Gunnedah Shire Council

Water Conservation & Demand Management Plan

Adopted

19 July 2017

Resolution No 20.07/17

Presented by Hunter H_2O

ABN 16 602 201 552

Report Details

Report Title	Gunnedah Shire Council: Demand Management Plan
Project No.	3851-006
Status	Final Draft
File Location	\\ho-fs1\Projects\Gunnedah SC\3851-006 Gunnedah DMPs Update\2. Tasks\7 Demand Mgt Plan\Gunnedah Demand Mgt Plan (Final Draft).docx
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Document History and Status

Revision	Report Status	Prepared by	Reviewed by	Approved by	Issue Date
A	Draft	A Dwyer	G Long	G Long	15-Mar-17
B	Final Draft	A Dwyer	G Long	G Long	24-May-17

Overview & Purpose

The 2017 revision of the Demand Management Plan has been prepared as a major update to the previous Plan which was originally prepared in 2006. The Plan has been prepared based on a template that was prepared for the Namoi Water Alliance by Hunter H2O for the purpose of providing a consistent approach to demand management across the Namoi Region.

The Demand Management Plan has been prepared in accordance with NSW Department of Primary Industries – Water (DPI Water) requirements, as documented in their Best Practice Management of Water Supply and Sewerage Guidelines (DWE, 2007). With recent changes to best practice requirements, Demand Management can now be considered within Council's Integrated Water Cycle Management (IWCM) Strategy and also evaluated and updated as part of Council's Strategic Business Plan (SBP). However, GSC considers it more practical to have a standalone Demand Management Plan that can be reviewed and updated as required, as updates may not necessarily line up with updates to Council's IWCM (now required every eight years).

The fundamental objective of preparing and adopting a Demand Management Plan is to encourage efficient water use through the adoption of various demand management measures. This Plan outlines the various water conservation measures that are to be employed by Council in order to ensure that town water demand levels are both efficient and sustainable. By employing effective demand management measures, Council can expect significant reductions in water supply system capital and operating costs, along with the environmental and social benefits associated with maximising urban water efficiencies.

This Demand Management Plan has been developed in association with a Drought Management Plan, which focuses on both the demand and supply side measures that should be employed during drought periods. Consequently, during drought periods there is an overlap between the two plans. The Demand Management Plan and all rebates and offers contained within are only applicable to customers connected to the reticulated town water supply systems operated by Council.

DEMAND MANAGEMENT PLAN - DOCUMENT CONTROL TABLE

Revision	***Revision Date*** *(from when Revision Applies)*	***Resolved by Council*** *(date of Council Meeting)*
Draft Report (for public exhibition)		
Final Report		
Revision 1		

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Appendices

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Tables

1 Introduction

Demand management is an essential component of modern water resource planning and management. The implementation of a comprehensive Demand Management Program provides benefits to customers, council and the environment, including:

- Reduced customer costs due to water savings (lower water & wastewater charges) and energy savings (lower energy charges)
- Reduced long-term costs for providing water due to avoided or delayed water supply infrastructure
- Reduced environmental impacts due to lower water extractions and lower energy usage

This Demand Management Plan has been prepared by Gunnedah Shire Council (GSC) to ensure a structured and consistent approach is taken for the promotion of demand management initiatives across the region. The Plan includes Council's Demand Management Program, which includes a range of water conservation measures that Council will be targeting to ensure that future town water demand levels are both efficient and sustainable.

The Plan is only applicable to customers connected to the reticulated water supply systems operated by GSC, which includes systems operated in the following towns:

- Gunnedah
- Curlewis
- Mullaley
- Tambar Springs

Management of water supply in NSW is administered by the *Water Management Act 2000, Water Act 1912* and *Local Government Act 1993*. Demand management planning is an essential component of the NSW Government's *Best Practice Management of Water Supply and Sewerage Guidelines* (DWE, 2007) for local water utilities. This Demand Management Plan has been prepared in accordance with these guidelines and the associated Water Conservation and Demand Management Check List.

This Plan contains the following sections:

Section 2 contains a brief review of historical demands and considers the key influences on demands.

Section 3 contains a summary of current situation with water demands, including a breakdown of demands, benchmark data for residential consumption, water loss estimates and an overview of current demand management initiatives.

Section 4 contains 30-year demand forecasts for each water supply system.

Section 5 contains a summary of the Demand Management Program along with further details for each demand management measure.

Section 6 outlines the steps for implementing and monitoring the Demand Management Program.

Section 7 contains the references to this report.

2 Historical Water Use

Historical water consumption is typically influenced by a variety of factors, including:

- Prevailing climatic conditions and climate change (refer to **Appendix A**)
- Residential and non-residential development
- Planning regulations for new developments
- Demand management measures
- Restriction rules during periods of drought
- Living standards, incomes and lifestyle factors.

The total annual water production for the Gunnedah water supply system since 2005/06 is shown in Figure 2-1. The average water production over the last 10 years was 2,395 ML/a, with production ranging from 1,820 ML in 2011/12 to 2,870 ML in 2006/07.

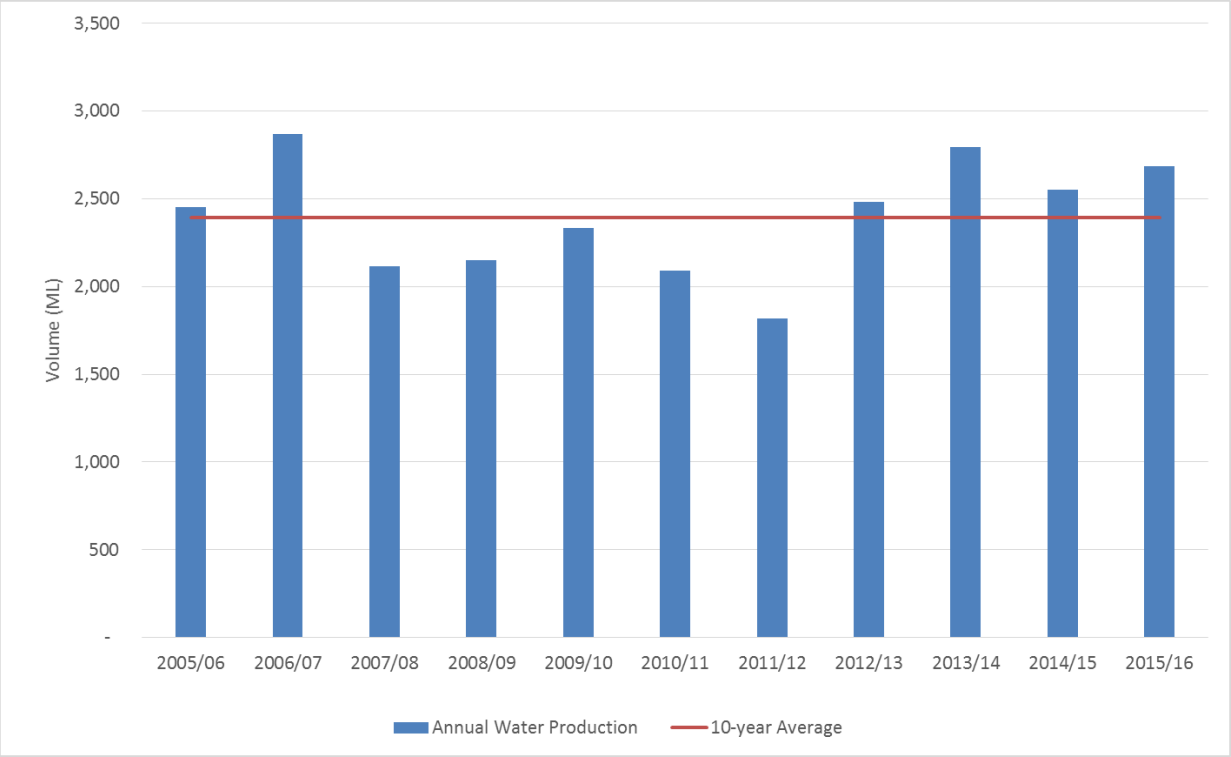

Figure 2-1 Annual Treated Water Production – Gunnedah Water Supply (10 years)

