



Charters Towers

Regional water supply security assessment



February 2016

This publication has been compiled by the Department of Energy and Water Supply.

© State of Queensland, 2016



The Queensland Government supports and encourages the dissemination and exchange of its information. The copyright in this publication is licensed under a Creative Commons Attribution 3.0 Australia (CC BY) licence.

Under this licence you are free, without having to seek our permission, to use this publication in accordance with the licence terms.

You must keep intact the copyright notice and attribute the State of Queensland as the source of the publication.

Note: Some content in this publication may have different licence terms as indicated.

For more information on this licence, visit <http://creativecommons.org/licenses/by/3.0/au/deed.en>

The information contained herein is subject to change without notice. The Queensland Government shall not be liable for technical or other errors or omissions contained herein. The reader/user accepts all risks and responsibility for losses, damages, costs and other consequences resulting directly or indirectly from using this information.



Introduction

Charters Towers is a regional mining, agriculture and education centre located approximately 133 km southwest of Townsville. Charters Towers is the regional marshalling centre for live cattle exports out of Townsville, and is known as the education centre of the west, with a total of eight schools including three large private boarding schools.

.....

The Queensland Government Statistician's Office (QGSO) estimates the total population of Charters Towers will marginally decline from approximately 8414 (June 2015) to approximately 8207 by the mid-2030s. However, depending on developments that may result from expanded investment in agriculture and industry, including mining, this projected population decline is subject to change. Such development has the potential to maintain or even increase the population of Charters Towers.

Safe, secure and reliable water supplies are an essential resource for Charters Towers, not only for the health and wellbeing of the community, but also for providing a basis for encouraging and supporting Charters Towers' economic growth and development.

Charters Towers Regional Council (Council) is the registered water service provider for Charters Towers' urban water supply.

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 Charters Towers' 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 Charters Towers' water supply security and presents a summary of information used to define and assess the current water supply situation, thereby providing a foundation for future water supply planning.

This assessment has considered a number of growth scenarios for the population of Charters Towers 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 sources

Primary water supply source

Charters Towers' primary water supply source is Charters Towers Weir, located on the Burdekin River approximately 14 km northeast of the city.

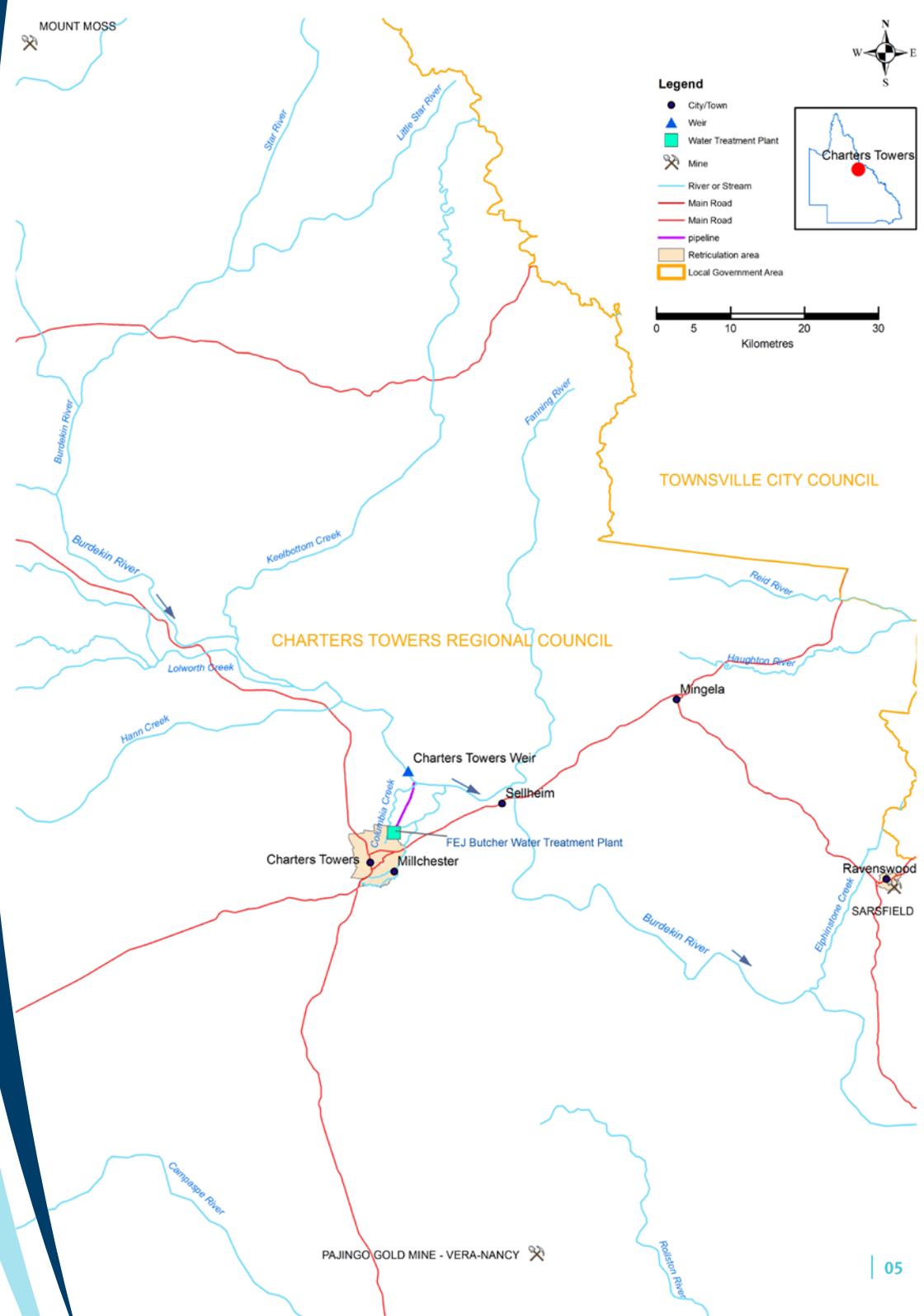
The catchment area of the Burdekin River above Charters Towers Weir is approximately 34 980 km². Completed in 1902 and raised a further 2.2 m in 1996, Charters Towers Weir has a full capacity of approximately 5227 megalitres (ML) and a minimum operating volume of around 135 ML.

