



Integrated Water Cycle Management

Strategy and Financial Plan

Queanbeyan-Palerang Regional Council

27 October 2022



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Executive summary

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.2 and the assumptions and qualifications contained throughout the Report.

Queanbeyan Palerang Regional Council (Council) has stewardship for provision of water and wastewater services for Queanbeyan Local Government Area. The NSW Integrated Water Cycle Management (IWCM) strategic planning instrument provides a framework for Council to determine long-term strategic planning for water management.

Council has recently undertaken the required analysis and prepared the IWCM Issues Paper (AECOM, 2019 and 2020). Council has also undertaken a strategic review of its water and wastewater services. These reviews considered the current and future water and wastewater infrastructure to identify feasible scenarios for the IWCM strategic plan. The issues identified covered general, water supply, sewerage, and stormwater system issues.

Following the development of this Issues Paper, Council engaged GHD to undertake a review of the water supply system and Hunter H₂O to prepare a review of the sewerage system.

The issues relating to sewerage services, as outlined in QPRC's supplementary report (AECOM, 2020), are:

1. Queanbeyan sewage treatment plant (STP) hydraulic capacity will be exceeded by 2025
2. The Community based Level of Service requirements needs to be revised and documented in future Asset Management Plans (strategic, tactical and operational)
3. Existing STP needs to be operated and maintained to continue to meet discharge license conditions until the new STP is commissioned
4. Design options and timing of potential upgrades for Morisset SPS needs to be reviewed as part of the Queanbeyan STP Upgrade Project
5. Lack of detailed knowledge of capacity constraints may lead to additional augmentation work required to meet acceptable service standards
6. Sewer model is not up to date and not calibrated
7. Sewer network asset condition assessments needs to be improved

Items 1 and 3 are being addressed as part of the STP Upgrade project and a summary of the master planning, options assessment and concept design have been drawn from Hunter H₂O (2021). Items 2 and 7 are being addressed by Council in parallel with the IWCM strategy development. Discussions regarding Items 4, 5 and 6 in Hunter H₂O (2021) are reproduced in this document.

Following the analysis undertaken for the water system, by GHD, the critical upgrade option to be considered for the current network is a duplication of the Jerrabomberra Reservoir. It was also recommended that further work to improve the model be undertaken including development and calibration of an operational model. It was also noted that there would be benefit in undertaking further investigation into the current system to confirm the chlorine levels and provide additional chlorine dosing if areas are found to be deficient.

It was determined through this process that there is only one feasible scenario for each of water and sewerage.

The preferred scenario for water supply is continued supply of bulk treated water from Icon Water. The preferred scenario for wastewater is the upgrade of the Queanbeyan STP.

Based on the above scenarios, analysis of financial modelling was undertaken. This modelling utilised financial information provided by Council, including water and sewer fund status, review of assets remaining life, cost estimates for proposed works, including the STP upgrade and operational costs.

Financial analysis was undertaken to assess the impact of the proposed capital expenditure programs on the financial position of the Council over a twenty-year period. The analysis considered the forecasted cashflow and account balances under external funding (grant and loan) scenarios.

QPRC is facing a more significant capital expenditure program for sewer infrastructure, with a growth/enhancement program of in excess \$160m in the four years, whereas the water capital funding relates mainly to the \$20m required for the duplication of the Jerrabomberra Reservoir.

Table 1 *Recommended Water funding scenario*

Water Scenarios		Water Scenario1		
		No Grant, No Loans		
Sect 64 Balance		\$10,000,000		
Fund Balance		\$11,600,000		
Interest Rate - Debt		6.00%		
Interest Rate - Earned		1.00%		
Loan Term (years)		20		
Rate Increase - Initial 4 years		2.50%		
Rate increases - balance of the 20 years		2.50%		
CPI - Water		2.50%		
Capital cost CPI (CPI+Margin)		1.00%		
Grant Funding - Percentage ask of eligible		0.00%		
Grant Funding - Net Percentage		0.00%		
		Grant Funding	Loan Funding	Closing Balance
2021/22		0	0	26,851,093
2022/23		0	0	32,325,725
2023/24		0	0	30,259,360
2024/25		0	0	31,003,677
2025/26		0	0	36,318,780
2026/27		0	0	6,580,176
2027/28		0	0	12,221,324
2028/29		0	0	18,735,533
2029/30		0	0	24,965,308
2030/31		0	0	31,924,641
2031/32		0	0	40,728,536
2032/33		0	0	50,036,903
2033/34		0	0	58,315,081
2034/35		0	0	68,685,694
2035/36		0	0	79,398,152
2036/37		0	0	90,927,984
2037/38		0	0	102,263,138
2038/39		0	0	110,852,023
2039/40		0	0	124,256,394
2040/41		0	0	137,665,480
		\$0	\$0	

The table above shows the preferred scenario and is based on:

- ✓ No grant funding sought
- ✓ No additional loans sought
- ✓ Annual rate increases aligned to consumer price index (2.5%)

Table 2 Recommended Sewer funding scenario

Sewer Scenarios		Recommended Scenario		
		25% Grant request, \$40m Loans		
Opening Balance - Section 64		\$7,000,000		
Opening Balance - Sewer Fund		\$58,000,000		
Interest Rate - Debt		6.00%		
Interest Rate - Earnt		1.00%		
Loan Term (years)		20		
Rate increases		6yrs/0 yrs/14 years		
Rate Increase - Initial period		6.50%		
Rate Increase - second period				
Rate increases - balance of 20 years		2.50%		
CPI - Sewer		2.50%		
Capital cost CPI (CPI+Margin)		1.00%		
Grant Funding - Percentage ask of eligible		0.00%		
Grant Funding - Net Percentage		16.72%		
		Grant Funding	Loan Funding	Closing Balance
2021/22		0	0	59,604,903
2022/23		2,700,000	0	70,493,332
2023/24		17,648,432	20,000,000	44,233,581
2024/25		18,543,306	20,000,000	13,879,918
2025/26		0	0	11,502,257
2026/27		0	0	17,206,724
2027/28		0	0	8,949,438
2028/29		0	0	18,032,995
2029/30		0	0	27,566,075
2030/31		0	0	15,562,936
2031/32		0	0	11,402,223
2032/33		0	0	6,191,701
2033/34		0	0	10,440,744
2034/35		0	0	23,269,450
2035/36		0	0	36,733,177
2036/37		0	0	51,827,066
2037/38		0	0	61,502,430
2038/39		0	0	77,556,785
2039/40		0	0	94,338,828
2040/41		0	0	113,318,603
		\$38,891,738	\$40,000,000	

The table above shows the preferred sewer funding scenario, based on the following:

- ✓ 25% grant funding sought QSTP upgrades in 2023/24 and 2024/25 in addition to the \$2.7m already granted for 2022/23
- ✓ Loan funding of \$40m over the two year period 2023/24 and 2024/25
- ✓ Rate increases budget for across two stages;
 - Initial increase of 6.5% for six years.
 - Balance (14 years) annual rate increase aligned to consumer price index (2.5%)

Based on the existing data, the 'typical' residential bill is expected to increase by 2.98% per annum, increasing the 'typical residential bill' to \$3,587 by 2040/41 compared to the current 'typical' bill of \$2,054. Table 3 sets out the annual profile of the 'typical' residential bill.

Table 3 **Summary of water and sewerage charges for selective financial years**

	Sewer		Water		Typical Residential Bill
	Rate Increase	Charge	Rate Increase	Water Bill	
		\$733.00		\$1,321.89	\$2,054.89
2022/23	6.5%	\$780.65	2.5%	\$1,354.93	\$2,135.58
2023/24	6.5%	\$831.39	2.5%	\$1,388.81	\$2,220.19
2024/25	6.5%	\$885.43	2.5%	\$1,423.53	\$2,308.96
2025/26	6.5%	\$942.98	2.5%	\$1,459.12	\$2,402.10
2026/27	6.5%	\$1,004.27	2.5%	\$1,495.59	\$2,499.87
2027/28	6.5%	\$1,069.55	2.5%	\$1,532.98	\$2,602.54
2028/29	2.5%	\$1,096.29	2.5%	\$1,571.31	\$2,667.60
2029/30	2.5%	\$1,123.70	2.5%	\$1,610.59	\$2,734.29
2030/31	2.5%	\$1,151.79	2.5%	\$1,650.86	\$2,802.65
2031/32	2.5%	\$1,180.58	2.5%	\$1,692.13	\$2,872.71
2032/33	2.5%	\$1,210.10	2.5%	\$1,734.43	\$2,944.53
2033/34	2.5%	\$1,240.35	2.5%	\$1,777.79	\$3,018.14
2034/35	2.5%	\$1,271.36	2.5%	\$1,822.24	\$3,093.60
2035/36	2.5%	\$1,303.14	2.5%	\$1,867.79	\$3,170.94
2036/37	2.5%	\$1,335.72	2.5%	\$1,914.49	\$3,250.21
2037/38	2.5%	\$1,369.12	2.5%	\$1,962.35	\$3,331.47
2038/39	2.5%	\$1,403.34	2.5%	\$2,011.41	\$3,414.75
2039/40	2.5%	\$1,438.43	2.5%	\$2,061.69	\$3,500.12
2040/41	2.5%	\$1,474.39	2.5%	\$2,113.24	\$3,587.62

3.75%

2.50%

2.98%

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1. Introduction

1.1 Purpose of this report

Queanbeyan-Palerang Regional Council (Council) have completed the first stage of the Integrated Water Cycle Management (IWCM) strategy for Queanbeyan: the IWCM Issues Paper (AECOM, 2019), including the Issues Paper Supplementary Report (AECOM, 2020). These documents have identified several issues for the water supply and sewerage network.

Council, together with their consultants, has also identified the available options for water and wastewater. This report brings the identified options together to present the recommended scenarios for the IWCM strategy and the water and wastewater typical residential bill (TRB) for those scenarios.

The outputs of this report will be used by Council to further develop the IWCM strategic implementation and planning into the future.

This report only addresses services in Queanbeyan and adjacent urban areas as an IWCM report has already been prepared and approved for Bungendore, Braidwood and Captains Flat.

1.2 Scope and limitations

This report has been prepared by GHD for Queanbeyan-Palerang Regional Council and may only be used and relied on by Queanbeyan-Palerang Regional Council for the purpose agreed between GHD and Queanbeyan-Palerang Regional Council as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Queanbeyan-Palerang Regional Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring after the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report based on information provided by Queanbeyan-Palerang Regional Council, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the financial assessment set out in section 7 of this report ("IWCM analysis") using information provided by Council or reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD and as agreed with Council.

The financial assessment has been prepared for the purpose of determining the water supply and wastewater typical residential bill (TRB) as required under the IWCM process and must not be used for any other purpose.

The financial assessment is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the financial assessment and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the typical residential bill can or will be the same or less than the financial analysis.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be

greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

1.3 Assumptions

Separate sets of assumptions were made for the water (GHD, 2021) and wastewater (Hunter H₂O, 2021) reports. Additional assumptions relevant to the financial modelling of the systems have also been made for this report. These assumptions are summarised below.

1.3.1 Water

The assumptions made in GHD (2021) while undertaking the water system assessment included the following:

- The model provided by QPRC is suitable for use as the basis for this assessment
- Demands for 2050 growth scenario are correct
- The capital works for Googong will be sized, designed, and constructed by the developer to suit the development pattern. This is independent of the Queanbeyan water supply network.
- The infrastructure to supply the Tralee development has been design and constructed by the developer to suit the demands.

1.3.2 Wastewater

The Design Criteria and Assumptions Report was prepared by Hunter H₂O in 2019 and summarised in Hunter H₂O (2021). The report outlines the design criteria and assumptions that were used as the basis for the development of upgrade options and subsequent concept and reference designs. The design criteria and assumptions in the report were presented to QPRC at a Design Basis Workshop in June 2019 and were adopted as the basis for proceeding with the upgrade project. The noted assumptions include:

- The Queanbeyan STP adopted EP projections to 2038, and adopted flow and temperature assumptions
- The connection of a new regional pump station to the existing system via the Tralee SPS
- The inclusion of a developer funding new SPS servicing the Jumping Creek development area
- A review of historical inflows to STP data, which concluded that the catchment had moderate infiltration during wet weather

1.3.3 Financial modelling

Assumptions used in the financial modelling have been included in section 7.

2. Developing the IWCM Strategy

In accordance with the requirements of the NSW IWCM process, Council has considered the elements of the IWCM checklist as presented below.

2.1 Queanbeyan – description of existing systems

2.1.1 Water

Treated bulk water is supplied to Queanbeyan by Icon Water, which is the water service provider responsible for providing potable water supply to the ACT. Treated bulk water is transferred to Queanbeyan from Icon Water's Mt Stromlo Water Treatment Plant (located in the ACT) and Googong Water Treatment Plant (located in NSW) via two bulk supply 'offtakes' to end users in Queanbeyan. A service level agreement is in place to manage this supply.

2.1.2 Wastewater

The sewerage system in the study area is predominantly a gravity reticulation system, comprising over 282 km of pipelines and 15 pumping stations. The reticulated network services the majority of Queanbeyan and Jerrabomberra, except for some semi-rural outer suburbs (e.g., The Ridgeway) where decentralised septic systems are used. The reticulated sewerage network transfers sewerage to the Queanbeyan Sewage Treatment Plant (STP), located to the north of Queanbeyan, within the ACT, on the south bank of the Queanbeyan River. The Queanbeyan STP is operated by Council. The treatment plant discharges to Molonglo River in accordance with ACT Environment Protection Authority (EPA) licence conditions. Downstream of the STP the Molonglo River drains into Lake Burley-Griffin.

2.1.3 Stormwater

The stormwater system for Queanbeyan comprises a reticulated system that drains via gravity into the Queanbeyan River, which in turn flows into Lake Burley-Griffin. Stormwater from Jerrabomberra and future development areas to the south of the city drain into Jerrabomberra Creek, which feeds the Jerrabomberra Wetlands and Lake Burley-Griffin.

2.2 Issues identified

A final draft version of the IWCM Issues Paper for Queanbeyan was prepared by AECOM in late 2019 (AECOM, 2019). The issues identified in this Paper have been presented here.

2.2.1 Water

The AECOM (2019) IWCM Issues Paper identified that a review of the Queanbeyan bulk water system was required. The objectives of this review included the establishment of future capital work projects, the provision of scenario planning, and the provision of order of magnitude costs.

GHD (2021) drew on the issues identified in AECOM (2019) as a basis and considered other relevant planning studies and reports to identify and analyse upgrade options for the potable water supply services for Queanbeyan.

2.2.2 Wastewater

Following AECOM (2019), QPRC submitted a Supplementary Report to DPIE in May 2020 that summarised the most recent 30-year water demand and sewage loading projections and provided a brief description of the issues that QPRC will address as part of the IWCM Strategy. Hunter H₂O (2021) subsequently described the feasibility review of options and options assessment for the identified IWCM issues related to the Queanbeyan sewerage system.

The issues relating to sewerage services, as outlined in QPRC's supplementary report (AECOM, 2020), are:

1. Queanbeyan STP hydraulic capacity will be exceeded by 2025
2. The Community based Level of Service requirements needs to be revised and documented in future Asset Management Plans (strategic, tactical and operational)
3. Existing STP needs to be operated and maintained to continue to meet discharge license conditions until the new STP is commissioned
4. Design options and timing of potential upgrades for Morisset SPS needs to be reviewed as part of the Queanbeyan STP Upgrade Project
5. Lack of detailed knowledge of capacity constraints may lead to additional augmentation work required to meet acceptable service standards
6. Sewer model is not up to date and not calibrated
7. Sewer network asset condition assessments needs to be improved

Items 1 and 3 are being addressed as part of the STP Upgrade project and a summary of the master planning, options assessment and concept design have been drawn from Hunter H2O (2021). Items 2 and 7 are being addressed by Council in parallel with the IWCM strategy development and were excluded from Hunter H2O (2021). Discussions regarding Items 4, 5 and 6 in Hunter H2O (2021) are reproduced in this document.

2.2.3 Stormwater

The following items were identified as issues for the stormwater system.

1. There is up to 2 GL/year of extra stormwater discharge that could be captured (under average rainfall) as potable water offset when considering projected future water demand.
2. There is a large nutrient contribution from stormwater which could be managed to offset wastewater loads.

2.3 Assess strategic options

An evaluation of the options for the provision of water and wastewater to Queanbeyan and adjacent urban areas has been undertaken. The findings of these assessments are provided in this report from section 4 onwards.

2.4 Financial modelling

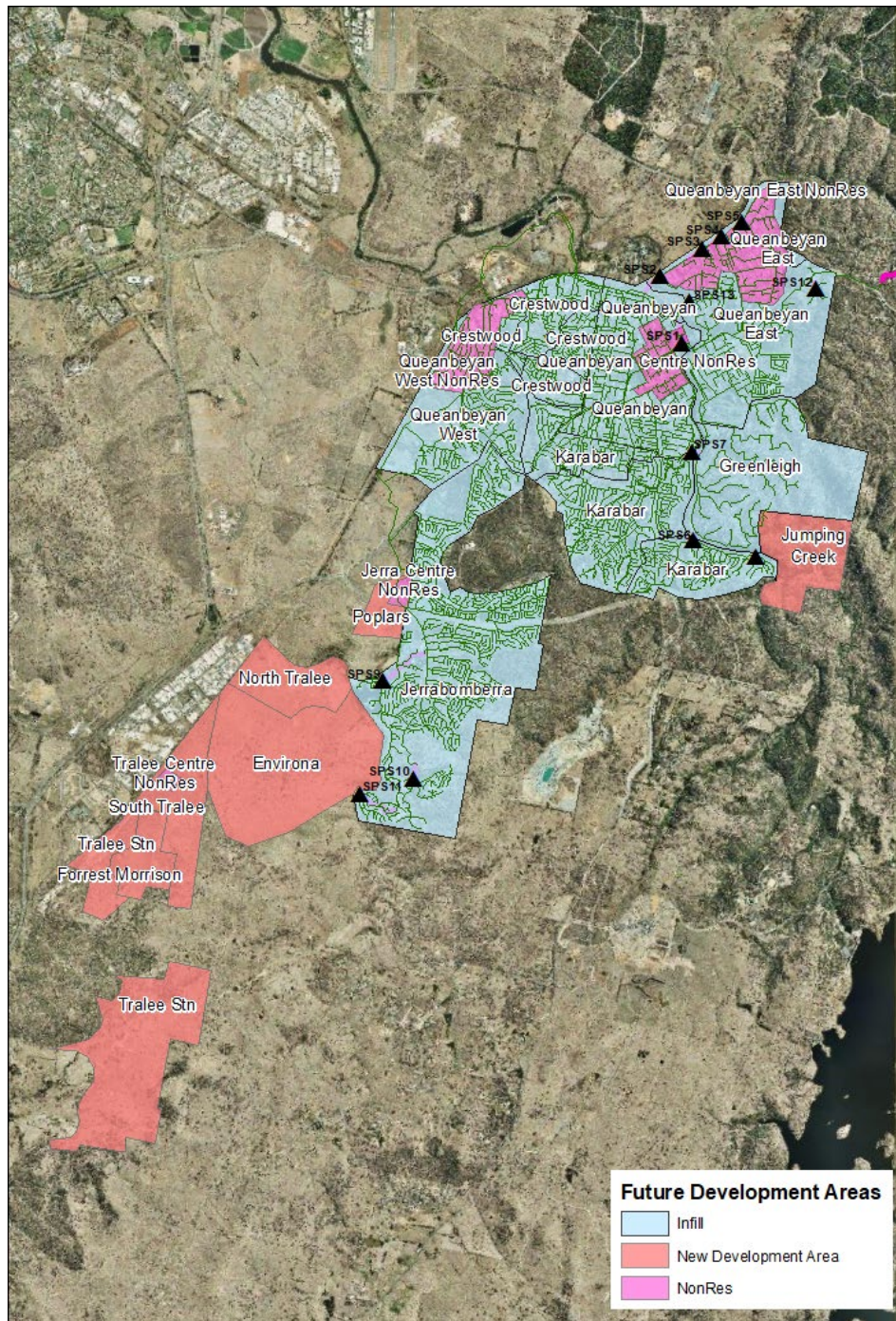
A financial assessment for the preferred scenario has been undertaken and this is presented at section 7.

3. Population, demands and growth

To prepare the IWCM strategy, consideration needs to be given to the population that the strategy will serve into the future and where infrastructure will be required to service this population. Below is an outline of the growth areas, populations and demands determined for this IWCM strategy.

3.1 Growth areas

Council has identified the location of future developments affecting water and wastewater services for Queanbeyan as shown in Figure 1 below.



3.2 Population projections

The population projections that were included in the IWCM Issues Paper are presented in Figure 2. These projections didn't make allowance for the growth areas of South Jerrabomberra and Jumping Creek.

Queanbeyan IWCM	Forecast Year					
	2016	2021	2026	2031	2036	2050 ²
Residential Population	41,952	42,584	43,874	45,690	46,931	46,931
Residential Dwellings ¹	17,374	17,985	18,650	19,443	20,094	20,094
Non-residential (employment) Area, Ha	163	200	211	231	245	283
Non-residential (recreational) Area, Ha ^{3,4}	UNK	3	13	26	26	26

Notes:

1. Dwellings assumed to represent low, medium and high density from private and non-private dwellings
2. There are no projections available for development areas beyond 2036 hence for the 2050 planning horizon there is no further growth assumed (as agreed with QPRC)
3. Existing (2016) recreational land area unknown (data not available)
4. Additional future recreational development (2021-2050) assumed to represent Public Open Space

Figure 2 Population projections (Queanbeyan IWCM Issues Paper, AECOM, 2019)

3.3 Demand projections

Investigations into demand projections have been included in previous documents. When preparing the water supply strategy, GHD was provided with the EP projections for future developments used by Hunter H₂O in their sewerage network analysis for consistency. For 2050, there is an EP of 77,521 which, when adopting a scaling factor of 0.88 (based on previous population to EP ratios), equates to a population of approximately 68,000 and a peak day demand (PDD) for water of 36.5 ML/d.

The stormwater discharge volumes are shown in Figure 3.

Table E4 Projected Stormwater Discharge (2050)

Future Land Use (2050)	2050 Area (Ha)	Stormwater (GL/yr)	Total Suspended Solids (Tonne/yr)	Total Phosphorus (Tonne/yr)	Total Nitrogen (Tonne/yr)
Industrial	207	1.1	89	0.2	1.2
Commercial	95	0.5	76	0.1	1.2
Residential	3,190	9.6	1,297	2.3	17.7
Parkland and Open Space	88	0.2	17	<0.1	0.3
Forest	2,460	<0.1	23	<0.1	1.1
Rural residential	13,461	8.5	742	1.3	14.0
Total Study Area	19,500	19.8	2,245	4.0	35.4

Notes:

1. No stormwater discharge is expected from the existing local quarry (55 Ha) therefore it is not featured in Table E4.

Figure 3 Projected stormwater discharge volumes (Queanbeyan IWCM Issues Paper, AECOM 2019)

4. Water supply scenarios

4.1 Existing water supply

4.1.1 Service level agreement

The current Queanbeyan bulk water supply is from Icon Water's network under a Service Level Agreement. Table 4 summarises the connections and supply from the Icon Water network, noting the following naming conventions:

- Offtake – a branch main off an Icon Water asset. It may have multiple supply points.
- Supply point – the meter on a line supplying a reservoir
- Limit of supply responsibility – a valve located on the Council side of the supply point that demarcates the limit of respective ownership for Council and Icon Water.

Table 4 *Queanbeyan supply from Icon Water*

Offtake	Supply Point	Description	Offtake Maximum Supply – Case 1	Offtake Maximum Supply – Case 2	Offtake Maximum Supply - Case 3
1	Jerrabomberra	Supply line to Jerrabomberra Reservoir	20 ML/d	27 ML/d	33 ML/d
	Tralee	Supply line to Tralee Low Level Reservoir			
2	East Queanbeyan	Supply line to East Queanbeyan Reservoir	7 ML/d	14 ML/d	17 ML/d
3	Googong Potable	Supply line to Googong Potable Water Reservoir	2.5 ML/d	2.5 ML/d	2.5 ML/d
	Googong Recycled	Supply line to Googong Recycled Water Storage Tank at WRP			
4	Kendall Avenue	Connection to facilitate emergency supply in the event of catastrophic incident on Googong Bulk Supply Main	To meet agreed emergency supply rates.		
Case 1 – Maximum off-peak daily demand where only Stromlo WTP is in operation. Off-peak is defined as the winter months Case 2 – Maximum peak daily demand. Both Googong and Stromlo WTP in operation Case 3 – Maximum daily demand where total Queanbeyan daily demand exceeds 41 ML/d and Icon have excess supply capacity					

An overview of the Queanbeyan network is shown in Figure 4. Note that the locations of the Offtakes are not shown accurately. A water system supply schematic is shown as Figure 5.

Whilst Googong is not covered in this document or the Queanbeyan IWCM it is worth noting that Googong currently exceeds the maximum demand of 2.5 ML/d. The reservoirs supplying Googong have a combined capacity of 5.9 ML, with a further 8 ML of storage planned to be added in the next two years.

Based on the current consumption data for Queanbeyan, and the forecast peak day demand of 36.5 ML/d in 2050, the demand is within the limits nominated in the current Service Level Agreement. It is however recommended that the Service Level Agreement be reviewed in line with the recommendations made in the Queanbeyan IWCM Issues Paper (AECOM, 2019).

