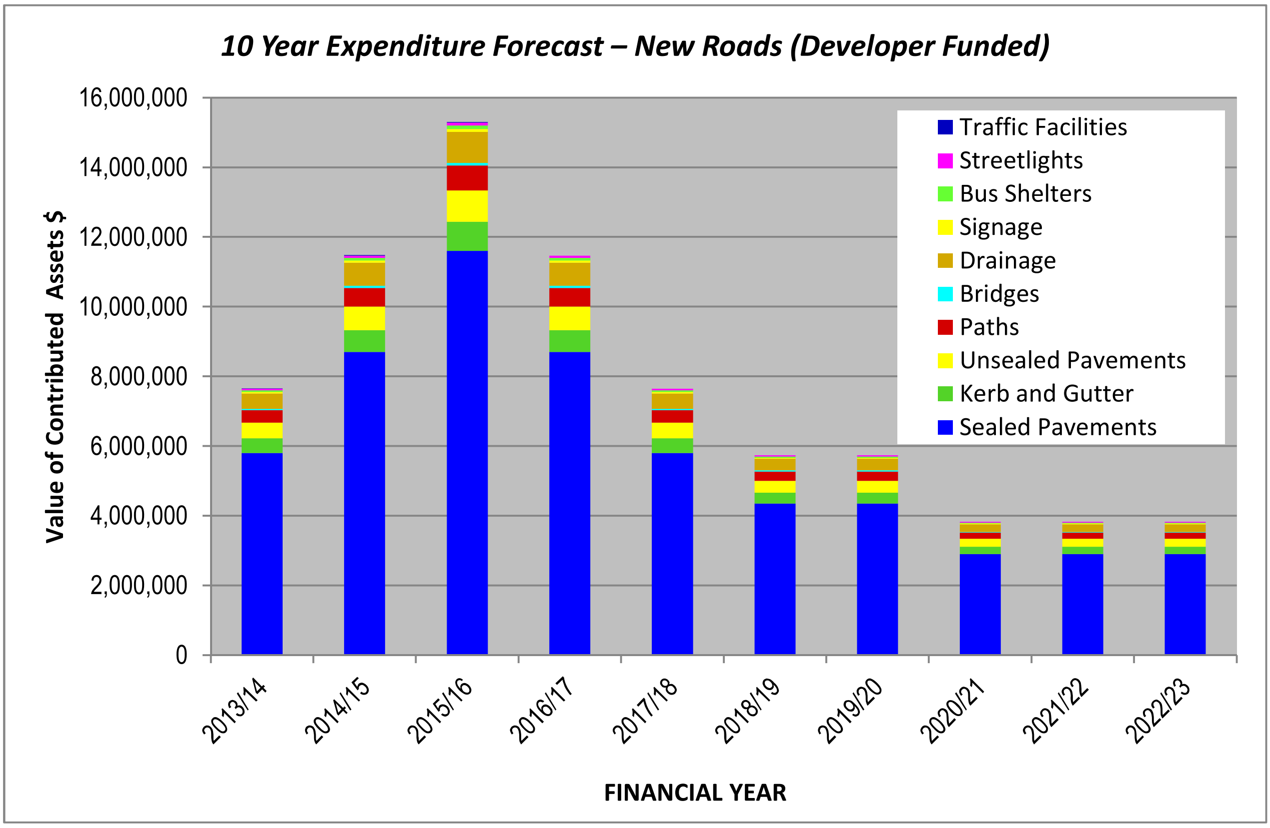
Table 16 - Demand Management Plan Summary

Service Activity	Demand Management Plan
Bridges	Use of load limits on bridges in poor condition where reasonable alternate access is available.
Sealed Pavement	Use of load limits on sealed pavements that are not designed to handle increased traffic loads.

5.4 New Road Assets from Growth

The new road assets required to meet growth will be acquired from land developments and others will be constructed by Council. A description of the expected extra road assets that will be acquired are tabulated in Attachment B and new asset values are summarised in *Figure 2* below. Acquiring these new assets will commit council to fund ongoing operations and maintenance costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operating and maintenance costs.

Figure 2 – 10 Year Expenditure Forecast – New Road Asset (Developer Funded)



5.5 Lifecycle Management for Road Asset Groups

Lifecycle management plans are defined for each of the key asset groups detailed below:

Section 5.5.1	Sealed Pavements
Section 5.5.2	Kerb and Gutter
Section 5.5.3	Unsealed Pavements
Section 5.5.4	Paths
Section 5.5.5	Drainage
Section 5.5.6	Bridges and Major Culverts
Section 5.5.7	Transport and Traffic Facilities

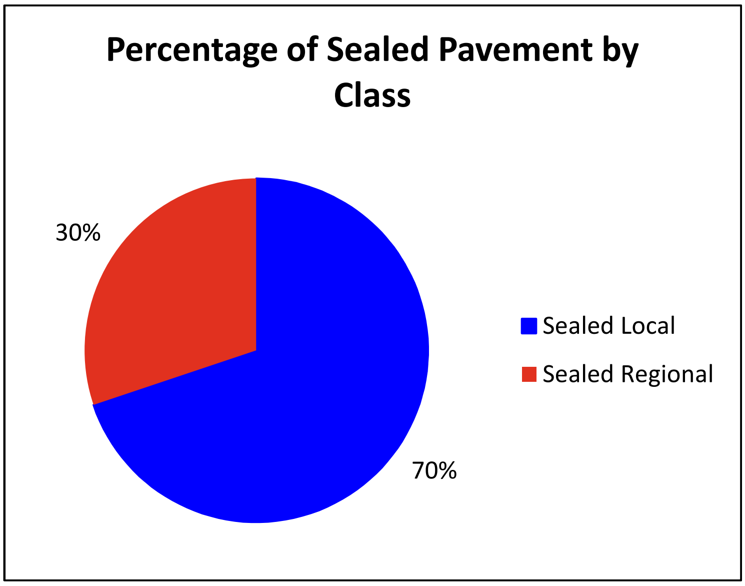
5.5.1 Sealed Pavements

5.5.1.1 Background Data

(a) Asset Description

Council is currently responsible for approximately 561km of sealed pavement, 394km of which is classed as Local and 167km as Regional. This is further illustrated in *Figure 3*

Figure 3 - Percentage of Sealed Pavement Length by Class



Data on sealed pavements is currently stored in Council's PARADOX Road Database. Each sealed pavement that Council is responsible for is identified in the database by a unique number (e.g. ID 1219 – Burra Road).

Each sealed pavement in the database is then further broken down into horizontal segments (Sealed Segments) identified by a second unique number (Segment Number) and a 'From' and 'To' description detailing where the segment is located in the field, which could be either a cross-road name or some obvious landmark such as a bridge, culvert or change of seal type.

Each segment is then further broken down into smaller horizontal sections (Sealed Sections) identified by a third unique number and the start and end chainage of the seal that was last placed on the road segment. Sealed pavements are re-segmented automatically in the database as reseals are entered into the database.

In addition to the horizontal break down, sealed pavements also comprise of 3 vertical components:

- Seal
- Pavement
- Formation

Formation is the area of disturbed natural ground that the pavement is formed on. Pavement is the area of compacted granular material above the formation and below the sealed top surface (seal).

In 2013 the roads data will be loaded into the Council's Asset Management System and linked to the road map. This will be used for the valuation and management of the road assets.

(b) Asset Capacity and Performance

There are an increasing number of failures of seal and pavement (e.g. edge break, potholes, and structural failures of pavement) which are causing a corresponding reduction in the level of service (e.g. reduction in speed, ride comfort, road width and aesthetics).

A number of sealed pavements do not comply with Council's current design standard. As a result, a number of roads are load limited to prevent accelerated deterioration as a result of heavy vehicle loadings.

(c) Asset Condition

A condition audit of sealed roads was conducted in July 2012. The audit was undertaken by Infrastructure Management Group Pty Ltd and involved digital image capture of the sealed road network to display pavement seals, kerbs, various roadside assets and footpath structures visible from roadside viewing. The detailed video was used to provide an accurate assessment of the sealed road network, including pavement defects & condition attributes (Crocodile Cracking, Linear Cracking, Pavement Defect, Local Surface Defects, No of Potholes, Edge Defects, Stripping, Flushing) at 20m increments, reported as the percentage of each defect for each road segment.

The road and condition data has been loaded into the Councils Asset Management and Predictive modelling systems which were acquired from Assetic Australia Pty Ltd in 2012.

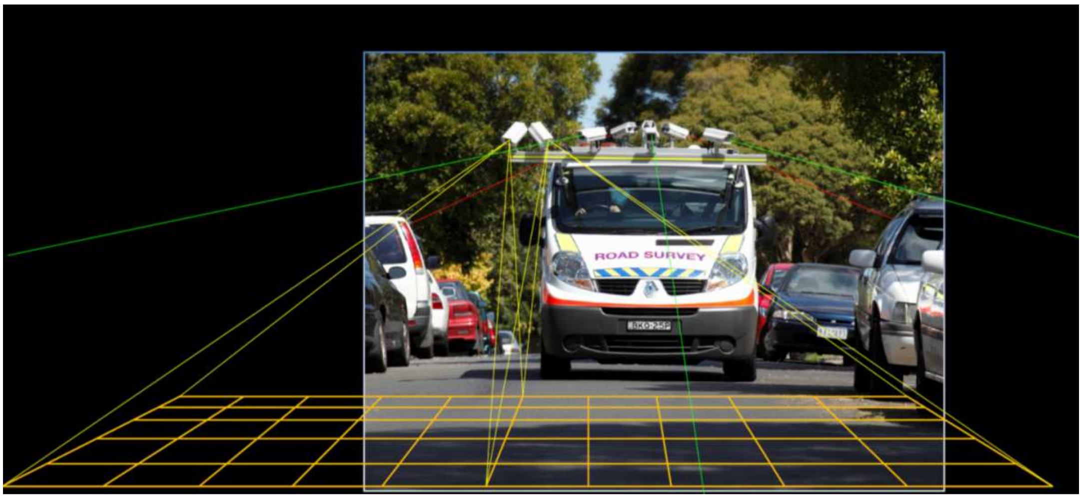
The road components are given a 1-5 condition rating which provides an assessment of the depreciated condition of the components and allows for prediction of the renewal and maintenance requirements for up to a 20 year period.

The worst of the roads requiring rehabilitation include the following:

- Burra Road – older sections
- Captains Flat Road – older sections
- Hoskinstown Road
- Norton Road – Sutton Road to Weeroona Road
- Macs Reef Road
- Bungendore Road – north of Macs Reef Road
- Plains Road – eastern end
- Wattle Avenue
- Jerangle Road - at Captains Flat village boundary
- Cooma Road – especially between Braidwood and Captains Flat Road
- Majors Creek Road
- Araluen Road
- Park Lane
- Nerriga Road
- Little River Road - older sections

Graphs indicating the severity and extent of pavement distress for each of the above roads are included in **Attachment C** and a map of Road Crash locations for 2005 to 2012 is shown in **Attachment E**

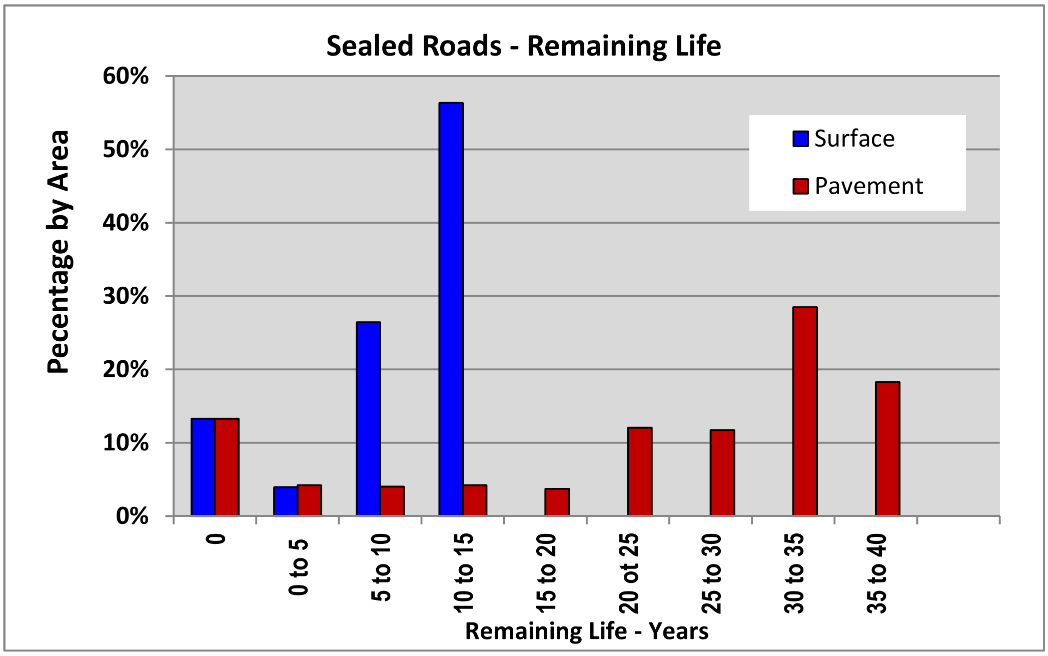
The Councils intention is to conduct regular condition audits of the sealed roads (ideally on an annual basis). This will provide an up to date accurate assessment of road condition and the effect of expenditure on road renewal and maintenance. It will also provide for ongoing modelling of the road condition and funding requirements for renewals and maintenance.



Infrastructure Management Group data audit vehicle and equipment

The remaining useful life (as a percentage of asset area) for seals and pavements is detailed in *Figure 4* below.

Figure 4 - Remaining Useful Life - Sealed Pavements



According to *Figure 4* approximately 21% of pavements (by area) are approaching the end of their useful life within the next 10 years.

5.5.1.2 Maintenance

(a) Maintenance Activities

Maintenance of sealed pavements is predominantly reactive. Activities include:

- Pothole repairs;
- Surface defect repairs;
- Edge break repairs;
- Crack sealing;

- Heavy patching;
- Vegetation clearing;
- Spraying; and
- Line marking.

(b) Maintenance Expenditure Trends

Maintenance expenditure trends are shown in *Table 17*.

Table 17 - Maintenance Expenditure Trends

Year	Maintenance Expenditure
2010/11	$608,000
2011/12	$862,000
2012/13 budget	$502,000

Reactive, planned and cyclic maintenance works have not been identified separately in the table above. Assessment and prioritisation of maintenance is currently undertaken by Council staff using experience and judgement. Council staff regularly traverse a major proportion of the road network as part of their work activities or transit to and from work. Any road condition issues are reported to Maintenance Supervisors. This information, as well as customer requests and audit of the road condition, is used to establish work programs for road maintenance. The introduction of predictive modelling of regular condition audits will aid this process.

(c) Maintenance Standards and Specifications

Maintenance work is carried out in accordance with the following Standards and Specifications.

- AUS-SPEC #1 – Development Specification Series Design
- Various RTA standards for construction and materials; and
- Various Australian standards for testing and materials.

5.5.1.3 Renewals

(a) Renewal Plan

A seal may be renewed independently of the underlying pavement. The adopted useful life for a seal is 15 years, whereas that of a pavement is 40 years. A seal may therefore be renewed several times prior to the underlying pavement requiring renewal. Renewal of a pavementwill always require renewal of the accompanying seal. At the pavement renewal stage there will be a significant amount of residual pavement and a total replacement is not required.

The results of the sealed road audit have been analysed in the predictive modelling system for the current budget on renewals and for an optimal level of renewal funding.

Forecast renewal dates for the 1- 5 condition ratings are shown in *Table 18*. Forecast renewal dates have been identified from the remaining useful life estimates as detailed in Section 5.5.1.1.

Renewal of the formation is driven by catastrophic events (e.g. major washout), redevelopment, or the need for realignment. No significant formation reconstruction is planned for the 10 year time frame of this plan.

Table 18 - Renewal Forecast of Sealed Pavements

Condition Rating	Surface Remaining Life	Pavement Remaining Life
1	15	40
2	10	22
3	7	14
4	3	6
5	0	0

The predictive modelling for the current expenditure and optimal expenditure on sealed road renewals is shown below.

	Sealed Roads Current Spend			Sealed Roads Optimal Spend		
Period	Renewal	Required Maintenance	Total	Renewal	Required Maintenance	Total
10 Years	20,446,000	12,317,000	32,763,000	29,397,000	5,797,000	35,194,000
20 Years	40,895,000	32,868,000	73,763,000	49,156,000	6,934,000	56,090,000

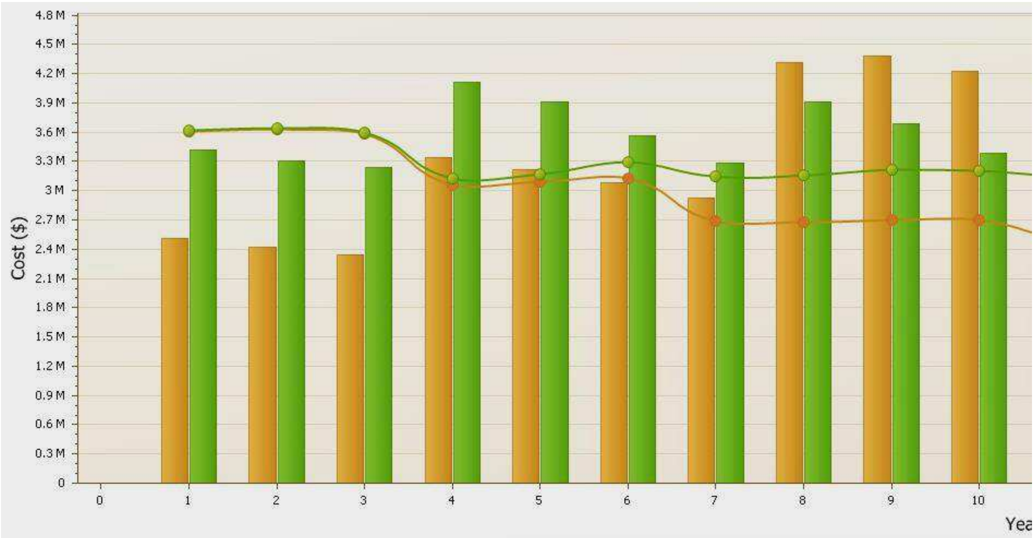
The optimal budget involves the provision of an additional $900,000 per annum on renewals.

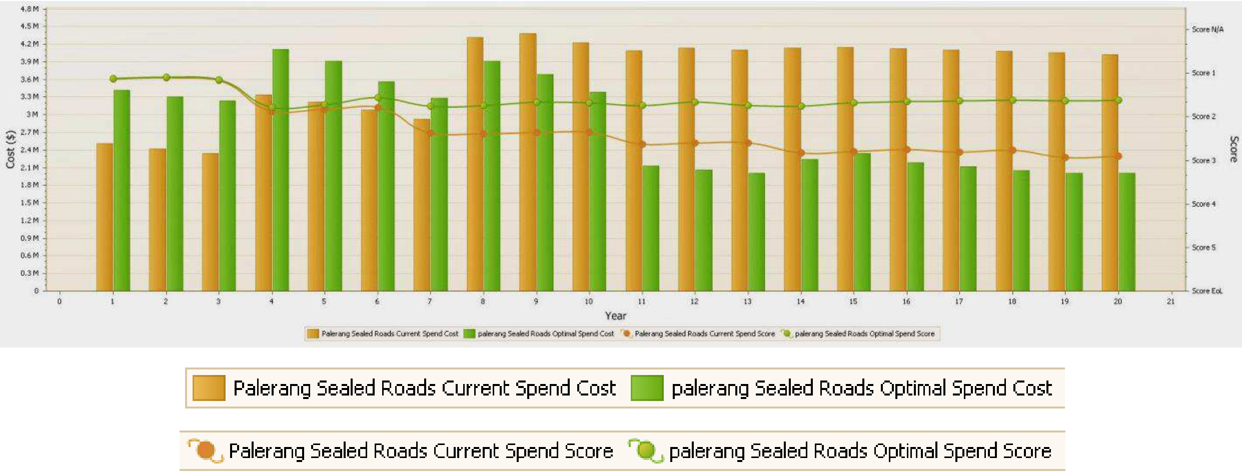
The current budget results in an escalation of the required maintenance budget due to inadequate renewal expenditure. The maintenance requirement for the 10 year period is $12,317,000 compared with the current budget of about $5,000,000

Over a 20 year period, with an increase in the renewal budget of $900,000 per annum for the first 10 years, the total expenditure is about $24,000,000 less compared with the current level of expenditure on renewals. This results from the large amount of expenditure required on maintenance due to the more rapid degradation of the road condition and amount required to keep the roads operational.

A comparison of the road condition rating for the alternative budgets on is shown below.

Figure 5 – Road Condition Rating and Budget Comparison





This indicates that over the 20 year period the current level of funding will result in many roads being well below expected service levels.

The above modelling does not take into account extra work effort which is typically required at renewal for the road to be upgraded to meet latest design standards (strength, width and alignment) for the current and predicted road traffic loads and usage. This particularly applies in high growth areas. The works required therefore have a renewal and new asset component to increase service capacity. Typically, the new asset component adds about 50% above the straight renewal cost.

Attachment B details Council staff's assessed need for renewal projects, identified as priorities 1 & 2 and extended reseal and rehabilitation programs, to overcome these deficiencies over the 10 year period of the plan and are summarised as follows

Environs	Length (km)	Amount
Braidwood	36.3	$15,585,000
Bungendore	23.6	$12,069,000
Burra/Urila/Royalla	3.2	$1,725,000
Captains Flat	2.8	$732,000
All Areas – extended reseals and rehabilitation program		$7,500,000
Total:	71.9	$37,611,000

(b) Renewal Standards and Specifications

Standards and specifications for the renewal of existing assets are the same as those for maintenance shown in Section 5.5.1.2 in addition to the following document:

- Road Access Requirements for Rural, Rural Residential and Environmental Protection Zones, 27 July 2004.

5.5.1.4 New Works

(a) Creation / Acquisition / Upgrade Plan

Engineering staff currently make an assessment of the need for projects to build new assets and upgrade/expand existing assets based on their knowledge of the network, expected growth in traffic and feedback to date from the community. Further revisions of this plan will formalise methodologies for establishing future capital works programmes for undertaking Council funded road and drainage projects. This will include setting priorities and timeframes based on expected revenues.

(b) New Works Standards and Specifications

Standards and specifications for new assets and for upgrade/expansion of existing assets are the same as those for renewal shown in Section 5.5.1.2.

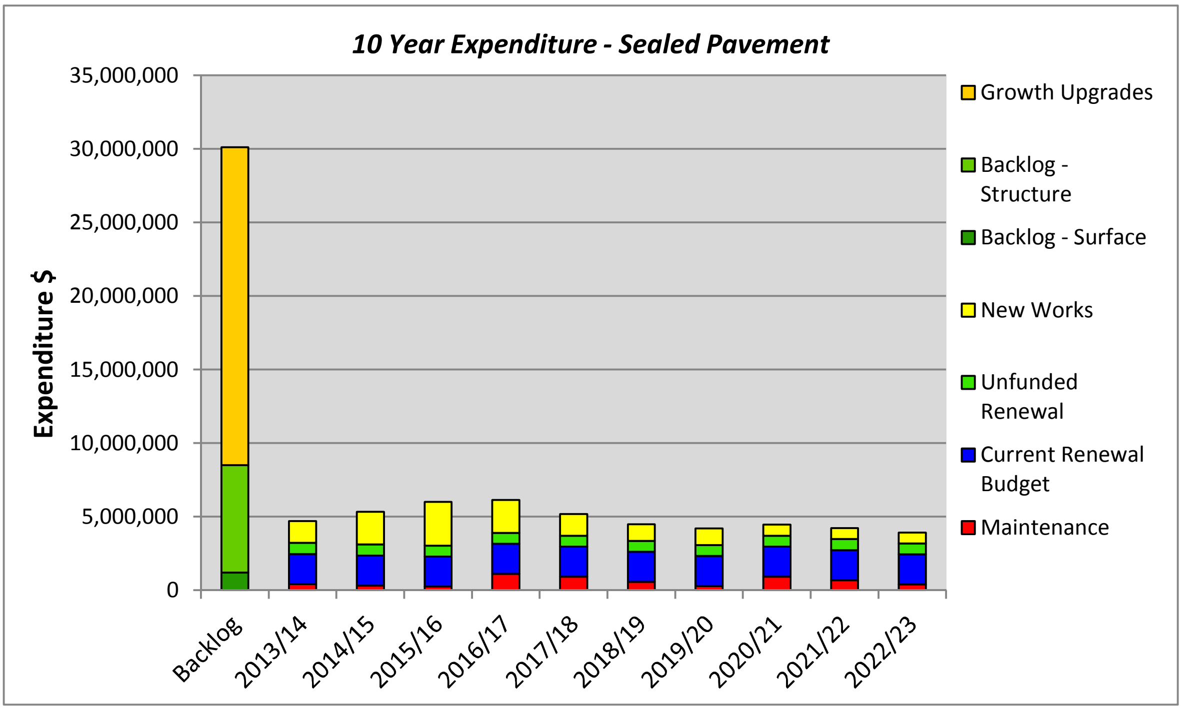
5.5.1.5 Disposal Plan

No sealed pavement assets have been identified for possible decommissioning or disposal.

5.5.1.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 6* below.

Figure 6 – 10 Year Expenditure - Sealed Pavement



5.5.2 Kerb and Gutter

5.5.2.1 Background Data

(a) Asset Description

Council is currently responsible for approximately 47km of kerb and gutter. The distribution of kerb and gutter by length across the major town centres is:

- Bungendore – approximately 29km
- Braidwood – approximately 14km; and
- Captains Flat – approximately 4km.

Approximately 1.2km of kerb and gutter is made of bluestone (all located within Braidwood) with the remainder made of concrete.

Data on kerb and gutter was initially collected in the field by Council staff in January 2010 and has been maintained for any additions. Approximately 5 km of kerb and gutter has been constructed since 2010. The data is currently stored in a spreadsheet and is being prepared for input to the Asset Management System for revaluation of the Kerb and Gutter for 2012/13.

Each kerb and gutter asset is currently identified by a description that details the 'From and To' road name that the asset is associated with as well as the side of the road that the asset belongs to.

(b) Asset Capacity and Performance

There is insufficient kerb and gutter in the urban areas causing ponding, which in turn accelerates pavement condition deterioration and reduces level of service (e.g. nuisance, reduced safety and other asset failures).

(c) Asset Condition

The Road audit provided details of the Kerb & Gutter condition which has been used to update the condition rating of these assets. Kerb and gutter condition was assessed using the grading system detailed in Attachment D. The condition profile for kerb and gutter is detailed in *Figure 7* below.

***Figure 7* – Kerb and Gutter Condition Profile**

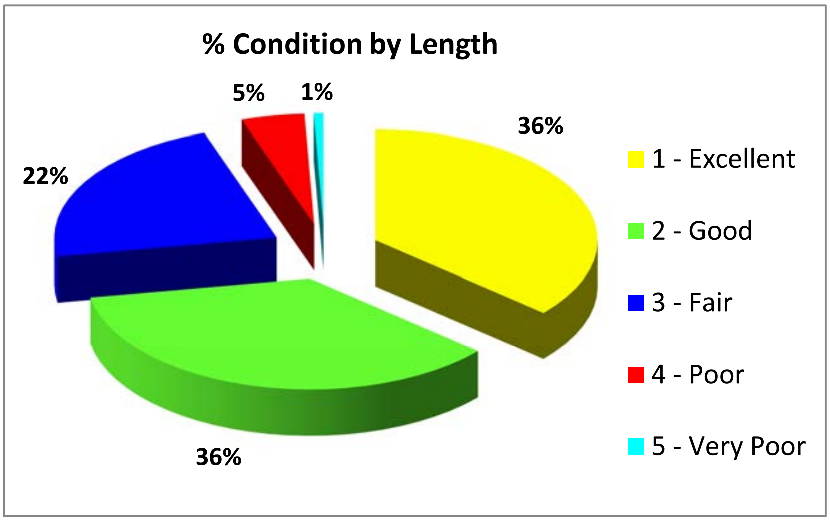


Figure 7 shows that approximately 6% of kerb and gutter is in poor or very poor condition.

5.5.2.2 Maintenance

(a) Maintenance Activities

Maintenance of kerb and gutter is predominantly reactive. Activities include:

- Grinding; and
- Replacement of small lengths of kerb and gutter;

(b) Maintenance Expenditure Trends

Maintenance expenditure trends are shown in *Table 19.*

Table 19 - Maintenance Expenditure Trends

Year	Maintenance Expenditure
2010/11	$2,290
2011/12	$6,530
2012/13 budget	$39,351

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

Maintenance work is carried out in accordance with the same Standards and Specifications detailed for sealed pavement in Section 5.5.1.2.

5.5.2.3 Renewals

(a) Renewal Plan

Forecast renewal dates have been identified from the condition data as detailed in Section 5.5.2.1(c). A useful life of 75 years has been adopted for this plan.

Unfunded renewals (renewals that have been identified but not carried out prior to the first year of the plan) are estimated to be approximately $46,000. No further kerb and gutter is currently forecast to be renewed within the 10 year time frame of this plan.

(b) Renewal Standards and Specifications

Renewal work is carried out in accordance with the same Standards and Specifications detailed for sealed pavements in Section 5.5.1.2.

5.5.2.4 New Works

(a) Creation / Acquisition / Upgrade Plan

The process for identifying and prioritising the Creation / Acquisition / Upgrade of kerb and gutter is the same as that detailed for sealed pavements in Section 5.5.1.4.

Attachment B details Council staff's Assessed Need for New Works.

(b) New Works Standards and Specifications

Standards and specifications for new assets and for upgrade/expansion of existing assets are the same as those for renewal shown in Section 5.5.1.2.

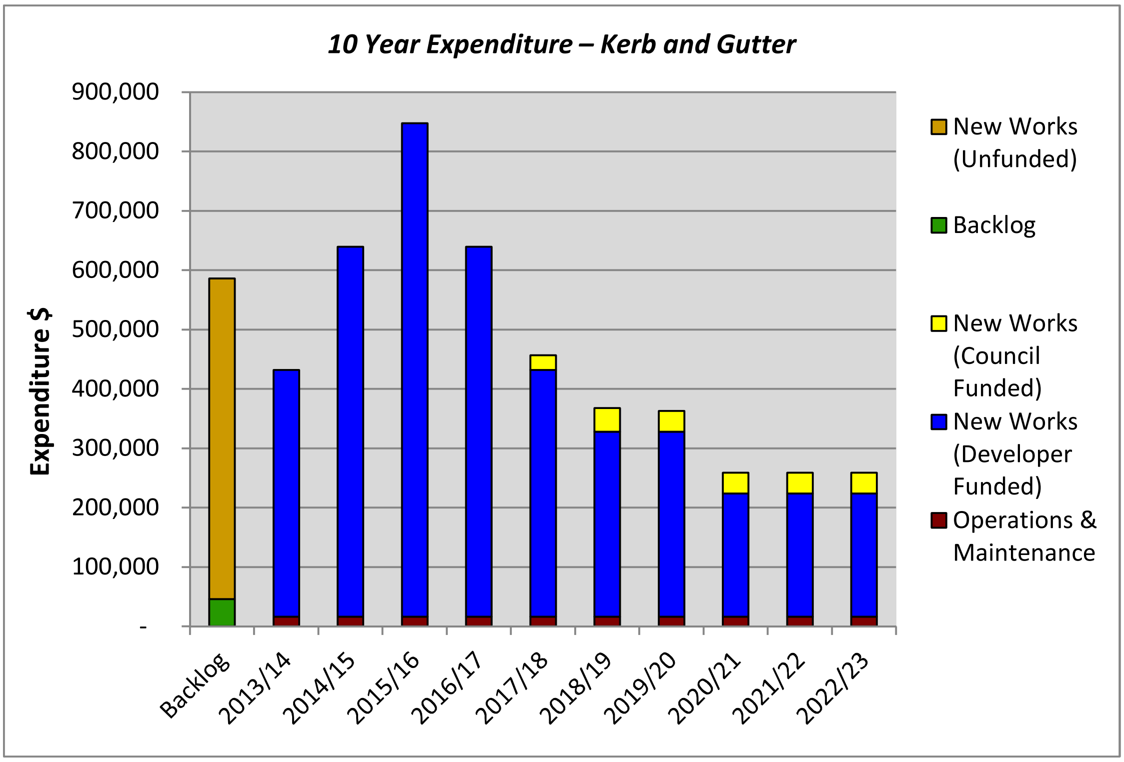
5.5.2.5 Disposal Plan

No kerb and gutter has been identified for possible decommissioning or disposal within the time frame of this 10 year plan.

5.5.2.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 8.*

Figure 8 - 10 Year Expenditure – Kerb and Gutter



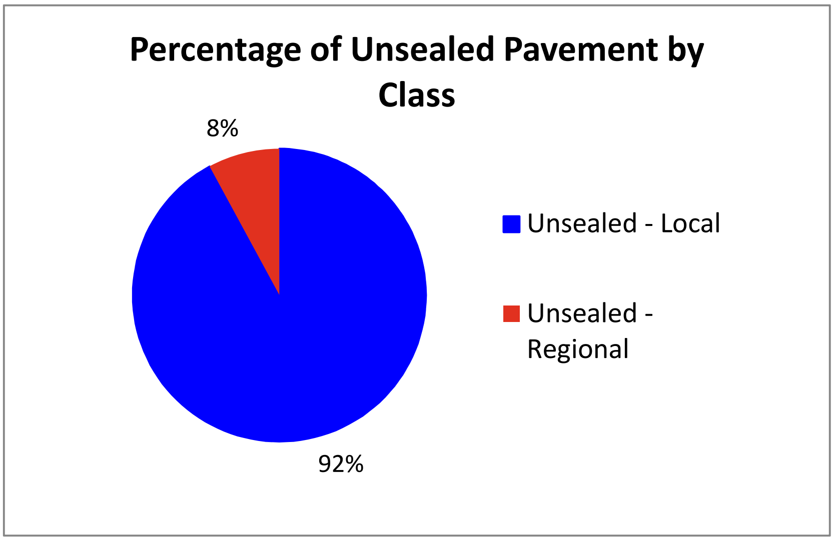
5.5.3 Unsealed Pavements

5.5.3.1 Background Data

(a) Asset Description

Council is currently responsible for approximately 747km of unsealed pavement, 688km of which is classed as Local and 59km as Regional. This is further illustrated in *Figure 9.*

Figure 9 – Unsealed Pavement by Class



Data on unsealed pavements is currently stored in Council's PARADOX Road Database. Each unsealed pavement that Council is responsible for is identified in the database by a unique number (e.g. ID 1000 – Mayfield Road).

Each unsealed pavement in the database is then further broken down into horizontal segments (Unsealed Segments) identified by a second unique number (Segment Number) and a 'From' and 'To' description detailing where the segment is located in the field, which could be either a cross-road name or some obvious landmark such as a bridge, culvert or a gate.

In addition to the horizontal break down, sealed pavements also comprise of 2 vertical components:

- Pavement; and
- Formation

Formation is the area of disturbed natural ground that the pavement is formed on. Pavement is the area of compacted granular material above the formation.

(b) Asset Capacity and Performance

The following unsealed pavements require consideration for upgrade to sealed pavement.

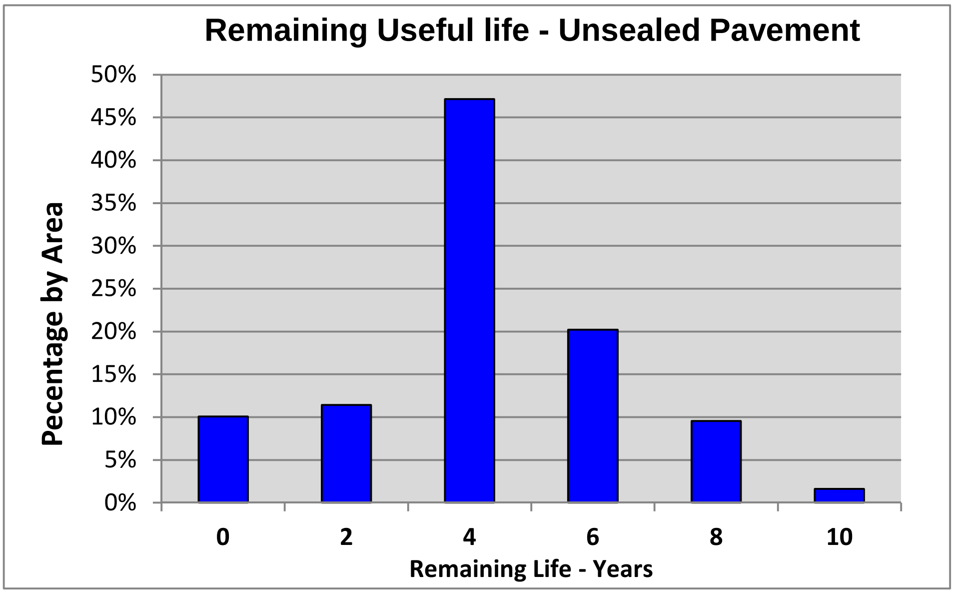
- Nerriga Road – 17km
- Woolcara Lane – 5.2km
- Gidleigh Lane – 6.8km
- Urila Road – 2.0km to Hardy Road
- Wlliamsdale Road – 5.8km remaining length
- Hoskinstown Road – 4.9km to Hoskinstown
- Various town streets

Unsealed pavements are considered for upgrade to sealed pavements if there is a traffic volume of 120-150 vpd and other factors (such as potential for traffic growth, unsafe alignment, dust nuisance/hazard, insitu materials and geographic location) which impact on the safety and amenity of the road and warrant the work. **Attachment F** provides details of the Decision Criteria for Sealing Gravel Roads. A map of Road Crash locations for 2005 to 2012 is shown in **Attachment E** and is referred to in the process for setting priorities for sealing of unsealed roads

(c) Asset Condition

Pavement condition was assessed in December 2012. This consisted of a workshop evaluation by the Regional Maintenance Supervisors to determine the condition of the pavement shape and depth of each unsealed road segment based on their experience with the pavement assets. Unsealed Segments range in length in the database from 4m to 7,800m for Local unsealed pavements and 20m to 12,700m for Regional unsealed pavements. The short segments are generally for causeways, bridges and major culverts. When the data is set up in the Asset Management System, the road segments will be reconfigured so that the maximum segment length is 1200 metres, to provide for more detailed management of maintenance data. The remaining useful life (as a percentage of asset area) for unsealed pavements is detailed in *Figure 10* below.

Figure 10 - Remaining Useful Life - Unsealed Pavements



5.5.3.2 Maintenance

(a) Maintenance Activities

Maintenance of unsealed pavements predominantly involves periodic grading. The frequency of grading ranges from 4 months to 3 years and is dictated by the traffic volume of the unsealed pavement. This is further detailed in *Table 20* below.

Table 20 – Grading Frequency of Unsealed Pavements

Category	Grading Frequency (months)	Criteria
3	3	340 vpd < AADT < 360 vpd
4	4	180 vpd < AADT < 260 vpd
5	6	80 vpd < AADT < 200 vpd
6	12	50 vpd < AADT < 100 vpd
7	18	20 vpd < AADT < 60 vpd
8	24	AADT < 40 vpd (Public Roads (dedicated and crown roads) previously not maintained by Council (prior to 1/7/05) but 4.0m wide and serving two or more residences.
9	36	0 vpd < AADT < 20 vpd
10	Not Maintained	Unformed Crown and dedicated roads, rights of way, public roads less that 4m wide and/or serving only one residence.

(b) Maintenance Expenditure Trends

Maintenance expenditure trends are shown in ***Table 21****.*

Table 21 - Maintenance Expenditure Trends

Year	Maintenance Expenditure
2010/11	$795,000
2011/12	$760,000
2012/13 budget	$787,000

An annual grading schedule is prepared using the Grading Frequency Criteria and last grading dates. Work done is monitored against the schedule on a weekly basis. Adjustment to the schedule is undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

Maintenance work is carried out in accordance with the same Standards and Specifications detailed for sealed pavement in Section 5.5.1.2 in addition to the following document:

- Unsealed Roads Manual – Guidelines to Good Practice, ARRB, 3rd Edition, March 2009.

5.5.3.3 Renewals

(a) Renewal Plan

Forecast renewal dates have been identified from the condition data as detailed in Section 5.5.3.15.6.1(c).

The useful life for pavements (the gravel sheeting) is between 5 – 12 years depending on traffic counts. An average useful life of 10 years has been adopted for this plan. Based on road use and accounting for some roads being in areas with natural gravel subgrade, it is estimated that that 600 km (80%) of pavement will require renewal within the 10 year time frame of this plan. About 10% of these pavements are at the end of their useful life and is regarded as backlog. This equates to a backlog of $1,500,000 and approximately $1,350,000 per annum for a total of $15,000,000 over 10 years.

There is a significant length (about 46 km) of unsealed roads that require renewal with sealed roads to bring them up to satisfactory standard to meet the current road usage. Attachment B details Council staff's assessed need for renewal works to overcome these deficiencies

The need for sealing of gravel roads with traffic counts greater than 150 vpd is summarised as follows.

Environs	Length (km)	Amount
Braidwood	19.8	$13,380,000
Bungendore	15.8	$4,897,000
Burra/Urila/Royalla	9.1	$2,785,000
Captains Flat	1.4	$540,000
Total:	46.1	$21,602,000

Renewal of the formation is driven by catastrophic events (e.g. major washout), redevelopment, or the need for realignment. Sealing of gravel roads will include formation upgrading.

(b) Renewal Standards and Specifications

Renewal work is carried out in accordance with the same Standards and Specifications detailed for sealed pavements in Section 5.5.1.2.

5.5.3.4 New Works

(a) Creation / Acquisition / Upgrade Plan

The process for identifying and prioritising the Creation / Acquisition / Upgrade of unsealed pavements is the same as that detailed for sealed pavements in Section 5.5.1.4.

Attachment B details Council staff's Assessed Need for New Works.

(b) New Works Standards and Specifications

Construction of new assets and upgrade/expansion of existing assets is carried out in accordance with the same Standards and Specifications detailed for sealed pavements in Section 5.5.1.2.

5.5.3.5 Disposal Plan

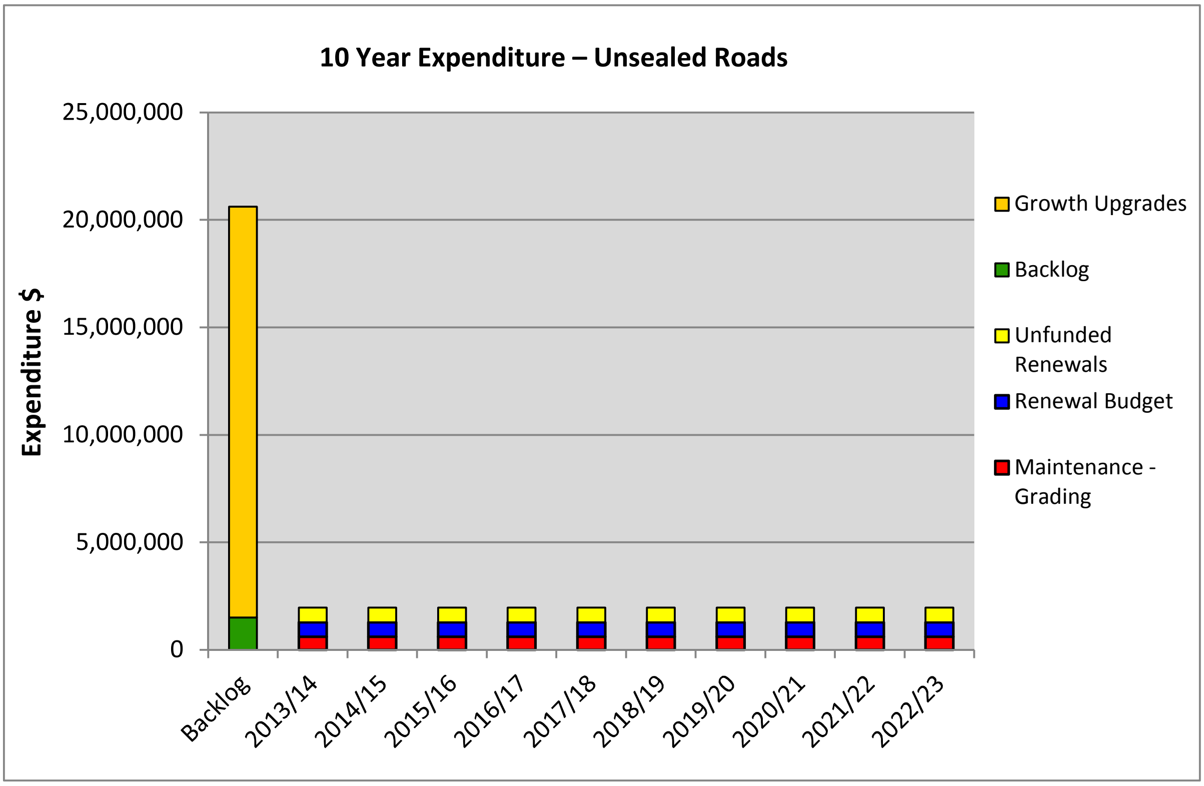
Unsealed pavement assets that have been identified for disposal will be upgraded to sealed pavements as detailed in Attachment B (Council's Assessed Need for New Works).

5.5.3.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in Figure 11 is as follows

- Maintenance Grading $610,000 p.a.
- Current renewal budget $660,000 p.a.
- Unfunded renewals $690,000 p.a.
- Renewal/Upgrading Backlog $21,612,000

Figure 11 - ***10 Year Expenditure – Unsealed Pavement***



5.5.4 Paths

5.5.4.1 Background Data

(a) Asset Description

Council is currently responsible for approximately 13.7km of path. The distribution of path by length across the major town centres is:

- Bungendore – approximately 9.4km
- Braidwood – approximately 3km; and
- Captains Flat – approximately 1.3km.

Approximately 11.6km of paths are made of concrete with the remainder made of asphaltic concrete, segmented pavers and gravel.

Data on paths was collected in the field by Council staff in January 2010 and is currently stored in a spreadsheet. This data has been updated for new paths, mainly constructed in Bungendore, such as in Ellendon Street and the shared paths in Bungendore Park and along Turallo Terrace. Each path asset is currently identified by a description that details the ‘From and To’ road name that the asset is associated with as well as the side of the road that the asset belongs to.

(b) Asset Capacity and Performance

About 2 km of new concrete paths have been constructed since 2010. However, there is still insufficient extent of paths in the urban areas causing the public to walk on roads. People with disabilities are not adequately catered for in some locations.

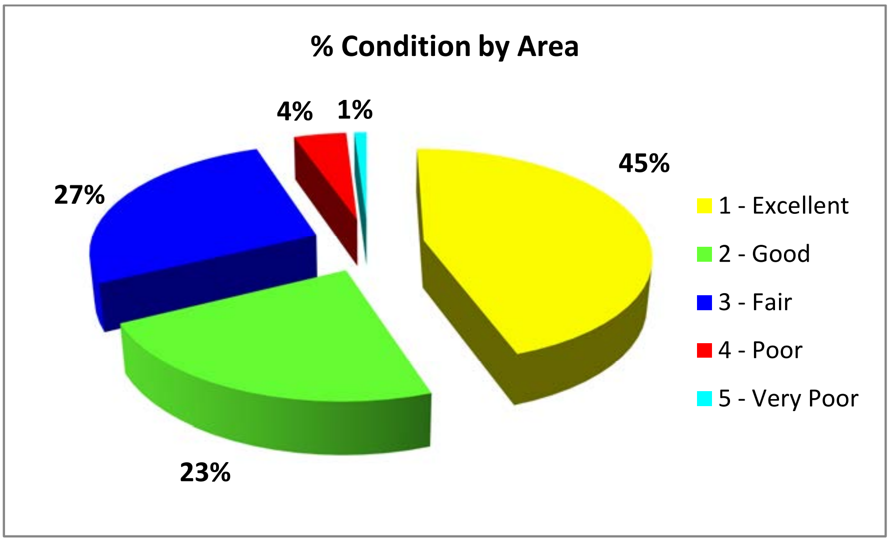
(c) Asset Condition

Path condition was assessed in January 2010 using the grading system detailed in Attachment D. The condition assessment was carried out by Council staff. The assessment has been updated for the new paths and repair work on existing paths. The condition profile for paths is detailed in Figure 12 below.

A condition audit of the footpaths was undertaken in December 2012. When the results of the audit have been compiled and are available the data will be loaded into the Asset Management System

Path Condition Profile

Figure 12 - Path Condition Profile



5.5.4.2 Maintenance

(a) Maintenance Activities

Maintenance of paths is predominantly reactive. Activities include:

- Grinding; and
- Replacement of sections;

(b) Maintenance Expenditure Trends

Maintenance expenditure trends are shown in ***Table 22Table 27***.

Table 22 – Maintenance Expenditure Trends

Year	Maintenance Expenditure
2010/11	$22,500
2011/12	$24,250
2012/13 budget	$12,800

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement. A significant amount of the maintenance relates to grinding uneven joints between adjacent footpath slabs.

(c) Maintenance Standards and Specifications

Maintenance work is carried out in accordance with the same Standards and Specifications detailed for sealed pavement in Section 5.5.1.2.

5.5.4.3 Renewals

(a) Renewal Plan

Forecast renewal dates have been identified from the condition data as detailed in Section 5.5.4.1(c). Useful lives of 50 years for concrete paths, 30 years for asphaltic concrete paths and 15 years for gravel paths have been adopted for this plan.

The total projected renewal of paths is approximately $17,000 over the 10 year time frame of this plan. In addition, unfunded renewals (renewals that have been identified but not carried out prior to the first year of the plan) are estimated to be approximately $40,000. It is not expected that the condition audit data will significantly effect the projected renewals for the 10 year time frame

(b) Renewal standards

Renewal work is carried out in accordance with the same Standards and Specifications detailed for sealed pavements in Section 5.5.1.2.

5.5.4.4 New Works

(a) Creation / Acquisition / Upgrade Plan

The process for identifying and prioritising the Creation / Acquisition / Upgrade of paths is the same as that detailed for sealed pavements in Section 5.5.1.4.

A Bike Plan & Pedestrian Access and Mobility Plan was developed by Hub Traffic and Transport for Bungendore and Braidwood in 2009. The identified works to implement the recommendations from this plan was estimated to be $340,000 per annum over a 5 year period. This amount has not been included in the expenditure forecast for paths as Council has not yet committed to the suggested programme of works.

Attachment B details Council staff's Assessed Need for New Works.

(b) New Works Standards and Specifications

Construction of new assets and upgrade/expansion of existing assets is carried out in accordance with the same Standards and Specifications detailed for sealed pavements in Section 5.5.1.2. Minimum pedestrian path width is 1.2m and ideal shared path (pedestrian and cyclist) width is 2.5m.

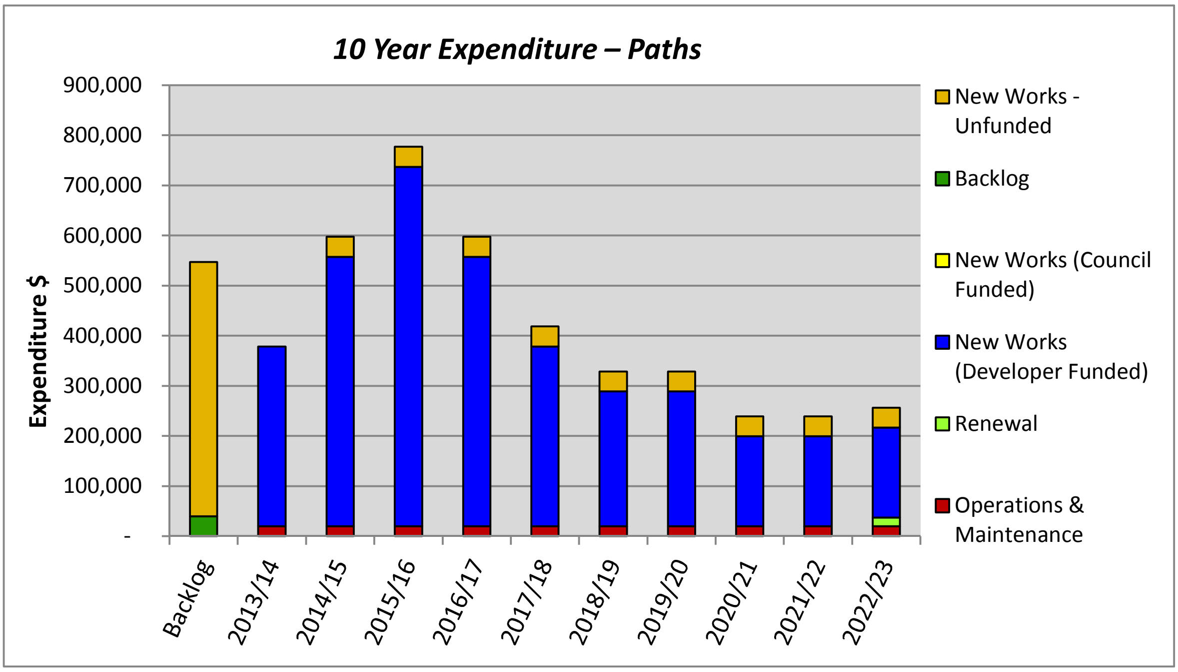
5.5.4.5 Disposal Plan

No path assets have been identified for possible decommissioning or disposal within the time frame of this 10 year plan.

5.5.4.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in Figure 13, *below.*

Figure 13 - *10 Year Expenditure – Paths*



5.5.5 Drainage

5.5.5.1 Background Data

(a) Asset Description

The drainage asset group consists of:

- Pipes;
- Pits / Manholes; and
- Culverts and Headwalls.

There are some gaps in the data for drainage assets. For example, there are a number of drainage assets, including open drains and gross pollutant traps, where the data has not been collated from hard copy records or condition data has not been collected.

<u>Urban Drainage</u>

The data on pipes was collected from Works as Executed drawings. The distribution of drainage pipes across the major town centres is:

- Bungendore –15.3km and about 910 pits, manholes or headwalls;
- Braidwood –0.8km and about 100 pits, manholes or headwalls; and
- Captains Flat – 2.0km with about 110 pits, manholes or headwalls.

The number of pits / manholes has obtained from the drawings or assumed that there is a pit, manhole or headwall at each end of a pipe section

Rural Drainage

A program for collection of culvert details and condition assessment of the pipes and headwalls was commenced in 2010 using local staff. To date 2650 culverts have been audited, representing about 70% of all culverts. The total number of culverts is estimated at 3780 with total length of 38.7km (35.1km pipes, 3.5km box culverts)

The distribution of pipe culverts size is as follows

Pipe Diameter (mm)	%
< 375	4.3
375	24.6
450	25.1
525	4.2
600	15.0
700 - 900	15.4
1000 - 1800	11.4

The 3.5 km of box culverts have an average width of 900mm and average depth of 1500mm

There are approximately 6,700 headwalls

Data on culverts is currently stored in an MSAccess database and is being configured for loading into the Asset Management System

(b) Asset Capacity and Performance

There is insufficient drainage in both urban and rural areas.

There is open drainage in the urban areas which needs to be placed underground for safety and aesthetics reasons.

(c) Asset Condition

The collection of data for rural culverts has provided condition information for about 70% of the assets. This information has been used to estimate the condition for all rural culverts.

There is a large gap with condition data for drainage in the urban areas. In 2010 an estimate of the condition of pipes for Braidwood was provided by Council's Assets and GIS Officer using the grading system detailed in Attachment D. An estimated construction date has been allocated to the remaining urban drainage assets in order to estimate a remaining useful life and hence the timing for renewal.

Due to the importance of drainage in urban areas and the impact of any issues with poor condition any problems are attended to as a matter of priority.

5.5.5.2 Maintenance

(a) Maintenance Activities

Maintenance of drainage is predominantly reactive. Activities include:

- Clearing of pits;
- Clearing culverts; and
- Repairing / replacing headwalls.

(b) Maintenance Expenditure Trends

Maintenance expenditure trends are shown in ***Table 23***.

Table 23 - Maintenance Expenditure Trends

Year	Maintenance Expenditure
2010/11	$201,000
2011/12	$87,000
2012/13 budget	$151,000

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement. The culvert audit has been used to identify the most urgent requirements for repairs and maintenance. Some cleaning and repair work was undertaken as a result of damage caused during the 2011 floods.

(c) Maintenance Standards and Specifications

Maintenance work is carried out in accordance with the same Standards and Specifications detailed for sealed pavement in Section 5.5.1.2.

5.5.5.3 Renewals

(a) Renewal Plan

Forecast renewal dates have been based on condition data for the pipe assets located in Braidwood and age for the remaining drainage assets as detailed in Section 5.5.5.1(c). A useful life of 40 years for pipes / pits, and 50 years for culverts / manholes has been adopted for this plan.

The total projected renewal of drainage assets is approximately $330,000 over the 10 year time frame of this plan. In addition, unfunded renewals (renewals that have been identified but not carried out prior to the first year of the plan) are estimated to be approximately $80,000 and is attributed to rural culverts and headwalls.

(b) Renewal standards

Renewal work is carried out in accordance with the same Standards and Specifications detailed for sealed pavements in Section 5.5.1.2.

5.5.5.4 New Works

(a) Creation / Acquisition / Upgrade Plan

The process for identifying and prioritising the Creation / Acquisition / Upgrade of drainage assets is the same as that detailed for sealed pavements in Section 5.4.

Attachment B details Council staff's Assessed Need for New Works.

(b) New Works Standards and Specifications

Construction of new assets and upgrade/expansion of existing assets is carried out in accordance with the same Standards and Specifications detailed for sealed pavements in Section 5.5.1.2.

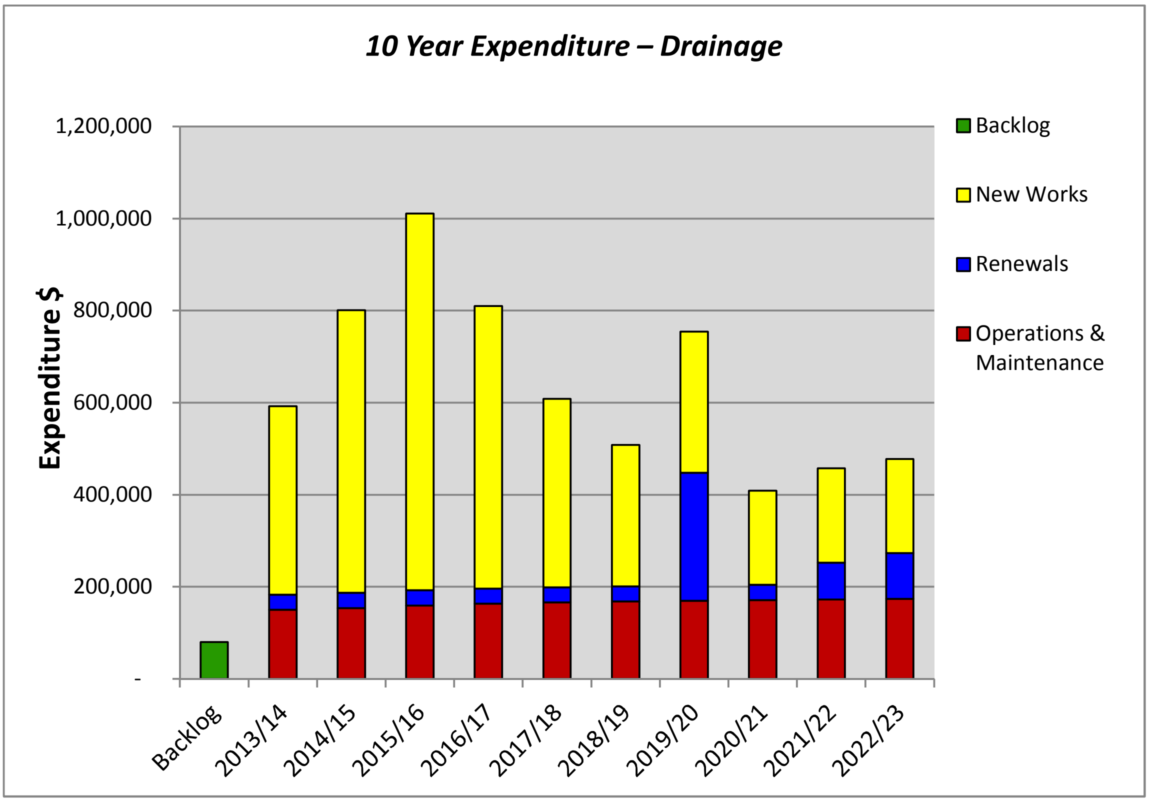
5.5.5.5 Disposal Plan

No urban drainage assets have been identified for possible decommissioning or disposal within the time frame of this 10 year plan.

5.5.5.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in Figure 14.

Figure 14 - *10 Year Expenditure – Drainage*



5.5.6 Bridges and Major Culverts

5.5.6.1 Background Data

(a) Asset Description

Council is currently responsible for 119 bridges and major culverts. The bridges and major culverts asset group consists of:

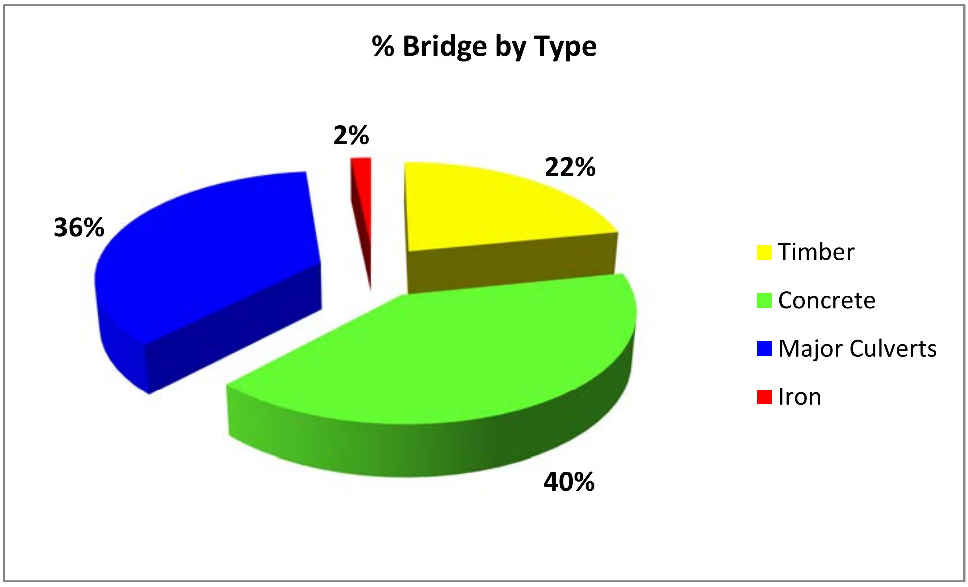
- Timber Bridges (26)
- Concrete Bridges (48)
- Iron Bridges (2)
- Major Culverts (culverts that have a span of greater than or equal to 6m – 43 in total).

Three timber bridges have been replaced with concrete since 2010, as follows

- Jembaicumbene Creek Bridge on Captains Flat Road
- Pipeclay Creek Bridge on Stewarts Crossing Road
- Tindery Creek Bridge on Urila Road

The distribution of bridges by type of bridge is detailed in Figure 15, below.

Figure 15 - *10 Year Expenditure – Drainage*



(b) Asset Capacity and Performance

Timber bridges are approaching the end of their useful life and there is a lack of availability of structural timber material for repairs.

There is currently load limits on Foxlow Bridge, the Molonglo River Bridge on MR270 and Back Creek Bridge and each has been reduced to single lane access.

(c) Asset Condition

The condition of bridges and major culverts condition was assessed in January 2010. This consisted of a desktop evaluation (except for timber bridges) by the Director Works using the grading system detailed in Attachment D. The condition of timber bridges is assessed annually via field inspections. The condition has been updated for the 3 timber bridges that have been replaced with concrete

The condition profile for bridges (by bridge type) is detailed in Figure 16 to 18 below.

The assessed condition for all major culverts is 3 (Fair Condition).

