



Gympie

regional water supply security assessment



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Introduction

The city of Gympie is located approximately 170 km north of Brisbane and lies within the Mary Valley. The Mary Valley supports an extensive agricultural industry that includes cattle, forestry and irrigated cropping.

The Queensland Government Statistician's Office estimates the total population of the city of Gympie will increase from approximately 21 000 (June 2015) to approximately 27 133 by the mid 2030s.

Safe, secure and reliable water supplies are an essential resource for Gympie—not only for the health and wellbeing of the community, but also for supporting Gympie's economic growth and development. Additionally, a significant agricultural sector surrounding Gympie relies heavily on the availability of water for irrigation and other purposes.

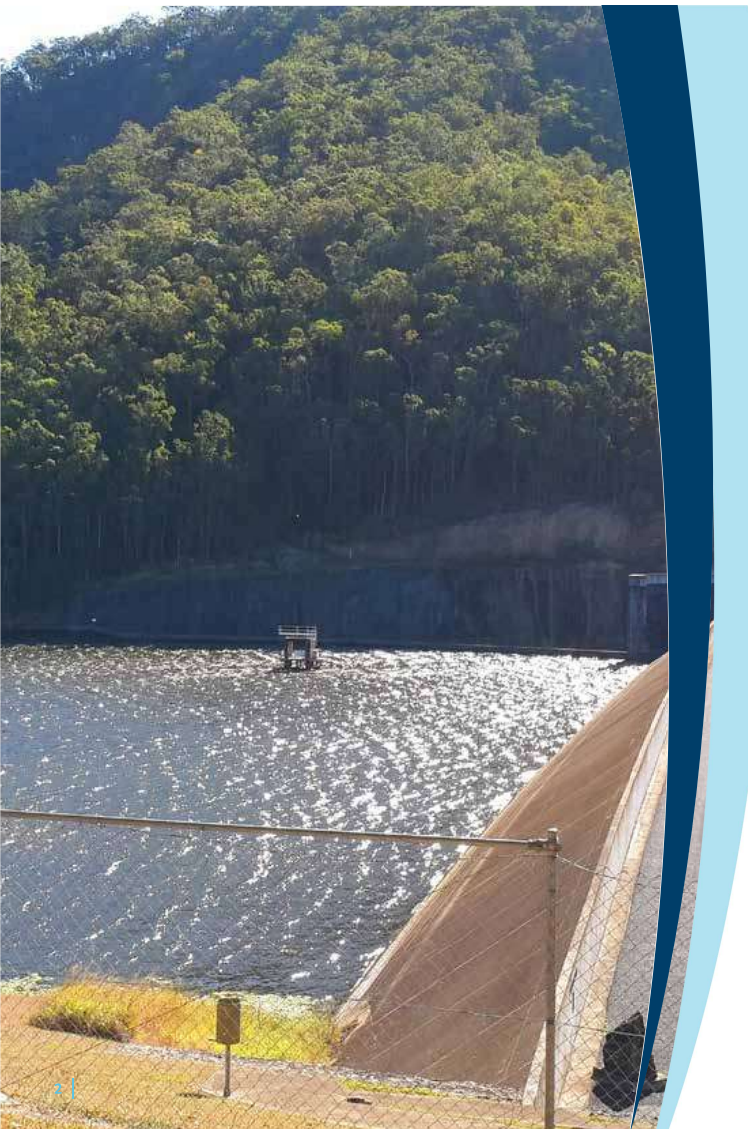
Gympie Regional Council is the registered water service provider for Gympie's urban water supply, and provides both water and wastewater services to Gympie's urban areas.

The Department of Energy and Water Supply and council have committed to a partnership to investigate and establish a shared understanding of the existing security of Gympie's water supply system and its capacity to support current demands and future growth.

Arising from this partnership, this regional water supply security assessment (RWSSA) provides valuable information to the community and water supply planners about Gympie's urban water supply security, providing a foundation for future water supply planning by council.

This assessment has considered a number of growth scenarios for the population of Gympie to identify the timing and magnitude of potential water supply risks. The scope of the assessment is limited to the volume of available water and does not address water quality issues that may affect water supplies.

It is important to note that information presented in this assessment does not consider any changes to the capacity of the existing water supply system and associated infrastructure.



Water supply source

Water for Gympie's reticulated urban supply system is sourced from the Mary River (just upstream of the town) within the Mary Valley Water Supply Scheme (Mary Valley WSS), which is supported by releases from Borumba Dam, located on Yabba Creek.

Water extracted from the Mary River for Gympie is treated at the nearby Jones Hill Water Treatment Plant, located adjacent to the Mary River on the south side of Gympie. Treated water is transferred to the city's reservoir system and distributed to customers via the city's reticulation network. As with most of the Mary River WSS, 'run of river' flows are often sufficient to meet water demands. Controlled releases from Borumba Dam ensure that this supply can be maintained during drier periods.

Borumba Dam lies approximately 36 km south-south-west of Gympie and is located on Yabba Creek, approximately 31 km upstream from Yabba Creek's junction with the upper Mary River. Constructed in 1964, Borumba Dam is owned and managed by Seqwater and has a catchment area of approximately 465 km². Borumba Dam was raised to its present height in 1997, bringing its full storage capacity to approximately 46 000 megalitres (ML), with a minimum operating volume of about 1200 ML.