The average annual residential usage has ranged from 207 kL/ property in 2011/12 to 427 kL/property in 2014/15, with a 10-year average of 329 kL/ property, as shown in Figure 2-2.

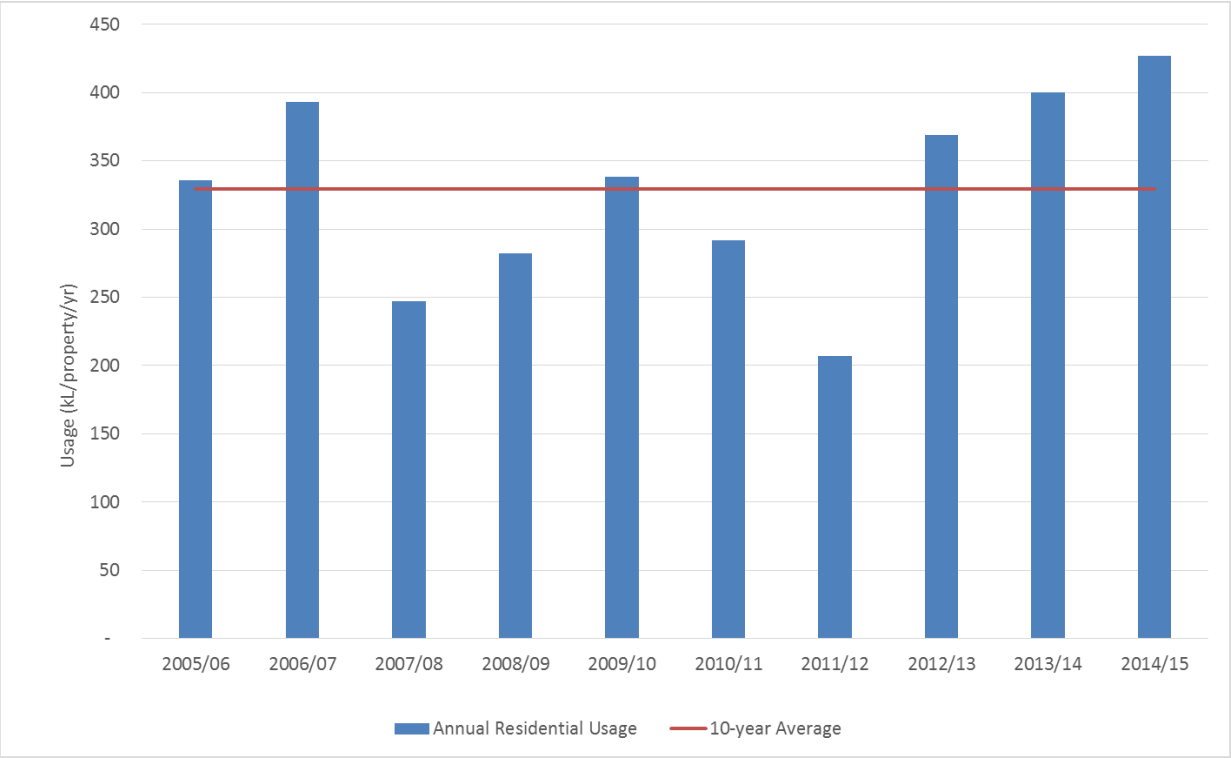

Figure 2-2 Average Annual Residential Usage per Property – Gunnedah Shire Council (10 years)

Prevailing climatic conditions, particularly maximum temperatures and rainfall during summer months, have a significant impact on water consumption – particularly residential outdoor water usage. GSC's annual water production figures indicate that demands are heavily influenced by climatic conditions with demands increasing in hotter, drier years (e.g. 2006/07 and 2013/14) and decreasing in wetter years (e.g.2010/11 and 2011/12). A comparison of annual water production and annual rainfall is provided in Figure 2-3. GSC has not imposed water restrictions during the last 10 years apart from Permanent Level P Water Conservation Measures (refer Section 3.5).

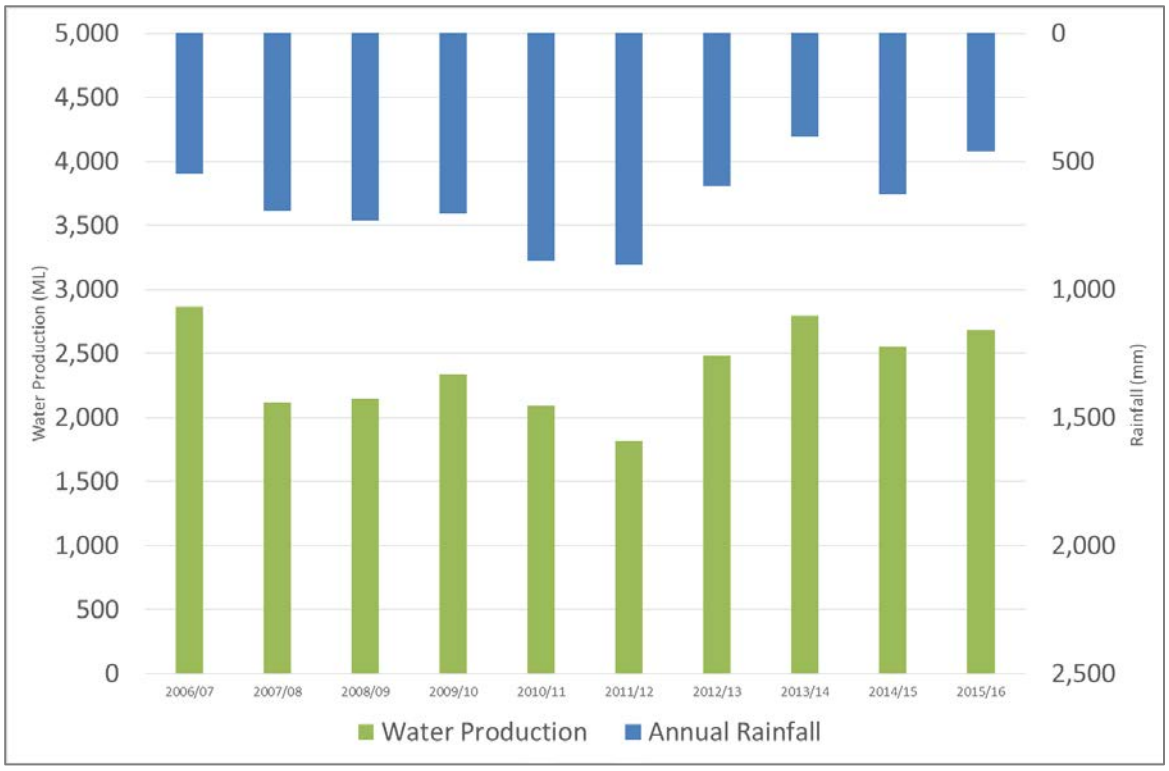

Figure 2-3 Comparison of Annual Water Production and Annual Rainfall

3 How Water is Currently Used

3.1 Demand Categories

The breakdown of current water consumption by major demand type for the combined water supply systems is shown in Figure 3-1.