Figure 16 – Timber Bridge Condition Profile

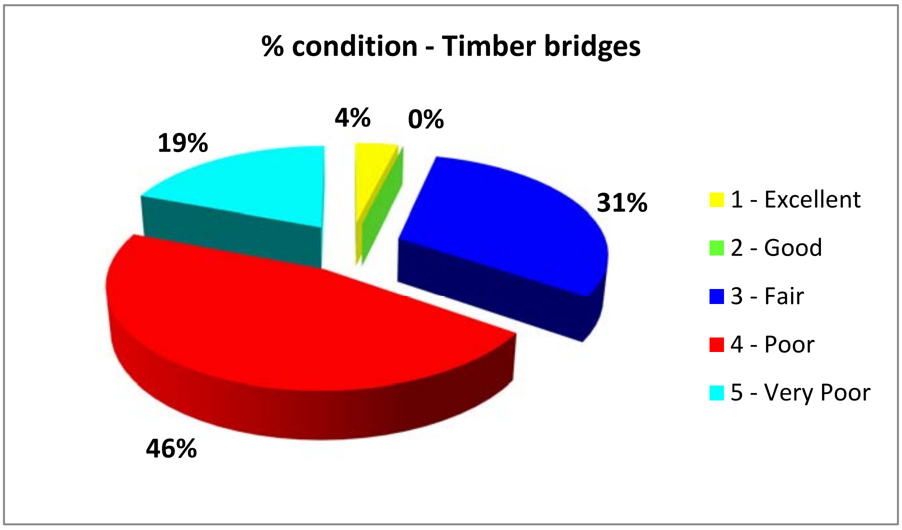


Figure 17 – Concrete Bridge Condition Profile

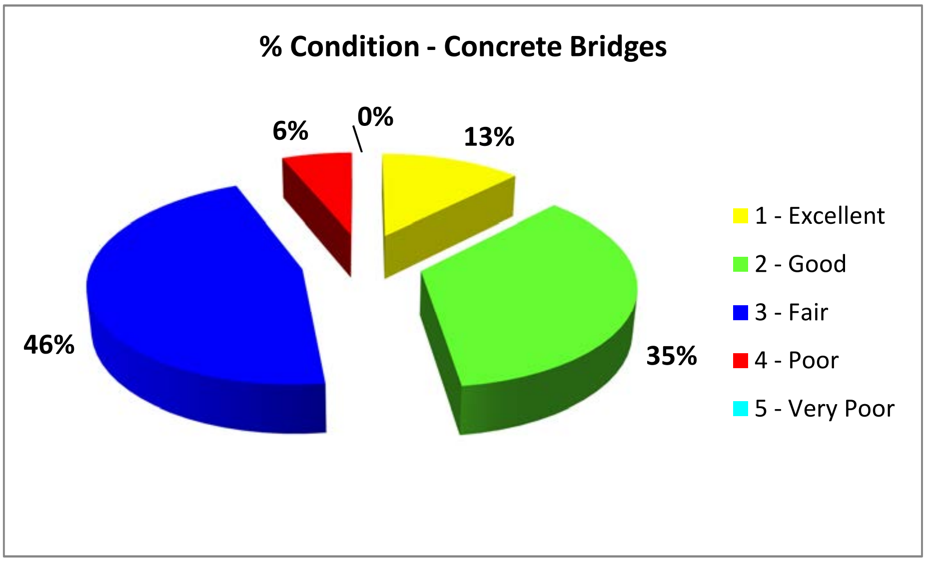
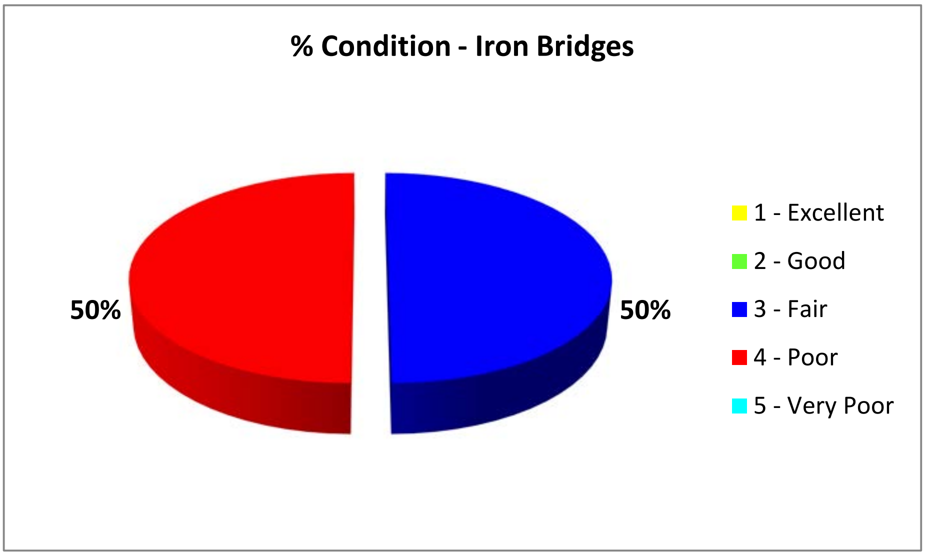


Figure 18 – Iron Bridge Condition Profile



A field based condition assessment is required on all bridges and major culverts to verify the desktop evaluation.

5.5.6.2 Maintenance

(a) Maintenance Activities

Maintenance of major culverts is predominantly reactive, however annual condition assessments are carried out on timber and concrete bridges. Activities include:

- Replacement of components of timber bridges; and
- Debris clearing out of major culverts.

(b) Maintenance Expenditure Trends

Maintenance expenditure trends are shown in *Table 24.*

Table 24 - Maintenance Expenditure Trends

Year	Maintenance Expenditure
2010/11	$94,400
2011/12	$169,900
2012/13 budget	$88,300

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

Maintenance work is carried out in accordance with the same Standards and Specifications detailed for sealed pavement in Section 5.5.1.2. In addition, the following standards are followed:

- VicRoads Bridge Inspection Guidelines

5.5.6.3 4Renewals

(a) Renewal Plan

Forecast renewal dates have been identified from the condition data as detailed in Section5.5.6.1. Useful lives of 40, 80, 75 and 50 years have been adopted for timber bridges, concrete bridges, iron bridges and major culverts respectively for this plan.

Unfunded renewals (renewals that have been identified but not carried out prior to the first year of the plan) are estimated to be approximately $3,775,000 and is attributed to timber bridges listed in Table 25. Further timber bridge renewals and large culverts at flood prone causeways, estimated at $5,500,400, are forecast to be required within the 10 year time frame of this plan.

Table 25 – Unfunded Timber Bridges renewal

Road Name	Bridge Name	Renewal Cost
Nerriga Road	St Omers Creek Bridge	$305,000
Captains Flat Road	Back Creek Bridge	$1,300,000
Reidsdale Road	Bedding Ground Creek Bridge	$350,000
Foxlow Street	Foxlow Street Bridge (Molonglo River)	$350,000
Captains Flat Road	Molonglo River Bridge	$1,000,000
Other Major repairs		150,000
	Total:	**$3,305,000**

(b) Renewal standards

Renewal work is carried out in accordance with the same Standards and Specifications detailed for sealed pavements in Section 5.5.1.2. For the purpose of this plan, it has been assumed that timber bridges will be replaced by concrete bridges.

5.5.6.4 New Works

(a) Creation / Acquisition / Upgrade Plan

The process for identifying and prioritising the Creation / Acquisition / Upgrade of drainage assets is the same as that detailed for sealed pavements in Section 5.5.1.4.

Attachment B details Council staff's Assessed Need for New Works.

(b) New Works Standards and Specifications

Construction of new assets and upgrade/expansion of existing assets is carried out in accordance with the same Standards and Specifications detailed for sealed pavements in Section 5.5.1.2.

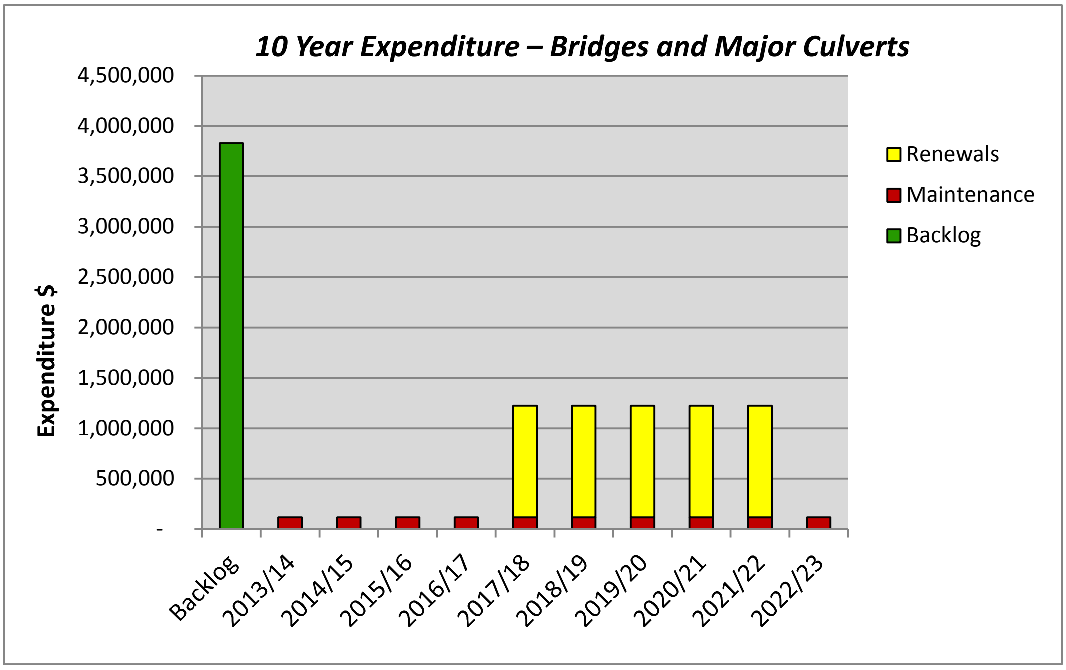
5.5.6.5 Disposal Plan

No bridges or major culverts have been identified for possible decommissioning or disposal within the time frame of this 10 year plan.

5.5.6.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in Figure 19.

Figure 19 - ***10 Year Expenditure – Bridges and Major Culverts***



5.5.7 Transport and Traffic Facilities

5.5.7.1 Background Data

(a) Asset Description

The transport and traffic facilities asset group consists of:

- Signs;
- Guide Posts; and
- Bus Shelters.

Traffic islands and pedestrian refuges are also part of the transport and traffic facilities group, and will be included in future revisions of this plan.

All of the data on signs has been obtained by sampling. Approximately 46km (3.5% of total road length) was sampled. Extrapolation of the sampled data gives a total of approximately 3,465 signs.

Data on guide posts for sealed roads was compiled using a review of the road condition video audit for a sample of 19km of sealed roads. This indicates that there is 1 guide post per side per 65 m of road. This equates to a normal spacing of 100m with additional guide posts on corners plus extra 2 guide posts for culverts. Using a normal spacing of 1 guide post per 250 of rural unsealed road (per side) there would be 1guide post per side per 160m for unsealed roads. This gives a total of about 24,500 guide posts

Data on bus shelters has been obtained via a field survey in 2010. There are a total of 26 bus shelters, the majority of which are constructed from timber / colourbond or metal / colourbond.

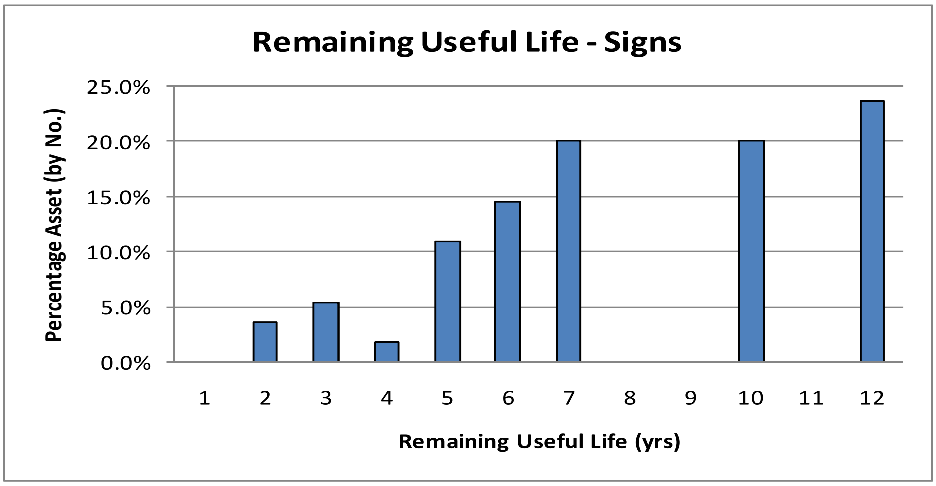
(b) Asset Capacity and Performance

There is a lack of guide posts on unsealed roads.

(c) Asset Condition

Sign condition was assessed in January 2010. The condition assessment was carried out by Council field staff on the sample of signs that were used to gather the inventory data. The remaining useful life (as a percentage of the total number of signs) is detailed in *Figure 20* below.

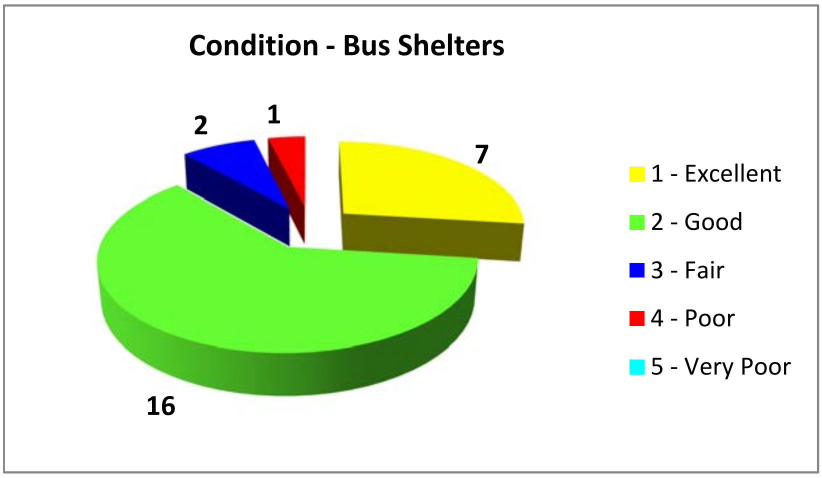
Figure 20 - Remaining Useful Life – Signs



Condition assessment of guide posts is not carried out.

Bus shelter condition was assessed in August 2010. The condition assessment was carried out by Council field staff using the grading system detailed in Attachment D. A condition profile is detailed in *Figure 21* below.

Figure 21- Bus Shelter Condition Profile



5.5.7.2 Maintenance

(a) Maintenance Activities

Maintenance of signs and guideposts is predominantly reactive. Activities include:

- Replacing guide posts;
- Replacing signs / blades; and
- Washing signs.

(b) Maintenance Expenditure Trends

Maintenance expenditure trends are shown in *Table 26.*

Table 26 - Maintenance Expenditure Trends

Year	Maintenance Expenditure
2010/11	$204,000
2011/12	$150,000
2012/13 budget	$270,000

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

Maintenance work is carried out in accordance with the same Standards and Specifications detailed for sealed pavement in Section 5.5.1.2. In addition, the following standards are followed:

- RTA Road Design Guide for guide posts and signs.

5.5.7.3 Renewals

(a) Renewal Plan

There is currently no renewal plan for signs and guide posts as the replacement of these assets is currently expensed.

Forecast renewal dates for bus shelters have been identified from the condition data as detailed in Section 5.5.7.1 (c). A useful life of 20 years for bus shelters has been adopted for this plan.

The total projected renewal of bus shelters is approximately $31,500 over the 10 year time frame of this plan.

(b) Renewal standards

Not applicable.

5.5.7.4 New Works

(a) Creation / Acquisition / Upgrade Plan

The creation of signs and guide posts is driven by creation of new roads and Traffic Committee recommended upgrades.

There is expected to be 12 new bus shelters resulting from new development over the 10 year

Attachment B details Council staff's Assessed Need for New Works.

(b) New Works Standards and Specifications

Not applicable.

5.5.7.5 Disposal Plan

No transport and traffic facilities assets have been identified for possible decommissioning or disposal within the time frame of this 10 year plan.

5.5.7.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 22* for signs, *Figure 23* for guide posts and *Figure 24* for bus shelters respectively.

Figure 22- 10 Year Expenditure – Signage

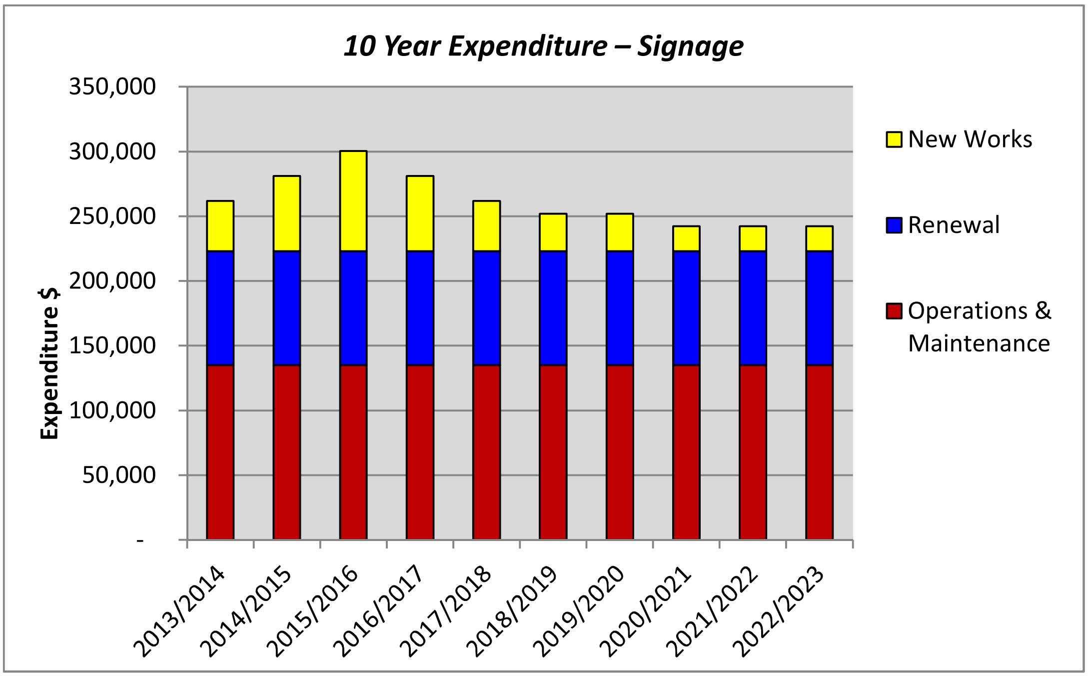


Figure 23- 10 Year Expenditure – Guide Posts

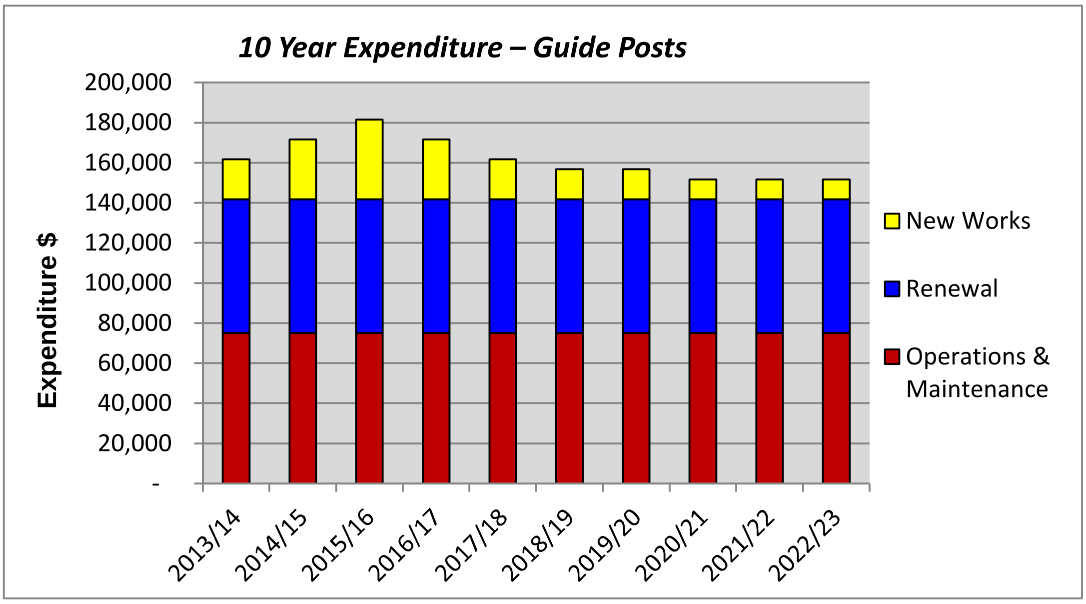
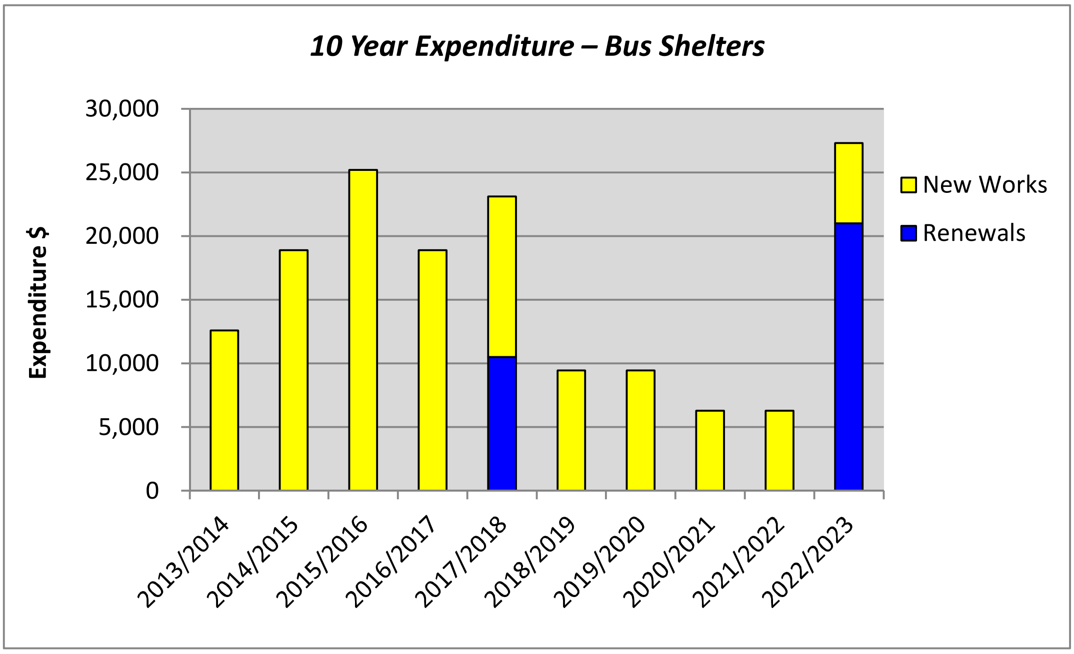


Figure 24- 10 Year Expenditure – Bus Shelters



5.6 Roads Risk Management Plan

Council has developed and adopted a corporate risk framework based on the Australian / New Zealand standard for Risk Management 4360:2004. The corporate risk framework (referred to as the Risk Management Plan) consists of a policy statement, roles and responsibilities for risk management across Council, a process for carrying out risk assessments and likelihood / consequence tables for rating risks.

A formal assessment of risks associated with service delivery from infrastructure assets is yet to be carried out by Council. The risk assessment process will identify credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks. Critical risks, being those assessed as 'Very High' - requiring immediate corrective action and 'High' – requiring prioritised corrective action will be identified in the infrastructure risk management plan once developed and subsequently summarised in future revisions of this asset management plan.

Council has, however, developed a draft risk based framework to assist with the management of planned and reactive maintenance. Routine inspection frequencies (planned maintenance) are set according to the hierarchy of the road (more important roads will be inspected more frequently than less important roads). Response times for reactive maintenance are dictated by a combination of the road hierarchy, the type and severity of the defect / hazard and the location of the defect / hazard on the road.

The framework currently covers the following asset groups:

- Sealed Pavement;
- Unsealed Pavement; and
- Transport and Traffic Facilities.

This framework should be piloted in the field and then eventually expanded to cover all asset groups that Council manages.

Further details on the draft framework can be obtained from the document "Risk Management Policy for Roads, September 2008".

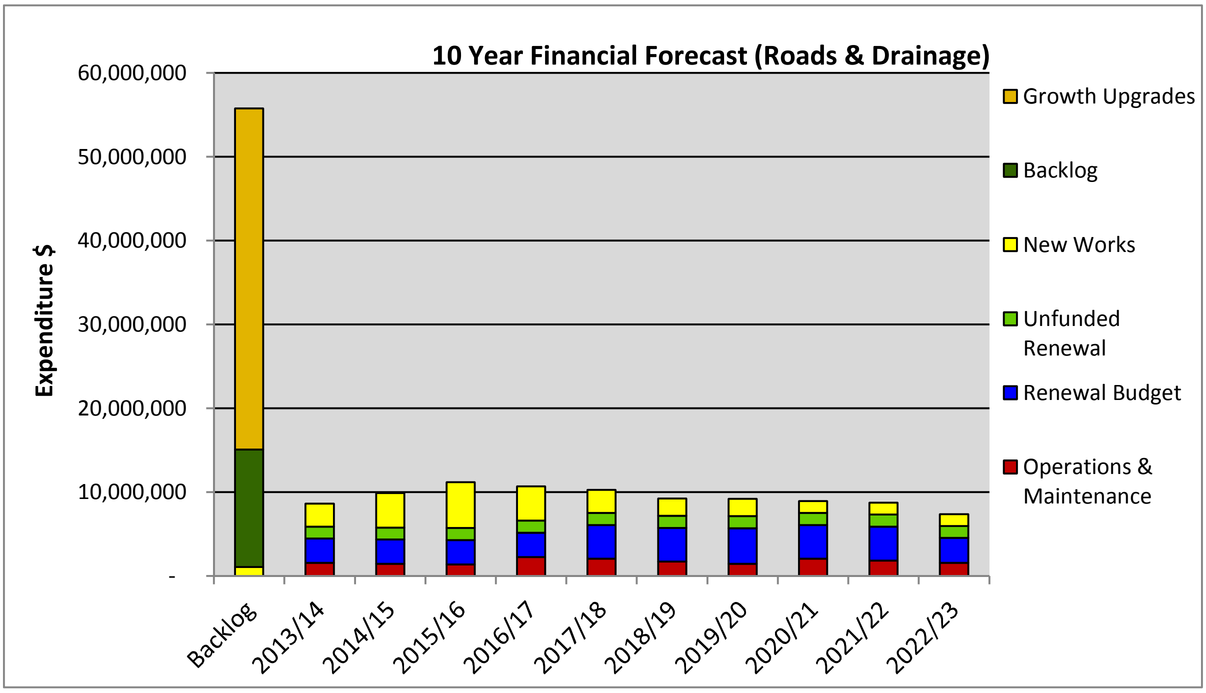
5.7 Financial Summary - Roads

This section contains the financial requirements resulting from all the information presented in the previous sections of this asset management plan. The financial projections will be improved as further information becomes available on desired levels of service and current and projected future asset performance.

5.7.1 Financial Statements and Projections (Roads & Drainage)

The financial projections are shown in *Figure 25* below for planned operating (operations and maintenance), capital expenditure (renewal and upgrade/expansion/new assets) and estimated unfunded renewals (renewals that have been identified but not carried out prior to the first year of the asset management plan).

Figure 25- 10 Year Expenditure – Roads & Drainage



Notes on 10 Year Financial Forecast:

1. Total forecast required expenditure over the 10 year planning period are estimated to be approximately:
   - $17,155,000 – Operations and Maintenance;
   - $103,972,000 – Renewals (including the above Growth Upgrades); and
   - $28,536,000 – New Works.

A breakdown of this 10 Year Financial Forecast by asset group is detailed in the corresponding lifecycle sections of this plan.

5.7.1.1 Sustainability of Service Delivery

This asset management plan identifies the estimated maintenance and capital expenditures required to provide an agreed level of service to the community over a 10 year period for input into a 10 year financial plan and funding plan to provide the service in a sustainable manner.

Figure 26 shows the projected asset renewals in the 10 year planning period from the asset register. The projected asset renewals are compared to capital renewal expenditure in the 2012/13 budget. *Table 27* shows the annual and cumulative funding gap between projected renewals and reducing the current level of renewal expenditure by 20% annually until expenditure on renewals is reduced to zero.

Figure 26- Projected Renewals & Current Renewal Expenditure (Roads & Drainage)

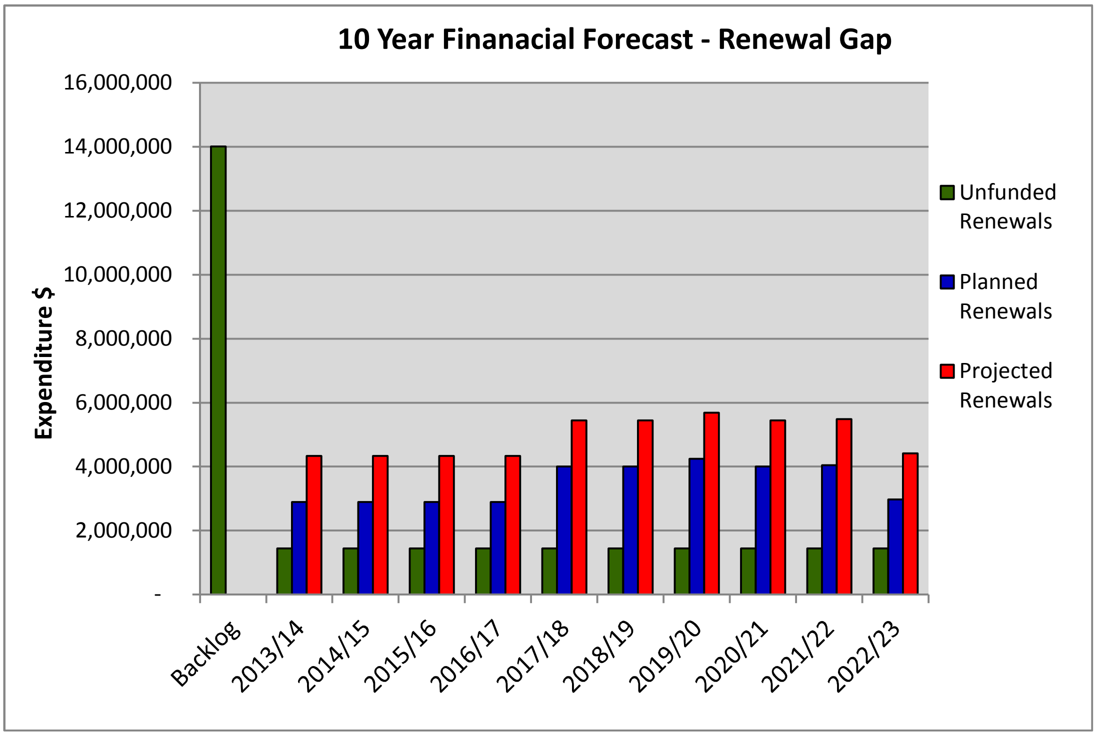


Table 27 - Projected and Planned Renewals and Expenditure Gap (Roads & Drainage)

	Unfunded Renewals	Projected Renewals	Planned Renewals	Renewal Funding Gap	Cumulative gap
2013/14	14,007,000	4,332,824	2,938,824	15,401,000	15,401,000
2014/15	0	4,332,824	2,892,824	1,440,000	16,841,000
2015/16	0	4,332,824	2,892,824	1,440,000	18,281,000
2016/17	0	4,332,824	2,892,824	1,440,000	19,721,000
2017/18	0	5,442,824	2,892,824	2,550,000	22,271,000
2018/19	0	5,442,824	2,892,824	2,550,000	24,821,000
2019/20	0	5,687,376	6,403,776	-716,400	24,104,600
2020/21	0	5,442,824	2,892,824	2,550,000	26,654,600
2021/22	0	5,489,723	2,939,723	2,550,000	29,204,600
2022/23	0	4,416,404	2,976,404	1,440,000	30,644,600

Note that ***Table 27*** includes the estimated $14,007,000 required to close the gap of prior unfunded renewals.

Planned Renewals includes the current sealed and unsealed road renewal budget of $2,705,000 per annum

Providing services in a sustainable manner will require matching of projected asset renewals to meet agreed service levels with planned capital works programs and available revenue.

A gap between projected asset renewals, planned asset renewals and funding indicates that further work is required to manage required service levels and funding to eliminate any funding gap.

Council will manage the 'gap' by developing this asset management plan to provide guidance on future service levels and resources required to provide these services. In particular improvement of the asset register, reassessment of useful lives and remaining lives will greatly improve the confidence level in the calculated results.

5.7.2 Funding Strategy Roads

Projected expenditure identified in Section 5.7.1 is to be funded from Council's operating and capital budgets. The funding strategy will be detailed in Council's 10 year long term financial plan.

5.7.3 Valuation Forecasts Roads

The current value of road asset is detailed in ***Table 28*** below

Table 28 – Road Infrastructure Values

Asset Group	Asset Type	Component	Replacement Cost($)	Depreciated Replacement Cost ($)	Qty	Units	Annual Dep.n Expense	Effective Life (yrs)
Roads	Sealed Pavement	Seal	15,449,510	10,855,610	3,678,000	m2	1,029,970	15
		Pavement	92,604,110	66,069,000	4,520,000	m2	2,315,000	40
		Formation	223,968,100	223,968,100	584,300	M	0	Infinite
	Kerb and Gutter		6,340,230	4,028,460	46,990	m	84,540	75
	Unsealed Pavement	Pavement	22,396,360	9,043,800	4,479,000	m2	2,239,640	10
		Formation	205,299,990	205,299,990	747,500	M	0	Infinite
Paths	Paved Footpaths		3,435,000	2,505,000	24,284	m2	76,850	50
Drainage	Pipes		5,746,000	4,264,300	18,016	m	143,650	40
	Pits / Manholes		1,070,278	807,865	720	No.	26,760	40
	Culverts	Culverts	16,678,500	13,063,200	38,660	m	367,450	50
		Headwalls	1,685,670		6740	No.		50
Bridges and Major Culverts	Bridges - Timber		13,149,000	4,708,000	26	No.	328,730	40
	Bridges - Concrete		23,445,600	17,076,900	48	No.	293,070	80
	Bridges - Iron		288,000	108,000	2	No.	3,840	75
	Bridges - Major Culverts		1,789,050	894,530	43	No.	35,780	50
Transport and Traffic Facilities	Signage		1,056,590	739,600	3465	No.	88,050	12
	Bus Shelters		285,000	195,000	26	No.	14,250	20

	Guide Posts		1,335,500	934,850		No.	66,780	20
Totals			**636,022,488**	**564,562,205**			**7,114,360**	

Asset values are forecast to increase as additional assets are added to the asset stock from construction and acquisition by Council and from assets constructed by land developers and others and donated to Council. Figure 27 shows the projected replacement cost asset values over the planning period in 2010 dollar values. Depreciation expense values are forecast in line with asset values as shown in Figure 27.

Figure 27 – Projected Road Asset Replacement Cost

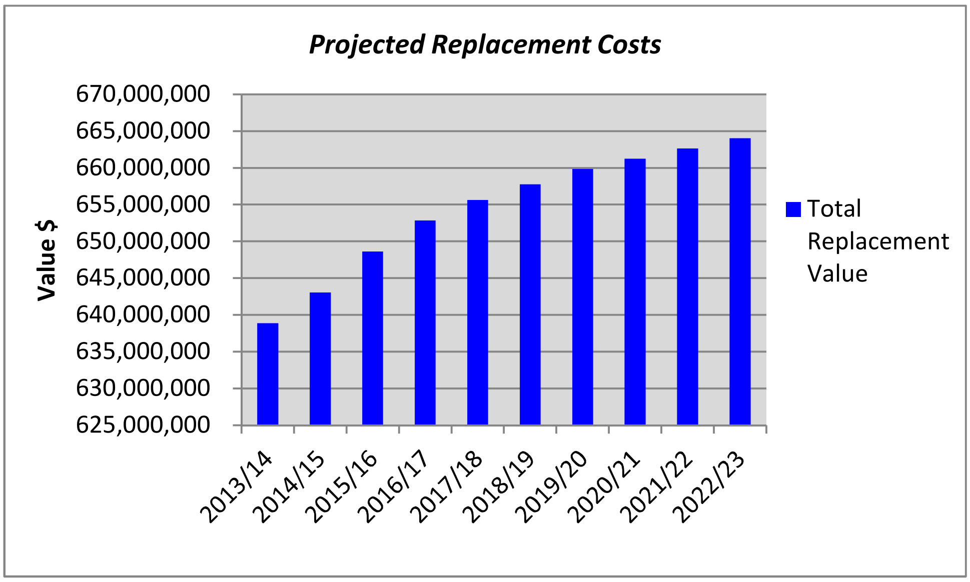
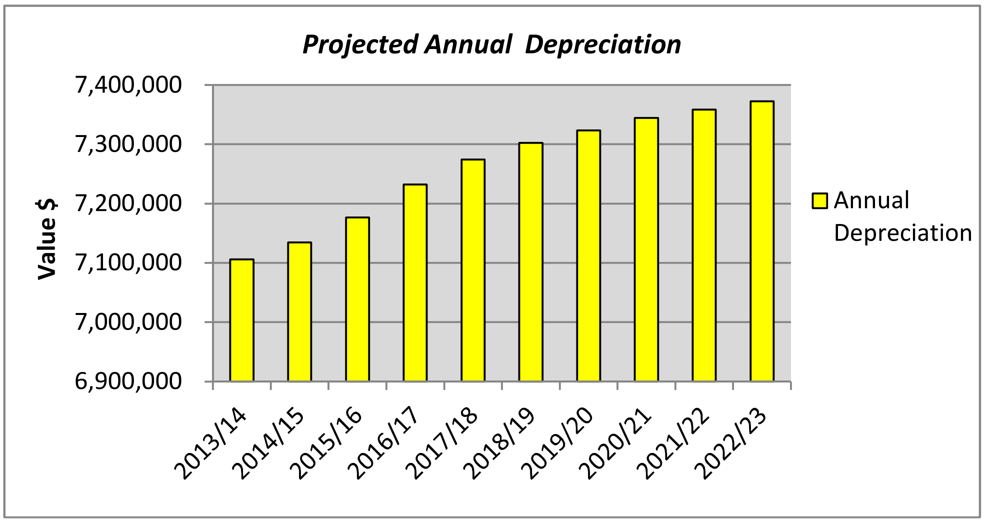
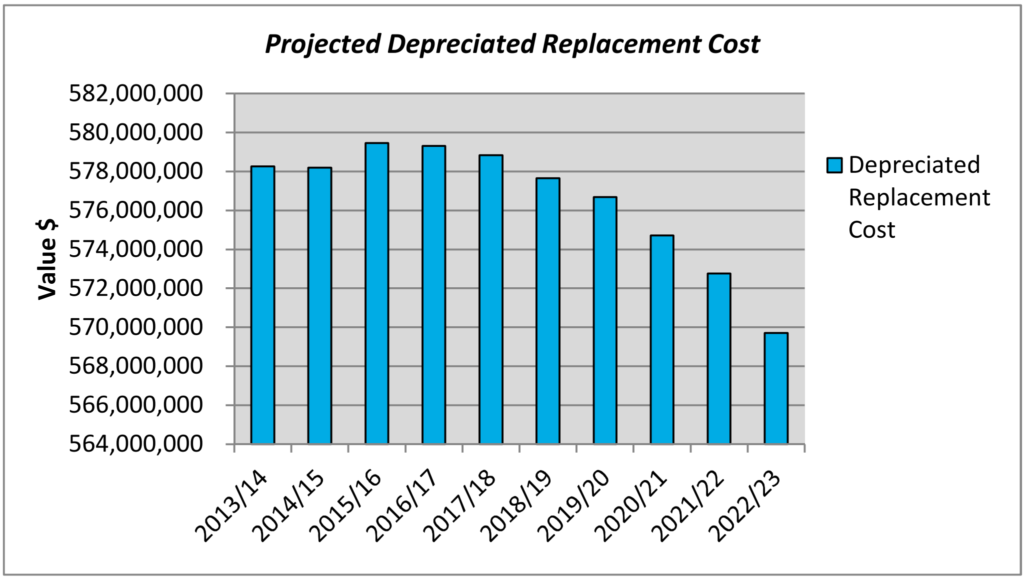


Figure 28 – Projected Road Depreciation Expense



The depreciated replacement cost (current replacement cost less accumulated depreciation) will vary over the forecast period depending on the rates of addition of new assets, disposal of old assets and consumption and renewal of existing assets. Forecast of the assets' depreciated replacement cost is shown in Figure 29.

Figure 29 – Projected Road Depreciated Replacement Cost



5.7.4 Key Assumptions made in Financial Forecasts

Refer Section 2.6

5.7.5 Road & Drainage Asset Valuations

A revaluation of Roads and Drainage assets was carried out in 2010. These values have been updated for 2012 values, including any changes to the asset base (renewals and disposals). A summary of the financial values is shown below, with a more detailed breakdown (including adopted Useful Lives) in ***Table 28 – Road Infrastructure Values*** :

- Current Replacement Cost $635,999,830
- Depreciated Replacement Cost $590,865,770
- Annual Depreciation Expense $7,105,850

6 RECREATION FACILITIES

6.1 Current Levels of Service

Current levels of service for recreation facilities assets are detailed in ***Table 29*** *below.* The current performance of many of the levels of service that are detailed is still unknown. However, performance monitoring processes can be established using these tables as a guide, thus enabling this missing information to be included in future revisions of this asset management plan.

Table 29 – Current Levels of Service (Recreation Facilities)

Recreation Facility	Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
	COMMUNITY LEVELS OF SERVICE				
Public Reserves and Parks	Quality Function Safety	Provide naturally vegetated, accessible reserves for passive recreation pursuits, free of erosion, weeds and pest animals and managed for fire hazard.	Customer survey relating to state of public reserves Monitoring and inspection by Council staff	General satisfaction with state of public reserves Adherence to maintenance standards	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings.
		Provide mown urban parks with relatively short grass and mixture of tree and shrub types with occasional park style seating and paths but without vehicular access.	Customer surveyrelating to standard of town parks Monitoring and inspection by Council staff	General satisfaction with standard of town parks Adherence to maintenance standards	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
		Provide safe, readily accessible and interesting playgrounds in residential areas, supplemented by shade structures and supported by public amenities, seating, BBQs, waste bins and parking for high use areas	Customer survey relating to number and standard of facilities Monitoring and inspection by Council staff	General satisfaction with number and standard of facilities Adherence to maintenance standards	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
Playing Fields and Sports Facilities	Quality Function Safety	Provide an adequate number and range of well grassed and regularly mown playing fields and safe, good standard sports facilities, supported by modern amenities buildings, waste bins and adequate parking.	Customer survey relating to number and standard of facilities. Monitoring and inspection by Council staff	General satisfaction with number and standard of facilities Adherence to maintenance standards	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings

Recreation Facility	Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
Public Swimming Pools	Quality Function Safety	Provide viable, adequately sized and managed, good standard swimming pools in the larger urban areas.	Customer survey relating to availability and standard of facilities Monitoring and inspection by Council staff	General satisfaction with size and standard of facilities Adherence to maintenance standards	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
	TECHNICAL LEVELS OF SERVICE				
Public Reserves and Parks	Quality Function Safety	Inspect reserves and program any follow up actions such as weed spraying. Inspect parks and program any follow up actions such as mowing and tree and park furniture care Inspect children's playgrounds in keeping with the draft Risk Management Plan	Inspections twice a year. Inspections undertaken fortnightly. Compliance against the Draft Policy.	Inspections undertaken. Necessary follow up actions undertaken.	Issues and actions are reported at weekly Works Planning meetings
Playing Fields and Sports Facilities	Quality Function Safety	Inspect playing fields and sports facilities and program any follow up actions such as mowing, watering, attention to supplementary facilities.	Inspections undertaken weekly.	Inspections undertaken. Necessary follow actions undertaken.	Issues and actions are reported at weekly Works Planning meetings
Public Swimming Pools	Quality Function Safety	Pool water is tested daily during swimming season and remediation actions taken as necessary. Pools are supervised by appropriately qualified staff.	Daily water quality tests	Compliance with test requirements	Issues and actions are reported at weekly Works Planning meetings

6.2 Desired Levels of Service

At present, indications of desired levels of service are obtained from various sources including feedback from residents to Councillors and staff, service requests and correspondence. It is considered that the above listed levels of service reasonably reflect desired levels of service. These will be further refined in future revisions of this asset management plan.

6.3 Future Demand for Recreation Facilities Assets

6.3.1 Demand Forecast

A description of the expected demand for extra recreation facilities assets is included in Section 4.

In summary, a major new playing fields/sports complex and a larger swimming pool are required in Bungendore to cater for future population growth.

In Braidwood the existing playing fields at The Recreation Ground need to be enlarged and supplemented with new floodlighting, irrigation system and modern canteen, change rooms and public amenities.

Extra reserves will be acquired in areas of rural and rural developments where land will be required for the siting of new buildings infrastructure such as halls and fire sheds and to meet passive and active recreation pursuits by the new residents of these areas.

In addition to the above, new parks and children's playgrounds will be acquired through new developments in Bungendore and Braidwood.

6.3.2 New Assets from Growth

The new assets required to meet growth will be acquired from land developments as well as those constructed by Council. The new asset values are summarised below. Acquiring these new assets will commit council to fund ongoing operations and maintenance costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operating and maintenance costs.

Total expenditure for new assets is estimated at $4,091,000 as follows

Replacement of Bungendore Swimming Pool	$4,000,000
Parks & Reserves from Developers	$31,000
Playground Equipment from Growth	$60,000

Unfunded works includes the following

New Bungendore Recreation Grounds	$3,000,000 (Unfunded)
Upgrade Braidwood Recreation Grounds	$1,300,000 (Unfunded)

6.4 Lifecycle Management Plan for Recreation Facilities Asset Groups

Lifecycle management plans are defined for each of the key asset groups detailed below:

Section 6.4.1 Public Reserves, Parks, Playing Fields and other Sports Facilities

Section 6.4.2 Swimming Pools

A summary of expenditure and changes to the asset base over the 10 year period is provided at the end of the section for each asset group. A complete financial summary is included in Section 6.6.

6.4.1 Public Reserves, Parks, Playing Fields and Sports Facilities

6.4.1.1 Background Data

(a) Asset Description

Public Reserves, Parks

Council is currently responsible for approximately 101 public reserves mostly in rural areas. It is also responsible of 8 parks in mainly urban areas. There are also 9 children's playgrounds throughout our LGA.

Data on public reserves and parks is currently being collated from Council's Property Database and spreadsheets. Each is also identifiable on Council's GIS system which links to limited data including lot description and area. The collated data will be loaded into the asset management system for the revaluation of these assets for 2012/13.

Most of the public reserves and parks have been classified as community land and many are under management control provided through Section 355 Committees of Council. Some have community halls, equestrian facilities, fire sheds, children's playgrounds, barbeques and public amenities erected on them. Some are used as greenways. Many others have no improvements and remain as passive recreation areas.

To date there has been little opportunity to determine a suitable listing of sub–assets for this class of asset.

There is a requirement for Council to develop Management Plan(s) for these properties.

Playing Fields and Sports Facilities

Council currently provides playing fields and sports facilities at the following locations:

At Bungendore:

i. Mick Sherd Oval comprises an oval shaped area that with various field layouts caters for most outdoor sports played in the town. This includes rugby union, rugby league and touch football, as well as training for junior soccer and cricket. It is also used for school sports activities. There are also three tennis courts located at the site located adjacent to the oval.

ii. BBB Oval on the Elmslea side of Turallo Creek provides a venue for cricket and Aussie Rules.

iii. The Bungendore Skateboard Park has a skateboard/BMX bike bowl and an adjacent half basketball court and hit up wall.

iv. The Bungendore School Hall provides a venue for indoor sports such as netball and basketball. This is a 'joint facility' that Council contributes to financially but only part of the building is on Council land.

At Braidwood

i. Braidwood Recreation Ground has one senior and one junior sized football fields with a concrete cricket pitch between the fields. Area is also used for touch football and little athletics. A dirt BMX track is located in the corner of the grounds. There are also two tennis courts at the site.

ii. The Braidwood School Gymnasium allow not owned by Council can be used for indoor netball, basketball and gymnastics especially associated with school sports programs.

At Captains Flat

i. Col Winchester Oval is used for cricket and football matches.

At Other villages

Sports grounds at Araluen, Majors Creek and Nerriga on crown reserves are maintained by local trusts that are independent of Council.

(b) Asset Capacity and Performance

Most of these assets are performing well in terms of utilisation by community groups and individuals however there are many improvements that could be made if funds permitted.

Mick Sherd Oval has reached its capacity in terms of scheduling extra sports and matches and the level of existing wear and tear on the oval's surface. Extra playing fields are needed to cater for expected future growth in sports such as cricket and soccer. The local tennis club has identified the need for an extra tennis court to meet increased demand.

The Braidwood Recreation Ground is short on capacity to stage larger sporting events such a regional football carnivals due to the unsuitability of the smaller field for senior sports. The current configuration of fields also does not provide an ideal situation for spectators with the building shelter and canteen being remote from the main field where the feature main football games are played.

The Captains Flat playing fields appear to be adequate for the population served.

Public amenities at sports grounds are included in Section 7 under General Fund Property.

(c) Asset Condition

The various sports fields are maintained with good grass cover and are kept in good order through regular mowing and watering programs.

The dirt BXM track at Braidwood needs refurbishment to bring it up to an interesting and safe configuration.

This class of asset, being land, has unlimited useful life and is not depreciated. The capital improvements constructed on them do however have a limited life and require maintenance attention. These assets if they are buildings are included in Section 7. The existing children's playground equipment and other park furniture is in a good and safe condition.

6.4.1.2 Maintenance

(a) Maintenance Activities

Rural Public Reserves:

Maintenance of reserves is very limited due to lack of funds but is generally restricted to environmental land management activities. Grants funds are occasionally acquired for specific projects. Activities include:

- Weed inspection and spraying
- Stream banks stabilisation;
- Access maintenance;
- Erosion remediation;
- Fire hazard reduction

A significant amount of the maintenance effort at public reserves is organised and funded by the voluntary members of Council's S355 Committee who raise funds through fees and fund raising events.

Town Parks and Reserves: Town parks and reserves require a higher maintenance effort than public reserves in rural areas due to their greater intensity of use. The main activity in urban area parks and reserves is mowing, especially in the growing season, with the aims of keeping them neat and tidy and to maintain grass height suitable for walking. Park equipment and furniture require regular attention to ensure they remain functional and safe and to repair periodic vandalism damage. Park trees require periodic lopping and sometimes removal to deal with dead limbs that pose a public safety risk. Replacement with new stock is part of maintenance activities. Some parks have irrigation systems that need to be kept in functional condition.

Table 30 – Mowing Frequency for Town Reserves and Parks

Park/Reserve	Mowing Frequency in Growing Season (weeks)
Turallo Creek Reserve	4
Elmslea linear parks	6
Mick Sherd Oval Surrounds	4
Frogs Hollow	6
Duralla St Park	6
Days Hill Reserve fringe areas and trails	8
Ryrie Park	4
Bi-Centennial Park	4
Braidwood Recreation Ground Surrounds	4
Hassell Reserve	6
Winchester Reserve	4

Playing Fields

Playing fields require a high level of maintenance effort to keep them ready for sports activities at the various venues.

Table 31 – Mowing Frequency for Playing Fields

Playing Fields	Mowing Frequency in Growing Season (weeks)
Mick Sherd Oval	weekly
BBB Oval	2
Braidwood Recreation Ground	2
Winchester Park Playing Fields	4

(b) Operations and Maintenance Expenditure Trends

Council maintenance expenditure trends are shown in ***Table 32***

Table 32 - Maintenance Expenditure Trends

Year	Operations and Maintenance Expenditure
2010/11	$312,000
2011/12	$364,000
2012/13 budget	$317,000

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

No specific standards or specifications are used for maintenance works.

6.4.1.3 Renewals

Playing fields being basically land are long lasting and do not need total renewal as such. However, a healthy fertile and well drainage topsoil layer is necessary for growing a thick and durable grass playing field surface. This may require reworking and supplementing the topsoil layer and re-turfing about every 10 years. This may also involve renewing any insitu irrigation systems at these grounds.

A renewal project of this nature is needed at the Braidwood Recreation Ground in association with the re-configuration of playing fields as described above.

No other existing sports facility assets are expected to need replacement in the next 10 year period.

Park play equipment, furniture, barbeques, fences, water systems and trees all need to be replaced over time with half of these being replaced over the next 10 years.

6.4.1.4 New Works

(a) Creation / Acquisition / Upgrade Plan

A major new playing fields/sports complex is required in Bungendore to cater for future population growth. This is needed to cater for an expected growth in teams playing the football codes, cricket and netball. Council Community Strategic Plan has identified the need to survey the various sporting clubs to verify and quantify the need. The results of this survey which is expected to be undertaken during 2013/14 will be used to revisions of this sub-section of this plan.

From time to time Council inherits new parks and public reserves in areas where large urban and rural residential subdivisions are undertaken.

In rural areas, these are often tracks of land on ridge tops and along watercourses where valuable remnant vegetation or native grasslands exist. These require some management and minor maintenance for which Council incurs a minor increase in expenditure. There are also a number of projects that could be undertaken to improve the facilities available on these reserves including construction of a new community hall and ground improvements at the Royalla reserve and upgraded pony club facilities at a number of other reserves.

As identified in Attachment B details Council staff's Assessed Need for New Works.

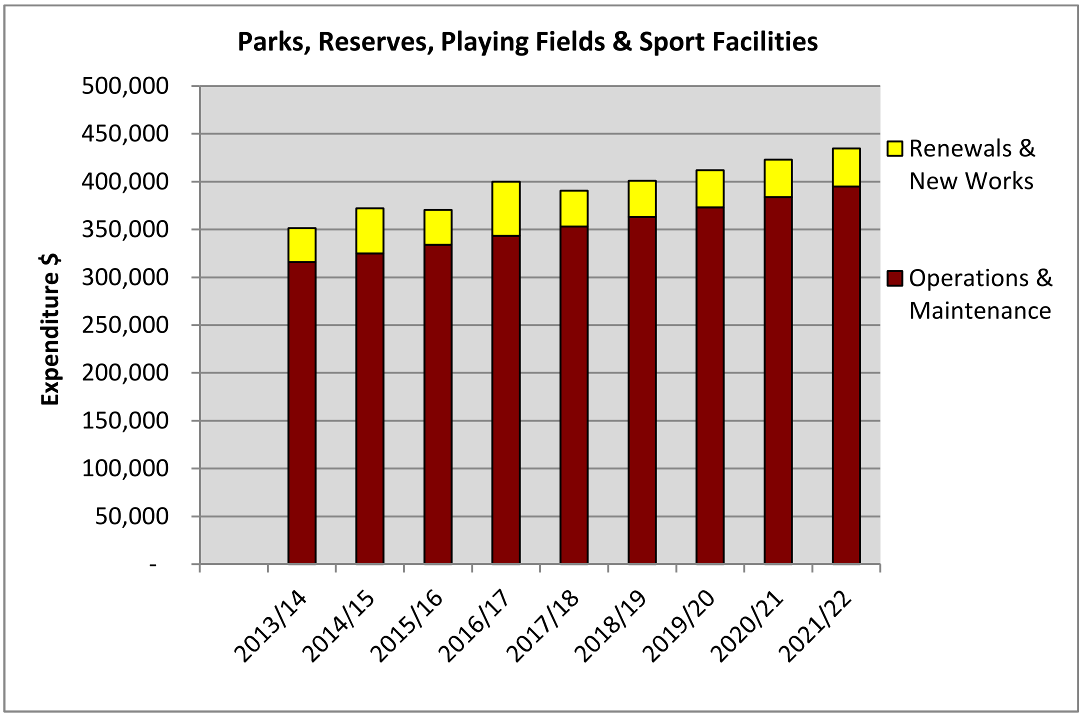
6.4.1.5 Disposal Plan

No public reserve and park assets have been identified for possible decommissioning or disposal in the next 10 year period.

6.4.1.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 30* below.

Figure 30 - 10 Year Expenditure – Public Reserves, Parks, Playing Fields and Sports Facilities



6.4.2 Public Swimming Pools

6.4.2.1 Background Data

(a) Asset Description

Council owns and operates public swimming pools at Bungendore, Braidwood and Captains Flat.

Bungendore Pool: The main pool is 25m x 8m with 6 marked lanes. It was constructed in 1991. The pool is covered with a thermal cover during the winter months and fringe periods of the swimming season. There is also a 5m diameter wading pool at the site and toilets and change room building that is shared by teams playing football at adjacent Mick Sherd Oval during the winter months.

Braidwood Pool: The main pool is 20m x10m with 5 marked lanes. It was constructed in 1965. The pool water is heated by supplementary solar panels which were renewed in 2011. A small wading pool sits beside the main pool. Open roof change room and a toilet block supplement the pool facilities.

Captains Flat Pool: The main pool is 22m x 9m with 5 marked lanes. It was constructed by the Lake George Mining Company in the 1950's with ownership passing over to Council in the 1970s. At the site there is also a 4m x 5m wading pool and supplementary toilets and change rooms.

Data on swimming pools is currently stored in Council's spreadsheets and will be loaded into the Asset Management System for the 2013 revaluation of these assets. Each is also identifiable on Council's GIS system which links to limited data including lot description and area.

All pools are located on public recreation reserves.

There is a requirement for Council to develop Management Plan(s) for these properties.

(b) Asset Capacity and Performance

Bungendore Pool: This pool is regularly at or close to maximum capacity during the hotter summer days when the water circulation/filtration system is at its peak but cannot always safely cater for the number of patrons who wish to enter the pool. It has been necessary on occasions to turn patrons away. A full description of the deficiency of this pool is included in the "Proposals for the Renovation, Enlargement or Replacement of the Bungendore Pool (29 March 2011)" report

Braidwood Pool: While this pool has adequate capacity for the catchment it serves, it is an old pool that needs to be modernised.

Captains Flat Pool: This pool has adequate capacity provided by aging filtration equipment but is reaching the end of its useful life.

(c) Asset Condition

Bungendore Pool: This pool is generally in good condition but basically it is too small for the increasing population that it is required to serve and it needs enlarging or replacing in the near future.

Braidwood Pool: The pool is now 50 years old and needs upgrading to meet modern standards. A local interest group has approached Council about undertaking upgrade and refurbishment works for the pool and surrounds, including lengthening the pool to 25m

Captains Flat Pool: This 60 year old pool which has corroding steelwork and wall sections with crumbling concrete has developed a serious water leak that is costing Council $25,000 p.a. in water bills.

Decision time has come on the future of this pool to determine whether:

i. It receives temporary patching and repairs that may need to be repeated again within a few years.

ii. It is replaced at great cost.

iii. It is permanently closed to save costs for a facility that is poorly patronised and loses as much as $75,000 pa.

6.4.2.2 Maintenance

(a) Maintenance Activities

Council's pools operate during the Summer months from the beginning of November to mid-March each year and are closed over the rest of the year.

Pool season maintenance and operations activities include:

- Start of season pool emptying and cleaning;
- Water filter servicing;
- Pool water testing;
- Weekly lawn mowing and landscaping care;
- Supervisor duties
- Collecting entry fees and checking season passes
- First aid when necessary;
- Toilet cleaning and servicing;
- Opening and closing the facility each day

There are also power and chemical costs.

Off season maintenance activities include:

- Necessary pool repairs
- Periodic mowing
- Inspections for vandalism

(b) Maintenance Expenditure Trends

Council maintenance expenditure trends are shown in ***Table 33***.

Table 33 - Maintenance and Operations Expenditure Trends

Year	Maintenance and Operations		
	Maintenance	Operations	Total
2010/11	$80,500	$107,000	$187,500
2011/12	$60,600	$148,200	$208,800
2012/13 budget	$61,500	$168,700	$230,200

Assessment and prioritisation of maintenance is currently undertaken by Council staff on an annual basis using experience and judgement.

(c) Maintenance Standards and Specifications

Pools are operated to Australian Lifesaving Standards.

6.4.2.3 Renewals

The pools have been assessed as having a 60 year life. On this basis and with reference to its existing condition the Captains Pool is due for renewal/replacement now.

The Braidwood pool is not due for renewal within the 10 years term of this plan.

The Bungendore pool needs to be replaced not because of its age but because it is now too small.

6.4.2.4 New Works

(a) Creation / Acquisition / Upgrade Plan

It is proposed to construct a replacement Bungendore pool within the next four years to meet the demands of Bungendore's growing population.

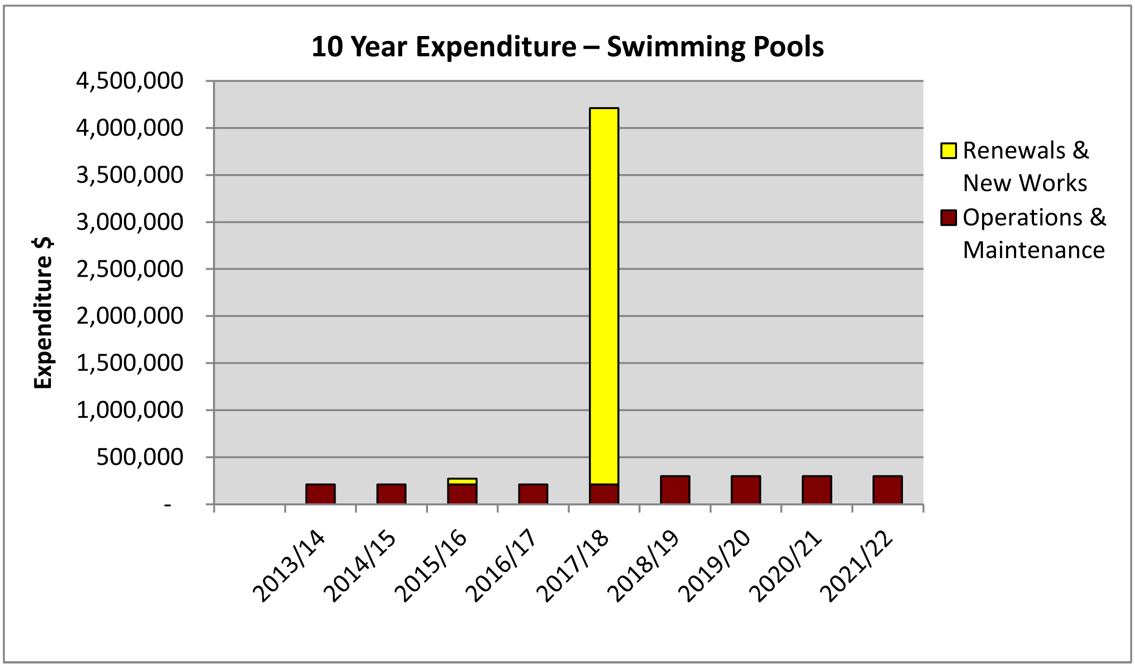
6.4.2.5 Disposal Plan

Serious consideration needs to be given to permanently closing the Captains Flat pool, dismantling it and restoring the site as open space.

6.4.2.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 31* below.

Figure 31 - 10 Year Expenditure – Swimming Pools



6.5 Recreation Facilities Risk Management Plan

Council has developed and adopted a corporate risk framework based on the Australian / New Zealand standard for Risk Management 4360:2004. The corporate risk framework (referred to as the Risk Management Plan) consists of a policy statement, roles and responsibilities for risk management across Council, a process for carrying out risk assessments and likelihood / consequence tables for rating risks.

A formal assessment of risks associated with service delivery from infrastructure assets is yet to be carried out by Council. The risk assessment process will identify credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks. Critical risks, being those assessed as 'Very High' - requiring immediate corrective action and 'High' – requiring prioritised corrective action will be identified in the infrastructure risk management plan once developed and subsequently summarised in future revisions of this asset management plan.

Council has, however, developed a draft risk based framework to assist with the management of planned and reactive maintenance. A routine inspection frequencies (planned maintenance) has been set for children's playgrounds with the check list covering faulty equipment, condition of freefall material and look-out for syringes in the play area). Response times for reactive maintenance are dictated by the type and severity of the defect / hazard and the location of the defect / hazard.

The framework currently covers the following asset groups:

- Children's playgrounds;
- Playing Fields; and
- Sports facilities.

This framework should be piloted in the field and then eventually expanded to cover all asset groups that Council manages.

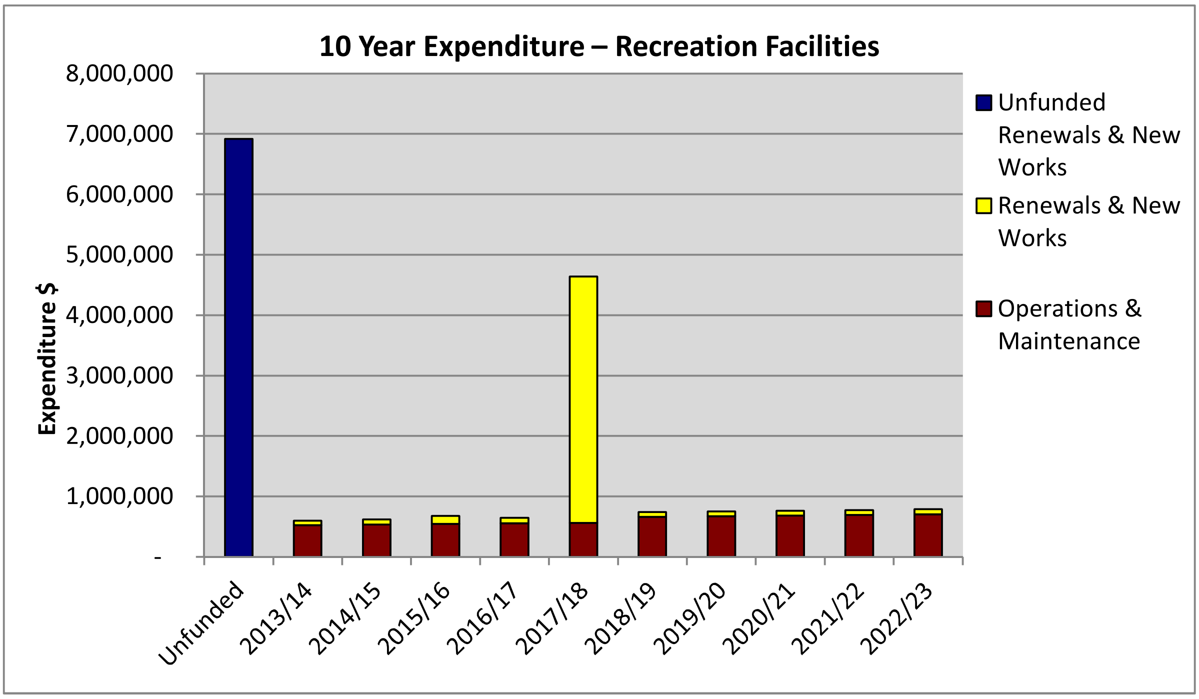
6.6 Financial Summary – Recreation Facilities

This section contains the financial requirements resulting from all the information presented in the previous sections of this asset management plan. The financial projections will be improved as further information becomes available on desired levels of service and current and projected future asset performance.