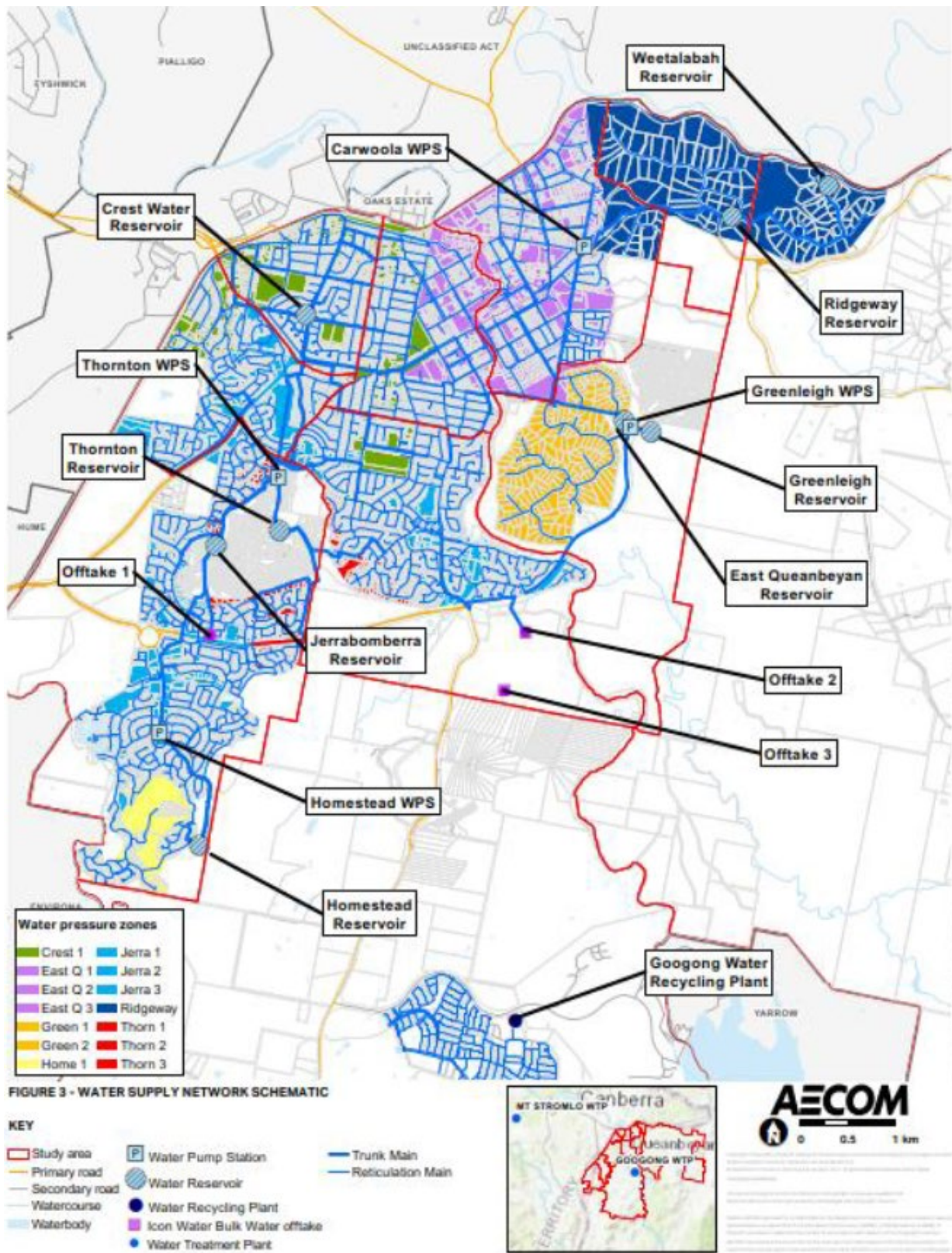


Figure 4 Water supply network layout (Queanbeyan IWCM Issues Paper, AECOM, 2019)

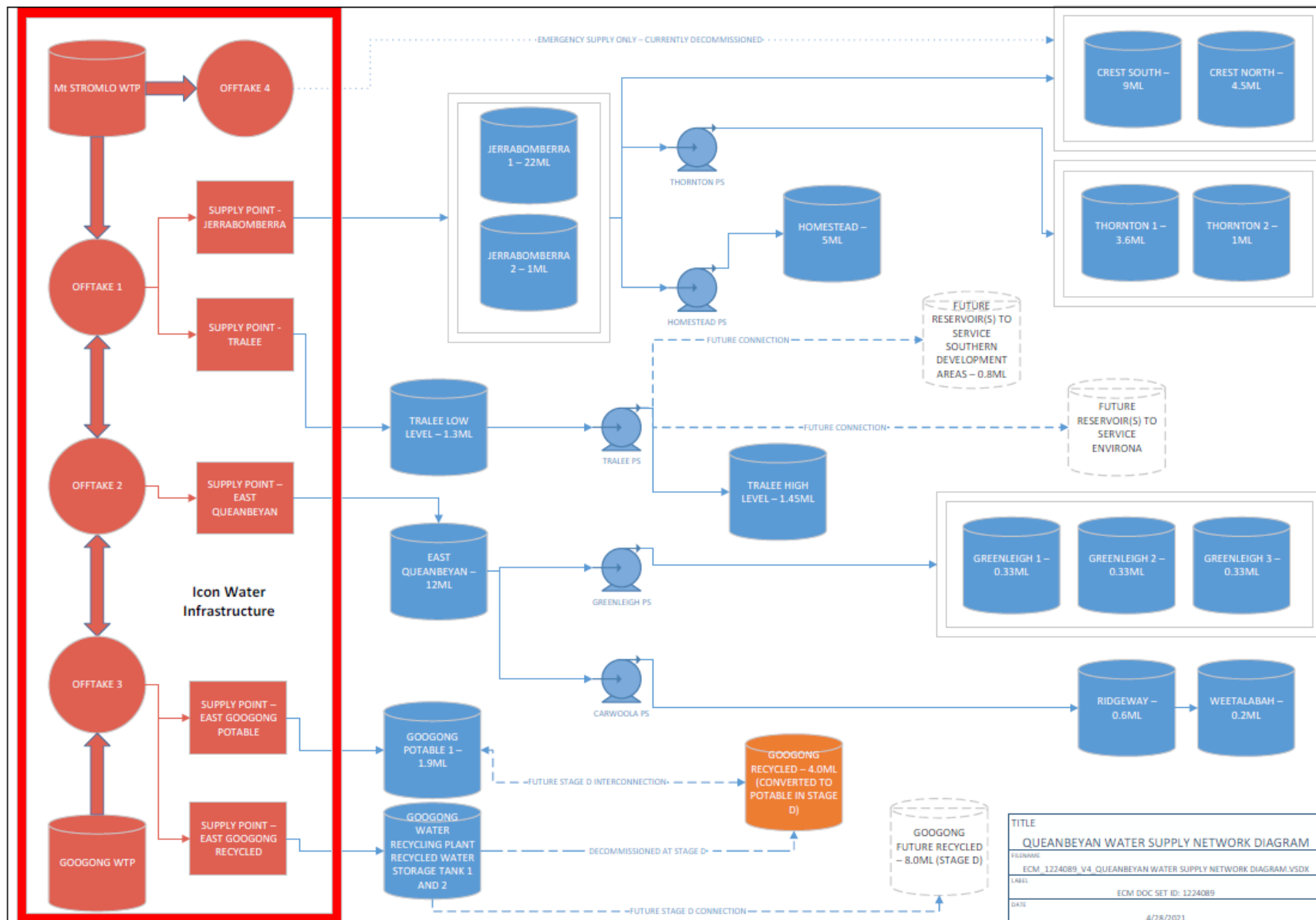


Figure 5 Water supply system schematic

There are currently no recycled water schemes or plans for one in Queanbeyan or Jerrabomberra.

QPRC also hold Water Access Licences (WAL) issued under the Water Management Act 2000 to extract either groundwater or water from Queanbeyan River for irrigation. Further details are included in the *Queanbeyan IWCM Issues Paper* (AECOM, 2019).

4.1.2 Water quality management

With reference to the ADWG, the safety of water in public health terms is determined by the microbial, physical, chemical and radiological quality of the water. Microbial quality is typically the most important issue. Effective disinfection of water using chlorine is the main treatment process used to achieve safe microbial quality in drinking water for Queanbeyan. In addition, maintaining chlorine residual in the water supply network and ultimately up to the customer taps is also recommended to minimize contamination risk.

The ADWG states *“When operating a distribution system, it is important to understand the difference between effective disinfection and maintaining a disinfectant residual. The water is effectively disinfected when the required C.t value has been achieved. After effective disinfection, enteric pathogens should not reappear within the distribution system, unless there is a failure in the integrity of the system. Therefore, unless there is a barrier breach within the distribution system the water should remain safe to drink even in the absence of adequate disinfectant residual. Barrier breaches could include such things as ingress, backflow, loss of pressure within the distribution system, or contamination within post-treatment storage tanks”*.

From GHD corporate experience and with reference to the ADWG Chlorine fact sheet, the typical ranges for total and free chlorine in reticulation networks are as follows:

- Between 0.2 mg/L and 0.6 mg/L of total chlorine considering odour threshold
- Between 0.1 mg/L and 0.4 mg/L free chlorine

Given most of the time Queanbeyan is supplied with water from the Stromlo WTP, a significant distance away, there is a re-chlorination point owned by Icon Water and operated by Council to maintain a chlorine residual in the reticulation network. It is understood however that Council do not currently operate the re-chlorination system. There is only a dosing point at Offtake 2 and none at Offtake 1. It is understood that Council manually dose chlorine into the reservoirs.

Sampling is undertaken by Council within its network. The location of the sampling sites in Queanbeyan is shown in Figure 6. The light blue dots are current water sampling sites, and the dark blue ones are sampling sites no longer in use (GHD, 2021).

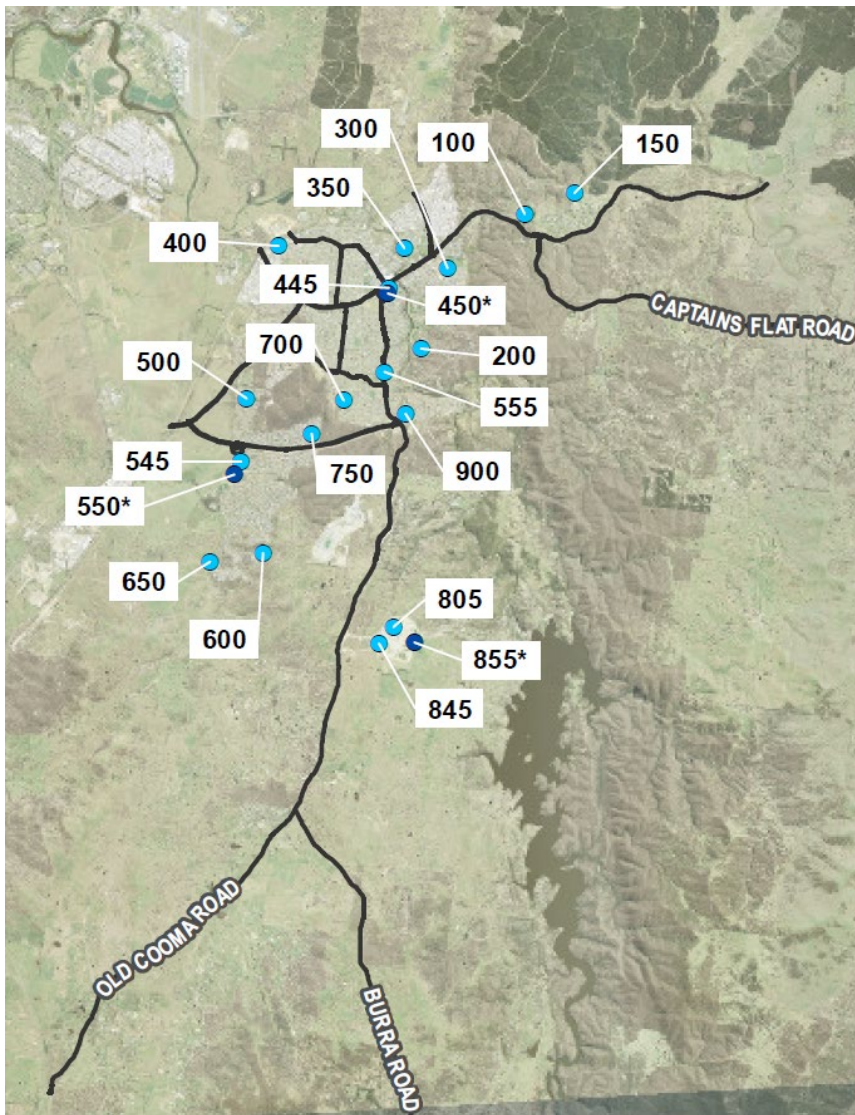


Figure 6 Chlorine residual sampling sites

4.1.3 Chlorine residuals

Figure 7 to Figure 10 show the sample values for free and total chlorine at the various sampling points in the reticulation network based on the data provided by Council. The typical range is shown as a light blue block on the charts. The data indicates that there is more chlorine in the water than would be typically expected which may result in customer taste and odour complaints.

Additional commentary from Council operations staff is that:

1. There are locations within the network where there is zero chlorine residual.
2. Within the network there are several dead ends and currently there are no regular operation plans that include flushing of these sections of the network.
3. Anecdotally there have been no customer complaints related to taste and odour.

Free Chlorine 2019

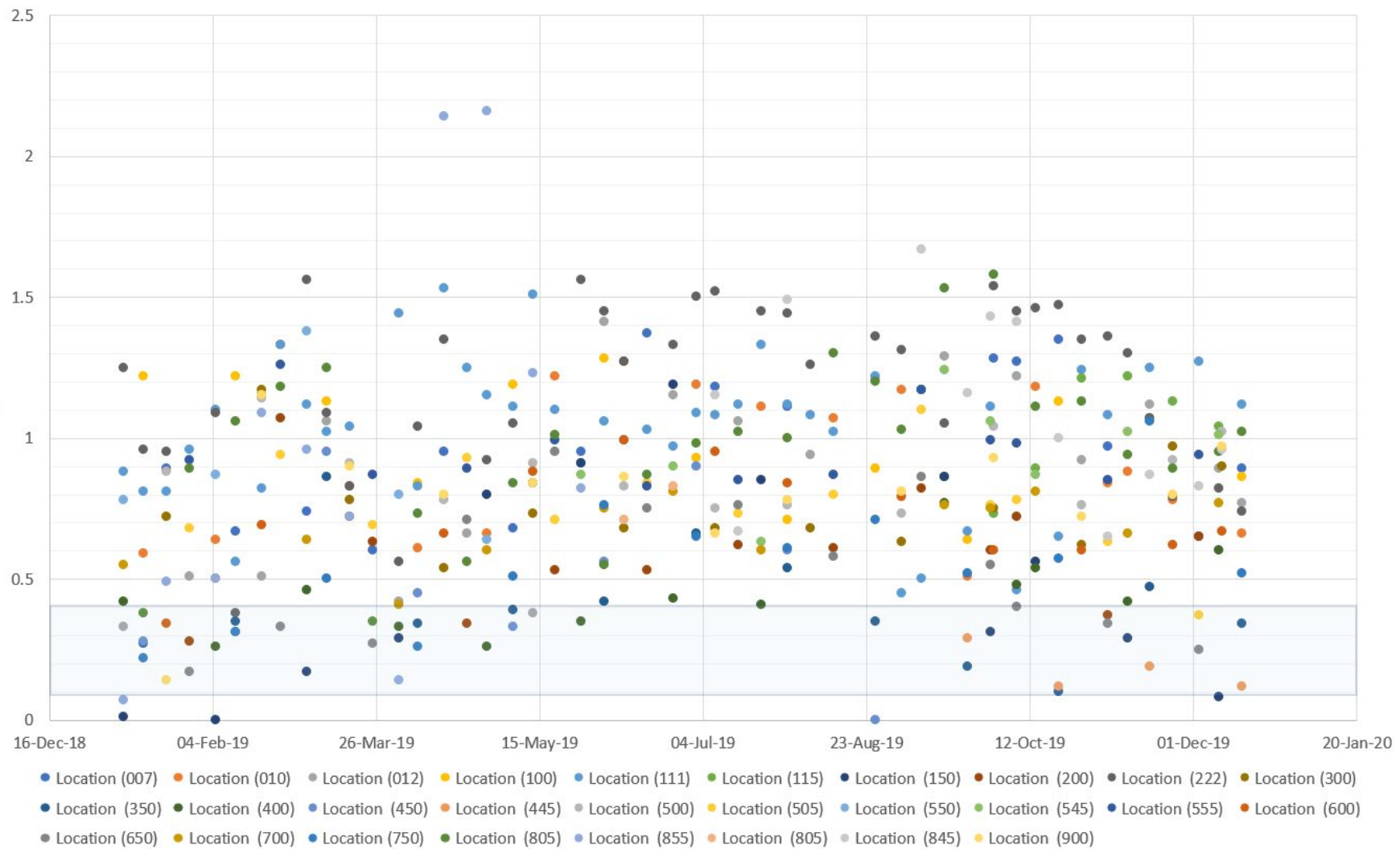


Figure 7 Free chlorine (mg/L) 2019

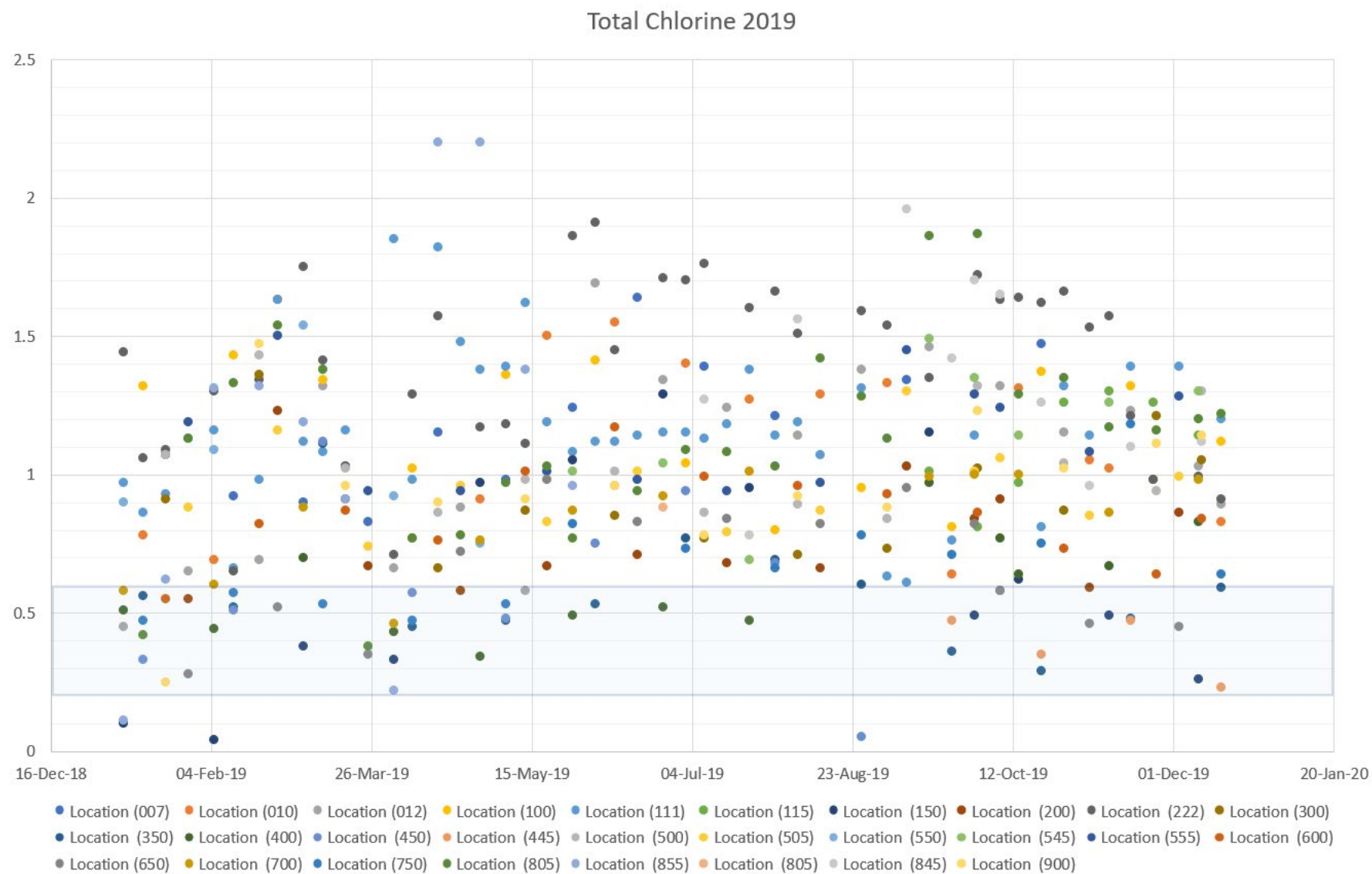


Figure 8 *Total chlorine (mg/L) 2019*

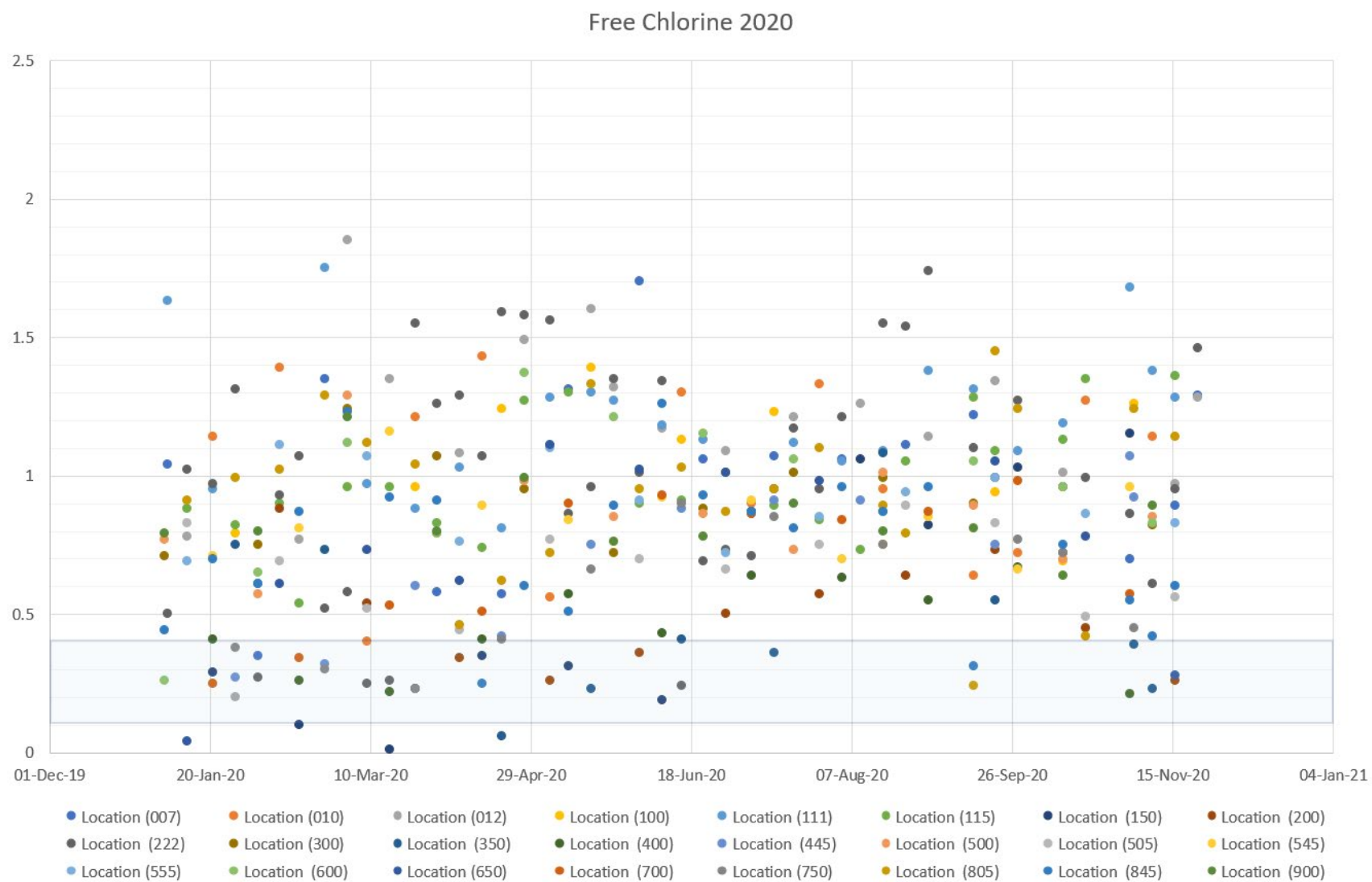


Figure 9 Free chlorine (mg/L) 2020

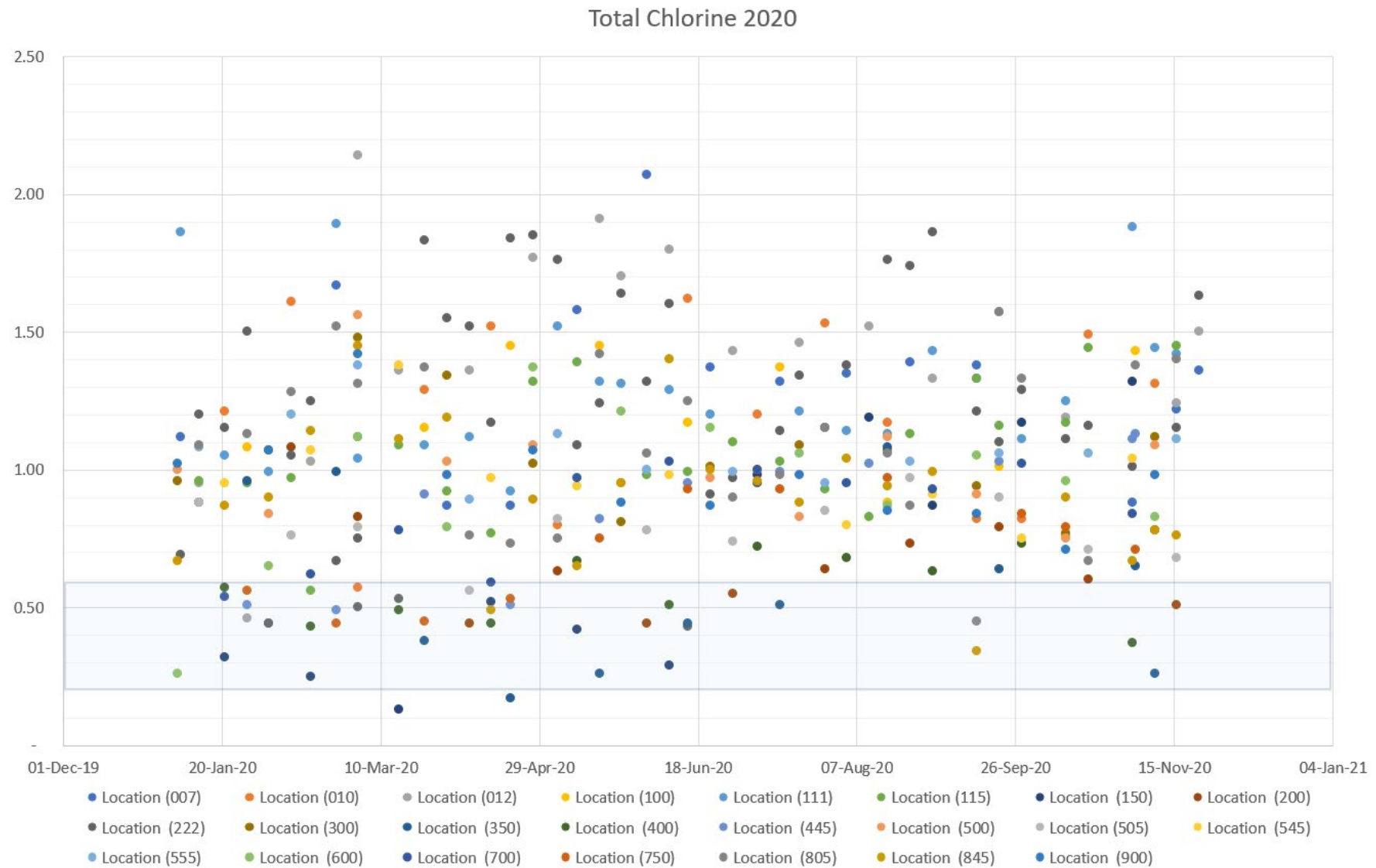


Figure 10 **Total chlorine (mg/L) 2020**

4.2 Demand analysis

4.2.1 Objectives

A demand analysis of the water system was performed through hydraulic modelling. The objectives of the hydraulic modelling included:

1. Assess the capacity of the trunk water supply network considering:
 - a. Ability of reservoirs to meet demand conditions
 - b. Ability of Icon Water offtakes to supply the service reservoirs
 - c. Ability of supply network if any of the reservoirs are offline
2. Determine upgrade requirements.