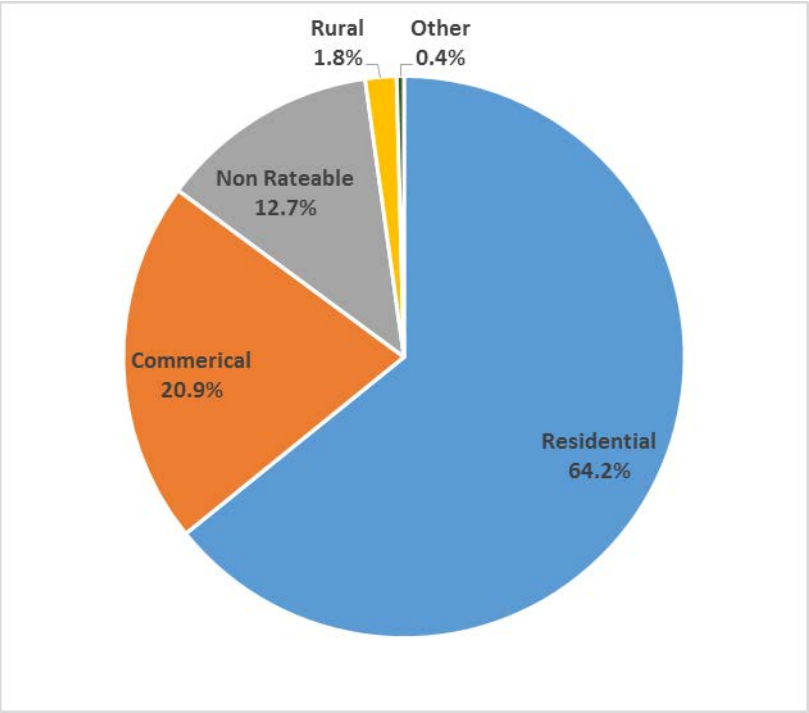

Figure 3-1 GSC Water Supply Systems – Consumption by Major Demand Type (2015/16)

An analysis of metered water consumption by demand category was undertaken for the Gunnedah town water supply system and is shown in Table 3-1.

Table 3-1 Gunnedah Water Supply System – Metered Consumption by Category (2015/16)

Demand Category	2015/16 Consumption (ML/a)	% of Total Consumption	Connections	Consumption per Connection (kL/a/property)
Residential	1,569.4	64.2%	3,858	406.8
Commercial	511.8	20.9%	360	1,421.6
Non Rateable	309.8	12.7%	125	2,478.3
Rural	44.1	1.8%	39	1,130.5
Other	10.2	0.4%	8	1,274.8
TOTALS	**2,445.3**	**100.0%**	**4,390**	

A simplified analysis of metered water consumption by demand category was also undertaken for the remaining small town water supply systems and is included on Table 3-2.

Table 3-2 Small Town Water Supply Systems – Metered Consumption Summary (2015/16)

System	2015/16 Total Consumption (ML/a)	Proportion Residential	Residential Consumption per Connection (kL/a/dwelling)	Total Consumption per Connection (kL/a/property)
Curlewis	101.9	77.0%	317.8	369.3
Mullaley	17.6	53.0%	301.7	577.2
Tambar Springs	15.1	61.3%	188.3	224.7

Typical residential consumption per property is lower in the villages than in the Gunnedah Township due to both lower water quality and less garden and outdoor usage. Many properties in the villages have rainwater tanks for drinking water supply, due to lower quality town water supply.

3.2 Benchmarking of Residential Consumption

Benchmarking of residential consumption was undertaken using performance data from 2014/15 from across the state (Department of Primary Industries Water, 2016) as shown on Figure 3-2.

GSC's average residential consumption for 2014/15 was 427 kL/property, based on DPI Water's performance reporting, which is the highest it has been for the past 10 years. GSC's residential consumption was almost double the weighted median for inland water utilities of 225 kL/property. Consumption is high in Gunnedah Shire due to the relatively dry climate conditions experienced in the region and the resulting increase in irrigation requirements and high use of evaporative coolers. Residential blocks tend to be large with extensive lawn coverage (Woodlots & Wetlands Pty Ltd, 2010), and there are a large number of properties with pools. Water restrictions have not been imposed over the past 10 years.

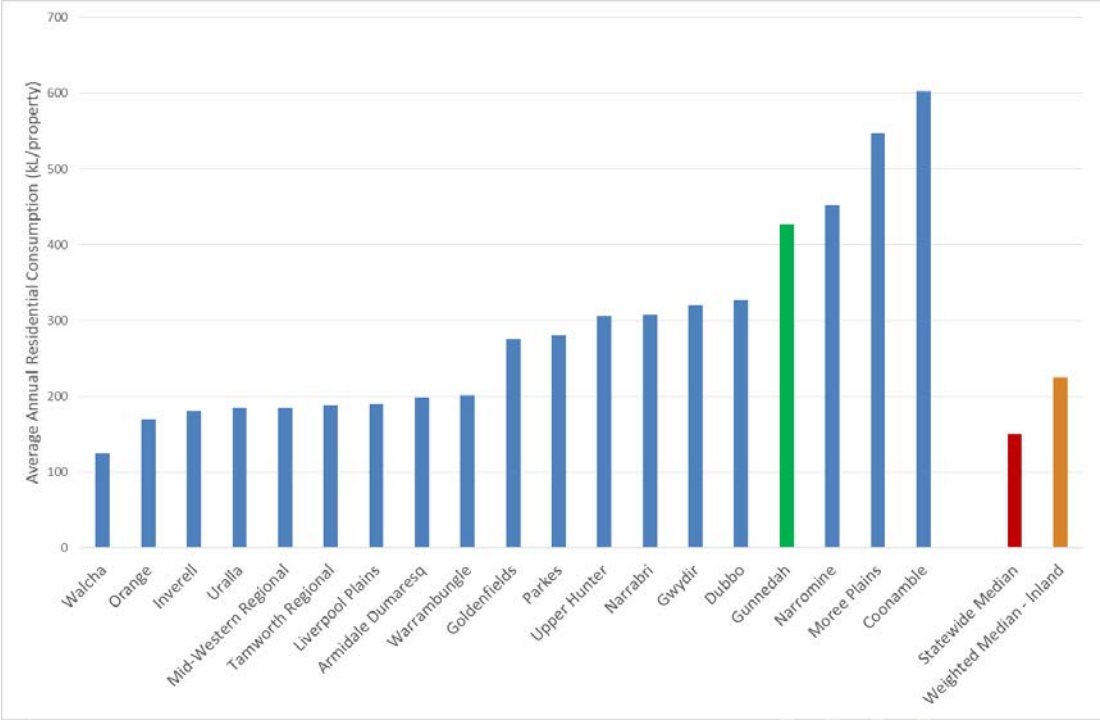

Figure 3-2 2014/15 NSW Benchmarking Data for Residential Consumption

3.3 Residential End-Use

In the absence of local residential end-use metering data to provide an accurate estimate of end-use consumptions, typical values have been adopted based on recent end-use studies conducted across Australia. These studies have typically been undertaken by large metropolitan water utilities that were coastal based. However, while external water usage and evaporative coolers usage can differ substantially across Australia, particularly when comparing coastal areas to inland areas, the breakdown of internal usage is generally relatively consistent across water utilities.