6.6.1 Financial Statements and Projections (Recreation Facilities)

The financial projections are shown in ***Figure 32*** below for planned operating (operations and maintenance), capital expenditure (renewal and upgrade/expansion/new assets) and estimated unfunded renewals (renewals that have been identified but not carried out prior to the first year of the asset management plan).

Figure 32 – 10 Year Financial Forecast (Recreation Facilities)



Notes on 10 Year Financial Forecast:

Total forecast expenditure over the 10 year planning period is estimated to be approximately:

Operations and Maintenance	$6,142,000
New Works and Upgrades (Council Funded)	$4,373,000
New Works and Upgrades (Council Unfunded)	$4,300,000

6.6.1.1 Sustainability of Service Delivery

This asset management plan identifies the estimated operation and maintenance and capital expenditures required to provide an agreed level of service to the community over a 10 year period for input into a 10 year financial plan and funding plan to provide the service in a sustainable manner.

Providing services in a sustainable manner will require matching of projected asset renewals to meet agreed service levels with planned capital works programs and available revenue.

6.6.2 Funding Strategy Recreation Facilities

Projected expenditure identified in Section 6.6.1 is to be funded from Council's operating and capital budgets. The funding strategy will be detailed in Council's 10 year long term financial plan.

6.6.3 Valuation Forecasts Recreation Facilities

Asset values are forecast to increase as additional assets are added to the asset stock from construction and acquisition by Council and from assets constructed by land developers and others and donated to Council. Figure 33 shows the projected replacement cost asset values over the planning period in 2010 dollar values. Depreciation expense values are forecast in line with asset values as shown in Figure 34

Figure 33 – Projected Recreation Facilities Asset Replacement Cost

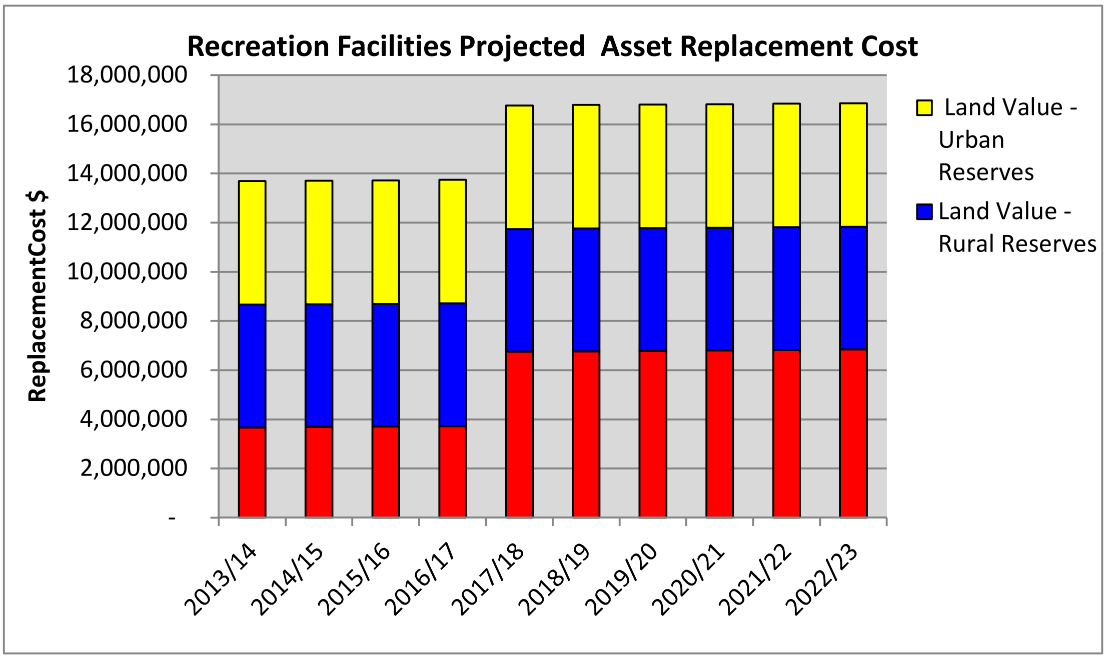
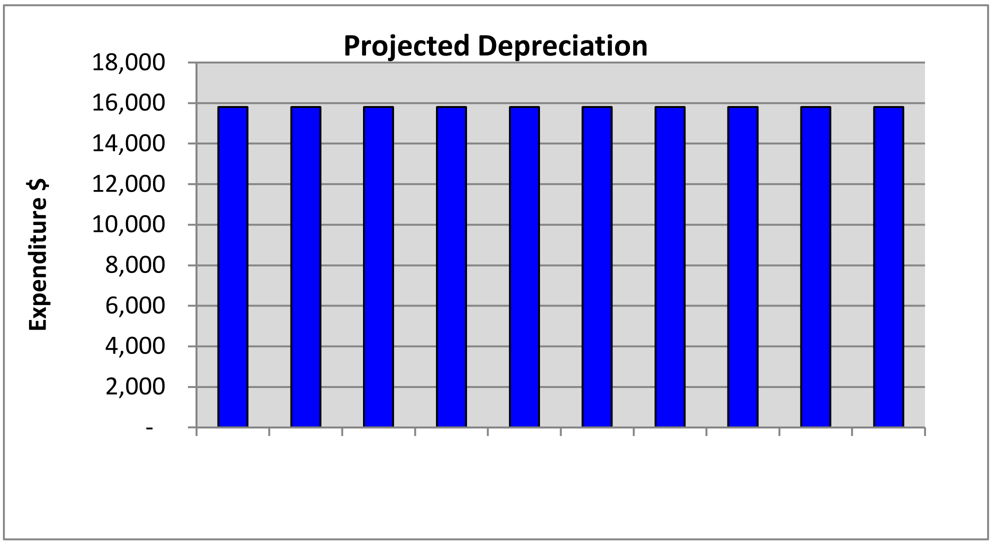
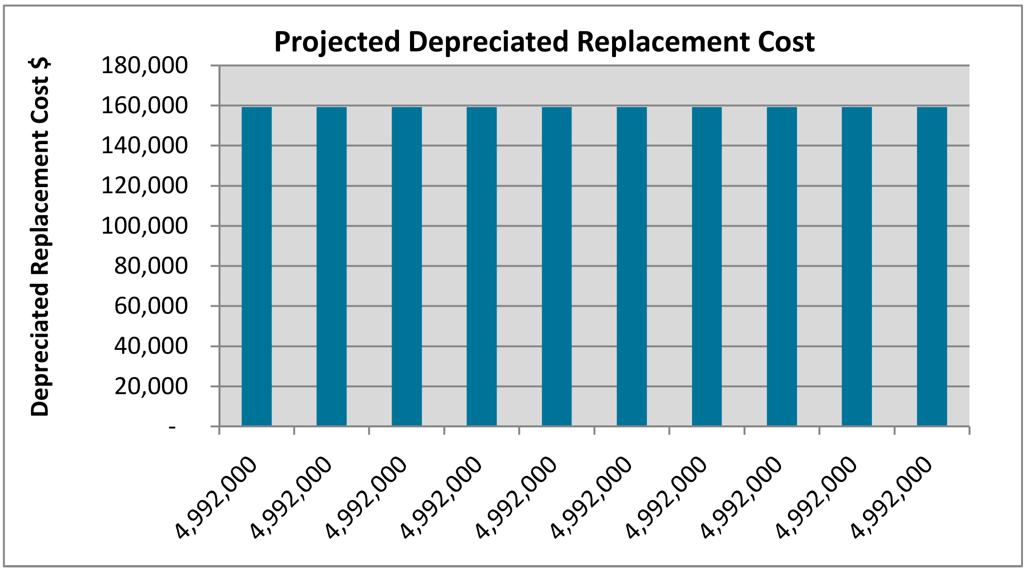


Figure 34 – Projected Recreation Facilities Depreciation Expense



The depreciated replacement cost (current replacement cost less accumulated depreciation) will vary over the forecast period depending on the rates of addition of new assets, disposal of old assets and consumption and renewal of existing assets. Forecast of the assets' depreciated replacement cost is shown in Figure 35.

Figure 35 – Projected Recreation Facilities Depreciated Replacement Cost



6.6.4 Key Assumptions made in Financial Forecasts

Refer Section 2.6

6.6.5 Recreation Facilities Asset Valuations

A revaluation of Recreation Facilities assets will be carried out for 2012/13. A summary of the current financial values is shown below.

Current Replacement Cost	$13,111,000
Depreciated Replacement Cost	$11,395,000

Annual Depreciation Expense	$88,063

7 GENERAL FUND PROPERTIES AND FACILITIES

7.1 Current Levels of Service

Current levels of service for recreation facilities assets are detailed in ***Table 34** below.* The current performance of many of the levels of service that are detailed is still unknown. However, performance monitoring processes can be established using these tables as a guide, thus enabling this missing information to be included in future revisions of this asset management plan.

Table 34 – Current Levels of Service (General Fund Properties and Facilities)

Recreation Facility	Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
	COMMUNITY LEVELS OF SERVICE				
Public Buildings (including halls, public toilets, playing field amenities, community centres)	Quality Function Safety	Provide clean and functional buildings to meet community needs	Customer survey relating to state of public buildings. Inspections and reporting by staff	General satisfaction with the state of the public buildings	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
Council Offices and Depots	Quality Function Safety	Provide modern, comfortable and functional Council Offices and Council Chambers. Provide well located, modern and functional depots that do not adversely impact on neighbouring properties.	Customer survey relating to the standard and state of these facilities Staff inspection and feedback on operation of the offices and depots	General satisfaction with state of these facilities	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
Council Public Domain Facilities (including cemeteries, saleyards, the Braidwood showground)	Quality Function Safety	Provide well maintained and pleasant cemeteries with sufficient vacant plots to meet community needs Provide and operate modern well maintained saleyards at Braidwood Provide a functional showground complex at Braidwood	Customer survey relating to the state of these facilities Staff inspection and feedback on operation and condition of these facilities	General satisfaction with state of these facilities Facilities maintained to adopted standards	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings

Recreation Facility	Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
Other property (including residential, commercial, industrial properties)	Quality Function Safety	Maintain properties in a neat and tidy condition	Customer survey relating to the state of these facilities Staff inspection and feedback on operation and condition of these facilities	General satisfaction with condition of these facilities Facilities maintained to adopted standards	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
	TECHNICAL LEVELS OF SERVICE				
Public Buildings (including halls, public toilets, playing field amenities, community centres)	Quality Function Safety	Public toilets are cleaned and serviced daily Inspect buildings and program any follow up actions	Customer survey relating to the state of these facilities Inspections undertaken as follows a. public toilets - daily. b. public halls – quarterly c. playing field amenities – weekly d. community centres - fortnightly	General satisfaction with condition of these facilities Inspections undertaken. Necessary follow actions undertaken.	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
Council Offices and Depots	Quality Function Safety	Council offices are cleaned and serviced each week day Depots are maintained in a tidy and safe condition	Staff inspections and reports relating to the state of these facilities	General satisfaction with condition of these facilities Inspections undertaken. Necessary follow actions undertaken	Issues and actions are reported at weekly Works Planning meetings
Council Public Domain Facilities (including cemeteries, saleyards, the Braidwood showground)	Quality Function Safety	Maintain neat and tidy facilities that are operated efficiently	Customer survey relating to the state of these facilities Staff inspections and reports relating to the state of these facilities	General satisfaction with condition of these facilities Inspections undertaken. Necessary follow actions undertaken	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings

Recreation Facility	Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
Other property (including residential commercial industrial properties)	Quality Function Safety	Maintain properties in good condition	Customer survey relating to the state of these facilities Staff inspections and reports relating to the state of these facilities	General satisfaction with condition of these facilities Inspections undertaken. Necessary follow actions undertaken	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings

7.2 Desired Levels of Service

At present, indications of desired levels of service are obtained from various sources including feedback from residents to Councillors and staff, service requests and correspondence. It is considered that the above listed levels of service reasonably reflect desired levels of service. These will be further refined in future revisions of this asset management plan.

7.3 Future Demand for General Fund Properties and Facilities

7.3.1 Demand Forecast

There is demand for new assets under this category including the following

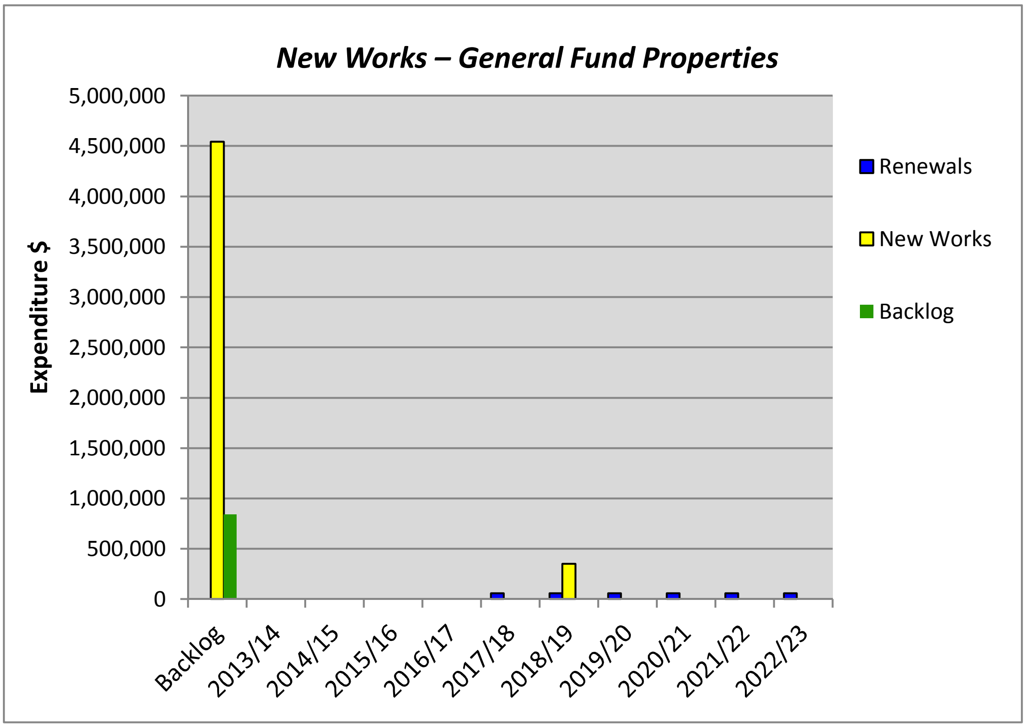
- A replacement community health centre at Captains Flat ($450,000)
- New public amenities (public toilets and baby change facilities in the Bungendore CBD ($350,000)
- New amenities, change rooms, meeting room and canteen at the Braidwood Recreation Ground ($520,000)
- Upgrading/modernising/replacement of Council's works depots at Bungendore, Braidwood and Captains Flat ($2,610,000)
- Modernised Council Offices at Braidwood ($400,000)
- New community hall at Royalla ($600,000)
- Public toilets at Nerriga Reserve ($412,000)
- Land Acquisitions in Bungendore for development of a town square near Gibraltar/Ellendon Streets, Ambulance Station, Lake George Fire Control headquarters, Town Fire Brigade and Smartwork Centre ($1,550,000)

7.3.2 New Assets from Growth

There are not expected to be new assets in the category required to meet growth from land developments over the next decade apart from those listed above and new public buildings that may be required as part of any residential rezoning that may occur on the fringes of

Bungendore. The new asset values are summarised In *Figure 36* below. Acquiring these new assets will commit council to fund ongoing operations and maintenance costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operating and maintenance costs.

Figure 36 – 10 Year Expenditure Forecast – New Works (Council Funded)



7.4 Lifecycle Management Plan for General Fund Properties and Facilities

Lifecycle management plans are defined for each of the key asset groups detailed below:

Section 7.4.1 Public Buildings (including halls, public toilets, playing field amenities, community centres);

Section 7.4.2 Council Offices and Depots;

Section 7.4.3 Council Public Domain Facilities (including cemeteries, saleyards, the Braidwood showground);

A summary of expenditure and changes to the asset base over the 10 year period is provided at the end of the section for each asset group. A complete financial summary is included at the end of the Section.

7.4.1 Public Buildings (halls, public toilets, playing field amenities, community centres)

7.4.1.1 Background Data

(a) Asset Description

Council is currently responsible for approximately 22 public buildings. These are made up of:

Building Type	Quantity
Public halls that Council maintains directly	0
Public hall that are maintained through s355 Committees	7
Public toilets	5
Amenity buildings at sports venues	3
Community centres	4

Data on public buildings is currently being compiled from spreadsheets and the Finance One database. The data will be loaded into the Council's asset management system and will be used for revaluation of the buildings for 2012/13. Each asset location is identifiable on Council's property GIS system which links to limited data including lot description and area.

(b) Asset Capacity and Performance

These assets are performing well in terms of utilisation by community groups and individuals however there are many improvements that could be made to some of them if funds permitted. Most of these buildings are in good condition but some need upgrading works.

7.4.1.2 Maintenance

(a) Maintenance Activities

Maintenance activities include:

- Cleaning and servicing of buildings to match usage
- Painting;
- Repairs;
- Dealing with vandalism when it occurs;
- Paying power, water and sewerage charges

A significant amount of the maintenance effort is organised and funded by the voluntary members of Council's S355 Committee at some of the public buildings. The committees raise funds through fees and fund raising events. Some assistance is given by Council when major expense items are involved.

(b) Maintenance Expenditure Trends

Council maintenance expenditure trends are shown in ***Table 35***.

Table 35 - Maintenance Expenditure Trends

Year	Operations and Maintenance Expenditure
2010/11	$290,500
2011/12	$316,500
2012/13 budget	$375,000

Assessment and prioritisation of maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

It is intended that buildings will comply with the Building Code of Australia. No specific standards or specifications are used for maintenance works.

7.4.1.3 Renewals

The Captains Flat Community Health Centre and the Braidwood Recreation Ground's public amenities and canteen are at the end of their useful life and replacement facilities are needed as soon as possible. With timely maintenance and repair it is not expected that any other buildings will need to be replaced over the next 10 year period.

7.4.1.4 New Works

(a) Creation / Acquisition / Upgrade Plan

As indicated above new public amenities (public toilets and baby change facilities) are required in the Bungendore CBD to meet existing and future demands for such facilities from shoppers and visitors to the area.

There have also been enquiries from the 355 Committee responsible for the Royalla Reserve for Council assistance to construct a new hall and amenities at this public reserve on Royalla Drive.

From time to time Council may also inherit new public buildings such as new amenities buildings in areas where large urban and rural residential subdivisions are undertaken.

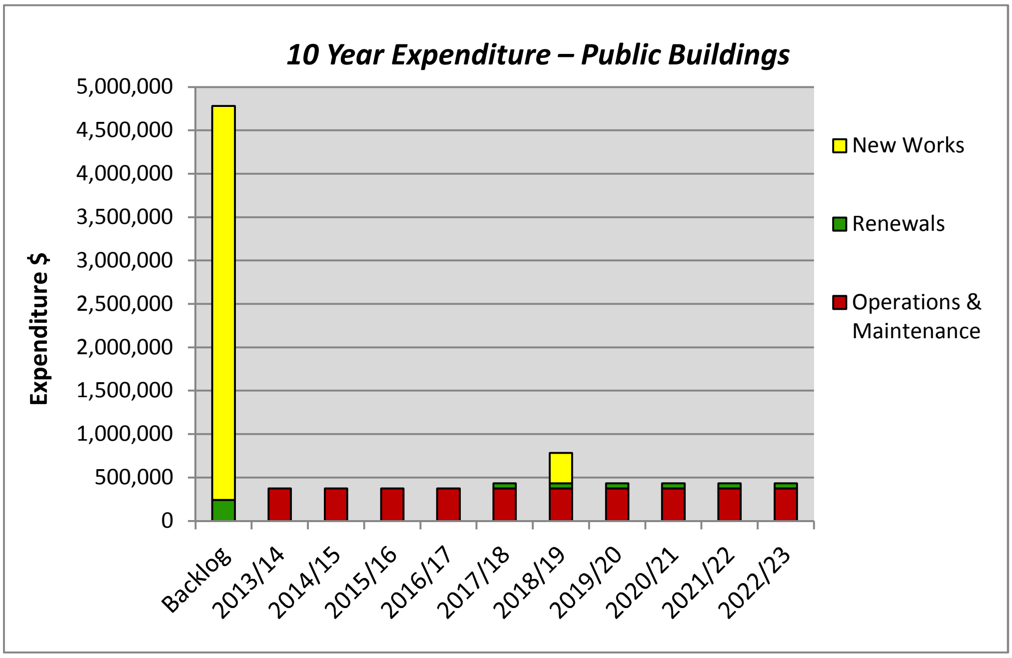
7.4.1.5 Disposal Plan

If a replacement facility can be funded, the existing Captains Flat community centre will be disposed of in the next 10 year period.

7.4.1.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 37* below.

Figure 37 - 10 Year Expenditure – Public Buildings



7.4.2 Council Offices and Depots

7.4.2.1 Background Data

(a) Asset Description

There are Council offices at Bungendore and Braidwood and Council depots in Bungendore, Braidwood and Captains Flat.

(b) Asset Capacity, Performance and Condition

While these facilities currently serve their purpose, the Braidwood Council offices and depot and the Captains Flat depot are old and deficient premises and need refurbishment or replacement to meet future needs.

7.4.2.2 Maintenance

(a) Maintenance Activities

Maintenance activities include:

- Cleaning and servicing of buildings to match need
- Painting;
- Repairs;
- Some mowing and weeding;
- Paying power, water and sewerage charges;
- Opening and closing of facilities.

(b) Maintenance Expenditure Trends

Council maintenance expenditure trends are shown in ***Table 36***.

Table 36 - Maintenance Expenditure Trends for Council's Offices and Depots

Year	Operations and Maintenance Expenditure
2010/11	$224,500
2011/12	$228,000
2012/13 budget	$230,000

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

It is intended that buildings will comply with the Building Code of Australia. No specific standards or specifications are used for maintenance works.

7.4.2.3 Renewals

The Braidwood depot is most in need of replacement as it is old and no longer fit for efficient use. With timely maintenance and repairs, and some major upgrading to the other depots and the Braidwood offices these assets will continue to serve their purpose for the next 10 years.

7.4.2.4 New Works

(a) Creation / Acquisition / Upgrade Plan

As indicated above, a new works depot is needed at Braidwood and is expected to be constructed within the next 4 years.

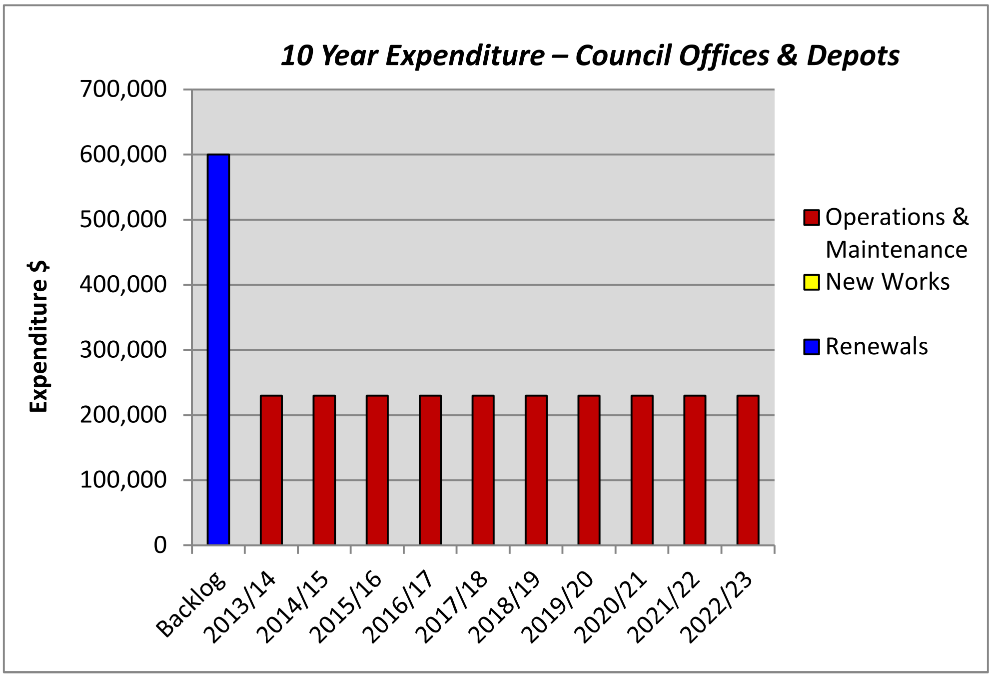
7.4.2.5 Disposal Plan

With the construction of a new Braidwood works depot at a new location the old facility can be closed and pulled down and the site restored for new uses.

7.4.2.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 38* below.

Figure 38 - 10 Year Expenditure – Council Offices and Depots



7.4.3 Council Public Domain Facilities

7.4.3.1 Background Data

(a) Asset Description

These facilities include the Bungendore, Braidwood, Captains Flat, Araluen and Gundillion cemeteries, the Braidwood saleyards and the Braidwood showgrounds.

Data on these facilities is currently stored in Council's Finance Database and spreadsheets. Each is also identifiable on Council's GIS system which links to limited data including lot description and area. The data is being collated and verified for inclusion in the asset management system and valuation of the assets for 2012/13.

To date there has been little opportunity to determine a suitable listing of sub-assets for this class of asset.

(b) Asset Capacity, Performance and Condition

Cemeteries: Capacity at these cemeteries is more than adequate for the next 10 years apart from the old Braidwood Cemetery which has been closed and burials are now restricted to the newer Braidwood lawn cemetery.

The Bungendore and Braidwood lawn cemeteries are the most utilised are kept in good order with the lawns cut and trimmed on a fortnightly basis in the growing season. The older headstone type cemeteries are more difficult to keep in good condition and require a lot of hand work between the graves.

Braidwood Saleyards: The saleyards can cater for 3500 head of cattle on any one sale day. This capacity has proven to be adequate for the all sales to date.

The saleyards are cleaned after each sale and the facility is kept in good order.

Braidwood Showgrounds: This complex comprises a number of pavilions and ground amenities and a land area of 18.88 ha. There is plenty of space to hold the annual show and other events.

Some of the buildings are getting old and require maintenance.

7.4.3.2 Maintenance

(a) Maintenance Activities

Cemetery maintenance and operations activities include:

- Lawn mowing and trimming around graves;
- Weed spraying;
- Grave digging;
- Topping-up sunken graves;

The **Braidwood Saleyards** maintenance and operations activities include:

- Necessary yard and ramp repairs
- Periodic mowing and trimming
- Inspections for vandalism

The **Braidwood Showgrounds** maintenance and operations activities are undertaken by the s355 showgrounds committee and the costs involved are not recorded in Council's financial system.

(b) Maintenance Expenditure Trends

Council maintenance expenditure trends are shown in ***Table 37***.

Table 37 - Maintenance Expenditure Trends for Council Public Domain Facilities

Year	Maintenance Expenditure
2010/11	$125,100
2011/12	$133,300
2012/13 budget	$146,500

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

There are no standards for these areas.

7.4.3.3 Renewals

No renewals are anticipated in these areas during the next 10 year period.

7.4.3.4 New Works

(a) Creation / Acquisition / Upgrade Plan

Extended concrete burial beams will be required in the Bungendore and Braidwood lawn cemeteries within 5 years.

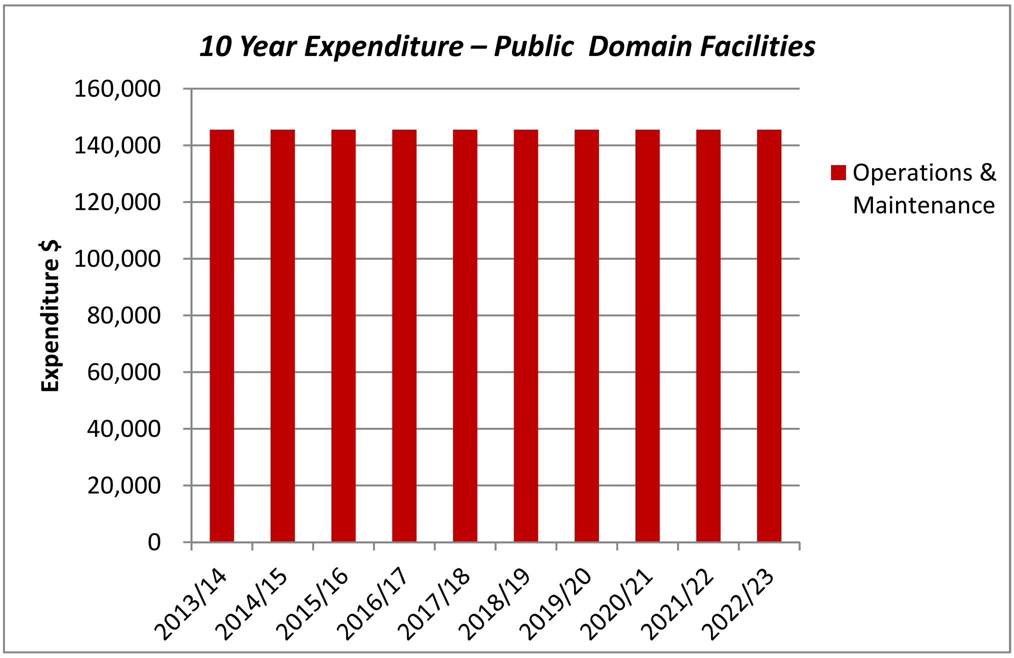
7.4.3.5 Disposal Plan

No disposals are planned in the next decade.

7.4.3.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 39* below.

Figure 39 - 10 Year Expenditure – Public Domain Facilities



7.5 General Fund Properties and Facilities Risk Management Plan

Council has developed and adopted a corporate risk framework based on the Australian / New Zealand standard for Risk Management 4360:2004. The corporate risk framework (referred to as the Risk Management Plan) consists of a policy statement, roles and responsibilities for risk management across Council, a process for carrying out risk assessments and likelihood / consequence tables for rating risks.

A formal assessment of risks associated with service delivery from infrastructure assets is yet to be carried out by Council. The risk assessment process will identify credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks. Critical risks, being those assessed as 'Very High' - requiring immediate corrective action and 'High' – requiring prioritised corrective action will be identified in the infrastructure risk management plan once developed and subsequently summarised in future revisions of this asset management plan.

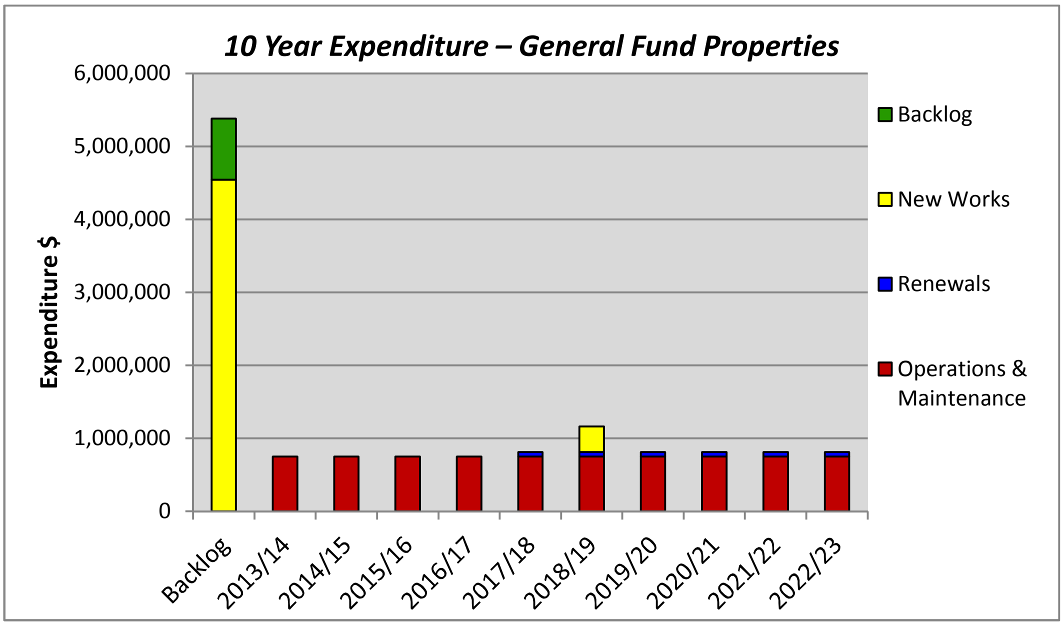
7.6 Financial Summary – General Fund Properties and Facilities

This section contains the financial requirements resulting from all the information presented in the previous sections of this asset management plan. The financial projections will be improved as further information becomes available on desired levels of service and current and projected future asset performance.

7.6.1 Financial Statements and Projections (General fund Properties & Facilities)

The financial projections are shown in *Figure 40* below for planned operating (operations and maintenance), capital expenditure (renewal and upgrade/expansion/new assets) and estimated unfunded renewals (renewals that have been identified but not carried out prior to the first year of the asset management plan).

Figure 40 – 10 Year Financial Forecast General Fund Properties & Facilities)



Notes on 10 Year Financial Forecast:

Total forecast expenditure over the 10 year planning period is estimated to be approximately:

Operations and Maintenance	$7,506,000
Renewals	$1,200,000
New Works and Upgrades (Council Funded)	$4,892,000

A breakdown of this 10 Year Financial Forecast by asset group is detailed in the corresponding lifecycle sections of this plan.

7.6.1.1 Sustainability of Service Delivery

This asset management plan identifies the estimated maintenance and capital expenditures required to provide an agreed level of service to the community over a 10 year period for input into a 10 year financial plan and funding plan to provide the service in a sustainable manner.

This may be compared to existing or planned expenditures in the 10 year period to identify any gap. In a core asset management plan, a gap is generally due to increasing asset renewals.

The projected unfunded asset renewals amount to $3,380,000 for the following works

- New amenities, change rooms, meeting room and canteen at the Braidwood Recreation Ground ($520,000)

- Upgrading/modernising/replacement of Council's works depots at Bungendore, Braidwood and Captains Flat. ($2,610,000)

- Refurbish National Theatre at Braidwood ($200,000)

Providing services in a sustainable manner will require matching of projected asset renewals to meet agreed service levels with planned capital works programs and available revenue.

A gap between projected asset renewals, planned asset renewals and funding indicates that further work is required to manage required service levels and funding to eliminate any funding gap.

Council will manage the 'gap' by developing this asset management plan to provide guidance on future service levels and resources required to provide these services. In particular improvement of the asset register, reassessment of useful lives and remaining lives will greatly improve the confidence level in the calculated results.

7.6.2 Funding Strategy General Fund Properties & Facilities

Projected expenditure identified in Section 7.1 is to be funded from Council's operating and capital budgets. The funding strategy will be detailed in Council's 10 year long term financial plan.

7.6.3 Valuation Forecasts General Fund Properties and Facilities

Asset values are forecast to increase as additional assets are added to the asset stock from construction and acquisition by Council and from assets constructed by land developers and others and donated to Council. Figure 41 shows the projected replacement cost asset values over the planning period in 2010 dollar values. Depreciation expense values are forecast in line with asset values as shown in Figure 42.

Figure 41 – Projected General Fund Properties & Facilities Asset Replacement Cost

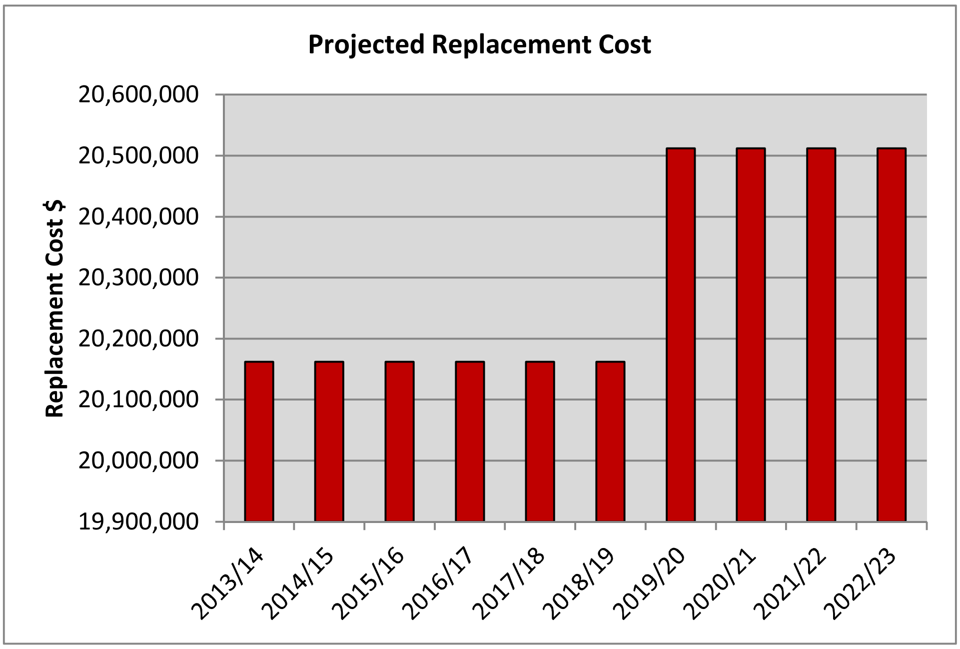
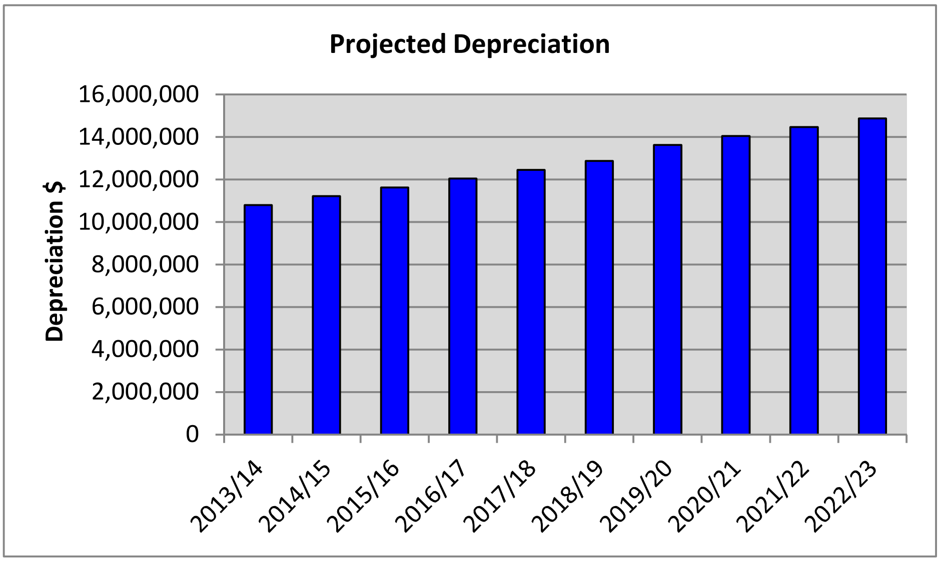
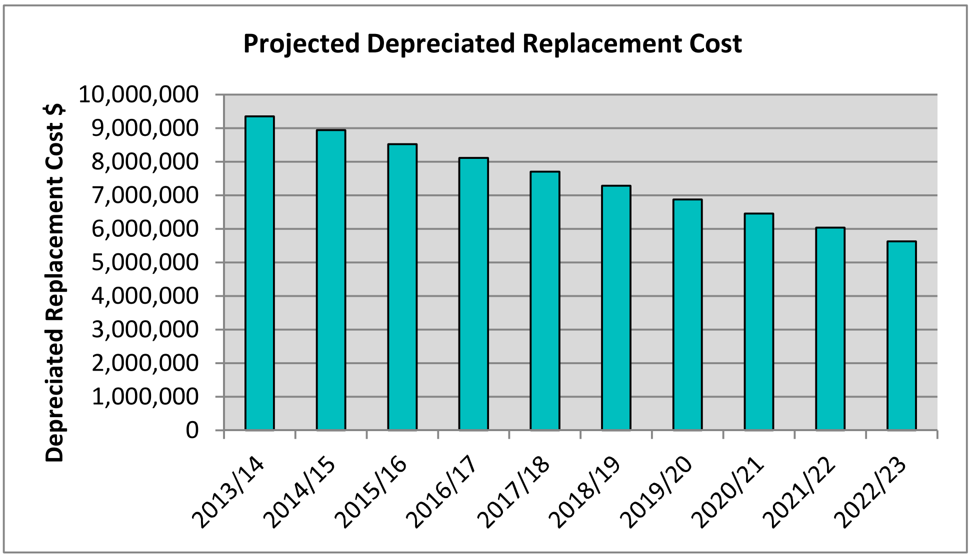


Figure 42 – Projected General Fund Properties & Facilities Depreciation Expense



The depreciated replacement cost (current replacement cost less accumulated depreciation) will vary over the forecast period depending on the rates of addition of new assets, disposal of old assets and consumption and renewal of existing assets. Forecast of the assets' depreciated replacement cost is shown in **Figure 43**.

Figure 43 – Projected General Fund Properties & Facilities Depreciated Replacement Cost



7.6.4 Key Assumptions made in Financial Forecasts

Refer Section 2.6

7.6.5 General Fund Properties & Facilities Asset Valuations

Building Assets are currently being revalued for the 2013/14 financial reporting requirements. A summary of the financial values is shown below.

Current Replacement Cost	$20,162,000
Depreciated Replacement Cost	$9,355,000
Annual Depreciation Expense	$412,700

8 WASTE FACILITIES

8.1 Current Levels of Service

Current levels of service for waste assets are detailed in ***Table 38*** *below.* The current performance of many of the levels of service that are detailed are not measured. However, performance monitoring processes can be established using these tables as a guide, thus enabling this missing information to be included in future revisions of this asset management plan.

Table 38 – Current Levels of Service (Waste Facilities)

Waste Facilities Asset Groups	Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
	COMMUNITY LEVELS OF SERVICE				
Landfills	Quality Function Health & Safety	Safe and functional locations are available at which waste can be dispose of Basic arrangements provided for the separation of suitable items for recycling or reuse	Customer survey relating to standard of arrangements	General satisfaction with standard of arrangements Closure of all Landfills	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
Waste Transfer Stations	Quality Function Health & Safety	Safe, functional, efficient and 'pleasant to visit' facilities are provided that make separation of useable materials from residue waste simple and quick	Customer survey relating to standard of facilities Staff inspections and reports	General satisfaction with standard of arrangements	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
	TECHNICAL LEVELS OF SERVICE				
Landfills	Quality Function Health & Safety	Waste covered by soil at least once per week All weather access available to dumping points Recycling made easy	Customer survey relating to standard of facilities Staff inspections and reports	General satisfaction with standard of facilities	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings
Waste Transfer Stations	Quality Function Health & Safety	Facilities with sealed access and manoeuvring areas Separate designated areas to place re-usable/recyclable material Facilities without offensive odour, dust and flies	Customer survey relating to standard of facilities Staff inspections and reports	General satisfaction with standard of facilities	To be included in next survey. Issues and actions are reported at weekly Works Planning meetings

8.2 Desired Levels of Service

At present, indications of desired levels of service are obtained from various sources including feedback from residents, service complaints and correspondence. It is considered that the levels of service desired by the community are covered by the various levels of service described above. It is also appreciated that there is a lot of dissatisfaction with landfills that are typically unpleasant to visit. The move to modern waste stations is expected to result in higher levels in the future.

8.3 Future Demand for Waste Facility Assets

8.3.1 Demand Forecast

The adopted Palerang Waste Strategy 2005-2025 identifies the waste facilities that will be needed in the LGA over the next 10 years. This document has been prepared taking into account expected population increases over the next two decades and recognises that all of the remaining landfills are all but full and need to be replaced with alternative waste management arrangements.

The difficulty of finding suitable locations for new landfill sites, together with the costs of establishing and operating them has ruled out including them in the strategy. Instead it has been adopted that landfills will be replaced with transfer stations that temporarily stored materials and waste prior to being transport to final destinations.

The strategy has suggested that waste transfer stations (WTSs) be located at Captains Flat (already operating), Bungendore, Braidwood, Majors Creek, Araluen and Nerriga. Processes to review the strategy are underway. Council has agreed to provide an extra WTS at Macs Reef and to undertake community engagement to explore the possibility of providing roadside bin collection services at Araluen and Majors Creek in lieu of constructing WTSs at these locations. Council recently gained approval to transport its residual waste to the Woodlawn Bioreactor, subject to paying a gate fee.

8.3.2 Changes in Technology

Technology changes may affect the delivery of services covered by this plan in the areas detailed in ***Table 39*** below. These changes in technology will need to be reflected in the financial forecasts of future versions of this plan as and when these technologies are introduced at Council.

Table 39 - Changes in Technology and Forecast Effect on Service Delivery

Technology Change	Effect on Service Delivery
Improved recycling arrangements e.g. the E-waste Stewardship Scheme	An increased level of materials, including e-waste products, will be presented for recycling under the new arrangements and diverted from landfill.
Improvement of information systems and asset knowledge	Improvements in monitoring condition, capturing and analysing data, planning works and making information available to Council staff to enable more efficient service delivery.

8.3.3 Demand Management Plan

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand, and demand management. Demand management practices include non-asset solutions, insuring against risks and managing failures.

Opportunities identified to date for demand management are shown in ***Table 40***. Further opportunities will be developed in future revisions of this asset management plan.

Table 40 - Demand Management Plan Summary

Service Activity	Demand Management Plan
Waste Transfer Stations	Gates fees at WTSs will be structured to reward visitors to the facilities that reduce the amount of waste going to landfill by arranging their loads for ready separation and recovery of reusable/recyclable material in their loads.

8.3.4 New Assets from Growth

The new assets required to meet growth will be constructed by Council. None are expected to be received directly from new developments. The new asset values are summarised in ***Table 41*** below. Providing these new assets will commit council to fund ongoing operations and maintenance costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operating and maintenance costs.

Table 41 - 10 Year Expenditure Forecast – New Works (Council Funded)

Location	Cost of Works
Bungendore	$4,610,000
Macs Reef	$1,500,000
Braidwood	$2,000,000
Araluen	$400,000
Majors Creek	$400,000
Nerriga	$450,000
Total	**$9,360,000**

8.4 Lifecycle Management Plan for Waste Facility Assets

Lifecycle management plans are detailed below in Section 8.4.1 Landfills;

A summary of expenditure and changes to the asset base over the 10 year period is provided at the end of the section for each asset group. A complete financial summary is included in Section 8.6.

8.4.1 Landfills

8.4.1.1 Background Data

(a) Asset Description

Council is currently responsible for six landfills located at Bungendore, Macs Reef, Braidwood, Majors Creek, Araluen and Nerriga.

(b) Asset Capacity, Condition and Performance

All but the Nerriga landfill are close to being full and their closure is programmed as follows:

Landfill	Closure Date
Bungendore	By 30/06/2014
Macs Reef	By 30/06/2014
Braidwood	By 30/06/2015
Araluen	By 30/06/2105
Majors Creek	By 30/06/2015
Nerriga	By 30/06/2018

8.4.1.2 Operation and Maintenance

(a) Operation and Maintenance Activities

Four of the landfills have on-site supervisors during the hours of operations. These include Bungendore, Macs Reef, Braidwood and Nerriga. Staff duties include:

- checking tip passes and turning away non-Palerang residents
- directing customers to the recycling areas and residual waste dumping areas
- opening and closing the landfill gates
- recovering useful material from waste dumped
- keeping the facility as tidy as possible
- liaising with waste management to co-ordinate pick-up of recyclable materials
- liaising with waste management staff to dispatch plant for the covering of waste.

Ideally waste deposited in trenches should be covered with earth fill each day but due to the expense of having plant available at often remote locations this is at best undertaken once a week. Council is not bound by any licence conditions in this regard.

(b) Operation and Maintenance Expenditure Trends

Council operation and maintenance expenditure trends are shown in ***Table 42***. Expenses will decrease as landfills as closed.

Table 42 – Operation and Maintenance Expenditure Trends for Landfills

Year	Operation and Maintenance Expenditure
2010/11	784,000
2011/12	913,000
2012/13 budget	747,000

The majority of the expenditure relates to operation of the landfills.

Assessment and prioritisation of maintenance is currently undertaken by Council staff using experience and judgement.

(c) Operation and Maintenance Standards and Specifications

No particular standards are used or available.

8.4.1.3 Renewals

As indicated above no renewals are proposed.

8.4.1.4 New Works

As indicated above no renewals are proposed.

8.4.1.5 Disposals

All landfills in our LGA area will be closed within the next decade. The sites will be restored and revegetated and written off in Council's accounts.

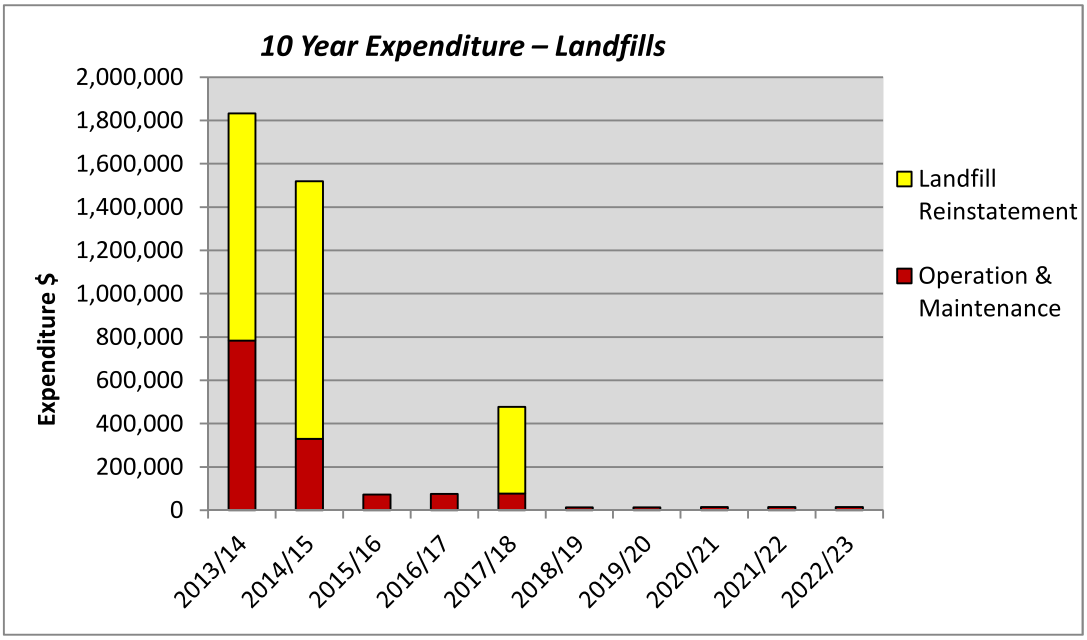
The costs of closure and restoration as expect to be as follows:

Landfill	Cost of Restoration at Closure	Date
Bungendore	$600,000	2014/15
Macs Reef	$450,000	2014/15
Braidwood	$550,000	2015/16
Araluen	$320,000	2015/16
Majors Creek	$320,000	2015/16
Nerriga	$400,000	2018/19
Total	**$2,640,000**	

8.4.1.6 Summary Planned Future Expenditure on Landfills

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 44* below.

Figure 44 - 10 Year Expenditure – Landfills



8.5 Waste Facility Risk Management Plan

Council has developed and adopted a corporate risk framework based on the Australian / New Zealand standard for Risk Management 4360:2004. The corporate risk framework (referred to as the Risk Management Plan) consists of a policy statement, roles and responsibilities for risk management across Council, a process for carrying out risk assessments and likelihood / consequence tables for rating risks.

A formal assessment of risks associated with service delivery from infrastructure assets is yet to be carried out by Council. The risk assessment process will identify credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks. Critical risks, being those assessed as 'Very High' - requiring immediate corrective action and 'High' – requiring prioritised corrective action will be identified in the infrastructure risk management plan once developed and subsequently summarised in future revisions of this asset management plan.

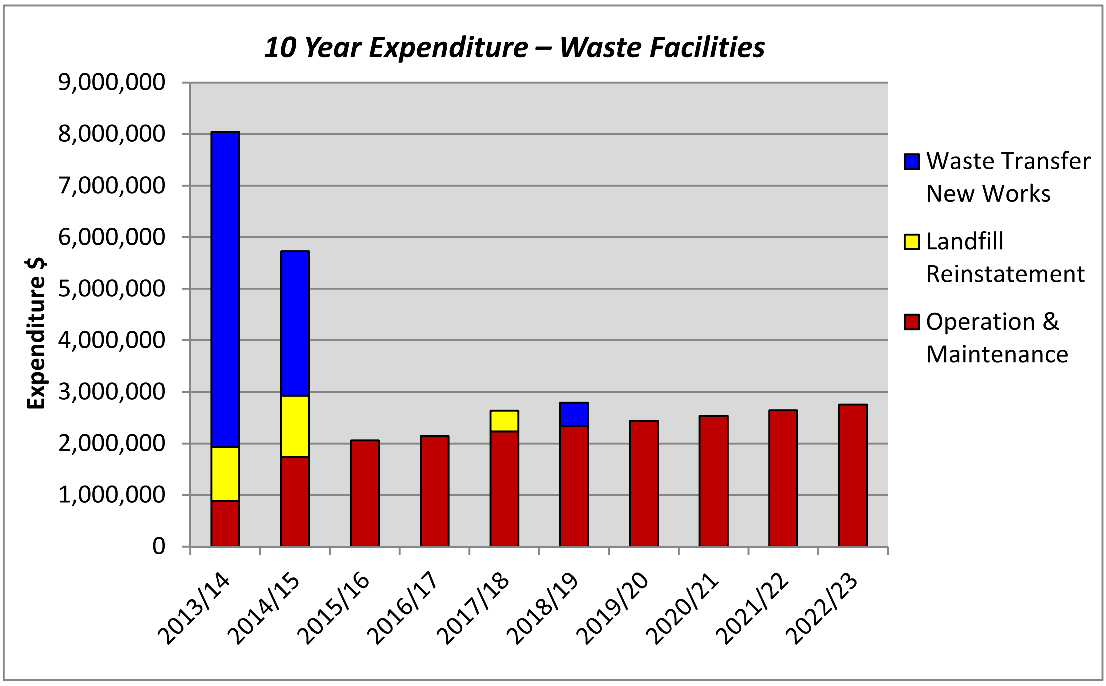
8.6 Financial Summary – Waste Facilities

This section contains the financial requirements resulting from all the information presented in the previous sections of this asset management plan. The financial projections will be improved as further information becomes available on desired levels of service and current and projected future asset performance.

8.6.1 Financial Statements and Projections (Waste Facilities)

The financial projections are shown in *Figure 45* below for planned operating (operations and maintenance), capital expenditure (renewal and upgrade/expansion/new assets) and estimated unfunded renewals (renewals that have been identified but not carried out prior to the first year of the asset management plan).

Figure 45 – 10 Year Financial Forecast (Waste Facilities)



Notes on 10 Year Financial Forecast:

Total forecast expenditure over the 10 year planning period is estimated to be approximately:

Operations and Maintenance	$21,791,446
Landfill Reinstatements	$2,640,000
New Transfer Stations	$9,360,000

8.6.1.1 Sustainability of Service Delivery

This asset management plan identifies the estimated operation and maintenance and capital expenditures required to provide an agreed level of service to the community over a 10 year period for input into a 10 year financial plan and funding plan to provide the service in a sustainable manner.

Since all landfill sites are being replaced with new Waste Transfer Stations there will be no asset renewals in the 10 year planning period for this asset management plan

8.6.2 Funding Strategy Waste Facilities

Projected expenditure identified in Section 8.6.1 is to be funded from Council's operating and capital budgets. The funding strategy will be detailed in Council's 10 year long term financial plan.

8.6.3 Valuation Forecasts Waste Facilities

Asset values are forecast to increase as additional assets are added to the asset stock from construction and acquisition by Council and from assets constructed by land developers and others and donated to Council. Figure 46 shows the projected replacement cost asset values over the planning period in 2010 dollar values. Depreciation expense values are forecast in line with asset values as shown in Figure 47.

Figure 46 – Projected Waste Facility Assets Replacement Cost

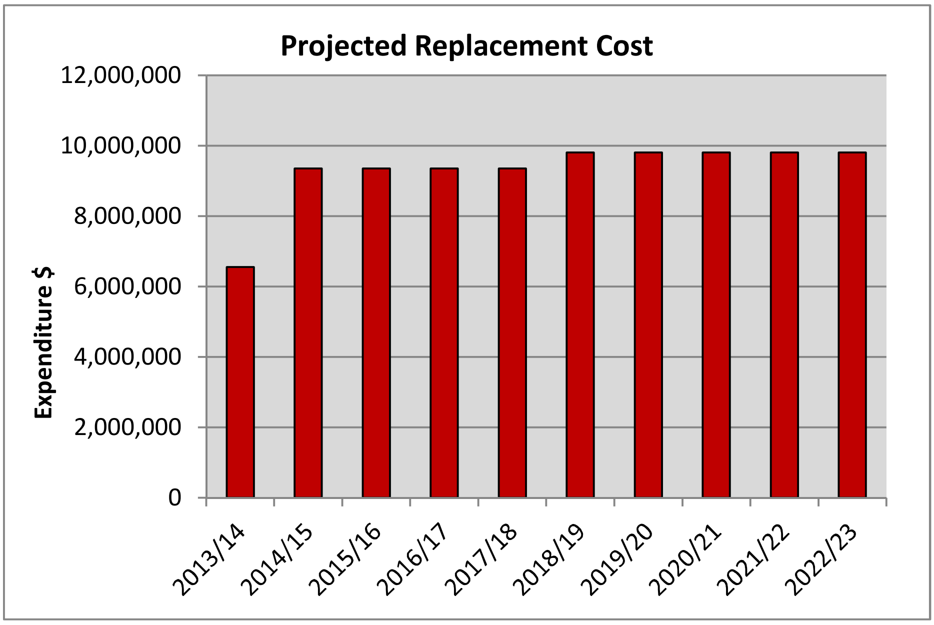
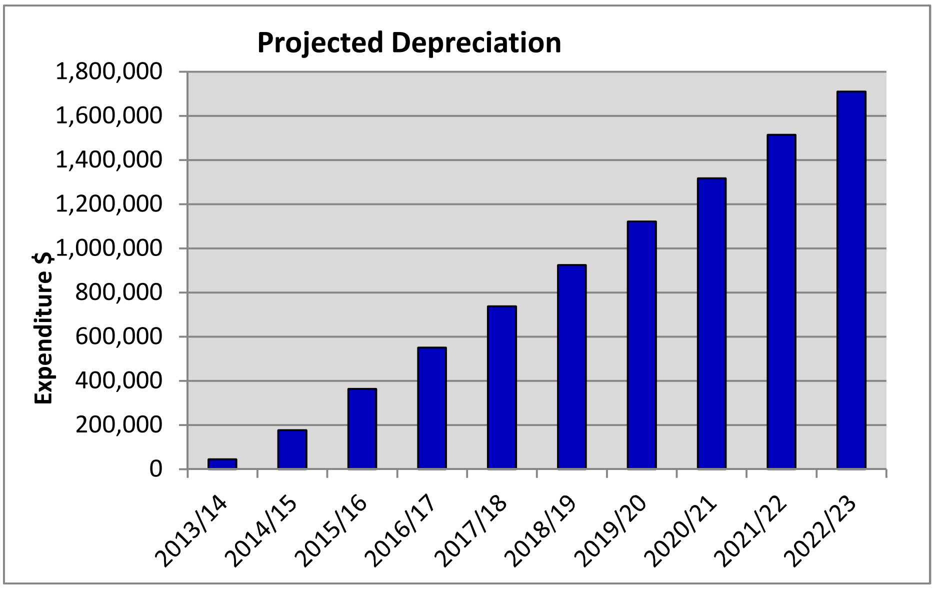
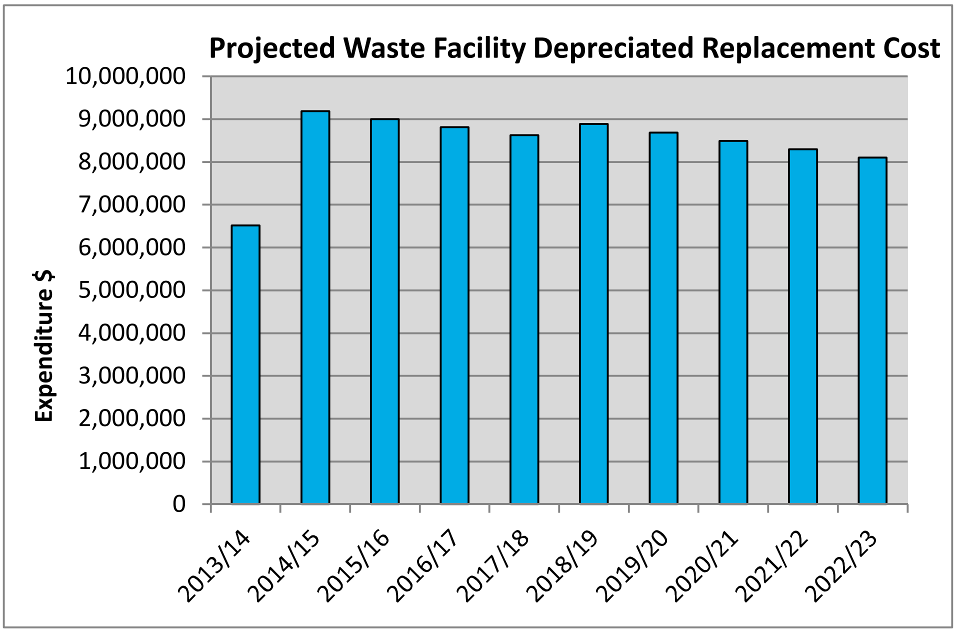


Figure 47 – Projected Waste Facilities Depreciation Expense



The depreciated replacement cost (current replacement cost less accumulated depreciation) will vary over the forecast period depending on the rates of addition of new assets, disposal of old assets and consumption and renewal of existing assets. Forecast of the assets' depreciated replacement cost is shown in Figure 48.

Figure 48 – Projected Waste Facilities Depreciated Replacement Cost



8.6.4 Key Assumptions made in Financial Forecasts

Refer Section 2.6

8.6.5 Waste Facilities Asset Valuations

The value of existing landfill sites is included under land values and building values as the landfill area is deemed to have no capital value

When the proposed waste transfer stations are completed the vales will be added to the asset register and included in the Council financial reports.

The component of the transfer stations will be recorded and depreciation applied as appropriate to the type of component (earthworks, buildings, siteworks, etc.).

9 WATER SUPPLY SYSTEMS

9.1 Current Levels of Service

Current levels of service for water supply assets are detailed in ***Table 43*** *below.* The current performance of many of the levels of service that are detailed is still unknown. However, performance monitoring processes can be established using these tables as a guide, thus enabling this missing information to be included in future revisions of this asset management plan.

Table 43 – Current Levels of Service (Water Supply)

Water Supply Asset Groups	Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
	COMMUNITY LEVELS OF SERVICE				
Water Supply Systems including: Water Treatment Plants Bores Reservoirs Dams Delivery Pumps Delivery Mains Reticulation Mains & services	Quality Function Health & Safety	Provide reliable urban water supply systems, at a fair and transparent price, that have good water quality and adequate pressure to cater for more than one tap operating at a time in a household.	Customer survey. Monitoring by Council staff Customer complaints relating to substandard supply Operator and Supervisor reports	General satisfaction with level of service	Customer satisfaction to be included in future surveys Defects and actions are reported at weekly Works Planning meetings
	TECHNICAL LEVELS OF SERVICE				
Water Supply Systems including: Water Treatment Plants Bores Reservoirs Dams Delivery Pumps Delivery Mains Reticulation Mains & services	Quality Function Health & Safety	1. Headworks capacity can meet demands of a.) Peak Daily Demand for 10 years growth based on 3KL/day/property b) Average Annual Demand of 200KL/property 2. Residual water pressure ranging between 12-80m head with a minimum instantaneous flow of at least 0.1L/s at all properties 3. Water quality to meet NHMRC guidelines. 4. Supplies to be chlorinated and fluoridated to acceptable residual content. 5. System failures to be rare.	Telemetry records Water test results Operator and Supervisor reports	General achievement and maintenance of levels of service	Defects and actions are reported at weekly Works Planning meetings

9.2 Desired Levels of Service

At present, indications of desired levels of service are obtained from various sources including design standards, feedback from residents, service complaints and correspondence. It is considered that the levels of service desired by the community are covered by the various levels of service described above.

9.3 Future Demand for Water Supply Assets

9.3.1 Demand Forecast

A description of the expected demand for extra water supply assets is included in Section 4.

Council will acquire a significant length of new delivery and reticulation mains and services in new subdivisions at Bungendore and Braidwood. These are listed in Attachment B. No significant development is expected in Captains Flat.

At the time of writing this document Council was about to commission a new water treatment plant at Braidwood and the supplementary Currandooly water supply system at Bungendore, including new bore, bore delivery main, water treatment plant, clear water storage tank and clear water delivery main to town.

Further new water supply assets will be required to meet water demand over the next 10 years of growth including an extra 1.5ML reservoir at Braidwood and an extra 2.0ML reservoir and additional bore at Currandooly to service Bungendore. Supplementary delivery mains will also be required in the south Bungendore area to maintain supply volumes and mains pressure requirements of new subdivisions in this area.

It is to be noted that the new assets will be required in readiness for the impending population that follows after subdivisions are released for housing construction.

