



# **Ordinary Meeting of Council**

**25 June 2025**

**UNDER SEPARATE COVER  
ATTACHMENTS**

**ITEM 9.5**

**QUEANBEYAN-PALERANG REGIONAL COUNCIL  
ORDINARY MEETING OF COUNCIL**

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# **QUEANBEYAN-PALERANG REGIONAL COUNCIL**

## **Council Meeting Attachment**

**25 JUNE 2025**

ITEM 9.5                      PALERANG COMMUNITIES INTEGRATED WATER CYCLE  
MANAGEMENT (IWCM) ISSUES PAPER 2025

ATTACHMENT 1      PALERANG COMMUNITIES INTEGRATED WATER CYCLE  
MANAGEMENT PLAN - ISSUES PAPER 2025

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# Queanbeyan-Palerang Regional Council

## Water and Sewer Strategic Planning

Issues Paper update 2025



Report Number: P-FY20231576-PWO-WSP-RP-001-01

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## Executive Summary

The former Palerang Local Government Area (LGA) is in south-eastern New South Wales, immediately to the east of Canberra. The area is predominately rural, with some rural residential areas and several small towns and villages. The major town is Bungendore, followed by Braidwood and Captains Flat. In May 2016, Palerang Council amalgamated with the former Queanbeyan City Council to form the Queanbeyan-Palerang Regional Council (QPRC).

The former Palerang Council developed a water and sewerage strategic plan in 2018 (formerly known as the IWCN Strategy) to prepare a 30 year Total Asset Management Plan (TAMP) and a supporting financial plan to deal with the issues identified in the IWCN process. Principal amongst these were strategies for the augmentation of the Bungendore water supply and sewerage schemes in an effort to support the significant growth pressures in and around the town of Bungendore.

Since the last strategic plan was completed, there has been a significant drought (from 2017-2019), Council has been unable to secure the required licences and approvals to secure additional groundwater for Bungendore (leading to the development of alternate options) and the projected growth around Braidwood has increased significantly. Therefore, updated water demand assessments are required for Bungendore and Braidwood.

The growth expected in Captains Flat has not increased and is still very low and water security has not been identified as an issue. Therefore, the analysis for Captains Flat is limited to an updated non-revenue water analysis.

## Water supply service

The Palerang community sits within three catchments, with the major townships in different catchments: Captains Flat in the Murrumbidgee Catchment, Braidwood in the Shoalhaven Catchment and Bungendore in the Lake George Catchment respectively. Each township has its own separate water supply scheme. The Bungendore and Braidwood schemes will need to supply water to an estimated serviced population of 14,430 in 2054.

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 the former Palerang LGA, are serviced by On-site Sewage Management Systems (OSSMS) including septic tanks and aerated wastewater treatment systems.

The serviced and un-serviced towns and villages in Council's area are outlined in Table S-1.

Table S-1: Serviced and Unserviced areas in the former Palerang LGA

Town / village	Water supply service	Sewerage service
Bungendore	Bungendore water supply scheme	Bungendore sewerage scheme
Braidwood	Braidwood water supply scheme	Braidwood sewerage scheme
Captains Flat	Captains Flat water supply	Captains Flat sewerage scheme with some On-site Sewerage Management Systems (OSSMS)
Major Creek	Nil	On-site Sewerage Management Systems (OSSMS)
Araluen	Nil	On-site Sewerage Management Systems (OSSMS)
Nerriga	Nil	On-site Sewerage Management Systems (OSSMS)

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## Water supply schemes

### Bungendore water supply scheme

Bungendore water supply scheme extracts water from the Turallo and Currandooley bore fields, both subsets of the Bungendore Alluvial Groundwater Source. Water from the Turallo bore fields is aerated, chlorinated, and fluoridated before distribution to customers. Water from the Currandooley bore fields is treated through a conventional water treatment plant, chlorinated and fluoridated before distribution to customers.

The current water demands are very close to the water access licence allocation. Therefore, Council has been working on acquiring additional water for Bungendore and has placed a moratorium on the development of new subdivisions until the additional water is secured.

In 2024 additional water quality sampling was undertaken for Per- and polyfluoroalkyl substances (PFAS), the results showed that there were low levels of PFAS (between the current Australian Drinking Water Guidelines (ADWG) concentrations and the proposed ADWG) in two of the five town water supply bores.

### Braidwood water supply

The Braidwood water supply scheme draws water from an off-stream storage dam which is filled by water extracted from the Shoalhaven River. Water is treated in a Dissolved Air Flotation Filtration (DAFF) plant and is chlorinated and fluoridated before distribution.

### Captains Flat water supply

The Captains Flat water supply scheme draws water from a dam on the Molonglo River. Water is treated in a membrane ultra-filtration (20nm) plant and chlorinated and fluoridated before distribution.

## Sewerage schemes

### Bungendore sewerage scheme

The Bungendore sewerage scheme has a gravity reticulation system, incorporating 10 Sewage Pumping Stations (SPS). Bungendore Sewerage Treatment Plant (STP) has two IDEA reactors for secondary treatment. Effluent is disinfected by UV prior to discharge into Mill Post Creek. The plant has been recently upgraded to cater for a separate high quality recycled water stream complete with UF membranes, dedicated UV, NaOCL dosing and a 300 kL storage reservoir. This treated effluent is used for onsite reuse, the truck fill, for irrigation of Mick Sherd Oval and will be used for the new Bungendore Sports Hub.

In addition to the 10 SPS discussed above, a new pump station has been added to service the Bungendore Sports Hub (SPS 11). This SPS pumps a short distance into the SPS 1 catchment. For the purposes of this project, the current loads are assigned to SPS 1. This will be updated in future projects.

### Braidwood sewerage scheme

The Braidwood sewage collection system is a conventional gravity sewerage system with seven pumping stations. The STP receives sewage from SPS 1. Braidwood STP has one IDEA reactor. The effluent is disinfected via a UV unit prior to discharge to Flood Creek.

### Captains Flat sewerage scheme

Captains Flat has a gravity reticulation system with one sewage pumping station. The Captains Flat STP comprises of a Pasveer channel for secondary treatment. Since the last IWCN Strategy was completed, the plant has undergone a complete upgrade with new inlet works (screen and grit removal), provision for chemical phosphorus treatment (Alphos) dosing into the Pasveer channel, new sludge lagoons, new drying beds and a new UV system prior to discharge. The maturation ponds are no longer routinely used but have been retained as an emergency storage if required.

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## Population and demographic projections

### Growth

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 population of Bungendore is projected to grow at 3.3% (from 2021 to 2054). The population in Braidwood is expected to grow at 0.8% per year from 2021 to 2026 and then 2.5% per year from then on. 2.5% per year respectively.

Table S-2: Bungendore and Braidwood serviced population projection

		2021	2024	2026	2031	2036	2041	2046	2051	2054
Bungendore	Water	3,935	4,338	4,629	5,444	6,404	7,533	8,860	10,422	11,488
	Sewerage	3,736	4,136	4,427	5,242	6,202	7,331	8,658	10,220	11,286
Braidwood	Water	1,416	1,450	1,474	1,667	1,886	2,134	2,415	2,732	2,942
	Sewerage	1,325	1,359	1,383	1,576	1,795	2,043	2,324	2,641	2,851

The population growth projected in the 2018 IWCN for Bungendore was based on Council quickly securing additional water to support growth. In 2019, Council undertook additional groundwater investigations in the district but was unable to secure the required water access licences and works approvals. Therefore, a moratorium on subdivision approvals has been in place and therefore the growth forecast in the 2018 IWCN has not occurred, and the 2021 census population is approximately equal to the previously projected 2018 population. The 2046 population projected in the 2018 IWCN (11,734) will now be reached in 2054, assuming that the issue of additional sources of water can be resolved.

Most of the new development areas in Bungendore are on the northern edge of the existing town, these will be serviced by the recently completed North Elmslea Reservoir. There will also be a development to the east of town, along Kings Highway, this will be serviced by North Elmslea Reservoir through a separate trunk main that crosses the railway, this service area has been designated as North Elmslea zone 2. The final development area is located to the south of Currandooley Water Treatment Plant, this area will not be required until after 2054, and will probably require a separate reservoir.

The ABS estimates that population in Braidwood grew by 140 people between the 2016 and 2021 Censuses, that the number of occupied houses increased by 46 (16 more than forecast) and that the number of occupied semi-detached properties increased by 43 (none were forecast), this occupied dwelling growth was accompanied by a population growth of 56 people in the detached dwellings and 56 people in the semi-detached dwellings. The average household size for both houses and semi-detached dwellings declined slightly between the censuses. At the time of the 2021 Census, the ABS estimated that there were 1,209 people in standard private dwellings (houses, semi-detached dwellings and units), 20 in other private dwellings (4 in caravans and 16 in homes attached to businesses), and about 187 in "other" dwellings. Based on other information sources there were 27 aged care beds in the multi-purpose service (and these were probably all occupied), there may have been up to about 30 people in visitor accommodation (though this is likely to be an over-estimate given the COVID-19 related restrictions on travel). This leaves about 130 people who were in some other form of accommodation not mentioned previously, there were a similar number of people in this category in the 2016 Census and they were excluded from the IWCN population estimates.

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As projected in the previous IWCN, the growth will lead to the unrestricted yearly water demand in hot dry years exceeding the current allocation and the load on the sewage treatment plant reaching the current capacity imminently.

The increased growth in Braidwood will lead to a need for increased annual water allocation, secure yield, water treatment capacity and sewage treatment capacity within the next 30 years.

### Water demand analysis and assessment

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, Braidwood and Captains Flat has remained around 86, 259 and 119 L/connection/day respectively for 2021-22, though over the last few years the NRW at Braidwood has varied between 402 and 82 L/connection/day.

The unit demand per active residential assessment is provided in Table S-3, the per person demands were developed using the current average household size for occupied standard dwellings as listed in Table S-2. Note that the term unrestricted future year is used instead of the term dry year in this report as some demands vary due to heat (or in other towns, due to visitor numbers), therefore the peak annual demand may occur during a quite dry year with heat waves rather than a very dry year without heat waves.

Table S-3: Unit demand per active residential assessment

WSS	Average year (kL/year)	Average day (kL/day)	Unrestricted future year (kL/year)	Average Day Peak Week (kL/day)	Climate dependence	Climate independent (kL/day)	Climate independent (kL/person/day)	Approximate WELS* Rating
Bungendore	203	0.556	245	1.317	Irrigation	0.424	0.145	2 to 3
Braidwood	153	0.419	177	0.709	Irrigation	0.317	0.149	2 to 3

\* WELS the national Water Efficiency Labelling Scheme

The unit demands in Bungendore and Braidwood are similar to those presented in the 2018 IWCN, in Bungendore average year demand decreased by 4.2% and the unrestricted future year decreased by 5.8%, in Braidwood the average year increased by 2.7% and the dry year decreased by 1.1%.

The unit water demands for the new dwellings in Bungendore and Braidwood have been developed using the requirements of Council's 2015 Development Control Plan, this requires the installation and connection of larger rainwater tanks than are required under BASIX (policy implementing water and energy standards for new dwellings in NSW). All the new dwellings in Bungendore are expected to be medium sized detached dwellings and to have an average household size of 3 people (based on the Bungendore Structure Plan). Most of the new dwellings in Braidwood will be medium sized detached dwellings with a household size of 2.2, there will also be a smaller number of attached dwellings, with an average household size of 1.5, these household sizes are based on the 2021 ABS Census results as the Braidwood Structure Plan is yet to be published. The unit demands for new dwellings are summarised in Table S-4. Note that separate unit demands were not developed for Braidwood in the 2018 IWCN as there was very little growth projected.

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Table S-5: Unit water demands for new dwellings

Town	Dwelling type	Household size	Average year (kL/year)	Average day (kL/day)	Unrestricted future year (99th %ile) (kL/year)	Peak day (kL/day)
Bungendore	House	3.0	139	0.381	208	1.243
	2018 IWCM	2.9	180	0.493	240	1.243
Braidwood	House	2.2	115	0.316	209	1.875
	2018 IWCM	2.9	180	0.493	240	1.612
	Villa home	1.5	52	0.141	62	0.299

A summary of the water projections for Bungendore is given in Table S-5.

Table S-5: Summary of water supply projections – Bungendore WSS

Reservoir		2025	2030	2035	2040	2045	2050	2055
Days Hill	Average Year Demand (ML/year)	134	165	166	166	167	167	168
	Unrestricted Future Year Extraction (ML/year)	149	190	190	191	192	194	195
	Peak Day Production (ML/day)	0.64	0.85	0.86	0.86	0.87	0.87	0.88
Turallo	Average Year Demand (ML/year)	191	198	206	216	227	240	256
	Unrestricted Future Year Extraction (ML/year)	230	241	255	271	291	313	340
	Peak Day Production (ML/day)	1.05	1.11	1.19	1.29	1.39	1.52	1.68
North Elmslea	Average Year Demand (ML/year)	0	21	66	66	66	66	66
	Unrestricted Future Year Extraction (ML/year)	0	28	85	85	85	85	85
	Peak Day Production (ML/day)	0.00	0.14	0.43	0.43	0.43	0.43	0.43
North Elmslea Zone 2*	Average Year Demand (ML/year)	0	0	18	91	177	278	397
	Unrestricted Future Year Extraction (ML/year)	0	0	23	117	228	358	512
	Peak Day Production (ML/day)	0.00	0.00	0.12	0.60	1.17	1.84	2.62
Total of all zones (historical climate)	Average Year Demand (ML/year)	325	385	455	539	636	751	887
	Unrestricted Future Year Extraction (ML/year)	378	459	553	665	796	950	1131
	Peak Day Production (ML/day)	1.69	2.11	2.60	3.18	3.86	4.67	5.61
Combined system	Average Year Demand (ML/year)	372	432	502	586	683	798	934
	Unrestricted Future Year Extraction (ML/year)	441	521	616	727	858	1,012	1,194
	Peak Day Production (ML/day)	2.40	2.82	3.32	3.90	4.58	5.38	6.33
	Average Year Demand (ML/year)	389	452	526	613	716	836	978

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Reservoir		2025	2030	2035	2040	2045	2050	2055
Combined system with climate change	Unrestricted Future Year Extraction (ML/year)	471	557	658	777	917	1,081	1,275
	Peak Day Production (ML/day)	2.50	2.93	3.44	4.05	4.75	5.59	6.57

\* This is for a new subdivision to the east of Bungendore (parts of 4610 Kings Highway)

A summary of the water projections for Braidwood is given in Table S-6. The NRW water has varied significantly over recent years. Therefore, there is a projection based on the average NRW (the High NRW projection) and the minimum annual NRW (the Low NRW projection).

Table S-6: Summary of water supply projections with historical climate – Braidwood WSS

		2025	2030	2035	2040	2045	2050	2055
Historical climate	Braidwood (Low NRW)							
	Average Year Demand (ML/year)	151	162	181	209	240	275	315
	Unrestricted Future Year Extraction (ML/year)	192	206	232	272	317	368	425
	Peak Day Production (ML/day)	0.83	0.90	1.06	1.33	1.64	1.99	2.38
	Braidwood (High NRW)							
	Average Year Demand (ML/year)	240	254	279	314	354	398	449
	Unrestricted Future Year Extraction (ML/year)	281	298	330	378	431	491	559
	Peak Day Production (ML/day)	1.07	1.15	1.33	1.62	1.95	2.32	2.75
Climate change	Braidwood (Low NRW)							
	Average Year Demand (ML/year)	164	175	195	224	256	293	335
	Unrestricted Future Year Extraction (ML/year)	192	206	232	272	317	368	425
	Peak Day Production (ML/day)	1.46	1.52	1.69	1.97	2.29	2.65	3.05
	Braidwood (High NRW)							
	Average Year Demand (ML/year)	249	264	290	326	366	412	464
	Unrestricted Future Year Extraction (ML/year)	281	298	330	378	431	491	559
	Peak Day Production (ML/day)	1.45	1.53	1.71	2.01	2.35	2.73	3.16

Demands in Bungendore are projected to exceed the water access licence allocation between 2025 and 2028.

Demands in Braidwood are expected to exceed the:

- water access licence allocation between 2039 and 2041 under the high NRW scenario, though this is pushed out to 2049 or further under the low NRW scenario
- secure yield between 2035 and 2036 under the high NRW scenario, though under the low NRW scenario this is pushed out to between 2045 and 2047.
- WTP capacity under both low and high NRW scenario by about 2040 and combined reservoir capacity by about 2050

### Sewer load analysis and assessment

The estimated sewage load to each SPS in terms of Equivalent Tenements (ET), Average Dry Weather Flow (ADWF), Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF) is given in Table S-7.

Table S-7: The average dry weather flows (ADWF) for each sewerage scheme

Sewer catchment	ET	ADWF (kL/day)	PDWF (L/s)	PWWF (L/s)
Bungendore	1,544	643	25.2	123.1
Braidwood	761	278	10.7	54.9

The current and projected sewer system nutrient loads in terms of Equivalent Population (EP) and hydraulic loads (in terms of ET as well as volumetric flows) for each sewerage scheme is provided in Table S-7. The EP projections include both residential and non-residential customers and are therefore higher than the populations projected earlier. The network modelling for the Bungendore sewerage scheme has been undertaken using a specialist software package, the model will be updated as part of the IWCN process. The Braidwood network is yet to be modelled as there was minimum growth forecast in the previous IWCN, therefore a simplified calculation method has been used to estimate the PWWF.

Table S-8: Projected STP flows

		2022	2025	2030	2035	2040	2045	2050	2055
Bungendore sewerage scheme	EP	4,565	4,907	5,810	6,873	8,122	9,591	11,321	13,355
	ET	1,544	1,657	1,957	2,310	2,725	3,214	3,788	4,464
	ADWF* (kL/day)	644	702	859	1,043	1,260	1,515	1,815	2,168
	ADWF** (kL/day)	1,004	1,080	1,278	1,512	1,787	2,110	2,491	2,938
	PDWF** (L/s)	25.2	26.9	31.2	36.2	41.9	48.6	56.3	65.3
	PWWF** (L/s)	The PWWF projections will be estimated from the sewer modelling for the nominated containment standard of 1 in 5 ARI.							
Braidwood sewerage scheme	EP	1,755	1,782	1,918	2,148	2,469	2,833	3,243	3,707
	ET	762	773	831	930	1,070	1,230	1,409	1,612
	ADWF* (kL/day)	278	283	308	351	410	478	553	639
	ADWF** (kL/day)	386	392	422	473	543	623	713	816
	PDWF** (L/s)	10.7	10.8	11.5	10.4	11.7	13.2	14.8	16.7
	PWWF** (L/s)	54.9	55.6	59.7	64.3	73.8	84.5	96.5	110.1

\* ADWF based on current ADWF plus 180 L/EP/day for growth

\*\* based on 220 L/EP/day for all users

The Bungendore STP currently has a capacity of 5,000 EP, Council has commissioned the design of an upgrade to the plant that will result in a total capacity of 12,000 EP, it is expected that the STP will reach this capacity in about 2052. The construction of this upgrade will be scheduled once additional water has been secured for the town.

The Braidwood STP was built in 2010, the civil works were built with a capacity of 3,000 EP and the initial mechanical and electrical equipment installed had a capacity of 2,000 EP with the expectation that they would be upgraded during the routine renewals scheduled in 2030. The increased growth in Braidwood will

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result in the mechanical and electrical upgrade being required by 2032 and a major plant upgrade being required by 2048.

### Issues

The issues have been split between current issues and resolved issues. The resolved issues are in the final table in this section.

QPRC's general issues that have been identified through the analyses are outlined in Table S-9.

Table S-9: General water and sewer issues

Issue Type	Target for Compliance	Issue (2015-2019 IWCM)	2023-25 Council Updates
Compliance	BASIX	N/A new issue	Council's 2015 DCP increases the minimum rain water tank size for new dwellings in the former Palerang Shire, this contravenes the NSW State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004

The water supply system issues are outlined in Table S-10.

Table S-10: Water Supply System Issues

Issue Type	Target for Compliance	Issue (2015-2019 IWCM)	2023-25 Council Updates
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.	Council now has a calibrated hydraulic model for Bungendore through an engagement with Public Works (Source: Email correspondence)
Best Practice	Pricing	N/A new issue	Council's 2015 DCP increases the minimum rain water tank size for new dwellings in the former Palerang Shire, new dwellings will require significantly less water in average years and nearly as much in hot dry years, increasing the difficulty of achieving an average of 50% of revenue from usage
Regulatory	Fluoridation of Public Water Supplies	The requirement for periodic auditing of the fluoridation systems is not always being met.	Council has confirmed that the requirement for periodic auditing is still not being met. (Source: Email correspondence)
Regulatory	Drinking Water Management System	Several of the nominated CCPs in the DWMS are not considered CCPs, for example free chlorine in the reticulation is an operational control point.	Council is currently revising the DWMS

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
Bungendore water supply issues			
Water security	Licensed allocation	It is estimated that Bungendore water supply dry year extraction will exceed its licensed extraction limit from the Bungendore and Currandooley bores by 2018.	<p>Still the biggest issue for the Palerang Communities</p> <p>History of the past few years of groundwater investigation is now well known.</p> <p>Current strategy is to develop the Q2B proposal, which will transfer water from Queanbeyan to Bungendore. In the meantime, all greenfield development for Bungendore is stalled.</p> <p>(Source: Email correspondence)</p>
Water quality	ADWG (Australian Drinking Water Guidelines)	N/A new issue	<p>Proposed ADWG concentration limits for Per- and Polyfluoroalkyl Substances (PFAS) are significantly lower than the current limits. In response to the expected change, Council has undertaken additional sampling. Two of the four Bungendore bores tested positive for PFAS and the concentration of Perfluorooctane sulfonic acid (PFOS) exceeds the proposed guidelines.</p>
Level of Service	Headworks capacity	The peak day demand will exceed the combined capacity of the Bungendore and Currandooley 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.	<p>The peak day demand will exceed the combined capacity of the Bungendore and Currandooley WTP soon, the exact timing is dependent on the time required to resolve the water security issue and the extent to which additional development is permitted.</p> <p>If one or two of the existing bores need to be removed from service due to PFAS contamination, this will become an immediate serious issue.</p>

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
CCP1(a)-chlorination in reticulation	DWMS (Drinking Water Management System)	Bungendore WTP: The DWMS (and possibly the plant) needs to be updated so that CCP1(a) is between the tank and the pump, rather than before the dosing point.	Council had deduced that it was more operational than critical due to the fact that water from this plant essentially hits the reticulation (and therefore consumers) only 170m from the Bungendore WTP. Council had confirmed that this test will be added to the daily monitoring field sheets. Council understands the need for a free chlorine sensor between the 100kL collection tank and the pump to ensure that the water is correctly chlorinated before distribution. Longer term, the plan is to establish a direct rising main between this plant and the reservoirs thus improving the chlorine concentration times contact time (C.t).
Pathogen cross contamination	DWMS	Based on the DWMS [1] the Residual Risk with Preventative Measures continues to remain 'Very High' for the following: potential pathogen contamination issues due to breach of pipeline and cross contamination due to backflow	Council is currently revising the DWMS
Minimum C.t. value	Local Water Utility (LWU) Circular 18 - ADWG	The total C.t from chlorination at Bungendore aeration tower to outflow is 6.2 mg.min/L, which is not above the recommended minimum value of 15 mg.min/L. Residual risk of chlorine sensitive pathogens: <b>High</b> .	Council to strictly monitor and document free chlorine concentration. Longer term, and as part of the Q2B project, the aim is to install a dedicated rising main from this plant to the service reservoirs. This will address any issues with C.t
Residual risk of chlorine resistant pathogens	Pathogen contamination	New issue	Residual risk of chlorine resistant pathogens Medium due to insufficient treatment. Disinfection barriers such as UV or Ozone are also effective at disabling chlorine resistant pathogens. However, Bungendore and Currandooley WTPs do not have UV or Ozone. UV or ozone treatment systems to be installed as part of either the next capacity upgrade or WTP replacement or when DCCEEW policy changes

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
Braidwood water supply issues			
Water security	Secure Yield	N/A new issue	The un-restricted annual demand will exceed the secure yield (320 ML/year with 1 degree warming) between 2039 and 2047*
Water security	Licensed allocation	N/A new issue	The un-restricted annual demand will exceed the licenced water entitlement (360 ML) between 2038 and 2052*
Capacity	WTP capacity	N/A new issue	The un-restricted peak day demand will exceed the WTP capacity (2 ML/day) between 2040 and 2042*
Performance - leaks	Non-Revenue Water	The historical average unit water loss is estimated to be 249 L/connection/day, which is approximately 3.4 times the state median of 74 L/connection/day.  The daily NRW calculated for the previous IWCN was 168 kL/day (2013/14), 154 kL/day (2014/15) and 183 kL/day (2015/16), about 35%. The NRW for the period used for the water balance averaged 127 kL/day, showing some improvement. Note that the period used for the water balance was also relatively wet, greatly reducing the overall demand for water, causing the percentage NRW to increase.	This remains a significant problem for Council. Since last IWCN Council has taken advantage of a DCCEE funded leak detection program. This was of only limited success. Another initiative is a program of revenue meter replacement. Currently Council has rolled out 130 NB-IoT meters with a further 500 to be deployed in 2024/25. Results are already promising with a number of letters already being issued for properties with persistent low flows. The intention is to completely change Braidwood revenue meters to NB-IoT by the end of 2025
Pathogen Contamination	DWMS	Based on the DWMS [1] the Residual Risk with Preventative Measures continues to remain 'Very High' for the following: dead end in reticulation system leading to stagnation and loss of chlorine residual; breach of pipeline through breaks and service works; cross contamination due to backflow and growth of biofilms/sludge causing degradation of water quality	Council is reviewing the DWMS.

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
Residual risk of chlorine sensitive pathogens	Pathogen contamination	New issue	Residual risk of chlorine resistant pathogens Medium due to moderately protected catchment. Disinfection barriers such as UV or Ozone are also effective at disabling chlorine resistant pathogens. However, Braidwood WTP does not have UV or Ozone. UV treatment system to be installed as part of either the next WTP capacity upgrade or WTP replacement or when DCCEEW policy changes
Captains Flat water supply system			
Water loss	Major Water Residential User	This residential property (Property ID – 340223) has been flagged for investigation. A flow restrictor was installed in September 2021. The property is currently carrying in excess of \$40,000 worth of unpaid rates and charges.	Council suspecting serious leakage issues and investigation is underway.
Water loss	Water Balance	The historical average unit water loss is estimated to be 106 L/connection/day, which is approximately 1.4 times the state median of 74 L/connection/day.	Network investigations are ongoing
Regulatory	Drinking Water Management System	The turbidity alert limit corrective action for Captains Flat WTP needs to include a membrane integrity test.	Turbidity monitoring at Captains Flat is now continuous online and monitored by GeoSCADA. Membranes were replaced in May 2024. Regular membrane integrity testing still to be enacted and included in field sheets.

\* Range due to use of high and low NRW forecasts

The sewerage system issues are outlined in Table S-11.

Table S-11: Sewerage System Issues

Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023 Updates
General sewerage system issues			
Unserviced communities	On-site sewage management systems	<b>Village of Majors Creek</b> – potential issue due to the following reasons: Small lot sizes (some around 3,000 & several around 1,000 m <sup>2</sup> )	No action here

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023 Updates
		<p>Inadequate buffer distance from Majors Creek</p> <p>Moderately well to imperfectly drained soil</p> <p><b>Village of Nerriga</b> – potential issue due to the following reasons:</p> <p>Small lot sizes (various sizes below 3,000 m<sup>2</sup>)</p> <p>Some properties may have inadequate buffer distance from Bindi Brook</p> <p><b>Village of Araluen</b> – potential issue due to the following reasons:</p> <p>Small lot sizes (several properties less than 1,500 m<sup>2</sup> bordering each other)</p> <p>Moderately permeable, imperfectly drained soil.</p>	
Bungendore sewerage system issues			
Regulatory	EPA Licence non-compliance	The Bungendore STP exceeded the volumetric discharge limit (2.16 ML/day) in 2016, 2014, 2012 and 2011. Council needs to consider undertaking an inflow/infiltration study.	<p>Council has confirmed that they have undertaken several sewer relining projects since last IWCN. This was informed by precursor cleaning and CCTV work. Council also mentioned about carrying out targeted smoke testing for catchment 4 (Bungendore - a new development area) to try and resolved an emerging inflow problem.</p> <p>(Source: Email correspondence)</p> <p>Wet weather flows exceeded the licence limits more often during the recent wet years</p> <p>Licence is being reviewed as part of the upgrade process.</p>
Pump sizing at PWWF	Sewer catchment performance	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.	<p>Catchment #2 has had pumps upgraded. Catchment #4 has had pumps upgraded. Catchments #8 &amp; #9 to be upgraded in the future.</p> <p>(Source: Email correspondence)</p>

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023 Updates
	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.	No immediate action. Both SPS7 & SPS8 will increase both capacity and throughput at northern greenfield development progresses. This will lower rising main detention times.
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.	Design engagement currently underway with supporting SSWP funding for a tender ready package (+7,000 EP giving a total capacity of 12,000 EP) by 30 June 2025. The construction will commence once additional water for Bungendore has been secured The spare 2,000 EP IDEA was re-commissioned in March 2023. (Source: Email correspondence)
STP inflow	ADWF compliance	STP inflow continues to be high, regardless of the time since the last rainfall	Council undertaking CCTV inspections and targeted relining.
STP Capacity	STP Capacity Compliance	The current estimated EP load for Bungendore sewerage scheme is 4,549 EP which is reaching the STP Design EP of 5,000,	Design engagement currently underway with supporting SSWP funding for a tender ready package (+7,000 EP giving a total capacity of 12,000 EP) by 30 June 2025.
Odour/septicity potential	WSAA Guidelines	Rising mains that have residence time greater than eight hours are potential to septicity for BU SPSs.	Council to monitor
Braidwood sewerage system issues			
Regulatory	EPA Licence non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.	Inflow/Infiltration study completed. Large program of relining subsequently conducted. Inflow continues to be an issue over recent wet years. (Source: Email correspondence)
Odour/septicity potential	Sewer catchment performance	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.	No action (Source: Email correspondence)

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023 Updates
Increased dry weather flow	Sewage inflow compliance	In winter, spring and early summer 2019, while the weather was extremely dry, the dry weather flows increased to over 400 kL/day.  This is substantially higher than the dry weather flows in 2017/18 of 290 kL/day.	Council to investigate potential factors contributing to these high flows
PWWF	Pump rate	The PWWF from the catchments is estimated to be 54 L/s and likely to exceed SPS1 capacity when the fifty-six 2-to-3-bedroom units in the Summerfield - Braidwood Retirement village are completed. Pump rate lower than the combined capacity of the upstream pumps and local flow.	Current. Council to investigate and monitor
Captains Flat sewerage system issues			
Regulatory	EPA Licence non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.	Inflow/Infiltration study completed. Large program of relining subsequently conducted. Inflow continues to be an issue in the La Nina years. (Source: Email correspondence)
Performance	Sewage Treatment Plant compliance	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 has confirmed that the plant has been augmented. 2018 Issue now resolved an outcome of a significant investment of capital. (Source: Email correspondence)

Table S-12: Resolved issues

Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
General water and sewer issues 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	Council has HSEQ accreditation. (Source: Email correspondence)  Issue resolved

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
General water and sewer issues 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 has a centralised records management system in ECM where plant field sheets are scanned and imported.  Key data is also transcribed into spreadsheets for use in regulatory reporting.  GeoSCADA also records key plant data. (Source: Email correspondence)  Customer Request Management system also in place.  Issue resolved
General water supply issues 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.	Council has implemented a single block tariff system for water charging (Source: Email correspondence and Council's publicly available revenue policy)  Issue resolved
Bungendore water supply issues CCP2 Fluoridation in Bungendore	DWMS	From January 2015 and February 2023, there were recent exceedances below the lower critical limit of less than 0.9 mg/L for 72 hrs.	Fluoride levels started to decrease from February 2023 due to issues with the saturators causing bed caking. Council stated that they had replaced the beds of all four branded NaF saturators and recommissioned.  Issue resolved
Bungendore water supply issues CCP2 Fluoridation in Currandooly	DWMS	From January 2015 and June 2023, there were recent exceedances below the lower critical limit of less than 0.9 mg/L for 72 hrs. Before July, were maintained to be within the target range.	Fluoride levels started to decrease from February 2023 due to issues with the saturators causing bed caking. Council stated that they had replaced the beds of all four branded NaF saturators and recommissioned.  Issue resolved.
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 statewide median of 92 L/connection/day for 2015/16.	Significant program of water meter replacement has been undertaken.  Many Itron electronic meters deployed. Now moving to NB-IoT meters as the LGA wide standard. (Source: Email correspondence)  Bungendore NRW has reduced significantly, from 125 L/connection/day to 86 L/connection/day in 2021/22.  Council will continue to monitor NRW.  Issue resolved
Braidwood water supply issues Main breaks	Non-Revenue Water	Main breaks every 1-3 months with some months have main breaks more than once.  26 out of 173 complaints was related to main bursts over 3 years from October 2019 to November 2022.	A program of water main replacement has been undertaken. Frequency of main breaks has reduced.  Issue resolved

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
Captains Flat water supply issues 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 pool site is now well metered although it still has a significant leak problem. The P&G section of Council remains committed to deal with similar issues that arise. (Email correspondence). Issue resolved
Bungendore sewerage 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.	Bungendore has a Recycled Water Management System and has formal s.60 approval. (Source: Email correspondence) Issue resolved.
		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 updated that this is completed. (Source: Email correspondence) Issue resolved.
Bungendore sewerage issues 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.	New RWP at the STP has incorporated a whole new system of metering. (Source: Email correspondence) Issue resolved
Braidwood sewerage issues Pump sizing	Sewer catchment performance	The PWWF at catchment #1 will exceed the capacity of a single pump by 2021. Council has funded an upgrade.	Pumps upgraded together with supporting electrical network. 2018 Issue resolved. (Source: Email correspondence)
Captains Flat sewerage issues Pump sizing	Sewer catchment performance	The PWWF at catchment #1 is expected to exceed the duty pump capacity.	Pumps have been upgraded since last IWCN. Both now capable of 15L/s which is sufficient. 2018 Issue now resolved (Source: Email correspondence)

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## 1 Introduction

### 1.1 Purpose

The water and sewer strategic plan 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 water and sewer strategy:

- Identifies the water supply and sewerage needs of the LWU.
- 'Right sizes' any infrastructure projects and determines their priority.
- Provides an initial estimate of developer contributions
- Identifies the lowest level of stable Typical Residential Bill (TRB) to meet the levels of service; and
- Includes a 30-year Total Asset Management Plan and Financial Plan.

### 1.2 Process

The process of preparing the water and sewer strategy in conjunction with the Department of Climate Change Energy, the Environment and Water's (DCCEEW) supports the integration of state, regional and local water utility and includes the following steps:

- Preparation of a water and sewer strategy planning paper
- Evaluation of feasible options
- Creation of water and sewer strategy planning scenarios
- Triple bottom line assessment of the scenarios
- Developing the water and sewer strategy, and
- Preparation of a Total Asset Management Plan and Financial Plan.

### 1.3 Water and Sewer Strategic Planning Paper

The water and sewer strategic planning paper presents the analyses that have been undertaken and summarises the water and sewer issues that have been identified through the analysis. The following are inputs to the water and sewer strategic planning paper:

- Service Objectives and Targets
- Growth strategy
- Existing systems
- Water demand analysis
- Sewer loading analysis.
- Existing system performance assessment, and
- Assessment of unserved areas.

This report presents the outcomes of the analysis.

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#### 1.4 Queanbeyan-Palerang Local Government Area

The Queanbeyan-Palerang local government area (LGA) is located approximately 40 km East of Canberra. In May 2016, the former Palerang Council amalgamated with Queanbeyan City Council to form the Queanbeyan-Palerang Regional Council. QPRC supplies water and sewerage services to cities and towns in the LGA.

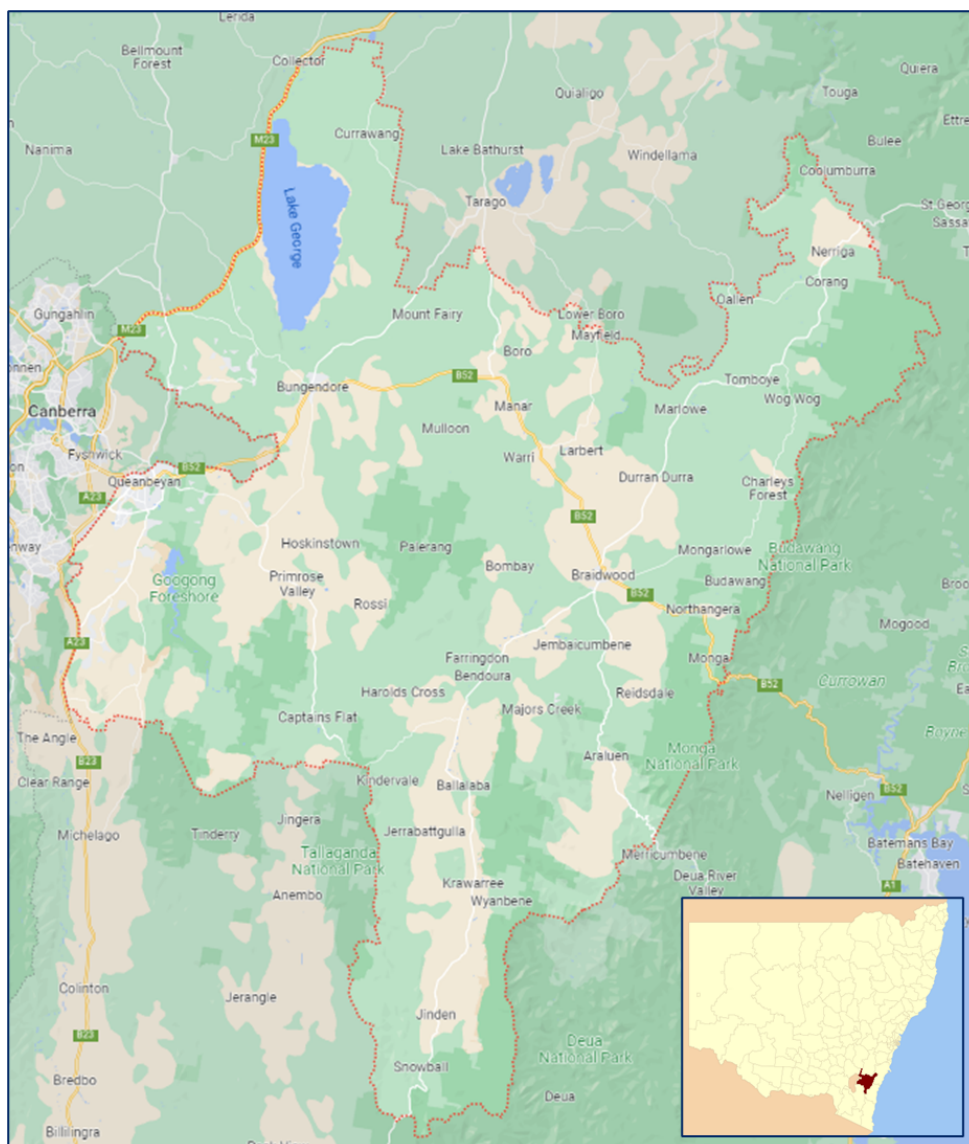
A map of the Queanbeyan-Palerang LGA from Google Maps is shown in Figure 1-1-1. This Issues Paper identifies the issues in the serviced areas covered by the former Palerang Council.

The combined serviced population of Bungendore, Braidwood and Captains Flat is about 10% of the LGA serviced population (the other 90% is in Queanbeyan, Googong, Jerrabomberra). Therefore, anything reported on a LGA wide basis does not necessarily reflect the three towns of interest.

It is expected that the next iteration of this planning process will see the amalgamation of the former Palerang and Queanbeyan Integrated Water Cycle Plans into a single strategic document.



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Source: Google Maps

Figure 1-1-1: Map of Queanbeyan – Palerang LGA

### 1.5 Water Supply and Sewerage Schemes

A summary of the serviced areas is given in Table 1-1.

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Table 1-1: A summary of the serviced areas

Town / village	Water supply service	Sewerage service
Bungendore	Bungendore water supply scheme	Bungendore sewerage scheme
Braidwood	Braidwood water supply scheme	Braidwood sewerage scheme
Captains Flat	Captains Flat water supply	Captains Flat sewerage scheme

1.6 Un-serviced Communities

In addition to the Bungendore, Braidwood and Captains Flat sewerage schemes, there are also schemes servicing Queanbeyan and Googong. Outside of these serviced areas the homes and businesses treat sewage using on-site sewage management systems (OSSMS), mostly septic tank systems. The villages of Majors Creek, Araluen and Nerriga have on-site sewage management systems. Some limited water supply areas in Captains Flat also utilise OSSMS – those properties on the Beverly Hills water main.

## 2 Operating environment and levels of service

### 2.1 Regulatory Compliance

The delivery of urban water services including water supply, sewerage and stormwater services is subject to many legislative and regulatory requirements, guidelines, contractual obligations for delivery of services and other external and internal factors, collectively referred to as the operating environment. A water and sewer strategic planning 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))
- Regulatory assurance framework (RAF).

The operating environment compliance situation is analysed in this Section to identify the water and sewer strategic planning 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 the status of compliance with the with the legislative and regulatory requirements by the Council.

Table 2-1: Palerang Community Council Legislative requirements

Key Legislative Framework and their main purposes	Council current performances and future targets
<b>Local Government Act (1993)</b>	
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:	Council operates three water supply schemes and three sewerage schemes under the authority of the Local Government Act 1993.
<p>Section 60 (S60) – Ministerial approval required for certain council works.</p> <p>A council must not, except in accordance with the approval of the Minister for Primary Industries, do any of the following:</p> <ul style="list-style-type: none"> <li>• as to water treatment works – construct or extend any such works,</li> <li>• as to sewage – provide for sewage from its area to be discharged, treated or supplied to any person</li> </ul>	Council has Section 60 approval for its water and wastewater system operations. Council has both a RWMP and formal s.60 approval for the recently constructed Bungendore reuse scheme.

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Key Legislative Framework and their main purposes	Council current performances and future targets
<p>Section 61 – Ministerial directions concerning certain works.</p> <p>The Minister for Primary Industries or a person authorised by the Minister may direct a council to take such measures as are specified in the direction to ensure the proper safety, maintenance and working of any of the following works:</p> <ul style="list-style-type: none"> <li>water treatment works,</li> <li>sewage treatment works.</li> </ul>	<p>The WTPs and STPs in Bungendore, Braidwood and Captains Flat are inspected regularly by DCCEEW Water.</p> <p>The following issues were noted during the most recent inspections:</p> <ul style="list-style-type: none"> <li>Braidwood STP (18/4/23) – replacement of decant weir cables and boots required based on age even though condition appeared acceptable. An order to undertake this work has been placed with the relevant supplier</li> <li>Braidwood WTP (2/3/22) - caustic dosing system had leaks, PAC shed required bird proofing, Issues resolved .</li> <li>Bungendore WTPs (2/2/23) – softener off-line and fluoride saturator not operating correctly. All NaF saturators have since had their media changed and softeners serviced.</li> <li>No issues were noted at Braidwood WTP or at Captains Flat</li> </ul>
<p>Section 64 – Construction of works for developers.</p> <p>As a precondition to granting a certificate of compliance for development, a water supply authority may, by notice in writing served on the applicant, require the applicant to do either or both of the following:</p> <ul style="list-style-type: none"> <li>to pay a specified amount to the water supply authority by way of contribution towards the cost of such water management works as are specified in the notice, being existing works or projected works, or both,</li> <li>to construct water management works to serve the development.</li> </ul>	<p>As part of the 2018 IWCN process a revised Development Contribution plan was developed and adopted by Council for the former Palerang Schemes (except Captains Flat). It is expected that these will be reviewed again as part of this current refresh along with the global tariff structure.</p>
<p>Section 68 – What activities require the approval of the council.</p> <ul style="list-style-type: none"> <li>A person may carry out operation of a system of sewage management (meaning to hold or process, or re-use or discharge, sewage or by-products of sewage) only with the prior approval of the council.</li> <li>Council can manage the approval process under their liquid trade waste policy.</li> </ul>	<p>Council has a Liquid Trade Waste policy and has implemented the policy and associated charges.</p>
<p>Section 382 – Insurance against liability</p> <p>A Council must make arrangements for its adequate insurance against public liability and professional liability.</p>	<p>In accordance with Section 382 of the Local Government Act, Council is insured against public liability and professional indemnity claims. Councillors are included as a named insured on this Policy.</p>
Environmental Planning and Assessment Act (1979) (incl. the EPA Regulation 2000).	

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Key Legislative Framework and their main purposes	Council current performances and future targets
<p>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:</p> <ul style="list-style-type: none"> <li>Local Environmental Plans (LEP)</li> <li>Environmental Impact Statement (EIS)</li> <li>Reviews of Environmental Factors (REF)</li> <li>State Environmental Planning Policy (SEPP)</li> </ul>	<p>These Legislative and regulatory requirements are met by Council.</p>
<b>Public Health Act (2010)</b>	
<p>This Act aims to promote, protect, and improve public health; by providing safe drinking water to the community.</p> <p>Section 25 – Quality assurance programs</p> <p>A supplier of drinking water must have a quality assurance program in place and must comply with its requirements.</p> <p>A Drinking Water Management System (DWMS) satisfies this requirement.</p> <p>The requirements of the DWMS are as follows:</p> <ul style="list-style-type: none"> <li>Produce an annual report to be made available to consumers, regulatory authorities, and stakeholders.</li> <li>The DWMS will be internally reviewed. The review will assess Council's performance in relation to:</li> <li>CCPs and their exceedances</li> <li>Improvement Plan</li> <li>Record keeping</li> <li>NSW Health Database performance</li> </ul>	<p>A DWMS covering the three water supply schemes in QPRC was last updated in September 2017. This is currently being updated.</p> <p>The water quality performance for council has been measured against the current DWMS.</p>
<b>Local Government Amendment (Planning and Reporting) Act 2009</b>	
<p>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).</p>	<p>Council adheres to these requirements.</p>
<b>Seat of Government Acceptance Act 1909 – First Schedule</b>	
<p>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.</p>	<p>Council has an EPA licence for the Captains Flat (EPL1929) STP which discharges to waters upstream of the Territory.</p>

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Key Legislative Framework and their main purposes	Council current performances and future targets
<b>Water Management Act (2000) Section 66</b>	
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.	<p>Council has several water access licences issued under the Water Management Act 2000.</p> <p>Council's licensed allocation for Bungendore is barely sufficient for the current customers a will not support the growth forecast. Council is working on accessing additional water from ICON Water (ACT) via a pipeline from Queanbeyan.</p> <p>The licenced allocation for Braidwood will also need to be increased to service the forecast growth.</p> <p><b>Issue</b></p>
<b>Protection of the Environment Operations Act (1997)</b>	
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.	<p>Council has EPA licences for the three STPs at Bungendore, Braidwood and Captains Flat; licence numbers 201, 1733 and 1929 respectively.</p> <p>Council has a single Pollution Incident Response Management Plan (PIRMP) that covers these schemes as well as the Googong and Queanbeyan City (reticulation only) schemes. The PIRMP is up to date.</p>
<b>Dam Safety Act 2015</b>	
<p>Under this act, the owner of any dam listed as a prescribed dam must meet the requirements of the Dams Safety NSW.</p> <p>Dams Safety NSW 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).</p>	<p>Captains Flat Dam is owned by Council and is a declared under the act.</p> <p>Council had engaged NSW Public Works (PW) to undertake a Dam Surveillance Report and PW are also Council's nominated dam experts.</p> <p>Council is required to maintain a Safety Management System (SMS), an Emergency Plan (EP) and an Operations and Maintenance Plan (O&amp;M) for the dam. All three of these are current. In addition, 5 yearly precise surveys are required, 10 yearly post tension cable lift testing and thrice weekly status inspections are required. All of these requirements are currently being met.</p>
<b>Work Health and Safety Act 2011 and WHS Regulation 2011</b>	
This Act has an objective to provide a consistent framework to secure the health and safety of workers and workplaces.	Council maintains HSEQ accreditation.
<b>Fluoridation of Public Water Supplies Act (1957)</b>	
This Act covers the addition of fluoride to public water supply under the NSW Fluoridation Code of Practice.	<p>The fluoridation systems at all water supply schemes comply with the code. Council advises that the requirement for periodic auditing is still not being met.</p> <p><b>Issue</b></p>

## 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.

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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.

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).

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 when this project had commenced. Council now has a centralised records management system in ECM where plant field sheets are scanned and imported. Key data is also transcribed into spreadsheets for use in regulatory reporting. GeoSCADA also record key planned data.

Table 2-2: QPRC water supply service objectives and targets

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	80	90
Fire-Fighting:			
Compliance with The Water Supply Investigation Manual	% area served	95	100
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

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DESCRIPTION	UNIT	LEVEL OF SERVICE	
		Target	Current Performance assessed by Council
Total number of interruptions	No./year/1000 tenements	10	8
Response Times (Defined as time to have staff on-site to rectify problem) Note: Times apply for 95% of occasions			
Supply Failure (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	
Non-compliance with DWMS	No./year	0	

Table 2-3: QPRC sewerage service objectives and targets

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)			

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DESCRIPTION	UNIT	LEVEL OF SERVICE	
		Target	Current Performance assessed by Council
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

In addition to the water supply and sewerage specific objectives and targets, Council has additional strategies and policies that need to be considered, examples include:

- QPRC Council Operations Climate Change Action Plan commits Council to a 20% reduction in energy use by 2030 compared with 2017-18 baseline levels, and a 45% reduction in emissions by 2030 compared with 2017-18 levels.
- The Complaints Management Policy
- Enterprise Risk Management Policy.

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### 3 Financial performance and issues

#### 3.1 Water supply services

##### 3.1.1 Tariff structure

Council's water supply fees and charges for 2023/24 are shown in Table 3-1.

Table 3-1: Fees and charges for water supply 2023/24 – Palerang Water Supply Schemes

Fee component	Unit	Potable water – Unit cost
Residential access		
20mm	\$/year	596.00
Non-Residential access		
20mm	\$/year	596.00
25mm	\$/year	931.00
32mm	\$/year	1,526.00
40mm	\$/year	2,385.00
50mm	\$/year	3,726.00
65mm	\$/year	6,297.00
80mm	\$/year	9,537.00
100mm	\$/year	14,903.00
150mm	\$/year	33,532.00
Usage		
Potable	\$/kL	3.81

The usage charge for the Googong and Queanbeyan supplies was \$4.48 in 2023/24, this is slightly higher than the charge for the communities in the former Palerang Shire of \$3.81.

#### 3.2 Sewerage services

##### 3.2.1 Council's tariff structure

All rateable land categorised as residential (including strata units) within the areas of Bungendore, Braidwood and Captains Flat sewerage supply schemes will be charged for each water supply service that is connected to the property. Land that is vacant with no existing premises connected to the Council water supply will be charged the equivalent to the annual sewerage access charge.

The sewerage fees and charges are shown in Table 3-2. The data was obtained from Council's 2023-2024 revenue policy.

Table 3-2: Fees and charges for sewerage 2023/24- Palerang Water Supply Schemes

Fee component	Unit	Unit cost
Residential	\$/year	1,214
Non-residential		
20mm	\$/year	1,399

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25mm	\$/year	2,186
32mm	\$/year	3,581
40mm	\$/year	5,596
50mm	\$/year	8,744
65mm	\$/year	14,777
80mm	\$/year	22,384
100mm	\$/year	34,975
150mm	\$/year	78,694

The usage charge for non-residential users is calculated based on the water billing data and a discharge factor.

### 3.2.2 Liquid Trade Waste Policy

Council's current Liquid Trade Waste (LTW) Policy requires all individuals wishing to discharge liquid trade waste to obtain Council's approval. Fees and charges for liquid trade waste for 2023/24 is shown in Table 3-3.

Table 3-3: Liquid Trade Waste charges

Fee component	Unit	Unit cost
Application Fee— Category 1	\$ per year	102.51
Application Fee— Category 2	\$ per year	205.02
Application Fee— Category 3	\$ per year	685.13

Category 1 liquid trade waste dischargers are those conducting an activity deemed by Council as requiring nil or only minimal pre-treatment equipment and whose effluent is well defined and of a relatively low risk to the sewerage system. These users include food preparation (that do not generate oily/greasy waste), and other commercial activities such as animal wash, dental surgery etc. Some users are categorised to be '1A' dischargers, where pre-treatment is required, but overall impact on the sewerage system is low (examples include laundry, cooling tower, vehicle washing).

Category 2 liquid trade waste dischargers are those conducting an activity deemed by Council as requiring a prescribed type of liquid trade waste pre-treatment equipment and whose effluent is well characterised. These users include food preparation that serve hot food or foods that generate oily/greasy waste, and other commercial Classification A activities such as car detailing, dental surgery with X-ray etc. Some users are categorised as Classification B activity, which includes users such as hospital, shopping complex, auto dismantler etc.

Category 3 dischargers are those conducting an activity which is of an industrial nature and/or which results in the discharge of large volumes (over 20 kL/d) of liquid trade waste to the sewerage system. Any Category 1 or 2 discharger whose volume exceeds 20 kL/d becomes a Category 3 discharger, except shopping complexes and institutions (for example hospitals, educational facilities, correctional facilities, etc). Users include abattoir, food processing, dairy processing etc.

## 4 Population and development

### 4.1 Historical Population

The Palerang Communities portion of the Queanbeyan-Palerang LGA consists of three main urban centres of Bungendore, Braidwood, and Captains Flat and surrounding rural areas. Council has advised that the Captains Flat growth has not changed much since the last IWCN Strategy, hence only the growth for just Bungendore and Braidwood was reviewed. The historical population of Historical Queanbeyan Palerang LGA have been obtained from the Australian Bureau of Statistics (ABS) Census data [2].

The historical Estimated Resident Population (ERP) for the Queanbeyan Palerang LGA is presented in Figure 4-1, split between Queanbeyan and surrounds and the rest of the LGA. The ABS ERP is released every year and uses data from several sources, including the Census and information provided by Council. [3] The 2023 population estimate was released on the 26 March 2024.

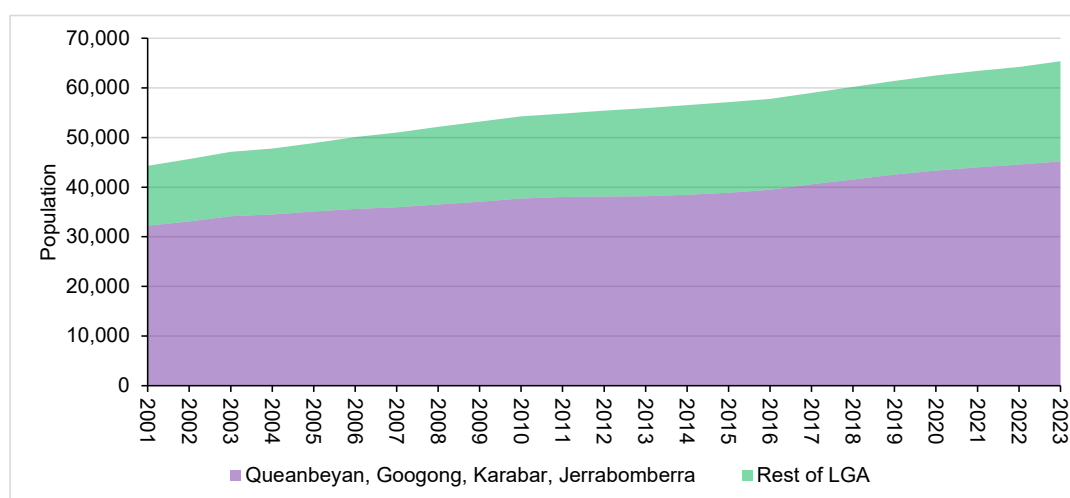


Figure 4-1: Historical Queanbeyan Palerang LGA estimated residential population.

Table 4-1: Population growth since 2001 in Queanbeyan and surrounds

		2001	2006	2011	2016	2021	2023
Queanbeyan, Googong, Karabar, Jerrabomberra	Population	32,222	35,614	38,032	39,494	44,022	45,227
	% annual growth		2.0%	1.3%	0.8%	2.2%	1.4%
Rest of LGA	Population	12,067	14,456	16,812	18,296	19,382	20,142
	% annual growth		3.7%	3.1%	1.7%	1.2%	1.9%
LGA	Population	44,289	50,070	54,844	57,790	63,404	65,369
	% annual growth		2.5%	1.8%	1.1%	1.9%	1.5%

The population growth in Queanbeyan and surrounds has been quite high, varying between 0.12% and 3.18% per year. The growth in the rest of the LGA has slowed from over 3% per year between 2001 and 2011 to an average of 1.9% over the last three years, this may be due to moratorium on the development of new subdivisions in Bungendore until additional water is secured

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The historical population for the Urban Centres is presented in Figure 4-1. This data is obtained from the ABS census data releases [2].

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	2021	2001 to 2006	2006 to 2011	2011 to 2016	2016 to 2021	
Bungendore	1,685	2,183	2,754	3,320	3,935	5.32	4.76	3.81	3.46	4.33
Braidwood	996	1,108	1,158	1,276	1,414	2.15	0.89	1.96	2.08	1.77
Captains Flat	419	447	436	449	473	1.30	-0.50	0.59	1.05	0.61

Table 4-3 outlines the historical household size and occupancy ratio recorded by ABS over the past five Censuses [2]. Household size is expressed in terms of occupants per occupied dwellings i.e. people per household. The following trends in household size are notable:

- Bungendore household size has remained close to 2.9.
- Braidwood household size was stable at about 2.3 until recently when it decreased to 2.12.
- Captains Flat household size has been generally close to 2.3.

Table 4-3: Historical Household Size and Occupancy Ratio

Area	Household Size *					% of dwellings occupied*				
	2001**	2006**	2011	2016	2021	2001**	2006**	2011	2016	2021
Bungendore	2.9	2.9	2.89	2.96	2.92	94%	92%	92.7%	93.6%	95.9%
Braidwood	2.3	2.3	2.28	2.28	2.12	80%	83%	84.5%	88.6%	86.3%
Captains Flat	2.3	2.3	2.29	2.22	2.33	83%	96%	88.3%	87.6%	87.1%

\* Dwellings include houses, townhouses, semidetached, flats and units

\*\* Sourced from the ABS QuickStats service, no additional decimal places available

Note that due to the percentage of dwellings occupied this is equivalent to 2.8 people per dwelling in Bungendore, 1.8 people per dwelling in Braidwood and 2.0 people per dwelling in Captains Flat.

The 2021 household size for detached dwellings is summarised in Table 4-5. This is important as a detached dwelling is the basis of the water and sewer developer charges.

Table 4-4: Household size for detached dwellings

Town	Bungendore	Braidwood	Captains Flat
Household size	2.94	2.21	2.34

The reported decline in the percentage of dwellings occupied in Braidwood (from 88.6% in 2016 to 86.3% in 2021) may be due to the residents having additional difficulty in completing the Census due to the reduces assistance available due to COVID-19 travel restrictions.

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Council has adopted an assumed dwelling capacity of 3 people per lot for Bungendore (slightly higher than the current 2.92) in the structure plan.

In Bungendore, the percentage of dwellings occupied in 2021 was 95.9%, this indicates that there is likely to be significant housing stress as residents cannot easily find a new home when their needs change. Historically, 90% of dwellings occupied has been regarded as an optimum level of dwelling occupancy.

There are two main sources of Census data used in this analysis, the General Community Profile and a custom export from the table builder system. The General Community Profile provides the total population, the number of occupied dwellings by dwelling type, the total number of un-occupied dwellings (not split by type) and the number of people living in each dwelling type. The Table builder system provides the number of occupied, unoccupied and total dwellings, all by dwelling type. Unfortunately, the total occupied dwellings and total dwellings exported from each system is markedly different as summarised in Table 4-5. The difference between the two data sets is greater than that usually observed.

Table 4-5: ABS dwelling data comparison

	General community profile							Table Builder						
	Occupied dwellings					Un-occupied	Total	Occupied dwellings					Un-occupied	Total
	Detached	Semi-detached	Units	Other + not stated	Total			Detached	Semi-detached	Units	Other + not stated	Total		
Bungendore	1,215	50	19	5	1,301	79	1,367	1,259	56	17	9	1,341	67	1,408
Braidwood	498	66	6	16	579	99	672	542	68	3	19	632	86	718
Captains Flat	183	3	0	0	186	33	216	192	3	0	0	195	33	228

In general, data from the general community profile is used to estimate the population and household size, and the table builder data is used to estimate the percentage of dwellings occupied as there is un-occupied dwelling data by dwelling type. It is very common for the percentage of dwellings occupied to vary significantly between houses, semi-detached dwellings and units.

## 4.2 Serviced Population and Dwellings

The service area private dwelling numbers were estimated using Council's water billing data.

The number of occupied dwellings connected to water or sewerage is approximately equal to the number of "active" residential assessments in the customer water billing data that are within the boundaries of the serviced area. An "active" residential assessment was one that had an average usage of at least 60 L/assessment/day. Most of the dwellings in blocks of flats and units (and businesses in commercial strata developments) have individual assessments and water meters.

The service area of each scheme is described in further detail in the relevant Sections 5 to 10.

The serviced area population was estimated by multiplying the number of "active" residential assessments by the estimated average household size for each community from the 2021 ABS Census [2] (see Table 4-3).

The historical residential active, inactive, and total assessments, along with the estimated private dwelling serviced population (calculated from the average detached dwelling household size multiplied by the number of assessments) is summarised for Bungendore in Table 4-6. The census occurred during August 2021 (read

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period 2022-1, the first read period of the 2021/22 financial year). For Bungendore, the ABS estimates that there were 1,289 occupied and 78 unoccupied (total 1,367) houses, semi-detached dwellings, flats and units. It is likely that there some vacant residential assessments (contributing to there being more than twice the number of inactive residential assessments than there are vacant dwellings) and about occupied 156 dwellings that are still on shared assessments.

Table 4-6: Historical residential assessments and serviced population Bungendore

Read periods			2018-2 to 2019-1	2019-2 to 2020-1	2020-2 to 2021-1	2021-2 to 2022-1	2022-2 to 2023-1
Water	Residential Assessments	Active	1,054	1,066	1,128	1,176	1,187
		Inactive	215	214	189	202	223
		Total	1,269	1,280	1,317	1,378	1,410
	Additional dwellings		156	156	156	156	156
	Serviced private dwelling population		3,533	3,568	3,749	3,889	3,921
	Population in other dwellings		46	46	46	46	46
	Serviced population		3,579	3,614	3,795	3,935	3,967
Sewer	Residential Assessments	Active	997	1,006	1,060	1,107	1,118
		Inactive	199	199	179	191	211
		Total	1,196	1,205	1,239	1,298	1,329
	Additional dwellings		156	156	156	156	156
	Serviced private dwelling population		3,367	3,393	3,550	3,688	3,720
	Population in other dwellings		46	46	46	46	46
	Serviced Population		3,412	3,439	3,596	3,734	3,766

The historical residential active, inactive, and total assessments, along with the estimated private dwelling serviced population (calculated from the average detached dwelling household size multiplied by the number of assessments) is summarised for Braidwood in Table 4-7

Table 4-7: Historical residential assessments and serviced population Braidwood

Read periods			2018-2 to 2019-1	2019-2 to 2020-1	2020-2 to 2021-1	2021-2 to 2022-1	2022-2 to 2023-1
Water	Residential Assessments	Active	441	429	439	454	497
		Inactive	172	185	180	170	138
		Total	613	614	619	624	635
	Additional dwellings		116	116	116	116	116
	Serviced private dwelling population		1,181	1,156	1,177	1,209	1,300
	Population in other dwellings		205	205	205	205	205

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Read periods			2018-2 to 2019-1	2019-2 to 2020-1	2020-2 to 2021-1	2021-2 to 2022-1	2022-2 to 2023-1
Sewer	Served Population		1,386	1,361	1,382	1,414	1,505
	Residential Assessments	Active	397	387	396	413	454
		Inactive	157	168	162	149	119
		Total	554	555	558	562	573
	Additional dwellings		116	116	116	116	116
	Served private dwelling population		1,088	1,067	1,086	1,122	1,209
	Population in other dwellings		205	205	205	205	205
	Served Population		1,293	1,272	1,291	1,327	1,414

The historical residential active, inactive, and total assessments, along with the estimated private dwelling served population (calculated from the average detached dwelling household size multiplied by the number of assessments) is summarised Captains Flat in Table 4-8. An extra 2-meter reading periods of data were provided for Captains Flat, therefore the time period used for the Captains Flat assessment is slightly different than that for Braidwood and Bungendore, as additional data was requested to assess the rectification of some problems identified during the project.

Table 4-8: Historical residential assessments and served population Captains Flat

Read periods			2019-1 to 2019-4	2020-1 to 2020-4	2021-1 to 2021-4	2022-1 to 2022-4	2023-1 to 2023-4
Water	Residential Assessments	Active	166	189	196	193	190
		Inactive	75	52	45	48	34
		Total	241	241	241	241	224
	Additional dwellings		7	7	7	7	7
	Served private dwelling population		403	456	473	466	459
	Population in other dwellings		7	7	7	7	7
	Served population		410	464	480	473	466
Sewer	Residential Assessments	Active	158	181	187	187	182
		Inactive	72	49	43	43	33
		Total	230	230	230	230	215
	Additional dwellings		7	7	7	7	7
	Served private dwelling population		384	438	452	452	440
	Population in other dwellings		7	7	7	7	7
	Served population		392	445	459	459	447



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### 4.3 Visitor Contribution

#### 4.3.1 Accommodation providers

Limited commercial visitor accommodation is available in Bungendore, Braidwood and Captains Flat. Council's 2017-2025 Tourism Plan states that:

- The major category of visitor accommodation is 'a friend's or relative's property'.
- There is a lack of a range of accommodation types and accommodation capacity.

The main commercial visitor accommodation in Bungendore is:

- Carrington Inn (22 rooms and 4 suites).
- Lake George Hotel (7 motel rooms and 1 cabin).
- The Showground provides powered and unpowered campsites although is outside of both the water and sewerage serviced areas

The main visitor accommodation in Braidwood is:

- Colonial Motel (10 rooms).
- Cedar Lodge Motel (10 rooms).
- Royal Mail Hotel (16 rooms).
- The Showground provides powered and unpowered campsites and does have access to reticulated town water but not sewerage.

Captains Flat:

- Captains Flat Hotel has 19 rooms, it reopened in June 2024 after being closed since 2020.
- Informal camping is available at Captains Flat Park.

The projections do not currently include an increase in visitor accommodation capacity.

#### 4.3.2 Seasonal visitor statistics

Between 2012/13 and 2015/16, the Bureau of Statistics collected and published monthly visitor accommodation data from hotels, motels, and serviced apartment complexes with 15 or more rooms. No data was published for the Braidwood region (including Captains Flat) or the Queanbeyan Region (including Bungendore) as there were insufficient accommodation providers of the required size for the data to be published without breaking confidentiality. The area of interest is in "Capital Country" tourism region. There was comparatively little variability in the average room occupancy in the region, (between 0.74 and 1.22 people per room per night) with the highest occupancy in spring (especially in September), medium occupancy in autumn and lower occupancy in winter and summer.

Based on this data there is no evidence that the summer peak water demands are likely to be impacted significantly by higher-than-average visitor numbers.

### 4.4 Growth distribution

#### 4.4.1 Timing of growth

Council has adopted a structure plan for Bungendore [4] and is in the process of developing the Structure Plan for Braidwood. The structure plans provide forecasts for population and dwelling growth in these communities. No growth is projected in Captains Flat.

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The population of Bungendore is projected to grow at 3.3% per year. All the growth in Bungendore is expected to be housed in new detached dwellings. The new dwellings are expected to house 3 people per dwelling.

The population of Braidwood is expected to grow at 2.5% per year. The new houses in Braidwood are expected to house 2.2 people per dwelling, and the new villa homes or flats are expected to house 1.5 people per dwelling.

#### 4.4.2 Bungendore residential greenfield subdivisions

The initial Bungendore Structure Plan 2048 contains a map of the proposed residential investigation areas. Since the structure plan was completed, Council has revised the growth expectations for these areas. The priority areas are mapped in Figure 4-2.

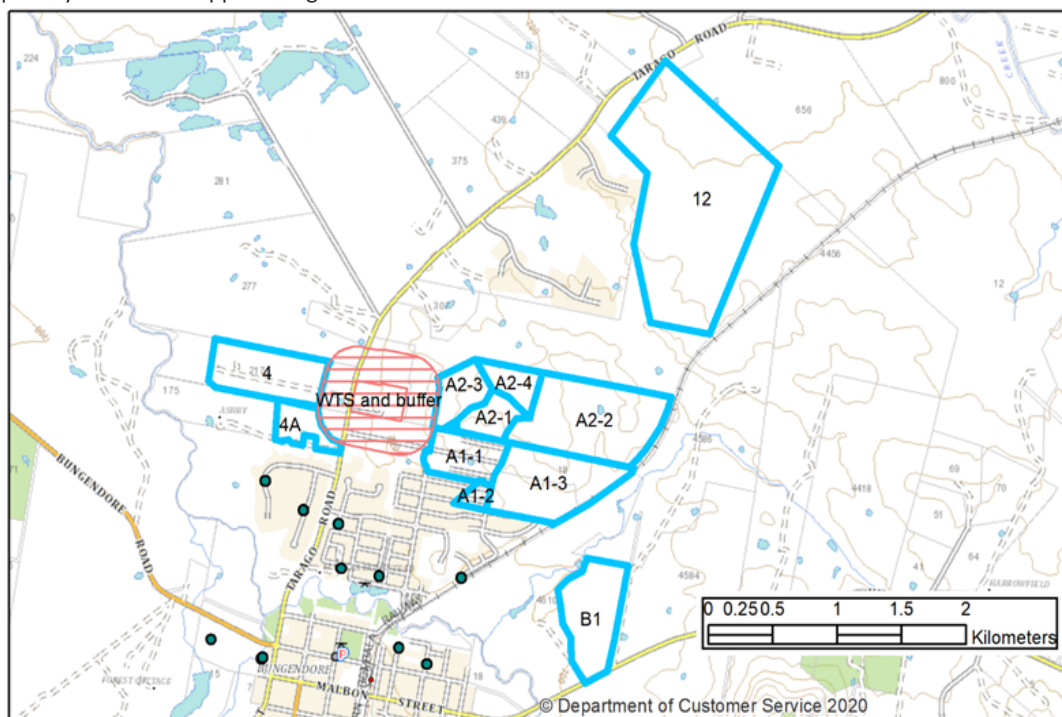


Figure 4-2: Bungendore planned subdivisions and investigation areas

Some of the development areas cannot be serviced using either existing reservoirs and/or sewage pumping stations (SPS). Development area 12 will require a new reservoir, its named New Currandooley Reservoir in this report. The new SPSs are designated New1 to New 5. The lot yields, reservoir zones and sewage pumping station catchments are summarised in Table 4-9. Note that only part of investigation area 4 and none of investigation area 12 are expected to be developed within the next 30 years, all other zones will be fully developed.

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Table 4-9: Bungendore planned subdivisions and investigation areas

Investigation area or subdivision	Reservoir zone	SPS	Priority	Structure Plan (22/01/20)	Expected Growth in Bungendore (9/03/23)	Subdivision Plan	Total
A1 - Elm Grove Estate	North Elmslea Reservoir	SPS7	3	300	80	66	146
		SPS9	1		0	25	25
		SPS10	2		0	260	260
A2 - Elm Grove North	North Elmslea Reservoir	SPS7	7	789			95
		SPS10	8				118
		New3, Pumps to SPS7	9				95
		New4, Pumps to New3	10				481
B1	North Elmslea zone 2	New 1, Pumps to SPS2	5	327			327
4	North Elmslea Reservoir	New 2, Pumps to SPS6	6	1,148			1,148
4A	Days Hill	SPS6	4	117	250		250
12	New Currandooly Reservoir	New5, Pumps to New3	11	1,809			1,809
Total							4,754

#### 4.4.3 Bungendore residential infill

In November 2022 Council estimated that there were 175 vacant subdivided lots within Bungendore suitable for infill development [4].

For the purposes of the projection NSW PW has assumed that 4 infill lots will be developed per year (120 over 30 years). Based on the 2024 aerial photos on Google Maps, it's estimated that:

- 60 lots are in SPS catchment 4 and Turallo reservoir zone.
- 32 lots are in SPS catchment 2 and Turallo reservoir zone.
- 5 lots are in SPS catchment 3 and Turallo reservoir zone.
- 8 lots are in SPS catchment 7 and Days Hill reservoir zone.
- 15 lots are in SPS catchment 1 and Turallo reservoir zone.

#### 4.4.4 Bungendore non-residential growth

The Bungendore Structure Plan (22/01/20) [4] states that additional employment lands are required and that a separate plan needs to be developed to select suitable locations. Therefore, for the water and sewer

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projections, the non-residential growth has been assumed to occur at the same rate as the residential population growth and be distributed between service areas proportionally to the existing non-residential loads.

Council has completed stage 1 of the Bungendore Sports Hub. This consists of four hard surface netball courts, two turf fields (irrigated using treated effluent), and a facility building with public toilets, change rooms, a kiosk and a multi-use room. The facility building is sewered using a small sewage pumping station (SPS 11) that pumps into the SPS1 gravity catchment. Further stages of the hub are planned, including a Men's Shed, and an indoor aquatic centre (the aquatic centre is currently un-funded). When this occurs, Council will need to upgrade the pump in SPS11. The current projection includes a relatively generous sewage load for the current facilities and other minor users and these loads are assigned straight on SPS1.

Once the aquatic centre is built, it is expected to have a similar sewage load to the existing Bungendore Pool (which will close). The water demands for the new aquatic centre are expected to be slightly higher overall as it will operate all year round, though the peak summer demands may be slightly lower as there will be less evaporation.

SPS11 will be added to the analysis in future studies as will changes to the water demand and sewage loads due to the switch from the outdoor pool to the indoor pool.

#### 4.4.5 Braidwood residential growth

Council released a discussion paper for the Braidwood Structure Plan In 30 January 2023 [5]. The plan includes a map of the infill development potential and a description of the dwelling capacity calculation method. The mapped lots were cross referenced with the current Google aerial photos to check whether any had already been developed. The potential number of dwellings on these lots were estimated using the same assumptions as listed in the zoned R2 (low density residential):

- The minimum lot size is 850 m<sup>2</sup> though there is a preference for lots of around 1,000 m<sup>2</sup> (based on the recent Braidwood Ridge development)
- Any lot under 1,900 m<sup>2</sup> will be developed into a single dwelling.
- Any lot between 1,700 m<sup>2</sup> and 2550 m<sup>2</sup> will be subdivided into 2 lots.
- Lots larger than 2,550 m<sup>2</sup> will be subdivided into lots with a minimum area of 1,000 m<sup>2</sup> with a 21% allowance for roads, drainage, and other communal uses.

The exemption to this is Maddrell Place, which has already been subdivided into 10 lots.

The only area zoned R1 (general residential) is 29-31 Coronation Ave, this lot is expected to be developed into 29 two-bedroom units. For the purpose of the projection, it is assumed that these dwellings will come online between 2031 and 2035 and will have separate water and sewer assessments (rather than a shared meter for the development).

The infill lots are mapped in Figure 4-3.

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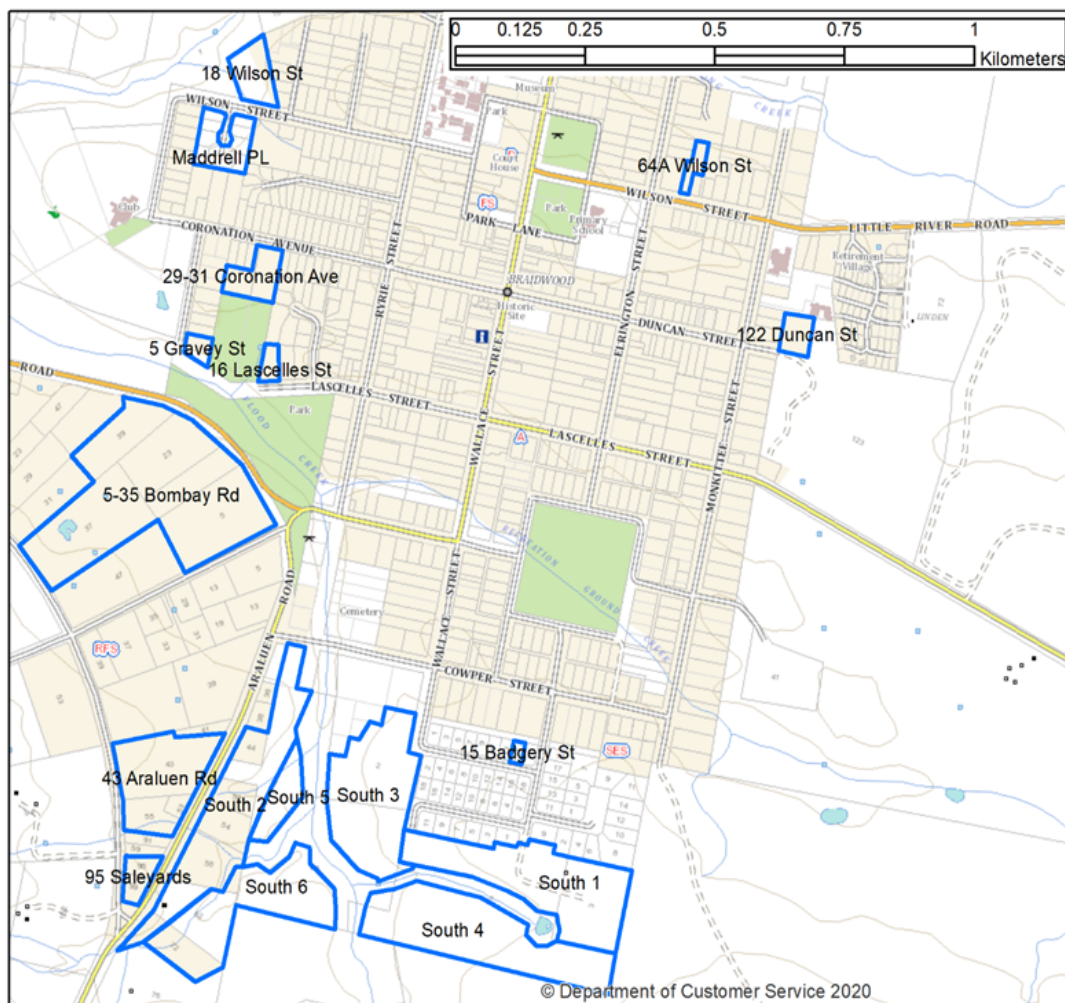


Figure 4-3: Braidwood residential infill

The area, capacity, and order of development for the Braidwood infill lots are summarised in Table 5 8. As with Bungendore, some of the development areas are unable to be serviced using existing SPSs, the new SPS are named New 1 and New 2.

Table 4-10: Braidwood detached dwelling infill lots

Name	SPS	Area (m2)	Capacity	Order of development
15 Badgery St	SPS1	928	1	1
5 Garvey St	SPS1	2,250	2	2
16 Lascelles St	SPS1	2,291	2	3
64A Wilson St	SPS1	2,418	2	4
122 Duncan St	SPS1	4,081	3	5
95 Saleyards	SPS6	4,514	3	6

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Name	SPS	Area (m2)	Capacity	Order of development
18 Wilson St	SPS2	7,629	6	7
Maddrell PL (10 lots)**	SPS2	9,403	7	8
43 Araluen Rd	SPS6	27,248	21	9
5-35 Bombay Rd	SPS5	88,863	70	10
South 1	SPS1	44,004	34	11
South 2	SPS6	46,343	36	12
South 3	New1	40,001	31	13
South 4	New1	46,385	36	14
South 5	New2	8,365	6	15
South 6	New2	36,437	28	16
Total			317	

\* this lot is zoned R1 and will be developed into 29 2-bedroom units

\*\* this lot has already been subdivided

In addition to the infill lots, there are still some lots in Braidwood Ridge that are yet to be developed. Braidwood Ridge is a development area to the south of Braidwood including Badgery St, Nomchong St, Elrington St, and Coffey St. The first lots were released in about 2017. The development will end up with about 100 lots, of these lots 52 have already been subdivided and at least 28 have already had homes built (an average of more 4.6 dwellings per year). Of the subdivided lots, only one is marked for infill development, therefore it is assumed that the others have already been constructed or Council has received development applications.

For the purposes of the population and loading projection, it is assumed that between 2021/22 and 2023/24, 5 dwellings per year were built at Braidwood Ridge (15 over the three years).

The development of the Summerfield in Braidwood retirement village (70 Little River Rd) had just started when the data for this project was provided. The village will have 56 units and semi-detached villa homes with two or three bedrooms each and a range of community facilities including a swimming pool. For the projections, it has been assumed that these dwellings will house an average of 1.5 people, have two bedrooms and will be developed between 2023 and 2030. Braidwood SPS7 has been built to service this development.

Council has started planning for the additional growth expected. The areas currently being considered for long term growth are mapped in Figure 4-4.



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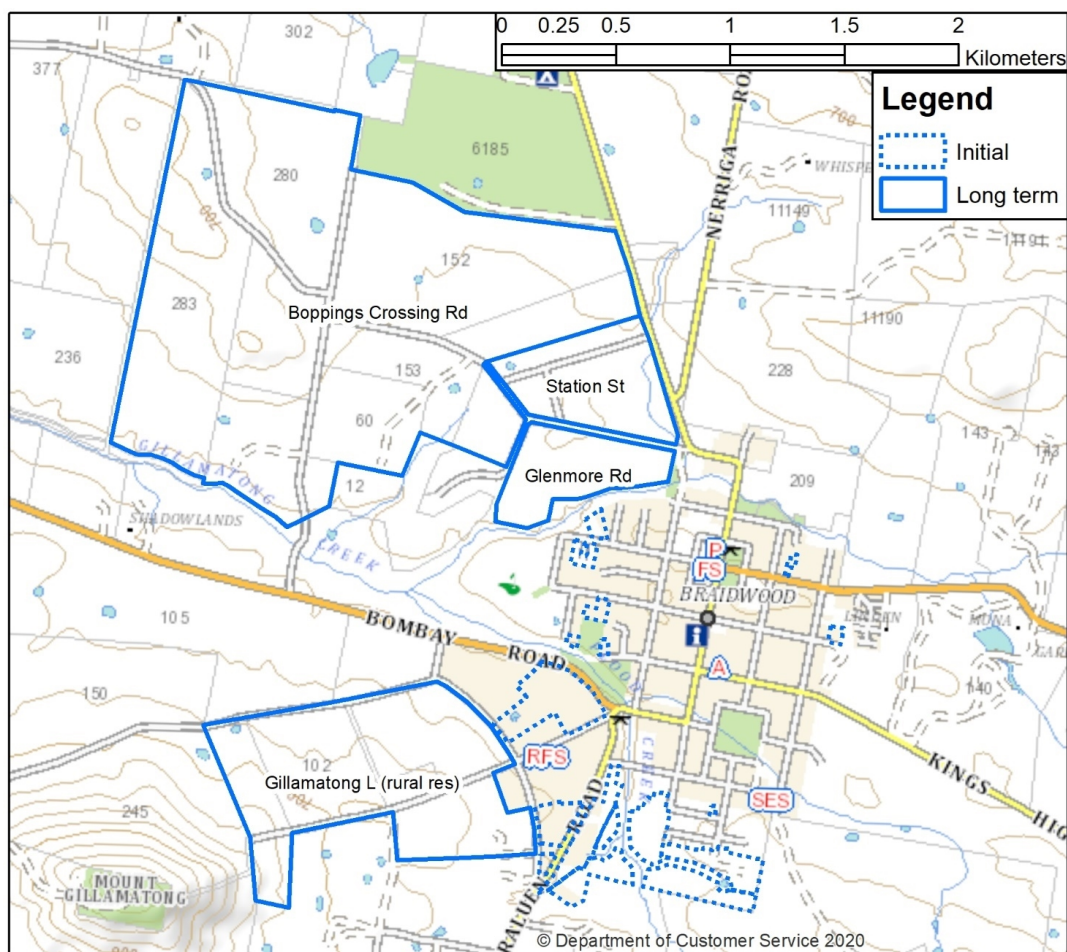


Figure 4-4: Braidwood long term growth areas

The area, capacity, and order of development for the Braidwood long term growth areas are summarised in Table 4-11. As with the initial growth, Boppings Crossing Road will be unable to be sewered using the existing SPS, the new SPS is named New 3. Areas of Boppings Crossing Road will also need a separate water reservoir due to the elevation,

Table 4-11: Braidwood long-term growth areas

Name	SPS	Area (ha)	Capacity	Order of development
Station St	SPS 2	28	274	1
Gillamatong L (rural res)	SPS 5	80	32	Parallel with 1
Glenmore Rd	SPS 4	20	235	2
Boppings Crossing Rd	New 3	261	Unknown	4

Based on the 2.5% per year population growth rate for Braidwood (discussed in 4.4.1), 727 new dwellings are required between 2021 and 2054. These will consist of 15 new dwellings at Braidwood Ridge in the areas

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already subdivided, 317 infill dwellings, and an additional 399 dwellings in the long-term growth areas. Station St and Gillamatong are expected to be fully developed, these three areas can be serviced using existing the existing reservoir and existing sewage pumping stations.