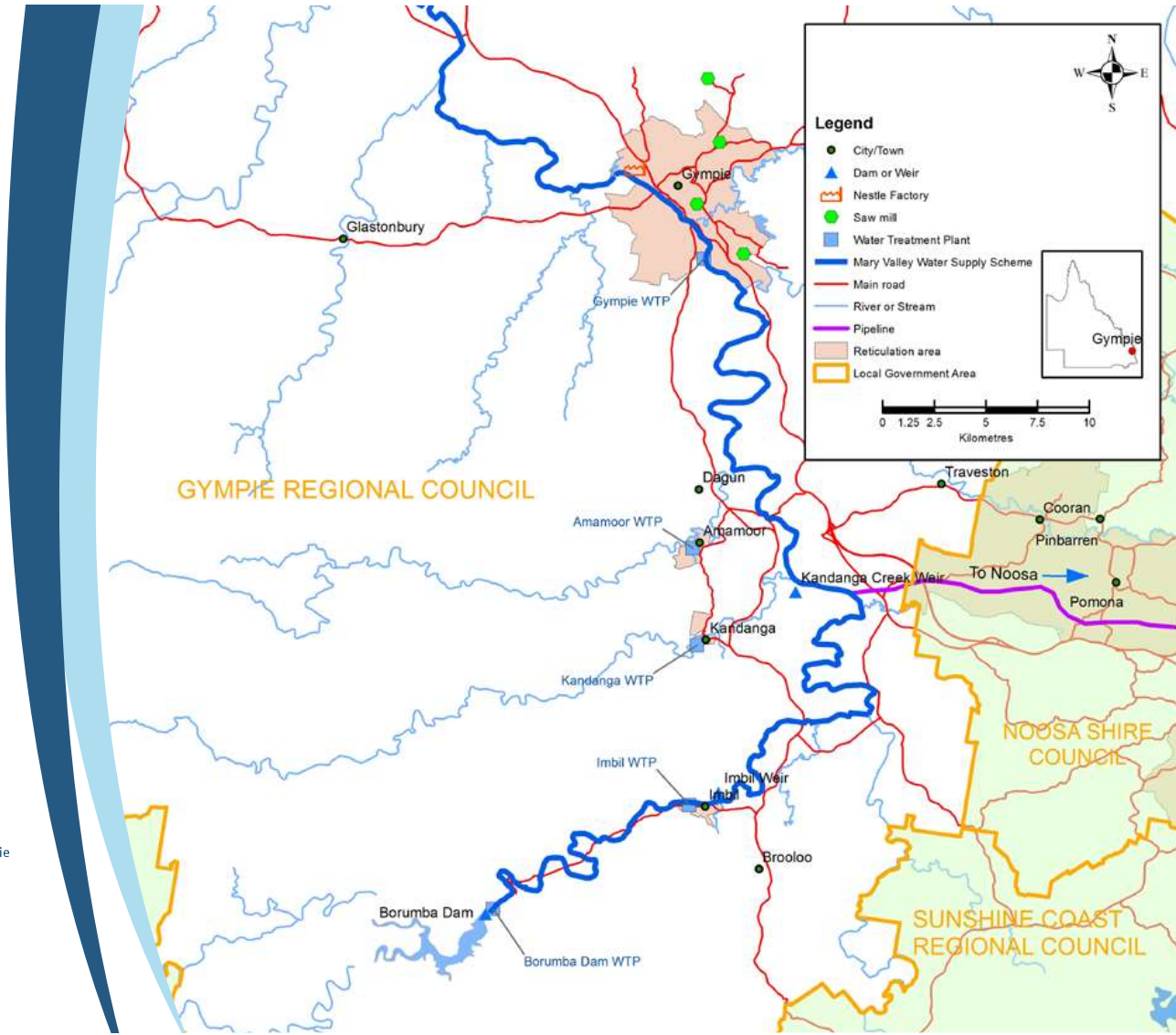
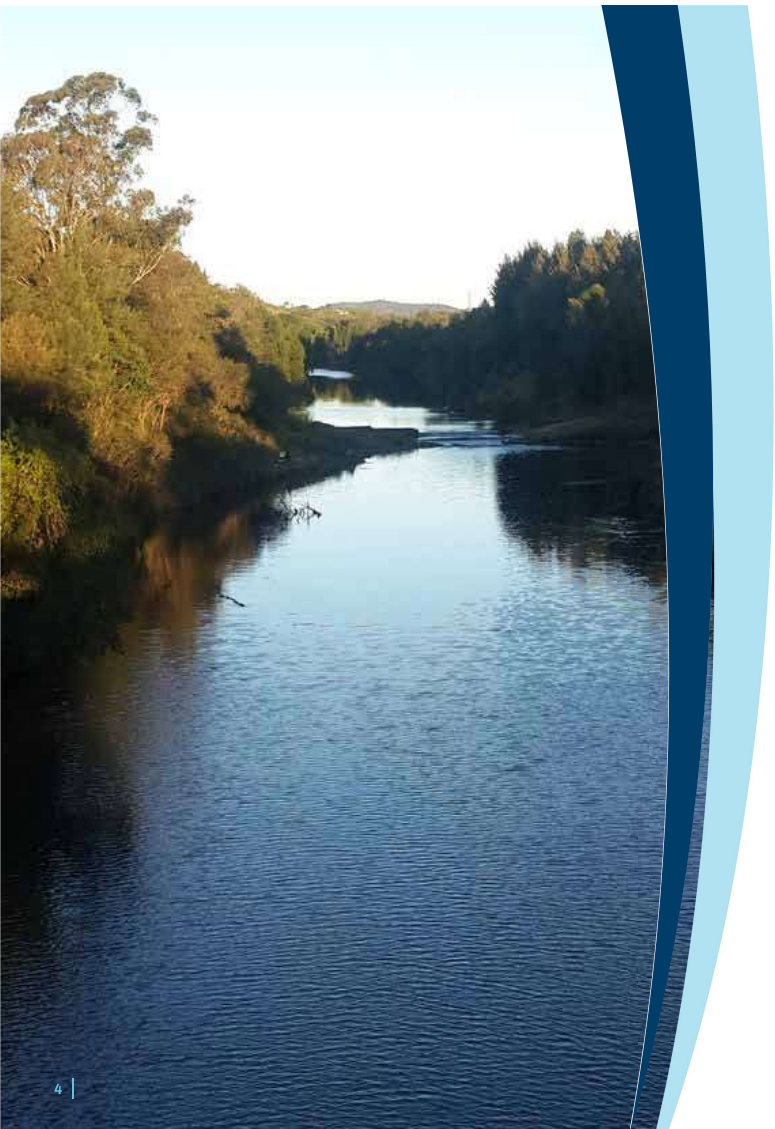


Figure 1: Location of Gympie and Borumba Dam



Water users and water demand

Gympie's reticulation network

Gympie has a population of approximately 21 000 (June 2015). Over 91% of Gympie's population (or around 19 110 people) are connected to Gympie's reticulation network, which supplies water for residential, commercial, municipal and industrial purposes.