9.3.2 Changes in Technology

Technology changes may affect the delivery of services covered by this plan in the areas detailed in ***Table 44*** below. These changes in technology will need to be reflected in the financial forecasts of future versions of this plan as and when these technologies are introduced at Council.

Table 44 - Changes in Technology and Forecast Effect on Service Delivery

Technology Change	Effect on Service Delivery
Improved telemetry	Upgraded remote monitoring and control methods will assist in optimising system operation and reduce costs associated with staff call-outs.
Improvement of information systems and asset knowledge including new asset software to tracks service requests	Improvements in monitoring condition, capturing and analysing data, planning works and making information available to Council staff to enable more efficient service delivery.
Improved dynamic reticulation system hydraulic modelling software	The design and timing for providing upgraded infrastructure can be optimised through better knowledge of impacts of increases in water demand on the systems.

9.3.3 Demand Management Plan

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand, and demand management. Demand management practices include non-asset solutions, insuring against risks and managing failures.

Opportunities identified to date for demand management are shown in ***Table 45***. Further opportunities will be developed in future revisions of this asset management plan.

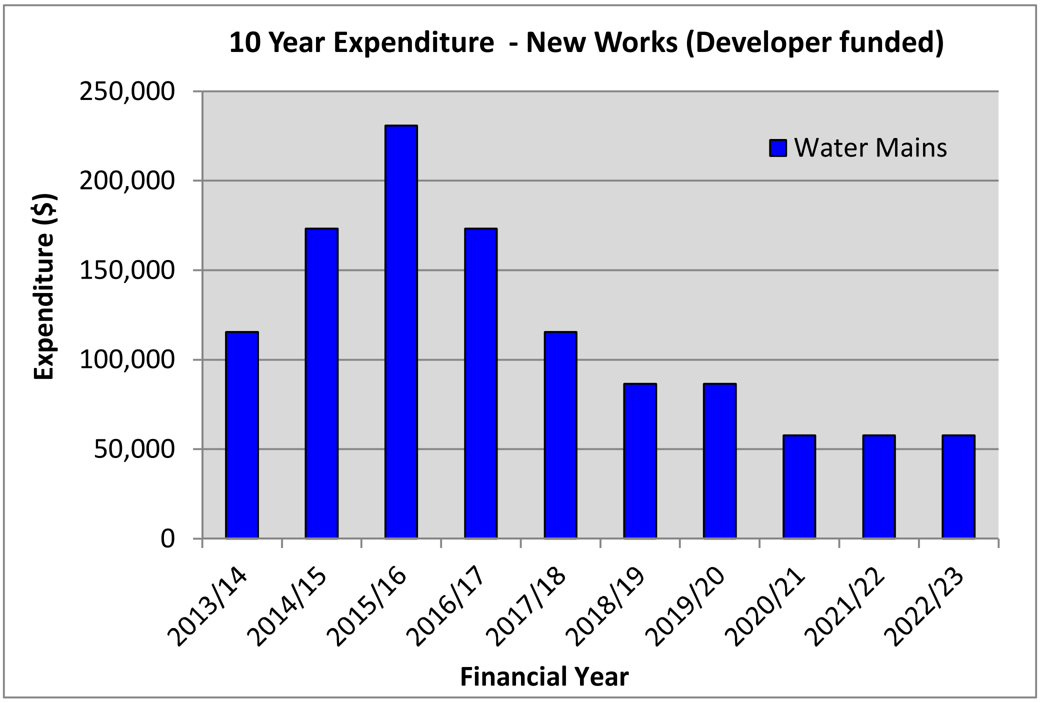
Table 45 - Demand Management Plan Summary

Service Activity	Demand Management Plan
Water Consumption	The following water demand management measures have been adopted and are applied in all three water supply systems: a. A two tier 'best practice' water charging policy approved by IPART, with higher users paying more for water. b. BASIX for new buildings and a default requirement for large rain water tanks to be installed at all new residences. c. Operation of the 'Waterwise' program whereby customers are offered a number of retro-fit rebate incentive schemes to install to save water involving cash payments to install rainwater tanks, replace single flush with dual flush toilets, and replace inefficient water appliances. d. Installation of effluent recycling system to replace potable water as source for water playing fields at Bungendore. e. Operation of a Council's Water Restrictions Policy to ensure sustainability of supply during extended dry period when water sources are drawn down and are not being replenished.

9.3.4 New Assets from Growth

The new assets required to meet growth will be acquired from land developments and constructed by Council. The new asset values are summarised in *Figure 49* below. Acquiring these new assets will commit council to fund ongoing operations and maintenance costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operating and maintenance costs.

Figure 49 – 10 Year Expenditure Forecast – New Works (Developer Funded)



9.4 Lifecycle Management Plan for Water Supply Assets

Lifecycle management plans are defined for each of the key asset groups detailed below:

Section 8.4.1 Water Supply Headworks;

Section 8.4.2 Water Supply Mains;

A summary of expenditure and changes to the asset base over the 10 year period is provided at the end of the section for each asset group. A complete financial summary is included in Section 9.5.

9.4.1 Water Supply Headworks

9.4.1.1 Background Data

(a) Asset Description

Council is currently responsible for three water supply schemes located at Bungendore, Braidwood and Captains Flat. Water Supply Headworks includes all of the components of the systems that source, treat, store and transfer water to the distribution pipe network within the towns served. This includes dams, bores, water treatment works and reservoirs. Bore and river delivery mains from the water source and clear water delivery mains from treatment works have not been included under this category but are included in Water Supply Mains for asset maintenance and financial accounting purposes.

The three water systems currently serve about 2150 properties (Braidwood 720, Bungendore 1160, Captains Flat 268) some of which are undeveloped.

(b) Asset Capacity, Condition and Performance

The capacity, condition and current utilisation of the Headworks components are as follows:

i) Bungendore

Bungendore's current water source is a series of bores on the western fringe of the town. These all pump to a collection tank on Bungendore Road through an aeration tower on the site that removes carbon dioxide from the water. The quality of the groundwater is such that it does not need conventional treatment other than precautionary chlorination and fluoridation for dental health of consumers. From this collection storage an adjacent pumping station delivers the supply to town through the pipe reticulation system, with excess flow being forwarded to the town's three reservoirs (totalling 3.5 ML) until they are full.

A summary of current water demand, based on the existing level of development in the town and the predicted future water demand based on a continuing high scenario growth rate of 5.0% p.a., is as follows:

Criteria	Current Demand	Predicted demand in 10 years at 5.0% growth	Predicted demand in 20 years at 5.0% growth
Average Annual Demand	230 ML per year	375 ML per year	610 ML per year
Peak Daily Demand	1.2 ML per day	2.0 ML per day	3.2 ML per day

Water Use

Reticulated water supply use and change was:

Township	Water use 2011/12 (ML)	Change from 2009-10
Braidwood	120.3	+28%
Bungendore	230.0	-2%
Captains Flat	49.3	+9%

Despite some increased usage from the very low levels last year, all towns still used less than in 2009-10. There were no water restrictions, only water conservation measures.

Groundwater

Council extracted 230.0 ML of bore water, for Bungendore, less than the 233.6 ML in 2010-11 and 259.7 ML previous five year average.

This existing supply system has adequate capacity to provide the current demands of the town. However due to the safe yield of the Lake George aquiver being reached at the current water entitlement of 330 ML pa, it is not permissible to further exploit the existing borefield for the future growth of the town. A new supplementary source has been discovered and is being developed at Currandooly, 8km north of the town, for commissioning by March 2013.

The supplementary Currandooly system will include new bore, bore delivery main, water treatment plant, clear water storage tank and clear water delivery pump and main to town.

Once the new Currandooly system is commissioned other new water assets needed in the next decade will be an extra bore at Currandooly planned for construction in 2015/16 to provide standby capacity at a cost of $250,000, an extra 2.0 ML reservoir in 2021/22 at a cost of $1.1mill, and reticulation mains upgrades in southern Bungendore in 2013/14 at a cost of $300,000.

ii) Braidwood

The water source is the Shoalhaven River to the west of the town. An on-river pump station delivers water to an 800 ML off-stream storage dam on Sandholes Road. A new diffused air flotation treatment works to be commissioned in February 2013 will treat the dam water which after processing, including chlorination and fluoridation, will be stored in 2 @ 0.55ML concrete reservoirs. From these reservoirs, the potable water gravitates to town to the reticulation pipe network.

A summary of current water demand based on the existing level of development in the town and the predicted future water demand based on a high scenario 2% growth rate, is as follows:

Criteria	Current Demand	Predicted demand in 10 years at 2.0% growth	Predicted demand in 20 years at 2.0% growth
Average Annual Demand	121 ML per year	148 ML per year	180 ML per year
Peak Daily Demand	0.56 ML per day	0.68 ML per day	0.83 ML per day

The river pumping station in combination with the delivery main to the off-stream storage dam has a capacity of 20L/s (both a duty pump and standby pump are available). Over a 22hr period a total of 1.6 ML can be pumped. This adequately meets current and predicted future demands. There is a need to expend about $200,000 within the next 5 years to upgrade the deficient pump building and switchgear controls of the facility.

The 80 ML off-stream storage dam is expected, with application of water restrictions to the current demand and allowing for evaporation (Av 135mm per month), to provide at least 8 months storage should the Shoalhaven River run dry. At the 2% growth rate these times will be reduced by 22% to 6 months in 10 years and by 49% to 4 months in 20 years. These timeframes are considered adequate to outlast expected droughts or to otherwise make arrangements to truck in emergency water supplies.

The new water 2.0 ML/day water treatment plant, operational from February 2013, will adequately serve the town for the next 20 years.

The 1.1 ML existing total reservoir storage is not however adequate for the town. It would be desirable to have clear water storage for 2-3 days average supply should there be a serious mal-function that puts the treatment works off-line for this period. An extra 1.5ML reservoir is proposed for construction in 2013/14 at a cost of $1.05 mill.

iii) Captains Flat

The water source is the 800ML Captains Flat dam on the Molonglo River above the town. Water from the dam feeds the 0.7 ML/day Ultra Membrane Filtration water treatment plant below the dam and from there the treated water is pumped to two reservoirs of 1.2ML total storage at Keatings Hill. From this point the water can gravitate through the pipe network serving the town.

The 800ML dam storage and the reliable catchment ensure that the available storage capacity is well in excess of the annual usage figures, which will remain at about 50 ML given that there is insignificant growth. The dam being a high consequence but low risk dam requires formal 5 year inspections by the State Safe Dam Surveillance team and as a result there are often many maintenance actions identified for follow up action.

Although it needs close monitoring and regular adjustment, the treatment works consistently produces high quality water. The high position of the reservoirs above the town ensure high mains pressure to consumers.

The only aspect of poor performance is the highly concerning level of corrosion that is occurring inside the WTP building where fumes from the chemicals stored there are reacting with the metal and concrete components of the building including the electrical switchgear. A new separate masonry building is required urgently to isolate the chemical storage. The switchgear and treatment plant will also require maintenance attention to bring these items back to good condition.

9.4.1.2 Operation and Maintenance

(a) Operation and Maintenance Activities

Operation and maintenance of water supply headworks facilities requires trained and experienced staff. The activities undertaken ensure that plant and equipment is maintained in good condition, supply sources are properly monitored and the correct operational procedures are followed.

The tasks and procedures involved are listed in the Operations Manuals that have been provided by the designers of the works. Some of the servicing is provided by external contractors engaged for the purpose.

Costs of operation increase as more water is pumped and treated resulting from higher power and chemical bills and greater wear and tear.

(b) Operation and Maintenance Expenditure Trends

Council operation and maintenance expenditure trends are shown in ***Table 46***.

Table 46 - Maintenance Expenditure Trends for Water Supply Headworks

Year	Maintenance Expenditure	Operations Expenditure	Total Expenditure
2010/11	$31,252	$314,623	$345,875
2011/12	$30,961	$375,536	$406,497
2012/13 budget	$112,304	$384,662	$496,966

Currandooley water treatment plant and fluoridation will add about $40,000 to the annual operational expenditure

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Operation and Maintenance Standards and Specifications

Maintenance work is carried out in accordance with the following:

a) Relevant Australian Standards

b) Relevant Industry Specifications and Codes of Practice

c) Relevant ‘manuals’ provided with specialised equipment (e.g. pumps, blowers, screens, mixers, etc.), including the following documents:

- Currandooly WTW Operations Manual
- Braidwood WTW Operations Manual
- Affordable Water Supply & Sewerage for Small Communities (Water Services Australia).
- SW Public Works Water Supply Guidelines

9.4.1.3 Renewals

The Shoalhaven River pumping station building, pumps and switchgear need renewal works within the next decade.

Various Bungendore bore pumps will need renewal over the next decade.

The total cost of this work is estimated at $460,000

9.4.1.4 New Works

New water assets needed in the next decade will be an extra bore at Currandooly planned for construction in 2015/16 to provide standby capacity at a cost of $250,000, an extra 2.0 ML reservoir at Bungendore in 2021/22 at a cost of $1.1mill, and an extra 1.5ML reservoir at Braidwood in 2013/14 at a cost of $1.05 mill.

9.4.1.5 Disposals

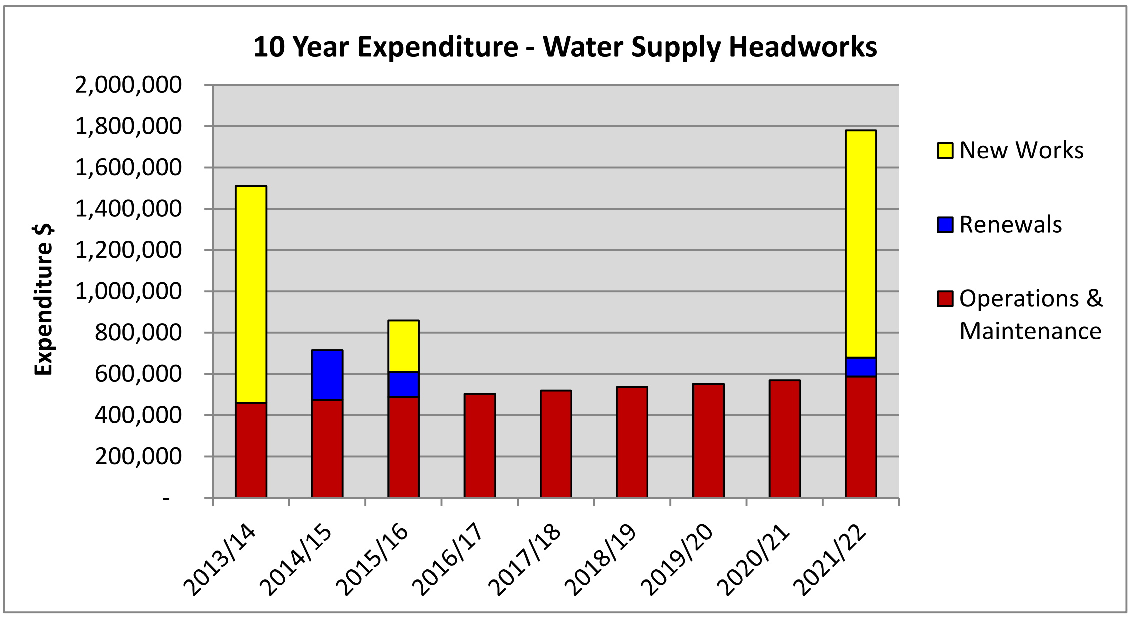
No disposals are planned.

9.4.1.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 50* below

Figure 50 – 10 Year Expenditure Forecast – Water supply Headworks

There are no directly provided Water Supply Headworks provided developers. Contributions provided by developers will be used for future Headworks augmentation



9.4.2 Water Supply Mains

9.4.2.1 Background Data

(a) Asset Description

Council is currently responsible for approximately 80.8 km of water supply mains as detailed in the following table:

Town	Bulk Mains (km)	Reticulation Mains (km)
Bungendore	9.9	33.0
Braidwood	11.8	17.5
Captains Flat	0	8.6
Totals	21.7	59.1

(b) Asset Capacity, Condition and Performance

While each of the town water reticulation systems are operating satisfactorily with adequate flow and pressure capacity, the oldest mains are now over 60 years old and are becoming increasingly suspect to breakages. Of particular concern is the 250/300 mm diameter asbestos cement main that delivers flow to Braidwood from the new water treatment plant site on Sandholes Road. Programs to replace these mains will be required over the next decade, as detailed under ***Renewals*** below.

9.4.2.2 Maintenance

(a) Maintenance Activities

Maintenance of water mains is predominately reactive however periodic inspections are undertaken to pick up defects and deficiencies that require attention. Activities include:

- Repairing pipe breakages and leakages;
- Scouring mains to remove dirty water;
- Locating/providing/repairing services
- Mains replacement programs;
- Servicing/replacing valves

(b) Maintenance Expenditure Trends for Water Supply Mains

Council maintenance expenditure trends are shown in ***Table 47Table 17***.

Table 47 - Maintenance Expenditure Trends for Water Supply Mains

Year	Operations & Maintenance Expenditure
2010/11	$108,103
2011/12	$91,842
2012/13 budget	$213,110

Assessment and prioritisation of maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

Maintenance work is carried out in accordance with the following:

a) Relevant Australian Standards

b) Relevant Industry Specifications and Codes of Practice

c) Relevant 'manuals' provided with specialised equipment (e.g. pumps, blowers, screens, mixers, etc.)

9.4.2.3 Renewals

Forecast renewal dates have been identified from the expected condition based on age of asset. A useful life of 80 years for water supply mains has been adopted for this plan.

The total projected renewal of water mains is approximately $990,000 over the 10 year time frame of this plan.

9.4.2.4 New Works

Additional reticulation mains will be constructed to service new development in the Bungendore and Braidwood. These works are estimated to cost $970,000.00 in Bungendore and $185,000 in Braidwood over the next 10 years.

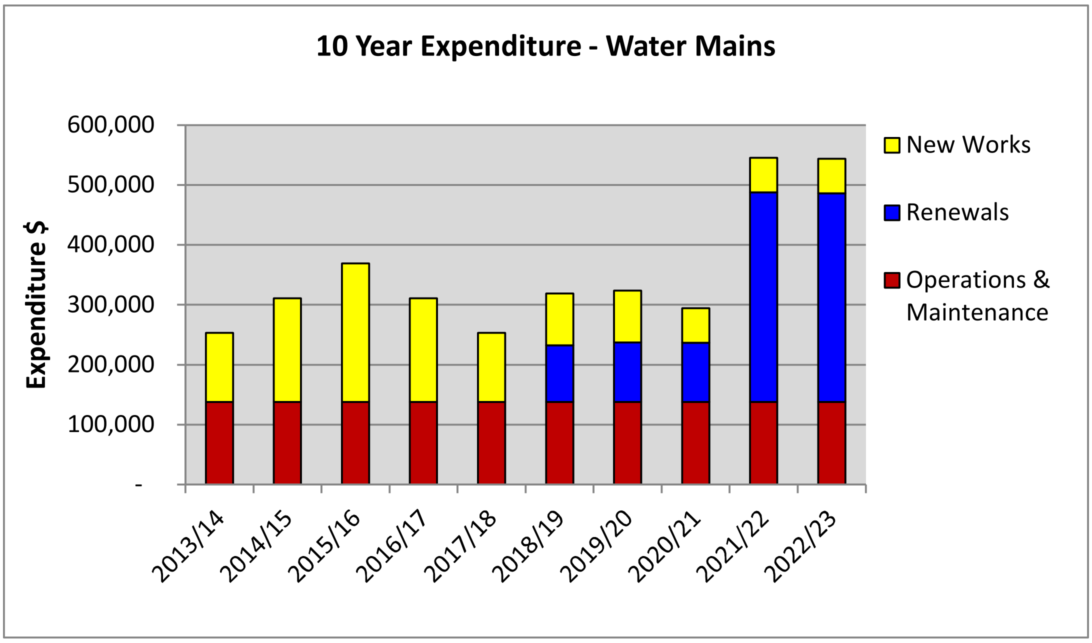
9.4.2.5 Disposal Plan

No water mains have been identified for possible decommissioning or disposal.

9.4.2.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 51* below.

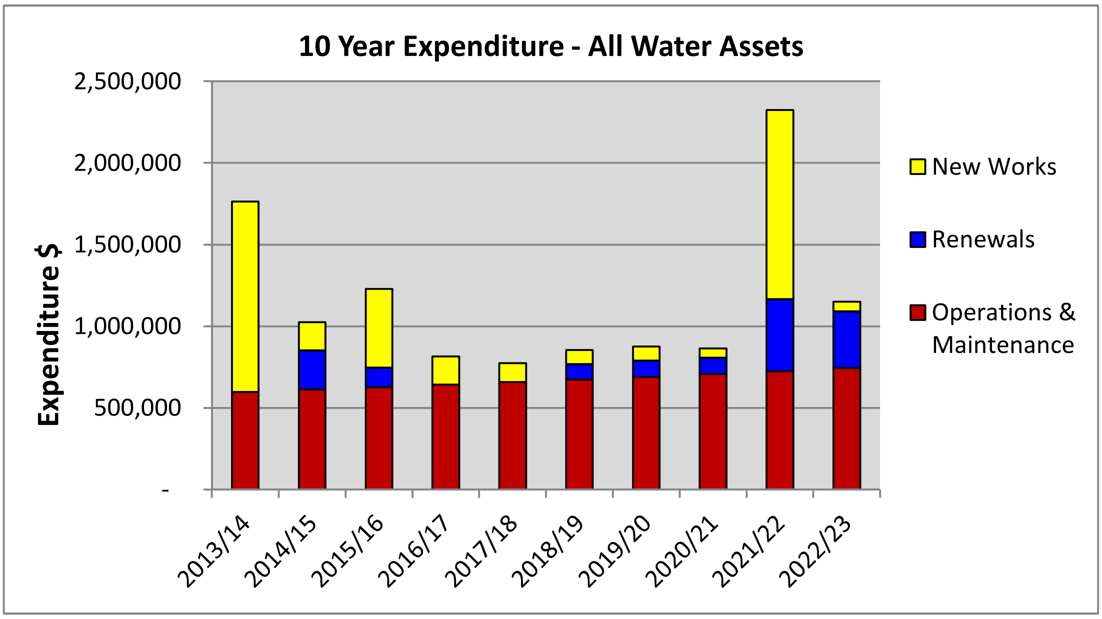
Figure 51 - 10 Year Expenditure –Water Supply Mains



9.4.3 Summary All Planned Future Expenditure for Water Supply Systems

The projected expenditure resulting from the lifecycle plans for combined water headworks water treatment, pumping and gravity main assets is detailed in ***Table 48*** below.

Table 48 - 10 Year Expenditure - All Water Assets



9.4.4 Water Supply Risk Management Plan

Council has developed and adopted a corporate risk framework based on the Australian / New Zealand standard for Risk Management 4360:2004. The corporate risk framework (referred to as the Risk Management Plan) consists of a policy statement, roles and responsibilities for risk management across Council, a process for carrying out risk assessments and likelihood / consequence tables for rating risks.

A formal assessment of risks associated with service delivery from infrastructure assets is yet to be carried out by Council. The risk assessment process will identify credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks. Critical risks, being those assessed as 'Very High' - requiring immediate corrective action and 'High' – requiring prioritised corrective action will be identified in the infrastructure risk management plan once developed and subsequently summarised in future revisions of this asset management plan.

It is important for Council to quantify and make informed decisions on how to deal with risks. The assessments will need to cover WH&S, operational and environmental aspects and will inherently need to involve programmed and targeted inspections with frequency based on the criticality of the asset. The result will be the preparation of contingency plans for each risk.

The contingency plans will allow Council to respond to events that last for extended periods and facilitate a return to normal operation as soon as possible after interruption.

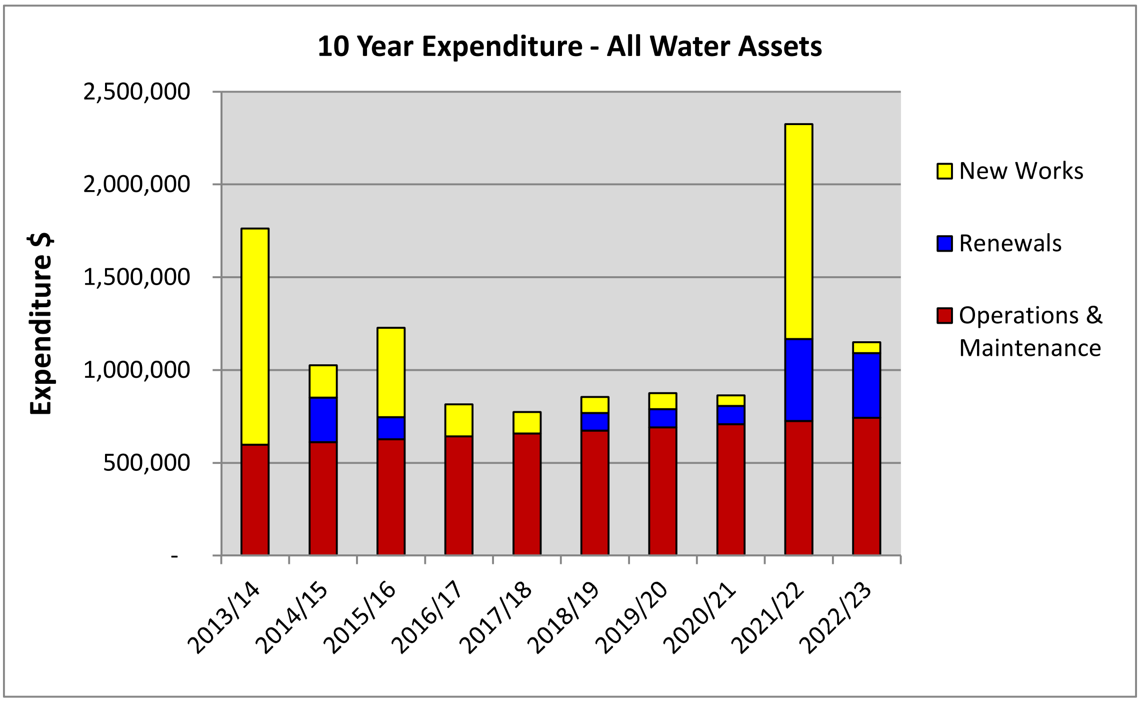
9.5 Financial Summary – Water Supply

This section contains the financial requirements resulting from all the information presented in the previous sections of this asset management plan. The financial projections will be improved as further information becomes available on desired levels of service and current and projected future asset performance.

9.5.1 Financial Statements and Projections (Water Supply)

The financial projections are shown in *Figure 52* below for planned operating (operations and maintenance), capital expenditure (renewal and upgrade/expansion/new assets) and estimated unfunded renewals (renewals that have been identified but not carried out prior to the first year of the asset management plan).

Figure 52 – 10 Year Financial Forecast (Water Supply)



Notes on 10 Year Financial Forecast:

Total forecast expenditure over the 10 year planning period are estimated to be approximately:

Operations and Maintenance	$6,678,000
Renewals	$1,442,000
New Works and Upgrades	$3,554,000

A breakdown of this 10 Year Financial Forecast by asset group is detailed in the corresponding lifecycle sections of this plan.

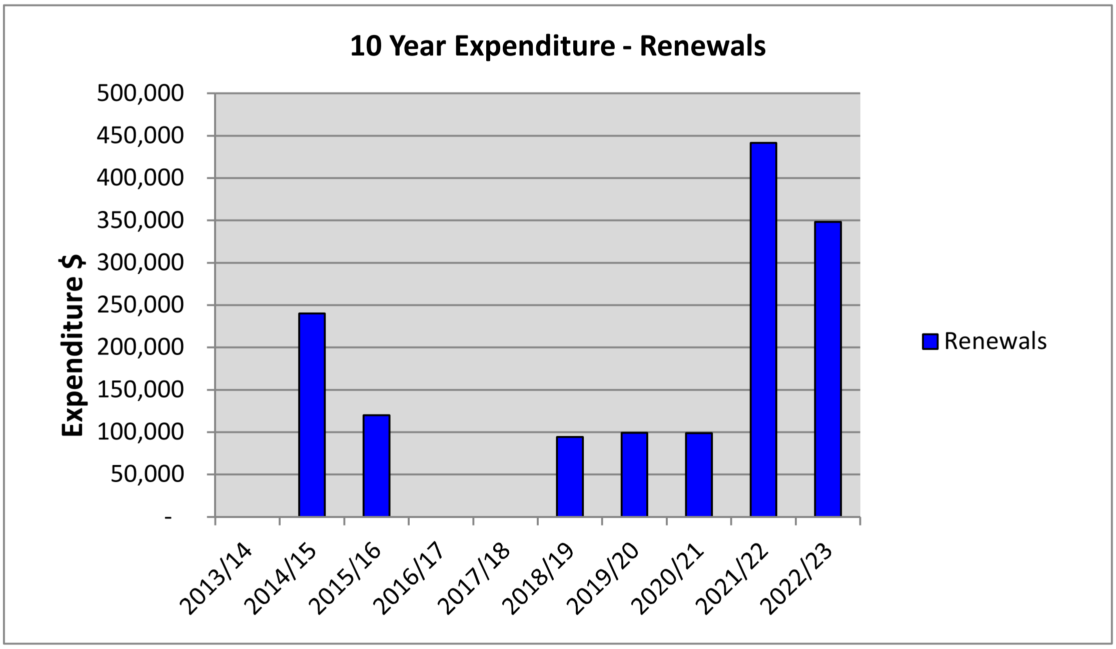
9.5.1.1 Sustainability of Service Delivery

This asset management plan identifies the estimated maintenance and capital expenditures required to provide an agreed level of service to the community over a 10 year period for input into a 10 year financial plan and funding plan to provide the service in a sustainable manner.

This may be compared to existing or planned expenditures in the 10 year period to identify any gap. In a core asset management plan, a gap is generally due to increasing asset renewals.

Figure 53 shows the projected asset renewals in the 10 year planning period from the asset register.

Figure 53 - Projected Renewals (Water Supply)



The projected renewals for water mains and headworks are shown in ***Table 49***

Table 49 - Projected and Planned Renewals (Water Supply)

Year	Projected Renewals	
	Water Mains	Headworks
2013/14	-	0
2014/15	-	140,000
2015/16	-	120,000
2016/17	-	0
2017/18	-	0
2018/19	94,000	0
2019/20	99,000	0
2020/21	99,000	0
2021/22	350,000	92,000
2022/23	348,000	0
Total:	**990,000**	**352,000**

Water main renewals mainly refer to replacement of AC mains in Captains Flat and Bungendore

Headworks renewals are for replacement of pumps in Braidwood Pump Station No.1, Bungendore Pump Station No. 1 and Bungendore Bore No. 1

Providing services in a sustainable manner will require matching of projected asset renewals to meet agreed service levels with planned capital works programs and available revenue.

A gap between projected asset renewals, planned asset renewals and funding indicates that further work is required to manage required service levels and funding to eliminate any funding gap.

Council will manage the 'gap' by developing this asset management plan to provide guidance on future service levels and resources required to provide these services. In particular improvement of the asset register, reassessment of useful lives and remaining lives will greatly improve the confidence level in the calculated results.

9.5.2 Funding Strategy Water Supply

Projected expenditure identified in Section 7.1 is to be funded from Council's operating and capital budgets. The funding strategy will be detailed in Council's 10 year long term financial plan.

9.5.3 Valuation Forecasts Water Supply

Asset values are forecast to increase as additional assets are added to the asset stock from construction and acquisition by Council and from assets constructed by land developers and others and donated to Council. *Figure 54* shows the projected replacement cost asset values over the planning period in 2012 dollar values. Depreciation expense values are forecast in line with asset values as shown in *Figure 55.*

Figure 54 – Projected Replacement Costs (Water Supply)

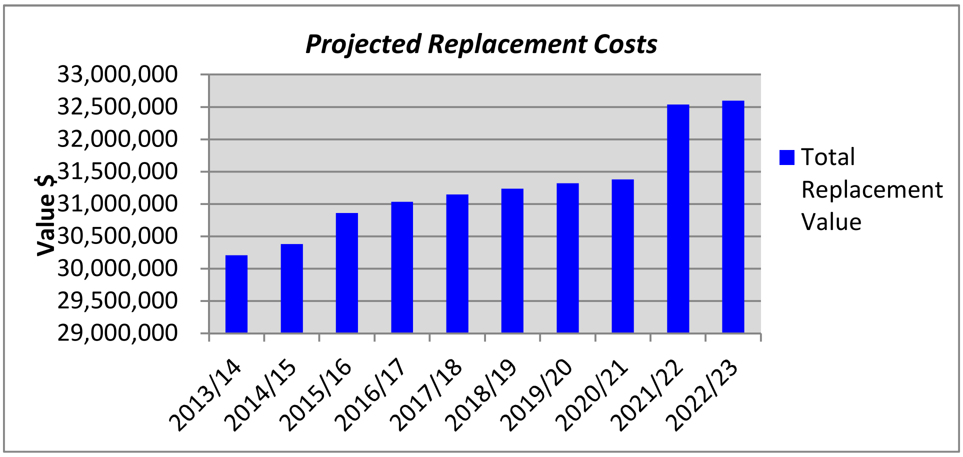
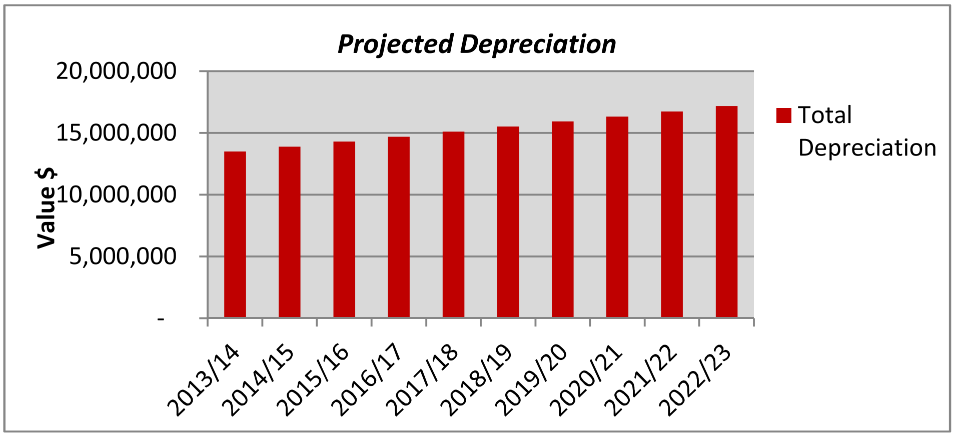
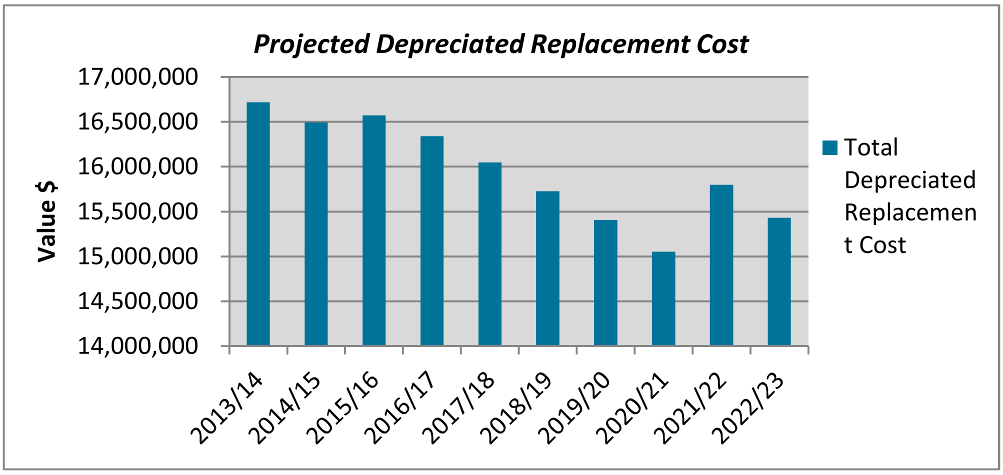


Figure 55 - Projected Depreciation Expense (Water Supply)



The depreciated replacement cost (current replacement cost less accumulated depreciation) will vary over the forecast period depending on the rates of addition of new assets, disposal of old assets and consumption and renewal of existing assets. Forecast of the assets' depreciated replacement cost is shown in *Figure 56.*

Figure 56 - Projected Depreciation Replacement Cost (Water Supply)



9.5.4 Key Assumptions made in Financial Forecasts for Water Supply

Refer Section 2.6

9.5.5 Water Supply Asset Valuations

A revaluation of Water Supply Assets was carried out in 2012. A summary of the financial values is shown below, with a more detailed breakdown (including adopted Useful Lives) in Table 50

Current Replacement Cost	$29,041,000
Depreciated Replacement Cost	$15,551,578
Annual Depreciation Expense	$393,300

Table 50 – Water Supply Asset Values as at 30 June 2012

Asset Group	Asset Types	Gross Replacement Cost ($)	Depreciated Replacement Cost ($)	Qty	Units	Annual Depreciation Expense ($)	Effective Life (yrs)
Water Supply Headworks	Dams, Reservoirs, Pump Stations, Bores, Treatment	20,047,000	9,368,578			280,882	Dams & Reservoirs - 100 Pumps - 25 Pump Station Structure - 50
Water Mains	Bulk Mains	3,104,000	2,371,000	21,690	m	38,798	80
	Reticulation Mains	5,890,000	3,812,000	59,070	m	73,620	80
	Totals	29,041,000	15,551,578			393,300	

10 SEWERAGE SYSTEMS

10.1 Current Levels of Service

Current levels of service for sewerage system assets are detailed in ***Table 51*** *below.* The current performance of many of the levels of service that are detailed is still unknown. However, performance monitoring processes can be established using these tables as a guide, thus enabling this missing information to be included in future revisions of this asset management plan.

Table 51 – Current Levels of Service (Sewerage Systems)

Recreation Facility	Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
	COMMUNITY LEVELS OF SERVICE				
Sewage Treatment Works	Quality Function Safety	Provide modern, well-kept sewage treatment plants with adequate capacity for future growth and which operate without perceivable odour and produce high quality effluent that can be safely discharged/reused in keeping with EPA licence conditions	Meet EPA licence conditions. Customer survey relating to the operation of the plants Operator and Supervisor reports	General satisfaction with plant operation	Customer satisfaction to be included in future surveys Defects and actions are reported at weekly Works Planning meetings
Sewage Pumping Stations	Quality Function Safety	Provide trouble free sewage pumping stations that reliably transfer collected sewage flows without odour and noise impacts or overflows.	Avoidance of pump station overflows. Customer service complaints relating to operation of facilities Operator and Supervisor reports	No more than 1 PS overflow per annum. Average less than 1 customer service complaint per PS p.a.	Defects and actions are reported at weekly Works Planning meetings
Sewer Mains (including gravity and rising mains)	Quality Function Safety	Provide adequately sized and suitably designed mains for ready connection of properties to convey predicted peak sewage flows via sewage pumping stations to the treatment works.	Avoidance of blockages and overflows in the mains network Customer service complaints relating to the operation of the network Operator and Supervisor reports	Size of mains is adequate for sewage flows.	Operation of sewers is monitored and issues and actions are reported at weekly Works Planning meetings

Recreation Facility	Key Performance Measure	Level of Service	Performance Measure Process	Performance Target	Current Performance
	TECHNICAL LEVELS OF SERVICE				
Sewage Treatment Works	Quality Function Safety	Treatment plants are designed, operated and maintained to consistently produce effluent meeting licence criteria: All STWs to have remote monitoring via telemetry.	Weekly tests of effluent undertaken and results satisfactory results achieved. Operator and Supervisor reports	Treatment plants are operated in accordance with standards	Operation of treatment plants is monitored. Issues and actions are reported at weekly Works Planning meetings
Sewage Pumping Stations	Quality Function Safety	Pumping stations designed, constructed, operated, maintained and managed in accordance with Water Services Association Handbook and references. Each PS to have duty and standby dual system pump arrangement and minimum 8 hours ADWF storage provision. All PSs to have remote monitoring via telemetry	Site inspections and cleaning undertaken daily. All PSs designed and constructed to standards set, including new PSs in new subdivisions.	Inspections undertaken and necessary follow-up actions undertaken. Standby pumping, 8 hrs ADWF storage and telemetry available at all PSs	Operation of pumping stations is monitored. Issues and actions are reported at weekly Works Planning meetings
Sewer Mains (including gravity and rising mains)	Quality Function Safety	Sewer mains are designed, constructed, operated, maintained and managed in accordance with Water Services Association Handbook and references.	All sewer mains designed, constructed and maintained to standards set, including new mains in new subdivisions	Bi-annual inspections of manholes and 5 yearly in-pipe TV inspections of gravity mains undertaken and necessary follow actions programmed.	Operation of sewers monitored. New sewers and as constructed drawings are inspected prior to handover Issues and actions are reported at weekly Works Planning meetings

10.2 Desired Levels of Service

At present, indications of desired levels of service are obtained from various sources including design standards, feedback from residents, service complaints and correspondence. It is considered that the levels of service desired by the community are covered by the various levels of service described above.

10.3 Future Demand for Sewerage Assets

10.3.1 Demand Forecast

Factors affecting demand for sewerage assets will largely be as a result of the development of new subdivisions within and adjacent to Bungendore and Braidwood that are currently provided with sewerage systems. No multi-lot subdivisions are expected at Captains Flat. It is not expected that any of the other Palerang LGA's villages will be sewered in the next decade, and current arrangements with use of septic tanks and ATWs will prevail.

A description of the expected demand for extra sewerage assets is included in Section 4 and more detailed assessment based on expected subdivision developments is included in Attachment B.

In summary, it is expected that the following additional sewerage assets will be constructed over the next decade to cater for future population growth:

Bungendore 12.2 km of gravity sewers, 4 km of rising mains, 3 pump stations and a 3000P extension to the sewage treatment works.

Braidwood 3.8 km of gravity sewers, 1 km of rising mains and 2 pump stations.

It is to be noted that the new assets will be required in readiness for the impending population after the subdivisions are released for housing construction.

10.3.2 Changes in Technology

Technology changes may affect the delivery of services covered by this plan in the areas detailed in ***Table 52*** below. These changes in technology will need to be reflected in the financial forecasts of future versions of this plan as and when these technologies are introduced at Council.

Table 52 - Changes in Technology and Forecast Effect on Service Delivery

Technology Change	Effect on Service Delivery
Improved telemetry	Upgraded remote monitoring and control methods will assist in optimising system operation and reduce costs associated with staff call-outs.
Improvement of information systems and asset knowledge	Improvements in monitoring condition, capturing and analysing data, planning works and making information available to Council staff to enable more efficient service delivery.
Replacement of in-situ gravity sewers by pipe bursting and modern pipe thrusting methods	Renewal of pipelines by these techniques reduces the impact and cost of work, whilst still extending the useful life of the pipelines.

10.3.3 Demand Management Plan

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand and demand management. Demand management practices include non-asset solutions, insuring against risks and managing failures.

Opportunities identified to date for demand management are shown in ***Table 53***. Further opportunities will be developed in future revisions of this asset management plan.

Table 53 - Demand Management Plan Summary

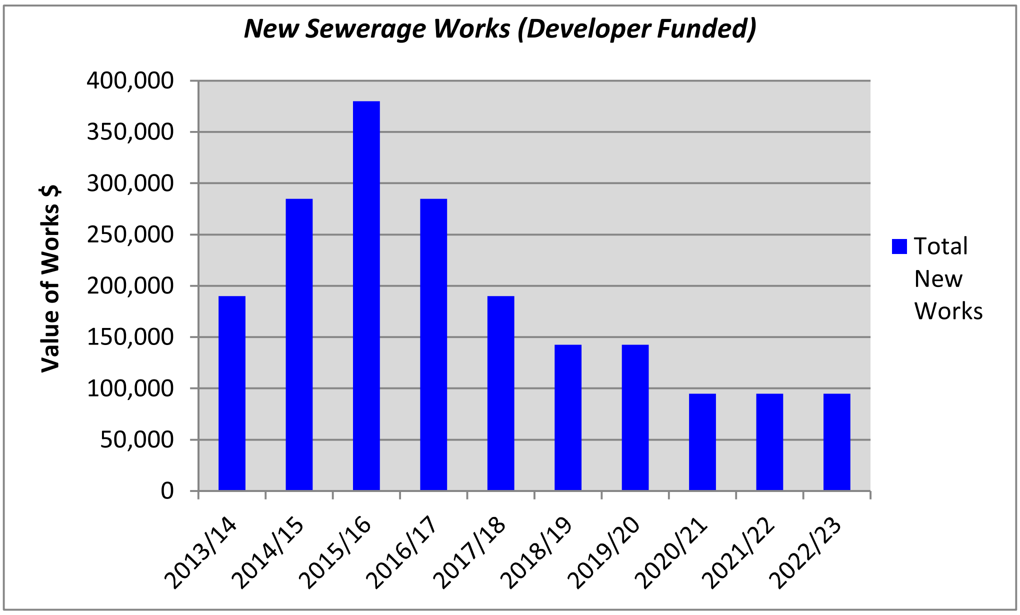
Service Activity	Demand Management Plan
Sewerage System	In addition to access charges for non-residential properties, application of user charges based on water usage. This will make non-residential customers aware and therefore encourage them to address the wasting of water to the sewerage system (e.g. leaking taps and running urinals).

10.3.4 New Assets from Growth

The new assets required to meet growth will be acquired from land developments and constructed by Council. The new asset values are summarised in

Figure 57 below. Acquiring these new assets will commit council to fund ongoing operations and maintenance costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operating and maintenance costs.

Figure 57 – 10 Year Expenditure Forecast – New Sewerage Works (Developer Funded)



10.4 Lifecycle Management Plan for Sewerage Assets

Lifecycle management plans are defined for each of the key asset groups detailed below:

Section 10.4.1 Sewage Treatment Works;

Section 10.4.2 Sewage Pump Stations;

Section 10.4.3 Sewer Mains;

A summary of expenditure and changes to the asset base over the 10 year period is provided at the end of the section for each asset group. A complete financial summary is included in Section 10.6.

10.4.1 Sewage Treatment Works

10.4.1.1 Background Data

(a) Asset Description

Council is currently responsible for three sewerage schemes located at Bungendore, Braidwood and Captains Flat.

The plants currently serve about 2000 properties some of which are undeveloped.

(b) Asset Capacity, Condition and Performance

The capacity, condition and current utilisation of the three STWs are as follows:

i) Bungendore – The recently augmented STW, has a capacity to serve 5000 equivalent persons (EP). The current load on the plant is estimated to be 3000 EP. The plant is in good condition and consistently meets license requirements and receives very few complaints. Some refurbishment of the older components of the existing plant, including the replacement of deficient electrical switchgear, is required to optimise the full potential of the capacity.

ii) Braidwood – This is newly constructed plant has a capacity of 2000 EP and current load of about 1250 EP. With the installation of larger aerators the capacity could be increased to 3000 EP. Being new the plant is in excellent condition. There were some initial teething problems that have since been overcome.

iii) Captains Flat – This old Pasveer Channel has capacity of 500 EP and current loading of about 475 EP. While it has consistently produced effluent that meets EPA licence requirements, some components of the plant are considered to be old technology and will require replacement.

10.4.1.2 Operation and Maintenance

(a) Operation and Maintenance Activities

Operation and maintenance of sewage treatments works requires trained and experienced staff. The activities undertaken ensure that plant and equipment is maintained in good condition and the correct operational procedures are followed.

The tasks and procedures involved are listed in the Operations Manuals that have been provided by the designers of the works. Some of the servicing is provided by external contractors engaged for the purpose.

Costs of operation increase as more load is accepted at the works with higher power and chemical bills and greater wear and tear.

(b) Operation and Maintenance Expenditure Trends

Council operation and maintenance expenditure trends are shown in ***Table 54.***

Table 54 - Maintenance and Operation Expenditure Trends for Sewage Treatment Works

Year	Expenditure	
	Maintenance & Repairs	Operations
2010/11	$61,124	$336,000
2011/12	$66,166	$325,000
2012/13 budget	$62,492	$390,000

Planned and cyclic maintenance works have not been identified separately in the table above. The intention is to capture future maintenance costs against the categories indicated in the table above.

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

The following documents are reference by sewerage staff:

- Bungendore STW Operations Manual
- Braidwood STW Operations Manual.
- NSW Public Works Sewage Treatment Works Guidelines

10.4.1.3 Renewals

The Braidwood STW is new and will not require any renewal works within the next decade.

The Bungendore STW has recently been augmented to add an extra 3000 EP capacity aeration vessel and matching sludge handling facilities. Renewal works will however be required to recommission the old 2000 EP aeration vessel involving replacement of electrical switchgear and controllers.

10.4.1.4 New Works

The Bungendore STW will need further augmentation to add further treatment capacity towards the end of the decade on the assumption that Bungendore will continue to grow at about 5.0% per annum. By this time the demand for sewage treatment is expected to be at about 5000 EP. As there is typically at least a 2 years lead time for design and construction of new facilities, the extra capacity will need to be available by the end of the decade (2022). It is expected that an extra 3000-5000 EP plant will be added, depending on the local water supply being able to service the potential population growth at that time. Based on the recent upgrade the new works are estimated to Cost $7,500,000 to $12,000,000

At the Captains Flat STW it is planned to upgrade the standard of the facility without adding an extra capacity. This will involve the effluent ponds being decommissioned and replaced with ultra-violet treatment equipment and upgrading of amenities and sludge lagoons.

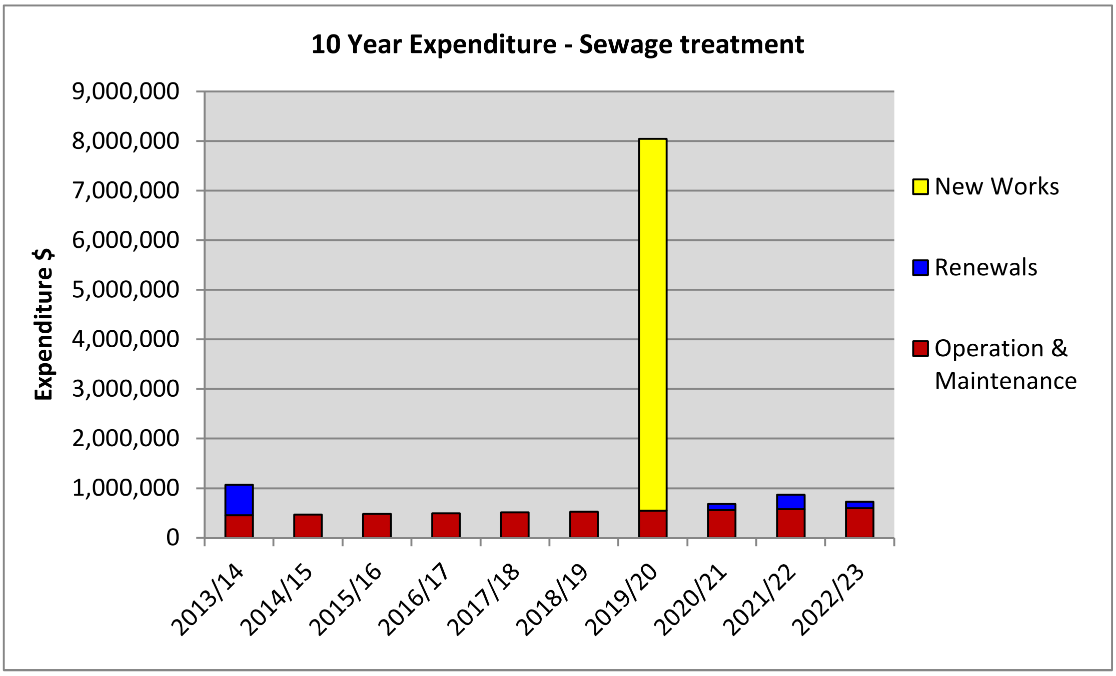
10.4.1.5 Disposals

The only disposal works anticipated involve those proposed at the Captains Flat STW as described in the sub-section above.

10.4.1.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 58* below.

Figure 58 - 10 Year Expenditure – Sewage Treatment Works



10.4.2 Sewage Pump Stations

10.4.2.1 Background Data

(a) Asset Description

Council is currently responsible for 18 submersible sewage pump stations. There are eleven pump stations in Bungendore, four in Braidwood and one in Captains Flat which serves the whole of the town. Each pump station contains 2 submersible pumps.

(b) Asset Capacity, Condition and Performance

Each of the pump stations and rising mains in Braidwood has recently been reconstructed to the latest specifications and provide adequate capacity for growth. Most of the Captains Flat and Bungendore pump stations and rising mains have adequate capacity for growth over the next decade. However the main pump station at Bungendore is short on required storage capacity and has old pumps. A replacement pump station at this location is planned for early completion. The continuing monitoring and due replacement of old pumps will ensure satisfactory future operation.

10.4.2.2 Operations and Maintenance

(a) Operation and Maintenance Activities

The activities undertaken ensure that plant and equipment is maintained in good condition and the correct operational procedures are followed.

The tasks and procedures involved are listed in the Operations Manuals that have been provided by the designers of the works. Some of the servicing is provided by external contractors engaged for the purpose.

(b) Maintenance Expenditure Trends

Council operation and maintenance expenditure trends are shown in ***Table 55***

Table 55 – Operations and Maintenance Expenditure Trends for Sewage Pump Stations

Year	Expenditure	
	Maintenance & Repairs	Operations
2010/11	$5,645	$73,000
2011/12	$12,953	$77,000
2012/13 budget	$12,466	$98,000

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

No specific standards or specifications are used for maintenance works.

10.4.2.3 Renewals

Forecast renewals of pumps and switchgear have been identified by the condition assessment undertaken by staff based on age of these components and their assumed useful lives.

10.4.2.4 New Works

A new sewage pump station will be constructed in 2013 at west Braidwood on the road reserve adjacent to the intersection of Araluen and Bombay Roads. This will be part of works to extend the Braidwood sewerage scheme to the western side of town to service emerging light industrial and residential development proposals in this area, involving subdivisions into smaller lots.

The main pump station (No1) at Bungendore will be replaced in 2013/14 with a larger facility at the same site. The existing pump station is short on required storage capacity and has old pumps and switchgear. Currently there is an unacceptable risk that the pump station could overflow with failure of the pumps and insufficient time to make repairs. It is expected that the existing pump well will provide added storage of sewage flow during emergency events such as during prolonged mains power outages.

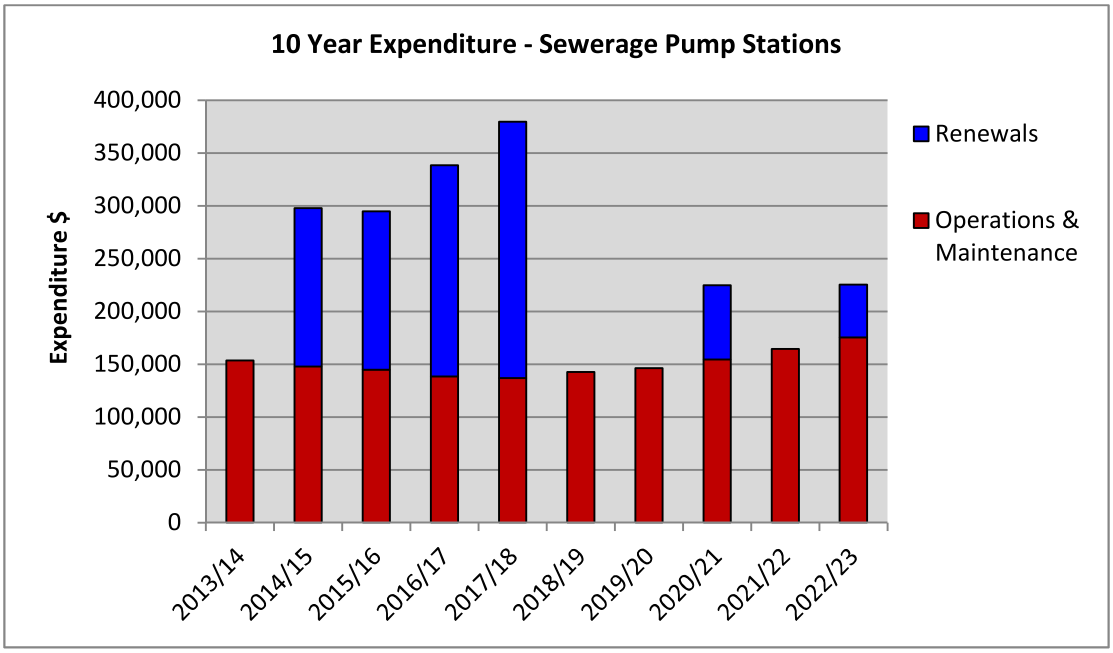
10.4.2.5 Disposal Plan

It is not expected that any sewage pumping stations will be disposed of in the next decade.

10.4.2.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 59* below

Figure 59 - 10 Year Expenditure – Sewerage Pump Stations



10.4.3 Sewer Mains

10.4.3.1 Background Data

(a) Asset Description

Council is currently responsible for approximately 55.1 km of gravity sewers and junction lines and 7.7 km of rising mains of various sizes.

(b) Asset Capacity, Condition and Performance

The gravity reticulation system of Braidwood, while adequate in capacity to serve the town, is for the most part now towards the latter end of its useful life. The original VC mains were laid in the 1960s and are showing increasing signs of deterioration. Programs to replace many of these mains will be required over the next decade. The mains in Captains Flat (1980s) and Bungendore (earliest 1970s) are newer and have a longer timeframe to renewal.

Each of the rising mains in Braidwood has recently been reconstructed to the latest specifications and provide adequate capacity for growth. The Captains Flat and Bungendore rising mains have adequate capacity for growth over the next decade and should not require renewal within the next decade.

10.4.3.2 Maintenance

(a) Maintenance Activities

Maintenance of sewer mains is predominately reactive however periodic inspections are undertaken to pick up defects and deficiencies that require attention. Activities include:

- Repair of manholes
- Clearing of blocked mains;
- In line TV camera monitoring of condition;
- Locating sewer junctions;

- Servicing valves on rising mains
- Repairing rising main breaks;

(b) Maintenance Expenditure Trends

Council maintenance expenditure trends are shown in ***Table 56***.

Table 56 - Maintenance Expenditure Trends for Sewer Mains

Year	Expenditure	
	Maintenance & Repairs	Operations
2010/11	$27,951	$13,000
2011/12	$19,387	$12,000
2012/13 budget	$27,436	$24,000

Planned and cyclic maintenance works have not been identified separately in the table above. The intention is to capture future maintenance costs against the categories indicated in the table above.

Assessment and prioritisation of reactive maintenance is currently undertaken by Council staff using experience and judgement.

(c) Maintenance Standards and Specifications

No specific standards or specifications are used for maintenance works.

10.4.3.3 Renewals

Forecast renewal dates have been identified from the expected condition based on age of asset as detailed in Section 10.4.1.3. A useful life of 70 years for sewerage pipes and manholes has been adopted for this plan.

The total projected renewal of sewer mains is approximately $755,000 over the 10 year time frame of this plan.

10.4.3.4 New Works

As part of works to extend the Braidwood sewerage scheme to the western side of the town new gravity mains will be constructed to service emerging light industrial and residential development proposals in this area involving subdivisions into smaller lots. A new rising main will deliver sewage collected via a new pump station to the existing sewerage system.

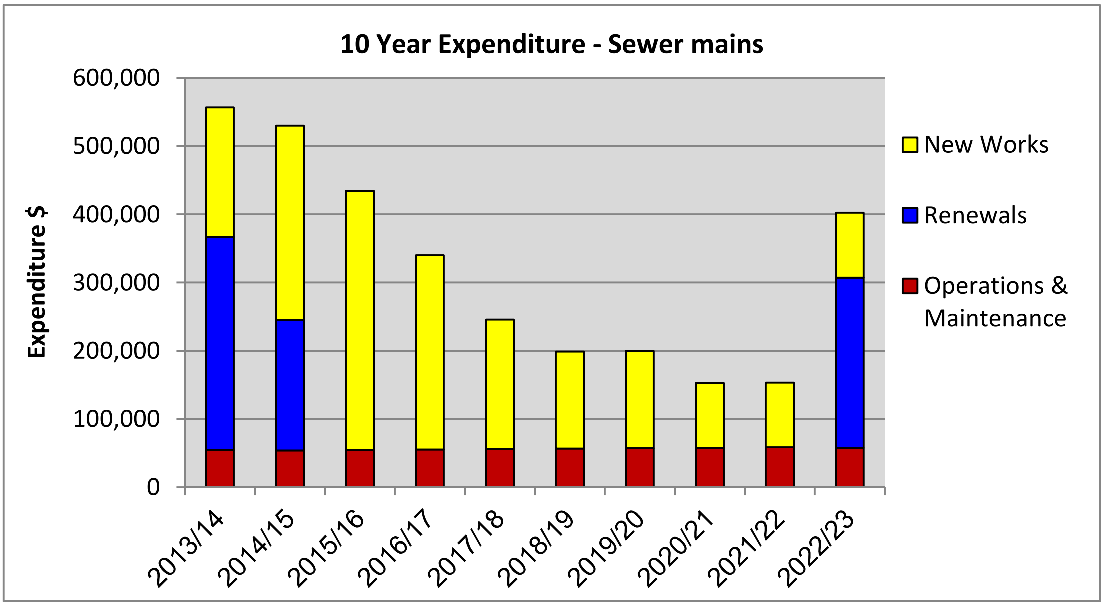
10.4.3.5 Disposal Plan

No sewer mains have been identified for possible decommissioning or disposal.

10.4.3.6 Summary Planned Future Expenditure

The projected expenditure resulting from this lifecycle plan is detailed in *Figure 60* below

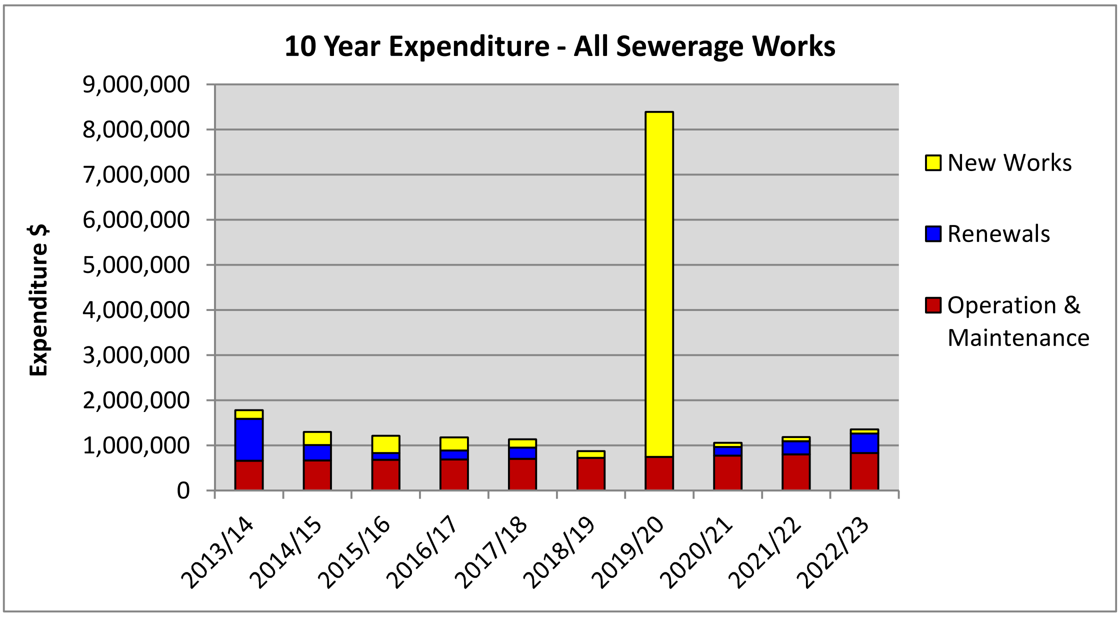
Figure 60 - 10 Year Expenditure – Sewer Mains



10.4.4 Summary All Planned Future Expenditure for Sewerage Systems

The projected expenditure resulting from the lifecycle plans for combined sewage treatment, sewage pumping and gravity main assets is detailed in *Figure 61* below.

Figure 61 - 10 Year Expenditure – All Sewerage System Assets



10.5 Sewerage Risk Management Plan

Council has developed and adopted a corporate risk framework based on the Australian / New Zealand standard for Risk Management 4360:2004. The corporate risk framework (referred to as the Risk Management Plan) consists of a policy statement, roles and responsibilities for risk management across Council, a process for carrying out risk assessments and likelihood / consequence tables for rating risks.

A formal assessment of risks associated with service delivery from infrastructure assets is yet to be carried out by Council. The risk assessment process will identify credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks. Critical risks, being those assessed as 'Very High' - requiring immediate corrective action and 'High' – requiring prioritised corrective action will be identified in the infrastructure risk management plan once developed and subsequently summarised in future revisions of this asset management plan.

It is important for Council to quantify and make informed decisions on how to deal with risks. The assessments will need to cover WH&S, operational and environmental aspects and will inherently need to involve programmed and targeted inspections with frequency based on the criticality of the asset to the systems operation. The result will be the preparation of contingency plans for each risk.

The contingency plans will allow Council to respond to events that last for extended periods and facilitate a return to normal operation as soon as possible after outages, blockages and overflows.