4.2.2 Model scope

The water supply option developed by GHD (2021) included the following requirements about the modelling:

- A dynamic extended period simulation of the flows to be undertaken
- Network model to include pipes that distribute water to the service area and service reservoirs i.e. greater than DN250
- Model to include reservoirs, hydraulic structures, pump stations, rising mains connected to the water supply trunk system.

The modelling has been undertaken using Bentley's WaterCAD CONNECT Edition Update 3 (10.03.01.08).

Council provided a copy of the existing model that has been used as the basis for modelling undertaken. On review of the model and agreed with Council, the model was not skeletonised to include only the trunk infrastructure.

4.2.3 Modelling parameters

The modelling parameters adopted based on IWCM Issues Paper (AECOM, 2019) include:

- Annual average water demand 233 L/cap/day
- PDD = 2.3 ADD
- Ratio of the Peak Day to Average Day = 2.3
- Ratio of the Peak Day to Peak Week (7-day average) = 1.4

The following criteria are the conditions against which the hydraulic performance of the network was assessed:

- Reservoir capacity - Maintain a minimum of 2/3 PDD storage volume
- Pump stations - Pump Duty (extracted from middle value in pump curve) exceeds downstream PDD of the supply zone
- Trunk mains – Pipe velocity to be less than 2 m/s

4.2.4 Existing model

A high-level review was performed by GHD upon receipt of the existing model from Council. The condition and status of the model is summarised in the following sub sections.

4.2.4.1 Demands

The average daily demand and peak day demand of the existing model are shown in Table 5.

Table 5 Existing model demands

	Flow supplied (ML/d)	Flow demanded (ML/d)
Average daily demand	10.55	9.62
Peak day demand	24.26	22.12

4.2.4.2 Pipe details

After a review of the pipe data of the existing model, the following items were noted:

- There are 6,870 pipe elements in the model and 81 of which are inactive.
- Pipes were modelled using nominal diameter and not internal diameter.
- User-defined lengths were used in the model except for 39 pipes that have model-scaled lengths.
- Hazen Williams Roughness Coefficient (C) was used to account for the friction loss in pipes. It is noted that a constant C value was adopted for each pipe material, thus the age of the pipes was not considered. Table 6 shows the C values used in the model for different pipe materials.

Table 6 Hazen Williams coefficient, C

Pipe Material	Number of Pipes in the Model	Hazen Williams Coefficient (C)
Asbestos Cement (AC)	3,044	130 (1 pipe with C=90)
Cast Iron Cement Lined (CICL)	625	130
Ductile Iron (DI)	36	130, (2 pipes with C=90 and 1 pipe with C=120)
Ductile Iron Cement Lined (DICL)	2,963	120
PVCU	45	130
Steel	1	90
Unknown Pipe Material	156	90

4.2.4.3 Reservoirs

The existing model has two major offtakes, 1 and 2, that are represented by fixed-head reservoirs. The model also consists of thirteen service reservoirs that are represented as tanks. It is observed that some of these service reservoirs are inactive and not connected to the network. Table 7 summarises the details of the service reservoirs contained within the existing model. Note that some of the modelled reservoir volumes do not match the volumes nominated in Figure 5 water supply schematic. These differences have been noted but did not make material difference to the results and recommendations.

Table 7 Reservoir conditions

Reservoir	Existing model condition
Crest North / Tank 1	Inactive and not connected to the network. Storage volume is added to Crest South / Tank 2.
Crest South / Tank 2	Volume: 13.50 ML @ 7.68 m depth BWL: 636.12 mAHD
East Queanbeyan	Volume: 12.0 ML @ 8.50 m depth BWL: 661.50 mAHD
Greenleigh 1	Volume: 0.99 ML @ 5.0 m depth BWL: 687.50 mAHD
Greenleigh 2	Inactive and not connected to the network. Storage volume is added to Greenleigh 1.
Greenleigh 3	Inactive and not connected to the network. Storage volume is added to Greenleigh 1.
Homestead	Volume: 4.50 ML @ 6.0 m depth

Reservoir	Existing model condition
	BWL: 736.50 mAHD <i>Note: Network schematic nominates 5 ML volume</i>
Jerrabomberra 1	Volume: 23.60 ML @ 9.25m depth BWL: 674.25 mAHD <i>Note: Network schematic nominates 22 ML volume</i>
Jerrabomberra 2	Inactive and not connected to the network. Storage volume is added to Jerrabomberra 1.
Ridgeway	Volume: 0.77 ML @ 16.88 m depth BWL: 721 mAHD Combined inlet and outlet. <i>Note: Network schematic nominates 0.6 ML volume</i>
Thornton 1	Inactive. Storage volume is added to Thornton 2.
Thornton 2	Volume: 4.90 ML @ 5.0 m depth BWL: 739.88 mAHD <i>Note: Network schematic nominates total 4.6 ML volume</i>
Weetalabah	Volume: 0.27 ML @ 7.59 m depth BWL: 730.51 mAHD Combined inlet and outlet <i>Note: Network schematic nominates 0.2 ML volume</i>

4.2.4.4 Pumping stations

The existing model includes five pumping stations. Four pump stations are active whilst Water Pump Station 19 is set as inactive. Pump definitions are available in the model however it is observed that there are extra / redundant pump definitions that are not used in the model. Table 8 provides a summary of the pump station information as included in the model.

Table 8 Pumping station conditions

Pump station	Pump definition	Elevation	BEP Max. Flow (L/s)
Water Pump Station 1 (Homestead)	Water Pump Station 1	615.50	70.41
Water Pump Station 3 (Thornton Tank)	Water Pump Station 3	668.00	236.70
Water Pump Station 6 (Greenleigh)	Water Pump Station Greenleigh	640.00	53.33
Water Pump Station 8 (Ridgeway/ Carwoola)	Water Pump Station 8	598.09	44.69
Water Pump Station 19	N/A	0	N/A

In addition to the above water pump stations there is a water pump station at Tralee servicing the new development areas. This is not currently included in the model and has not been reviewed as part of this study.

4.2.4.5 Zone and control valves

The existing model contains seven zones namely Homestead, Thornton, Ridgeway, Crestwood, East Queanbeyan, Greenleigh and Jerra Park. This does not have an effect to the model results as zones are only used to group the elements physically.

The model consists of three types of control valves namely general-purpose valve (GPV), check valve (CV) and pressure release valve (PRV). From a high-level review of the model, several GPVs are closed and some PRVs and CVs are inactive, which can greatly affect the network, thus further investigation, beyond the scope of this engagement is needed to understand the purpose of these control valves in the model. Table 9 summarises the details of the control valves contained within the existing model. For the investigation, it has been assumed that the model reflects the true status of the valves.

Table 9 Control valve conditions

Valve Type	Number of Elements in the Model	Existing Model Condition
General-purpose Valve (GPV)	1,495	88 GPVs are closed
Pressure Release Valve (PRV)	9	3 PRVs are inactive
Check Valve (CV)	3	All are inactive 2 CVs are not connected to the network

4.2.5 2050 Peak day demand scenario

The 2050 base case scenario adopted the 2050 planning horizon along with a peak day 24-hour period. The adopted 2050 demand was 36.5 ML/d as per the adopted populations in the sewerage analysis (refer section 3.3).

As agreed with Council, the demands within the existing WaterCAD model were scaled such that the total system demand was equal to the Queanbeyan network peak day demand of 36.5 ML/d, including Tralee and Environa.

The location of connection point for Jumping Creek will be a new dedicated supply line constructed along Ellerton Drive, connecting to the network near the East Queanbeyan Reservoir (based on Jumping Creek water alignment sketches dated April 2020, provided to GHD). The connection point to the Poplars was assumed based on its proximity to the existing network. The demand for infill and non-residential areas were applied as a global multiplier to the existing network.

The supply to Tralee and Environa will be via a new supply line from Offtake 1. This line will supply a new low-level reservoir, that in turn feeds a high-level reservoir.

As noted in Table 5 (Section 3.4.1), the existing WaterCAD model has a PDD of 22.12 ML/d. This means that there is a 14.38 ML/d variance between the demand in the existing model and the projected demand for 2050 EP. This variance was distributed based on the projected EP of each area, and the computed demands were used in the model. The projected demand in 2050, distributed to future development areas, is detailed in Table 10.

Table 10 Projected 2050 future development EP and PDD

Future development area	Additional EP	% of total	Demand in ML/d	Service reservoir
Jumping Creek	960	2.9	0.41	Greenleigh 1– 100%
Tralee	4,040	12.0	1.73	Tralee Low Level & Tralee High Level
Tralee Station	10,800	32.1	4.61	Future reservoir– size unknown
The Poplars	2,160	6.4	0.92	Jerrabomberra– 100%
Environa / Robin	6,000	17.8	2.56	Future Reservoir– Environa – 100%
Infill – Crestwood	559	1.7	0.24	Crest South/ Tank 2– 100%
Infill – Jerrabomberra	67	0.2	0.03	Jerrabomberra 1– 100%
Infill – Karabar	214	0.6	0.09	Jerrabomberra 1– 75% Thornton– 25%
Infill – Queanbeyan	739	2.2	0.31	East Queanbeyan– 75% Crest South/Tank 2– 25%
Infill – Queanbeyan East	586	1.7	0.25	East Queanbeyan – 100%
Infill – Queanbeyan West	125	0.4	0.05	Jerrabomberra– 75% Crest South/ Tank 2– 25%
Non-Res	7,428	22.1	3.17	Crest South/ Tank 2– 10% East Queanbeyan – 50% Jerrabomberra 1– 40%

Future development area	Additional EP	% of total	Demand in ML/d	Service reservoir
TOTAL	33,678	100	14.38	

However, based on the drawing “Potable Water Supply Concept” for South Tralee dated February 2020 that was provided to GHD (see Figure 11), South Tralee will have an independent supply point from Offtake 1. Thus, the demands for South Tralee were assumed to be excluded from Queanbeyan water supply network.

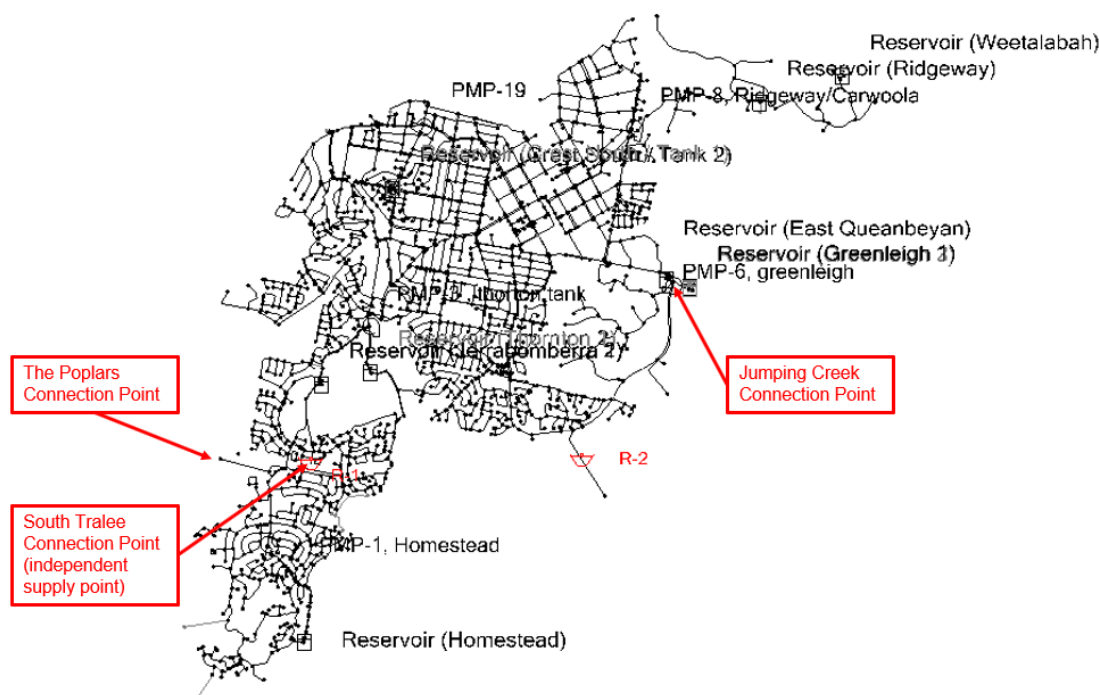


Figure 11 Connection points for future developments

4.2.5.1 Changes to the original model

Before running the 2050 PDD scenario, changes were made to the model to fix a model validation error. In the model provided to GHD, the trunk main that supplies Jerrabomberra 1 reservoir from offtake 1 was initially set to be closed, thus causing Jerrabomberra 1 reservoir to reach its emptying point. Similarly, the upstream and downstream pipes of Water Pump Station 1-Homestead were closed causing it to be isolated from the network. To correct these errors, the initial setting of these pipes was changed to “open”.

In addition, the sizes of the trunk mains were also update from nominal diameter to actual internal diameter. Table 11 shows the changes in the pipe sizes. The reference tables for the adopted pipe sizes are included in Appendix A.

Table 11 Pipe size updates

Pipe type	Diameter in existing model (mm)	Adopted internal diameter (mm)
D1CL	250	264.80
	300	322.40
	375	401.40
	450	479.90
	250	231.00

AC	300	279.40
	375	370.40
	450	444.00
	600	586.80

Lastly, the labels of offtakes 1 and 2 have been switched to match Figure 5 Water Supply System Schematic.

4.2.5.2 Pipe velocity results

Under the 2050 PDD scenario, the DN375 trunk main that extends from the offtake to East Queanbeyan reservoir has a velocity of 2.63 m/s. The total length of this trunk main is 2.88 km. All other trunk mains have a velocity of less than 2 m/s.

In the existing model maximum day scenario, the DN375 trunk main has a velocity of 2.53 m/s. Figure 12 below shows the location of this trunk main.

While this velocity is high, it does not appear to impact on the ability of the network to maintain supply to East Queanbeyan reservoir (see further results and discussion below). Notwithstanding this finding, high pipe velocities are associated with other risk factors, such as pipe scouring and water hammer.

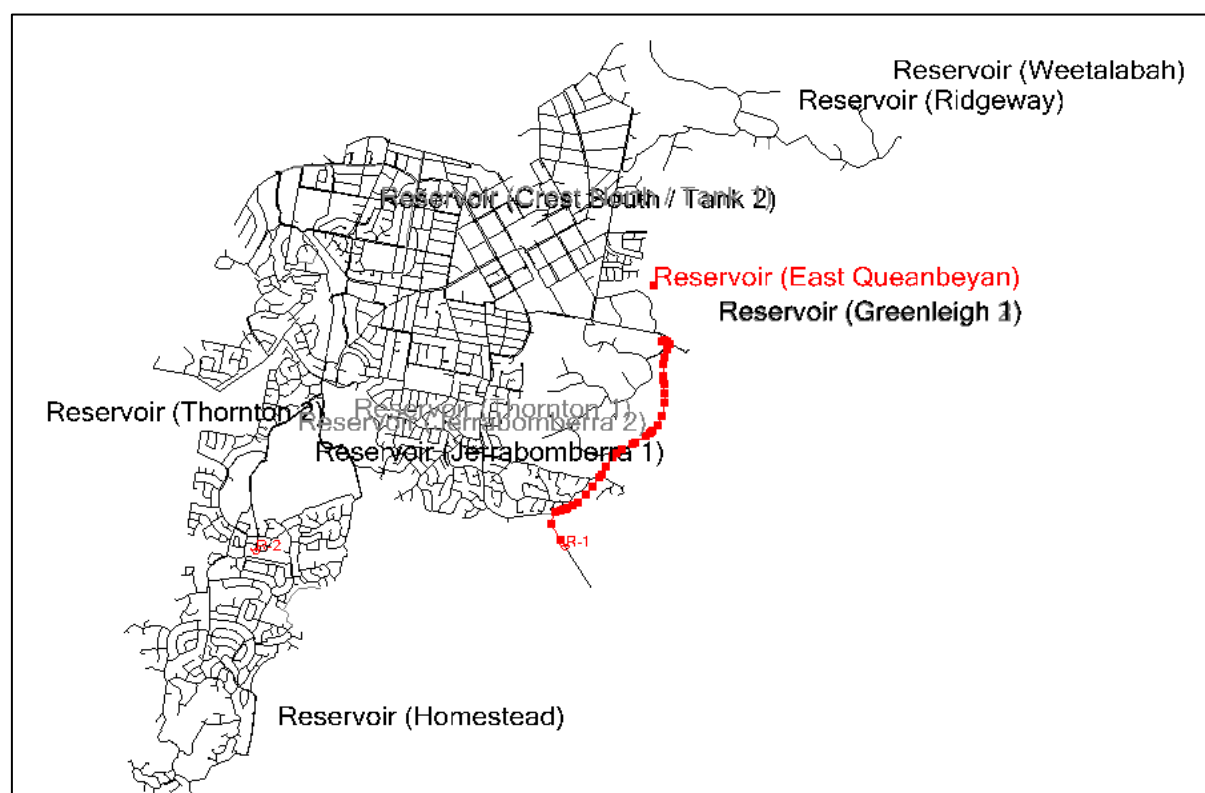


Figure 12 DN375 trunk main location

4.2.5.3 Reservoir storage

On a 24-hour period simulation under 2050 PDD scenario, Greenleigh 1, Jerrabomberra 1, Thornton 2 and Weetalabah reservoirs are observed to reach a storage level that is less than 67% of its capacity.

Table 12 shows a comparison of the lowest percentage of storage experienced by the active reservoirs under existing model PDD scenario and 2050 PDD scenario. Figure 13 shows the percentage over the 24 hour simulation period.

Table 12 Reservoirs storage

Reservoir	Lowest Percentage of Storage Under Existing Model PDD Scenario	Lowest Percentage of Storage Under 2050 PDD Scenario
Crest South/ Tank 2	82.0 %	82.0 %
East Queanbeyan	79.9 %	79.7 %
Greenleigh 1	57.7 %	57.5 %
Homestead	83.3 %	83.3 %
Jerrabomberra 1	83.2 %	62.9 %
Ridgeway	92.0 %	91.8 %
Thornton 2	48.4 % *	48.4 % *
Weetalabah	47.3 % *	47.3 % *

* Reservoir starting level based on model provided. Both reservoirs fill to 100% over 24 hr period

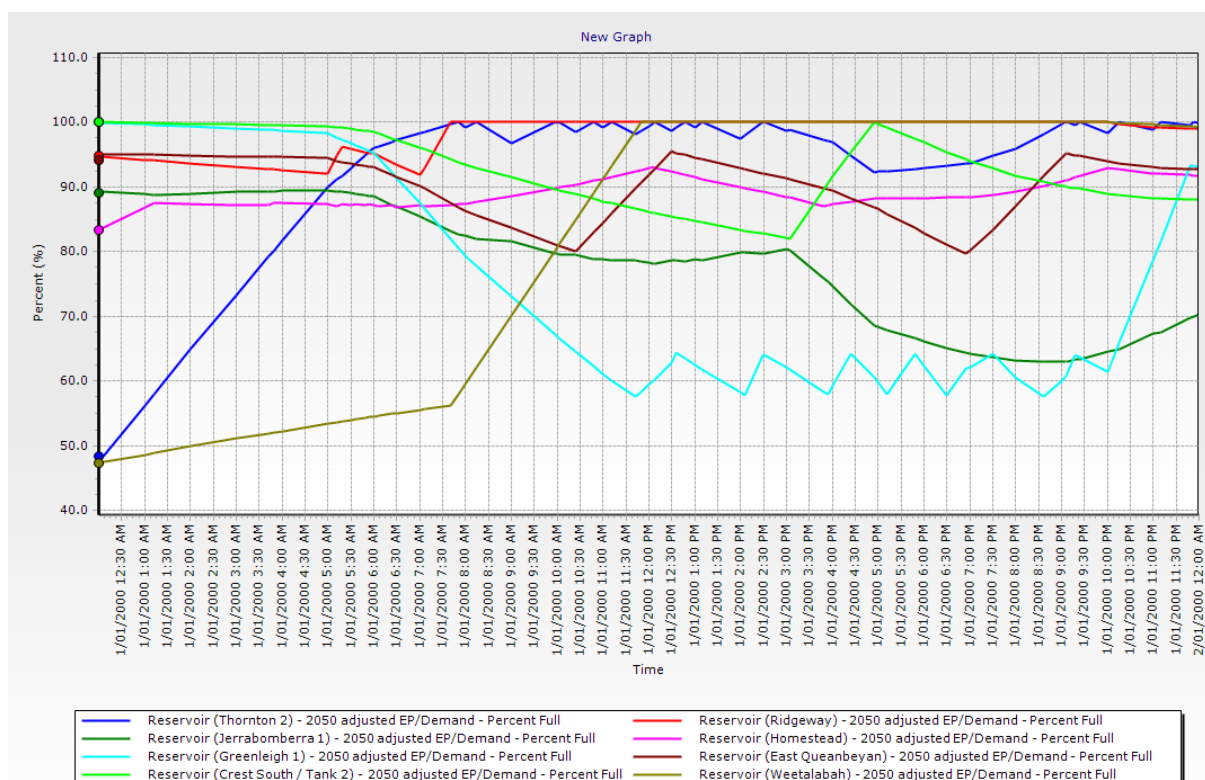


Figure 13 Reservoir storage percentage full

From the table and figure above, Greenleigh 1, Jerrabomberra and Homestead reach a level lower than 67% of their storage capacity on both present day and future 2050 PDD scenarios. Jerrabomberra 1 reservoir storage falls to 62.90% under the 2050 PDD scenario.

While the above reservoirs fail the criteria used for the purposes of this investigation, purely from worst-case security of supply perspective, the reservoir performance is deemed adequate. The figures below show that these reservoirs, except for Jerrabomberra 1 and Homestead, recover 70% to 100% of their capacity by the end of the 2050 PDD scenario.

Appendix B shows the graphs of Greenleigh 1, Jerrabomberra 1, Thornton 2 and Weetalabah reservoirs for the 24-hour simulation as well the behaviour of Jerrabomberra 1 reservoir during a 7-day simulation.

4.2.5.4 Water pumping stations performance

During 2050 PDD scenario, three out of four water pumping stations are operating at flows that are significantly less than their best efficiency points (BEP), as detailed in Table 13. Given that the 2050 PDD scenario contains no changes to reservoir operating levels, this may be an indication that the existing pump selections are unsuitable for their current purpose. More detailed investigations, involving a review of existing pump curves and operating pressures, would be required to confirm if there are any issues with pumping.

Table 13 Pump flows

Pump Station	BEP Max. Operating Flow (L/s)	Max. Flow at 2050 PDD Scenario (L/s)
Water Pump Station 1 (Homestead)	70.41	44.41
Water Pump Station 3 (Thornton Tank)	236.70	121.67
Water Pump Station 6 (Greenleigh)	53.33	53.75
Water Pump Station 8 (Ridgeway/ Carwoola)	44.69	33.28
Water Pump Station 19	N/A	N/A

4.2.5.5 System Pressures

Figure 14 and Figure 15 show the maximum and minimum pressures in the network under 2050 PDD scenario.