The Glenmore Road development area is not required within the life of this study and can be served using the existing reservoir SPS pumping stations.

#### 4.4.6 Major events

The QPRC 2018-2025 events strategy splits events into three categories:

1. Category 1 events have the primary purpose of enhancing community inclusion and social engagement within the Local Government Area. They also include events that are undertaken by Council to meet civic responsibility. These events include Australia Day, Seniors Week and the annual Reconciliation Walk. Based on the information provided, these events are not expected to draw significant numbers of visitors from outside the area.
2. Category 2 events include events or festivals with the primary purpose of:
  - a. celebrating local culture and/or promoting the liveability of the Local Government Area or
  - b. activating spaces and places in town and city centres; that inspire creativity and vivacity in public realm and contribute to economic and social activity in central business districts.These events include community Christmas parties, the annual multicultural festival and Christmas in July Markets. This category of events is not expected to attract significant numbers of attendees from outside the area.
3. Category 3 events include events or festivals with a primary purpose to showcasing and attracting visitors to the region. These events focus on creating significant economic and/or visitor generation within the Local Government Area. These events include performances by the Canberra Symphony Orchestra and major sporting fixtures. The events listed appear to be mostly based in Queanbeyan.

None of the events listed in the strategy are expected to draw significant numbers of visitors to Bungendore, Braidwood or Captains Flat, though there may be some overflow from major events in Queanbeyan or Canberra.

There are also local events that are not listed in the events strategy including the:

- Braidwood Agricultural Show (held in March)
- Bungendore Agricultural Show (held in October).

Local agricultural shows typically attract many overnight visitors, though a large proportion camp at the show grounds.

Up until January 2020, Council published monthly event guides. These do not appear to have recommenced since the COVID-19 event restrictions were lifted. Therefore, it is difficult to assess which major events have continued.

## 4.5 Projections

### 4.5.1 Population and dwelling projection

The town population projection and the new dwelling projection are summarised in Table 4-12 and the serviced population and residential assessment projection is summarised in Table 4-13.



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Table 4-12: Bungendore and Braidwood population and dwelling growth projection

		2021	2024	2026	2031	2036	2041	2046	2051	2054
Population growth rate	Bungendore		3.30%	3.30%	3.30%	3.30%	3.30%	3.30%	3.30%	3.30%
	Braidwood		0.80%	0.80%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Average population	Bungendore	3,935	4,338	4,629	5,444	6,404	7,533	8,860	10,422	11,488
	Braidwood	1,416	1,450	1,474	1,667	1,886	2,134	2,415	2,732	2,942
Additional people	Bungendore		403	694	1,509	2,469	3,598	4,925	6,487	7,553
	Braidwood		34	58	251	470	718	999	1,316	1,526
Household size for new dwellings	Bungendore		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	Braidwood (houses)		2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
	Braidwood (flats & townhouses)		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
New dwellings required	Bungendore		134	231	503	823	1,199	1,642	2,162	2,518
	Braidwood		6	7	21	86	199	327	471	566
New Flats & townhouses	Bungendore		0	0	0	0	0	0	0	0
	Braidwood		6	13	62	85	85	85	85	85
New Detached Dwellings	Bungendore		134	231	503	823	1,199	1,642	2,162	2,518
	Braidwood		6	7	21	86	199	327	471	566

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Table 4-13: Bungendore and Braidwood serviced population and residential assessments projection

		2021	2024	2026	2031	2036	2041	2046	2051	2054
Water serviced population	Bungendore	3,935	4,338	4,629	5,444	6,404	7,533	8,860	10,422	11,488
	Braidwood	1,416	1,450	1,474	1,667	1,886	2,134	2,415	2,732	2,942
Water serviced active residential assessments	Bungendore	1,128	1,233	1,330	1,602	1,922	2,298	2,741	3,261	3,617
	Braidwood	439	497	508	571	659	772	900	1,044	1,139
Water serviced inactive residential assessments	Bungendore	189	223	223	223	223	223	223	223	223
	Braidwood	179	211	211	211	211	211	211	211	211
Total water serviced residential assessments	Bungendore	1,317	1,456	1,553	1,825	2,145	2,521	2,964	3,484	3,840
	Braidwood	618	708	719	782	870	983	1,111	1,255	1,350
Sewer serviced population	Bungendore	3,736	4,136	4,427	5,242	6,202	7,331	8,658	10,220	11,286
	Braidwood	1,325	1,359	1,383	1,576	1,795	2,043	2,324	2,641	2,851
Sewer serviced active residential assessments	Bungendore	1,060	1,164	1,261	1,533	1,853	2,229	2,672	3,192	3,548
	Braidwood	396	454	465	528	616	729	857	1,001	1,096
Sewer serviced inactive residential assessments	Bungendore	179	211	211	211	211	211	211	211	211
	Braidwood	162	119	119	119	119	119	119	119	119
Total sewerred residential assessments	Bungendore	1,239	1,375	1,472	1,744	2,064	2,440	2,883	3,403	3,759
	Braidwood	558	573	584	647	735	848	976	1,120	1,215



5 Bungendore water supply scheme

5.1 Raw water source

5.1.1 Water resource

Bungendore relies on groundwater sourced from alluvial paleo drainage channels in two sub-catchments for its water supply. These two are Turallo Creek and Butmaroo Creek. The Lake George Basin is to the north of the site area with associated channels and alluvial flats extending south. Groundwater is primarily recharged by local rainfall infiltration and runoff. In recent history, groundwater levels have a high Standing Water Level (SWL), however there have been low rainfall events in the past 10 to 15 years.

5.1.2 Raw water extraction

The main water source consists of four bores located at Turallo bore fields with NSW Office of Water approved entitlement of 322 ML. Currandooly consists of one bore at Butmaroo Creek with an approved entitlement of 150 ML, where raw water is transferred through a 1.8 km raw water rising main, a water treatment plant located on the Tarago Road about 5 km north of Bungendore.

Capacities of assets for raw water extraction for Bungendore and Currandooly are as follows:

Table 5-1: Bungendore raw water extraction asset’s capacities

Asset	Capacity (L/s)
Bungendore	
Bore 1	11.5
Bore 2	14.6
Bore 3	6.5
Bore 6	16.25
Currandooly	
Bore	20.5

A map of the raw water bores and the Bungendore WTP is shown in Figure 5-1.

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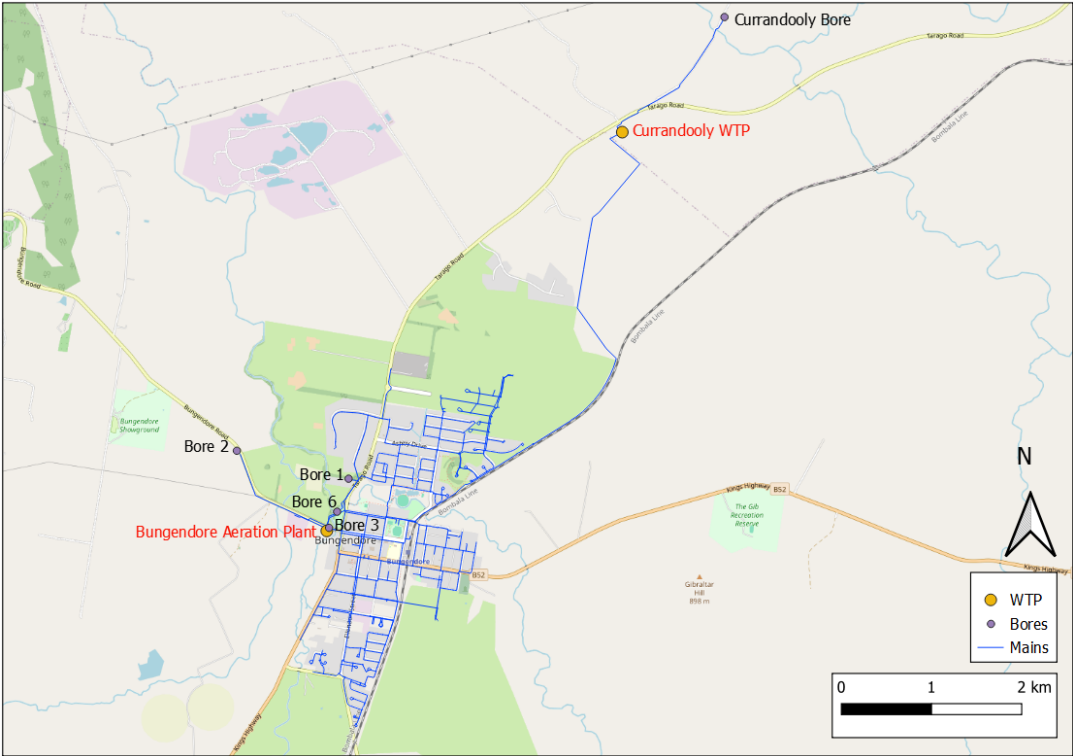


Figure 5-1: Location of raw water intake for Bungendore WTP

5.1.3 Water access licences

Council holds Local Water Utility Water Access Licenses (WAL32742 and WAL36260), issued under the Water Management Act 2000, which relate to the water supply to Bungendore. The following apply to the WALs:

Table 5-2: WAL Licence numbers

WAL license number	WAL32742	WAL36260
Category [Subcategory]	Local Water Utility	Local Water Utility
Entitlement	322.0 ML/year	150.0 ML/year
Water Source	Bungendore Alluvial Groundwater Source	Bungendore Alluvial Groundwater Source
Water Sharing Plan (WSP)	Murrumbidgee Alluvial Groundwater Sources 2020	Murrumbidgee Alluvial Groundwater Sources 2020
Works approval	40CA412631	40CA415918

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WAL32742 is from the Bungendore alluvial source. It includes approvals to 4 town-based bores which all supply the aeration tower. WAL36260 is associated with the Currandooley bore and supplies the Currandooley WTP.

#### 5.1.4 Source water quality

Raw water quality was sampled between March 2014 and March 2023 approximately once every quarter. The samples are collected both at the intake to the aeration plant and for the Currandooley bores.

Typical raw water quality for the Bungendore Bores and Currandooley Bore is shown in Appendix table A-1 and Appendix table A-2 respectively.

The main parameters of interest in the Bungendore bores raw water source are:

- Aluminium - About 18% of the samples contain aluminium in concentrations above the limit of reading.
- Copper - one sample contained relatively high concentrations of copper, it was collected in November 2015 (140 µg/L), this was not during drought, other than this, the samples have been relatively low in copper.
- pH - The pH was frequently quite high but below the ADWG (Australian Drinking Water Guidelines) of 8.5 pH units, 5 out of 37 (14%) samples had a pH of 8.2 pH and above.
- Sodium - Sodium is frequently high but within the ADWG (Australian Drinking Water Guidelines). The highest concentration recorded was 95.1 mg/L, 11 out of 38 of samples contained concentrations of more than 80 mg/L.
- PFAS – in response to a plan to lower the ADWG concentration limits for Polyfluoroalkyl Substances (PFAS) NSW Health funded additional testing for these substances. The testing showed that water extracted from bores 3 and 6 contains concentration of a particular PFAS substance (perfluorooctane sulfonic acid (PFOS)) that is below the current guideline but exceeds the proposed guideline. New **issue**

The main parameters of interest in the Currandooley raw water are:

- Aluminium – one sample collected on 9/12/2014 was exceptionally high in aluminium with a reading of 99.8 mg. Other than this sample, about 33% of the samples contain aluminium in concentrations above the limit of reading.
- Copper – two samples contained relatively high concentrations of copper, one was collected in August 2018 (60 µg/L) and the other in May 2019 (294 µg/L), both were collected during drought, other than this, the samples have been relatively low in copper.
- Iodide – two samples contained relatively high concentrations of iodide (0.24 and 0.17 mg/L), one was collected in December 2021 and the other in December 2022, both wet summers.
- Iron – 29 out of 33 (87%) samples contained above 20 mg/L.
- Lead – during the dry weather in 2017-2019, several samples contained more the 1 µg/L of lead with the highest concentration 36.1 µg/L (
- Manganese – samples generally contain around 500 µg/L.

Based on the results of the reticulation water quality testing undertaken as part of the NSW Health verification program (section 5.3.6), the current treatment systems are removing the aluminium, copper, iodide, iron, lead and manganese.

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## **5.2 Water treatment**

### **5.2.1 Treatment process**

Water from the four Bungendore bores is treated at with the following processes:

- Aerated in the aeration towers
- Chlorine dosing in a 100 kL collection tank.
- Fluoride dosing

Water from the Currandooly bore is treated at the Currandooly WTP using a conventional treatment process:

- Pre-dosing with caustic soda, potassium permanganate and Aluminium Chlorohydrate (ACH)
- Clarification
- Filtration
- Post dosing using gas chlorine for disinfection, caustic soda for pH correction, and fluoride.

A schematic showing an overview of the Bungendore/ Currandooly water supply scheme is provided in Figure 5-2.

## BUNGENDORE DRINKING WATER MANAGEMENT SCHEME

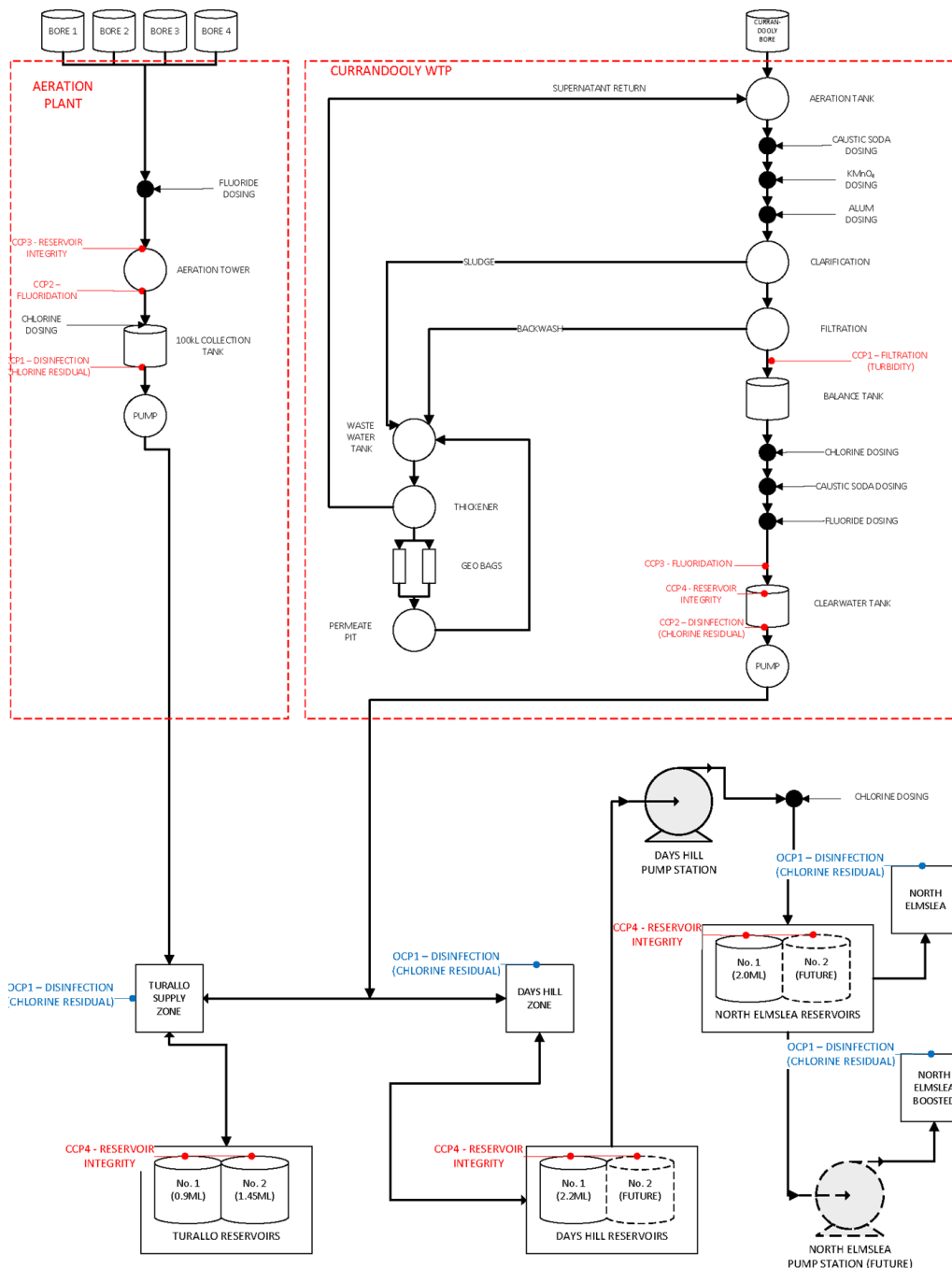


Figure 5-2: Schematic flow diagram of the Bungendore / Currandooley water supply scheme

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### 5.2.2 Historical water production

Bungendore WSS supplies potable water to customers connected to the Bungendore and Elmslea Estate reticulation system. Council provided the potable water production records from July 2001 to February 2023 for both the Bungendore bore aeration plant and the Currandooly WTP. The potable water meters record flow being pumped out of the aeration tower and out of the Currandooly WTP. This data is summarised in Figure 5-3, which also show the stages of water restrictions that were implemented over this period.

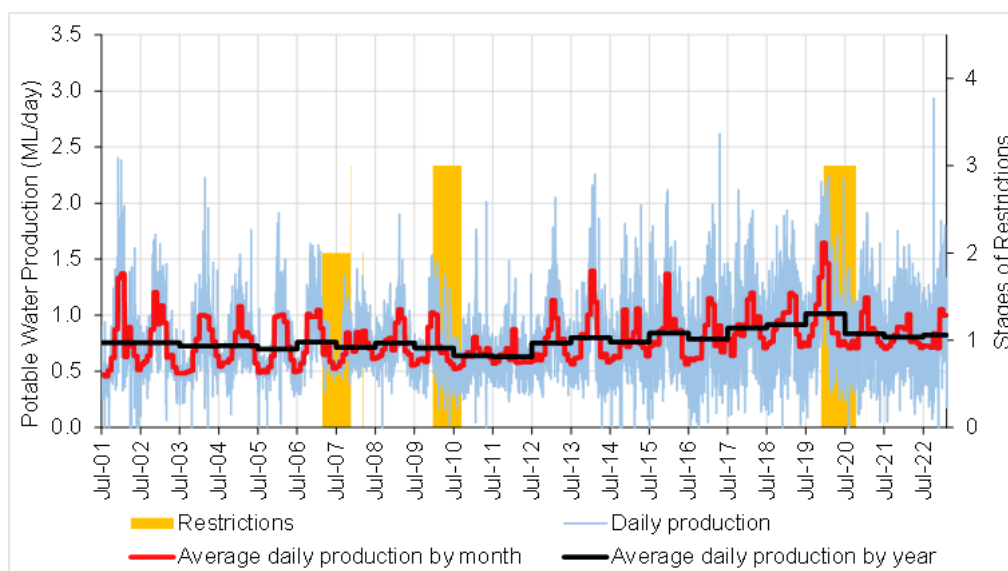


Figure 5-3: Historical production data- Bungendore potable water production

The annual summary of water production for the Bungendore WTP as shown in Table 5-3.

Table 5-3: Historical annual water production – Bungendore WTP (ML/year)

Financial Year	ML/year
2001/02	275.5
2002/03	276.2
2003/04	265.0
2004/05	265.1
2005/06	255.4
2006/07	277.8
2007/08	260.7
2008/09	274.9
2009/10	258.6



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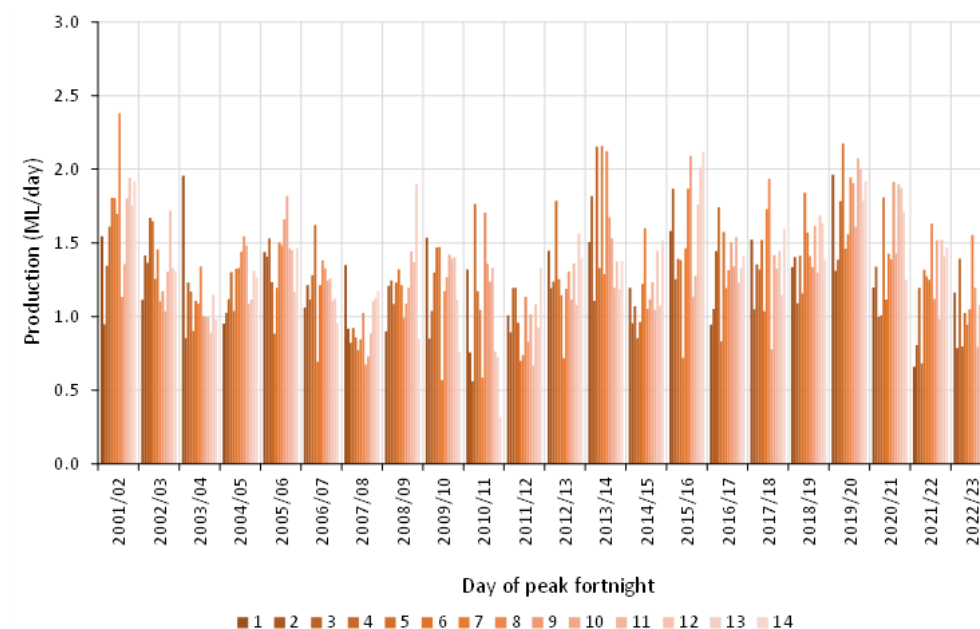


Financial Year	ML/year
2010/11	233.6
2011/12	230.0
2012/13	275.1
2013/14	291.9
2014/15	277.9
2015/16	307.6
2016/17	287.4
2017/18	332.1
2018/19	334.1
2019/20	371.3
2020/21	304.3
2021/22	294.0

The maximum production was 371.3 ML/year for the 2019/20 financial year.

### 5.2.3 Peak production analysis

The historical peak fortnight pattern for the Bungendore WSS is shown in Figure 5-4.



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Figure 5-4: Peak fortnightly production patterns – Bungendore aeration tower and Currandooly WTP

The highest recorded daily production in Bungendore aeration tower and Currandooly WTP was 2.93 ML which occurred on 6 October 2022. However, as the temperature of this peak day is relatively low (15°C), this day is not considered to be the true peak production representative of the scheme demand.

The nominated peak day production is 2.24 ML which occurred on 31 January 2020. There was only 0.2mm of rainfall after 7 days of no rainfall. The maximum temperatures surrounding this day was high (ranged from 30°C to 41.9°C).

The average daily production over the peak week (ADPW) and peak fortnight (ADPF) was 1.89 ML/day of week starting 31 Dec 2019 and 1.78 ML/day of fortnight starting 24 December 2019 respectively. The ADPW and ADPF graphs are shown in Figure 5-5.

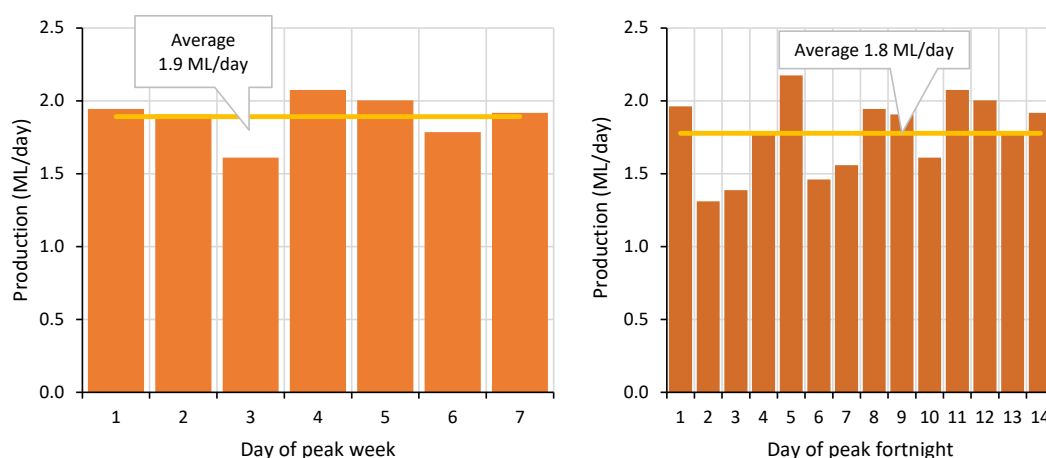


Figure 5-5: Peak week and peak fortnight production – Bungendore aeration tower and Currandooly WTP

The PD to ADPW ratio for Bungendore WSS is 1.19.

#### 5.2.4 Treated water quality

According to Council's Drinking Water Management System (DWMS) [1], there are four Critical Control Points (CCP) adopted for Bungendore WTP, shown in Table 5-4. It is noted that the free chlorine residual in the reticulation is not a Critical Control Point.

Table 5-4: Bungendore WSS – Aeration tower Critical Control Point summary

CCP		Control parameter	Target	Alert Limit	Critical limit
Bungendore WTP	CCP1(a) Chlorination	Free clearwater daily chlorine tank residual	>1.2 mg/L	<0.9 mg/L or >2.0 mg/L	<0.7 mg/L or >5.0 mg/L
	CCP1(b) Chlorination	Free reticulation daily chlorine residual	>0.4 mg/L	<0.3 mg/L	<0.2 mg/L or >5.0 mg/L

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CCP2 Fluoridation	Fluoride clearwater daily tank weekly	0.95 – 1.05 mg/L	0.9 – 0.95 mg/L or 1.05-1.35 mg/L	<0.9 for 72 hrs or >1.5 mg/L
CCP3 Reservoir	Reservoir Weekly Integrity	No gaps, vermin proof, secure, enclosed, locked	Breach of reservoir integrity	Evidence of vermin

#### 5.2.4.1 Bungendore WTP

Council provided data for chlorine in Bungendore’s reticulation and fluoride in the clear water tank. Data sets was provided for the period between January 2015 and June 2023. Data was not provided for chlorine in the aerator (CCP 1 (a)). The DWMS and the plant needs to be updated so that CCP1(a) is between the tank and the pump, rather than before the dosing point. Council had deduced that it was more operational than critical was due to the fact that water from this plant essentially hits the reticulation (and therefore consumers) only 170 m from the Bungendore WTP. Council had confirmed that this test will be added to the daily monitoring field sheets. Council understands the need for a free chlorine sensor between the 100 kL collection tank and the pump to ensure that the water is correctly chlorinated before distribution. The DWMS (and possibly the plant) needs to be updated so that CCP1(a) is between the tank and the pump, rather than before the dosing point. **Non-conformance issue.** Council plans to resolve the issue by installing rising mains from both Bungendore WTP and Currandooly WTP to all reservoirs as part of the Q2B project, thereby eliminating the C.t. issue.

CCP1(b) Chlorination based on free reticulation daily chlorine residual has been presented in Figure 5-6. It is noted that this is not a CCP.

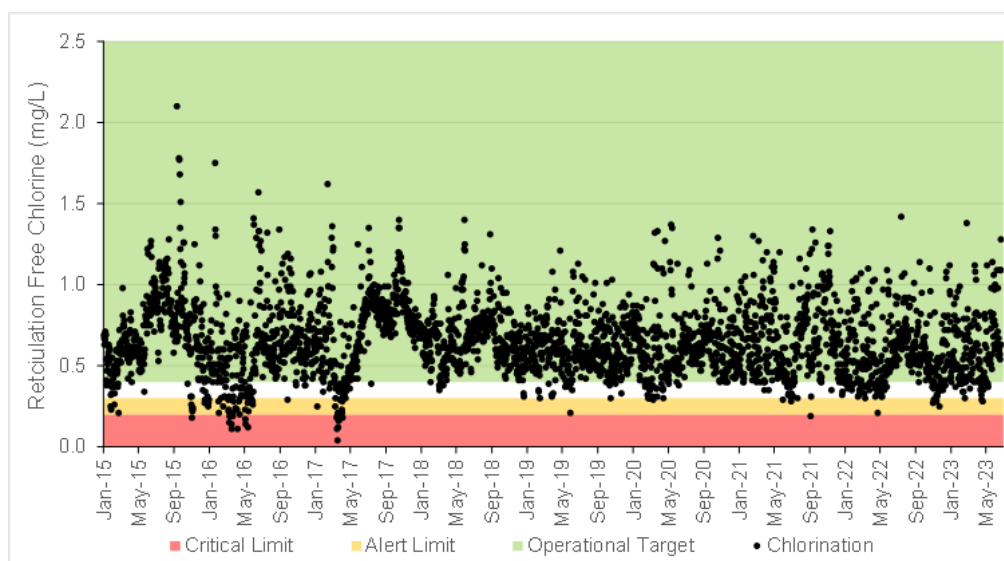


Figure 5-6: CCP1(a) Chlorination – Historical free chlorine in reticulation of Bungendore

Based on the data from January 2015 and February 2023, there were 20 out of 3088 records where chlorination levels were recorded to be lower than the 0.2 mg/L lower critical limit. Two recent records exceeded the lower critical limit occurring in September 2021 and December 2022. The reading of 0.19 mg/L on 4th September 2021 was at Simms Drive. It is a very low usage area; hence it was chosen to be a monitoring point. With typical low readings, lines are flushed to draw through higher chlorinated water.

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Council confirmed that when the reading is out the target range, lines are typically flushed with higher chlorinated water. Post the chlorine flush the reading was 0.55 mg/L at the same monitoring point. Majority of the records have maintained to be with the target range.

CCP2 Fluoridation has been presented in Figure 5-7.

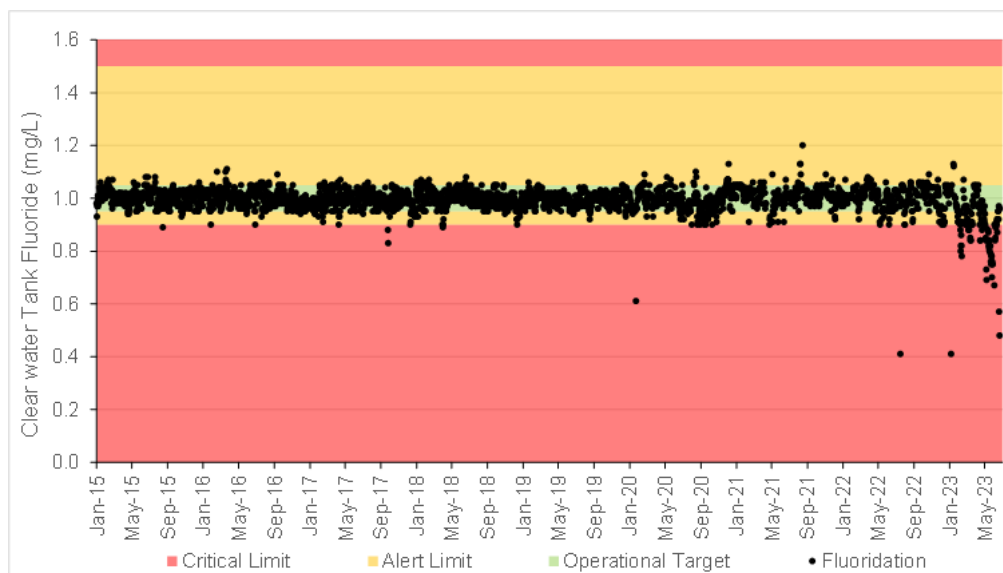


Figure 5-7: CCP2 Fluoridation- Historical fluoride in clean water tank in Bungendore

Based on the data from January 2015 and February 2023, there were recent exceedances below the lower critical limit of less than 0.9 mg/L for 72 hrs. Before July, fluoridation was maintained to be within the target range. Fluoride levels started to decrease from February 2023 due to issues with the saturators causing bed caking. Council stated that they had replaced and recommissioned the beds of all four sodium fluoride saturators. Email evidence from council to NSW Health was sighted.

#### 5.2.4.2 Currandooly WTP

According to Council's Drinking Water Management System (DWMS) [1], there are five Critical Control Points (CCP) adopted for Currandooly WTP, shown in Table 5-5.

Table 5-5: Bungendore WSS –Currandooly WTP Critical Control Point Summary

CCP		Control parameter	Target	Alert Limit	Critical limit
Currandooly WTP	CCP1 Turbidity Post filtration	Filtration and chemical dosing online continuous	<0.2 NTU	>0.3 NTU	>1.0 NTU
	CCP2(a) Chlorination	Free clear water online, chlorine tank continuous residual	1.0 – 1.5 mg/L	<1.0 mg/L or >2.0 mg/L	<0.5 mg/L or >5.0 mg/L
	CCP2(b) Chlorination	Free reticulation daily chlorine residual	>0.4 mg/L	<0.3 mg/L	<0.2 mg/L or >5.0 mg/L
	CCP3 Fluoridation	Fluoride clear water daily tank weekly	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

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CCP	Control parameter	Target	Alert Limit	Critical limit
CCP4 Reservoir	Reservoir weekly integrity	No gaps, vermin proof, secure, enclosed, locked	Breach of reservoir integrity	Evidence of vermin

Council provided data for turbidity, chlorination, and fluoridation post filtration in the tank. Data sets was provided for the period between January 2015 and June 2023. Data was not provided for chlorine in reticulation as this is not a required CCP. Currandooly WTP is not run daily.

CCP1 Filtration recorded at the clear water tank has been presented in Figure 5-8.

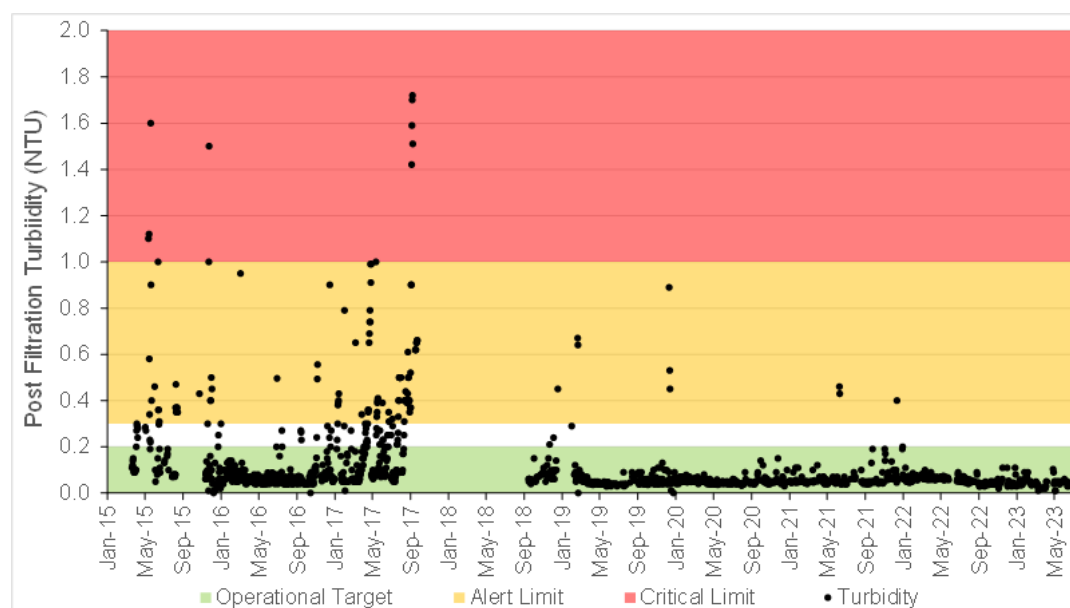


Figure 5-8: CCP1 Filtration- Historical turbidity of Currandooly WTP filtrate

Majority of the recent records have been within the target range. There was no data recorded from September 2017 to September 2018 and results prior to September 2017 are unreliable. Council has stated that the Currandooly WTP had a very difficult commissioning and the council decided to keep the principal contractor (Water Treatment Australia) on site until the WTP was rectified to run correctly. Council handed the plant back to WTA between September 2017 and September 2018 and water was not delivered to the town. On 6 September marks the onset of water delivery to town. Since then, it has been operational and run two to four times a week to the aeration tower (rarely in combination with the aeration plant).

CCP2 (a) Chlorination recorded at the clear water tank post filtration has been presented in Figure 5-9.

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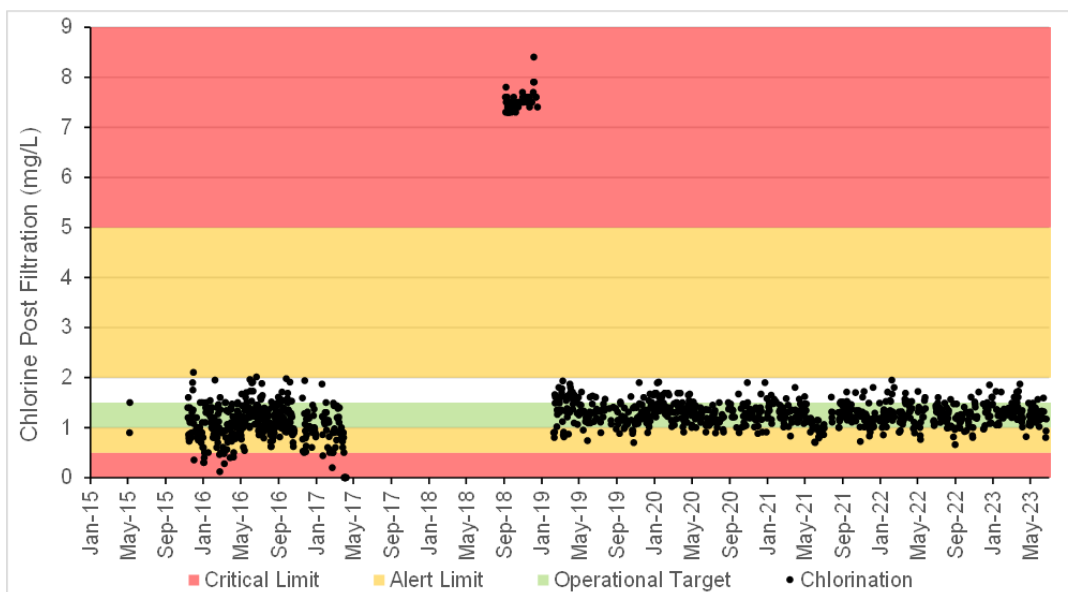


Figure 5-9: CCP2(a) Chlorination – Historical free chlorine in clear water at Currandooly.

One recent record exceeded the lower critical limit of 0.5 which occurring in July 2023. Between September to December in 2018, Chlorine levels exceeded the upper critical limit of 5.0 mg/L reaching level above 7.0 mg/L. This was because the entry for 0.053 mg/L was an error. The true reading for free chlorine was 1 mg/L.

CCP3 Fluoridation recorded at the clear water tank post filtration has been presented in Figure 5-10.

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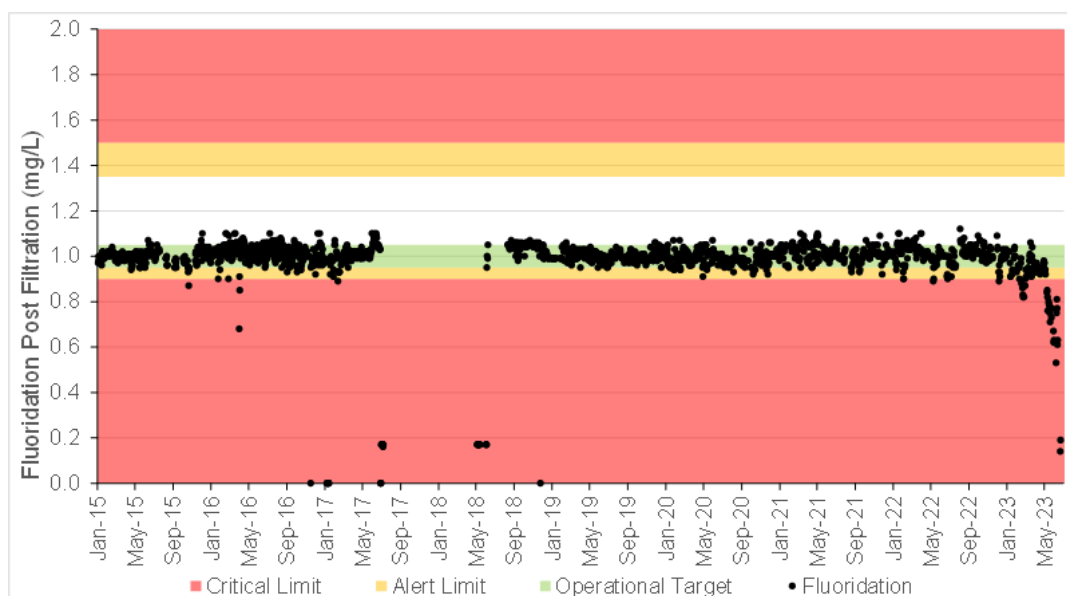


Figure 5-10: CC3 Fluoridation – Historical fluoride in clear water tank in Currandooley

Based on the data from January 2015 and June 2023, there were recent exceedances below the lower critical limit of less than 0.9 mg/L for 72 hrs. Before July 2023, concentrations were maintained to be within the target range. Fluoride levels started to decrease from February 2023 due to issues with the saturators causing bed caking. Council stated that they had replaced the beds of all four branded Sodium Fluoride (NaF) saturators and recommissioned. Email evidence from council to NSW Health was sighted.

### 5.3 Distribution

#### 5.3.1 Distribution system

Treated water from the Bungendore aeration plant and Currandooley WTP is pumped to the Turallo Reservoirs (0.91 ML and 1.45 ML) and the Days Hill Reservoir (2.2ML) according to each site's requirements. From there, these reservoirs directly gravitate water to customers via the reticulation network. The Turallo Reservoirs operate in a lower pressure zone and typically service the older sections of the village south of Turallo Creek, this zone has the lowest pressure. Days Hill services the section of the town immediate north of Turallo Creek and the new North Elmslea Reservoir (2 ML) is filled from a pump station located at Days Hill and serves properties within the Elm Grove subdivision.

The layout of the distribution network for the Bungendore WSS is shown Figure 5-11.

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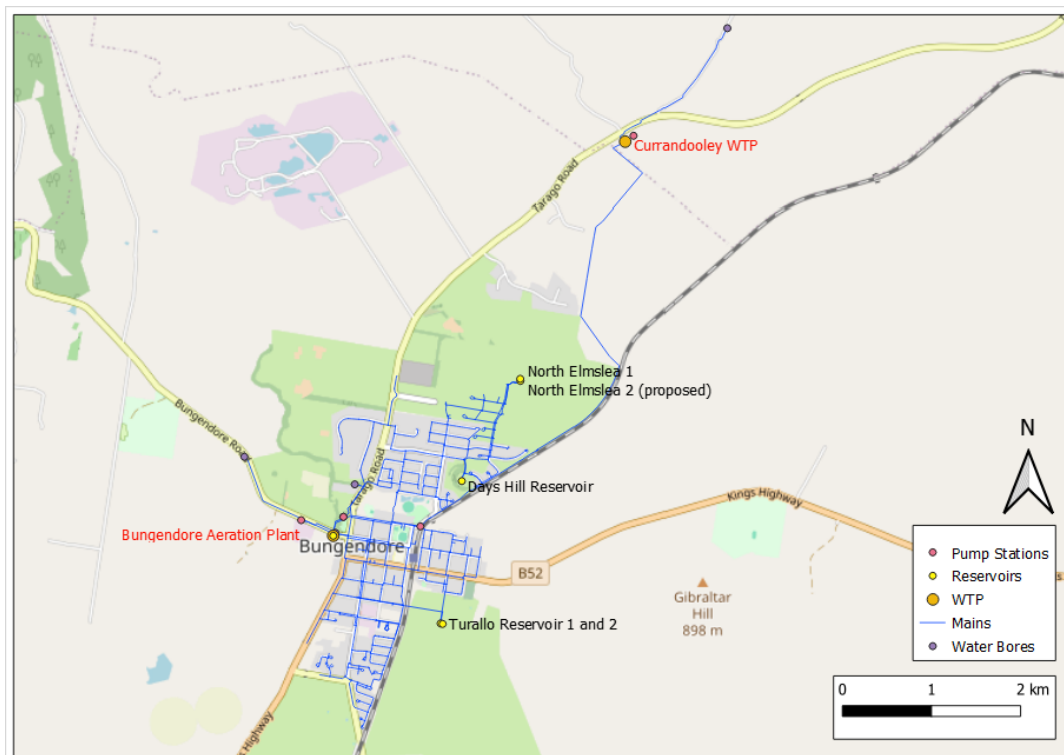


Figure 5-11: Bungendore WSS distribution

### 5.3.2 Metered customer demand

Council supplied billing data for all potable water customers from July 2017 to December 2022, with the water meters being read quarterly. User classes from the billing data were residential, commercial, mixed, municipal excluding parks, municipal public parks, rural and vacant.

The historical number of customer meters in the billing data and the historical metered customer usage of the last six years are shown in Table 5-6 and Table 5-7 respectively.

Table 5-6: Historical number of meters – Bungendore Potable WSS

User Types	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Residential	1,190	1,218	1,263	1,302	1,320	1,304
Commercial	57	59	60	58	59	58
Mixed	1	1	1	1	1	1
Municipal - excluding parks	22	23	22	21	18	19
Municipal - public parks	3	4	4	5	5	5
Rural	1	1	1	1	1	1
Vacant	62	62	62	62	62	62



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User Types	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Total	1,336	1,368	1,413	1,450	1,466	1,450

Table 5-7: Historical metered customer usage (ML/year) – Bungendore Potable WSS

User Types	2017/18 reads 2 to 4*	2018/19	2019/20**	2020/21	2021/22	2022/23 read 1*
Residential	197	236	265	217	212	100
Commercial	20	20	21	17	15	7
Institutional	0	1	1	0	1	0
Farm	3	5	6	3	4	2
Vacant	2	6	20	9	5	5
Mixed	0	0	1	0	1	0
Education	9	11	11	9	8	4
Total	197	236	265	217	212	100

\*Demand for the 2017/18 and 2022/23 financial years is included but not complete

\*\* Level 1 water restrictions in place from 22/11/2019 to 5/03/2020

In 2021/22, the total customer usage in Bungendore was 212 ML. Customer usage was high during the very dry and hot conditions in 2019/20. Historical customer usage split has been on average around 85% residential to 15% non-residential.

The historical usage for all available billing periods for Bungendore is given in Figure 5-12.

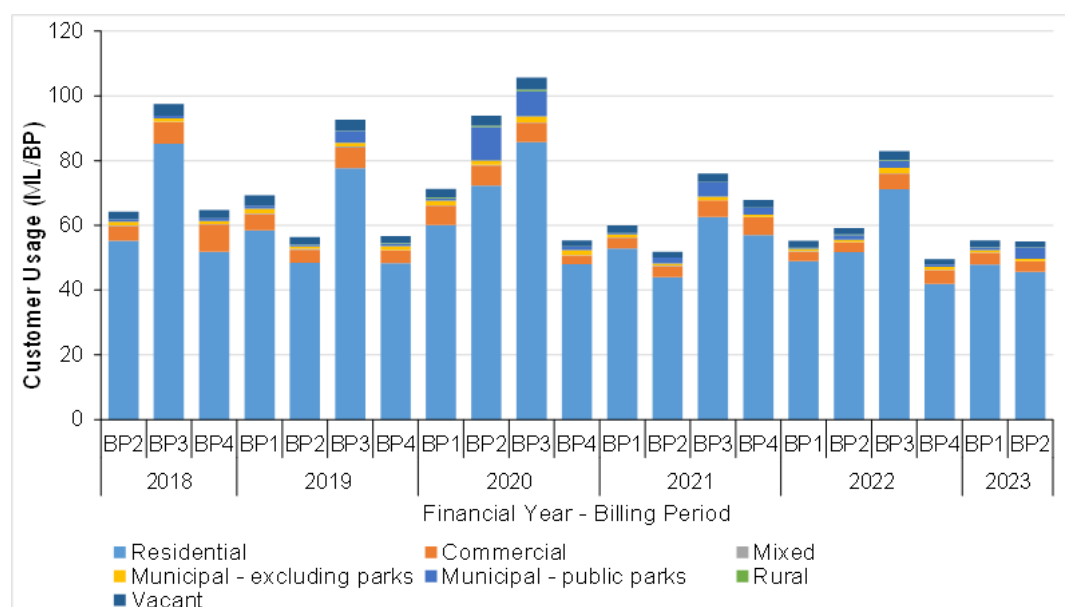


Figure 5-12: Historical metered customer usage by user category - Bungendore Potable WSS

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### 5.3.3 Major non-residential users

The criteria used to identify major non-residential users was any non-residential customer that used more than 1% of the total metered customer usage for the Bungendore Potable WSS. This results in four major users. There is also a plant nursery growing seedlings in greenhouses, this has been added as a major user as the water consumption is nearly as high as the other major users and the expected sewer load is low and therefore, the site needs special consideration. The historical usage for the major users is shown in Table 5-8.

Table 5-8: Major Water Users – Bungendore WSS

Major User	Average Yearly Demand (ML/year)	Highest Yearly Demand (ML/year)
Bungendore Park	5.62	17.53
The Lake George Hotel	2.02	2.98
The Village Square	1.59	4.75
Bungendore Sports Hub	0.83	3.20
Nursery	1.56	2.28

The average yearly demand for Bungendore Sports Hub is higher than presented in the table because data was collated in its formative years. The average yearly demand for the Bungendore Park is less than the data presented in the table because potable water formally used for irrigation has been replaced by treated effluent from the STP.

### 5.3.4 Water balance

The historical water production from the WTP, and metered customer usage data were used to calculate a water balance over Bungendore WSS. The water balance used is the standard developed by the International Water Association (IWA) Water Loss Task Force. The method used to calculate the different components of the water balance is given in Appendix D.1.

The water balance for Bungendore WSS is shown in Table 5-9, and shown graphically in Figure 5-13.

The historical averages over eight billing periods 2020/21 Q2 (6/10/2020) and 2022/2023 Q1 (23/09/2022) were used in the water balance.

Table 5-9: Water Balance – Bungendore WSS

Raw water supplied to WTP 324 ML/year	Water supplied to Bungendore WSS (WTP production) 300 ML/year	Authorised consumption 255 ML/year	Billed authorised consumption <b>253 ML/year</b>	Residential	226 ML/year
				Rural	0 ML/year
				Commercial	16 ML/year
				Municipal- excluding parks	4 ML/year
				Municipal- public parks	7 ML/year
			Unbilled authorised consumption		2 ML/year
			Apparent losses		1 ML/year
			Real losses	Avoidable real losses	10 ML/year

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		Water losses in distribution <b>45 ML/year</b>	44 ML/year	Unavoidable real losses from mains	16 ML/year
				Unavoidable real losses from service connections	18 ML/year
	Losses at WTP <b>24 ML/year</b>				24 ML/year

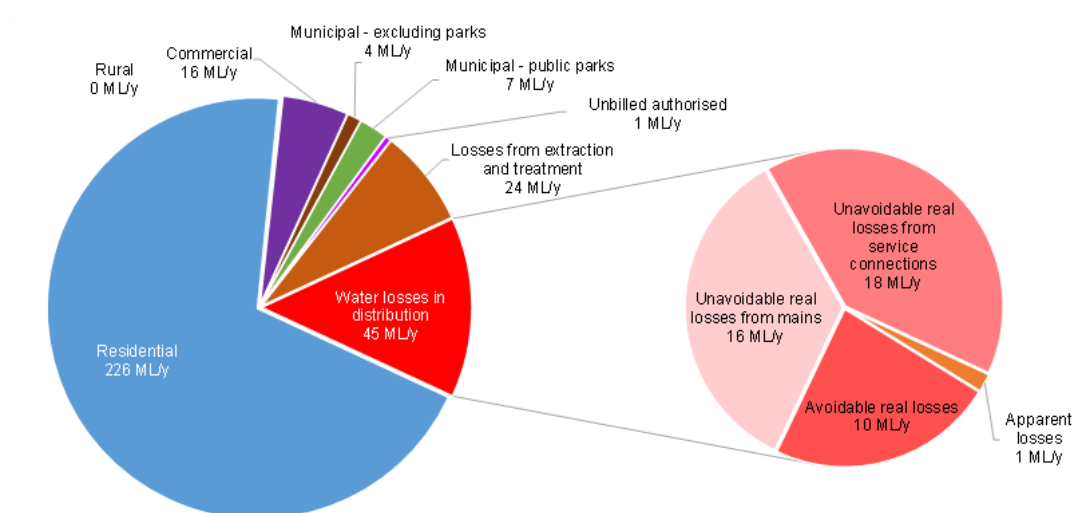


Figure 5-13: Water Balance – Bungendore WSS (ML/year)

Based on the above water balance, Bungendore WSS has an average Infrastructure Leakage Index (ILI) (the ratio of current annual real losses to unavoidable real losses) of around 1.3 which is categorised in the best performing leakage performance category (LPC A1) [6]. For Utilities with losses in this range it is not economically viable to reduce leakage further unless there are water shortages.

On average, authorised consumption made up around 85% of the water produced by the WTP in the billing data. This results in non-revenue water accounting for 15% of the total water produced. The historical average unit water loss is estimated to be 80 L/connection/day, which is approximately 1.08 times the state median of 74 L/connection/day.

### 5.3.5 Non-Revenue Water

Non-revenue water (NRW) is made up of several 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 Bungendore schemes is given in Table 5-10. NRW is higher than the 2021-22 state-wide median of 73 L/connection/day and the LGA yearly average of 46 L/connection/day. The LGA yearly average is based on the combined service areas including Queanbeyan and adjacent suburbs and villages, who are served with water from ICON Water (ACT).

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Table 5-10: Bungendore NRW Summary

	2017/18	2018/19	2019/20	2020/21	2021/22
Bungendore					
Average NRW (kL/day)	108	150	120	133	132
Number of Connections	1392	1418	1456	1509	1543
Average NRW (L/connections/day)	77	106	83	88	86

The water balance period used in Section 5.3.4 used the period from Q2 2021 to Q1 2023, the NRW in Q1 2023 was lower (78 L/connection/day) than in Q1 2021 (102 L/connection/day) bringing down the average reported (80 L/connection/day) when compared to the 2020/21 and 2021/22 financial years.

The average daily non-revenue water by quarter for Bungendore is graphed in Figure 5-14.

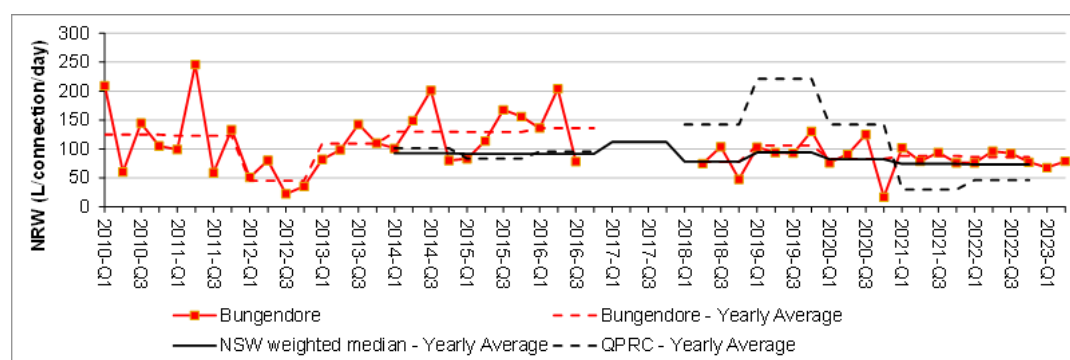


Figure 5-14: Bungendore historical non-revenue water

Overall, the NRW has improved since the previous IWCM analysis was completed. For the last two years, NRW has been reasonably stable and only varying between 68 and 102 L/connection/day). Since the last IWCM, the annual average NRW to decreased from 125 L/connection/day to range between 90 and 105 L/connection/day.

The historical average unit water loss for the water balance period is estimated to be 80 L/connection/day using the water balance methodology (see Section 5.3.4), this accounts for some meter losses not accounted for in the NRW calculation. The unit NRW for the water balance period is 82.4 L/connection/day. This will be used in the projection.

### 5.3.6 NSW Health independent verification

As of 2023 Council collects water quality samples for the NSW Health verification program from two points in the Bungendore.

NSW Health water quality data from the previous seven years (July 2016 to October 2023) were analysed. Typical water quality from the points in Bungendore in Appendix table A-5. The parameters that did not meet the guideline values were:

- pH exceeded 8.5 in January 2017 (two samples collected a fortnight apart) and January 2023 (a single sample). There have also been several periods when the pH has been between 8 and 8.5 for extended periods, including over six months between July 2016 and January 2017.
- Turbidity exceeded 5 NTU in for a single sample collected in January 2017.

While the following parameters complied with the ADWG, they are still of interest:

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- A sample contained an arsenic concentration close to the guideline in August 2019 and samples regularly have concentrations over the limit of reading. Therefore, increased testing for arsenic in the raw water may be required.
- Sodium exceeds the concentration recommended for those on low sodium diets. Therefore, doctors and hospitals need to be informed of the sodium concentration so they can provide appropriate advice to their patients.

### 5.3.7 Risks identified from the DWMS Risk Register

According to the DWMS Risk register, for Bungendore WSS, the 'Very High' risks are identified below:

- STP overflows and leaks;
- OSSMS and other contaminants in the aquifer;
- Chlorine dose failure causing ineffective disinfection and alarm failures;
- Naturally occurring contaminants such as iron and manganese were found in the source water;
- Loss of trained operators;
- pH correction failure;
- Filters failure and ineffective backwash;
- Faecal contamination due to access by birds and rats;
- Dead end in reticulation leading to loss of chlorine residual, and contaminating the treated water due to back flow and cross connection;
- Aged water/short circuiting/thermal stratification/loss of chlorine residual;
- Breach of pipelines through breaks, inappropriate maintenance, new or service works.

Based on the DWMS [1] the Residual Risk with Preventative Measures continues to remain 'Very High' for the following: potential pathogen contamination issues due to breach of pipeline, and cross contamination due to backflow. **Issue.** Council is currently reviewing the DWMS including this risk assessment.

## 5.4 Best practice compliance – LWU Circular 18

This circular was prepared in 2014 to address local water utilities of a new protocol to ensure safety of drinking water supplies across regional NSW. LWUs were required to review and update their standard operating procedures to ensure three key barriers were achieved.

### 5.4.1 Barrier 1: Effective distribution

LWU Circular 18 states that disinfection is the single process that has had the greatest impact on drinking water safety. Two actions should be undertaken to achieve effective disinfection.

#### 5.4.1.1 Action 1: Monitoring of factors which affect disinfection

LWU Circular 18 recommends LWUs to monitor the factors which affect effective disinfection including chlorine residual, turbidity and pH levels. These factors are monitored at Bungendore WTP as part of its CCP (see Section 5.2.4).

Circular 18 recommends keeping turbidity as low as practicable, aiming for less than 1 NTU. pH should be as low as possible and Circular 18 states that a level between 7.2 to 8.2 is desirable.

Turbidity is not a CCP or collected in Bungendore. The Currandooley WTP filtered water turbidity has been consistently below 1 NTU since 2018. (See Figure 5-8).

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#### 5.4.1.2 Action 2: Achieve minimum chlorine contact time (C.t)

Circular 18 recommends that a minimum C.t. value of 15 mg.min/L is achieved, as recommended by the ADWG.

C.t. is calculated for the 100-kL collection tank at Bungendore Aeration tower and the clear water tank at Currandooley WTP.

C.t. for water leaving collection tank at Bungendore Aeration tower:

- Aeration tower flow = 4.5 ML/day on a 22-hour basis
- Collection Tank = 100 kL
- Baffling factor of 0.3 used for contact tank assuming it has 'single or multiple unbaffled inlets and outlets, no intra-basin baffles' [7]
- Free chlorine concentration = 0.7 mg/L (Council's CCP critical limit)
- C.t. = 6.2 mg.min/L

The total C.t from chlorination at Bungendore aeration tower to outflow is 6.2 mg.min/L, which is below the recommended minimum value of 15 mg.min/L. **Issue**

C.t for water leaving the Currandooley's clear water tank.

- Plant flow = 2 ML/day on a 22-hour basis
- Clear water tank = 4.56 ML
- Baffling factor of 0.3 used for contact tank assuming it has 'single or multiple unbaffled inlets and outlets, no intra-basin baffles' [7]
- Free chlorine concentration = 0.5 mg/L (Council's CCP critical limit)
- C.t. = 451.4 mg.min/L

The total C.t from chlorination at Currandooley WTP to outflow is 451.4 mg.min/L which is above the recommended minimum value of 15 mg.min/L.

#### 5.4.2 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 recently for each reservoir. As of the last inspection no issues were identified, and no actions were required at any of the eight reservoirs.

#### 5.4.3 Barrier 3: Maintain a free chlorine residual in the distribution system.

Circular 18 recommends a minimum chlorine residual of 0.2 mg/L in the distribution system. Council monitors free chlorine daily in the reticulation of each of the water supply schemes.

Refer to Section 5.3.6 for the reticulation water quality of Bungendore WSS. Most of the free chlorine measurements of the reticulation water were above the minimum requirements.

### 5.5 Analysis of production data

A water demand analysis is undertaken to calculate the unit demands, estimate the water losses and forecast the following demands:

- Average (rainfall) year demands – for revenue planning

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- Unrestricted future year demands – to assess drought security
- Peak day demands – to assess system reliability.

The 30-year forecasts based on the nominated growth, are used to identify the issues in meeting the adopted water supply security, and reliability objectives of the urban water supply system. Further explanation on the water demand analysis can be found in Appendix E.

Analysis and modelling were undertaken on the water production data i.e. the water going into the reticulation system, recorded at the outlet of the treated water pumps.

#### 5.5.1 Trend correction

Analysis and modelling were undertaken on the water production data i.e., the water going into the system.

Modelling was undertaken to understand the impact of various factors/trends (demographic, climatic, economic etc.) on the variability of town water demand.

The factors that were considered were:

- Historical water requirement for grass irrigation (lawns and public open spaces) obtained from the simulated water use model by PW. The model uses location-specific historical rainfall and evaporation data, soil type and grass type.
- Historical water requirement for use of evaporative coolers. The model uses location-specific historical maximum temperature data.
- Historical number of water connections.
- Non-revenue water.

The weather data (rainfall, temperature, synthetic pan evaporation, evapotranspiration) was all sourced from SILO (Scientific Information for Land Owners) data service (State of Queensland (Department of Environment and Science), 2023).

The aim was to develop models which, when input with historical factors/trends, would output a production that correlates well with the actual historic production.

Once the best model is selected, the production was hindcast to estimate the likely water production for a repeat of the historical climate from July 1889 to June 2023, with the current users and losses.

#### 5.5.2 Production modelling

Water production records from July 2001 to February 2023 were analysed. The production data is the sum of the volume pumped out of the aeration tower at the bores and volume pumped from Currandooley WTP to the reservoirs.

The model showed that outdoor irrigation was the most significant contributor to Bungendore's demand variability. There was also an additional increase in demand during warm to hot weather that resembles evaporative cooler air conditioning water use when the maximum temperature was over 25°C as well as an increase in demand in line with customer growth.

The production model was then hindcast over a 133-year period of available climate data of historical temperature, rainfall and evaporation to estimate the annual demands if the current conditions of lot size, household size, number of connections, pricing and usage patterns were to prevail. The hindcast is shown in Figure 5-15.

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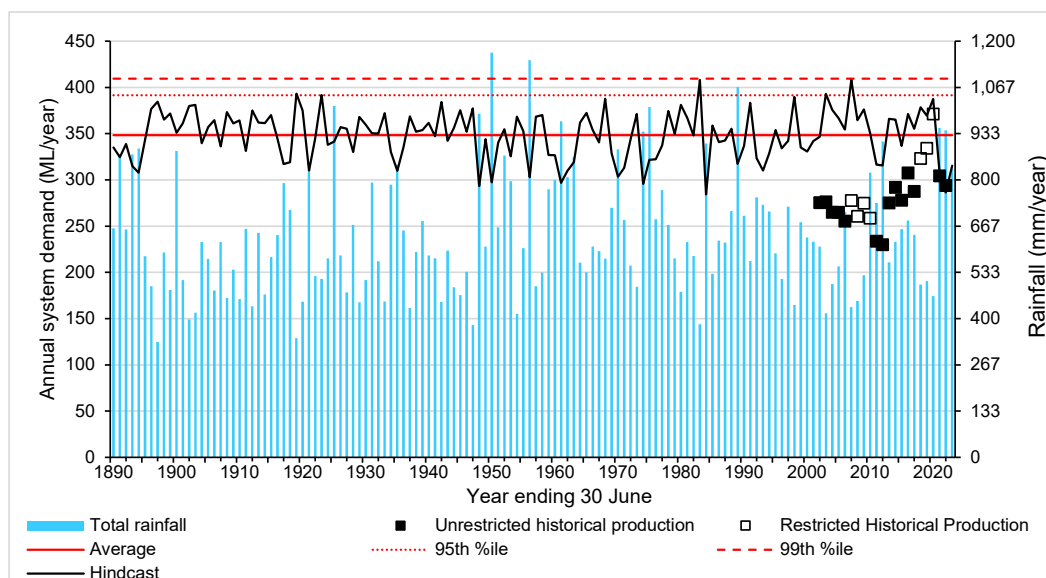


Figure 5-15: Production model hindcast – Bungendore raw water supply

The hindcast was also used to estimate the historical ADPW production. For the analysis the 99th%ile (1 in 100 year) unrestricted future production was selected from the hindcast as the starting points for the forecasts. The model results are presented in Table 5-11.

Table 5-11: Bungendore modelled unrestricted production

	From historical data	Modelled outcomes
Average year (ML/year)*	307	348
99th percentile unrestricted future year (ML/year)**	371	410
Average day peak fortnight (ML/day)	1.78	1.91
Average day peak week (ML/day)	1.89	2.09
Peak day (ML/day)	2.24	2.98

\* Historical average from the 10 years 2012/13 and 2021/22, there were some water restrictions in this period

\*\* Historical maximum was from 2019/20, there were severe water restrictions

Bungendore's peak day was estimated to be 2.8 ML/day in 2016 as per the previous IWCN. From the updated modelled unrestricted production, the modelled peak day is 2.98 ML/day. Between 2016 and 2022 there was a 20% increase in the number of water assessments consuming water. Therefore, the 6% increase in the peak day demand is lower than would be expected from assessment growth.

### 5.5.3 Effect of climate change

#### 5.5.3.1 Previous IWCN methodology

Since the previous IWCN climate change analysis was completed, there have been two major revisions to the NSW Public Works climate change modelling method.



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The previous IWCN methodology used seasonal changes to rainfall and evapotranspiration sourced from the CSIRO "Climate Change in Australia Report" and the maximum daily temperature increased by 1.25°C. The climate dependent use has been re-calculated using the current climate dependent consumption models, the current SILO Data and the weather data modified in the same way as was used in the previous IWCN. Refer to Appendix table F-1 and Appendix table F-2 for detailed calculation output.

#### 5.5.3.2 NARClIM 1.5

More recently, DCCCEW has started to recommend the use of data from the New South Wales (NSW) and Australian Capital Territory (ACT) regional climate modelling (NARClIM) version 1.5.

The NARClIM 1.5 dataset contains information for two future greenhouse gas concentration trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC). The trajectories are known as representative concentration pathways (RCPs). The RCPs for which data is available are:

- RCP 4.5, this is the most probable baseline scenario (no climate policies) considering the exhaustible character of non-renewable fuels. Under this scenario, the greenhouse gas concentration stabilise in 2080.
- RCP8.5, generally taken as the basis for worst-case climate change scenarios, was based on what proved to be overestimation of projected coal outputs. Under this scenario, the greenhouse gas concentration stabilises in 2250.

The data is available for:

- Three global climate models (GCMs), these models have a resolution of 100's of square kilometres.
  - CanESM2 produced by the Canadian Centre for Climate Modelling and Analysis (CCCMA)
  - ACCESS1.0 produced by a CSIRO and Bureau of Meteorology collaboration.
  - ACCESS1.3 produced by a CSIRO and Bureau of Meteorology collaboration.
- The ERA-Interim reanalysis data set, this is a global atmospheric reanalysis produced by the European Centre for Medium-Range Weather Forecasts (ECMWF). This dataset uses historical observations to create global data sets describing the recent history of the atmosphere, land surface, and oceans.

Each of these data sets is then downscaled using two separate regional climate models (RCMs).

The demand changes for Bungendore and Braidwood were estimated using the three GCMs, two RCMs, and two future time periods (before and after 2060). The results are summarised in Appendix table F-7 to Appendix table F-12. When there was a decrease in demand instead of an increase, the cells are shaded grey.

For the demand forecasts, the probable climate change forecasts have been calculated using the maximum increase from the RCP 4.5 models for the period between 2006/07 to 2058/59. The more severe climate change forecast uses the maximum increase from either the RCP 4.5 or 8.5 models and either time period. For Bungendore, the highest increase in the 99th percentile dry year demand was the maximum increase under RCP 4.5 between 2006/07 and 2058/59. The increase in system demand for Bungendore is summarised in Table 5-12.

Table 5-12: Climate change impact on system demand

Representative Concentration Pathway	RCP description	Average year	99th %ile dry year	Average day peak week	Average day peak fortnight
RCP4.5	Probable	4.77%	6.81%	3.86%	3.73%
RCP8.5	High severity	8.08%	6.81%	1.47%	3.68%

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### 5.5.3.3 Paleo-stochastic

DCCEEW generated 10,000-year daily data sets of rainfall and potential evapotranspiration using observed data sets (at meteorological stations) combined with paleo climate data for use in the regional water strategies. Data is currently publicly available for selected weather stations in the NSW and ACT Murray Darling Basin catchments and will be released soon for the Nepean and Shoalhaven catchments. The closest site with the required parameters for irrigation modelling was Ainslie ACT in the Murrumbidgee Catchment.

The results from the paleo stochastic data were compared to the results from the SILO data for the same period. The results are summarised in Appendix table F-26.

Overall, based on the stochastic data, there is a very low probability (less than 0.1%) of more water being required for irrigation than was shown in the SILO data on a yearly basis. There is a chance that the average day peak week irrigation demand may be higher than estimated from the SILO data, using the SILO data, irrigation was required 4 days during the maximum week, using the stochastic data, irrigation was required 5 days during the maximum week, though this only occurred in 5 out of the 9,999 financial years.

## 5.6 Analysis of customer usage

The billing data was provided by assessment and meter. Some assessments had more than one meter, these are either major users (like the school) or properties where the meters were replaced. As each assessment was taken as a connected property, analysis was undertaken on an assessment basis.

### 5.6.1 Modelling of customer usage

Customer usage patterns were modelled in a similar way to production data.

The maximum and 99th percentile (1 in 100 year) unrestricted future year demands were selected as the starting points for the 30-year projections. The model results for user classes are given in table 6-12.

Table 5-13: Estimated customer usage from climate correction – Bungendore WSS

User Class	Average year demand (kL/year)	Unrestricted future year demand (kL/year)	Average day demand (kL/day)	Peak day demand (kL/day)
Business	14,496	17,669	39.7	83.9
Church	454	2,183	1.2	12.0
Community	939	1,455	2.6	9.6
Council General	873	1,319	2.4	7.3
Council Sewer	200	765	0.5	3.3
Council Water	15	65	0.0	0.8
Education	1,604	2,143	4.4	8.6
Farm	528	1,338	1.4	5.2
Government	440	617	1.2	2.4
Mixed	575	946	1.6	4.7
Major User	12,456	29,574	34.1	229.9
Public Parks and Gardens	1,497	2,410	4.1	11.3
Residential	220,147	239,090	602.7	907.0
Total	254,222	299,573	696.0	1,286.0

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The residential, non-residential and total consumption were significantly climate dependent.

Overall, residential users were significantly climate dependent, whereas most non-residential user classes were climate independent.

## 5.6.2 Unit residential demands

### 5.6.2.1 Existing dwellings

The residential unit demands for each scheme were assessed by climate correcting historical data, using the modelled demand for lawn irrigation.

Using a threshold of 60 L/connection/day for an active connected residential property resulted in 94% of the assessments in Bungendore WSS being active in 2022/23, which corresponds reasonably well to the percentage of dwellings occupied from the 2021 ABS Census data. (See Table 4-3).

The unit demand per active residential connection is then estimated from the number of active assessments. The results are given in Table 5-14.

Table 5-14: Unit demand per active residential assessment – Bungendore WSS

	Average year (kL/year)	Average day (kL/day)	Unrestricted future year (kL/year)	ADPW (kL/day)	Climate dependence	Climate independent (kL/day)	Climate independent (kL/person/day)	Approximate WELS Rating
All	203	0.556	245	1.317	Irrigation	0.424	0.145	2 to 3
Unsewered	174	0.478	174	0.478	Irrigation	0.478	0.164	1 to 2
Sewered	202	0.554	245	1.324	Irrigation	0.421	0.144	2 to 3

The baseline internal demand per person was estimated by dividing the internal demand by the household size of standard private dwellings in Bungendore.

### 5.6.2.2 New dwellings

In July 2004 the NSW Government implemented the Building Sustainability Index (BASIX) with the purpose of reducing the use of potable water and to produce less greenhouse gas emissions.

Bungendore is in the BASIX 40% reduction target zone for water [8]. This means that the target average annual water demand for a resident in a BASIX dwelling is 54 kL/person/year. Using current the household size of 2.92 for Bungendore to provide a baseline, the target average annual water demand for a BASIX compliant dwelling is 158 kL/year. This is substantially less than the current average demand by sewerage dwellings of 202 kL/year.

Council has implemented the Palerang Development Control Plan 2015, it provides detailed development provisions for development in the former Palerang LGA and states that is "subject to overriding planning controls in State Environmental Planning Policies and legislation". Section B17 requires all new dwellings in areas with reticulated water have rainwater tanks installed with a minimum tank size determined by Council, this contravenes the NSW State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004 which states that it overrides provisions of other environmental planning instruments and development

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control plans that would otherwise add to, subtract from, or modify any obligations arising under the BASIX Scheme. **Issue.**

A sensitivity analysis was undertaken to assess the impact of these tank sizes for two and three bedrooms dwellings a range of household sizes. The results are discussed in Appendix G. The tanks are significantly more effective at reducing demand in average years than in hot dry years, increasing the demand variability and therefore increasing the variability in water sales. **Issue**

The unit demands for Bungendore were based on the following dwelling and household configuration: 3 (or more) bedroom house, 22.5 kL rainwater tank, 190 m<sup>2</sup> connected roof area, rainwater tank supplying water to the irrigated garden area, toilets and washing machine, 250 m<sup>2</sup> of lawn irrigated by the tank (the same area used in the 2018 IWCM), 3\* WELS appliances, 3 person households.

The demands for new dwellings in Bungendore are summarised in Table 5-15.

Table 5-15: Unit demands for new houses in Bungendore

Tank	Household size	Average year (kL/year)	Average day (kL/day)	Unrestricted future year (99th %ile) (kL/year)	Peak day (kL/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)
With tank	3.0	139	0.381	208	1.243	1.243	1.151
Without tank	3.0	233	0.637	269	1.243	1.243	1.151
66% with tank	3.0	171	0.468	229	1.243	1.243	1.151
95% with tank	3.0	230	0.629	267	1.243	1.243	1.151
Previous IWCM	2.9	180	0.493	240	1.612		

In June-July 2014 Hunter Water and Hunter Research Foundation carried out a study of rainwater tank functionality in 191 properties in the suburbs of Cameron Park and Fletcher (new suburbs in the west of the Newcastle LGA and Lake Macquarie LGA) built since BASIX was enacted [9]. This study found that

- 18% of the tanks had failed (tank leaking, gutter to tank plumbing not operational, switching device not operating, pump not operational)
- 16% of the systems had previously required pump or switch replacement
- 23% of systems were underperforming.

In 2018, Hunter Water commissioned the Institute for Sustainable Futures at University of Technology Sydney to review recent publications and case studies on potable rainwater substitution through household rainwater harvesting [10]. This study reported that it would be reasonable to assume that an average of 66% of rainwater tanks are functional at any time.

Therefore, the main projection will be undertaken on the basis that 33% of homes not using tanks. A sensitivity analysis will also be undertaken on the basis that 5% of homes are not using tanks to simulate the impact of Council assistance, subsidies or other incentives to residents to keep systems operating optimally.

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## 5.7 Projections

Average year demand projection will be used for revenue requirement planning, un-restricted (dry) year demand for sizing of headworks and peak day production is used for sizing of water treatment works or pumping facilities.

Water demands for the Bungendore WSS are projected as follows:

- The initial unrestricted annual demands are based on the 99th percentile unrestricted demand and the peak day demands estimated from the 120-year hindcast.
- For each new residential dwelling the unit demand is developed from the data provided in Table 5-15, adjusted for the percentage of operating rainwater tanks assumed for the case.
- The unit NRW for existing and new customers is assumed to be 82.4 L/meter/day (see Section 5.3.5).
- For non-residential demand, the future demands are based on the initial demand multiplied by a population growth scaler. The population scaler is a ratio between average projected population (see Table 4-12) and average population in 2022.

A summary of the average year metered consumption projection is given in Table 5-16. The main projection is based on 66% of the residential rainwater tanks in new dwellings operating optimally. Sensitivity assessments were undertaken to assess the impact of tank failure on residential consumption.

Table 5-16: Summary of projected average year metered consumption (ML/year) – Bungendore

% of residential tanks operating	User category	2025	2030	2035	2040	2045	2050	2055
66%	Residential	236	281	334	396	469	555	656
	Non-residential	38	44	52	61	72	85	99
	Total	274	325	386	457	541	639	755
95%	Residential	234	272	316	369	430	503	588
0%	Residential	242	303	375	460	560	677	815

A summary of the water projections (based on 66% of the tanks operating) is given in Table 5-17.

Table 5-17: Summary of water supply projections – Bungendore WSS

Reservoir		2025	2030	2035	2040	2045	2050	2055
Days Hill	Average Year Demand (ML/year)	134	165	166	166	167	167	168
	Unrestricted Future Year Extraction (ML/year)	149	190	190	191	192	194	195
	Peak Day Production (ML/day)	0.64	0.85	0.86	0.86	0.87	0.87	0.88
Turallo	Average Year Demand (ML/year)	191	198	206	216	227	240	256
	Unrestricted Future Year Extraction (ML/year)	230	241	255	271	291	313	340
	Peak Day Production (ML/day)	1.05	1.11	1.19	1.29	1.39	1.52	1.68

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Reservoir		2025	2030	2035	2040	2045	2050	2055
North Elmslea	Average Year Demand (ML/year)	0	21	66	66	66	66	66
	Unrestricted Future Year Extraction (ML/year)	0	28	85	85	85	85	85
	Peak Day Production (ML/day)	0.00	0.14	0.43	0.43	0.43	0.43	0.43
North Elmslea Zone 2	Average Year Demand (ML/year)	0	0	18	91	177	278	397
	Unrestricted Future Year Extraction (ML/year)	0	0	23	117	228	358	512
	Peak Day Production (ML/day)	0.00	0.00	0.12	0.60	1.17	1.84	2.62
Total of all zones (historical climate)	Average Year Demand (ML/year)	325	385	455	539	636	751	887
	Unrestricted Future Year Extraction (ML/year)	378	459	553	665	796	950	1131
	Peak Day Production (ML/day)	1.69	2.11	2.60	3.18	3.86	4.67	5.61
Combined system	Average Year Demand (ML/year)	372	432	502	586	683	798	934
	Unrestricted Future Year Extraction (ML/year)	441	521	616	727	858	1,012	1,194
	Peak Day Production (ML/day)	2.40	2.82	3.32	3.90	4.58	5.38	6.33
Combined system with climate change	Average Year Demand (ML/year)	389	452	526	613	716	836	978
	Unrestricted Future Year Extraction (ML/year)	471	557	658	777	917	1,081	1,275
	Peak Day Production (ML/day)	2.50	2.93	3.44	4.05	4.75	5.59	6.57

## 5.8 Water security assessment

Water for Bungendore WSS is supplied by four groundwater bores in Bungendore and one groundwater bore in Currandooly. An investigation into the sustainability and drought resilience of the groundwater source is being undertaken.

Council's WAL entitlement to extract water from the Bungendore Alluvial Groundwater bores is 472 ML/year. The water security assessment is done for the future unrestricted extraction which is based on the 99th percentile from the hindcast. RCP 4.5 was adopted as the probable climate change scenario for forecasting unrestricted future extraction shown in Figure 5-16, an additional projection was undertaken to assess the impact of keeping 95% of the rainwater tanks operating and this is included in the graph.

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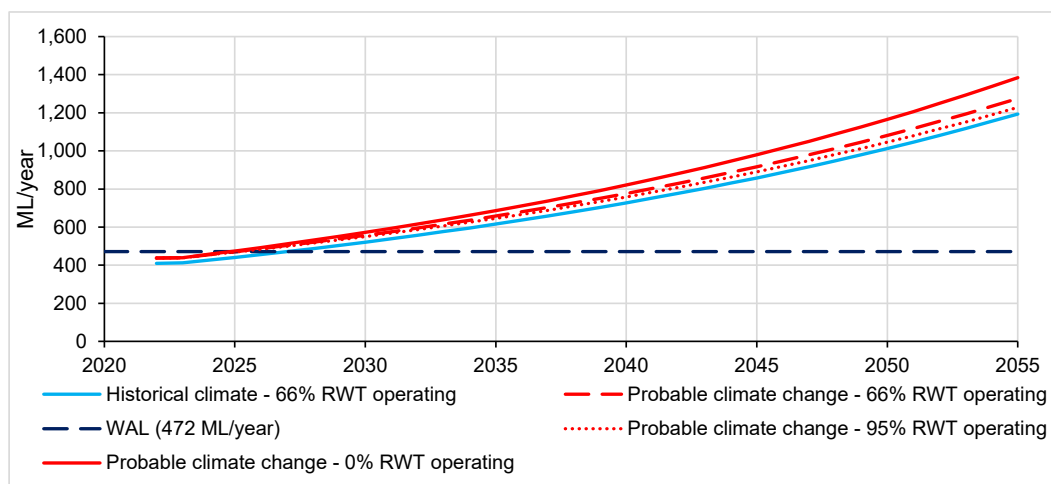


Figure 5-16: Projected unrestricted future extraction for Bungendore WSS compared to historical production (RCP 4.5 probable climate change scenario)

Projected unrestricted future extraction with the effect of climate change reaches between 1,107 and 1,260 ML/year by 2055 depending on the proportion of rainwater tanks operating correctly. The 99<sup>th</sup> percentile dry year extraction reaches the 472 ML/year WAL entitlement by 2028 (or soon after development resumes).

## 5.9 System capacity assessment

This will be undertaken through a review of the hydraulic model built by Public Works in the previous engagement.

## 5.10 Application of Health-Based Treatment Targets

Health-Based Target (HBT) have been introduced in the Australian Drinking Water Guidelines to determine the tolerably low level of microbial risk for drinking water. The HBT will provide the basis for determining the treatment requirements and will help define the performance standards that apply to treatment processes.

The application of HBTs requires that the source risk to a drinking water supply be assessed and quantified, and depending on the risk, a log-reduction in pathogens by treatment is required. If a system were not to meet the recommended Log Reduction Values (LRVs) then a potential issue would arise.

