



Bundaberg

Regional Water Supply Security Assessment

November 2015

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Introduction

Bundaberg is a growing community and key location for both domestic and international tourism situated within one of Queensland’s most significant sugarcane producing regions. Supporting this important area are vibrant and expanding commercial and industrial sectors together with a range of public facilities and infrastructure.

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Located around 300 km north of Brisbane and 160 km southeast of Gladstone, Bundaberg is the commercial and service centre for a diverse and economically important region (see Figure 1). The population of Bundaberg is projected by the Queensland Government Statistician’s Office (QGSO) to grow by around 33 per cent between 2013 and the mid-2030s.

Safe, secure and reliable water supplies are critical for sustaining economic growth in the area, as well as for the well-being of the community. The Department of Energy and Water Supply (DEWS) and the Bundaberg Regional Council (Council) have formed a partnership to establish a joint understanding of the capability of Bundaberg’s water supply system to meet current and future water demand.

The Regional Water Supply Security Assessment (RWSSA) for Bundaberg provides the community and water supply planners with a better understanding of Bundaberg’s water supply security. The information and data generated by the RWSSA, which are summarised in this document, will contribute to future water supply planning in Bundaberg.

The assessment process considered a number of population and water use growth scenarios as well as the capacity of the existing water supply infrastructure to identify the timing and magnitude of any potential water supply shortfalls.

Bundaberg's water supply sources

The Bundaberg reticulation network (the network) supplies treated water from both surface water and groundwater sources to a range of users in and around Bundaberg itself as well as surrounding areas including the coastal communities from Burnett Heads through Bargara to Elliott Heads.

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The extent of the Bundaberg reticulation network and the area's key water supply infrastructure are shown in Figure 1.

Surface water supplies

All of the network's surface water supply is extracted from the Burnett River at Ben Anderson Barrage, which is part of SunWater's Bundaberg Water Supply Scheme (BWSS).

The BWSS has a total water supply capacity of 44 372 Megalitres per annum (ML/a) of High Priority (HP) allocations and 335 957 ML/a of Medium Priority (MP) allocations. The majority of the water is used by agricultural businesses across the Lower Burnett area, with Council's supplies from the BWSS representing only a small component of the scheme's available supplies.

The water supply capability of the BWSS is supported by water stored in Paradise Dam (capacity of 300 000 ML) on the Burnett River and Fred Haigh Dam (capacity of 562 000 ML) on the Kolan River. If necessary, water can be transferred from Fred Haigh Dam into the Burnett River to maintain supplies in the Burnett River catchment.

In total, Council owns 9258 ML/a of the HP allocations from the BWSS, of which 7702 ML/a is assigned by Council for supply to the network. Council also owns other surface water entitlements which, together with the balance of its BWSS allocations, are used to supply other communities outside the network.

Most of the network's surface water supply is treated at the Branyan water treatment plant (WTP), however, surface water is also treated at the Kalkie and River Park WTPs. Raw water supply for the Branyan WTP is extracted directly from the Burnett River at the Ben Anderson Barrage, whilst Kalkie WTP receives its raw water supply from the Woongarra Main Channel and River Park WTP sources raw water from the Woongarra storage located near River Park. Raw water supplies for both the Woongarra Main Channel and Woongarra storage also originate from the Burnett River within the Ben Anderson Barrage storage.

Groundwater supplies

In addition to surface water supplies, Council also owns 6020 ML/a of high reliability groundwater allocation from the Coastal Burnett Groundwater Management Area (CBGMA) that it uses for supply to the network.

Council extracts and treats this groundwater at a number of borefields located across the Bundaberg area.

Council seeks to maximise its use of groundwater as it is of very good quality and requires minimal treatment. In recent years this has resulted in a ratio of about 65:35 groundwater to surface water use.

Council also owns other groundwater allocations which are used for supplying other communities outside of the network.

In total, up to approximately 84 000 ML/a of groundwater is authorised to be extracted from the CBGMA, of which some 75 000 ML/a is lower reliability groundwater entitlement that is mainly used for irrigation.