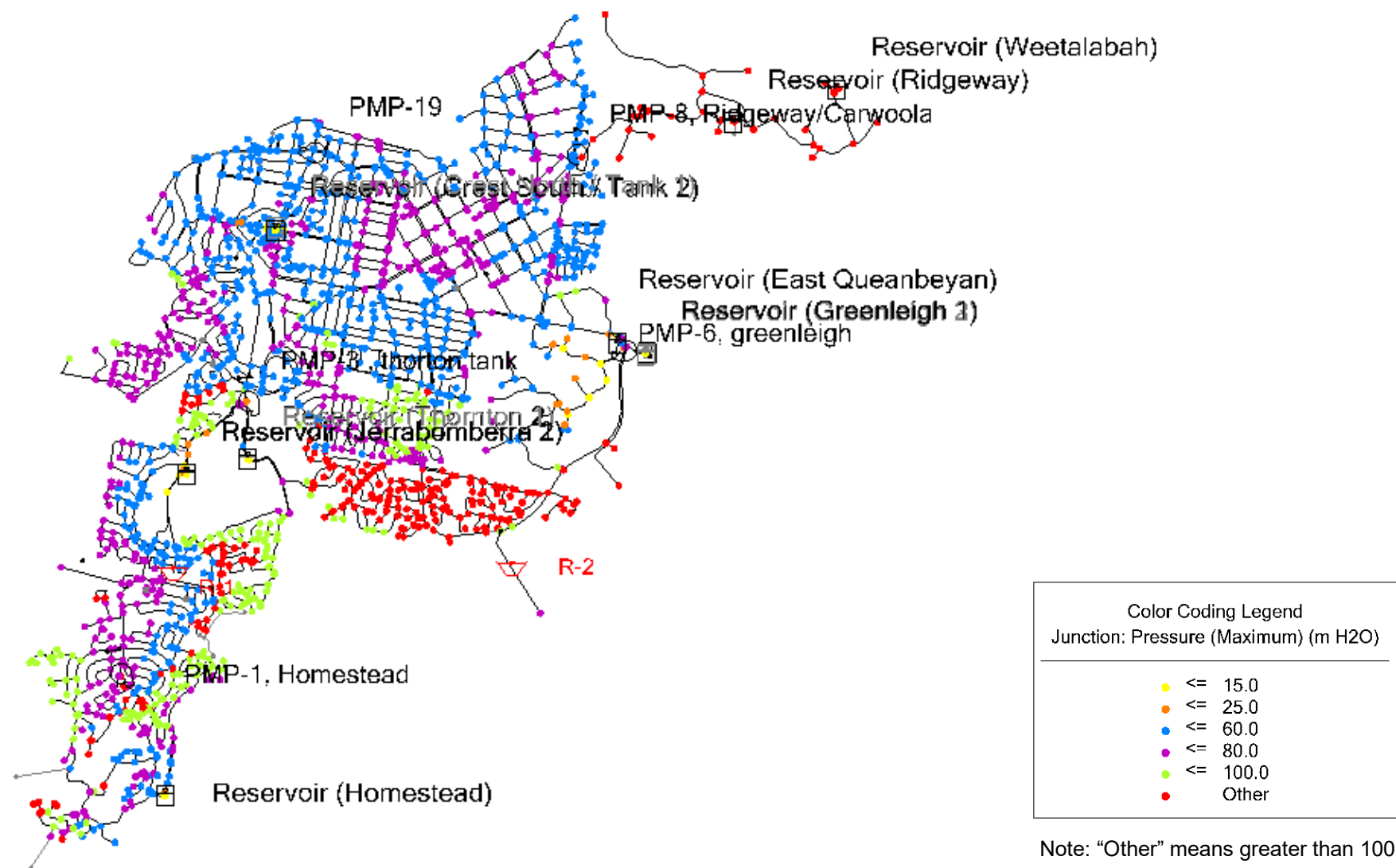


Figure 14 Maximum pressure plot

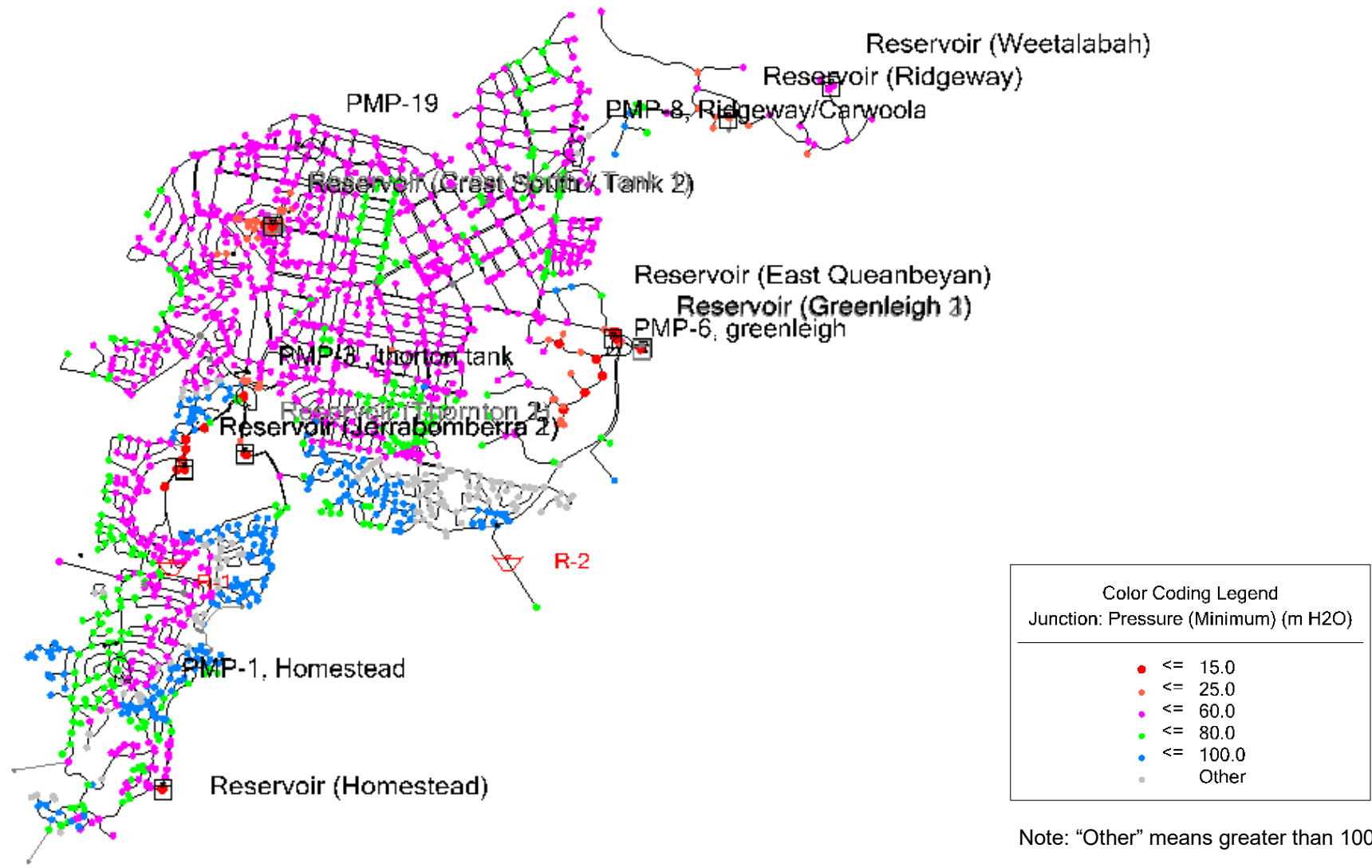


Figure 15 Minimum pressure plot

4.2.6 Stress tests

To further assess the performance of the network during possible worse case scenarios, GHD performed the following stress tests:

1. Global increase in demand by 20%
2. Taking offtake 1 offline
3. Taking offtake 2 offline
4. Taking Jerrabomberra 1 reservoir offline

4.2.6.1 Global increase in demand by 20%

If the actual demand became greater than the projected 2050 peak day demand, GHD globally scaled up the 2050 peak day demand by a factor of 1.20 and assessed the network performance against the modelling parameters. The 20% increase in demand is envisaged to allow for some increased per capita consumption as well as unplanned growth. The percentage full estimates for the reservoirs over the course of a day, with the increased demand, are presented in Figure 16.

With the 20% increase in demand, the following results are noted:

- Like the 2050 PDD scenario results Greenleigh 1, Thornton 2 and Weetalabah reservoirs still have storage below 67%.
- Jerrabomberra 1 reservoir's storage dropped to 42.40%. Refer to Table 14 for the summary of reservoir storage results.
- The DN375 trunk main that extends from the offtake to East Queanbeyan reservoir has a velocity of 2.63 m/s. All other trunk mains have a velocity less than 2 m/s.
- Pump 6 Greenleigh slightly exceeded maximum operating point.

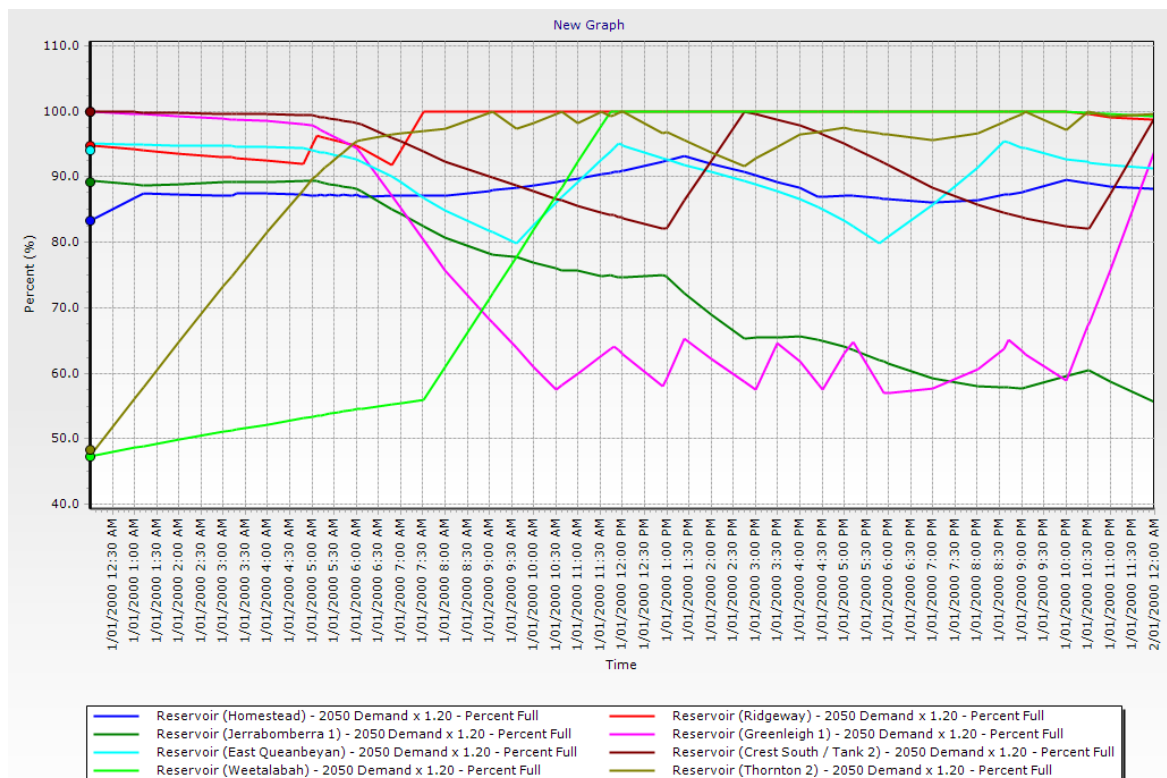


Figure 16 Reservoir percentage full global increase on demands

4.2.6.2 Offtake 1 is offline

Offtake 1 supplies Jerrabomberra 1 reservoir whilst Jerrabomberra 1 supplies three other smaller reservoirs (Greenleigh 1, Homestead, and Crest South Tank 2 reservoirs). In this scenario, since Offtake 1 is offline, the demand from the catchments of all these four reservoirs will need to be catered by the available storage in Jerrabomberra 1. The percentage full estimates for the reservoirs over the course of a day, with Offtake 1 offline, are presented in Figure 17.

At the end of the 24-hour period, the results are summarised as:

- Like the 2050 PDD scenario results Greenleigh 1, Thornton 2 and Weetalabah reservoirs still have storage below 67%.
- The results show that even if Jerrabomberra 1 is offline, Homestead reservoir can still get enough supply and maintain high storage. Refer to Table 14 and Figure 17 for the summary of reservoir storage result.
- The DN375 trunk main that extends from the offtake to East Queanbeyan reservoir has a velocity of 2.63 m/s. All other trunk mains have a velocity less than 2 m/s.
- Water Pump Station 6 Greenleigh slightly exceeded maximum operating point.

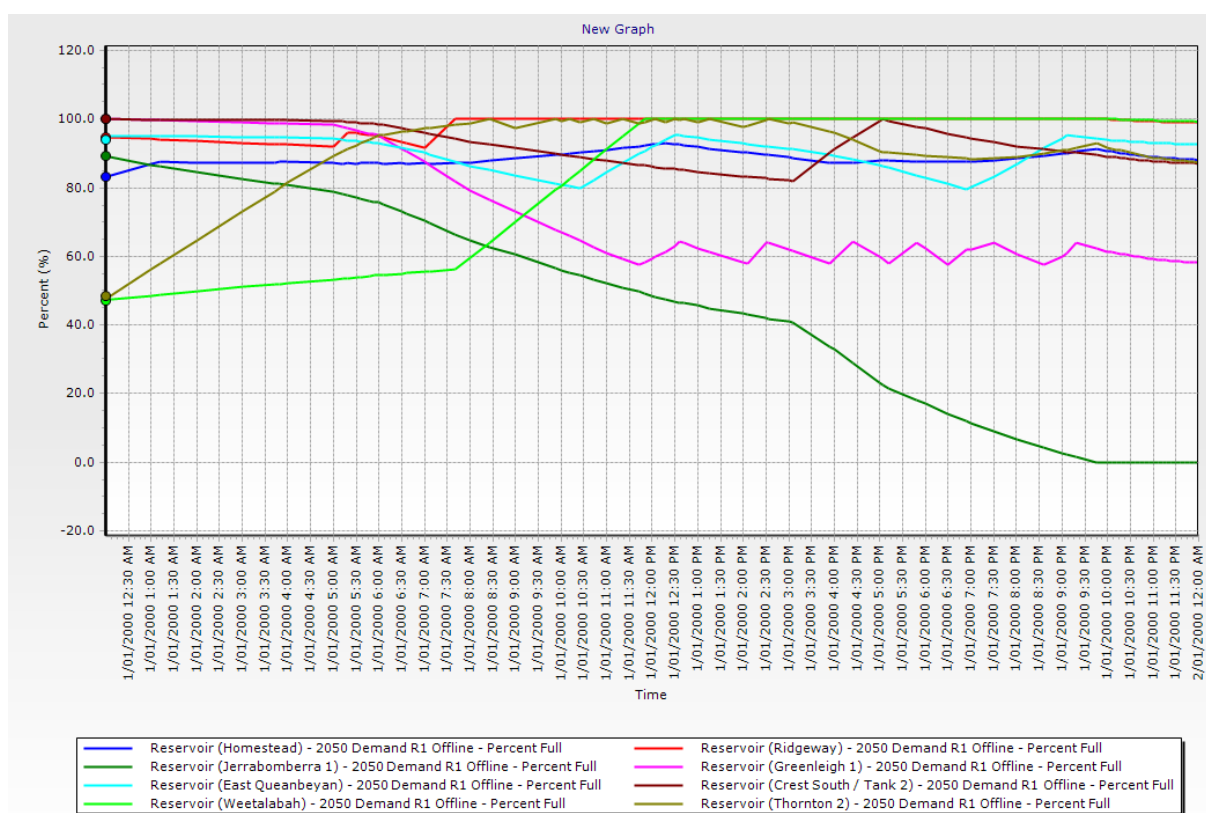


Figure 17 Reservoir percentage full Offtake 1 offline

4.2.6.3 Offtake 2 is offline

In this scenario, Offtake 2 is set as inactive, thus no supply is coming to East Queanbeyan reservoir. It is assumed that the supply to Greenleigh 1, Ridgeway and Weetalabah reservoirs will solely depend on what is stored in East Queanbeyan reservoir. The percentage full estimates for the reservoirs over the course of a day, with Offtake 2 offline, are presented in Figure 18.

At the end of the 24-hour period, the results are noted to be:

- Like the 2050 PDD scenario results Greenleigh 1, Thornton 2, Weetalabah and Jerrabomberra 1 reservoirs still have storage below 67%.

- East Queanbeyan reservoir's storage dropped to 43.5%. This is an expected result since East Queanbeyan reservoir supplies three subsequent reservoirs. Refer to Table 14 for the summary of reservoir storage results.
- Since Offtake 2 is offline, there is no flow for the DN375 trunk main that supplies East Queanbeyan reservoir. All other trunk mains have a velocity less than 2 m/s.
- Maximum flow at Water Pump Station 6 Greenleigh drops to 29.5 L/s.

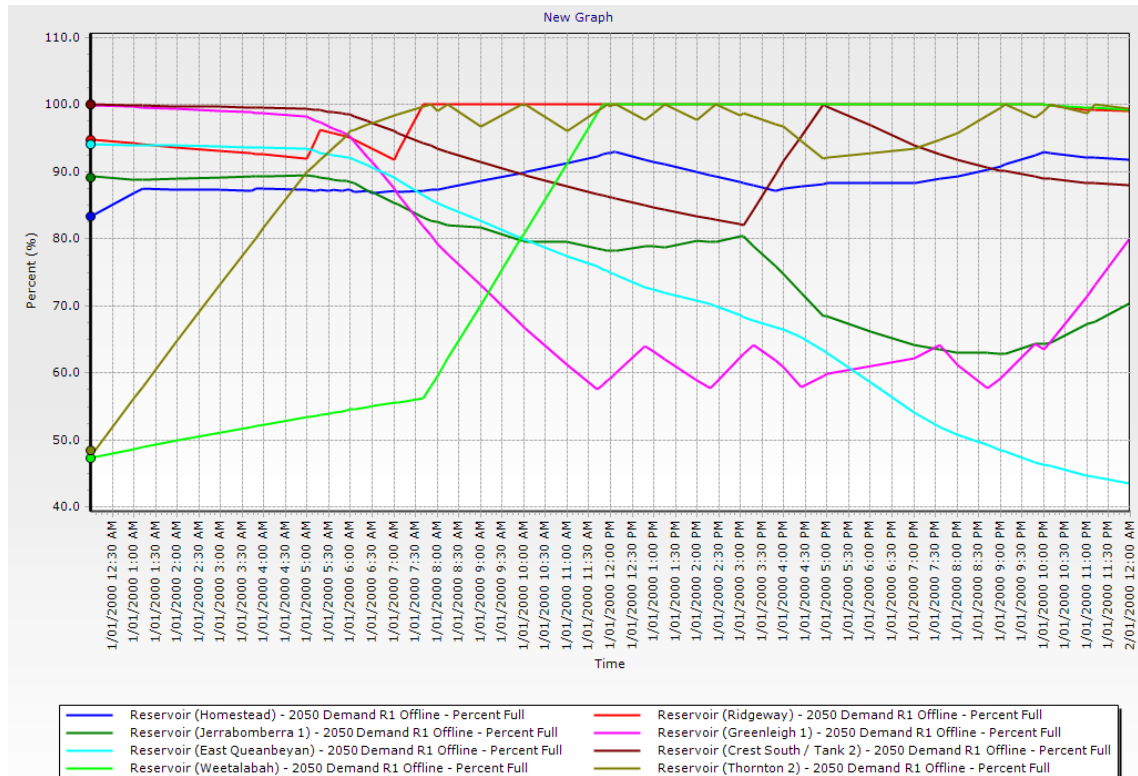


Figure 18 Reservoir percentage full Offtake 2 offline

4.2.6.4 Jerrabomberra 1 reservoir is offline

Since Jerrabomberra 1 is known to be in poor condition and it has the largest downstream supply zone, it plays a particularly crucial part in the network to ensure security of supply. This stress test scenario assessed the network performance when Jerrabomberra 1 becomes offline for at least 24-hour period. The minimum storage estimates for the reservoirs under this scenario are shown in Table 14, and the maximum flow estimates at the water pump stations are shown in Table 15. The operational observations from this scenario are summarised as follows:

- When Jerrabomberra 1 is offline, two of its subsequent reservoirs (Crest South Tank and Thornton 2) will reach their emptying point. Crest South Tank 2 will be empty after operating for 19 hours whilst Thornton 2 will be empty after approximately 12 hours of operation. Also, Homestead reservoir's storage dropped to 37.6%.
- The DN375 trunk main that extends from the offtake to East Queanbeyan reservoir has a velocity of 2.63 m/s. All other trunk mains have a velocity less than 2 m/s.
- Water Pump Station 6 Greenleigh slightly exceeded maximum operating point.

Given that there is a potential that Jerrabomberra 1 reservoir can be taken offline for three days, a separate run was made to check the condition of the network during this event. The results of this run can be summarised as follows:

- East Queanbeyan maintains 68.6% storage, Ridgeway maintains 87% storage and Weetalabah maintains 47.3% storage.
- All reservoirs downstream of Jerrabomberra 1 will be empty. Greenleigh reservoir will be the last to be emptied after operating for 1 day and 21 hours.

Table 14 Reservoir storage under stress test scenarios

Reservoir	Lowest percentage of storage using 2050 PDD x 1.20 (%)	Lowest percentage of storage when 1 is offline (%)	Lowest percentage of storage when 2 is offline (%)	Lowest percentage of storage when Jerrabomberra 1 is offline (%)
Crest South / Tank 2	82.0	82.0	82.2	0 (empty)
East Queanbeyan	79.8	79.9	43.5	79.9
Greenleigh 1	57.0	57.5	57.5	26.5
Homestead	83.3	83.3	83.3	37.6
Jerrabomberra 1	42.4	0 (empty)	62.9	Offline
Ridgeway	91.7	91.8	91.8	87.0
Thornton 2	36.9	48.4	48.4	0 (empty)
Weetalabah	47.3	47.3	47.3	47.3

Table 15 Pump flows under stress test scenarios

Water Pump Station	Max. Flow using 2050 PDD x 1.20 (%)	Max. flow when 1 is offline (L/s)	Max. flow when 2 is offline (L/s)	Max. flow when Jerrabomberra 1 is offline (L/s)
Water Pump Station 1 (Homestead)	44.4	44.4	44.4	26.7
Water Pump Station 3 (Thornton)	121.6	121.6	121.7	0.03
Water Pump Station 6 (Greenleigh)	53.8	53.8	29.5	53.9
Water Pump Station 8 (Ridgeway/ Carwoola)	33.3	33.3	33.3	33.4

4.2.6.5 Jerrabomberra 1 reservoir is offline under 2050 ADD

2050 average day demand was calculated by dividing the peak daily demand, which is 36.5 ML/d by a factor of 2.3 resulting to a demand of 15.90 ML/d. GHD derived the ADD of Tralee, Envirova and The Poplars based on the PDD in Table 16 and added them in the existing “average day” demand in the existing model.

Table 16 Reservoir storage using 2050 ADD

Reservoir	Lowest percentage of storage when Jerrabomberra 1 is offline (%)
Crest South/ Tank 2	85.6
East Queanbeyan	79.9
Greenleigh 1	59.2
Homestead	83.3
Jerrabomberra 1	Offline
Ridgeway	92.0
Thornton 2	48.4
Weetalabah	47.3

To assess the severity of the effect of having Jerrabomberra 1 reservoir offline, a separate check was performed using 2050 ADD. Under this scenario, the results can be summarised in the following items:

- East Queanbeyan, Ridgeway, Thorton, Weetalabah and Homestead, reservoirs have maintained similar storage as compared 2050 PDD scenario.
- Crest South Tank 2 storage has jumped to 85.6% storage and Greenleigh 1 has increased to 59.2%.
- Similar to other scenarios, the DN375 trunk main that extends from the offtake to East Queanbeyan reservoir has a velocity of 2.63 m/s. All other trunk mains have a velocity less than 2 m/s.
- Water Pump Station 6 Greenleigh slightly exceeded maximum operating point.

4.2.7 Conclusion of hydraulic modelling

Overall, the network performance under the different scenarios is acceptable except for the scenario where Jerrabomberra 1 reservoir is offline. It is evident that having Jerrabomberra 1 offline has the worst effect in the network in terms of maintaining sufficient supply to the community. The East Queanbeyan reservoir is also identified as a critical asset in the network.

Based on the WaterCAD model, at 2050 PDD scenario, the combined demand of the downstream supply zones of Jerrabomberra 1 and its subsequent reservoirs comprises 75% of the total demand in the network. Jerrabomberra 1 reservoir is known to be in poor condition and cannot be taken offline without triggering service continuity risks due to insufficient by-pass assembly. To lessen the risk of supply interruption, the following recommendations can be considered.

- Duplication of Jerrabomberra reservoir.
- In the event the Jerrabomberra 1 is offline, GPVs installed at reticulations linking Crest South Tank 2 and East Queanbeyan reservoir supply zones can be opened. There are at least 15 GPVs that could link these supply zones given that East Queanbeyan reservoir has a capacity to supply a portion of its adjacent supply zone. Below is a list of GPVs that can be explored for this option. Note however, given the limited understanding of the network and location and status of valves this is unlikely to be a viable option.

Valve	ID number in Model
GPV	3033, 3349, 4097, 3353, 3906, 3679, 27460, 4036, 3723, 3038, 396, 3061, 2794, 27757, 2934

- Construct by-pass assembly to allow Offtake 1 to directly supply Pump 1 Homestead, Pump 3 Thornton and Crest South Tank 2 when Jerrabomberra is offline.
- Building an interconnecting pipeline between Offtake 1 and Offtake 2.

4.3 Water service extension

4.3.1 Option identification

Previous planning studies have considered the options available for the upgrading of Queanbeyan's water supply. These previous studies include:

- Queanbeyan STP Upgrade Masterplan, GHD Pty Ltd, 2016
- Queanbeyan IWCM Situational Analysis, AECOM Pty Ltd, 2019
- Queanbeyan IWCM Issues Paper, AECOM Pty Ltd, 2019
- Queanbeyan IWCM Issues Paper Supplemental Report, QPRC, 2020
- Queanbeyan STP Upgrade Concept Design Report, HunterH₂O Pty Ltd, 2020

The options considered from the noted previous studies can be summarised as follows:

1. Provision of a fourth connection from the Icon Water Stromlo to Googong Bulk Supply Main
2. Duplication of the Jerrabomberra Reservoir
3. Duplication of the East Queanbeyan Reservoir
4. Rationalisation of other service reservoirs, in particular Crest Reservoirs, Greenleigh Reservoirs
5. Installation of additional chlorination facilities
6. Renegotiation of tighter water supply targets with Icon Water

Regarding Item 6, it is unclear if this is about quantity, quality or both.

4.3.2 Infrastructure upgrades

Following the analysis undertaken, the proposed infrastructure upgrades include:

- Duplication of Jerrabomberra Reservoir. Based on GHD cost curves, a high-level cost estimate for a 20 ML steel reservoir would be in the order of is \$10 million. This includes upgrades to access roads.

In addition, further investigation to be undertaken regarding:

- Additional reservoir at East Queanbeyan
- Recommissioning the Kendall Avenue connection to provide emergency supply only in the event of a major event affecting Offtake 1 and Offtake 2
- Installation of chlorination infrastructure at appropriate locations in the network, likely to be at Jerrabomberra and East Queanbeyan reservoirs.
- Possibility of decommissioning Crest Reservoirs
- Upgrades for WHS access for all reservoirs

4.3.3 Recommendations

Following the analysis undertaken to date, the critical upgrade option to be considered for the current network is a duplication of the Jerrabomberra Reservoir.

It is also recommended that further work to improve the model be undertaken including development and calibration of an operational model. This is a considerable project given the limited data available and understanding that significant ground truthing survey and field measurements will be required.

In addition to this, given the chlorine residual data analysed to date and commentary from Council, there would be benefit in undertaking further investigation into the current system to confirm the chlorine levels and provide additional chlorine dosing if areas are found to be deficient.

4.4 Preferred water supply scenario

Based on the above analysis the preferred water supply scenario is to continue to supply water to Queanbeyan and adjacent urban areas as bulk treated water from Icon Water whilst also undertaking the duplication of Jerrabomberra Reservoir.

5. Wastewater management scenarios

5.1 Queanbeyan sewage treatment plant

As identified in the IWCM Issues Paper (AECOM 2019), the capacity of the existing Queanbeyan STP is anticipated to be exceeded by 2025. There are also risks associated with the operation of the existing plant in terms of work health and safety and reliability. To address this, Council is currently undertaking an upgrade project for the Queanbeyan STP. The existing STP will need to continue operation until the STP upgrade project is complete.

5.2 Existing sewerage systems

5.2.1 Morisset St SPS

Morisset Street sewage pump station (SPS) is Council's largest sewer pump station. It receives gravity inflows from around 1/3 of the Queanbeyan sewerage network. It also receives pumped inflows from seven upstream sewage pump stations (River Drive, Lochiel Street, Kathleen Street, Weetalabah 1, Weetalabah 2, Regent Drive and Blundell Street).

Since the preparation of the IWCM Issues Paper (AECOM 2019), both a capacity review and condition assessment of the Morisset St SPS have been undertaken and the outcomes of each of these assessments are provided in this section.

Capacity Assessment

The Morisset St SPS Capacity Review was undertaken by Hunter H2O in 2019. The hydraulic capacity of the Morisset SPS pumps and discharge rising main from the Morisset SPS to the Morisset trunk sewer manhole was assessed. The key outcomes of the assessment were:

1. The existing Morisset SPS pumps are prone to ragging and blockage. It was recommended that QPRC progressively replace the pumps with Flygt N-Series pumps each selected for an individual duty point of 435 L/s @ 34 m. The preliminary system investigation showed that this requirement can be achieved by a Flygt NP 3312/835-670 pump with 565 mm impeller and 250 kW motor. The replacement pumps should be fitted with a 4901 flushing valve. This replacement may be achieved by a factory refurbishment of the existing pumps or a complete replacement (Hunter H2O, 2019).
2. The existing rising main is suitable for flow rates up to the design horizon and will not require augmentation to meet the required capacity (Hunter H2O, 2019).