PW has developed an HBT Assessment tool which categorised catchments into vulnerability categories (See Appendix figure C-1 for Bungendore bores and Appendix figure C-2 for Currandooley bores). The tool was used to assess the inherent microbial risk from each water source catchment, the performance of the treatment barriers, and the residual microbial risk after treatment.

### 5.10.1 HBT assessment of threats

Bungendore WSS sources water from four Bungendore bores and one Currandooley Bore. Since this water source is a groundwater, vulnerability assessment is not required.

### 5.10.2 Inherent risk

Based on the HBT assessment, the Bungendore groundwater source has an inherent risk of Medium (Vulnerability Class 2) (ADWG [11]) assuming:

- Bore caps and bore casing are in good condition and prevents surface water ingress.



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- There is aquitard layer between the surface water and the water bearing aquifer.
  - Based on the bore drill logs, there are several clay layers between the surface water and the water bearing aquifer
  - Council's bores are screened in the deeper semi-confined Lachlan formation alluvium, which is not directly connected to surface water.
- there are no disused uncapped bores close to the town water supply bore allowing ingress of surface water into the aquifer.

The aerial view of the catchment of Bungendore/Currandooley water supply source is shown in Figure 5-17.

Overall inherent risk prior to the treatment is 'Medium' from Bungendore bores and Currandooley bore.

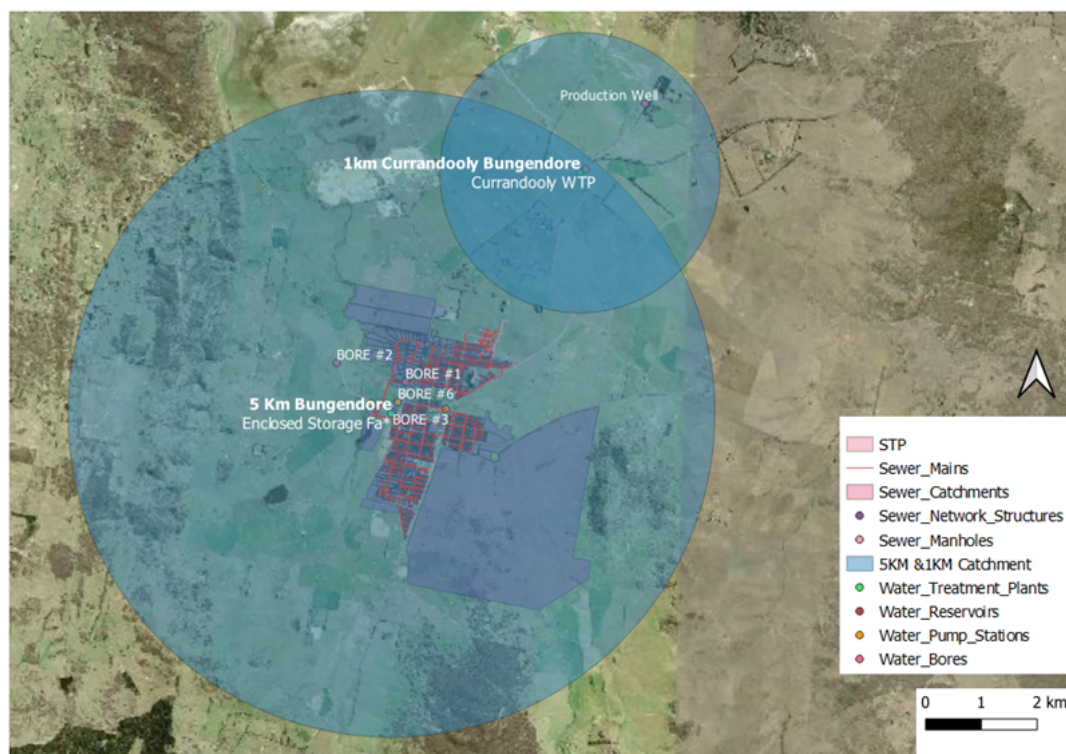


Figure 5-17: Bungendore/Currandooley water supply source

### 5.10.3 HBT assessment of treatment barriers

#### 5.10.3.1 Treatment barriers for chlorine sensitive pathogens

Currandooley WTP is a conventional filtration plant with chlorine as the disinfection barrier. The criteria used for assessing the effectiveness of treatment barriers are as follows:

- Filtered water turbidity < 1 NTU
- Chlorine contact > 15 mg.min/L

Between 2015 and 2017, the filtered water turbidity from Currandooley exceeded 1 NTU on 13 occasions. Between 2018 and 2023 the turbidity has been consistently less than 1 NTU. Currandooley WTP does achieve



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a chlorine contact time of more than 15 mg.min/L. Therefore, the treatment barrier for chlorine sensitive pathogens is considered effective.

Bungendore WTP does not achieve a chlorine contact of 15 mg.min/L (see 5.4.1.2), therefore the treatment barrier for chlorine sensitive pathogens not is considered effective.

Residual risk of chlorine sensitive pathogens: Medium (Vulnerability Class 2) (ADWG [11]). **Issue**

#### **5.10.3.2 Treatment barriers for chlorine resistant pathogens**

There is Currandooley WTP monitoring turbidity after filtration, however no data is available for the Bungendore WTP turbidity as there is no filtration. The criteria used for assessing the effectiveness of the filters are:

- Highest individual filtered water turbidity recorded  $\leq 0.3$  NTU
- Highest monthly 95th percentile individual filtered water turbidity  $\leq 0.15$  NTU

From Section 5.2.4 using the most recent (2021) data, the highest filtered water turbidity exceeded 0.3 NTU, and the highest monthly 95th percentile turbidity was calculated to be 0.4 NTU.

Residual risk of chlorine resistant pathogens **Medium. Issue**

#### **5.10.4 NSW Health preliminary cryptosporidium risk assessment**

Based on NSW Health (letter sent to Council in November 2019), there is a '**Low**' risk rating of cryptosporidium in the raw water source for Bungendore (see Appendix figure C-5)

### **5.11 Work health and safety**

No major WHS issues were noted from the condition assessment site visit.



6
Braidwood water supply scheme

6.1
Raw water source

6.1.1
Water resource

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 catchment area above the intake is 1,114 km². The river intake pumps are operated manually as required. When in operation they run 24 hours per day at 1.38 to 1.68 ML/day (depending on which pump is in service).

6.1.2
Raw water extraction

After raw water extraction from the Shoalhaven River to the 80 ML off-stream dam, the water is then pumped from a submerged pipe in the off-stream dam to the Braidwood WTP.

Capacities of assets for raw water extraction for Braidwood are as follows:

Table 6-1: Braidwood raw water extraction asset’s capacities

Asset	Capacity
Braidwood	
Shoalhaven River transfer pumps	16 -19.5 L/s
Braidwood WTP	2 ML/d (25 L/s) – 22 hours/day

The schematic arrangement of the raw water and Braidwood WTP is shown in Figure 6-1.

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Figure 6-1: Location of raw water intake for Braidwood WTP

### 6.1.3 Water access licences

Council holds Local Water Utility Water Access License (WAL25376), issued under the Water Management Act 2000, which relates to the water supply to Braidwood. The following table summarises the key details of the WAL.

Table 6-2: WAL Licence numbers

WAL license number	WAL25376
Category [Subcategory]	Local Water Utility
Entitlement	360.0 ML/year
Water Source	Mid Shoalhaven River Water Source
Works approval	10CA102425

WAL25376 is sourced from Mid Shoalhaven River Water Source via two 100 mm centrifugal pump and one overshot dam.

### 6.1.4 Source water quality

Raw water quality was sampled between March 2014 and March 2023 approximately once every quarter. The samples are collected at Shoalhaven River intake and from the off-stream storage dam (80 ML)

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Typical raw water quality for the Shoalhaven River is shown in Appendix table A-3.

The main parameters of interest in the Braidwood raw water are:

- Aluminium – one sample collected on 30/11/2020 (1.3 mg/L) was exceptionally high in aluminium. Other than this sample, about 2 out of 38 (approximately 5%) of samples contain aluminium in concentrations above 0.2 mg/L.
- Blue-green algae – 298 cells/mL of Total Cyanophyta was detected in the off-stream storage dam (80 ML) on 13/11/2019.
- *Escherichia coli* (E. coli) – has been tested using a method that provides an estimate of the Most Probable Number (MPN), 26 out of 38 (68%) of samples were above 1 MPN/100 mL and 3 (less than 1%) of samples were above 100 MPN/100mL. The maximum E.coli recorded was 250 MPN/100 mL.
- pH – pH occasionally increases but remains below the ADWG (Australian Drinking Water Guidelines) of 8.5 pH Unit. 2 out of 38 (5%) samples are above 8.2 pH Unit.
- Iron – 4 out of 38 (11%) of the samples contained above 0.3 mg/L.
- Turbidity - one sample collected on 30/11/2020 (7.2 NTU) was above 5 NTU.

## 6.2 Water treatment

### 6.2.1 Treatment process

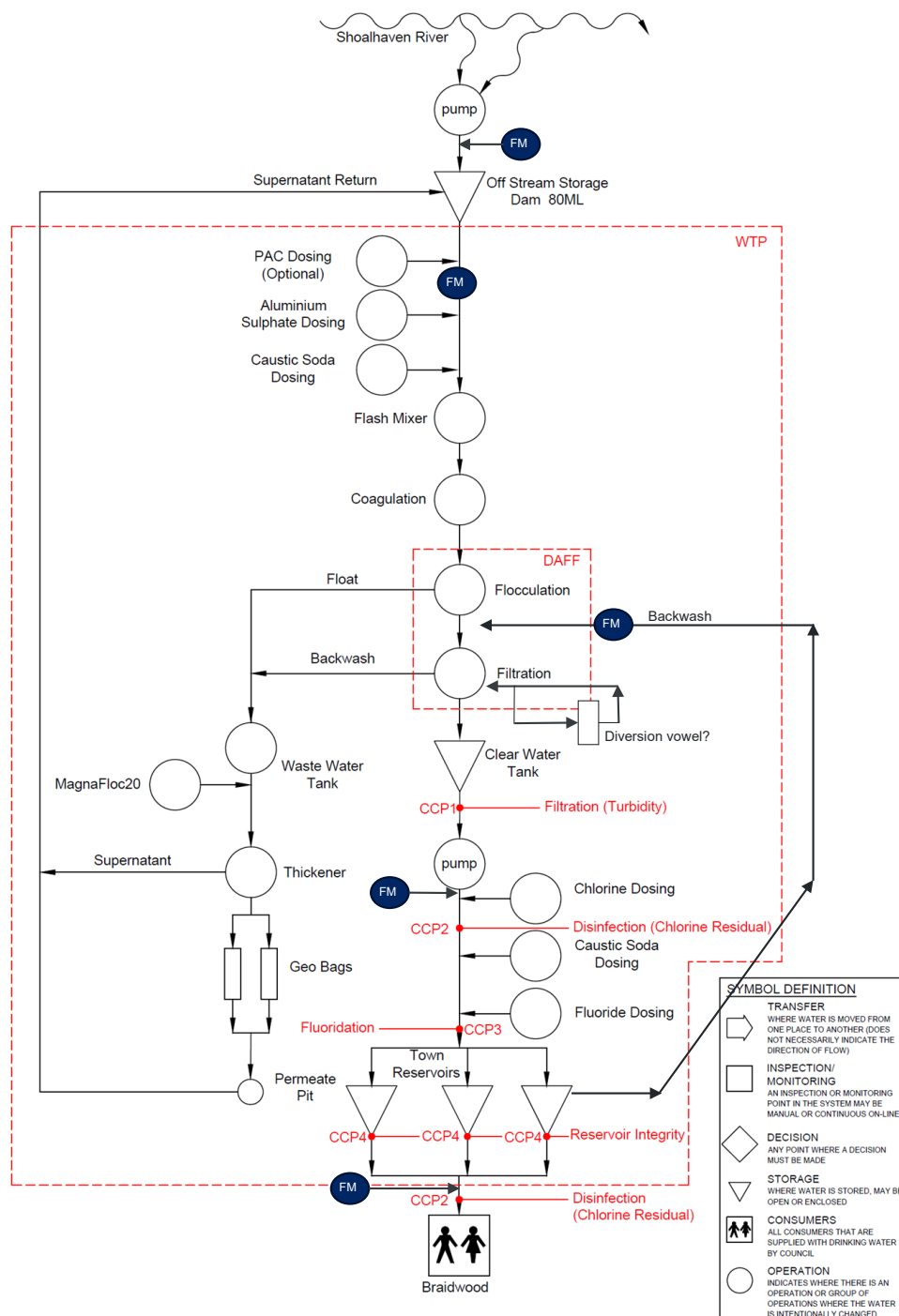
Water pumped from the Shoalhaven River is treated with the following Dissolved Air Flotation and Filtration treatment process at Braidwood WTP:

- Pre-dosing with optional power activated carbon, aluminium chlorohydrate (ACH) and caustic soda
- Flash Mixer to uniformly disperse the chemicals dosed
- Coagulation, flocculation, flotation and filtration
- Post dosing using gas chlorine for disinfection, caustic soda for pH correction, and fluoride.

The WTP has a capacity of 2 ML/day.

A schematic showing an overview of the Braidwood water supply scheme is provided in Figure 6-2.

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Flow Diagram sourced from council.

Figure 6-2:Schematic flow diagram of the Braidwood water supply scheme

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## 6.2.2 Historical water production

Braidwood WSS supplies potable water to customers in Braidwood's reticulation system. Council provided the potable water data recording from July 2004 to February 2023. The potable water meter records flow being pumped out of the Braidwood WTP. The historical potable water volume supplied is summarised in Figure 6-3.

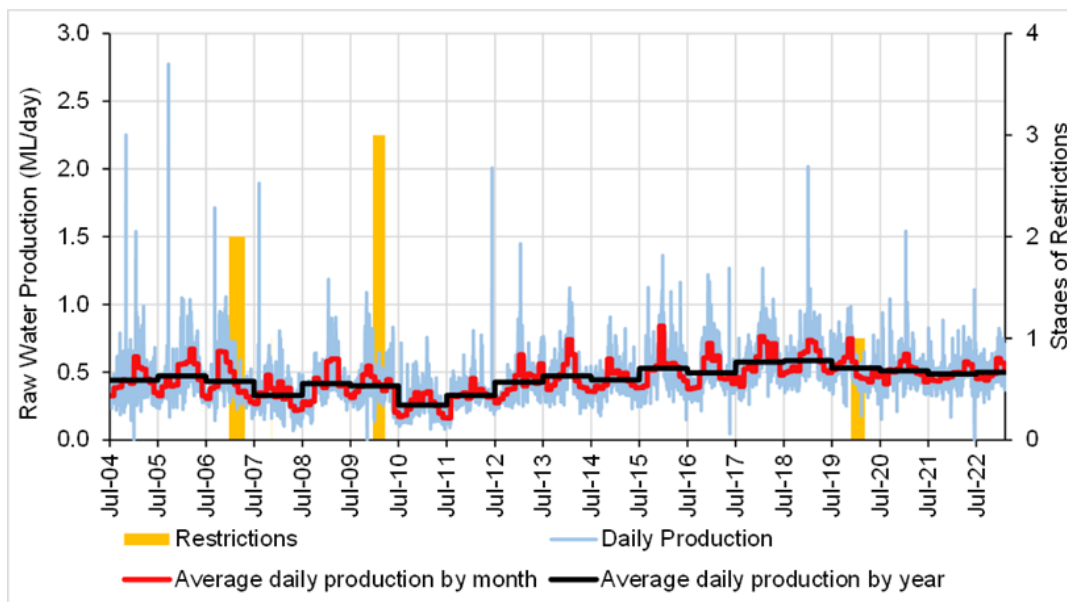


Figure 6-3: Historical production data – Braidwood potable water production

The annual summary of water production for the Braidwood WTP is shown in Table 6-3.

Table 6-3: Historical annual water production – Braidwood WTP (ML/year)

Financial Year	ML/year
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

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Financial Year	ML/year
2013/14	171.9
2014/15	161.7
2015/16	193.0
2016/17	180.6
2017/18	209.6
2018/19	213.5
2019/20	193.7
2020/21	186.1
2021/22	177.2

The maximum production was 213.5 kL/year for the 2018/19 financial year.

### 6.2.3 Peak production analysis

The historical peak fortnight pattern for the Braidwood WSS is shown in Figure 6-4.

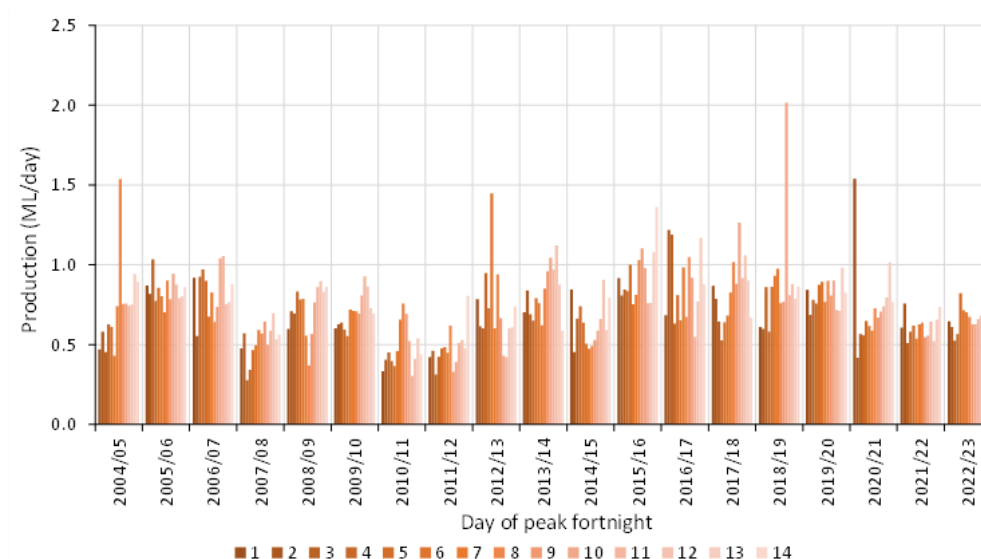


Figure 6-4: Peak fortnightly production patterns – Braidwood WTP

The highest recorded daily production in Braidwood WTP was 2.773ML which occurred on 19 September 2005. However, as the temperature of this peak day is relatively low (12.8°C), this day is not considered to be the true peak production representative of the scheme demand. It appears that this was probably a transcription error as the daily production in the week before and the week after are all less than 0.5 ML/day. This is also likely to occurred on the 31<sup>st</sup> of October 2004, with a recorded daily production of 2.251 ML/day.

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The second highest peak day production was 2.02 ML which occurred on 1 January 2019. There was no rainfall recorded leading up to the day for 8 days except 0.2 mm on the previous day and the maximum temperatures surrounding this day was high (ranged from 25°C to 35°C) as graphed in Figure 6-5. The demand was much higher than any of the days in the week before or week after even though the maximum temperature was similar. This pattern is usually seen as a response to an operational issue (for example a main break or treatment plant outage) rather than in response to customer demand. Similar peaks also occurred on 11/1/2021 (1.5 ML).

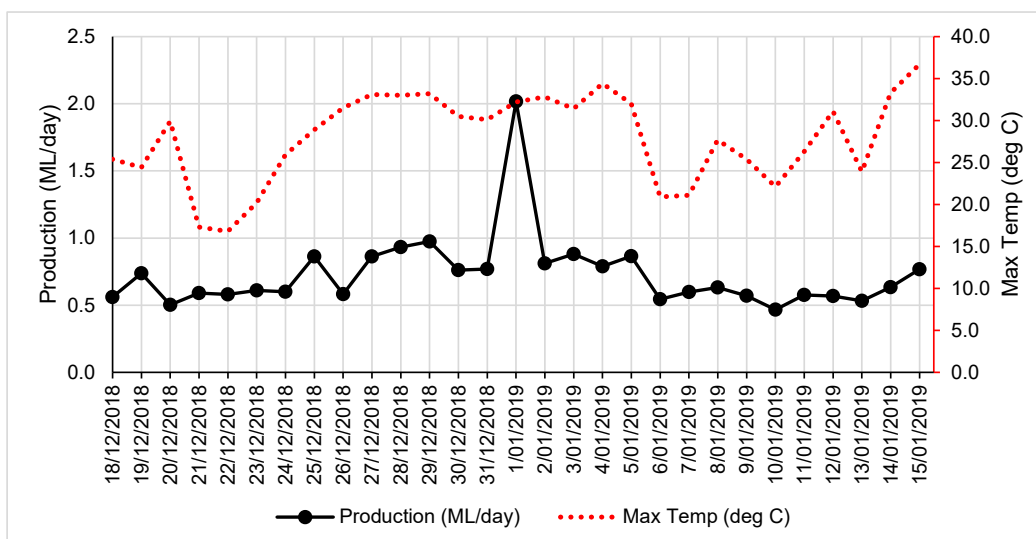


Figure 6-5: Production and maximum temperature around peak day

The average daily production over the peak week (ADPW) and peak fortnight (ADPF) was 1.01 ML/day of week starting 19 Dec 2015 and 0.93 ML/day of fortnight starting 12 December 2015 respectively. The ADPW and ADPF graphs are shown in Figure 6-6.



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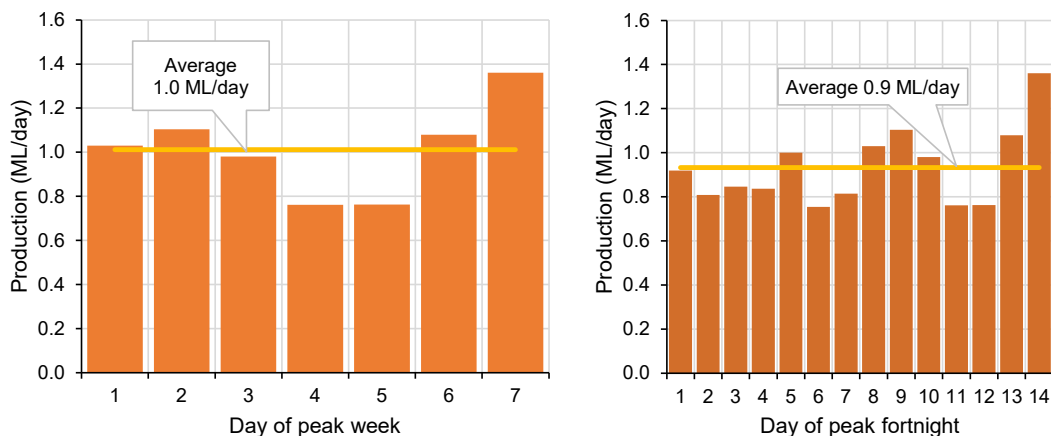


Figure 6-6: Peak week and peak fortnight production – Braidwood WTP

The PD to ADPW ratio for Braidwood WSS is **1.97**. Once the peak days of 2 ML/day are excluded, the PD to ADPW ratio is 1.36. this rounds to the PD to ADPW ratio of 1.4 observed in other systems of similar size in similar climates. a PD to ADPW ratio of **1.4** is adopted for Braidwood WSS.

A peak day production of 1.4 ML/day has been adopted for the starting point for the projection.

#### 6.2.4 Treated water quality

According to Council's Drinking Water Management System (DWMS) [1], there are five critical control points (CCP) adopted for Braidwood WTP, shown in Table 6-4.

Table 6-4: Braidwood WSS - Critical Control Point Summary

CCP		Control parameter	Target	Alert Limit	Critical limit
Braidwood WTP	CCP1 Filtration	Filter turbidity in channel (after ripening up to 15 mins)	<0.1 NTU	>0.3 NTU	>0.5 NTU
	CCP2 Chlorination (a)	Free chlorine residual in clear water tank	1.0 to 2.0 mg/L	<0.8 mg/L or >2.0 mg/L	<0.5 mg/L or >5.0 mg/L
	CCP2 Chlorination (b)	Free chlorine residual in reticulation	>0.4 mg/L	<0.3 mg/L	<0.2 mg/L or 5.0 mg/L
	CCP3 Fluoridation	Fluoride in clearwater tank	0.95 – 1.05 mg/L	0.9 – 0.95 mg/L or 1.05-1.35 mg/L	<0.9 for 72 hrs or >1.5 mg/L
	CCP4 Reservoir	Reservoir Weekly Integrity	No gaps, vermin proof, secure, enclosed, locked	Breach of reservoir integrity	Evidence of vermin

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#### 6.2.4.1 Braidwood WTP

Council provided data for chlorine in Braidwood's reticulation and turbidity, chlorine, and fluorine in the clear water tank. Data sets was provided for the period between January 2015 and June 2023. All parameters increased in March/May 2020. Free chlorine in the reticulation is not considered to be a CCP.

CCP1 Filtration recorded at the clear water tank has been presented in Figure 6-7.

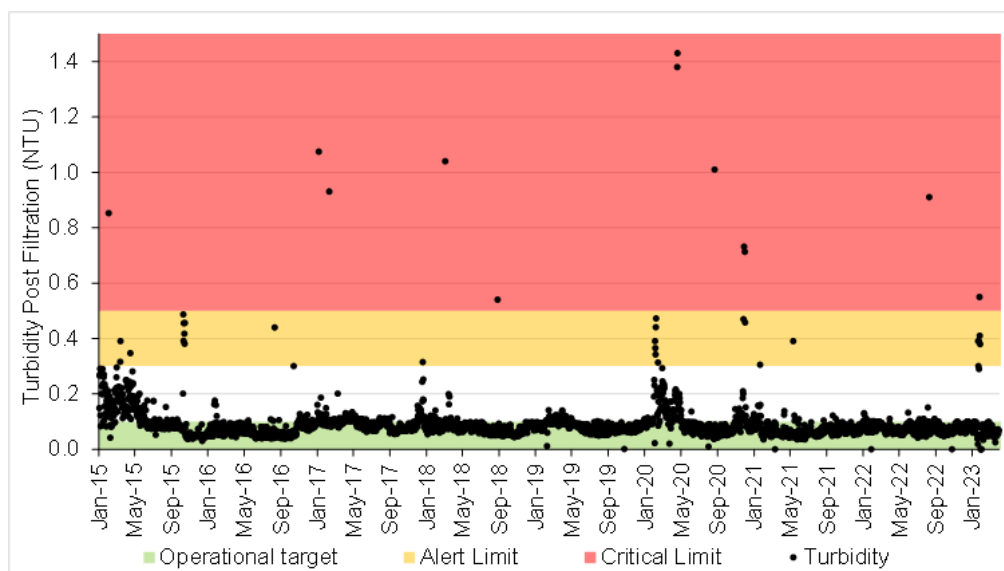


Figure 6-7: CCP1 Filtration – Historical turbidity of Braidwood WTP filtrate

Majority of the records have maintained to be around the target range. There have been 12 records which exceeded the critical limit of 0.5 NTU. Explanation from the council for the exceedances are listed below.

- Entries on 10/8/22 read 0.91 entered, however the actual result is 0.091 NTU. Master sheet modified to reflect the actual result.
- Entries on 22/8/20 read 1.01. It was noted by the supervisor as erroneous reading, field sheet shows this figure. Noted circled by supervisor. Suspect erroneous reading.
- Entries on 19/4/20 and 20/4/20 read 1.38 and 1.43 respectively. It was reviewed on the sheet for alum dosing.

CCP2 (a) Chlorination recorded at the clear water tank post filtration has been presented in Figure 6-8.

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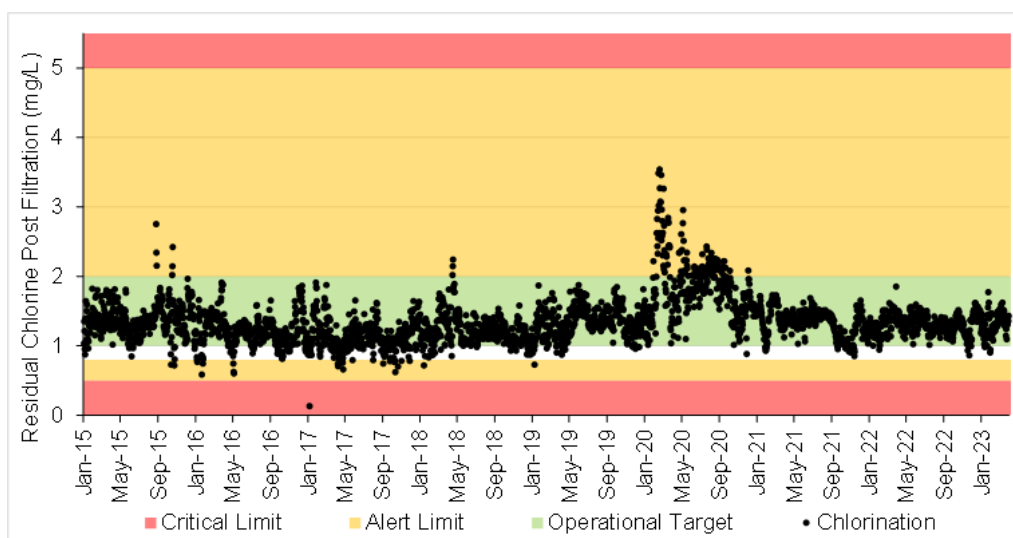


Figure 6-8: CCP2 (a) Chlorination – Historical free chlorine in clear water tank at Braidwood

Majority of the records have maintained to be around the target range.

CCP2 (b) Chlorination based on free reticulation chlorine residual has been presented in Figure 6-9

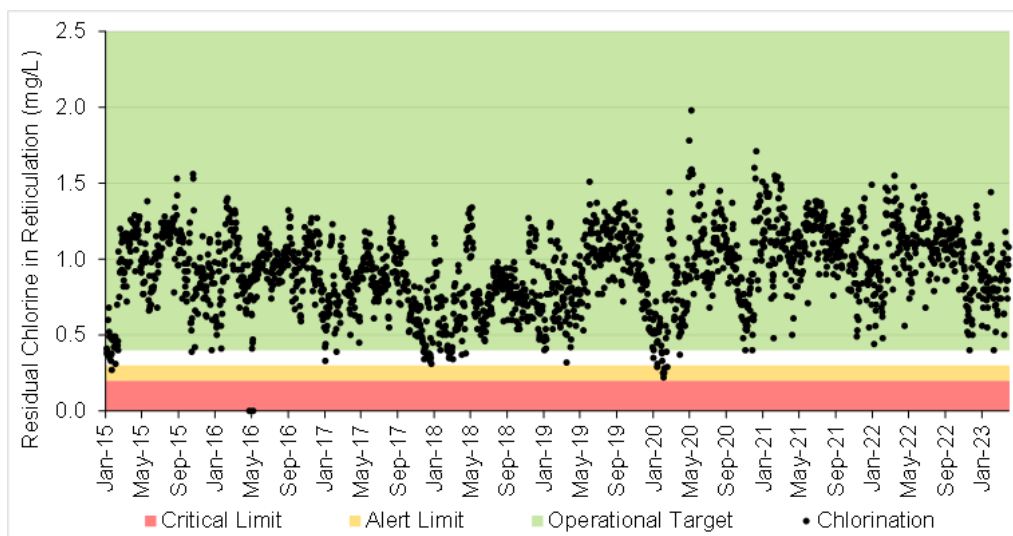


Figure 6-9: CCP1 (b) Chlorination – Historical free chlorine in reticulation of Braidwood

Majority of the records have maintained to be around the target range.

CCP3 Fluoridation recorded at the clear water tank post filtration has been presented in Figure 6-10.

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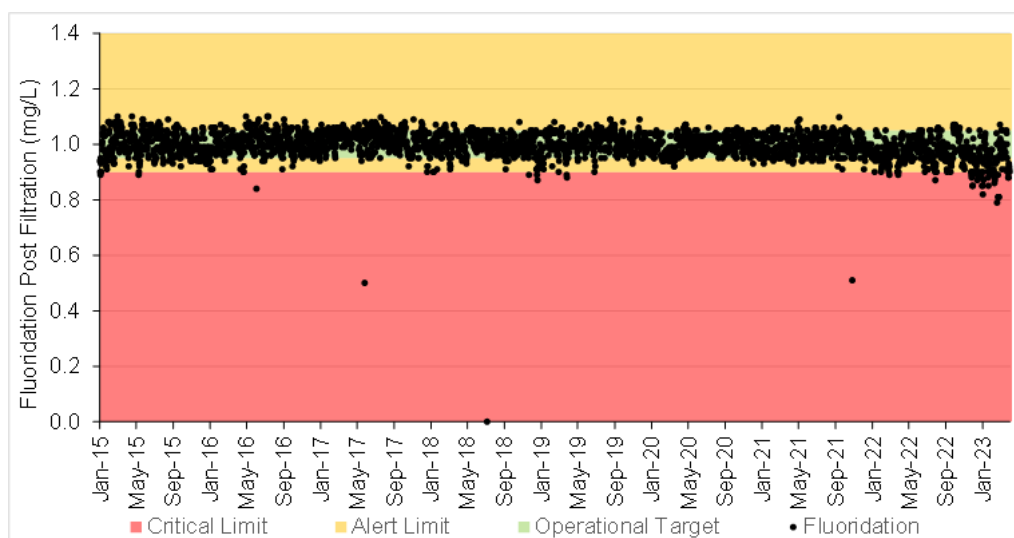


Figure 6-10: CCP2 Fluoridation – Historical fluoride in clear water tank in Braidwood

Based on the data from January 2015 and February 2023, there were recent exceedances below the lower critical limit of less than 0.9 mg/L for 72 hrs. Before July, were maintained to be within the target range. Fluoride levels started to decrease from February 2023 due to issues with the saturators causing bed caking. Council stated that they had replaced the beds of all four branded NaF saturators and recommissioned. Email evidence from council to NSW Health was sighted.

### 6.3 Distribution

#### 6.3.1 Distribution system

Treated water stored at the reservoirs supply Braidwood via a 2.3 kilometre main, and gravity mains service the township. Reservoirs include two older reservoirs (0.55ML each – total 1.1ML) and a new reservoir (1.5 ML). The layout of the distribution network for the Braidwood WSS is shown Figure 6-11.

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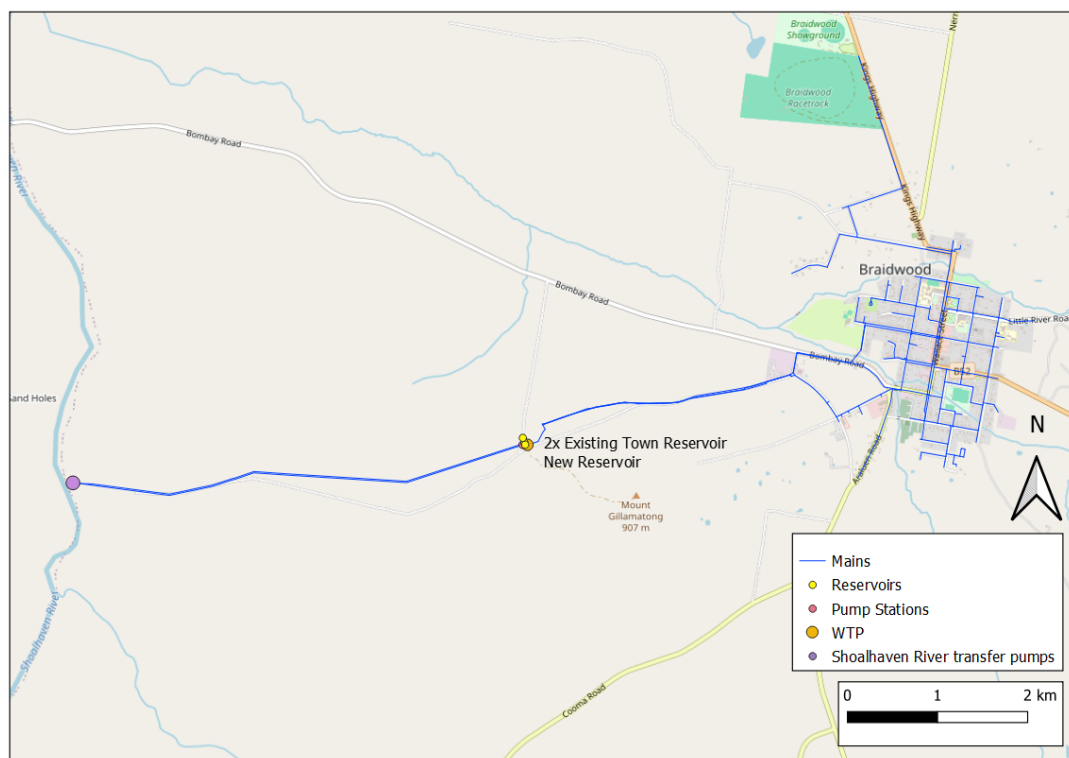


Figure 6-11: Braidwood WSS distribution

### 6.3.2 Metered customer demand

Council supplied billing data for all potable water customers from July 2017 to December 2022, with the water meters being read quarterly. User classes from the billing data were residential, commercial, mixed, municipal excluding parks, municipal public parks, rural and vacant.

The historical number of customer meters in the billing data and the historical metered customer usage of the last six years are shown in Table 6-5 and Table 6-6 respectively.

Table 6-5: Historical number of meters – Braidwood Potable WSS

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Residential	572	566	582	601	603	598
Commercial	49	49	50	49	50	47
Mixed	16	16	16	16	15	15
Municipal - excluding parks	26	27	27	25	26	25
Municipal - public parks	5	6	5	6	6	6
Rural	3	4	3	3	2	2
Vacant	2	2	2	2	2	2
<b>Total</b>	<b>673</b>	<b>670</b>	<b>685</b>	<b>702</b>	<b>704</b>	<b>695</b>

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Table 6-6: Historical metered customer usage (ML/year) – Braidwood Potable WSS

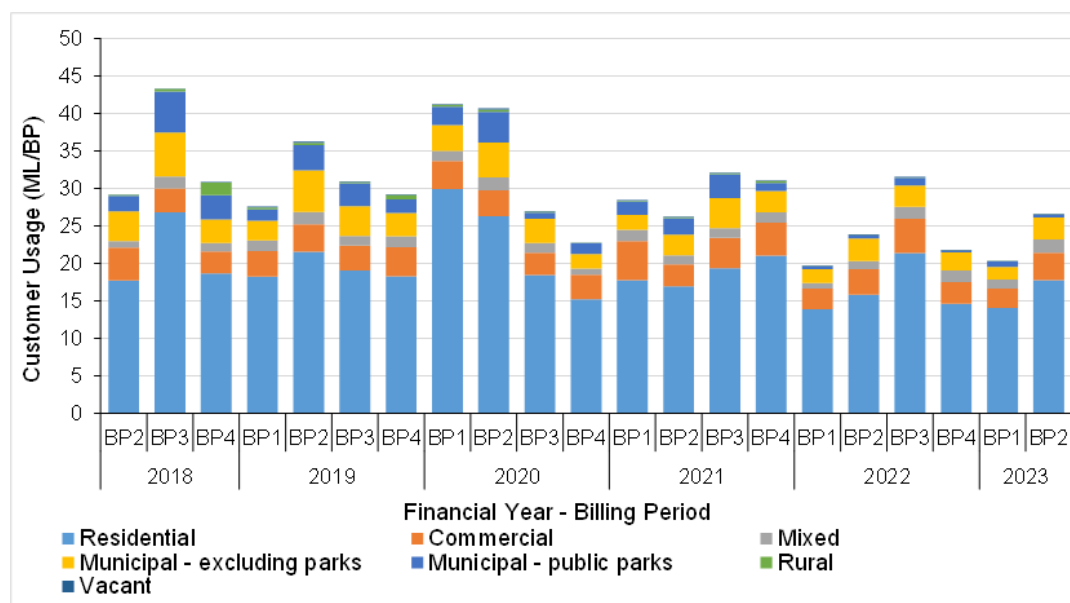
	2017/18 reads 2 to 4*	2018/19	2019/20**	2020/21	2021/22	2022/23 read 1*
Residential	70	76	91	73	69	30
Commercial	12	14	14	16	14	6
Institutional	4	6	5	5	5	3
Farm	14	15	13	11	11	4
Vacant	11	10	9	8	2	1
Mixed	2	1	1	1	0	0
Education	0	0	0	0	0	0
<b>Total</b>	<b>112</b>	<b>123</b>	<b>133</b>	<b>115</b>	<b>102</b>	<b>44</b>

\*Demand for the 2017/18 and 2022/23 financial years is included but not complete

\*\* Stage 2 to 4 water restrictions in place from 22/11/2019 to 5/03/2020

Customer usage was high during the dry and warm conditions in 2019/20. Historical customer usage split has been on average around 65% residential to 35% non-residential.

The historical usage for all available billing periods for Braidwood is given in Figure 6-12.



Note: Vacant are not shown in the column graph due to negligible consumption

Figure 6-12: Historical metered customer usage by user category – Braidwood Potable WSS

### 6.3.3 Major non-residential users

The criteria used to identify major non-residential users was any non-residential customer that used more than 3% of the total metered customer usage for the Braidwood WSS. This results in four major users; their historical usage is shown in Table 6-7.

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Table 6-7: Major Water Users – Braidwood WSS

Major User	Average Yearly Demand (ML/year)	Highest Yearly Demand (ML/year)
Braidwood Recreation Grounds	2.76	5.34
Ryrie Park North (Inc Braidwood Memorial Pool)	2.44	4.63
Ryrie Park South	2.06	3.60
The Firewood King (Firewood Supplier) and TEGRA (Quarry)	2.74	3.07

There is not currently an effluent reuse scheme in Braidwood. Future capital works for the sewerage scheme may include an option for a recycled effluent scheme.

#### 6.3.4 Water balance

The historical water production from the WTP, and metered customer usage data were used to calculate a water balance over Braidwood WSS. The water balance used is the standard developed by the International Water Association (IWA) Water Loss Task Force. The method used to calculate the different components of the water balance is given in Appendix D.1

The water balance for Braidwood WSS is shown in Table 6-8, and shown graphically in Figure 6-13.

The historical averages over eight billing periods 2020/21 Q1 (28/06/2020) and 2021/2022 Q4 (16/06/2022) were used in the water balance.

Table 6-8: Water Balance – Braidwood WSS (ML/year)

Raw water supplied to WTP 197 ML/year	Water supplied to Braidwood WSS (WTP production) 182 ML/year	Authorised consumption 110 ML/year	Billed authorised consumption 109 ML/year	Residential		77 ML/year
				Rural		0 ML/year
				Commercial		15 ML/year
				Municipal- excluding parks		11 ML/year
				Municipal- public parks		5 ML/year
		Unbilled authorised consumption		1 ML/year		
		Water losses in distribution 72 ML/year	Apparent losses		1 ML/year	
			Real losses 71 ML/year	Avoidable real losses		38 ML/year
				Unavoidable real losses from mains		17 ML/year
				Unavoidable real losses from service connections		16 ML/year
Losses at WTP 15 ML/year					15 ML/year	

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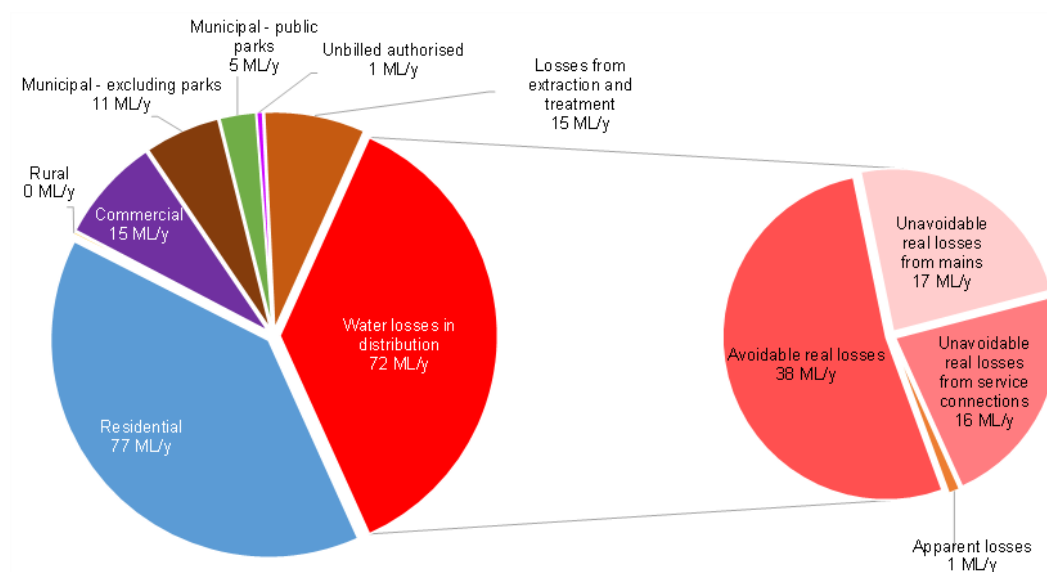


Figure 6-13: Water Balance – Braidwood WSS (ML/year)

Based on the above water balance, Braidwood WSS has an average ILI (current annual real losses / unavoidable real losses) of around 2.1 which is categorised in the third-best performing leakage performance category, B1 [12]. Utilities with losses in this range are expected to be able to make significant improvement using techniques including pressure management, active leakage control and better maintenance.

On average, authorised consumption made up around 61% of the water produced by the WTP in the billing data. This results in non-revenue water accounting for 39% of the total water produced. The historical average unit water loss is estimated to be 249 L/connection/day, which is approximately 3.4 times the state median of 74 L/connection/day. **Issue**

The daily NRW calculated for the previous IWCM was 168 kL/day (2013/14), 154 kL/day (2014/15) and 183 kL/day (2015/16), about 35%. The NRW for the period used for the water balance averaged 127 kL/day, showing some improvement. Note that the period used for the water balance was also relatively wet, greatly reducing the overall demand for water, causing the percentage NRW to increase.

### 6.3.5 Non-Revenue Water

Non-revenue water (NRW) is made up of several 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 Braidwood schemes is given in Table 6-9 NRW is higher than the 2021-22 state-wide median of 73 L/connection/day and the LGA yearly average of 46 L/connection/day. The LGA yearly average is based on the combined service areas including Queanbeyan and adjacent suburbs and villages, who are served with water from ICON Water (ACT).

Table 6-9: Braidwood NRW Summary

	2017/18	2018/19	2019/20	2020/21	2021/22
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Average NRW (kL/day)	202	248	167	193	205
Number of Connections	709	763	772	781	792
Average NRW (L/connection/day)	285	325	216	247	259

The average daily non-revenue water by quarter for Braidwood is displayed in Figure 6-14

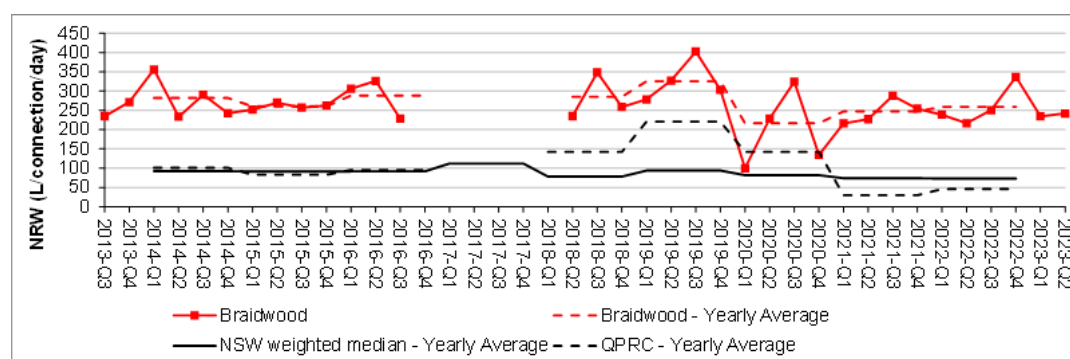


Figure 6-14: Braidwood historical non-revenue water

Braidwood has highest NRW of the Palerang water supplies as it is the oldest network. Approximately 12 km out of 19 km of Braidwood's network is 65 years old (sourced from water asset list provided by council). It has the highest number of main breaks. 26 out of 173 complaints was related to main bursts over 3 years from October 2019 to November 2022 (sourced from water complaints since 2019 provided by council). There have been main breaks every 1-3 months with some months have main breaks more than once. **Issue.**

Since the previous IWCN, council has replaced 2.2 km of trunk main connecting the reservoirs to the town and spent \$50,000 replacing old, galvanised water mains in town. These measures may have contributed to a decrease in NRW observed starting in Q1 2020.

In 2018/19, the NRW reached high values which have not been observed before. In 2019/20, the NRW values returned to the previously observed range. As seen in Figure 7-13, NRW is climate dependent. There may be a user that is not metered which uses water to irrigate and council may need to investigate.

The historical average unit water loss for the water balance period is estimated to be 249 L/connection/day using the water balance methodology (see Section 6.3.4), this accounts for some meter losses not accounted for in the NRW calculation below. The unit NRW for the water balance period is 253.2 L/connection/day, this will be used as the unit water loss in the high NRW projection for the new properties.

The minimum unit NRW was 99.8 L/connection/day for the quarter ending September 2019, this will be used as the unit water loss in the low NRW projection for the new properties.

### 6.3.6 NSW Health independent verification

Council collects water quality samples for the NSW Health verification program from four points in the Braidwood as of 2023.

NSW Health water quality data from the previous seven years (July 2016 to October 2023) were analysed. Typical water quality from the points in Braidwood in Appendix table A-6. The parameters that did not meet the guideline values were:

- Aluminium (0.2): 1 exception in February 2020.
- Fluoride weekly laboratory sampling (0.9 – 1.5): 23 exceptions, all with concentrations slightly below the recommended minimum concentration.

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- Fluoride ratio (0.8 - 1.2) 1 exception in March 201.8
- pH exceeded 8.5 in January 2017 (two samples collected a fortnight apart) and January 2023 (a single sample). There have also been several periods when the pH has been between 8 and 8.5 for extended periods, including over six months between July 2016 and January 2017.

While the following parameter did not comply the ADWG, though it is still of interest:

- Sodium exceeds the concentration recommended for those on low sodium diets. Therefore, doctors and hospitals need to be informed of the sodium concentration so they can provide advice to their patients.

### 6.3.7 Risks identified from the DWMS Risk Register

According to the DWMS Risk register [1], for Braidwood WSS, the 'Very High' risks are identified below:

- Onsite Sewage Management System discharges/failures;
- Unrestricted livestock/stockyards access;
- Flooding event, storm flows (and turbidity and colour);
- Turnover of dam leading to elevated pathogens and metals (e.g., manganese and iron);
- Cyanobacterial (blue green algae) outbreak;
- Alum dosing system failure (and turbidity, aluminium);
- Filtration and flocculation failure;
- Chlorine dose failure causing ineffective disinfection;
- Loss of trained operators;
- Faecal contamination due to access by birds and rats;
- Dead ends in reticulation leading to loss of chlorine residual;
- Breach of pipelines through breaks, inappropriate maintenance, new or service works.
- Contaminating the treated water due to back flow and cross connection;
- Growth of biofilms, sludge causing degradation of water quality;
- STP overflows/ leaks/ OSSMS contaminating aquifer due to discharges and failures;
- Aged water/short circuiting/thermal stratification/loss of chlorine residual;
- Unrestricted livestock access to water supply;
- Point sources (e.g., mines), Sedimentation in dam and leachate, stratification/turnover of dam leading to elevated pathogens and metals;
- Operator cross-over between water and sewer assets due to use of same tools leading to cross contamination error.

Based on the DWMS [1] the Residual Risk with Preventative Measures continues to remain 'Very High' for the following: dead end in reticulation system leading to stagnation and loss of chlorine residual; breach of pipeline through breaks and service works; cross contamination due to backflow and growth of biofilms/ sludge causing degradation of water quality. **Issue** Council is currently reviewing the DWMS including this risk assessment.

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## 6.4 Best practice compliance – LWU Circular 18

This circular was prepared in 2014 to inform local water utilities of a new protocol being implemented to ensure the microbial safety of drinking water supplies across regional NSW. LWUs were required to review and update their standard operating procedures to ensure three key barriers were achieved.

### 6.4.1 Barrier 1: Effective distribution

LWU Circular 18 states that disinfection is the single process that has had the greatest impact on drinking water safety. Two actions should be undertaken to achieve effective disinfection.

#### 6.4.1.1 Action 1: Monitoring of factors which affect disinfection

LWU Circular 18 recommends LWUs to monitor the factors which affect effective disinfection including chlorine residual, turbidity and pH levels. These factors are monitored at Braidwood WTP as part of its CCP (see Section 6.2.4)

Circular 18 recommends keeping turbidity as low as practicable, aiming for less than 1 NTU. pH should be as low as possible and Circular 18 states that a level between 7.2 to 8.2 is desirable.

The Braidwood WTP filtered water turbidity is predominantly below 1 NTU with few results that fall out of Circular 18 recommended range. (see Figure 6-7).

#### 6.4.1.2 Action 2: Achieve minimum chlorine contact time (C.t)

Circular 18 recommends that a minimum C.t. value of 15 mg.min/L is achieved, as recommended by the ADWG.

C.t. is calculated only for the clear water tank at Braidwood WTP.

C.t. for water leaving clear water tank:

- Plant flow = 1.38 ML/day
- Clear water tank = 2.6 ML
- Baffling factor of 0.3 used for contact tank assuming it has 'single or multiple unbaffled inlets and outlets, no intra-basin baffles' [7]
- Free chlorine concentration = 0.5 mg/L (Council's CCP critical limit)
- C.t. = 407 mg.min/L

The total C.t from chlorination at Braidwood WTP to outflow is 407 mg.min/L, which is above the recommended minimum value of 15 mg.min/L.

### 6.4.2 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 recently for each reservoir. As of the last inspection no issues were identified, and no actions were required at any of the eight reservoirs.

### 6.4.3 Barrier 3: Maintain a free chlorine residual in the distribution system

Circular 18 recommends a minimum chlorine residual of 0.2 mg/L in the distribution system. Council monitors free chlorine daily in the reticulation of each of the water supply schemes.

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## 6.5 Analysis of production data

A water demand analysis is undertaken to calculate the unit demands, estimate the water losses and forecast the following demands:

- Average (rainfall) year metered demands – for revenue planning
- Unrestricted future year system demands – to assess drought security
- Peak day system demands – to assess system reliability.

The 30-year forecasts based on the nominated growth, are used to identify the issues in meeting the adopted water supply security, and reliability objectives of the urban water supply system. Further explanation on the water demand analysis can be found in Appendix E.

Analysis and modelling were undertaken on the water production data i.e. the water going into the reticulation system, recorded at the outlet of the treated water pumps.

### 6.5.1 Trend correction

Analysis and modelling were undertaken on the water production data i.e., the water going into the system.

Modelling was undertaken to understand the impact of various factors/trends (demographic, climatic, economic etc.) on the variability of town water demand.

The factors that were considered were:

- Historical water requirement for grass irrigation (lawns and public open spaces) obtained from the simulated water use model by PW. The model uses location-specific historical rainfall and evaporation data, soil type and grass type.
- Historical water requirement for use of evaporative coolers. The model uses location-specific historical maximum temperature data.
- Historical number of connections.
- Non-revenue water.

The weather data (rainfall, temperature, synthetic pan evaporation, evapotranspiration) was sourced from SILO (State of Queensland (Department of Environment and Science), 2023).

The aim was to develop models which, when input with historical factors/trends, would output a production that correlates well with the actual historic production.

Once the best model is selected, the production was hindcast to estimate the likely water production for a repeat of the historical climate from July 1889 to June 2023, with the current users and losses.

### 6.5.2 Production modelling

Water production records from July 2004 to February 2023 provided by council were analysed. The model showed that the most significant contributors to Braidwood's demand variability were:

- outdoor irrigation
- an additional increase in demand during warm to hot weather that resembles evaporative cooler air conditioning water use when the maximum temperature was over 20°C.
- Non-revenue water.

The production model was then hindcast over a 133-year period of available climatic data of historical temperature, rainfall and evaporation to estimate the annual demands if the current conditions of lot size, household size, number of connections, pricing and usage patterns were to prevail. The Low NRW case is based on the lowest NRW per billing period from December 2017 to December 2022 and the High NRW case

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is based on the highest NRW per billing period from December 2017 to December 2022. The hindcast is shown in Figure 6-15.

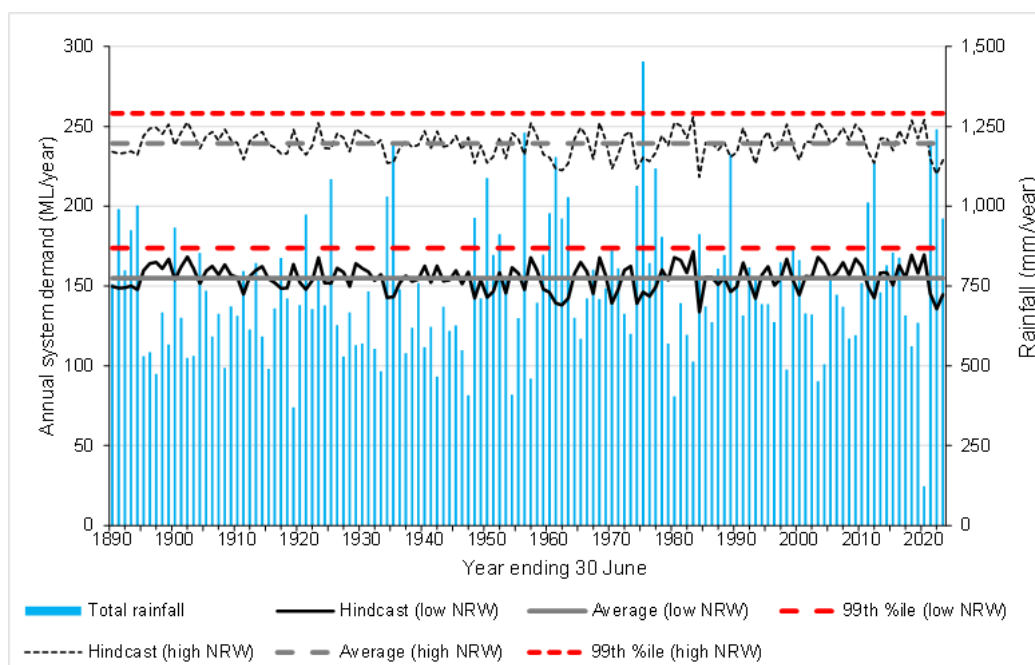


Figure 6-15: Production model hindcast – Braidwood raw water supply

The hindcast was also used to estimate the historical ADPW production. For the analysis the 99th%ile (1 in 100 year) unrestricted future production was selected from the hindcast as the starting points for the forecasts. The model results are presented in Table 6-10.

Table 6-10: Braidwood modelled unrestricted production

	From historical data	Modelled outcomes (High NRW)	Modelled outcomes (Low NRW)
Average year (ML/year)*	184	239	155
99th percentile unrestricted future year (ML/year)	214**	258	174
Average day peak fortnight (ML/day)	0.88	0.98	0.75
Average day peak week (ML/day)	1.02	1.02	0.79
Peak day (ML/day)**	1.4	1.38	1.15

\* Historical average from the 10 years 2012/13 and 2021/22, there were some water restrictions in this period

\*\* 2018/19 there were no water restrictions

\*\*\* See discussion in Section 6.2.3 on historical peak days

The historical recorded production is generally between the modelled outcomes for the high and low NRW scenarios as is expected from the historical variation in NRW.

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In the previous IWCN, Braidwood's peak day production was estimated to be 1.5 ML/day (in 2016). From the modelled unrestricted production, the modelled peak day is 1.15 to 1.38 ML/day depending on the NRW scenario. This is much less than the peak days recorded on 1/1/2019 (2.02 ML) and 11/1/2021 (1.5 ML).

### 6.5.3 Effect of climate change

As with Bungendore, for comparison purposes, the impact of climate change on the 2023 demand was calculated using the method from the previous IWCN. Refer to Appendix table F-3 and Appendix table F-4 for detailed calculation output for Braidwood.

#### 6.5.3.1 SEACI

Shortly after the previous IWCN analysis was completed, DCCEEW started providing the data sourced from the South Eastern Australian Climate Initiative (SEACI). This data included rainfall and evapotranspiration datasets for 1 historical dataset and 17 Global Climate Models (GCMs) and was based on a 1°C warming scenario from a 1990 baseline. The Daily maximum temperatures assumed to be 1°C higher. Data from this data set was used to calculate the secure yield of the surface water source at Braidwood and Captains Flat.

SEACI data was obtained for Braidwood.

Refer to Appendix table F-5 and Appendix table F-6 for detailed calculation output.

#### 6.5.3.2 NARCIIM 1.5

The demand changes for Bungendore and Braidwood were estimated using the three GCMs, two RCMs, and two future time periods (before and after 2060). The results are summarised in Appendix table F-13 to Appendix table F-24. When there was a decrease in demand instead of an increase, the cells are shaded grey.

For the demand forecasts, the probable climate change forecasts have been calculated using the maximum increase from the RCP 4.5 models for the period between 2006/07 to 2058/59. The more severe climate change forecast uses the maximum increase from either the RCP 4.5 or 8.5 models and either time period. For both Braidwood and Bungendore, the highest increase in the 99th percentile dry year demand was the maximum increase under RCP 4.5 between 2006/07 and 2058/59. The increase in system demand for Braidwood is summarised in Table 6-11, note that as the NRW is assumed to be climate independent, the climate change impact on the low NRW scenario is more severe than on the high NRW scenario.

Table 6-11: Climate change impact on system demand

Projection	Climate change scenario	Average year	99th %ile dry year	Average day peak week	Average day peak fortnight
Low NRW	Probable	4.42%	5.75%	3.06%	3.52%
	High severity	7.02%	5.75%	3.86%	5.17%
High NRW	Probable	2.85%	3.85%	2.39%	2.70%
	High severity	4.56%	3.85%	3.01%	3.97%

#### 6.5.3.3 Paleo-stochastic

Overall, based on the stochastic data, there is a very low probability (less than 0.1%) of more water being required for irrigation than was shown in the SILO data on a yearly basis.

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## 6.6 Analysis of customer usage

The billing data was provided by assessment and meter. Some assessments had more than one meter, these are either major users (like the school) or properties where the meters were replaced. As each assessment was taken as a connected property, analysis was undertaken on an assessment basis.

### 6.6.1 Modelling of customer usage

Customer usage patterns were modelled in a similar way to production data.

The maximum and 99th percentile (1 in 100 year) unrestricted yearly demands were selected as the starting points for the 30-year projections. The model results for user classes are given in Table 6-12.

Table 6-12: Estimated customer usage from climate correction – Braidwood WSS

User Class	Average year demand (ML/year)	Unrestricted yearly demand (ML/year)	Average day demand (kL/day)	Peak day demand (kL/day)
Business	10,987	13,092	30.1	63.1
Church	272	348	0.7	1.2
Community	1,806	2,332	4.9	12.0
Council General	1,940	3,043	5.3	16.1
Council Sewer	1,621	2,346	4.4	8.2
Education	3,032	3,957	8.3	21.4
Farm	985	2,407	2.7	25.9
Government	314	704	0.9	6.5
Hospital	1,082	1,610	3.0	8.8
Mixed	5,055	5,953	13.8	21.3
Major User	12,361	18,384	33.8	114.8
Public Parks and Gardens	2,322	5,526	6.4	37.4
Residential	78,690	101,149	215.4	476.7
Total	120,468	160,851	329.8	813.3

The residential, non-residential, and total consumption were significantly climate dependent.

Overall, residential users were significantly climate dependent, whereas most non-residential user classes were climate independent.

### 6.6.2 Unit residential demands

#### 6.6.2.1 Existing dwellings

The residential unit demands for each scheme were assessed by climate correcting historical data, using the modelled demand for lawn irrigation.

Using a threshold of 60L/connection/day for an active connected residential property resulted in 91% of the assessments in Braidwood WSS being active in 2022/23.

The unit demand per active residential connection is then estimated from the number of active assessments. The results are given in Table 7-11.

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Table 6-13: Unit demand per active residential assessment – Braidwood WSS

	Average year (kL/year)	Average day (kL/day)	Unrestricted future year (kL/year)	ADPW (kL/day)	Climate dependence	Climate independent (kL/day)	Climate independent (kL/person/day)	Approximate WELS Rating
All	153	0.419	177	0.709	Irrigation	0.317	0.149	2 to 3
Unsewered	183	0.500	243	1.211	Irrigation	0.329	0.155	2 to 3
Sewered	150	0.410	171	0.659	Irrigation	0.321	0.152	2 to 3

The baseline internal demand per person was estimated by dividing the internal demand by the average household size of standard private dwellings in Braidwood.

#### 6.6.2.2 New dwellings

In July 2004 the NSW Government implemented the Building Sustainability Index (BASIX) with the purpose of reducing the use of potable water and to produce less greenhouse gas emissions.

Braidwood is in the BASIX 40% reduction target zone for water [8]. This means that the target average annual water demand for a resident in a BASIX dwelling is 54 kL/person/year. Using the household size of 2.12 for Braidwood, the target average annual water demand for a BASIX compliant dwelling is 115 kL/year, this is substantially less than the current average demand by sewerred dwellings of 150 kL/year.

The unit demands for new houses in Braidwood were developed based same logic used for Bungendore: 3 or more bedroom house, 22.5 kL rainwater tank, 190 m<sup>2</sup> connected roof area, rainwater tank supplying water to the irrigated garden area, toilets and washing machine, 250 m<sup>2</sup> of lawn irrigated by the tank (same as for Bungendore as the new lots are currently projected to mostly be between 800 m<sup>2</sup> and 1200 m<sup>2</sup> and have larger watered gardens than most homes in the town currently appear to have), 3\* WELS appliances, 2.2 person households. The demands for new dwellings in Braidwood are summarised in Table 6-14. For the previous IWCN there was little growth projected for Braidwood, therefore the same unit demands were used for Braidwood and Bungendore.

Table 6-14: Unit demands for new houses in Braidwood

Tank	Household size	Average year (kL/year)	Average day (kL/day)	Unrestricted future year (99th %ile) (kL/year)	Peak day (kL/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)
With tank	2.2	115	0.316	209	1.875	1.875	1.677
Without tank	2.2	196	0.537	258	1.875	1.875	1.677
66% with tank	2.2	196	0.537	258	1.875	1.875	1.677
95% with tank	2.2	196	0.537	258	1.875	1.875	1.677
Previous IWCN	2.9	180	0.493	240	1.612		

The unit demands for new villa homes in Braidwood were developed based on the following assumptions: 2 bedroom house, 13 kL rainwater tank, 90 m<sup>2</sup> connected roof area, rainwater tank supplying water to the



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irrigated garden area, toilets and washing machine, 20 m<sup>2</sup> of lawn irrigated by the tank, 3\* WELS appliances, 1.5 person households. The unit demands for these dwellings are summarised in Table 6-15.

Table 6-15: Unit demands for villa homes in Braidwood

Tank	Average year (kL/year)	Average day (kL/day)	Unrestricted future year (99th %ile) (kL/year)	Peak day (kL/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)
With tank	39	0.107	52	0.299	0.299	0.267
Without tank	76	0.208	81	0.299	0.299	0.267
66% with tank	52	0.141	62	0.299	0.299	0.267
95% with tank	75	0.204	80	0.299	0.299	0.267

## 6.7 Projections

Average year demand projection will be used for revenue requirement planning, dry year demand for sizing of headworks and peak day production is used for sizing of water treatment works or pumping facilities. Water demands for the Braidwood WSS are projected as follows:

- The initial demands are based on the 99th percentile unrestricted demand and the peak day demands estimated from the 120-year hindcast.
- For each new residential dwelling the unit demand is developed from the data provided in Section 6.6.2.2, adjusted for the percentage of operating rainwater tanks assumed for the case.
- For the low NRW scenario the unit NRW for existing and new customers is assumed to be 100 L/meter/day (see Section 6.3.5).
- For the high NRW scenario the unit NRW for existing customers is assumed to be 402 L/meter/day and for new customers 253 L/meter/day (see Section 6.3.5).
- For non-residential demand, future demands are based on the initial demand multiplied by a population scaler. The population scaler is a ratio between average projected population (see Table 4-12) and average population in 2022.

A summary of the water projections is given in Table 6-16. This projection is based on 66% of the residential rainwater tanks in new dwellings operating optimally.

Table 6-16: Summary of water supply projections – Braidwood WSS

		2025	2030	2035	2040	2045	2050	2055
Historical climate	Braidwood (Low NRW)							
	Average Year Demand (ML/year)	157	168	187	214	245	281	320
	Unrestricted Future Year Extraction (ML/year)	177	190	216	256	301	352	409
	Peak Day Production (ML/day)	1.41	1.48	1.64	1.91	2.22	2.57	2.96
	Braidwood (High NRW)							
	Average Year Demand (ML/year)	242	257	281	317	356	401	451

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		2025	2030	2035	2040	2045	2050	2055
	Unrestricted Future Year Extraction (ML/year)	262	279	311	358	412	472	540
	Peak Day Production (ML/day)	1.41	1.49	1.67	1.96	2.29	2.67	3.09
Climate change	Braidwood (Low NRW)							
	Average Year Demand (ML/year)	164	175	195	224	256	293	335
	Unrestricted Future Year Extraction (ML/year)	192	206	232	272	317	368	425
	Peak Day Production (ML/day)	1.46	1.52	1.69	1.97	2.29	2.65	3.05
	Braidwood (High NRW)							
	Average Year Demand (ML/year)	249	264	290	326	366	412	464
	Unrestricted Future Year Extraction (ML/year)	281	298	330	378	431	491	559
	Peak Day Production (ML/day)	1.45	1.53	1.71	2.01	2.35	2.73	3.16

## 6.8 Water security assessment

### 6.8.1 Licensed entitlement

Council's WAL entitlement to extract water from the Shoalhaven River off stream dam Bungendore Alluvial Groundwater bores is 360 ML/year. The water security assessment is done for the future unrestricted extraction which is based on the 99th percentile from the hindcast. RCP 4.5 was adopted as the probable climate change scenario for forecasting unrestricted future extraction shown in Figure 6-16 for the Low NRW and the High NRW case.

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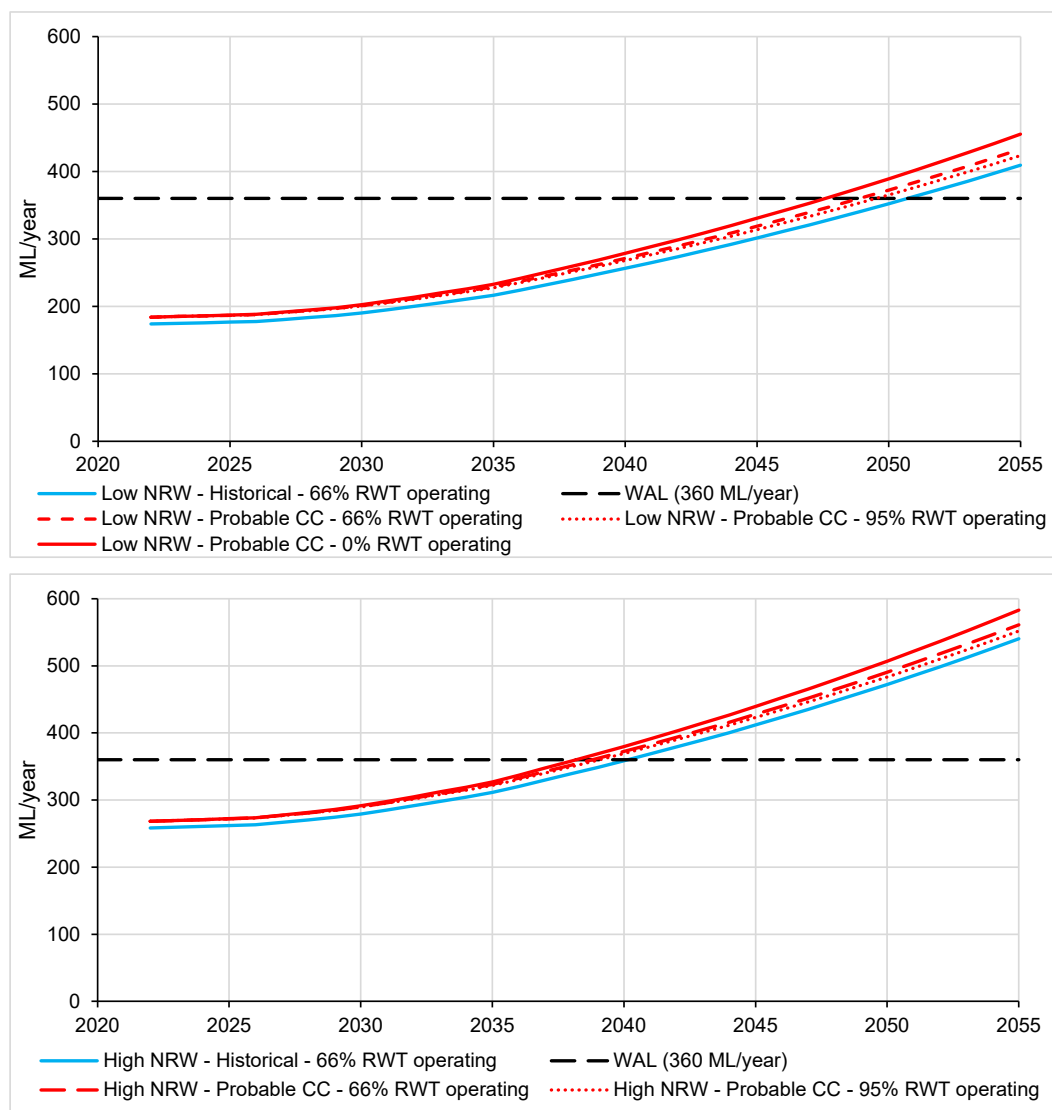


Figure 6-16: Projected unrestricted future extraction for Braidwood WSS compared to historical production (RCP 4.5 probable climate change scenario)

This 99<sup>th</sup> percentile dry year extraction reaches the 360 ML/y WAL entitlement between 2041 and 2043 under the high NRW scenario (**ISSUE**) and not until after 2048 under the low NRW scenario. While Council will probably be able to significantly decrease the NRW, there is a moderate chance that some of the NRW is unmetered demand and therefore will become revenue water, therefore the most probable future demand is between the two sets of projections.

### 6.8.2 Secure yield

Secure yield analysis was undertaken for Braidwood in 2020. The estimated secure yield under the 5/10/10 rule is 320 ML/year. Under the high NRW scenarios, this will be exceeded between 2039 and 2041 under the high NRW scenario and under the low NRW scenarios, this will be exceeded between 2045 and 2047.

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## 6.9 System capacity assessment

The peak day demand is expected to exceed the WTP capacity (2 ML/day) between 2040 and 2042 and the reservoir capacity (2.6 ML/day) between 2049 and 2051. **Issue**

While persistence analysis can be used to optimise the reservoir and WTP capacities, the peak day production is expected to reach between 3.1 and 3.2 ML/day and therefore, upgrades to the WTP and/or reservoir capacities are likely to be required.

## 6.10 Application of Health Based Treatment Targets

See Appendix figure C-3 for Braidwood's HBT tool.

## 6.11 HBT assessment of threats

Braidwood WTP sources water from Shoalhaven River. Since this water source is a surface water source, vulnerability assessment is required.

### 6.11.1 Inherent risk

The assessed is undertaken for an inner catchment and outer catchment:

- Inner catchment – 1 km radius from the extraction point in Shoalhaven River
- Outer catchment – 5 km radius from the extraction point in Shoalhaven River

The likelihood of the threat occurring in the outer catchment is considered to be lower than the inner catchment, therefore risk ratings within the outer catchment is reduced.

The aerial view of the catchment of Braidwood water supply source is shown in Figure 6-17.

The threats within the catchment are as follows:

- Sewage entering the water source
  - There are very few OSSMS within the inner or outer catchment
- Contamination by stock – around 80% of the catchment is grazing land
- Stormwater runoff from roads, drains within the catchment

The risk from stock is partly mitigated by the fencing of the perennial waterways and presence of riparian vegetation.

Based on the assessment, Braidwood catchment has an **inherent risk of 'Medium'**.

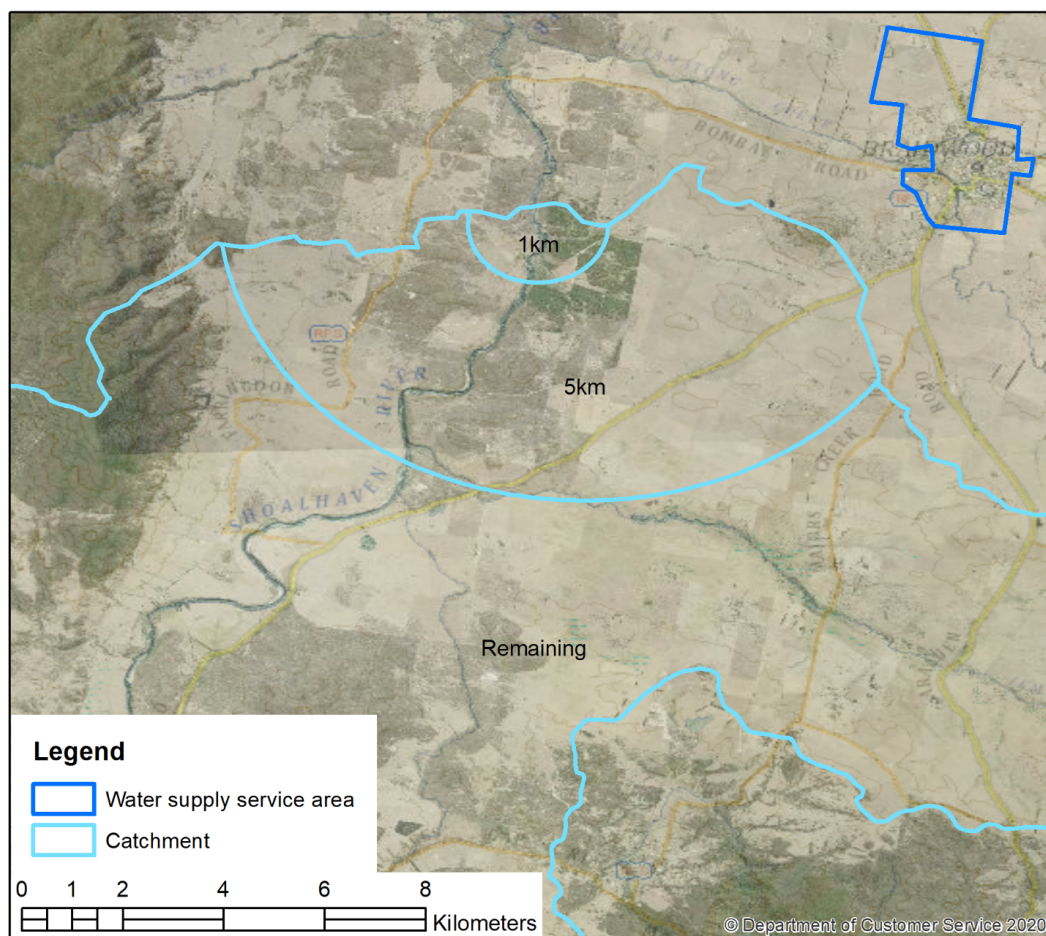


Figure 6-17: Inner and outer catchment of Braidwood raw water source

#### 6.11.2 HBT assessment of treatment barriers

##### 6.11.2.1 Treatment barriers for chlorine sensitive pathogens

Braidwood WTP is a conventional filtration plant with chlorine as the disinfection barrier. The criteria used for assessing the effectiveness of treatment barriers are as follows:

- Filtrate turbidity < 1 NTU
- Chlorine contact > 15 mg.min/L

Historically, there were 6 cases when filtered water turbidity from Braidwood WTP exceeded 1 NTU.

Braidwood WTP achieves a chlorine contact of 15 mg.min/L (see 6.4.1.2), therefore the treatment barrier for chlorine sensitive pathogens is considered effective.

Residual risk of chlorine sensitive pathogens: **Low**.

##### 6.11.2.2 Treatment barriers for chlorine resistant pathogens

Braidwood WTP has individual monitoring of turbidity at each filter. The criteria used for assessing the effectiveness of the filters are:

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- Highest individual filtered water turbidity recorded  $\leq 0.3$  NTU
- Highest monthly 95<sup>th</sup> percentile individual filtered water turbidity  $\leq 0.15$  NTU

From Section 6.2.4, using the most recent (2021) data, the highest filtered water turbidity exceeded 0.3 NTU, and the highest monthly 95<sup>th</sup> percentile turbidity was calculated to be 0.17 NTU.

Residual risk of chlorine resistant pathogens **Medium** due to partly protected catchment. **Issue**

Disinfection barriers such as UV or Ozone are also effective at disabling chlorine resistant pathogens. However, Braidwood WTP does not have UV or Ozone.

#### 6.11.3 NSW Health preliminary cryptosporidium risk assessment

Based on NSW Health (letter sent to Council in November 2019), there is a 'Low' risk rating of cryptosporidium in the raw water source for Braidwood (see Appendix figure C-5)

#### 6.12 Work health and safety

No major WHS issues were noted from the condition assessment site visit.



7 Captains Flat water supply scheme

7.1 Raw water source

7.1.1 Water resource

Raw water is sourced from the Molonglo River which is part of the Murrumbidgee catchment within the Murray–Darling basin. The dam’s catchment has an area of 33 square kilometres, with land use dominated by extensive agriculture and grazing occupying 64 per cent of the catchment.

7.1.2 Raw water extraction

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.

Capacities of assets for raw water extraction for Captains Flat are as follows:

Table 7-1: Captains Flat raw water extraction asset’s capacities

Asset	Capacity
Captains Flat	
Captains Flat Dam (Molonglo River)	820 ML
Captains Flat WTP	0.7ML/d (8.83 L/s)

The schematic arrangement of the raw water and Captains Flat WTP is shown in Figure 7-1.

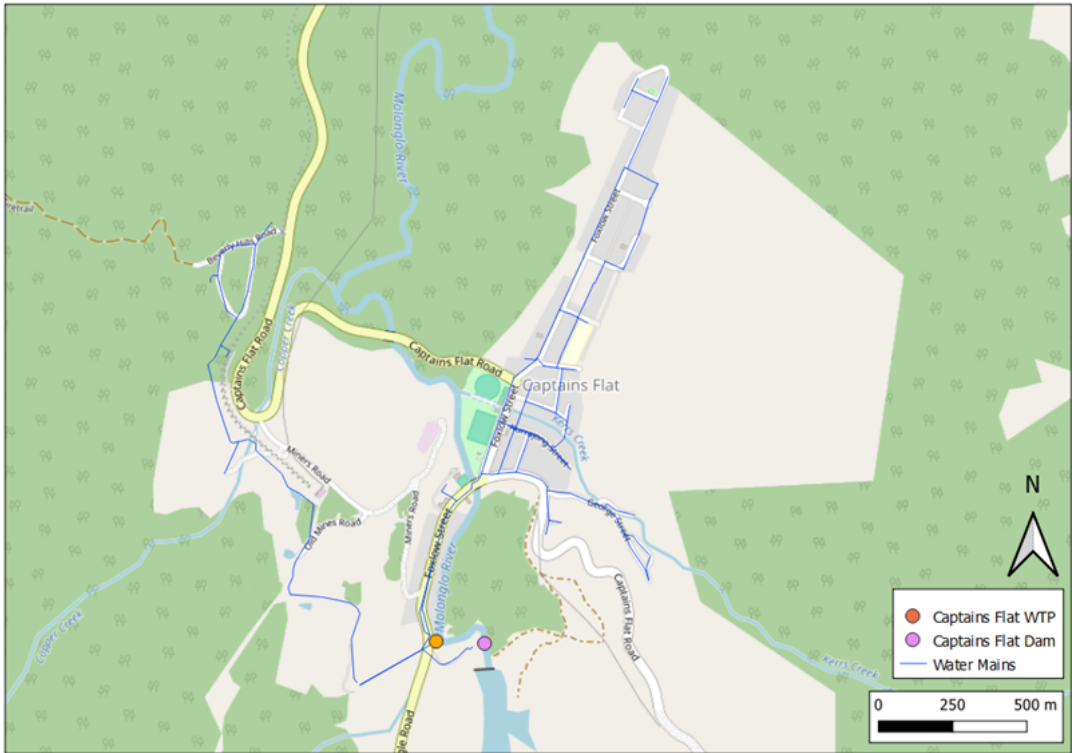


Figure 7-1: Location of raw water intake for Captains Flat WTP

7.1.3
Water access licences

Council holds Local Water Utility Water Access License (WAL36281), issued under the Water Management Act 2000, which relates to the water supply to Captains Flat. The following table summarises the key details of the WAL:

Table 7-2: WAL Licence numbers

WAL license number	WAL36281
Category [Subcategory]	Local Water Utility
Entitlement	250.0 ML/year
Water Source	Molonglo Water Source
Works approval	40CA415962

WAL25376 is sourced from Molonglo Water Source via one diversion pipe, one 80 mm centrifugal pump and one overshot dam.