Water extracted from the weir is treated at the FEJ Butcher Water Treatment Plant located on the outskirts of Charters Towers, before being transferred to the city's reservoir system and distributed to customers via the city's reticulation network. Charters Towers Weir is owned and operated by Charters Towers Regional Council.

Other water supply sources

In addition to sourcing surface water, Council produces recycled water. This recycled water is used by Council, some schools and the local golf club for the irrigation of lawns, ovals and recreational areas. The use of this recycled water potentially reduces the treated water demand from the reticulation system.

Figure 1 (right): Location of Charters Towers, Charters Towers Weir and FEJ Butcher Water Treatment Plant



Water users and water use

Charters Towers' reticulation network

Charters Towers has a current population (June, 2015) of approximately 8414 (QGSO). Approximately 99 per cent of the Charters Towers population (or currently, approximately 8330 people) are connected to the reticulation network, which supplies water for residential, commercial, municipal and industrial purposes.

.....

Council holds a water licence with a volumetric limit of 7500 ML/annum (ML/a) for extracting water from the ponded area of Charters Towers Weir to supply Charters Towers' urban water demand. Council also holds a licence for extracting 19.2 ML/a from Gladstone Creek, a tributary of the Burdekin River, for rural purposes.

Information from the Statewide Water Information Management database shows that the total volume of surface water sourced from Charters Towers Weir for the reticulation network for the two years 2012–13 and 2013–14 was 4680 ML/a and 4590 ML/a, respectively. Based on the total volume of water sourced for the serviced population for these years, the average daily per capita water use was approximately 1522 litres per capita per day (L/c/d). The L/c/d water use figure accounts for all water sourced to meet residential, commercial, municipal and industrial water demands from the reticulation network.

Recycled water

Council supplied approximately 405 ML of recycled water in 2012–13 and 341 ML in 2013–14. This recycled water is used by Council, some of the schools and the local golf club for the irrigation of lawns, ovals and recreational areas. If for any reason the recycled water was not available, there is potential that some or all of this demand may switch to demand from the reticulation network. If all additional demand were placed on the town's reticulation system, this would equate to an additional average demand of approximately 123 L/c/d.

Water demand can be impacted by variations in rainfall

Urban water demand varies between years, and within each year, depending on various factors including climatic conditions such as rainfall, with higher demand usually occurring during drier periods. Charters Towers' average annual rainfall is approximately 659 mm and is strongly dominated by summer falls. However, rainfall at Charters Towers airport for the 2012–13 and 2013–14 water years (July to June) was drier than average, measuring only 479.6 and 498.4 mm, respectively. This may account for their high average water demand over these years. Table 1 shows the historical average rainfall at the Charters Towers Airport and Post Office rainfall stations.

Table 1: Charters Towers rainfall

Charters Towers rainfall stations	Annual average	Historic low	Historic high
Airport (1992–2015)	666 mm	262 mm	1287mm
Post Office (1882–1992)	659 mm	109 mm	1632 mm

Figure 2 shows the average daily water production (at the water treatment plant) for each month compared to monthly rainfall from February 2014 to February 2015, and highlights the trend of average daily water demand increasing as average monthly rainfall decreases.