In 2020, the pump station was refurbished with the new pumps as described in Item 1 above. The pumps were selected to be capable of a combined duty/ assist duty performance of 870 L/s at 34 m. These new pumps provide sufficient capacity for projected loadings beyond 2050. The pump controls have also been updated so they rotate duty between all pumps. There are no additional capacity related upgrades for the SPS and rising main prior to 2050.

Condition Assessment

A visual condition assessment of the Morisset SPS and the discharge manhole on Carinya Street was completed by Hunter H2O in April 2020.

The Morisset SPS was in good overall condition. The assessment identified some concerns that should be monitored/maintained over time to ensure continued reliable performance. This included coating deterioration, odour control and sewage sludge build-up (Hunter H2O, 2020).

The discharge manhole was in reasonable condition. It was noted that the step irons are in poor conditions and should be either removed or replaced with stainless items (Hunter H2O, 2020).

The condition assessment recommended additional coating inspection within 5 years and potential review of H₂S levels within the structure. Council will reinspect the pump station in 5 years, and reevaluate the need for relining, which may be required in 10 years.

5.2.2 Sewerage network

At the time of the Issues Paper preparation, Council did not have an up-to-date model of its sewerage system. A trunk main model was developed in 2019 as part of the STP Upgrade project to evaluate whether there was sufficient capacity in the Jerrabomberra and Morisset trunk main for existing and future loadings. The trunk main modelling identified potential capacity constraints in both trunk mains that would be exacerbated under projected future loadings. It was recommended that a more detailed network model be developed to better assess capacity constraints and develop a staged upgrade strategy.

A detailed hydraulic model was developed in 2020. The model is currently not calibrated but Council is planning to calibrate the model using sewer flow gauging data collected over the past five years. This capacity analysis undertaken by Hunter H₂O is based on the theoretical model.

Existing Loadings Capacity Assessment

Capacity limitations were identified where the HGL rises to within 0.5 m of the ground surface (based on theoretical peak wet weather loadings) and are shown in Figure 19.

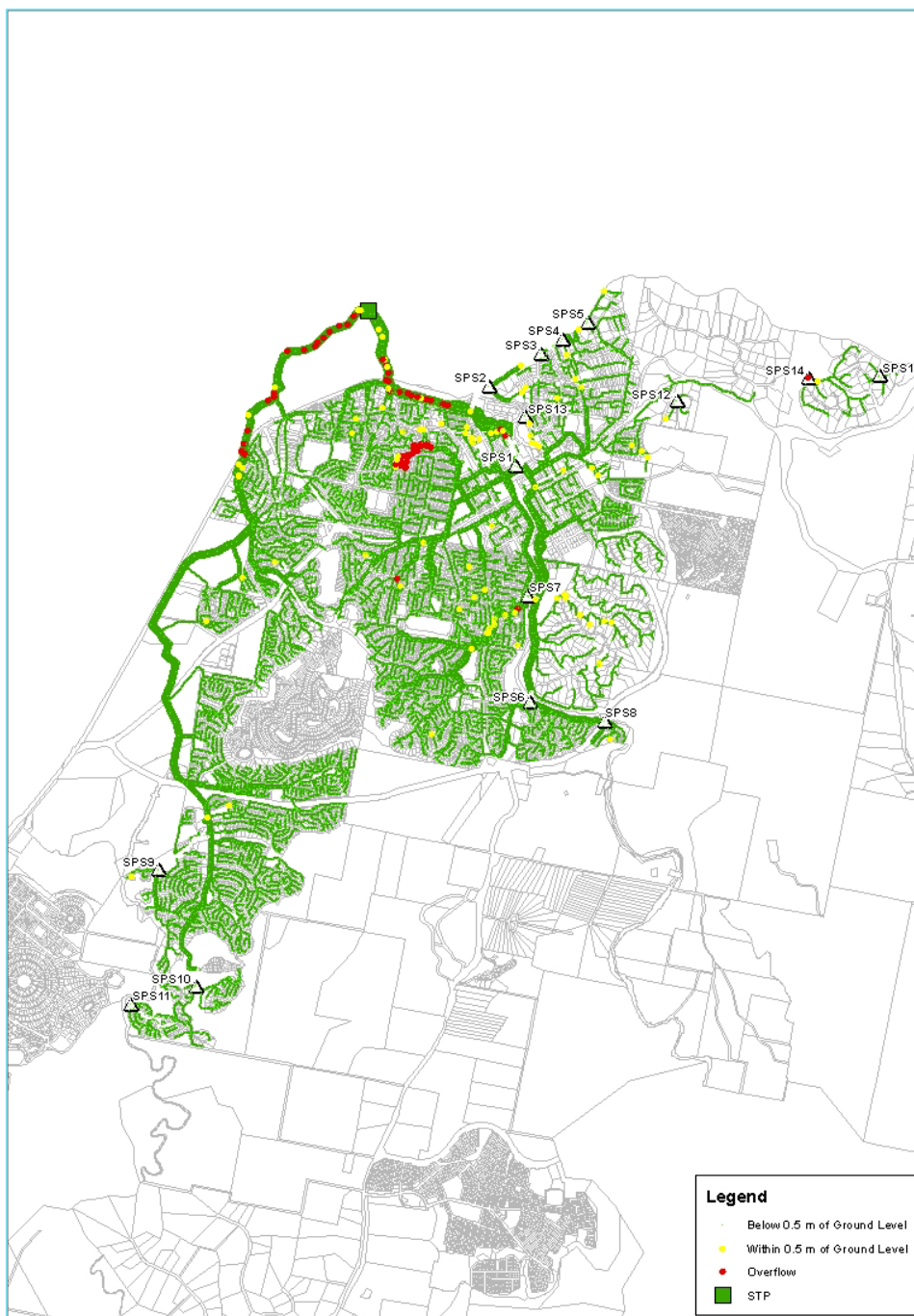


Figure 19 Existing system capacity constraints under peak wet weather flow conditions (existing loadings)

The hydraulic modelling identified that there are parts of the network that have insufficient capacity under existing peak wet weather flow conditions. The locations with capacity constraints are:

- The DN600 Jerrabomberra trunk main downstream of W34
- The DN750 Morisset trunk main downstream of the Morisset St SPS rising main discharge point
- Sections of the DN375 trunk main (parallel to the DN750 Morisset trunk main) downstream of F15
- Sections of the DN300 gravity main between Stomaway Road and Ross Road
- Sections of the DN300/375 between Sorrell Place and Malcolm Road immediately upstream of Kathleen St SPS and sections of DN150 between Kenneth Place and Dane Street

Future Loadings Capacity Assessment

Models were also developed to represent future loadings conditions in 2025 (+5 years), 2030 (+10 years), 2040 (+20 years) and 2050 (+30 years). The adopted future loadings from new development areas and infill

development are summarised in Table 17, along with their proposed method for connection to the existing sewerage system.

Table 17 *Future development areas EP and timing*

Development area	Additional EP					Servicing notes
	Total	2020-25	2025-30	2030-40	2040-50	
Jumping Creek	960	960	0	0	0	Requires new SPS
Tralee	4,040	1082	2030	927	0	Requires new SPS
Tralee Station	10,800	0	0	5,400	5400	Requires new SPS
The Poplars	2,160	0	0	2,160	0	Gravity connection via sewer extension
Environa / Robin	6,000	0	0	2,626	3,374	Gravity connection via sewer extension
Infill - Crestwood	559	112	224	224	0	Infill
Infill - Jerrabomberra	67	13	27	27	0	Infill
Infill - Karabar	214	43	85	85	0	Infill
Infill - Queanbeyan	739	148	296	296	0	Infill
Infill - Queanbeyan East	586	117	234	234	0	Infill
Infill - Queanbeyan West	125	25	50	50	0	Infill
Non-Residential development	7,428	1,238	1,238	2,476	2,476	Infill or gravity connection via sewer extension

Loadings from new development areas and infill development were assigned to downstream trunk mains and the system capacity was assessed for future loading condition.

Capacity limitations (where the HGL rises to within 0.5 m of the ground surface) are shown in Figure 20 (based on theoretical peak wet weather loadings). There is also insufficient pump capacity at ARC SPS (SPS 2) and Weetalabah (SPS 14).

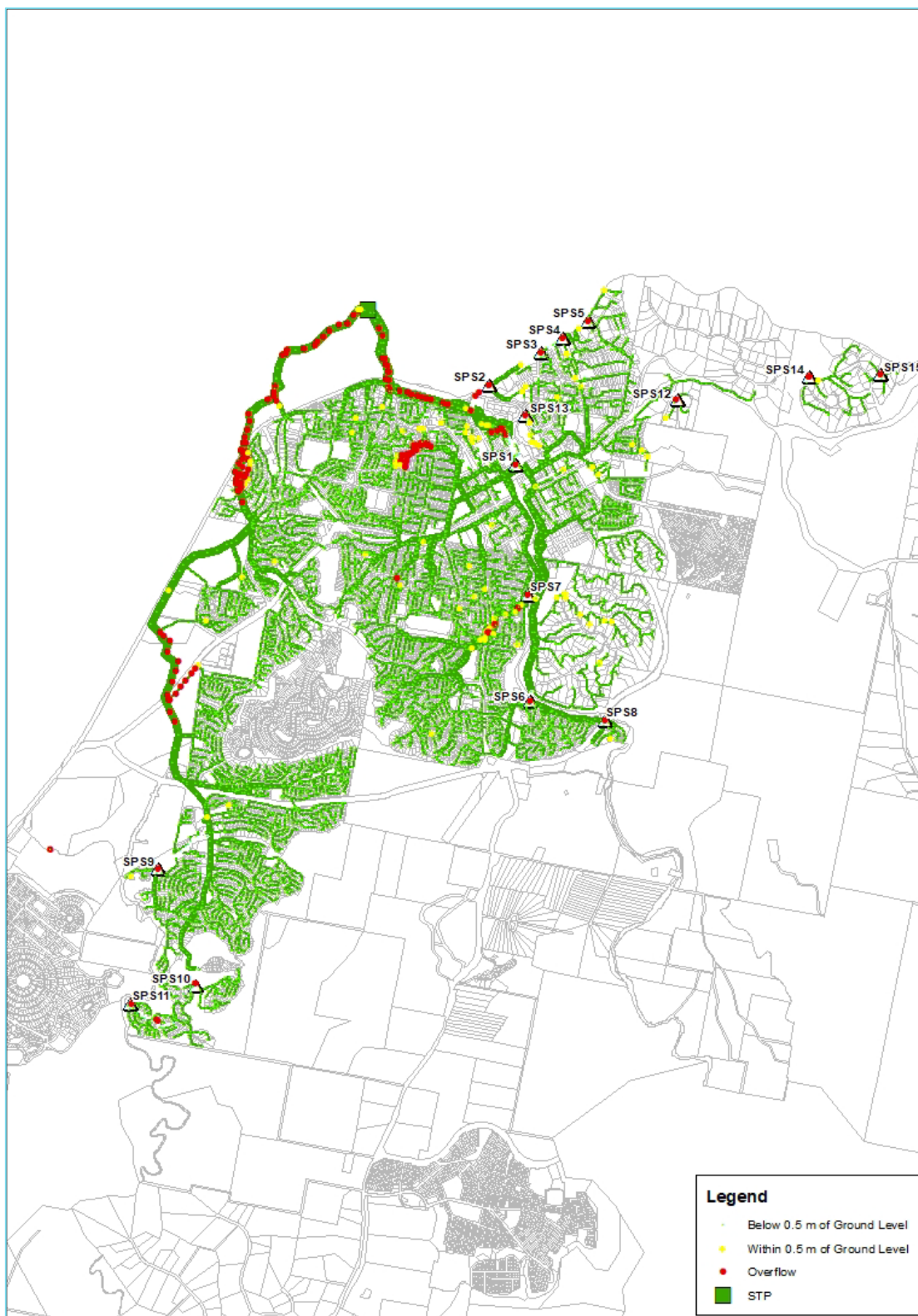


Figure 20 Existing system capacity constraints under peak wet weather flow conditions (2050 loadings)

5.3 Wastewater service extension

5.3.1 Feasibility review of options for non-build measures

Before consideration is given to the capital works upgrades that are required to address the identified IWCMIssues, non-build measures – including sewer inflow and infiltration (I&I) reduction and various operational /

management improvements – firstly need to be considered. This section provides an overview of the non-build measures that have been considered in the development of the inputs to the IWCM strategy.

A detailed assessment of the current levels of I&I into the sewerage system has not been undertaken at this stage. High volume of I&I was not identified as an IWCM issue but the potential for I&I reduction has been considered as part of options review and assessment.

Council has collected flow monitoring data in the sewerage systems over the past five years and is planning to calibrate its model of the Jerrabomberra subsystem in 2020/2021, and the Morisset subsystem in 2021/22. Following model calibration, Council will be in a better position to quantify the levels of I&I into the system and consider a targeted program for I&I reduction.

Council has previously implemented a pipe relining program with approximately 10% of pipes relined, the majority of which are in the Morisset subsystem. An overview of the extent of the pipe relining is provided in Figure 21. The effectiveness of the pipe relining to reduce I&I has not been monitored. Anecdotal information from Council has indicated that there have been no marked changes in I&I volumes because of the pipe relining program, and that the key benefit of the relining program has been to extend the life of the existing sewers and defer renewals.

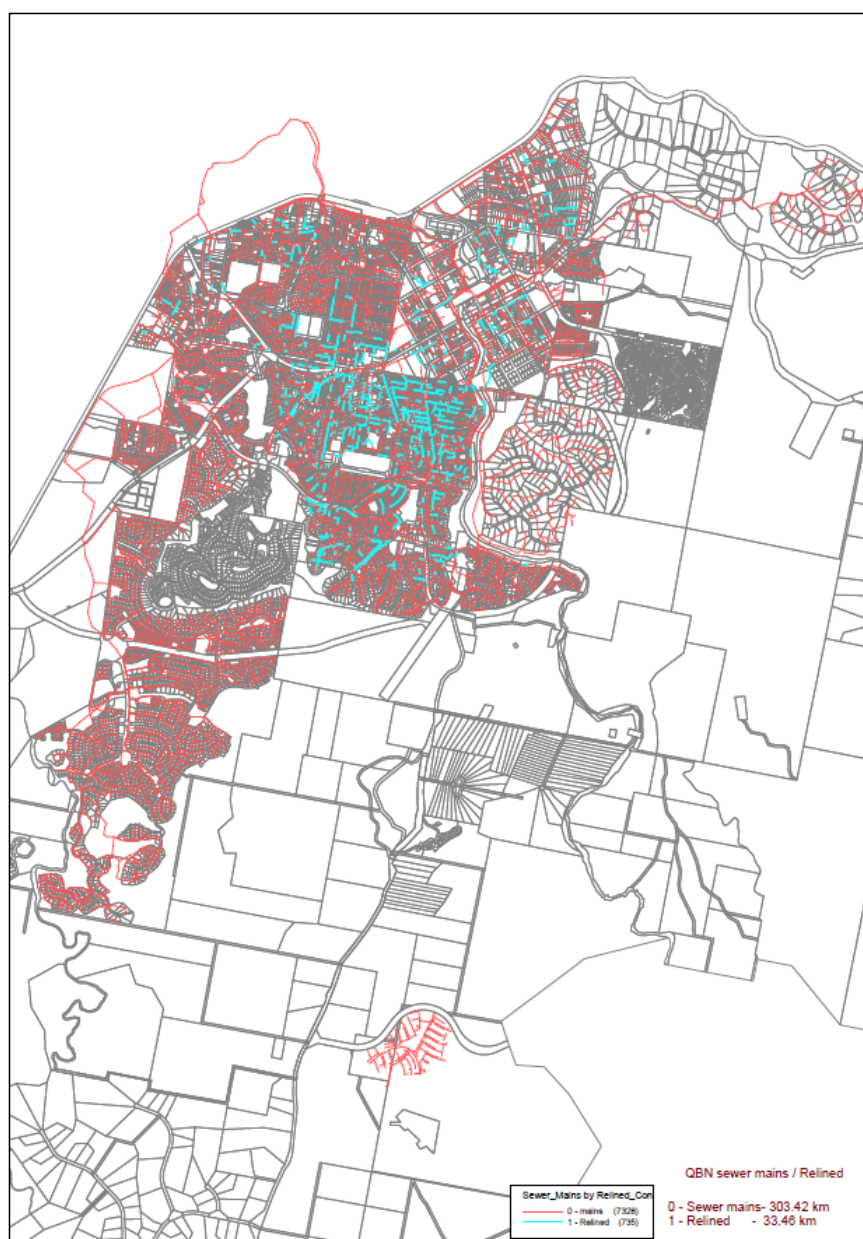


Figure 21 Relined pipes

A review of historical flow data (inflows to the STP) was undertaken by Hunter H2O as part of the design criteria and assumptions development for the STP upgrade project. The analysis found that there was a weak correlation between flow and 3-day rainfall, and that plant inflow does not significantly increase above dry weather values for low to moderate rainfall events less than 40 mm over three days (Hunter H2O, 2019). The analysis indicated that the highest flow over the period of analysis was up to 9 times average dry weather flow (ADWF), and a peak wet weather flow (PWWF) of 9 ADWF was adopted for the upgrade design. It was concluded that overall, the catchment looks like typical NSW catchments with moderate infiltration in wet weather (Hunter H2O, 2019).

A high-level assessment of the levels of ground water infiltration (GWI) in the catchment was also undertaken as part of this feasibility review to determine whether further investigation of rehabilitation works is warranted. Data from the flow gauges was analysed to assess if there is an excessive groundwater infiltration problem in the catchment. The analysis was based on the method described in the Water Services Association of Australia "Management of Wastewater System Infiltration and Inflow Good Practice Guide" and summarised below:

$$GWI_1 = \text{GWI}_{(80\% \text{ of minimum flow})} / \text{ADWF}$$

If GWI_1 is greater than 20%, it is an indicator that GWI, or base flow, is higher than expected.

Estimates of GWI_1 during dry weather for each flow gauge catchment WWTW catchment are provided in Table 18.

Table 18 Groundwater Infiltration Estimates

Flow Gauge	Subsystem	GWI_1 (%)	Notes
PFM_G01	Jerrabomberra	21%	
PFM_G02	Morisset	10%	
PFM_G03	Jerrabomberra	19%	
PFM_G04	Morisset	20%	
PFM_G05	Morisset	45%	
PFM_G06	Morisset	21%	
PFM_G07	Morisset	21%	
PFM_G08	Morisset	19%	
PFM_G09	Morisset	23%	Data unreliable; overnight flows less than 1 L/s
PFM_G10	Morisset	20%	
PFM_G11	Jerrabomberra	15%	

The analysis indicated that GWI is either within acceptable ranges or only marginally higher within the Jerrabomberra subsystem and most flow gauge catchments in the Morisset subsystem. Rehabilitation works to reduce groundwater infiltration within these catchments is not expected to have enough benefit to justify the cost of the works.

The only flow gauge catchment with high levels of GWI is PFM_G05, which is located near the Morisset St SPS. Its contributing catchment is part of the Morisset St SPS catchment. Further analysis of I&I levels during the model calibration phase is recommended to better define the extent of the problem. More targeted monitoring may also be required to better identify hotspots.

The above information suggests that inflow and infiltration volumes are not excessive, and the benefits of increased I&I reduction measures may be limited. It is recommended that Council reviews the need for additional I&I reduction measures following sewer model calibration.

5.3.2 Wastewater treatment options

This section describes the options assessment for the STP upgrade. Development in the ACT that may impact the STP upgrades in the future has not been considered at this stage, due to the uncertainty about the timing and extent of such development. The timing of these developments are unlikely to be within the 30-year horizon of this IWCM.

The IWCM Issues Paper Supplementary Report (QPRC, 2020) summarised the issues related to the Queanbeyan STP, that are being addressed by Council in parallel with the IWCM Strategy development. The issues related to the STP are:

- Queanbeyan STP hydraulic capacity will be exceeded by 2025
- Existing STP needs to be operated and maintained to continue to meet discharge license conditions until the new STP is commissioned

Several studies have informed the development of the STP concept to date, including:

- Masterplan for Sewage Treatment Plant Upgrade (GHD, 2016)
- Queanbeyan Sewage Treatment Plant Upgrade Project Design Criteria and Assumptions Report (Hunter H2O, 2019)
- Queanbeyan Sewage Treatment Plant Upgrade Project Design Options Selection Report (Hunter H2O, 2019)
- Queanbeyan Sewage Treatment Plant Upgrade Project Concept Design Report (Hunter H2O, 2020)
- Queanbeyan Sewage Treatment Plant Upgrade Environmental Impact Statement (Arup, 2020)

A summary of the outcomes from these previous studies is provided in this section, along with a brief summary of the proposed timeframe for completion of the STP upgrade.

5.3.3 Feasibility review of wastewater treatment options

The Masterplan for Sewage Treatment Plant Upgrade (GHD 2016, referred to as the Masterplan in this document) discussed three alternatives for the Queanbeyan STP:

1. Do Nothing
2. Build a new STP, using restored parts of the existing facility
3. Restore the STP and expand as needed to provide sufficient capacity.

The 'Do Nothing' option was not considered feasible due to the significant environmental and human health impacts (ARUP, 2020). A condition assessment was undertaken to investigate the option of reuse of parts of the existing facility. The assessment identified only limited components of the existing STP that could plausibly be used as structures, and not necessarily for their current process unit operations (ARUP, 2020). Many parts of the plant were considered not fit for reuse due to poor condition and being affected by the 100-year average recurrence interval (ARI) flood level.

Six build options were compared and are summarised in Table 19.

Table 19 QSTP upgrade options considered in the Master Plan

Option	Build strategy	Treatment technology
1A	Build New all process units and equipment, completely abandon the existing plant	BNR (Biological Nutrient Removal)/ CAS (Conventional activated sludge process)
1B	Build New all process units and equipment, completely abandon the existing plant	BNR/ MBR (Membrane process)
2A	Build New main process units and reuse some process units from the STP	BNR/ CAS
2B	Build New main process units and reuse some process units from the STP	BNR/ MBR
3A	Renew main QSTP process units & augment with new additional process units	BNR/ CAS
3B	Renew main QSTP process units & augment with new additional process units	BNR/ MBR

Data Source - Queanbeyan STP Upgrade Environmental Impact Statement

A Multi-Criteria Analysis (MCA) indicated that Options 1A and 1B were the preferred options. The MCA considered cost, constructability, operability, sustainability, future proofing and community acceptance. The “Build New” option was adopted as the basis for future planning.

5.3.4 Assessment of STP upgrade options

This section provides an overview of the development of the design criteria for the STP upgrade and the more detailed options assessment that was undertaken following the Masterplan.

5.3.4.1 STP upgrade design criteria and assumptions

The Design Criteria and Assumptions Report (Hunter H2O, 2019) set out the design criteria and assumptions that were used as the basis for the development of upgrade options and subsequent concept and reference designs. The design criteria and assumptions in the report were presented to QPRC at a Design Basis Workshop in June 2019 and were adopted as the basis for proceeding with the upgrade project. This section contains a summary of the design criteria and assumptions.

Population, size and flow

A significant review of EP projections from the STP Masterplan was undertaken with consideration given to the likely timeframe for the plant to be operational (2023/24) and QPRC’s preference to have at least 15 years between upgrades. The adopted EP projections are summarised in Table 20.

Table 20 *Queanbeyan STP Adopted EP Projections*

Year	Projected EP	Growth Rate	Additional connection from Jumping Creek & Tralee	Total
2019	52,300			
2025	57,706	1.65%		
2038	71,832	1.70%	5,000	76,832
Ultimate				150,000

Data Source - Queanbeyan STP Upgrade Design Criteria and Assumptions Report

Following a review of data and inputs, the criteria shown in Table 21 were adopted for the design basis.

Table 21 *Adopted Sewage EP, flow and temperature design summary*

Parameter	Value	Units	Notes
EP Stage 1	75,000	EP	Increased from masterplan to account for higher measured load determined, increased current growth and future likely developments
Stage 2 EP	112,500	EP	
ADWF Flow loading	230	L/EP/day	200 L/EP day measured. Additional allowance as sewer may degrade over time and increase infiltration
Design ADWF	17.25 (Stage 1)	ML/d	34.5 ML/day ultimate with future upgrade
PDWF	1.35 (Stage 1)	ML/hr	Based on measured 95 %ile of 1.88 x average
PWWF	155.25 (Stage 1)	ML/d	Note one event of 9 ADWF was recorded
PIF	1,797	L/s	Set equal to PWWF.
Bioreactor and Sewage Temperature	12 – 24	°C	Operating temperature range

Data Source - Queanbeyan STP Upgrade Design Criteria and Assumptions Report

Influent and Effluent Quality

Influent quality data was analysed, and it was noted that it was generally typical of predominantly domestic sewage (Hunter H2O, 2019).

The ACT EPA advised that the current licence conditions will apply to the new plant (as at 9 September 2019). However, there are two issues with the licence which are difficult to comply with: Total Dissolved Solids (TDS) and ammonia limits. The treatment process cannot remove salt. As it is not practical or economic to remove salt to meet a TDS limit, an approach where the design was optimised to minimise salt addition was therefore proposed (Hunter H2O, 2019). Higher ammonia concentrations occur during wet weather bypass events. The design uses storm storage to balance wet weather flows and greatly reduce frequency of bypass events.

Biosolids

The upgrade is proposed to include a digestion process to achieve a biosolids stabilisation grade B suitable for Restricted use 2 applications under the current NSW EPA Biosolids Guidelines.

5.3.4.2 STP options selection

The Options Selection Report (Hunter H2O, 2019c) provided details on the treatment options that were selected for the STP upgrade, and the reasons for the selection.

Three secondary treatment options were developed for the upgrade for comparison:

- Oxidation ditch with continuous gravity clarification
- Membrane Bioreactor (MBR)
- Intermittently Decanted Extended Aeration (IDEA)

An Options Selection workshop was used to present and score each option using an MCA that considered whole of life cost, effluent quality, operability/complexity, maintainability, robustness, power and chemical use (Hunter H2O, 2019). The workshop was attended by stakeholders from the Department of Planning, Industry and Environment (DPIE) who agreed to the option selected as part of the Section 60 approval process for the STP upgrade.

The preferred secondary treatment process for the STP upgrade was an oxidation ditch with gravity clarifiers, tertiary granular filter media filter, UV disinfection, aerobic sludge digestion and sludge dewatering. It was noted that the plant would be configured to adopt full biological phosphorous removal in the future.

The key benefits of the selected process are:

- High ammonia removal to meet regulatory requirements
- Potential high total nitrogen removal or high nitrate production if required to protect Lake Burley Griffin
- Good treatment of storm flows
- Simple and robust process with many examples of successful implementation
- Multiple suppliers are available to provide replacement parts and equipment servicing
- Fewer chemicals are required than an MBR option and the same number of chemicals are required as the IDEA option.