7.1.4
Source water quality

Raw water quality was sampled between March 2014 and March 2023 approximately once every quarter. The samples are collected both at the Captains Flat Dam.

Typical raw water quality for the Molonglo River is shown in Appendix table A-4.



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The main parameters of interest in the Captains Flat raw water are:

- Aluminium – one sample collected on 30/03/2021 was exceptionally high in aluminium. 19 out of 37 (51%) samples contain aluminium in concentrations above 0.2 mg/L.
- *Escherichia coli* (E. coli) – 29 out of 37 (78%) samples was above 1 MPN/100mL and 5 out of 37 (14%) sample was above 100 MPN/100mL. The maximum E.coli recorded is 390 MPN/100mL.
- Iron – All records are above 0.3 mg/L.
- pH – pH occasionally reaches quite low values but remains above the ADWG (Australian Drinking Water Guidelines) of 6.5 pH Unit. 3 out of 37 (14%) samples are below 6.5 pH Unit.
- Turbidity – 22 out of 32 (69%) samples are above 5 NTU and 9 out of 32 (28%) samples are above 10 NTU.

## 7.2 Water treatment

### 7.2.1 Treatment process

Water from the Molonglo River is treated with the following conventional treatment process at Captains Flat WTP:

- Raw water filtered through a coarse screen.
- Pre-dosing with aluminium chlorohydrate and caustic soda.
- Membrane Ultra-filtration
- Post dosing using sodium fluoride and sodium hypochlorite (disinfection).

A schematic showing an overview of the Captains Flat water supply scheme is provided in Figure 7-2.

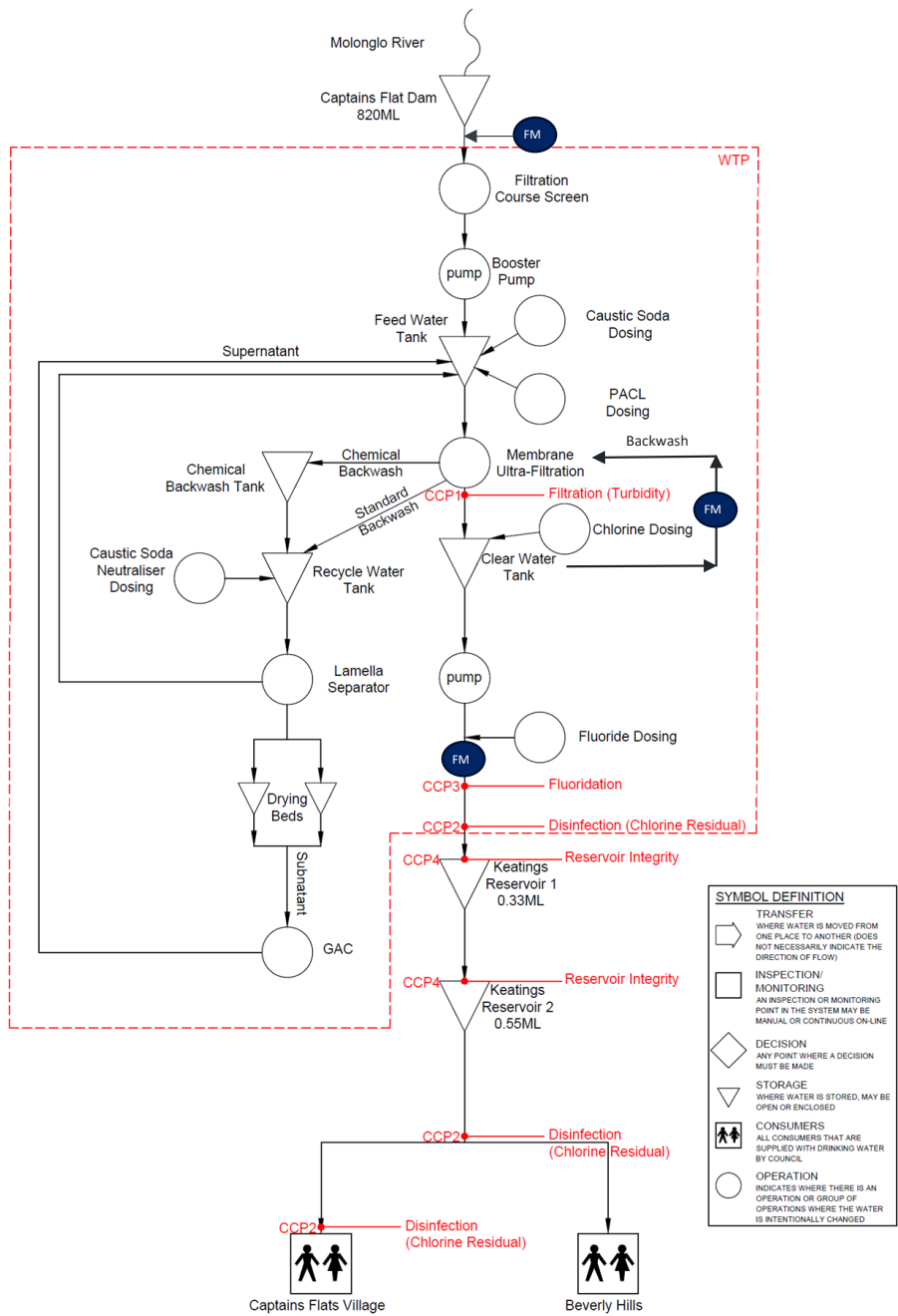


Figure 7-2: Schematic flow diagram of the Captains Flat water supply scheme

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### 7.2.2 Historical water production

Captain Flat WSS supplies potable water to customers in Captains Flat Village and Beverly Hills through the reticulation system. Water sourced from the Captains Flat Dam (on the Molonglo River) is treated at the Captains Flat WTP. Council provided the potable water production data records from July 2003 to February 2023. The potable water meter records flow being pumped out of the Captains Flat WTP to the reservoirs. The historical potable water volume supplied is summarised in Figure 7-3.

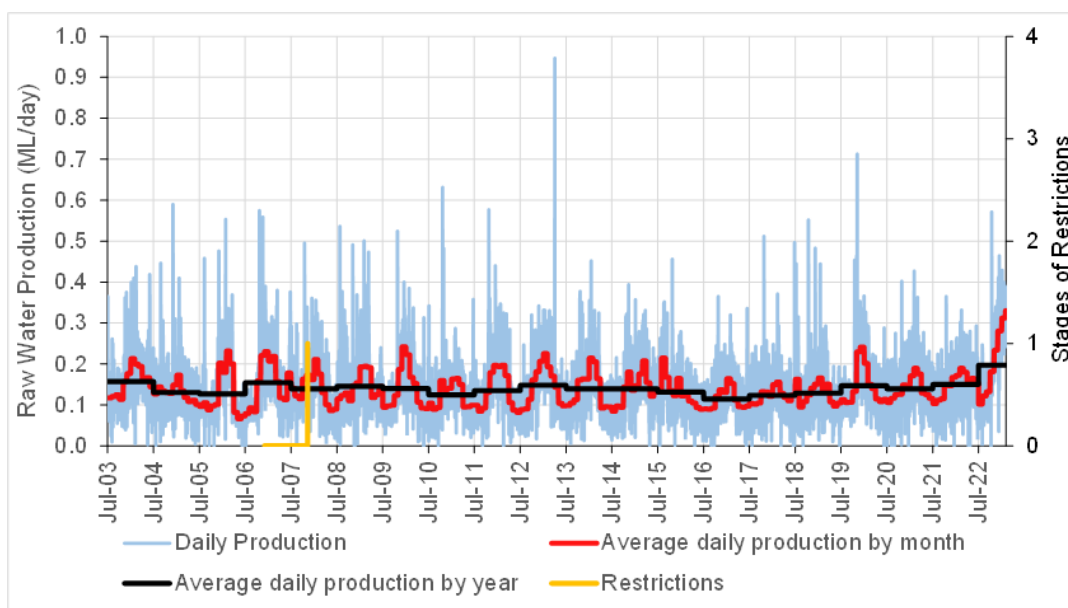


Figure 7-3: Historical production data – Captains Flat potable water production

Council is still investigating the January 2023 rise in production. Council is aware of an undetected leak just before July 2022 which corresponds to the decline in the total volume of Keatings Reservoir in Captains Flat. They advise that the high use of water between October 2022 to March 2023 is most likely related to leakage of Captains Flat pool because the drop in usage coincided with pool closure even if it doesn't appear to be explained by the pool's water meter data. See Appendix figure B-1.

The annual summary of water production for the Captains Flat WTP is shown in Table 7-3.

Table 7-3: Historical annual water production – Captains Flat WTP (ML/year)

Financial Year	ML/year
2003/04	57
2004/05	47
2005/06	46
2006/07	56
2007/08	51
2008/09	52

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Financial Year	ML/year
2009/10	51
2010/11	45
2011/12	49
2012/13	54
2013/14	51
2014/15	51
2015/16	48
2016/17	42
2017/18	45
2018/19	47
2019/20	53
2020/21	51
2021/22	54
2022/23	65

The maximum production was 65 ML/year for the 2022/23 financial year.

### 7.2.3 Peak production analysis

The historical peak fortnight pattern for the Captains Flat WSS is shown in Figure 7-4.

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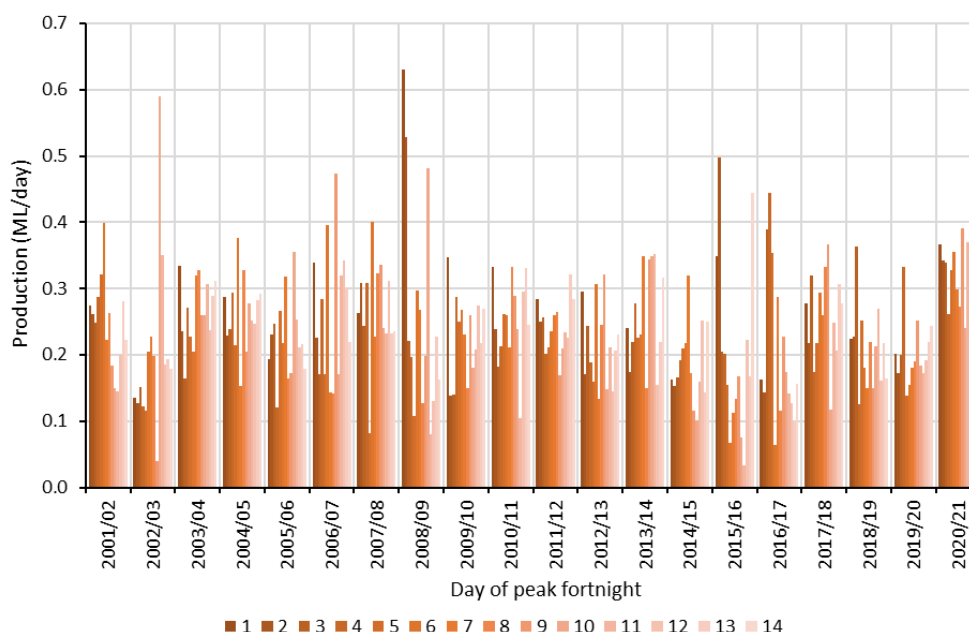


Figure 7-4: Peak fortnightly production patterns – Captains Flat WTP

As discussed in Section 7.2.2, there have been unexpected rises in production post July 2022.

A number of reasons that could have caused this rise in production were investigated. There was no evidence found about weather related affects such as extremely high temperature or bushfires post July 2022. The number of connections did not suddenly increase. Captains Flat is not known to experience tourism related population increases, and tourism generally causes spikes for short periods which is not the case in Captains Flat. None of the above reasons can explain that rise in production. Council has explained that there was an undetected leak before July 2022 which was related to the leakage of Captains Flat pool. The reason for spike is still unclear, but it seems more recent data shows production has decreased. Hence, data prior to June 2022 has been used for peak production analysis.

The highest recorded daily production in Captains Flat WTP was 0.95 ML which occurred on 2 April 2013. However, as the temperature of this peak day is relatively low (20.8°C), this day is not considered to be the true peak production representative of the scheme demand.

The nominated peak day production is 0.48 ML which occurred on 8 December 2018. There was no rainfall recorded leading up to the day and the maximum temperatures surrounding this day was high (ranged from 20°C to 30.5°C).

The average daily production over the peak week (ADPW) and peak fortnight (ADPF) was 0.28 ML/day for the week starting 25 Dec 2019 and 0.26 ML/day of fortnight starting 23 December 2019 respectively. The ADPW and ADPF graphs are shown in Figure 7-5.

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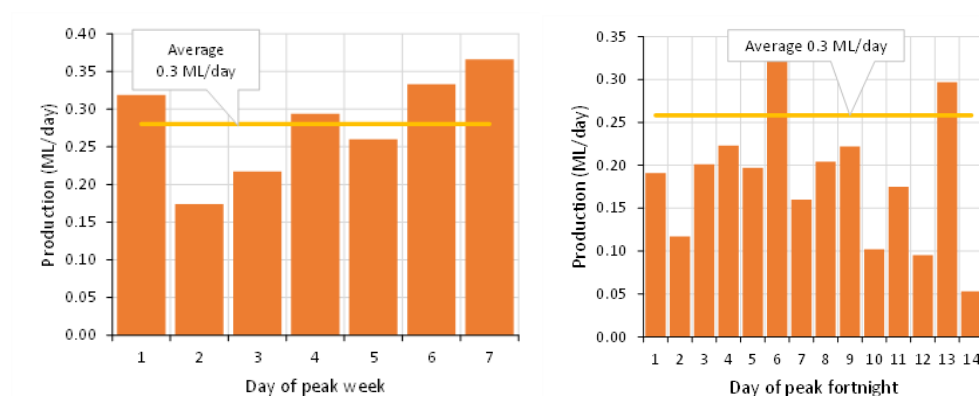


Figure 7-5: Peak week and peak fortnight production – Captains Flat WTP

The PD to ADPW ratio for Captains Flat WSS is **1.72**

From PW's experience, this high ratio is not normally seen and could be partially due to operational errors, for example, the meter being read at different times. Based on other similar sized water utilities in similar climate zones, a PD to ADPW ratio of **1.4** is adopted for Captains Flat WSS.

#### 7.2.4 Treated water quality

According to Council's Drinking Water Management System (DWMS) [1], there are six critical control points (CCP) adopted for Captains Flat WTP, shown in Table 7-4.

Table 7-4: Captains Flat WSS - Critical Control Point Summary

CCP		Control parameter	Target	Alert Limit	Critical limit
Captains Flat WTP	CCP1 Filtration	Filter turbidity	<0.2 NTU	>0.5 NTU	>1.0 NTU
	Interim CCP2*(a) Chlorination at WTP – Old Chlorine Shed (going up to reservoir)	Free chlorine residual at WTP	5.0 – 8.0 mg/L	<4.0 mg/L or >8.8 mg/L	<3.0 mg/L or >10 mg/L
	Interim CCP2*(b) Chlorination at reservoir outlet – Old Chlorine Shed (coming from reservoir)	Free chlorine residual at reservoir outlet	>1.0 mg/L	<0.8 mg/L or >3.0 mg/L	<0.2 mg/L or >5.0 mg/L
	Interim CCP2*(c) Chlorination at reticulation	Free chlorine residual at reticulation	>0.3 mg/L	<0.3 mg/L	<0.2 mg/L or >5.0 mg/L
	CCP3 Fluoridation	Fluoridation post filtration at reservoir outlet	0.95 – 1.05 mg/L	0.9 – 0.95 mg/L or 1.05-1.35 mg/L	<0.9 for 72 hrs or >1.5 mg/L

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CCP	Control parameter	Target	Alert Limit	Critical limit
CCP4 Reservoir	Reservoir Weekly Integrity	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 chlorine reservoir. Limits are to be reviewed following the replacement of reservoir.

#### 7.2.4.1 Captains Flat WTP

Council provided data for turbidity, fluoride and chlorine in Captains Flats reservoir outlet post filtration, and data for chlorine at the WTP and in the reticulation. Data sets was provided for the period between January 2015 and June 2023.

CCP1 Filtration has been presented in Figure 7-6.

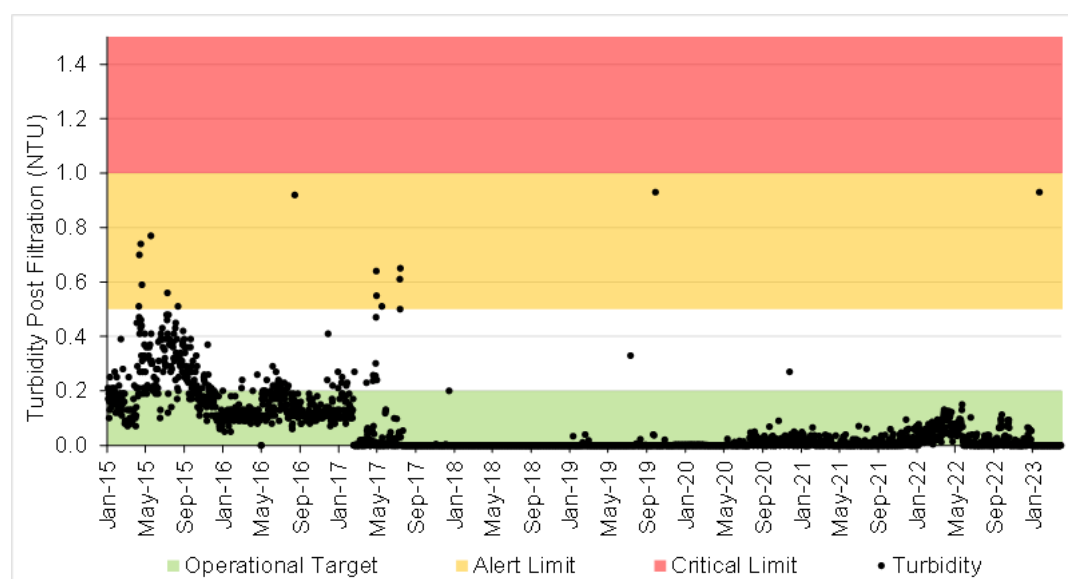


Figure 7-6: CCP1 Filtration – Historical turbidity of Captains Flat WTP filtrate

Majority of the recent records have maintained to be within the target range. Turbidity readings prior to January 2017 are scattered, because they were recorded on working days on a desk top analyser that had low range reading errors. Post January 2017, in tank continuous WTW analysers were installed commissioned by Xylem. It was also realised that these too needed further adjustment to better read very low ranges, which was in effect from May 2020. In May 2020 Xylem again adjusted the sensitivity. Subsequently, failure occurred in the centralised system for these turbidity units in early 2023. The units failed and read zero for a majority of early 2023. It has been fixed now.

CCP2 (a) Chlorination recorded at the WTP has been presented in Figure 7-7.

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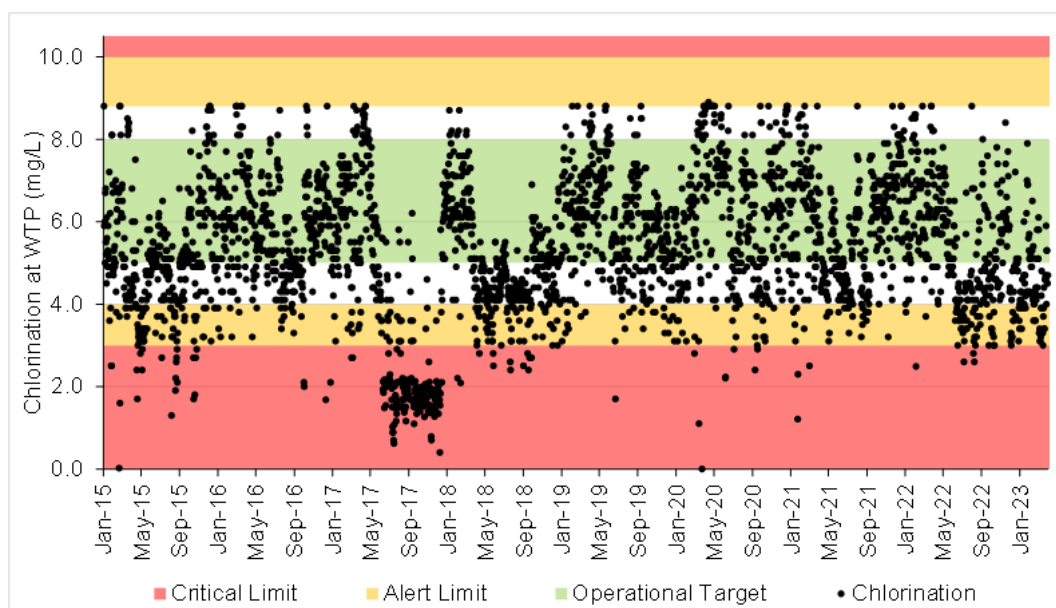


Figure 7-7: CCP2 (a) Chlorination – Historical free chlorine at Captains Flat WTP - Old Chlorine shed (going up to reservoir)

There have been 15 records cases exceeded the lower critical limit of 3.0 mg/L since 2019.

CCP2 (c) Chlorination recorded in reticulation of Captains Flat has been presented in Figure 7-8.

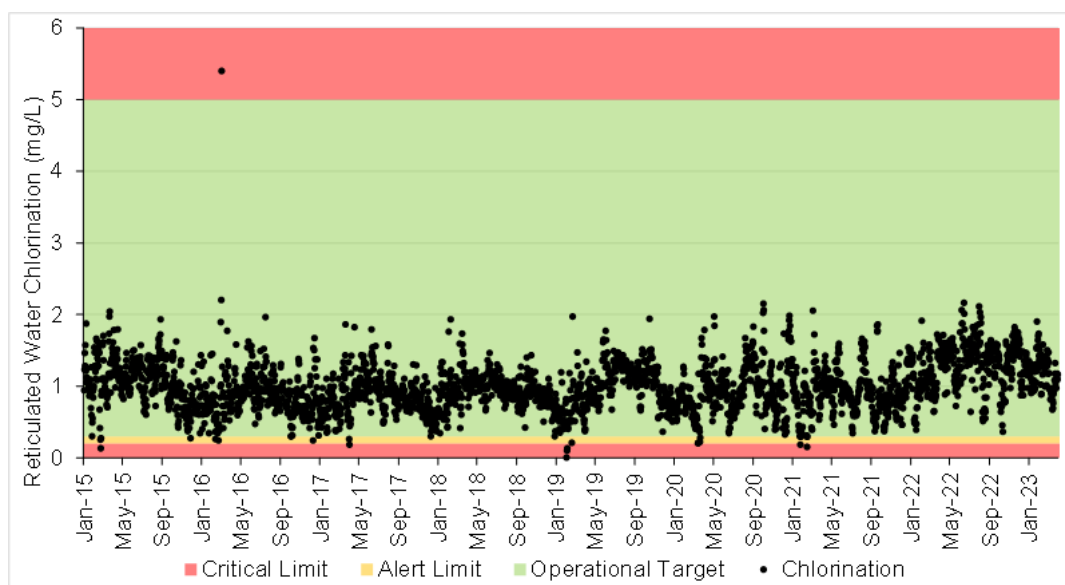


Figure 7-8: CCP2 (c) Chlorination – Historical free chlorine in reticulation of Captains Flat

Majority of the recent records have been within the target range. There have been 2 recent records that have exceeded the lower critical limit of 0.2 mg/L in January and February of 2021. Supervisor observed the readings on the field sheet, and it was rectified.



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CCP3 Fluoridation post filtration recorded has been presented in Figure 7-9.

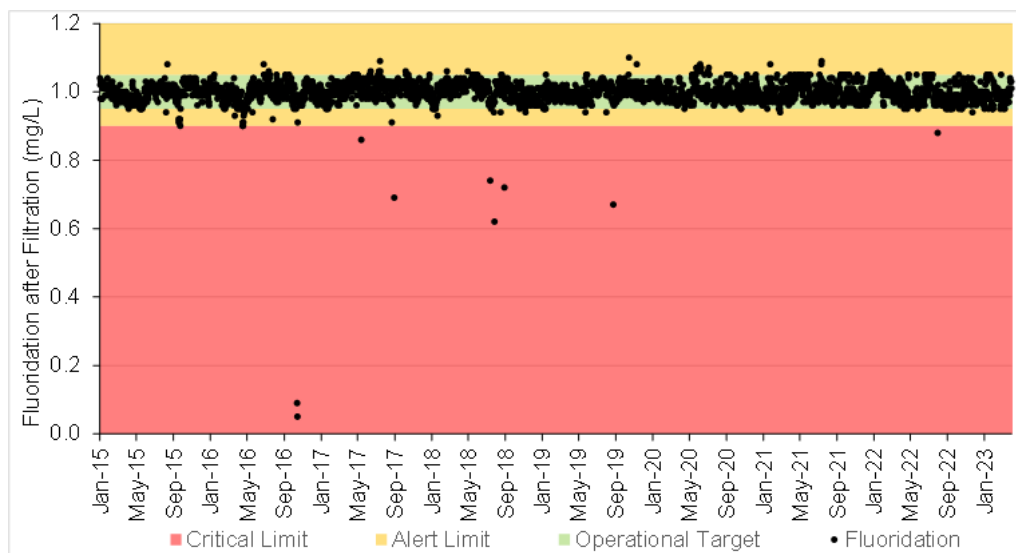


Figure 7-9: CCP3 Fluoridation – Historical fluoride at reservoir outlet in Captains Flat

Majority of the recent records have been around the target range. There was a recent record that was below the lower critical limit of 0.9 mg/L on 30<sup>th</sup> July 2022. Readings on the 29<sup>th</sup> and 31<sup>st</sup> July were 0.97 mg/L, therefore it is likely to be a sampling error.

### 7.3 Distribution

#### 7.3.1 Distribution system

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. Treated water from both reservoirs can be distributed to both reticulated systems; therefore, this is considered a single supply zone system. The layout of the distribution network for the Captains Flat WSS is shown Figure 7-10.

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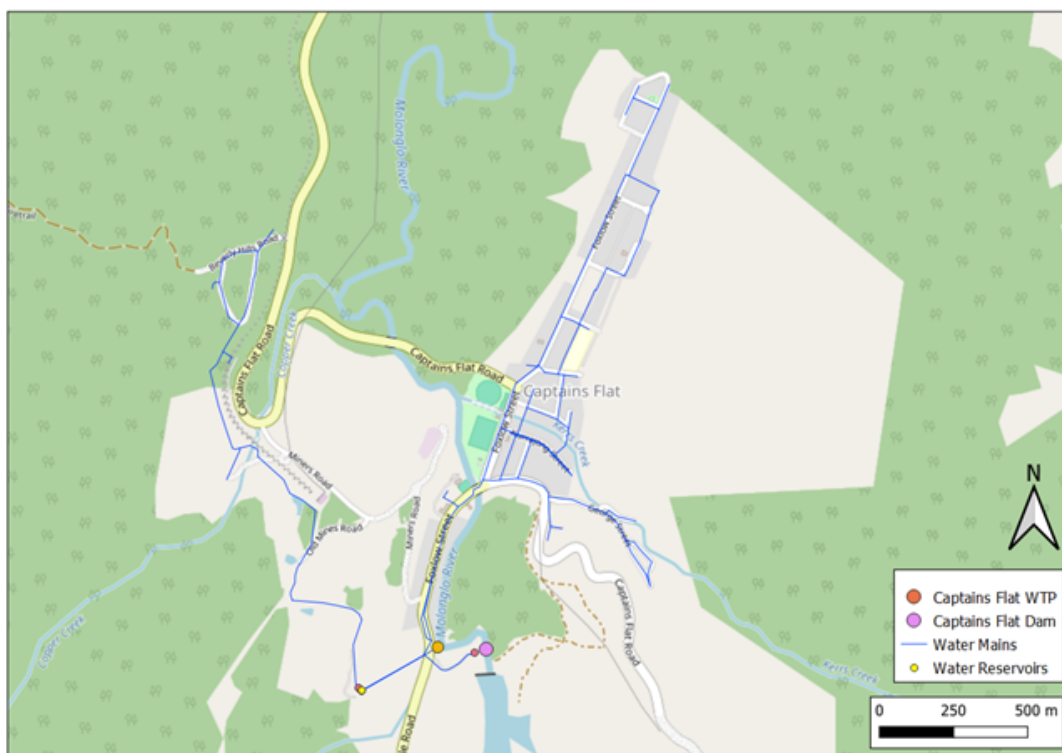


Figure 7-10: Captains Flat WSS distribution

### 7.3.2 Metered customer demand

Council supplied billing data for all potable water customers from July 2017 to December 2022, with the water meters being read quarterly. User classes from the billing data were residential, commercial, mixed, municipal excluding parks, municipal public parks, rural and vacant.

The historical number of customer meters in the billing data and the historical metered customer usage of the last six years are shown in Table 7-5 and Table 7-6.

Table 7-5: Historical number of meters – Captains Flat Potable WSS

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Residential	229	231	231	231	231	227
Commercial	4	5	5	6	6	6
Mixed	0	0	0	0	0	0
Municipal - excluding parks	15	16	14	15	15	13
Municipal - public parks	1	1	1	1	1	1
Rural	0	0	0	0	0	0
Vacant	0	0	1	1	1	1
Total	249	253	252	254	254	248

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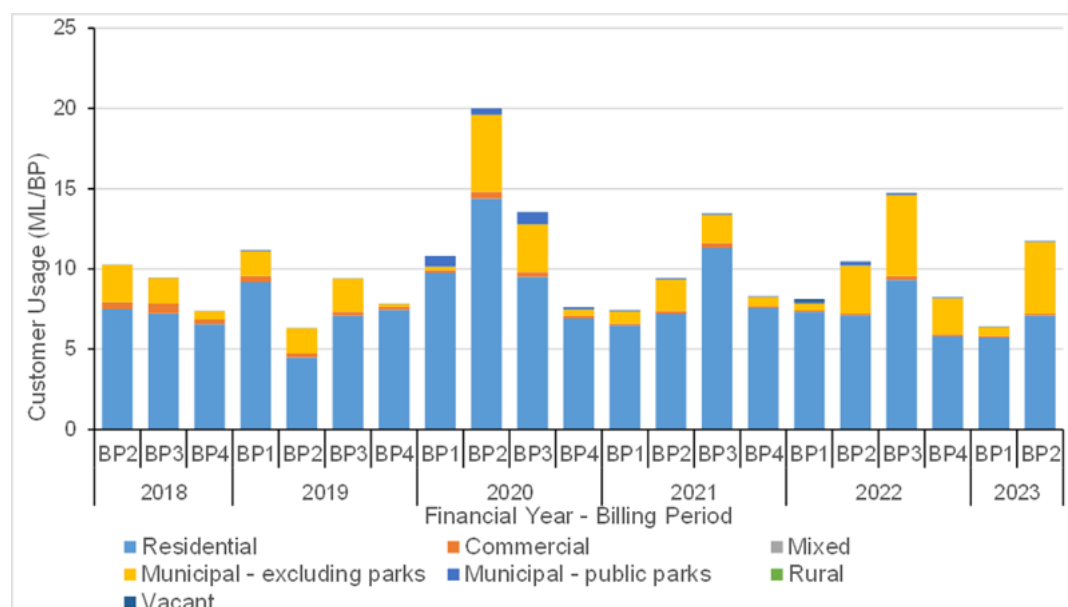
Table 7-6: Historical metered customer usage (ML/year) – Captains Flat Potable WSS

	2017/18*	2018/19	2019/20**	2020/21	2021/22	2022/23*
Residential	197	236	265	217	212	100
Commercial	20	20	21	17	15	7
Institutional	0	1	1	0	1	0
Farm	3	5	6	3	4	2
Vacant	2	6	20	9	5	5
Mixed	0	0	1	0	1	0
Education	9	11	11	9	8	4
Total	197	236	265	217	212	100

\*Demand for the 2017/18 and 2022/23 financial years is included but not complete

Customer usage was high during the dry and warm conditions in 2019/20. Captains Flat water has been unrestricted since 2010. Historical customer usage split has been on average around 77% residential to 23% non-residential, this is on the high side for communities of this size.

The historical usage for all available billing periods for Captains Flat is given in Figure 7-11.



Note: Mixed, rural vacant are not shown in the column graph due to negligible numbers.

Figure 7-11: Historical metered customer usage by user category – Captains Flat Potable WTP

### 7.3.3 Major users

#### 7.3.3.1 Major non-residential users

The criteria used to identify major non-residential users was any non-residential customer that used more than 2% of the total metered customer usage for the Captains Flat WSS. This results in four major users; there historical usage is shown in Table 7-7.

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Table 7-7: Major Water Users – Captains Flat WSS

Major User	Average Yearly Demand (ML/year)	Highest Yearly Demand (ML/year)
Colin Winchester Oval and Captains Flat Pool	3.97	7.86
Sewer Works	1.50	3.32
Wilkins Park	0.48	1.96
Captains Flat Public School	0.34	0.85

### 7.3.3.2 Major residential user

A single property with exceptionally high consumption was identified, the consumption is summarised in Table 7-8.

Table 7-8: Major Water Residential User – Captains Flat WSS

Major Residential User	Average Yearly Demand (ML/year)	Highest Yearly Demand (ML/year)
Residential Property ID - 340223	2.06	5.49

This residential property has been flagged for investigation. A flow restrictor was installed in September 2021. The property is currently carrying in excess of \$40,000 worth of unpaid rates and charges. Council suspects that there is a serious leak and investigation is underway. **Issue.**

### 7.3.4 Water balance

The historical water production from the WTP, and metered customer usage data were used to calculate a water balance over Captains Flat WSS. The water balance used is the standard developed by the International Water Association (IWA) Water Loss Task Force. The method used to calculate the different components of the water balance is given in Appendix D.1

The water balance for Captains Flat WSS is shown Table 7-9, and shown graphically in Figure 7-12.

The historical averages over eight billing periods 2020/21 Q1 (15/07/2020) and 2021/2022 Q4 (07/06/2022) were used in the water balance.

Table 7-9: Water Balance- Captains Flat WSS (ML/year)

Raw water supplied to WTP 57 ML/year	Water supplied to Captains Flat WSS (WTP production) 53 ML/year	Authorised consumption 43 ML/year	Billed authorised consumption 42 ML/year	Residential	33 ML/year
				Rural	0 ML/year
				Commercial	1 ML/year
				Municipal- excluding parks	8 ML/year
				Municipal- public parks	0 ML/year
			Unbilled authorised consumption		1 ML/year
		Water losses in distribution 10 ML/year	Apparent losses		0 ML/year
			Real losses 10 ML/year	Avoidable real losses	-1 ML/year
				Unavoidable real losses from mains	5 ML/year

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				Unavoidable real losses from service connections	6 ML/year
	Losses at WTP 4 ML/year				4 ML/year

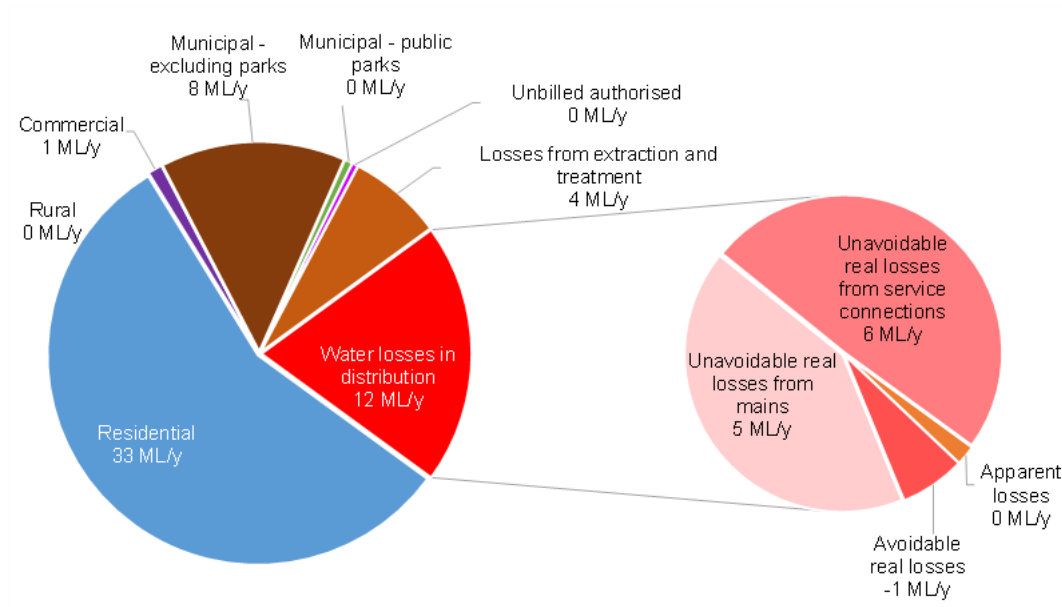


Figure 7-12: Water Balance – Captains Flat WSS (ML/year)

Based on the above water balance, Captains Flat WSS has an average ILI (current annual real losses / unavoidable real losses) of around 1.3 which is categorised in the best performing leakage performance category (LPC A1) [12] Utilities with losses in this range are expected to have difficulty economically reducing leakage further unless there are water shortages.

On average, authorised consumption made up around 81% of the water produced by the WTP in the billing data. This results in non-revenue water accounting for 19% of the total water produced. The historical average unit water loss is estimated to be 106 L/connection/day, which is approximately 1.4 times the state median of 74 L/connection/day. **Issue**

### 7.3.5 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 Captains Flat schemes is given in Table 7-10 For all schemes, NRW is higher than the 2021-22 state-wide median of 74 L/connection/day and the LGA yearly average of 46 L/connection/day. The LGA yearly average is based on the combined service areas including Queanbeyan and adjacent suburbs and villages, who are served with water from ICON Water (ACT).

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Table 7-10: Captains Flat NRW Summary

	2017/18	2018/19	2019/20	2020/21	2021/22
Captains Flat					
Average NRW (kL/day)	29	35	8	26	31
Number of Connections	261	282	276	262	262
Average NRW (L/connections/day)	110	124	28	99	119

The average daily non-revenue water by quarter for Captains Flat is displayed in Figure 7-13.

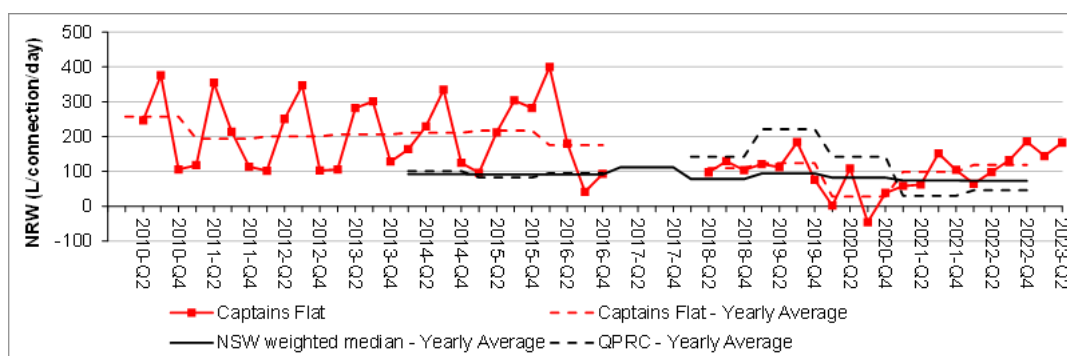


Figure 7-13: Captains Flat historical non-revenue water

Captains Flat had data issues in 2019/20. The NRW has been trending upwards since mid-2020. Overall, it has improved since the previous IWCN analysis was done. With the exception of 2016 Q1, the maximum NRW was generally during Q3 in Summer, and quite high in Q2 in Spring. As discussed in the previous IWCN, the meter to the pool and neighbouring parks has been replaced, and there has also been a major project converting all customer meters to smart meters, these are likely to be the main factors contributing to the decrease in NRW.

### 7.3.6 NSW Health independent verification

Council collects water quality samples for the NSW Health verification program from two points in the Captains Flat as of 2023.

NSW Health water quality data from the previous seven years (July 2016 to October 2023) were analysed. Typical water quality from the points in Captains Flat in Appendix table A-7. The parameters that exceeded the guideline values were:

- Fluoride weekly laboratory sampling (0.9 – 1.5): 4 exceptions in June and July 2023, two exceptions in February 2021 and two exceptions in November 2017, all when the fluoridation system was off-line, resulting in fluoride concentrations slightly below the recommended minimum concentration.
- pH between July 2016 and October 2019 the pH was frequently over 8.5, since February 2019, the pH has only exceeded 8.5 on 6 occasions and has not exceeded 8.7.

While the following parameter did not exceed the ADWG, it is still of interest:

- Sodium exceeds the concentration recommended for those on low sodium diets. Therefore, doctors and hospitals need to be informed of the sodium concentration so they can provide advice to their patients.

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### 7.3.7 Risks identified from the DWMS Risk Register

According to the DWMS Risk register [1], for Captains Flat WSS, the 'Very High' risks are identified below:

- OSSMS discharges and failures;
- Unrestricted livestock access to water supply;
- Point sources (e.g., mines);
- Stratification/turnover of dam leading to elevated pathogens and metals;
- Filters failure and ineffective backwash;
- Chlorine dose failure causing ineffective disinfection;
- Loss of trained operators;
- Faecal contamination due to access by birds and rats;
- High chlorine take-up within reservoir;
- Dead end in reticulation leading to loss of chlorine residual, and contaminating the treated water due to back flow and cross connection;
- Breach of pipelines through breaks, inappropriate maintenance, new or service works.
- Growth of biofilms, sludge causing degradation of water quality;
- Operator cross-over between water and sewer assets due to use of same tools leading to cross contamination error;

Based on the DWMS [1] the Residual Risk with Preventative Measures continues to remain 'Very High' for the hazardous events summarised in Table 7-11.

Table 7-11: Captains Flat Risks with very high residual risks after mitigation

Location	Hazard	Hazardous Event	Preventative measures
Service Reservoirs	Pathogens	Faecal contamination (access by birds, rats)	Fortnightly visual inspection; vermin proofing; covered reservoirs; chlorine residual in treated water
Service Reservoirs	Pathogens	High chlorine take-up within reservoir	Chlorine test inflow and outflow
Reticulation system	Pathogens or chemicals	Contaminating the treated water due to back flow & cross connection (e.g. water carters)	Chlorine residual; metered standpipe (top fill airgap) for hire from Council; Double check valve on meters (RPZ on critical users - SPS, STP, hospital, pool etc); backflow prevention training; Plumbing Code of Australia; spring loaded fire hydrants maintain pressure
Reticulation system	Pathogens or chemicals	Growth of biofilms, sludge causing degradation of water quality (includes metals)	Chlorine residual; operational monitoring at point of supply; deadend flushing; WTP process control (also for removal of nutrients); reactive mains replacement
Reticulation system	Pathogens	Use of same tools between sewage and water treatment systems	Well-trained operators; disinfect/ wash tools, clothes etc; chlorine residual; flush; pressure in system

There are other risks that have High residual risk including: OSSMs in the catchment failing and contaminating the raw water (mitigated by inspecting the OSSMs every two years and WTP process control; unrestricted

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livestock access to the raw water (mitigated by WTP process control), primary and secondary contact recreation in the dam (mitigated by WTP process control) and several others.

Council is currently reviewing the DWMS including this risk assessment.

#### **7.4 Best practice compliance – LWU Circular 18**

This circular was prepared in 2014 to address local water utilities of a new protocol to ensure safety of drinking water supplies across regional NSW. LWUs were required to review and update their standard operating procedures to ensure three key barriers were achieved.

##### **7.4.1 Barrier 1: Effective distribution**

LWU Circular 18 states that disinfection is the single process that has had the greatest impact on drinking water safety. Two actions should be undertaken to achieve effective disinfection.

###### **7.4.1.1 Action 1: Monitoring of factors which affect disinfection**

LWU Circular 18 recommends LWUs to monitor the factors which affect effective disinfection including chlorine residual, turbidity and pH levels. These factors are monitored at Captains Flat WTP as part of its CCPs (see Section 7.2.4).

Circular 18 recommends keeping turbidity as low as practicable, aiming for less than 1 NTU. pH should be as low as possible and Circular 18 states that a level between 7.2 to 8.2 is desirable.

The Captains Flat WTP filtered water turbidity has been consistently below 1 NTU (see Figure 7-6).

###### **7.4.1.2 Action 2: Achieve minimum chlorine contact time (C.t)**

Circular 18 recommends that a minimum C.t. value of 15 mg.min/L is achieved, as recommended by the ADWG.

C.t. is calculated only for the Keating's Reservoirs 1 and 2 (capacities 0.33 ML and 0.55 ML respectively)

C.t. for water leaving reservoirs:

- Plant flow = 0.7 ML/day
- Reservoirs = 0.88 ML
- Baffling factor of 0.3 used for contact tank assuming it has 'single or multiple unbaffled inlets and outlets, no intra-basin baffles' [source]
- Free chlorine concentration = 0.7 mg/L (Council's CCP critical limit)
- C.t. = 108.6 mg.min/L

The total C.t. from chlorination at Captains Flat WTP to outflow is 108.6 mg.min/L, which is above the recommended minimum value of 15 mg.min/L.

##### **7.4.2 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 recently for each reservoir. As of the last inspection no issues were identified, and no actions were required at any of the eight reservoirs.

##### **7.4.3 Barrier 3: Maintain a free chlorine residual in the distribution system**

Circular 18 recommends a minimum chlorine residual of 0.2 mg/L in the distribution system. Council monitors free chlorine daily in the reticulation of each of the water supply schemes.

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## 7.5 Water cycle analysis

This was not undertaken as there has not been much growth in Captains Flat since the last IWCN. Hence it was not included in the scope.

## 7.6 Application of Health-Based Treatment Targets

See Appendix figure C-4 for Captains Flat's HBT tool.

### 7.6.1 HBT assessment of threats

Captains Flat WTP sources water from Molonglo River. Since this water source is a river source, a catchment vulnerability assessment is required.

#### 7.6.1.1 Inherent risk

The assessed is undertaken for an inner catchment and outer catchment:

- Inner catchment – 1 km radius from the extraction point in Molonglo River
- Outer catchment – 5 km radius from the extraction point in Molonglo River

The likelihood of the threat occurring in the outer catchment and impacting the water quality at the intake is considered to be lower than the inner catchment, therefore risk ratings within the outer catchment is reduced.

The aerial view of the catchment of Captains Flat water supply source is shown in Figure 7-14.

Based on the assessment, Captains Flat catchment has an **inherent risk of 'Medium'** because of free roaming livestock within the catchment (grazing animals).

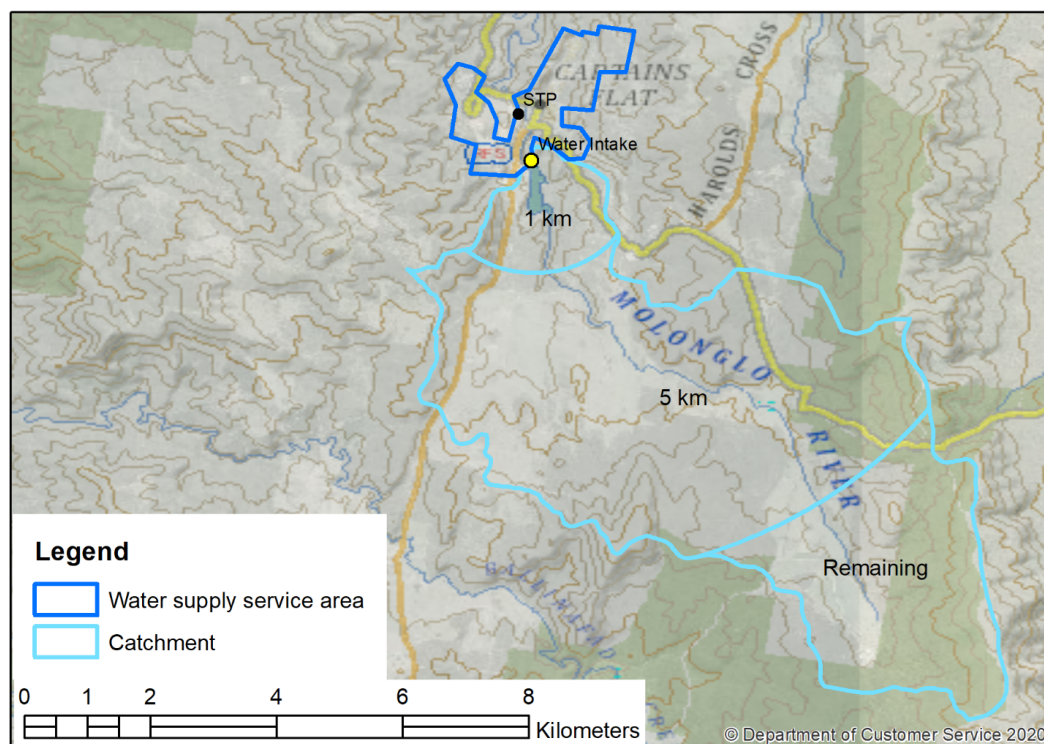


Figure 7-14: Inner and outer catchment of Captains Flat raw water source

## 7.6.2 HBT assessment of treatment barriers

### 7.6.2.1 Treatment barriers for chlorine sensitive pathogens

Captains Flat WTP is an ultra-filtration membrane filtration plant with chlorine as the disinfection barrier. Refer to Section 7.4.3 for the CCP results. The criteria used for assessing the effectiveness of treatment barriers are:

- Filtrate turbidity < 1 NTU
- Chlorine contact > 15 mg.min/L

Historically, there is only one case where filtered water turbidity from Captains Flat WTP exceeded 1 NTU.

Captains Flat WTP achieves a chlorine contact of 15 mg.min/L (see 7.4.1.2), therefore the treatment barrier for chlorine sensitive pathogens is considered effective.

Residual risk of chlorine sensitive pathogens: **Low**.

### 7.6.2.2 Treatment barriers for chlorine resistant pathogens

Captains Flat WTP has individual monitoring of turbidity at each filter. The criteria used for assessing the effectiveness of the filters are:

- Highest individual filtered water turbidity recorded  $\leq 0.3$  NTU
- Highest monthly 95<sup>th</sup> percentile individual filtered water turbidity  $\leq 0.15$  NTU

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From Section 7.2.4, using the most recent (2021) data, the highest filtered water turbidity exceeded 0.3 NTU and the highest monthly 95th percentile turbidity was calculated to be 0.23 NTU.

Residual risk of chlorine resistant pathogens **Very Low**.

#### **7.6.3 NSW Health preliminary cryptosporidium risk assessment**

Based on NSW Health (letter sent to Council in November 2019), there is a '**Medium**' risk rating of cryptosporidium in the raw water source for Captains Flat (see Appendix figure C-5).

#### **7.7 Work health and safety**

No major WHS issues were noted from the condition assessment site visit.

No major WHS issues were noted from NSW PW staff site visit.



8
Bungendore sewerage scheme

8.1
Sewage collection and transfer

The Bungendore sewerage scheme consists of 10 sewage pumping stations, 8 km of rising sewer mains and 44 km of gravity sewer mains.

Figure 8-1 shows an overview of Bungendore sewerage scheme with the inclusion of the new growth zones.

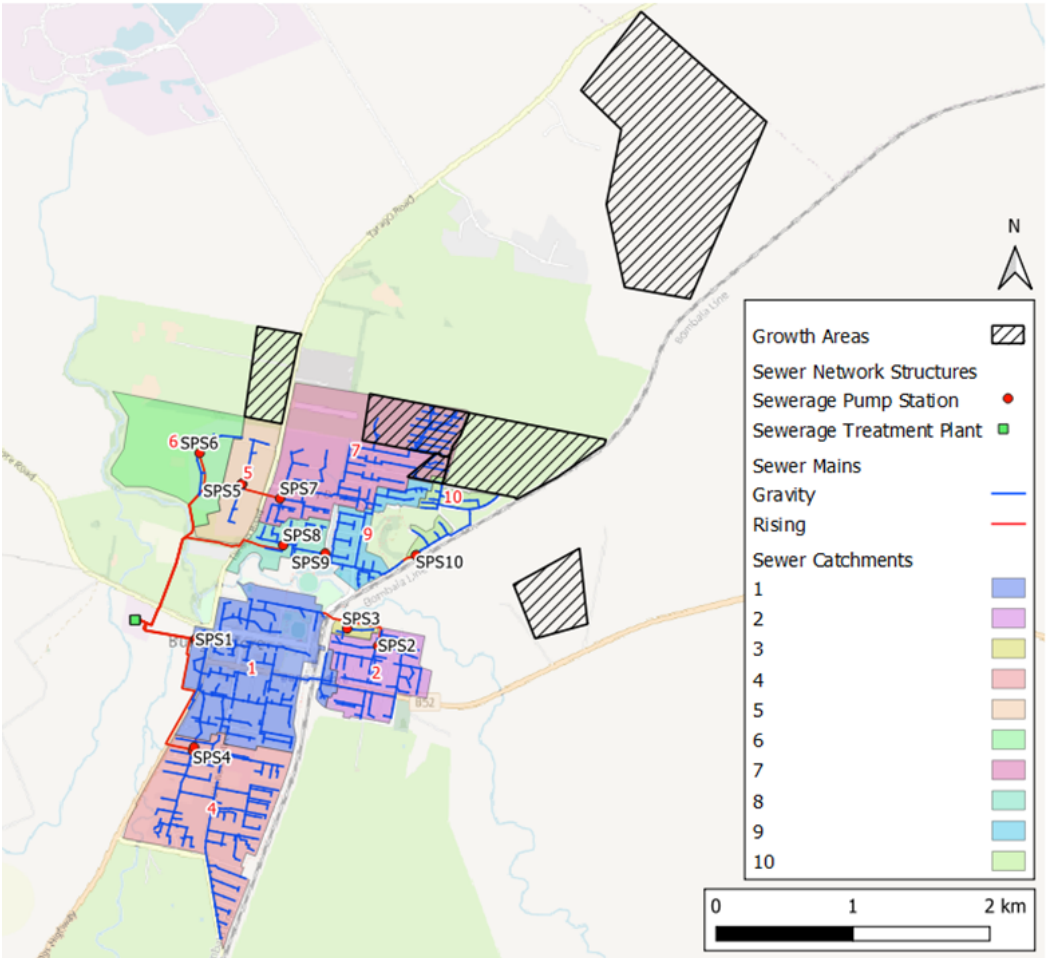


Figure 8-1: Bungendore sewerage scheme

A pump hierarchy diagram of Bungendore sewerage scheme with pump rates is shown in Figure 8-2.

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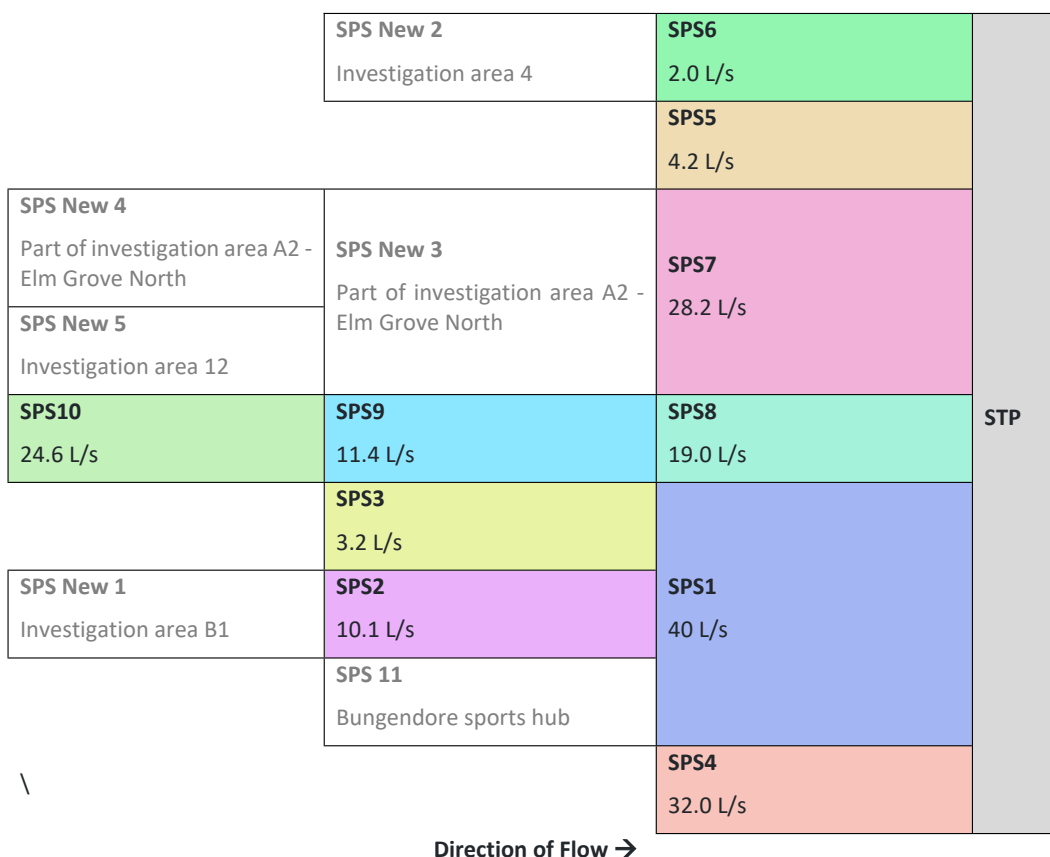


Figure 8-2: Bungendore sewerage scheme SPS hierarchy

A new pump station has been added to service the Bungendore Sports Hub (SPS 11). This SPS pumps a short distance into the SPS 1 catchment. For the purposes of this project, the current loads are assigned to SPS 1. This will be updated in future projects.

SPS 1's design pump capacity was 61.5 L/s, based on recent Council checks, it appears that the actual pump capacity installed is 40 L/s.

## 8.2 Sewage treatment

### 8.2.1 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 was recommissioned in March 2023, bringing the total capacity of the plant to 5,000 EP.

The Bungendore STP consists of the following process units:

- Inlet works Inflow reception, screening, grit removal, flow measurement, and flow division;
- 2 x IDEA reactors (a 3,000 EP (new), a 2,000 EP (old))
- Catch/balance pond;

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- Effluent ponds;
- Alum dosing facilities;
- Sludge Lagoons;
- Sludge drying beds;
- UV disinfection system and
- Chlorination system.

A summary of the Bungendore STP design capacities for each process unit is given in Appendix table H-1.

Figure 8-3 shows the process flow diagram of the Bungendore STP. See Appendix figure H-1 for the detailed process flow schematic.

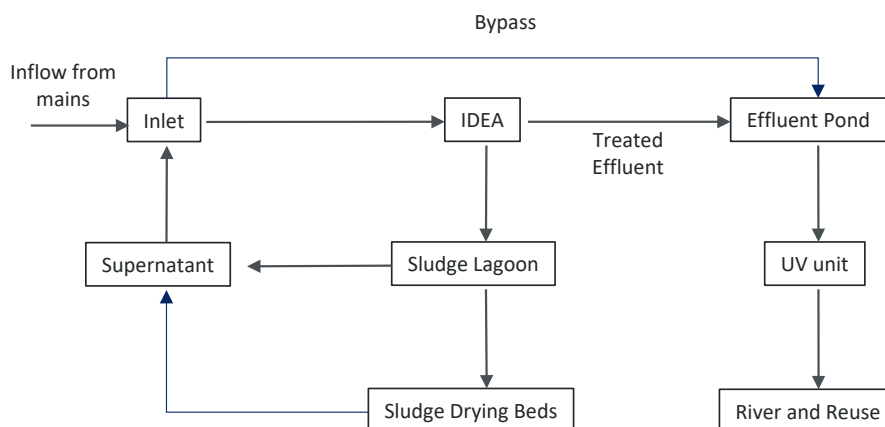


Figure 8-3: Process Flow Diagram – Bungendore STP

See the plan view of the Bungendore STP in Appendix figure H-2.

### 8.2.2 Historical flows

STP inflow daily data was available from July 2012 to February 2023. Daily rainfall data is available at the STP site over the period as well. Rainfall data were obtained from the Bureau of Meteorology (BOM weather station number 70011 – Bungendore Post Office).

The historical sewage inflow to the Bungendore STP is shown in Figure 8-4.

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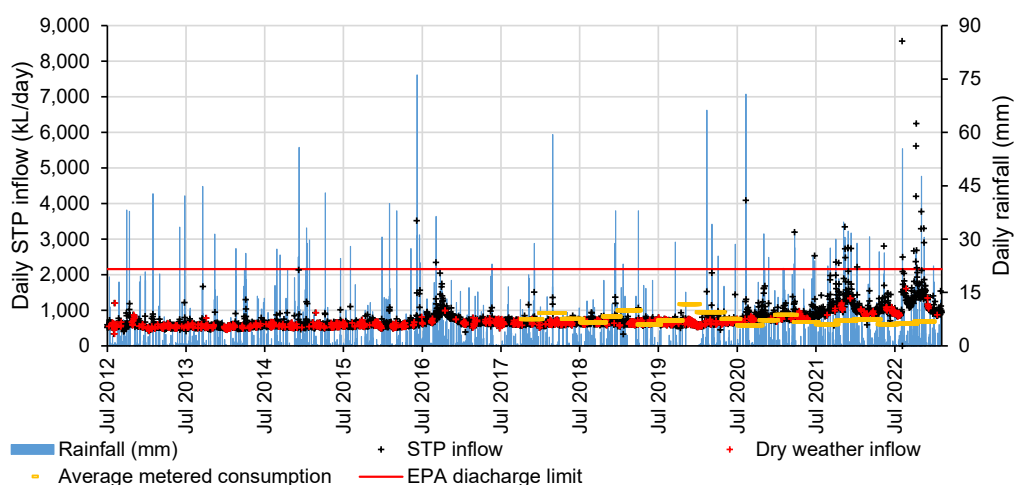


Figure 8-4: Bungendore STP historical inflow, rainfall and metered consumption

The dry weather inflow exceeded the volume of metered consumption during the winter of 2019, a very dry period. It was also observed that during the extended wet weather from 2020 to 2022, the STP inflow is persistently high, even after 14 to 16 dry days in a row. Between July 2012 and July 2021, the STP inflow very rarely exceeded the EPA licence outflow limit (2,160 kL/day) and it is likely that the storage at the STP could buffer these flows to keep daily releases below the limit, in 2021/22 and 2022/23 the climate was significantly wetter leading to months when the average daily inflow was over 1,500 kL/day and it is likely that the outflow exceeded the licence limit during these periods. This is examined further in Section 8.3.1.1.

### 8.3 STP inflow analysis

#### 8.3.1 Average dry weather flow (ADWF) estimated from STP inflow data

STP daily inflow data was analysed to estimate the average dry weather flow (ADWF). To estimate historical ADWF, a dry day was taken as a day with less than 3 mm of rainfall on that day, any of the eight preceding days and one day following. All historical rainfall data was obtained from the Bureau of Meteorology (BOM).

The historical annual ADWF from 2012/13 to 2017/18 is shown in Table 8-1.

Table 8-1: Bungendore STP – ADWF estimated from STP inflow data

Financial Year	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
ADWF (kL/day)	566	537	567	583	662	639	642	639

There have been some trends in changes to the recorded ADWF: between and May 2016 the ADWF averaged 563 kL/day, there was then a wet weather period from June 2016 to May 2017 after this period there was a mostly quite dry period between May 2017 to early July 2020, over this drier period the ADWF was 641 kL/day, with the monthly average only below 600 kL/day in January 2020. This 14% increase in ADWF after the wet weather in 2016/17 indicate that there may have been a change in the STP flow meter calibration.

The 2020/21 and 2021/22 data has been excluded from the ADWF calculation due to the impact of the extremely wet weather. Therefore, on the STP inflow data from 2017/18 to 2019/20, the ADWF for the Bungendore STP is around 640 kL/day.

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### 8.3.1.1 Average Dry Weather Flow (ADWF) comparison with river level data

From July 2020 to February 2023 STP inflow has been almost continuously above 660 kL/day, and almost all of 2021/22 over 800 kL/day. It appears that the infiltration to the system is likely due to continued high water levels in the local groundwater system and local waterways. There are three monitoring bores in Bungendore, though there were no readings available between August 2021 and December 2023 (as of 6 December 2023). Therefore, the closest environmental water level data monitoring available is from the river gauge at Butmaroo Creek, Butmaroo (station number 411003, about 9 km east of Bungendore in an adjacent Lake George sub-catchment). The creek levels and STP inflow from July 2017 to February 2023 are shown in Figure 9 6 and show that when the creek levels are over 500 mm for an extended period, the STP inflow continues to be high, regardless of the time since the last rainfall. **Issue**

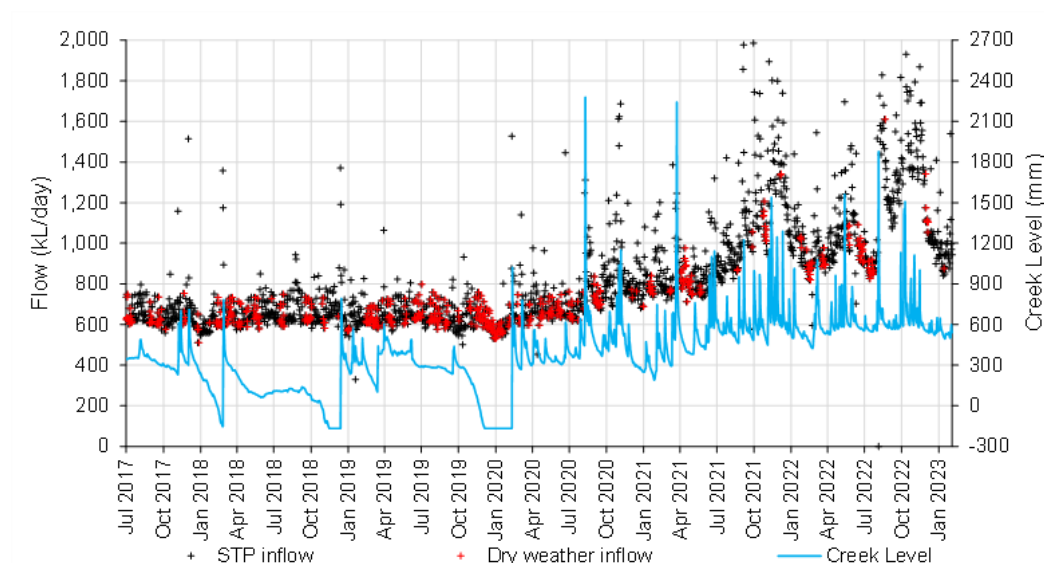


Figure 8-5: Bungendore STP historical inflow and Butmaroo Creek water levels – Jan 2017 to Feb 2023

### 8.3.2 ADWF estimated from customer billing data

The unit climate independent demand for the sewered Bungendore residential properties was 421 L/property/day, or 144 L/person/day.

In general, most winter water consumption by sewered properties is expected to become dry weather sewage flow. Between 2018 and 2022 the winter metered water consumption (generally using the billing periods running between March or April to September or October) by sewered properties has varied between 614 and 801 kL/day, averaging 693 kL/day over the entire period and 659 kL/day for 2021 and 2022.

An alternate method to estimating the average dry weather flow is to assume that the climate independent flow (for properties with climate dependent use) is approximately equal to the sewer flow and then to use the average winter metered demand for the properties with climate dependent consumption. Using this method, the estimated average dry weather flow was 623 kL/day.

### 8.3.3 Nominated ADWF and unit hydraulic loading

The ADWF measured from the STP inflow data (refer to Figure 8-5 and Table 8-1) recorded an average of **600 kL/day** from year 2013 to year 2019. At year 2019, STP inflow has recorded **640 kL/day** followed by



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significant increase reaching to **959 kL/day** in year 2022 due to extreme wet weather events in year 2021 and year 2022 as shown on Figure 8-8.

The ADWF calculated from customer billing data analysis was **643 kL/day** (the average winter water consumption by seweraged customers during winter 2018, 2019 and 2022 (skipping the COVID-19 lockdown winters), with the exception of SPS 4 where 2022 was used as there has been significant development in this catchment) and this has been nominated ADWF for the Bungendore sewerage scheme, as it is close to the ADWF from the inflow data (640 kL/day) and the meter data can be easily assigned to the individual SPS catchments.

Table 8-2: Bungendore ADWF based on winter metered consumption

Sewer catchment	ADWF (local catchment) (kL/day)	ADWF (local and upstream catchments) (kL/day)
BU SPS1	196.9	289.9
BU SPS2	88.8	88.8
BU SPS3	4.1	4.1
BU SPS4	95.8	95.8
BU SPS5	10.1	10.1
BU SPS6	9.5	9.5
BU SPS7	114.6	114.6
BU SPS8	44.5	123.7
BU SPS9	57.4	79.1
BU SPS10	21.7	21.7
STP	643	643

The total Equivalent Person (EP) for the Bungendore sewerage scheme has been estimated as **4,540 EP**, which is explained in more detail in Section 8.5. Using this EP, the unit hydraulic loading is calculated to be **142 L/EP/day**. This is very low compared to the standard design load for sewerage systems of 240 L/EP/day developed in the 1980s, and significantly lower than the 180 L/EP/day used for some modern designs. This is likely due to the widespread use of water efficient appliances and moderate climate (evaporative air-conditioner waste water contributes to dry weather flows in some communities with high temperatures and low humidity).

### 8.3.4 Estimated Peak dry weather flow (PDWF)

The PDWF in each SPS catchment are calculated using the method in the Public Works Sewer Design Manual [13]. The total Equivalent Tenement (ET) for the Bungendore sewerage scheme has been estimated as 1568 ET, explained in more detail in Section 8.5.

The estimated sewage load to each SPS in terms of Average Dry Weather Flow (ADWF), Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF) is shown in Table 8-3.

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Table 8-3: Estimated ADWF, PDWF and PWWF - Bungendore sewerage scheme

Sewer catchment	ET	Local catchment flow				Cumulative		
		ADWF (kL/day)	ADWF (L/s)	PDWF (L/s)	PWWF (L/s)	ADWF (kL/day)	ADWF (L/s)	PWWF (L/s)
BU SPS1	518	198.7	2.3	5.8	35.8	290.4	3.4	49.1
BU SPS2	207	87.5	1.0	2.9	14.9	87.5	1.0	14.9
BU SPS3	12	4.1	0.0	0.3	1.0	4.1	0.0	1.0
BU SPS4	281	95.8	1.1	3.1	19.4	95.8	1.1	19.4
BU SPS5	21	10.1	0.1	0.5	1.8	10.1	0.1	1.8
BU SPS6	24	9.5	0.1	0.5	1.9	9.5	0.1	1.9
BU SPS7	210	114.6	1.3	3.8	16.0	114.6	1.3	16.0
BU SPS8	93	44.5	0.5	1.7	7.1	123.7	1.4	19.0
BU SPS9	123	57.4	0.7	2.1	9.2	79.1	0.9	35.6
BU SPS10	55	21.7	0.3	0.9	4.1	21.7	0.3	4.1
Total	1,544	643.9	7.5	16.1	105.6	643.9	7.5	107.1

Note that the PDWF and PWWF do not add up to the total of the STP because not every catchment is expected to experience peak flows at the same time.

The peaking factor ('r') for the whole sewerage scheme was calculated to be 2.2. Using the number of ET, the PDWF was estimated to be **16 L/s**. The PWWF from all catchments in Bungendore sewerage scheme is further discussed in Section 8.3.5.

### 8.3.5 Peak wet weather flow (PWWF)

A hydraulic model for Bungendore was completed by NSW PW in 2018. In the model, a 1 in 5-year 1 hour duration rainfall event was selected so that there will be no overflows during that event. Simulations predicted that no upgrades are required at sewage load of 1,368 ET for Bungendore sewerage scheme. The estimated equivalent tenement in year 2022 for Bungendore is 1,568 ET, a increase of about 14.6% from the ET used in the model. An update and recalibration of this model for current equivalent tenement of 1,568 ET will be undertaken separately. Hence, the PWWF in each SPS catchment are calculated using the method in the Public Works Sewer Design Manual [13].

The design hydraulic capacity of the inlet works needs to be sufficient to receive the pumped flow from all of the SPS immediately upstream.

### 8.3.6 Biological and nutrient loading

Council undertakes regular sampling and testing of effluent concentrations at Bungendore as required under the EPL. Council doesn't test raw sewage concentrations. Standard biological allowances that are commonly adopted as typical for sewage that is essentially domestic in origin as shown on Table 8-4. These are adopted in the absence of other data in the option study done by NSW PW in June 2016 for Bungendore STP Augmentation (from 5,000 EP to 12,000 EP capacity). [14]

Table 8-4: Bungendore Inflow Biological Loading Results

Parameter	Standard Allowances (Unit Loading)	
Biochemical Oxygen Demand (BOD <sub>5</sub> )	70	g/EP.d
Suspended Solids (SS)	65	g/EP.d
Total Nitrogen (TN)	12	g/EP.d

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Total Phosphorus (TP)	2.7	g/EP.d
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The STP and the collection system operate under EPL No. 201 granted by the NSW EPA that is renewed annually.

Effluent quality limitations on EPA licence are summarized in Table 8-5.

Table 8-5: Pollutant List - Sewage and Effluent for Bungendore STP

Parameter	Typical Raw Sewage	Effluent (90 percentile) *	Effluent (100 percentile) *
Biochemical Oxygen Demand (BOD <sub>5</sub> )	270 mg/L	<5 mg/L	<10 mg/L
Suspended Solids (SS)	270 mg/L	<10 mg/L	<15 mg/L
Total Nitrogen (TN)	53 mg/L	<8 mg/L	<10 mg/L
Ammonia	12 mg/L	<2 mg/L	<5 mg/L
Total Phosphorus (TP)	11 mg/L	<0.5 mg/L	<1 mg/L
Oil and grease (O&G)	< 10 mg/L	<2 mg/L	<10 mg/L
Faecal coliforms (FC)	1,000,000 cfu/100 mL	<100 cfu/100 mL	<200 cfu/100 mL
pH	6.5 – 8.5		6.5 – 8.5

Note: \*Licence Conditions

Source: PIRMP, V2 [15]

#### 8.4 Bungendore Recycled Water Management System

The Bungendore STP includes a recycled water component that treats effluent from the Bungendore STP's catch pond to a suitable standard. The sewage inflow is treated by screening, grit removal, biological and chemical treatment before flowing to the catch pond. [16]

The recycled water plant includes the following:

- A pumping system for the catch pond to the recycled water treatment
- A disc filter for pre-screening
- An ultra-filtration (UF) membrane system
- An ultraviolet (UV) disinfection system
- A liquid chlorine storage and dosing disinfection system
- An on-site recycled water storage tank
- A pump station to transport the water to the irrigation sites and the tanker fill station.
- Rising mains to the irrigation sites
- A schematic of the Recycled Water Management System (RWMS) is in Figure 8-6.

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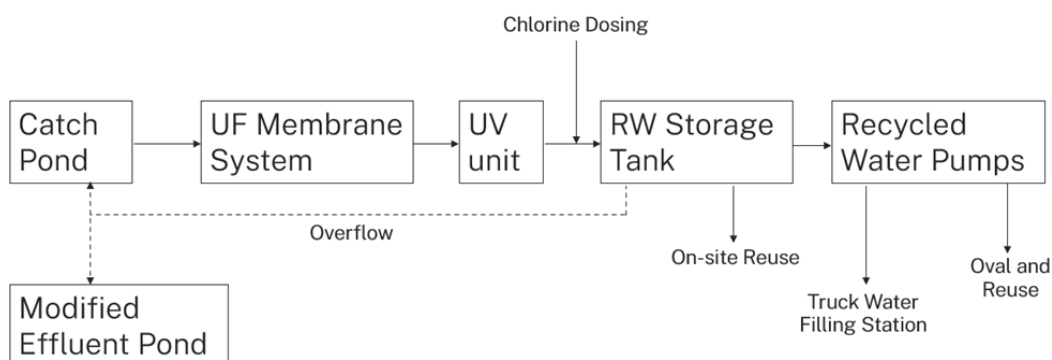


Figure 8-6: Bungendore STP Reuse flow diagram

The detailed Bungendore STP reuse flow diagram is shown in Appendix figure I-1.

The new recycled water scheme will provide recycled water to the following users:

- Dust suppression for road construction (current user)
- On site STP reuse (current user)
- Mick Sherd Oval (MS Oval)
- The future Bungendore Sports Hub Area (currently under construction)
- Other potential future users.

Table 8-6: Approved end users

Users	Purpose	Quantity
Ad hoc	Dust suppression for road construction	240 kl/d
Mick Sherd Oval	Municipal irrigation of sporting grounds including golf, horse racing and lawn bowls but excluding wet synthetic hockey fields	28 kl/d
Bungendore Sports Hub Area (Bungendore West)	Municipal irrigation of sporting excluding wet synthetic hockey fields	134 kl/d

The recycled water scheme is shown in Figure 8-7.

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Figure 8-7: Bungendore Recycled Water Scheme

Council monitors the outflow quality from the catch pond (EPA Identification point 2 - Discharge Point Catch Pond). Results from June 2013 to May 2018, a total of 64 samples, is shown below in Table 8-7. This quality has been used as the basis of design for the RWP feed.

Table 8-7: Catch Pond Effluent Quality-RWMS Bungendore

	Max	95th %ile	Average	5th %ile	Min
Ammonia (mg/L N)	8	4.9	1	0.5	0
Biochemical Oxygen Demand (mg/L)	10	7	1.91	0	0
Faecal Coliforms (CFU/100 ml)	490,000	123,000	18,000	1,500	20
Total Nitrogen (mg/L N)	12	8.2	4.6	4.5	0.1
Oil & Grease (mg/L)	0	0	0	0	0
Phosphorus (mg/L P)	2.85	0.48	0.23	0.17	0.06
Total Suspended Solids (mg/L)	38	20	9.83	9	0
pH	8	7.9	7.6	7.7	7.1

The catch pond is an open structure which could encourage algae growth. Algae tests were completed in March 2019. The maximum algae count was 11,000 cells/ml. The RWP is designed to handle up to 400,000 cells/ml.

Four CCPs have been identified for the Bungendore RWP:

- CCP 1 – Membrane system
- CCP 2 – UV system
- CCP 3 and 4 – Chlorine systems

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The design operating target, adjustment and critical limits for each CCP are shown in Table 8-8. Each CCP with the limits as well as the required actions are displayed at the STP.

Once CCP data for Bungendore RWMS is provided to NSW Public Works it can be graphically represented and analysed whether values fall within limits in the next report.

Table 8-8: Critical Control Points and Critical Limits

Critical Control Point	Description	Monitoring Process/Type	Operational Target	Adjustment Limit	Critical Limit
CCP1	Membrane treatment	Turbidity and pressure decay test (PDT)	Turbidity <0.1 NTU PDT <2.7 kPa/min	Turbidity >0.1 NTU PDT >2.7 kPa/min	PDT >3.2 kPa/min
CCP2	UV system	Lamp age, ultra-violet transmittance (UVT) and Reduced Equivalent Dose (RED)	Age <10,000 h UVT > 50% RED > 43 mJ/cm <sup>2</sup>	Age >10,000 h UVT <50% RED <43 mJ/cm <sup>2</sup>	Age >12,000 h UVT <43.6% RED <39 mJ/cm <sup>2</sup>
CCP3	Chlorination System	Free Residual chlorine after contact time and pH	Residual between 1.0 - 4.5 mg/L pH between 6.5-8.5	Residual <1.0 mg/L pH < 6.5 or >8.5	Residual <0.8 mg/L pH < 6.0 or >9.0
CCP4	Chlorination System	Free Residual chlorine after contact time and pH	Residual between 1.0 - 4.5 mg/L pH between 6.5-8.5	Residual <1.0 mg/L pH < 6.5 or >8.5	Residual <0.8 mg/L pH < 6.0 or >9.0

Table 8-9 and Table 8-10 details the monitoring plan. These results will be kept with the STP operational logs.

Table 8-9: Recycled water quality monitoring schedule

Parameter	Location	Frequency	Limit/Range	Responsibility
E. coli	Recycled Water Pumps	Weekly	<1 CFU per 100 mL	Plant operator
Audit of calibration activities	STP and RWP	Monthly	Monitoring equipment stays accurate	Manager, Utilities
Audit of preventative maintenance activities	STP and RWP	Annually	No unforeseen breakdowns	Manager, Utilities
Audit of operational monitoring activities	STP and RWP	Monthly	Safe recycled water scheme	Manager, Utilities

Table 8-10: End user water quality monitoring schedule

Parameter	Location	Frequency	Limit/Range	Responsibility
E. coli	Recycled Water Storages	Monthly	<1 CFU per 100 mL	Plant operator
Residual Chlorine	Recycled Water Storages	Monthly	0.5 mg/L	Plant operator
Phosphorus in soil	Irrigation Sites	Annually	As per site specific irrigation plan	End User

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Table 8-11 shows the LRV for this process. A validated membrane filtration and UV unit will be installed, and chlorination will be required to ensure that the LRV for adenovirus is achieved.

Table 8-11: LRV calculation for process

Treatment process	Protozoa	Virus	Bacteria
Membrane filtration (validated unit)	2	2	2
UV disinfection (validated unit)	2	0.5	1
Chlorination (C.t calculation)	0	2.7	1
Scheme Requirement	4	5.2	4

The C.t requirements for disinfection have been based on the USEPA Guidance manual for compliance with the filtration and disinfection requirements for public works systems using surface water sources (USEPA (1991)). The treated wastewater is essentially free of suspended solids having been through ultrafiltration membranes. It is therefore considered reasonable to apply the design guidance from this document. For a pH range of 6-9, a C.t of 3.7 mg.min/L is required for 2.7 log virus disinfection. A pipe contactor has been selected as it allows the use of a baffling factor of 1, which minimises the detention volume required, and avoids mixing and recirculation issues. This is generally considered an acceptable assumption provided  $L/d > 40$  (length is at least 40 times the diameter). The following equation shows that the C.t target will be met in the contact pipe if the chlorine residual is above 0.8 mg/L.

$$C.t \text{ (Calculated)} = \left(0.395^2 \times \frac{\pi}{4} \times 30\right) kL \times 1 \times \frac{s}{11.5 L} \times \frac{0.8 mg}{L} \times \frac{1000L}{kL} \times \frac{min}{60s} = 4.3mg \cdot \frac{min}{L}$$

## 8.5 EP and ET estimates

An Equivalent Person (EP) is defined as the quantity of sewage discharge for a resident in a detached house. For a non-residential establishment, the EP represents the number of persons who would contribute the same quantity and/or quality of domestic sewage as the establishment being considered. An Equivalent Tenement (ET) is similar to EP, but instead of a person used in the definition, an occupied detached house is used.

The residential sewer ET in each sewer catchment is equal to the number of occupied private residential dwellings, estimated from customer billing data. The non-residential ET is calculated by dividing the non-residential sewer load by the unit residential sewage load. Note that other ET definitions may be used for other purposes).

EP is then calculated by multiplying the ET by the current household size for Bungendore of 2.92 people per household, see Table 4-3.

Using the unit residential water consumption analysis undertaken in 5.6.2.1, EP unit flow is 144 L/EP/day and the ET unit flow is 421 L/ET/day.

The estimated EP and ET for each sewer catchment is given in Table 8-12.

Table 8-12: Bungendore sewerage scheme – Estimated ET and EP for each sewer catchment

Sewer catchment	ET			EP		
	Residential	Non-res	Total	Residential	Non-res	Total
BU SPS1	351	164	515	1032	482	1514

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Sewer catchment	ET			EP		
	Residential	Non-res	Total	Residential	Non-res	Total
BU SPS2	205	5	210	603	14	617
BU SPS3	12	0	12	35	0	35
BU SPS4	266	15	281	782	45	827
BU SPS5	21	0	21	62	0	62
BU SPS6	20	4	24	59	11	70
BU SPS7	210	0	210	617	0	617
BU SPS8	92	1	93	270	4	275
BU SPS9	122	1	123	359	3	361
BU SPS10	55	0	55	162	0	162
<b>Total</b>	<b>1,354</b>	<b>190</b>	<b>1,544</b>	<b>3,981</b>	<b>559</b>	<b>4,540</b>

The estimated residential EP of 3,981 is slightly higher than the estimated serviced private dwelling population of 3,720 in Table 4-6.