Availability of uncommitted water

Of the total allocation associated with the BWSS, approximately 110 000 ML of the MP water allocation and 17 000 ML of the HP water allocation is not committed. Any water user may seek to purchase or lease some or all of this water allocation from SunWater. These allocations, which are primarily associated with Paradise Dam, can be accessed at a number of locations along the Burnett River downstream of Paradise Dam.

Figure 1 The Bundaberg reticulation network and associated water supply infrastructure



Legend

- City/Town
- Water Treatment Plant
- ⚡ Earth Commodities sand mining
- ⚓ Port
- Stream or River
- Channel
- Coastal Burnett Groundwater Management Area
- Bundaberg Reticulation Network
- Water Service Area
- Local Government Area

0 2.5 5 10 15 20
Kilometres

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REGIONAL COUNCIL**



Existing water use

Bundaberg's reticulation network

The Bundaberg reticulation network currently supplies treated water to approximately 70 000 people, the network's serviced population, as well as for commercial, industrial and municipal purposes.

Figure 2 shows the combined total annual volume of water extracted from the BWSS and the CBGMA for supply to the network over the period 2007 to 2013 and compares these figures against annual rainfall at Bundaberg Airport. Over this period, the total annual volume of water extracted varied between a high of 9450 ML/a in 2009 and a low of 7650 ML/a in 2010.

In 2009 Council introduced a two tiered metered charging scheme which contributed to the marked drop in water use seen in 2010. Although total water extractions have climbed steadily each year since 2010, this appears to be associated with increasing population and as a response to some extended periods of low rainfall during these years.

As an example, although 2013 had above average rainfall over the year, the majority fell early in the year, in particular in January, whilst the remainder of the year saw mostly well below average rain. As a result of the lengthy dry period during the majority of the year and an associated increase in garden watering and other outdoor uses, water use in 2013 as a whole was the highest it has been since the introduction of the new charging scheme.

Analysis of rainfall and water use records at a monthly scale shows that water use in the Bundaberg reticulation network is influenced by two to three monthly rainfall patterns.

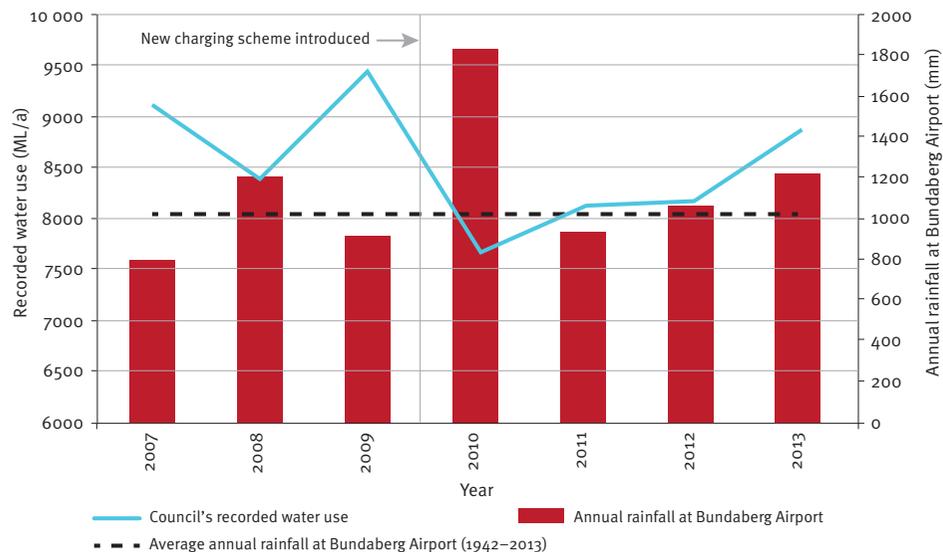


Figure 2 Comparison of annual water use and rainfall in Bundaberg (2007–2013)

Figure 3 shows the network’s average daily per capita water consumption (total water use from the network divided by the serviced population) between 2007 and 2013. During the years prior to the new charging scheme, water use was around 390 litres per capita per day (L/c/d) on average, peaking in excess of 400 L/c/d in 2007. Following the commencement of the new charging system water use fell markedly and has averaged around 330 L/c/d for the four years 2010 to 2013.