5.4 Preferred wastewater scenario

5.4.1 STP Upgrade Preferred Option

The preferred option for the STP Upgrade is described in the Concept Design report (Hunter H2O, 2020a) and the Concept Design Addendum (Hunter H2O, 2022), to inform the preparation of the Business Case and Environmental Impact Statement (EIS). A Concept Design workshop was attended by DPIE, who gave approval for the concept to be used as the basis for the EIS and detailed design. The concept design also formed the basis for further design development prior to inviting tenders for the construction of the works. An overview of the concept design is provided in this section, based on the concept design as of October 2020.

The Queanbeyan STP Upgrade proposes the construction of a new treatment plant complete with screening and grit removal, a continuous oxidation ditch activated sludge process with gravity clarifiers, tertiary filtration, and UV disinfection. Waste sludge produced by the treatment process will be stabilised in an aerobic digester and dewatered; producing a biosolids product that is suitable for reuse. Treated effluent will be discharged via an on-bank discharge structure adjacent to the Molonglo River. Infrequent overflows from the Storm Pond will discharge at the same location (Hunter H2O, 2020).

An overview of the process showing major treatment processes is shown in Figure 22.

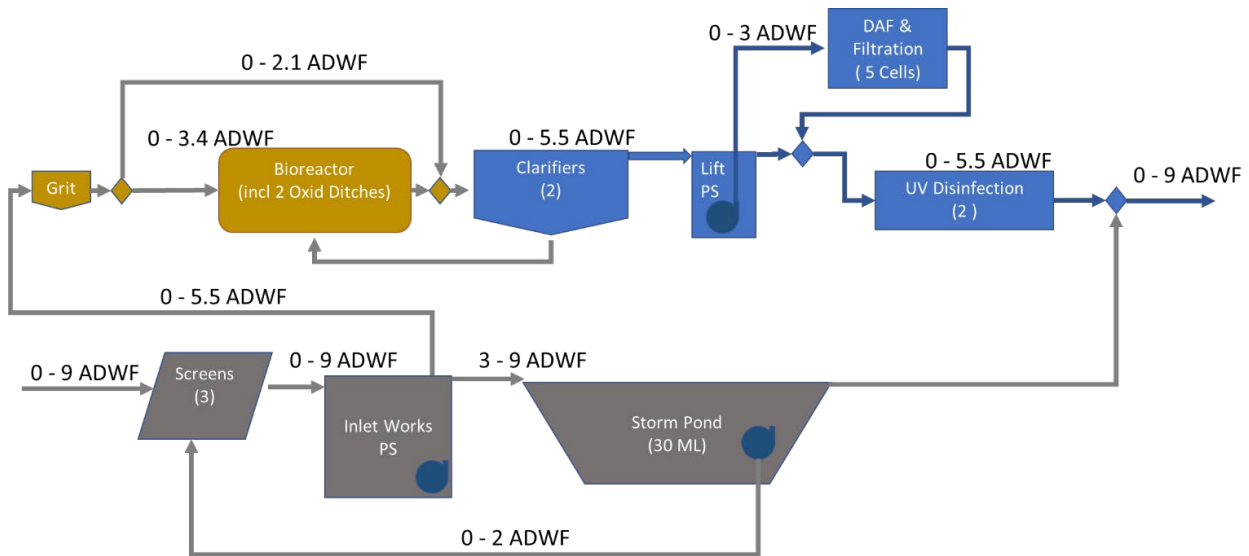


Figure 22 STP Upgrade – Proposed process configuration overview (Hunter H2O, 2020)

The design has been developed to provide a simple and robust process that provides reliable removal of nitrogen and phosphorus and treatment of storm flows (Hunter H2O, 2020).

The new STP will be constructed on the existing lease area to the south east of the existing treatment process. The site location provides a predominantly level area where the new treatment process may be constructed while maintaining operation of the existing STP. An overview of the site arrangement is provided in Figure 23.

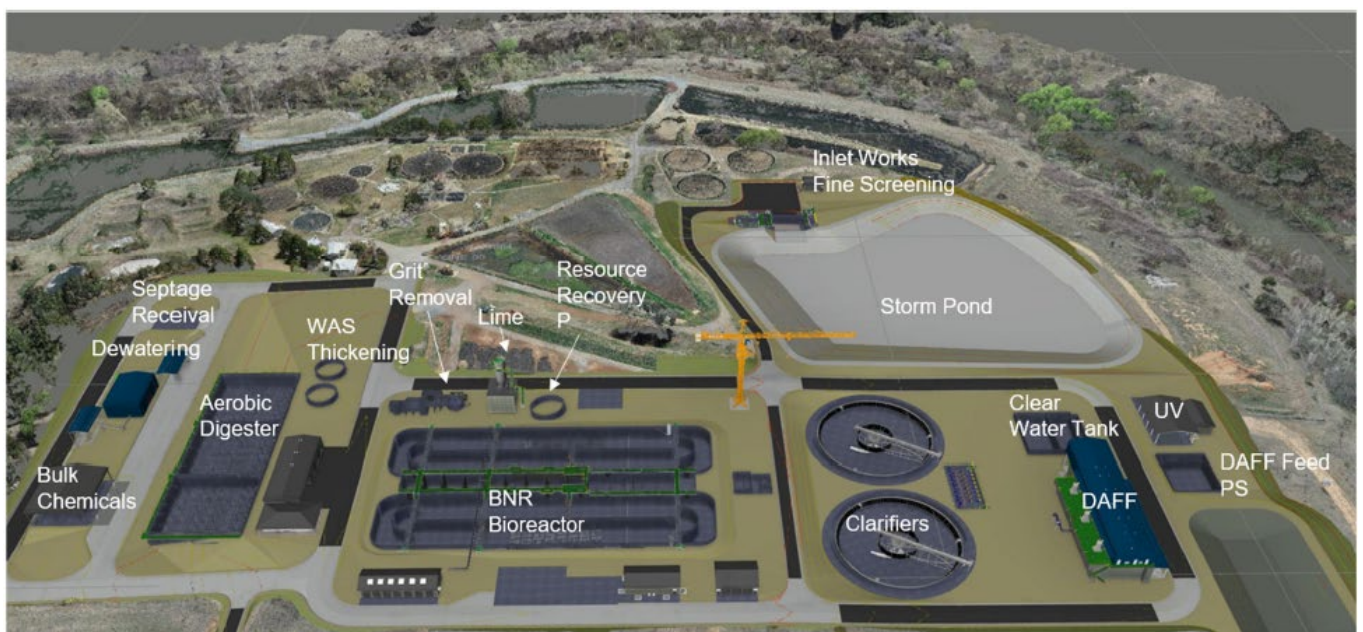


Figure 23 Overview of the Queanbeyan STP upgrade (existing plant in foreground) (Hunter H2O, 2022)

Development of the upgrade layout has considered the potential future requirements of the site. The site arrangement leaves space for a future stage 2 upgrade to expand the treatment capacity by 50% to 112,500 EP. Consideration to the needs of the future upgrade has been given as part of the hydraulic design, site layout and the process sizing of some aspects of the treatment facility which would be difficult to upgrade at a later date, such as the inlet works and grit removal facilities (Hunter H2O, 2020).

Effluent management

The STP currently discharges treated effluent to the Molonglo River. Treated effluent from the upgraded plant will be discharged via an on-bank discharge structure located adjacent the Molonglo River (Hunter H2O, 2020). Initially recycled water from the upgraded plant will be used onsite as well as being provided to water tankers for offsite uses such as dust suppression. The tertiary treatment will produce a high quality of treated effluent that will support future reuse opportunities (Hunter H2O, 2020).

5.4.1.1 STP upgrade costs

A cost estimate for the project was prepared in conjunction with the Concept Design. This estimate is being updated as the design progresses. The current estimate for the total project cost including the STP upgrade, maturation pond decommissioning and Mountain Road upgrade is in the order of \$155M.

5.4.1.2 STP upgrade – project timeline

The current timeline for the STP upgrade is summarised in Table 22.

Table 22 Key milestones for STP upgrade project

Milestone	Current estimate
Draft EIS	Complete (October 2020)
Final EIS	August 2022
Detailed design complete	July 2022
Contract award	February 2023
Construction	February 2022 – June 2025
Decommissioning of maturation ponds	June 2025

5.4.2 Assessment of sewerage network options

This section describes the developed augmentation strategy for the sewerage network. The existing Morisset St SPS is described in section 5.2.1, and the sewerage network is described in section 5.2.2.

This section describes the options assessment for the network upgrades. Development in the ACT that may impact the existing sewerage network in the future has not been considered at this stage due to the uncertainty about the timing, extent, and connection point. The timing of these developments is unlikely to be within the 30-year horizon of this IWCM.

The IWCM Issues Paper Supplementary report (QPRC, 2020) summarised the issues related to the sewer network:

- Design options and timing of potential upgrades for Morisset SPS needs to be reviewed as part of the Queanbeyan STP Upgrade Project
- Lack of detailed knowledge of capacity constraints may lead to additional augmentation work required to meet acceptable service standards
- Sewer model is not up to date and not calibrated

Since the IWCM Issues Paper development, a capacity and condition assessment of the Morisset St SPS has been completed. A theoretical model of the sewerage system has also been developed and used to determine a preliminary upgrade strategy. Model calibration is expected to be completed in 2021/22.

Augmentation strategy methodology

Capacity limitations were identified where the HGL rises to within 0.5 m of the ground surface. Options to increase the hydraulic capacity at these locations were investigated. This usually involved augmentation of the system by adding parallel mains. All proposed augmentations were modelled and costed as parallel pipes i.e. the existing pipes would be maintained in operation. If this is not feasible, replacement pipes of larger diameter may be required.

Sewage pumping station capacity was assessed by comparing the current pump duty with the projected peak wet weather flow. Augmentations have been recommended where the capacity of the duty pumps (or duty/assist pumps depending on the station arrangement) is less than the peak wet weather inflow.

A staged augmentation strategy was developed to address the capacity constraints and allow for capacity for future connections in the catchment. The upgrades described in this section have been based on the theoretical model and will need to be refined following the development of the calibrated model.

Preliminary cost estimates were developed and for the proposed upgrades. The pipeline cost estimates are based on the latest rates for sewer mains provided as part of the current revaluation process. Sewage pump station cost estimates are based on the NSW Reference Rates Manual (Department of Primary Industries Office of Water, 2014). The estimates include:

- Survey, Investigation, Design and Project Management (SID) costs; the SID component can vary from 5% to 20% depending on the complexity of the project. An allowance of 10% of the project cost was applied for the pipeline cost estimates and 15% for the sewage pump stations
- Total preconstruction contingencies includes: an allowance for uncertainty in the scope of work, uncertainty in the costs to be applied and uncertainty in site conditions. An allowance of 30% of the contract rate was applied to the cost estimates to account for the high level of uncertainty at this preliminary planning stage
- Total preconstruction contingencies accounts for factors beyond the control of the designers or constructors, such as industrial issues, adverse weather, availability of labour and materials and extensions of time due to unforeseen circumstances. A contingency allowance of 20% of the contract rate was applied for all estimates.

Augmentation strategy overview

An overview of the proposed augmentation strategy is provided in Figure 24.

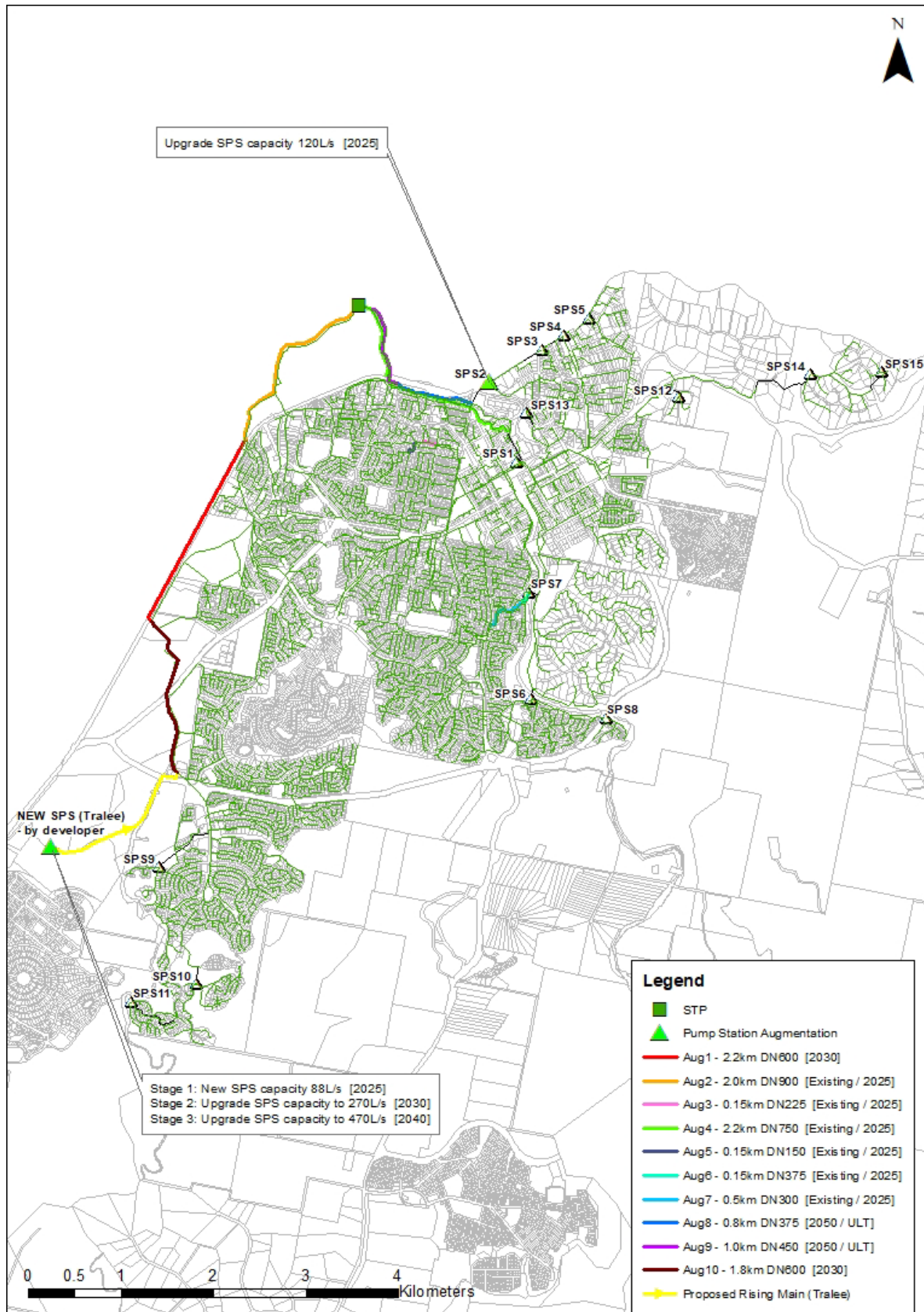


Figure 24 Augmentation strategy overview

Jerrabomberra subsystem augmentation strategy

The main capacity constraint in the Jerrabomberra subsystem is the Jerrabomberra trunk main. There are no capacity constraints in other parts of the system and all existing sewage pump stations have sufficient capacity for the additional projected loadings from infill development.

Augmentations required to increase system capacity are summarised in Table 23 along with their estimated capital cost and anticipated timing. For augmentations where modelling shows an existing capacity constraint, a timing of 2024 was adopted to reflect the likely timeframe required for project investigation, design, and construction.

Table 23 Sewerage network– staged augmentation strategy for the Jerrabomberra subsystem

Timing	Description	Estimated capital cost
2024 (part of STP upgrade)	Jerrabomberra trunk-main diversion/replacement - 225 m x DN900 gravity main from W1 to the new inlet works	\$880,000
2024	1,775 m x DN900 gravity main from W26 to W1	\$10,040,000
2030	2,200 m x DN600 gravity main from W61 to W26	\$5,470,000
2030	1,850 m x DN600 gravity main from W76 to W61	\$4,480,000

The upgrade from W26 to W1 is through an environmentally sensitive area owned by ACT government and would require an EIS. Sections of the Jerrabomberra trunk main within the STP site are known to leak and contain asbestos and would need to be replaced. Further analysis to determine the preferred route for the trunk main upgrade is required subject to field investigations. Alternatively, construction of a new SPS and rising main instead of the proposed trunk main augmentation, would provide more flexibility on the proposed pipeline route and may be a more cost-effective solution depending on the outcomes of the field investigations.

A new regional SPS will be required to service future developments in Tralee which do not drain via gravity to the existing sewerage system. Based on advice provided by Council, the new Tralee SPS will initially have a capacity of 88 L/s and discharge into the existing system at W76. The Jerrabomberra trunk main between the connection point and W61 has sufficient capacity for both existing and future connections up to 2030.

From around 2030, the projected peak flow from developments in the area will exceed 88 L/s. The SPS would either require an upgrade or replacement to increase station capacity to 270 L/s by 2030. The increased inflows will trigger augmentation of the Jerrabomberra trunk main downstream of the SPS discharge point from manhole W76 to W26. An alternative option for connecting the SPS further downstream and diverting flows from existing SPSs (SPS 9, 10 and 11) to reduce the loadings on sections of the Jerrabomberra trunk main could be assessed following development of the calibrated model. It is also noted that servicing the Tralee Station development area will require at least one additional SPS. It has been assumed that this SPS will connect to the existing system via the Tralee SPS, but the sizing and costing of the additional SPS(s) has not been considered at this stage.

An additional upgrade would be required for the Tralee SPS (beyond 2030) to accommodate the ultimate projected loadings of 470 L/s. Additional parallel rising main(s) will also be required with the proposed future pump upgrade. A summary of the regional infrastructure required to service large development areas is summarised in Table 24. Cost estimates have not been included as the infrastructure will be developer funded.

Table 24 Proposed Capacity and Timing for New Tralee SPS

Description	Timing
New Tralee SPS - 88L/s capacity and rising main 1,800 m x DN250	Under construction
Upgrade Tralee SPS to 270L/s capacity and upgrade rising main	2030
Upgrade Tralee SPS to 470L/s capacity and upgrade rising main	2040

Morisset subsystem augmentation strategy

The main capacity constraint in the Morisset subsystem is the Morisset trunk main. Other smaller upgrades are also required including two pump station upgrades.

Augmentations required to increase system capacity are summarised in Table 25 along with their estimated capital cost and anticipated timing. Upgrades required to alleviate existing system capacity constraints have been sized with sufficient capacity for future projected loadings. The ARC pump station upgrade has been costed as a replacement SPS. For the Woodland Ave SPS upgrade, the modelling indicated that the Woodland Ave SPS needs to be upgraded from 5 to 6 L/s. A cost has not been included for this upgrade as further investigation would be required to confirm what flow rate the SPS operates at and whether the upgrade could be achieved by impeller or pump replacement.

Table 25 Sewerage network– staged augmentation strategy for the Morisset subsystem

Timing	Description	Estimated Capital Cost
2024 (part of STP upgrade)	Morisset trunk-main diversion/replacement - 465 m x DN900 gravity main from F7 to the new inlet works	\$1,980,000
2024	1,735 m x DN750 gravity main from MH 103303 to F7	\$7,430,000
2024	150 m x DN225 gravity main from C604 to C371	\$88,000
2024	150 m x DN150 gravity main from C703 to C605	\$63,000
2024	150 m x DN375 gravity main from S26 to Kathleen St SPS	\$242,000
2024	500 m x DN300 gravity main from S38 to S26	\$330,000
2025	Replacement of ARC SPS – new 120 L/s capacity pump station	\$1,790,000
2050	800 m x DN375 gravity main from F30 to F16	\$1,045,000
2050	1,000 m x DN450 gravity main from F16 to F2	\$1,408,000

A new SPS will be required for the Jumping Creek development area. It is assumed that this SPS will be developer funded and it has therefore not been included in the augmentation strategy. An allowance for the loadings from the new SPS was included in the modelling in the Morisset St SPS catchment.

6. Asset management

QPRC undertook a revaluation of the Water and Sewer Asset registers in August 2021. The restated asset register has been used to determine the 'assumed' asset replacement regime for existing assets. The replacement program was combined with the enhancement and growth profiles to establish the 20 year capital expenditure program applied to the funding and debt analysis.

6.1 Sewer Assets

Sewer Asset register had a WDBV of \$75.5m as of 30th June 2021, consisting of 8,074 individually identified assets, remaining useful life ranging from 1 to 85 years.

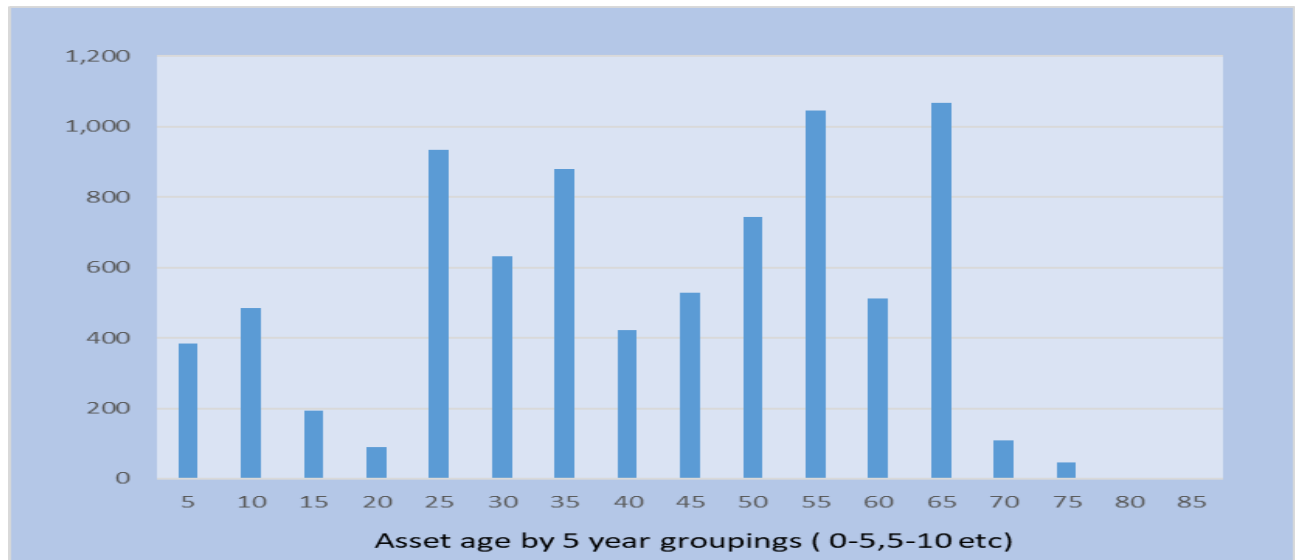


Figure 25 Sewer Assets - Remaining useful life (Yrs)

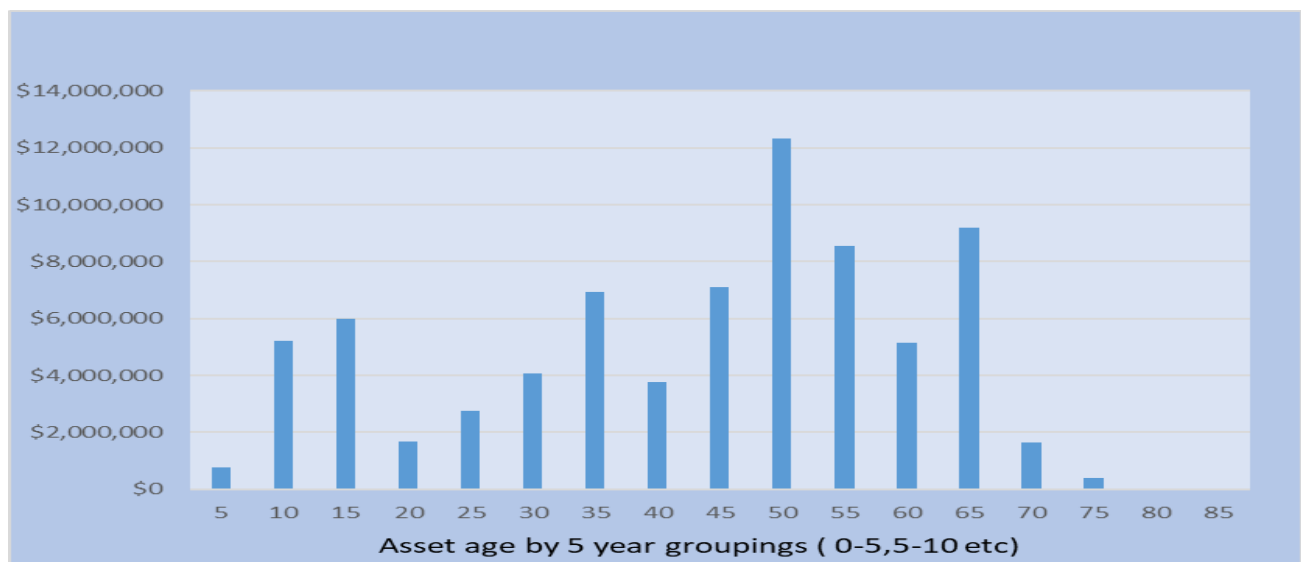


Figure 26 Sewer Assets - Written Down Book Value (\$)

Table 26 Sewer Asset Register Summary

SEWER ASSET SUMMARY						Percentage Changes
	Year	Open Bal	Capex	Depn	WDBV	With Capex
1	2021/2022	75,534,532	0	2,951,535	72,582,997	-3.91%
2	2022/2023	73,671,742	72,115,750	2,951,535	142,836,065	93.88%
3	2023/2024	144,978,606	95,377,469	4,365,303	235,990,773	62.78%
4	2024/2025	239,530,635	28,537,094	6,214,334	261,853,395	9.32%
5	2025/2026	265,781,196	0	6,764,748	259,027,429	-2.54%
6	2026/2027	262,912,840	259,762	6,753,422	256,646,964	-2.38%
7	2027/2028	260,496,669	13,772,269	6,492,266	267,778,556	2.80%
8	2028/2029	271,795,234	36,498	6,762,556	265,160,097	-2.44%
9	2029/2030	269,137,498	18,096,164	6,378,105	280,864,841	4.36%
10	2030/2031	285,077,813	311,927	6,953,093	278,458,918	-2.32%
11	2031/2032	282,635,802	2,764,292	6,813,862	278,702,916	-1.39%
12	2032/2033	282,883,460	6,402,455	6,694,970	282,591,299	-0.10%
13	2033/2034	286,830,168	122,825	6,965,449	280,020,997	-2.37%
14	2034/2035	284,221,312	930,026	6,929,326	278,314,452	-2.08%
15	2035/2036	282,489,169	4,508,039	6,783,741	280,216,708	-0.80%
16	2036/2037	284,419,959	357,872	6,963,155	277,820,673	-2.32%
17	2037/2038	281,987,983	885,104	6,958,014	275,948,049	-2.14%
18	2038/2039	280,087,270	2,850,848	6,893,098	276,045,019	-1.44%
19	2039/2040	280,185,695	0	6,966,733	273,218,962	-2.49%
20	2040/2041	277,317,246	0	6,966,733	270,351,736	-2.51%

Note: Capex includes growth/enhancement assets as well as replacement of existing assets at their assumed 'end of useful' life.