The key assumptions used in developing the residential end-use breakdown were:

- Total household usage was assumed to be 400 kL/a based on the average of the last 3 three years
- Internal household usage (excluding evaporating coolers) was assumed to be 150 kL/a (about 40% of total consumption)
- Internal consumption breakdown was based on typical values from recent end-use studies across Australia
- Evaporative cooler usage was estimated to be around 30 kL/a per household, which equates to around 1,500 hr operation time per annum (assuming average consumption of 20 L/hr)
- Outdoor water usage (primarily irrigation) was assumed to be the remainder of water usage after accounting for internal usage and evaporative cooler usage.

Figure 3-3 below shows the assumed breakdown of residential end-use that has been adopted for the purposes of assessing demand management options.

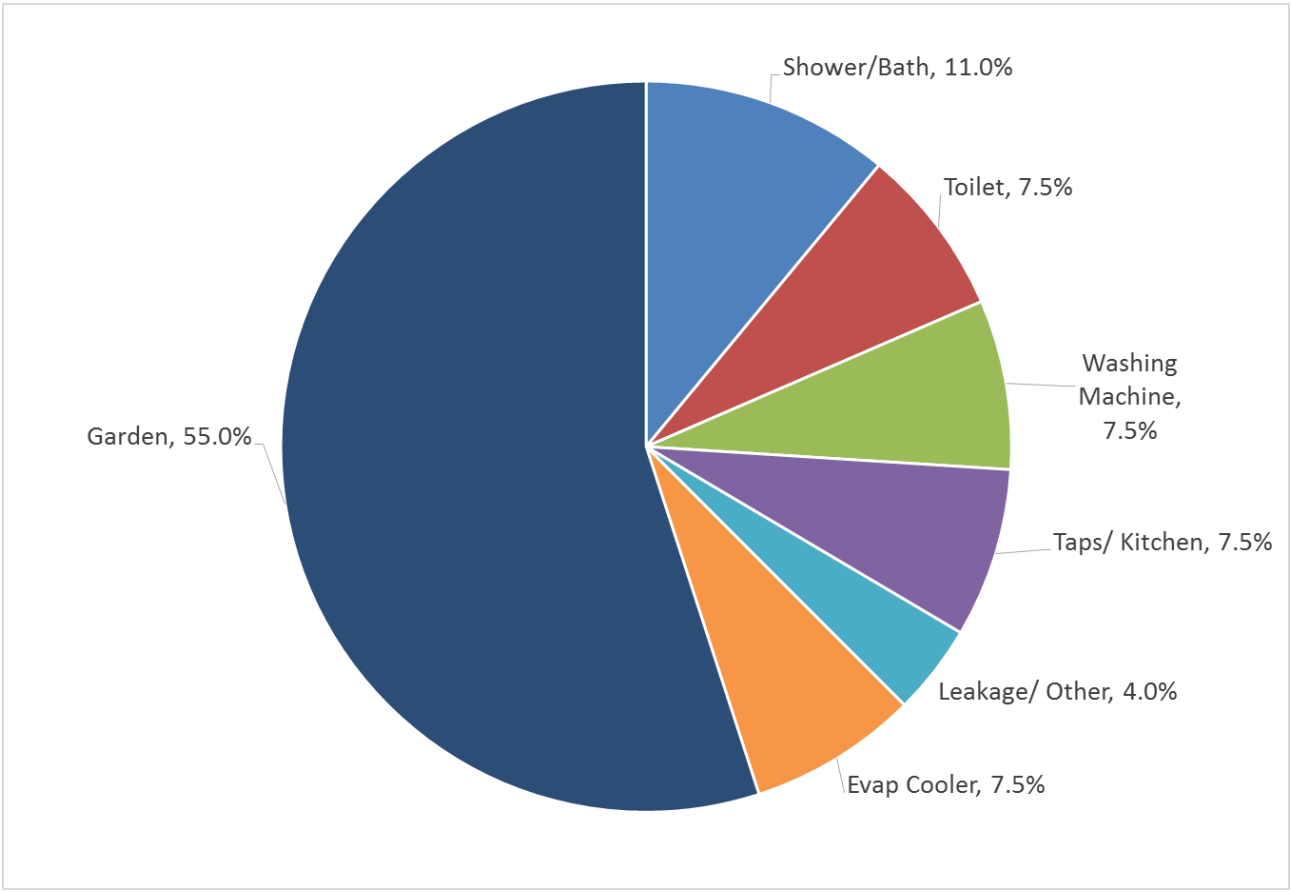

Figure 3-3 End-Use for Residential Properties based on 400 kL/a per household (Estimate Only)

3.4 Water Losses / Non-Revenue Water (NRW)

For the NSW Performance Monitoring Reporting (NOW, 2015), DPI Water has adopted the following terms used by the International Water Association (IWA) to define key components of losses from a water supply system:

1. **Physical / real losses**: including leakage and overflows from all parts of the water supply system
2. **Apparent losses**: including metering inaccuracies and unauthorised consumption (theft)
3. **Unbilled authorised consumption**: including water used by the local water utility for operational reasons, water used for firefighting and water supplied free of charge

Water losses are generally defined as physical / real losses plus apparent losses, while non-revenue water (NRW) is generally defined as water losses plus unbilled authorised consumption and can be calculated from the difference between water production (metered flow into a water supply system) and metered consumption (metered flow from the water supply system to the end user).

Key water loss indicators included in the 2014/15 NSW Performance Monitoring Benchmark Report (NOW, 2015) are included in Table 3-3. The figures are Council wide and were not available for the individual towns/ water supply systems.

Table 3-3 Water Loss Indicators – Council & NSW Performance Monitoring Benchmarks (2014/15)

Water Loss Indicator	Council	NSW State-Wide Benchmarks (2014/15)		
		20th percentile	Median (50th percentile)	80th percentile
Real Loss (L/service connection/day)	80	50	60	90
NRW (L/service connection/day)	156	67	94	136
NRW (%)	11	Target 10% or less		

GSC's reported water losses are higher than the State-Wide medians for both real loss and NRW. The real loss figure is between the State-Wide 50th and 80th percentile values, but the NRW component is higher than the State-Wide 80th percentile value. GSC's high water losses indicate that reductions in NRW are achievable and reductions in NRW will continue to be targeted over the life of this Plan.