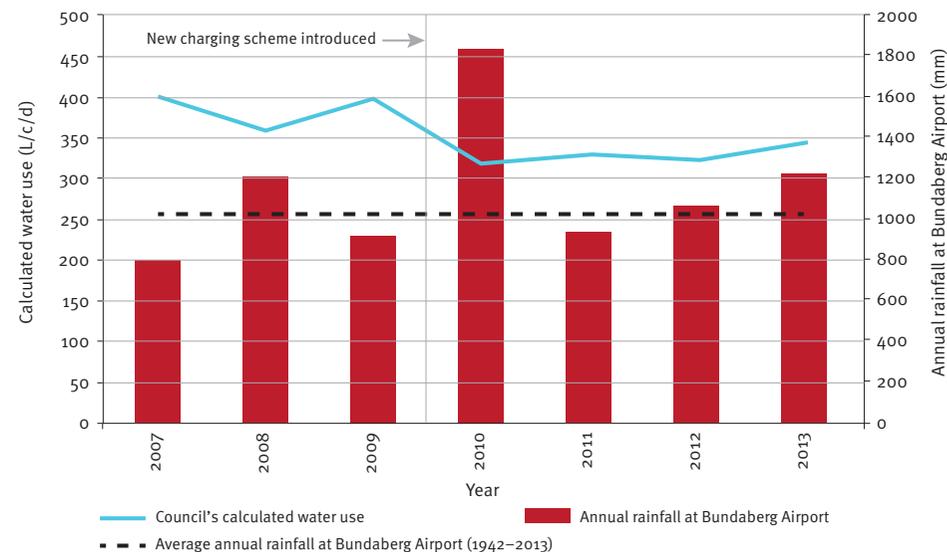


Figure 3 Comparison of average water use per capita and rainfall (2007–2013)

As already discussed, water use in 2013 was influenced mostly by the extended period of low rainfall that occurred over the majority of that year. As a result, water use per person in 2013 is reflective of what could be expected during future extended dry periods.

Water use restrictions

Council does not have a defined restrictions regime for water users serviced by the network. This is mainly due to the fact that in the past, even during extended dry periods, the availability of water supplies has not been significantly constrained.

However, in the future, there may be a need for Council to impose water restrictions in some situations, for example:

- due to severe drought
- loss of continuity of supply due to short term problems with system capacity, water quality or asset performance
- in response to natural disasters or other emergency situations.

Other users of the bulk water supply sources

Urban

In addition to the communities serviced by the Bundaberg reticulation network, a number of other communities also use the BWSS and or the CBGMA to either supplement their local water supplies or as their primary water supply source. Consequently, water use in these communities could potentially impact on the water supply security of the network.

These communities include Gin Gin, Wallaville, Childers, Woodgate and Moore Park and are all supplied by Council.

In 2013, these communities had a combined serviced population of around 11 000 people and water use of around 1000 ML. This equates to an average water use of around 250 L/c/d, a lower figure than the water use within the Bundaberg reticulation network.

This lower water use is likely to be due to the absence of, or at least proportionally much lower, water use by commercial and industrial businesses connected to the local reticulated supply. It is also likely that there is a greater use of rainwater tanks and or domestic boreholes in these communities.



Image courtesy Tourism and Events Queensland

Agriculture

The Lower Burnett area, in particular around Bundaberg, has a large and thriving agricultural industry due to its fertile soils, favourable climate and abundant water supply. The area is Queensland's third largest sugar producing district, Australia's largest producer of tomatoes and a significant producer of other fruits and vegetables. Associated with these farming activities are a wide range of secondary industries including sugar mills, processors and farm machinery support businesses.