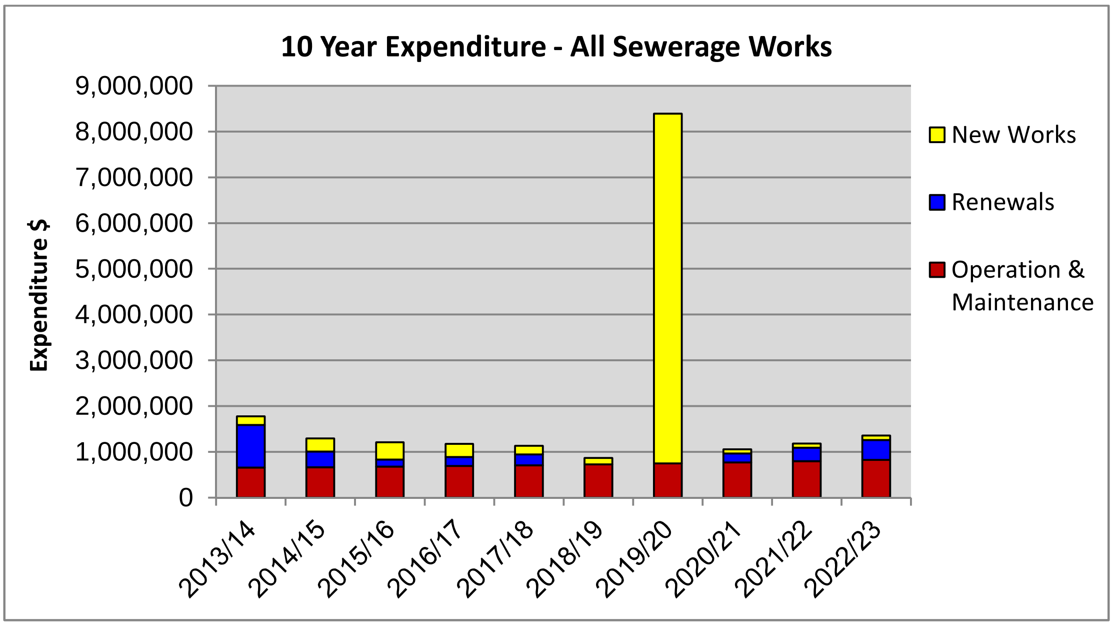
10.6 Financial Summary - Sewerage

This section contains the financial requirements resulting from all the information presented in the previous sections of this asset management plan. The financial projections will be improved as further information becomes available on desired levels of service and current and projected future asset performance.

10.6.1 Financial Statements and Projections (Sewerage)

The financial projections are shown in *Figure 62* below for planned operating (operations and maintenance), capital expenditure (renewal and upgrade/expansion/new assets) and estimated unfunded renewals (renewals that have been identified but not carried out prior to the first year of the asset management plan).

Figure 62 – 10 Year Financial Forecast (Sewerage Systems)



Notes on 10 Year Financial Forecast:

Total forecast expenditure over the 10 year planning period are estimated to be approximately:

Operations & Maintenance	$7,277,000
Renewals	$2,772,000 includes $1,155,000 - Treatment Works (Captains Flat), $863,000 - Pump Stations, $754,000 – Sewer Mains
New Works and Upgrades	$9,399,000 includes $7,500,000 for Bungendore Treatment Works upgrade.

A breakdown of this 10 Year Financial Forecast by asset group is detailed in the corresponding lifecycle sections of this plan.

10.6.1.1 Sustainability of Service Delivery

This asset management plan identifies the estimated maintenance and capital expenditures required to provide an agreed level of service to the community over a 10 year period for input into a 10 year financial plan and funding plan to provide the service in a sustainable manner.

Forecast operation and maintenance expenditure is based on current budget levels. Any shortfall in funding for the projected renewals could also add a gap in the operation and maintenance funding, due to the deteriorated condition of the asset requiring renewal.

Forecast projected renewal expenditure is shown in ***Table 57***

Table 57 - Projected Renewals Expenditure (Sewerage)

Year	Projected Renewals	Cumulative Renewals
2013/2014	925,500	925,500
2014/2015	341,300	1,266,800
2015/2016	150,000	1,416,800
2016/2017	200,000	1,616,800
2017/2018	242,700	1,859,500
2018/2019	0	1,859,500
2019/2020	0	1,859,500
2020/2021	190,500	2,050,000
2021/2022	290,000	2,340,000
2022/2023	432,000	2,772,000
Total	**2,772,000**	

Providing services in a sustainable manner will require matching of projected asset renewals to meet agreed service levels with planned capital works programs and available revenue.

Any gap between projected asset renewals and available funding indicates that further work is required to manage required service levels and funding to eliminate any funding gap.

Council will manage the 'gap' by developing this asset management plan to provide guidance on future service levels and resources required to provide these services. In particular improvement of the asset register, reassessment of useful lives and remaining lives will greatly improve the confidence level in the calculated results.

10.6.2 Funding Strategy Sewerage

Projected expenditure identified in Section 10.6.1 is to be funded from Council's operating and capital budgets. The funding strategy will be detailed in Council's 10 year long term financial plan.

10.6.3 Valuation Forecasts Sewerage

Asset values are forecast to increase as additional assets are added to the asset stock from construction and acquisition by Council and from assets constructed by land developers and others and donated to Council. ***Figure 63*** shows the projected replacement cost asset values over the planning period in 2012 dollar values. Depreciation expense values are forecast in line with asset values as shown in *Figure 64*.

Figure 63 **- Projected Sewerage Asset Replacement Cost**

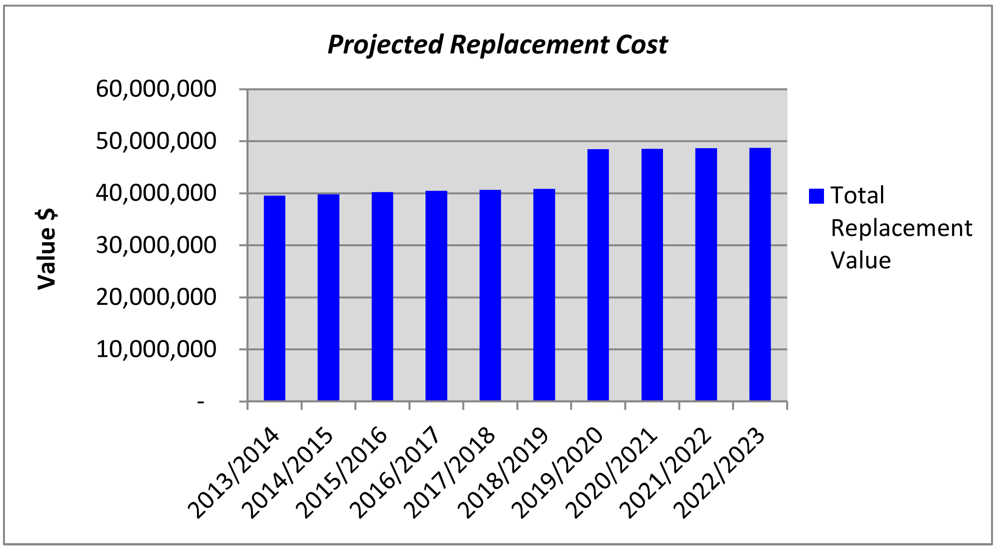
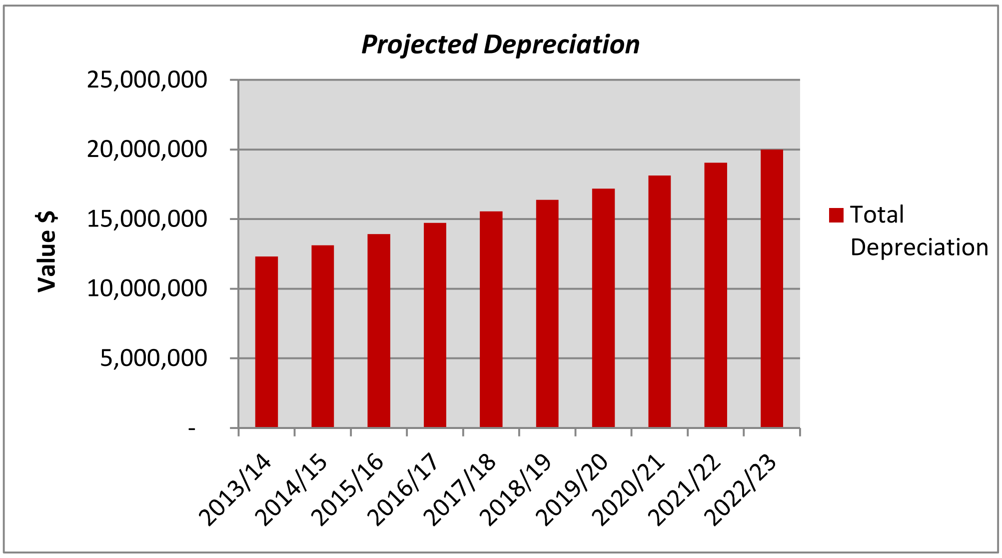
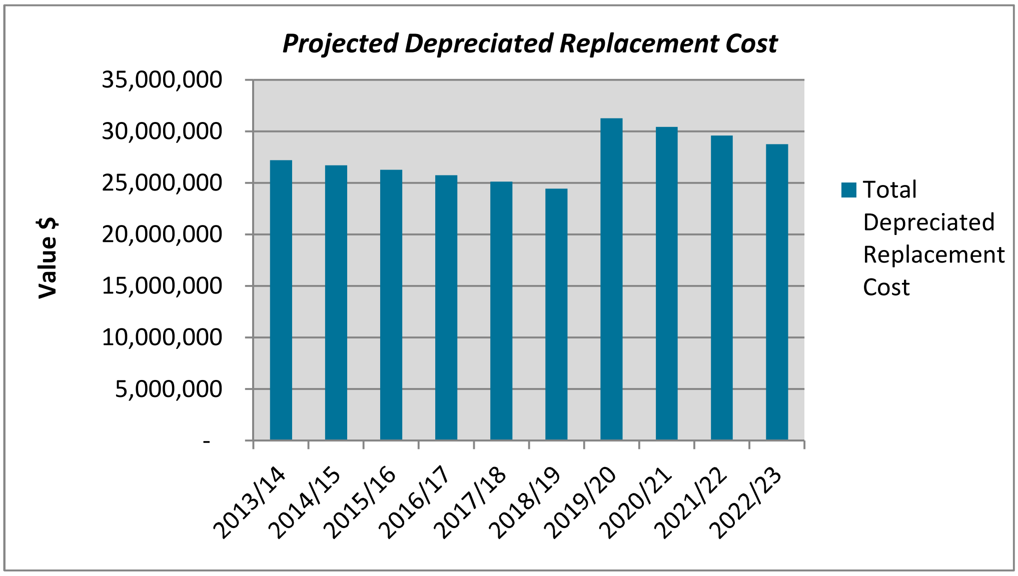


Figure 64 **- Projected Sewerage Depreciation Expense**



The depreciated replacement cost (current replacement cost less accumulated depreciation) will vary over the forecast period depending on the rates of addition of new assets, disposal of old assets and consumption and renewal of existing assets. Forecast of the assets' depreciated replacement cost is shown in Figure 65.

Figure 65 – Projected Sewerage Depreciated Replacement Cost



10.6.4 Key Assumptions made in Financial Forecasts

Refer Section 2.6

10.6.5 Sewerage Asset Valuations

A revaluation of sewerage assets was carried out in 2012. A summary of the financial values is shown below, with a more detailed breakdown (including adopted Useful Lives) in *Table 58*.

- Current Replacement Cost $38,991,000
- Depreciated Replacement Cost $29,023,000
- Annual Depreciation Expense $810,835

Table 58 – Sewerage Asset Values as at 30 June 2012

Asset Group	Asset Types	Gross Replacement Cost ($)	Depreciated Replacement Cost ($)	Qty	Units	Annual Depreciation Expense ($)	Effective Life (yrs)
Sewage Treatment		20,770,000	17,137,000	3	No	511,900	40
Sewer Pump Stations	Pump Station Civil	3,481,000	2,792,000	16	No.	54,867	70
	Sewer Pumps	1,561,000	927,000	16	No.	57,940	25
Sewer Mains	Rising Mains	1,044,000	636,000	7,670	m	12,773	45 -70
	Reticulation Mains	12,135,000	7,531,000	55,100	m	173,355	70
Totals		38,991,000	29,023,000			810,835	

11 PLANT, EQUIPMENT AND MISCELLANEOUS ITEMS

11.1 Current Levels of Service

Current levels of service for plant, equipment and miscellaneous items are detailed in ***Table 59*** *below.*

The performance of many of the levels of service that are detailed are not formally measured. However, Council staff receive training in the use of plant and equipment and are expected to unsure that plant and equipment is properly maintained. Operators are required to act responsibly in ensuring that plant and equipment items are properly maintained and any faults are reported and rectified. Council policy requires that vehicles and plant are operated and serviced in accordance with the Manufacturers guidelines. In addition, vehicles are replaced at set periods (e.g. motor vehicles – 2 years or 60,000km, trucks – 5 years) to ensure optimum trade-in values and performance.

Plant and vehicle usage and an operator training schedule is prepared and monitored weekly

Table 59 – Current Levels of Service (Plant, Equipment and other items)

Recreation Facility	Key Performance Measure	Level of Service	Performance Measure Process
	COMMUNITY LEVELS OF SERVICE		
Plant and vehicles	Quality Function Safety	Effective, safe and reliable plant and vehicles are available to enable efficient service delivery	Number of plant and vehicle breakdowns
Equipment including office equipment	Quality Function Safety	Equipment is functional and serviceable and available to facilitate efficient administration	Customer service requests relating to standard of office equipment
Miscellaneous Items	Quality Function Safety	Items are functional and serviceable and available to use	Customer service requests relating to condition of items
	TECHNICAL LEVELS OF SERVICE		
Plant and vehicles	Quality Function Safety	Plant is productively utilised on a full time basis to justify ownership Servicing is undertaken when due Items are replaced at adopted service life	All large plant items are utilised Servicing schedule Plant replacement policy
Equipment including office equipment	Quality Function Safety	Servicing is undertaken when due Items are replaced at adopted service life	Servicing schedule Equipment replacement policy
Miscellaneous Items	Quality Function Safety	Items replaced when due.	Replacement policy

11.2 Desired Levels of Service

At present, indications of desired levels of service are obtained from various sources including Council policy and feedback from staff and other users. Levels of service for safety of vehicles and construction plant is also set by manufacturer's operation instructions and guidelines

11.3 Future Demand for Plant and Equipment

11.3.1 Demand Forecast

Factors affecting demand include level of works projects requiring plant and equipment. It is not expected however that Council's plant fleet will be significantly increased over time as Council will likely rely on hiring additional plant to meet peaks in workloads.

11.3.2 Changes in Technology

Technology changes may affect the delivery of services covered by this plan in the areas detailed in ***Table 60*** below. These changes in technology will need to be reflected in the financial forecasts of future versions of this plan as and when these technologies are introduced at Council.

Table 60 - Changes in Technology and Forecast Effect on Service Delivery

Technology Change	Effect on Service Delivery
Developments in machine technology making available new and more innovative items.	New types and more efficient machines will allow increases in productivity in works tasks.

11.3.3 Demand Management Plan

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand and demand management. Demand management practices include non-asset solutions, insuring against risks and managing failures.

Opportunities identified to date for demand management are shown in ***Table 61***. Further opportunities will be developed in future revisions of this asset management plan.

Table 61 - Demand Management Plan Summary

Service Activity	Demand Management Plan
Plant	Hire rather than buy plant to meet peak work loads

11.3.4 New Assets from Growth

The only new extra plant required is likely to result for an extension of services to cater for an increasing population, e.g. extension of waste collection services.

11.4 Lifecycle Management Plan

11.4.1 Introduction

The lifecycle management plan details how Council plans to manage and operate the assets at the agreed levels of service (defined in section 3) while optimising lifecycle costs.

11.4.2 Asset Groups

Lifecycle management plans are defined for each of the key asset groups detailed below:

- Plant and vehicles
- Equipment including office equipment

- Miscellaneous Items

The lifecycle management plan outlines for each asset group:

- Background data – a description of the assets, capacity and performance and condition.
- Management tactics to achieve the levels of service defined in Section 11.1, which are divided into the work categories defined in Section 11.5 below.

A summary of expenditure and changes to the asset base over the 10 year period is provided at the end of the section for each asset group. A complete financial summary is included in Section 11.6.

11.4.3 Plant and Vehicles

11.4.3.1 Background Data

(a) Asset Description

Council is currently responsible for over 200 items of Plant and Equipment, including 60 vehicles, 71 plant items (trucks, road plant, mowers and construction plant)

11.5 Plant, Equipment and Miscellaneous Items Risk Management Plan

Council has developed and adopted a corporate risk framework based on the Australian / New Zealand standard for Risk Management 4360:2004. The corporate risk framework (referred to as the Risk Management Plan) consists of a policy statement, roles and responsibilities for risk management across Council, a process for carrying out risk assessments and likelihood / consequence tables for rating risks.

A formal assessment of risks associated with service delivery from infrastructure assets is yet to be carried out by Council. The risk assessment process will identify credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks. Critical risks, being those assessed as 'Very High' - requiring immediate corrective action and 'High' – requiring prioritised corrective action will be identified in the infrastructure risk management plan once developed and subsequently summarised in future revisions of this asset management plan.

Council has, however, developed a draft risk based framework to assist with the management of planned and reactive maintenance. Routine inspection frequencies (planned maintenance) are set according to the hierarchy of the road (more important roads will be inspected more frequently than less important roads). Response times for reactive maintenance are dictated by a combination of the road hierarchy, the type and severity of the defect / hazard and the location of the defect / hazard on the road.

The framework currently covers the following asset groups:

- Plant and vehicles
- Equipment including office equipment
- Miscellaneous Items

This framework should be piloted in the field and then eventually expanded to cover all asset groups that Council manages.

Further details on the draft framework can be obtained from the document “Risk Management Policy for Roads, September 2008”.

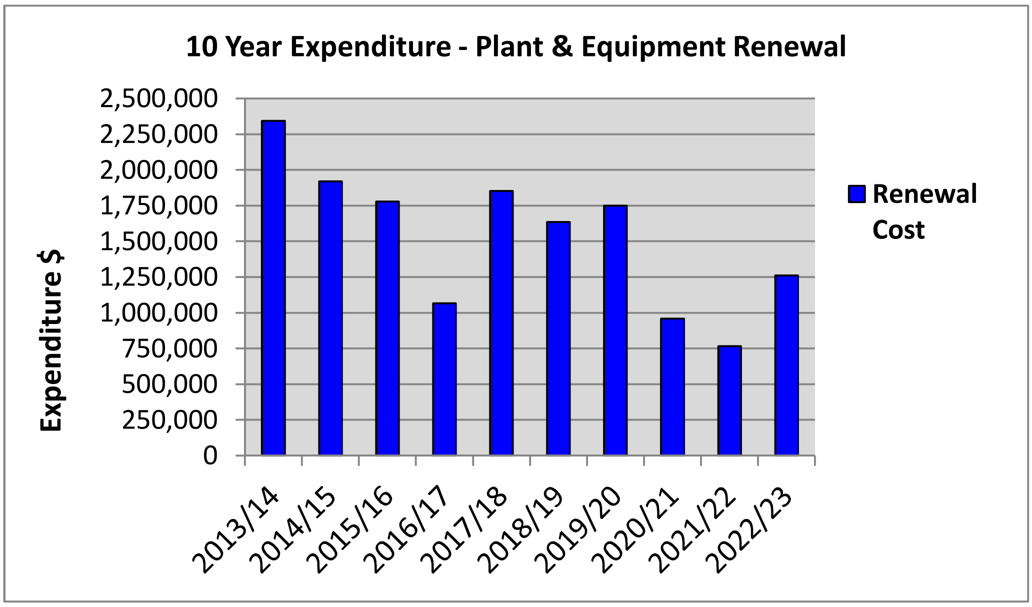
11.6 Financial Summary - Plant, Equipment and Miscellaneous Items

This section contains the financial requirements resulting from all the information presented in the previous sections of this asset management plan. The financial projections will be improved as further information becomes available on desired levels of service and current and projected future asset performance.

11.6.1 Financial Statements and Projections (Plant, Equipment and Miscellaneous Items)

The financial projections are shown in *Figure 66* below for planned operating (operations and maintenance), capital expenditure (renewal and upgrade/expansion/new assets) and estimated unfunded renewals (renewals that have been identified but not carried out prior to the first year of the asset management plan).

Figure 66 - 10 Year Expenditure – Plant and Equipment Renewal



Notes on 10 Year Financial Forecast:

Total forecast expenditure on renewals over the 10 year planning period are estimated to be $15,330,000

11.6.2 Funding Strategy Plant, Equipment and Miscellaneous Items

Projected expenditure identified in Section 11.6.1 is to be funded from Council’s operating and capital budgets. The funding strategy will be detailed in Council’s 10 year long term financial plan.

11.6.3 Valuation Forecasts Plant, Equipment and Miscellaneous Items

Asset values are forecast to increase as additional assets are added to the asset stock from acquisition by Council. The growth rate of 3.1% per annum has been used to estimate the increase in the asset stock value. *Figure 67*, shows the projected replacement cost asset values over the planning period in 2012 dollar values. Depreciation expense values are forecast in line with asset values as shown in *Figure 68*.

Figure 67 – Projected Replacement Value – Plant and Equipment Renewal

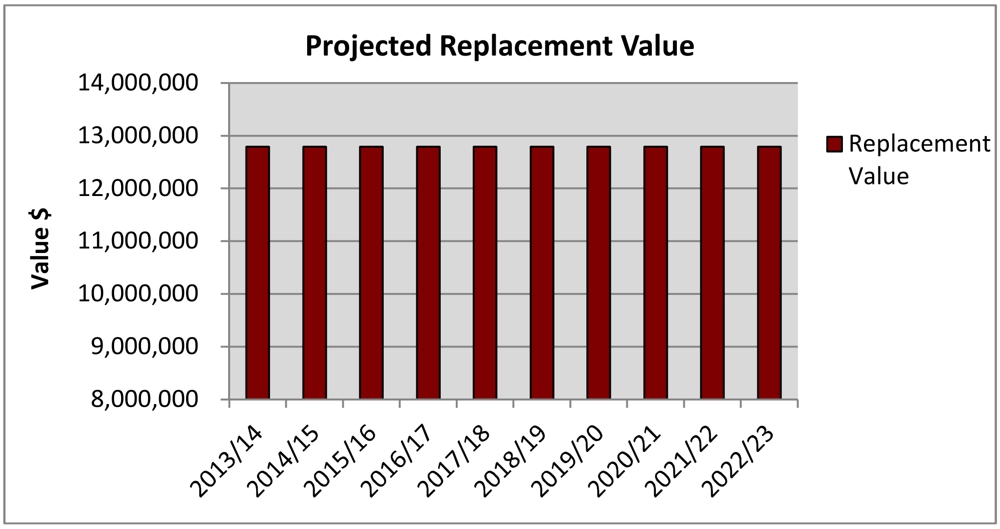
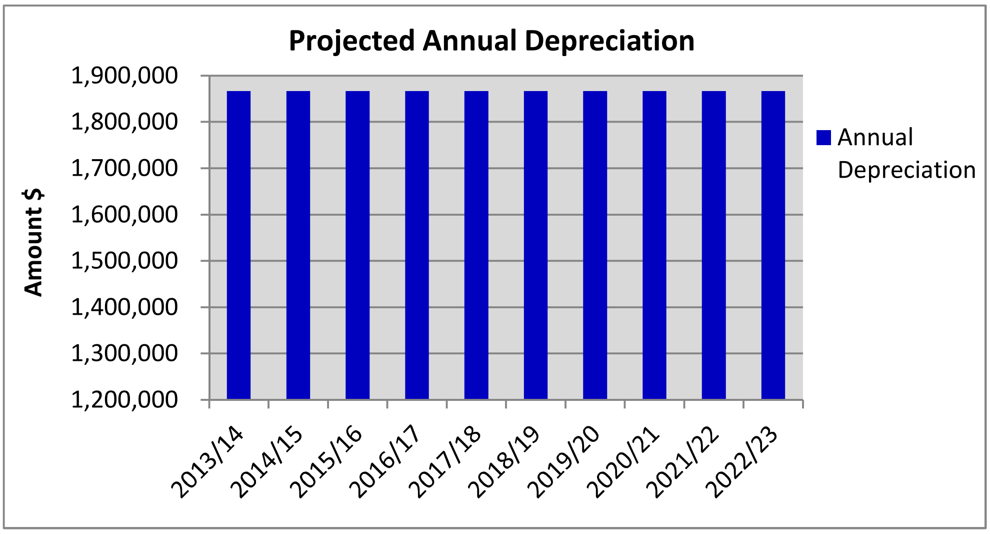


Figure 68 – Projected Annual Depreciation – Plant and Equipment Renewal



11.6.4 Key Assumptions made in Financial Forecasts

Refer Section 2.6

11.6.5 Plant, Equipment and Miscellaneous Items Asset Valuations

A summary of the financial values is shown below.

Vehicles, Plant and Construction Equipment

- Current Replacement Cost $12,794,000
- Replacement Cost (Ex Trade-in Allowance) $8,240,000
- Depreciated Replacement Cost $4,981,000
- Annual Depreciation Expense $1,460,000

Office Equipment and Furniture

- Current Replacement Cost $2,044,000
- Depreciated Replacement Cost $865,000
- Annual Depreciation Expense $410,000

12 ASSET MANAGEMENT PRACTICES

12.1 Accounting/Financial Systems

Council uses Finance ONE as its Financial System. Accountability and responsibility of the Finance System lies with the Manager Finance. A summary of Council's capitalisation thresholds (extracted from Council's General Purpose Financial Report for 30 June 2009) is shown in *Table 62* below:

Table *62* – Council's Capitalisation Thresholds

Asset Group / Activity	Threshold
Road construction and reconstruction	> $10,000
Reseal / resheet and major repairs	> $10,000
Bridge construction and reconstruction	> $10,000
Drainage assets	> $5,000

The relevant principal standard for asset accounting is AASB116 – Property, Plant and Equipment. In addition, financial reporting is prepared to meet the requirements of the Local Government Code of Accounting Practice and Financial Reporting.

12.2 Asset Management Systems

Council currently uses the following systems to manage its assets:

- Assetic Asset Management and Predictive modelling systems
- ESRI / MapInfo – Geographical Information System (GIS);
- An in-house developed PARDOX database to assist with job tracking and history;
- A Customer Complaint System; and
- Various spreadsheets.

The Assetic Asset Management and Predictive modelling Systems were purchased in 2012. To date, Water and Sewer Assets have been loaded into the asset system and used for the 2011/12 revaluation of these assets.

The road condition audit data has been configured and loaded into the asset and predictive modelling system data.

Data for buildings, land and plant and equipment will be loaded in 2012 for the 2012/13 revaluation of these asset classes.

It is intended that all classes of assets will be loaded into the asset management system. An important part of this process it to link the asset data to the GIS and other Council systems

The functionality of the PARADOX database is being used as a "limited" maintenance management system. It facilitates the capture of what work was done, to what (if work was done to an asset), when and by whom. It also flags when recurrent maintenance is due for an asset. The system does not however have the ability to capture any costs.

No links exist between any of the asset management systems, or between any of these systems and the Finance System.

Council staff are currently reviewing the alternatives to provide integration of the asset and finance system to provide for data flow between these systems and support the Strategic Management of the assets

12.3 Information Flow Requirements and Processes

The key information flows into this asset management plan are:

- The asset register data on size, age, value, remaining life of the network;
- The unit rates for categories of work/material;
- The adopted service levels;
- Projections of various factors affecting future demand for services;
- Correlations between maintenance and renewal, including decay models; and
- Data on new assets acquired by council.

The key information flows *from* this asset management plan are:

- The assumed Works Programme and trends;
- The resulting budget, valuation and depreciation projections; and
- The useful life analysis.

These will impact the Long Term Financial Plan, Strategic Business Plan, annual budget and departmental business plans and budgets.

There is a Financial Asset Register defined in Finance ONE, and a Technical Asset Register spread across a number of systems (Assetic Asset Management and Predictive modelling, PARADOX Road database, GIS, spreadsheets and hard copy records). There is no direct link between the various systems. This means the values associated to the assets defined in the Financial Asset Register (Deemed Cost and Written Down Value) cannot be related back to the movement (capital additions and disposals) of individual assets in the Technical Asset Register. The quality of the asset registers has been substantially improved over the past 2 years. Considerable effort has been given to establishing complete sets of data for the assets. As mentioned above, a concise set of water and sewer data was compiled for the 2011/12 valuation of these assets and a road condition audit has been undertaken for the road network, including Kerb and Gutter and Footpaths. Data is also being compiled for Buildings and Land.

The Assetic Asset Management System will become the source of the asset financial values and depreciation calculations as each asset class is loaded and the assets revalued. In 2012 the water and sewer assets were revalued in the asset system. In 2013, this will include roads, footpaths, kerb & gutter, buildings, plant & equipment and land

12.4 Standards and Guidelines

The following standards and guidelines are used for asset management at Council:

- Asset Management Policy (2006);
- Asset Management Strategy (2006);
- Draft Risk Management Policy for Roads (2008); and
- International Infrastructure Management Manual - Version 3.0, 2006.

13 PLAN IMPROVEMENT AND MONITORING

13.1 Performance Measures

The effectiveness of the asset management plan can be measured in the following ways:

- The degree to which the required cashflows identified in this asset management plan are incorporated into council's Long Term Financial Plan, Delivery Plan and Operational Plan; and
- The degree to which 1-5 year detailed works programmes, budgets, business plans and organisational structures take into account the 'global' works programme trends provided by the asset management plan.

13.2 Improvement Plan

The asset management improvement plan generated from this asset management plan is shown in Table 63. Council appointed an Asset Management Co-ordinator (AMC) in 2011. An Asset Management System was acquired in 2012. The Asset System was used for the 2011/12 revaluation of Water and Sewerage assets following a rigorous review and cleansing of the data (Finance Fixed Assets, GIS and Spreadsheets).

The following asset management information activities have been activities are in progress

- Detailed video audit of Roads, Kerb & Gutter and Footpaths was undertaken in 2012 It is proposed that there will be regular audit of these assets which will provide for accurate analysis of asset performance and condition projections against annual budgets and revaluation of these assets
- Re-segmentation of roads (Maximum length – 1,000m for sealed and 1,200m for unsealed) to provide for more detailed analysis and management of road works.
- Completion of audit of urban and rural drainage assets
- Collation of Recreational Facilities and General Fund Properties for input to the asset management system and valuation of these assets for 2012/13
- Collation of Council land holding data for input to the asset management system and valuation of these assets for 2012/13
- Establishment of links between the asset and GIS data

The asset management improvement plan will continue to be monitored and refined and provide a base for the enhancement of Council Asset Management

Table 63 – Asset Management Improvement Plan

Task No.	Task	Responsibility	Resources Required	Timeline
1.	Verify the value of unfunded renewals and investigate options to close the gap.	Director Works	AMC / Works Staff / Infrastructure Planning Staff	

Task No.	Task	Responsibility	Resources Required	Timeline
2.	Verify unit / renewal rates and useful lives across all asset groups.	Director Works	AMC / Works Staff	
3.	Continue with the establishment of a single asset register that is suitable for financial reporting and technical asset management. Develop formal processes for maintaining the asset register. Close the gaps in asset register data (in particular drainage assets).	Director Infrastructure Planning	AMC / Finance Staff / Works Staff	2013 - 2015
4.	Load asset data for roads, footpaths, kerb & gutter, buildings, plant & equipment and land in the Asset Management System and revalue these assets as at 30 June 2013	Director Infrastructure Planning	AMC	2013
5.	Integrate the Asset Management System with other information systems (Finance, GIS, Customer Requests, Document Management	Director Infrastructure Planning	AMC / Information Services Staff	2014
6.	Investigate the acquisition of a Strategic Infrastructure Management module that supports the operational management of Council Assets and integrates with other information systems	Director Infrastructure Planning	AMC / Information Services/ Works Staff / Infrastructure Planning Staff/ Finance Staff	2013/14
7.	Formalise condition inspection frameworks and establish process for on-going condition assessment (in particular, undertake regular audits of sealed and unsealed pavements, footpaths and Kerb & Gutter). Close gaps in condition data. Consider the re-segmenting of the road network to improve the condition forecasting and determining job lots for renewal.	Director Works	AMC / Works Staff	2013/14
8.	Pilot the inspection frequencies and maintenance response times as detailed in draft risk management policy. Expand the draft risk policy to cover all asset groups.	Director Works	AMC / Works Staff	2013 - 2015
9.	Develop and implement monitoring and reporting processes for current service levels.	Director Infrastructure Planning	AMC / Works Staff / Customer Service Staff	2013 - 2015

Task No.	Task	Responsibility	Resources Required	Timeline
10.	Carryout a risk assessment to identify credible risks and develop a risk treatment plan for non-acceptable risks.	Director Infrastructure Planning	AMC / Works Staff / OH&S/Risk Management Officer	2013 - 2015
11.	Formalise methodologies for establishing future capital works programmes for undertaking necessary Council funded road and drainage upgrade projects, including setting priorities for each category of assets.	Director infrastructure planning	AMC / Works	2013/14

13.3 Monitoring and Review Procedures

This asset management plan will be reviewed during annual budget preparation and amended to recognise any changes in service levels and/or resources available to provide those services as a result of the budget decision process.

The Plan has a life of 4 years and is due for revision and updating within 2 years of each Council election.

REFERENCES

Palerang Council, 'Management Plan 2010 – 2011'.

Palerang Council, 'General Purpose Financial Report 30 June 2009'.

Palerang Council, 'Draft Risk Management Policy for Roads 28 September 2008'.

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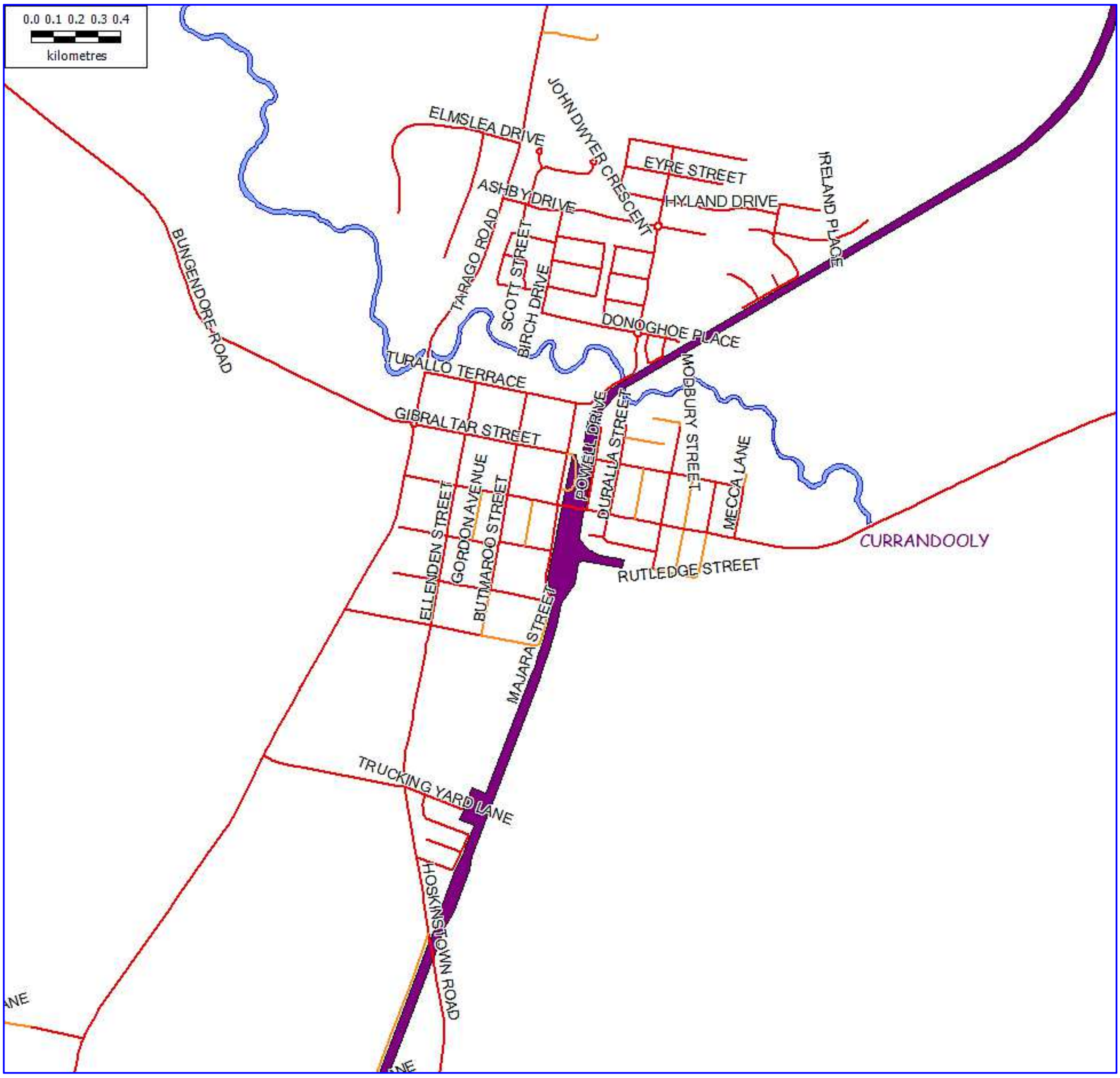
IPWEA, 'International Infrastructure Management Manual', International Edition 2011, Institute of Public Works Engineering Australia, Sydney, www.ipwea.org.au

Attachment A – Main Urban Centre Maps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SCOTT STREET
BIRCH DRIVE
DONOGHOE PLACE
TURALLO TERRACE
GIBRALTAR STREET
POWELL DRIVE
DURALLA STREET
MODBURY STREET
MECCA LANE
ELLENDEN STREET
GORDON AVENUE
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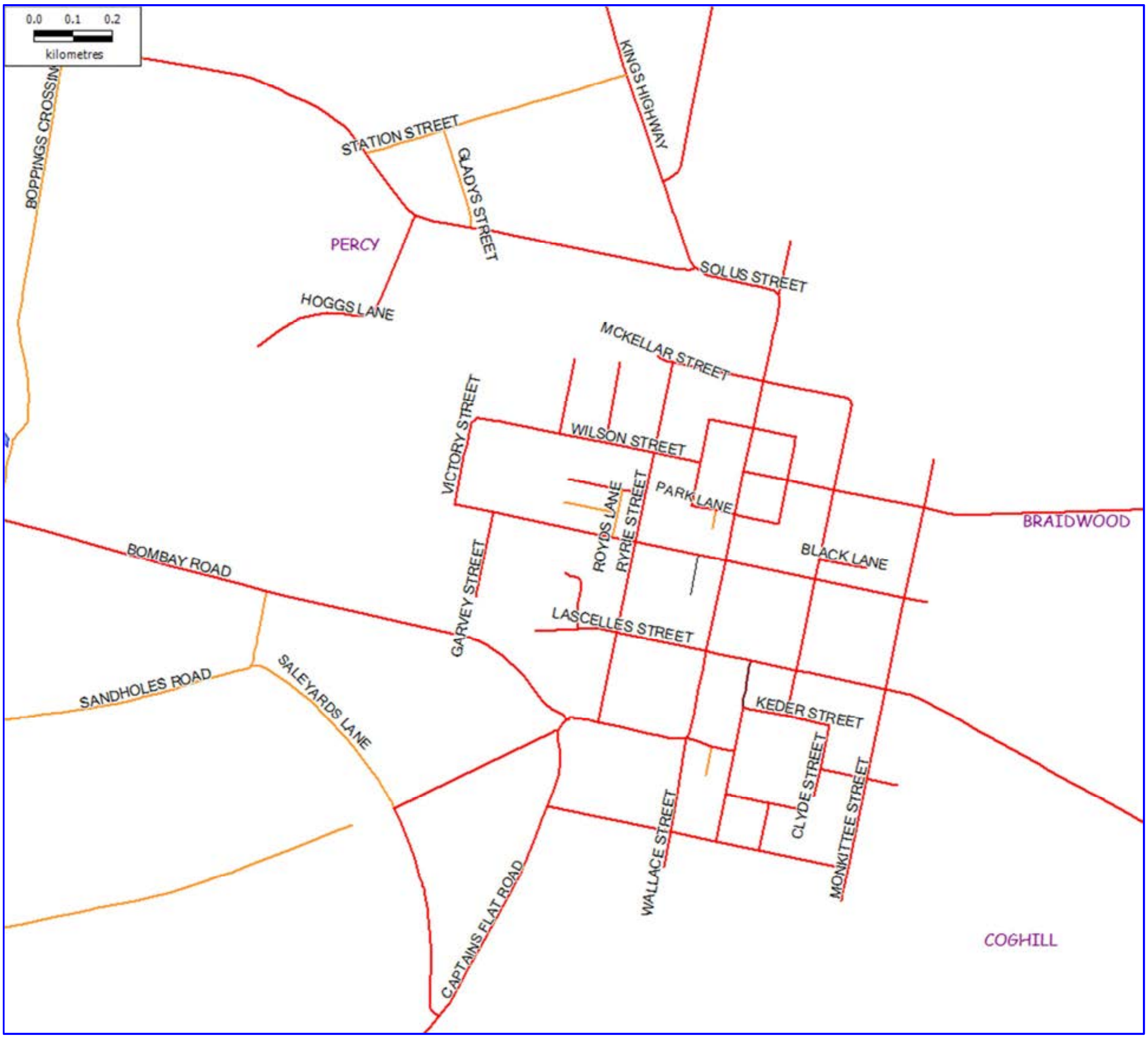
MAJARA STREET
TRUCKING YARD LANE
HOSKINSTOWN ROAD

BUNGENDORE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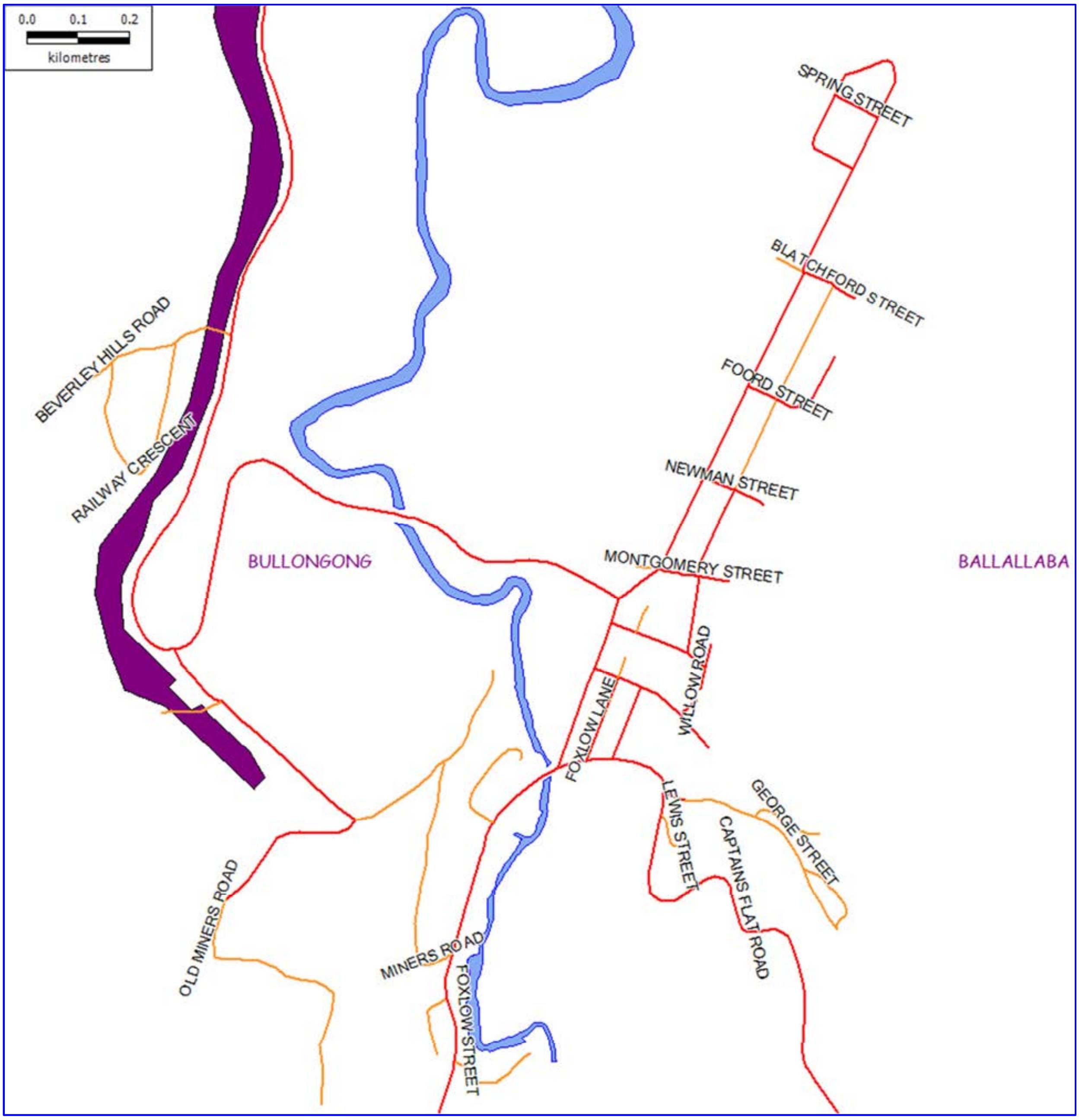
WILSON STREET
PARK LANE
ROYDS LANE
RYRIE STREET
BRAIDWOOD
BLACK LANE
BOMBAY ROAD
GARVEY STREET
LASCELLES STREET
SANDHOLES ROAD
SALEYARDS LANE
KEDER STREET
CLYDE STREET
MONKITTEE STREET
WALLACE STREET
CAPTAINS FLAT ROAD
COGHILL

BRAIDWOOD



CAPTAINS FLAT

Attachment B – Assessed Need for Capital Works

Capital Works Needed

NOTES:

Priority 1 (within 0-4 years)	The most urgent projects that need to be undertaken in the 4 years of the Delivery Plan commencing in 2013/14
Priority 2 (5-10 years)	Urgent works that need to be undertaken in the 10 year period of the Long Term Financial Planning. However, currently available funding and revenue sources do not cover many of these projects
Priority 3 (>-10 years)	Worthy projects that cannot be given a high priority within the next decade due to insufficient financial resources. Some may however be undertaken should Section 94 contributions be collected for the purpose

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Locality: All Areas														
All Areas	Local Roads	Unsealed Roads	Formation upgrading	Various	New program to improve the worst sections of gravel roads-$50,000 per yr		0	200,000	1	New		200,000	200,000	There are currrently 748 kms of unsealed roads most of which will never be bitumen sealed. There are however many safety deficiencies along these roads that should be addressed by local re-alignment/culvert widening/etc projects.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
All Areas	Local Roads	Unsealed Roads	Formation upgrading	Various	New program to improve the worst sections of gravel roads - $50,000 per year		0	300,000	2	New		300,000		There are currrently 748 kms of unsealed roads most of which will never be bitumen sealed. There are however many safety deficiencies along these roads that should be addressed by local re-alignment/culvert widening/etc projects.
All Areas	Local/Regional Roads	Unsealed Roads	Re-sheeting roads	Various - 748 km	Extended program to address re-sheeting needs (10 yr cycle on average)-Extra $300,000 per year		0	1,200,000	1	Renewal	1,200,000		1,200,000	Extra funds are needed to allow a more desirable frequency of re-sheets on gravel roads. Assessment of backlog is provided at sect 5.5.3.3 of Council's AM Plan.
All Areas	Local/Regional Roads	Unsealed Roads	Re-sheeting roads	Various - 748 km	Extended program to address re-sheeting needs (10 yr cycle on average)-Extra $300,000 per year		0	1,800,000	2	Renewal	300,000	1,500,000	300,000	Extra funds are needed to allow a more desirable frequency of re-sheets on gravel roads. Assessment of backlog is provided at sect 5.5.3.3 of Council's AM Plan.
All Areas	Local/Regional Roads	Sealed Roads	Resealing roads	Various - 584 km	Extended program to meet resealing needs (15yr cycle)-Extra $250,000 per year (Existing $515,000 for local rds and $200,000 for reg rds)		0	1,000,000	1	Renewal	1,000,000		1,000,000	Extra funds are needed to allow a more desirable frequency of reseals on sealed roads. With reference to section 5.5.1.1 Fig 4 of AM Plan backlog is about 12% of sealed surfaces.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
All Areas	Local/Regional Roads	Sealed Roads	Resealing roads	Various - 584 km	Extended program to meet resealing needs (15yr cycle)- Extra $250,000 per year (Existing $515,000 for local rds and $200,000 for reg rds)		0	1,500,000	2	Renewal		1,500,000		Extra funds are needed to allow a more desirable frequency of reseals on sealed roads. With reference to section 5.5.1.1 Fig 4 of AM Plan backlog is about 12% of sealed surfaces.
All Areas	Local Roads	Sealed Roads	Heavy Patching	Various	New program to keep up with pavement ruptures- $200,000 per year		0	800,000	1	Renewal	200,000	600,000	200,000	Not all sealed roads that need rehabilitation can be treated at the one time. Up until rehabs can be funded, serious pavement ruptures will need repair by isolated heavy patching
All Areas	Local Roads	Sealed Roads	Heavy Patching	Various	New program to keep up with pavement ruptures- $200,000 per year		0	1,200,000	2	Renewal		1,200,000		Not all sealed roads that need rehabilitation can be treated at the one time. Up until rehabs can be funded, serious pavement ruptures will need repair by isolated heavy patching
All Areas	Local/Regional Roads	Sealed Roads	Rd Rehabilitation	Various	Extended program to catch up with the ongoing deterioration and failure of pavements - $300,000 per year			1,200,000	1	Renewal Yes	300,000	900,000	1,200,000	The existing $550,000 annual rehab program and the other existing programs are insufficient to address the ongoing failure of sealed road pavements over time

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
All Areas	Local/Regional Roads	Sealed Roads	Rd Rehabilitation	Various	Extended program to keep up with the ongoing deterioration and failure of pavements - $300,000 per year			1,800,000	2	Renewal		1,800,000		The existing $550,000 annual rehab program and the other existing programs are insufficient to address the ongoing failure of sealed road pavements over time
All Areas	Local/Regional Roads	Footpaths	Construct new paths/Replace damaged paths	Various	Annual Footpath Construction/Replacement program - $40,000 per year			160,000	1	New	40,000	120,000	160,000	There is no existing Council funding program to provide new paths that are needed.
All Areas	Local/Regional Roads	Footpaths	Construct new paths/Replace damaged paths	Various	Annual Footpath Construction program/Replacement program - $40,000 per year			240,000	2	New		240,000		There is no existing Council funding program to provide new paths that are needed.
All Areas	Local/Regional Roads	Kerb & Gutter	Replace damaged K&G	Various	Backlog Program to replace unservicable and uneven K&G			46,000	1	Renewal	46,000		46,000	A once allocation is required to put all K7G asset back in satisfactory order
All Areas	Parks & Reserves	Recreation Facilities	RecreationFacilities	Various	Annual Parks/Reserves/Streetscape program - $30,000 per year			120,000	1	New	120,000		120,000	There is no existing Council funding program to provide carry out major repairs and improvements in our public spaces
All Areas	Parks & Reserves	Recreation Facilities	New RecreationFacilities	Various	Annual Parks/Reserves/Streetscape program - $30,000 per year			180,000	2	New		180,000		There is no existing Council funding program to provide carry out major repairs and improvements in our public spaces

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
All Areas	General Fund Properties	Public Halls/Buildings	Refurbishment	Various	New program to cover periodic projects at halls & buildings involving major repair &/or updating facilities - $60,000 per year		0	240,000	1	Renewal	240,000		240,000	Many of our halls and other public buildings are old or outdated and need periodic repair/refurbishmnet. Program would assist s355 Committees with larger projects.
All Areas	General Fund Properties	Public Halls/Buildings	Refurbishment	Various	New program to cover periodic projects at halls & buildings involving major repair &/or updating facilities - $60,000 per year		0	360,000	2	Renewal		360,000		Many of our halls and other public buildings are old or outdated and need periodic repair/refurbishmnet. Program would assist s355 Committees with larger projects.
				Total Locality: All Areas				**12,346,000**			**3,446,000**	**8,900,000**	**4,666,000**	
Locality: Braidwood & Environs														
Braidwood & Environs	Regional Roads	Gravel/Sealed Roads	Seal Gravel Roads	MR 92 - Nerriga Road	Bitumen seal gravel sections in ongoing program	600	8	6,000,000	1	New		6,000,000	6,000,000	Stage 1 -This road is now carrying too much traffic to be effectively maintained as a gravel road. Bitumen sealing would also be a boost to Braidwood economy. Needs special grant.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Braidwood & Environs	Regional Roads	Gravel/Sealed Roads	Seal Gravel Roads	MR 92 - Nerriga Road	Bitumen seal gravel sections in ongoing program	600	9	6,750,000	1	New		6,750,000	6,750,000	Stage 1 -This road is now carrying too much traffic to be effectively maintained as a gravel road. Bitumen sealing would also be a boost to Braidwood economy. Needs special grant.
Braidwood & Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Saleyards Lane	Bitumen seal gravel section-Gillamatong Lane and Sandholes Ln	59	0.52	140,400	1	New		140,400	140,000	A town street that needs sealing to met urban road standards in a location of further building developments.
Braidwood & Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Station/Gladys Street	Bitumen Seal gravel section		1.05	240,000	2	New		240,000		A town street serving a dozen residences
Braidwood & Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Hawthorne Lane	Bitumen seal gravel section		1.25	250,000	2	New		250,000		A town street serving 8 residences
Braidwood & Environs	Regional Roads	Gravel/Sealed Roads	New Nerriga Bypass Rd	MR 92 - Nerriga Road	Construct a 100kph bypass road on the eastern side of Nerriga	600	3	5,000,000	3	New		5,000,000		Council has a current policy to support a future Bypass of Nerriga.(But only with special funding)
Braidwood & Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 92 - Nerriga Road	Widen & strengthen I km of older sections between Kings Hwy & Nerriga	500	1.3	530,000	1	New	265,000	265,000	530,000	Many of the older sections of this road need widening and strengthening to meet expected future traffic demand.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Braidwood & Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 92 - Nerriga Road	Widen & strengthen older sections between Kings Hwy & Nerriga	400	3	1,200,000	2	New		1,200,000		Many of the older sections of this road need widening and strengthening to meet expected future traffic demand.
Braidwood & Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 92 - Nerriga Road	Widen & strengthen older sections between Kings Hwy & Nerriga	400	20	8,000,000	2	New		8,000,000		Many of the older sections of this road need widening and strengthening to meet expected future traffic demand.
Braidwood & Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 - Cooma Rd	Widen & Strengthen various sections	490	1.75	530,000	1	New	300,000	230,000	530,000	Seriously damaged pavement on this road needs urgent rehabilitation
Braidwood & Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 - Cooma Rd	Widen & Strengthen various sections	490	2	600,000	1	New	400,000	200,000	600,000	Damaged, high maintenance pavement on this road will need ongoing rehabilitation
Braidwood & Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 - Cooma Rd	Widen & Strengthen various sections	490	8	2,400,000	1	New	1,200,000	1,200,000	2,400,000	Damaged, high maintenance pavement on this road will need ongoing rehabilitation
Braidwood & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Araluen Road	Widen & Strengthen various sections	610	1	250,000	1	New	125,000	125,000	250,000	Damaged pavement on this road needs rehabilitation
Braidwood & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Araluen Road	Widen & Strengthen various sections	610	1	250,000	2	New		250,000		Damaged pavement on this road will need ongoing rehabilitation

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Braidwood & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Park Lane	Rip, strengthen and reseal between Wallace St & Wilson St west	200	0.20	75,000	1	New	75,000		75,000	Patched tired old pavement needs re-doing
Braidwood & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Majors Creek Rd	Unity Mine entrance to Arual	300	3	750,000	1	New	375,000	375,000	750,000	Road with many ruptures will need ongoing attention. Darques Reef Mine will provide one off $600,000 towards works and annual $85,000 for ongoing works.
Braidwood & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Majors Creek Rd	Widen & Strengthen various sections - Unity Mine Entrance to Araluen Rd	300	2	500,000	2	New		500,000		Road with many ruptures will need ongoing attention. Darques Reef Mine will provide $85,000 pa for ongoing works.
Braidwood & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Majors Creek Rd	Widen & Strengthen various sections - Unity Mine Entrance to Majors Creek	300	1	250,000	1	New	125,000	125,000	250,000	Road with many ruptures needs rehabilitation in worst sections.
Braidwood & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Majors Creek Rd	Widen & Strengthen various sections over full length	300	2	500,000	3	New		500,000		Road with many ruptures will need ongoing attention. Darques Reef Mine is expected to close within next decade.
Braidwood & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Little River Road	Rip, strengthen & reseal failing pavement	400	1.0	250,000	2	New		250,000		Out of shape road with ruptures for 300m each side of 1st bridge

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Braidwood & Environs	Local Roads	Sealed Roads	Shoulder K&G Constn	Wilson st	Place K&G & seal shoulder on north side near pre-school	1,000	0	140,000	1	New		140,000	140,000	This area of shoulder becomes muddy where parents pull up to drop off/collect children from the pre-school during rain. Parking also needs to be better controlled .
Braidwood & Environs	Local Roads	Sealed Roads	Shoulder K&G Constn	Monkittee St	Widen & K&G missing section east side north of hospital (in conjunction with new path)	427	75	25,000	1	New		25,000	25,000	Project will improve parking arrangements at the hospital and replace erodable gravel road shoulder surface. Do at same time as new footpath.
Braidwood & Environs	Regional Roads	Bridges	Replace timber bridge	MR 92 - St Omers Ck	Construct new concrete bridge or culvert to replace old structure	550	0	305,000	1	Renewal	305,000		305,000	The deck of this old timber bridge is temporarily propped. A replacement structure is urgently needed.
Braidwood & Environs	Regional Roads	Bridges	Replace timber bridge	MR 92 - Mongarlowe River	Replace single lane old timber bridge with 2 lane B-Double standard concrete structure plus approaches	400	0	7,000,000	2	Renewal		7,000,000		A bridge that is currently not a Council asset but its early replacement is required to guarantee the viability of upgrading MR 92 to Kings Hwy
Braidwood & Environs	Regional Roads	Bridges	New/Replacement Bridges	MR92 - various	New bridges/large culverts at existing flood prone causeways and replacement of narrow old bridges	0	0	4,000,000	2	Renewal		4,000,000		Replacement flood free creek crossing structures will be required if MR 92 is to reach highway and freight route standard.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Braidwood & Environs	Regional Roads	Bridges	Replace timber bridge	MR 270 - Back Creek	Construct new concrete bridge to replace old structure	400	0	1,300,000	1	Renewal	1,300,000		1,300,000	Another old timber bridge. Has a 5t load limit and relies on flood liable low level bypass track for heavier vehicles
Braidwood & Environs	Local Roads	Bridges	Replace timber bridge	Other local road bridges	Replace old timber bridges with concrete	0	0	1,000,000	2	Renewal	350,000	650,000	350,000	Some other smaller old timber bridges should ideally be repalced with concrete stucture to reduce upkeep costs.
Braidwood & Environs	Flood Management	Urban Drainage	Construct u/g drainage	From Council Depot	Acquire an easement & construct an underground drainage pipe from the Council Depot to Lascelles St/wallace St	0	0	200,000	1	New		200,000	200,000	Stormwater from upslope including run-off from Council's depot flows under houses fronting Lascelles St.
Braidwood & Environs	Local Roads	Paths	Construct new path	Duncan St south side	Construct missing path link from popular street parking area to shops	0	0.12	15,000	1	New		15,000	15,000	New path needed in high pedestrian area
Braidwood & Environs	Local Roads	Paths	Construct new path	Coronation Av	Construct missing path link from Ryrie St to Club	0	0.40	48,000	2	New		48,000		New path needed in realively high pedestrian area especially at night.
Braidwood & Environs	Local Roads	Paths	Construct new path	Park Lane east	Construct missing path link used by school children	0	0.15	18,000	3	New		18,000		New path- Need identified in PAMP
Braidwood & Environs	Local Roads	Paths	Construct new path	Wilson St south side	Construct missing path link 1.8m wide-Elrington St to Monkittee	0	0.22	27,500	2	New		27,500		New path- Need identified in PAMP

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Braidwood & Environs	Local Roads	Paths	Construct new path	Monkittee St	Construct missing path link 1.8m wide-Little River Rd to existing path near hosp	0	0.04	5,000	1	New		5,000	5,000	New path- Need identified in PAMP
Braidwood & Environs	Local Roads	Paths	Construct new path	Wilson St west	Construct path link 1.8m wide-South side from Ryrie to Park Ln	0	0.10	12,500	3	New		12,500		New path- Need identified in PAMP
Braidwood & Environs	Local Roads	Paths	Construct new path	Ryrie St	Construct path 1.8m wide-MacKellar St to Wilson st	0	0.22	28,000	3	New		28,000		New path- Need identified in PAMP
Braidwood & Environs	Business Activities - State Rds	Traffic Facilities	Construct traffic facilities	Wallace St	Construct pedestrian crossing(s) between Park Ln & Lolly Shop	0	0.00	50,000	1	New		50,000	50,000	Recommended project in current Traffic study. Location supported by community. Funding expected from RMS in 2013/14
Braidwood & Environs	Business Activities - State Rds	Traffic Facilities	Construct traffic facilities	Wallace St/Lascelles	Construct Roundabout	0	0.00	750,000	1	New		750,000	750,000	Recommended project in current Traffic study with general support from community. Funding expected from RMS in future year.
Braidwood & Environs	Business Activities - State Rds	Future Kings Hwy Bypass	Braidwood Bypass Study	From Kings Hwy	Undertake study to determine a corridor for Kings Hwy By-pass	0	0.00	75,000	1	New		75,000	75,000	Continue to seek funding from RMS