Council holds a water allocation with a volumetric limit of 3464 ML per annum (ML/a) for extracting water from the Mary River to supply Gympie's urban water demand. The total volume of water sourced from the Mary River for the reticulation network over the 7 years from 2007–08 to 2013–14 averaged 2488 ML/a (ranging from 2186 ML/a to 2794 ML/a).

Based on the total volume of water sourced for the serviced population for these years, the average water demand was approximately 374 litres per capita per day (L/c/d). This water demand figure accounts for residential, commercial, municipal and industrial water supplied from the reticulation network, plus any system losses. The residential portion of this demand averaged 184 litres per person per day (L/p/d).

Variations in rainfall

Urban water demand varies between years and within each year depending on various factors (including rainfall), with higher demand usually occurring during drier periods. Annual rainfall at Gympie is highly variable and is dominated by summer falls, with an average of 55% falling between December and March. The mean annual rainfall at Gympie is approximately 1127 mm, while at Borumba Dam the mean annual rainfall is slightly higher at around 1155 mm.

Table 1 shows historical rainfall ranges for Gympie and Borumba Dam rainfall stations.

Table 1: Rainfall at Gympie and Borumba Dam

Rainfall station	Annual average	Historic low	Historic high
Gympie (1870–2015) (station no. 040093)	1127 mm	458 mm	2243 mm
Borumba Dam (1882–1992) (station no. 040481)	1155 mm	727 mm	1971 mm

Figure 2 shows that for the period 2007–08 to 2013–14, average daily water demand (L/c/d) generally decreases during wetter years and increases during drier years.

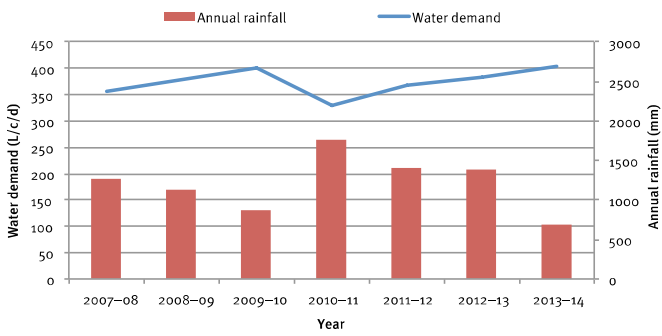
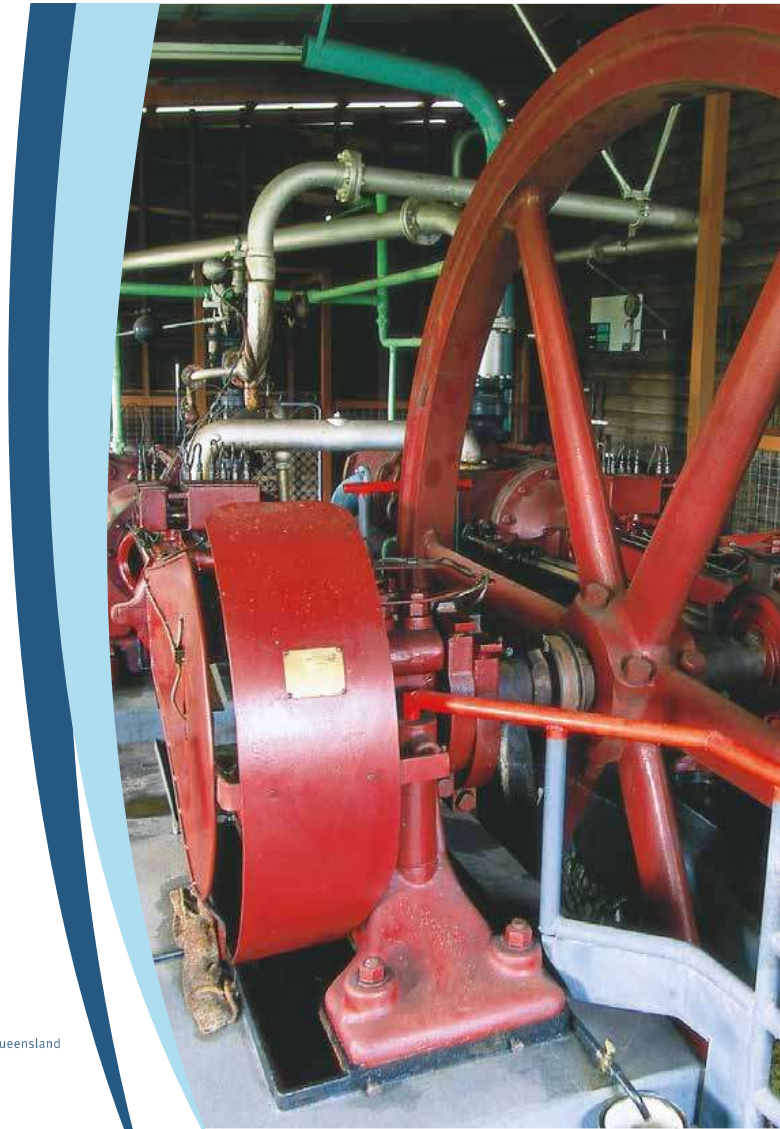
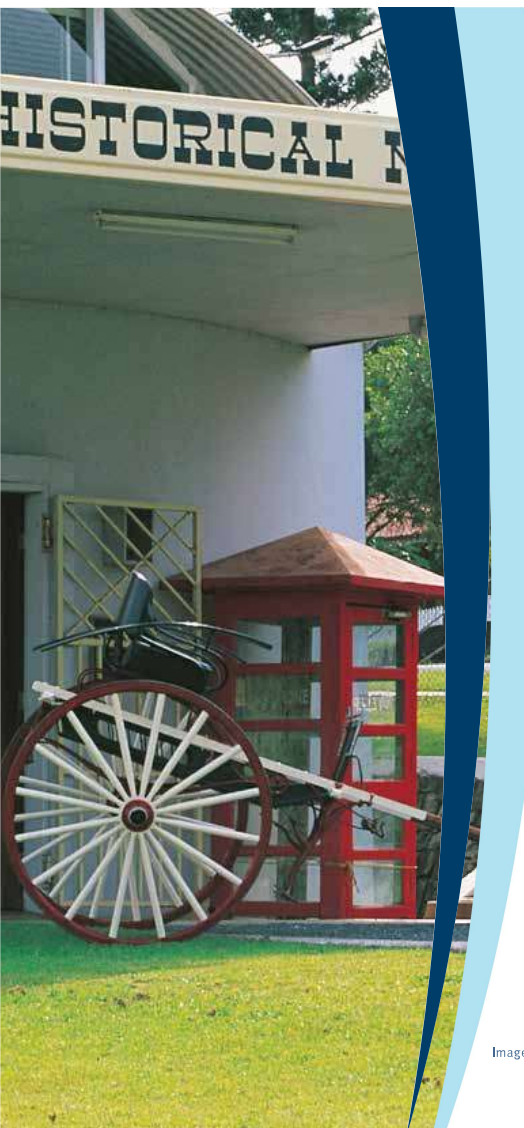