Water supply to irrigators, especially sugarcane growers, represents the most significant (by volume) use of water from the BWSS. In addition, some irrigators also have access to groundwater and/or local unsupplemented water.

Historically, water use has consistently been less than the volume of allocation available to agricultural businesses, however, actual water use is heavily influenced by the amount and timing of rainfall compared with crop water requirements.

Industry and mining

Most of the industrial water used in the Bundaberg area is sourced from the Bundaberg reticulation network. As such, the water use of these businesses is accounted for within the total water use of the network.

There is very little mining activity in the Bundaberg area at present. The silica mine near Woodgate uses groundwater extracted from the local coastal sands for its processing activities and therefore does not impact on water supplies to the Bundaberg reticulation network.

Future water use

The development of effective water supply plans requires a sound understanding not only of current water use, but also of the possible changes to water demand in the future. As such, this RWSSA includes consideration of future water use across the Bundaberg reticulation network as well as the other communities and the agricultural, industrial and mining sectors that access the same bulk water supply sources.



Image courtesy Tourism and Events Queensland

Bundaberg's reticulation network

The QGSO prepares projections of population across the state based on census data, economic trends and information from local governments. The population serviced by the Bundaberg reticulation network is projected to increase under a medium growth scenario to around 90 000 people by the mid-2030s.

When comparing water demand against the water supply system's capability it is important to consider demands that reflect water use during dry periods (i.e. when low rainfall conditions lead to higher rates of use). This, combined with consideration of the historical water use, the rainfall conditions prevailing at the time and the characteristics of the water supply system itself, suggests that a figure of 350 L/c/d is reasonable to adopt for planning purposes.

Figure 4 shows the medium growth in annual water demand projection for the network using the adopted 350 L/c/d. The graph shows how annual water demand is projected to rise from around 9000 ML/a in 2013 to around 12 000 ML/a by 2036, a growth of 33 per cent over the period.

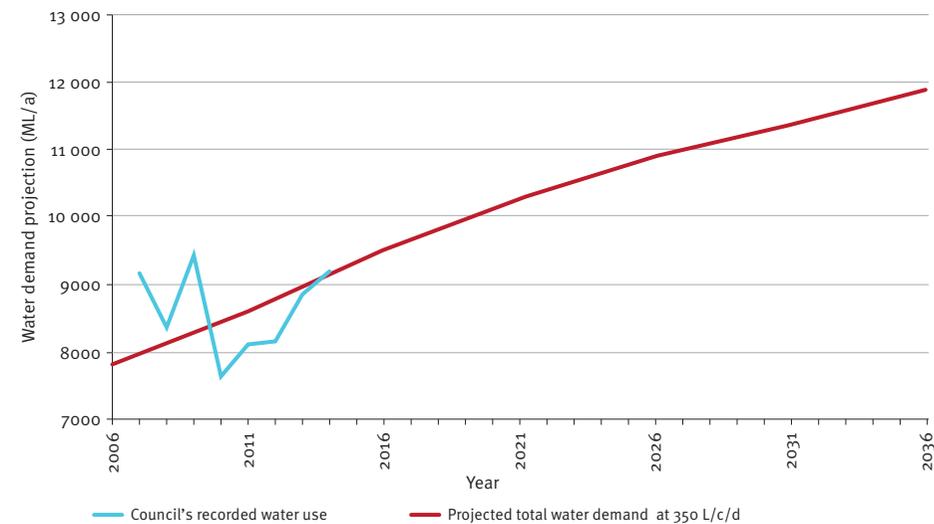


Figure 4 Projected water demand for the Bundaberg reticulation network

Other urban communities

Comparing this projected demand against Council's total available water allocations of around 13 500 ML/annum, it can be seen that Council owns adequate water allocations to meet the network's demand to 2036 and beyond.

However, it is important to note that extended drought periods could impact on water availability, potentially resulting in temporary water supply shortfalls in some years for all water users, including Council. This would be expected to impact surface water supplies in the first instance, but could also affect groundwater availability if a drought was sufficiently prolonged.