6.2 Water Assets

Water Asset register had a WDBV of \$80.7m as of 30th June 2021, consisting of 2,877 individually identified assets, with remaining useful life ranging from 1 to 100 years.

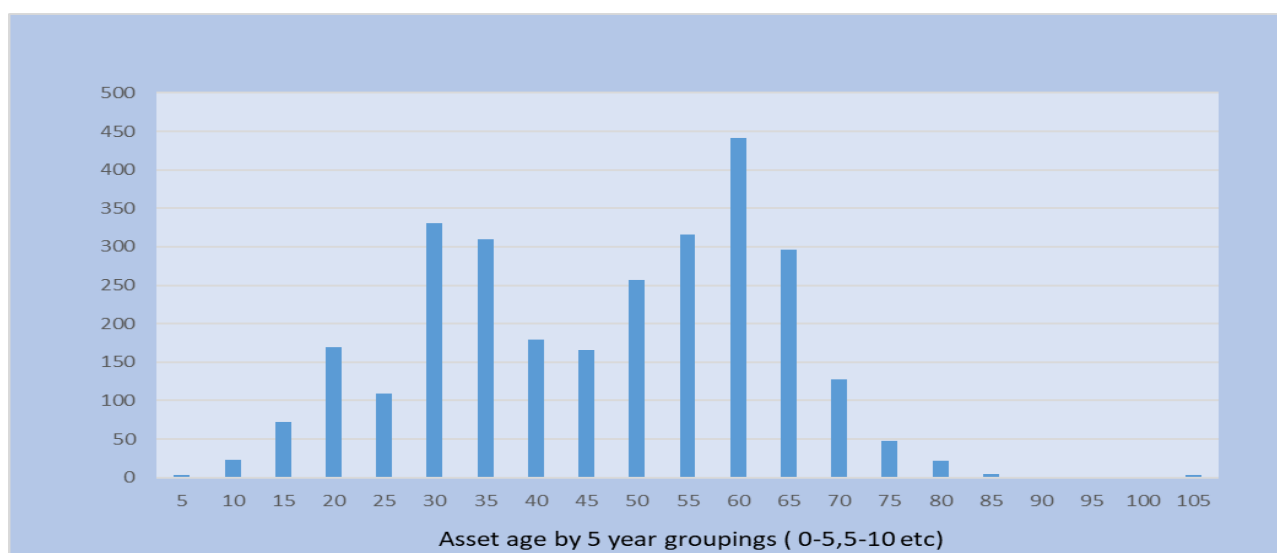


Figure 27 Water assets - remaining useful life (years)

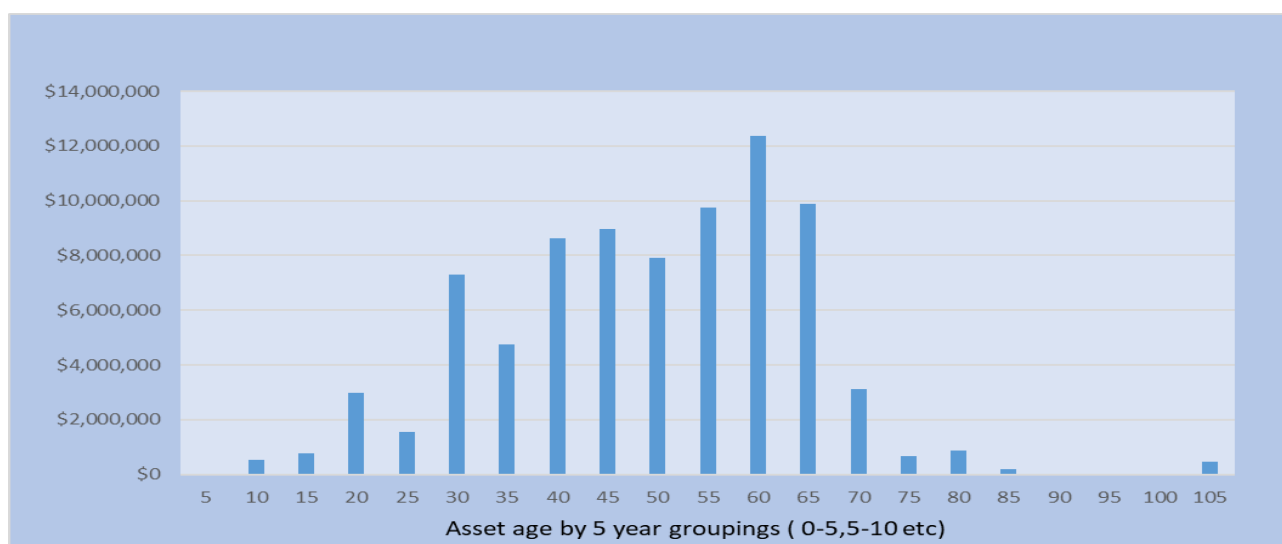


Figure 28 Water asset WDBV - remaining useful life (yrs)

Table 27 Water Asset Register Summary

ASSET SUMMARY						Percentage Changes
	Year	Open Bal	Capex	Depn	WDBV	With Capex
1	2021/2022	80,685,215	0	2,067,437	78,617,778	-2.56%
2	2022/2023	79,797,045	6,696,463	2,067,437	84,426,071	5.80%
3	2023/2024	85,692,462	3,659,874	2,232,374	87,119,962	1.67%
4	2024/2025	88,426,761	0	2,350,791	86,076,602	-2.66%
5	2025/2026	87,367,751	32,406,869	2,348,016	117,426,604	34.40%
6	2026/2027	119,188,003	0	2,655,291	116,539,183	-2.22%
7	2027/2028	118,287,270	475,774	2,643,025	116,120,019	-1.83%
8	2028/2029	117,861,819	0	2,655,291	115,221,445	-2.24%
9	2029/2030	116,949,767	1,105,757	2,591,010	115,464,515	-1.27%
10	2030/2031	117,196,482	0	2,655,291	114,541,192	-2.27%
11	2031/2032	116,259,309	0	2,655,291	113,616,207	-2.27%
12	2032/2033	115,320,450	664,055	2,626,905	113,357,600	-1.70%
13	2033/2034	115,057,964	0	2,655,291	112,408,940	-2.30%
14	2034/2035	114,095,074	165,142	2,648,928	111,612,163	-2.18%
15	2035/2036	113,286,346	42,671	2,653,559	110,701,138	-2.28%
16	2036/2037	112,361,655	2,835,016	2,626,946	112,569,724	0.19%
17	2037/2038	114,258,270	0	2,655,291	111,617,801	-2.31%
18	2038/2039	113,292,068	1,930,293	2,622,189	112,616,195	-0.60%
19	2039/2040	114,305,438	9,028,556	2,568,965	120,765,028	5.65%
20	2040/2041	122,576,504	0	2,655,291	119,921,213	-2.17%

Note: Capex includes growth/enhancement assets as well as replacement of existing assets at their assumed 'end of useful' life.

7. Adopted IWCM scenarios

7.1 Adopted scenarios

Based on the information presented above there is only one feasible scenario each for water and wastewater. As such the financial analysis has been prepared on this basis.

Table 28 Sewer Capex - Growth & Enhancement

Sewerage Capex by project			Asset Life
FY	Description	Amount (\$)	
Pre 2020/21	Part QSTP Upgrade (spent to date) - current total estimated QSTP CAPEX is \$155M	13,400,000	
2022/23	Part QSTP Upgrade	4,000,000	50
2023/24	Part QSTP Upgrade	65,900,000	50
2024/25	Part QSTP Upgrade	66,900,000	50
2024/25	Part Jerrabomberra trunk main (QSTP component)	880,000	50
2024/25	Part Jerrabomberra trunk main	10,040,000	50
2024/25	Part Morriset trunk main (QSTP component)	1,980,000	50
2024/25	Part Morriset trunk main	7,430,000	50
2024/25	Morriset gravity system upgrades	723,000	20
2025/26	Redundant QSTP Infrastructure Decommissioning	5,000,000	40
2025/26	ARC sewage pump station replacement	1,790,000	10
2030/31	Part Jerrabomberra trunk main	9,950,000	50
2032/33	Redundant QSTP Demolition	20,000,000	50
2049/50	Part Morriset trunk main	2,453,000	50
	Total Sewerage Infrastructure CAPEX (excl spent to date)	210,446,000	
	Total Infrastructure CAPEX (water + sewerage) excl spent to date	250,446,000	

Table 29 Water Capex - Growth & Enhancement

Water Capex by project			Est Life
FY	Description	Amount (\$)	
Pre 2020/21			
2022/23			
2023/24	Water supply safety upgrade works	6,500,000	20
2024/25	Water supply chlorination upgrade works	2,000,000	20
2024/25	Water supply safety upgrade works	1,500,000	20
2026/27	Jerrabomberra Reservoir Duplication	20,000,000	80
2026/27	Water supply chlorination upgrade works	3,000,000	20
2026/27	Water supply safety upgrade works	7,000,000	20
Total Water Infrastructure CAPEX		40,000,000	

7.2 Financial analysis

Financial analysis was undertaken to assess the impact of the proposed capital expenditure programs on the financial position of the Council over a twenty-year period. The analysis considered the forecasted cashflow and account balances under several alternative external funding options, assuming that external funding support would be available (modelling tests for 0%, 25%, and 50% and for specific asset support only). Grant funding was assumed to be available for the QSTP upgrades (\$132.8m) over two years. Given the nature and the size of the Water capital expenditure, it was assumed that no request would be made for Water asset expansion.

7.2.1 Modelling Parameters

Table 30 summarises the key parameters adopted in the financial model as the base assumptions.

Table 30 Summary of general parameters adopted in the financial model

General Parameters		
Staff cost increase		2.50%
Inflation (CPI)		2.50%
Residential houses (growth_		0.50%
Vacant land (growth)		0.00%
Units (growth)		2.00%
Persons per household	#	2.60
Icon Bulk Water price re QPRC price		83.00%

Sewer and water access charges that are adopted in the financial model are presented in Table 31 and Table 32

Table 31 Sewer access charges for the financial year 2020 / 21

Sewer Access Charges	
Sewer Access Charge 2020/21	
Residential	Rate
Residential	\$769.00
Industrial	
Average	\$1,566.25

Table 32 Water access charges for the financial year 2020 / 21

Water Access Charges	
Residential	Rate
Average	\$290.40
Industrial	
Average	\$616.52
Water Usage Charge	
Average per kilolitre	\$4.48
Water Usage (kl/annum)	233

Note: 2020/21 data CPI adjusted in the financial modelling, and/or rates based on average derived from the 2021/22 rates notices.

Table 33 Water – Equivalent Tenancies Forecast – Water/Sewer

Growth re Table 16 - IWMC Finalisation Report																			
		-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	18	27
		2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2039/40	2048/49
Residential Growth																			
	Jumping Creek	960	0	240	240	240	240	0	0	0	0	0	0	0	0	0	0	0	0
	Tralee	4,039	0	271	271	271	271	406	406	406	406	406	93	93	93	93	93	927	0
	Trale Station	10,800	0	0	0	0	0	0	0	0	0	0	540	540	540	540	540	5400	540
	The Populars	2,160	0	0	0	0	0	0	0	0	0	0	216	216	216	216	216	2160	0
	Environ/Robin	6,000	0	0	0	0	0	0	0	0	0	0	263	263	263	263	263	2626	337
		23,959	0	511	511	511	511	406	406	406	406	406	1,111	1,111	1,111	1,111	1,111	11,113	877
Infill																			
	Crestwood	560	0	28	28	28	28	45	45	45	45	45	22	22	22	22	22	224	0
	Jerrabomberra	67	0	3	3	3	3	5	5	5	5	5	3	3	3	3	3	27	0
	Karabar	213	0	11	11	11	11	17	17	17	17	17	9	9	9	9	9	85	0
	Queanbeyan	740	0	37	37	37	37	59	59	59	59	59	30	30	30	30	30	296	0
	Queanbeyan East	585	0	29	29	29	29	47	47	47	47	47	23	23	23	23	23	234	0
	Queanbeyan West	125	0	6	6	6	6	10	10	10	10	10	5	5	5	5	5	50	0
		2,290	0	115	115	115	115	183	183	183	183	183	92	92	92	92	92	916	0
Non Residential Development																			
		7,428	0	310	310	310	310	248	248	248	248	248	248	248	248	248	248	2476	248

Based on development sites forecasts and uptake rates

Table 34 Water Financial Statement

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Financial Statement	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Income																				
Rates and Annual Charges	6,318,879	6,831,364	7,383,774	7,979,136	8,611,461	9,292,277	9,648,682	10,017,100	10,397,908	10,915,623	11,452,726	12,009,861	12,587,695	13,186,915	13,808,228	14,452,365	15,120,079	15,812,146	16,529,366	17,188,289
User Charges and Fees	398,224	414,387	456,389	504,970	478,638	500,247	503,666	515,853	518,594	534,963	543,770	553,994	563,707	575,248	585,526	596,191	606,972	618,035	628,973	636,961
Water Consumption	16,266,370	16,524,041	16,907,312	17,183,651	18,045,387	18,522,158	18,342,153	18,711,526	19,104,998	19,599,805	19,871,543	20,261,915	20,657,858	21,054,507	21,425,515	21,822,574	22,221,428	22,621,087	23,021,572	23,315,477
Developer Contributions																				
Infill (based on 2004 DSP)	243,263	243,263	243,263	243,263	389,221	389,221	389,221	389,221	389,221	194,611	194,611	194,611	194,611	194,611	194,611	194,611	194,611	194,611	194,611	0
Developer - 5 years)	871,508	871,508	871,508	871,508	693,109	693,109	693,109	693,109	693,109	1,897,173	1,897,173	1,897,173	1,897,173	1,897,173	1,897,173	1,897,173	1,897,173	1,897,173	1,897,173	1,497,867
Total Income	24,098,244	24,884,563	25,862,246	26,782,528	28,217,817	29,397,014	29,576,831	30,326,809	31,103,830	33,142,174	33,959,822	34,917,553	35,901,043	36,908,453	37,911,053	38,962,913	40,040,263	41,143,051	42,271,694	42,638,594
Expenditure																				
Employee Expenses	875,622	898,870	922,714	947,170	972,148	997,767	1,024,044	1,050,995	1,078,638	1,108,278	1,138,667	1,169,826	1,201,776	1,234,537	1,268,131	1,302,579	1,337,905	1,374,132	1,411,283	1,448,663
Materials and contracts	1,669,120	1,645,708	1,730,382	1,745,155	1,757,007	1,779,748	1,814,430	1,836,178	1,859,730	1,886,310	1,913,883	1,939,616	1,966,381	1,993,976	2,021,835	2,049,768	2,078,270	2,107,221	2,136,523	2,166,198
Internal Charges	2,623,539	2,736,899	2,787,239	2,773,828	2,798,636	2,843,504	2,870,822	2,892,240	2,922,583	2,954,344	2,982,747	3,011,428	3,041,970	3,072,563	3,102,856	3,133,634	3,164,950	3,196,463	3,228,213	3,260,336
Operational	100,000	102,500	819,488	1,378,420	860,974	316,794	324,714	332,832	950,354	349,682	358,424	367,384	1,049,013	385,983	395,633	405,523	1,157,914	426,053	436,704	447,622
Bulk Water Supply(icon)	13,501,087	13,714,954	14,033,069	14,262,430	14,977,671	15,373,391	15,223,987	15,530,566	15,857,148	16,267,838	16,493,381	16,817,389	17,146,022	17,475,241	17,783,178	18,112,736	18,443,785	18,775,502	19,107,905	19,351,846
Depreciation & Amortisation	2,108,174	2,108,174	2,108,174	2,468,508	2,666,495	2,669,324	3,117,787	3,130,295	3,130,295	3,064,747	3,130,295	3,130,295	3,101,350	3,130,295	3,123,806	3,130,295	3,128,529	3,101,391	3,130,295	3,130,295
Disposal of waste	36,995	25,066	25,223	24,354	28,607	26,458	26,815	27,223	27,958	27,791	28,133	28,470	28,790	29,003	29,314	29,617	29,911	30,198	30,504	30,809
Total Expenditure	20,914,537	21,232,173	22,426,288	23,599,865	24,061,538	24,006,987	24,402,599	24,800,329	25,826,706	25,658,990	26,045,529	26,464,409	27,535,301	27,321,598	27,724,753	28,164,153	29,341,264	29,010,961	29,481,427	29,835,768
Net cashflow from Operations	5,291,881	5,760,564	5,544,132	5,651,170	6,822,773	8,059,351	8,292,019	8,656,775	8,407,419	10,547,931	11,044,588	11,583,439	11,467,091	12,717,150	13,310,106	13,929,055	13,827,528	15,233,482	15,920,562	15,933,121
Capital Expenditure																				
Replacement Capex	0	0	0	0	97,403	0	545,407	0	0	1,364,172	0	0	868,632	0	224,615	0	61,254	4,149,780	0	0
Growth Capex	0	0	6,962,963	3,880,513	0	35,630,589	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net cashflow from Operations	5,291,881	5,760,564	-1,418,831	1,770,658	6,725,370	-27,571,239	7,746,613	8,656,775	8,407,419	9,183,760	11,044,588	11,583,439	10,598,459	12,717,150	13,085,491	13,929,055	13,766,274	11,083,702	15,920,562	15,933,121

Table 35 Sewer Financial Statement

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Financial Statement	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2034/35	2035/36	2036/37	2037/38	2038/39	2039/40	2040/41
Income																				
Rates and Annual Charges																				
Residential	11,239,864	11,763,678	12,715,960	13,742,336	14,836,226	16,014,259	17,282,755	18,648,494	19,363,126	20,367,051	21,409,071	22,490,462	23,612,543	24,776,671	25,984,247	27,236,717	28,535,570	29,882,343	31,278,620	32,545,966
Industrial	2,174,258	2,293,749	2,498,484	2,720,144	2,947,441	3,192,795	3,457,592	3,743,322	3,899,417	4,060,977	4,228,178	4,401,201	4,580,232	4,765,465	4,957,096	5,155,330	5,360,378	5,572,456	5,791,788	6,018,604
Grants Contribution - Operating																				
Grants Contribution - Capital																				
DSP Revenue - infill	63,758	130,703	200,957	274,641	394,109	519,380	650,667	788,195	932,192	1,019,196	1,109,969	1,204,642	1,303,356	1,406,253	1,513,479	1,625,189	1,741,537	1,862,688	1,988,807	2,038,527
DSP Revenue - Developments /	304,499	312,111	319,914	327,912	267,307	273,990	280,840	287,861	295,057	827,819	848,515	869,728	891,471	913,758	936,602	960,017	984,017	1,008,617	1,033,833	836,644
Other Revenue	72,796	66,051	55,818	51,337	61,500	58,676	56,833	57,087	58,524	57,780	57,556	57,737	57,899	57,743	57,734	57,778	57,788	57,761	57,765	57,773
Interest & Investment Revenue																				
Total Income	13,855,174	14,566,293	15,791,131	17,116,369	18,506,584	20,059,101	21,728,686	23,524,958	24,548,316	26,332,824	27,653,288	29,023,770	30,445,501	31,919,888	33,449,158	35,035,030	36,679,291	38,383,865	40,150,813	41,497,514
Expenditure																				
Employee Expenses	1,754,217	1,800,930	1,848,842	1,897,983	1,948,163	1,999,630	2,052,419	2,106,562	2,162,095	2,221,753	2,282,914	2,345,621	2,409,913	2,475,835	2,543,429	2,612,739	2,683,812	2,756,695	2,831,434	2,906,582
Materials and Services	6,079,177	6,391,970	6,719,212	7,061,531	7,411,248	7,776,795	8,158,851	8,558,125	8,975,353	9,524,446	10,100,981	10,706,207	11,341,424	12,007,991	12,707,325	13,440,902	14,210,263	15,017,014	15,862,831	16,664,809
Operational	0	102,500	420,250	215,378	386,335	995,639	614,638	451,701	645,754	1,098,999	678,445	498,593	712,791	1,213,090	748,876	550,353	786,788	1,339,024	826,619	607,487
Depreciation (from Schedule)	3,009,693	3,009,693	3,088,017	4,549,975	6,108,661	6,258,399	5,992,097	6,267,713	6,267,713	5,864,014	6,620,835	8,059,239	8,222,387	8,498,195	8,465,275	8,495,590	8,312,907	8,495,856	8,490,614	8,499,505
Revaluation decrement/impairment																				
Disposal of Assets/Waste	7,025	8,781	7,199	8,387	7,848	8,054	7,872	8,040	7,954	7,980	7,962	7,984	7,970	7,974	7,972	7,975	7,973	7,973	7,973	7,974
Total Expenditure	10,850,112	11,313,875	12,083,521	13,733,254	15,862,254	17,038,517	16,825,877	17,392,140	18,058,868	18,717,192	19,691,137	21,617,643	22,694,485	24,203,085	24,472,877	25,107,560	26,001,743	27,616,563	28,019,471	28,686,356
Net cashflow from Operations	6,014,755	6,262,111	6,795,627	7,933,089	8,752,991	9,278,982	10,894,907	12,400,530	12,757,161	13,479,645	14,582,986	15,465,366	15,973,404	16,214,999	17,441,556	18,423,061	18,990,455	19,263,159	20,621,956	21,310,663
Capital Expenditure																				
Replacemet Capex	0	0	175,282	111,539	0	292,026	15,787,947	42,665	44,158	8,623,191	0	3,546,023	8,374,880	163,830	-31,485,221	389,457	6,471,172	523,839	1,321,108	0
Growth Capex	0	4,140,000	70,593,728	74,974,829	7,791,681	0	0	0	0	13,560,829	15,403,738	13,738,315	0	0	32,373,890	0	0	0	0	0
Net cashflow from Operations	6,014,755	2,122,111	-63,973,382	-67,153,279	961,310	8,986,957	-4,893,040	12,357,866	12,713,003	-8,704,374	-820,752	-1,818,972	7,598,523	16,051,169	16,552,886	18,033,603	12,519,282	18,739,320	19,300,849	21,310,663

7.3 Water & Sewer Accounts (Reserve & Loan)

QPRC operate two major fund accounts for the funding of their water and sewer infrastructure:

- Water/Sewer 'Working' Accounts – internal account which is used as a 'clearing account' between the income from water/sewer operations and the debt/repayments required to be made from time to time to ensure that the accounts are maintained according to the Council's guidelines.
- Water/Sewer Loan Accounts – comes into play when the internal operating cashflow plus grant funding is insufficient to match the capital expenditure needs to undertake the required capital expansion program. Rarely applied for water, as QRPC does not operate water treatment plants. The proposed sewer expansion program indicates that, besides grant funding, QRPC will need to seek loan funding post the upgrading of the QSTP in 2022/24.

7.4 Account Balances

7.4.1 Water

The capital expenditure program for water is \$40m, with \$20m in 2026/27.

7.4.1.1 Scenario 1

Water Scenarios		Recommended Scenario		
		No Grant, No Loans		
Sect 64 Balance		\$10,000,000		
Fund Balance		\$11,600,000		
Interest Rate - Debt		6.00%		
Interest Rate - Earnt		1.00%		
Loan Term (years)		20		
Rate Increase - Initial 4 years		2.50%		
Rate increases - balance of the 20 years		2.50%		
CPI - Water		2.50%		
Capital cost CPI (CPI+Margin		1.00%		
Grant Funding - Percentage ask of eligible		0.00%		
Grant Funding - Net Percentage		0.00%		
	Grant Funding	Loan Funding	Closing Balance	
2021/22	0	0	26,851,093	
2022/23	0	0	32,325,725	
2023/24	0	0	30,259,360	
2024/25	0	0	31,003,677	
2025/26	0	0	36,318,780	
2026/27	0	0	6,580,176	
2027/28	0	0	12,221,324	
2028/29	0	0	18,735,533	
2029/30	0	0	24,965,308	
2030/31	0	0	31,924,641	
2031/32	0	0	40,728,536	
2032/33	0	0	50,036,903	
2033/34	0	0	58,315,081	
2034/35	0	0	68,685,694	
2035/36	0	0	79,398,152	
2036/37	0	0	90,927,984	
2037/38	0	0	102,263,138	
2038/39	0	0	110,852,023	
2039/40	0	0	124,256,394	
2040/41	0	0	137,665,480	
	\$0	\$0		

Figure 29 Water fund balances/funding assumptions

Modelling Assumptions

- ✓ Water fund has an open balance of \$22.6m
- ✓ Pricing is based on the BAU pricing regime/mix.
- ✓ Rate increase have been assumed to be aligned to CPI growth (2.5%) and will be held at that rate across the analysis period.
- ✓ Capital cost is anticipated to increase at 1.0% in excess of CPI (2.5%+1.0%)
- ✓ With a balance increasing over the 20-year period, no grant funding.
- ✓ No additional loans sought

7.4.2 Sewer

QPRC is facing a more onerous capital expenditure program for sewer infrastructure, with a growth/enhancement program of in excess \$160m in the four years. It is likely that QPRC will need to seek both grant funding and external (loan) funding to support this capital expenditure program.

7.4.2.1 Scenario 1

Sewer Scenarios	Scenario 1		
	Zero Grant, Zero Loans		
Opening Balance - Section 64	\$7,000,000		
Opening Balance - Sewer Fund	\$58,000,000		
Interest Rate - Debt	6.00%		
Interest Rate - Earnt	1.00%		
Loan Term (years)	20		
Rate increases	4yrs/0 yrs/16 years		
Rate Increase - Initial period	4.50%		
Rate Increase - second period	-		
Rate increases - balance of 20 years	2.50%		
CPI - Sewer	2.50%		
Capital cost CPI (CPI+Margin)	1.00%		
Grant Funding - Percentage ask of eligible	0.00%		
Grant Funding - Net Percentage	1.16%		
	Grant Funding	Loan Funding	Closing Balance
2021/22	0	0	59,753,211
2022/23	2,700,000	0	70,801,444
2023/24	0	0	7,087,754
2024/25	0	0	-60,020,079
2025/26	0	0	-59,189,100
2026/27	0	0	-50,543,626
2027/28	0	0	-56,389,901
2028/29	0	0	-45,676,671
2029/30	0	0	-34,478,977
2030/31	0	0	-44,570,325
2031/32	0	0	-46,632,858
2032/33	0	0	-49,530,578
2033/34	0	0	-42,828,903
2034/35	0	0	-27,472,743
2035/36	0	0	-11,391,962
2036/37	0	0	6,478,833
2037/38	0	0	19,230,185
2038/39	0	0	38,687,618
2039/40	0	0	59,229,479
2040/41	0	0	82,349,831
	\$2,700,000	\$0	

Figure 30 Sewer fund balance – Scenario 1

Modelling assumption

- ✓ Sewer fund has an open balance of \$65.0m
- ✓ Pricing is based on the BAU pricing regime/mix.
- ✓ Rate increase have been assumed to be set at 4.5% for the initial four years and then reduced to the CPI rate of 2.5%.
- ✓ Capital cost is anticipated to increase at 1.0% more than CPI (2.5%+1.0%)
- ✓ No grant funding is assumed, except for the \$2.7m already committed for 2022/23.