3.5 Current Demand Management Measures

GSC currently has Level P (Permanent) Water Conservations Levels in place for all properties connected to town water supplies. These measures are:

- Fixed hoses and sprinklers restricted except between 6-8am and 6-10 pm during daylight savings time and 6-8am and 5-9pm during EST
- Wash down of hard/ paved surface is permitted with high pressure hose only
- Use pool cover to reduce evaporation

GSC is a supporter of Smart Water Advice, along with six other Namoi council members. A link to the Smart Water Advice website is provided on GSC's website, and provides information to the community on water sustainability and water savings tips.

Council staff advised that the community is generally compliant with the Level P measures particularly the early morning watering. However, Council owned parks do not have generally automated irrigation systems and are typically run during business hours rather than at night.

4 Future Water Use

4.1 Gunnedah Water Supply

Demand forecasts have been estimated based on assumed future residential usage and growth figures and associated non-residential growth (see **Appendix B** for more details). Three demand scenarios have been determined – low, average and high.

The medium (or average) demand scenario has assumed an annual residential usage of 400 kL/property based on recent consumption levels from the last few years. The lower bound demand scenario adopted 50 kL/property less, while the higher bound scenario adopted 50 kL/property more. These upper and lower bound annual residential usage figures represent the level of uncertainty associated with predicting future demand levels. The upper bound figure is higher than the highest average historical consumption over the past 10 years.

In addition to the three residential usage scenarios, three dwelling growth rates have been adopted. The average growth was assumed to be 0.75% pa. A lower bound growth rate of 0.5% pa and a higher bound growth rate of 1.0% pa were also adopted.

The projected bulk water demands shown in Table 4-1 are based on the residential usage and growth assumptions discussed above and also include allowance for growth of non-residential demands (such as commercial, institutional and industrial) in line with residential growth and water loses of 10% (see **Appendix B**).

Table 4-1 Projected Bulk Water Demands – Gunnedah Water Supply (30 years)

Demand Scenario	Annual Demand for Bulk Water (ML/a)			
	2017 (Existing)	2027 (+10yr)	2037 (+20yr)	2047 (+30yr)
Low (350kL/a, 0.5%pa)	2,100	2,200	2,300	2,400
Average (400kL/a, 0.75% pa)	2,300	2,500	2,700	2,900
High (450kLa/, 1.0% pa)	2,500	2,800	3,100	3,400

The projections indicate that the Gunnedah water demand is not expected to exceed the ground water allocation of 3,900 ML/a, even under the high demand/growth scenario, as shown in Figure 4-1.

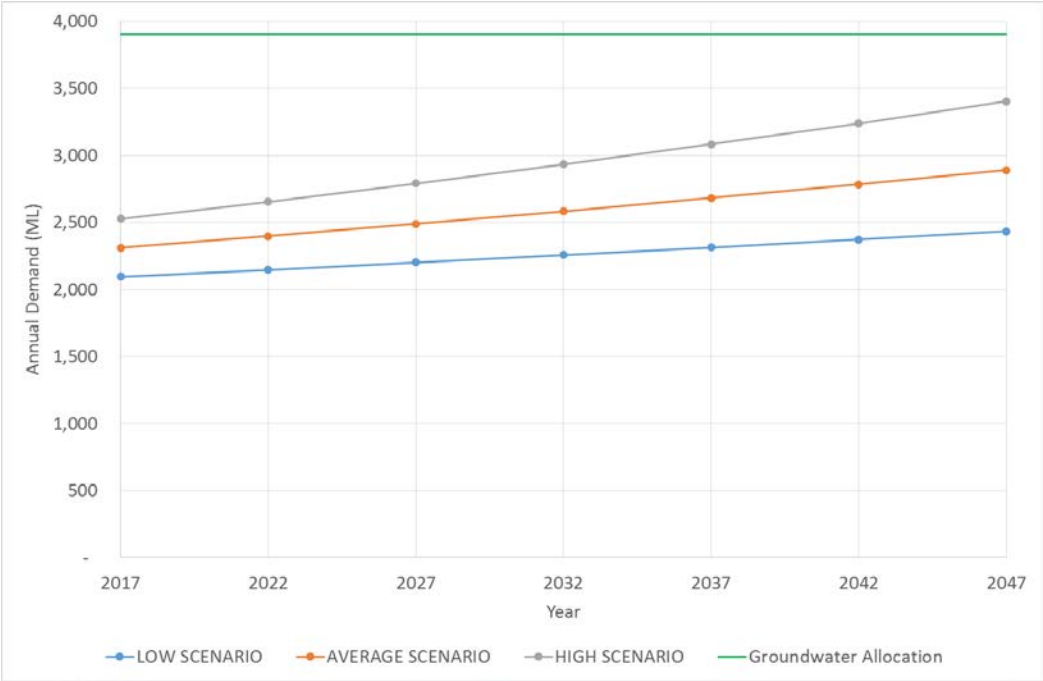

Figure 4-1 Comparison of Projected Bulk Water Demands and Groundwater Allocation (Gunnedah)

4.2 Other Systems

Projected bulk water demands for Curlewis are shown in Table 4-2. Projected demands are based on an assumed annual demand growth rate of 0.5% pa. This growth rate is equivalent to the lowest projected growth rates for Gunnedah, as population growth is expected to be lower in Curlewis than in Gunnedah. A second scenario was developed for Curlewis, representing the scenario in which the Curlewis water supply system is connected to the Gunnedah system via the proposed Curlewis pipeline. For this scenario, it was assumed that improvements in water quality would increase the town's demand by up to 20% due to less reliance on rainwater tanks to supplement the water supply. Under both scenarios, the projected annual demand is less than the groundwater allocation, as shown in Figure 4-2 . The combined projected 30-year water demand for Gunnedah and Curlewis (3,557 ML) does not exceed the Gunnedah allocation (3,900 ML).

Table 4-2 Projected Bulk Water Demands – Curlewis Water Supply Systems (30 years)

Water Supply System	Annual Demand Growth Rate	Annual Demand for Bulk Water (ML/a)				Groundwater Allocation (ML/a)
		2017 (Existing)	2027 (+10yr)	2037 (+20yr)	2047 (+30yr)	
Curlewis	0.5%	113	119	125	131	198
Curlewis with proposed connection to Gunnedah	0.5%	113	142	150	157	198