It is also important to note that should population growth differ from the medium growth projection or if water use trends either higher or lower than assumed the projected water demand is also likely to change.

As discussed earlier, a number of other communities around Bundaberg also draw some or all of their water supplies from the same bulk water sources as the network. The water allocations and other water entitlements owned by Council for meeting the water demand of these locations are expected to be sufficient to meet the needs of these communities for the foreseeable future.

However, in the event of an extended drought resulting in water supply shortfalls for these communities, Council may need to use water from its BWSS and or CBGMA allocations associated with the Bundaberg reticulation network. Any arrangements of this nature could have an impact on the network's water supply security.



Agriculture

The agricultural sector around the Bundaberg area is already well established and has developed to use the land resources available to it. Changing water use practices, especially across the sugarcane industry, are expected to see improving water use efficiency which will reduce the amount of water needed per tonne of crop grown. This is expected to place downward pressure on water demand.

However, changing crop types may occur in response to market fluctuations for certain produce which could result in crops being grown that have a higher water requirement, for example a move towards more or larger macadamia nut or citrus plantations. Such changes could result in increasing water use in these locations.

A combination of these two factors and other drivers is expected to result in an overall decline in water use across the agricultural sector. Consequently, the volume of water allocations available for sale may increase allowing water to be traded between agricultural businesses.

Whilst such projections are inevitably subject to periodic fluctuations in the demand for particular products, there is sufficient underutilised allocation already held within the sector to meet increases in water demand should they arise. In addition there is a large volume of uncommitted MP water allocation available in the BWSS that could meet significant increases in water demand should any occur. Agricultural users may also seek to purchase some of the higher security uncommitted HP water allocation which may be needed for certain crops, such as high value tree crops.

Industry and mining

Industrial activity is currently centred on Bundaberg itself as the regional centre and this is expected to continue in the future. There are currently no new industrial projects known of that may increase the sector's use of water from the BWSS or the CBGMA.

There has been some limited exploration of potential coal and mineral deposits around the Wide Bay Burnett Region, however, none of this has been in the immediate vicinity of Bundaberg.

At the present time there is no expectation of any expansion of the mining sector that may impact on Bundaberg or its bulk water supply sources. Whilst the Bundaberg area could become a more popular hub for fly-in, fly-out mine workers in the future, this would be accounted for within population growth figures for the Bundaberg reticulation network itself.

Any industrial or mining growth would have the option to purchase uncommitted water from the BWSS.



Water supply system capability

Hydrologic assessments have been undertaken to ascertain the capability of Bundaberg’s existing water supply system to meet current and projected future water demands. Both historical and stochastic modelling was used to simulate the performance of Bundaberg’s water supply sources.

As discussed earlier, the Bundaberg reticulation network sources water primarily from the CBGMA using its groundwater allocations, with surface water from the BWSS being used to make up the balance of water required to meet the network’s demand.

In order to quantify the capability of the network, both of these supply components need to be considered.



Image courtesy Tourism and Events Queensland

Groundwater supplies

In the past, Council’s groundwater supply has proven to be a highly reliable water source. This is reflected in the Burnett Basin Water Resource Plan which sets a water security objective that 90 per cent or more of Council’s allocation from the CBGMA is to be available 100 per cent of the time.

The Burnett Basin Resource Operations Plan restricts access to groundwater in the CBGMA if salinity levels in the aquifers reach predefined triggers. This protects the aquifers from excessive saline intrusion and thereby maintains the reliability of the CBGMA as a water source, particularly for Council’s urban supply requirements.

Given these two factors, protecting the reliability of Council’s groundwater allocation and its known historical reliability, it is assumed in this assessment that all of the the groundwater is available all the time.

Nevertheless, during a severe drought it is possible that Council’s groundwater allocation may not be fully available which would require Council use more surface water supplies and/or reduce demand.

Surface water supplies

In order to assess the reliability of the network’s surface water supplies, both historical and stochastic hydrological modelling was used.