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Braidwood & Environs	Parks & Reserves	Playg Fields/Amenities	Facilty Refurbishment	Braidwood Recreation Ground	Expand playing fields and construct new amenities building	0	0.00	1,300,000	1	Renewal	300,000	1,000,000	1,300,000	Project concepts and designs developed with $355 Committee input and project supported by letters from local sporting clubs and schools. $400,000 contibution will come from Dargues Reef Mine.
Braidwood & Environs	Parks & Reserves	Swimming Pools	Pool Facilty Study	Braidwood Pool	Upgrade 45 year old pool to meet more modern standards	0	0.00	60,000	1	Renewal		60,000	60,000	The current change rooms and amenities are very spartan (no roof over change rooms). Pool walls and floor need re-tiling. Other requests from locals.
Braidwood & Environs	Parks & Reserves	Swimming Pools	Facilty Refurbishment	Braidwood Pool	Upgrade 45 year old pool to meet more modern standards	0	0.00	300,000	2	Renewal		300,000		The current change rooms and amenities are very spartan (no roof over change rooms). Pool walls and floor need re-tiling. Other requests from locals.
Braidwood & Environs	Council Buildings & Halls	Old Council chambers	Facilty Refurbishment	Park Lane	Upgrade/expand the facilitate to accommodation Braidwood staff.	0	0.00	400,000	2	Renewal		400,000		Current Council resolution to re-locate staff into this building once refurbished and hand-over existing offices to craft groups.
Braidwood & Environs	Council Buildings & Halls	Halls	Refurbish Hall	Braidwood	Refurbishment works-National Theatre building	0	0.00	200,000	2	Renewal		200,000		Old cold building will need work.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Braidwood & Environs	Depot	Council depot	Plan new depot	Braidwood west	Investigate and design for the construction of new depot to accommodate work staff and for parking of plant & vehicles and materials storage to replace existing works; at which contamination needs assessing.	0	0.00	100,000	1	Renewal	100,000		100,000	Current depot is no longer fit for purpose and poorly located in the middle of town. Site could be used for more beneficial purposes. A new site on the western site of town is being investigated.
Braidwood & Environs	Depot	Council depot	Construct new depot	Braidwood west	Construct new depot to accommodate works staff plant & vehicles and materials storage	0	0.00	1,700,000	1	Renewal	500,000	1,200,000	1,700,000	Current depot is no longer fit for purpose and poorly located in the middle of town. Site could be used for more beneficial purposes. A new site on the western site of town is to be investigated.
Braidwood & Environs	Depot	Council depot	Re-instate old depot site	Off Ryrie & Duncan	Rehabilitate site once depot is relocated. Use as carpark or sell	0	0.00	200,000	1	Renewal		200,000	200,000	Depot site will need to be rehabilitated and buildings demolished ready for a new purpose or possible sale.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Braidwood & Environs	Public Privies	Public Toilets	Construct public toilets	Nerriga Reserve	Plan for the Provision of a new public toilets for the large increase in visitors	0	0.00	12,000	1	New		12,000	12,000	This project was requested by the local community at the Nerriga IP&R workshop. The sealing of MR92 from Nowra has added many travellers through the village at which point a toilet stop is needed by many.
Braidwood & Environs	Public Privies	Public Toilets	Construct public toilets	Nerriga Reserve	Provide new public toilets for the large increase in visitors travelling MR92	0	0.00	350,000	1	New		350,000	350,000	This project was requested by the local community at the Nerriga IP&R workshop. The sealing of MR92 from Nowra has added many travellers through the village at which point a toilet stop is needed by many.
				Total: Braidwood & Environs			**145.74**	**54,086,400**			**5,720,000**	**48,366,400**	**25,212,000**	
Locality: Bungendore &Environs														
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Old Goldmines Road	Bitumen seal from end of existing seal for 700m	25	0.70	140,000	3	New		140,000		Will be constructed when S94 funds collected with subdivisions.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Summerhill Rd	Bitumen seal from end of existing seal to end	75	0.64	128,000	3	New		128,000		$13,500 S94 available for project. Rural Residential area road. More S94 expected.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Clare Lane	Bitumen seal from end of existing seal to end	63	0.90	180,000	3	New		180,000		$10,500 S94 available for project. Rural Residential area road. More S94 expected
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	The Forest Rd	Bitumen seal from end of existing seal to end	100	1.35	270,000	3	New		270,000		Rural Residential area road still gravel.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Joe Rocks Rd	Bitumen seal from end of existing seal to end (public rd)	183	0.85	187,000	1	New		187,000	187,000	$45,700 S94 available towards project. Recently approved Subdivisions will add funds
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Donnelly Lane	Bitumen seal from end of existing seal to end	30	0.80	160,000	3	New		160,000		Rural Residential area road still gravel
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Taylors Creek Rd	Bitumen seal from end of existing seal to Western Leg Rd	50	2.00	600,000	3	New		600,000		Un-sealed link section to Western Leg Rd
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Collector Rd	Bitumen seal from end of existing seal for 2 km	60	2.00	600,000	3	New		600,000		A regional link road between Tarago Rd and Federal Hwy
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Collector Rd	Bitumen seal missing links between sealed sections	60	4.30	1,290,000	3	New		1,290,000		A regional link road between Tarago Rd and Federal Hwy
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Mount Fairy Rd	Bitumen seal missing link between sealed sections	35	9.00	2,700,000	3	New		2,700,000		A regional link road between Goulburn Rd and Tarago Rd. Would be used if sealed.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Hoskinstown Rd	Bitumen seal gravel section from end of seal western end towards Hoskintown	146	1.20	360,000	2	New		360,000		Unsealed road with relatively high traffic. Links Hoskinstown/Forbes Ck/Rossi directly to Bungendore. Would enhance Bung businesses.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Hoskinstown Rd	Bitumen seal gravel sections between Briars-Sharrow Rd and Hoskintown	146	3.70	1,110,000	2	New		1,110,000		Unsealed road with relatively high traffic. Links Hoskinstown/Forbes Ck/Rossi directly to Bung. Would enhance Bung businesses.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Hoskinstown Rd	Bitumen seal gravel sections- Between Forbes Ck Rd & Rossi Rd	146	4.40	1,320,000	3	New		1,320,000		Unsealed road with relatively high traffic. Links Hoskinstown/Forbes Ck/Rossi directly to Bung. Would enhance Bung businesses.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Rossi Rd	Bitumen seal gravel sections- Between Hoskinstown Rd & Rossi	80	6.00	1,800,000	3	New		1,800,000		Nice to do project but others have higher priority based on traffic counts.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Forbes Creek Rd	Bitumen seal gravel sections- Hoskinstown Rd to Sheahan Rd	146	1.00	300,000	2	New		300,000		Unsealed road with relatively high traffic. Past church and fireshed to branching road.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Forbes Creek Rd	Bitumen seal gravel sections - Sheahan Rd to Forbes Creek	80	3.00	900,000	3	New		900,000		Nice to do project but others have higher priority based on traffic counts.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Lake Rd	Bitumen seal gravel section- from end of bitumen for 1km	111	1.00	270,000	3	New		270,000		Nice to do project on tourist interest road with moderate traffic
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Mathews Lane	Bitumen seal gravel section-end of bitumen to Range Rd	60	1.50	330,000	3	New		330,000		Subject to receipt of S94 Funds
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Mathews Lane	Bitumen seal gravel section- from Range Rd to end in accordance with S94 Plan	<50	1.50	250,000	3	New		250,000		Subject to receipt of S94 Funds
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Gidleigh Lane	Bitumen seal gravel section- Hoskinstown Road to 2.5kms	187	2.50	750,000	1	New		750,000	750,000	Higher trafficked gravel road with school bus run.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Gidleigh Lane	Bitumen seal gravel section- from 2.5Km from Hoskinstown Road to Gidleigh Stn	170	2.00	600,000	2	New		600,000	600,000	Higher trafficked gravel road with school bus run.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Gidleigh Lane	Bitumen seal gravel section-Gidleigh Station to Ingeldow	60	2.60	780,000	3	New		780,000		Nice to do project but others have higher priority based on traffic counts.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Millpost Lane	Bitumen seal gravel section-Kings Hwy to bottom of escarpmt	46	1.90	380,000	3	New		380,000		Nice to do project but others have higher priority based on traffic counts.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Woolcara Lane	Bitumen seal gravel section-Capt Flat Rd for 2kms as Stage 1	174	2.00	600,000	1	New		600,000	600,000	Higher trafficked gravel road with school bus run.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Woolcara Lane	Bitumen seal gravel section-Stage 1 to Koombahlah Rd as Stage2	164	2.30	690,000	2	New		690,000	690,000	Higher trafficked gravel road with school bus run.
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Butmaroo St	Bitumen seal/K&G gravel section-Forster to King St, add supplementary drainage	225	0.21	300,000	1	New		300,000	300,000	Already in 2013/14 R2R. Unsealed urban road to industrial area and close to houses that suffer dust impact
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Turallo Tce	Bitumen seal gravel section-Modbury St to dead-end	40	0.20	36,000	3	New		36,000		Unsealed urban road close to houses that suffer dust impact but low traffic
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	King St	Bitumen seal gravel section-Ellendon St to Majara St	76	0.60	120,000	3	New		120,000		Urban street which has some traffic, bur residential
Bungendore &Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Majara st	Bitumen seal gravel section-Forster St to King St	76	0.21	42,000	3	New		42,000		Urban street which has some traffic, bur residential
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Norton Road	Widen & Strengthen between Sutton Rd & Fernloff Rd	1,766	1.60	848,000	1	New	424,000	424,000	848,000	High traffic road with 30 yr old failing pavement & narrow seal, partly on steep grade
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Norton Road	Widen & Strengthen between Fernloff Rd & Poppet Rd	1,766	0.70	245,000	1	New	125,000	120,000	245,000	High traffic road with failing pavement and narrow seal
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Norton Road	Widen & Strengthen between Poppet Rd & Bingley Rd	882	1.90	665,000	2	New		665,000		High traffic road with failing pavement and narrow seal

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Norton Road	Widen & Strengthen between Merino Vale Rd & Weeroona Dr	882	2.30	805,000	2	New		805,000		High traffic road with failing pavement and narrow seal
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Denley Dr	Widen & Strengthen between Macs Reef Rd & Weeroona Dr	513	0.95	285,000	2	New		285,000		Existing formation and seal too narrow for traffic levels
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Bungendore Rd	Widen & Strengthen between Macs Reef Rd & Summerhill Rd	1,126	1.90	570,000	1	New	285,000	285,000	570,000	Failing pavement with existing formation and seal too narrow for increasing traffic levels
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Bungendore Rd	Widen & Strengthen worst sections between Summerhill Rd & Shinglehouse Rd	1,126	3.00	900,000	1	New	300,000	600,000	900,000	Failing pavement with existing formation and seal too narrow for increasing traffic levels
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	RR 7607 - Macs Reef Road	Widen & Strengthen sections between Newington Rd & Gum Flat	4,200	1.20	420,000	2	New		420,000		Failing pavement with existing formation and seal too narrow for high and increasing traffic levels
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	RR 7607 - Macs Reef Road	Widen & Strengthen worst sections between east of Yass River and tip entrance	4,500	2.40	840,000	3	New		840,000		Failing pavement with existing formation and seal too narrow for high and increasing traffic levels

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	Tarago Road	Widen & Strengthen from 0.9 km to 2.9 km south of Taylors Ck Rd	1,000	2.00	800,000	1	New	400,000	400,000	800,000	Failing pavement with existing formation and seal too narrow for increasing traffic levels
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	Tarago Road	Widen & Strengthen south from Mount Fairy Rd for 2.5km	1,200	2.50	750,000	2	New		750,000	750,000	Failing pavement with existing formation and seal too narrow for increasing traffic levels
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	Tarago Road	Widen & Strengthen north from Currandooley Rd for 2 km	1,250	2.00	500,000	2	New		500,000		Failing pavement with existing formation and seal too narrow for increasing traffic levels
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	The Forest Rd	Widen & Strengthen between Bede Rd and end of seal	140	1.10	143,000	3	New		143,000		Existing seal too narrow for traffic levels
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Hoskistown Rd	Widen & Strengthen - from Trucking Yard Lane to Railway line	500	0.60	140,000	2	New		140,000		Deteriorating pavement too narrow for traffic levels
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Hoskistown Rd	Widen & Strengthen - from Railway line east for 300m	573	0.30	45,000	1	New	25,000	20,000	45,000	Failing high maintenance section of pavement on busy through road
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Hoskistown Rd	Widen & Strengthen - from Gidleigh Lane east for 800m	400	0.80	120,000	1	New	80,000	40,000	120,000	Failing high maintenance section of pavement on busy through road
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Hoskistown Rd	Widen & Strengthen various sects	400	3.00	450,000	3	New		450,000		Deteriorating sections of pavement on busy through road

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 Capt Flat Rd	Widen & Strengthen between Qbn Bdy & Stony Creek Pl	1,300	0.85	340,000	2	New		340,000	340,000	Rough, narrow seal on narrow formation between already improved sections each side
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 Capt Flat Rd	Widen & Strengthen from near Molonglo River Dr to Douglas Cl	1,100	1.60	480,000	2	New		480,000		Failing pavement with narrow seal between already improved sections each side
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 Capt Flat Rd	Widen & Strengthen south from Briars-Sharrow Rd for 1.2km	800	1.20	360,000	1	New	180,000	180,000	360,000	Failing pavement with narrow seal
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 Capt Flat Rd	Widen & Strengthen from Church at Chimney Creek for 1.2km south to rehabed section.	750	1.20	360,000	1	New	180,000	180,000	360,000	Failing pavement with some narrow seal between already improved sections each side
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 Capt Flat Rd	Widen & Strengthen from bottom of Cockatoo Hill west towards Kings Hwy	750	1.20	360,000	1	New	180,000	180,000	360,000	This project would treat a narrrow failing seal section, heavily wheeltracked between previously rehabilitated sections.
Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 Capt Flat Rd	Widen & Strengthen from 1.2 km south of Briars-Sharrow Rd to Chimney Creek	800	4.00	1,200,000	2	New	300,000	900,000	600,000	This project would treat a narrrow failing seal section between previously rehabilitated sections.

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Bungendore &Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 Capt Flat Rd	Widen & Strengthen from east of Rehab at Cockatoo Hill to Hoskinstown Rd	750	4.40	1,320,000	2	New	300,000	1,020,000	600,000	Failing pavement with many surface repairs and continuing ruptures.
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Ellendon St	Widen & Strengthen sections between King St to Trucking Yard Lane	600	0.40	96,000	2	New		96,000		Old narrow pavement serving an increasing number of subdivisions
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Collector Rd	Rip, Strengthen and Reseal bad sections between Upper Lachlan Bdy & Lucky Pass Rd		1.70	340,000	2	New	100,000	240,000	200,000	Failing, poorly constructed pavement
Bungendore &Environs	Local Roads	Sealed Roads	Road Rehabilitation	Plains Road	Rip, Strengthen and Reseal bad section at east end of road	220	0.50	120,000	1	New	120,000		120,000	Pavement damaged by timber trucks
Bungendore &Environs	Regional Roads	Sealed Roads	Road Safety Treatment	RR 7607 - Smiths Gap	Widen sharp curve & place central Jersey lane separation barrier (Do if Blackspot funding received)	4,000	0.40	600,000	1	New		600,000	600,000	The curve with the 55KPH warning signs half way down Smiths Gap is the site of many accidents including by vehicles crossing to the wrong side of the road. The installation of Jersey barrier along the centreline would prevent possible future fatalities.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Sealed Roads	Shoulder K&G Constn	King St	Widen & K&G north side-Ellendon St to Kings Hwy	589	0.36	110,000	1	New		110,000	110,000	K&G & shoulder seal needed to address ponding water on flat, busy road. Will match similiar treatment on opposite side of street
Bungendore &Environs	Local Roads	Sealed Roads	Shoulder K&G Constn	Ellendon St	Widen & K&G both sides-Gibraltar to Turallo Tce	331	0.21	130,000	1	New		130,000	130,000	K&G & shdr seal needed both sides to address ponding water on street partly in CBD. Will match similiar treatment near new roundabout & would complement new shared path needed along this block.
Bungendore &Environs	Local Roads	Sealed Roads	Shoulder K&G Constn	Molonglo St	Widen & K&G east side-missing sections King St-Foster St	4,850	0.23	100,000	1	New		100,000	100,000	Project needed in conjunction with project for footpath along narrow verge with existing open trench drainage at hazardous Kings Hwy location
Bungendore &Environs	Local Roads	Sealed Roads	Shoulder K&G Constn	Turallo Tce	Widen & K&G north side in front of pre-school and scout hall site to link with existing K&G	1,000	0.10	40,000	1	New		40,000	40,000	Project needed to improve drainage and parking amenity and safety for pre-school & proposed scout hall
Bungendore &Environs	Local Roads	Sealed Roads	Shoulder K&G Constn	Malbon St	Widen shoulders & K&G both sides-between Butmaroo St and Majara St	5,665	0.22	140,000	2	New		140,000		Project needed to improve drainage and parking amenity adjacent to busy Kings Hwy. Will match treatment on adjoining block.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Sealed Roads	Shoulder K&G Constn	Majara St	Widen shoulder & K&G on west side from Gibraltar St to Turallo Tce to provide 90° parking for oval	1,200	0.13	60,000	1	New		60,000	60,000	All weather sealed carparking for oval activites needed to replace worn grassed areas.
Bungendore &Environs	Local Roads	Paths	Construct new paths	Majara St	New Shared path between Malbon St & Trucking Yard Lane	0	1.50	262,000	1	New		262,000	262,000	Grant appln made for 50%:50%/RMS:Council funding using S94 from Bung Meadows sub. Direct route to school, pool and oval
Bungendore &Environs	Local Roads	Paths	Construct new paths	Turallo Tce/Ellendon	New Shared link path between Butmaroo St & Gibraltar St	0	0.48	84,000	1	New		84,000	84,000	Missing path link between Elmslea and CBD on logical desire line.
Bungendore &Environs	Local Roads	Paths	Construct new paths	Malbon St	New footpath between Duralla St & Modbury St-north side	0	0.22	27,500	1	New		27,500	27,500	Relatively high pedestrian route requiring footpath to replace foot worn path on verge
Bungendore &Environs	Local Roads	Paths	Construct new paths	Malbon St	New footpath between Modbury St & Mecca Lane-north side	0	0.32	40,000	3	New		40,000		Relatively high pedestrian route requiring footpath to replace foot worn path on verge
Bungendore &Environs	Local Roads	Paths	Construct new paths	Molonglo St/Forster	New footpath sections east side-King St-Forster St Cul-de-sac	0	0.23	31,050	1	New		31,050	31,050	Pedestrian route requiring footpath to replace hazardous foot worn path on verge and link with existing concrete path.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Paths	Construct new paths	Molonglo St	New footpath east side-Forster St to Rutledge St	0	0.23	31,050	1	New		31,050	31,050	Pedestrian route requiring footpath to replace foot worn path on narrow verge
Bungendore &Environs	Local Roads	Paths	Construct new paths	Molonglo St	New footpath east side-Rutledge St to Malbon St	0	0.22	27,500	2	New		27,500		Pedestrian route requiring footpath to replace foot worn path on narrow verge
Bungendore &Environs	Local Roads	Paths	Construct new paths	Molonglo St	New footpath east side-Malbon St to Gibraltar St	0	0.22	28,000	2	New		28,000		Relatively high pedestrian route requiring footpath to replace foot worn path on verge
Bungendore &Environs	Local Roads	Paths	Construct new paths	Molonglo St	New shared path 2.5m wide - Turallo Ck Bridge to Gibraltar St-west side	0	0.26	42,000	1	New		42,000	42,000	Un-completed project to link Turallo Ck footbridge to CBD. Expect high recreational circuit use.
Bungendore &Environs	Local Roads	Paths	Construct new paths	Turallo Ck/Frogs Hol	New shared path-Turallo/Ellendon to new Recreation Res, under bridge,across Frogs Hollow and Halfway Ck	0	0.50	125,000	2	New		125,000		An important path construction to provide safe foot/bike access from residential areas and the school to the new playing fields on the LEP identified land west of Halfway Ck.
Bungendore &Environs	Local Roads	Paths	Construct new paths	Elmslea Link Rd	New raised path section under railway bridge	0	0.04	10,000	1	New		10,000	10,000	The flood prone section of the existing path under the railway bridge needs raising above lying water.
Bungendore &Environs	Local Roads	Paths	Construct new paths	Ellendon St	New footpath sections east side-King St-Trucking Yard Lane	0	0.53	71,550	2	New		71,550		This project would complete the path link to Trucking Yard Lane. Subds will do some leng.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Drainage	Urban Drainage	Install new drainage	Molonglo St	New Multi-cell culvert under Kings Hwy with flood flaps	0	0.00	200,000	1	New		200,000	200,000	A committed project for which S94 contributions are being collected
Bungendore &Environs	Drainage	Urban Drainage	Do Drainage Strategy	Bungendore old area	Prepare a strategy to prioritise future drainage upgrades	0	0.00	50,000	1	New		50,000	50,000	An overall Bungendore drainage plan is needed for staged upgrading of the system which will need to cater for increased run-off from developments
Bungendore &Environs	Drainage	Urban Drainage	Install new drainage	Majara St	Pipe open drain between Malbon St & Gibraltar St	0	0.00	300,000	1	New		300,000	300,000	An untidy, 'hard to maintain' open drain near the school & railway station needs to be piped to complete the U/G drainage system between the Kings Hwy and Turallo Ck
Bungendore &Environs	Drainage	Urban Drainage	Install new drainage	Bungendore	Undertake high priority projects identified in Drainage Strategy	0	0.00	600,000	3	New		600,000		Further drainage projects will be needed as town grows
Bungendore &Environs	Regional Roads	Bridges/Major Culverts	Refurbish Bridge	RR 7607-Bungendore Rd	Refurbish/strengthen bridge over Halfway Ck & provide footway	4,319	0.00	300,000	2	Renewal		300,000		The road surface and railings of this bridge need replacement, at which time a footbridge could be added to access the new playing fields to the west.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Bridges/Major Culverts	Major Bridge Repair	Hoskinstown Road	Repalce deteriorated and defective timber members	25		100,000	1	Renewal	100,000		100,000	Some key structural timber members need relatively urgent replacement on Foxlow Bridge
Bungendore &Environs	Local Roads	Bridges/Major Culverts	Replace timber bridges	Various locations	Replace old timber bridges with concrete	0	0.00	1,000,000	2	Renewal	50,000	950,000	100,000	All timber bridges will need to be replaced as they reach their use by date.
Bungendore &Environs	Local Roads	Bus Bays/shelters	Install bus bays/shltrs	Various locations	Constuct atleast one new bus bay with shelter each year ($15,000 each)	0	0.00	60,000	1	New		60,000	60,000	A desirable program for the benefit of school children during unpleasnt weather
Bungendore &Environs	Local Roads	Streetlighting	Install streetlights	Various locations	Install new street lights where missing in older Bungendore	0	0.00	8,000	1	New		8,000	8,000	More streetlights are needed around Bungendore especially.
Bungendore &Environs	Local Roads	Road Verges	Undergrounding power	Ellendon/Gibraltar	Undergrounding power lines in these main shopping streets	0	0.00	2,000,000	3	Renewal		2,000,000		A desirable project to allow meaningful streetscape embellishment, but would require substantial grant and possible assistance of power supply authority

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Local Roads	Road & Verges	Streetscape Upgrading	Ellendon/Gibraltar	Pavement rehabilitation, street furniture, trees, footpath paving, landscaping to master plan - Stage 1	0	0.00	300,000	1	Renewal		300,000	300,000	Gibraltar and Ellendon St pavements in CBD need rehab and some regrading along with supplementary u/g drainage and kerb renewals. Add footpath treatments, street furniture and landscaping
Bungendore & Environs	Local Roads	Road & Verges	Streetscape Upgrading	Ellendon/Gibraltar	Pavement rehabilitation, street furniture, trees, footpath paving, landscaping to master plan - Stage 2	0	0.00	300,000	2	Renewal		300,000		Gibraltar and Ellendon St pavements in CBD need rehab and some regrading along with supplementary u/g drainage and kerb renewals. Add footpath treatments, street furniture and landscaping
Bungendore &Environs	State Roads	Traffic Facilities	Construct traffic facilities	MR 51 - Malbon St	Install pedestrian refuges and indented parking	0	0.00	150,000	1	New		150,000	150,000	In Traffic Study and funding assistance expected from RMS
Bungendore &Environs	State Roads	Traffic Facilities	Construct traffic facilities	Mr 51 Malbon/Molonglo	Construction of a roundabout	4,849	0.00	750,000	1	New		750,000	750,000	RMS will fund in future program
Bungendore &Environs	Parks & Reserves	Playing Fields/Amenities	Construct playing fields and amenities	Bungendore	Stage 1 - Land acquisition, access, parking, amenities, football/cricket fields, dirt BMX track, linking paths			1,500,000	1	New		1,500,000	1,500,000	More playing fields/sports facilities are needed in Bungendore. A current budget item and project is covered by S94 Plan.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Parks & Reserves	Playing Fields	Construct playing fields	Bungendore	Stage 2 - Irrigation, lighting, more fields, netball courts, passive	0	0.00	900,000	2	New		900,000	900,000	Need for both active & passive recreational pursuits will contine as Bungendore grows.
Bungendore &Environs	Parks & Reserves	Playing Fields	Construct playing fields	Bungendore	Stage 3 - Continuing development to meet sporting & rec pursuits	0	0.00	500,000	3	New		500,000		Need for both active & passive recreational pursuits will contine as Bungendore grows.
Bungendore &Environs	Parks & Reserves	Childrens Playgrounds	Construct children playground	Bungendore	Construct new childrens playground at south Bungendore	0	0.00	50,000	1	New		50,000	50,000	Playground needed for the many young families expected to occupy subdivisions at southern end of town. Approach to be made to State Rail to buy/lease cattle yards site on end of Trucking Yard Lane.
Bungendore &Environs	Parks & Reserves	Swimming Pools	Construct new pool	Bungendore	Construct new pool complex capable of expansion for dry facilities	0	0.00	4,000,000	1	Renewal		4,000,000	4,000,000	The current swimming pool is too small to cater for the increasing population of Bungendore & district. $620,000 of S94 held, with further to be collected.
Bungendore &Environs	Parks & Reserves	Swimming Pools	Construct dry facilities	Bungendore	Construct dry facilities to supplement new pool	0	0.00	1,500,000	3	New		1,500,000		The community has indicated a desire for supplementary dry facilities that should make the facility more viable as may enclosing pool at same time.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Parks & Reserves	Public Reserves	Purchase land	Bungendore	Purchase land on Turallo Creek and open as public reserve			100,000	2	New		100,000		Zoning of land for public reserve is included in the draft PLEP.
Bungendore &Environs	Parks & Reserves	Public Parks	Construct Balladeers Pl	Bungendore	Facilitate construction of a Balladeers Place at Mick Sherd Oval	0	0.00	200,000	2	New		200,000		The Bungendore Muster Committee is keen to do this project. But problem with grave site at preferred location at Mick Sherd Oval. The Committee will need to provide the funding.
Bungendore &Environs	Public Privies	Public Toilets	Construct Toilets	Bungendore	Construct modern public toilets and baby change room in CBD	0	0.00	350,000	2	New		350,000		The CBD needs public toilets to cater for an increasing number of visitors to the precinct.
Bungendore &Environs	Council Buildings & Halls	Halls	Refurbish Hall	Bungendore	Refurbish the School of Arts building	0	0.00	200,000	2	Renewal		200,000		Old building will need work.
Bungendore &Environs	Council Buildings & Halls	Halls	Refurbish Hall	Hoskinstown	Refurbish the Community Hall	0	0.00	200,000	2	Renewal		200,000		Old building will need work.
Bungendore &Environs	Local Roads	Public Carpark	Construct Public Carpark	Bungendore	Stage 1 Construct off-street public carpark in CBD for 100 cars	0	0.00	1,100,000	1	New		1,100,000	1,100,000	Needed to cater for the growth of businesses in the CBD including a much larger supermarket.
Bungendore &Environs	Local Roads	Public Carpark	Construct Public Carpark	Bungendore	Stage 2 Construct off-street public carpark for further 100 cars	0	0.00	1,100,000	2	New		1,100,000		Needed to cater for the growth of businesses in the CBD including a much larger supermarket.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Council Buildings & Halls	Town Square Bung CBD	Acquire land/develop	Bungendore CBD	Acquire land and develop a town square near Gibraltar/Ellendon	0	0.00	350,000	2	New		350,000		An often mentioned desirable project to create a pleasant focal point in a central location in the CBD where shoppers/visitors could rest, have lunch, enjoy a busker, etc
Bungendore &Environs	Council Buildings & Halls	Operational property	Acquire land	Bungendore	Provide land for Ambulance Station	0	0.00	200,000	1	New		200,000	200,000	An ambulance station is included in the CSP
Bungendore &Environs	Council Buildings & Halls	Operational property	Acquire land	Bungendore	Provide land for Lake George Fire Control headquarters	0	0.00	400,000	1	New		400,000	400,000	The Lake George Fire Control want to move to Bungendore. Council will need to provide a site.
Bungendore &Environs	Council Buildings & Halls	Operational property	Acquire land	Bungendore	Provide land for Town Fire Brigade			200,000	1	New		200,000	200,000	Bungendore has reached a size where a town brigade is required
Bungendore &Environs	Council Buildings & Halls	Operational property	Acquire land	Bungendore	Provide land for Smartwork Centre			400,000	1	New		400,000	400,000	Bungendore on the fringe of the ACT is a logical place for the establisment of one of these facilities
Bungendore &Environs	Council Buildings & Halls	Operational property	Investigate new library	Bungendore	Prepare a study to determine future facilities needed for library services and in Bungendore.			10,000	1	Renewal		10,000	10,000	With the existing library and the school in general becoming too small for the increasing population, a study is needed to determine future requirements and options for library services.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Bungendore &Environs	Council Buildings & Halls	Operational property	Constructa new library	Bungendore	Construct new larger library			1,000,000	2	New		1,000,000		With the existing library and the school in general becoming too small for the increasing population there is a case to relocate the library to new larger premises
Bungendore &Environs	Flood Management	Levee Bank	Construct Levee Bank	Turallo Ck Reserve	Upgrade including lifting of levee bank Molonglo St - railway	0	0.00	702,000	2	Renewal		702,000		Desirable flood control measure included in the Bungendore Floodplain Risk Manangement Study
Bungendore &Environs	Flood Management	Creek Works	Creek Bank Project	Turallo/Half Way Cks	Remove vegetation and reshape creeks to improve flood flows	0	0.00	300,000	1	New		300,000	300,000	Desirable flood control measure included in the Bungendore Floodplain Risk Manangement Study
Bungendore &Environs	Flood Management	Flood Diversion facility	Construct flood channel	Tarago Rd nth of T Ck	Construct high level flood overflow channel over property and rd	0	0.00	600,000	2	New		600,000		Desirable flood control measure included in the Bungendore Floodplain Risk Manangement Study
Bungendore &Environs	Flood Management	Flood Diversion facility	Construct fld diversion	West of Kings Hwy	Construct diversion bank & channel - Halfway Ck to Millpost Ck	0	0.00	1,500,000	2	New		1,500,000		Desirable flood control measure included in the Bungendore Floodplain Risk Manangement Study
Bungendore &Environs	Business Activities - State Rds	Future Bypass	Bundgendore Bypass Study	From kings Hwy	Undertake study to determine a corridor for suitable Bungendore By-pass(es)	0	0.00	75,000	1	New		75,000	75,000	Keep approaching RMS for funding.
				Total: Bungendore &Environs			**112.06**	**56,209,650**			**3,149,000**	**53,060,650**	**23,025,600**	

Locality: Burra/Urila/Royalla

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Burra/Urila/ Royalla	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Urila Rd	Bitumen seal gravel road from end of seal to Naylor Rd	176	1.35	340,000	1	New		340,000	340,000	Missing link to other sealed roads & serving about 70 properties.
Burra/Urila/ Royalla	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Urila Rd	Bitumen seal gravel road from Naylor Rd to Hardy Rd	138	0.65	165,000	2	New		165,000	165,000	Missing link to other sealed road & serving about 50 properties.
Burra/Urila/ Royalla	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Williamsdale Rd	Bitumen seal gravel road- from Badgery Rd west for 1 km.	192	1.00	400,000	1	New		400,000	400,000	Direct route from Burra/Urila to Monaro Hwy (including to school bus)& south Canberra.Project would realign poor alignmant.
Burra/Urila/ Royalla	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Williamsdale Rd	Bitumen seal gravel road-Badgery Rd to end of seal Gibraltar Pass	192	1.25	500,000	2	New		500,000	500,000	Direct route from Burra/Urila to Monaro Hwy (including to school bus)& south Canberra. Links sealed section to sealed section.
Burra/Urila/ Royalla	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Williamsdale Rd	Bitumen seal gravel road-west of Gibraltar Pass- seal to seal	192	3.45	1,380,000	2	New		1,380,000		Direct route from Burra/Urila to Monaro Hwy (including to school bus) & south Canberra. Links sealed section to sealed section.
Burra/Urila/ Royalla	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Burra Rd	Bitumen seal gravel road from Urila Rd to Lucas Ck	96	4.30	1,075,000	3	New		1,075,000		25 lot subdivision approved in Cooma-M just over LGA bdy- will pay large S94 for roads
Burra/Urila/ Royalla	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Plummers Rd	Bitumen seal gravel road from Burra Rd to end	80	2.00	560,000	3	New		560,000		An unsealed Rural Residential area road. The next highest trafficked unsealed road in the area.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Burra/Urila/Royalla	Local Roads	Sealed Roads	Road Rehabilitation	Burra Rd	Straighten, widen,strengthen pavement-Little Burra Rd to London Bridge Rd	848	1.60	800,000	1	New	400,000	400,000	800,000	Existing poor alignment & narrow seal with failing pavement and relatively high traffic
Burra/Urila/Royalla	Local Roads	Sealed Roads	Road Rehabilitation	Burra Rd	Widen & Strengthen pavement on worst sections both sides of Burra Ck & south of Plummers Rd	484	1.00	250,000	1	New	125,000	125,000	250,000	High maintenance failing pavement
Burra/Urila/Royalla	Local Roads	Sealed Roads	Road Rehabilitation	Burra Rd	Widen & Strengthen worst sections Moore Rd to Williamsdale Rd	484	2.70	675,000	2	New	340,000	335,000	675,000	High maintenance failing pavement
Burra/Urila/Royalla	Local Roads	Sealed Roads	Road Rehabilitation	Burra Rd	Widen & Strenthen pavement Ch - continuing	848	2.60	650,000	3	New		650,000		High maintenance failing pavement
Burra/Urila/Royalla	Local Roads	Bridges/Major Culverts	Reconstruct Culvert	Williamsdale Rd	Replace new multi-cell culvert over Burra Ck	484	0.00	750,000	2	New	375,000	375,000	750,000	Single lane, regularly flooded old culvert needs upsizing with replacement structure
Burra/Urila/Royalla	Council Buildings & Halls	Public Reserve	Reserve Development	317 Royalla Dr	Stage 1 Develop public hall, access, basic parking to Master Pl	0	0.00	600,000	1	New		600,000	600,000	Very keen S355 Comm have prepared Master Plan for Cl reserve inc new hall. $180,000 S94 funds available to build public toilets.
Burra/Urila/Royalla	Council Buildings & Halls	Public Reserve	Reserve Development	317 Royalla Dr	Stage 2 Continue to develop the Master Plan	0	0.00	600,000	3	New		600,000		Very keen S355 Comm have prepared Master Plan for Cl reserve inc new hall. .

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
				Total: Burra/Urila/Royalla			21.90	8,745,000			1,240,000	7,505,000	4,480,000	
Locality: Captains Flat & Environs														
Captains Flat & Environs	Local Roads	Gravel/Sealed Roads	Seal Gravel Roads	Miners Road	Upgrade and seal gravel road from Foxlow St to lookout	50	0.72	288,000	3	New		288,000		Would be desirable to make this road a safe, all weather, bitumen sealed alternative route in times of flooding and road closures on the normal route into town.
Captains Flat & Environs	Regional Roads	Gravel/Sealed Roads	Seal Gravel Roads	MR 270 - Captains Flat Rd	Bitumen seal missing gravel sections between town & WTS	216	1.35	540,000	2	New		540,000	540,000	High traffic count for a gravel road on way to WTS
Captains Flat & Environs	Regional Roads	Gravel/Sealed Roads	Seal Gravel Roads	MR 270 - Captains Flat Rd	Bitumen seal missing gravel sections between WTS & Harolds X	124	0.65	215,000	3	New		215,000		Nice to do project but others have higher priority based on traffic counts.
Captains Flat & Environs	Regional Roads	Gravel/Sealed Roads	Seal Gravel Roads	MR 270 - Captains Flat Rd	Bitumen seal missing gravel sections- Harolds X - Cooma Rd	100	19.00	6,650,000	3	New		6,650,000		Nice to do project but others have higher priority based on traffic counts.
Captains Flat & Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 - Captains Flat Rd	Widen & strengthen pavement on worst sections from Hoskinstown Rd to Capt Flat - Stage 1	738	1.00	300,000	1	New	150,000	150,000	300,000	This section of Capt Flat Rd already requires rehabilitation of failing, high maintenance sections which will continue to get worse.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Captains Flat & Environs	Regional Roads	Sealed Roads	Road Rehabilitation	MR 270 - Captains Flat Rd	Widen & strengthen pavement on worst sections from Hoskinstown Rd to Capt Flat - Stage 2	738	1.00	300,000	2	New		300,000		This section of Capt Flat Rd already requires rehabilitation of failing, high maintenance sections which will continue to get worse.
Captains Flat & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Foxlow St	Widen & Strengthen pavement Rutledge to Beasley	100	0.25	50,000	3	New		50,000		Narrow, rough section of pavement needs widening and strengthening
Captains Flat & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Wattle St	Rip, Strengthen and Reseal from Foxlow St to Mulga St	100	0.15	24,000	1	New	24,000		24,000	Distressed pavement - gone out of shape and breaking up
Captains Flat & Environs	Local Roads	Sealed Roads	Road Rehabilitation	Jerangle Rd	Rip, Strengthen and Reseal from edge of town up the steep hill	170	0.60	108,000	1	New	108,000		108,000	Distressed pavement - with ruptures
Captains Flat & Environs	Regional Roads	Bridges/Major Culverts	Refurbish Timber Bdge	MR 270 - Captains Flat Rd	Replace the deck of the bridge over the Molonglo River	518	0.00	1,000,000	1	Renewal	1,000,000		1,000,000	An old timber bridge, currently load limited with temporary structural repair. Council has agreed to replace the timber deck and keep as single lane. Funding assistance is being sought from Fed /state governments.
Captains Flat & Environs	Local Roads	Bridges/Major Culverts	Replace Timber Bdge	Foxlow St	Replace the timber bridge over Molonglo River with concrete structure	216	0.00	350,000	2	Renewal	350,000			High Maintenance timber bridge that traps debris in floods. Preferable to construct concrete bridge with more clearance.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Captains Flat & Environs	Flood Management	Urbn Drainge/Flood Mgt	Provide drainage	Foxlow St	Construct escape path arrangements for flood waters in Kerrs Ck	400	0.00	150,000	2	New		150,000		Expected to one of the measures looked at in the Capt Flood Floodplain Management Study and Plan
Captains Flat & Environs	Flood Management	Urbn Drainge/Flood Mgt	Flood Reduction Measure	Lower Foxlow St area	Undertake flood reduction works as determined by FPRM Plan	0	0.00	480,000	2	Renewal		480,000		Expected to one of the measures looked at in the Capt Flood Floodplain Management Study and Plan
Captains Flat & Environs	Flood Management	Flood Study	Undertake FPRM Study and Plan	Captains Flat	This project needs to be undertaken as follow-up to the current Flood Study	0	0.00	75,000	1	New		75,000		The Flood Managemen Study and Plan will identify the measures that could be implemented to address flooding impacts.
Captains Flat & Environs	Parks & Reserves	Public Reserve	Refurbish tennis court	Wilkens Park	Re-surface and provide upgraded lighting and fencing at court	0	0.00	50,000	2	Renewal		50,000		A previously requested project by local community
Captains Flat & Environs	Parks & Reserves	Swimming Pool	Replace swimming pool	Wilkens Park	Construct new modern swimming pool facility	0	0.00	2,000,000	2	Renewal		2,000,000		Current swimmimg pool is past its use by date and either needs replacement or permanently closing.
Captains Flat & Environs	Parks & Reserves	Swimming Pool	Study - swimming pool	Wilkens Park	Prepare swimming pool status report to assit in determining pool's future	0	0.00	15,000	1	Renewal		15,000	15,000	Study to determine necessary upgrading or replacement or whether best to permanently close.

Locality	Function	Asset Group	Work Type	Location	Description of Project	AADT vpd	Length (km)	Total Cost	Priority	New or Renewal	Renewal Component (Infrastructure Backlog)	Growth & Enhancement Component	Needed Now Projects (includes Backlog	Comments
Captains Flat & Environs	Council Buildings & Halls	Community Hlth Centre	Build new facility	Foxlow St	Construct new community health centre at rear of community hall	0	0.00	450,000	1	New	250,000	200,000	450,000	Old and deficient current facility in Foxlow St needs to be replaced. Current RDA grant application being made. Cost to be offset by sale of existing facility.
				Total: Captains Flat & Environs			**24.72**	**13,045,000**			**1,882,000**	**11,163,000**	**2,437,000**	

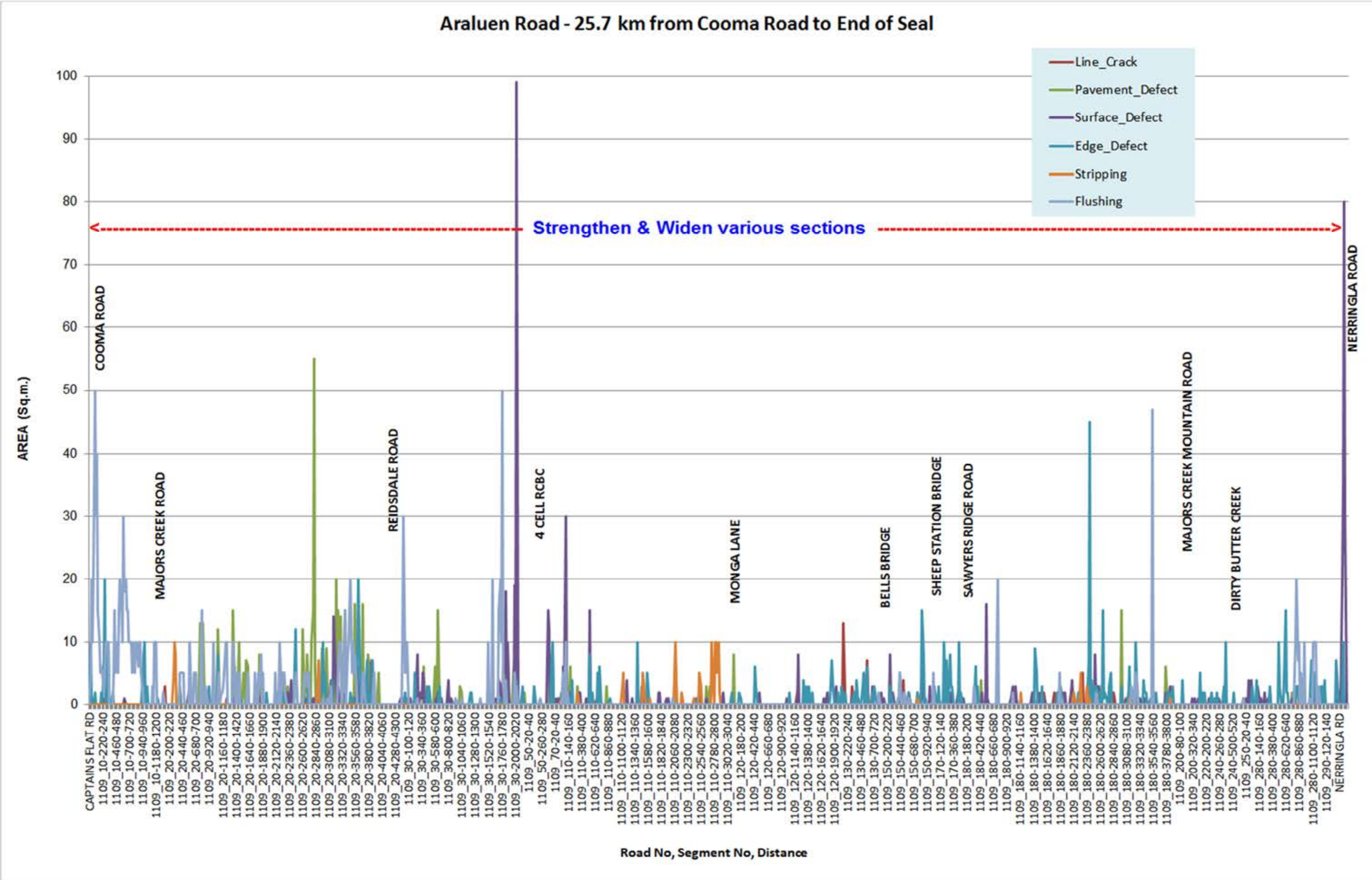
Summary	Total Cost
Priority 1 - New Assets	24,441,050
Priority 1 - Renewal Assets	17,982,000
Total Priority 1	**42,423,050**
Priority 2 - New Assets	14,746,500
Priority 2 - Renewal Assets	53,201,000
Total Priority 2	**67,947,500**
Priority 3 - New Assets	29,382,500
Priority 3 - Renewal Assets	4,633,000
Total Priority 3	**34,015,500**
Total New Assets	68,570,050
Total Renewal Assets	75,816,000
Total Projects	**144,386,050**

New Assets From Growth - Developer Funded Works

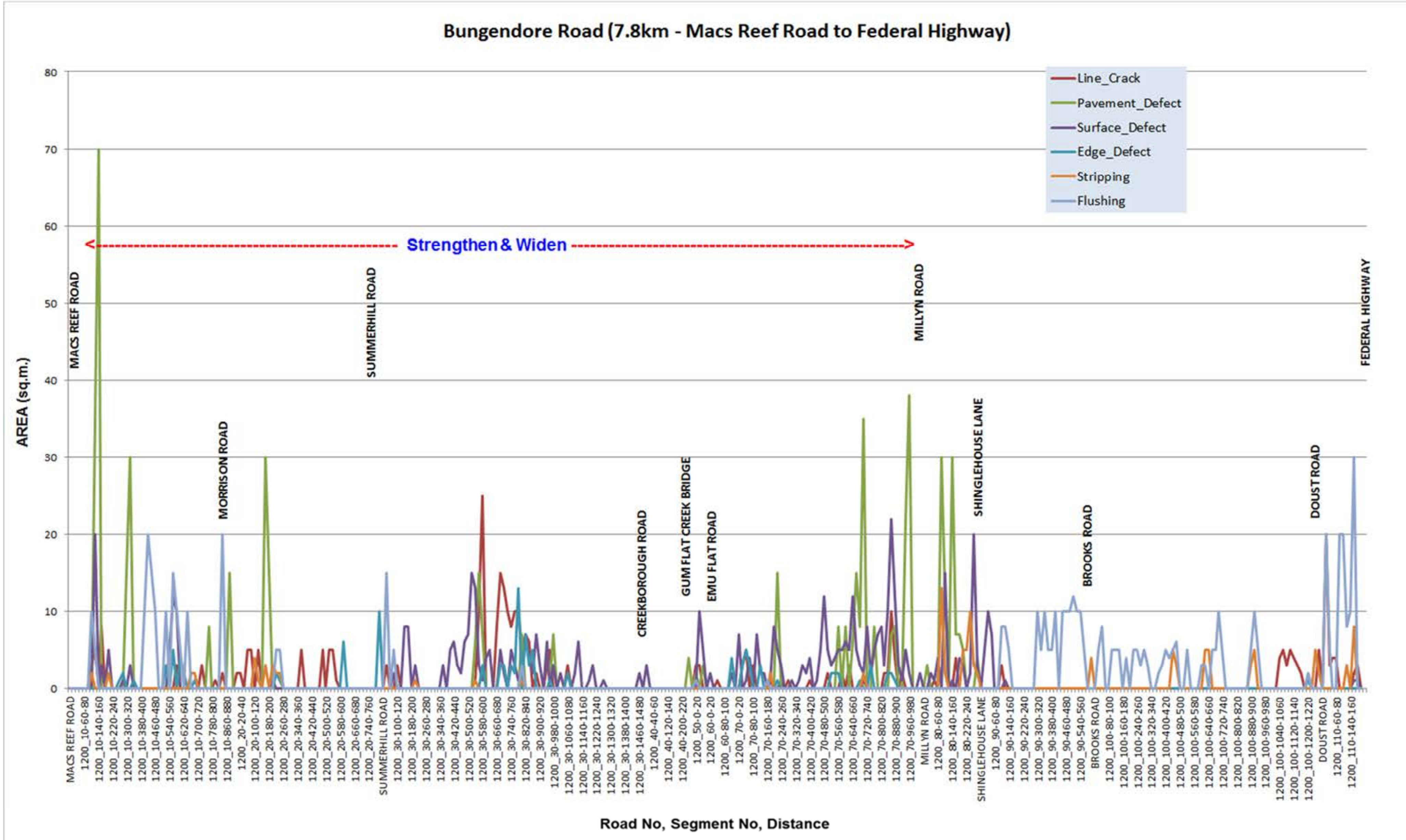
Year	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	Total
Sealed Pavements	5,801,775	8,702,663	11,603,550	8,702,663	5,801,775	4,351,331	4,351,331	2,900,888	2,900,888	2,900,888	**58,017,750**
Kerb and Gutter	415,665	623,498	831,330	623,498	415,665	311,749	311,749	207,833	207,833	207,833	**4,156,650**
Unsealed Pavements	448,536	672,804	897,072	672,804	448,536	336,402	336,402	224,268	224,268	224,268	**4,485,360**
Paths	358,440	537,660	716,880	537,660	358,440	268,830	268,830	179,220	179,220	179,220	**3,584,400**
Bridges	39,600	59,400	79,200	59,400	39,600	29,700	29,700	19,800	19,800	19,800	**396,000**
Drainage	445,098	667,647	890,196	667,647	445,098	333,824	333,824	222,549	222,549	222,549	**4,450,980**
Signage	38,667	58,000	77,333	58,000	38,667	29,000	29,000	19,333	19,333	19,333	**386,665**
Bus Shelters	51,600	77,400	103,200	77,400	51,600	38,700	38,700	25,800	25,800	25,800	**516,000**
Sewer Manholes	46,767	70,151	93,534	70,151	46,767	35,075	35,075	23,384	23,384	23,384	**467,670**
Sewer Mains	143,165	214,748	286,330	214,748	143,165	107,374	107,374	71,583	71,583	71,583	**1,431,650**
Water Mains	115,440	173,160	230,880	173,160	115,440	86,580	86,580	57,720	57,720	57,720	**1,154,400**
Streetlights	41,612	62,418	83,224	62,418	41,612	31,209	31,209	20,806	20,806	20,806	**416,120**
Traffic Facilities	10,000	20,000	20,000	0	0	0	0	0	0	0	**50,000**
Parks & Reserves	0	11,900	0	19,530	0	0	0	0	0	0	**31,430**
Totals	**7,956,365**	**11,951,449**	**15,912,729**	**11,939,079**	**7,946,365**	**5,959,774**	**5,959,774**	**3,973,184**	**3,973,184**	**3,973,184**	**79,545,075**

Attachment C – Sealed Road Condition Audit Charts

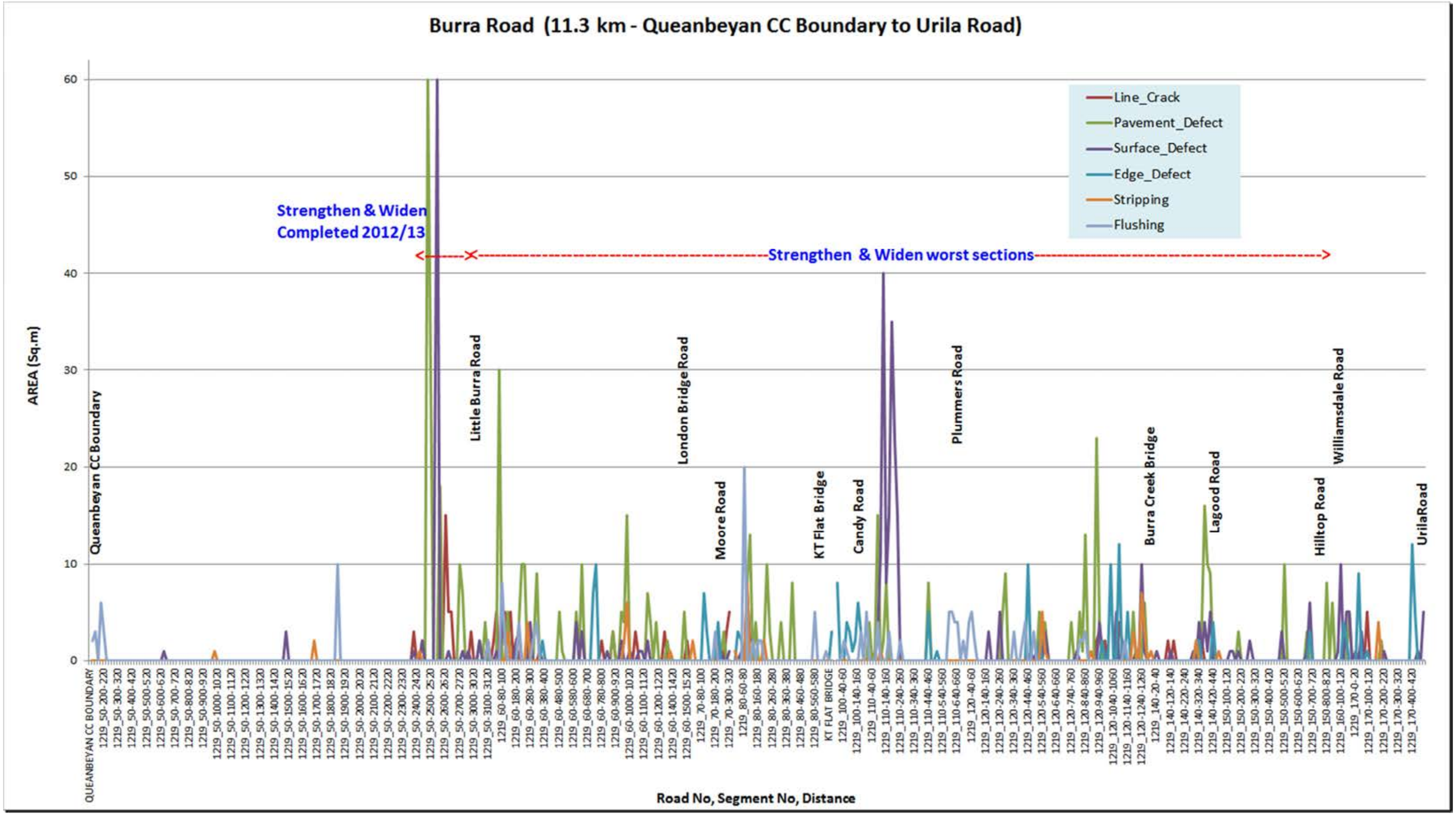
1. Araluen Road
2. Bungendore Road
3. Burra Road
4. Captains Flat Road
5. Cooma Road
6. Hoskinstown Road
7. Macs Reef Road
8. Majors Creek Road
9. Nerriga Road
10. Norton Road
11. Park Lane
12. Plains Road
13. Jerangle Road
14. Wattle Avenue



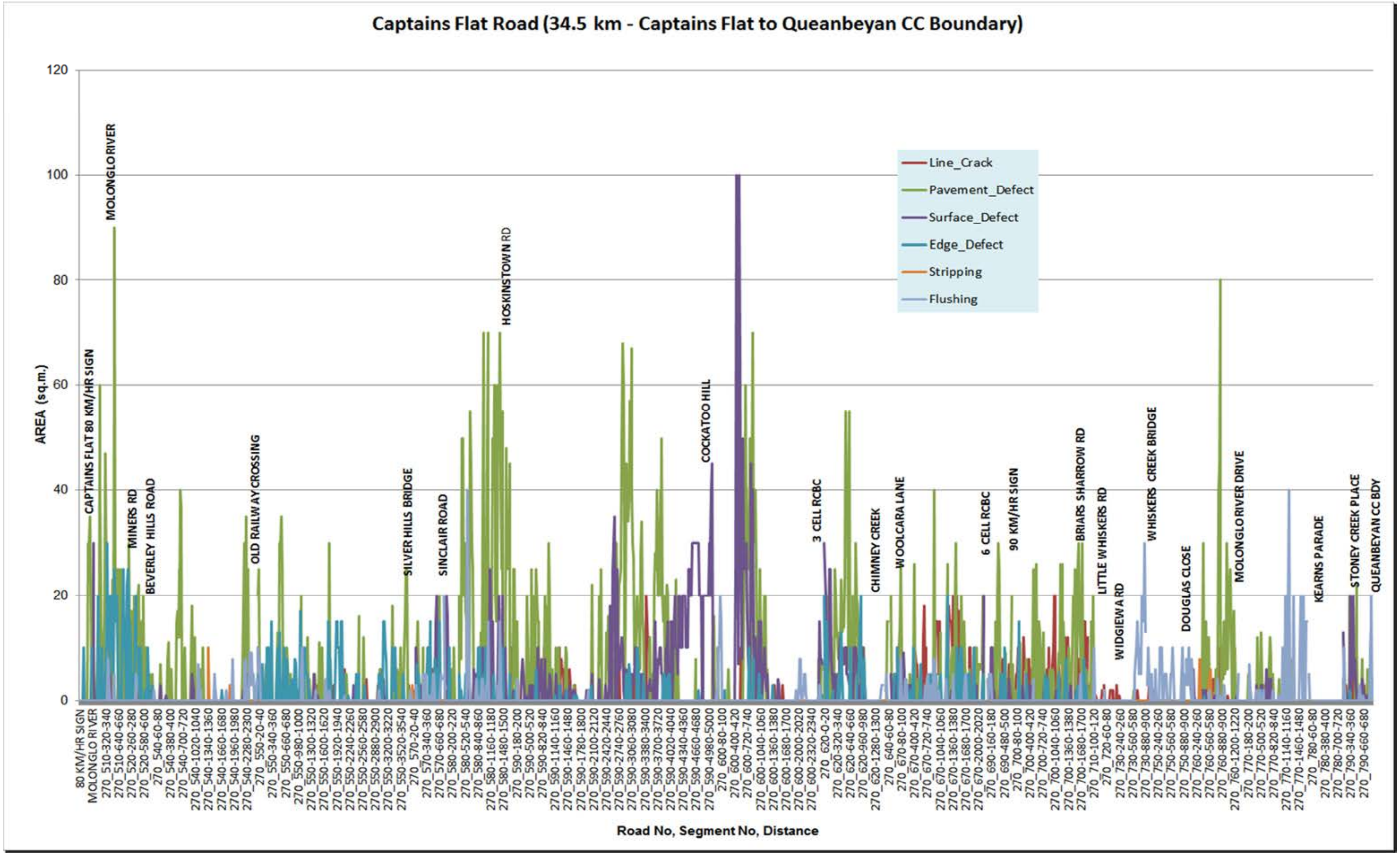
Araluen Road - 25.7 km from Cooma Road to End of Seal
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
Strengthen & Widen various sections
AREA (Sq.m.)
COOMA ROAD
MAJORS CREEK ROAD
REIDSDALE ROAD
4 CELL RCBC
MONGA LANE
BELLS BRIDGE
SHEEP STATION BRIDGE
SAWYERS RIDGE ROAD
MAJORS CREEK MOUNTAIN ROAD
DIRTY BUTTER CREEK
NERRINGLA ROAD
CAPTAINS FLAT RD
NERRINGLA RD
Road No, Segment No, Distance



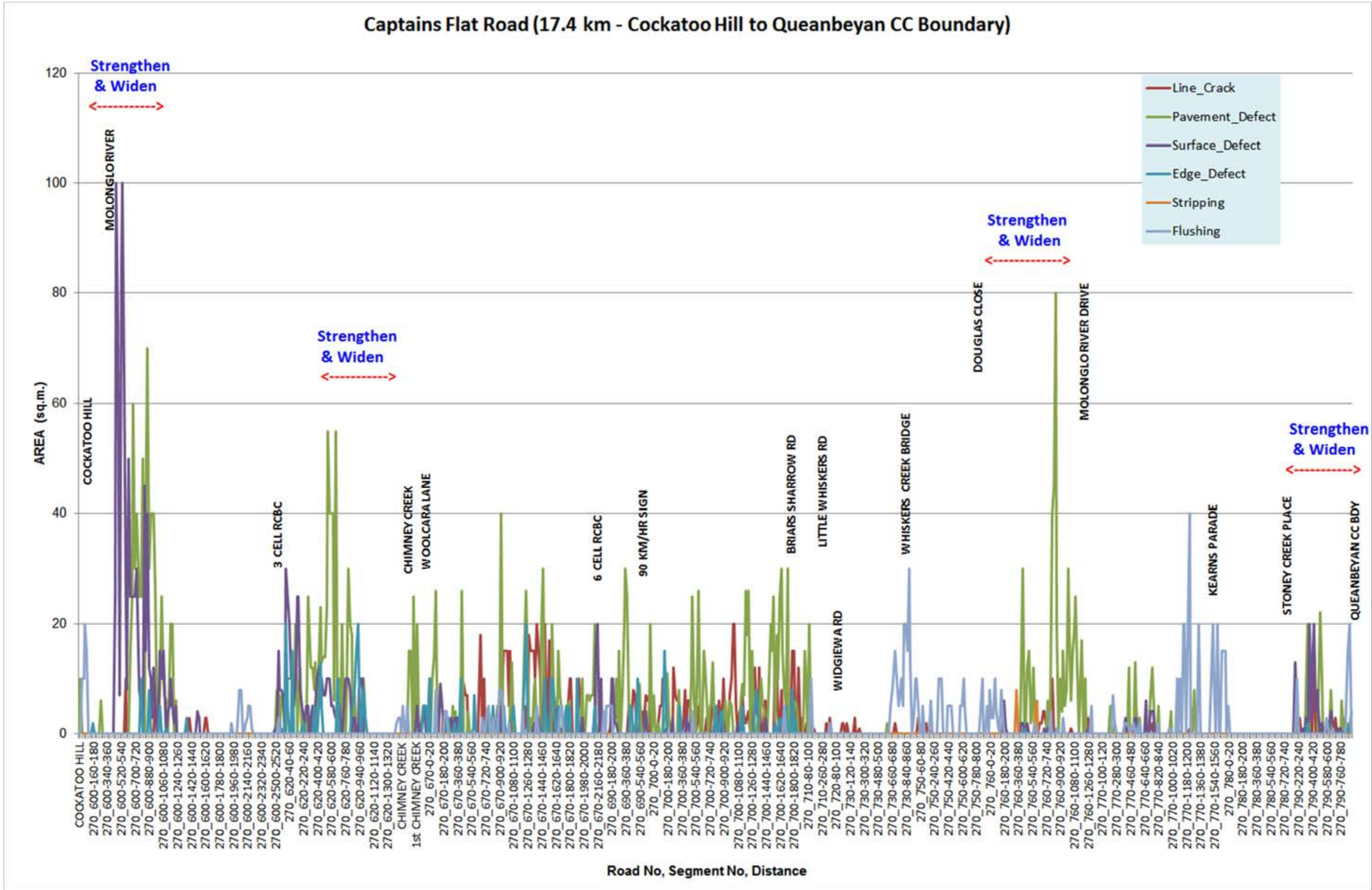
Bungendore Road (7.8km - Macs Reef Road to Federal Highway)
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
Strengthen & Widen
AREA (sq.m.)
Road No, Segment No, Distance
MACS REEF ROAD
MORRISON ROAD
SUMMERHILL ROAD
CREEKBOROUGH ROAD
GUM FLAT CREEK BRIDGE
EMU FLAT ROAD
MILLYN ROAD
SHINGLEHOUSE LANE
BROOKS ROAD
DOUST ROAD
FEDERAL HIGHWAY



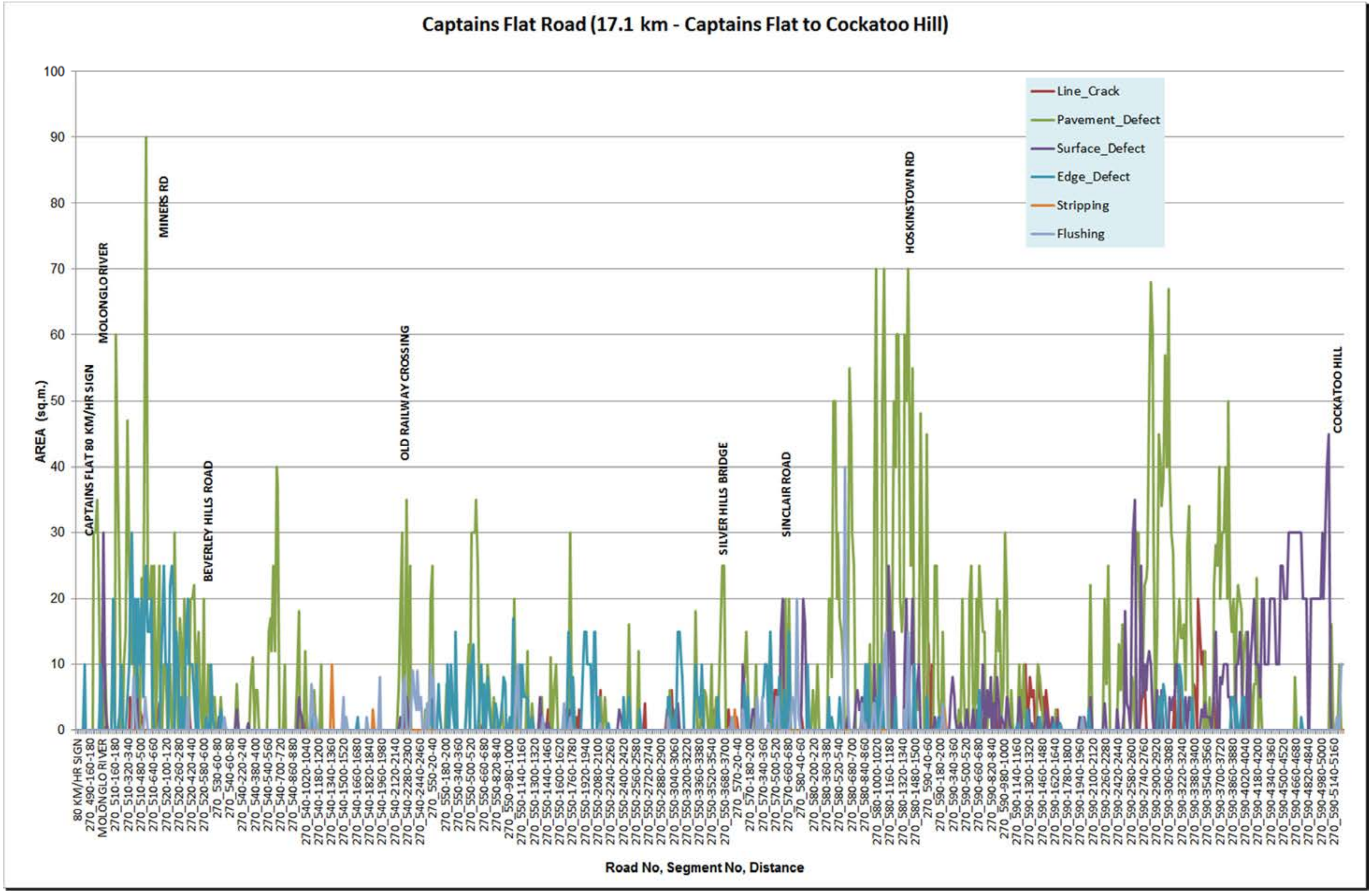
Burra Road (11.3 km - Queanbeyan CC Boundary to Urila Road)
AREA (Sq.m)
Road No, Segment No, Distance
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
Strengthen & Widen
Completed 2012/13
Strengthen & Widen worst sections
Queanbeyan CC Boundary
Little Burra Road
London Bridge Road
Moore Road
KT Flat Bridge
Candy Road
Plummers Road
Burra Creek Bridge
Lagood Road
Hilltop Road
Williamsdale Road
UrilaRoad