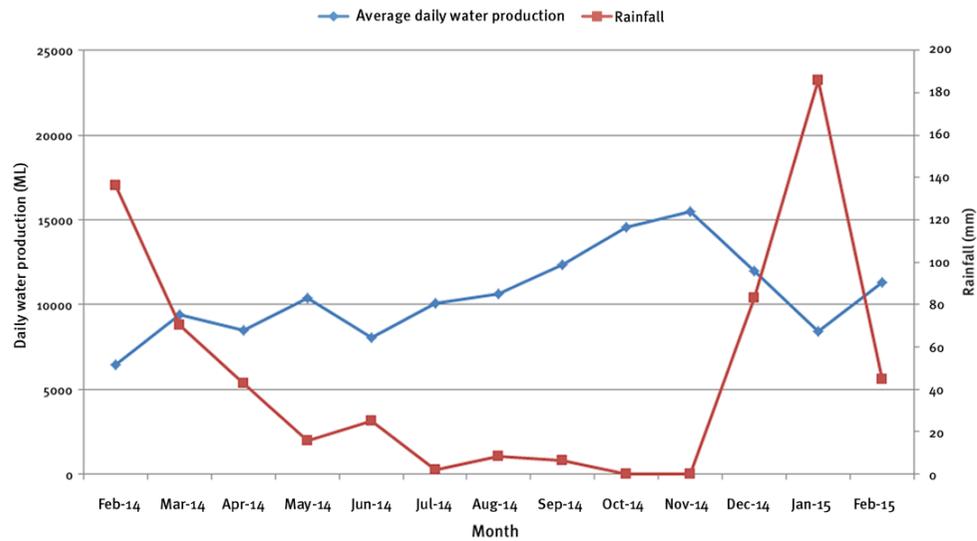


Figure 2: Average daily water produced and monthly rainfall



Other users of the bulk water supply sources

Charters Towers is highly dependent on agriculture and mining, both directly and indirectly, as a major source of economic activity and employment. Agriculture and mining have, over the years, allowed Charters Towers to prosper and support its population.

Agriculture

Most of the land use (90–95 per cent) in the upper Burdekin catchment above Charters Towers Weir is extensive cattle grazing. Dryland and irrigation cropping is restricted to relatively small areas which are predominately in the lower reaches of the Burdekin River.

There is no irrigated agricultural activity supplied directly from the ponded area of Charters Towers Weir. However, the total combined annual volume of water licensed to be extracted from above the weir for agriculture, and from the weir for urban purposes, is in the vicinity of 1 per cent of the Burdekin River's mean annual flow measured below Charters Towers Weir at Sellheim.

Industry and mining

Most of the industrial water use within the Charters Towers town area (e.g. for local manufacturing, engineering and other commercial operations) is sourced from Charters Towers Weir. As such, this industrial water use is accounted for within the total water taken to supply the reticulation network. Water for the Pajingo Mine is also extracted from Charters Towers Weir, and is currently supplied as part of Council's 7500 ML/a allocation under a private agreement between Council and the mine.

There are a number of other mines in the Charters Towers region. These mines do not take water directly from Charters Towers Weir, but can impact on the population of Charters Towers as they provide employment in the mines and in mining-related industries.

Historical performance of Charters Towers Weir storage

The storage volume of Charters Towers Weir (5227 ML) is relatively small and relies heavily on seasonal filling cycles and continual inflows from the Burdekin River. Seasonal inflows are generally sufficient to continuously overtop the weir for around six months or more of the year. This is often followed by a period during which the weir level is slowly drawn down through a combination of water use, evaporation and natural seepage losses. Consequently, a reduction in inflows for one or more seasons can drastically reduce water levels in the weir. Therefore, late commencement of the wet season, periods of failed or low yielding wet seasons, or extended periods of low inflow, when there is significant potential for water levels in the weir to drop considerably, pose a risk to supply security.

Charters Towers Weir has no recorded water supply shortfalls since the weir was raised in 1996 (a supply shortfall is the inability of the network system to meet water demand). However, there have been numerous times when water levels in the weir have fallen to low levels. Figure 3, below, shows the simulated historical storage behaviour of Charters Towers Weir for an assumed annual demand of 4500 ML/a and illustrates modelled water levels in the weir falling to low levels on numerous occasions.