Historical modelling enables a water supply system’s performance to be simulated for periods in the historical record before particular elements of its infrastructure had been constructed, for example, simulating what the storage level of Paradise Dam would have been during years prior to its actual completion in 2005. Historical modelling also enables assessment of the effect factors such as different operating arrangements or water demands would have had on the past performance of a water supply system.

For most places in Queensland, including Bundaberg, the historical data required for this type of modelling is available for around 100 years at most.

Stochastic modelling involves generating sequences of river flow and other data using key statistical properties of the historical data. Stochastic modelling can account for a wider variation of potential climatic scenarios than the historical record. Using this methodology, 100 sequences of 10 000 years of stochastic data were generated for the catchments supplying water to the network.

The results of the stochastic modelling were aggregated and the median output used to identify, among other things, the likelihood of water supply shortfalls occurring in the BWSS. Using the median output means that half of the sequences had a lower likelihood and half had a higher likelihood of an event occurring.

All other existing water entitlements in the Burnett River and Kolan River catchments were assumed to be fully used in all of the scenarios.

The hydrological assessments modelled the entitlements used by Council to supply the Bundaberg reticulation network and the uncommitted water in the BWSS (held by SunWater) at various demand levels, growing in 25 per cent increments from current use (Scenario 1) to full water use (Scenario 5) – see Table 1.

Supply of water to all entitlements was modelled in accordance with the arrangements specified in the Burnett Basin WRP and ROP and/or any other applicable licence conditions.

These demand scenarios for surface water use in the BWSS, shown in Table 1, enable the effect of increasing water use on the performance of water supplies from the BWSS to be assessed.

As stated earlier, Council does not currently have a water restrictions programme, therefore the potential effects of restrictions have not been modelled.

Table 1 Assumed use of surface water supplies from BWSS in modelling scenarios

Scenario		Assumed use of BWSS water allocations (ML/a)				Combined total
		Council (all HP)		Others + uncommitted		
		Bundaberg network*	Other communities	HP	MP	
1	Current use	3060	1156	17 463	224 309	245 988
2	Current use + 25% of unused allocation**	4220	1256	21 875	252 221	279 572
3	Current use + 50% of unused allocation**	5380	1356	26 288	280 133	313 157
4	Current use + 75% of unused allocation**	6540	1456	30 701	308 045	346 742
5	Full use	7702	1556	35 114	335 957	380 329

* Groundwater use, assumed to be 6020 ML/a, is additional to these volumes—note that Council’s groundwater allocation may not be fully available during a severe drought; and that it is assumed Council will continue to prioritise the use of groundwater over surface water sources.

** Unused allocation means the difference between current use (scenario 1) and full use (scenario 5).

Frequency of low water supply volumes and water supply shortfalls

Modelled historical performance

Figure 5 shows the simulated storage behaviour of Paradise Dam and Ben Anderson Barrage between 1890 and 2008 for Scenario 1 and Scenario 5 described in Table 1.

What figure 5 shows is that, even under full use of all water allocations (scenario 5), the water level in Ben Anderson Barrage would have been maintained at or above its Nominal Operating Level in nearly all years across the historical period. Further, at this level of demand, Ben Anderson Barrage would not have fallen to its Minimum Operating Level and would therefore have been able to maintain supplies at all times.

Figure 5 also shows the dynamic behaviour of Paradise Dam, with water levels falling rapidly and to low levels in response to water use during drier periods, as well as significant inflows regularly filling the storage. This is mainly due to Paradise Dam having a relatively small storage capacity compared with the flows that have occurred in the lower reaches of the Burnett Basin.