## 8.6 EP and ET projections

The growth strategy for Bungendore is discussed in Section 4.4 and Section 4.5. Dwelling growth and priority areas are mapped on Figure 4-2 and the lot yields and receiving sewage pumping station catchments are summarised in Table 4-9. Bungendore residential infill and non-residential growth are discussed in 4.4.3 and Section 4.4.4 respectively.

Using the growth rates as discussed in Section 4 the ET projections for each SPS catchment are given in Table 8-13 and the EP projection is summarised in Table 8-14.

Table 8-13: Bungendore sewerage scheme ET projection

	SPS	2022	2025	2030	2035	2040	2045	2050	2055
Residential	BU SPS1	351	351	351	351	351	351	351	351
	BU SPS2	205	205	205	205	205	205	205	205
	BU SPS3	12	12	12	12	12	12	12	12
	BU SPS4	266	266	266	266	266	266	266	266
	BU SPS5	21	21	21	21	21	21	21	21
	BU SPS6	20	114	270	270	270	270	270	270
	BU SPS7	210	210	210	210	379	451	451	451
	BU SPS8	92	92	92	92	92	92	92	92
	BU SPS9	122	122	122	147	147	147	147	147
	BU SPS10	55	55	55	120	315	433	433	433
	BU New1	0	0	107	327	327	327	327	327
	BU New2	0	0	0	0	0	95	95	95



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	SPS	2022	2025	2030	2035	2040	2045	2050	2055
	BU New3	0	0	0	0	0	143	481	481
	BU New4	0	0	0	0	0	0	166	759
	BU New5	0	0	0	0	0	0	0	0
	Total	1,354	1,448	1,711	2,021	2,385	2,813	3,317	3,910
Non-residential	BU SPS1	167	184	216	254	299	351	413	486
	BU SPS2	2	2	2	3	3	4	5	5
	BU SPS3	0	0	0	0	0	0	0	0
	BU SPS4	15	17	20	23	27	32	38	44
	BU SPS5	0	0	0	0	0	0	0	0
	BU SPS6	4	4	5	6	7	8	9	11
	BU SPS7	0	0	0	0	0	0	0	0
	BU SPS8	1	2	2	2	3	3	4	4
	BU SPS9	1	1	1	1	2	2	2	3
	BU SPS10	0	0	0	0	0	0	0	0
	BU New1	0	0	0	0	0	0	0	0
	BU New2	0	0	0	0	0	0	0	0
	BU New3	0	0	0	0	0	0	0	0
	BU New4	0	0	0	0	0	0	0	0
	BU New5	0	0	0	0	0	0	0	0
	Total	190	209	246	289	340	401	471	554
Total	BU SPS1	518	535	567	605	650	702	764	837
	BU SPS2	207	207	207	208	208	209	210	210
	BU SPS3	12	12	12	12	12	12	12	12
	BU SPS4	281	283	286	289	293	298	304	310
	BU SPS5	21	21	21	21	21	21	21	21
	BU SPS6	24	118	275	276	277	278	279	281
	BU SPS7	210	210	210	210	379	451	451	451
	BU SPS8	93	94	94	94	95	95	96	96
	BU SPS9	123	123	123	148	149	149	149	150
	BU SPS10	55	55	55	120	315	433	433	433
	BU New1	0	0	107	327	327	327	327	327
	BU New2	0	0	0	0	0	95	95	95
	BU New3	0	0	0	0	0	143	481	481
	BU New4	0	0	0	0	0	0	166	759
	BU New5	0	0	0	0	0	0	0	0

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	SPS	2022	2025	2030	2035	2040	2045	2050	2055
	Total	1,544	1,657	1,957	2,310	2,725	3,214	3,788	4,464

Table 8-14: Bungendore sewerage scheme EP projection

	SPS	2022	2025	2030	2035	2040	2045	2050	2055
Residential	BU SPS1	1,032	1,032	1,032	1,032	1,032	1,032	1,032	1,032
	BU SPS2	603	603	603	603	603	603	603	603
	BU SPS3	35	35	35	35	35	35	35	35
	BU SPS4	782	782	782	782	782	782	782	782
	BU SPS5	62	62	62	62	62	62	62	62
	BU SPS6	59	341	809	809	809	809	809	809
	BU SPS7	617	617	617	617	1,124	1,340	1,340	1,340
	BU SPS8	270	270	270	270	270	270	270	270
	BU SPS9	359	359	359	434	434	434	434	434
	BU SPS10	162	162	162	357	942	1,296	1,296	1,296
	BU New1	0	0	321	981	981	981	981	981
	BU New2	0	0	0	0	0	285	285	285
	BU New3	0	0	0	0	0	429	1,443	1,443
	BU New4	0	0	0	0	0	0	498	2,277
	BU New5	0	0	0	0	0	0	0	0
	Total	<b>3,981</b>	<b>4,263</b>	<b>5,052</b>	<b>5,982</b>	<b>7,074</b>	<b>8,358</b>	<b>9,870</b>	<b>11,649</b>
Non-residential	BU SPS1	515	568	668	785	924	1,087	1,278	1,503
	BU SPS2	6	7	8	10	12	14	16	19
	BU SPS3	0	0	0	0	0	0	0	0
	BU SPS4	45	49	58	68	80	94	111	131
	BU SPS5	0	0	0	0	0	0	0	0
	BU SPS6	11	12	15	17	20	24	28	33
	BU SPS7	0	0	0	0	0	0	0	0
	BU SPS8	4	5	6	7	8	9	11	13
	BU SPS9	3	3	4	4	5	6	7	8
	BU SPS10	0	0	0	0	0	0	0	0
	BU New1	0	0	0	0	0	0	0	0
	BU New2	0	0	0	0	0	0	0	0
	BU New3	0	0	0	0	0	0	0	0
	BU New4	0	0	0	0	0	0	0	0
	BU New5	0	0	0	0	0	0	0	0

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	SPS	2022	2025	2030	2035	2040	2045	2050	2055
	Total	<b>585</b>	<b>644</b>	<b>758</b>	<b>891</b>	<b>1,049</b>	<b>1,233</b>	<b>1,451</b>	<b>1,707</b>
Total	BU SPS1	1,547	1,600	1,700	1,817	1,956	2,119	2,310	2,535
	BU SPS2	609	610	611	612	614	616	619	621
	BU SPS3	35	35	35	35	35	35	35	35
	BU SPS4	827	831	840	850	862	877	893	913
	BU SPS5	62	62	62	62	62	62	62	62
	BU SPS6	70	353	823	826	829	832	837	842
	BU SPS7	617	617	617	617	1,124	1,340	1,340	1,340
	BU SPS8	275	275	276	277	278	280	281	283
	BU SPS9	361	362	362	438	439	439	441	442
	BU SPS10	162	162	162	357	942	1,296	1,296	1,296
	BU New1	0	0	321	981	981	981	981	981
	BU New2	0	0	0	0	0	285	285	285
	BU New3	0	0	0	0	0	429	1,443	1,443
	BU New4	0	0	0	0	0	0	498	2,277
	BU New5	0	0	0	0	0	0	0	0
	Total	<b>4,565</b>	<b>4,907</b>	<b>5,810</b>	<b>6,873</b>	<b>8,122</b>	<b>9,591</b>	<b>11,321</b>	<b>13,355</b>

The EP load will reach the STP design in about 2026, **Issue**. Council has commissioned a detailed design for an upgrade to the STP to bring the design capacity to 12,000 EP. The construction of the upgrade will commence once additional water has been secured for Bungendore.

## 8.7 Sewer system flow projections

### 8.7.1 System ADWF projections

The estimated ADWF projections for Bungendore sewerage scheme are shown in Table 8-15. The ADWF has been projected using the unit hydraulic loading of 180 L/EP/day for new residential developments and current loads for existing users and non-residential growth, the existing hydraulic load as discussed in Section 8.3.3.

The 220 L/EP/day used for some modern designs has been projected and plotted as shown in Figure 8-8, this graph shows that the current hydraulic capacity will not be reached until well after the nutrient treatment (EP) capacity is reached in 2026 (as discussed in Section 8.6).

The current STP Design ADWF is based on STP design criteria of 5000EP and ADWF of 240 L/EP/day. The projected sewage loading is plotted against the hydraulic capacity of the STP in Figure 8-8.

Table 8-15: Bungendore sewerage scheme ADWF projection (historical with 180L/EP for growth) (kL/day)

	SPS	2022	2025	2030	2035	2040	2045	2050	2055
Residential	BU SPS1	132.5	132.5	132.5	132.5	132.5	132.5	132.5	132.5
	BU SPS2	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8
	BU SPS3	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1

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	SPS	2022	2025	2030	2035	2040	2045	2050	2055
	BU SPS4	90.6	90.6	90.6	90.6	90.6	90.6	90.6	90.6
	BU SPS5	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
	BU SPS6	7.9	58.6	142.9	142.9	142.9	142.9	142.9	142.9
	BU SPS7	114.6	114.6	114.6	114.6	205.9	244.7	244.7	244.7
	BU SPS8	43.9	43.9	43.9	43.9	43.9	43.9	43.9	43.9
	BU SPS9	57.0	57.0	57.0	70.5	70.5	70.5	70.5	70.5
	BU SPS10	21.7	21.7	21.7	56.8	162.1	225.8	225.8	225.8
	BU New1	0.0	0.0	57.8	176.6	176.6	176.6	176.6	176.6
	BU New2	0.0	0.0	0.0	0.0	0.0	51.3	51.3	51.3
	BU New3	0.0	0.0	0.0	0.0	0.0	77.2	259.7	259.7
	BU New4	0.0	0.0	0.0	0.0	0.0	0.0	89.6	409.9
	BU New5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	<b>Total</b>	<b>569.2</b>	<b>620.0</b>	<b>762.0</b>	<b>929.4</b>	<b>1,125.9</b>	<b>1,357.1</b>	<b>1,629.2</b>	<b>1,949.4</b>
Non-residential	BU SPS1	66.2	72.9	85.8	100.9	118.7	139.6	164.2	193.2
	BU SPS2	0.8	0.8	1.0	1.2	1.4	1.6	1.9	2.2
	BU SPS3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU SPS4	5.2	5.7	6.7	7.9	9.3	10.9	12.8	15.1
	BU SPS5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU SPS6	1.6	1.8	2.1	2.5	2.9	3.4	4.0	4.7
	BU SPS7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU SPS8	0.6	0.7	0.8	1.0	1.1	1.3	1.6	1.8
	BU SPS9	0.4	0.4	0.5	0.6	0.7	0.8	1.0	1.2
	BU SPS10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	<b>Total</b>	<b>74.7</b>	<b>82.4</b>	<b>96.9</b>	<b>114.0</b>	<b>134.1</b>	<b>157.7</b>	<b>185.5</b>	<b>218.2</b>
Total	BU SPS1	198.7	205.4	218.3	233.4	251.2	272.1	296.7	325.7
	BU SPS2	87.5	87.6	87.8	87.9	88.1	88.4	88.7	89.0
	BU SPS3	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
	BU SPS4	95.8	96.3	97.3	98.5	99.9	101.5	103.4	105.7
	BU SPS5	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
	BU SPS6	9.5	60.4	145.0	145.3	145.8	146.3	146.9	147.6

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	SPS	2022	2025	2030	2035	2040	2045	2050	2055
	BU SPS7	114.6	114.6	114.6	114.6	205.9	244.7	244.7	244.7
	BU SPS8	44.5	44.6	44.7	44.9	45.0	45.2	45.5	45.7
	BU SPS9	57.4	57.4	57.5	71.1	71.2	71.3	71.5	71.7
	BU SPS10	21.7	21.7	21.7	56.8	162.1	225.8	225.8	225.8
	BU New1	0.0	0.0	57.8	176.6	176.6	176.6	176.6	176.6
	BU New2	0.0	0.0	0.0	0.0	0.0	51.3	51.3	51.3
	BU New3	0.0	0.0	0.0	0.0	0.0	77.2	259.7	259.7
	BU New4	0.0	0.0	0.0	0.0	0.0	0.0	89.6	409.9
	BU New5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	<b>Total</b>	<b>643.9</b>	<b>702.3</b>	<b>858.9</b>	<b>1,043.4</b>	<b>1,260.0</b>	<b>1,514.8</b>	<b>1,814.7</b>	<b>2,167.6</b>

Table 8-16: Bungendore sewerage scheme ADWF projection (220 L/EP/day) (kL/day)

	SPS	2022	2025	2030	2035	2040	2045	2050	2055
Residential	BU SPS1	227.0	227.0	227.0	227.0	227.0	227.0	227.0	227.0
	BU SPS2	132.6	132.6	132.6	132.6	132.6	132.6	132.6	132.6
	BU SPS3	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
	BU SPS4	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0
	BU SPS5	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
	BU SPS6	12.9	75.0	177.9	177.9	177.9	177.9	177.9	177.9
	BU SPS7	135.8	135.8	135.8	135.8	247.4	294.9	294.9	294.9
	BU SPS8	59.5	59.5	59.5	59.5	59.5	59.5	59.5	59.5
	BU SPS9	78.9	78.9	78.9	95.4	95.4	95.4	95.4	95.4
	BU SPS10	35.6	35.6	35.6	78.5	207.2	285.1	285.1	285.1
	BU New1	0.0	0.0	70.6	215.8	215.8	215.8	215.8	215.8
	BU New2	0.0	0.0	0.0	0.0	0.0	62.7	62.7	62.7
	BU New3	0.0	0.0	0.0	0.0	0.0	94.4	317.5	317.5
	BU New4	0.0	0.0	0.0	0.0	0.0	0.0	109.6	500.9
	BU New5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	<b>Total</b>	<b>875.8</b>	<b>937.8</b>	<b>1,111.4</b>	<b>1,316.0</b>	<b>1,556.2</b>	<b>1,838.7</b>	<b>2,171.3</b>	<b>2,562.7</b>

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	SPS	2022	2025	2030	2035	2040	2045	2050	2055
Non-residential	BU SPS1	113.3	124.9	146.9	172.8	203.2	239.1	281.2	330.8
	BU SPS2	1.4	1.6	1.8	2.2	2.5	3.0	3.5	4.1
	BU SPS3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU SPS4	9.9	10.9	12.8	15.0	17.7	20.8	24.4	28.8
	BU SPS5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU SPS6	2.5	2.7	3.2	3.8	4.4	5.2	6.1	7.2
	BU SPS7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU SPS8	1.0	1.1	1.2	1.5	1.7	2.0	2.4	2.8
	BU SPS9	0.6	0.7	0.8	0.9	1.1	1.3	1.5	1.8
	BU SPS10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BU New5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	128.6	141.8	166.7	196.1	230.7	271.4	319.2	375.4
Total	BU SPS1	340.3	351.9	373.9	399.8	430.3	466.1	508.2	557.8
	BU SPS2	134.0	134.2	134.4	134.7	135.1	135.6	136.1	136.7
	BU SPS3	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
	BU SPS4	181.9	182.9	184.8	187.1	189.7	192.8	196.5	200.8
	BU SPS5	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
	BU SPS6	15.4	77.7	181.1	181.7	182.4	183.1	184.1	185.1
	BU SPS7	135.8	135.8	135.8	135.8	247.4	294.9	294.9	294.9
	BU SPS8	60.5	60.6	60.8	61.0	61.2	61.5	61.9	62.3
	BU SPS9	79.5	79.6	79.7	96.3	96.5	96.7	96.9	97.2
	BU SPS10	35.6	35.6	35.6	78.5	207.2	285.1	285.1	285.1
	BU New1	0.0	0.0	70.6	215.8	215.8	215.8	215.8	215.8
	BU New2	0.0	0.0	0.0	0.0	0.0	62.7	62.7	62.7
	BU New3	0.0	0.0	0.0	0.0	0.0	94.4	317.5	317.5
	BU New4	0.0	0.0	0.0	0.0	0.0	0.0	109.6	500.9
	BU New5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	1,004.4	1,079.6	1,278.1	1,512.1	1,786.9	2,110.1	2,490.5	2,938.2

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The forecast sewer loads compared to the STP capacity is shown in Figure 8-8.

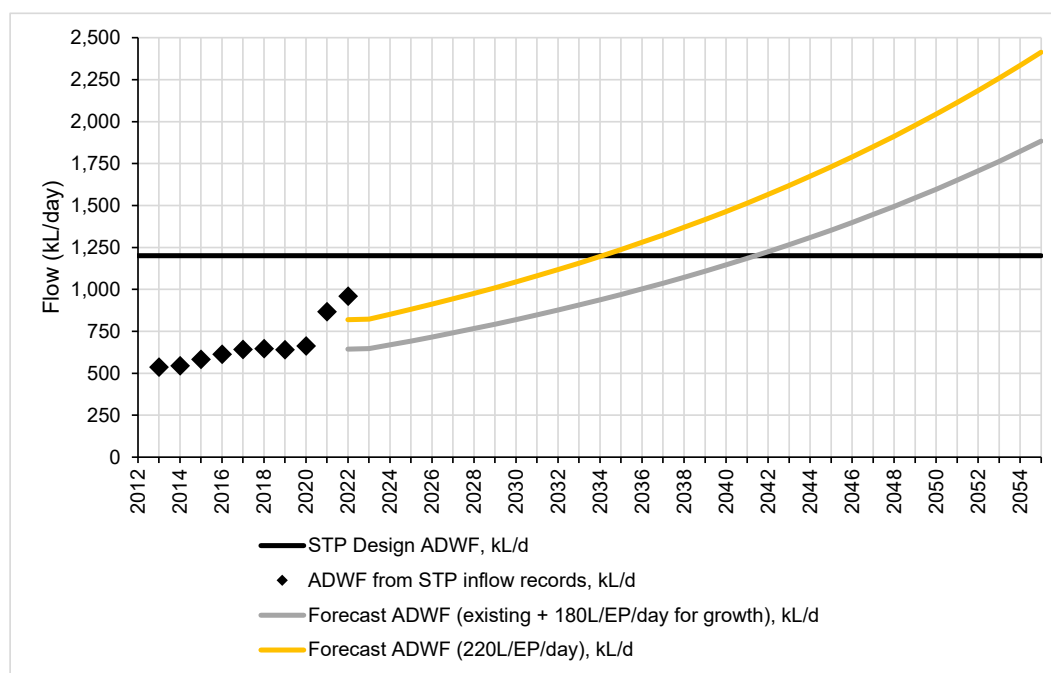


Figure 8-8: Bungendore projected hydraulic loading

### 8.7.2 System PDWF projections

The projected PDWF for the Bungendore sewerage scheme is shown in Table 8-17. The projected PDWF was calculated using the Public Works Sewer Design Manual [17] where the total ETs (residential and non-residential) were taken from Table 8-13, a unit EP flow of 220 L/EP/day was used for all customers.

Table 8-17: Bungendore sewerage scheme PDWF projections (L/s)

	SPS	2022	2025	2030	2035	2040	2045	2050	2055
Local catchment inflow	BU SPS1	9.9	10.2	10.8	11.4	12.1	13.0	14.0	15.2
	BU SPS2	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.6
	BU SPS3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	BU SPS4	5.8	5.8	5.9	5.9	6.0	6.1	6.2	6.3
	BU SPS5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	BU SPS6	0.8	2.8	5.8	5.8	5.8	5.9	5.9	5.9
	BU SPS7	4.5	4.5	4.5	4.5	7.5	8.8	8.8	8.8
	BU SPS8	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.4
	BU SPS9	2.9	2.9	2.9	3.4	3.4	3.4	3.4	3.4
	BU SPS10	1.5	1.5	1.5	2.9	6.5	8.5	8.5	8.5
	BU New1			2.6	6.7	6.7	6.7	6.7	6.7

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	SPS	2022	2025	2030	2035	2040	2045	2050	2055
	BU New2						2.4	2.4	2.4
	BU New3						3.4	9.3	9.3
	BU New4							3.8	13.8
	BU New5								
	STP	25.2	26.9	31.2	36.2	41.9	48.6	56.3	65.3
	Total	9.9	10.2	10.8	11.4	12.1	13.0	14.0	15.2

### 8.7.3 System PWWF projections

The PWWF projections will be estimated from the sewer modelling for the nominated containment standard of 1 in 5 ARI.

## 8.8 SPS current performance and projections

The current SPS performance is assessed with respect to the following factors:

- The pump run time in dry weather – to assess the capacity
- The emergency storage volume – to assess if the response time is adequate
- The odour/septicity potential in the rising main

### 8.8.1 Pump run time in dry weather

As a rule of thumb PWWF is around seven times ADWF for a gravity system, therefore if a pump is running more than three hours at ADWF it may indicate that the SPS may not have the capacity to pump out the excess flow during wet weather, and sewage overflow may occur.

The results for Bungendore sewerage scheme are given in Table 8-18. Using the ADWF from customer billing data, there were no instances where the average day pump run time exceeds three hours.

Table 8-18: SPS assessment - pump run time

SPS Catchment	ADWF (local catchment) (kL/day)	ADWF (inc. upstream catchments) (kL/day)	Pump Capacity (L/s)	Pump run time (hours/day)
BU SPS1	196.9	196.9	40.0	2.0
BU SPS2	88.8	88.8	10.1	2.4
BU SPS3	4.1	4.1	3.2	0.4
BU SPS4	95.8	95.8	32.0	0.8
BU SPS5	10.1	10.1	4.2	0.7
BU SPS6	9.5	9.5	2.0	1.3
BU SPS7	114.6	114.6	28.2	1.1
BU SPS8	44.5	123.7	19.0	1.8
BU SPS9	57.4	79.1	11.4	1.9
BU SPS10	21.7	21.7	24.6	0.2



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SPS Catchment	ADWF (local catchment) (kL/day)	ADWF (inc. upstream catchments) (kL/day)	Pump Capacity (L/s)	Pump run time (hours/day)
Total	643.5	643.5		

### 8.8.2 Emergency storage time

If a technical issue causes a pump to stop working, extended mechanical breakdown or electrical failures for examples, the emergency storage volume in the pump well should be able to store the incoming volume of sewage without overflow until Council can restore the operation of the pump.

Each of the SPSs' in the sewerage system is designed to have 8 hours of ADWF emergency storage from the inflows from its immediate catchment.

All SPS have ability to detect and respond to abnormal operating conditions via telemetry system in the events of power failure, pump failure, etc.

As per the past records kept by Council, there are no major overflow events have occurred in the reticulation system in the recent past. [15]

### 8.8.3 Odour/septicity potential

Septicity potential is generally assessed by reviewing sewage detention times in SPS rising mains. According to WSAA Guidelines, sewage [18]with a detention time between four and eight hours has a medium risk of septicity, and above eight hours has a high risk of septicity.

The assessed rising main detention time is shown in Table 8-19. Detention times greater than eight hours are highlighted in red. **Issue**. The ADWF is based on the metered water consumption as discussed earlier. The detention for the SPS 4 rising main is calculated for the section from SPS 4 to SPS 1 because the rising main from SPS 1 to the STP carries effluent from both SPS 1 and SPS 4.

Table 8-19: SPS Assessment - rising main detention time

SPS	ADWF kL/d	Rising main			Residence time	
		Diameter (mm)	Length (m)	Volume (m³)	Day	Hours
BU SPS1	290.4	200	461.3	14.5	0.076	1.82
BU SPS2	87.5	80	564	2.8	0.032	0.78
BU SPS3	4.1	80	255	1.3	0.309	7.43
BU SPS4*	95.8	150	1126.6	19.9	0.208	4.99
BU SPS5	10.1	80	1455.7	7.3	0.726	17.43
BU SPS6	9.5	50	238	0.5	0.049	1.18
BU SPS7	114.6	150	1758.9	31.1	0.271	6.51
BU SPS8	123.7	150	1517.8	26.8	0.217	5.21
BU SPS9	79.1	100	18.2	0.1	0.002	0.04
BU SPS10	21.7	150	104.2	1.8	0.085	2.03

\* Section from SPS 4 to SPS 1

There are no odour treatment units used at Bungendore STP.

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Within the reticulation system, odours are generated in the network and are treated by an activated carbon unit installed on each SPSs.

Source: PIRMP, V2 [15]

### **8.9 STP current performance and projections**

Based on inspection done at Bungendore STP in year 2022, its performance is found satisfactory as discussed in more details on Section 8.10.

The Bungendore STP Design ADWF is based on STP design criteria of 5000 EP and ADWF of 240 L/EP/day. This upgrade is expected to be required as soon as the moratorium on residential subdivisions is lifted and the new homes are completed.

The hydraulic capacity of the upgrade is based on the same unit flow as the existing of 240 L/EP/day. Therefore, given the very low current unit EP flow for the customers already connected to the system and the use of water efficient appliances in new homes, the hydraulic capacity of the plant is expected to be significantly above the nutrient treatment capacity of the plant. There are some mechanical and electrical upgrades that will be able to slightly increase the nutrient treatment capacity of the plant beyond the 12,000 EP.

### **8.10 Section 61 inspections and recommendations**

Bungendore STP was inspected on 19/12/2023 and found the plant was performing satisfactorily and appeared well maintained and operated. Sampling analysis results showed the treatment process was well managed and operating as expected.

### **8.11 Work Health and Safety**

No major WHS issues were noted/found from NSW PW staff site visit.

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## 9 Braidwood sewerage scheme

### 9.1 Sewage collection and transfer

The Braidwood sewerage scheme consists of 7 sewage pumping stations, 3km of rising sewer mains and 20km of gravity sewer mains.

Figure 9-1 shows an overview of Braidwood sewerage scheme.

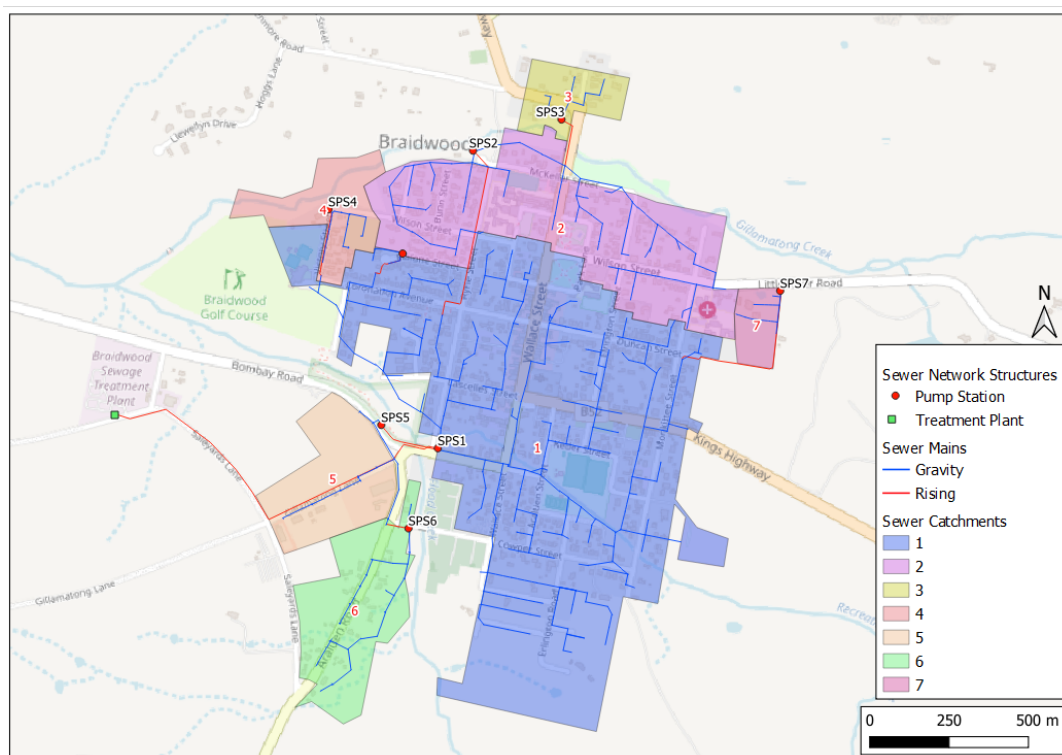


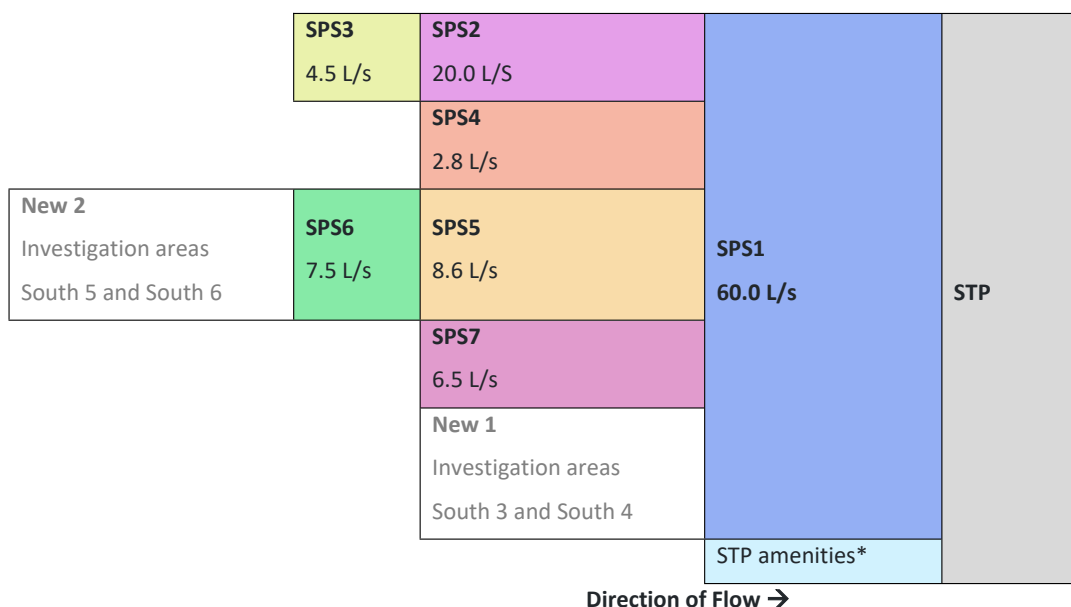
Figure 9-1: Braidwood sewerage scheme

The Braidwood sewage collection system comprises of the following:

- Gravity mains;
- Main SPS 1;
- 6 other sewage pumping stations, the arrangement of all SPSs is shown in Figure 9-1;
- Rising mains (from each SPS); and
- Saleyard tank.

A pump hierarchy diagram of Braidwood sewerage scheme with pump rates is shown in Figure 9-2.

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\* a small pumping station is used to transfer effluent from the STP amenities to the inlet works

Figure 9-2: Braidwood sewerage scheme SPS hierarchy

Based on the records in Councils telemetry system, it is possible that SPS 2 may have a capacity of 15 L/d and SPS 1 may have a capacity of 51 L/s.

## 9.2 Sewage treatment

### 9.2.1 STP description

Braidwood sewage treatment plant was commissioned in 2010. This was an entire replacement of a trickling filter plant built in 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.

The Braidwood STP with design capacity of 2,000 EP consists of the following process units:

- A septage receival facility with screens receiving septage wastes delivered to the plant via tanker truck;
- A packaged waste pump station receiving sewage from the plant amenities building;
- Inlet works including a mechanical fine screen with bypass channel fitted with manually raked bar screen, grit removal, storm bypass, flow measurement unit and flow divider;
- An emergency overflow/ storage pond receiving inflow in excess of 64 L/s from the overflow chamber of the inlet works and draining to the plant supernatant pump station;
- An intermittently decanted extended aeration (IDEA) reactor with surface aeration systems to accommodate a peak load of 2,000 EP;
- Alum dosing system for two-stage chemical phosphorus removal (using Alphas);
- A catch/balance pond, located downstream of the IDEA reactor to attenuate IDEA effluent flows and capture second stage chemical (alum) sludge;
- An effluent UV disinfection system;

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- A reclaimed water storage tank and two on-site reuse pressure pumps;
- Biosolids treatment and handling facilities, including sludge lagoons, sludge drying beds and sludge storage area;
- A supernatant and storm return pumping station; and
- Site works including amenities building, site drainage and lighting, etc.

A summary of the Braidwood STP design capacities for each process unit is given in Appendix table H-2.

Figure 9-3 shows the process flow diagram of the Braidwood STP. See Appendix figure H-3 for the detailed process flow schematic.

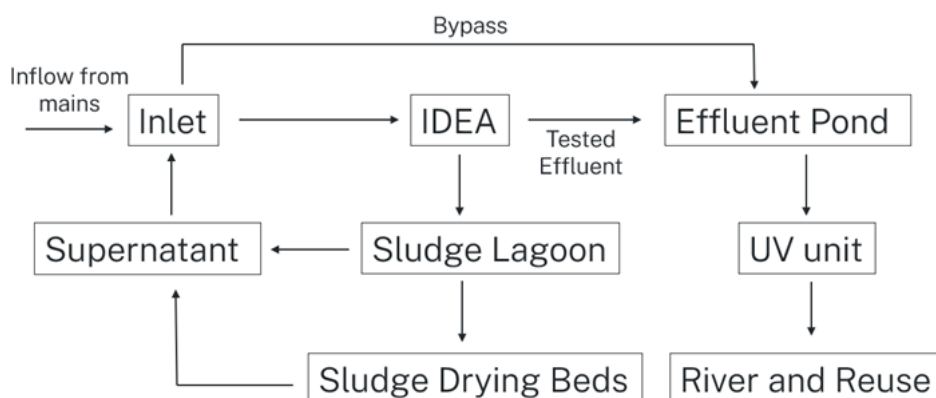


Figure 9-3: Process Flow Diagram – Braidwood STP

See the plan/aerial view of the Braidwood in Figure 9-4.

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Figure 9-4: Plan/ aerial view of the Braidwood below

### 9.2.2 Historical flows

Daily STP inflow data was provided for the period from July 2012 to February 2023. Rainfall data was obtained from the Bureau of Meteorology (BOM weather station number 69132 – Braidwood Racecourse).

The historical sewage inflow to the Braidwood STP is shown in Figure 9-5.

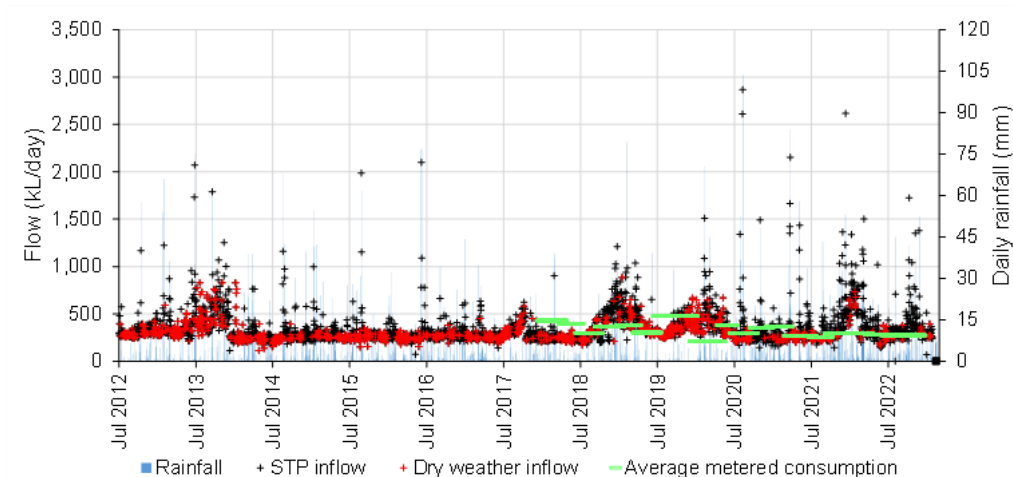


Figure 9-5: Braidwood STP historical inflow, rainfall and metered consumption

From the figure above, the STP inflow increases after rainfall. This indicates that there is some infiltration into the sewerage system. The maximum wet weather inflow is 2.9 ML/day.

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In wet years, the network takes a long time to dry out with some years having flows over 350 kL/day for most of the year. This can be seen more easily in Figure 9-6 where only the lower flows are graphed.

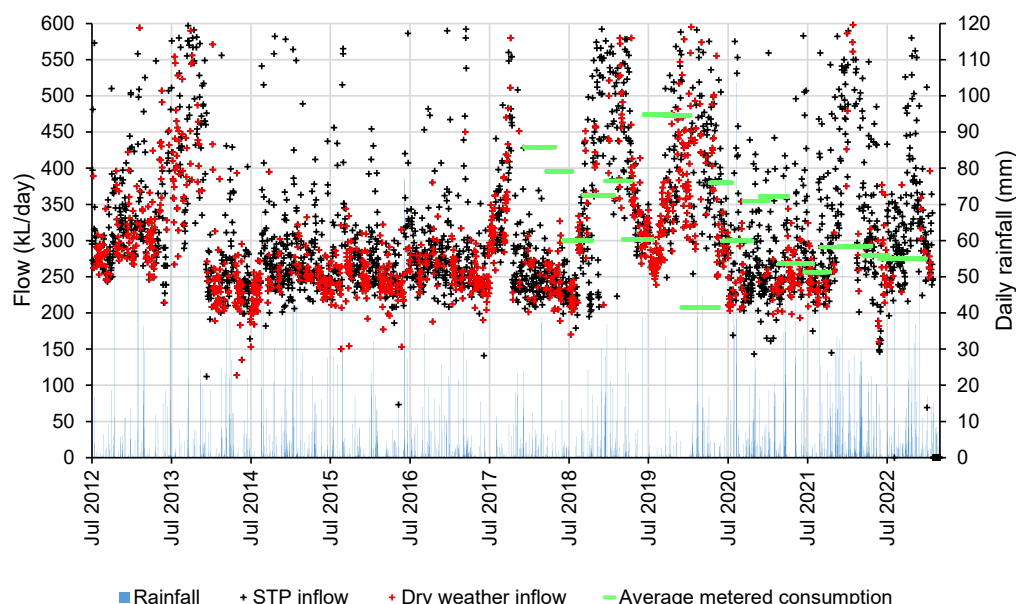


Figure 9-6: Braidwood STP historical inflow up to 600 kL/day, rainfall and metered consumption

Figure 9-6 also shows that in winter, spring and early summer 2019, while the weather was extremely dry, the dry weather flows increased to over 400 kL/day, this is substantially higher than the dry weather flows in 2017/18 of 290 kL/day. Council suspects that this was due to an issue with the STP inflow meter (noticeable because the daily flows were very inconsistent even during extremely dry periods), therefore, on 29 February 2020 Council switched to using the recorded flow data from the SPS 1 magflow meter to collect the STP inflow data.

### 9.3 STP inflow analysis

#### 9.3.1 Average dry weather flow (ADWF) estimated from STP inflow data

STP daily inflow data was analysed to estimate the average dry weather flow (ADWF). To estimate historical ADWF, a dry day was taken as a day with less than 3 mm of rainfall on that day, any of the eight preceding days and one day following..

The historical ADWF from 2012/13 to 2017/18 is shown in Table 9-1.

Table 9-1: Braidwood STP – ADWF estimated from STP inflow data

Financial Year	2012/ 13	2013/ 14	2014/ 15	2015/ 16	2016/ 17	2017/ 18	2018/ 19	2019/ 20	2020/ 21	2021/ 22
ADWF (kL/day)	310	350	245	249	258	291	355	362	250	296
Annual rainfall (mm)	730	815	854	840	658	562	635	124	1,205	1,241
Wet weather impact	High	High	Low	Low	Low	High	High	*	Low	High

\*very dry weather, dry weather flows very high



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Since March 2020 (after the flow records started to be taken from the SPS 1 pump flows), the ADWF has averaged 286 kL/day.

### 9.3.2 ADWF estimated from customer billing data

The unit climate independent demand for the sewerage Braidwood residential properties was 321 L/property/day, or 152 L/person/day.

The ADWF calculated from customer billing data analysis was **278 kL/day** (the average winter water consumption by sewerage customers during winter 2018, 2019 and 2022 (skipping the COVID-19 lockdown winters), and this has been nominated ADWF for the Braidwood sewerage scheme, as it is close to the ADWF from the inflow data (286 kL/day) and the meter data can be easily assigned to the individual SPS catchments.

An alternate method to estimating the average dry weather flow is to assume that the climate independent flow (for properties with climate dependent use) is approximately equal to the sewer flow and then to use the average winter metered demand for the properties with climate independent consumption. Using this method, the estimated average dry weather flow was 253 kL/day.

### 9.3.3 Nominated ADWF and unit hydraulic loading

The ADWF measured from the recent STP inflow data is 286 kL/day.

The ADWF measured from customer billing data analysis was **278 kL/day** and this has been nominated ADWF for the Braidwood sewerage scheme, as it is close (within 3%) to the ADWF estimated from the inflow data, and the meter data can be easily assigned to the individual SPS catchments.

The total Equivalent Person (EP) for the Braidwood sewerage scheme has been estimated as **1,755 EP**, which is explained in more detail in Section 9.4. Using this EP, the unit hydraulic loading is calculated to be **158 L/EP/day**. This is very low compared to the standard design load for sewerage systems of 240 L/EP/day developed in the 1980s, and significantly lower than the 180 L/EP/day used for some modern designs. This is likely due to the widespread use of water efficient appliances and moderate climate.

### 9.3.4 Estimated PDWF and PWWF

The Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF) in each SPS catchment are calculated using the method in the Public Works Sewer Design Manual [17]. The total Equivalent Tenement (ET) for the Braidwood sewerage scheme has been estimated as 762 ET, explained in more detail in Section 9.4.

The estimated sewage load to each SPS in terms of Average Dry Weather Flow (ADWF), Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF) is given in Table 9-2. SPS 7 is not included as there was insufficient water consumption data available.

Table 9-2: Estimated ADWF, PDWF and PWWF - Braidwood sewerage scheme

Sewer catchment	ET	Cumulative ADWF (kL/day)	PDWF (L/s)	PWWF (L/s)
BR SPS1	469	261.9	5.3	70.4
BR SPS2	219	73.0	2.4	15.1
BR SPS3	27	9.8	0.5	2.0
BR SPS4	20	6.1	0.3	1.5
BR SPS5	11	4.5	0.4	8.5
BR SPS6	16	282.6	0.3	1.2
STP amenities	2		0.2	0.2



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Sewer catchment	ET	Cumulative ADWF (kL/day)	PDWF (L/s)	PWWF (L/s)
Total*	762	277.8	7.7	60.2

\* Note that the PDWF and PWWF do not add up to the total of the STP because not every catchment is expected to experience peak flows at the same time.

The peaking factor ('r') for the whole sewerage scheme was calculated to be 2.4 using the number of ET, and the PDWF was estimated to be **6.9 L/s**. The PWWF from all catchments in Braidwood sewerage scheme is estimated to be **54 L/s**.

### 9.3.5 Biological and nutrient loading

The STP and the collection system operate under EPL No. 1733 granted by the NSW EPA that is renewed annually.

Effluent quality limitations on EPA licence are summarized in Table 9-3.

Table 9-3: Pollutant List - Sewage and Effluent for Braidwood STP

Parameter	Typical Raw Sewage	Effluent (90 percentile) *	Effluent (100 percentile) *
Biochemical Oxygen Demand (BOD5)	270 mg/L	<5 mg/L	<10 mg/L
Suspended Solids (SS)	270 mg/L	<10 mg/L	<15 mg/L
Total Nitrogen (TN)	53 mg/L	<8 mg/L	<10 mg/L
Ammonia	12 mg/L	<2 mg/L	<5 mg/L
Total Phosphorus (TP)	11 mg/L	<0.5 mg/L	<1 mg/L
Oil and grease (O&G)	< 10 mg/L	<2 mg/L	<10 mg/L
Faecal coliforms (FC)	1,000,000 cfu/100 mL	<100 cfu/100 mL	<200 cfu/100 mL
pH	6.5 – 8.5		6.5 – 8.5

Note: \*Licence Conditions

Source: PIRMP, V2 [15]

## 9.4 EP and ET estimates

EP is calculated by multiplying the ET by the average detached dwelling household for Braidwood of 2.21 people per household, see Table 4-4. Using the unit residential water consumption analysis undertaken in 6.6.2.1, EP unit flow is 180 L/EP/day and the ET unit flow is 398 L/ET/day.

The estimated EP and ET for each sewer catchment is given in Table 9-4.

Table 9-4: Braidwood sewerage scheme – Estimated ET and EP for each sewer catchment

Sewer catchment	ET			EP		
	Residential	Non-res	Total	Residential	Non-res	Total
BR SPS1	391	78	469	864	185	1,049
BR SPS2	131	88	219	290	252	542
BR SPS3	18	9	27	40	19	59
BR SPS4	20	0	20	44	0	44

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Sewer catchment	ET			EP		
	Residential	Non-res	Total	Residential	Non-res	Total
BR SPS5	7	4	11	15	8	23
BR SPS6	16	0	16	35	0	35
STP amenities	0	2	2	0	3	3
Total	583	179	762	1,288	467	1,755

The residential EP (1,288) is quite close to the estimated serviced private dwelling population of 1,209 in Table 4-7.

## 9.5 EP and ET projections

The growth strategy for Braidwood is discussed in Section 4.4.5 and Section 4.5. Dwelling growth and order of development are mapped on Figure 4-3 and the lot yields and sewage pumping station catchments are summarised in Table 4-10. Using the growth rates as discussed in Section 4.5.1, the ET projections for each SPS catchment are given in Table 9-5 and the EP projection is summarised in Table 9-6.

Table 9-5: Braidwood sewerage scheme ET projection

		2022	2025	2030	2035	2040	2045	2050	2055
Residential	BR SPS1	391	391	397	420	449	454	454	454
	BR SPS2	131	131	131	144	144	147	258	417
	BR SPS3	18	18	18	18	18	18	18	18
	BR SPS4	20	20	20	20	20	20	20	20
	BR SPS5	7	7	7	19	69	92	109	109
	BR SPS6	16	16	16	40	71	76	76	76
	BR SPS7	0	7	37	37	37	37	37	37
	STP amenities	0	0	0	0	0	0	0	0
	BR New1	0	0	0	0	0	55	67	67
	BR New2	0	0	0	0	0	34	34	34
	BR New3	0	0	0	0	0	0	0	0
	Total	583	590	626	699	809	934	1,074	1,233
Non-residential	BR SPS1	78	79	88	100	113	128	145	164
	BR SPS2	88	90	101	114	129	146	165	187
	BR SPS3	9	9	10	11	12	14	16	18

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		2022	2025	2030	2035	2040	2045	2050	2055
	BR SPS4	0	0	0	0	0	0	0	0
	BR SPS5	4	4	4	5	5	6	7	7
	BR SPS6	0	0	0	0	0	0	0	0
	BR SPS7	0	0	0	0	0	0	0	0
	STP amenities	2	2	2	2	2	2	3	3
	BR New1	0	0	0	0	0	0	0	0
	BR New2	0	0	0	0	0	0	0	0
	BR New3	0	0	0	0	0	0	0	0
	Total	179	184	204	231	262	296	335	379
Total	BR SPS1	469	470	485	520	562	582	599	618
	BR SPS2	219	221	232	258	273	293	423	604
	BR SPS3	27	27	28	29	30	32	34	36
	BR SPS4	20	20	20	20	20	20	20	20
	BR SPS5	11	11	11	24	74	98	116	116
	BR SPS6	16	16	16	40	71	76	76	76
	BR SPS7	0	7	37	37	37	37	37	37
	STP amenities	2	2	2	2	2	2	3	3
	BR New1	0	0	0	0	0	55	67	67
	BR New2	0	0	0	0	0	34	34	34
	BR New3	0	0	0	0	0	0	0	0
	Total	762	773	831	930	1,070	1,230	1,409	1,612

Table 9-6: Braidwood sewerage scheme EP projection

		2022	2025	2030	2035	2040	2045	2050	2055
Residential	BR SPS1	864	864	877	930	993	1,004	1,004	1,004
	BR SPS2	290	290	290	318	318	325	569	919

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		2022	2025	2030	2035	2040	2045	2050	2055
	BR SPS3	40	40	40	40	40	40	40	40
	BR SPS4	44	44	44	44	44	44	44	44
	BR SPS5	15	15	15	42	152	202	240	240
	BR SPS6	35	35	35	88	156	167	167	167
	BR SPS7	0	15	84	84	84	84	84	84
	STP amenities	0	0	0	0	0	0	0	0
	BR New1	0	0	0	0	0	121	147	147
	BR New2	0	0	0	0	0	75	75	75
	BR New3	0	0	0	0	0	0	0	0
	Total	1,288	1,303	1,386	1,546	1,788	2,063	2,371	2,721
Non-residential	BR SPS1	185	189	211	238	270	305	345	391
	BR SPS2	252	258	287	325	368	416	471	533
	BR SPS3	19	19	21	24	27	31	35	40
	BR SPS4	0	0	0	0	0	0	0	0
	BR SPS5	8	8	9	10	11	13	15	16
	BR SPS6	0	0	0	0	0	0	0	0
	BR SPS7	0	0	0	0	0	0	0	0
	STP amenities	3	3	4	4	5	5	6	7
	BR New1	0	0	0	0	0	0	0	0
	BR New2	0	0	0	0	0	0	0	0
	BR New3	0	0	0	0	0	0	0	0
	Total	467	478	532	602	681	771	872	987
Total	BR SPS1	1,049	1,054	1,088	1,168	1,263	1,310	1,350	1,395
	BR SPS2	542	548	577	643	686	741	1,040	1,451
	BR SPS3	59	59	61	64	67	71	75	80
	BR SPS4	44	44	44	44	44	44	44	44

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		2022	2025	2030	2035	2040	2045	2050	2055
	BR SPS5	23	23	24	52	163	215	254	256
	BR SPS6	35	35	35	88	156	167	167	167
	BR SPS7	0	15	84	84	84	84	84	84
	STP amenities	3	3	4	4	5	5	6	7
	BR New1	0	0	0	0	0	121	147	147
	BR New2	0	0	0	0	0	75	75	75
	BR New3	0	0	0	0	0	0	0	0
	Total	1,755	1,782	1,918	2,148	2,469	2,833	3,243	3,707

The STP EP load will reach the current treatment capacity with the installed aeration system (2,000 EP) in 2032 and the design capacity of 3,000 EP in 2048.

## 9.6 Sewer system flow projections

### 9.6.1 System ADWF projections

The ADWF has been projected using both the current ADWF plus 180 L/EP/day for growth (Table 9-7) and 220 L/EP/day for all users (Table 9-8). Using the first method, the hydraulic capacity of the plant will be reached in about 2047 (slightly before the nutrient capacity is reached in 2048), using the second method, the hydraulic capacity will be reached in 2043.

Table 9-7: Braidwood sewerage scheme ADWF projection (historical with 180L/EP for growth) (kL/day)

		2022	2025	2030	2035	2040	2045	2050	2055
Residential	BR SPS1	119.3	119.3	121.6	131.0	142.5	144.5	144.5	144.5
	BR SPS2	46.6	46.6	46.6	51.7	51.7	52.9	96.9	159.9
	BR SPS3	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
	BR SPS4	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
	BR SPS5	2.1	2.1	2.1	6.9	26.7	35.8	42.5	42.5
	BR SPS6	4.8	4.8	4.8	14.3	26.6	28.6	28.6	28.6
	BR SPS7	0.0	2.7	15.1	15.1	15.1	15.1	15.1	15.1
	STP amenities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR New1	0.0	0.0	0.0	0.0	0.0	21.8	26.5	26.5
	BR New2	0.0	0.0	0.0	0.0	0.0	13.5	13.5	13.5

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		2022	2025	2030	2035	2040	2045	2050	2055
	BR New3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	<b>Total</b>	<b>184.6</b>	<b>187.3</b>	<b>202.1</b>	<b>230.9</b>	<b>274.5</b>	<b>324.0</b>	<b>379.4</b>	<b>442.4</b>
Non-residential	BR SPS1	59.8	61.3	68.2	77.1	87.3	98.7	111.7	126.4
	BR SPS2	26.4	27.0	30.1	34.0	38.5	43.6	49.3	55.8
	BR SPS3	4.1	4.2	4.7	5.3	6.0	6.8	7.7	8.7
	BR SPS4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR SPS5	2.4	2.5	2.7	3.1	3.5	4.0	4.5	5.1
	BR SPS6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR SPS7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	STP amenities	0.5	0.5	0.6	0.6	0.7	0.8	0.9	1.0
	BR New1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR New2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR New3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	<b>Total</b>	<b>93.2</b>	<b>95.5</b>	<b>106.2</b>	<b>120.2</b>	<b>136.0</b>	<b>153.9</b>	<b>174.1</b>	<b>197.0</b>
Total	BR SPS1	179.1	180.5	189.8	208.2	229.8	243.2	256.2	270.9
	BR SPS2	73.0	73.6	76.7	85.8	90.3	96.5	146.2	215.6
	BR SPS3	9.8	9.9	10.4	11.0	11.7	12.5	13.4	14.4
	BR SPS4	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
	BR SPS5	4.5	4.6	4.8	10.0	30.2	39.7	47.0	47.6
	BR SPS6	4.8	4.8	4.8	14.3	26.6	28.6	28.6	28.6
	BR SPS7	0.0	2.7	15.1	15.1	15.1	15.1	15.1	15.1
	STP amenities	0.5	0.5	0.6	0.6	0.7	0.8	0.9	1.0
	BR New1	0.0	0.0	0.0	0.0	0.0	21.8	26.5	26.5
	BR New2	0.0	0.0	0.0	0.0	0.0	13.5	13.5	13.5
	BR New3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	<b>Total</b>	<b>277.8</b>	<b>282.8</b>	<b>308.3</b>	<b>351.1</b>	<b>410.4</b>	<b>477.8</b>	<b>553.5</b>	<b>639.3</b>

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Table 9-8: Braidwood sewerage scheme ADWF projection (220 L/EP/day for all users) (kL/day)

		2022	2025	2030	2035	2040	2045	2050	2055
Residential	BR SPS1	190.1	190.1	193.0	204.5	218.6	221.0	221.0	221.0
	BR SPS2	63.7	63.7	63.7	70.0	70.0	71.4	125.2	202.1
	BR SPS3	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
	BR SPS4	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
	BR SPS5	3.4	3.4	3.4	9.2	33.4	44.5	52.8	52.8
	BR SPS6	7.8	7.8	7.8	19.4	34.4	36.8	36.8	36.8
	BR SPS7	0.0	3.3	18.5	18.5	18.5	18.5	18.5	18.5
	STP amenities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR New1	0.0	0.0	0.0	0.0	0.0	26.6	32.4	32.4
	BR New2	0.0	0.0	0.0	0.0	0.0	16.5	16.5	16.5
	BR New3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	283.5	286.8	304.8	340.1	393.3	453.8	521.6	598.5
Non-residential	BR SPS1	40.7	41.7	46.4	52.5	59.4	67.2	76.0	86.0
	BR SPS2	55.5	56.8	63.2	71.5	80.9	91.5	103.6	117.2
	BR SPS3	4.1	4.2	4.7	5.3	6.0	6.8	7.7	8.8
	BR SPS4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR SPS5	1.7	1.8	2.0	2.2	2.5	2.8	3.2	3.6
	BR SPS6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR SPS7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	STP amenities	0.7	0.8	0.8	0.9	1.1	1.2	1.4	1.5
	BR New1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR New2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BR New3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	102.7	105.2	117.1	132.5	149.9	169.6	191.8	217.1

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		2022	2025	2030	2035	2040	2045	2050	2055
Total	BR SPS1	230.8	231.8	239.4	257.0	277.9	288.1	296.9	306.9
	BR SPS2	119.2	120.5	126.9	141.5	150.9	163.0	228.7	319.3
	BR SPS3	12.9	13.0	13.5	14.1	14.8	15.6	16.5	17.5
	BR SPS4	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
	BR SPS5	5.1	5.2	5.4	11.4	35.9	47.4	56.0	56.4
	BR SPS6	7.8	7.8	7.8	19.4	34.4	36.8	36.8	36.8
	BR SPS7	0.0	3.3	18.5	18.5	18.5	18.5	18.5	18.5
	STP amenities	0.7	0.8	0.8	0.9	1.1	1.2	1.4	1.5
	BR New1	0.0	0.0	0.0	0.0	0.0	26.6	32.4	32.4
	BR New2	0.0	0.0	0.0	0.0	0.0	16.5	16.5	16.5
	BR New3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	386.2	392.0	421.9	472.5	543.2	623.4	713.4	815.6

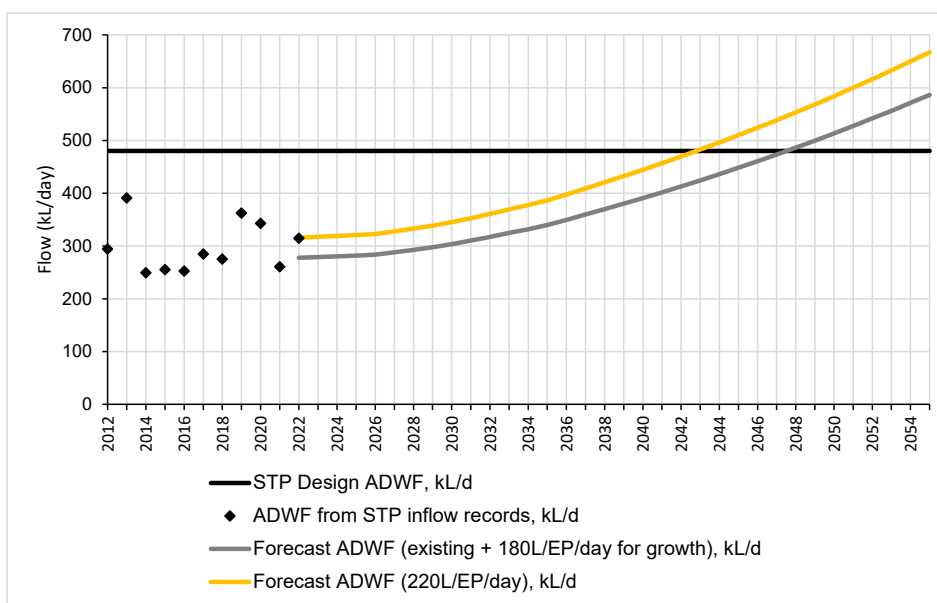


Figure 9-7: Braidwood projected hydraulic loading



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### 9.6.2 System PDWF projections

The projected PDWF for the Braidwood sewerage scheme is shown in Table 9-9. The projected PDWF was calculated using the Public Works Sewer Design Manual [13] where the total ETs (residential and non-residential) were taken from Table 9-5.

Table 9-9: Braidwood sewerage scheme - PDWF projections (L/s)

SPS Catchment	2022	2026	2031	2036	2041	2046	2051	2053
BR SPS1	34.0	34.1	35.2	37.7	40.6	42.0	43.2	44.6
BR SPS2	16.7	16.8	17.6	19.5	20.7	22.2	31.4	44.1
BR SPS3	2.2	2.2	2.3	2.3	2.5	2.6	2.7	2.9
BR SPS4	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
BR SPS5	1.0	1.0	1.0	2.0	5.7	7.5	8.8	8.8
BR SPS6	1.4	1.4	1.4	3.2	5.5	5.9	5.9	5.9
BR SPS7		0.7	3.0	3.0	3.0	3.0	3.0	3.0
STP amenities	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5
BR New1						4.3	5.2	5.2
BR New2						2.7	2.7	2.7
BR New3								
Total	54.9	55.6	59.7	64.3	73.8	84.5	96.5	110.1

### 9.6.3 System PWWF projections

The projected PWWF for Braidwood is shown on Table 9-10. The projected PWWF was calculated using the Public Works Sewer Design Manual where the total ETs were taken from Table 9-5. It should be noted that the PWWF reported here is the combined PWWF from all sewer catchments and does not account for the SPS pump rates. The PWWF to each SPS catchment is assessed in Section 9.7.2.

Table 9-10: Braidwood sewerage scheme - PWWF projections (L/sec)

	SPS Catchment	2022	2026	2031	2036	2041	2046	2051	2053
Local catchment	BR SPS1	34.0	34.1	35.2	37.7	40.6	42.0	43.2	44.6
	BR SPS2	16.7	16.8	17.6	19.5	20.7	22.2	31.4	44.1
	BR SPS3	2.2	2.2	2.3	2.3	2.5	2.6	2.7	2.9
	BR SPS4	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
	BR SPS5	1.0	1.0	1.0	2.0	5.7	7.5	8.8	8.8
	BR SPS6	1.4	1.4	1.4	3.2	5.5	5.9	5.9	5.9
	BR SPS7		0.7	3.0	3.0	3.0	3.0	3.0	3.0
	STP amenities	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5
	BR New1						4.3	5.2	5.2
	BR New2						2.7	2.7	2.7
	Total	54.9	55.6	59.7	64.3	73.8	84.5	96.5	110.1

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Cumulative	BR SPS1	71.9	74.0	76.1	82.0	95.4	98.8	111.0	125.4
	BR SPS2	16.7	16.8	17.6	19.5	20.7	22.2	31.4	44.1
	BR SPS3	2.2	2.2	2.3	2.3	2.5	2.6	2.7	2.9
	BR SPS4	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
	BR SPS5	8.5	8.5	8.5	9.5	13.2	15.0	16.3	16.3
	BR SPS6	1.4	1.4	1.4	3.2	5.5	5.9	5.9	5.9
	BR SPS7	0.0	0.7	3.0	3.0	3.0	3.0	3.0	3.0
	STP amenities	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5
	BR New1	0.0	0.0	0.0	0.0	0.0	4.3	5.2	5.2
	BR New2	0.0	0.0	0.0	0.0	0.0	2.7	2.7	2.7
	Total	60.3	75.3	77.3	82.4	96.4	99.4	112.4	126.5

## 9.7 SPS current performance and projections

### 9.7.1 Pump run time in dry weather

As a rule of thumb PWWF is around seven times ADWF for a gravity system, therefore if a pump is running more than three hours at ADWF it may indicate that the SPS may not have the capacity to pump out the excess flow during wet weather, and sewage overflow may occur.

The results for Braidwood sewerage scheme are given in Table 9-11. Using the ADWF from billing data, there were no instances where the average day pump run time exceeds three hours.

Table 9-11: Pump run time in dry weather

SPS Catchment	ADWF (kL/d)	Pump Capacity (L/s)	Pump run time (hours)
BR SPS1	261.9	60.0	1.2
BR SPS2	73.0	20.0	1.0
BR SPS3	9.8	4.5	0.6
BR SPS4	6.1	2.8	0.6
BR SPS5	4.5	8.6	0.1
BR SPS6	4.8	7.5	0.2

### 9.7.2 Pump rate compared to PWWF

The PWWF in each SPS catchment is calculated using the method in the Public Works sewer design manual [13], also presented in Section 9.6.3. A PDWF and storm allowance (0.058 L/s per ET) is calculated for each catchment based on the estimate ET, which combined give the PWWF. The pump rate of any SPS that are directly upstream of the catchment also contribute to the estimated PWWF. The SPS 7 has nil ET at the time of study but will service the Under Development (U/D) Summerfield in Braidwood retirement village.

The PWWF in each SPS catchment in Braidwood is shown in red text in Figure 9-8.

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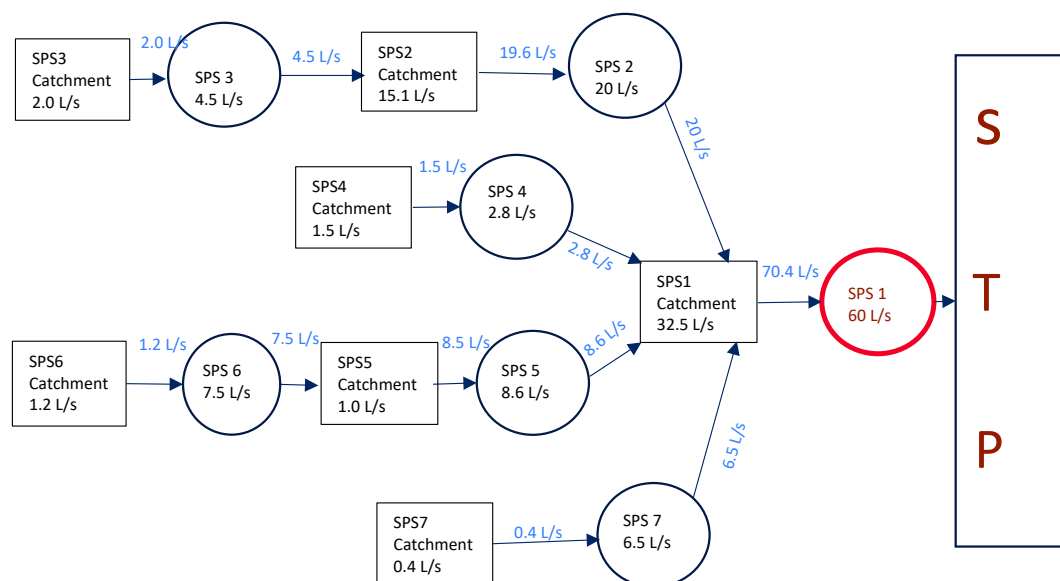


Figure 9-8: Estimated PWWF to each SPS in Braidwood sewerage scheme

BR SPS1 (60 L/s) is undersized to pump wet weather flows. **Issue**

SPS pump rate imbalance is also identified for BR SPS6. It has a pumping rate more than five times the estimated catchment PWWF. Therefore, SPS 5 may need to be upgraded sooner than expected.

### 9.7.3 Emergency storage time

If a technical issue causes a pump to stop working, extended mechanical breakdown or electrical failures for examples, the emergency storage volume in the pump well should be able to store the incoming volume of sewage without overflow until Council can restore the operation of the pump.

Each of the SPSs in the sewerage system is designed to have 8 hours of ADWF emergency storage from the inflows from its immediate catchment.

All SPS have ability to detect and respond to abnormal operating conditions via telemetry system in the event of power failure, pump failure, etc.

## 9.8 Odour/septicity potential

Septicity potential is generally assessed by reviewing sewage detention times in SPS rising mains. According to WSAA Guidelines [18], sewage with a detention time between four and eight hours has a medium risk of septicity, and above eight hours has a high risk of septicity.

The assessed rising main detention time is shown in Table 9-12. Detention times greater than eight hours are highlighted in red. **Issue**.

Table 9-12: SPS assessment - rising main detention time

SPS	ADWF (kL/d)	Rising main			Residence time	
		Diameter,(mm)	Length (m)	Volume (kL)	Day	Hours
BR SPS1	261.9	200	1239.541	38.9	0.2	3.57

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BR SPS2	73.0	150	604.37	10.7	0.2	3.51
BR SPS3	9.8	100	168.703	1.3	0.2	3.24
BR SPS4	6.1	63	216.062	0.7	0.1	2.65
BR SPS5	4.5	110	210.412	2.0	0.3	10.64
BR SPS6	282.6	110	70.482	0.7	0.1	3.35
BR SPS7*	0.0					

\*Note: The SPS 7 has nil value at the time of study data provision as construction of the Summerfield - Braidwood Retirement village had barely commenced

At Braidwood STP, odour is not an issue.

At reticulation system, odours are generated in the sewerage system and treated by an activated carbon unit installed on each SPSs. Source: PIRMP, V2 [15]

## 9.9 STP current performance and projections

Based on inspections done at Braidwood STP in 2021 and 2023, its performance is found satisfactory as discussed in more details on Section 9.10.

The Braidwood STP Design ADWF is based on STP design criteria of 2000 EP and ADWF of 240 L/EP/day. The STP design ADWF will be reached during year 2049 based on nominated flow of 253 kL/d, a hydraulic loading of 147L/EP/d. If based on hydraulic loading of 180 L/EP/day is used, the STP design ADWF will be reached earlier (in year 2041), as shown in Figure 9-7.

## 9.10 Section 61 inspections and recommendations

Inspection records on 01/03/2021 and 18/04/2023 found the Braidwood STP plant was performing satisfactorily. There was a recommendation made for the replacement of the decant weir cables and boots every five years as part of preventative maintenance on the risk of major operational disruption and damage to decant equipment, Council has scheduled these works.

## 9.11 Work Health and Safety

No major WHS issues were noted/found from NSW PW staff site visit.

However, Pollution Incident Response Management Plan (PIRMP) [15] report done by NSW PW states that for the following incidents and injuries must be reported to SafeWork NSW:

- Notifiable incidents involving a fatality or a serious injury or illness,
- Notifiable incidents involving a fatality or serious injury or illness to other people at your workplace.
- Notifiable incidents that present a serious risk to health and safety at your workplace (dangerous incidents), and
- Other incidents involving an injury or illness where workers compensation is payable.

Council's WHS policies and procedures do exist to be followed.



10
Captains Flat sewerage scheme

10.1
Sewage collection and transfer

The Captains Flat Sewerage Scheme (Captains Flat SS) consists of 1 sewage pumping station, 0.2 km of sewer rising main and 7km of sewer gravity mains.

Figure 10-1 shows an overview of Captains Flat Sewerage Scheme (Captains Flat SS) with the inclusion of the new growth zones.

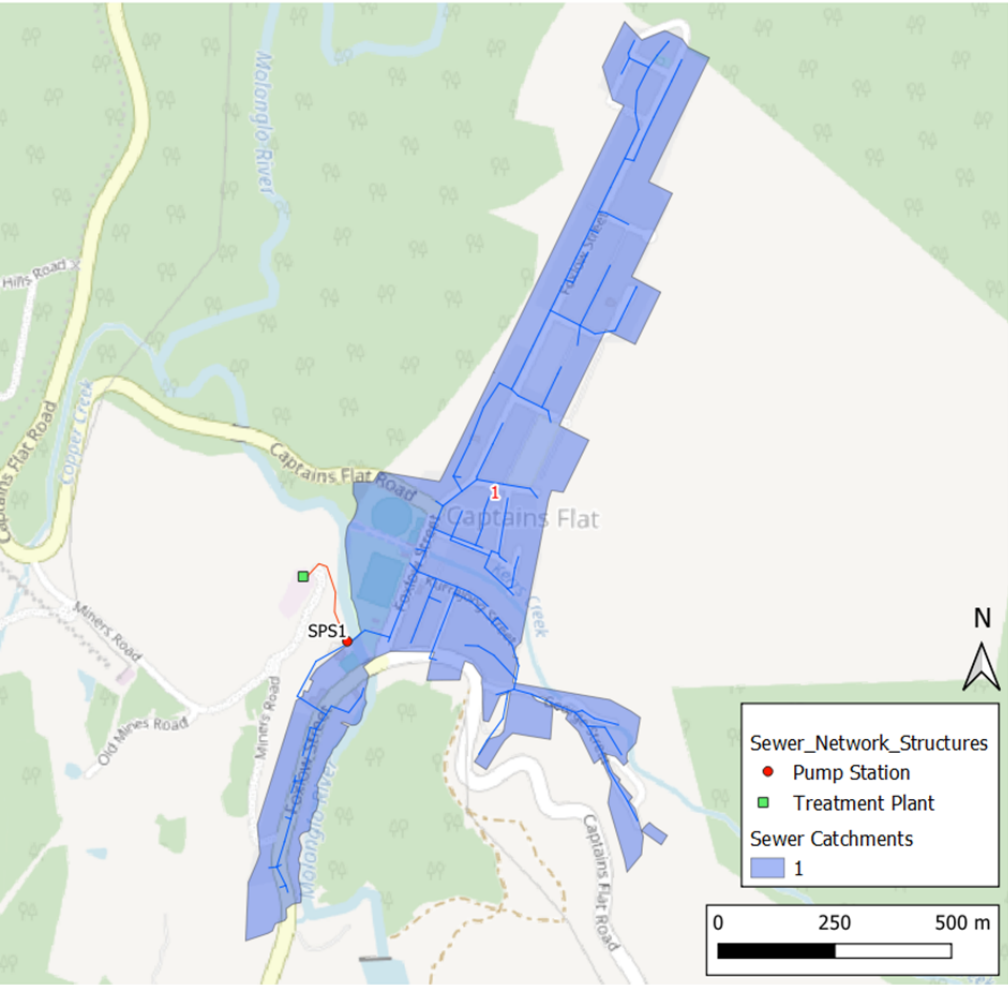


Figure 10-1: Captains Flat Sewerage Scheme

A pump hierarchy diagram of Captains Flat SS with pump rates is shown in Figure 10-2.

SPS1	STP
15.0 L/s	

Figure 10-2: Captains Flat SS SPS hierarchy

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## 10.2 Sewage treatment

### 10.2.1 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.

The Captains Flat STP consists of the following process units and discharges to Molonglo River:

- Inlet works - Inflow reception, screening, grit removal, flow measurement and flow division;
- Pasveer channel;
- Chemical dosing unit;
- UV disinfection unit;
- On-site reuse unit;
- Emergency storage ponds;
- Sludge lagoons; and
- Sludge drying beds.

A summary of the Captains Flat STP design capacities for each process unit is given in Appendix table H-3

Figure 10-3 shows the process flow diagram of the Captains Flat STP. See Appendix figure H-4 for the detailed process flow schematic.

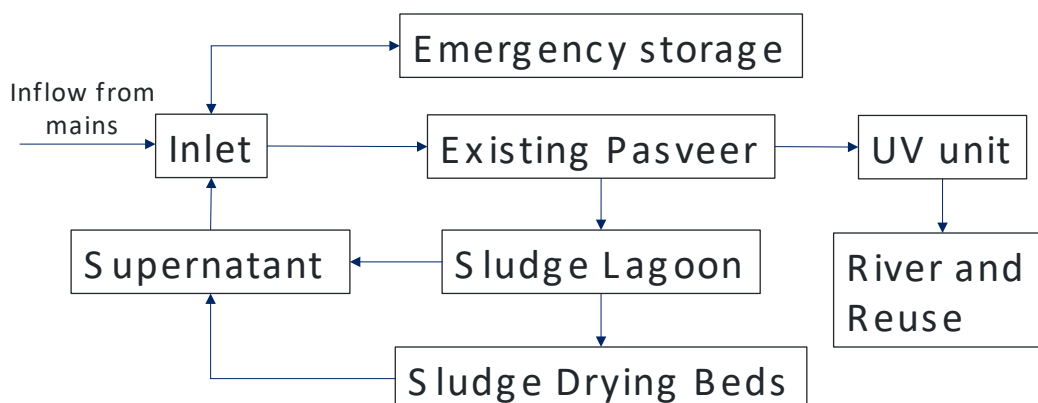


Figure 10-3: Process Flow Diagram – Captains Flat STP

### 10.2.2 Historical flows

STP inflow daily data was available from July 2012 to February 2023. Rainfall data was obtained from the Bureau of Meteorology (BOM weather station number 70016 – Foxlow St Captains Flat).

The historical sewage inflow to the Captains Flat STP is shown in Figure 10-4.

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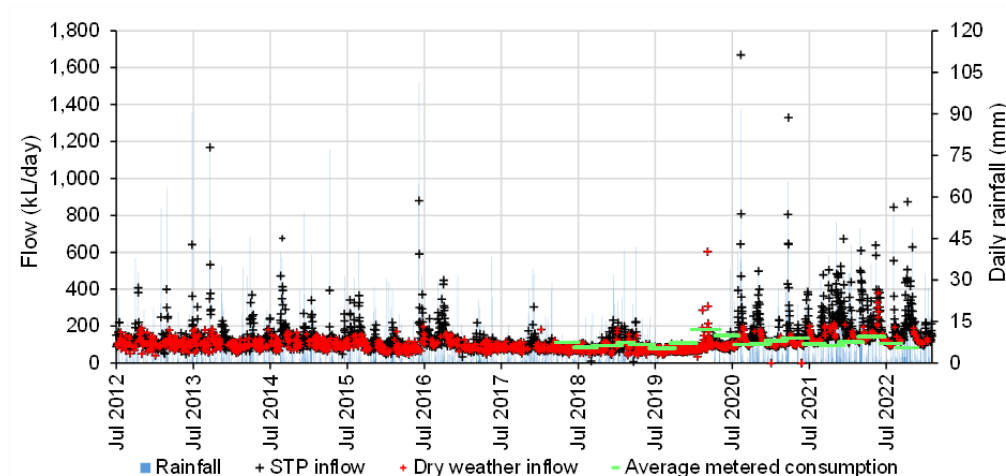


Figure 10-4: Captains Flat STP historical inflow, rainfall and metered consumption

From the figure above, the STP inflow increases after rainfall. This indicates that there is inflow and infiltration into the sewerage system.

It was also observed that during the extended wet weather in 2020 to 2022, the STP inflow is continuing to decrease after 10 dry days in a row. This is examined further in Section 10.3.1.1.

### 10.3 STP inflow analysis

#### 10.3.1 Average dry weather flow (ADWF) estimated from STP inflow data

STP daily inflow data was analysed to estimate the average dry weather flow (ADWF). To estimate historical ADWF, a dry day was taken as a day with less than 4 mm of rainfall on that day, any of the seven preceding days and one day following. All historical rainfall data was obtained from the Bureau of Meteorology (BOM).

The historical ADWF from 2012/13 to 2017/18 is shown in Table 10-1.

Table 10-1: Captains Flat STP – ADWF estimated from STP inflow data

Financial Year	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
ADWF (kL/day)	107	103	104	91	95	81	81	84	112	155

Based on the STP inflow data, the ADWF for the Captains Flat STP is around 95 kL/day.

##### 10.3.1.1 Average Dry Weather Flow (ADWF) comparison with river level data

From September 2021 to June 2022 the STP inflow was almost continuously over 150 kL/day. It appears that the infiltration to the system is likely due to continued high water levels in the local aquifers and waterways. The closest environmental water level data monitoring available is from the river gauge at Molonglo River, Kobada (station number 4100208, about 2 km upstream of Captains Flat Dam). The creek levels and STP inflow from March 2020 to February 2023 are shown in Figure 10-5 and show that when the creek levels are over 450 mm continuously, the STP inflow continues to be high even after several “dry days”.

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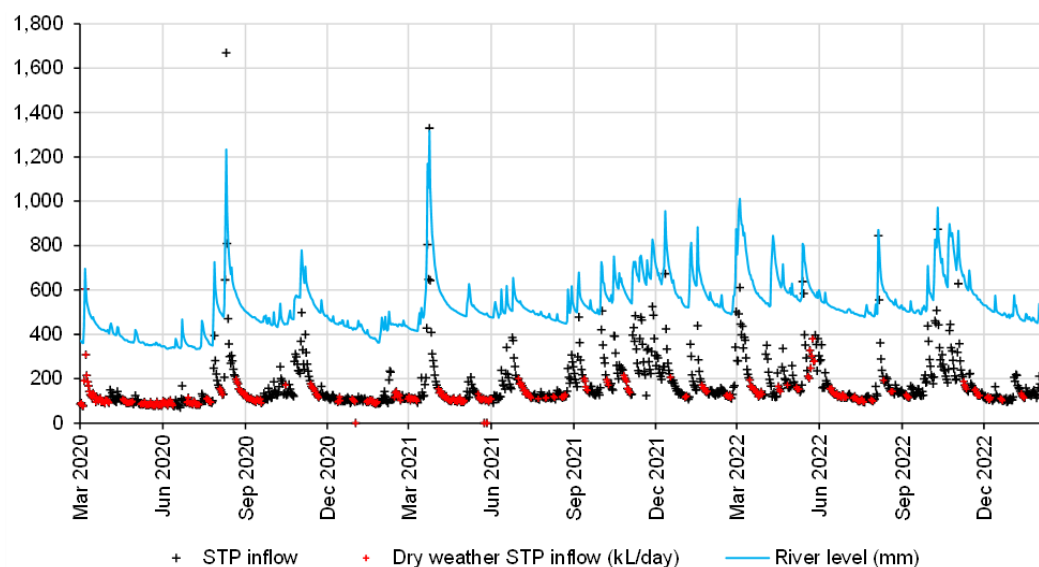


Figure 10-5: Captains Flat STP historical inflow and Molonglo River at Kobada water levels – Mar 2020 to Feb 2023

### 10.3.2 Biological and nutrient loading

The STP and the collection system operate under EPL No. 1929 granted by the NSW EPA that is renewed annually.

Effluent quality limitations on EPA licence are summarized in Table 10-2.

Table 10-2: Pollutant List - Sewage and Effluent for Braidwood STP

Parameter	Typical Raw Sewage	Effluent (90 percentile) *	Effluent (100 percentile) *
Biochemical Oxygen Demand (BOD5)	270 mg/L	<10 mg/L	<20 mg/L
Suspended Solids (SS)	270 mg/L	<10 mg/L	<15 mg/L
Total Nitrogen (TN)	53 mg/L	<8 mg/L	<10 mg/L
Ammonia	12 mg/L	<2 mg/L	<5 mg/L
Total Phosphorus (TP)	11 mg/L	<0.5 mg/L	<1 mg/L
Oil and grease (O&G)	< 10 mg/L	<2 mg/L	<10 mg/L
Faecal coliforms (FC)	1,000,000 cfu/100 mL	<100 cfu/100 mL	<200 cfu/100 mL
pH	6.5 – 8.5		6.5 – 8.5

Note: \*Licence Conditions

Source: PIRMP, V2 [15]



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## **10.4 SPS current performance**

### **10.4.1 Emergency storage time**

If a technical issue causes a pump to stop working, extended mechanical breakdown or electrical failures for examples, the emergency storage volume in the pump well should be able to store the incoming volume of sewage without overflow until Council can restore the operation of the pump.

There is only one SPS in the sewerage system and it is designed to have 8 hours of ADWF emergency storage before an overflow occurs.

The SPS has the ability to detect and respond to abnormal operating conditions via the telemetry system in the event of power failure, pump failure, etc.

### **10.4.2 Odour/septicity potential**

Septicity potential is generally assessed by reviewing sewage detention times in SPS rising mains. According to WSAA Guidelines [18], sewage with a detention time between four and eight hours has a medium risk of septicity, and above eight hours has a high risk of septicity. The sewer rising is very short and the septicity risk is correspondingly low.

At Captains Flat STP, there is no odour treatment unit used.

At reticulation system, there is no odour treatment unit used for the SPS.

## **10.5 STP current performance**

From recent inspections of the STP, as detailed in Section 10.6, it is performing satisfactorily.

## **10.6 Section 61 inspections and recommendations**

Captain Flat STP was inspected on 02/03/2021 and the report states that the plant was performing satisfactorily. There was concern on the proximity of the inlet to decant weir. Baffles were installed to mitigate this. There were signs of corrosion on the decant scum baffles and some gaps. It was recommended that maintenance of this equipment should be carried out. Results of sampling tests showed treatment process was being well managed and operating as expected.

The inspection on 27/04/2022 found the STP was performing satisfactorily. Sampling test analysis results showed treatment process was being well managed and operating as expected.

## **10.7 Work Health and Safety**

No major WHS issues were noted/found from NSW PW staff site visit.

Council's WHS policies and procedures do exist and are followed.

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## 11 Unserved communities

There are numerous remote small villages and rural localities throughout the LGA without sewerage service. These residents treat wastewater using on-site sewage management systems (OSSMS) (typically septic tanks or aerated wastewater treatment systems).

### 11.1 OSSMS Assessment

A desktop assessment was undertaken for the villages that use OSSMS. The villages where potential issues have been identified are Nerriga, Majors Creek, Araluen and some unsewered properties on the edges of Captains flat. To assess the risk and impact for these unsewered villages, a prioritisation assessment was developed (based on the Safe and Secure Risk Prioritisation Framework by DCCEEW). An inherent risk score was assigned to each village based on potable water source, lot sizes for effective effluent disposal, access to reticulated water supply, proximity to water course and population growth. The inherent risk score is categorised based on the criteria shown in Table 11-1.