Overall result fails to achieve the required outcome, fund to achieve a positive balance, while minimising borrowings.

7.4.2.2 Scenario 2

Sewer Scenarios	Scenario 2		
	25% Grant request,		No Loans
Opening Balance - Section 64	\$7,000,000		
Opening Balance - Sewer Fund	\$58,000,000		
Interest Rate - Debt	6.00%		
Interest Rate - Earnt	1.00%		
Loan Term (years)	20		
Rate increases	4yrs/0 yrs/16 years		
Rate Increase - Initial period	4.50%		
Rate Increase - second period	-		
Rate increases - balance of 20 years	2.50%		
CPI - Sewer	2.50%		
Capital cost CPI (CPI+Margin	1.00%		
Grant Funding - Percentage ask of eligible	25.00%		
Grant Funding - Net Percentage	16.72%		
	Grant Funding	Loan Funding	Closing Balance
2021/22	0	0	59,753,211
2022/23	2,700,000	0	70,801,444
2023/24	17,648,432	0	24,736,186
2024/25	18,543,306	0	-23,828,341
2025/26	0	0	-22,997,361
2026/27	0	0	-14,351,888
2027/28	0	0	-20,198,163
2028/29	0	0	-9,484,933
2029/30	0	0	1,729,889
2030/31	0	0	-8,361,459
2031/32	0	0	-10,423,992
2032/33	0	0	-13,321,712
2033/34	0	0	-6,620,037
2034/35	0	0	8,823,484
2035/36	0	0	25,153,308
2036/37	0	0	43,389,556
2037/38	0	0	56,510,015
2038/39	0	0	76,340,246
2039/40	0	0	97,258,634
2040/41	0	0	120,759,277
	\$38,891,738	\$0	

Figure 31 Sewer fund balance - Scenario 2

Modelling assumptions

- ✓ As for Scenario 1
- ✓ 25% grant funding application for QSTP upgrading.

Improvement in the net financial position but fails to maintain a positive account balance.

7.4.2.3 Scenario 3

Sewer Scenarios	Scenario 3		
	50% Grant request,		No Loans
Opening Balance - Section 64	\$7,000,000		
Opening Balance - Sewer Fund	\$58,000,000		
Interest Rate - Debt	6.00%		
Interest Rate - Earnt	1.00%		
Loan Term (years)	20		
Rate increases	4yrs/0 yrs/16 years		
Rate Increase - Initial period	4.50%		
Rate Increase - second period	-		
Rate increases - balance of 20 years	2.50%		
CPI - Sewer	2.50%		
Capital cost CPI (CPI+Margin	1.00%		
Grant Funding - Percentage ask of eligible	50.00%		
Grant Funding - Net Percentage	32.28%		
	Grant Funding	Loan Funding	Closing Balance
2021/22	0	0	59,753,211
2022/23	2,700,000	0	70,801,444
2023/24	35,296,864	0	42,384,618
2024/25	37,086,613	0	12,363,397
2025/26	0	0	13,326,321
2026/27	0	0	22,191,512
2027/28	0	0	16,508,690
2028/29	0	0	27,494,139
2029/30	0	0	39,078,752
2030/31	0	0	29,277,277
2031/32	0	0	27,486,892
2032/33	0	0	24,835,064
2033/34	0	0	31,852,106
2034/35	0	0	47,680,348
2035/36	0	0	64,398,741
2036/37	0	0	83,027,443
2037/38	0	0	96,544,281
2038/39	0	0	116,774,855
2039/40	0	0	138,097,589
2040/41	0	0	162,006,621
	\$75,083,477	\$0	

Modelling assumptions

- ✓ As for Scenario 1
- ✓ 50% grant funding application for QSTP upgrading.

Overall result like 25% grant funding scenario. Optimal solution may be achievable with a slight increase in rates and consider both grant and loan funding.

7.4.2.4 Scenario 4

Sewer Scenarios	Scenario 4		
	0% Grant request, \$40m Loans		
Opening Balance - Section 64	\$7,000,000		
Opening Balance - Sewer Fund	\$58,000,000		
Interest Rate - Debt	6.00%		
Interest Rate - Earnt	1.00%		
Loan Term (years)	20		
Rate increases	4yrs/0 yrs/16 years		
Rate Increase - Initial period	4.50%		
Rate Increase - second period	-		
Rate increases - balance of 20 years	2.50%		
CPI - Sewer	2.50%		
Capital cost CPI (CPI+Margin	1.00%		
Grant Funding - Percentage ask of eligible	0.00%		
Grant Funding - Net Percentage	1.16%		
	Grant Funding	Loan Funding	Closing Balance
2021/22	0	0	59,753,211
2022/23	2,700,000	0	70,801,444
2023/24	0	20,000,000	27,087,754
2024/25	0	20,000,000	-21,763,770
2025/26	0	0	-24,420,173
2026/27	0	0	-19,262,082
2027/28	0	0	-28,595,739
2028/29	0	0	-21,369,891
2029/30	0	0	-13,659,579
2030/31	0	0	-27,238,310
2031/32	0	0	-32,788,225
2032/33	0	0	-39,173,327
2033/34	0	0	-35,959,034
2034/35	0	0	-24,090,257
2035/36	0	0	-11,496,858
2036/37	0	0	2,885,506
2037/38	0	0	12,113,542
2038/39	0	0	28,012,426
2039/40	0	0	44,960,153
2040/41	0	0	64,450,430
	\$2,700,000	\$40,000,000	

Modelling assumptions

- ✓ As for Scenario 1
- ✓ Zero grant funding application for QSTP upgrading.
- ✓ Loan funding of \$40m over two years

Improvement in the net financial position. Alternative funding options to be considered, as 50% grant funding may not be achievable.

7.4.2.5 Recommended Scenario

Sewer Scenarios	Recommended Scenario		
	25% Grant request, \$40m Loans		
Opening Balance - Section 64	\$7,000,000		
Opening Balance - Sewer Fund	\$58,000,000		
Interest Rate - Debt	6.00%		
Interest Rate - Earnst	1.00%		
Loan Term (years)	20		
Rate increases	6yrs/0 yrs/14 years		
Rate Increase - Initial period	6.50%		
Rate Increase - second period			
Rate increases - balance of 20 years	2.50%		
CPI - Sewer	2.50%		
Capital cost CPI (CPI+Margin)	1.00%		
Grant Funding - Percentage ask of eligible	0.00%		
Grant Funding - Net Percentage	16.72%		
	Grant Funding	Loan Funding	Closing Balance
2021/22	0	0	59,604,903
2022/23	2,700,000	0	70,493,332
2023/24	17,648,432	20,000,000	44,233,581
2024/25	18,543,306	20,000,000	13,879,918
2025/26	0	0	11,502,257
2026/27	0	0	17,206,724
2027/28	0	0	8,949,438
2028/29	0	0	18,032,995
2029/30	0	0	27,566,075
2030/31	0	0	15,562,936
2031/32	0	0	11,402,223
2032/33	0	0	6,191,701
2033/34	0	0	10,440,744
2034/35	0	0	23,269,450
2035/36	0	0	36,733,177
2036/37	0	0	51,827,066
2037/38	0	0	61,502,430
2038/39	0	0	77,556,785
2039/40	0	0	94,338,828
2040/41	0	0	113,318,603
	\$38,891,738	\$40,000,000	

Modelling assumptions

- ✓ Increase rates to 6.5% for the initial 6-year period, 14 year balance rate increase reduced to CPI (2.5%) annual increase.
- ✓ Grant funding sought for 25% for QSTP upgrade.
- ✓ Loan funding application for \$40m over two years

7.5 Typical residential bills

The forecasted 'typical' residential bill is based on a BAU pricing regime, both in terms of how QPRC charge their users and how they QPRC is charged for labour, goods, and services, and in particular the pricing regime with Icon Water for the supply of bulk water. Based on the existing data and the recommended funding scenarios, the 'typical' residential bill is expected to increase by 2.98% (2/5% for water and 3.75% for sewer). The 'typical' bill will increase from \$1,957 in 2021/22 to \$3,587 by 2040/41.

Table 36 Typical residential bill values

	Sewer		Water		Typical Residential Bill
	Rate Increase	Charge	Rate Increase	Water Bill	
		\$733.00		\$1,321.89	\$2,054.89
2022/23	6.5%	\$780.65	2.5%	\$1,354.93	\$2,135.58
2023/24	6.5%	\$831.39	2.5%	\$1,388.81	\$2,220.19
2024/25	6.5%	\$885.43	2.5%	\$1,423.53	\$2,308.96
2025/26	6.5%	\$942.98	2.5%	\$1,459.12	\$2,402.10
2026/27	6.5%	\$1,004.27	2.5%	\$1,495.59	\$2,499.87
2027/28	6.5%	\$1,069.55	2.5%	\$1,532.98	\$2,602.54
2028/29	2.5%	\$1,096.29	2.5%	\$1,571.31	\$2,667.60
2029/30	2.5%	\$1,123.70	2.5%	\$1,610.59	\$2,734.29
2030/31	2.5%	\$1,151.79	2.5%	\$1,650.86	\$2,802.65
2031/32	2.5%	\$1,180.58	2.5%	\$1,692.13	\$2,872.71
2032/33	2.5%	\$1,210.10	2.5%	\$1,734.43	\$2,944.53
2033/34	2.5%	\$1,240.35	2.5%	\$1,777.79	\$3,018.14
2034/35	2.5%	\$1,271.36	2.5%	\$1,822.24	\$3,093.60
2035/36	2.5%	\$1,303.14	2.5%	\$1,867.79	\$3,170.94
2036/37	2.5%	\$1,335.72	2.5%	\$1,914.49	\$3,250.21
2037/38	2.5%	\$1,369.12	2.5%	\$1,962.35	\$3,331.47
2038/39	2.5%	\$1,403.34	2.5%	\$2,011.41	\$3,414.75
2039/40	2.5%	\$1,438.43	2.5%	\$2,061.69	\$3,500.12
2040/41	2.5%	\$1,474.39	2.5%	\$2,113.24	\$3,587.62

3.75%

2.50%

2.98%

8. References

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- AECOM (2019a). Queanbeyan IWCM Situational Analysis
- ARUP (2020). Queanbeyan Sewage Treatment Plant Upgrade Environmental Impact Statement.
- Department of Primary Industries, Office of Water (2014). NSW Reference Rates Manual
- GHD (2016). Queanbeyan STP Upgrade Masterplan
- Hunter H₂O (2019). Queanbeyan Sewage Treatment Plant Upgrade Project Design Criteria and Assumptions Report
- Hunter H₂O (2019a). Queanbeyan IWCM Issues Paper - Supplementary Report
- Hunter H₂O. (2019b). Morisset St SPS Capacity Review - Rev A.
- Hunter H₂O. (2019c). Queanbeyan Sewage Treatment Plant Upgrade Project Options Selection Report.
- Hunter H₂O (2019d). Queanbeyan Sewage Treatment Plant Upgrade Project Design Criteria and Assumptions Report
- Hunter H₂O. (2020). Morisset St SPS Condition Assessment - Rev A.
- Hunter H₂O. (2020a). Queanbeyan Sewage Treatment Plant Upgrade Project Concept Design Report.
- Hunter H₂O (2021). Queanbeyan IWCM – sewerage options assessment (final draft), 22/07/2021
- QPRC (2020). Queanbeyan IWCM Issues Paper Supplementary Report

Appendices

Appendix A

Pipe size catalogues

PRODUCT DATA
A.C. Pressure Pipe

Dimensions and Classes — Australian Standard 1711-1975

Nominal Diameter of Pipe (mm)	Class	AS** 1711-1975 Factory Test Head (m)	*** Nominal Working Head (m)	Pipe							Coupling		Ring Code No.	Mass	
				Overall Dimensions		Machining Dimensions					External Diameter E (mm)	Length L (mm)		Pipe Complete with Coupling (kg)	Coupling (kg)
				Internal Diameter I.D. (mm)	Wall Thick. H (mm)	D ±0.8 (mm)	X min (mm)	F ±0.8 (mm)	Y ±1 (mm)	Z ±2 (mm)					
58 80 80 80	F B D F	• 122 245 367	183 61 122 183	57.4 76.8 75.2 69.6	10.1 9.4 10.2 13.0	77.6 95.6 95.6 95.6	68 68 68 68	— — — —	— — — —	62 62 62 62	125 139 143 151	130 130 130 130	V58 V80 V80 V80	20.5 24.0 26.0 32.0	2.0 2.0 2.5 3.0
100 100 100	B D F	122 245 367	61 122 183	100.5 96.5 88.9	10.7 12.7 16.5	121.9 121.9 121.9	81 81 81	— — —	— — —	75 75 75	170 178 194	156 156 156	V100 V100 V100	36.0 42.0 53.0	3.5 4.0 5.5
150 150 150 150 150 150	B C D E F	122 184 245 306 367	61 92 122 153 183	154.5 146.3 141.7 139.1 133.5	11.4 15.5 17.8 19.1 21.9	177.3 177.3 177.3 177.3 177.3	83 83 83 83 83	— — — — —	— — — — —	78 78 78 78 78	227 238 246 251 262	172 172 172 172 172	V150 V150 V150 V150 V150	57.0 75.0 85.0 91.0 103.0	5.5 7.0 8.0 8.5 10.0
200 200 200 200	A* B C D	61 122 184 245	30 61 92 122	208.2 203.2 195.6 186.4	12.0 14.5 18.3 22.9	232.2 232.2 232.2 232.2	83 83 83 83	— — — —	— — — —	78 78 78 78	281 287 299 315	172 172 172 172	V200 V200 V200 V200	79.0 94.0 116.5 143.0	7.0 8.0 10.0 12.5
225 225 225 225	A* B C D	61 122 184 245	30 61 92 122	233.7 228.5 218.9 209.3	12.7 15.3 20.1 24.9	259.1 259.1 259.1 259.1	91 91 91 91	257.1 257.1 257.1 257.1	54 54 54 54	78 78 78 78	307 314 329 346	172 172 172 172	V225 V225 V225 V225	93.0 111.0 142.5 173.5	8.0 9.5 12.0 15.0
250 250 250 250	A* B C D	61 122 184 245	30 61 92 122	259.6 253.4 243.4 231.0	13.2 16.3 21.3 27.5	286.0 286.0 286.0 286.0	91 91 91 91	284.0 284.0 284.0 284.0	54 54 54 54	78 78 78 78	335 344 359 380	172 172 172 172	V250 V250 V250 V250	107.0 130.5 167.0 211.0	9.0 11.0 13.5 18.0
300 300 300 300	A* B C D	61 122 184 245	30 61 92 122	304.8 299.2 294.6 279.4	14.5 17.3 25.4 33.0	333.8 333.8 345.4 345.4	91 91 91 91	331.8 331.8 343.4 343.4	54 54 54 54	78 78 78 78	385 393 429 454	172 172 172 172	V300AB V300AB V300CD V300CD	137.0 161.5 239.5 305.0	11.0 12.5 18.5 24.5
375 375 375	A* B C	61 122 184	30 61 92	381.0 370.4 363.2	16.0 21.3 31.5	413.0 413.0 426.2	107 107 107	410.0 410.0 423.2	67 67 67	91 91 91	468 482 526	208 208 208	V375AB V375AB V375C	190.5 249.0 371.5	17.5 22.0 33.0
450 450 450	A* B C	61 122 184	30 61 92	457.2 444.0 432.4	17.5 24.1 37.3	492.2 492.2 507.0	107 107 107	489.2 489.2 504.0	67 67 67	91 91 91	557 568 621	208 208 208	V450AB V450AB V450C	250.5 335.5 521.0	24.5 28.5 44.5
525 525 525	A* B C	61 122 184	30 61 92	533.3 515.7 506.0	19.1 27.9 40.6	571.5 571.5 587.2	107 107 107	568.5 568.5 584.2	67 67 67	91 91 91	633 657 709	208 208 208	V525AB V525AB V525C	314.0 449.5 660.5	26.5 37.0 56.5
600 600 600	A* B C	61 122 184	30 61 92	609.6 586.8 575.6	20.3 31.7 45.7	650.2 650.2 667.0	107 107 107	647.2 647.2 664.0	67 67 67	91 91 91	714 745 821	208 208 208	V600AB V600AB V600C	379.5 579.5 851.0	31.5 46.0 78.0

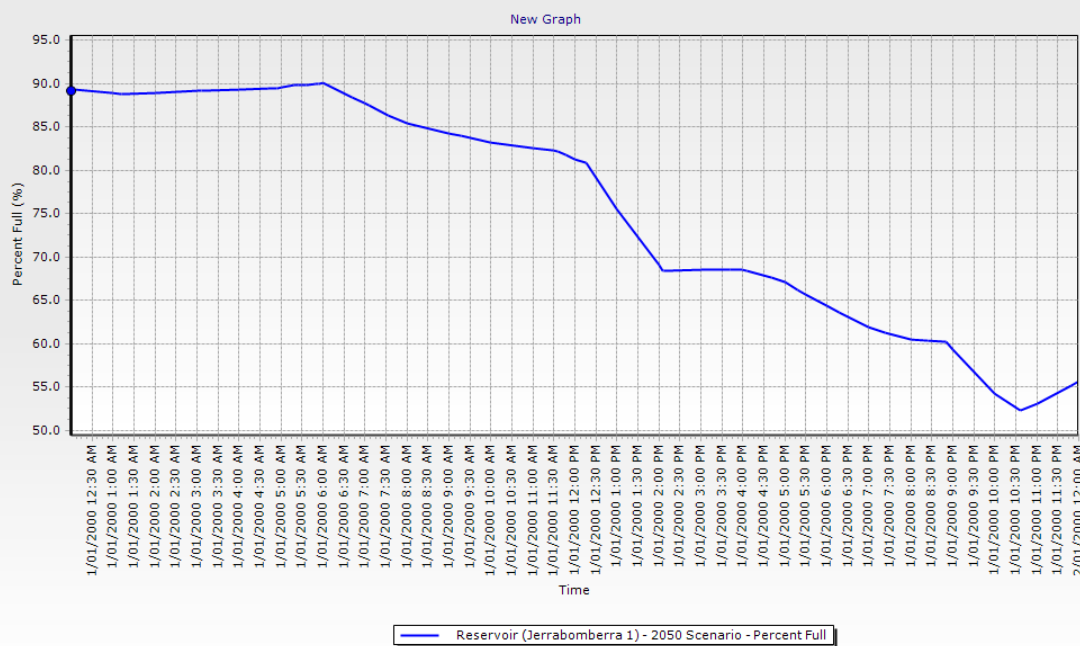
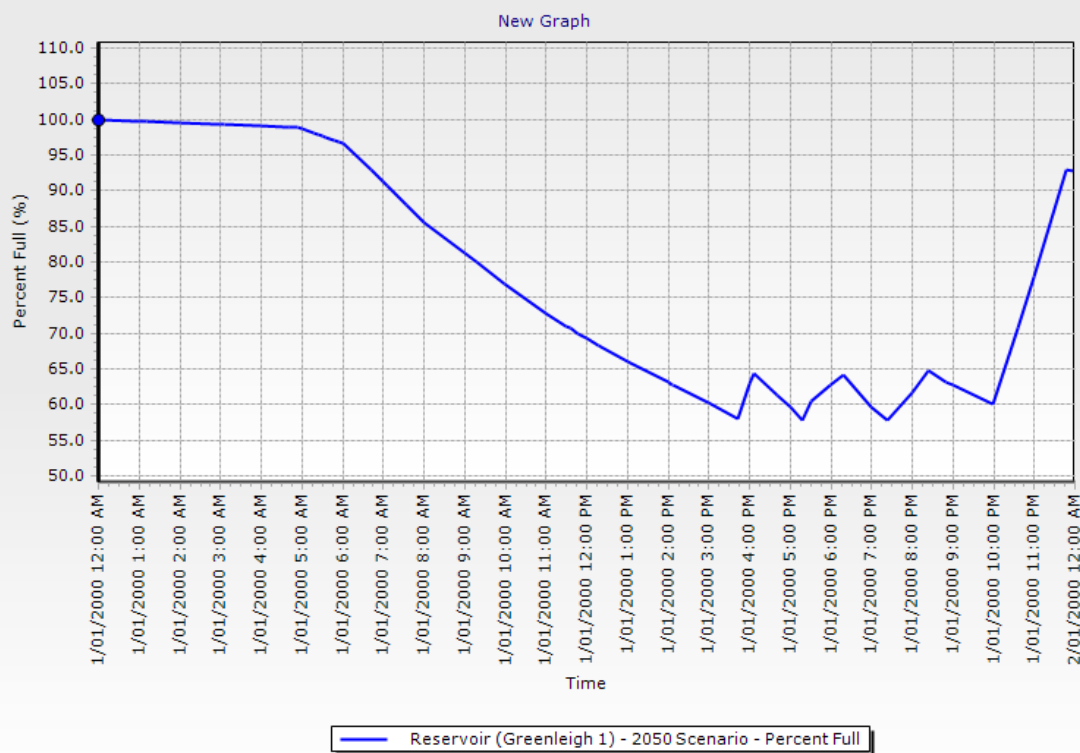
NOTE: For larger diameter pipe see Revised Standard Table on page 5.

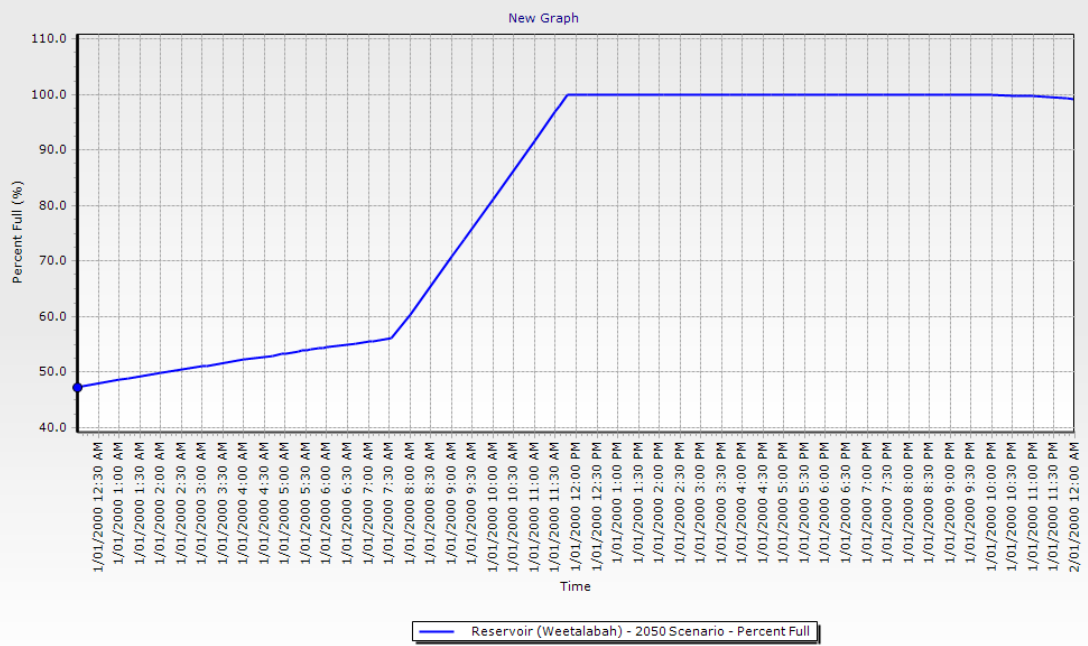
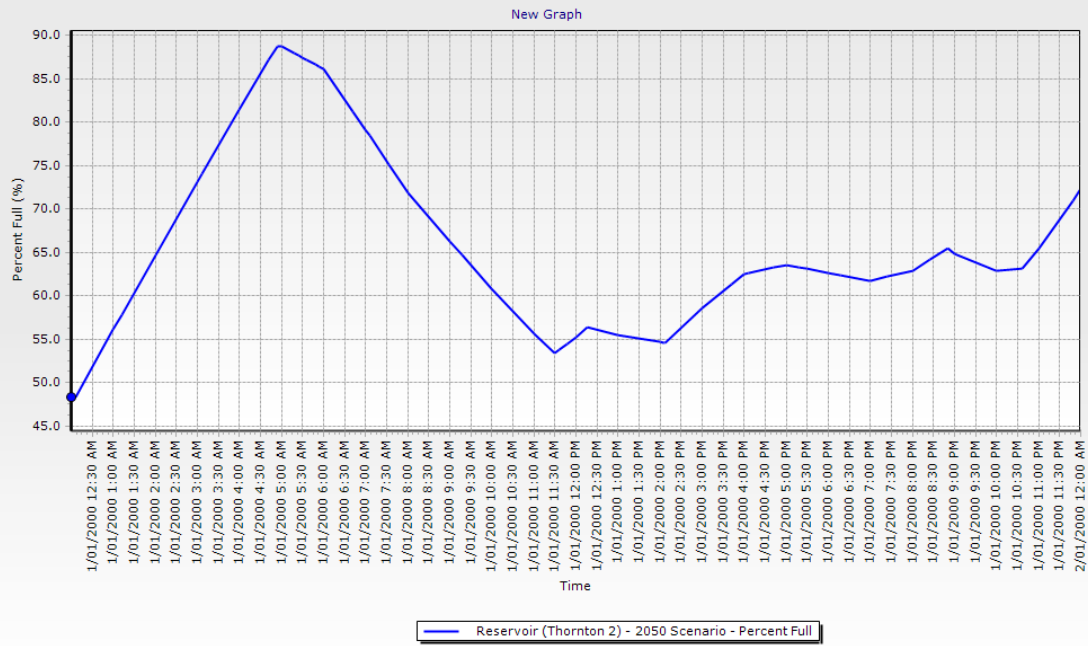
Ironbite® pipe dimensions

Nominal diameter DN	PN35		Flange class		Mean outside diameter (y) mm	Allowable ovality mm
	Nominal wall thickness (t) mm	Minimum wall thickness (a) mm	Nominal wall thickness (t) mm	Minimum wall thickness (a) mm		
100	5.0	3.0	7.0	6.0	122 +1, -2	4
150	5.0	3.0	8.0	6.0	177 +1, -2	5
200	5.0	3.0	8.0	7.0	232 +1, -2	7
225	5.2	3.2	9.0	7.0	259 +1, -2	8
250	5.6	3.6	9.0	8.0	286 +1, -2	9
300	6.3	4.3	10.0	8.0	345 +1, -2	10
375	7.3	5.3	10.0	9.0	426 ± 2	12
450	8.3	6.3	11.0	10.0	507 ± 2	15
500	9.0	7.0	12.0	10.0	560 ± 2	15
600	10.3	8.3	13.0	11.0	667 ± 2	15
750	12.2	10.2	15.0	13.0	826 ± 2	15

Appendix B

Percent full graphics of reservoirs







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→ **The Power of Commitment**