Figure 2: Average daily water demand (L/c/d) for each year compared with annual rainfall

Image courtesy Tourism and Events Queensland





Other users of bulk water supply sources

Gympie is located within the Mary Valley, where demand for water is primarily met through supplies from the Mary Valley WSS. The Mary Valley WSS provides water for agriculture and industry, and to meet the urban supply requirements for Gympie. It also supplements supplies to Noosa and other parts of the Sunshine Coast in conjunction with other sources in the SEQ Water Grid.

Agriculture

Agriculture within the Mary Valley is an integral part of Gympie's economy and includes cattle, forestry and irrigated cropping. Medium priority water allocations within the Mary Valley WSS, which are primarily used for agricultural purposes including irrigation, currently total 21 829 ML/a (including 3000 ML/a held by Seqwater).

Historically, the volume of water available under these water allocations has not been fully utilised. Over the past 12 years (from 2003–04 to 2014–15 inclusive), the average annual water use from these allocations (5788 ML/a) has been around one-third of the total entitlements (excluding Seqwater's allocation), with the highest use for any year being less than two-thirds of total entitlements.

Industry and mining

The Gympie region is home to several of Australia's market leaders in the manufacturing industry. Manufacturing contributed 10.5% to the Gympie region's gross regional product during the 2013–14 financial year. Some of the key manufacturing industries located within Gympie include Carter Holt Harvey, Corbet's Group of Companies, Laminex, Nestlé and Nolan Meats. Industrial water demand from these combined industries is significant (generally in the vicinity of 400 ML/a or more). This industrial water is supplied through the reticulation network and therefore included in the total water-use figures for Gympie.

Gympie has a history of mining activity, with gold first discovered in the Gympie area in 1867. Goldmining continued on a significant scale until approximately 1925, by which time the city was an important regional centre for the surrounding rich agricultural district. The last operating goldmine in the Gympie area, the Gympie Eldorado Mine, was permanently closed in 2008. While there are still industries involved in the mining of sand and gravel in the Gympie area, there is not a significant demand from any mining industries for water from the sources that are used to supply Gympie's urban water demands.

Noosa and the SEQ Water Grid

Seqwater holds a water allocation of 6500 ML/a from the Mary Valley WSS, under which it extracts water approximately 30 km upstream from where Gympie's urban water supply is taken. Seqwater uses this allocation, in conjunction with other sources in the SEQ Water Grid, to supplement supplies to Noosa and other parts of the Sunshine Coast.

Image courtesy Tourism and Events Queensland

Historical performance of Borumba Dam storage

There are no recorded supply failures for high priority water (used for urban supplies) from Borumba Dam since the scheme was constructed in 1964. Severe water restrictions have been required at times, such as during 2002–03 when drought conditions resulted in water levels in the dam becoming extremely low. Additionally, historical performance is not always a suitable indicator of future performance because of changes in climatic variability and total water demand.

Historical data shows that the water levels in Borumba Dam have varied over time. The storage behaviour of Borumba Dam is shown in Figure 3 for the 50-year period from 1965 to 2015. Over this period, Borumba Dam drew down significantly on several occasions, with the lowest recorded levels being reached in early 2003 (after which, new operating rules were developed). Borumba Dam was raised from EL 132.28 m (Australian Height Datum) to EL 135.01 m in 1997.

A reduction in inflows for one or more seasons can significantly reduce water levels in the dam. Therefore, late commencement of the wet season, periods of failed or low-yielding wet seasons, or extended periods of low inflow pose a risk to supply security.