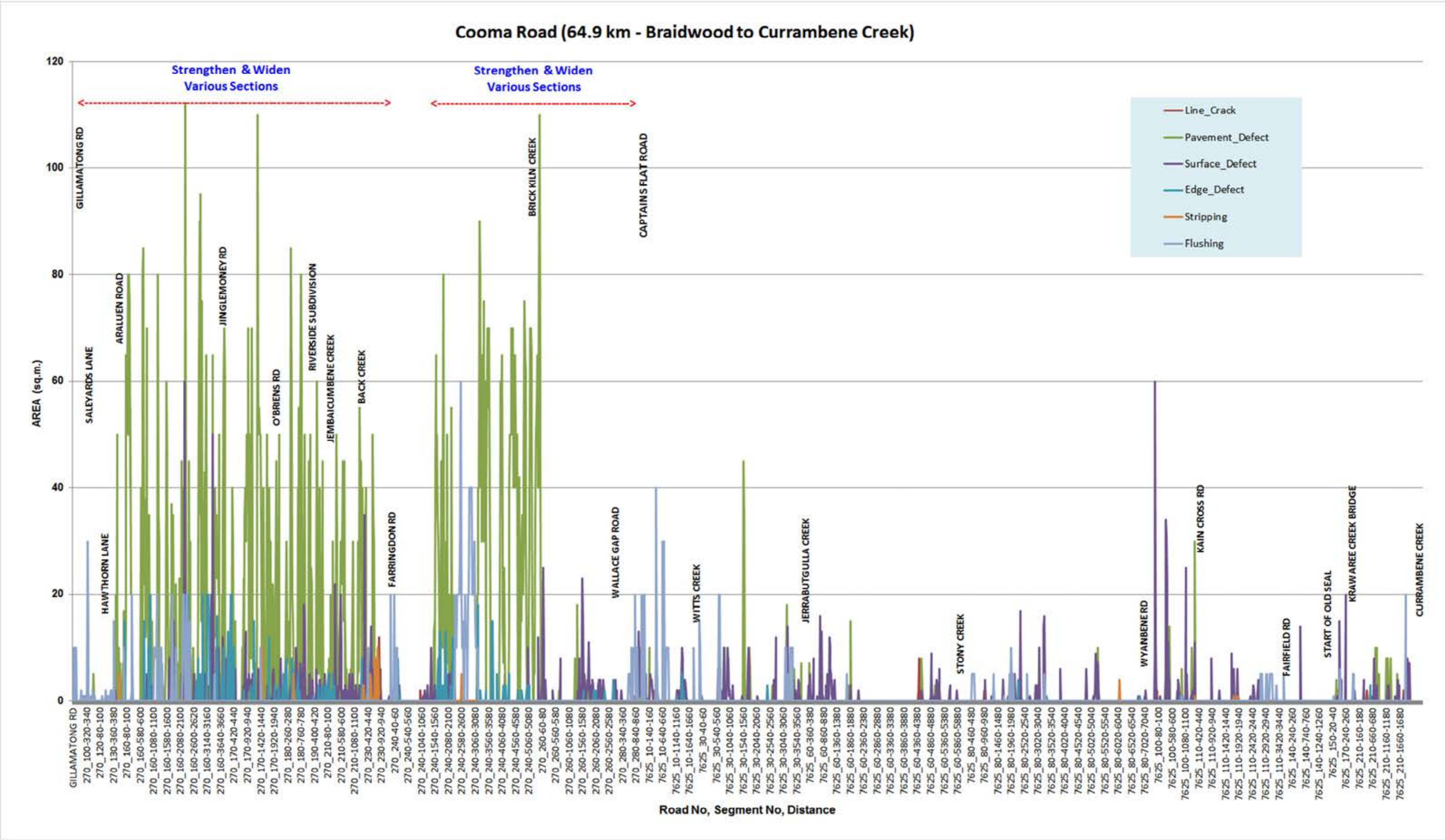


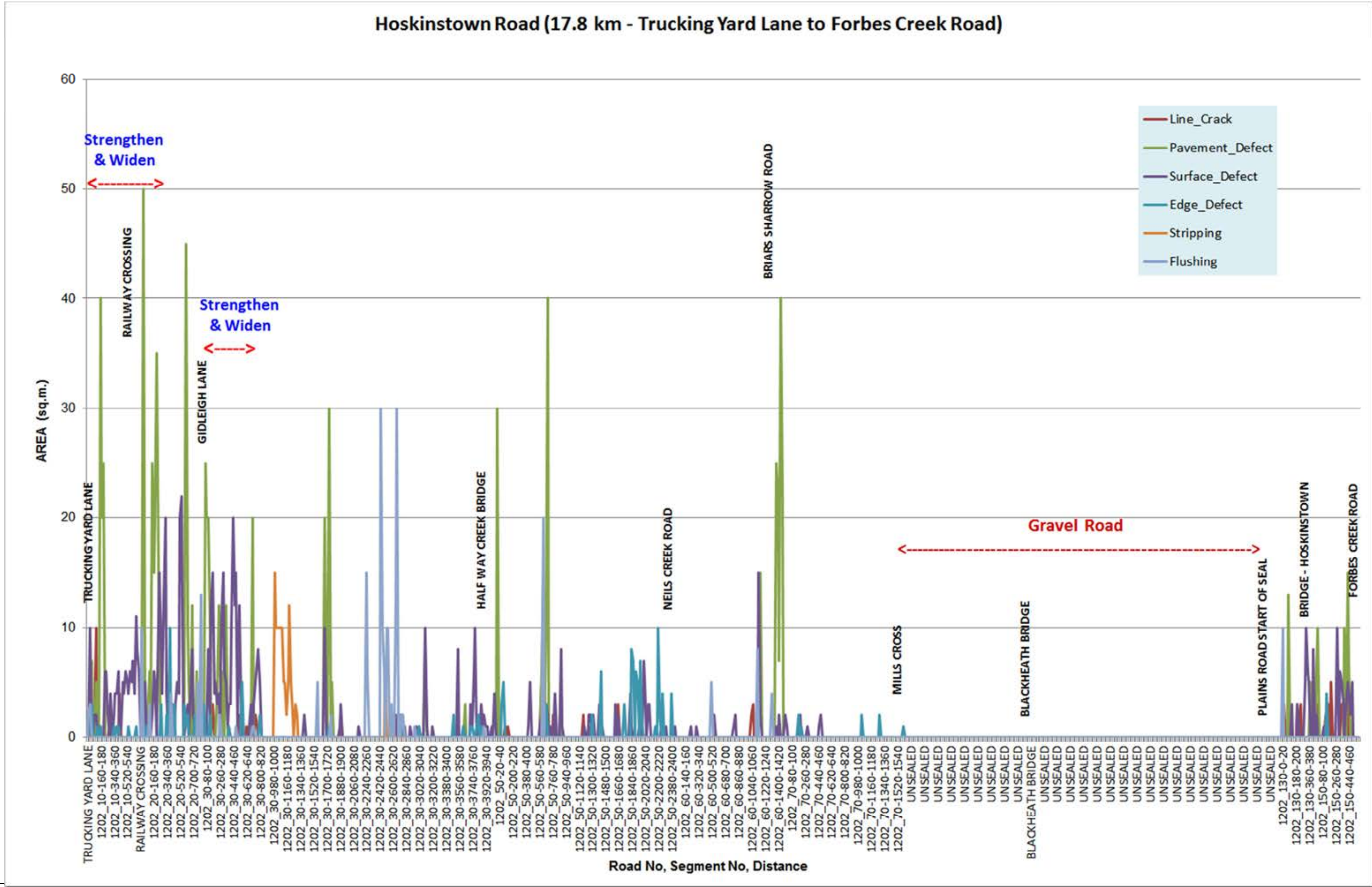
Captains Flat Road (34.5 km - Captains Flat to Queanbeyan CC Boundary)
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
AREA (sq.m.)
Road No, Segment No, Distance
CAPTAINS FLAT 80 KM/HR SIGN
MOLONGLO RIVER
MINERS RD
BEVERLEY HILLS ROAD
OLD RAILWAY CROSSING
SILVER HILLS BRIDGE
SINCLAIR ROAD
HOSKINSTOWN RD
COCKATOO HILL
3 CELL RCBC
CHIMNEY CREEK
WOOLCARA LANE
6 CELL RCBC
90 KM/HR SIGN
BRIARS SHARROW RD
LITTLE WHISKERS RD
WIDGIEWA RD
WHISKERS CREEK BRIDGE
DOUGLAS CLOSE
MOLONGLO RIVER DRIVE
KEARNS PARADE
STONEY CREEK PLACE
QUEANBEYAN CC BDY



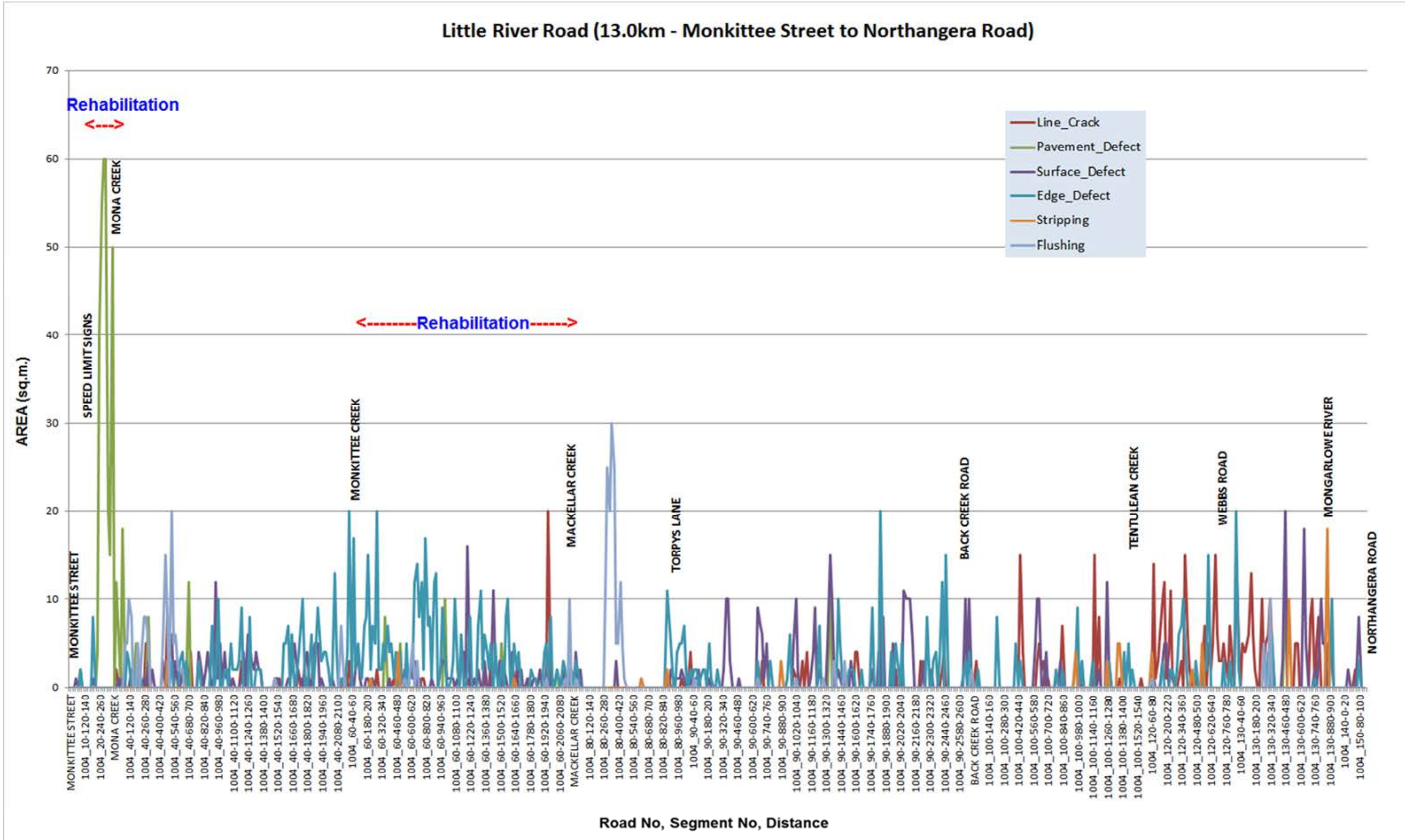
Captains Flat Road (17.4 km - Cockatoo Hill to Queanbeyan CC Boundary)
Strengthen & Widen
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
AREA (sq.m.)
Road No, Segment No, Distance
COCKATOO HILL
MOLONGLO RIVER
3 CELL RCBC
CHIMNEY CREEK
WOOLCARA LANE
6 CELL RCBC
90 KM/HR SIGN
BRIARS SHARROW RD
LITTLE WHISKERS RD
WIDGIEWA RD
WHISKERS CREEK BRIDGE
DOUGLAS CLOSE
MOLONGLO RIVER DRIVE
KEARNS PARADE
STONEY CREEK PLACE
QUEANBEYAN CC BDY

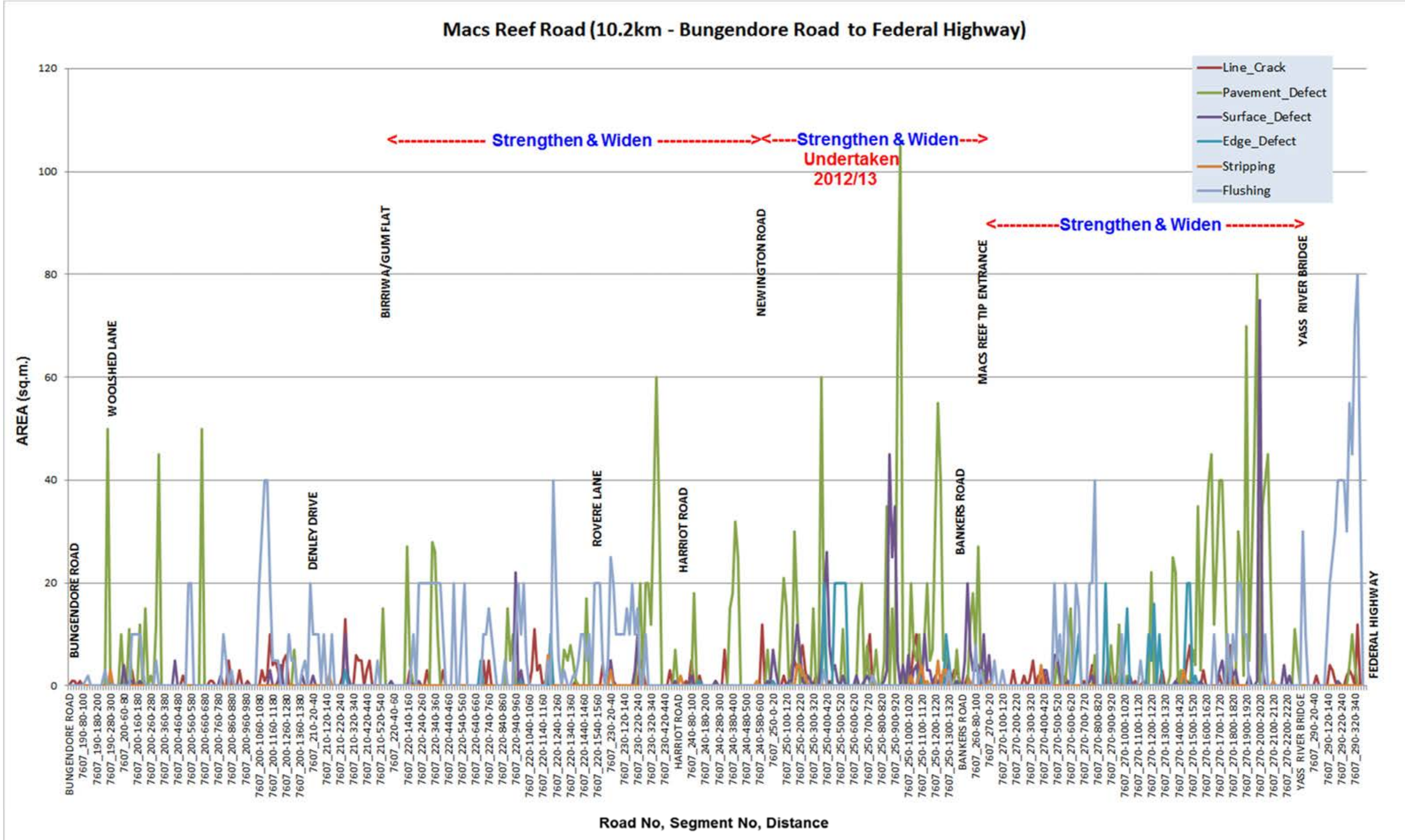

Captains Flat Road (17.1 km - Captains Flat to Cockatoo Hill)
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
AREA (sq.m.)
Road No, Segment No, Distance
CAPTAINS FLAT 80 KM/HR SIGN
MOLONGLO RIVER
MINERS RD
BEVERLEY HILLS ROAD
OLD RAILWAY CROSSING
SILVER HILLS BRIDGE
SINCLAIR ROAD
HOSKINSTOWN RD
COCKATOO HILL


Cooma Road (64.9 km - Braidwood to Currambene Creek)
Strengthen & Widen Various Sections
Strengthen & Widen Various Sections
AREA (sq.m.)
Road No, Segment No, Distance
GILLAMATONG RD
SALEYARDS LANE
HAWTHORN LANE
ARALUEN ROAD
JINGLEMONEY RD
O'BRIENS RD
RIVERSIDE SUBDIVISION
JEMBAICUMBENE CREEK
BACK CREEK
FARRINGDON RD
BRICK KILN CREEK
CAPTAINS FLAT ROAD
WALLACE GAP ROAD
WITTS CREEK
JERRABUTGULLA CREEK
STONY CREEK
WYANBENE RD
KAIN CROSS RD
FAIRFIELD RD
START OF OLD SEAL
KRAWAREE CREEK BRIDGE
CURRAMBENE CREEK
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing

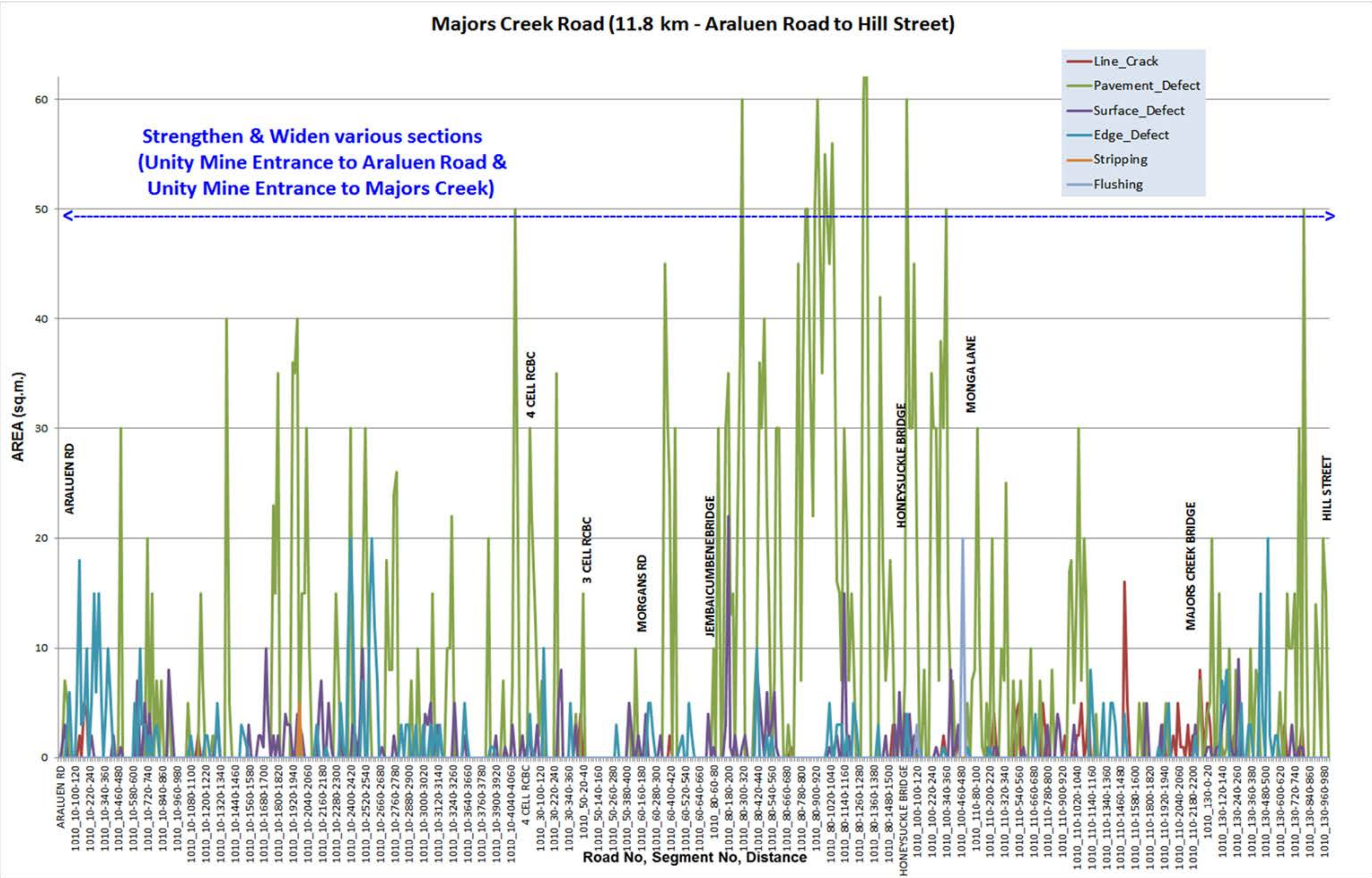


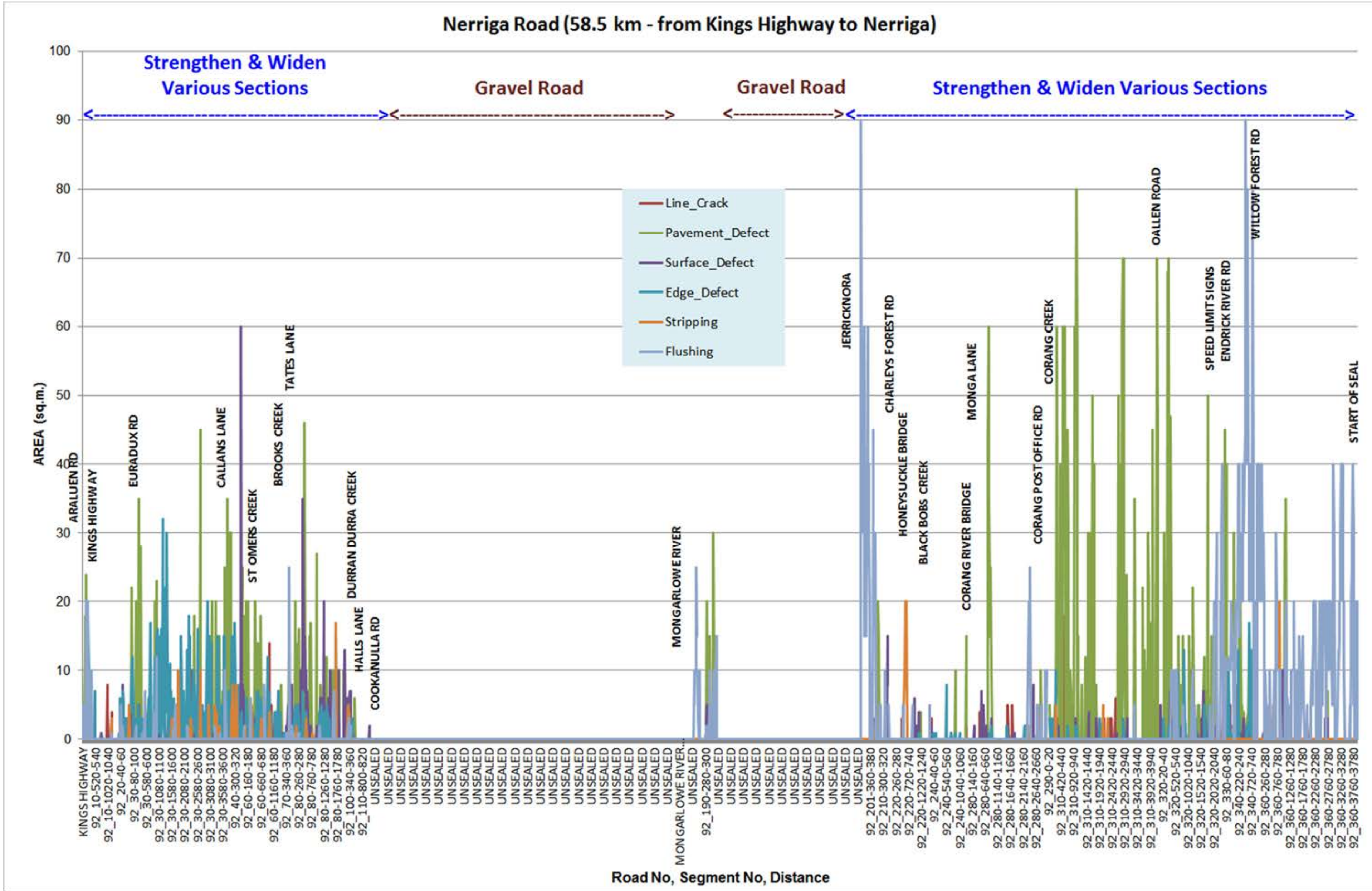
Hoskinstown Road (17.8 km - Trucking Yard Lane to Forbes Creek Road)
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
Strengthen & Widen
Strengthen & Widen
Gravel Road
TRUCKING YARD LANE
RAILWAY CROSSING
GIDLEIGH LANE
HALF WAY CREEK BRIDGE
NEILS CREEK ROAD
BRIARS SHARROW ROAD
MILLS CROSS
BLACKHEATH BRIDGE
PLAINS ROAD START OF SEAL
BRIDGE - HOSKINSTOWN
FORBES CREEK ROAD
AREA (sq.m.)
Road No, Segment No, Distance

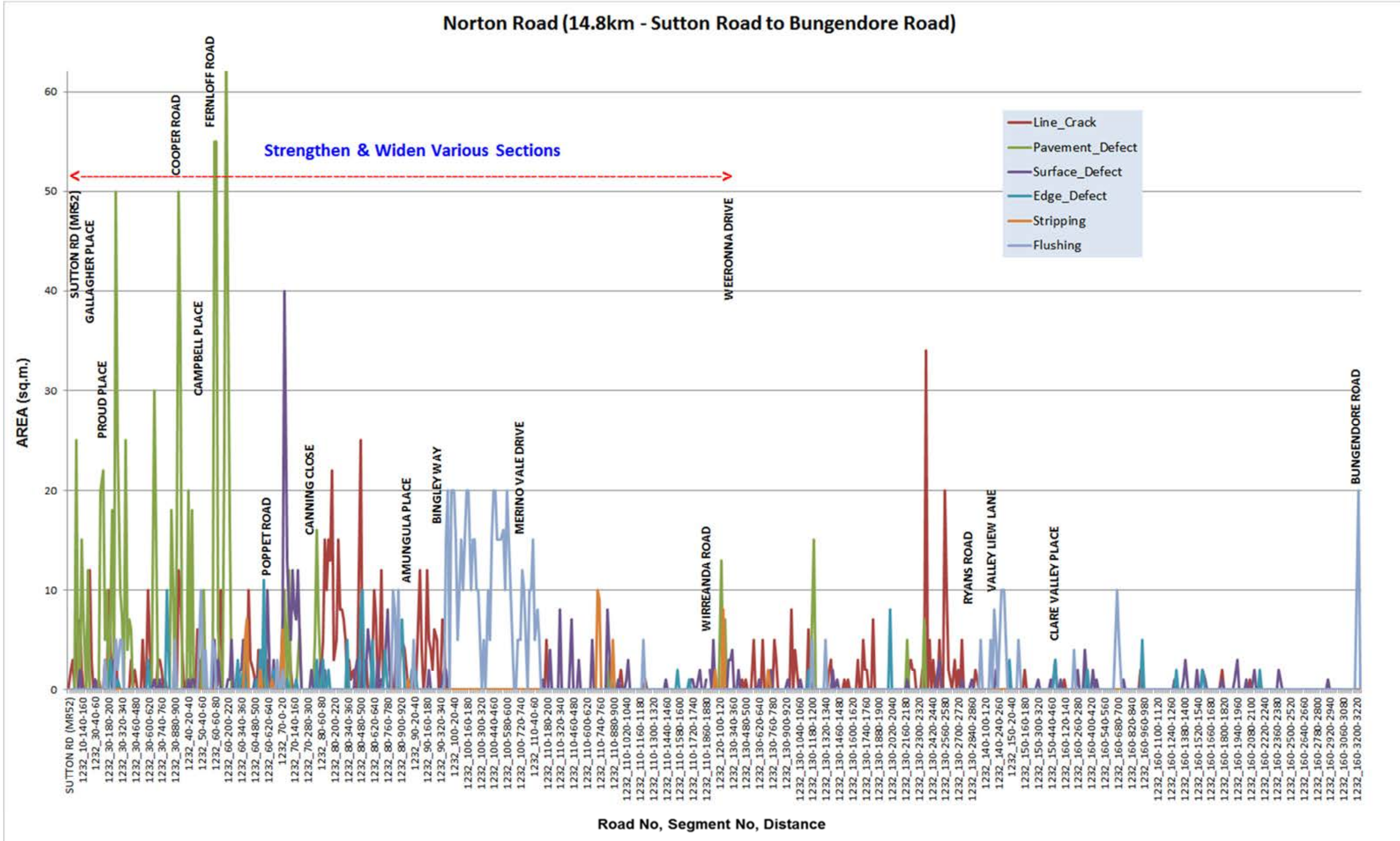

Little River Road (13.0km - Monkittee Street to Northangera Road)
Rehabilitation
<--->
<--------Rehabilitation------>
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
AREA (sq.m.)
Road No, Segment No, Distance
MONKITTEE STREET
SPEED LIMIT SIGNS
MONA CREEK
MONKITTEE CREEK
MACKELLAR CREEK
TORPYS LANE
BACK CREEK ROAD
TENTULEAN CREEK
WEBBS ROAD
MONGARLOWE RIVER
NORTHANGERA ROAD



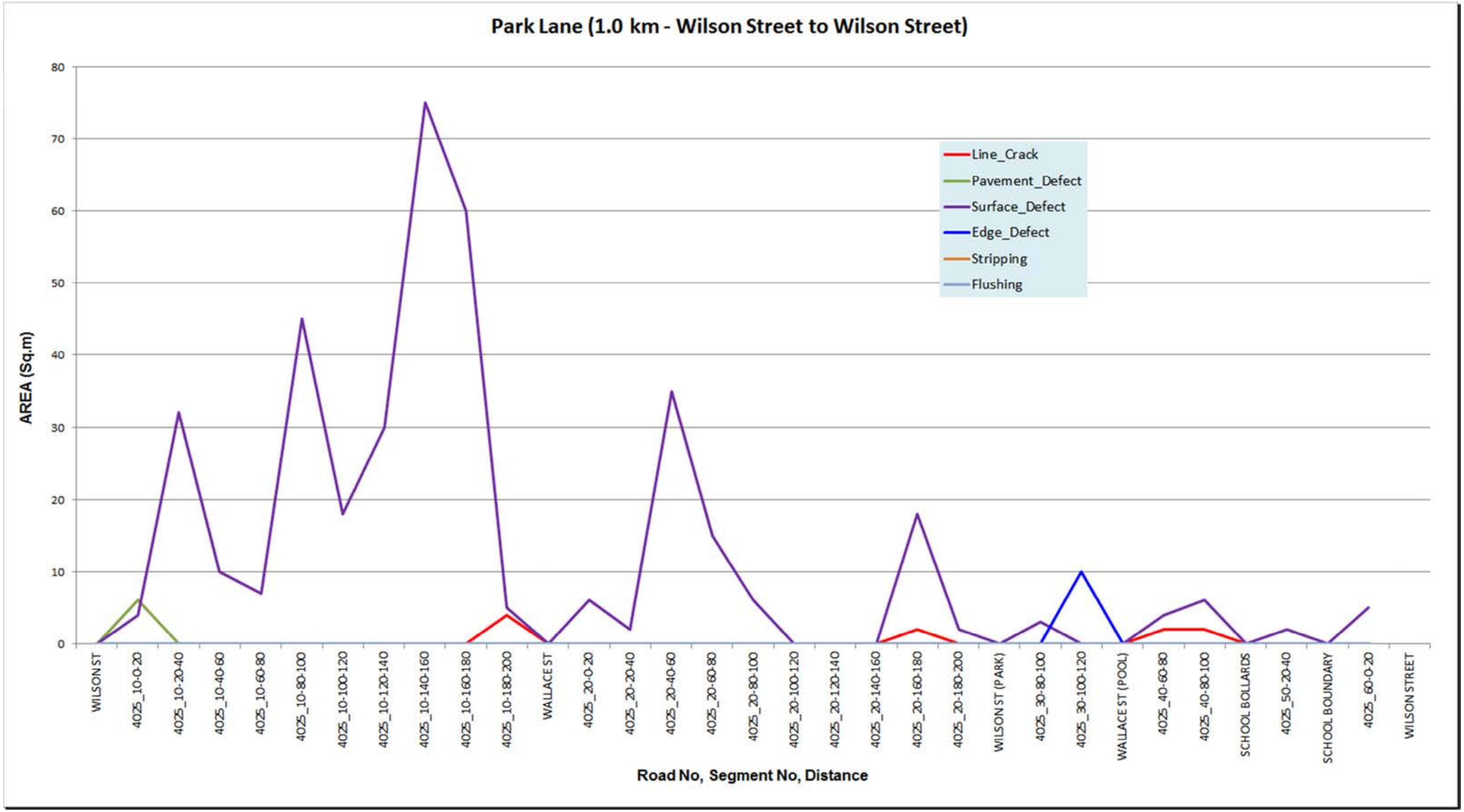
Macs Reef Road (10.2km - Bungendore Road to Federal Highway)
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
<-------------- Strengthen & Widen -------------><----Strengthen & Widen--->
Undertaken 2012/13
<----------Strengthen & Widen ---------->
AREA (sq.m.)
Road No, Segment No, Distance
BUNGENDORE ROAD
WOOLSHED LANE
DENLEY DRIVE
BIRRIWA/GUM FLAT
ROVERE LANE
HARRIOT ROAD
NEWINGTON ROAD
BANKERS ROAD
MACS REEF TIP ENTRANCE
YASS RIVER BRIDGE
FEDERAL HIGHWAY


Majors Creek Road (11.8 km - Araluen Road to Hill Street)
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
Strengthen & Widen various sections
(Unity Mine Entrance to Araluen Road &
Unity Mine Entrance to Majors Creek)
AREA (sq.m.)
Road No, Segment No, Distance
ARALUEN RD
4 CELL RCBC
3 CELL RCBC
MORGANS RD
JEMBAICUMBENE BRIDGE
HONEYSUCKLE BRIDGE
MONGA LANE
MAJORS CREEK BRIDGE
HILL STREET
0
10
20
30
40
50
60

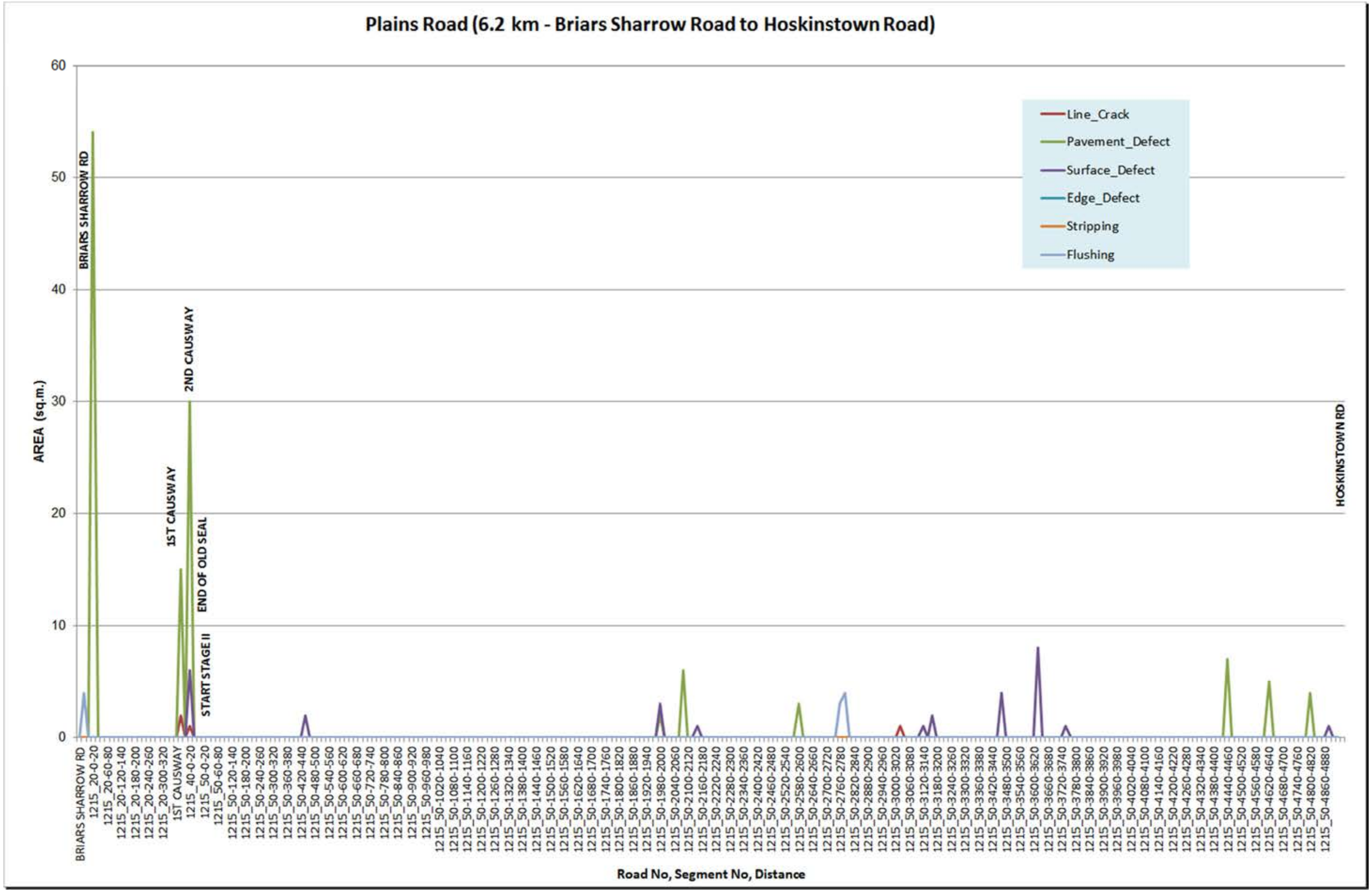

Nerriga Road (58.5 km - from Kings Highway to Nerriga)
Strengthen & Widen Various Sections
Gravel Road
Gravel Road
Strengthen & Widen Various Sections
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
AREA (sq.m.)
Road No, Segment No, Distance
KINGS HIGHWAY
ARALUEN RD
EURADUX RD
CALLANS LANE
ST OMERS CREEK
BROOKS CREEK
TATES LANE
DURRAN DURRA CREEK
HALLS LANE
COOKANULLA RD
MONGARLOWE RIVER
JERRICKNORA
CHARLEYS FOREST RD
HONEYSUCKLE BRIDGE
BLACK BOBS CREEK
CORANG RIVER BRIDGE
MONGA LANE
CORANG POST OFFICE RD
CORANG CREEK
OALLEN ROAD
SPEED LIMIT SIGNS
ENDRICK RIVER RD
WILLOW FOREST RD
START OF SEAL



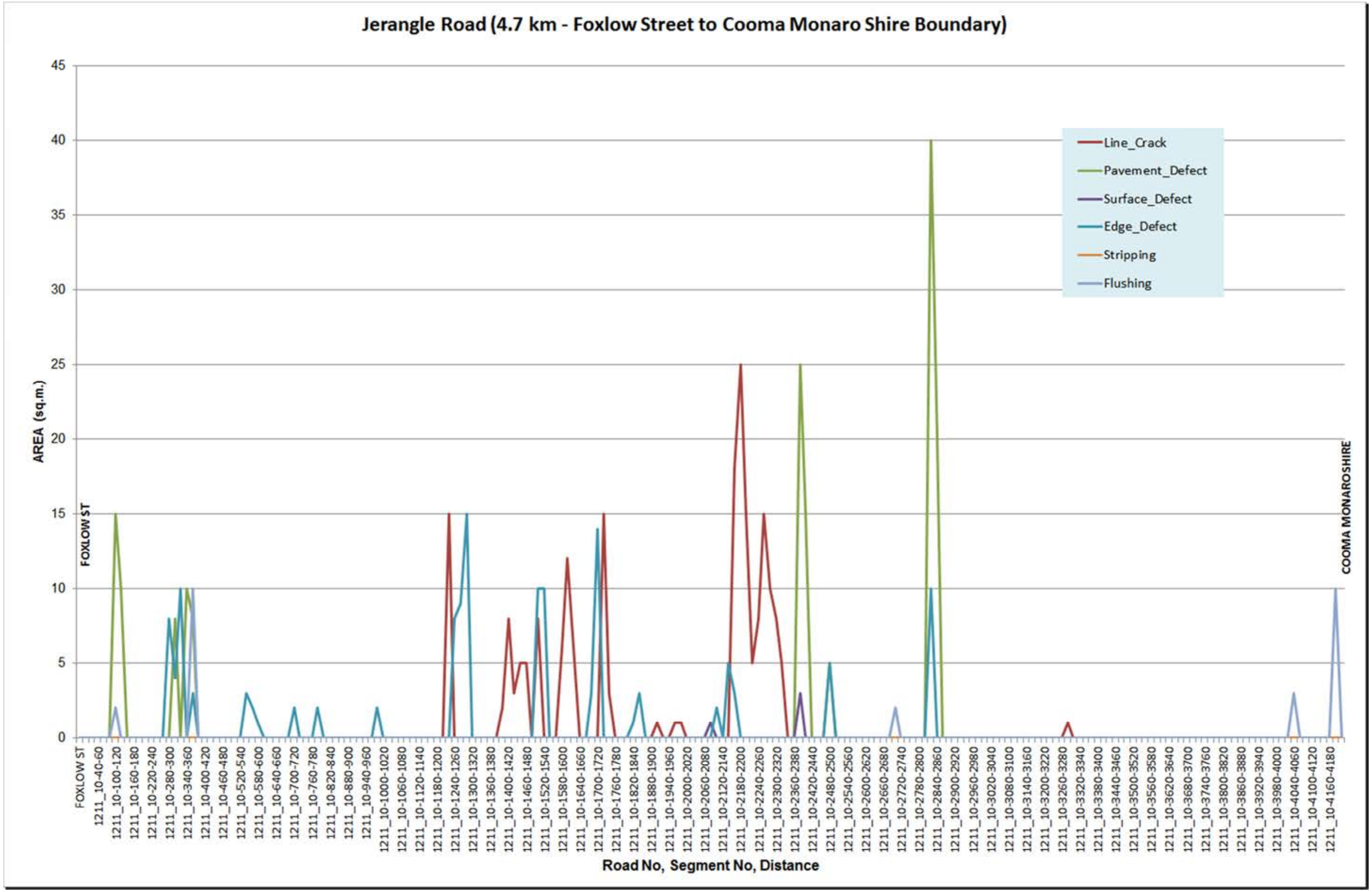
Norton Road (14.8km - Sutton Road to Bungendore Road)
Strengthen & Widen Various Sections
AREA (sq.m.)
0
10
20
30
40
50
60
Road No, Segment No, Distance
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
SUTTON RD (MR52)
GALLAGHER PLACE
PROUD PLACE
COOPER ROAD
CAMPBELL PLACE
FERNLOFF ROAD
POPPET ROAD
CANNING CLOSE
AMUNGULA PLACE
BINGLEY WAY
MERINO VALE DRIVE
WIRREANDA ROAD
WEERONNA DRIVE
RYANS ROAD
VALLEY LIEW LANE
CLARE VALLEY PLACE
BUNGENDORE ROAD



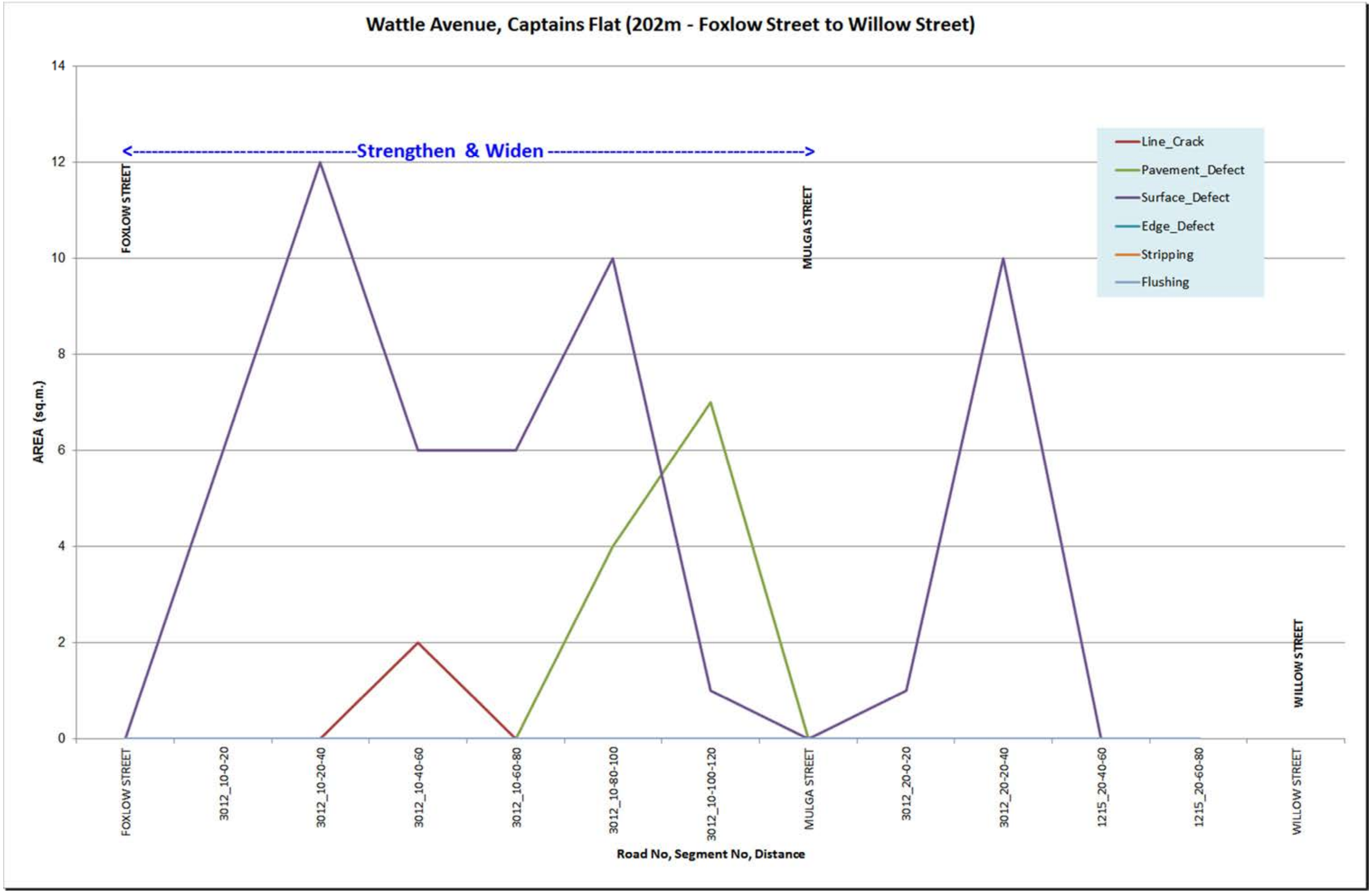
Park Lane (1.0 km - Wilson Street to Wilson Street)
AREA (Sq.m)
80
70
60
50
40
30
20
10
0
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
WILSON ST
4025_10-0-20
4025_10-20-40
4025_10-40-60
4025_10-60-80
4025_10-80-100
4025_10-100-120
4025_10-120-140
4025_10-140-160
4025_10-160-180
4025_10-180-200
WALLACE ST
4025_20-0-20
4025_20-20-40
4025_20-40-60
4025_20-60-80
4025_20-80-100
4025_20-100-120
4025_20-120-140
4025_20-140-160
4025_20-160-180
4025_20-180-200
WILSON ST (PARK)
4025_30-80-100
4025_30-100-120
WALLACE ST (POOL)
4025_40-60-80
4025_40-80-100
SCHOOL BOLLARDS
4025_50-20-40
SCHOOL BOUNDARY
4025_60-0-20
WILSON STREET
Road No, Segment No, Distance



Plains Road (6.2 km - Briars Sharrow Road to Hoskinstown Road)
AREA (sq.m.)
Road No, Segment No, Distance
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
BRIARS SHARROW RD
1ST CAUSWAY
2ND CAUSWAY
END OF OLD SEAL
START STAGE II
HOSKINSTOWN RD



Jerangle Road (4.7 km - Foxlow Street to Cooma Monaro Shire Boundary)
AREA (sq.m.)
Road No, Segment No, Distance
FOXLOW ST
COOMA MONAROSHIRE
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing



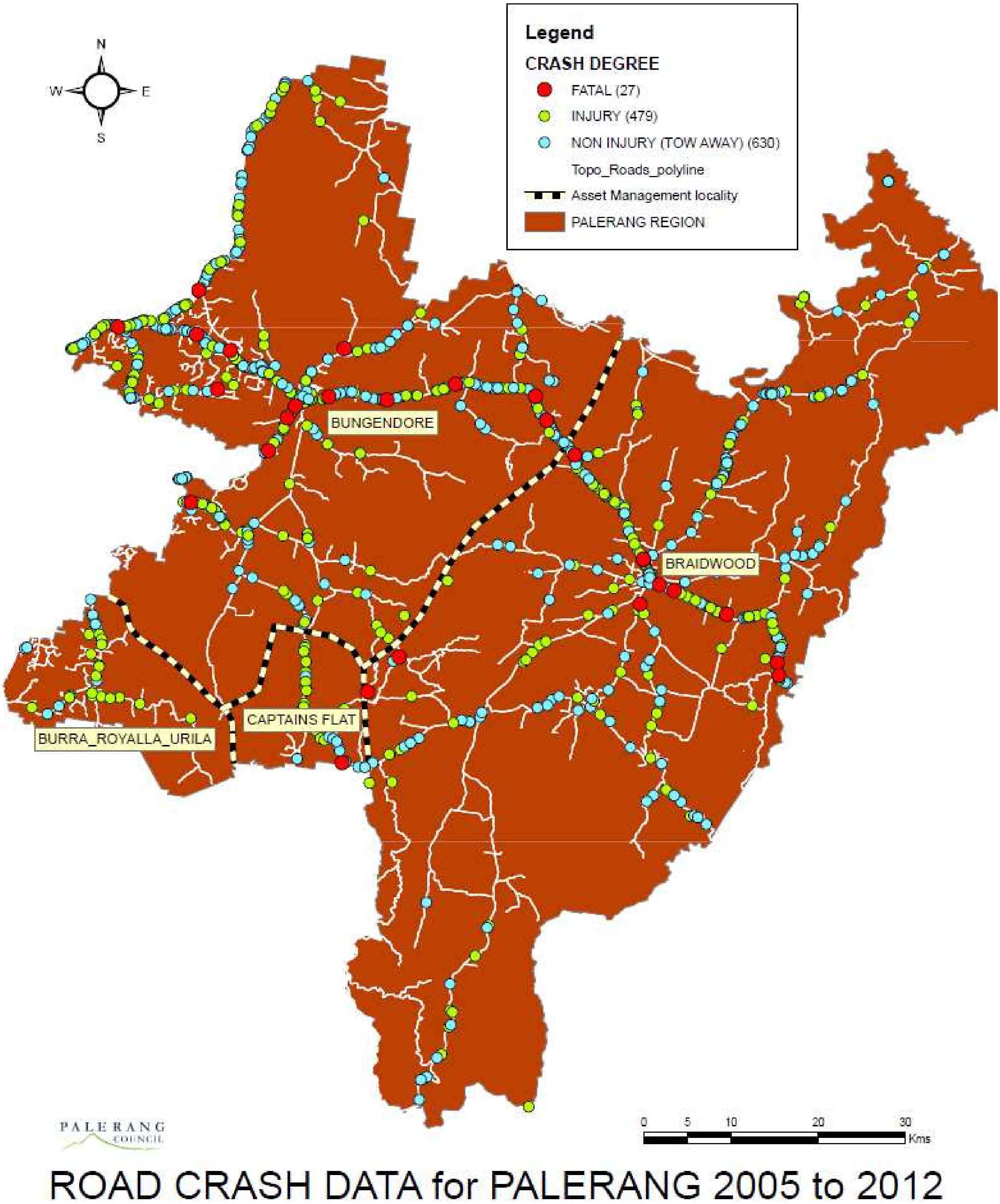
Wattle Avenue, Captains Flat (202m - Foxlow Street to Willow Street)
<---Strengthen & Widen--->
FOXLOW STREET
MULGA STREET
WILLOW STREET
Line_Crack
Pavement_Defect
Surface_Defect
Edge_Defect
Stripping
Flushing
AREA (sq.m.)
14
12
10
8
6
4
2
0
FOXLOW STREET
3012_10-0-20
3012_10-20-40
3012_10-40-60
3012_10-60-80
3012_10-80-100
3012_10-100-120
MULGA STREET
3012_20-0-20
3012_20-20-40
1215_20-40-60
1215_20-60-80
WILLOW STREET
Road No, Segment No, Distance

Attachment D – Condition Grading Standard

Basic Condition Grading System
(adapted from the International Infrastructure Management Manual, V4.0 - 2011)

Rating	Description of Condition
1	**Excellent Condition**: Only planned maintenance required
2	**Good**: Minor maintenance required plus planned maintenance
3	**Fair**: Significant maintenance required
4	**Poor**: Significant renewal/upgrade required
5	**Very Poor**: Unserviceable

Attachment E – Road Accident Data



Attachment F – Decision Criteria for Sealing Gravel Roads

Gravel Roads Whole of Life Costs Vs. Sealed Roads Whole of Life Costs

(assuming sealed road is constructed for 40 year design life)

Gravel Roads – whole of life costs		
Cost Items	Costs per Km	Costs over 40 years
Re-sheet 180 vpd road every 6 years	$25,000	40/6x25000=170,000
Re-sheet 80 vpd road every 10 years	$25,000	40/10x25000=100,000
Grading for 80 vpd road – 6 monthly	$2000	2000x2x40=160,000
Grading for 180vpd road – 4 monthly	$2000	2000x3x40=240,000
Other maintenance and repair items – clear blocked culverts & roadside drainage, gravel patch washed surfaces, clear roadside vegetation, replace guideposts & signs	Similar costs as for 'Other Maintenance & Repair' required for sealed roads	
	Total for 80 vpd road	260,000
	Total for 180 vpd road	410,000

Sealed Roads – whole of life costs		
Cost Items	Costs per Km	Costs over 40 years
Construction	$300,000	300,000
Reseals every 15 years	$28,000	40/15x28000=75,000
Other maintenance and repair items- pothole patching later in life of seals, some heavy patching in latter part of pavement life, clear roadside vegetation, replace guideposts & signs	Similar costs as for 'Other Maintenance & Repair' required for gravel roads	
	Total	375,000

Advantages of a sealed road over a gravel road (welfare benefits)

1. Ride quality is superior and consistent for sealed surface.
2. Quicker travel time on sealed road.
3. Sealed road is safer- has been properly aligned and its steerage is predictable , can have centrelines, no loose surface, no slippery surface, shorter breaking distances, no dust hazard
4. Less wear & tear on vehicles – less tyre wear, fewer flat tyres, fewer stone chips, no dust in engine & body, longer life of filters, vehicles not shaken to bits, do not need to wash vehicles as often.
5. Improved environmental outcomes – less wash of sediments to streams, no dust entering nearby residences, no dust coating vegetation, crops and livestock, sealed roads do not need replenishment of pavement every 6 years and so result in lower greenhouse emissions due to less truck haulage during life of road.
6. Improved health of users- no breathing of dust, less stressful travel.
7. Less use of resources – suitable gravel sheeting material is getting harder to source and needs to be hauled longer distances at increasing costs. Sealed roads are becoming relatively more resource sustainable.
8. The requirement to regularly re-sheet gravel roads means many more laden truck movements on the road network, adding to traffic congestion and added road safety concerns.
9. Wash of sediments from gravel roads clogs the roads drainage systems with under road culverts often becoming blocked and needing more attention.
10. The extra material haulage requirements of gravel roads results in much more damage to existing pavements and more costly repairs and earlier renewal.

Conclusion: Depending on site conditions and topography, the upgrading of gravel roads to sealed road standard starts to become cost effective for Council at about 120-150 vpd. To this can be added the extra welfare benefits as described in the table above that will be appreciated by road users.

GLOSSARY

Annual service cost (ASC)	An estimate of the cost that would be tendered, per annum, if tenders were called for the supply of a service to a performance specification for a fixed term. The Annual Service Cost includes operating, maintenance, depreciation, finance/ opportunity and disposal costs, less revenue.
Asset class	Grouping of assets of a similar nature and use in an entity's operations (AASB 166.37).
Asset condition assessment	The process of continuous or periodic inspection, assessment, measurement and interpretation of the resultant data to indicate the condition of a specific asset so as to determine the need for some preventative or remedial action.
Asset management	The combination of management, financial, economic, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost effective manner.
Assets	Future economic benefits controlled by the entity as a result of past transactions or other past events (AAS27.12). Property, plant and equipment including infrastructure and other assets (such as furniture and fittings) with benefits expected to last more than 12 month.
Average annual asset consumption (AAAC)*	The amount of a local government's asset base consumed during a year. This may be calculated by dividing the Depreciable Amount (DA) by the Useful Life and totalled for each and every asset OR by dividing the Fair Value (Depreciated Replacement Cost) by the Remaining Life and totalled for each and every asset in an asset category or class.
Backlog Works* **	Estimated cost to bring infrastructure, buildings and other structures and depreciable land improvements to a satisfactory standard, measured at a particular point in time
Brownfield asset values **	Asset (re)valuation values based on the cost to replace the asset including demolition and restoration costs.
Capital expansion expenditure	Expenditure that extends an existing asset, at the same standard as is currently enjoyed by residents, to a new group of users. It is discretional expenditure, which increases future operating, and maintenance costs, because it increases council's asset base, but may be associated with additional revenue from the new user group, e.g. extending a drainage or road network, the provision of an oval or park in a new suburb for new residents.
Capital expenditure	Relatively large (material) expenditure, which has benefits, expected to last for more than 12 months. Capital expenditure includes renewal, expansion and upgrade. Where capital projects involve a combination of renewal, expansion and/or upgrade expenditures, the total project cost needs to be allocated accordingly.
Capital funding	Funding to pay for capital expenditure.
Capital grants	Monies received generally tied to the specific projects for which they are granted, which are often upgrade and/or expansion or new investment proposals.
Capital investment expenditure	See capital expenditure definition
Capital new expenditure	Expenditure which creates a new asset providing a new service to the community that did not exist beforehand. As it increases service potential it may impact revenue and will increase future operating and maintenance expenditure.

Capital renewal expenditure	Expenditure on an existing asset, which returns the service potential or the life of the asset up to that which it had originally. It is periodically required expenditure, relatively large (material) in value compared with the value of the components or sub-components of the asset being renewed. As it reinstates existing service potential, it has no impact on revenue, but may reduce future operating and maintenance expenditure if completed at the optimum time, e.g. resurfacing or resheeting a material part of a road network, replacing a material section of a drainage network with pipes of the same capacity, resurfacing an oval. Where capital projects involve a combination of renewal, expansion and/or upgrade expenditures, the total project cost needs to be allocated accordingly.
Capital upgrade expenditure	Expenditure, which enhances an existing asset to provide a higher level of service or expenditure that will increase the life of the asset beyond that which it had originally. Upgrade expenditure is discretional and often does not result in additional revenue unless direct user charges apply. It will increase operating and maintenance expenditure in the future because of the increase in the council's asset base, e.g. widening the sealed area of an existing road, replacing drainage pipes with pipes of a greater capacity, enlarging a grandstand at a sporting facility. Where capital projects involve a combination of renewal, expansion and/or upgrade expenditures, the total project cost needs to be allocated accordingly.
Carrying amount	The amount at which an asset is recognised after deducting any accumulated depreciation / amortisation and accumulated impairment losses thereon.
Class of assets	See asset class definition
Component	An individual part of an asset which contributes to the composition of the whole and can be separated from or attached to an asset or a system.
Cost of an asset	The amount of cash or cash equivalents paid or the fair value of the consideration given to acquire an asset at the time of its acquisition or construction, plus any costs necessary to place the asset into service. This includes one-off design and project management costs.
Current replacement cost (CRC)	The cost the entity would incur to acquire the asset on the reporting date. The cost is measured by reference to the lowest cost at which the gross future economic benefits could be obtained in the normal course of business or the minimum it would cost, to replace the existing asset with a technologically modern equivalent new asset (not a second hand one) with the same economic benefits (gross service potential) allowing for any differences in the quantity and quality of output and in operating costs.
Current Replacement Cost "As New" (CRC)	The current cost of replacing the original service potential of an existing asset, with a similar modern equivalent asset, i.e. the total cost of replacing an existing asset with an as NEW or similar asset expressed in current dollar values.
Cyclic Maintenance**	Replacement of higher value components/sub-components of assets that is undertaken on a regular cycle including repainting, building roof replacement, cycle, replacement of air conditioning equipment, etc. This work generally falls below the capital/ maintenance threshold and needs to be identified in a specific maintenance budget allocation.
Depreciable amount	The cost of an asset, or other amount substituted for its cost, less its residual value (AASB 116.6)
Depreciated replacement cost (DRC)	The current replacement cost (CRC) of an asset less, where applicable, accumulated depreciation calculated on the basis of such cost to reflect the already consumed or expired future economic benefits of the asset
Depreciation / amortisation	The systematic allocation of the depreciable amount (service potential) of an asset over its useful life.

Economic life	See useful life definition.
Expenditure	The spending of money on goods and services. Expenditure includes recurrent and capital.
Fair value	The amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties, in an arms length transaction.
Greenfield asset values **	Asset (re)valuation values based on the cost to initially acquire the asset.
Heritage asset	An asset with historic, artistic, scientific, technological, geographical or environmental qualities that is held and maintained principally for its contribution to knowledge and culture and this purpose is central to the objectives of the entity holding it.
Impairment Loss	The amount by which the carrying amount of an asset exceeds its recoverable amount.
Infrastructure assets	Physical assets of the entity or of another entity that contribute to meeting the public's need for access to major economic and social facilities and services, e.g. roads, drainage, footpaths and cycleways. These are typically large, interconnected networks or portfolios of composite assetsThe components of these assets may be separately maintained, renewed or replaced individually so that the required level and standard of service from the network of assets is continuously sustained. Generally the components and hence the assets have long lives. They are fixed in place and are often have no market value.
Investment property	Property held to earn rentals or for capital appreciation or both, rather than for: (a) use in the production or supply of goods or services or for administrative purposes; or (b) sale in the ordinary course of business (AASB 140.5)
Level of service	The defined service quality for a particular service against which service performance may be measured. Service levels usually relate to quality, quantity, reliability, responsiveness, environmental, acceptability and cost).
Life Cycle Cost **	The life cycle cost (LCC) is average cost to provide the service over the longest asset life cycle. It comprises annual maintenance and asset consumption expense, represented by depreciation expense. The Life Cycle Cost does not indicate the funds required to provide the service in a particular year.
Life Cycle Expenditure **	The Life Cycle Expenditure (LCE) is the actual or planned annual maintenance and capital renewal expenditure incurred in providing the service in a particular year. Life Cycle Expenditure may be compared to Life Cycle Expenditure to give an initial indicator of life cycle sustainability.
Loans / borrowings	Loans result in funds being received which are then repaid over a period of time with interest (an additional cost). Their primary benefit is in 'spreading the burden' of capital expenditure over time. Although loans enable works to be completed sooner, they are only ultimately cost effective where the capital works funded (generally renewals) result in operating and maintenance cost savings, which are greater than the cost of the loan (interest and charges).
Maintenance and renewal gap	Difference between estimated budgets and projected expenditures for maintenance and renewal of assets, totalled over a defined time (e.g. 5, 10 and 15 years).
Maintenance and renewal sustainability index	Ratio of estimated budget to projected expenditure for maintenance and renewal of assets over a defined time (e.g. 5, 10 and 15 years).

Maintenance expenditure	Recurrent expenditure, which is periodically or regularly required as part of the anticipated schedule of works required to ensure that the asset achieves its useful life and provides the required level of service. It is expenditure, which was anticipated in determining the asset's useful life.
Materiality	An item is material is its omission or misstatement could influence the economic decisions of users taken on the basis of the financial report. Materiality depends on the size and nature of the omission or misstatement judged in the surrounding circumstances.
Modern equivalent asset.	A structure similar to an existing structure and having the equivalent productive capacity, which could be built using modern materials, techniques and design. Replacement cost is the basis used to estimate the cost of constructing a modern equivalent asset.
Non-revenue generating investments	Investments for the provision of goods and services to sustain or improve services to the community that are not expected to generate any savings or revenue to the Council, e.g. parks and playgrounds, footpaths, roads and bridges, libraries, etc.
Operating expenditure	Recurrent expenditure, which is continuously required excluding maintenance and depreciation, e.g. power, fuel, staff, plant equipment, on-costs and overheads.
Pavement management system	A systematic process for measuring and predicting the condition of road pavements and wearing surfaces over time and recommending corrective actions.
Planned Maintenance**	Repair work that is identified and managed through a maintenance management system (MMS). MMS activities include inspection, assessing the condition against failure/breakdown criteria/experience, prioritising scheduling, actioning the work and reporting what was done to develop a maintenance history and improve maintenance and service delivery performance.
PMS Score	A measure of condition of a road segment determined from a Pavement Management System.
Rate of annual asset consumption*	A measure of average annual consumption of assets (AAAC) expressed as a percentage of the depreciable amount (AAAC/DA). Depreciation may be used for AAAC.
Rate of annual asset renewal*	A measure of the rate at which assets are being renewed per annum expressed as a percentage of depreciable amount (capital renewal expenditure/DA).
Rate of annual asset upgrade*	A measure of the rate at which assets are being upgraded and expanded per annum expressed as a percentage of depreciable amount (capital upgrade/expansion expenditure/DA).
Reactive maintenance	Unplanned repair work that carried out in response to service requests and management/supervisory directions.
Recoverable amount	The higher of an asset's fair value, less costs to sell and its value in use.
Recurrent expenditure	Relatively small (immaterial) expenditure or that which has benefits expected to last less than 12 months. Recurrent expenditure includes operating and maintenance expenditure.
Recurrent funding	Funding to pay for recurrent expenditure.
Rehabilitation	See capital renewal expenditure definition above.
Remaining life	The time remaining until an asset ceases to provide the required service level or economic usefulness. Age plus remaining life is economic life.
Renewal	See capital renewal expenditure definition above.
Residual value	The net amount which an entity expects to obtain for an asset at the end of its useful life after deducting the expected costs of disposal.