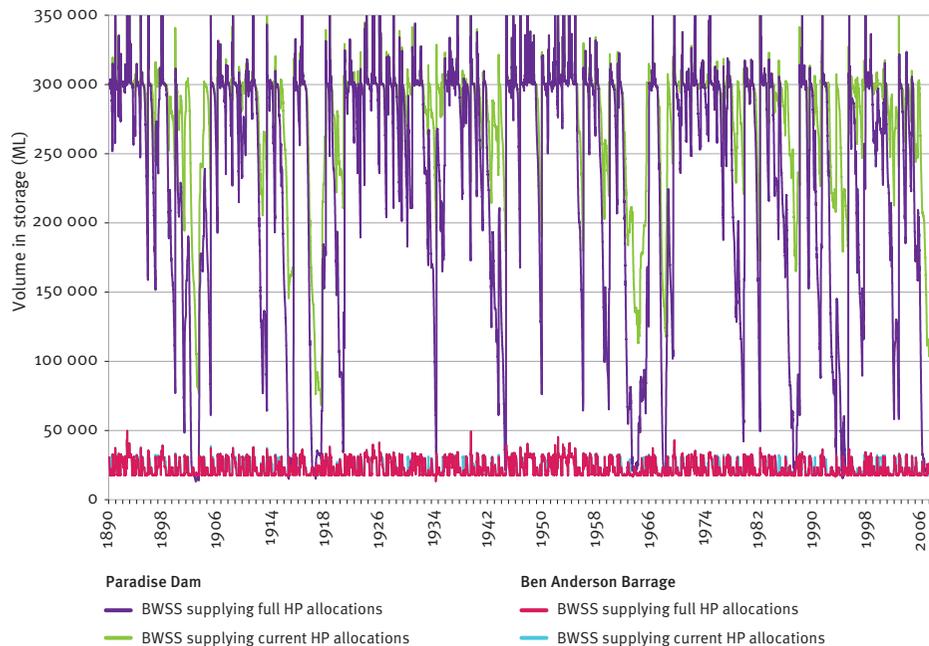


Figure 5 Simulated storage behaviour of Paradise Dam and Ben Anderson Barrage

Stochastic modelling performance

Figure 6 shows the estimated frequency of the following events occurring for the water demand scenarios shown in Table 1:

- the storage volume in Paradise Dam falling below 23 390 ML—that is the level below which the model assumes that water will be transferred from Fred Haigh Dam into the Burnett River (subject to availability of water in Fred Haigh Dam)
- Ben Anderson Barrage falling below its Nominal Operating Level (AHD 2.2 metres, 17 000ML of storage)—indicating low water levels in Paradise Dam
- Bundaberg water supply shortfalls—that is when Bundaberg’s water supply sources (CBGMA and BWSS) are unable to fully meet Bundaberg’s water demands.