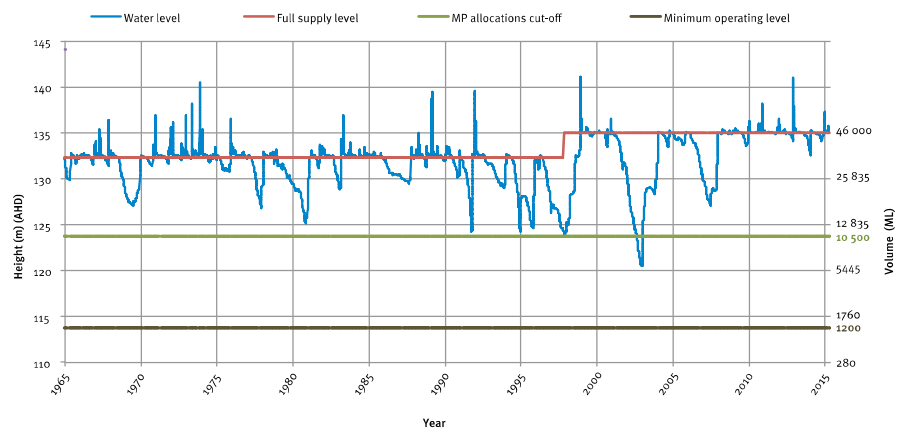


Figure 3: Historical storage behaviour of Borumba Dam



Future water demand

Effective water supply planning must be evidence-based and consider likely and possible changes in future water demand.

In developing an agreed forecast of Gympie's future water demand, it is essential that all key assumptions, such as rates of water use and population, are identified and agreed upon. The projections will, of course, remain subject to ongoing monitoring of actual population growth and variations in water use trends (e.g. education may reduce consumption).



Image courtesy Gympie Regional Council

Gympie's reticulation network

The current population of Gympie is approximately 21 000 (June 2015). This population figure is predicted to grow to about 22 662 by the year 2021 and to 27 133 by 2036. It is expected that the proportion of Gympie's population that is connected to the reticulation network will increase over time, approaching 95% of Gympie's population by 2036. Consequently, it is expected that the population connected to the reticulated water supply will increase to approximately 20 849 by 2021 and to 25 505 by 2036.

Information collated for the past 7 years suggests that a value of 374 L/c/d represents the average water demand on the reticulation network to support residential water users and associated commercial, municipal and industrial water users. It is important to note that this figure of 374 L/c/d represents average demand rather than high demand, which may occur during drier periods, and therefore the average daily demand level will sometimes be exceeded (e.g. low rainfall conditions leading to higher water demand). Higher demand during drier periods is often associated with increased outdoor water use, such as more water being used on gardens.

However, the use of average demand figures provides a means of directly comparing future demand projections to determine when demand is likely to exceed available supply. For planning purposes, this means an appropriate balance can be reached between the cost of water supply and the demand for available water.

In addition, it is important to consider and plan for likely demands during drier periods, as these are likely to exceed average demand levels. For example, water demand was 8.3% above average during 2013–14, which was the driest of the 7 years from 2007–08 to 2013–14, with 57% below average rainfall. Based on the information collated for the past 7 years, water demand (L/c/d) may reasonably be expected to be 10% higher than average demand during drier years, even with the likely imposition of water restrictions. In such a scenario, annual water demand may increase from the average of 374 L/c/d to reach a demand of 411 L/c/d. While a 10% increase in water demand may not sound very significant, it can have a significant impact on when Gympie may be using the full volume of its water allocation.

These projections are reflected in Figure 4 under different scenarios using average demands and dry period demands. Figure 4 shows the projected average annual water demand for Gympie's reticulation network, using the growth figures predicted for the residential population of Gympie and an average water demand figure of 374 L/c/d. Figure 4 also illustrates the effect of the likely higher demands during drier periods, using a water demand figure of 411 L/c/d. As previously mentioned, existing water demand from industry is currently met through the reticulated system. Any future growth in this demand is expected to be approximately proportionate to population growth, and therefore reflected in the growth figures for urban water demand.