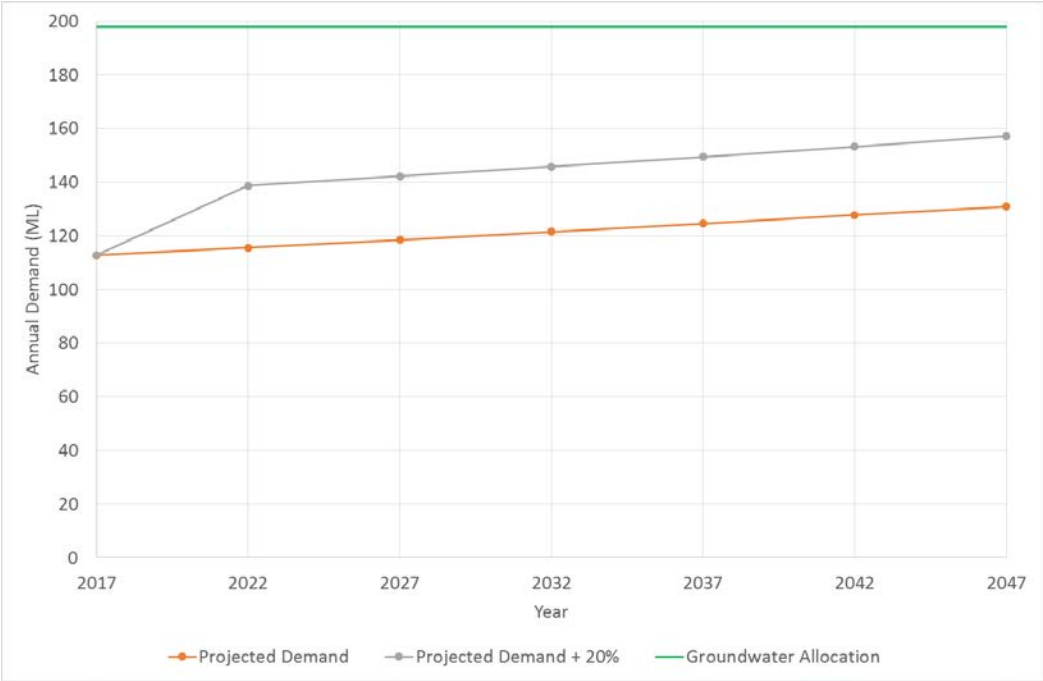

Figure 4-2 Comparison of Projected Bulk Water Demands and Groundwater Allocation (Curlewis)

Minimal growth in water consumption is expected in Mullaley and Tambar Springs, as GSC has indicated that there is minimal population growth expectations for these villages. Additionally, there are no planned commercial or industrial developments that would increase annual water demand. Current annual demand in both villages is significantly less than the groundwater allocation, as shown in Table 4-3.

Table 4-3 Bulk Water Demands –Village Water Supply Systems

Water Supply System	Annual Demand (ML)	Annual Demand Growth Rate	Groundwater Allocation (ML/a)
Mullaley	18	0.0%	59
Tambar Springs	15	0.0%	42

5 Demand Management Program

The proposed demand management program is outlined in Table 5-1.

Table 5-1 Demand Management Program

Demand Management Measure	Details / Timing	Customers Targeted	Estimated Council Program Cost* ($ pa)
Community Awareness Program / Pricing	• Continuation and ongoing development of Community Awareness Program, including: 1. Participation in National Water Week by providing links on Council's website to relevant information 2. Participate in School Education Program by providing links on Council's website to relevant information 3. Customer water accounts to include comparisons to benchmark usage, year to date consumption and water efficiency tips. 4. Provide link to Smart Water Advice website from Council's website • All customers, including Council owned properties, are metered; bulk water production is metered daily • Maintain strong water conservation signals through the continued use of tiered water usage pricing • Customers are billed a minimum 4 times per year (some customers are billed at monthly intervals)	All	**$5k**
Non-Residential Large User Audits	• Large User Audits for Council owned parks (one per year)	Council owned properties	**$3k**
Permanent Water Conservation Measures	The following PWCM will continue to be publicised as an integral part of the Community Awareness Program: • Use of sprinklers, sprays, microsprays and fixed hoses is not allowed during the heat of the day • Trigger nozzles must be used on all hoses to help conserve water & avoid waste • No washdown of hard surfaces unless using a high-pressure cleaner or water efficient nozzle • Pool covers to be used to reduce evaporation	All	*(Costs included in Community Awareness Program)*

Demand Management Measure	Details / Timing	Customers Targeted	Estimated Council Program Cost* ($ pa)
Regulation & Planning Controls	The following regulation and planning controls will contribute to water savings over the life of the Program: • BASIX • WELS Rating Scheme • Smart Approved WaterMark Program	New Residential + New Fittings / Appliances	*(Costs included in Community Awareness Program)*
Water Loss Management	Water Loss Management Program, which includes: • Metering of all properties / connections • 10-year Meter replacement program • Annual water loss assessment • Periodic inspection of key assets for leaks	All water supply systems	*(Costs already included in Water Operations Budget)*
Water Recycling	Use of recycled effluent from the Gunnedah STP at the cotton farm, whilst not potable substitution, reduces groundwater extraction for irrigation purposes		

More details on the estimated program costs and water savings are included in Appendix C.

5.1 Current and Proposed Initiatives

Community Awareness Program / Pricing

A Community Awareness Program will continue to be developed and implemented by Council. The awareness program will include internet resources and community education. The awareness program will also need to be consistent with similar programs that have been developed and implemented by other Namoi Water Alliance member councils.

The Community Awareness Program will include:

1. Setting up of avenues for the community to access resources on water efficiency, including Smart Water Advice linked from Council's website
2. Providing links on Council's website during National Water Week.
3. A School Education Program, utilising available online tools, to encourage schools to integrate water conservation into their curriculum and reduce water consumption throughout the school. Example resources are available at: http://www.environment.nsw.gov.au/sustainableschools/teach/water.htm

4. Customer water accounts that include water efficiency tips and provide information on customer's water usage relative to water efficient benchmarks, and year to date consumption indicating remaining water consumption until the second pricing tier is reached.

The initial implantation of a comprehensive Community Awareness Program should see water savings of up to 5 % reduction in residential usage. Once the program has been implemented, the continuation and ongoing development of the program is needed to maintain the savings associated with the reduction in residential usage. A relaxation of the Community Awareness Program is likely to result in a gradual increase in residential usage over time, as inefficient water habits are once again adopted.

A strong water conservation signal should also be maintained through the use of Best Practice Pricing, including tiered water usage tariffs.

Non-Residential Large User Audits

Council has indicated that any non-residential large user audits would be restricted to Council owned property. A non-residential audit program will be implemented with the aim of auditing one Council property per year. The audit program will be based on the guidelines for Water Savings Action Plans, prepared by DPI Water. The purpose of Water Savings Action Plans is to identify and help deliver cost effective water savings in a practical, effective and flexible way. The initial audit and subsequent preparation of the Water Savings Actions Plan would be undertaken by Council.

As one of the region's largest users, the Water Saving Actions Plan would set an example to the other large users and the community in general. It is important that Council sets the example for water efficiency for the whole community, particularly in high visibility areas such as watering of parks and gardens.

Permanent Water Conservation Measures

Permanent Water Conservation Measures (PWCM) have been adopted as a key component of Council's Demand and Drought Management Plans in order to ensure that common sense water use practices are always adopted and to reinforce other demand management measures by developing a culture of water efficiency. The PWCM rules are easy to understand and follow and are designed not to cause undue hardship on the community.