Table 11-1: Inherent risk categorisation for OSSMS

Risk outcomes	Risk score
<b>Widespread high-risk properties:</b> Wastewater from on-site wastewater management facilities has <b>potential for direct</b> impact on drinking water supply source and/or with widespread direct primary contact impact to resident population and/or high impact on waterway uses and values Criteria: Large percentage (>70%) of properties with insufficient lot sizes for effluent disposal for well-drained soil, under 2,000 m <sup>2</sup> or less is considered insufficient for poorly drained soil, under 4,000 m <sup>2</sup> is considered insufficient <b>AND</b> reticulated water (potential to overload existing septic tanks) <b>OR</b> residents using private bores for potable water <b>OR</b> greater than 40 properties within 100 m buffer distance to surface waterway	4
<b>Localised high-risk properties:</b> Wastewater from on-site wastewater management facilities has <b>potential for localised</b> direct primary contact impact to resident population and/or medium impact on waterway uses and values Criteria: Smaller percentage (<70%) of properties with insufficient lot sizes for effluent disposal for well-drained soil, under 2,000 m <sup>2</sup> or less is considered insufficient for poorly drained soil, under 4,000 m <sup>2</sup> is considered insufficient <b>AND</b> reticulated water (potential to overload existing septic tanks) <b>OR</b> residents using private bores for potable water <b>OR</b> greater than 30 properties within 100 m buffer distance to surface waterway	3
Medium risk properties (lot sizes 2,000 – 4,000 m <sup>2</sup> with well drained soils). Potential direct health impact due to: Direct primary contact caused by overloading or ineffective effluent disposal Environmental: Low number (<20) of properties within 100 m buffer distance to surface waterway	2
Low risk properties (lot size greater than 4,000 m <sup>2</sup> ). Potential direct health impact due to: Direct primary contact caused by overloading or ineffective effluent disposal Environmental: Less than five properties within 100 m buffer distance to surface waterway	1

Table 11-2: Unsewered villages – risk score

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	Soil drainage	% of properties with insufficient lot size	Potable water source	Number of properties close to waterway	Risk score
Requirement	Ideally well drained soils	Well drained soil: minimum 2,000 m <sup>2</sup> Poorly/imperfectly drained soil: 2,000 to 4,000 m <sup>2</sup> Practically impervious soil: minimum 4,000 m <sup>2</sup>	No private bores are used for potable water. Reticulated water can also be an issue as there are risks of overloading septic tanks	Minimum 100 m away from surface waterway	
Risk if requirements not met	Resurfacing hazard (leading to potential human contact)	Public health risk: Insufficient area for effluent disposal leading to potential human contact	Bores – possible contamination Reticulated – increases loading	Contamination of surface water	
Village assessment					
Nerriga ~7 properties [1]	Profile is Well drained [2]	< 5 properties less than 4,000 m <sup>2</sup> Minimum lot size from LSC LEP is 4,000 m <sup>2</sup> .	Reticulated non-potable water supply.	No surface water nearby	1
Majors Creek ~100 properties [1]	Profile is imperfectly drained [2]	< 20 properties less than 4,000 m <sup>2</sup> Minimum lot size from LSC LEP is 4,000 m <sup>2</sup> .	Reticulated non-potable water supply.	No surface water nearby	1
Araluen ~65 properties [1]	Profile is Well drained [2]	< 20 properties less than 4,000 m <sup>2</sup> Minimum lot size from LSC LEP is 4,000 m <sup>2</sup> .	Reticulated non-potable water supply.	No surface water nearby	1
Captains flat ~30 properties [1]	Profile imperfectly drained [2]	< 10 properties less than 4,000 m <sup>2</sup> Minimum lot size from LSC LEP is 4,000 m <sup>2</sup> .	Reticulated non-potable water supply.	No surface water nearby	1

[1] Counted from aerial map

[2] Soil Profile is from eSpade2 [19]

All villages have a risk score of 1 as they have suitable lot sizes, well-drained soil and no surface water is located nearby area.

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## 12 Water and sewer strategic planning issues

Table 12-1: General water and sewer system issues

Issue Type	Target for Compliance	Issue (2015-2019 IWCM)	2023-25 Council Updates
Compliance	BASIX	N/A new issue	Council's 2015 DCP increases the minimum rain water tank size for new dwellings in the former Palerang Shire, this contravenes the NSW State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004

Table 12-2: Water Supply System Issues

Issue Type	Target for Compliance	Issue (2015-2019 IWCM)	2023-25 Council Updates
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.	Council now has a calibrated hydraulic model for Bungendore through an engagement with Public Works (Source: Email correspondence)
Best Practice	Pricing	N/A new issue	Council's 2015 DCP increases the minimum rain water tank size for new dwellings in the former Palerang Shire, new dwellings will require significantly less water in average years and nearly as much in hot dry years, increasing the difficulty of achieving an average of 50% of revenue from usage
Regulatory	Fluoridation of Public Water Supplies	The requirement for periodic auditing of the fluoridation systems is not always being met.	Council has confirmed that the requirement for periodic auditing is still not being met. (Source: Email correspondence)
Regulatory	Drinking Water Management System	Several of the nominated CCPs in the DWMS are not considered CCPs, for example free chlorine in the reticulation is an operational control point.	Council is currently revising the DWMS

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
Bungendore water supply issues			
Water security	Licensed allocation	It is estimated that Bungendore water supply dry year extraction will exceed its licensed extraction limit from the Bungendore and Currandooley bores by 2018.	Still the biggest issue for the Palerang Communities  History of the past few years of groundwater investigation is now well known.  Current strategy is to develop the Q2B proposal, which will transfer water from Queanbeyan to Bungendore. In the meantime, all greenfield development for Bungendore is stalled.  (Source: Email correspondence)
Water quality	ADWG (Australian Drinking Water Guidelines)	N/A new issue	Proposed ADWG concentration limits for Per- and Polyfluoroalkyl Substances (PFAS) are significantly lower than the current limits. In response to the expected change, Council has undertaken additional sampling. Two of the four Bungendore bores tested positive for PFAS and the concentration of Perfluorooctane sulfonic acid (PFOS) exceeds the proposed guidelines.
Level of Service	Headworks capacity	The peak day demand will exceed the combined capacity of the Bungendore and Currandooley 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.	The peak day demand will exceed the combined capacity of the Bungendore and Currandooley WTP soon, the exact timing is dependent on the time required to resolve the water security issue. If one or two of the existing bores need to be removed from service due to PFAS contamination, this will become an immediate serious issue.

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
CCP1(a)-chlorination in reticulation	DWMS (Drinking Water Management System)	Bungendore WTP: The DWMS (and possibly the plant) needs to be updated so that CCP1(a) is between the tank and the pump, rather than before the dosing point.	Council had deduced that it was more operational than critical due to the fact that water from this plant essentially hits the reticulation (and therefore consumers) only 170m from the Bungendore WTP. Council had confirmed that this test will be added to the daily monitoring field sheets. Council understands the need for a free chlorine sensor between the 100kL collection tank and the pump to ensure that the water is correctly chlorinated before distribution. Longer term, the plan is to establish a direct rising main between this plant and the reservoirs thus improving the chlorine concentration times contact time (C.t).
Pathogen cross contamination	DWMS	Based on the DWMS [1] the Residual Risk with Preventative Measures continues to remain 'Very High' for the following: potential pathogen contamination issues due to breach of pipeline and cross contamination due to backflow	Council is currently revising the DWMS
Minimum C.t. value	Local Water Utility (LWU) Circular 18 - ADWG	The total C.t from chlorination at Bungendore aeration tower to outflow is 6.2 mg.min/L, which is not above the recommended minimum value of 15 mg.min/L. Residual risk of chlorine sensitive pathogens: <b>High</b> .	Council to strictly monitor and document free chlorine concentration. Longer term, and as part of the Q2B project, the aim is to install a dedicated rising main from this plant to the service reservoirs. This will address any issues with C.t
Residual risk of chlorine resistant pathogens	Pathogen contamination	New issue	Residual risk of chlorine resistant pathogens Medium due to insufficient treatment. Disinfection barriers such as UV or Ozone are also effective at disabling chlorine resistant pathogens. However, Bungendore and Currandooley WTPs do not have UV or Ozone. UV or ozone treatment systems to be installed as part of either the next capacity upgrade or WTP replacement or when DCCEEW policy changes

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
Braidwood water supply issues			
Water security	Secure Yield	N/A new issue	The un-restricted annual demand will exceed the secure yield (320 ML/year with 1 degree warming) between 2039 and 2047*
Water security	Licensed allocation	N/A new issue	The un-restricted annual demand will exceed the licenced water entitlement (360 ML) between 2038 and 2052*
Capacity	WTP capacity	N/A new issue	The un-restricted peak day demand will exceed the WTP capacity (2 ML/day) between 2040 and 2042*
Performance - leaks	Non-Revenue Water	The historical average unit water loss is estimated to be 249 L/connection/day, which is approximately 3.4 times the state median of 74 L/connection/day.  The daily NRW calculated for the previous IWCN was 168 kL/day (2013/14), 154 kL/day (2014/15) and 183 kL/day (2015/16), about 35%. The NRW for the period used for the water balance averaged 127 kL/day, showing some improvement. Note that the period used for the water balance was also relatively wet, greatly reducing the overall demand for water, causing the percentage NRW to increase.	This remains a significant problem for Council. Since last IWCN Council has taken advantage of a DCCEE funded leak detection program. This was of only limited success. Another initiative is a program of revenue meter replacement. Currently Council has rolled out 130 NB-IoT meters with a further 500 to be deployed in 2024/25. Results are already promising with a number of letters already being issued for properties with persistent low flows. The intention is to completely change Braidwood revenue meters to NB-IoT by the end of 2025
Pathogen Contamination	DWMS	Based on the DWMS [1] the Residual Risk with Preventative Measures continues to remain 'Very High' for the following: dead end in reticulation system leading to stagnation and loss of chlorine residual; breach of pipeline through breaks and service works; cross contamination due to backflow and growth of biofilms/sludge causing degradation of water quality	Council is reviewing the DWMS.

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
Residual risk of chlorine sensitive pathogens	Pathogen contamination	New issue	Residual risk of chlorine resistant pathogens Medium due to moderately protected catchment. Disinfection barriers such as UV or Ozone are also effective at disabling chlorine resistant pathogens. However, Braidwood WTP does not have UV or Ozone. UV treatment system to be installed as part of either the next WTP capacity upgrade or WTP replacement or when DCCEEW policy changes
Captains Flat water supply system			
Water loss	Major Water Residential User	This residential property (Property ID – 340223) has been flagged for investigation. A flow restrictor was installed in September 2021. The property is currently carrying in excess of \$40,000 worth of unpaid rates and charges.	Council suspecting serious leakage issues and investigation is underway.
Water loss	Water Balance	The historical average unit water loss is estimated to be 106 L/connection/day, which is approximately 1.4 times the state median of 74 L/connection/day.	Network investigations are ongoing
Regulatory	Drinking Water Management System	The turbidity alert limit corrective action for Captains Flat WTP needs to include a membrane integrity test.	Turbidity monitoring at Captains Flat is now continuous online and monitored by GeoSCADA. Membranes were replaced in May 2024. Regular membrane integrity testing still to be enacted and included in field sheets.

\* Range due to use of high and low NRW forecasts

Table 12-3: Sewerage System Issues

Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023 Updates
General sewerage system issues			
Unserviced communities	On-site sewage management systems	<b>Village of Majors Creek</b> – potential issue due to the following reasons: Small lot sizes (some around 3,000 & several around 1,000 m <sup>2</sup> ) Inadequate buffer distance from Majors Creek Moderately well to imperfectly drained soil	No action here

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Issue Type	Target for Compliance	Issue (2015-2019 IWC)	2023 Updates
		<p><b>Village of Nerriga</b> – potential issue due to the following reasons:</p> <p>Small lot sizes (various sizes below 3,000 m<sup>2</sup>)</p> <p>Some properties may have inadequate buffer distance from Bindi Brook</p> <p><b>Village of Araluen</b> – potential issue due to the following reasons:</p> <p>Small lot sizes (several properties less than 1,500 m<sup>2</sup> bordering each other)</p> <p>Moderately permeable, imperfectly drained soil.</p>	
Bungendore sewerage system issues			
Regulatory	EPA Licence non-compliance	The Bungendore STP exceeded the volumetric discharge limit (2.16 ML/day) in 2016, 2014, 2012 and 2011. Council needs to consider undertaking an inflow/infiltration study.	<p>Council has confirmed that they have undertaken several sewer relining projects since last IWC. This was informed by precursor cleaning and CCTV work. Council also mentioned about carrying out targeted smoke testing for catchment 4 (Bungendore - a new development area) to try and resolved an emerging inflow problem. (Source: Email correspondence)</p> <p>Wet weather flows exceeded the licence limits more often during the recent wet years</p> <p>Licence is being reviewed as part of the upgrade process.</p>
Pump sizing at PWWF	Sewer catchment performance	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.	<p>Catchment #2 has had pumps upgraded. Catchment #4 has had pumps upgraded. Catchments #8 &amp; #9 to be upgraded in the future. (Source: Email correspondence)</p>

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023 Updates
	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.	No immediate action. Both SPS7 & SPS8 will increase both capacity and throughput at northern greenfield development progresses. This will lower rising main detention times.
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.	Design engagement currently underway with supporting SSWP funding for a tender ready package (+7,000 EP giving a total capacity of 12,000 EP) by 30 June 2025. The construction will commence once additional water for Bungendore has been secured The spare 2,000 EP IDEA was re-commissioned in March 2023. (Source: Email correspondence)
STP inflow	ADWF compliance	STP inflow continues to be high, regardless of the time since the last rainfall	Council undertaking CCTV inspections and targeted relining.
STP Capacity	STP Capacity Compliance	The current estimated EP load for Bungendore sewerage scheme is 4,549 EP which is reaching the STP Design EP of 5,000,	Design engagement currently underway with supporting SSWP funding for a tender ready package (+7,000 EP giving a total capacity of 12,000 EP) by 30 June 2025.
Odour/septicity potential	WSAA Guidelines	Rising mains that have residence time greater than eight hours are potential to septicity for BU SPSs.	Council to monitor
Braidwood sewerage system issues			
Regulatory	EPA Licence non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.	Inflow/Infiltration study completed. Large program of relining subsequently conducted. Inflow continues to be an issue over recent wet years. (Source: Email correspondence)
Odour/septicity potential	Sewer catchment performance	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.	No action (Source: Email correspondence)

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023 Updates
Increased dry weather flow	Sewage inflow compliance	In winter, spring and early summer 2019, while the weather was extremely dry, the dry weather flows increased to over 400 kL/day.  This is substantially higher than the dry weather flows in 2017/18 of 290 kL/day.	Council to investigate potential factors contributing to these high flows
PWWF	Pump rate	The PWWF from the catchments is estimated to be 54 L/s and likely to exceed SPS1 capacity when the fifty-six 2-to-3-bedroom units in the Summerfield - Braidwood Retirement village are completed. Pump rate lower than the combined capacity of the upstream pumps and local flow.	Current. Council to investigate and monitor
Captains Flat sewerage system issues			
Regulatory	EPA Licence non-compliance	The plant exceeded the volumetric discharge limit every year in the last five years. Council is currently undertaking an inflow/infiltration study.	Inflow/Infiltration study completed. Large program of relining subsequently conducted. Inflow continues to be an issue in the La Nina years. (Source: Email correspondence)
Performance	Sewage Treatment Plant compliance	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 has confirmed that the plant has been augmented. 2018 Issue now resolved an outcome of a significant investment of capital. (Source: Email correspondence)

Table 12-4: Resolved issues

Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
General water and sewer issues 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	Council has HSEQ accreditation. (Source: Email correspondence)  Issue resolved

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
General water and sewer issues 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 has a centralised records management system in ECM where plant field sheets are scanned and imported.  Key data is also transcribed into spreadsheets for use in regulatory reporting.  GeoSCADA also records key plant data. (Source: Email correspondence)  Customer Request Management system also in place.  Issue resolved
General water supply issues 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.	Council has implemented a single block tariff system for water charging (Source: Email correspondence and Council's publicly available revenue policy)  Issue resolved
Bungendore water supply issues CCP2 Fluoridation in Bungendore	DWMS	From January 2015 and February 2023, there were recent exceedances below the lower critical limit of less than 0.9 mg/L for 72 hrs.	Fluoride levels started to decrease from February 2023 due to issues with the saturators causing bed caking. Council stated that they had replaced the beds of all four branded NaF saturators and recommissioned.  Issue resolved
Bungendore water supply issues CCP2 Fluoridation in Currandooly	DWMS	From January 2015 and June 2023, there were recent exceedances below the lower critical limit of less than 0.9 mg/L for 72 hrs. Before July, were maintained to be within the target range.	Fluoride levels started to decrease from February 2023 due to issues with the saturators causing bed caking. Council stated that they had replaced the beds of all four branded NaF saturators and recommissioned.  Issue resolved.
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 statewide median of 92 L/connection/day for 2015/16.	Significant program of water meter replacement has been undertaken.  Many Itron electronic meters deployed. Now moving to NB-IoT meters as the LGA wide standard. (Source: Email correspondence)  Bungendore NRW has reduced significantly, from 125 L/connection/day to 86 L/connection/day in 2021/22.  Council will continue to monitor NRW.  Issue resolved
Braidwood water supply issues Main breaks	Non-Revenue Water	Main breaks every 1-3 months with some months have main breaks more than once.  26 out of 173 complaints was related to main bursts over 3 years from October 2019 to November 2022.	A program of water main replacement has been undertaken. Frequency of main breaks has reduced.  Issue resolved

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Issue Type	Target for Compliance	Issue (2015-2019 IWCN)	2023-25 Council Updates
Captains Flat water supply issues 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 pool site is now well metered although it still has a significant leak problem. The P&G section of Council remains committed to deal with similar issues that arise. (Email correspondence). Issue resolved
Bungendore sewerage 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.	Bungendore has a Recycled Water Management System and has formal s.60 approval. (Source: Email correspondence) Issue resolved.
		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 updated that this is completed. (Source: Email correspondence) Issue resolved.
Bungendore sewerage issues 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.	New RWP at the STP has incorporated a whole new system of metering. (Source: Email correspondence) Issue resolved
Braidwood sewerage issues Pump sizing	Sewer catchment performance	The PWWF at catchment #1 will exceed the capacity of a single pump by 2021. Council has funded an upgrade.	Pumps upgraded together with supporting electrical network. 2018 Issue resolved. (Source: Email correspondence)
Captains Flat sewerage issues Pump sizing	Sewer catchment performance	The PWWF at catchment #1 is expected to exceed the duty pump capacity.	Pumps have been upgraded since last IWCN. Both now capable of 15L/s which is sufficient. 2018 Issue now resolved (Source: Email correspondence)

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## Appendix A Raw Water quality

### A.1 Raw Water quality

Appendix table A-1: Bungendore bores raw water quality

Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Acid Soluble Aluminium	µg/L	38	25	5	5	17	40
Aluminium	mg/L	28	23	0.02	0.02	0.06	0.13
Aluminium	µg/L	9	8	9	9	14	14
Antimony	µg/L	36	36	3	1		
Arsenic	µg/L	36	27	1	1	1	2
Barium	µg/L	36	0	0	0	38	56.6
Bicarbonate Alkalinity as CaCO <sub>3</sub>	mg/L	37	0	0	0	169	331
Boron	mg/L	37	4	0.02	0.01	0.02	0.03
Cadmium	µg/L	36	36	0.05	0.05		
Calcium	mg/L	37	0	0	0	24	26.4
Calcium Hardness as CaCO <sub>3</sub>	mg/L	37	0	0	0	61	66
Carbonate Alkalinity as CaCO <sub>3</sub>	mg/L	37	36	0.1	0.1	8	8.4
Chloride	mg/L	38	0	0	0	87	111
Chromium	mg/L	28	20	0.002	0.001	0.002	0.003
Chromium	µg/L	9	8	2	2	2	2
Colour (True)	PCU	36	21	1	1	2	3
Combined Chlorine	mg/L	59	31	0.03	0.03	0.05	0.15
Copper	µg/L	58	2	1	1	6	140
Dissolved Organic Carbon (as NPOC)	mg/L	12	7	1	1	2	3
E.coli (Colilert)	MPN/100 mL	37	37	1	1		
Fluoride	mg/L	36	0	0	0	0.9	1.1
Free Chlorine	mg/L	60	0	0	0	0.8	1.34
Hexavalent Chromium	mg/L	1	1	0.01	0.01		

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Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Hydroxide Alkalinity as CaCO <sub>3</sub>	mg/L	37	37	0.1	0.1		
Iodide	mg/L	37	37	0.05	0.01		
Iron	mg/L	38	12	0.02	0.01	0.07	0.35
Lead	µg/L	36	25	0.2	0.2	0.5	1.6
Magnesium	mg/L	37	0	0	0	21	23.2
Manganese	mg/L	37	22	0.001	0.001	0.002	0.006
Manganese	µg/L	21	5	0.5	0.5	1	5.4
Mercury	µg/L	35	35	0.1	0.1		
Mercury	mg/L	1	1	0.0001	0.0001		
Molybdenum	µg/L	35	32	1	1	9	20
Nickel	µg/L	36	0	0	0	3	6
Nitrate as N	mg/L N	36	0	0	0	2	3.16
Nitrite + Nitrate as N	mg/L N	36	0	0	0	2	3.16
Nitrite as N	mg/L N	36	36	0.01	0.01		
pH	pH Unit	37	0	0	0	8	8.24
Selenium	µg/L	36	5	1	1	3	8
Silver	µg/L	36	36	1	1		
Sodium	mg/L	38	0	0	0	77	95.1
Sulfate	mg/L	59	0	0	0	29	38.7
Total Alkalinity as CaCO <sub>3</sub>	mg/L	37	0	0	0	170	331
Total Chlorine	mg/L	59	0	0	0	0.8	1.34
Total Coliforms (Colilert)	MPN/100 mL	37	37	1	1		
Total Cyanide	mg/L	37	37	0.004	0.004		
Total Dissolved Solids	mg/L	36	0	0	0	368	445
Total Hardness as CaCO <sub>3</sub>	mg/L	12	0	0	0	151	160
Total Residual Chlorine	mg/L	1	1	0.03	0.03		
Turbidity	NTU	38	0	0	0	0.7	2.3
Zinc	mg/L	29	4	0.005	0.005	0.009	0.013
Zinc	µg/L	9	1	5	5	8	18

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Appendix table A-2: Currandooly bores raw water quality

Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Acid Soluble Aluminium	µg/L	33	26	5	5	14266.57	99800
Aluminium	µg/L	9	3	9	9	19021	114000
Aluminium	mg/L	24	19	0.02	0.02	0.08	0.24
Antimony	µg/L	33	32	3	1	0	0
Arsenic	µg/L	33	22	1	1	0.909091	1
Barium	µg/L	33	0	0	0	81.04242	97.9
Bicarbonate Alkalinity as CaCO <sub>3</sub>	mg/L	33	0	0	0	116.0939	163
Boron	mg/L	33	20	0.02	0.01	0.012308	0.02
Cadmium	µg/L	33	32	0.05	0.05	0	0
Calcium	mg/L	33	0	0	0	15.42848	42.6
Calcium Hardness as CaCO <sub>3</sub>	mg/L	33	0	0	0	38.54545	106
Carbonate Alkalinity as CaCO <sub>3</sub>	mg/L	33	33	0.1	0.1		
Chloride	mg/L	33	0	0	0	38.32727	112
Chromium	µg/L	9	9	2	2		
Chromium	mg/L	24	22	0.002	0.001	0.001	0.001
Colour (True)	PCU	33	0	0	0	209.2727	460
Copper	µg/L	53	35	1	1	42.44444	294
Dissolved Organic Carbon (as NPOC)	mg/L	12	0	0	0	3.166667	6
E.coli (Colilert)	MPN/100 mL	34	34	1	1		
Fluoride	mg/L	33	9	0.1	0.05	0.188333	0.93
Hexavalent Chromium	mg/L	1	1	0.01	0.01		
Hydroxide Alkalinity as CaCO <sub>3</sub>	mg/L	33	33	0.1	0.1		
Iodide	mg/L	33	13	0.05	0.01	0.0525	0.24
Iron	mg/L	33	1	0.02	0.02	25.71375	31.9
Lead	µg/L	33	22	0.2	0.2	4.727273	36.1
Magnesium	mg/L	33	0	0	0	11.28242	12.4

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Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Manganese	µg/L	22	0	0	0	433.9636	551
Manganese	mg/L	31	0	0	0	0.450742	0.514
Mercury	mg/L	1	1	0.0001	0.0001		
Mercury	µg/L	33	32	0.1	0.1	0	0
Molybdenum	µg/L	33	19	1	1	1	2
Nickel	µg/L	33	25	1	1	2.375	8
Nitrate as N	mg/L	9	9	0.05	0.01		
Nitrate as N	mg/L N	24	16	0.01	0.01	0.2675	1.44
Nitrite + Nitrate as N	mg/L	9	9	0.05	0.05		
Nitrite + Nitrate as N	mg/L N	24	16	0.05	0.05	0.2725	1.44
Nitrite as N	mg/L	9	9	0.01	0.01		
Nitrite as N	mg/L N	24	21	0.01	0.01	0.013333	0.03
pH	pH Unit	33	0	0	0	6.948788	7.35
Selenium	µg/L	33	23	1	1	1.6	3
Silver	µg/L	33	32	1	1	0	0
Sodium	mg/L	33	0	0	0	33.49394	70.4
Sulfate	mg/L	54	0	0	0	8.285185	17.1
Total Alkalinity as CaCO <sub>3</sub>	mg/L	33	0	0	0	116.1212	163
Total Coliforms (Colilert)	MPN/100 mL	34	30	1	1	5.25	8
Total Cyanide	mg/L	33	33	0.004	0.004		
Total Dissolved Solids	mg/L	33	0	0	0	209.2727	376
Total Hardness as CaCO <sub>3</sub>	mg/L	12	0	0	0	84.91667	98
Turbidity	NTU	33	0	0	0	197.1939	369
Zinc	µg/L	9	6	5	5	19	30
Zinc	mg/L	24	13	0.005	0.005	0.026	0.164

Appendix table A-3: Braidwood raw water quality

Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Acid Soluble Aluminium	µg/L	38	6	5	5	90	1330

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Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Aluminium	µg/L	6	1	9	9	28	63
Aluminium	mg/L	29	8	0.02	0.02	0.2	1.33
Anabaena	cells/mL	1	0	0	0	0	0
Anabaenopsis	cells/mL	1	0	0	0	0	0
Anatheece	cells/mL	1	0	0	0	0	0
Antimony	µg/L	38	37	3	1	0	0
Aphanizomenon	cells/mL	1	0	0	0	0	0
Aphanocapsa	cells/mL	1	0	0	0	106	106
Aphanothece	cells/mL	1	0	0	0	0	0
Arsenic	µg/L	38	37	1	1	0	0
Bacillariophyceae	cells/mL	2	0	0	0	22445	44697
Barium	µg/L	38	0	0	0	14	34.6
Bicarbonate Alkalinity as CaCO <sub>3</sub>	mg/L	38	0	0	0	39	61.3
Boron	mg/L	38	33	0.02	0.01	0.01	0.01
Cadmium	µg/L	38	37	0.05	0.05	0	0
Calcium	mg/L	38	0	0	0	6	10.5
Calcium Hardness as CaCO <sub>3</sub>	mg/L	38	0	0	0	16	26
Carbonate Alkalinity as CaCO <sub>3</sub>	mg/L	38	38	0.1	0.1		
Chloride	mg/L	38	0	0	0	10	20
Chlorophyta	cells/mL	2	0	0	0	201	210
Chromium	µg/L	9	9	2	2		
Chromium	mg/L	29	26	0.002	0.001	0.002	0.003
Chroococcus	cells/mL	1	0	0	0	0	0
Chrysophyceae	cells/mL	2	0	0	0	24	48
Chrysosporum	cells/mL	1	0	0	0	0	0
Colour (True)	PCU	38	0	0	0	13	33
Copper	µg/L	45	39	1	1	1	2
Cryptophyceae	cells/mL	2	0	0	0	475	844
Cuspidothrix	cells/mL	1	0	0	0	0	0
Cyanophyta	cells/mL	2	0	0	0	1354	2410
Cylindrospermopsis	cells/mL	1	0	0	0	0	0
Dissolved Organic Carbon (as NPOC)	mg/L	1	0	0	0	8	8
Dolichospermum	cells/mL	1	0	0	0	0	0

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Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
E.coli (Colilert)	MPN/100 mL	38	12	1	1	31	250
Euglenophyta	cells/mL	2	0	0	0	0	0
Fluoride	mg/L	38	0	0	0	0.3	1.1
Hexavalent Chromium	mg/L	1	1	0.01	0.01		
Hydroxide Alkalinity as CaCO <sub>3</sub>	mg/L	38	38	0.1	0.1		
Iodide	mg/L	38	35	0.05	0.01	0.01	0.01
Iron	mg/L	38	1	0.01	0.01	0.2	0.76
Lead	µg/L	38	36	0.2	0.2	0.2	0.4
Magnesium	mg/L	38	0	0	0	3	4.85
Manganese	µg/L	16	0	0	0	7	22.4
Manganese	mg/L	29	0	0	0	0.02	0.184
Mercury	mg/L	1	1	0.0001	0.0001		
Mercury	µg/L	37	36	0.1	0.1	0	0
Merismopedia	cells/mL	1	0	0	0	0	0
Microcystis	cells/mL	1	0	0	0	192	192
Molybdenum	µg/L	38	37	1	1	0	0
Nickel	µg/L	38	34	1	1	1	2
Nitrate as N	mg/L N	38	36	0.05	0	0.08	0.15
Nitrite + Nitrate as N	mg/L N	38	36	0.05	0.05	0.08	0.15
Nitrite as N	mg/L N	38	36	0.01	0.01	0.005	0.01
Nodularia	cells/mL	1	0	0	0	0	0
Oscillatoria	cells/mL	1	0	0	0	0	0
Other	cells/mL	1	0	0	0	0	0
pH	pH Unit	38	0	0	0	8	8.33
Phormidium	cells/mL	1	0	0	0	0	0
Planktolyngbya	cells/mL	1	0	0	0	0	0
Planktothricoides	cells/mL	1	0	0	0	0	0
Planktothrix	cells/mL	1	0	0	0	0	0
Pseudanabaena	cells/mL	1	0	0	0	0	0
Pyrrophyta	cells/mL	2	0	0	0	0	0
Radiocystis	cells/mL	1	0	0	0	0	0
Selenium	µg/L	38	35	1	1	0.7	1
Silver	µg/L	38	37	1	1	0	0
Sodium	mg/L	38	0	0	0	10	14.5

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Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Sphaerospermopsis	cells/mL	1	0	0	0	0	0
Spirulina	cells/mL	1	0	0	0	0	0
Sulfate	mg/L	45	0	0	0	7	17.2
Tot. Algae	cells/mL	2	0	0	0	24485	47400
Total Alkalinity as CaCO <sub>3</sub>	mg/L	38	0	0	0	39	61
Total Coliforms (Colilert)	MPN/100 mL	38	5	1	1	608	2400
Total Cyanide	mg/L	38	38	0.004	0.004		
Total Cyanophyta	cells/mL	1	0	0	0	298	298
Total Dissolved Solids	mg/L	38	0	0	0	75	111
Total Hardness as CaCO <sub>3</sub>	mg/L	13	0	0	0	28	42
Turbidity	NTU	38	0	0	0	1	7.2
Tychonema	cells/mL	1	0	0	0	0	0
Unknown	cells/mL	2	0	0	0	0	0
Xanthophyceae	cells/mL	2	0	0	0	0	0
Zinc	µg/L	9	9	5	5		
Zinc	mg/L	29	27	0.005	0.005	0.007	0.007

Appendix table A-4: Captains Flat raw water quality

Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Acid Soluble Aluminium	µg/L	37	0	0	0	75	501
Aluminium	µg/L	9	0	0	0	290	557
Aluminium	mg/L	28	0	3	1	0.3	2.08
Antimony	µg/L	37	36	1	1	0	0
Arsenic	µg/L	37	18	0	0	1	2
Barium	µg/L	37	0	0	0	14	21.8
Bicarbonate Alkalinity as CaCO <sub>3</sub>	mg/L	37	0	0.02	0.01	28	71.5
Boron	mg/L	37	36	0.05	0.05	0.01	0.01
Cadmium	µg/L	37	30	0	0	0.05	0.08
Calcium	mg/L	37	0	0	0	4	4.99
Calcium Hardness as CaCO <sub>3</sub>	mg/L	35	0	0.1	0.1	9	12

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Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Carbonate Alkalinity as CaCO <sub>3</sub>	mg/L	37	37	0	0		
Chloride	mg/L	37	0	2	0.001	6	14.6
Chromium	µg/L	9	9	0	0		
Chromium	mg/L	28	22	1	1	0.002	0.003
Colour (True)	PCU	37	0	0	0	49	90
Copper	µg/L	44	1	1	1	3	4
Dissolved Organic Carbon (as NPOC)	mg/L	11	0	0.1	0.05	8	15
E.coli (Colilert)	MPN/100 mL	37	2	0.01	0.01	47	390
Fluoride	mg/L	41	28	0.1	0.1	0.07	0.12
Hexavalent Chromium	mg/L	1	1	0.05	0.01		
Hydroxide Alkalinity as CaCO <sub>3</sub>	mg/L	37	37	0	0		
Iodide	mg/L	37	34	0	0	0.01	0.01
Iron	mg/L	37	0	0	0	0.8	1.34
Lead	µg/L	38	0	0	0	8	27.4
Magnesium	mg/L	37	0	0.1	0.0001	4	5.19
Manganese	µg/L	16	0	1	1	42	82.9
Manganese	mg/L	28	0	1	1	0.09	0.242
Mercury	mg/L	1	1	0.05	0		
Mercury	µg/L	36	35	0.05	0.05	0	0
Molybdenum	µg/L	37	36	0.01	0.01	0	0
Nickel	µg/L	37	2	0	0	2	4
Nitrate as N	mg/L	9	9	1	1		
Nitrate as N	mg/L N	28	25	1	1	0.1	0.24
Nitrite + Nitrate as N	mg/L	9	9	0	0		
Nitrite + Nitrate as N	mg/L N	28	25	0	0	0.1	0.24
Nitrite as N	mg/L	9	9	0	0		
Nitrite as N	mg/L N	28	25	1	1	0.007	0.01
pH	pH Unit	37	0	0.004	0.004	7	7.65

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Parameter	Units	Number of samples	Samples below LOR	Max LOR	Min LOR	Average above LOR	Max above LOR
Selenium	µg/L	37	35	0	0	0.5	1
Silver	µg/L	37	36	0	0	0	0
Sodium	mg/L	37	0	0	0	6	7.6
Sulfate	mg/L	44	0	0	0	11	25.8
Total Alkalinity as CaCO <sub>3</sub>	mg/L	37	0	0	0	28	71
Total Coliforms (Colilert)	MPN/100 mL	37	8	0	0	670	2800
Total Cyanide	mg/L	37	37	0	0		
Total Dissolved Solids	mg/L	37	0	0	0	402	12500
Total Hardness as CaCO <sub>3</sub>	mg/L	12	0	0	0	21	28
Turbidity	NTU	37	0	0	0	8	32
Zinc	µg/L	9	0	0	0	77	144
Zinc	mg/L	28	0	0	0	0.05	0.098

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## A.2 NSW Health Water Quality Monitoring Analysis

Appendix table A-5: Bungendore NSW Health Water Quality

Characteristic	First sample	Last Sample	Samples	Guideline	Number non-compliant	Minimum Concentration (if ADWG has min)	Maximum Concentration	Average Concentration	% of samples non-compliant	% of samples above limit of reading
Aluminium	4/10/16	20/02/23	13	0.2 mg/L			0.020	0.011	0%	54%
Antimony	4/10/16	20/02/23	13	0.003 mg/L			<LOR		0%	0%
Arsenic	4/10/16	20/02/23	13	0.01 mg/L			0.009	0.002	0%	85%
Barium	4/10/16	20/02/23	13	2 mg/L			0.048	0.031	0%	100%
Boron	4/10/16	20/02/23	13	4 mg/L			0.012	0.010	0%	31%
Cadmium	4/10/16	20/02/23	13	0.002 mg/L			<LOR		0%	0%
Calcium	4/10/16	20/02/23	13	10000 mg/L			26	22	0%	100%
Chloride	4/10/16	20/02/23	13	250 mg/L			114	85	0%	100%
Chromium	4/10/16	20/02/23	13	0.05 mg/L			<LOR		0%	0%
Copper	4/10/16	20/02/23	13	2 mg/L			0.033	0.013	0%	77%
E. coli	5/07/16	3/10/23	249	0 mpn/100 mL			<LOR		0%	0%
Fluoride	5/07/16	5/09/23	93	1.5 mg/L			1.10	0.96	0%	100%
Fluoride (weekly WU)	6/07/16	6/09/23	749	0.9 / 1.5 mg/L	19	0.47	1.11	0.99	3%	100%
Fluoride (WU result)	5/07/16	5/09/23	86	1.5 mg/L			1.06	0.99	0%	100%
Fluoride Ratio	5/07/16	5/09/23	86	0.8 / 1.2	1	0.87	1.21	1.03	1%	100%
Free Chlorine	5/07/16	3/10/23	249	0.2 / 5 mg/L	1	0.10	1.99	1.09	0%	100%

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Characteristic	First sample	Last Sample	Samples	Guideline	Number non-compliant	Minimum Concentration (if ADWG has min)	Maximum Concentration	Average Concentration	% of samples non-compliant	% of samples above limit of reading
Iodine	4/10/16	20/02/23	13	0.5 mg/L			0.080	0.062	0%	92%
Iron	4/10/16	20/02/23	13	0.3 mg/L			0.010	0.010	0%	15%
Lead	4/10/16	20/02/23	13	0.01 mg/L			0.002	0.001	0%	38%
Magnesium	4/10/16	20/02/23	13	10000 mg/L			24	19	0%	100%
Manganese	4/10/16	20/02/23	13	0.5 mg/L			0.006	0.002	0%	31%
Mercury	4/10/16	20/02/23	13	0.001 mg/L			0.0002	0.00012	0%	38%
Molybdenum	4/10/16	20/02/23	13	0.05 mg/L			0.0011	0.0009	0%	31%
Nickel	4/10/16	20/02/23	13	0.02 mg/L			0.0006	0.00055	0%	15%
Nitrate	4/10/16	20/02/23	13	50 mg/L			12.50	7.42	0%	92%
Nitrite	4/10/16	20/02/23	13	3 mg/L			<LOR		0%	0%
pH	5/07/16	3/10/23	258	6.5 / 8.5	5	6.50	8.79	7.91	2%	100%
Selenium	4/10/16	20/02/23	13	0.01 mg/L			0.003	0.003	0%	15%
Silver	4/10/16	20/02/23	13	0.1 mg/L			<LOR		0%	0%
Sodium	4/10/16	20/02/23	13	180 mg/L			81	72	0%	100%
Sulfate	4/10/16	20/02/23	13	250 mg/L			36	24	0%	100%
Total Chlorine	5/07/16	3/10/23	249	5 mg/L			2.08	1.20	0%	100%
Total Coliforms	5/07/16	3/10/23	249	0 mpn/100 mL			<LOR		0%	0%
Total Dissolved Solids (TDS)	4/10/16	20/02/23	13	10000 mg/L			348	298	0%	100%
Total Hardness as CaCO <sub>3</sub>	4/10/16	20/02/23	13	200 mg/L			164	131	0%	100%

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Characteristic	First sample	Last Sample	Samples	Guideline	Number non-compliant	Minimum Concentration (if ADWG has min)	Maximum Concentration	Average Concentration	% of samples non-compliant	% of samples above limit of reading
True Colour	4/10/16	20/02/23	13	15 Hazen Units (HU)			3.00	1.50	0%	31%
Turbidity	4/10/16	3/10/23	236	5 NTU	1		7.62	0.07	0%	97%
Uranium	7/08/17	20/02/23	10	0.017 mg/L			0.0001	0.0001	0%	10%
Zinc	4/10/16	20/02/23	13	3 mg/L			0.060	0.026	0%	85%

Appendix table A-6: Braidwood NSW Health Water Quality

Characteristic	First sample	Last Sample	Samples	Guideline	Number non-compliant	Minimum Concentration (if ADWG has min)	Maximum Concentration	Average Concentration	% of samples non-compliant	% of samples above limit of reading
Aluminium	4/10/16	1/08/23	18	0.2 mg/L	1		0.250	0.052	6%	100%
Antimony	4/10/16	1/08/23	18	0.003 mg/L			0	0.0001	0%	6%
Arsenic	4/10/16	1/08/23	18	0.01 mg/L			0.004	0.001	0%	50%
Barium	4/10/16	1/08/23	18	2 mg/L			0.063	0.021	0%	100%
Boron	4/10/16	1/08/23	18	4 mg/L			0.011	0.007	0%	44%
Cadmium	4/10/16	1/08/23	18	0.002 mg/L			0.0005	0.0005	0%	6%
Calcium	4/10/16	1/08/23	18	10000 mg/L			14	8	0%	100%
Chloride	4/10/16	1/08/23	18	250 mg/L			33	16	0%	100%

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Characteristic	First sample	Last Sample	Samples	Guideline	Number non/compliant	Minimum Concentration (if ADWG has min)	Maximum Concentration	Average Concentration	% of samples non/compliant	% of samples above limit of reading
Chromium	4/10/16	1/08/23	18	0.05 mg/L			0.001	0.001	0%	6%
Copper	4/10/16	1/08/23	18	2 mg/L			0.542	0.057	0%	78%
E. coli	5/07/16	3/10/23	367	0 mpn/100 mL			<LOR		0%	0%
Fluoride	5/07/16	5/09/23	97	1.5 mg/L			1.20	1.00	0%	100%
Fluoride (weekly WU)	6/07/16	6/09/23	737	0.9 / 1.5 mg/L	23	0.68	1.10	1.00	3%	100%
Fluoride (WU result)	5/07/16	5/09/23	85	1.5 mg/L			1.09	0.99	0%	100%
Fluoride Ratio	5/07/16	5/09/23	85	0.8 / 1.2	1	0.46	1.17	0.99	1%	100%
Free Chlorine	5/07/16	3/10/23	368	0.2 / 5 mg/L		0.20	1.90	1.05	0%	100%
Iodine	4/10/16	1/08/23	18	0.5 mg/L			<LOR		0%	0%
Iron	4/10/16	1/08/23	18	0.3 mg/L			0.050	0.014	0%	72%
Lead	4/10/16	1/08/23	18	0.01 mg/L			0.002	0.001	0%	39%
Magnesium	4/10/16	1/08/23	18	10000 mg/L			5	3	0%	100%
Manganese	4/10/16	1/08/23	18	0.5 mg/L			0.018	0.005	0%	56%
Mercury	4/10/16	1/08/23	18	0.001 mg/L			0.0001	0.0001	0%	11%
Molybdenum	4/10/16	1/08/23	18	0.05 mg/L			0.0004	0.000178	0%	50%
Nickel	4/10/16	1/08/23	18	0.02 mg/L			0.0015	0.0009	0%	22%
Nitrate	4/10/16	1/08/23	18	50 mg/L			9.00	9.00	0%	6%
Nitrite	4/10/16	1/08/23	18	3 mg/L			<LOR		0%	0%
pH	5/07/16	3/10/23	383	6.5 / 8.5	32	6.55	9.23	8.03	8%	100%

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Characteristic	First sample	Last Sample	Samples	Guideline	Number non/compliant	Minimum Concentration (if ADWG has min)	Maximum Concentration	Average Concentration	% of samples non/compliant	% of samples above limit of reading
Selenium	4/10/16	1/08/23	18	0.01 mg/L			<LOR		0%	0%
Silver	4/10/16	1/08/23	18	0.1 mg/L			<LOR		0%	0%
Sodium	4/10/16	1/08/23	18	180 mg/L			27	16	0%	100%
Sulfate	4/10/16	1/08/23	18	250 mg/L			28	16	0%	94%
Total Chlorine	5/07/16	3/10/23	368	5 mg/L			2.12	1.22	0%	100%
Total Coliforms	5/07/16	3/10/23	367	0 mpn/100 mL	2		16	16	1%	0%
Total Dissolved Solids (TDS)	4/10/16	1/08/23	18	10000 mg/L			116	71	0%	100%
Total Hardness as CaCO <sub>3</sub>	4/10/16	1/08/23	18	200 mg/L			56	32	0%	100%
True Colour	4/10/16	1/08/23	18	15 Hazen Units (HU)			8.00	1.64	0%	61%
Turbidity	4/10/16	3/10/23	357	5 NTU			2.00	0.04	0%	99%
Uranium	1/08/17	1/08/23	15	0.017 mg/L			0.0001	0.0001	0%	7%
Zinc	4/10/16	1/08/23	18	3 mg/L			0.240	0.034	0%	89%

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Appendix table A-7: Captains Flats NSW Health Water Quality

Characteristic	First sample	Last Sample	Samples	Guideline	Number non/compliant	Minimum Concentration (if ADWG has min)	Maximum Concentration	Average Concentration	% of samples non/compliant	% of samples above limit of reading
Aluminium	4/10/16	20/02/23	16	0.2 mg/L			0.080	0.029	0%	94%
Antimony	4/10/16	20/02/23	16	0.003 mg/L			0	0.00025	0%	25%
Arsenic	4/10/16	20/02/23	16	0.01 mg/L			0.004	0.001	0%	56%
Barium	4/10/16	20/02/23	16	2 mg/L			0.018	0.010	0%	100%
Boron	4/10/16	20/02/23	16	4 mg/L			0.006	0.004	0%	38%
Cadmium	4/10/16	20/02/23	16	0.002 mg/L			0.0001	0.0001	0%	6%
Calcium	4/10/16	20/02/23	16	10000 mg/L			7	5	0%	94%
Chloride	4/10/16	20/02/23	16	250 mg/L			20	13	0%	100%
Chromium	4/10/16	20/02/23	16	0.05 mg/L			<LOR		0%	0%
Copper	4/10/16	20/02/23	16	2 mg/L			0.051	0.012	0%	81%
E. coli	12/07/16	3/10/23	304	0 mpn/100 mL			<LOR		0%	0%
Fluoride	5/07/16	5/09/23	97	1.5 mg/L			1.11	0.99	0%	100%
Fluoride (weekly WU)	6/07/16	6/09/23	749	0.9 / 1.5 mg/L	10	0.78	1.07	0.99	1%	100%
Fluoride (WU result)	5/07/16	5/09/23	87	1.5 mg/L			1.05	0.99	0%	100%
Fluoride Ratio	5/07/16	5/09/23	87	0.8 / 1.2		0.91	1.16	1.01	0%	100%
Free Chlorine	12/07/16	3/10/23	304	0.2 / 5 mg/L		0.22	4.59	1.16	0%	100%
Iodine	4/10/16	20/02/23	16	0.5 mg/L			<LOR		0%	0%

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Characteristic	First sample	Last Sample	Samples	Guideline	Number non/compliant	Minimum Concentration (if ADWG has min)	Maximum Concentration	Average Concentration	% of samples non/compliant	% of samples above limit of reading
Iron	4/10/16	20/02/23	16	0.3 mg/L			0.030	0.014	0%	44%
Lead	4/10/16	20/02/23	16	0.01 mg/L	1		0.025	0.005	6%	38%
Magnesium	4/10/16	20/02/23	16	10000 mg/L			6	4	0%	100%
Manganese	4/10/16	20/02/23	16	0.5 mg/L			0.016	0.007	0%	75%
Mercury	4/10/16	20/02/23	16	0.001 mg/L			0.0001	0.0001	0%	13%
Molybdenum	4/10/16	20/02/23	16	0.05 mg/L			0.0002	0.000133	0%	19%
Nickel	4/10/16	20/02/23	16	0.02 mg/L			0.01	0.0019	0%	50%
Nitrate	4/10/16	20/02/23	16	50 mg/L			14.00	5.76	0%	88%
Nitrite	4/10/16	20/02/23	16	3 mg/L			<LOR		0%	0%
pH	12/07/16	3/10/23	318	6.5 / 8.5	29	7.02	9.04	8.05	9%	100%
Selenium	4/10/16	20/02/23	16	0.01 mg/L			<LOR		0%	0%
Silver	4/10/16	20/02/23	16	0.1 mg/L			<LOR		0%	0%
Sodium	4/10/16	20/02/23	16	180 mg/L			20	15	0%	100%
Sulfate	4/10/16	20/02/23	16	250 mg/L			23	11	0%	100%
Total Chlorine	12/07/16	3/10/23	303	5 mg/L	2		5.33	1.33	1%	100%
Total Coliforms	12/07/16	3/10/23	304	0 mpn/100 mL	1		2	2	0%	0%
Total Dissolved Solids (TDS)	4/10/16	20/02/23	16	10000 mg/L			80	63	0%	100%
Total Hardness as CaCO3	4/10/16	20/02/23	16	200 mg/L			38	28	0%	100%

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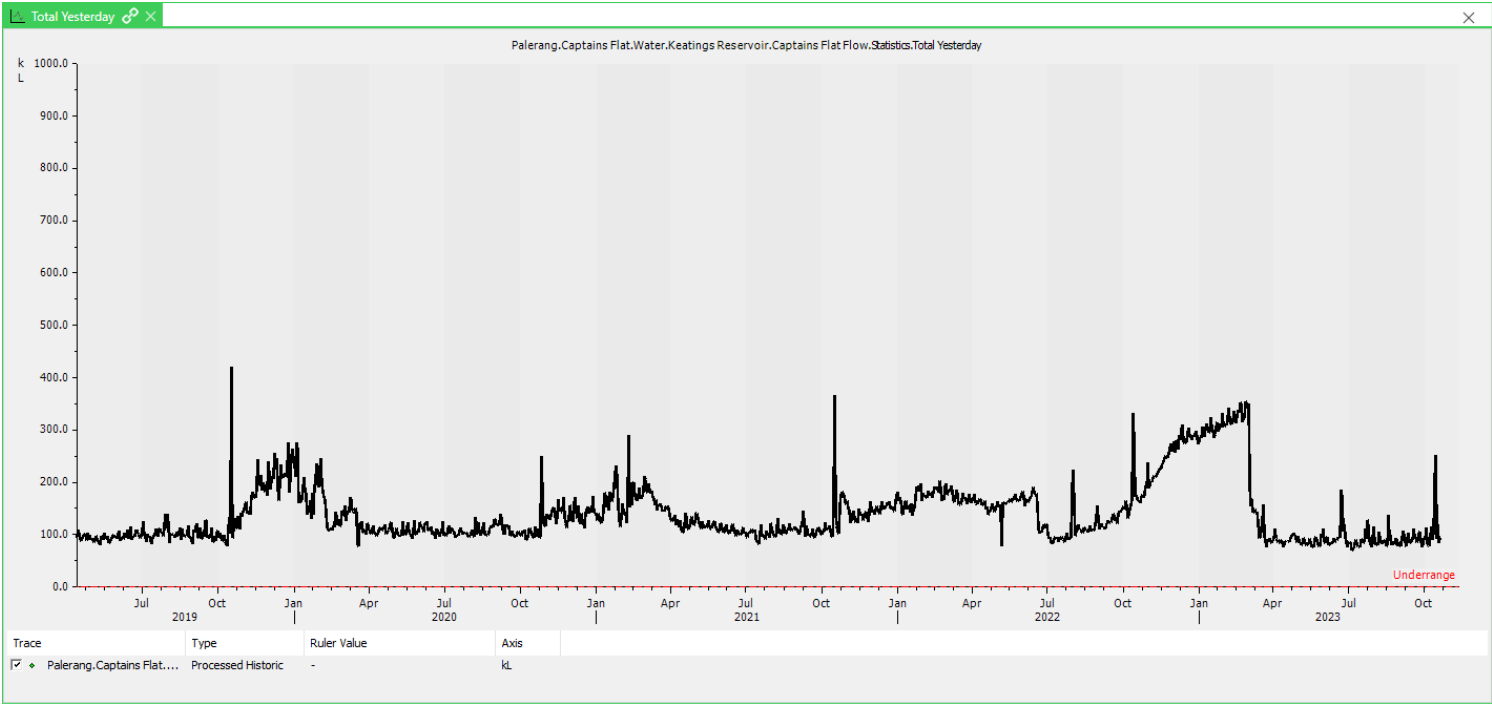


Characteristic	First sample	Last Sample	Samples	Guideline	Number non/compliant	Minimum Concentration (if ADWG has min)	Maximum Concentration	Average Concentration	% of samples non/compliant	% of samples above limit of reading
True Colour	4/10/16	20/02/23	16	15 Hazen Units (HU)			3.00	1.56	0%	100%
Turbidity	4/10/16	3/10/23	305	5 NTU	3		49.00	0.34	1%	98%
Uranium	1/08/17	20/02/23	13	0.017 mg/L			0.0001	0.0001	0%	8%
Zinc	4/10/16	20/02/23	16	3 mg/L			0.130	0.033	0%	88%

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Appendix B Captains Flat Keating Reservoir Flow



Appendix figure B-1: Captains Flat Keating Reservoir Flow



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Appendix C
Water quality risk assessment

C.1
HBT Assessment Tool Water quality risk assessment – Bungendore WSS

HBT Assessment Tool
Reset Form

Question	Answer	Catchment characteristics		
<b>Catchment Assessment</b>				
1.1 Name of water supply	Bungendore Drinking water supply system	1.5 Average slope 2%		
1.2 Name of water source	Bungendore-Bore 1, Bore 2, Bore 3 and Bore 6	1.6 Average annual rainfall (mm) 640		
1.3 Is this a primary or secondary source	Primary Source	1.7 Area NSW South East NSW		
1.4 Is the water source groundwater or surface water	Groundwater	1.8 Soil drainage Poorly drained		
		1.9 Land use grazing (%) 80%		
<b>Groundwater Assessment</b>				
3.1 Are there disused uncapped bores allowing ingress of surface water into aquifer?	No			
3.2 Can surface water ingress into aquifer through bore casing?	No			
3.3 Type of aquifer water is being extracted (where the screens are located)?	Alluvial			
3.4 Is there an aquitard (impervious) layer between surface and water-bearing aquifer (where screened)?	No			
3.5 Is Aquifer level directly influenced by surface water?	No			
3.6 What is the depth of the water-bearing aquifer (m)?	37			
3.7 Any change in turbidity? e.g. linked to rain events	No			
<b>Vulnerability Assessment Required?</b>				
No				
<b>Vulnerability Assessment</b>				
Question	Answer - Inner Catchment	Answer - Outer Catchment	Inherent Risk Rating - Inner Catchment	Inherent Risk Rating - Outer Catchment
<b>Urban Areas</b>				
No of properties with OSSMS in catchment	0	0	Low	Low
<b>Threats</b>				
Are there STPs in catchment	Yes	Yes	Very High	High
Are there possibilities of sewer overflows in catchment	Yes	Yes	Very High	High
Are there biosolids reuse in catchment	No	No	Low	Low
Are there industrial WWTS in catchment	No	No	Low	Low
Are there landfill type facilities in catchment	No	No	Low	Low
Are there urban stormwater discharges in catchment	No	No	Low	Low
Is there aquifer recharge with stormwater or effluent	No	No	Low	Low
<b>Effluent Reuse</b>				
Any effluent reuse in catchment	No	No		
<b>Stock animals</b>				
Are dairies, feedlots or other intensive farming operations in catchment	Yes	No	Very High	Low
Are there free-roaming livestock within catchment	Yes	No		
Is number of calves and lambs in catchment known?	Yes			
Number of calves / Ha grazing land				
Number of lambs / Ha grazing land				
% of perennial waterways fenced off	>90%	>90%		
% of perennial waterways with riparian vegetation	>90%	>90%		
<b>Weighted risk from livestock</b>			Low	Low
<b>Highest catchment rating</b>	Very High			
<b>Inherent Risk</b>	Moderate			

Note: There is not an aquitard (impervious) layer between surface and water-bearing aquifer, however aquifer level is not directly influenced by surface water - moderate risk

Appendix figure C-1: HBT Assessment Tool Water quality risk assessment – Bungendore Bores, Bungendore WSS



Appendix figure C-2: HBT Assessment Tool Water quality risk assessment – Currandooly Bores, Bungendore WSS

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C.2
HBT Assessment Tool Water quality risk assessment – Braidwood WSS

Catchment Assessment

1.1 Name of water supply

Braidwood Drinking Water Supply System

1.5 Average slope

2%

1.2 Name of water source

Shoalhaven River

1.6 Average annual rainfall (mm)

658

1.3 Is this a primary or secondary source

Primary Source

1.7 Area NSW

South East NSW

1.4 Is the water source groundwater or surface water

Surface Water

1.8 Soil drainage

Moderately well drained

1.9 Land use grazing (%)

80%

Surface Water Assessment

2.1 Is extraction from a storage or dam?

No

Assessment is for the river not the storage.

Vulnerability Assessment Required?

Yes

Vulnerability Assessment

Question

Answer - Inner Catchment

Answer - Outer Catchment

Inherent Risk Rating - Inner Catchment

Inherent Risk Rating - Outer Catchment

Definition:

1km radius upstream from surface intake (only land that slopes towards water body)

5km radius upstream from surface intake (only land that slopes towards water body)

Urban Areas

No of properties with OSSMS in catchment

2

5

Low

Low

Threats

Are there STPs in catchment

No

No

Low

Low

Are there possibilities of sewer overflows in catchment

No

No

Low

Low

Are there biosolids reuse in catchment

No

No

Low

Low

Are there industrial WWTs in catchment

No

No

Low

Low

Are there landfill type facilities in catchment

No

No

Low

Low

Are there urban stormwater discharges in catchment

No

No

Low

Low

Effluent Reuse

Any effluent reuse in catchment

No

No

Stock animals

Are dairies, feedlots or other intensive farming operations in catchment

No

No

Low

Low

Are there free-roaming livestock within catchment

Yes

Yes

Is number of calves and lambs in catchment known?

No

No

% of perennial waterways fenced off

>90%

>90%

% of perennial waterways with riparian vegetation

%65 to 90%

%65 to 90%

Weighted risk from livestock

Medium

Medium

Highest catchment rating

Medium

Inherent Risk

Medium

Note: Extraction is from a surface water intake - requires catchment vulnerability assessment

Appendix figure C-3: HBT Assessment Tool Water quality risk assessment – Braidwood WSS

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### C.3 HBT Assessment Tool Water quality risk assessment – Captains Flat WSS

Catchment Assessment		Catchment characteristics	
1.1 Name of water supply	Captains Flat water supply scheme	1.5 Average slope	7%
1.2 Name of water source	Molonglo River	1.6 Average annual rainfall (mm)	747
1.3 Is this a primary or secondary source	Primary Source	1.7 Area NSW	South East NSW
1.4 Is the water source groundwater or surface water	Surface Water	1.8 Soil drainage	Imperfectly drained
		1.9 Land use grazing (%)	90%

Surface Water Assessment	
2.1 Is extraction from a storage or dam?	Yes Dam
2.2 Is water pumped to storage from a different water source?	No
2.3 What is the storage volume at full supply level (FSL)? (in ML)	820 CAPTAINS FLAT DAM, 5 Yearly Surveillance Report (July 2016)
2.4 Does the storage have a variable off-take?	No Direct from dam
2.5 Is the storage used for primary contact recreation? (i.e. where full body is submerged)	No
2.6 Is the storage used for secondary contact recreation? (i.e. where chance of swallowing water is high)	No
2.7 Is water extracted daily from the storage?	Yes
2.8 Can the storage filling be controlled based on water quality?	No
2.9 What is the maximum monthly demand? (in ML/month)	7.5
2.10 What is the average annual demand? (in ML/year)	4.14
2.11 Is there local runoff to storage?	Yes
2.12 Is the storage adequately secured? (Or can it be easily secured?)	Yes Fenced

**Vulnerability Assessment Required?** Yes

Question	Answer - Inner Catchment	Answer - Outer Catchment	Inherent Risk Rating - Inner Catchment	Inherent Risk Rating - Outer Catchment
<b>Urban Areas</b>				
No of properties with OSSMS in catchment	0	0	Low	Low
<b>Threats</b>				
Are there STPs in catchment	No	No	Low	Low
Are there possibilities of sewer overflows in catchment	No	No	Low	Low
Are there biosolids reuse in catchment			Not assessed	Not assessed
Are there industrial WWTs in catchment	No	No	Low	Low
Are there landfill type facilities in catchment	No	No	Low	Low
Are there urban stormwater discharges in catchment	No	No	Low	Low
<b>Effluent Reuse</b>				
Any effluent reuse in catchment	No	No		
<b>Stock animals</b>				
Are dairies, feedlots or other intensive farming operations in catchment	No	No	Low	Low
Are there free-roaming livestock within catchment	Yes	Yes		
Is number of calves and lambs in catchment known?	No	No		
% of perennial waterways fenced off	>90%	>90%		
% of perennial waterways with riparian vegetation	>90%	>90%		
<b>Weighted risk from livestock</b>			Medium	Medium
<b>Highest catchment rating</b>	Medium			
<b>Inherent Risk</b>			Low	

Note: Water is extracted daily from the storage, but the storage is large enough that sediment reduces pathogens. However there is local runoff to storage - requires catchment vulnerability assessment, however risk is

Appendix figure C-4: HBT Assessment Tool Water quality risk assessment – Captains Flat WSS

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#### C.4 NSW Health Letter

22 November 2019

Mr Peter Tegar  
General Manager  
Queanbeyan-Palerang Regional Council  
PO Box 90  
QUEANBEYAN NSW 2620



Dear Mr Tegar

I am writing to share the preliminary outcomes of NSW Health's recent *Cryptosporidium* risk assessment of drinking water supplies operated by Queanbeyan-Palerang Regional Council.

##### ***Cryptosporidium***

*Cryptosporidium* is a microorganism found in water that can cause serious gastrointestinal disease. Livestock and sewage can be sources of *Cryptosporidium* that can infect humans. *Cryptosporidium* is of particular concern for water supplies because it is not controlled by normal doses of chlorine. A high standard of filtration or an alternative disinfection, such as ultraviolet light, is needed to control *Cryptosporidium*.

##### **Preliminary risk assessment for *Cryptosporidium***

The risk assessment used a model that considered potential *Cryptosporidium* sources in the catchment(s) and any existing controls, such as catchment management and water treatment. The Public Health Unit can provide the detailed report on the model. The assessment was based on information provided by Queanbeyan-Palerang Regional Council, with a preliminary *Cryptosporidium* risk rating determined as high, medium or low, as shown in the following table and attachment 1. The table also identifies potential improvements to better control *Cryptosporidium*. NSW Health will advise Department of Planning, Industry and Environment - Water of the risk ratings of drinking water supplies, to be prioritised for investigation through the Safe and Secure Water Program, where upgrades are not already approved.

Supply system	Preliminary <i>Cryptosporidium</i> risk rating	Potential action and/or improvement
Captains Flat	Medium	Maintaining the operation and monitoring (ideally continuously) of membranes to identify any breakdown of integrity and assessing the need for further treatment that can control <i>Cryptosporidium</i> .
Bungendore	Low	Confirming the aquifer is protected from surface water and confirming the integrity of the bore (including head and bore casing).
Braidwood	Low	Maintaining the operation and monitoring (ideally continuously) of processes to consistently reduce turbidity of individual filters to <0.2 NTU and identify any reduction in process quality.

Public Health Unit  
Murrumbidgee and Southern NSW Local Health District  
PO Box 3095 Albury NSW 2640  
Tel 02 6080 8900 Fax 02 6080 8999  
Website [www.mhnd.health.nsw.gov.au](http://www.mhnd.health.nsw.gov.au)

Appendix figure C-5: NSW Health Letter

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## Appendix D Water supply analysis

### D.1 Water Balance Method

The historical water production data and customer usage data were used to calculate a water balance over the system. The water losses represent the difference between the volume of water delivered into a network and the metered customer usage. The water balance used is the standard developed by the International Water Association (IWA) Water Loss Task Force.

The system losses can be estimated through finding the differences of water produced and water consumed. Assumptions were made to further categorise water losses into apparent losses (such as unauthorised consumption – theft/illegal use and customer meter under-registration) and real losses (such as leakages).

Unbilled authorised consumption was estimated as 0.5% of water supplied. Apparent losses are estimated as customer meter under-registration (2% of metered consumption) plus theft (0.1% of water supplied). These assumptions are from the Australian Government National Performance Framework [20]. Unavoidable real losses are calculated using the average pressure, length of main and number connections using equations from the IWA paper titled 'A Review of Performance Indicators for Real Losses from Water Supply Systems' [21]. As these losses are calculated using assumptions, actual volumes may differ, however they are a useful indicator of where losses are occurring.

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## Appendix E Water demand analysis – background

The water demand analysis is described below.

### Outcomes of water demand analysis

A water demand analysis is undertaken to calculate the unit demands, estimate the non-revenue water and forecast the following demands:

- Average (rainfall) year demands – for revenue planning
- Unrestricted future year demands – to assess drought security
- Peak day demands – to assess system reliability.

The 30-year forecasts based on the nominated growth, are used to identify the issues in meeting the adopted water supply security, and reliability objectives of the urban water supply system.

The analysis uses the water production data (that is the water delivered into the system), and the customer billing data (metered consumption by users in the system).

The billing data was provided by assessment with every assessment taken as a connected property. Therefore, analysis has been undertaken on an assessment basis.

### Peak usage analysis

Weather patterns in summer that result in prolonged periods of high demand can stress systems more than a large but isolated peak day demand. Historical daily production data is analysed to understand water usage patterns during these periods of peak usage.

The first aim of the analysis is to obtain a ratio of the peak day to the average day in the peak week, which is used to estimate peak day demands from the production model hindcast. The second aim is to obtain a demand “persistence pattern” during the peak period, which can be used to estimate whether the existing reservoirs and WTP capacity can supply demand during the peak period. The persistence pattern can also be used in simulating a peak demand period in a hydraulic model simulation.

### Water production and customer usage modelling

Modelling of water production data (that is the water delivered into the system), and the customer billing data (metered consumption by users in the system) is undertaken to understand the impact of various factors/trends (demographic, climatic, economic etc.) on the variability of town water demand.

The aim is to develop a model which, when input with historical factors/trends, will output a production that co-relates well with the actual historic production or customer usage.

The model is then hind-cast over a period of available climatic data of temperature and rainfall to estimate the annual demands if the current conditions of lot size, household size, number of connections, pricing and usage patterns were to prevail. The average year and dry year demand over the 120-year period are then determined and these demands are used as the starting point for the forecasts.

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## Appendix F Climate change impact comparison

Since the previous IWCN climate change analysis was completed, there have been two major revisions to the NSW Public Works climate change modelling method.

### F.1 Method used in previous IWCN

The previous IWCN methodology used seasonal changes to rainfall and evapotranspiration sourced from the CSIRO "Climate Change in Australia Report" and the maximum daily temperature increased by 1.25°C. The climate dependent use has been re-calculated using the current climate dependent consumption models, the current SILO Data and the weather data modified in the same way as was used in the previous IWCN.

Appendix table F-1: Bungendore change in climate dependent demand using method from previous IWCN

		Airconditioning - 25°C trigger (kL/dwelling)			Irrigation (ML/ha)		
		Annual Total (ML/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)	Annual Total (ML/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)
2023 SILO	Average	31	672	534	4.27	0.054	0.047
	99th %ile	58	1076	908	7.62	0.074	0.063
	Maximum	63	1086	926	7.44	0.063	0.056
2023 SILO adjusted using 2018 method	Average	42	769	634	4.80	0.058	0.050
	99th %ile	73	1145	990	8.33	0.077	0.067
	Maximum	76	1120	1011	8.11	0.079	0.063
% increase due to climate change	Average	38.06%	14.44%	18.70%	12.52%	6.99%	6.00%
	99th %ile	25.04%	6.39%	9.07%	9.30%	3.54%	5.19%
	Maximum	21.07%	3.16%	9.26%	8.96%	25.00%	14.29%

Appendix table F-2: Bungendore demand change using method from previous IWCN

		Annual Total (ML/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)
2023 SILO	Average	346	1532	1427
	99th %ile	388	1817	1671
	Maximum	387	1723	1601
2023 SILO adjusted using 2018 method	Average	354	1594	1477
	99th %ile	399	1861	1720
	Maximum	397	1906	1699
% increase due to climate change	Average	2.41%	4.07%	3.49%
	99th %ile	2.83%	2.42%	2.96%
	Maximum	2.66%	10.62%	6.13%

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Appendix table F-3: Braidwood change in climate dependent demand using method from previous IWCN

		Airconditioning - 25°C trigger (kL/dwelling)			Irrigation (ML/ha)		
		Annual Total (ML/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)	Annual Total (ML/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)
2023 SILO	Average	90	1.07	0.94	3.63	0.049	0.043
	99th %ile	130	1.44	1.28	6.83	0.069	0.062
	Maximum	130	1.53	1.35	6.44	0.063	0.056
2023 SILO adjusted using 2018 method	Average	112	1.16	1.04	4.13	0.053	0.046
	99th %ile	153	1.51	1.36	7.46	0.073	0.064
	Maximum	151	1.58	1.42	7.00	0.063	0.056
% increase due to climate change	Average	24.42%	8.15%	10.37%	13.55%	8.41%	7.41%
	99th %ile	17.56%	4.82%	5.88%	9.24%	7.01%	3.18%
	Maximum	16.07%	2.99%	5.08%	8.62%	0.00%	0.00%

Appendix table F-4: Braidwood demand change using method from previous IWCN

		Annual Total (ML/day)		Average day peak week (kL/day)		Average day peak fortnight (kL/day)	
		Low	High	Low	High	Low	High
2023 SILO	Average	155	239	670	901	631	862
	99th %ile	174	258	787	1018	746	977
	Maximum	172	256	769	1000	715	946
2023 SILO adjusted using 2018 method	Average	159	243	696	927	652	883
	99th %ile	178	263	816	1047	759	990
	Maximum	175	260	770	1001	718	949
% increase due to climate change	Average	2.27%	1.47%	3.85%	2.86%	3.29%	2.41%
	99th %ile	2.49%	1.68%	3.69%	2.85%	1.72%	1.31%
	Maximum	2.20%	1.48%	0.21%	0.16%	0.36%	0.27%

## F.2 SEACI

Shortly after previous IWCN analysis was completed, DCCEEW started providing the data sourced from the from South Eastern Australian Climate Initiative (SEACI). This data included rainfall and evapotranspiration datasets for 1 historical dataset and 17 Global Climate Models (GCMs) and was based on a 1°C warming scenario from a 1990 baseline. The Daily maximum temperatures assumed to be 1°C higher. Data from this data set was used to calculate the secure yield of the surface water source at Braidwood and Captains Flat.

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SEACI data was obtained for Braidwood.

Appendix table F-5: Braidwood change in climate dependent demand using SEACI data

		Airconditioning - 25°C trigger (kL/dwelling)			Irrigation (ML/ha)		
		Annual Total (ML/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)	Annual Total (ML/day)	Average day peak week (kL/day)	Average day peak fortnight (kL/day)
SEACI Historical	Average	92	1.07	0.95	3.72	0.047	0.042
	99th %ile	129	1.39	1.25	6.54	0.055	0.056
	Maximum	128	1.38	1.32	6.00	0.063	0.048
SEACI 1°C warming	Average	109	1.14	1.03	4.50	0.048	0.044
	99th %ile	148	1.44	1.31	7.18	0.058	0.056
	Maximum	147	1.46	1.29	6.56	0.063	0.056
% increase due to climate change	Average	18.74%	6.56%	8.07%	20.90%	1.72%	5.60%
	99th %ile	14.92%	3.79%	4.79%	9.77%	6.72%	-0.64%
	Maximum	14.78%	5.79%	-2.16%	9.26%	0.00%	16.67%

Appendix table F-6: Braidwood demand change using SEACI data

		Annual Total (ML/day)		Average day peak week (kL/day)		Average day peak fortnight (kL/day)	
NRW scenario		Low	High	Low	High	Low	High
SEACI Historical	Average	156	240	659	890	624	855
	99th %ile	172	257	711	942	711	942
	Maximum	169	253	761	992	666	897
SEACI 1C warming	Average	160	245	666	897	640	871
	99th %ile	176	261	730	961	713	944
	Maximum	172	257	763	994	711	942
% increase due to climate change	Average	3.18%	2.06%	1.14%	0.84%	2.60%	1.90%
	99th %ile	2.46%	1.65%	2.69%	2.03%	0.19%	0.14%
	Maximum	2.23%	1.49%	0.16%	0.12%	6.87%	5.10%

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### F.3 NARClIM 1.5

More recently, DCCCEW has started to recommend the use of data from the New South Wales (NSW) and Australian Capital Territory (ACT) regional climate modelling (NARClIM) version 1.5.

The NARClIM 1.5 dataset contains information for two future greenhouse gas concentration trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC). The trajectories are known as representative concentration pathways (RCPs). The RCPs for which data is available are:

- RCP 4.5, this is the most probable baseline scenario (no climate policies) considering the exhaustible character of non-renewable fuels. RCP8.5, generally taken as the basis for worst-case climate change scenarios, was based on what proved to be overestimation of projected coal outputs. Under this scenario, the greenhouse gas concentration stabilises in 2080.
- RCP8.5, generally taken as the basis for worst-case climate change scenarios, was based on what proved to be overestimation of projected coal outputs.

The data is available for:

- Three global climate models, these models have a resolution of 100's of square kilometres
  - CanESM2 produced by the Canadian Centre for Climate Modelling and Analysis (CCCMA)
  - ACCESS1.0 produced by a CSIRO and Bureau of Meteorology collaboration
  - ACCESS1.3 produced by a CSIRO and Bureau of Meteorology collaboration.
- The ERA-Interim reanalysis data set, this is a global atmospheric reanalysis produced by the European Centre for Medium-Range Weather Forecasts (ECMWF). This dataset uses historical observations to create global data sets describing the recent history of the atmosphere, land surface, and oceans.

Each of these data sets is then downscaled using two separate regional climate models.

The demand changes for Bungendore and Braidwood were estimated using the three GCMs, two RCMs, and two future time periods (before and after 2060). The results are summarised in the following tables. When there was a decrease in demand instead of an increase, the cells are shaded grey.