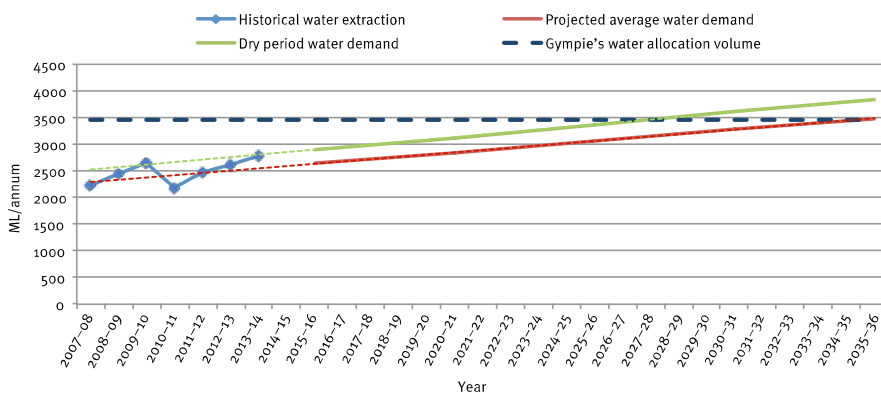


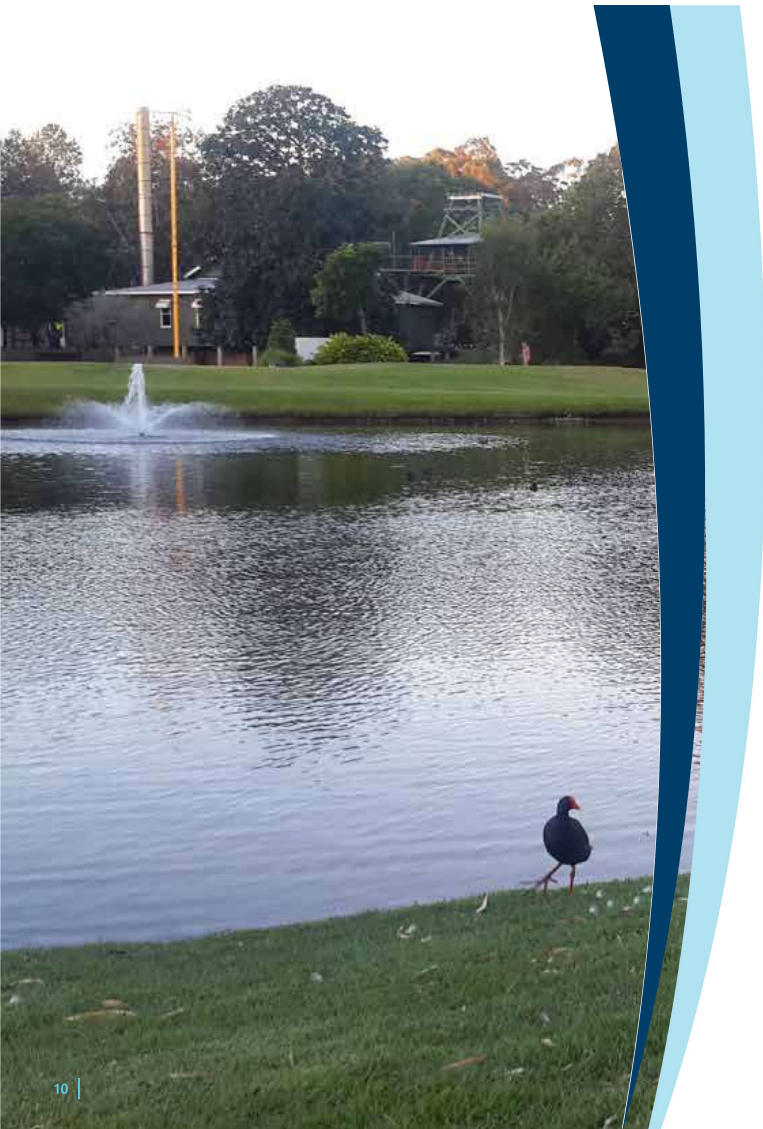
Figure 4: Projected water demand for Gympie

Figure 4 shows that, at average water demand levels, Gympie will be using its full water allocation by about 2035 and that, under a scenario of higher water demand (in drier years), Gympie is likely to be using its full allocation far sooner, by about 2028.



Image courtesy Gympie Regional Council





Other users of bulk water supply sources

Agriculture

There is potential for increased expansion of agricultural activities within the upper Mary River catchment. The Upper Mary Valley region has the advantages of key air and sea port facilities, existing railway facilities from Gympie to Brisbane, and close proximity to Brisbane markets.

Currently, the volume of medium priority water available is not a limiting factor for growth in agricultural activity in the Gympie region (particularly given that seasonal water trading is permitted). As such, it is envisaged that any growth in agricultural water demand is likely to be met from the volumes available from existing water allocations.

Industry and mining

There is potential for growth in the mining and industry sectors in the Gympie area, particularly through minerals exploration and the possibility of previously closed mines being reopened. Additionally, council actively promote the development of industry and manufacturing in the Gympie region, and work with industry leaders, prospective developers and new businesses to encourage growth in this sector.

Although such growth in the mining and industry sectors may not significantly impact directly on the water sources that supply Gympie, they do have the potential to support or increase the workforce in Gympie. As such, it is anticipated that any resulting growth in water demand would therefore be approximately reflected through increased urban demand linked to population growth.

Noosa and the SEQ Water Grid

Seqwater has advised that, depending on demand and operational requirements, there may be a need to start accessing their full allocation of 6500 ML/a for Noosa and other parts of the Sunshine Coast in the near future. For the purpose of this assessment, therefore, it is assumed that all future water demand from this allocation is at the full allocation volume (6500 ML/a).

Water supply system capability

Hydrologic assessment of Gympie's water supply system

Hydrologic assessments have been undertaken to ascertain the capability of Gympie's existing bulk water supply system (including existing operational arrangements and water entitlements) to meet current and projected future water demands.

Both historical and stochastic modelling were used to simulate the performance of Gympie's water supply sources. Modelling based on historical data can be used to demonstrate how the water supply system would perform at a range of demand levels if historical patterns of climatic conditions continue. However, historical modelling does not account for the possibility of changes to the pattern of historical climatic conditions experienced. Stochastic modelling involves generating data sequences that incorporate key statistical indicators from the historical record, and accounts for a wider variation of potential climatic scenarios than the historical record.

One hundred replicates of 10 000 years of stochastic data were generated for inflows to Borumba Dam and the Mary Valley WSS. This stochastic information was used in a

hydrologic model—the results were aggregated and the median output used to identify the likelihood of water supply shortfalls for the system (a water supply shortfall occurs when the water supply sources are unable to meet the water demands placed on them by the community). Using the median output means that half of the sequences had a lower likelihood and half had a higher likelihood of an event occurring.

The hydrologic assessments assume that all existing water entitlements from the dam or watercourses that support the system are fully developed and operational, with the exception of the water entitlements used to supply Gympie's reticulation network. Gympie's demands were represented at various annual demand levels to reflect the impact of population growth.

In an effort to reduce water consumption and maximise water-use efficiency during potential drought periods, council has put in place a system of uniform residential and commercial water restrictions across the region, with all areas having the same water-use rules for level 1–6 restrictions. Council has developed this water restriction regime based on the storage volume of Borumba Dam.

Table 2 shows the storage volumes that trigger the various water restriction levels and the corresponding residential water demand targets. Water restrictions primarily target outdoor water use, including watering gardens, irrigating sports fields and swimming pool use. Further details on water restriction rules are available on council's website (www.gympie.qld.gov.au/water-restrictions).