The three basic rules are:

Watering of Gardens & Lawns	**Minimise watering during the heat of the day.** *In practice, this means that sprinklers and fixed hoses should only be used between 6-8am and 6-10 pm during daylight savings times, and between 6-8am and 5-9pm during EST*
Washing Down of Hard Surfaces	**Wash down hard / paved surfaces with a high pressure hose.** *In practice, this means no hosing of hard surfaces, including driveways, paths, concrete, timber decking and external walls of houses / buildings unless using a high pressure cleaner unit, or if such a unit is not available, a water efficient nozzle (less than 9 L/min).*
Swimming Pools	**Use a pool cover to reduce evaporation.**

& Spas	*In practice, this means that it is recommended that private pools and spas should be covered when not in use in order to reduce evaporation.*

Regulation & Planning Controls

Council should actively support and implement various state and national based regulation and planning controls that promote water efficient products, practices and developments. Key regulation and planning controls that should be supported and promoted by the Community Awareness Program include:

- **BASIX**: The NSW Government has implemented residential building planning controls that require all new homes to be water and energy efficient. New homes are generally required to install water efficient fittings, have indigenous garden species and install a rainwater tank.
- **WELS Rating Scheme**: The State and Federal Government have implemented the Water Efficient Labelling & Standards (WELS) rating scheme which applies national mandatory water efficiency labelling (up to 6 Stars) and minimum performance standards to household water-using products.
- **Smart Approved WaterMark Program**: This program was established by four associations (Australia Water Association, Irrigation Australia, Nursery and Garden Industry and Water Services Association of Australia) as a nationally endorsed, non-compulsory water efficiency labelling scheme for products and services which primarily help reduce outdoor water use.

Water Loss Management

Physical / real losses are generally the largest component of water losses. They are primarily an operation and maintenance issue and are therefore generally the losses that are targeted in a demand management program. Water losses are best managed by way of a Water Loss Management Program (which often is a component of a more comprehensive Asset Management Program).

The Water Loss Management Program will focus on the following areas:

- Metering of all properties and connections, including all public facilities, parks and gardens, standpipes and Council's water and sewer facilities (e.g. pumping stations).
- A residential Water Meter Replacement Program – residential water meters are typically replaced every 8-12 years.
- An assessment of annual water loss is undertaken for the NSW Performance Reporting based on the preceding 12 months of metering data.

5.2 Future Initiatives

A list of potential future demand management initiatives that could be considered in the future (potentially in 5 – 6 years' time when the Demand Management Program is reviewed and updated), is included below:

- Implement Water Savings Actions Plans at Council owned properties such as parks
- Implement a customer education program in conjunction with rollout of smart meters which allow for instantaneous consumption readings (technical feasibility currently being assessed by Namoi Water Alliance and subject to business case approval)

6 Implementation & Monitoring

This Demand Management Plan outlines the various demand management measures that have been adopted by Council and will be employed to encourage water efficiency across the water supply systems that are operated by Council. The development of implementation plans and ongoing monitoring of the individual programs are critical to the success of the Demand Management Plan.

Any new demand management measures will require an implementation plan to be developed and documented by Council to ensure the successful setup and delivery of the specific program. The implementation plan would cover the following key areas:

1. Program objectives and duration
2. Identify key people responsible for implementing the program
3. Identify any specific training needs
4. Develop more detailed budgets, including identifying other resourcing requirements (need to develop annual budgets for the life of the program)
5. Develop a communication strategy (in association with Community Awareness Program)
6. Scheduling and specific requirements for monitoring and evaluation

For demand management measures that have been previously implemented by Council, these measure are unlikely to need a specific implementation plan unless the nature of the program has changed significantly or other issues such as additional training or monitoring have been identified.

Regular monitoring, evaluation and review will be required for each individual program, as well as the overall Demand Management Program. Monitoring and evaluation of individual programs should include consideration of key outcomes (e.g. water savings, participation rates, customer satisfaction) and key processes (e.g. ease of implementation, Council costs / resources to run program). Monitoring and evaluation of the full Demand Management Program should also be undertaken to assess effectiveness of the combined programs and how they relate to each other.

Annual progress reports on the Demand Management Program will be prepared in association with a progress report on Water Loss Management. The progress report will include the outcomes of regular monitoring and an evaluation of the ongoing effectiveness of the programs. Where necessary, adjustments and/or enhancements should be made to the program based on the annual progress reports.

The Demand Management Plan should be reviewed every 2 – 3 years and updated as circumstances change.

7 References

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Appendix A
Location & Climate

Appendix A – Location and Climate

GSC serves a population of over 12,000 people, over an area of around 5,000 km^2 on the Liverpool Plains, within the Namoi River catchment. In addition to the towns and villages that have reticulated water supply systems (Gunnedah, Curlewis, Mullaley and Tambar Springs) there are several other villages located within the local government area that do not have formal water supply systems, including Carroll, Breeza and Kelvin. The nearest towns to Gunnedah that are outside of the GSC area are Tamworth (around 80 km east), Quirindi (around 60 km south-east) and Narrabri (around 100 km north-west).

The Gunnedah Region experiences a dry sub–humid climate. Temperatures are warm to hot in summer with relatively low humidity, mild in autumn and spring and cool to mild in winter. Rainfall is generally lower over the autumn and winter months and highest in summer months due to a predominance of summer storms.

Median rainfall in Gunnedah is 623 mm per annum, average annual evaporation is 1752 mm per annum, and the mean maximum daily temperature is 26^{o}C. Monthly climate statistics for Gunnedah are included in Table A1.

Table A1 Climate Statistics – Gunnedah Pool (Site No. 055023)

Climate Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Median Rainfall (mm)	55.3	50.2	33.6	30.8	31.5	37.8	32.8	34.8	34.0	50.8	52.8	62.4	622.9
10%ile Rainfall (mm)	14.5	10.7	4.0	1.4	3.4	10.6	7.1	6.2	6.2	12.2	12.5	16.3	378.0
Mean Daily Evap (mm)*	7.7	6.8	6.0	4.3	2.7	1.9	1.9	2.8	4.0	5.4	6.7	7.8	1752
Mean Max. Temp (^{o}C)	34.0	32.9	30.7	26.4	21.3	17.6	16.9	18.9	22.8	26.7	30.3	32.9	26.0

Note: Mean Daily Evaporation was taken from Gunnedah Resource Centre (Site No. 055024)

It is widely accepted that future climate changes could impact water supply systems through changing frequency and duration of rainfall, as well as an increase in evaporation. While estimating the impacts associated with future climate change is very difficult and is an evolving science, recent studies have started to provide some indication of the potential climate impacts. However, modelling to-date has focused more on changes in average monthly or annual statistics and less on the duration and frequency of extreme events, which is more critical for drought management.

According to the Adapt NSW website (setup by the NSW Office of Environment and Heritage), average temperatures have been rising since the 1950s, with the rate of change increasing from about 0.1^{o}C per decade during the 1950s to 1980s, to about 0.5^{o}C per decade in the 1990s and 2000s. The decade from 2001 to 2010 was the hottest on record, while 2014 was the hottest year on record in NSW (OEH, 2016).

The Adapt NSW website includes climate projections for NSW as well as more specific catchment based projections. An extract from the *New England North West Climate Change Snapshot* (OEH, 2016) is included below:

Appendix A – Location and Climate

Based on long-term (1910–2011) observations, temperatures have been noted to have been increasing since about 1970, with higher temperatures experienced in recent decades.

The New England and North West Region is projected to continue to warm during the near future (2020–2039) and far future (2060–2079), compared to recent years (1990–2009). The warming is projected to be on average about 0.7°C in the near future, increasing to about 2.2°C in the far future. The number of high temperature days is projected to increase, with fewer potential frost risk nights anticipated.

The warming trend projected for the region is large compared to natural variability in temperature and is of a similar order to the rate of warming projected for other regions of NSW.