Revenue generating investments	Investments for the provision of goods and services to sustain or improve services to the community that are expected to generate some savings or revenue to offset operating costs, e.g. public halls and theatres, childcare centres, sporting and recreation facilities, tourist information centres, etc.
Risk management	The application of a formal process to the range of possible values relating to key factors associated with a risk in order to determine the resultant ranges of outcomes and their probability of occurrence.
Section or segment	A self-contained part or piece of an infrastructure asset.
Service potential	The capacity to provide goods and services in accordance with the entity's objectives, whether those objectives are the generation of net cash inflows or the provision of goods and services of a particular volume and quantity to the beneficiaries thereof.
Service potential remaining*	A measure of the remaining life of assets expressed as a percentage of economic life. It is also a measure of the percentage of the asset's potential to provide services that is still available for use in providing services (DRC/DA).
Strategic Management Plan (SA)**	Documents Council objectives for a specified period (3-5 yrs), the principle activities to achieve the objectives, the means by which that will be carried out, estimated income and expenditure, measures to assess performance and how rating policy relates to the Council's objectives and activities.
Sub-component	Smaller individual parts that make up a component part.
Useful life	Either: (a) the period over which an asset is expected to be available for use by an entity, or (b) the number of production or similar units expected to be obtained from the asset by the entity. It is estimated or expected time between placing the asset into service and removing it from service, or the estimated period of time over which the future economic benefits embodied in a depreciable asset, are expected to be consumed by the council. It is the same as the economic life.
Value in Use	The present value of estimated future cash flows expected to arise from the continuing use of an asset and from its disposal at the end of its useful life. It is deemed to be depreciated replacement cost (DRC) for those assets whose future economic benefits are not primarily dependent on the asset's ability to generate new cash flows, where if deprived of the asset its future economic benefits would be replaced.
	Source: DVC 2006, Glossary Note: Items shown * modified to use DA instead of CRC Additional glossary items shown ** *** NSW Treasury Corporation - Palerang Council – Financial Assessment, Sustainability and Benchmarking

Appendix G Financial Model Input and Output Data - Water

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

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Historical Operating Statement

	2015/16*	2016/17*
EXPENSES		
Management Expenses	*290*	*306*
Administration	164	263
Engineering and Supervision	126	43
Operation and Maintenance Expenses	*993*	*1112*
Operation Expenses	678	774
Maintenance Expenses	180	163
Energy Costs	108	122
Chemical Costs	27	53
Purchase of Water		
Depreciation	*605*	*534*
System Assets	573	534
Plant & Equipment	32	
Interest Expenses	262	102
Other Expenses		
TOTAL EXPENSES	**2150**	**2054**
REVENUES		
Rates & Service Availability Charges	*894*	*948*
Residential	757	802
Non-Residential	137	146
User Charges	*963*	*1020*
Sales of Water : Residential	757	802
Sales of Water : Non-Residential	206	218
Extra Charges	16	13
Interest Income	142	143
Other Revenues	13	
Grants	*11*	*11*
Grants for Acquisition of Assets		
Pensioner Rebate Subsidy	11	11
Other Grants		
Contributions	*377*	*342*
Developer Charges	299	342
Developer Provided Assets	78	
Other Contributions		
TOTAL REVENUES	**2416**	**2477**
OPERATING RESULT	**266**	**423**
OPERATING RESULT (less Grants for Acq of Assets)	**266**	**423**

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

Historical Statement of Financial Position

	2015/16*	2016/17*
Cash and Investments	5793	5004
Receivables	220	600
Inventories	17	25
Property, Plant & Equipment	*26878*	*27574*
System Assets (1)	24804	23450
Plant & Equipment	2074	4124
Other Assets		
TOTAL ASSETS	**32908**	**33203**
LIABILITIES		
Bank Overdraft		
Creditors	44	302
Borrowings	7086	6466
Provisions		
TOTAL LIABILITIES	**7130**	**6768**
NET ASSETS COMMITTED	**25778**	**26435**
EQUITY		
Accumulated Operating Result	18551	18973
Asset Revaluation Reserve	7227	7462
TOTAL EQUITY	**25778**	**26435**

(1) Notes to System Assets

Current Replacement Cost	40617	39773
Less: Accumulated Depreciation	15813	16323
Written Down Current Cost	24804	23450

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

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Base Forecast Data

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Financial Data																									
Inflation Rate - General (%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Inflation Rate - Capital Works (%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Borrowing Interest Rate for New Loans (%)	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Investment Interest Rate (%)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Number of Assessments																									
Growth Rate (%)																									
Residential Assessments	2.00	6.19	5.87	5.58	5.25	4.95	4.68	4.38	4.13	3.87	3.61	3.40	3.18	2.97	2.79	2.61	2.45	2.27	2.12	1.99	1.86	1.74	1.64	1.53	1.42
Non-Residential Assessments	0.77	0.00	0.76	0.00	0.76	0.00	0.75	0.75	0.37	0.37	0.37	0.37	0.00	0.73	0.00	0.36	0.36	0.36	0.36	0.36	0.71	0.35	0.00	0.70	0.35
Total Assessments	1.86	5.53	5.35	5.05	4.84	4.52	4.35	4.08	3.83	3.61	3.37	3.18	2.96	2.82	2.60	2.46	2.31	2.15	2.02	1.89	1.79	1.66	1.55	1.48	1.36
Number of New Assessments																									
Residential	43	136	137	138	137	136	135	132	130	127	123	120	116	112	108	104	100	95	91	87	83	79	76	72	68
Non-Residential	2	0	2	0	2	0	2	2	1	1	1	1	0	2	0	1	1	1	1	1	2	1	0	2	1
Total New Assessments	45	136	139	138	139	136	137	134	131	128	124	121	116	114	108	105	101	96	92	88	85	80	76	74	69
Projected Number of Assessments																									
Residential	2198	2334	2471	2609	2746	2882	3017	3149	3279	3406	3529	3649	3765	3877	3985	4089	4189	4284	4375	4462	4545	4624	4700	4772	4840
Non-Residential	262	262	264	264	266	266	268	270	271	272	273	274	274	276	276	277	278	279	280	281	283	284	284	286	287
Total Projected Assessments	2460	2596	2735	2873	3012	3148	3285	3419	3550	3678	3802	3923	4039	4153	4261	4366	4467	4563	4655	4743	4828	4908	4984	5058	5127
Backlog Assessments																									
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Backlog Assessments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Developer Charges / Vacant Assessments (Values in 2017/18 $)																									
Developer Charges $/Assessment																									
Residential	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150
Non-Residential	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150	10150
Number of Vacant Residential Assessments	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Average Charge of Vacant Assessments	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
% of Occupied Assessments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation of Existing Plant and Equipment (Values in 2017/18 $'000)																									
Current Replacement Cost of System Assets	40767																								
Override																									
Written Down Current Cost of System Assets	24036																								
Override																									
Annual Depreciation of Existing System Assets	547																								
Override																									
Written Down Value of Plant and Equipment	4124																								
Override																									
Annual Depreciation of Existing Plant and Equipment	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

Base Forecast Data

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Existing Loan Payments (Values in Inflated $'000)																									
Existing Loan Payments : Principal (Total:6466)	466	473	482	195	207	218	231	245	259	276	292	309	328	347	287	303	320	368	238	252	267	103	0	0	0
Existing Loan Payments : Interest (Total:3459)	303	294	284	274	263	252	240	215	190	178	164	150	135	118	102	87	72	55	39	27	14	3	0	0	0
Capital Works Program (Values in 2017/18 $'000)																									
Subsidised Scheme (Total:3666)	187	624	225	30	0	0	312	312	0	0	104	0	156	0	0	104	312	312	0	0	104	0	156	0	0
Other New System Assets (Total:20601)	31	9439	73	73	73	73	73	73	73	73	73	73	73	73	9160	73	73	73	73	73	73	73	73	73	73
Renewals (Total:14525)	614	624	331	1717	312	416	114	198	520	780	114	125	114	52	1695	52	530	52	894	291	530	52	114	52	551
Total Capital Works (Total:38792)	832	10687	629	1820	385	489	499	583	593	853	291	198	343	125	10855	229	915	437	967	364	707	125	343	125	624
Grant For Acquisition of Assets (% of Subsidised Scheme)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grant For Acquisition of Assets ($) (Total:0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Developer Provided Assets (Total:0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plant and Equipment Expenditure / Asset Disposal (Values in 2017/18 $'000)																									
Plant and Equipment Expenditure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Proceeds from Disposal of Plant and Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Written Down Value of Plant and Equipment Disposed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gain/Loss on Disposal of Plant and Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Proceeds from Disposal of Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Written Down Value of Assets Disposed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gain/Loss on Disposal of System Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

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Revised/Additional Forecast Data

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
OMA / Revenue Overrides (Values in 2017/18 $'000)																									
Administration	275	290	306	321	337	352	367	382	397	411	425	439	452	465	477	489	500	511	521	531	541	550	559	567	575
Override	300	364	304	318	364	347	362	411	448	404	417	430	442	539	466	477	488	572	508	565	526	584	543	551	558
Engineering and Supervision	45	47	50	53	56	59	62	65	67	69	71	73	75	77	79	81	83	85	87	89	91	93	94	95	96
Override	132	138	146	153	160	166	173	180	187	193	200	206	212	218	223	229	234	239	243	248	252	256	260	264	267
Operating Expenses	808	853	899	944	990	1035	1080	1124	1167	1209	1250	1290	1328	1365	1400	1434	1467	1499	1529	1558	1586	1612	1637	1661	1684
Override	808	851	894	937	980	1023	1065	1107	1148	1189	1227	1265	1301	1337	1371	1404	1435	1465	1494	1522	1548	1573	1597	1620	1642
Maintenance Expenses	170	179	189	199	209	218	227	236	245	254	263	271	279	287	294	301	308	315	321	327	333	339	344	349	354
Override	170	179	547	568	588	608	627	645	662	678	694	717	731	744	929	1228	1251	1272	1291	1308	1327	1343	1357	1371	1383
Energy Costs	127	134	141	148	155	162	169	176	183	190	196	202	208	214	220	225	230	235	240	245	249	253	257	261	265
Override																									
Chemical Costs	55	58	61	64	67	70	73	76	79	82	85	88	91	94	96	98	100	102	104	106	108	110	112	114	116
Override																									
Purchase of Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Override																									
Other Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Override	458	482	507	531	556	580	604	628	651	674	696	718	738	758	778	796	814	831	847	863	878	892	906	919	931
Other Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Override																									
Other Grants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Override																									
Other Contributions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Override	4593																								
Developer Charges Overrides (Values in 2017/18 $'000)																									
Calculated from Scheme Data	457	1380	1411	1401	1411	1380	1391	1360	1330	1299	1259	1228	1177	1157	1096	1066	1025	974	934	893	863	812	771	751	700
Override	382																								
Pensioner Rebate (Values in Inflated $)																									
Pensioner Rebate per Pensioner ($)	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50
Override																									
Pensioner Rebate Subsidy (%)	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00
Override																									
Number of Pensioner Assessments	234	248	263	277	292	306	321	335	349	362	375	388	400	412	424	435	445	455	465	474	483	492	500	507	514
Override																									
Percentage of Pensioners (%)	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63	10.63
Override																									
Pensioner Rebate	20	22	23	24	26	27	28	29	31	32	33	34	35	36	37	38	39	40	41	41	42	43	44	44	45
Pensioner Rebate Subsidy	11	12	13	13	14	15	15	16	17	18	18	19	19	20	20	21	21	22	23	23	23	24	24	24	25
Revenue Split (%)																									
Residential Rates	40.58	40.79	40.99	41.24	41.22	41.26	41.25	41.24	41.27	41.29	41.32	41.33	41.37	41.37	41.40	41.40	41.42	41.41	41.42	41.43	41.42	41.42	41.46	41.43	41.45
Override																									
Non-Residential Rates	7.25	7.08	6.93	6.74	6.75	6.72	6.73	6.74	6.71	6.69	6.68	6.67	6.63	6.64	6.61	6.61	6.60	6.60	6.59	6.59	6.60	6.60	6.57	6.59	6.58
Override																									
Sales of Water: Residential	40.57	40.79	40.99	41.23	41.22	41.26	41.25	41.23	41.28	41.30	41.31	41.33	41.38	41.36	41.40	41.41	41.41	41.42	41.43	41.43	41.41	41.42	41.45	41.44	41.44
Override																									
Sales of Water: Non-Residential	10.86	10.61	10.38	10.10	10.12	10.07	10.08	10.10	10.05	10.03	10.01	9.99	9.94	9.95	9.91	9.90	9.89	9.89	9.88	9.87	9.89	9.88	9.85	9.87	9.86
Override																									
Extra Charges	0.74	0.73	0.71	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.67	0.67	0.67
Override																									
Total Non-Residential Revenue (%)	18.11	17.69	17.31	16.84	16.87	16.79	16.81	16.84	16.76	16.72	16.69	16.66	16.57	16.59	16.52	16.51	16.49	16.49	16.47	16.46	16.49	16.48	16.42	16.46	16.44
Total Residential Revenue (%)	81.15	81.58	81.98	82.47	82.44	82.52	82.50	82.47	82.55	82.59	82.63	82.66	82.75	82.73	82.80	82.81	82.83	82.83	82.85	82.86	82.83	82.84	82.91	82.87	82.89
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

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Revised/Additional Forecast Data

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
New Loan Payment Overrides (Values in Inflated $'000)																									
Standard Loan Payments: Principal	0	162	170	178	186	194	203	212	222	232	243	253	265	277	470	491	513	536	560	586	612	245	255	267	279
Standard Loan Payments: Interest	0	229	222	214	206	197	188	179	169	159	149	137	127	115	353	332	311	286	263	238	210	187	175	165	151
Structured Loan Payments: Principal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Structured Loan Payments: Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitalised Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total New Loan Payments: Principal Override	0	162	170	178	186	194	203	212	222	232	243	253	265	277	470	491	513	536	560	586	612	245	255	267	279
Total New Loan Payments: Interest Override	0	229	222	214	206	197	188	179	169	159	149	137	127	115	353	332	311	286	263	238	210	187	175	165	151
Capitalised Interest Override	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

Operating Statement

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	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
EXPENSES																									
Management Expenses	*432*	*501*	*449*	*471*	*525*	*514*	*535*	*591*	*635*	*597*	*617*	*636*	*654*	*757*	*689*	*706*	*721*	*811*	*751*	*813*	*778*	*840*	*803*	*815*	*825*
Administration	300	364	304	318	364	347	362	411	448	404	417	430	442	539	466	477	488	572	508	565	526	584	543	551	558
Engineering and Supervision	132	138	146	153	160	166	173	180	187	193	200	206	212	218	223	229	234	239	243	248	252	256	260	264	267
Operation and Maintenance Expenses	*1160*	*1220*	*1643*	*1717*	*1790*	*1862*	*1934*	*2004*	*2072*	*2139*	*2202*	*2272*	*2331*	*2390*	*2616*	*2955*	*3015*	*3074*	*3129*	*3181*	*3232*	*3279*	*3323*	*3366*	*3406*
Operation Expenses	808	851	894	937	980	1023	1065	1107	1148	1189	1227	1265	1301	1337	1371	1404	1435	1465	1494	1522	1548	1573	1597	1620	1642
Maintenance Expenses	170	179	547	568	588	608	627	645	662	678	694	717	731	744	929	1228	1251	1272	1291	1308	1327	1343	1357	1371	1383
Energy Costs	127	134	141	148	155	162	169	176	183	190	196	202	208	214	220	225	230	235	240	245	249	253	257	261	265
Chemical Costs	55	58	61	64	67	70	73	76	79	82	85	88	91	94	96	98	100	102	104	106	108	110	112	114	116
Purchase of Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation	*625*	*758*	*760*	*760*	*759*	*758*	*761*	*765*	*764*	*764*	*765*	*764*	*766*	*765*	*886*	*887*	*891*	*894*	*894*	*895*	*896*	*895*	*897*	*898*	*898*
System Assets	550	685	689	690	691	692	697	702	703	704	706	707	710	710	833	835	840	845	846	848	850	851	854	855	856
Plant & Equipment	75	73	71	70	68	66	65	63	62	60	59	57	56	54	53	52	51	49	48	47	46	45	44	43	41
Interest Expenses	303	510	482	453	425	397	369	331	295	270	245	219	195	169	322	289	258	224	194	166	137	113	102	94	83
Other Expenses	458	482	507	531	556	580	604	628	651	674	696	718	738	758	778	796	814	831	847	863	878	892	906	919	931
TOTAL EXPENSES	**2978**	**3472**	**3842**	**3932**	**4055**	**4111**	**4204**	**4319**	**4417**	**4444**	**4525**	**4609**	**4684**	**4839**	**5291**	**5634**	**5699**	**5834**	**5815**	**5917**	**5921**	**6020**	**6031**	**6091**	**6143**
REVENUES																									
Rates & Service Availability Charges	*1081*	*1233*	*1416*	*1489*	*1568*	*1645*	*1725*	*1802*	*1874*	*1947*	*2018*	*2088*	*2153*	*2220*	*2279*	*2339*	*2398*	*2453*	*2504*	*2555*	*2605*	*2649*	*2692*	*2735*	*2774*
Residential	917	1051	1212	1281	1347	1414	1482	1549	1612	1676	1737	1797	1855	1913	1965	2018	2069	2116	2161	2204	2246	2285	2323	2360	2395
Non-Residential	164	182	205	209	221	231	242	253	262	271	281	290	297	307	314	322	329	337	344	351	358	364	368	375	380
User Charges	*1163*	*1323*	*1517*	*1592*	*1679*	*1760*	*1844*	*1928*	*2006*	*2084*	*2158*	*2232*	*2301*	*2372*	*2436*	*2499*	*2562*	*2621*	*2677*	*2730*	*2782*	*2831*	*2876*	*2923*	*2963*
Sales of Water : Residential	917	1050	1211	1279	1348	1414	1482	1549	1614	1677	1737	1798	1856	1912	1965	2017	2068	2116	2161	2204	2246	2286	2323	2361	2394
Sales of Water : Non-Residential	246	273	306	313	331	346	362	379	392	408	421	434	445	460	471	482	494	505	515	525	536	545	552	562	569
Extra Charges	17	19	21	21	23	24	25	26	27	28	29	30	30	31	33	33	34	35	35	36	37	38	38	38	39
Interest Income	204	181	106	91	88	103	116	130	141	150	165	185	203	222	134	98	94	91	85	85	84	95	105	118	124
Other Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grants	*11*	*12*	*12*	*12*	*13*	*13*	*13*	*13*	*14*	*14*	*14*	*14*	*14*	*15*	*14*	*14*	*14*	*14*	*15*	*14*	*14*	*14*	*14*	*14*	*14*
Grants for Acquisition of Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pensioner Rebate Subsidy	11	12	12	12	13	13	13	13	14	14	14	14	14	15	14	14	14	14	15	14	14	14	14	14	14
Other Grants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Contributions	*4975*	*1380*	*1411*	*1401*	*1411*	*1380*	*1391*	*1360*	*1330*	*1299*	*1259*	*1228*	*1177*	*1157*	*1096*	*1066*	*1025*	*974*	*934*	*893*	*863*	*812*	*771*	*751*	*700*
Developer Charges	382	1380	1411	1401	1411	1380	1391	1360	1330	1299	1259	1228	1177	1157	1096	1066	1025	974	934	893	863	812	771	751	700
Developer Provided Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Contributions	4593	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUES	**7451**	**4148**	**4483**	**4607**	**4781**	**4924**	**5114**	**5260**	**5391**	**5523**	**5643**	**5777**	**5879**	**6017**	**5992**	**6050**	**6127**	**6187**	**6250**	**6314**	**6385**	**6439**	**6495**	**6579**	**6614**
OPERATING RESULT	**4473**	**676**	**642**	**675**	**726**	**813**	**911**	**941**	**974**	**1079**	**1119**	**1168**	**1195**	**1178**	**701**	**416**	**428**	**354**	**435**	**397**	**464**	**419**	**464**	**487**	**471**
OPERATING RESULT (less Grants for Acq of Assets)	**4473**	**676**	**642**	**675**	**726**	**813**	**911**	**941**	**974**	**1079**	**1119**	**1168**	**1195**	**1178**	**701**	**416**	**428**	**354**	**435**	**397**	**464**	**419**	**464**	**487**	**471**

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

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DEPARTMENT OF COMMERCE

Cashflow Statement

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Cashflow From Operating Activities																									
Receipts																									
Rates and Charges	2261	2575	2954	3102	3270	3428	3594	3756	3907	4060	4205	4350	4484	4623	4747	4871	4994	5108	5217	5321	5423	5518	5605	5696	5776
Interest Income	204	181	106	91	88	103	116	130	141	150	165	185	203	222	134	98	94	91	85	85	84	95	105	118	124
Other Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grants	11	12	12	12	13	13	13	13	14	14	14	14	14	15	14	14	14	14	15	14	14	14	14	14	14
Contributions	4975	1380	1411	1401	1411	1380	1391	1360	1330	1299	1259	1228	1177	1157	1096	1066	1025	974	934	893	863	812	771	751	700
Total Receipts from Operations	**7451**	**4148**	**4483**	**4607**	**4781**	**4924**	**5114**	**5260**	**5391**	**5523**	**5643**	**5777**	**5879**	**6017**	**5992**	**6050**	**6127**	**6187**	**6250**	**6313**	**6385**	**6439**	**6495**	**6579**	**6614**
Payments																									
Management	432	501	449	471	525	514	535	591	635	597	617	636	654	757	689	706	721	811	751	813	778	840	803	815	825
Operations (plus WC Inc)	1174	1247	1670	1745	1818	1891	1963	2033	2102	2168	2232	2301	2360	2419	2645	2984	3043	3101	3156	3208	3259	3306	3349	3393	3432
Interest Expenses	303	510	482	453	425	397	369	331	295	270	245	219	195	169	322	289	258	224	194	166	137	113	102	94	83
Other Expenses	458	482	507	531	556	580	604	628	651	674	696	718	738	758	778	796	814	831	847	863	878	892	906	919	931
Total Payments from Operations	**2367**	**2740**	**3109**	**3200**	**3324**	**3381**	**3472**	**3584**	**3683**	**3710**	**3790**	**3873**	**3947**	**4103**	**4433**	**4775**	**4837**	**4967**	**4948**	**5050**	**5052**	**5151**	**5160**	**5220**	**5272**
Net Cash from Operations	**5084**	**1408**	**1374**	**1407**	**1457**	**1543**	**1643**	**1676**	**1709**	**1813**	**1854**	**1904**	**1932**	**1914**	**1558**	**1275**	**1290**	**1220**	**1302**	**1264**	**1332**	**1288**	**1335**	**1358**	**1342**
Cashflow from Capital Activities																									
Receipts																									
Proceeds from Disposal of Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Payments																									
Acquisition of Assets	832	10688	629	1820	385	490	499	583	593	853	291	198	343	125	10855	229	915	437	967	364	707	125	343	125	624
Net Cash from Capital Activities	**-832**	**-10688**	**-629**	**-1820**	**-385**	**-490**	**-499**	**-583**	**-593**	**-853**	**-291**	**-198**	**-343**	**-125**	**-10855**	**-229**	**-915**	**-437**	**-967**	**-364**	**-707**	**-125**	**-343**	**-125**	**-624**
CashFlow from Financing Activities																									
Receipts																									
New Loans Required	0	5000	0	0	0	0	1	0	0	0	0	0	0	0	3999	1	0	0	0	0	0	0	0	0	0
Payments																									
Principal Loan Payments	466	620	621	346	356	364	374	384	395	407	418	428	441	453	536	548	561	594	512	524	536	207	148	151	154
Net Cash from Financing Activities	**-466**	**4380**	**-621**	**-346**	**-356**	**-364**	**-373**	**-384**	**-395**	**-407**	**-418**	**-428**	**-441**	**-453**	**3464**	**-548**	**-561**	**-594**	**-512**	**-524**	**-536**	**-207**	**-148**	**-151**	**-154**
TOTAL NET CASH	**3786**	**-4900**	**125**	**-760**	**716**	**689**	**770**	**708**	**721**	**553**	**1145**	**1277**	**1148**	**1335**	**-5833**	**498**	**-186**	**189**	**-176**	**375**	**89**	**956**	**843**	**1082**	**564**
Current Year Cash	3786	-4900	125	-760	716	689	770	708	721	553	1144	1277	1148	1335	-5832	498	-187	189	-176	375	89	956	844	1082	564
Cash & Investments @Year Start	5004	8576	3586	3621	2791	3421	4011	4664	5241	5816	6214	7179	8250	9169	10249	4309	4689	4393	4470	4189	4453	4431	5256	5951	6862
Cash & Investments @Year End	8790	3676	3711	2861	3507	4111	4781	5372	5962	6370	7359	8457	9399	10505	4416	4806	4503	4582	4294	4564	4542	5388	6100	7033	7426
Capital Works Funding:																									
nternal Funding for New Works ($'000)	218	5063	298	103	73	73	385	385	73	73	177	73	229	73	5160	177	385	385	73	73	177	73	229	73	73
Internal Funding for Renewals	614	624	331	1717	312	416	114	198	520	780	114	125	114	52	1695	52	530	52	894	291	530	52	114	52	551
New Loans	0	5000	0	0	0	0	1	0	0	0	0	0	0	0	3999	1	0	0	0	0	0	0	0	0	0
Grants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capital Works	**832**	**10688**	**629**	**1820**	**385**	**490**	**499**	**583**	**593**	**853**	**291**	**198**	**343**	**125**	**10854**	**229**	**915**	**437**	**967**	**364**	**707**	**125**	**343**	**125**	**624**

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

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DEPARTMENT OF COMMERCE

Statement of Financial Position

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Cash and Investments	8790	3586	3532	2657	3177	3634	4123	4519	4893	5101	5750	6447	6990	7622	3127	3320	3035	3013	2754	2857	2774	3210	3546	3988	4107
Receivables	626	660	696	731	766	801	836	870	903	935	967	998	1027	1055	1083	1110	1135	1159	1183	1205	1227	1247	1267	1286	1303
Inventories	26	27	29	30	31	32	34	35	37	38	40	41	42	44	45	46	46	47	48	49	49	50	51	51	52
Property, Plant & Equipment	*28367*	*38198*	*37972*	*38942*	*38481*	*38129*	*37788*	*37530*	*37287*	*37306*	*36766*	*36137*	*35654*	*34958*	*44873*	*44164*	*44138*	*43634*	*43661*	*43089*	*42860*	*42052*	*41462*	*40655*	*40350*
System Assets (1)	24318	34321	34261	35391	35085	34882	34684	34565	34456	34604	34189	33680	33313	32728	42750	42145	42219	41811	41931	41447	41304	40579	40068	39338	39107
Plant & Equipment	4049	3877	3711	3551	3396	3247	3103	2965	2831	2702	2577	2457	2341	2230	2122	2019	1919	1823	1731	1641	1556	1473	1393	1317	1243
Other Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL ASSETS	**37809**	**42472**	**42228**	**42359**	**42456**	**42596**	**42779**	**42954**	**43120**	**43381**	**43524**	**43623**	**43714**	**43679**	**49127**	**48638**	**48354**	**47853**	**47647**	**47200**	**46910**	**46559**	**46325**	**45980**	**45812**
LIABILITIES																									
Bank Overdraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creditors	315	333	350	368	386	403	421	438	455	471	487	502	517	531	545	559	571	584	596	607	618	628	638	647	656
Borrowings	6000	10234	9364	8789	8219	7654	7094	6537	5982	5430	4879	4332	3785	3240	6625	5916	5210	4489	3868	3250	2634	2362	2157	1953	1751
Provisions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL LIABILITIES	**6315**	**10567**	**9714**	**9157**	**8605**	**8057**	**7515**	**6975**	**6437**	**5901**	**5366**	**4834**	**4302**	**3771**	**7170**	**6474**	**5782**	**5073**	**4464**	**3856**	**3252**	**2991**	**2795**	**2600**	**2407**
NET ASSETS COMMITTED	**31494**	**31905**	**32514**	**33202**	**33851**	**34538**	**35264**	**35979**	**36682**	**37480**	**38158**	**38789**	**39411**	**39908**	**41957**	**42164**	**42572**	**42780**	**43183**	**43344**	**43659**	**43568**	**43530**	**43380**	**43406**
EQUITY																									
Accumulated Operating Result	23446	23550	23617	23716	23864	24095	24418	24763	25133	25598	26093	26625	27170	27686	27711	27452	27210	26900	26679	26425	26245	26024	25853	25710	25554
Asset Revaluation Reserve	8048	8656	9535	10435	11388	12356	13342	14347	15374	16423	17504	18598	19703	20823	21951	23461	24986	26553	28143	29778	31435	33127	34831	36556	38292
TOTAL EQUITY	**31494**	**31995**	**32693**	**33406**	**34181**	**35016**	**35922**	**36832**	**37751**	**38749**	**39767**	**40799**	**41821**	**42791**	**43246**	**43651**	**44041**	**44350**	**44723**	**45052**	**45429**	**45747**	**46085**	**46426**	**46725**
(1) Notes to System Assets																									
Current Replacement Cost	40985	51049	51347	51450	51523	51597	51982	52367	52440	52513	52689	52763	52992	53065	62225	62403	62787	63172	63245	63318	63496	63569	63798	63871	63944
Less: Accumulated Depreciation	16667	16728	17086	16059	16438	16715	17298	17802	17984	17908	18500	19083	19679	20337	19475	20258	20568	21361	21314	21871	22191	22990	23730	24533	24838
Written Down Current Cost	24318	34321	34261	35391	35085	34882	34684	34565	34456	34604	34189	33680	33313	32728	42750	42145	42219	41811	41931	41447	41304	40579	40068	39338	39107

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

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Performance Indicators

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Typical Residential Bills	855	920	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Average Residential Bills (2017/18$)	834	900	980	981	981	981	983	983	984	984	984	985	986	987	987	987	988	988	988	988	989	988	989	989	989
Mgmnt Cost / Assessment (2017/18$)	176	193	165	163	174	164	163	173	179	163	162	162	162	182	161	162	162	177	162	171	161	171	161	161	161
OMA Cost per Assessment (2017/18$)	647	663	765	761	768	755	752	759	762	744	741	741	739	758	776	839	837	851	834	842	831	839	828	827	825
Operating Sales Margin (%)	63.09	25.33	23.24	22.97	22.64	22.97	23.27	22.27	21.48	22.31	21.87	21.49	20.91	19.42	15.17	10.21	9.81	7.99	8.83	7.67	8.19	6.90	7.21	7.16	6.64
Economic Real Rate of Return (%)	16.12	2.63	2.68	2.66	2.76	2.90	3.08	3.04	3.02	3.21	3.26	3.33	3.33	3.22	1.98	1.38	1.34	1.12	1.25	1.11	1.20	1.04	1.11	1.14	1.07
Debt Service Ratio	0.10	0.27	0.25	0.17	0.16	0.15	0.15	0.14	0.13	0.12	0.12	0.11	0.11	0.10	0.14	0.14	0.13	0.13	0.11	0.11	0.11	0.05	0.04	0.04	0.04
Debt/Equity Ratio	0.19	0.32	0.29	0.26	0.24	0.22	0.20	0.18	0.16	0.14	0.12	0.11	0.09	0.08	0.15	0.14	0.12	0.10	0.09	0.07	0.06	0.05	0.05	0.04	0.04
Interest Cover	15.76	2.33	2.33	2.49	2.71	3.05	3.47	3.84	4.31	5.00	5.58	6.34	7.13	7.97	3.18	2.44	2.66	2.58	3.25	3.40	4.39	4.71	5.57	6.21	6.64
Return on capital (%)	12.63	2.79	2.66	2.66	2.71	2.84	2.99	2.96	2.94	3.11	3.13	3.18	3.18	3.08	2.08	1.45	1.42	1.21	1.32	1.19	1.28	1.14	1.22	1.26	1.21
Cash and Investments (2017/18$'000)	8790	3676	3711	2861	3507	4111	4781	5372	5962	6370	7360	8458	9399	10506	4416	4806	4503	4583	4295	4565	4543	5388	6100	7033	7426
Debt outstanding (2017/18$'000)	6000	10234	9364	8789	8219	7654	7094	6537	5982	5430	4879	4332	3785	3240	6625	5916	5210	4489	3868	3250	2634	2362	2157	1953	1751
Net Debt (2017/18$'000)	0	6558	5653	5928	4712	3543	2313	1165	20	0	0	0	0	0	2209	1110	707	0	0	0	0	0	0	0	0

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

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STANDARD LOAN PAYMENT SCHEDULE

Drawdown	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
2018/19 Principal 5125		162	170	178	186	194	203	212	222	232	243	253	265	277	290	303	317	331	346	362	378	0	0	0	0
Interest		229	222	214	206	197	188	179	169	159	149	137	127	115	101	88	75	60	45	30	13	0	0	0	0
2023/24 Principal 1							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2031/32 Principal 5651															180	188	196	205	214	224	234	245	255	267	279
Interest															252	244	236	226	218	208	197	187	175	165	151
2032/33 Principal 1																0	0	0	0	0	0	0	0	0	0
Interest																0	0	0	0	0	0	0	0	0	0
Total Principal 10778	0	162	170	178	186	194	203	212	222	232	243	253	265	277	470	491	513	536	560	586	612	245	255	267	279
Total Interest	0	229	222	214	206	197	188	179	169	159	149	137	127	115	353	332	311	286	263	238	210	187	175	165	151

Palerang IWCM-Water Fund Financial Model : Adopted IWCM Scenario - Water

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Summary Report of Assumptions and Results

	2017/18	2021/22	2026/27	2031/32	2036/37	2041/42	2046/47
Inflation Rates - General (%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Inflation Rates - Capital Works (%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Borrowing Interest Rate (%)	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Term of New Loans (years)	20	20	20	20	20	20	20
Investment Interest Rate (%)	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Growth Rate - Residential (%)	2.00	5.25	3.87	2.79	1.99	1.42	1.10
Developer Charges per Assessment - Residential (2017/18 $)	10150	10150	10150	10150	10150	10150	10150
Subsidised Scheme Capital Works ($m)	0.19	0.00	0.00	0.00	0.00	0.00	0.00
Grants on Acquisition of Assets ($m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewals ($m)	0.61	0.31	0.78	1.70	0.29	0.55	1.35
Renewals (%)	1.50	0.60	1.49	2.72	0.46	0.86	2.08
Cash and Investments ($m)	8.79	3.18	5.10	3.13	2.86	4.11	3.45
Borrowing Outstanding ($m)	6.00	8.22	5.43	6.63	3.25	1.75	0.76
Mgmnt Cost / Assessment	176	174	163	161	171	161	171
Debt Equity Ratio	0.19	0.22	0.11	0.11	0.05	0.02	0.01
OMA Cost Per Assessment	647	768	744	776	842	825	874
Economic Real Rate of Return (%)	16.12	2.76	3.21	1.98	1.11	1.07	0.20
Return on Capital (%)	12.63	2.71	3.11	2.08	1.19	1.21	0.41
Net Debt ($m)	0.00	4.71	0.00	2.21	0.00	0.00	0.00
Debt Service Ratio	0.10	0.16	0.12	0.14	0.11	0.04	0.03
Average Residential Bills	834	981	984	987	988	989	990
Typical Residential Bills (2017/18$)	855	1000	1000	1000	1000	1000	1000

Appendix H Financial Model Input and Output Data - Sewer

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

Historical Operating Statement

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	2015/16*	2016/17*
EXPENSES		
Management Expenses	*354*	*385*
Administration	173	190
Engineering and Supervision	181	195
Operation and Maintenance Expenses	*727*	*808*
Operation Expenses	434	529
Maintenance Expenses	147	131
Energy Costs	120	113
Chemical Costs	26	35
Depreciation	*852*	*752*
System Assets	852	752
Plant & Equipment		
Interest Expenses	546	373
Other Expenses		
TOTAL EXPENSES	**2479**	**2318**
REVENUES		
Rates & Service Availability Charges	*2216*	*2060*
Residential	1751	1627
Non-Residential	465	433
Trade Waste Charges		
Other Sales and Charges		
Extra Charges	14	13
Interest Income	264	227
Other Revenues	14	30
Grants	*87*	*86*
Grants for Acquisition of Assets	75	74
Pensioner Rebate Subsidy	12	12
Other Grants		
Contributions	*492*	*428*
Developer Charges	363	428
Developer Provided Assets	129	
Other Contributions		
TOTAL REVENUES	**3087**	**2844**
OPERATING RESULT	**608**	**526**
OPERATING RESULT (less Grants for Acq of Assets)	**533**	**452**

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

Historical Statement of Financial Position

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	2015/16*	2016/17*
Cash and Investments	8742	8527
Receivables	194	580
Inventories		
Property, Plant & Equipment	*32363*	*33218*
System Assets (1)	30018	28941
Plant & Equipment	2345	4277
Other Assets		
TOTAL ASSETS	**41299**	**42325**
LIABILITIES		
Bank Overdraft		
Creditors		302
Borrowings	9066	8748
Provisions		
TOTAL LIABILITIES	**9066**	**9050**
NET ASSETS COMMITTED	**32233**	**33275**
EQUITY		
Accumulated Operating Result	23063	23589
Asset Revaluation Reserve	9170	9686
TOTAL EQUITY	**32233**	**33275**

(1) Notes to System Assets

	2015/16*	2016/17*
Current Replacement Cost	43258	42914
Less: Accumulated Depreciation	13240	13973
Written Down Current Cost	30018	28941

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

Base Forecast Data

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	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Financial Data																									
Inflation Rate - General (%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Inflation Rate - Capital Works (%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Borrowing Interest Rate for New Loans (%)	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Investment Interest Rate (%)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Number of Assessments																									
Growth Rate (%)																									
Residential Assessments	2.05	6.27	5.99	5.69	5.42	5.11	4.82	4.57	4.27	4.03	3.79	3.54	3.33	3.12	2.92	2.73	2.56	2.40	2.23	2.09	1.96	1.83	1.71	1.62	1.51
Non-Residential Assessments	0.00	0.90	0.00	0.45	0.00	0.89	0.00	0.88	0.87	0.00	0.43	0.43	0.43	0.00	0.85	0.00	0.42	0.42	0.42	0.42	0.42	0.83	0.41	0.00	0.82
Total Assessments	1.86	5.77	5.45	5.25	4.98	4.78	4.46	4.31	4.04	3.76	3.57	3.34	3.16	2.93	2.80	2.58	2.45	2.30	2.13	2.00	1.88	1.78	1.65	1.54	1.47
Number of New Assessments																									
Residential	43	134	136	137	138	137	136	135	132	130	127	123	120	116	112	108	104	100	95	91	87	83	79	76	72
Non-Residential	0	2	0	1	0	2	0	2	2	0	1	1	1	0	2	0	1	1	1	1	1	2	1	0	2
Total New Assessments	43	136	136	138	138	139	136	137	134	130	128	124	121	116	114	108	105	101	96	92	88	85	80	76	74
Projected Number of Assessments																									
Residential	2137	2271	2407	2544	2682	2819	2955	3090	3222	3352	3479	3602	3722	3838	3950	4058	4162	4262	4357	4448	4535	4618	4697	4773	4845
Non-Residential	222	224	224	225	225	227	227	229	231	231	232	233	234	234	236	236	237	238	239	240	241	243	244	244	246
Total Projected Assessments	2359	2495	2631	2769	2907	3046	3182	3319	3453	3583	3711	3835	3956	4072	4186	4294	4399	4500	4596	4688	4776	4861	4941	5017	5091
Backlog Assessments																									
Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Backlog Assessments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Developer Charges / Vacant Assessments (Values in 2017/18 $)																									
Developer Charges $/Assessment																									
Residential	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180
Non-Residential	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180	12180
Number of Vacant Residential Assessments	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244
Average Charge of Vacant Assessments	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% of Occupied Assessments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation of Existing Plant and Equipment (Values in 2017/18 $'000)																									
Current Replacement Cost of System Assets	43987																								
Override	46559																								
Written Down Current Cost of System Assets	29665																								
Override																									
Annual Depreciation of Existing System Assets	771																								
Override																									
Written Down Value of Plant and Equipment	4277																								
Override																									
Annual Depreciation of Existing Plant and Equipment	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145	145

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

Base Forecast Data

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	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Existing Loan Payments (Values in Inflated $'000)																									
Existing Loan Payments : Principal (Total:8748)	237	249	262	279	296	313	331	351	371	393	416	441	467	495	451	477	504	533	564	596	630	92	0	0	0
Existing Loan Payments : Interest (Total:5943)	483	471	456	441	425	409	392	362	332	313	293	271	248	223	198	173	148	120	92	61	29	3	0	0	0
Capital Works Program (Values in 2017/18 $'000)																									
Subsidised Scheme (Total:5130)	124	3976	500	0	0	2	104	0	0	0	2	104	0	0	0	2	104	0	0	0	2	104	0	0	0
Other New System Assets (Total:12338)	1	246	41	21	21	21	10504	21	21	21	21	21	21	21	21	21	21	271	271	271	271	21	21	21	21
Renewals (Total:15433)	42	1165	754	390	338	76	26	26	26	26	388	338	338	2626	2626	2676	26	296	296	608	658	338	26	26	26
Total Capital Works (Total:32901)	167	5387	1295	411	359	99	10634	47	47	47	411	463	359	2647	2647	2699	151	567	567	879	931	463	47	47	47
Grant For Acquisition of Assets (% of Subsidised Scheme)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grant For Acquisition of Assets ($) (Total:0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Developer Provided Assets (Total:0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plant and Equipment Expenditure / Asset Disposal (Values in 2017/18 $'000)																									
Plant and Equipment Expenditure	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Proceeds from Disposal of Plant and Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Written Down Value of Plant and Equipment Disposed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gain/Loss on Disposal of Plant and Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Proceeds from Disposal of Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Written Down Value of Assets Disposed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gain/Loss on Disposal of System Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

Revised/Additional Forecast Data

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OMA / Revenue Overrides (Values in 2017/18 $'000)	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Administration	198	209	220	232	244	256	267	279	290	301	312	322	332	342	352	361	370	379	387	395	402	409	416	422	428
Override	249	236	263	231	274	254	265	365	345	297	307	317	391	423	345	354	362	519	378	435	393	451	485	412	418
Engineering and Supervision	204	216	228	240	252	264	276	288	300	311	322	333	344	354	364	373	382	391	399	407	415	422	429	436	442
Override																									
Operating Expenses	552	584	616	648	680	713	745	777	808	838	868	897	925	952	979	1004	1029	1053	1075	1097	1118	1138	1157	1175	1192
Override	552	663	613	680	675	706	737	767	797	826	855	883	910	936	962	986	1009	1032	1053	1074	1094	1113	1130	1148	1164
Maintenance Expenses	137	145	153	161	169	177	185	193	201	209	216	223	230	237	244	250	256	262	268	273	278	283	288	292	296
Override	137	144	152	159	167	175	182	360	374	387	401	414	427	439	451	462	473	484	494	504	513	522	530	538	546
Energy Costs	118	125	132	139	146	153	160	167	174	181	187	193	199	205	211	216	221	226	231	236	240	244	248	252	256
Override																									
Chemical Costs	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	74	75	76	77	78	79
Override																									
Other Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Override	122	226	237	249	261	273	285	297	309	320	331	342	352	363	372	382	391	400	408	416	424	431	438	445	451
Other Revenue	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	62	63	64	65	66	67	68	69	70
Override																									
Other Grants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Override																									
Other Contributions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Override																									

Developer Charges Overrides (Values in 2017/18 $'000)	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Calculated from Scheme Data	524	1656	1656	1681	1681	1693	1656	1669	1632	1583	1559	1510	1474	1413	1389	1315	1279	1230	1169	1121	1072	1035	974	926	901
Override	524	1400	1400	1400	1400	1400	1400	1400	1400	1400	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	700	700	700	700	700

Pensioner Rebate (Values in Inflated $)	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Pensioner Rebate per Pensioner ($)	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50	87.50
Override																									
Pensioner Rebate Subsidy (%)	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00	55.00
Override																									
Number of Pensioner Assessments	254	270	286	302	319	335	351	367	383	399	414	428	443	456	470	482	495	507	518	529	539	549	558	568	576
Override																									
Percentage of Pensioners (%)	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89	11.89
Override																									
Pensioner Rebate	22	24	25	26	28	29	31	32	34	35	36	37	39	40	41	42	43	44	45	46	47	48	49	50	50
Pensioner Rebate Subsidy	12	13	14	14	15	16	17	18	19	19	20	20	21	22	23	23	24	24	25	25	26	26	27	28	28

Revenue Split (%)	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Residential Rates	78.84	79.66	80.55	81.30	82.07	82.64	83.28	83.77	84.20	84.70	85.11	85.48	85.82	86.18	86.41	86.72	86.96	87.17	87.36	87.54	87.70	87.80	87.94	88.10	88.17
Override																									
Non-Residential Rates	20.54	19.75	18.88	18.15	17.41	16.85	16.23	15.76	15.34	14.85	14.46	14.10	13.77	13.42	13.19	12.89	12.66	12.46	12.27	12.10	11.94	11.84	11.71	11.55	11.48
Override																									
Trade Waste Charges	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Override																									
Other Sales and charges	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Override																									
Extra Charges	0.62	0.59	0.57	0.55	0.52	0.51	0.49	0.47	0.46	0.45	0.43	0.42	0.41	0.40	0.40	0.39	0.38	0.37	0.37	0.36	0.36	0.36	0.35	0.35	0.35
Override																									
Total Non-Residential Revenue (%)	20.54	19.75	18.88	18.15	17.41	16.85	16.23	15.76	15.34	14.85	14.46	14.10	13.77	13.42	13.19	12.89	12.66	12.46	12.27	12.10	11.94	11.84	11.71	11.55	11.48
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total Residential Revenue (%)	78.84	79.66	80.55	81.30	82.07	82.64	83.28	83.77	84.20	84.70	85.11	85.48	85.82	86.18	86.41	86.72	86.96	87.17	87.36	87.54	87.70	87.80	87.94	88.10	88.17

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

Revised/Additional Forecast Data

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	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
New Loan Payment Overrides (Values in Inflated $'000)																									
Standard Loan Payments: Principal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Standard Loan Payments: Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Structured Loan Payments: Principal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Structured Loan Payments: Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitalised Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total New Loan Payments: Principal Override	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total New Loan Payments: Interest Override	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitalised Interest Override	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

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Operating Statement

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
EXPENSES																									
Management Expenses	*453*	*452*	*491*	*471*	*525*	*518*	*541*	*653*	*645*	*608*	*629*	*650*	*735*	*777*	*708*	*727*	*744*	*910*	*777*	*842*	*808*	*873*	*914*	*848*	*860*
Administration	249	236	263	231	274	254	265	365	345	297	307	317	391	423	345	354	362	519	378	435	393	451	485	412	418
Engineering and Supervision	204	216	228	240	252	264	276	288	300	311	322	333	344	354	364	373	382	391	399	407	415	422	429	436	442
Operation and Maintenance Expenses	*844*	*972*	*938*	*1021*	*1033*	*1081*	*1129*	*1346*	*1399*	*1449*	*1499*	*1549*	*1597*	*1643*	*1689*	*1731*	*1772*	*1813*	*1850*	*1888*	*1922*	*1955*	*1985*	*2016*	*2045*
Operation Expenses	552	663	613	680	675	706	737	767	797	826	855	883	910	936	962	986	1009	1032	1053	1074	1094	1113	1130	1148	1164
Maintenance Expenses	137	144	152	159	167	175	182	360	374	387	401	414	427	439	451	462	473	484	494	504	513	522	530	538	546
Energy Costs	118	125	132	139	146	153	160	167	174	181	187	193	199	205	211	216	221	226	231	236	240	244	248	252	256
Chemical Costs	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	74	75	76	77	78	79
Depreciation	*918*	*975*	*979*	*976*	*973*	*970*	*1118*	*1115*	*1112*	*1109*	*1106*	*1105*	*1102*	*1100*	*1098*	*1095*	*1095*	*1096*	*1098*	*1099*	*1100*	*1100*	*1098*	*1097*	*1095*
System Assets	773	833	841	841	842	841	993	993	993	993	993	995	994	995	995	995	997	1001	1005	1008	1012	1014	1014	1014	1015
Plant & Equipment	145	141	138	135	131	128	125	122	119	116	113	111	108	105	103	100	98	95	93	91	88	86	84	82	80
Interest Expenses	483	460	434	410	385	361	338	305	272	251	229	207	184	162	140	119	100	79	59	38	18	2	0	0	0
Other Expenses	122	226	237	249	261	273	285	297	309	320	331	342	352	363	372	382	391	400	408	416	424	431	438	445	451
TOTAL EXPENSES	**2820**	**3084**	**3080**	**3126**	**3177**	**3203**	**3411**	**3715**	**3737**	**3737**	**3794**	**3853**	**3971**	**4044**	**4007**	**4054**	**4100**	**4298**	**4192**	**4283**	**4273**	**4361**	**4435**	**4406**	**4451**
REVENUES																									
Rates & Service Availability Charges	*2725*	*2869*	*2646*	*2770*	*2894*	*3022*	*3147*	*3273*	*3397*	*3513*	*3630*	*3744*	*3853*	*3959*	*4065*	*4159*	*4257*	*4349*	*4440*	*4524*	*4606*	*4685*	*4757*	*4827*	*4897*
Residential	2162	2300	2143	2264	2387	2510	2633	2754	2873	2989	3103	3213	3321	3426	3527	3621	3716	3805	3893	3975	4054	4128	4198	4267	4333
Non-Residential	563	570	503	506	506	512	513	518	524	524	527	530	532	533	539	539	541	544	547	549	552	557	559	559	564
Trade Waste Charges	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Sales and Charges	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Extra Charges	17	17	15	16	15	16	16	15	16	16	16	16	16	16	16	17	16	16	17	16	16	17	17	17	17
Interest Income	271	235	188	212	247	288	174	103	147	191	223	248	271	260	236	213	230	253	274	290	300	319	347	376	403
Other Revenues	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	62	63	64	65	66	67	68	69	70
Grants	*12*	*13*	*13*	*13*	*14*	*14*	*15*	*15*	*16*	*15*	*16*	*15*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*15*	*16*	*16*	*15*
Grants for Acquisition of Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pensioner Rebate Subsidy	12	13	13	13	14	14	15	15	16	15	16	15	16	16	16	16	16	16	16	16	16	15	16	16	15
Other Grants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Contributions	*524*	*1400*	*1400*	*1400*	*1400*	*1400*	*1400*	*1400*	*1400*	*1400*	*1000*	*1000*	*1000*	*1000*	*1000*	*1000*	*1000*	*1000*	*1000*	*1000*	*700*	*700*	*700*	*700*	*700*
Developer Charges	524	1400	1400	1400	1400	1400	1400	1400	1400	1400	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	700	700	700	700	700
Developer Provided Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Contributions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUES	**3580**	**4567**	**4298**	**4448**	**4609**	**4781**	**4794**	**4850**	**5022**	**5184**	**4936**	**5076**	**5211**	**5309**	**5392**	**5465**	**5582**	**5697**	**5812**	**5911**	**5704**	**5804**	**5904**	**6004**	**6103**
OPERATING RESULT	**760**	**1483**	**1218**	**1322**	**1431**	**1578**	**1383**	**1135**	**1285**	**1447**	**1141**	**1223**	**1240**	**1265**	**1385**	**1411**	**1481**	**1399**	**1620**	**1628**	**1431**	**1443**	**1468**	**1599**	**1652**
OPERATING RESULT (less Grants for Acq of Assets)	**760**	**1483**	**1218**	**1322**	**1431**	**1578**	**1383**	**1135**	**1285**	**1447**	**1141**	**1223**	**1240**	**1265**	**1385**	**1411**	**1481**	**1399**	**1620**	**1628**	**1431**	**1443**	**1468**	**1599**	**1652**

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

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Cashflow Statement

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Cashflow From Operating Activities																									
Receipts																									
Rates and Charges	2742	2886	2661	2786	2909	3038	3162	3288	3413	3529	3646	3760	3869	3975	4081	4176	4273	4365	4457	4540	4622	4702	4774	4844	4915
Interest Income	271	235	188	212	247	288	174	103	147	191	223	248	271	260	236	213	230	253	274	290	300	319	347	376	403
Other Revenues	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	62	63	64	65	66	67	68	69	70
Grants	12	13	13	13	14	14	15	15	16	15	16	15	16	16	16	16	16	16	16	16	16	15	16	16	15
Contributions	524	1400	1400	1400	1400	1400	1400	1400	1400	1400	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	700	700	700	700	700
Total Receipts from Operations	**3580**	**4567**	**4298**	**4448**	**4609**	**4781**	**4794**	**4850**	**5022**	**5184**	**4936**	**5076**	**5211**	**5309**	**5392**	**5465**	**5582**	**5697**	**5812**	**5911**	**5704**	**5804**	**5904**	**6004**	**6103**
Payments																									
Management	453	452	491	471	525	518	541	653	645	608	629	650	735	777	708	727	744	910	777	842	808	873	914	848	860
Operations (plus WC Inc)	857	995	962	1046	1058	1107	1155	1373	1425	1476	1526	1575	1623	1669	1715	1757	1797	1838	1875	1913	1947	1980	2009	2041	2069
Interest Expenses	483	460	434	410	385	361	338	305	272	251	229	207	184	162	140	119	100	79	59	38	18	2	0	0	0
Other Expenses	122	226	237	249	261	273	285	297	309	320	331	342	352	363	372	382	391	400	408	416	424	431	438	445	451
Total Payments from Operations	**1915**	**2133**	**2124**	**2175**	**2230**	**2259**	**2319**	**2627**	**2651**	**2654**	**2715**	**2773**	**2895**	**2971**	**2936**	**2985**	**3031**	**3227**	**3119**	**3209**	**3197**	**3286**	**3361**	**3333**	**3380**
Net Cash from Operations	**1665**	**2434**	**2174**	**2273**	**2379**	**2522**	**2476**	**2223**	**2371**	**2530**	**2221**	**2302**	**2316**	**2339**	**2457**	**2480**	**2550**	**2470**	**2692**	**2702**	**2506**	**2518**	**2542**	**2671**	**2723**
Cashflow from Capital Activities																									
Receipts																									
Proceeds from Disposal of Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Payments																									
Acquisition of Assets	167	5386	1294	411	359	99	10634	47	48	46	412	463	359	2647	2647	2699	151	567	567	879	931	463	47	47	47
Net Cash from Capital Activities	**-167**	**-5386**	**-1294**	**-411**	**-359**	**-99**	**-10634**	**-47**	**-48**	**-46**	**-412**	**-463**	**-359**	**-2647**	**-2647**	**-2699**	**-151**	**-567**	**-567**	**-879**	**-931**	**-463**	**-47**	**-47**	**-47**
CashFlow from Financing Activities																									
Receipts																									
New Loans Required	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Payments																									
Principal Loan Payments	237	243	249	259	268	277	285	295	304	315	325	336	347	359	319	329	340	350	362	373	384	55	0	0	0
Net Cash from Financing Activities	**-237**	**-243**	**-249**	**-259**	**-268**	**-277**	**-285**	**-295**	**-304**	**-315**	**-325**	**-336**	**-347**	**-359**	**-319**	**-329**	**-340**	**-350**	**-362**	**-373**	**-384**	**-55**	**0**	**0**	**0**
TOTAL NET CASH	**1261**	**-3195**	**630**	**1603**	**1752**	**2146**	**-8444**	**1880**	**2019**	**2168**	**1484**	**1504**	**1610**	**-667**	**-510**	**-548**	**2060**	**1554**	**1763**	**1451**	**1191**	**2000**	**2495**	**2624**	**2676**
Current Year Cash	1261	-3196	630	1603	1752	2146	-8444	1880	2019	2168	1485	1504	1610	-667	-510	-548	2059	1554	1763	1451	1191	2000	2495	2624	2676
Cash & Investments @Year Start	8527	9549	6198	6662	8063	9576	11436	2919	4682	6538	8494	9736	10965	12268	11318	10545	9753	11524	12759	14168	15237	16028	17588	19594	21675
Cash & Investments @Year End	**9788**	**6353**	**6828**	**8265**	**9815**	**11722**	**2992**	**4799**	**6701**	**8706**	**9979**	**11239**	**12575**	**11601**	**10808**	**9997**	**11812**	**13078**	**14522**	**15618**	**16428**	**18028**	**20083**	**22217**	**24352**
Capital Works Funding:																									
nternal Funding for New Works ($'000)	125	4222	541	21	21	23	10608	21	21	21	23	125	21	21	21	23	125	271	271	271	273	125	21	21	21
Internal Funding for Renewals	42	1165	754	390	338	76	26	26	26	26	388	338	338	2626	2626	2676	26	296	296	608	658	338	26	26	26
New Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capital Works	**167**	**5387**	**1294**	**411**	**359**	**99**	**10634**	**47**	**48**	**46**	**411**	**463**	**359**	**2647**	**2647**	**2699**	**152**	**567**	**567**	**879**	**931**	**463**	**47**	**47**	**47**

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

Statement of Financial Position

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Cash and Investments	9788	6354	6829	8265	9816	11723	2993	4800	6702	8707	9979	11239	12575	11601	10808	9997	11813	13078	14522	15619	16429	18028	20084	22218	24353
Receivables	606	641	676	711	747	782	817	853	887	921	954	985	1016	1046	1075	1103	1130	1155	1180	1204	1226	1248	1269	1288	1307
Inventories	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Property, Plant & Equipment	*33191*	*37501*	*37721*	*37067*	*36369*	*35420*	*44863*	*43726*	*42598*	*41476*	*40726*	*40033*	*39243*	*40747*	*42257*	*43825*	*42848*	*42289*	*41732*	*41488*	*41297*	*40642*	*39574*	*38512*	*37452*
System Assets (1)	29059	33612	34064	33634	33151	32409	42050	41104	40159	39212	38631	38100	37465	39117	40769	42473	41627	41193	40756	40626	40545	39994	39027	38060	37092
Plant & Equipment	4132	3890	3657	3433	3218	3011	2813	2622	2439	2264	2095	1934	1779	1630	1488	1351	1221	1096	976	861	752	647	547	452	360
Other Assets	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL ASSETS	**43585**	**44497**	**45226**	**46044**	**46932**	**47925**	**48673**	**49380**	**50188**	**51104**	**51659**	**52258**	**52835**	**53394**	**54140**	**54924**	**55790**	**56522**	**57434**	**58310**	**58952**	**59918**	**60927**	**62018**	**63112**
LIABILITIES																									
Bank Overdraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creditors	315	334	352	371	389	407	426	444	462	480	497	514	530	546	561	575	589	603	616	629	640	651	662	672	682
Borrowings	8511	8060	7615	7170	6727	6286	5847	5409	4973	4537	4101	3665	3229	2791	2403	2015	1627	1237	845	452	56	0	0	0	0
Provisions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL LIABILITIES	**8826**	**8394**	**7967**	**7540**	**7115**	**6693**	**6273**	**5854**	**5435**	**5017**	**4598**	**4179**	**3759**	**3336**	**2964**	**2591**	**2216**	**1840**	**1461**	**1080**	**696**	**651**	**662**	**672**	**682**
NET ASSETS COMMITTED	**34759**	**36102**	**37260**	**38503**	**39817**	**41232**	**42400**	**43526**	**44753**	**46088**	**47061**	**48079**	**49076**	**50058**	**51176**	**52333**	**53574**	**54682**	**55973**	**57230**	**58256**	**59267**	**60265**	**61346**	**62430**
EQUITY																									
Accumulated Operating Result	24349	25238	25841	26533	27317	28229	28923	29353	29922	30639	31033	31499	31971	32457	33050	33655	34315	34877	35646	36405	36948	37490	38044	38714	39422
Asset Revaluation Reserve	10410	10864	11419	11971	12499	13003	13477	14174	14831	15448	16028	16580	17105	17601	18126	18678	19259	19805	20326	20824	21308	21777	22221	22631	23007
TOTAL EQUITY	**34759**	**36102**	**37260**	**38503**	**39817**	**41232**	**42400**	**43526**	**44753**	**46088**	**47061**	**48079**	**49076**	**50058**	**51176**	**52333**	**53574**	**54682**	**55973**	**57230**	**58256**	**59267**	**60265**	**61346**	**62430**
(1) Notes to System Assets																									
Current Replacement Cost	46684	50905	51446	51467	51488	51511	62119	62140	62162	62182	62205	62330	62352	62372	62394	62417	62541	62812	63083	63354	63627	63752	63773	63794	63815
Less: Accumulated Depreciation	17625	17294	17381	17833	18336	19102	20069	21036	22003	22970	23574	24231	24887	23256	21625	19943	20914	21619	22327	22728	23082	23758	24746	25734	26723
Written Down Current Cost	29059	33612	34064	33634	33151	32409	42050	41104	40159	39212	38631	38100	37465	39117	40769	42473	41627	41193	40756	40626	40545	39994	39027	38060	37092

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

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Performance Indicators

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41	2041/42
Typical Residential Bills	1022	1022	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
Average Residential Bills (2017/18$)	1012	1013	891	890	890	890	892	892	892	892	892	892	892	893	893	892	893	892	894	894	894	894	894	894	895
Mgmnt Cost / Assessment (2017/18$)	192	181	187	170	181	170	170	197	187	170	170	169	186	191	169	169	169	202	169	180	169	180	185	169	169
OMA Cost per Assessment (2017/18$)	550	571	543	539	536	525	524	602	592	574	573	573	590	594	573	572	572	605	572	582	572	582	587	571	571
Operating Sales Margin (%)	29.37	39.41	35.62	35.88	35.98	36.75	33.48	28.16	28.94	30.17	24.34	24.48	23.35	23.10	25.01	25.08	25.25	22.50	25.36	24.48	21.26	20.52	20.18	21.73	21.91
Economic Real Rate of Return (%)	2.93	4.55	3.88	4.10	4.31	4.66	3.45	3.06	3.31	3.63	2.82	2.95	2.94	2.86	3.05	3.01	3.15	2.90	3.36	3.32	2.78	2.77	2.83	3.18	3.33
Debt Service Ratio	0.20	0.15	0.16	0.15	0.14	0.13	0.13	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.01	0.00	0.00	0.00
Debt/Equity Ratio	0.24	0.22	0.20	0.19	0.17	0.15	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00
Interest Cover	2.57	4.23	3.81	4.23	4.72	5.36	5.09	4.73	5.72	6.77	5.99	6.92	7.73	8.82	10.88	12.81	15.86	18.74	28.46	43.67	81.86	808.67	0.00	0.00	0.00
Return on capital (%)	2.85	4.37	3.65	3.76	3.87	4.05	3.54	2.91	3.10	3.32	2.65	2.74	2.70	2.67	2.82	2.79	2.83	2.61	2.92	2.86	2.46	2.41	2.41	2.58	2.62
Cash and Investments (2017/18$'000)	9788	6354	6829	8265	9816	11723	2993	4800	6702	8707	9979	11239	12575	11601	10808	9997	11813	13078	14522	15619	16429	18028	20084	22218	24353
Debt outstanding (2017/18$'000)	8511	8060	7615	7170	6727	6286	5847	5409	4973	4537	4101	3665	3229	2791	2403	2015	1627	1237	845	452	56	0	0	0	0
Net Debt (2017/18$'000)	0	1706	786	0	0	0	2854	609	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Palerang Sewer Fund IWCM Financial Model : Adopted IWCM Scenario - Sewer

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Summary Report of Assumptions and Results

	2017/18	2021/22	2026/27	2031/32	2036/37	2041/42	2046/47
Inflation Rates - General (%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Inflation Rates - Capital Works (%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Borrowing Interest Rate (%)	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Term of New Loans (years)	20	20	20	20	20	20	20
Investment Interest Rate (%)	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Growth Rate - Residential (%)	2.05	5.42	4.03	2.92	2.09	1.51	1.10
Developer Charges per Assessment - Residential (2017/18 $)	12180	12180	12180	12180	12180	12180	12180
Subsidised Scheme Capital Works ($m)	0.12	0.00	0.00	0.00	0.00	0.00	0.00
Grants on Acquisition of Assets ($m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewals ($m)	0.04	0.34	0.03	2.63	0.61	0.03	0.34
Renewals (%)	0.09	0.66	0.04	4.21	0.96	0.04	0.53
Cash and Investments ($m)	9.79	9.82	8.71	10.81	15.62	24.35	33.36
Borrowing Outstanding ($m)	8.51	6.73	4.54	2.40	0.45	0.00	0.00
Mgmnt Cost / Assessment	192	181	170	169	180	169	179
Debt Equity Ratio	0.24	0.15	0.08	0.03	0.00	0.00	0.00
OMA Cost Per Assessment	550	536	574	573	582	571	581
Economic Real Rate of Return (%)	2.93	4.31	3.63	3.05	3.32	3.33	3.95
Return on Capital (%)	2.85	3.87	3.32	2.82	2.86	2.62	2.66
Net Debt ($m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Debt Service Ratio	0.20	0.14	0.11	0.09	0.07	0.00	0.00
Average Residential Bills	1012	890	892	893	894	895	895
Typical Residential Bills	1022	900	900	900	900	900	900

Public Works Advisory

Level 3, 66 Harrington Street
Sydney NSW 2000

www.publicworks.nsw.gov.au