Image courtesy Gympie Regional Council



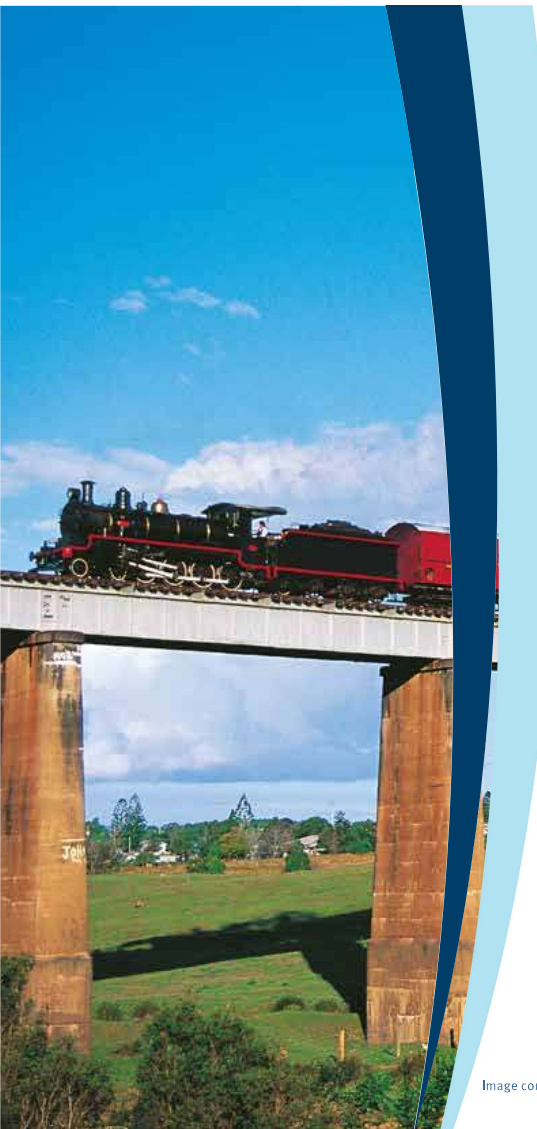


Table 2: Water restriction levels and assumed water demand reduction

Restriction level	Trigger levels (% of dam storage volume remaining)	Residential water consumption target (L/p/d)	% of demand supplied
Level 1	Permanent	230	–
Level 2	Below 50%	210	90%
Level 3	Below 30%	180	80%
Level 4	Below 20%	150	65%
Level 5	Below 10%	120	50%
Level 6	Extreme	60	30%

Note: Trigger levels and reduction targets are subject to review and amendment as determined by Gympie Regional Council from time to time.

Image courtesy Tourism and Events Queensland

Frequency of water supply shortfalls and water restrictions

As mentioned earlier, a community is considered to have experienced a water supply shortfall when its water supply sources are unable to meet the water demands placed on them by the community. This could be a result of sources becoming depleted due to, for example, severe or extended drought, or the community's demand exceeding the volume of water it is entitled to take.

Historical modelling results

Historical modelling results show that (for the full range of water demands modelled) Gympie is not expected to experience a water supply shortfall as a result of supply failure if water restrictions are adhered to and reductions in water consumption rates are achieved. However, historical modelling results also show the volume of water in Borumba Dam falling to very low levels on numerous occasions—below 10% of the full supply volume when water restrictions are in place, and below 5% of the full supply volume if water restrictions are not in place.

While historical modelling is useful, stochastic modelling accounts for a wider variation of potential climatic scenarios and is therefore considered to provide a better basis for understanding the future capacity of the water supply system.

Stochastic modelling results

Stochastic modelling results show that at Gympie's projected 2036 water demand levels, Gympie is expected to experience a water supply shortfall approximately 1 in every 63 years on average. These water supply shortfalls will be for a duration greater than 1 month, approximately 1 in every 238 years on average.

As mentioned earlier, Gympie's urban water is extracted from the Mary River, with controlled releases from Borumba Dam to maintain supply during drier periods. Council has a water restriction regime in place that is based on water levels in Borumba Dam, and is intended to reduce water demand during drier periods to extend the duration of the available water supply. Figure 5 provides an indication of the likelihood that various water restrictions could be triggered and the extent to which Gympie might experience water supply shortfalls, at a range of annual demands.

As illustrated by Figure 5, as Gympie's water demand increases, the frequency at which trigger levels are

reached will also increase. As an example, at Gympie's current annual demand (shown by the dotted red line in Figure 5), level 5 water restrictions are estimated to have a frequency of occurrence interval of about 32 years on average. When Gympie's full allocation of 3464 ML/a is being used, the estimated frequency of occurrence interval increases to about 28 years on average.

Considerations such as an acceptable frequency of the various restriction levels being applied, and the underlying likelihood of not being able to meet demand, are critical and fundamental parts of the water supply planning currently being undertaken by Gympie Regional Council and generally by councils across Queensland.

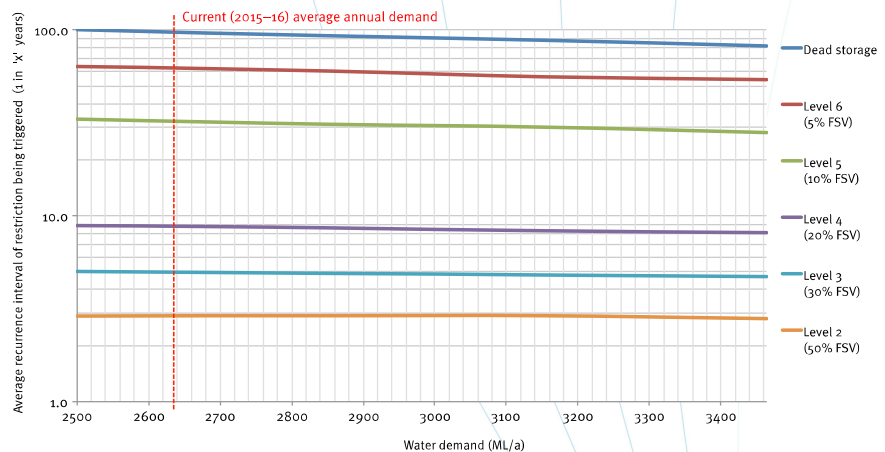


Figure 5: Frequency of various water restriction levels being triggered—percentage of full supply volume (FSV)

Duration and severity of water restrictions

Although the frequency of water restrictions is an important consideration, the duration and severity of each restriction period may be more important for many water users. For example, it may be more acceptable to experience less severe and shorter periods of water restrictions more frequently, than to experience more severe and longer periods of water restrictions less frequently.