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Appendix table F-7: Bungendore – CCCma-CanESM2 – RCP 4.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	335	1.53	1.40	343	1.53	1.42
		99th %ile	371	1.78	1.62	382	1.75	1.61
		Maximum	375	1.67	1.56	379	1.68	1.56
2006/07 to 2058/59 RCP 4.5	Modelled production	Average	335	1.54	1.41	343	1.56	1.44
		99th %ile	367	1.78	1.65	378	1.80	1.67
		Maximum	366	1.71	1.59	381	1.71	1.64
	% increase compared to 1951/52 to 2004/05	Average	-0.19%	0.92%	0.65%	0.21%	1.91%	1.44%
		99th %ile	-1.10%	0.02%	2.01%	-1.06%	2.88%	4.00%
		Maximum	-2.44%	1.99%	1.74%	0.58%	1.71%	5.52%
2059/60 to 2099/100 RCP 4.5	Modelled production	Average	351	1.56	1.44	359	1.59	1.48
		99th %ile	392	1.83	1.68	395	1.78	1.65
		Maximum	387	1.70	1.58	386	1.72	1.59
	% increase compared to 1951/52 to 2004/05	Average	4.77%	1.38%	2.14%	4.64%	2.06%	2.95%
		99th %ile	6.81%	2.83%	1.43%	4.43%	-0.94%	-1.28%
		Maximum	5.76%	-0.13%	-0.94%	1.32%	0.39%	-3.41%

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Appendix table F-8: Bungendore – CCCma-CanESM2 – RCP 8.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	335	1.53	1.40	343	1.53	1.42
		99th %ile	371	1.78	1.62	382	1.75	1.61
		Maximum	375	1.67	1.56	342	1.55	1.42
2006/07 to 2058/59 RCP 8.5	Modelled production	Average	336	1.51	1.39	342	1.55	1.42
		99th %ile	369	1.75	1.62	380	1.81	1.70
		Maximum	362	1.68	1.63	373	1.71	1.65
	% increase compared to 1951/52 to 2004/05	Average	0.28%	-1.18%	-0.60%	-0.10%	0.90%	-0.16%
		99th %ile	-0.69%	-1.67%	0.30%	-0.69%	3.28%	6.20%
		Maximum	-3.37%	0.40%	4.08%	-1.45%	1.71%	5.94%
2059/60 to 2099/100 RCP 8.5	Modelled production	Average	353	1.57	1.44	359	1.59	1.48
		99th %ile	392	1.75	1.64	395	1.80	1.65
		Maximum	387	1.69	1.58	386	1.72	1.59
	% increase compared to 1951/52 to 2004/05	Average	5.03%	4.04%	3.28%	4.94%	2.91%	4.58%
		99th %ile	6.40%	0.31%	1.17%	4.11%	-0.52%	-3.25%
		Maximum	6.78%	0.40%	-3.17%	3.41%	0.39%	-3.80%

Appendix table F-9: Bungendore – CSIRO-BOM-ACCESS1-0 – RCP 4.5

	RCM J	RCM K
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			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	330	1.52	1.40	327	1.47	1.36
		99th %ile	367	1.87	1.72	366	1.79	1.69
		Maximum	371	1.70	1.59	364	1.66	1.56
2006/07 to 2058/59 RCP 4.5	Modelled production	Average	332	1.54	1.40	335	1.54	1.40
		99th %ile	375	1.82	1.68	377	1.83	1.69
		Maximum	381	1.69	1.61	378	1.70	1.58
	% increase compared to 1951/52 to 2004/05	Average	0.59%	1.27%	-0.36%	2.48%	4.31%	3.02%
		99th %ile	2.20%	-3.17%	-1.96%	2.91%	2.14%	0.43%
		Maximum	2.66%	-0.26%	1.51%	3.80%	2.54%	0.92%
2059/60 to 2099/100 RCP 4.5	Modelled production	Average	335	1.54	1.39	337	1.53	1.42
		99th %ile	375	1.78	1.66	373	1.79	1.70
		Maximum	381	1.72	1.70	370	1.72	1.67
	% increase compared to 1951/52 to 2004/05	Average	0.76%	-0.39%	-0.28%	0.50%	-0.67%	1.82%
		99th %ile	0.05%	-2.10%	-1.25%	-0.92%	-1.85%	0.50%
		Maximum	-0.11%	1.57%	5.36%	-2.11%	1.04%	5.80%

Appendix table F-10: Bungendore – CSIRO-BOM-ACCESS1-0 – RCP 8.5

	RCM J	RCM K
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			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	330	1.52	1.40	366	1.79	1.69
		99th %ile	367	1.87	1.72	364	1.66	1.56
		Maximum	371	1.70	1.59	339	1.53	1.40
2006/07 to 2058/59 RCP 8.5	Modelled production	Average	333	1.54	1.39	339	1.53	1.40
		99th %ile	376	1.85	1.69	385	1.88	1.70
		Maximum	377	1.92	1.72	374	1.70	1.56
	% increase compared to 1951/52 to 2004/05	Average	0.83%	0.98%	-0.92%	3.59%	4.01%	3.03%
		99th %ile	2.52%	-1.56%	-1.37%	5.09%	5.17%	0.50%
		Maximum	1.50%	13.14%	8.35%	2.75%	2.41%	-0.21%
2059/60 to 2099/100 RCP 8.5	Modelled production	Average	345	1.59	1.45	348	1.59	1.47
		99th %ile	385	1.82	1.69	390	1.82	1.67
		Maximum	392	1.72	1.68	392	1.73	1.63
	% increase compared to 1951/52 to 2004/05	Average	3.61%	3.12%	4.45%	2.66%	3.83%	5.03%
		99th %ile	2.40%	-1.21%	0.01%	1.49%	-3.14%	-1.70%
		Maximum	4.08%	-10.23%	-2.06%	4.74%	1.96%	4.84%

Appendix table F-11: Bungendore – CSIRO-BOM-ACCESS1-3 – RCP 4.5

	RCM J	RCM K
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NSW Public Works



			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	338	1.57	1.44	346	1.56	1.44
		99th %ile	377	1.80	1.69	392	1.82	1.71
		Maximum	377	1.70	1.68	390	1.70	1.66
2006/07 to 2058/59 RCP 4.5	Modelled production	Average	345	1.58	1.45	351	1.60	1.47
		99th %ile	383	1.82	1.72	392	1.86	1.70
		Maximum	384	1.71	1.66	389	1.73	1.63
	% increase compared to 1951/52 to 2004/05	Average	1.92%	0.22%	0.47%	1.39%	2.26%	2.24%
		99th %ile	1.59%	1.11%	1.80%	0.08%	2.20%	-0.22%
		Maximum	1.79%	0.26%	-0.99%	-0.33%	1.96%	-1.47%
2059/60 to 2099/100 RCP 4.5	Modelled production	Average	354	1.60	1.47	356	1.61	1.48
		99th %ile	409	1.89	1.78	405	1.85	1.72
		Maximum	404	1.75	1.64	408	1.75	1.67
	% increase compared to 1951/52 to 2004/05	Average	2.75%	1.58%	1.43%	1.51%	0.54%	0.97%
		99th %ile	6.76%	3.86%	3.73%	3.07%	-0.65%	0.84%
		Maximum	5.39%	2.21%	-1.20%	4.93%	1.28%	2.44%

Appendix table F-12: Bungendore – CSIRO-BOM-ACCESS1-3 – RCP 8.5

	RCM J			RCM K		
	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)



NSW Public Works



1951/52 to 2004/05	Modelled production	Average	338	1.57	1.44	346	1.56	1.44
		99th %ile	377	1.80	1.69	392	1.82	1.71
		Maximum	377	1.70	1.68	390	1.70	1.66
2006/07 to 2058/59 RCP 8.5	Modelled production	Average	344	1.57	1.45	358	1.60	1.49
		99th %ile	396	1.81	1.75	410	1.82	1.71
		Maximum	398	1.70	1.66	403	1.72	1.67
	% increase compared to 1951/52 to 2004/05	Average	1.84%	-0.01%	0.53%	3.57%	2.76%	3.68%
		99th %ile	4.92%	0.67%	3.68%	4.59%	-0.17%	0.06%
		Maximum	5.69%	0.00%	-1.19%	3.35%	1.31%	0.80%
2059/60 to 2099/100 RCP 8.5	Modelled production	Average	372	1.66	1.56	381	1.66	1.56
		99th %ile	422	1.84	1.77	426	1.82	1.77
		Maximum	415	1.92	1.74	419	1.76	1.71
	% increase compared to 1951/52 to 2004/05	Average	8.08%	5.37%	7.57%	6.26%	3.60%	4.62%
		99th %ile	6.63%	1.47%	1.09%	3.87%	0.30%	3.48%
		Maximum	4.30%	12.44%	4.54%	3.94%	2.19%	2.26%

Appendix table F-13: Braidwood (low NRW) – CCCma-CanESM2 – RCP 4.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
	Modelled production	Average	154	0.70	0.64	160	0.71	0.66
		99th %ile	171	0.82	0.75	179	0.82	0.76

NSW Public Works



1951/52 to 2004/05		Maximum	172	0.76	0.71	179	0.76	0.71
2006/07 to 2058/59 RCP 4.5	Modelled production	Average	153	0.69	0.63	159	0.71	0.65
		99th %ile	171	0.84	0.76	179	0.82	0.76
		Maximum	175	0.76	0.71	175	0.76	0.71
	% increase compared to 1951/52 to 2004/05	Average	-0.43%	-0.85%	-1.44%	-0.40%	0.02%	-0.78%
		99th %ile	0.07%	2.32%	1.31%	-0.10%	-0.39%	-0.42%
		Maximum	1.44%	0.00%	-0.23%	-2.13%	0.16%	0.31%
2059/60 to 2099/100 RCP 4.5	Modelled production	Average	160	0.70	0.64	166	0.74	0.68
		99th %ile	181	0.83	0.77	184	0.82	0.76
		Maximum	175	0.77	0.72	182	0.77	0.72
	% increase compared to 1951/52 to 2004/05	Average	4.42%	1.46%	0.81%	4.48%	3.34%	3.60%
		99th %ile	5.75%	-1.00%	0.59%	2.79%	-0.32%	-0.63%
		Maximum	0.40%	0.05%	1.30%	4.06%	0.42%	0.84%

Appendix table F-14: Braidwood (low NRW) – CCCma-CanESM2 – RCP 8.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
	Modelled production	Average	154	0.70	0.64	160	0.71	0.66
		99th %ile	171	0.82	0.75	179	0.82	0.76

NSW Public Works



1951/52 to 2004/05		Maximum	172	0.76	0.71	162	0.72	0.66
2006/07 to 2058/59 RCP 8.5	Modelled production	Average	155	0.70	0.64	162	0.72	0.66
		99th %ile	179	0.85	0.78	187	0.84	0.78
		Maximum	182	0.76	0.75	186	0.77	0.75
	% increase compared to 1951/52 to 2004/05	Average	1.02%	-0.10%	-0.04%	1.41%	1.32%	0.10%
		99th %ile	4.63%	3.86%	4.18%	4.29%	1.40%	2.03%
		Maximum	5.91%	-0.05%	6.14%	3.63%	0.73%	6.24%
2059/60 to 2099/100 RCP 8.5	Modelled production	Average	161	0.71	0.65	168	0.74	0.69
		99th %ile	179	0.83	0.77	186	0.81	0.75
		Maximum	184	0.77	0.72	180	0.77	0.72
	% increase compared to 1951/52 to 2004/05	Average	3.61%	1.73%	1.92%	3.74%	3.08%	3.93%
		99th %ile	-0.29%	-2.01%	-1.27%	-0.70%	-3.07%	-3.18%
		Maximum	0.84%	0.37%	-4.80%	-2.84%	0.42%	-4.74%

Appendix table F-15: Braidwood (low NRW) – CSIRO-BOM-ACCESS1-0 – RCP 4.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
	Modelled production	Average	146	0.67	0.61	149	0.68	0.62
		99th %ile	162	0.84	0.78	168	0.85	0.79

NSW Public Works



1951/52 to 2004/05		Maximum	168	0.76	0.71	170	0.76	0.71
2006/07 to 2058/59 RCP 4.5	Modelled production	Average	147	0.67	0.60	153	0.70	0.65
		99th %ile	168	0.85	0.78	174	0.87	0.80
		Maximum	171	0.76	0.71	176	0.76	0.71
	% increase compared to 1951/52 to 2004/05	Average	0.91%	-0.67%	-1.59%	2.63%	2.87%	4.11%
		99th %ile	3.44%	0.13%	-0.47%	3.67%	2.49%	1.16%
		Maximum	1.33%	-0.16%	0.28%	3.53%	0.79%	-0.06%
2059/60 to 2099/100 RCP 4.5	Modelled production	Average	148	0.66	0.60	154	0.70	0.64
		99th %ile	167	0.86	0.77	173	0.83	0.78
		Maximum	171	0.77	0.76	171	0.77	0.75
	% increase compared to 1951/52 to 2004/05	Average	0.71%	-1.68%	-0.29%	0.27%	-0.33%	-0.74%
		99th %ile	-0.34%	1.81%	-0.39%	-0.62%	-4.40%	-1.83%
		Maximum	0.27%	0.26%	6.82%	-3.15%	0.16%	6.19%

Appendix table F-16: Braidwood (low NRW) – CSIRO-BOM-ACCESS1-0 – RCP 8.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
	Modelled production	Average	146	0.67	0.61	168	0.85	0.79
		99th %ile	162	0.84	0.78	170	0.76	0.71

NSW Public Works



1951/52 to 2004/05		Maximum	168	0.76	0.71	155	0.70	0.65
2006/07 to 2058/59 RCP 8.5	Modelled production	Average	146	0.66	0.60	155	0.70	0.65
		99th %ile	163	0.86	0.77	176	0.83	0.78
		Maximum	168	0.77	0.71	172	0.76	0.71
	% increase compared to 1951/52 to 2004/05	Average	0.28%	-1.58%	-2.82%	3.73%	2.12%	4.41%
		99th %ile	0.62%	1.31%	-1.49%	4.84%	-2.34%	-1.32%
		Maximum	-0.17%	0.73%	-0.45%	1.33%	0.63%	0.51%
2059/60 to 2099/100 RCP 8.5	Modelled production	Average	152	0.68	0.62	158	0.72	0.66
		99th %ile	169	0.85	0.77	177	0.83	0.76
		Maximum	165	0.77	0.72	177	0.77	0.72
	% increase compared to 1951/52 to 2004/05	Average	3.88%	2.64%	4.22%	1.79%	3.27%	2.03%
		99th %ile	3.35%	-0.65%	0.48%	0.45%	-0.58%	-1.85%
		Maximum	-1.91%	0.10%	2.32%	2.59%	1.21%	1.29%

Appendix table F-17: Braidwood (low NRW) – CSIRO-BOM-ACCESS1-3 – RCP 4.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
		Average	154	0.71	0.65	161	0.73	0.67

NSW Public Works



1951/52 to 2004/05	Modelled production	99th %ile	174	0.83	0.76	184	0.83	0.77
		Maximum	177	0.76	0.72	182	0.77	0.72
2006/07 to 2058/59 RCP 4.5	Modelled production	Average	156	0.70	0.64	161	0.73	0.67
		99th %ile	176	0.86	0.79	184	0.85	0.77
		Maximum	175	0.77	0.76	183	0.77	0.72
	% increase compared to 1951/52 to 2004/05	Average	0.77%	-0.50%	-0.21%	0.03%	-0.12%	0.56%
		99th %ile	1.24%	3.06%	3.52%	-0.16%	1.66%	-0.14%
		Maximum	-0.89%	0.63%	5.48%	0.34%	0.63%	0.20%
2059/60 to 2099/100 RCP 4.5	Modelled production	Average	159	0.72	0.65	164	0.73	0.68
		99th %ile	184	0.85	0.78	187	0.83	0.77
		Maximum	182	0.77	0.72	187	0.77	0.76
	% increase compared to 1951/52 to 2004/05	Average	2.05%	1.78%	1.17%	1.64%	1.19%	1.71%
		99th %ile	4.92%	-0.74%	-1.63%	1.93%	-2.38%	-0.03%
		Maximum	3.94%	0.52%	-5.30%	2.32%	0.21%	6.39%

Appendix table F-18: Braidwood (low NRW) – CSIRO-BOM-ACCESS1-3 – RCP 8.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	154	0.71	0.65	161	0.73	0.67
		99th %ile	174	0.83	0.76	184	0.83	0.77
		Maximum	177	0.76	0.72	182	0.77	0.72

NSW Public Works



2006/07 to 2058/59 RCP 8.5	Modelled production	Average	156	0.70	0.64	165	0.73	0.68
		99th %ile	182	0.84	0.80	190	0.83	0.77
		Maximum	186	0.77	0.76	190	0.77	0.76
	% increase compared to 1951/52 to 2004/05	Average	1.14%	-1.40%	-0.90%	2.31%	1.07%	2.54%
		99th %ile	4.88%	1.61%	5.17%	3.46%	-0.37%	0.40%
		Maximum	5.25%	1.00%	5.59%	3.94%	0.21%	5.32%
2059/60 to 2099/100 RCP 8.5	Modelled production	Average	167	0.75	0.69	174	0.75	0.70
		99th %ile	192	0.85	0.78	196	0.82	0.77
		Maximum	189	0.86	0.77	192	0.78	0.77
	% increase compared to 1951/52 to 2004/05	Average	7.02%	7.15%	8.08%	5.54%	2.03%	2.46%
		99th %ile	5.39%	0.66%	-2.33%	2.73%	-1.35%	-0.15%
		Maximum	1.61%	11.45%	1.40%	1.18%	0.99%	1.75%

Appendix table F-19: Braidwood (high NRW) – CCCma-CanESM2 – RCP 4.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	238	0.93	0.87	244	0.94	0.89
		99th %ile	255	1.05	0.98	264	1.06	0.99
		Maximum	256	1.00	0.94	263	0.99	0.94
		Average	237	0.92	0.86	243	0.94	0.89

NSW Public Works



2006/07 to 2058/59 RCP 4.5	Modelled production	99th %ile	256	1.07	0.99	263	1.05	0.99
		Maximum	259	1.00	0.94	260	1.00	0.94
	% increase compared to 1951/52 to 2004/05	Average	-0.28%	-0.64%	-1.06%	-0.26%	0.01%	-0.58%
		99th %ile	0.05%	1.81%	1.00%	-0.06%	-0.31%	-0.32%
		Maximum	0.97%	0.00%	-0.17%	-1.45%	0.12%	0.23%
2059/60 to 2099/100 RCP 4.5	Modelled production	Average	244	0.93	0.87	250	0.97	0.91
		99th %ile	265	1.06	1.00	268	1.05	0.99
		Maximum	260	1.00	0.95	267	1.00	0.95
	% increase compared to 1951/52 to 2004/05	Average	2.85%	1.10%	0.59%	2.93%	2.52%	2.66%
		99th %ile	3.85%	-0.78%	0.46%	1.90%	-0.25%	-0.49%
		Maximum	0.27%	0.04%	0.98%	2.74%	0.32%	0.64%

Appendix table F-20: Braidwood (high NRW) – CCCma-CanESM2 – RCP 8.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	238	0.93	0.87	244	0.94	0.89
		99th %ile	255	1.05	0.98	264	1.06	0.99
		Maximum	256	1.00	0.94	246	0.95	0.89
2006/07 to	Modelled production	Average	239	0.93	0.87	246	0.95	0.89
		99th %ile	263	1.08	1.01	271	1.07	1.01



NSW Public Works



2058/59 RCP 8.5		Maximum	267	1.00	0.98	270	1.00	0.99
	% increase compared to 1951/52 to 2004/05	Average	0.66%	-0.08%	-0.03%	0.92%	0.99%	0.07%
		99th %ile	3.10%	3.01%	3.20%	2.92%	1.10%	1.56%
		Maximum	3.97%	-0.04%	4.63%	2.47%	0.56%	4.71%
2059/60 to 2099/100 RCP 8.5	Modelled production	Average	245	0.94	0.88	252	0.97	0.92
		99th %ile	263	1.06	1.00	270	1.04	0.99
		Maximum	268	1.00	0.95	265	1.00	0.95
	% increase compared to 1951/52 to 2004/05	Average	2.34%	1.30%	1.41%	2.46%	2.33%	2.91%
		99th %ile	-0.20%	-1.58%	-0.98%	-0.48%	-2.41%	-2.45%
		Maximum	0.57%	0.28%	-3.68%	-1.95%	0.32%	-3.63%

Appendix table F-21: Braidwood (high NRW) – CSIRO-BOM-ACCESS1-0 – RCP 4.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	230	0.91	0.85	234	0.91	0.85
		99th %ile	247	1.08	1.01	252	1.08	1.02
		Maximum	253	1.00	0.94	255	0.99	0.94
2006/07 to 2058/59 RCP 4.5	Modelled production	Average	232	0.90	0.84	238	0.93	0.88
		99th %ile	252	1.08	1.01	259	1.10	1.03
		Maximum	255	0.99	0.94	261	1.00	0.94
		Average	0.57%	-0.50%	-1.16%	1.68%	2.14%	3.00%

NSW Public Works



	% increase compared to 1951/52 to 2004/05	99th %ile	2.27%	0.10%	-0.36%	2.46%	1.96%	0.90%
		Maximum	0.79%	-0.12%	0.21%	2.36%	0.61%	-0.04%
2059/60 to 2099/100 RCP 4.5	Modelled production	Average	233	0.89	0.83	238	0.93	0.88
		99th %ile	252	1.09	1.01	257	1.06	1.01
		Maximum	255	1.00	0.99	255	1.00	0.98
	% increase compared to 1951/52 to 2004/05	Average	0.45%	-1.25%	-0.21%	0.18%	-0.25%	-0.55%
		99th %ile	-0.25%	1.42%	-0.30%	-0.44%	-3.48%	-1.42%
		Maximum	0.18%	0.20%	5.15%	-2.22%	0.12%	4.67%

Appendix table F-22: Braidwood (high NRW) – CSIRO-BOM-ACCESS1-0 – RCP 8.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	230	0.91	0.85	252	1.08	1.02
		99th %ile	247	1.08	1.01	255	0.99	0.94
		Maximum	253	1.00	0.94	239	0.93	0.88
2006/07 to 2058/59 RCP 8.5	Modelled production	Average	231	0.89	0.83	239	0.93	0.88
		99th %ile	248	1.09	1.00	261	1.06	1.01
		Maximum	252	1.00	0.94	257	0.99	0.94
		Average	0.18%	-1.18%	-2.05%	2.38%	1.58%	3.22%

NSW Public Works



	% increase compared to 1951/52 to 2004/05	99th %ile	0.38%	1.03%	-1.15%	3.22%	-1.84%	-1.02%
		Maximum	-0.20%	0.56%	-0.34%	0.80%	0.49%	0.38%
2059/60 to 2099/100 RCP 8.5	Modelled production	Average	237	0.91	0.85	242	0.95	0.89
		99th %ile	253	1.08	1.00	261	1.06	0.99
		Maximum	249	1.00	0.95	261	1.00	0.95
	% increase compared to 1951/52 to 2004/05	Average	2.46%	1.96%	3.05%	1.16%	2.46%	1.50%
		99th %ile	2.23%	-0.51%	0.37%	0.31%	-0.46%	-1.43%
		Maximum	-1.27%	0.08%	1.75%	1.74%	0.93%	0.97%

Appendix table F-23: Braidwood (high NRW) – CSIRO-BOM-ACCESS1-3 – RCP 4.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	239	0.94	0.88	246	0.96	0.90
		99th %ile	258	1.06	0.99	268	1.06	1.00
		Maximum	261	0.99	0.95	267	1.00	0.95
2006/07 to 2058/59 RCP 4.5	Modelled production	Average	240	0.93	0.88	246	0.96	0.90
		99th %ile	260	1.09	1.02	268	1.08	1.00
		Maximum	259	1.00	0.99	267	1.00	0.95
	% increase compared to	Average	0.50%	-0.38%	-0.16%	0.02%	-0.09%	0.41%
		99th %ile	0.82%	2.39%	2.70%	-0.10%	1.30%	-0.11%

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	1951/52 to 2004/05	Maximum	-0.69%	0.48%	4.15%	0.23%	0.48%	0.15%
2059/60 to 2099/100 RCP 4.5	Modelled production	Average	243	0.95	0.88	248	0.97	0.91
		99th %ile	269	1.08	1.01	272	1.06	1.00
		Maximum	266	1.00	0.95	272	1.00	1.00
	% increase compared to 1951/52 to 2004/05	Average	1.33%	1.34%	0.86%	1.07%	0.90%	1.27%
		99th %ile	3.33%	-0.58%	-1.26%	1.32%	-1.87%	-0.02%
		Maximum	2.66%	0.40%	-4.06%	1.59%	0.16%	4.84%

Appendix table F-24:Braidwood (high NRW) – CSIRO-BOM-ACCESS1-3 – RCP 8.5

			RCM J			RCM K		
			Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)	Annual total (ML/year)	Average day peak week (ML/day)	Average day peak fortnight (ML/day)
1951/52 to 2004/05	Modelled production	Average	239	0.94	0.88	246	0.96	0.90
		99th %ile	258	1.06	0.99	268	1.06	1.00
		Maximum	261	0.99	0.95	267	1.00	0.95
2006/07 to 2058/59 RCP 8.5	Modelled production	Average	241	0.93	0.87	249	0.97	0.91
		99th %ile	266	1.07	1.03	275	1.06	1.00
		Maximum	270	1.00	0.99	274	1.00	0.99
	% increase compared to 1951/52 to 2004/05	Average	0.74%	-1.05%	-0.66%	1.52%	0.81%	1.89%
		99th %ile	3.27%	1.26%	3.97%	2.38%	-0.29%	0.30%
		Maximum	3.47%	0.76%	4.23%	2.69%	0.16%	4.02%
		Average	252	0.98	0.92	259	0.98	0.93

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2059/60 to 2099/100 RCP 8.5	Modelled production	99th %ile	276	1.08	1.01	280	1.05	1.00
		Maximum	273	1.09	1.00	276	1.01	1.00
	% increase compared to 1951/52 to 2004/05	Average	4.56%	5.37%	5.94%	3.67%	1.54%	1.84%
		99th %ile	3.71%	0.52%	-1.81%	1.94%	-1.06%	-0.12%
		Maximum	1.11%	8.81%	1.07%	0.81%	0.76%	1.34%

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For the demand forecasts, the probable climate change forecasts have been calculated using the maximum increase from the RCP 4.5 models for the period between 2006/07 to 2058/59. The more severe climate change forecast uses the maximum increase from either the RCP 4.5 or 8.5 models and either time period. For both Braidwood and Bungendore, the highest increase in the 99th percentile dry year demand was the maximum increase under RCP 4.5 between 2006/07 and 2058/59.

Appendix table F-25: Climate change impact on system demand

Projection	Climate change scenario	Average year	99th %ile dry year	Average day peak week	Average day peak fortnight
Braidwood Low NRW	Probable	4.42%	5.75%	3.06%	3.52%
	High severity	7.02%	5.75%	3.86%	5.17%
Braidwood High NRW	Probable	2.85%	3.85%	2.39%	2.70%
	High severity	4.56%	3.85%	3.01%	3.97%
Bungendore	Probable	4.77%	6.81%	3.86%	3.73%
	High severity	8.08%	6.81%	1.47%	3.68%

#### F.4 Paleo-stochastic

DCCEEW generated 10,000-year daily data sets of rainfall and potential evapotranspiration using observed data sets (at meteorological stations) combined with palaeo climate data for use in the regional water strategies. Data is currently publicly available for selected weather stations in the NSW and ACT Murray Darling Basin catchments and will be released soon for the Nepean and Shoalhaven catchments. The closest site with the required parameters for irrigation modelling was Ainslie ACT in the Murrumbidgee Catchment.

The results from the paleo stochastic data were compared to the results from the SILO data for the same period. The results are summarised in Appendix table F-26.

Appendix table F-26: Paleo-stochastic irrigation modelling results – Ainslie ACT

		Irrigation (ML/ha)		
		Annual Total	Average day peak week	Average day peak fortnight
2023 SILO (Ainslie ACT)	Average	4.76	0.058	0.050
	99th %ile	8.18	0.075	0.066
	Maximum	8.00	0.063	0.063
	% of years with maximum	0.75%	62.69%	3.73%
Paleo-stochastic (Ainslie ACT)	Average	4.32	0.055	0.051
	99th %ile	7.29	0.074	0.065
	Maximum	8.33	0.079	0.063
	% of years greater than or equal to SILO maximum	0.07%	47.34%	3.90%
Stochastic SILO	Average	90.84%	95.67%	100.77%
	99th %ile	89.05%	97.86%	99.52%
	Maximum	104.17%	125.00%	100.00%

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Overall, based on the stochastic data, there is a very low probability of more water being required for irrigation than was shown in the SILO data on a yearly basis. There is a chance that the average day peak week irrigation demand may be higher than estimated from the SILO data, using the SILO data, irrigation was required 4 days during the maximum week, using the stochastic data, irrigation was required 5 days during the maximum week, though this only occurred in 5 out of the 9,999 financial years.

## Appendix G New dwelling demand sensitivity analysis

The sensitivity analysis was undertaken for dwellings with rainwater tanks in Bungendore. The internal demands are based on dwellings having 3-star wells rated fittings and appliances, using an average 65.5 L/person/day of water from the potable supply and 59.6 L/person/day from the rainwater tanks.

### G.1 Dwellings with 2 bedrooms

Dwellings with 2 bedrooms were assumed to have

- 13 kL rainwater tanks, as per Council's 2015 DCP
- 90 m<sup>2</sup> of roof area draining into the tank
- a household size of 1, 2, or 3 people
- irrigated garden areas of 10, 20 and 40 m<sup>2</sup>.

Appendix Table G-1: Per person water demands – houses with two bedrooms

Irrigation area (m <sup>2</sup> )	Household size	With Tank			Without Tank			With Tank Without Tank	
		Average year (kl/person/year)	Unrestricted future year (99th %ile) (kl/person/year)	Peak Average	Average year (kl/person/year)	Unrestricted future year (99th %ile) (kl/person/year)	Peak Average	Average year	Unrestricted future year (99th %ile)
10	1	24.1	25.6	1.06	50.0	53.3	1.07	0.48	0.48
10	2	26.5	33.8	1.28	47.8	49.5	1.04	0.55	0.68
10	3	30.8	40.0	1.30	47.1	48.3	1.02	0.65	0.83
20	1	24.8	29.8	1.20	54.2	61.0	1.12	0.46	0.49
20	2	28.2	38.1	1.35	50.0	53.3	1.07	0.56	0.71
20	3	32.2	42.6	1.32	48.6	50.8	1.05	0.66	0.84
40	1	28.5	43.4	1.52	62.8	76.2	1.21	0.45	0.57
40	2	31.9	46.3	1.45	54.2	61.0	1.12	0.59	0.76
40	3	35.0	47.8	1.36	51.4	55.9	1.09	0.68	0.85

The key observations that can be made from Appendix Table G-1 are:

- the 9 kL tanks are highly effective at providing a large proportion of the water required for lone person households, with very small gardens
- the unrestricted future year demand per person is quite sensitive to the irrigated area, therefore, variations in the design of villa home estates can have a significant impact on the water demand
- Unless the dwellings have only one resident and the irrigation area is very small (10 m<sup>2</sup>), the relative increase in unrestricted future year demands is significantly higher for the dwellings with tanks



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- Unless the dwellings have only one resident and the irrigation area is very small (10 m<sup>2</sup>), the relative savings due to the tank are much lower in unrestricted future years.

## G.2 Dwellings with 3 or more bedrooms

Dwellings with 3 bedrooms were assumed to have:

- 22.5 kL rainwater tanks, as per Council's 2015 DCP
- 200 m<sup>2</sup> of roof area draining into the tank
- a household size of 1, 2, 3, 4 or 5 people
- irrigated garden areas of 117 m<sup>2</sup> (selected based on the analysis undertaken for existing homes in Bungendore).

Appendix Table G-2: Per person water demands – houses with three or more bedrooms

Household size	With Tank			Without Tank			With Tank Without Tank	
	Average year (kL/person/year)	Unrestricted future year (99th %ile) (kL/person/year)		Average year (kL/person/year)	Unrestricted future year (99th %ile) (kL/person/year)	Peak Average	Average year	Unrestricted future year (99th %ile)
1	37.1	72.6	1.96	95.6	134.9	1.41	0.39	0.54
2	34.3	57.4	1.67	70.7	90.3	1.28	0.49	0.64
3	34.3	53.3	1.56	62.3	75.4	1.21	0.55	0.71
4	34.8	51.8	1.49	58.2	68.0	1.17	0.60	0.76
5	35.6	51.3	1.44	55.7	63.5	1.14	0.64	0.81

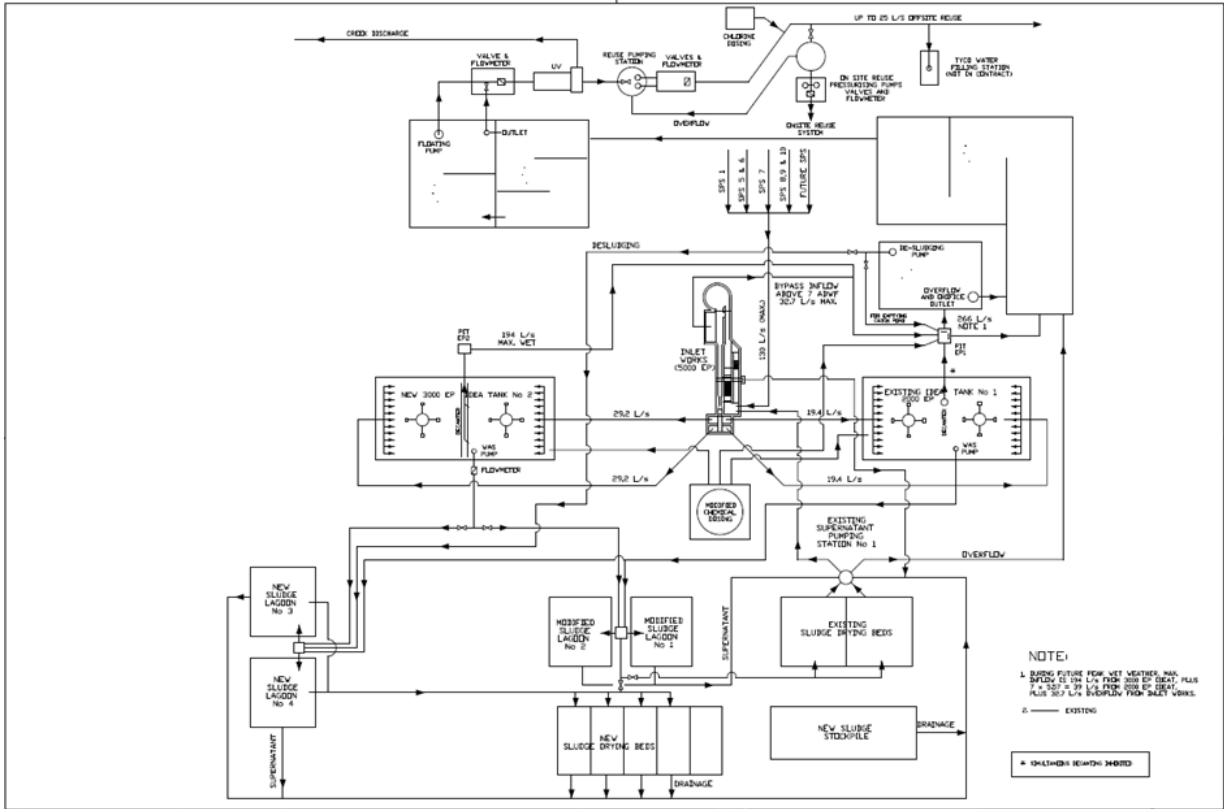
The key observations that can be made from Appendix Table G-1 and Appendix Table G-2 are:

- The tanks are highly effective at reducing the per-capita annual demand for smaller households, though the effectiveness decreases for larger households.
- The demands per person for the homes with three or more bedrooms are significantly higher than for two bedroom homes of the same household size due to the larger irrigated area.
- the relative increase in unrestricted future year demands is significantly higher for the dwellings with tanks.
- the relative savings due to the tank are much lower in unrestricted future years.

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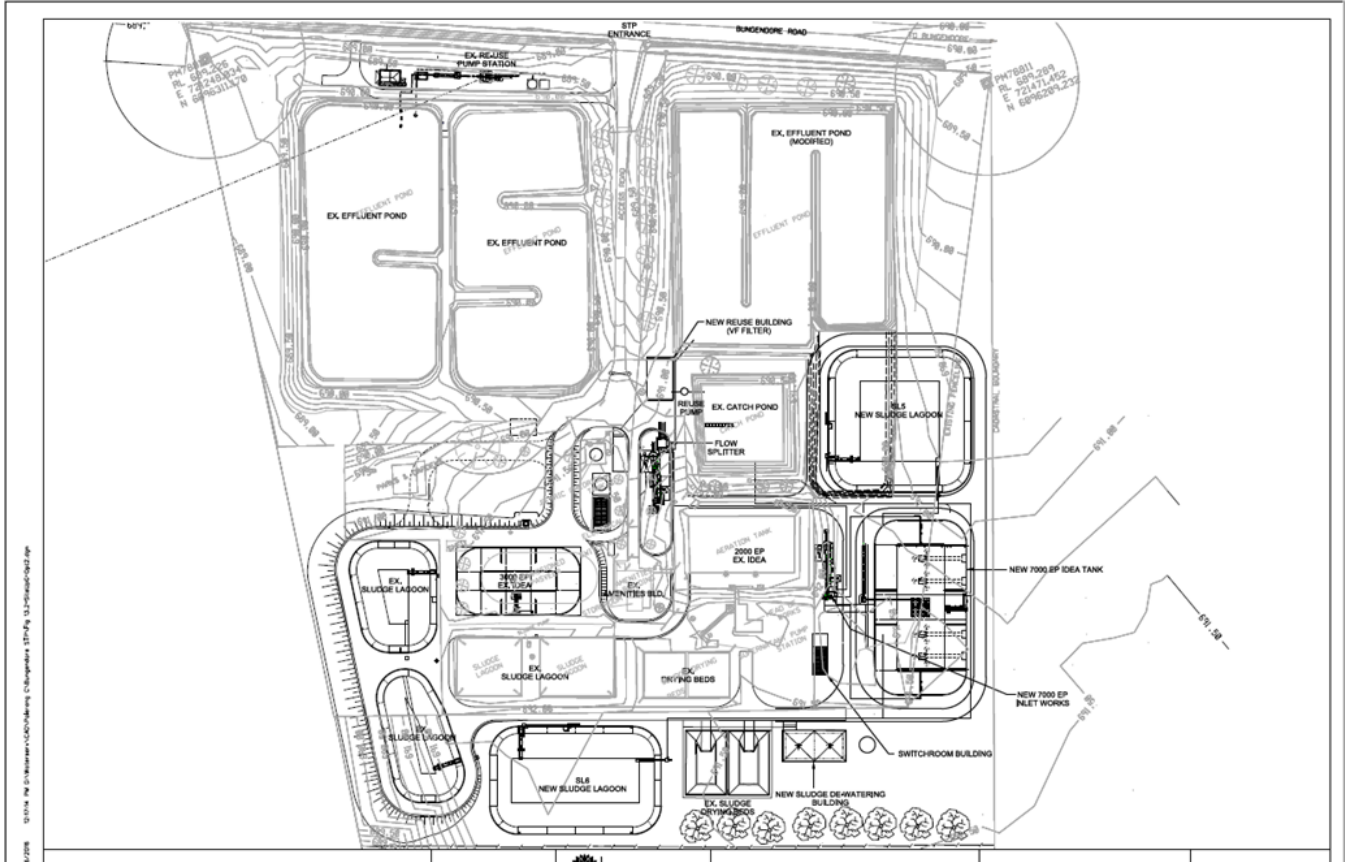


Appendix H
Sewerage process flow diagram



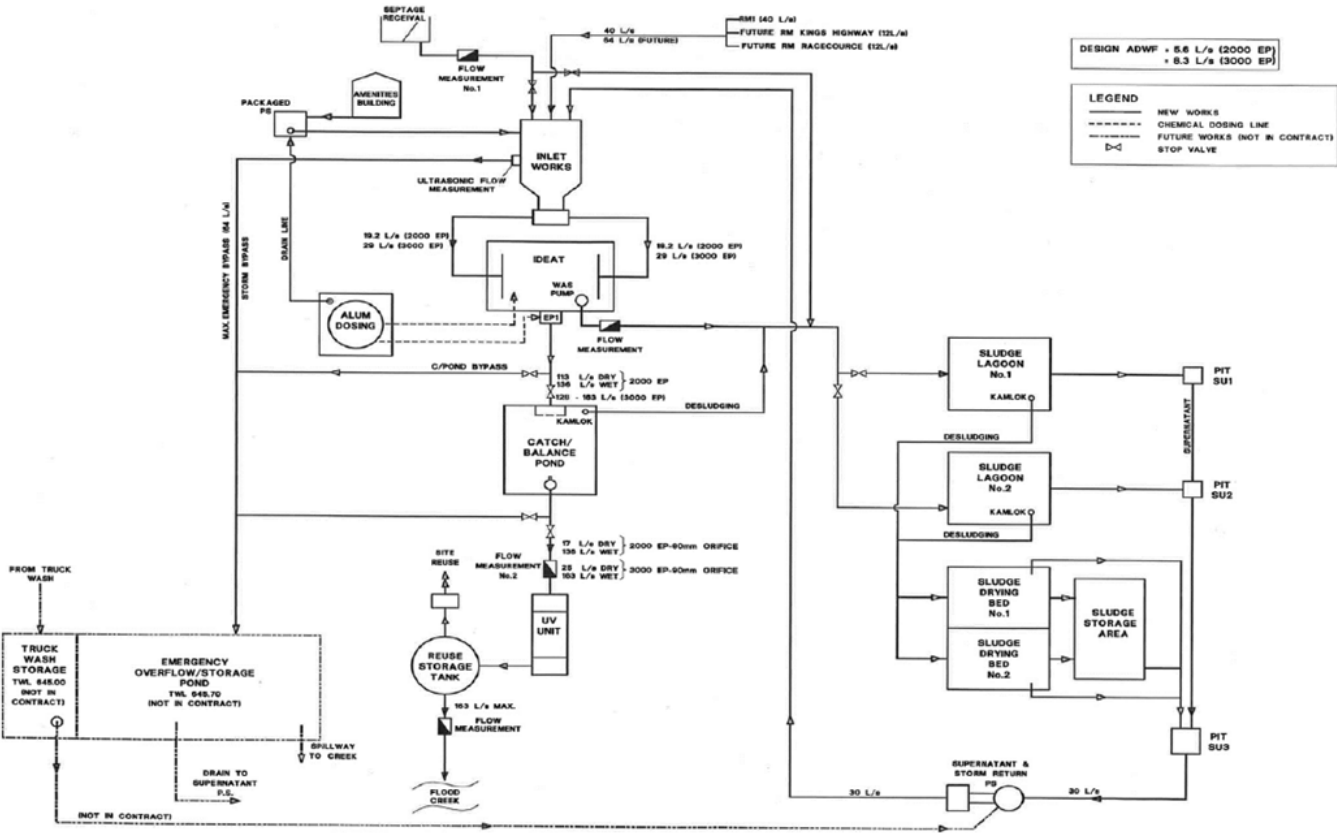
Appendix figure H-1: Detailed Process Flow Schematic – Bungendore STP

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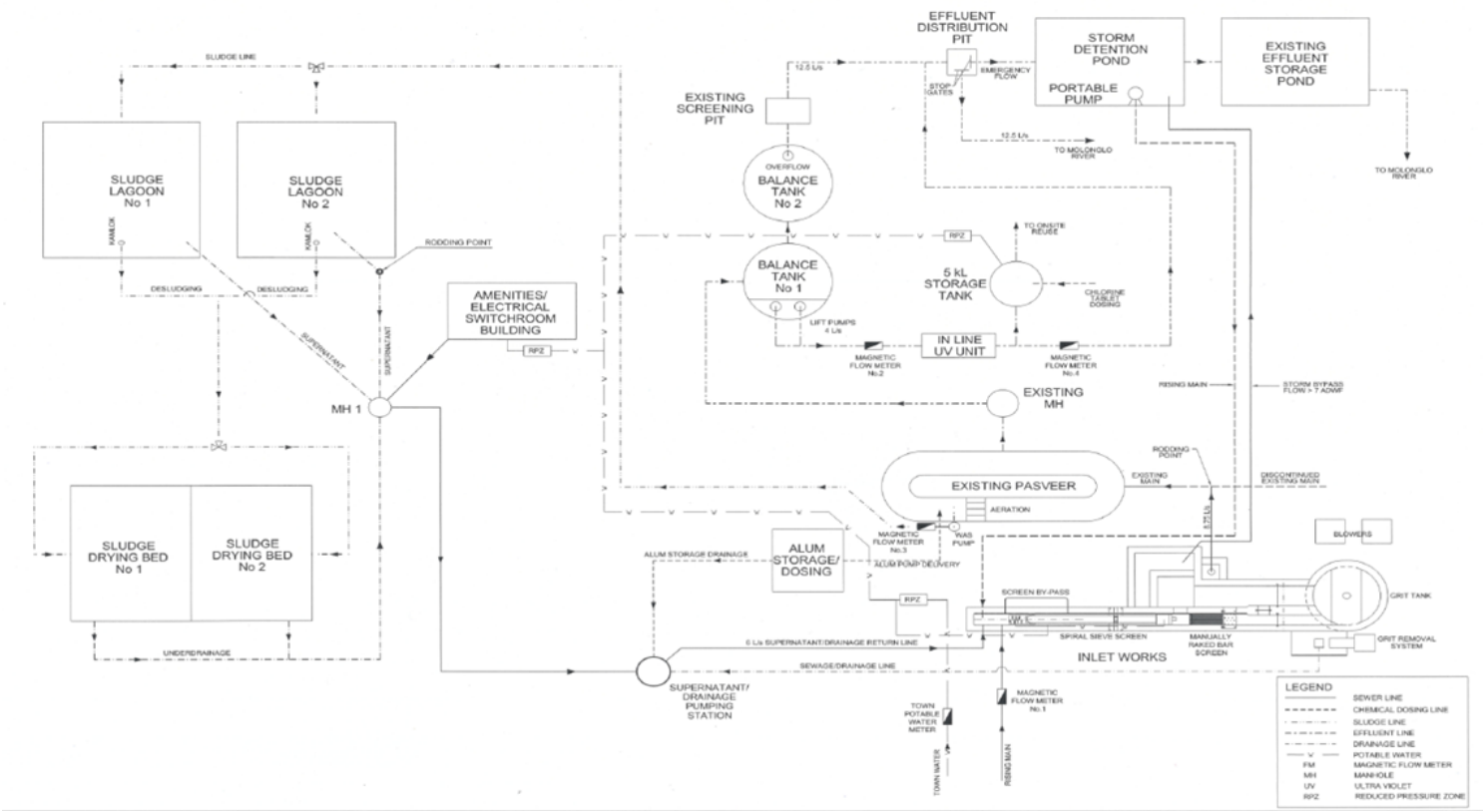
Appendix figure H-2: Plan view of Bungendore STP

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Appendix figure H-3: Detailed Process Flow Schematic – Braidwood STP

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Appendix figure H-4: Detailed Process Flow Schematic – Captains Flat STP



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Appendix table H-1: Bungendore STP's process units and capacities

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 <sub>5</sub>	70 g/EP/day <sup>1</sup> 3,000 EP 5,000 EP	210 kg/day 350 kg/day
TKN	12 g/EP/day <sup>1</sup> 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 <sup>3</sup> Total 2 x 2,150 m <sup>3</sup> 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

Appendix table H-2: Braidwood STP's process units and capacities

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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 <sup>3</sup> /m <sup>2</sup> /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	Treatment of flows up to PWWF	
BOD <sub>5</sub>	70 g/EP/day <sup>1</sup>	140 kg/day
NH <sub>3</sub>	12 g/EP/day <sup>1</sup>	24 kg/day
TP	2 g/EP/day	4 kg/day
1 x Catch / balance pond		101 m <sup>3</sup>
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 <sup>3</sup> per lagoon
2 x Sludge drying beds		440 m <sup>2</sup> 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	

Appendix table H-3: Captains Flat STP's process units and capacities

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		

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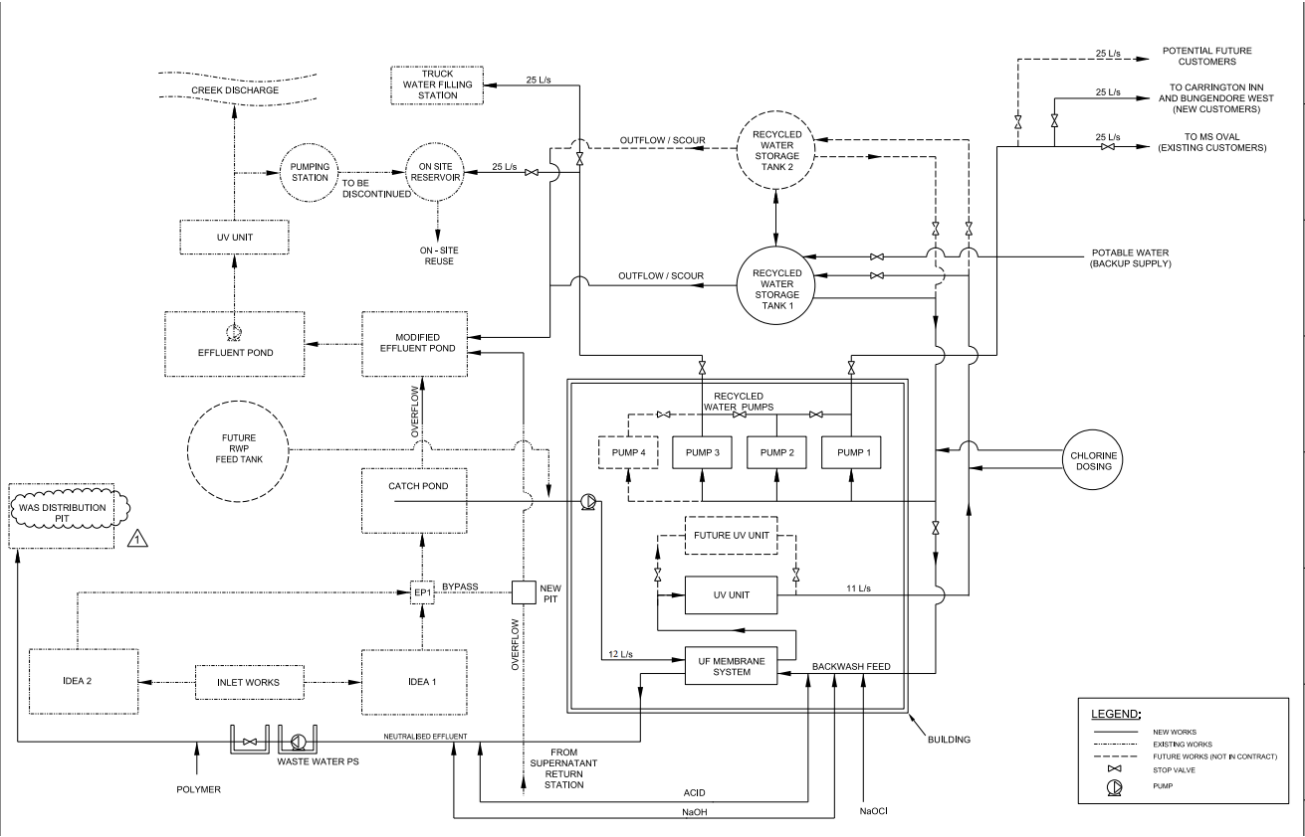


Emergency Overflow Storage		
None		
Secondary Treatment		
1 x Pasveer Channel	1 x 500 EP	
BOD <sub>5</sub>	70 g/EP/day <sup>1</sup>	210 kg/day
NH <sub>3</sub>	12.5 g/EP/day <sup>1</sup>	36 kg/day
TP	2.7 g/EP/day	6 kg/day
Chemical Dosing		
None		
Sludge Management		
2 x Sludge lagoons	Unknown	143 m <sup>3</sup> total
1 x Sludge drying bed	Unknown	Unknown
Disinfection		
None		
Effluent Management	Discharge to Molonglo River	
2 x Effluent Ponds	Unknown	900 m <sup>3</sup> total

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Appendix I Detailed Bungendore STP Reuse flow diagram



Appendix figure I-1: Detailed Bungendore STP Reuse flow diagram

# **QUEANBEYAN-PALERANG REGIONAL COUNCIL**

## **Council Meeting Attachment**

**25 JUNE 2025**

ITEM 9.5            PALERANG COMMUNITIES INTEGRATED WATER CYCLE  
MANAGEMENT (IWCM) ISSUES PAPER 2025

ATTACHMENT 2    REGULATORY AND ASSURANCE FRAMEWORK FOR LOCAL  
WATER UTILITIES

Department of Planning and Environment

[dpie.nsw.gov.au](http://dpie.nsw.gov.au)



# Regulatory and assurance framework for local water utilities

July 2022





## Acknowledgement of Country

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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Regulatory and assurance framework for local water utilities

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### Acknowledgements

Thank you to the many stakeholders across the local water utility sector who have partnered and collaborated within the Town Water Risk Reduction Program to design an improved regulatory and assurance framework for local water utilities.

This document was developed in collaboration with the Town Water Risk Reduction Program's sector stakeholders, and incorporates feedback received through the public consultation process.

### Front cover photograph

Carcoar water filtration plant, supplied by Central Tablelands Water

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## Foreword

This regulatory and assurance framework applies to local water utilities in regional NSW from 1 July 2022. It covers:

- local government councils exercising water supply and sewerage functions under Division 2 Part 3 Chapter 6 of the NSW *Local Government Act 1993* (**Local Government Act**)<sup>1</sup>
- water supply authorities exercising water supply and sewerage functions under the NSW *Water Management Act 2000* (**Water Management Act**)<sup>2</sup>
- guidelines for managing the provision of water supply and sewerage services by councils under section 409(6) of the Local Government Act.<sup>3</sup>

Local water utilities are responsible for delivering safe, secure, efficient, sustainable, and affordable water supply and sewerage services to 1.8 million people in regional NSW. They protect public health and the environment and support economic development and liveability.

The NSW Department of Planning and Environment (the department), along with other local water utility regulators, oversees and supports local water utilities in their delivery of water supply and sewerage services for healthy and resilient communities, businesses, and the environment, now and into the future.

Every local water utility faces unique challenges and risks. By working in partnership with regulators and the wider sector, local water utilities can manage risks and priorities in urban water systems more strategically and effectively. This will reduce the risks to regional NSW communities over time.

We are amending our regulation, assurance, and oversight roles in collaboration with the sector as reform is required. Improved regulatory settings and approaches are crucial to allow local water utilities and their NSW Government regulators to identify risks and effectively and efficiently manage them. This new regulatory and assurance framework empowers and enables local water utilities to address risks and strategic challenges effectively and efficiently, based on locally developed plans and management systems. Our advisory and support role is not substantially affected by the new regulatory and assurance framework. The department's Town Water Risk Reduction Program and its Water Utilities team has worked in partnership with the local water utility sector to produce this framework.

The new framework will take effect from 1 July 2022. This framework contributes to the implementation of relevant NSW Government commitments under the National Water Initiative,

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<sup>1</sup> A list of the local government councils exercising water supply functions under the *Local Government Act 1993* is available at: [www.industry.nsw.gov.au/water/water-utilities/local-water-utilities](http://www.industry.nsw.gov.au/water/water-utilities/local-water-utilities)

<sup>2</sup> The following utilities are exercising water supply functions under the *Water Management Act 2000*: Central Coast Council, Cobar Water Board, Essential Energy, and WaterNSW for the Fish River Water Supply.

<sup>3</sup> This relates to content covered in Sections 3 and 4 of this document, and applies to councils only.



National Competition Policy, and the NSW Water Strategy. Local water utilities that are currently preparing an Integrated Water Cycle Management (IWCN) Strategy will not be disadvantaged by any of the changes, as there will be a transition period for these utilities to 1 December 2022. The department will work with each utility to develop an appropriate individual transition plan, including where funding agreements are in place.

Once the Minister for Lands and Water (with the agreement of the Minister for Local Government) has published a notice in the NSW Government Gazette, sections 3 and 4 of the regulatory and assurance framework replace the 2007 Best-Practice Management of Water Supply and Sewerage Guidelines for dividend payments under section 409 of the Local Government Act, effective 1 July 2022. Local water utilities not making dividends payments are encouraged, but not compelled, to use the department's assurance framework and experience and capacity to support effective strategic planning, as outlined in section 3.

The department recognises that this framework represents a significant change to how the activities of local water utilities have been reviewed and regulated in the past. The department seeks to optimise the impact of this change on local water utilities through strengthening our partnership with them.

We will support the new framework by instituting a stronger partnership approach and culture, continuing to give advice and support, and taking a collaborative approach to problem-solving. We will proactively engage with local water utilities, other regulators, and the community to identify solutions to support the vision and objectives for the local water utility sector (section 1). This advisory and support role will be transparent in nature, and exercised distinctly from the department's broader regulatory, assurance, and oversight functions.

We are also aware that to support successful implementation of this new framework, the department needs to change our own culture and ways of working to operate in a manner consistent with the guiding principles outlined in this document at section 2.2. To support this, we are implementing new accountability, transparency, and quality assurance mechanisms as appropriate, to build trust and confidence in how we work.

This document sets out the department's regulatory and assurance framework for local water utilities. In addition to its regulatory role, the department gives expert strategic advice and financial and technical support to local water utilities and other stakeholders for regional urban water supply and sewerage services. This support covers planning, pricing, capital works, operation, maintenance, management, and training. We are also a funding partner with local water utilities in the delivery of critical water and sewerage projects.

The department acknowledges it is not expressly empowered under legislation to regulate strategic planning or to enforce compliance related to the strategic planning of local water utilities. However, the department seeks to use this framework to highlight the importance of effective strategic planning by local water utilities. Appropriate, effective, strategic planning by local water utilities represents a critical component of the department achieving all its statutory and other objectives.

As part of our commitment to continuous improvement, we will conduct a performance review of the implementation of this regulatory and assurance framework (and associated guidance materials) within 2 years from finalisation. There will also be regular periodic reviews of the full suite of relevant regulatory documents, which will happen at least every 5 years.

# 1 Vision and objectives of the local water utility sector

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## 1.1 Local water utility sector vision

This framework is guided by the collective vision of all sector stakeholders.

Our shared vision is:

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Safe, secure, sustainable and affordable water and sewerage services for healthy and resilient communities, businesses and the environment, now and into the future.

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## 1.2 Local water utility sector objectives

The local water utility sector includes local water utilities, the department, other regulators, industry associations, the private sector, and other interested stakeholders.

The sector objectives are to continue to ensure:

- safe and secure drinking water supply to protect public health and the environment, and to support economic development and liveability
- effective sewerage services to protect public health and the environment, and to support economic development and liveability
- services that meet customer and community needs, expectations, and preferences
- financially sustainable water utilities with efficient and affordable pricing for services.

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## 1.3 The role of local water utilities

The role of local water utilities is to deliver safe, secure, efficient, and affordable water and sewerage services to customers and communities, providing public health outcomes, and supporting economic development, liveability, and the environment.

Local water utilities are governed in NSW by the *Local Government Act 1993* and the *Water Management Act 2000*, as well as the:

- *Public Health Act 2010*
- *Protection of the Environment Operations Act 1997*
- *Environmental Planning and Assessment Act 1979*
- *Dams Safety Act 2015*
- *Work Health and Safety Act 2011*
- *Water Act 2007* (Cth),

and any other relevant and applicable legislative and regulatory instruments.

## 2 The department's role

Every local water utility faces unique challenges and risks. By working in partnership with regulators and the wider sector, local water utilities can manage risks and priorities in urban water systems more strategically and effectively and, as a result, reduce risks in regional NSW communities over time.

The [NSW Water Strategy](#) identifies the department as the primary regulator for regional local water utilities under the Local Government Act, as well as under the Water Management Act. The department works closely with other regulators to support and regulate these utilities.

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### 2.1 Oversight of local water utilities

The department is responsible for overseeing local water utilities in their delivery of safe, secure, sustainable, and affordable services and management of water service risks. To achieve this, the department:

- sets policy
- regulates, and makes regulatory decisions
- provides oversight and assurance
- monitors and reports on performance.

The department performs a variety of different roles (listed in section 2.4 below) to manage sector-wide and utility-specific risks. This is supported by the sector, which broadly acknowledges that it is reasonable for the department to play a leading role in ensuring local water utilities are managing risks, and that we do this by providing oversight and assurance. This regulatory and assurance framework has been developed in partnership with the sector.

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### 2.2 Guiding principles

The department has a series of guiding principles that influence the way it makes decisions, engages with local water utilities, and performs its regulatory and oversight functions. These principles govern our relationship with local water utilities and give a clear standard for how the department will conduct its regulatory, assurance, and oversight functions.

**We will focus on outcomes and be flexible and proportionate in our approach:**

- When exercising its role for local water utilities, the department will focus on outcomes and be flexible in assessing how different local water utilities achieve the required outcomes.
- The department will have guidelines in place that balance the need for clear expectations with giving local water utilities the flexibility to make their own decisions.

**We will prioritise according to risk:**

- The department will allocate its resources to deliver the greatest benefit, while prioritising the biggest risks to public health, customers, or the environment.

**We will work collaboratively with the sector, be fair, and accept accountability:**

- The department will work in partnership with the local water utility sector to ensure that its approach to regulation, oversight, and advice is relevant and targeted.
- The department will seek information and input from local water utilities before making key decisions and explain its decisions once it makes them. The department will be answerable for its decisions, including providing mechanisms for its decisions to be reviewed.
- The department will set clear timelines for its processes and keep local water utilities updated on how their matters with it are progressing. We will publicly report on how we are meeting our timelines.

**We will be transparent:**

- The department will publish its policies, priorities and expectations and give information that explains what local water utilities can expect from its processes.
- The department will use plain language and be clear and concise in its communications.
- The department will ensure there is a clear distinction between its oversight, advice, and support functions, its funding role, and its formal regulatory functions.

**We will work collaboratively with other regulators:**

- The department will work collaboratively with other regulators of local water utilities to ensure we all have clear roles and responsibilities and that we communicate effectively with each other and local water utilities.

**We will actively seek feedback and opportunities to improve:**

- The department will listen and be responsive to requests and feedback.
- The department will monitor and evaluate its performance as regulators and partners, including actively seeking feedback from local water utilities, regulators, and other stakeholders. The department will use this information to improve its regulatory approach and processes.

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## 2.3 Why the department oversees local water utilities

### 2.3.1 Ensuring utilities are managing key risks

The department's regulatory and assurance roles seek to ensure utilities are managing key areas of risk for:

- water security (including continuity of service)
- water quality
- the environment

- assets and infrastructure
- customers (including water supply and pricing)
- financial sustainability of the utility

## 2.3.2 Overarching regulatory and assurance objectives

In ensuring local water utilities manage risks, the department's overarching regulatory and assurance objectives are:

- driving the supply of safe and secure water and sewerage services
- supporting the protection of public health
- supporting the protection of the environment
- promoting the principles of Integrated Water Cycle Management to support sustainability and liveability
- promoting resilient infrastructure and fostering innovation
- promoting meaningful engagement with communities so that local water utility decisions meet their needs
- protecting the interests of current and future customers and the community.

The department achieves these regulatory and assurance objectives by expecting and enabling local water utilities to:

- conduct effective, evidence-based strategic planning for water supply and sewerage services that applies the principles of adaptive planning and integrated water cycle management, and considers climate risks
- identify and manage risks in strategic and effective ways
- implement robust and effective operational risk management, including effective and safe operation and maintenance of systems and robust emergency and incident management
- make fit-for-purpose infrastructure investments
- implement robust and effective processes to monitor performance
- protect and promote the interests of customers through efficient and affordable pricing
- be financially sustainable and manage finances prudently.

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## 2.4 The roles of the department

As outlined in section 2.1, the department may engage with local water utilities in a variety of different capacities. These roles (depicted in Figure 1) include:

- setting of statewide policy, and state and regional strategies (see section 2.4.1)
- giving advice (see section 2.4.2)
- providing regulation and assurance (see section 2.4.3)
- funding (see section 2.4.4).

The department performs these roles to ensure local water utilities are managing potential areas of risk appropriately.

Figure 1. The roles of the department



These 4 roles operate in a distinct manner, but will naturally interact and intersect. For example, the department may give advice and support in helping a utility prepare a section 60 application, before turning to its regulatory role of considering the formal application.

### 2.4.1 The department's role setting statewide policy and strategies

The department is responsible for the NSW Water Strategy, which takes a strategic and integrated approach to looking after the state's water. This is the first 20-year water strategy for all of NSW, and seeks to improve the security, reliability, quality, and resilience of our water resources over the long-term. It sets the priorities and outlines the implementation plan to delivering on these outcomes.

The NSW Water Strategy sets the overarching vision for 12 regional and 2 metropolitan water strategies, tailored to the individual needs of each region in NSW. Together, the strategies will improve the resilience of NSW's water services and resources.

### 2.4.2 The department's advisory and support role

The department has an advisory and support role, assisting local water utilities manage and reduce risks. Our staff act as trusted advisors to our stakeholders, working in partnership with local water utilities to facilitate outcomes by giving free, independent, and impartial advice and support.

The advice and support the department gives, over and above and separate to its regulatory and assurance role (outlined in section 2.4.3), includes:

- advice on planning for and managing regulatory issues with the department
- expert specific or general technical advice, including on planning, pricing, capital works, operation, maintenance, and management
- incident and emergency management support
- coordinating programs such as water efficiency and training
- promoting the exchange of insights between local water utilities to promote best practice in the industry.

Ongoing engagement with local water utilities means we gain an understanding of emerging risks and, together with the other local water utility regulators, can give advice to inform an appropriate and targeted response. Local water utilities benefit by gaining a better understanding the department's regulatory stance and processes. This makes the whole regulatory process more efficient.

During times of drought, flood or other water supply and sewerage emergencies, we give technical and/or financial assistance to help prepare or revise drought management plans, manage depleted supplies, implement emergency capital works, or cart water where appropriate and feasible.

Emergency capital works include things like emergency bore supplies, temporary or permanent connection to another source or water supply scheme, or the development of new water sources.

We may also give technical support to help manage risks to water and sewerage services, such as those posed to town drinking water following bushfires or flooding.

### 2.4.3 The department's regulatory and assurance roles

The department has formal regulatory roles. These are outlined in more detail throughout this framework. They are:

- providing oversight of utility's dividend payments (applicable to councils only under section 409(6) of the Local Government Act) (section 4 of this framework)
- giving approvals for applications under section 60 of the Local Government Act and section 292(1)(a) of the Water Management Act (section 5)
- inspecting water and sewage treatment works for the purposes of informing further action (section 6)
- concurrence to the discharge of liquid trade waste (section 7).

The department also performs an assurance role for strategic planning (section 3 of this framework).

The department performs these roles to manage sector-wide and utility-specific risks. These roles reflect the department's diverse expertise and independence. This is supported by the sector, which broadly acknowledges that it is reasonable for the department to play a leading role in managing risks by providing oversight and assurance.



In performing these roles, the department is committed to driving continuous improvement (both across utilities, and for its own role as a regulator, advisor, and supporter). In doing so, the department acknowledges that, in instances where it does not have legislated regulatory authority, it cannot bind or direct utilities, and there are no compliance requirements or enforcement measures that the department can use.

The department's consideration of the effectiveness of strategic planning done by local water utilities is important to:

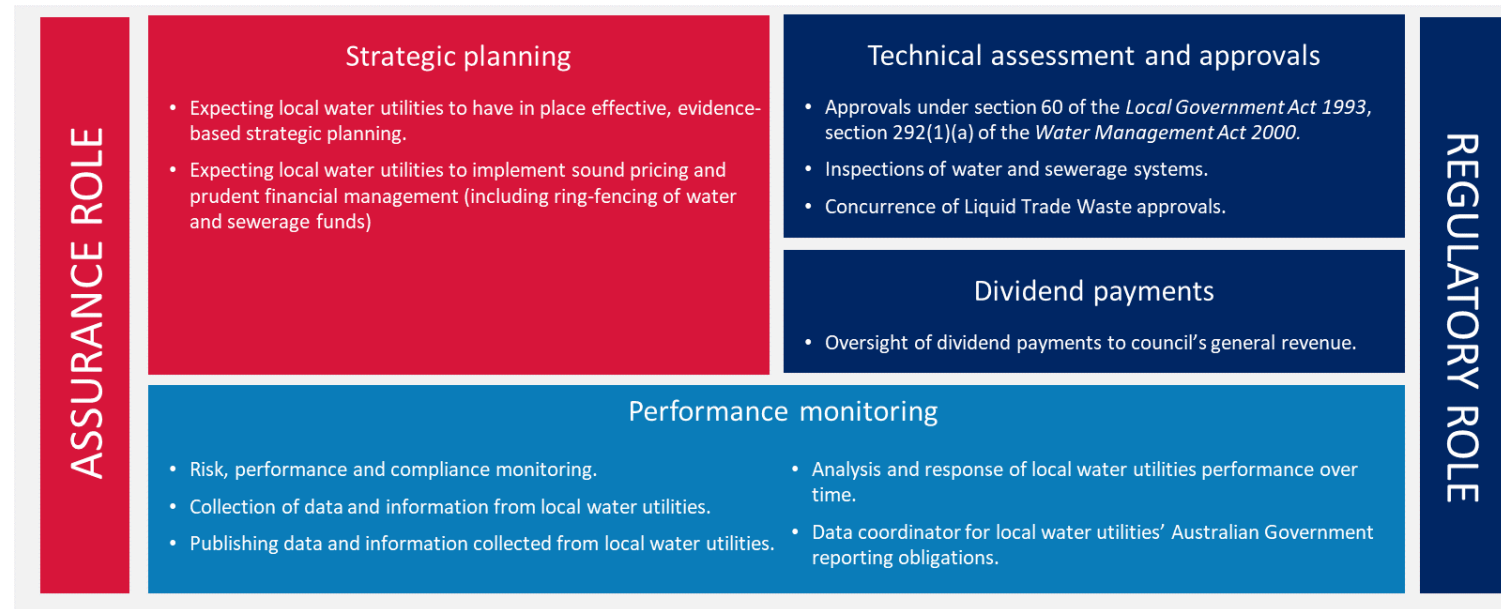
- inform the department's regulatory roles
- inform the policy, strategy and funding roles of the department
- ensure communities, decision-makers and other local water utility stakeholders have appropriate insight about:
  - the effectiveness of the utility's strategic planning
  - the utility's ability to deliver safe, secure, accessible, and affordable water supply and sewerage services to customers
  - the utility's ability to manage key risks now and into the future, and in the event of significant shocks
- enable the department to give enough advice and support to local water utilities.

While it is optional, we encourage utilities to use the department's assurance function so that additional perspectives, knowledge, and expertise are incorporated into activities such as strategic planning.

Performance monitoring and reporting (outlined in section 8 of this framework) is used to target regulatory effort and inform the assessments and activities we do under our regulatory and assurance roles.

Figure 2 summarises the department's regulatory and assurance roles.

Figure 2. The department has 3 core areas of responsibility to provide regulation and assurance for regional water supply and sewerage services



In performing its regulatory and assurance roles, the department will:

- set expectations for strategic planning and pricing, and assess whether they are being met in accordance with its regulatory objectives and principles
- approve (or not) construction or extension of water treatment works
- approve (or not) the provision of sewage from its area to be discharged, treated, or supplied to any person, this includes the treatment and supply of recycled water
- provide oversight of utility's dividend payments (this is relevant to councils only)
- liaise with local water utilities to coordinate and support the process of engagement and regulation, including giving general advice on how to comply with specific stages and requests in the relevant processes
- produce clear, concise, and accessible guidance that gives more detail about the expectations of local water utilities (within the boundaries of its regulatory and oversight objectives and principles, that is, outcomes-focused, and risk-based), as well as 'how to' guidance, templates, case studies and tools that help local water utilities understand and meet expectations, where required
- work with local water utilities to resolve any actual or perceived overlap between regulatory and assurance functions and requirements managed by the department and those managed by other regulators
- work with other regulators to assist local water utilities manage water quality, water security, environmental and financial sustainability risks (as outlined in more detail in section 10 of this framework)
- conduct performance and risk monitoring to inform regulatory assessments and activities, drive strategic and operational improvements, and identify performance trends over time.

#### 2.4.4 The department's funding role

The department manages the \$1-billion Safe and Secure Water Program, the NSW Government's flagship water infrastructure program for local water utilities. It gives co-funding to help regional towns remove risks to water quality, water security, and the environment.

The department also manages the Aboriginal Communities Water and Sewerage Program.

As described in section 2.4.2, during times of drought, flood or other water supply and sewerage emergencies, the department gives technical and/or financial assistance to help prepare or revise drought management plans, manage depleted supplies, implement emergency capital works, or cart water where appropriate and feasible.

Where funding may be given, the department has a role in considering if the investment is prudent and offers value for money. It will work closely with relevant utilities and regulators as appropriate.

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## 2.5 Risk-based regulation and assurance

The department takes a risk-based approach to regulation and assurance of local water utilities. This means we target our efforts for oversight, support and intervention based on analysis of the risk profile for each local water utility, and across the sector.

In applying a risk-based approach to regulation and assurance, the department will:

- do ongoing monitoring with early engagement to inform risk analysis and identification
- take a flexible and proportionate approach focused on achieving outcomes
- balance resourcing between our different roles
- balance best practice in infrastructure design and operation with how best to meet the needs of the communities that the infrastructure supports
- be clear about why data needs to be collected and proactive in how analysis is actioned.

In line with a risk-based and flexible approach, the department will support its regulatory and assurance objectives by giving information to support capability building. The department may give information in response to a request from a local water utility to help it comply with a specific regulatory matter, or a more general request for support to ensure regulatory objectives can be met.

The department will support implementation of this framework by giving advice and guidance to local water utilities. The department will publish guidance material that gives more detail on expectations, as well as templates, forms, and case studies to help local water utilities understand and meet expectations.

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## 2.6 Other regulators

The department is identified in the [NSW Water Strategy](#) as the primary regulator for regional local water utilities under the Local Government Act, as well as under the Water Management Act. The department works closely with other regulators to support and regulate these utilities.

In addition to the department, other NSW Government regulatory agencies are responsible for overseeing local water utilities within their own regulatory frameworks. The department works collaboratively with other regulatory agencies to ensure we provide efficient and effective support to local water utilities.

NSW Health, the NSW Environment Protection Authority, the Office of Local Government, the Natural Resources Access Regulator, Dams Safety NSW, and the Independent Pricing and Regulatory Tribunal of NSW all have specific responsibilities for overseeing and supporting local water utilities within their own regulatory frameworks.

Section 10 gives more information about coordination with local water utility regulators.

## 3 Strategic planning assurance

### Councils making a dividend payment

This section has been published in the NSW Government Gazette in accordance with s.409(6) of the *Local Government Act 1993*. Councils making a dividend payment from a surplus of their water and/or sewerage business must meet the expectations set out in this section and section 4.

Local water utilities can best meet the needs of their customers, and manage key risks, when their decisions and activities are based on effective, evidence-based strategic planning. Strategic planning is crucial to identifying and managing key risks to:

- water security
- water quality
- the environment
- assets and infrastructure
- customers
- their financial sustainability.

The department is committed that all local water utilities should do effective, evidence-based strategic planning. This will ensure utilities deliver safe, secure, accessible, and affordable water supply and sewerage services to customers and can manage key risks now and into the future, and in the event of significant shocks. Local water utilities remain responsible for conducting strategic planning.

Local water utilities' strategic planning contributes to the water security of their regions and the entire state. The department will work in partnership with local water utilities to support integration of state, regional and local water utility strategic planning. We will play a leadership role and give access to our resources (including models and data) as appropriate.

The department's assurance role gives assurance of effective, evidence-based strategic planning and effective management of key risks to service provision.

Under this assurance role, the department establishes what outcomes it expects effective, evidence-based strategic planning to achieve (see section 3.2) and assesses whether a local water utility's strategic planning achieves these outcomes to a reasonable standard (see sections 3.3 and 3.4).

From time to time, the department may request information from utilities to complete this assessment. While it cannot compel utilities to comply with these requests, the department expects that most utilities will, given the mutual benefits associated with the department's ability to

accurately assess the strategic planning done by local water utilities and make informed suggestions about their activities.

We then communicate the result of our assessments publicly so that the utility, its community, financiers, regulators, and other stakeholders are assured that effective, evidence-based strategic planning is in place (see section 3.5). Publishing the result of assessments is also a key incentive tool available to the department. In addition, we will write to general managers, councils, or boards about the result.

The department acknowledges it is not expressly empowered under legislation to regulate strategic planning or to enforce compliance. The department seeks to provide assurance of the effectiveness of strategic planning conducted by local water utilities to ensure that utilities address customer needs and key risk proactively. This also allows the department to meet its full suite of legislative responsibilities for local water utilities.

The department's review of the effectiveness of strategic planning done by local water utilities is important to:

- inform the department's regulatory roles
- inform the policy, strategy and funding roles of the department
- ensure communities, decision-makers and other local water utility stakeholders have appropriate insight about the effectiveness of the utility's strategic planning and ability to deliver safe, secure, accessible, and affordable water supply and sewerage services to customers and manage key risks now and into the future, and in the event of significant shocks
- enable the department to give adequate advice and support to local water utilities.

Before council takes a dividend payment under s 409(5) of the Local Government Act, its local water utilities must have in place effective, evidence-based strategic planning in accordance with this section. This section has been gazetted in accordance with that provision.

The department's strategic planning assurance role will work in tandem with our separate advisory and support role. As outlined in section 2, we give guidance, advice, and support to local water utilities to help them have in place effective, evidence-based strategic planning.

In addition, the Safe and Secure Water Program provides co-funding to eligible utilities to do strategic planning, including regional town water strategic planning.

To enable local water utilities to meet the expectations set out in the assurance framework, we will produce:

- Guidance that gives more detail on the expectations for achieving strategic planning outcome to a reasonable standard. The purpose of this guidance is to make expectations clear and enable the department to assess if the outcome is achieved to a reasonable standard.
- Optional 'how-to' guidance, which demonstrates how strategic planning outcomes can be achieved to a reasonable standard using the Integrated Planning and Reporting Framework for council under the *Local Government Act 1993* (NSW)

- Optional templates, case studies and tools to support utilities in achieving the strategic planning outcomes to a reasonable standard.

Gaps in a local utility's strategic planning may expose regional communities to risks. The department will proactively support utilities to identify any gaps. Where gaps are identified, we will help local water utilities by giving appropriate advice and guidance in a collaborative way. This will help local water utilities reduce risks and strengthen their strategic planning over time.

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### 3.1 Local water utilities decide how to achieve effective, evidence-based strategic planning

While the department sets expectations for the outcomes that strategic planning needs to achieve to be effective and evidence-based, utilities can decide what approach to take to meet them. Generally, the department will not specify the approaches, processes, and tools that a utility should use for strategic planning. Local water utilities are responsible for developing and implementing their own strategic planning. There is no single best-practice way for this work to be delivered, although the department will give 'how to' guidance, templates, case studies and tools to facilitate a streamlined process. Our overall priority is to ensure strategic planning outcomes (outlined in Section 3.2) are achieved to a reasonable standard.

Local water utilities vary in size, geography, demographics, challenges, and organisational arrangements, which means strategic planning approaches and outputs can be significantly different across regional NSW.

For example, many council-owned water utilities have expressed interest in using the Integrated Planning and Reporting (IP&R) framework of the Local Government Act as a vehicle for local water utility strategic planning. The value of the IP&R framework as a standardised and well understood approach to strategic planning and reporting is widely recognised by the local government sector. We acknowledge that some councils have already incorporated elements of the IP&R framework into their local water utility strategic planning. For others, the IP&R framework may not be an appropriate or desirable approach. In some instances, the framework may need to be supplemented to adequately cover key outcomes of local water utility strategic planning (such as understanding water security).

We will give ongoing support to ensure that local water utilities can do planning in a way that will meet the outcomes set by the department. A local water utility can also specifically request advice and support from department staff. In addition, when the department identifies (through data analysis and engagement) that a local water utility may face challenges in its strategic planning activities, we may give support on a proactive basis.

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### 3.2 Strategic planning outcomes

For effective, evidence-based strategic planning to occur, the department expects it to achieve the following outcomes to a reasonable standard:

#### **Understanding service needs**

- What are customers' needs, values, and preferences?
- What current and future demands are placed on water supply and sewerage systems?
- How will the local water utility consider and address objectives, priorities and evidence of other relevant state or regional strategic planning, including the NSW Water Strategy and regional water strategies?

#### **Understanding water security**

- What is the local water utility's access to current and potential water supply sources?
- How will the local water utility address current and future risks around continuity and reliability of access to water supply sources?

#### **Understanding water quality**

- How will the local water utility address current and future water quality risks in its supply systems?
- How will the local water utility meet relevant regulatory standards, such as on drinking water quality management?

#### **Understanding environmental impacts**

- How will the local water utility address current and future environmental impact risks in its sewerage systems?
- How will the local water utility meet relevant regulatory standards, such as licence requirements set by the environmental regulator?

#### **Understanding system capacity, capability and efficiency**

- What is the capacity and capability of systems to deliver water (and future capacity and capability needs)?
- What is the capacity and capability of its systems to collect and treat sewerage (and future capacity and capability needs)?
- How will the local water utility consider water efficiency in its systems?

#### **Understanding other key risks and challenges**

- How will the local water utility address other key risks in its systems now and into the future?
- How will the local water utility meet relevant regulatory standards (for example, such as on dam safety)?
- How has the local water utility considered climate risks?
- How is the local water utility planning for drought?
- How is the local water utility planning and preparing for incidents, emergencies, and extreme events and ensuring continuity of service?

#### **Understanding solutions to deliver services**

- How are options for delivering services and managing risks analysed?
- How are supply and demand side options for water supply identified and evaluated?
- How are assets managed over their life cycle to ensure service levels are met?



- How are the preparedness and resilience management during extreme events considered?

#### **Understanding resourcing needs**

- What resourcing is needed to deliver services and manage risks?
- What are the life-cycle costs of managing assets?
- What are the technical and operational skills needed to deliver services and manage risks?
- How does the local water utility do workforce planning?

#### **Understanding revenue sources**

- What are the revenue sources available to fund the delivery of services?
- What is the customers' ability to pay for services?
- What is the customers' willingness to pay for services?

#### **Make and implement sound strategic decisions**

- Based on its understanding of, and adequate consideration of, service needs, risks, and resources, how does the utility set service levels and efficient revenue requirements for providing services over an adequate forward period to capture asset lifecycle?
- How are customers engaged in decision-making and informed of choices between service levels, risks, and cost?
- How does the local water utility ensure its long-term financial sustainability, including managing unexpected financial shocks in future periods without having to introduce substantial or socially destabilising revenue or expenditure adjustments??
- How does the utility implement service levels and monitor, and report on, performance to understand if it is meeting service levels and managing risks?

#### **Implement sound pricing and prudent financial management**

- How does the utility set and structure its water supply and sewerage pricing to recover its revenue requirement, promote efficient use of water, and achieve equitable and affordable pricing and intergenerational equity?
- How does the utility implement a cost-reflective and consumption-based tariff structure and long-term stable price path?
- How does the utility set appropriate developer charges to recover the infrastructure cost of servicing growth?
- How does the utility consider payment of tax equivalents and dividends?
- How does the utility consider affordable access to essential water services for all customers?
- How does the utility 'ring-fence' the water supply and sewer business fund from council's general-purpose fund?

#### **Promote integrated water cycle management**

- How are urban water cycle outcomes including water security, public health, environmental and urban amenity and liveability identified, achieved and funded?

- How does the utility consider opportunities and methods to increase resource efficiency and recovery in urban water management?
- How is the local water utility supporting customers to increase water literacy and support water efficiency measures?

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### 3.3 Achieving outcomes to a reasonable standard

The department will assess whether a local water utility's strategic planning achieves the outcomes described in section 3.2 to a reasonable standard.

The department will consider that a reasonable standard for each outcome is met if the utility considers and addresses an outcome in a way that is:

- **sufficient** – underpinned by evidence-based analysis that supports the conclusions reached
- **appropriate** – underpinned by relevant departmental guidance and industry standard approaches to conduct planning and reach conclusions
- **robust** – underpinned by evidence that draws on appropriate sources, and recognises and rebuts potential alternative interpretations.

The considerations we will apply to the reasonable standard test and how these may be addressed are set out in more detail in Table 1. Importantly, 'sufficient', 'appropriate', and 'robust' are 3 separate but interlinked characteristics we assess when considering whether strategic planning outcomes are achieved to a reasonable standard, rather than tiered levels of assessment outcome (see Figure 3).

Figure 3. The 3 considerations comprising the 'reasonable standard test'



Table 1. Assessment of the 3 considerations of reasonable standard

Consideration	Sufficient	Appropriate	Robust
<b>Applied by department</b>	<p>The evidence that underpins each strategic planning outcome gives objective support for the conclusions reached</p> <p>We will consider:</p> <ul style="list-style-type: none"> <li>whether objective evidence has been given for each of the strategic planning outcomes</li> <li>whether the evidence given supports the conclusions drawn</li> <li>the extent to which any gaps in available evidence can be justified.</li> </ul>	<p>Use of standardised approaches to planning and reaching relevant conclusions</p> <p>We will consider:</p> <ul style="list-style-type: none"> <li>whether regulatory, legislative, industry or other standards or methodologies apply to the aspect of strategic planning under consideration</li> <li>if such standards or methodologies apply, whether the local water utility has both used those standards or methodologies and applied them correctly</li> <li>if such standards or methodologies apply and the utility has either not used them or not applied them correctly, whether there is any reasonable justification for this.</li> </ul>	<p>Evidence draws on appropriate sources that recognises and rebuts potential alternative interpretations.</p> <p>We will consider whether:</p> <ul style="list-style-type: none"> <li>the evidence presented was generated or prepared in an impartial manner to support the conclusion reached</li> <li>alternative constructions of the evidence presented have been considered (that is, if the evidence is open to interpretation, have all interpretations been considered and/or rebutted).</li> </ul>

Consideration	Sufficient	Appropriate	Robust
<b>Ways to substantiate</b>	<p>Evidence includes:</p> <ul style="list-style-type: none"> <li>expert advice or input (for example, reports from consultants, analysis on demographic projections)</li> <li>audited materials (for example, financial statements)</li> <li>external accreditation (for example, meeting ISO standards)</li> <li>public data (for example, NSW Common Planning Assumptions, ABS demographic projections)</li> <li>observations by the department's staff of processes and approaches where appropriate.</li> </ul>	<p>Local water utilities should:</p> <ul style="list-style-type: none"> <li>highlight what standards or methodologies they think apply</li> <li>outline how these standards or methodologies have been applied</li> <li>the extent to which they departed from these standards or methodologies and an explanation for that departure.</li> </ul>	<p>Local water utilities should:</p> <ul style="list-style-type: none"> <li>highlight what evidence has been used to support what conclusions</li> <li>outline the analysis of that evidence done to support the conclusions reached</li> <li>highlight any alternative interpretations of the evidence available</li> <li>Outline why the local water utility has reached the conclusion that it has.</li> </ul>

The department will produce guidance that gives more detail on the expectations for achieving strategic planning outcome to a reasonable standard.

The department is available to give guidance, advice, and support to local water utilities to help them understand and meet strategic planning outcomes to a reasonable standard. More detail on this advisory and support role is given in section 2.

### 3.4 Strategic planning assurance – assessment process and result

To provide assurance whether effective, evidence-based strategic planning occurs, the department will consider:

- if the strategic planning the local water utility does achieves each outcome to a reasonable standard
- based on its assessment of outcomes, whether the local water utility has in place effective, evidence-based strategic planning

- if we wish to make any recommendations to the utility, and if so, what these are.

The department will maintain an up-to-date public register of its assessment results.

The department acknowledges that, apart from issuing a direction to a council before the council may take any further dividend payments under section 409 of the Local Government Act, it does not have the legislative or regulatory authority to impose enforcement or compliance measures for the outcomes of its assessment of strategic planning.

### 3.4.1 Maintaining currency of assessment result

Local water utilities may request an initial assessment of the effectiveness of their strategic planning. They may also request a re-assessment at any time, to get an assessment result and maintain its currency. Initial and requested assessments will be conducted in line with the process outlined in section 3.4.2.

Local water utilities may also opt to participate in an annual 'check-in' process to ensure their assessment result remains current. This process is outlined in section 3.4.3.

The department may request an assessment at any time if it becomes aware of significant factors that suggest the local water utility may no longer have in place effective strategic planning. This assessment will be conducted in line with the process outlined in section 3.4.2.

Assessments consider whether the strategic planning a utility does is effective and evidence-based, including for the overall assessment and the assessment of individual strategic planning outcomes.

The department publishes assessment results on its website and will update these in accordance with the outcome of any assessment. Assessment results will reflect if a local water utility opts out of the annual check-in process or assessments requested by the department.

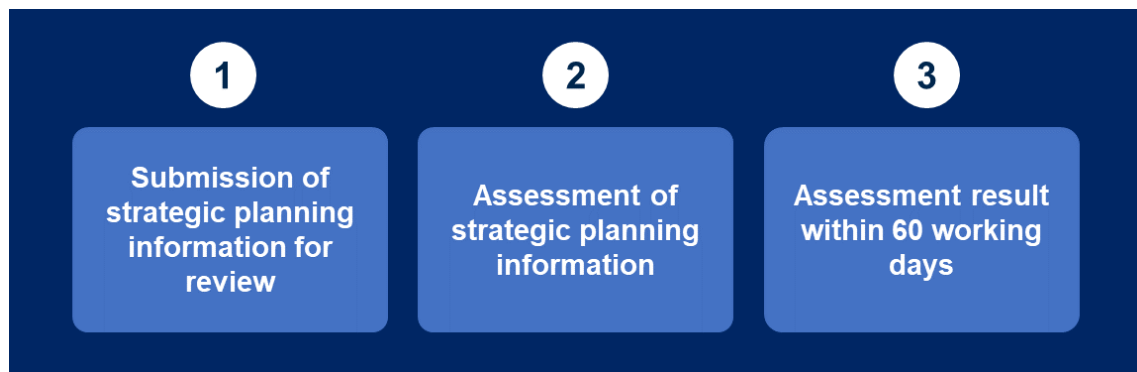
The department will also work with local water utilities to support the ongoing achievement of strategic planning outcomes to a reasonable standard. This work will include meetings and performance monitoring as required.

In addition to the assessment and annual check-in processes, we have access to a range of sources of information on the performance of local water utilities (through performance and risk monitoring, information provided by other regulators, and statewide and regional datasets. As part of our risk-based approach, we will draw on information collected directly from local water utilities (as outlined in this section) as well as other sources to inform our assessment, and our advisory, support, and regulatory activities.

### 3.4.2 Strategic planning assessment process

The assessment process that applies to both an initial assessment or requested re-assessment is outlined at Figure 4 and explored in more detail below.

Figure 4. Strategic planning assessment process



The process ensures we will give a decision about the assessment of a local water utility's strategic planning within 60 working days of receiving a review request accompanied by the relevant information (see phases 2 to 4 below).

If we need additional information for our assessment, we will request it in writing, update the public register status and 'stop the clock' until the local water utility supplies the information.

If a utility is unable to provide requested information, we may reach an assessment of 'unsatisfactory due to incomplete information'.

#### **Phase 1 – Submission of strategic planning information for review (starts the clock)**

We encourage local water utilities to liaise with us before submitting their strategic planning information for assessment. We can give informal advice to help utilities supply information that is fit-for-purpose and includes all required information.

The department will accept a range of information as evidence. There is no expectation that a single comprehensive document will detail the local water utility's 'strategic plan'. Rather, our emphasis is on ensuring effective, evidence-based strategic planning that best integrates with a local water utility's frameworks.

We encourage local water utilities to draw on existing materials wherever possible. There is no expectation that new information should be generated. Where information is published online, local water utilities can share a link to the information.

The associated information should include links or attachments for all relevant materials and supporting documentation.

#### **Phase 2 – Assessment of strategic planning information**

We will consider the information the utility supplies, and other information on the performance of local water utilities that is available to the department, and make an assessment. If necessary, we may request additional information in writing to the utility.

All assessments will consider the strategic planning outcomes expected by the department and if the outcomes are achieved to a reasonable standard.

Where the department is aware of other information that is not provided by the local water utility in its submission, it will advise the utility and consider the information in the assessment subject to sharing it with and requesting comment from, the local water utility.

Where any additional information is requested from a utility we will 'stop the clock' on the decision period until we receive the information. This will be reflected on the public register. Additional information given to the department is assessed as part of the application.

We or the local water utility may initiate further meetings to clarify an information request.

Subject to a threshold test related to factors such as cost, risk, and complexity of an approval or related project, decisions may be subject to an internal peer-review process. Where this process is triggered, the initial decision-maker must give another departmental staff member the opportunity to review the submission and decision. The department will give detailed guidance on factors that will trigger a peer review. This peer-review process is distinct from the formal decision-review process detailed in section 9.

While other regulators are responsible for overseeing and supporting local water utilities within their own regulatory frameworks, there are consistency benefits when all a utility's regulators have a coherent perspective. To enable this, we will share information on a utility's strategic planning with other regulators as appropriate. We will also seek advice from those regulators on how the information supplied by the local water utility aligns with their regulatory work.

If other regulators need additional information to clarify matters before giving us advice, we will communicate this request in writing to the utility. We will update the public register to 'status of assessment incomplete' and 'stop the clock' until we receive that information.

### **Phase 3 - Assessment result within 60 working days**

Once we have analysed the strategic planning information supplied, we will assess it and give our reasons to the local water utility in writing.

Where we consider making an assessment different to that requested (where the review is requested by utility) or changing the current assessment (where review is requested by the department), we will notify the utility of this intention and give the utility the opportunity to respond.

Final assessment decisions will be made by a senior executive within the department. The assessment will include written reasons. Where necessary, we will give recommendations or guidance for potential improvements.

### **3.4.3 Annual 'check-in' process**

We expect local water utilities to monitor any changes to their key assumptions, objectives or context that would trigger the need to update any part of their strategic planning. The department is available to give support and advice to ensure that strategic planning continues to be effective and evidence-based.

Local water utilities may opt to do an annual 'check-in' process to support this monitoring, report to the department on key changes in their strategic planning, and maintain currency of the assessment result. The process is outlined in Table 2.

The annual 'check-in' is designed to minimise the time and resource impost on local water utilities. We will work with individual local water utilities to identify a specific time for conducting an annual check-in, where possible taking capacity and resourcing constraints of both the department and local water utility into consideration.