The region currently experiences considerable rainfall variability across the region and from year-to-year and this variability is also reflected in the projections.

Currently, the biggest concern for local water utilities is the potential impact that climate change may have on rainfall patterns and volumes, and in turn how this will impact surface runoff and groundwater recharge rates. The latest estimates of hydrological climate change impacts are included in a recent report by the NSW Office of Environment and Heritage (OEH, 2015), which lists near future (2020 – 2039) and far future (2060 – 2079) estimates for rainfall, surface runoff and groundwater recharge for major river catchments across NSW. Hydrological climate change estimates for the Namoi River catchment are included in Table A2.

Table A2 Hydrological Climate Change Impacts – Namoi River (OEH, 2015)

Region	Percentage Change in Mean Annual:					
	Rainfall		Surface Runoff		Groundwater Recharge	
	Near Future	Far Future	Near Future	Far Future	Near Future	Far Future
Namoi River	+0.7%	+7.9%	+4.1%	+25.5%	-7.0%	+11.8%

The table reflects the level of uncertainty surrounding climate change, with rainfall predicted to increase slightly in the near future and then further increase in the far future. Surface runoff is predicted to increase slightly in the near future, but increase significantly (around 25%) in the far future. However, groundwater recharge rates are predicted to fall in the near future, but then increase again in the far future.

While the table gives some indication of the potential changes in mean annual rainfall, streamflow and groundwater recharge rates, the potential impact on water resources (including groundwater systems) is more difficult to predict, as the future nature of rainfall patterns is unknown. Climate change models have been used to estimate changes in seasonal rainfall patterns; however, these models are not currently capable of predicting future extreme rainfall patterns, such as flooding and drought events. Therefore, predictions on the future impact on water resources are currently very limited, as they generally do not consider future climate variability, particularly climate extremes.

Appendix B
Demand Projections

GUNNEDAH WATER SUPPLY - DEMAND PROJECTIONS

DEMAND PROJECTIONS ML/a LOW SCENARIO					Residential Dwelling Growth Residential Consumption			0.50% pa 350 kL pa
DEMAND COMPONENT	**Growth Rate (% pa)**	**2017**	**2022**	**2027**	**2032**	**2037**	**2042**	**2047**
Residential	0.50%	1,350	1,384	1,419	1,455	1,492	1,530	1,568
Commercial	0.50%	362	371	380	390	400	410	420
Non Rateable	0.50%	126	129	132	135	139	142	146
Rural	0.50%	39	40	41	42	43	44	46
Other	0.50%	8	8	8	9	9	9	9
Losses (10%)	NA	209	215	220	226	231	237	243
TOTAL		**2,100**	**2,100**	**2,200**	**2,300**	**2,300**	**2,400**	**2,400**

DEMAND PROJECTIONS ML/a AVERAGE SCENARIO					Residential Dwelling Growth Residential Consumption			0.75% pa 400 kL pa
DEMAND COMPONENT	**Growth Rate (% pa)**	**2017**	**2022**	**2027**	**2032**	**2037**	**2042**	**2047**
Residential	0.75%	1,543	1,602	1,663	1,726	1,792	1,860	1,931
Commercial	0.75%	363	377	391	406	421	437	454
Non Rateable	0.75%	126	131	136	141	146	152	158
Rural	0.75%	39	41	42	44	46	47	49
Other	0.75%	8	8	9	9	9	10	10
Losses (10%)	NA	231	240	249	258	268	278	289
TOTAL		**2,300**	**2,400**	**2,500**	**2,600**	**2,700**	**2,800**	**2,900**

DEMAND PROJECTIONS ML/a HIGH SCENARIO					Residential Dwelling Growth Residential Consumption			1.00% pa 450 kL pa
DEMAND COMPONENT	**Growth Rate (% pa)**	**2017**	**2022**	**2027**	**2032**	**2037**	**2042**	**2047**
Residential	1.00%	1,736	1,825	1,918	2,016	2,118	2,226	2,340
Commercial	1.00%	364	382	402	422	444	466	490
Non Rateable	1.00%	126	133	139	147	154	162	170
Rural	1.00%	39	41	44	46	48	51	53
Other	1.00%	8	8	9	9	10	10	11
Losses (10%)	NA	253	265	279	293	308	324	340
TOTAL		**2,500**	**2,700**	**2,800**	**2,900**	**3,100**	**3,200**	**3,400**

DWELLING PROJECTIONS	**Growth Rate (%pa)**	**2017**	**2022**	**2027**	**2032**	**2037**	**2042**	**2047**
Low	0.50%	3,858	3,955	4,055	4,157	4,262	4,370	4,480
Average	0.75%	3,858	4,005	4,157	4,315	4,479	4,650	4,827
High	1.00%	3,858	4,055	4,262	4,479	4,707	4,947	5,199

SMALL TOWNS WATER SUPPLY - DEMAND PROJECTIONS

Water Supply System	Annual Demand Growth Rate	2017	2022	2027	2032	2037	2042	2047
Curlewis	0.50%	113	116	119	122	125	128	131
Curlewis + 20%	0.50%	113	139	142	146	150	153	157
Mullaley	0.00%	19	19	19	19	19	19	19
Tambar Springs	0.00%	17	17	17	17	17	17	17

Appendix C
Estimated Costs & Water Savings

Appendix C – Estimated Costs & Water Savings

Table C1 **Direct Costs & Water Savings Associated with Demand Management Program (over 3 years)**

Demand Management Measure	Assumptions (Costs & Benefits)	Council Direct Costs (over 3 years)	Estimated Water Savings (over 3 years)
Community Awareness Program / Pricing	• Costs include marketing costs (pamphlets, advertising, handouts, etc) and membership to Smart Water Advice (no additional staff costs have been included) • Benefits assumed to be 5% reduction in residential usage in Gunnedah in the years the community awareness program is operating (74 ML/a)	$15K	221 ML
Non-Residential Large User Audits & Savings	• Costs include an allowance for 1 audit pa ($3K each) plus an allowance of $10K pa to implement a Water Savings Action Plan in Years 2 & 3 • Benefits are based on an assumed 5% reduction in the consumption of the target user group by year 3 (ie 5% of 60 ML)	$29K	4 ML
Permanent Water Conservation Measures	• Costs and benefits have been included in the Community Awareness Program	*(Costs included in Community Awareness Program)*	*(Savings assessed in Community Awareness Program)*
Regulation & Planning Controls	• No direct costs to Council • Benefits are based on around 35 new houses pa and a reduction in water consumption of 35% compared to the average house in Gunnedah	0	29 ML
Water Loss Management	• Benefits are based on an assumed 1.5% reduction in water losses (ie reduce from around 13% to 11.5%) by year 3 (ie 1.5% of 2,521 ML)	*(Costs already included in Water Operations Budget)*	76ML
TOTALS (over 3 years)		**$44k**	**329 ML**

Assuming total savings of 329 ML over 3 years and direct program costs of $44k, the unit cost of the program to GSC is around $0.13/kL (based on a simplified analysis). This compares favourably with the current water usage charge of $1.12/kL (tier 1, 2016/17).

Additional upfront and ongoing costs to the community, businesses and government have not been considered and additional benefits, including the deferral of capital works, reduced energy costs and reduced costs for wastewater treatment have also not been considered.