Figure 6 shows the predicted frequency of level 2 water restrictions lasting for longer than 1 month, 3 months and 6 months. It can be seen from Figure 6 that, with an increasing level of water demand, there is a trend of increasing occurrences of water restrictions being imposed for longer durations. Figure 7 shows this same effect for level 4 water restrictions.

Together, the frequency, severity and duration of water restrictions, along with the ability to maintain a minimum supply during drought, are fundamental parts of water supply planning and are referred to as 'level of service'. The level of service for Gympie is a matter for council to determine, in discussion with the community.

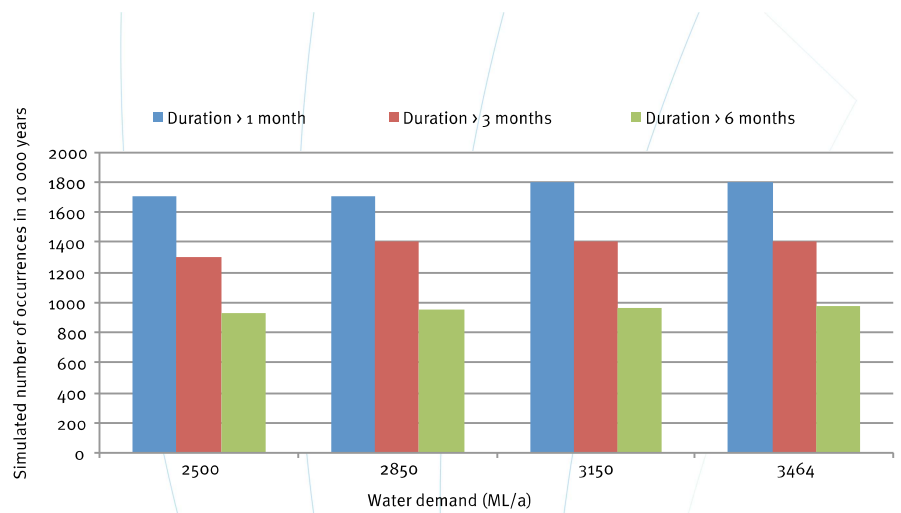


Figure 6: Number and duration of level 2 water restriction events occurring at various annual water demands

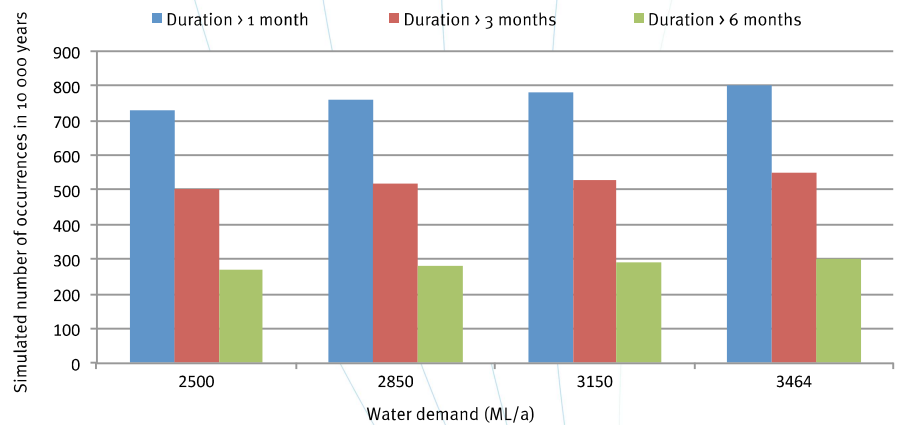


Figure 7: Number and duration of level 4 water restriction events occurring at various annual water demands

Moving forward

This RWSSA represents a collaborative approach between the Department of Energy and Water Supply and Gympie Regional Council to establish a shared understanding of the existing security of Gympie's water supply and its capacity to support future growth.

Council recognises the importance of ensuring Gympie's water supply security to support the city's current and future population. Water demand from Gympie's key industries and businesses, combined with Gympie's modest levels of residential water use and positive population growth, mean the capacity and reliability of Gympie's current water supply will need to be enhanced to meet future water demands. Council is committed to undertaking the steps required to achieve this outcome for the community, and is planning for the long-term water supply needs of the community.

Council is currently investigating a number of options to help achieve these goals, including:

- options to purchase additional high priority water allocation from within the Mary Valley WSS
- working with state government departments and agencies regarding the possibility of increasing the current water storage capacity within the wider region for urban supply
- demand management through optimisation of the reticulation system, education of the community on water-saving measures and appropriately applied tariffs.

Council is proactively pursuing sustainable outcomes to meet the water supply needs of its community, and regularly monitors water demand patterns across the community to help ensure that demand management strategies are appropriate and effective. Council will work with the community to identify an appropriate level of service for water supply security in Gympie, which will involve balancing an acceptable level of water availability with the lifestyle and expectations of residents. The viability of any water supply options will, among other things, need to consider economic, environmental, hydrologic and community outcomes, as well as statutory requirements.

Image courtesy Tourism and Events Queensland



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