Table 2. Annual review process

Step	Description
<b>1. Templated annual return</b>	<p>The department will send the local water utility a templated annual return that helps us and the utility understand whether strategic planning should be reassessed and potentially updated.</p> <p>The annual return will ask local water utilities to consider:</p> <ol style="list-style-type: none"> <li>1. Are the key assumptions and information underpinning strategic planning still current, effective, and appropriate?</li> <li>2. Are there any new strategic or operational events that need investigation or major changes?</li> <li>3. Are there any new strategic directions set by council or the Board, including within the IP&amp;R framework?</li> <li>4. If the answer is 'yes' to any of questions 1 to 3, does the local water utility intend to update any of its strategic planning documentation in the next year? If not, why not?</li> <li>5. Has any relevant strategic planning information been updated in the last year?</li> <li>6. How has the local water utility implemented any recommendations made by the department?</li> </ol>
<b>2. Analyse responses</b>	The department will collate annual return information and analyse them to identify where strategic planning may need updating, where the current assessment may need revision and any trends across a region or the local water utility sector.
<b>3. Proactively engage</b>	The department will apply risk-based principles to identify local water utilities that may benefit from engagement on strategic planning issues. The department will then schedule meetings as required.



Step	Description
<b>4. Communicate annual 'check-in' outcome</b>	<p>Based on the annual return information and any further discussions, the department will communicate its view on any gaps or risk profile issues to each local water utility for formal reporting to the council or Board. This will enable timely input into the organisation's overall strategic planning work.</p> <p>After we assess any strategic planning information supplied, the department will make an assessment in writing.</p> <p>Where the department considers changing its assessment result, it will notify the utility of its intention and give the utility the opportunity to respond.</p> <p>The department will consider the response and include its consideration in the reasons for the assessment.</p> <p>Final assessment decisions will be made by a senior executive within the department. The assessment will include written reasons. Where necessary, the department will give recommendations or guidance for potential improvements.</p>

### 3.4.4 Review of departmental decisions

Section 9 of this document outlines the process, scope, and rationale of the internal review mechanism that water utilities may use to have departmental decisions reviewed.

A local water utility can seek a review of the department's strategic planning assessment if it believes that, in making the decision, the department made a mistake or considered:

- matters outside those set out in this regulatory and assurance framework
- information that was irrelevant and/or misinterpreted by the department
- information that was not provided as part of the assessment
- information that was not requested to be provided by the local water utility
- information that was not provided by other local water utility regulators in response to the application.

This will help to ensure that that we make decisions that are consistent between any local water utilities seeking assessment of their strategic planning.

The strategic planning assessment that the department gives will be accompanied by guidance outlining how it can be reviewed.

## 3.5 Publishing and public reporting

The department will publish on its website a register that tracks the assessments of local water utility strategic planning.

This will include:

- our assessment of whether the department considers that a local water utility has in place effective, evidence-based strategic planning and achieves strategic planning outcomes to a reasonable standard
- the results of reviews and annual 'check-ins' done.

The register will identify:

- local water utilities that have in place effective, evidence-based strategic planning
- local water utilities that do not have in place effective, evidence-based strategic planning and any recommendations to be actioned by the utility
- local water utilities that have opted not to participate in assessment processes or have not submitted sufficient information on their strategic planning.

We will also publish on our website our performance against the committed assessment 'clock' of 60 working days.

Where a local water utility does not have in place effective, evidence-based strategic planning, the department may elect to write to the local water utility's senior representatives (such as senior executive, council, the Board or an audit, risk and improvement committee) or other stakeholders to highlight the need for strategic planning.

In publishing this information, the department acknowledges that it does not have the legislative or regulatory authority to conduct enforcement or compliance measures for the outcomes or publishing of its assessment of strategic planning. Any publishing will occur as part of the department's assurance role.

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## 3.6 Regionally based local water utility strategic planning

Groups of local water utilities may decide to work together to do certain elements of strategic planning on a regional basis. This could occur through joint organisations of councils or other groups of local water utilities facing similar strategic and operational issues.

These strategies may help address broader issues across local water utility boundaries, such as providing urban water security, water supply services or sewage management services across a region. Similarly, there may be efficiencies that groups of utilities could obtain by taking a regional approach to strategic planning (for example, combined scoping or procurement of data modelling services).

Critically, we recognise that such an approach could help to better integrate strategic planning of individual local water utilities with relevant regional water strategies and improve coordination of the delivery of regional water strategy outcomes at both the regional and local level.

A regional town water strategy could include:

- identification of local and regional cross-boundary options and development of effective and efficient regional solutions to address water security risks
- identification, assessment, and development of regional cross-boundary options for drinking water treatment, sewage treatment and reuse

- assessment of how regional cross-boundary solutions can be integrated into each local water utility's own strategic planning, including governance, asset ownership and ongoing management and pricing arrangements. Regional, catchment-based data collection or analysis could inform individual a local water utility's strategic planning, especially water security analysis
- identification, assessment, and development of options and processes to integrate with priorities identified in regional water strategies
- development of regional contingency and emergency response planning, including water restriction rules, and resource sharing.

On request, the department can assess if a regional town water strategy meets the criteria of sufficient, appropriate, and robust input to achieve the strategic planning outcomes (see section 3.2) covered by the regional town water strategy, using the same process outlined in this section.

## 4 Guidelines for council dividend payments for water supply or sewerage services

This section applies to councils only and has been published in the NSW Government Gazette in accordance with s.409(6) of the *Local Government Act 1993*.

Under section 409(5) of the Local Government Act, a council may pay an annual dividend from its water supply and sewerage business surplus to its council. A dividend is a return on investment paid to the 'shareholder', which in this case is the council responsible for managing and investing in the local water utility's water supply and sewerage functions. Such dividends may be paid for each business at the end of the financial year after meeting these Guidelines (see section 409(7)(a) of the Local Government Act).

A county council may pay a dividend to its constituent councils on a pro-rata basis, based on the number of assessments.

NSW Local Government has adopted the principle of 'competitive neutrality' in its business activities as part of the National Competition Policy, which is being applied throughout Australia at all levels of government. The framework for its application is set out in the June 1996 NSW Government Policy statement titled 'Application of National Competition Policy to Local Government', which should be read in conjunction with the department's 'The Pricing & Costing for Council Businesses – A Guide to Competitive Neutrality' (July 1997).

These documents set competitive expectations of council-owned water utilities depending on revenues. Specifically, a Category 1 utility, with water revenues greater than \$2 million, should separate its accounts, implement a complaints-handling mechanism, and set prices so annual cost recovery by a council's water supply or sewerage business includes taxes or tax-equivalents (excluding income tax).

The dividend comprises 2 parts: a dividend calculated for tax-equivalents, and a dividend calculated from the surplus.

This section sets out the requirements that a council must meet to pay a dividend.

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### 4.1 Dividend for tax-equivalents

All council-owned water supply or sewerage businesses must make a dividend payment for the amount calculated as the annual tax-equivalent payment.

The tax-equivalents are reported in council's water supply and sewerage businesses' special-purpose financial statements (SPFS) in their annual financial reports.

The upper limit for tax-equivalent dividend payments from each of a council's water supply or sewerage businesses is set at \$3/assessment.

The council may apply the dividend for tax-equivalents for any purpose under the Local Government Act or any other act, including local community and charitable purposes.

To ensure ongoing commercial viability, prices should be set so annual cost recovery by a council's water supply or sewerage business includes taxes or tax-equivalents (excluding income tax).

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## 4.2 Dividend from surplus

Before taking a dividend payment from a surplus of the council's water supply and/or sewerage business, a council must:

**1. calculate any dividend payment in accordance with the methodology in section 4.2**

The methodology for the calculation of surplus and payment of dividend from a surplus of the water supply and/or sewerage business is set out in section 4.3 of these Guidelines.

**2. be able to demonstrate there is a surplus**

The council must demonstrate there is a surplus in the council's water supply and/or sewerage business.

**3. demonstrate full cost-recovery pricing and developer charges**

The council must demonstrate full cost-recovery pricing and cost-reflective pricing including developer charges in place for the water supply and/or sewerage business.

**4. have in place effective, evidence-based strategic planning in accordance with section 3 of this regulatory and assurance framework**

The council must have in place effective, evidence-based strategic planning, as set out in section 3 of this regulatory and assurance framework.

**5. demonstrate financial reports are a true and accurate reflection of the business**

The council must demonstrate with an unqualified financial audit report of the special-purpose financial statements for the water supply and/or sewerage business, that the water supply and/or sewerage special-purpose financial reports are a true and accurate reflection of the business.

**6. demonstrate that the overhead reallocation charge is a fair and reasonable cost**

The council must demonstrate with an independent audit report of cost allocation of the water and/or sewerage business, that the overhead reallocation charge to the water supply and/or sewerage businesses is a fair and reasonable cost.

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## 4.3 Calculation of surplus and maximum dividend

The calculation of surplus and payment of dividend from a surplus of the council's water supply and sewerage businesses is subject to the following conditions:

- The dividend must be calculated based on the income statement of the business activity in council's audited special-purpose financial reports. The department's dividend payment form gives a step-by-step process for calculating maximum dividend from surplus.
- The dividend from surplus must not exceed 50% of this surplus in any one financial year.
- The dividend from surplus must not exceed the number of water supply or sewerage assessments as of 30 June of the relevant year multiplied by \$30 less the dividend for tax equivalents.
- The total dividend from surplus paid in each rolling 3-year period must not exceed the total relevant surplus in the same period.

Councils facing major capital expenditure for new or replacement water supply and/or sewerage infrastructure should defer paying a significant dividend from their surplus. Such a payment would directly increase the customers' bills. Such capital expenditure in any financial year is defined as that which exceeds 3% of the current replacement cost of the council's water supply or sewerage assets.

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## 4.4 Provision of information to the department

Following council indicating in an open meeting of the council as required by s.409(7) of the Local Government Act that section 4.2 and 4.3 of these Guidelines and any direction under s 409(6)(b) of the Local Government Act have been complied with, a council should give to the department:

- council's minutes resolving achievement of required outcome (as per section 4.2) and its decision of payment of dividend, including the amount of dividend
- statement of compliance and statement of dividend payment
- dividend payment form with its calculation of maximum dividend
- council's special-purpose financial statements for the dividend year
- unqualified independent financial audit report for water supply and/or sewerage business(es)
- independent audit report verifying that overhead reallocation charges are fair and reasonable.

The department will access the local water utility's current strategic planning assessment and pricing outcomes to confirm the council has in place effective, evidence-based local water utility strategic planning, in accordance with this regulatory and assurance framework.

The department will assess the information supplied and give advice to council and/or the minister of any non-compliance with these Guidelines.

## 5 Assessing and approving proposed works

Under section 60 of the Local Government Act and section 292(1)(a) of the Water Management Act, the Minister for Lands and Water is responsible for approving local water utility works, including:

- construction or extension of water treatment works by a council (section 60(b) of the Local Government Act)
- provision of sewage from its area to be discharged, treated, or supplied to any person by a council (section 60(c) of the Local Government Act)
- construction, maintenance, and operation of water management works and other associated works (including water treatment works and sewage works) by a water supply authority (section 292(1)(a) of the Water Management Act).

In this section, sewage and water management works include works for producing recycled water from sewage.

The Minister for Lands and Water has delegated the responsibility for assessing and approving of applications made under section 60 of the Local Government Act and section 292(1)(a) of the Water Management Act to the department.

The process explained in this section is designed to outline the implementation of the assessment and approval function. It seeks to ensure that works are fit for purpose, manage relevant risks, and provide robust and safe infrastructure for customers of council-owned local water utilities.

In addition to our regulatory role, we give technical and other advice to local water utilities proactively and whenever requested by the utility. We will always seek to clearly distinguish between our regulatory role and advisory and support role. We give advisory, technical, and other guidance without charge. However, this guidance cannot be considered binding on the department's exercise of approval functions under section 60 of the Local Government Act and section 292(1)(a) of the Water Management Act.

The processes outlined in this section are designed to apply to all applications related to section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act.

However, we may, at our discretion, consider alternative assessment processes to expedite applications being made for section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act. This is under emergency circumstances where rapid infrastructure approval and construction are required.

## 5.1 Works that need approval under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act

Table 3 gives a list of works that need approval under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act.

Table 3. Works that require approval under section 60 of the Local Government Act and section 292 (1)(a) Water Management Act

Work type	Works that need approval	Works that do not need approval
<b>Construction or extension of water treatment works by a council</b>  <b>Section 60(b) Local Government Act</b>	<ul style="list-style-type: none"> <li>• New water treatment plant</li> <li>• Augmentation of a water treatment plant</li> <li>• Replacement of a water treatment plant</li> <li>• Adding new treatment processes</li> </ul>	<ul style="list-style-type: none"> <li>• Replacement of treatment unit in a water treatment plant</li> <li>• Construction or extension of water supply network</li> <li>• Construction of raw water supply pipelines</li> </ul>
<b>Provision of sewage from its area to be discharged, treated, or supplied to any person</b>  <b>Section 60(c) Local Government Act</b>	<ul style="list-style-type: none"> <li>• New sewage treatment plant or water recycling plant</li> <li>• Augmentation of a sewage treatment plant with or without recycling capability</li> <li>• Adding new treatment processes</li> <li>• New sewage collection network</li> <li>• New network for supplying recycled water</li> <li>• New discharge of treated sewage to the environment</li> </ul>	<ul style="list-style-type: none"> <li>• Replacement of treatment unit in a sewage or recycled water treatment plant</li> <li>• Minor extension of sewage collection network</li> </ul>



Work type	Works that need approval	Works that do not need approval
<b>Water management works and other associated works</b>  <b>Section 292 Water Management Act</b>	<ul style="list-style-type: none"> <li>• New water treatment plant</li> <li>• Augmentation of a water treatment plant</li> <li>• Replacement of a water treatment plant</li> <li>• Adding new treatment processes</li> <li>• New sewage treatment plant or water recycling plant</li> <li>• Augmentation of a sewage treatment plant with or without recycling capability</li> <li>• New sewage collection network</li> <li>• New network for supplying recycled water</li> <li>• New discharge of treated sewage to the environment</li> </ul>	<ul style="list-style-type: none"> <li>• Replacement of treatment unit in a water treatment plant</li> <li>• Construction or extension of water supply network</li> <li>• Construction of raw water supply pipelines</li> <li>• Replacement of treatment unit in a sewage or recycled water treatment plant</li> <li>• Minor extension of sewage collection network</li> </ul>

If a local water utility is uncertain about what works need approval, it should contact the department.

## 5.2 Matters considered before granting approval

The department is required to consider certain matters before granting approval.

An approval under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act may be granted if certain matters have been satisfied. These include:

- provision of relevant documents in council's possession, such as plans and specifications of the construction or extension in question, and documents and data that are relevant to the construction or extension in question
- provision of any documents or information the minister needs to be satisfied of the council's competency to carry out the construction or extension in question
- more documents and information as required by the minister, including those for any inspections of the work and the site of the work that the minister directed the council to carry out.

These matters will form the basis of all assessment processes and criteria (outlined below). When preparing their applications, local water utilities should always consider these criteria, as well as the matters above. The criteria the department will apply to assess an application include, if the proposed works:

- **are fit for purpose**
  - Are the proposed works identified in the local water utility's strategic planning?
  - Does the local water utility have in place effective, evidence-based strategic planning in accordance with section 3 of this framework?
  - Is there another strategic justification for the works?
  - Have technical options for the works been considered adequately?
  - Does the scope of the works meet the intent of the project?
- **can manage risks**
  - What technical or operational risks are the works intended to overcome or mitigate?
  - Have these risks been considered as part of the design of the proposed works?
  - Will the proposed works manage these risks?
- **can meet public health and environmental standards**
  - Are the proposed works able to meet the Australian Drinking Water Guidelines, Australian Guidelines for Water Recycling, and other relevant health regulations and standards?
  - Are the proposed works able to meet relevant environmental regulations and standards?
- **can meet relevant regulations**
  - Are the proposed works capable of adhering to relevant industry standards and regulations related to the design and construction of infrastructure and the management of water supply and sewerage services?
- **are aligned to the competency of the local water utility**
  - Is the local water utility itself competent to carry out the proposed project or has it engaged another party who has the capability or competency to do so?

For applications under section 292 of the Water Management Act, we will consider whether the proposed works are consistent with water sharing plans, water management principles, and the objects under the Water Management Act.

We will not consider cost-effectiveness when assessing applications under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act. We expect local water utilities to consider cost-effectiveness in all decisions, including those for infrastructure investment. We consider cost-effectiveness in the context of the strategic planning assessment (outlined in section 3 of this framework).

Where the department or other NSW Government agency is giving funding for the works, a cost effectiveness and value-for-money assessment would be completed separately as part of that funding decision.

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## 5.3 Information to be submitted with an application

The department primarily bases its assessment on the suite of documents that accompany the application, and any subsequent requests for information from the local water utility or other regulators. The timing for the submission of an application is at the discretion of the council when the requested documentation is available. This will vary depending on the individual project plan.

The department strongly encourages early engagement and application to ensure that any issues can be resolved before work progresses.

Local water utilities must supply the information set out in Table 4 with their application.

Table 4. Material to be provided for section 60 and section 292(1)(a) assessment and approval

Material	Detailed description
<b>Works description</b>	<p>Documentation outlining the intended objective, nature, scope, and purpose of the proposed works.</p> <p>Include links to the existing strategic planning of the local water utility or other justification for the works. Documentation should contain sufficient detail to enable the department to assess whether the proposed works or disposal represents an appropriate solution.</p> <p>Describe the planned process for design and construction.</p>
<b>Risk assessment</b>	<p>Where relevant:</p> <ul style="list-style-type: none"> <li>Preliminary drinking water safety design assessment. This should assess: <ul style="list-style-type: none"> <li>The capability of the treatment process to manage all identified risks to drinking water quality, including microbial risk.</li> <li>Ability to monitor critical control points according to the Australian Drinking Water Guidelines and the requirements of the <i>Public Health Act 2010</i>.</li> </ul> </li> <li>Preliminary recycled water risk assessment that follows the Australian Guidelines for Water Recycling.</li> </ul>
<b>Early design for works</b>	<p>Technical drawings and other design materials, completed to at least the level of detail that would be expected at an early design stage of works, including:</p> <ul style="list-style-type: none"> <li>a plan of the works including a list of all inclusions and exclusions in the works and how it will be delivered, costed, and programmed</li> <li>operational philosophy</li> <li>process flow diagram, concept piping and instrumentation diagram, general arrangement overview, site layout and electrical line drawing</li> <li>site and infrastructure plans (and any other relevant site plans)</li> <li>descriptions of any relevant existing infrastructure (which may include existing reticulation pipework, storages, or treatment systems)</li> <li>description of the process, including a summary of the source water or sewage characterisation and the treated water or sewage targets</li> </ul>
<b>Documented experience</b>	<p>Documented previous experience with design and construction of water treatment infrastructure and/or having access to qualified and experienced technical resources, who have competence in water infrastructure</p> <p>Describe the intended approach to procurement</p>

Material	Detailed description
Confirmation of environmental planning assessment	<p>If the particular water treatment works or sewerage works require environmental impact assessment under Division 5.1 of the NSW <i>Environmental Planning and Assessment Act 1979</i>, the local water utility must provide with the application for approval under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act, either:</p> <ul style="list-style-type: none"> <li>review of environmental factors to demonstrate that the duty under section 5.5 of the Environmental Planning and Assessment Act has been discharged. The review of environmental factors must comply with the Planning Secretary's <a href="#">Guidelines for Division 5.1 assessments (PDF 5.40 MB)</a>,</li> <li>or</li> <li>environmental impact statement to demonstrate that the duty under section 5.7 of the Environmental Planning and Assessment Act has been discharged. The local water utility may refer to the department's <a href="#">State Significant Infrastructure Guidelines (PDF 664 KB)</a> on environmental impact statement preparation and processes.</li> </ul>

Some local water utilities may choose to progress design efforts to a more advanced stage (for example to a 75% design stage) to include additional design details before requesting an assessment under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act.

## 5.4 When applications should be submitted

Applications can be submitted once all required information is available. We encourage local water utilities to apply for assessment and approval at the earliest stage in their project where all required documentation is available. This provides certainty to progress the project to detailed design and avoids unnecessary costs for customers and the community.

The department may impose conditions to ensure that the works remain consistent with the application and approval through the subsequent design and delivery stages. For more information, see section 5.6.

## 5.5 Approvals will follow a clear, documented, and timely process

Before commencing any works, it is the responsibility of a local water utility to apply to the department for assessment and approval of works under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act.

We will maintain a public register of the approval of an application submitted by a utility and the department's decision.

Figure 5 shows the steps in the assessment and approval process.

This process ensures we will give a decision about a local water utility's application within 60 working days of receiving a completed application (phases 2, 3 and 4). If we require additional information, we will request it in writing, update the public register to 'status of assessment incomplete' and 'stop the clock' until we receive the information.

A local water utility can always withdraw, amend, or resubmit an application at any time. In these cases, the 'clock' for assessment and approval would restart.



Figure 5. Approvals process for section 60 of the Local Government Act and section 292(1)(a) of the Water Management Act

### Phase 1 – Initial engagement before making a submission

Before planning for any proposed works, we encourage local water utilities to proactively engage with the department. This engagement may include an informal discussion about the strategic context of the works proposed. The local water utility may also access our advisory and support role to seek expert strategic and technical advice from us throughout the life of the project (including after approval is given). This includes during the development and options consideration phases for treatment works.

In our regulatory role, we can also discuss completion of the template application form and any background information held by the utility that should be submitted with the application. We can also explain the matters that we must consider before granting approval of an application.

While local water utilities can leverage the department's advisory and support role during the life of a project, any advice given under the advisory role cannot be considered binding on a formal determination.

### Phase 2 – Submission of written application (starts the clock)

When it wishes to seek approval for works, a local water utility must make a written application to the department using our application form requesting approval under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act.

Local water utilities can apply at any time. However, they should have sufficiently detailed documentation to allow the department to decide before applying. The relevant documentations for the purposes of an application are outlined in section 5.3 of this document. Local water utilities should submit applications early to give us enough time to make an assessment – the 'clock' time is 60 working days. Local water utilities bear the risk associated with submitting a formal application at the later stages of planning and development.

All applications must use the same application form. This form will be published on our website and may be updated from time to time.

The application needs to address the works proposed, why the works are proposed, and how the works will meet the local water utility's strategic goals, including meeting their customers' needs.

This submission should include all relevant materials and supporting documentation.

### Phase 3 – Assessment of the application

We will assess the application and all material supplied and make a decision. All applications will be assessed against the matters that must be considered before granting approval. If necessary, we may request additional information in writing to the utility.

We may use internal resources or commission an independent expert or an independent expert panel to do all or part of the assessment and make recommendations to the department.

If we are aware of other relevant information that has not been provided in the submission, we will provide the local water utility with the opportunity to comment before considering that information in the assessment.

We will seek input from other regulators of the local water utility with the intention of agreeing on design outcomes that fulfill all relevant regulatory requirements. Where other regulators require additional information, we will communicate this request in writing. Other regulators are responsible for overseeing and supporting local water utilities within their own regulatory frameworks.

Where any additional information is requested from a utility we will 'stop the clock' on the decision period until we receive the information. This will be reflected on the public register. Additional information given to the department is assessed as part of the application.

Subject to a threshold test related to factors such as cost, risk, and complexity of an approval or related project, decisions may be subject to an internal peer-review process. Where this process is triggered, the initial decision-maker must give another departmental staff member the opportunity to review the submission and decision. This peer-review process is distinct from the formal decision-review process detailed in section 9.

If needed, we or the utility may initiate further meetings to clarify an information request.

### Phase 4 – Approval within 60 working days

A senior executive in the department with the appropriate delegation will make decisions within 60 working days. The department will communicate the decision to the utility in writing and include reasons reflecting the matters that must be addressed before the department grants approval.

We will either:

- approve the works
- approve the works subject to conditions
- not approve the works.

Where consideration of an application for approval under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act requires assessment under Part 5 of the NSW

Environmental Planning and Assessment Act 1979, the 60-working-day timeline may be extended with written notice to the local water utility.

We will publish the decision (including conditions, as appropriate), our reasons and any approval instrument on our website.

As described in section 9 of this framework, local water utilities can request internal review of applications under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act. Decisions may also be subject to review under administrative law.

As part of implementing this regulatory and assurance framework, the department will embed a quality assurance framework. This will assess and monitor its performance against several metrics, and be used to inform improvement opportunities and initiatives. Our adherence to giving approval within the 60-day timeframe is one such measure. We will publish performance results publicly each year, analysis trends and take proactive measures to respond to results and trends.

### Review of decisions

Section 9 of this document outlines the process, scope, and rationale of the internal review mechanism that water utilities may use to have departmental decisions reviewed. Consistent with the intent and process of section 9 of this framework, a local water utility can seek a review of the department's decision if it believes that, in making the decision, the department made a mistake or considered:

- matters outside those that must be considered before granting approval
- information that was misinterpreted by the department
- information that was not given with the application
- information that the department did not ask the local water utility to supply
- information that other local water utility regulators did not give in the assessment of the application.

This will help ensure that we can make decisions that are consistent between local water utilities seeking approval for works.

Section 9 gives further detail on options for review of the department's regulatory decisions.

### Phase 5 – Monitoring compliance with conditions

If an approval is given subject to conditions, we will monitor the progress of the works to ensure those conditions are complied with. This may include seeking additional information or input from the local water utility subject to the conditions set.

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## 5.6 Conditions on approvals and requests for more information

The department may approve an application under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act, subject to conditions. A local water utility must

comply with any conditions of approval when completing works. We can use conditions to give direction for, and oversight of, any works for which approval is sought.

The types of conditions attached to an approval may differ depending on the type of works being approved and the risk profile of the application.

We propose the following standard list of conditions, which are likely to be applied to most approvals:

- **Consistency with design** – will be a condition that a local water utility only construct drinking water treatment works that are consistent with those approved, or that it allows for sewage to be discharged, treated or supplied in a way that is broadly consistent with the way that was approved. Some degree of variation is acceptable to ensure that the practical realities associated with design and construction, or treatment and discharge, are accounted for.
- **Consistency with standards** – Local water utilities must always adhere to any relevant legal, regulatory, industry or technical standards in completing the works (including environmental planning requirements where relevant).

Additional conditions may be imposed to manage project-specific risks.

The department under delegation from the minister, may request additional information, including information to ensure any conditions imposed are being complied with by relying on powers under sections 61 of the Local Government Act and 138 of the Local Government Regulation, and for sewerage works by a water supply authority, section 301A of the Water Management Act and 121 of the Water Management Regulation.

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## 5.7 Publishing and public reporting

The department will maintain a register. On our website, we will publish our decisions about applications made under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act.

We will publish on our website our performance against our committed 'clock' of 60 working days for the assessment and approval of applications made under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act.

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## 5.8 Compliance and enforcement options

Several compliance and enforcement options are available to the minister and the department under the Local Government Act and the Water Management Act for approvals of works.

Compliance and enforcement options are used only as a last resort.

Compliance and enforcement options under the Local Government Act include:

- directions for the proper safety, maintenance, and working of water treatment and sewage treatment works (s.61)



- directions during emergencies (s.62)
- entry, inspections, and investigations powers (s.65 and Part 2 of Chapter 8; see also section 6 of this framework)
- notices to comply with a direction (s.63)
- any action to carry out directions if council does not comply (s.63)
- appointment of an administrator (s.66)
- revocation of an approval (c.138(3) of the Local Government (General) Regulation 2021)
- penalties for false or misleading information in relation to an application (s.665)
- start of legal proceedings where there has been a breach of the Local Government Act (s.674).

Compliance and enforcement options under the Water Management Act are similar to those available under the Local Government Act. Some additional compliance and enforcement mechanisms include:

- compliance audits (s.326A)
- stop-work orders for the unlawful construction or use of a water management work (s.327)
- removal of unlawful water management works (s.329)
- temporary stop-work order to protect public interest (s.330)
- direction to prepare a report about the progress of complying with any directions issued under the Water Management Act (s.334).

## 6 Inspecting water and sewage treatment works

This section applies to councils only.

Under section 65 of the Local Government Act, the department regularly inspects the safety, operation and maintenance of water treatment works and sewage treatment works owned and managed by councils in regional NSW.

These inspections confirm for the Minister for Lands and Water and the council that treatment works are being operated safely and appropriately. If they are not, the minister can exercise power under section 61 of the Local Government Act to direct the council to take the necessary measures to ensure the proper safety, maintenance and working of water treatment and sewage treatment works.

Key outcomes of the inspections are recommendations to councils for improvements to safety, operations, and maintenance of treatment works throughout NSW.

We also give staff mentoring for council operators as well as technical assistance in resolving operational matters before they become a problem.

We tailor the scope and frequency of inspections to the requirements of each treatment works using a risk-based approach.

Collaboration is an important part of the inspection process. We give help and advice to councils to avoid escalation of potential issues. The process is designed to build trust, foster relationships, and share information needed to build council capacity. Compliance and enforcement options are used only as a last resort.

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### 6.1 Inspection function

The department's regulatory role is to ensure council water treatment works and sewerage treatment works are being operated safely and appropriately.

Ultimately, under the NSW *Work Health and Safety Act 2011* and the Work Health and Safety Regulation 2017, councils are responsible for maintaining health and safety in the workplace.

In addition to our regulatory role, we have a separate advisory role where we give advice to and to advocate on behalf of councils. Within the inspection function, this role includes:

- giving advice to councils in their water and sewerage operations regarding the protection of public health and the environment

- giving operational and other council staff mentoring and training to complement the council's own capability building initiatives
- directly engaging with councils to avoid or reduce the risk and impact of incidents. The department is involved in incident management and departmental staff are nominated as an initial point of contact when an incident occurs
- ongoing, informal, engagement with councils to understand emerging regulatory issues and to give initial advice on their treatment or management
- under the Aboriginal Communities Water & Sewerage Program, facilitating interaction between Aboriginal communities, councils, and NSW Health.

## 6.2 Scope of inspections

The inspection process includes discussion with operational and other council staff on any existing and potential operational issues that are occurring at the time of the inspection. Inspections also entail a physical inspection of asset condition and maintenance and the general operations of the facilities.

The scope of each inspection is based on the department's assessment as set out in Table 5.

Table 5. Assessment of onsite inspection and performance

What is assessed	Considerations
<p>For water treatment this may include:</p> <ul style="list-style-type: none"> <li>• catchment</li> <li>• clarification</li> <li>• filtration</li> <li>• chemical dosing</li> <li>• fluoridation</li> <li>• disinfection</li> <li>• connect with networks</li> </ul>	<ul style="list-style-type: none"> <li>• Performance of process units</li> <li>• Compliance and understanding (for example, drinking water management system, environmental, relevant codes, and council policy)</li> <li>• Identification and mitigation of key risks and potential anomalies</li> <li>• Documentation and understanding of incident management procedures</li> </ul>
<p>For sewage treatment this may include:</p> <ul style="list-style-type: none"> <li>• connection with collection system</li> <li>• preliminary treatment</li> <li>• primary treatment</li> <li>• secondary treatment</li> <li>• tertiary treatment</li> <li>• chemical dosing</li> <li>• recycled water</li> <li>• reuse scheme</li> </ul>	<ul style="list-style-type: none"> <li>• Performance of process units</li> <li>• Compliance and understanding (for example, environmental protection licence, relevant codes, and council policy)</li> <li>• Identification and mitigation of key risks and potential anomalies</li> <li>• Documentation and understanding of incident management procedures</li> </ul>

What is assessed	Considerations
Samples may be taken from throughout the process for analysis off-site	Independent verification, process validation and supporting data
The operations and maintenance of the plant, including: <ul style="list-style-type: none"> <li>• maintenance of critical components</li> <li>• operational procedures and testing</li> <li>• operational data records</li> </ul>	May include review of: <ul style="list-style-type: none"> <li>• day sheets</li> <li>• lab records</li> <li>• diaries</li> <li>• laboratory equipment</li> <li>• online monitoring instrumentation</li> <li>• safety management processes</li> </ul>
Process control including critical control points (CCP)/operational control points (OCP)	<ul style="list-style-type: none"> <li>• Visibility, operator understanding, performance and appropriateness</li> <li>• Adherence with Drinking Water Quality Management System</li> </ul>

The scope of the inspection also includes preparing an inspection report to document findings and any recommended actions. Reports are presented to council for review and action. Councils may use inspection reports as evidence of operational performance and risk management in their engagement with other local water utility regulators.

## 6.3 Risk assessment to inform inspection frequency

We will determine inspection frequency by applying a risk-based approach using defined criteria.

This approach helps us target resources and assistance to ensure both our regulatory effort and advice and support addresses the highest risk. The considerations for a range of risks are set out in Table 6. Risk is re-assessed at every inspection and can change significantly with a change of staff, plant augmentation or process changes.

The frequency of each inspection is based on our assessment of the factors set out in Table 6.

Table 6. Risks to consider and combine into an overall risk rating

Risks	Considerations
Performance risk	<ul style="list-style-type: none"> <li>• Recent water quality test results</li> <li>• Council operations, capacity, and capability</li> <li>• Recent incidents</li> </ul>

Risks	Considerations
Operating environment risk	<ul style="list-style-type: none"> <li>Assets and asset condition</li> <li>Variability of raw water quality and quantity</li> <li>Seasonal variability of sewage quality and quantity loading</li> <li>System condition</li> <li>Safety</li> </ul>
Process risks (specifically CCP and OCP)	<ul style="list-style-type: none"> <li>How well the plant operates within the CCP/OCP/licence parameters</li> </ul>
Special case risk	<ul style="list-style-type: none"> <li>Various scenarios such as temporary augmentations, emergencies, and breakdowns</li> </ul>

## 7 Concurrence for approvals to discharge liquid trade waste

Sewerage systems are designed to safely collect, transfer, and treat wastewater, mostly of domestic origin. However, these systems may also be capable of accepting liquid trade waste if the discharges are planned, known, and controlled within acceptable limits.

In the absence of suitable controls and pricing, liquid trade waste may have adverse impacts on the sewerage system, the environment and the health and safety of workers and the public.

It is important that councils implement best practice in administering, regulating, monitoring, and pricing sewerage and liquid trade waste.

Councils are responsible for approving liquid trade waste discharges to their sewerage systems under section 68 of the Local Government Act. However, section 90(1) of the Act and clause 28 of the Local Government (General) Regulation 2021 require them to obtain concurrence to council approval from the Secretary, Department of Planning and Environment. The department's Water Utilities branch provides concurrence as nominated by the Secretary.

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### 7.1 NSW Framework for the Regulation of Sewerage and Liquid Trade Waste

The NSW Framework for the Regulation of Sewerage and Liquid Trade Waste involves a preventive, risk-management approach developed to address the use of common resources by giving economic incentives for dischargers to minimise their waste and to consistently comply with their conditions of approval.

Each council must implement all the following integrated measures under the NSW Framework for the Regulation of Sewerage and Liquid Trade Waste:

- preparation and implementation of a sound liquid trade waste regulation policy, assessment of each liquid trade waste application, and determination of appropriate conditions of approval. Conditions must be consistent with council's strategic planning
- preparation and implementation of a sound development servicing plan with commercial sewerage developer charges to ensure new development pays a fair share of the cost of the required infrastructure
- full cost recovery with appropriate sewer usage charges and liquid trade waste fees and charges to give the necessary pricing signals to dischargers. These charges must include non-compliance trade waste usage charges and non-compliance excess mass charges to give the necessary incentives for dischargers to consistently comply with their conditions of approval

- monitoring, mentoring, and coaching of dischargers to achieve cleaner production and assist them to comply with their conditions of approval
- enforcement, including appropriate use of penalty notices in the NSW legislation. Orders may also be issued under the Local Government Act (see section 2.8.3 of the Liquid Trade Waste Management Guidelines)
- disconnection of a liquid trade waste service in the event of persistent failure to comply with council's conditions of approval (see section 2.8.5 of the Liquid Trade Waste Management Guidelines).

The department has prepared the [Liquid Trade Waste Management Guidelines \(PDF 15 MB\)](#) for council staff who manage the approval, monitoring and cost recovery for sewage and liquid trade waste discharges to the sewerage system.

## 8 Performance monitoring and reporting

We will collect information from each local water utility on a regular basis. Over time, this information will enable increasingly granular analysis of performance trends for each local water utility and give a measure of performance relative to other local water utilities.

We will use this monitoring and reporting information and analysis to:

- target regulatory effort and inform risk-based approach to regulation and assurance of local water utilities (section 2.5)
- take proactive action to drive improvements in risk management and performance, and help local water utilities achieve their regulatory objectives, including by proactively engaging with local water utilities and by helping other regulators to do the same
- inform our responses to applications for local water utilities to develop new infrastructure
- identify performance trends over time and strengthen local water utilities' responses to those changes and ours
- publish information to facilitate local water utilities' understanding of their performance, including compared to other local water utilities, and opportunities to improve
- give information to customers and the community about the performance of local water utilities.

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### 8.1 Roles in performance monitoring

Both the department and local water utilities have a role to play in ensuring the performance monitoring process is efficient and effective.

Our role is to identify with utilities the information that will be of most use, analyse it when provided/collected, and use it to make regulatory and other decisions and sharing it in a timely manner with local water utilities for their use in strategic planning and risk management. Our role also includes:

- risk, performance, and compliance monitoring, collecting data and information and explaining how information supplied will be used
- coordinating with other regulatory agencies to share information and avoid duplication in reporting efforts
- implementing a proactive monitoring approach that includes analysis, publication, and responses to changes in performance to help local water utility officers and decision-makers to manage water security, water quality and environmental risks



- acting as the NSW data coordinator for local water utilities' obligations to report information to the Bureau of Meteorology's Urban Water National Performance Report<sup>4</sup> and the Australian Bureau of Statistics.

The role of local water utilities in performance monitoring is to supply all the necessary information as identified by the department in section 8.2. Utilities are also responsible for drawing on analysed outputs to benchmark their own activities and to make strategic decisions in response.

The department is committed to taking a proportionate approach to regulation, assurance, and oversight. This includes monitoring our success as a regulator and partner. We have committed to the following actions:

- We will develop a monitoring and evaluation framework to monitor our performance as a regulator and partner, and regularly review our processes – to be published in mid-2022. This includes consulting with the local water utilities sector on potential new measures and requirements to track the effectiveness of the proposed new approach to strategic planning.
- We will continue to investigate options for an integrated approach to local water utility reporting to NSW Government agencies.
- We will investigate and test analytical tools that meet the needs of local water utilities and allow them to do their own comparison analysis of performance and risks and maturity. We will report back to the sector by October 2022.

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## 8.2 Information that needs to be reported

When collecting information, the department commits to give clearly articulated reasons for why the information is required and how it will be used to monitor trends and identify whether outcomes have been achieved. We will apply criteria when deciding whether to collect information. These include:

- identifying whether there is a clear use-case or rationale for the data, and communicating this accordingly
- identifying whether the additional information has clear alignment to a key risk, regulatory or assurance outcome, as defined in sections 3 to 7
- assessing if the benefits of asking local water utilities to give information outweigh the costs of data gathering, cleansing, and provision
- assessing whether the information is already collected through other channels (for example, by other agencies or regulators)
- confirming that the information request itself is clear, easy to understand, and available in an accessible format.

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<sup>4</sup> As required under the *Water Act 2007 (Cth)*, *Water Regulations 2008 (Cth)* and the 2006 Deed National Framework for Reporting on Performance of Urban Water Utilities under clause 75 the National Water Initiative that specifies water information which urban water utilities with greater than 10,000 connections must give to the Bureau of Meteorology.

We require local water utilities to report:

- information to enable us to provide relevant indicators to the Bureau of Meteorology for inclusion in the Urban Water National Performance Report on behalf of utilities annually
- information to enable us to provide relevant indicators to the Australian Bureau of Statistics on behalf of utilities annually
- additional performance indicators specific to the NSW context required to monitor strategic planning outcomes and implementation, including local water utility levels of service, pricing, financial and workforce data, annually
- any information relevant to reviews of the department's assessment of utility strategic planning, needed annually and during reviews outside of the annual cycle
- in accordance with any conditions placed on an approval made under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act.

We will collect the National Performance Report indicators for all local water utilities and rely on this indicator set, combined with the additional information listed, to monitor the performance of local water utilities. The list of indicators collected will be maintained and publicly available on the website.

If we need new information to be reported, we will consult with local water utilities to identify what information may be useful and how best to collect it while minimising additional burdens on local water utilities.

Table 7 gives the specific types of data used to support the department's performance monitoring role, along with an explanation for why the data is collected, and how it will be used.

Table 7. Rationale for information collected by the department

Category	Reason for collection	How data is used
<b>Urban Water National Performance Report indicators</b>  <b>Australian Bureau of Statistics data set</b>	<p>Act as the NSW data coordinator for local water utilities' obligations to report to the Bureau of Meteorology's Urban Water National Performance Report and the Australian Bureau of Statistics.</p> <p>National Performance Report indicators are a comprehensive set of indicators for monitoring the performance of water utilities nationally, and appropriate for NSW local water utilities.</p>	<ul style="list-style-type: none"> <li>• Risk-based targeting of the department's resources</li> <li>• Triggers proactive actions by department</li> <li>• An evidence base for assessment of strategic planning and section 60 applications (please note that this evidence base is used to inform the department's analysis, rather than being used to support specific decisions)</li> <li>• Performance benchmarking to identify relative strengths and areas of improvement of utilities</li> </ul>

Category	Reason for collection	How data is used
<b>Indicators specific to the NSW context: local water utility service levels, pricing, financial and workforce indicators</b>	<p>Service levels, pricing, financial and workforce data supports the department's analysis of performance and risk.</p> <p>Levels of risk and resourcing are strongly correlated.</p> <p>Local water utility service levels, pricing, financial and workforce data is not sufficiently included in the National Performance Report indicators set.</p>	<ul style="list-style-type: none"> <li>• Risk-based targeting of departmental resources</li> <li>• Triggers proactive actions by department</li> <li>• Actions by department to support the establishment of sustainable training arrangements to reduce risks</li> </ul>
<b>Strategic planning information</b>	Monitor whether strategic planning outcomes are being achieved to a reasonable standard.	<ul style="list-style-type: none"> <li>• Risk-based targeting of departmental resources</li> <li>• Triggers proactive actions by department</li> </ul>
<b>Section 60 information</b>	Monitor whether local water utilities are complying with conditions of section 60 of the Local Government Act and section 292(1) of the Water Management Act approvals	<ul style="list-style-type: none"> <li>• Risk-based targeting of departmental resources</li> <li>• Triggers proactive actions by department</li> </ul>

**Note:** At the time of designing this framework, the National Performance Report Indicators were under review by the Bureau of Meteorology.

## 8.3 How the department uses the information provided

The department commits to using the information it collects in 4 key ways, as set out in Table 8.

Table 8. Use cases for performance monitoring data

Use case	Explanation and process
<b>Risk-based targeting of departmental resources</b>	<p>The department targets the allocation of its regulatory, inspector, advisory, program and other resources based on risks.</p> <p>Information and analytics allow the department to make informed assessments regarding anticipated regulatory or advisory support required by individual utilities, and to promote efficient and effective resource allocation.</p>

Use case	Explanation and process
<b>Proactive action by utility, other regulators, or department</b>	<p>The department may initiate proactive or reactive actions to enable local water utilities or other regulators to better manage water security, water quality and environmental risks.</p> <p>Proactive actions include engaging with senior representatives from a local water utility (for example, senior executive, general manager, council, Board or audit, risk and improvement committee) about performance to encourage planned, strategic responses from the utility.</p> <p>Proactive actions include the urgent escalation of issues identified in monitoring to a local water utility's senior representatives or other regulators.</p> <p>Proactive actions also include engaging with the local water utility sector and its stakeholders to advocate for strategic responses that lift performance.</p>
<b>Risk and performance monitoring</b>	<p>Information collected as part of performance and risk monitoring is used by the department in assurance of strategic planning and regulatory oversight of works that need approval under section 60 of the Local Government Act or section 292(1) of the Water Management Act.</p> <p>This information provides an evidence-based perspective on the performance of the utility in the context of the NSW local water utility sector.</p>
<b>Analysis and publishing of relevant data</b>	<p>The department publishes data, analysis, and benchmarking of data trends at least once a year so that the department, other regulators, utilities managers, councillors, Board directors, and the community all have publicly available, transparent information on the performance of individual local water utilities in a way that is consistent and comparable.</p>

## 8.4 Avoiding duplication of local water utility reporting

We work closely with other regulators of local water utilities and are committed to avoiding duplication in reporting requirements. For example, we will rely on health information reported to NSW Health, on environmental information reported to the NSW Environment Protection Authority, financial information reported to the Office of Local Government, dam safety information reported to Dams Safety NSW and customer satisfaction information collected by the Independent Pricing and Regulatory Tribunal of NSW.

To avoid duplication and inconsistencies, we:

- access information reported by local water utilities to other regulators and government agencies
- share information reported by local water utilities with other regulators and government agencies.

This sharing and access will be subject to the limitations of any personal privacy considerations or due process requirements of compliance prosecutions being done by a regulator.

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## 8.5 The schedule and format of information required

To ensure the data collection process is as simple as possible, we will give utilities clear instructions on timing and the format of the data required.

This guidance will describe how the department plans to use and publish the data and any findings or assessments it draws from its analysis.

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## 8.6 Proactive monitoring approach

The department has a proactive monitoring approach to changes in performance. This ensures that when we identify changes in performance through analysing information we have received, we communicate this promptly to senior representatives of the local water utilities, the community, and other regulators.

This underpins the department's risk-based approach to regulation and oversight.

After analysing data, we may engage with individual local water utility's senior representatives about performance to encourage planned, strategic responses from the utility. Other proactive actions include engaging with the sector and its stakeholders to advocate for strategic responses that lift performance.

As part of this proactive response, we will publish in an easy-to-understand format analysis related to the risk profile, performance, benchmarking, and compliance history of local water utilities. This includes a simple performance dashboard where local water utilities, regulators, customers, and the community can readily and easily see how they perform on key performance indicators.

Our analysis will:

- bring a 'whole-of-sector' perspective by providing utilities with regional-, state-, and national-level information to inform decisions
- facilitate collaboration between local water utilities and others to share experience and intelligence
- provide flexible, proportionate, and risk-based oversight, engagement, and regulation, based on the individual circumstances of local water utilities
- support informed decision-making and improvement actions by local water utilities
- give tailored guidance to local water utilities that builds capacity through collaboration and partnership
- set a clear foundation of best practice and minimum service level standards.

To support performance monitoring and risk management through access to regular and current data, local water utilities can opt-in to reporting on a smaller set of key performance indicators on a quarterly basis. We will analyse the data we receive, return it to local water utilities, and publish it promptly.

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## 8.7 Continuous improvement

The department will periodically review its regulatory approach, policies, processes, systems, and activities, considering feedback from local water utilities, councils, other regulatory agencies, and staff. We will assess whether we are achieving our desired outcomes and quality objectives, determine if our approach continues to reflect regulatory best practice, and improve our approach as necessary to meet the high expectations of the people of NSW.

As part of a commitment to continuous improvement, we will conduct a performance review of the implementation of this regulatory and assurance framework (and associated guidance materials) within 2 years from finalisation. This will be supported by a regular, periodic review of the full suite of relevant regulatory documents at least every 5 years.

## 9 Review of departmental decisions

To ensure fairness and equity, it is important that local water utilities affected by decisions have a mechanism to have a departmental decision about their regulation reviewed.

This section outlines the review process, its scope, and rationale for implementation.

In addition to internal review through the department, local water utilities may also be able to seek a review of a decision of the Minister under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act in a court or tribunal.

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### 9.1 Asking for a review

Local water utilities can seek internal review of any decisions made by the department as a regulator. For the purposes of this framework, a regulatory decision includes any decision, direction, assessment, advice or request made as part of that decision. This includes all decisions made by the department in relation to overseeing local water utilities in their delivery of safe, secure, efficient, sustainable, and affordable water and sewerage services and management of risks to service provision under the Local Government Act and the Water Management Act.

When making a regulatory decision, we will document our reasons and give these promptly to the local water utility. This will ensure decisions are clear and the local water utility is provided with information to decide whether to seek a review. The reasons behind a decision will be made available as a matter of course and will include any evidence or context that informed our position.

Internal review by the department does not guarantee that the decision will be overturned. In response to a review, we may change our regulatory decision and substitute new and/or altered recommendations and expectations for the local water utility or we may let the decision stand.

The review process seeks to ensure that local water utilities can understand why a decision has been made, and to put forward reasons why it may be necessary for the decision to change.

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### 9.2 Internal review pathway

We have developed the internal review to give local water utilities a quicker and less formal avenue to have an administrative decision reviewed. Local water utilities may still be able to seek a review of a decision of the Minister under section 60 of the Local Government Act or section 292(1)(a) of the Water Management Act in a court or tribunal.

The internal review allows local water utilities to formally request we reconsider our position. The process can be applied at the request of a local water utility when they do not understand, or disagree with, the department's position on a given matter. The department's review and decision process will be based on the specific circumstances of the case, including the cost, complexity, risk

profile, risk mitigation, and distribution of responsibility. If necessary, the department may source external service providers (that is, an independent water engineering expert) to deliver non-binding third-party technical recommendations to provide a 'peer review' to help facilitate the decision-review process.

Consistent with standard probity processes, any decision subject to review will not be returned to the original decision-maker for consideration. Information may be sought from the initial assessor and decision-maker as part of the review process to ensure the review process incorporates all relevant considerations and materials.

The department will manage the review process promptly, based on the specific circumstances of each review.

The process for internal review of decisions is outlined in Table 9.

Table 9. The department's internal decision review framework

Step	Explanation and process
<b>1. Provision of rationale and evidence</b>	The department, at the written request of a local water utility, will give further rationale about why the initial decision was made. This may include an explanation of any key evidence, information, data, or documentation that was used to inform the initial decision.
<b>2. Engagement regarding the decision</b>	<p>If the local water utility remains unsatisfied with the decision after the department gives additional reasons and detail, it may request a formal meeting with the department. When requesting a meeting, the utility must give information about its desired outcome, as well as the suggested evidence-base or justification for the appeal. The department may request additional information, or dismiss the request, if it is insufficiently substantiated.</p> <p>This meeting will be Chaired by the Director with delegated decision-making responsibility.</p> <p>The purpose of this engagement is to allow the local water utility to ask questions about the decision, to understand the department's position, and to present information to substantiate and support an alternative decision.</p> <p>Following this meeting the department may request additional information from the local water utility, and/or if necessary seek further advice from an independent reviewer. The department may also provide additional information to the local water utility.</p> <p>Based on this engagement process, the department may:</p> <ul style="list-style-type: none"> <li>change its regulatory decision and substitute new and/or altered recommendations and expectations for the local water utility</li> <li>or</li> <li>not change its regulatory decision.</li> </ul>



Step	Explanation and process
<b>3. Chief Operating Officer review</b>	<p>If the local water utility remains unsatisfied with the decision following the engagement stage, the decision will be escalated to the Chief Operating Officer or another Executive Director level position at the department who was not involved in the original decision. . The local water utility may use this opportunity to give additional evidence as appropriate.</p> <p>Based on this review process, the department may:</p> <ul style="list-style-type: none"> <li>• change its regulatory decision and substitute new and/or altered recommendations and expectations for the local water utility or</li> <li>• not change its regulatory decision.</li> </ul> <p>In communicating their decision regarding the review, the executive director will give the local water utility information about the decision as appropriate, regardless of whether it has changed, including an assessment of the evidence, information, data, or documentation that was used to inform their decision.</p>
<b>4. CEO NSW Water Sector review</b>	<p>If the local water utility remains unsatisfied with the department's position after a review by the Chief Operating Officer (or equivalent) either due to no change in the initial decision, or a change that does not satisfy the utility's concern), the decision will be escalated to the CEO NSW Water Sector (or equivalent deputy secretary level position) from the department for final consideration.</p> <p>If appropriate and useful, this consideration can involve engagement with relevant senior representatives of the local water utility, such as the general manager, with a view to discuss the decision and potential ways forward.</p> <p>The outcome of this review may be that the department:</p> <ul style="list-style-type: none"> <li>• changes its regulatory decision and substitute new and/or altered recommendations and expectations for the local water utility or</li> <li>• does not change its regulatory decision.</li> </ul> <p>The department will give high-level reasons for its position to either change or not change its decision at the CEO NSW Water Sector review stage. This will be accompanied by a notice indicating that no further internal review will be contemplated.</p>

## 10 Co-operation between local water utility regulators

The department seeks to be a best-practice, risk-based regulator that clearly understands its role and manages overlap with other regulators of local water utilities.

The department is identified in the [NSW Water Strategy](#) as the primary regulator for regional local water utilities under the Local Government Act, as well as under the Water Management Act.

Local water utilities can expect NSW Government regulatory agencies to coordinate their regulatory efforts and work collaboratively. Local water utilities can expect that, where agreed by the local water utility, information given to one regulator will be available to and can be relied upon by its other regulators.

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### 10.1 Regulatory roles and responsibilities

The department is one in a network of regulators that have different responsibilities to regulate local water utilities. Other agencies include:

- NSW Health
- NSW Environment Protection Authority
- Office of Local Government
- Natural Resources Access Regulator
- Dams Safety NSW
- Independent Pricing and Regulatory Tribunal of NSW.

The regulatory roles and responsibilities of each organisation within the sector, including what aspect of regulation each part leads, is outlined in Table 10.

In addition, the department and some of the other agencies may provide advisory or support services to local water utilities distinct from their regulatory responsibilities.

Table 10. Regulatory role and responsibilities

Regulator	Leads oversight and regulation for...	Regulatory and oversight role
<b>Water group within Department of Planning and Environment</b>	Water utility planning, operations, and infrastructure	Oversee and support local water utilities in their delivery of safe, secure, efficient, sustainable, and affordable water and sewerage services and management of risks to service provision by regulating and providing advice and support under the <i>NSW Local Government Act 1993</i> and the <i>NSW Water Management Act 2000</i> .  Regulate works on waterfront land and manage water licenses and approvals of larger entities including water utilities.
<b>NSW Health</b>	Public health, drinking water quality	Protect public health by regulating drinking water suppliers, including local water utilities, and providing advice and support for the effective management of public health risks from water under the <i>NSW Public Health Act 2010</i> .
<b>NSW Environment Protection Authority</b>	Environmental protection	Protect the environment and human health via a suite of legislation that establishes a strong basis for environmental regulation that is outcomes-focused, proactive and contains appropriate compliance mechanisms.  The NSW EPA is a risk-based regulator that focuses and prioritises its activities to address the greatest risks. It regulates local water utilities that hold licences under the <i>NSW Protection of the Environment Operations Act 1997</i> .
<b>Office of Local Government</b>	Council and local water utility governance	Oversee council and local water utility governance, financial management and reporting under the <i>NSW Local Government Act 1993</i> .
<b>Natural Resources Access Regulator</b>	Surface water and groundwater access and extraction	Enforce natural resources management legislation, including <i>NSW Natural Resources Access Regulator Act 2017</i> , <i>NSW Water Management Act 2000</i> , <i>NSW Water Act 1912</i> , and associated regulations.
<b>Dams Safety NSW</b>	Safety of dams	Prevent failure of declared dams through compliance monitoring of owners' management systems under <i>NSW Dams Safety Act 2015</i> and <i>Dams Safety Regulation 2019</i> .
<b>Independent Pricing and Regulatory Tribunal of NSW</b>	Pricing for some local water utilities	Set the maximum prices that Central Coast Council, Essential Energy and Water NSW for the Fish River Water Supply Scheme can charge for water and sewerage services under the <i>NSW Independent Pricing and Regulatory Tribunal Act 1992</i> .

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## 10.2 Minimising duplication of regulatory effort

The department will coordinate and collaborate with local water utility regulators to minimise regulatory duplication and inconsistency. This recognises that:

- the time and resources of local water utilities, their customers and communities are valuable
- local water utilities are entitled to expect certainty and consistency in their interactions with any government agencies they deal with.

We are committed to collaborating with other local water utility regulators to:

- give a coordinated response to issues with the potential to significantly affect NSW communities
- consult on issues that may have implications for other agencies' regulatory areas, including where we communicate on these issues with local water utilities.

This collaboration will include:

- regular engagement to agree on leads and responsibilities
- ongoing information sharing (subject to privacy and other relevant laws) to minimise the need for information requests
- engagement on the scheduling of regulatory reviews, information requests, performance reporting, engagement points and other oversight activities to minimise the burden on individual local water utilities at any given time
- the exchange of insights regarding regional or statewide issues that may affect multiple local water utilities, and which require a coordinated response from government.

We are also committed to managing any potential disagreements over jurisdiction or responsibility between local water utility regulators entirely within NSW Government and without requiring the involvement of local water utilities.

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## 10.3 Raising concerns about regulatory duplication

From time to time, the combined activities of the department and other local water utility regulators may give rise to a perception of duplication of effort.

When this occurs, we request that local water utilities advise their departmental contact of that inconsistency and, if necessary, consider whether to lodge a complaint to the department.

When an instance of perceived or actual duplication is brought to our attention, we commit to:

- understanding the view of the local water utility that has raised the issue of duplication
- engaging with other relevant local water utility regulators to determine the existence and extent of any duplication.
- reviewing our own work to determine whether the work is necessary

- agreeing with other relevant local water utility regulators a strategy for managing the actual or perceived duplication both in the specific instance raised by the local water utility and in all instances going forward
- communicating in writing the outcome of this process to the local water utility that raised the issue of duplication
- meeting with the local water utility that raised the issue of duplication to discuss the response of the department and to obtain additional input and feedback.

# **QUEANBEYAN-PALERANG REGIONAL COUNCIL**

## **Council Meeting Attachment**

**25 JUNE 2025**

ITEM 9.5 PALERANG COMMUNITIES INTEGRATED WATER CYCLE  
MANAGEMENT (IWCM) ISSUES PAPER 2025

ATTACHMENT 3 IWCM COUNCILLOR BRIEFING - JUNE 2025

# QPRC



## IWCM BRIEFING

[qprc.nsw.gov.au](http://qprc.nsw.gov.au)

18 June 2025

Doc Set ID: XXXXXXX

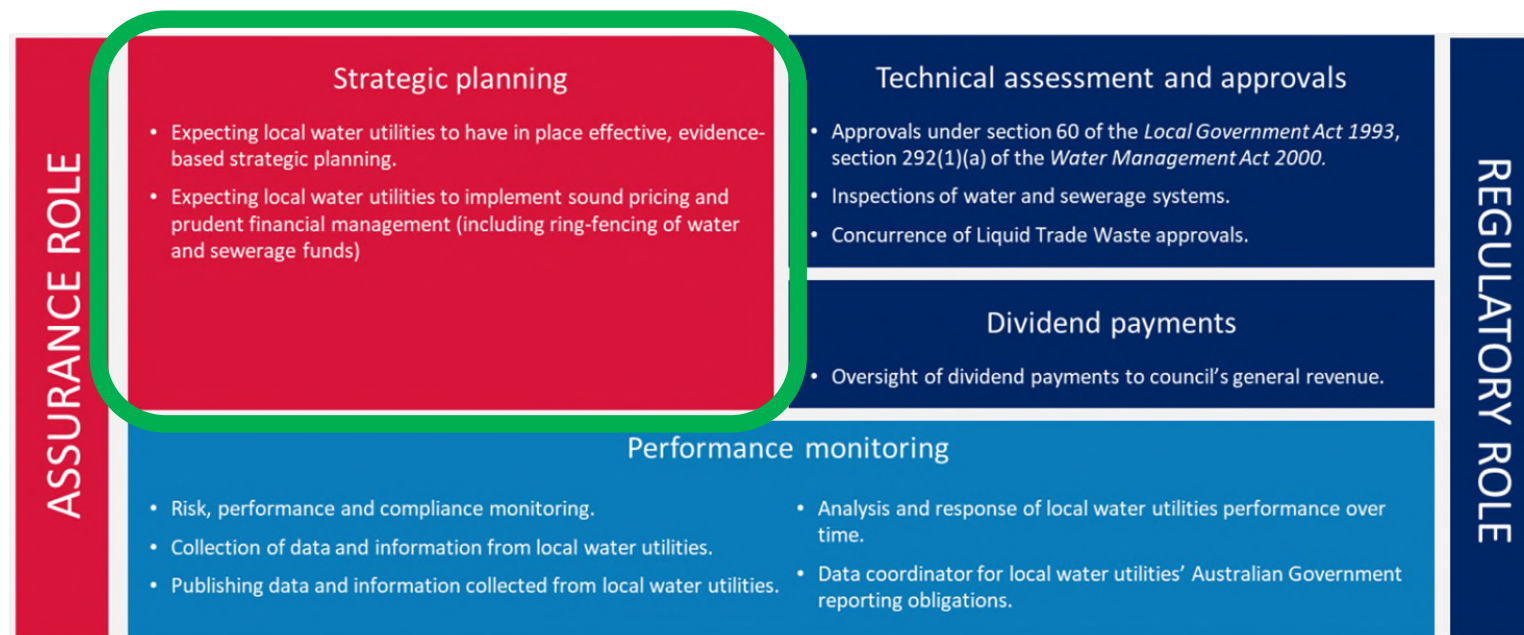
## What is IWCM



- IWCM is Integrated Water Cycle Management
- Strategic Planning for Local Water Utilities (LWUs)
- IWCM was a formally mandated process by regulator
- Followed a very rigid format (checklist)
- Recent Auditor General review caused change to Regulatory and Assurance Framework (RAF)
- LWUs now no longer required to follow IWCM to meet strategic planning objective of the RAF



# Regulatory and Assurance Framework





# Options for Strategic Planning

## 3. Water utilities that have not commenced scoping an IWCM strategy

Local water utilities that have not commenced scoping an IWCM strategy should refer to Section 3 [Regulatory and assurance framework for local water utilities \(PDF, 1100.53 KB\)](#) before starting the strategic planning process.

The framework does not prescribe specific strategic planning tools, processes, or approaches. You have three options to consider:

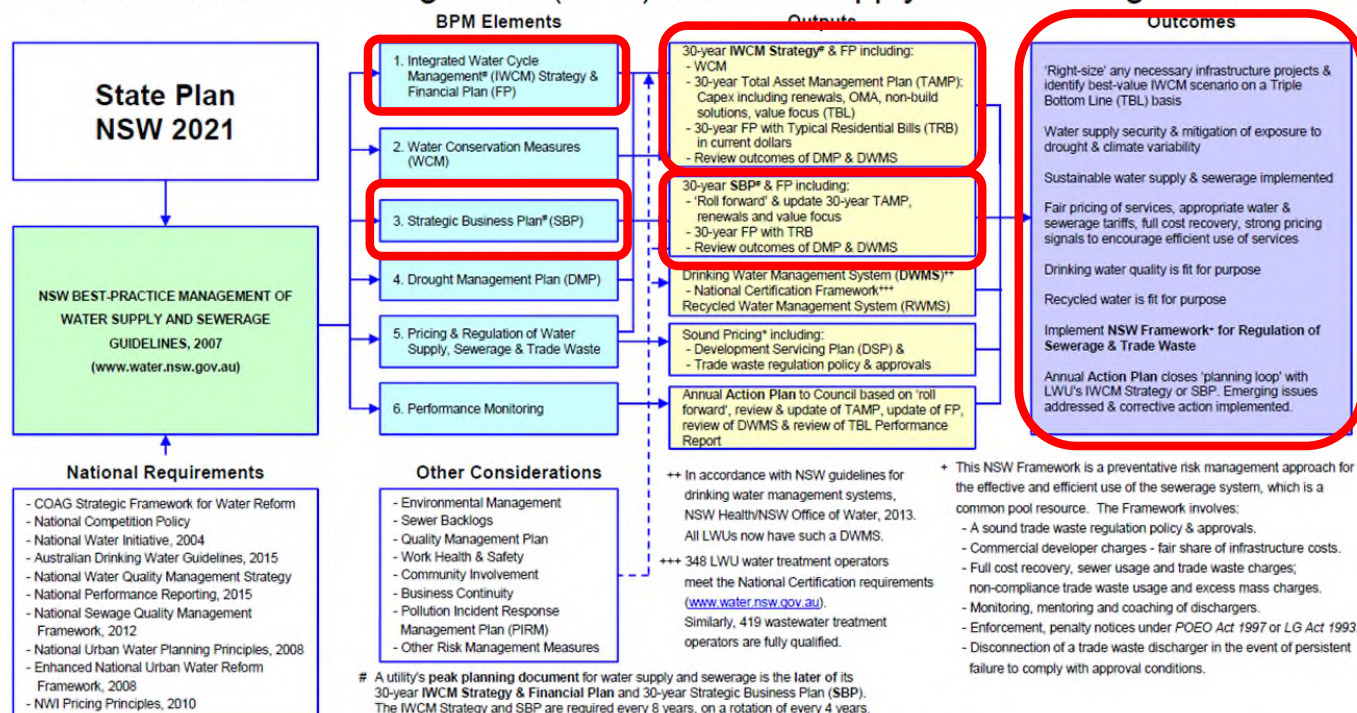
1. Continue to use the IWCM checklist as the basis for your strategic planning.
2. Participate in an Integrated Planning and Reporting focused local water utility strategic planning pilot – read the [Using the Integrated Planning and Reporting framework for local water utility strategic planning \(PDF, 573.34 KB\)](#) guidance document for more information.
3. Develop another approach to meet the outcomes-focused approach to local water utility strategic planning.

Local water utilities are encouraged to contact the [Town Water Risk Reduction Program](#) to discuss all the above options and your local contact in the department's water utilities team.

# Where the IWCM sits



## NSW Best-Practice Management (BPM) of Water Supply and Sewerage Framework



Note that the NSW Government's Best-Practice Management of Water Supply and Sewerage Framework is the practical means of implementing Goal 21 of the State Plan NSW 2021 by the regional NSW local water utilities (LWUs). The BPM Framework assures sound long-term planning, asset management, operation & maintenance, appropriate levels of service and community involvement, fair pricing of services, with strong pricing signals, full cost recovery and affordable water and sewerage services, without wasteful 'gold plating'. Each utility needs to closely involve its community in the utility's implementation of the following **nineteen (19) outcomes** required by the NSW BPM Framework:

**IWCM Strategy & Financial Plan (2)** - this is a required outcome for each of water supply and sewerage, Strategic Business Plan (**SBP - 2**), Water Conservation Measures (**WCM**), Drought Management Plan (**DMP**) and Performance Monitoring (**2**) and the following 11 Pricing\* Outcomes - **Full Cost Recovery (2)**, appropriate **residential charges (2)**, appropriate **non-residential charges (2)**, Development Servicing Plan (**DSP**) with commercial developer charges (**2**), **strong pricing signals**, with at least 75% of residential revenue from usage charges, appropriate **trade waste regulation policy** and approvals, and appropriate **trade waste fees and charges**.

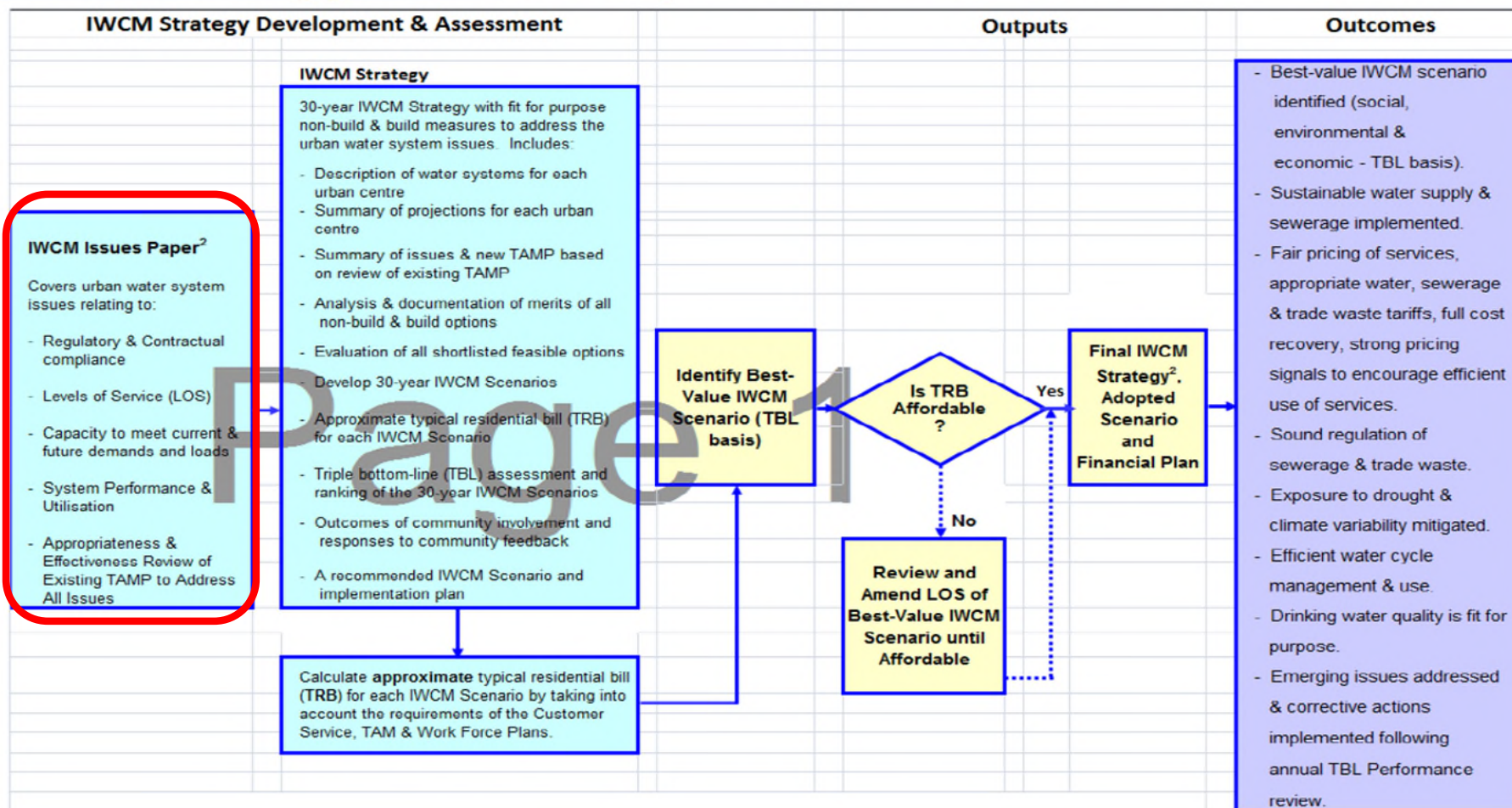
Directly supports achievement of GOALS 21, 22 and 5 of NSW 2021:

21 Secure potable water supplies – secure long term potable water supplies for towns and cities supported by effective effluent management.  
22 Protect our natural environment. 5 Place downward pressure on the cost of living.

DPI Water | July 2016



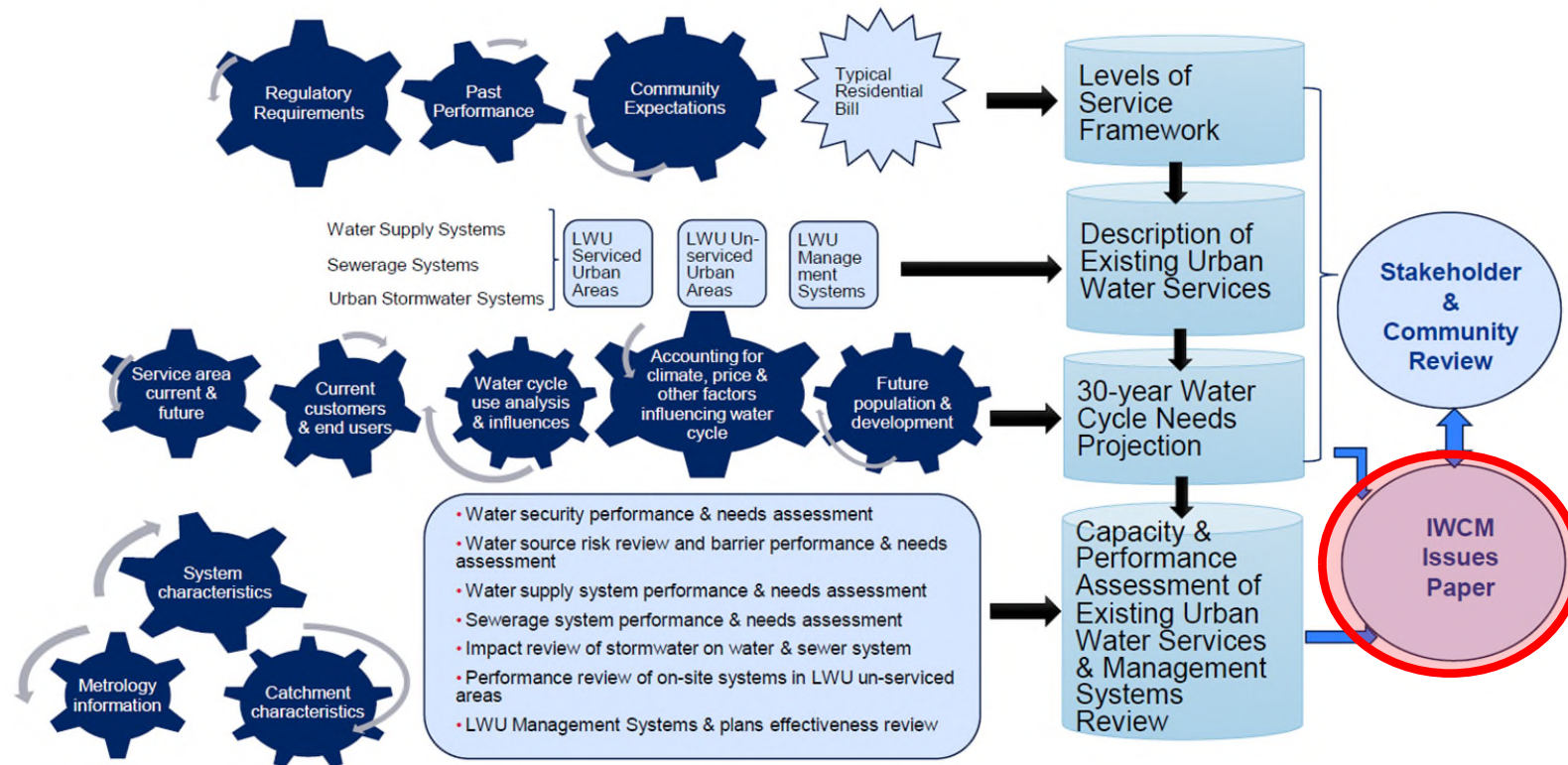
# IWCN Strategy – Development Framework



# The Issues Paper as part of IWCM



## IWCM Issues Paper – Development Framework





# Without a Plan....

Bungendore Bulletin Feb  
1998

**YARROWLUMLA COUNCIL**

**BUNGENDORE WATER CONSUMERS**  
Re: Bungendore Water Supply - "Boil Water" Notice

Council has received advice that the routine samples taken to test the Bungendore water supply have failed. The results indicate that the microbiological water quality of the Bungendore supply currently does not meet Health Department standards. Therefore, it is necessary to boil all drinking water.

Water should be boiled for at least three (3) minutes on a full rolling boil. Boiling water in an electric kettle is not sufficient.

All water used for drinking, teeth brushing, washing salad vegetables and similar uses needs to be boiled.

Bathing, washing dishes and clothes does not require boiled water.

Children should be prevented from ingesting bathwater.

A further notice will be sent to all residents once the "boiled water" notice has been lifted.

For all enquiries telephone Yarrowlumla Council on 6297 1311.

Inside of Captains Flat  
steel reservoir



Unroofed Braidwood  
reservoirs



EPA letter to Council  
August 2003

Your Reference: 28006194/PAF/94AW  
Our Reference: Annick Wakarshaw (02) 4224 4106  
Contact:

Tallaganda Shire Council  
(Attention: Alan Stewart)  
PO Box 91  
BRAIDWOOD NSW 2622

FILE COPY

Dear Sir

## ANNUAL RETURN FOR BRAIDWOOD SEWAGE TREATMENT PLANT

We refer to the Annual Return submitted by Tallaganda Shire Council for the sewage treatment plant (Licence Number 1733) 1 May 2002 to 30 April 2003. We note that you have reported no non-compliances.

The Environment Protection Authority (EPA) requested detailed monitoring data from Council and following our assessment of that data we consider that several conditions of the licence have not been complied with, including:

- Condition 1.3.2 states that discharges from Point 1 must comply with a 100 percentile concentration limit for total suspended solids limit of 30mg/L. Tallaganda Shire Council's own monitoring indicates that this limit was exceeded on 10 September 2002, 28 January 2003, 25 February 2003, and 29 April 2003.
- Condition 1.3.3 states that discharges from Point 1 must comply with a 100 percentile concentration limit for biochemical oxygen demand of 20mg/L. Tallaganda Shire Council's own monitoring indicates that this limit was exceeded on 14 August 2002, 10 September 2002, and 28 January 2003.
- Condition 1.6.1 requires the volume discharged from Point 1 to be monitored daily, meaning there must be 365 monitoring results for each reporting period. The annual return you submitted stated there are only 362 monitoring results available.
- Condition 1.4.1 states that discharges from Point 1 must not exceed 300kL/day. Tallaganda Shire Council monitor volume at the inlet flume, not at Point 1 so it is difficult to assess compliance with this Condition. The EPA has discussed the possibility of installing volume monitoring at Point 1 and it was determined that as the reuse scheme would replace the need to discharge to river, it was not economically feasible to install new equipment as the reuse scheme is required to be completed and commissioned by 30 November 2003. Council should ensure that works are progressing to meet this completion date.

The EPA advise that it is an offence to supply information to the EPA that is false or misleading in a material respect, or to certify a statement (including an Annual Return) that is false or misleading in a material respect. There is a maximum penalty of \$250,000 for a corporation or \$120,000 for an individual. You may wish to consider resubmitting your Annual Return to the EPA. Please find enclosed another copy of the annual return document. The revised Annual Return must reach the Wollongong office of EPA by 29 August 2003.

Boil water notice –  
Braidwood Dec 2011

PALERANG  
COUNCIL

BRAIDWOOD WATER SUPPLY

## Boil Water Notice

Regular monitoring for E. Coli bacteria in the Braidwood water supply system is conducted by NSW Health in accordance with the Australian National Drinking Water Guidelines. Recent test results indicate a problem in the disinfection of the supply and Council is unable properly guarantee the quality of the water at this time. Whilst E. Coli itself is generally not harmful, it is an indicator of the level of coliforms that may cause gastrointestinal complaints. As a result, the NSW Department of Health has issued a Boil Water Alert.

Residents in the Braidwood area are immediately advised that water used for consumption should be brought to a boil for at least three minutes on a full rolling boil.

Automatic cut-off kettles are not suitable. People should be careful when boiling water and be aware of the dangers of scalding.

Boiled water should be allowed to cool and stored in a clean container with a lid in the refrigerator for the use of:

Drinking, cooking, washing uncooked foods (such as seafood or salads) making ice, personal hygiene, pet's drinking water, washing hands, cleaning teeth, gargling, face washing of young children, washing toys and children's nappies.

This advice is in force until further notice.

All enquiries should be directed to Palerang Council on 1300 733 025.

P. Buscomb  
General Manager  
21 December 2011

Document Ref ID: 271188  
Version: 1. Version Date: 2011/12/21



## 2025 Issues Paper



- Update from that prepared in 2019
- Focussed on the schemes of:
  - Bungendore
  - Braidwood
  - Captains Flat
- Total of 36 issues identified and listed in Exec Summary under tables S-9 to S-11
- Not all issues will be subject to options and strategy development – some are BAU
- Palerang vs Queanbeyan Issues Papers

## Key Issues\*



- Bungendore Water Security Strategy pretty much set
  - Option 3 (Q2B) of 2019 study will be reinforced
  - Bungendore STP to be upgraded as a response
- Braidwood Water Security is new
  - Relates to growth identified in structure plan discussion paper
  - Reach secure yield of 320ML/a in 2045 ( $\approx$ 2,800 EP)
  - Reach daily capacity of WTP in 2040 ( $\approx$ 2,500 EP)
  - Require Mech & Elec upgrade of STP at 2033
  - Reach capacity of STP at 2048 ( $\approx$ 3,000 EP)
- Bungendore PFAS



## Other Issues

- BASIX vs DCP tank size
- DCP tanks and usage revenue
- Fluoride audit and CoP compliance
- Bungendore water chlorination C.t
- Cl resistant pathogens (UV)
- Water losses
- Sewer networks inflow/infiltrat
- Potential for rising main septicity
- Various SPS pump rates over time

Plus BAU matters not part of the Issues paper to develop....



## The Financial Part of the Strategy

Palerang Community DSP for Water Supply

WATER - 10-Year Capital Works Program														
Current Year					2019 /20									
CAPITAL WORKS IN 2019/20 (\$'000)														
ITEMS	ILOS	GROWTH	RENEW	Total	1	2	3	4	5	6	7	8	9	10
					2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29
A - NEW WORKS - BACKLOG														
	100%			0										
B - NEWWORKS - GROWTH														
B'dore WTP Upgrade (2 Md) - LF Belt Bores - Stage1		100%		11,807				6,807	5000					
B'dore WTP Upgrade (Addl. 2 Md) - LF Belt Bores - Stage2		100%		0										
Private works, connections, extensions		100%		516	52	52	52	52	52	52	52	52	52	52
New Meters and Connections		100%		206	21	21	21	21	21	21	21	21	21	21
Network development for Greenfield - Bores, mains and reservoirs		100%		10,334		1,000	1,154			5,000	3,180			
Council's Capital Proj Mgmt Charge		100%		502	3	3	3	275	203	3	3	3	3	3
C - NEWWORKS - SERVICE IMPROVEMENT / OTHER														
Bungendore - Water Bores	100%			508		508								
Dams (Component) upgrade	100%			0										
Braidwood W.T.P. - Improvements	100%			310					310					
Bungendore W.T.P. - Improvements	100%			722	155	258				310				
Captains Flat W.T.P. - Improvements	100%			0										
Pump Station - (Component) upgrade - Braidwood	100%			0										
Reservoirs - (Component) upgrade	100%			0										
Telemetry System upgrade	100%			103									103	
Council's Capital Proj Mgmt Charge	100%			65	6	31			12	12			4	
E - ASSET / COMPONENT RENEWAL														
Based on Asset Register														
Dams (Captains Flat)		100%		258							258			
Water Treatment Plants - Bungendore MSE		100%		722								722		
Pump Stations		100%		392	10	10	10	10	10	155	155	10	10	10
Replace Cap Flat Steel Reservoir		100%		0										
Water Mains		100%		457		457								
Service Connections		100%		310	62		62		62		62		62	
Captains Flat Dam 10 yearly post stressing lift off test		100%		124			124							
Replace Braidwood rising main		100%		1,651		1,651								
Paint Days Hill reservoir		100%		361				361						
Turallo Reservoirs retaining wall and leak repair		100%		206	206									
Establish Hydraulic model (all three schemes)	100%			108	77	31								
Replace membranes Captains Flat WTP		100%		144			72							72
Chemical storage shed Captains Flat WTP		100%		206	206									
Water loss studies	100%			155	155									
Water Meters		100%		310	31	31	31	31	31	31	31	31	31	31
Telemetry System		100%		103	10	10	10	10	10	10	10	10	10	10
Council's Capital Proj Mgmt Charge		100%		222	30	88	12	17	5	8	21	31	5	5
<b>GRAND TOTAL</b>				<b>30,804</b>	<b>1,025</b>	<b>4,151</b>	<b>1,551</b>	<b>7,584</b>	<b>5,715</b>	<b>5,601</b>	<b>3,792</b>	<b>880</b>	<b>301</b>	<b>204</b>

## Next Steps...



- Develop revised long term works plan for:
  - Palerang Water Supplies
  - Queanbeyan/Googong Water Supplies (using that IWCN)
  - Palerang Sewerage Schemes
  - Queanbeyan/Googong (inc Recycled Water) Schemes
- Develop DSPs against growth assessments
- Model TRBs against:
  - Palerang and Queanbeyan/Googong systems separately
  - Model as combined
- Present to Council for consideration and determination

# QPRC



## QUESTIONS

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[qprc.nsw.gov.au](http://qprc.nsw.gov.au)