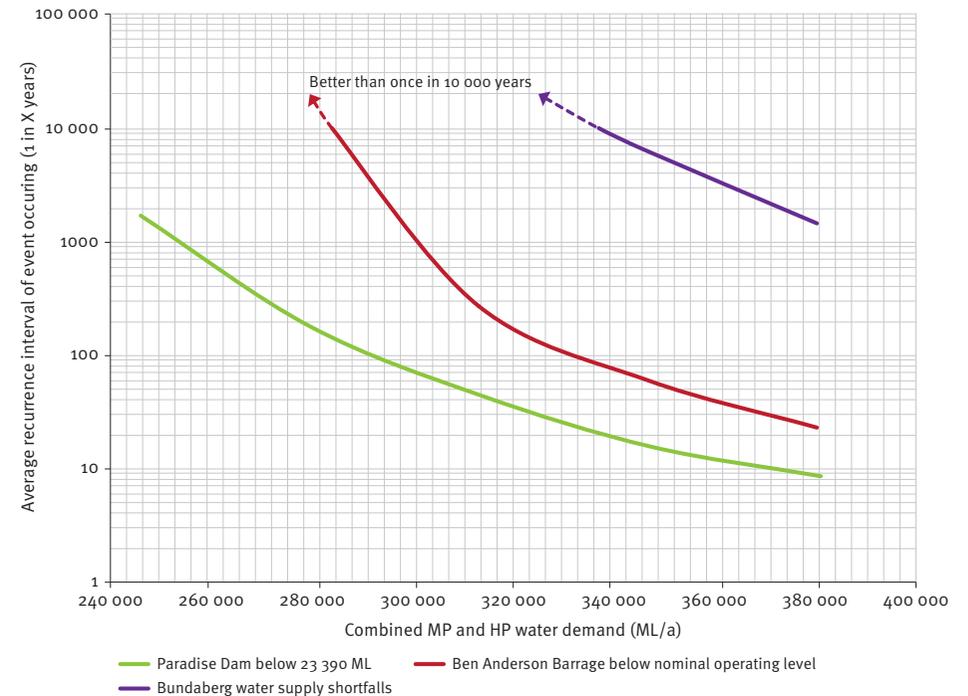


Figure 6 Frequency of events occurring in the BWSS

The average recurrence intervals achieved for a particular total water demand may differ if the ratio of HP to MP is different from those shown in Table 1.

The stochastic assessment indicates that at current levels of water demand, the network's supply of water from the BWSS has a median likelihood of shortfall of less than once in 10 000 years on average. This likelihood increases to about once in 1450 years if all of the water allocations supplied by the BWSS are being used.

As discussed previously, Council currently holds sufficient allocation from the BWSS and the CBGMA to meet the network's projected demand beyond the mid-2030s. Should the availability of groundwater be restricted, Council may need to use more surface water supplies to make up the balance of water required to meet the network's demand.



Moving forward

The Bundaberg Regional Council has partnered with the Queensland Government to establish a shared understanding of Bundaberg's long-term water supply security.

The region is blessed with an abundance of natural resources, including multiple water sources to meet Bundaberg City's projected needs. This water, which is secured by the highest priority allocations and administered by state government agencies, is high quality and suitable for treatment to meet drinking water guidelines.

Bundaberg has not experienced serious water shortages in recent memory due in large part to a conservative and prudent approach to water management. That approach will be continued.

Over the last several years annual water demand has seldom exceeded 70 per cent of available supply, maintaining a prudent safety margin to meet all but the most extreme circumstances. Looking to the future, projected scenarios demonstrate no foreseeable growth in short term raw water demands that could endanger Council's ability to provide adequate water supplies.

However, being aware that variations in water availability may occur, especially in times of extended drought, Council maintains a watching brief on the status of its current water supplies. Although supplies may be constrained by sustained and severe drought conditions, the likelihood of this occurring is considered to be well beyond Council's current risk appetite.

In the event that Council's water supply appears to be insufficient to meet our community's requirements in the medium- to long-term, Council will implement pre-planned actions. In the meantime Council will consider purchasing additional water allocations on an opportunity basis where good value is offered. These purchased reserves will, in time, become a vital part of Council's overall supplies for meeting future medium and long term requirements.

Council believes that continuing access to affordable water supply is an issue for many water users in the region, in particular the agricultural sector. To manage this and other issues Council will continue to advocate for all water users in the region and will commence an internal five year planning review cycle.

Among other things, Council will continue to provide comment on all forms of regulatory forum affecting the availability of water. This is vital in relation to decisions that could affect the economic, social and commercial viability of the region.

This ongoing role for Council is expected to include involvement with local research, monitoring and investigations. Factors to be considered include climate, storage capacity, supply conditions and management of water demand and losses.

Council will continue to work closely with state government agencies to ensure a safe, reliable and high quality supply of drinking water for residents.

In partnership with state government agencies, Council will continue, to monitor the city's raw water supply/demand balance to provide a reliable supply of drinking water, an essential commodity in the city's future. Council will also continue to be a good corporate citizen in matters such as:

- practicing water conservation
- purchasing appropriate water allocations and licenses
- advocating the interests of all water users in the region,
- commencing a five year planning cycle
- championing the initiation of required water supply projects with applicable funding and approval agencies
- meeting all applicable regulatory requirements
- advising local businesses and ratepayers on how to value this precious resource.



**For more information on the
Bundaberg regional water supply security assessment
please visit www.dews.qld.gov.au**