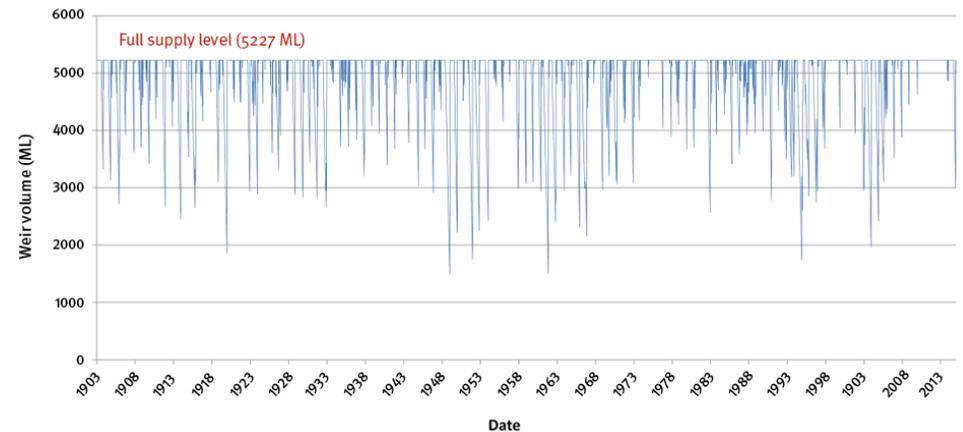


Figure 3: Simulated historical storage behaviour of Charters Towers Weir at 4500 ML/a demand



Future water use

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

In developing an agreed forecast of Charters Towers' future reticulated water demand, it is essential that the rates of water use and the larger volume of water sourced for all use across the reticulation network are identified and agreed upon. These 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).

Charters Towers' reticulation network

The current proportion of Charters Towers' population connected to the reticulation network (approximately 99 per cent) is assumed to be maintained in the future. However, the population growth profile projected by the QGSO indicates that the actual serviced population numbers are likely to decline to 8285 by the year 2021 and to 8125 by the year 2036.

Future serviced population numbers are subject to changes that may occur, for example, as a result of expanded investment and growth in agriculture or industry, including mining, within the area. Such expansion has the potential to maintain or even increase the population of Charters Towers, which has historically seen periods of growth followed by periods of no growth, or decline. A higher population growth scenario (and broadly in line with Charters Towers' historical growth patterns) may be a period of population growth for approximately ten years followed by zero growth. Such a scenario may see the serviced population increase to approximately 8519 by the year 2036.

Although this population growth period is not necessarily forecast to commence at any particular time, the accompanying growth in water demand has been positioned early in the projection period (from 2016) in figure 4, below, to ensure that the maximum potential impact of such population growth on water demand is fully recognised.

The average daily water demand over the two relatively dry years of 2012–13 and 2013–14 was 1522 L/c/d. Using both the QGSO and the higher growth figures forecast for the residential population of Charters Towers, and a total water demand figure of 1522 L/c/d, figure 4 shows the projected QGSO water demand and potential high growth water demand for Charters Towers' reticulation network.

Recycled water

The volume of recycled water provided from the Council's wastewater is not included in the demand forecast in figure 4 as this supply does not come from the Charters Towers Weir. If, for any reason, these recycled water supplies are unavailable in the future this may lead to a portion of this demand switching to the reticulated water supply, increasing the community's overall water demand. Alternatively if Council supplies more recycled water in the future (e.g. for irrigation of more urban areas), this may lead to an overall reduction in average water consumption from the weir.

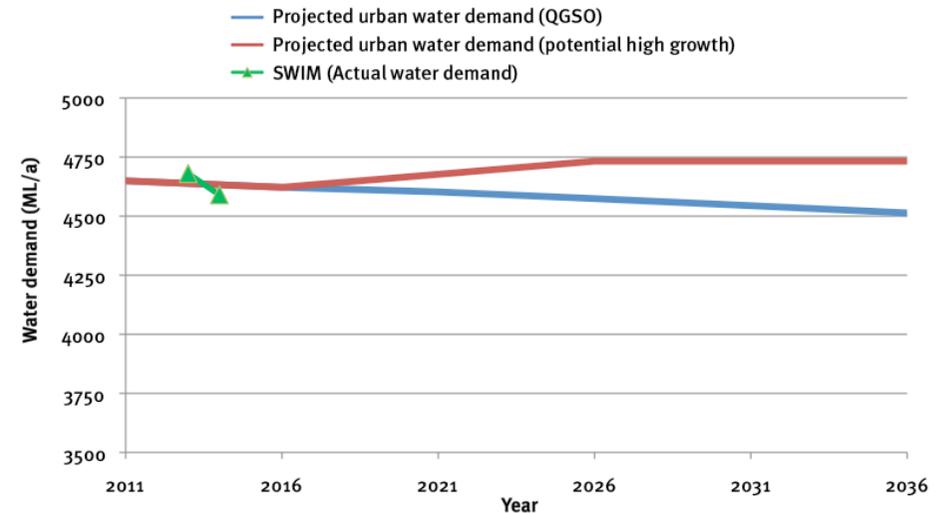


Figure 4: Projected water demand for Charters Towers

Other users of the bulk water supply sources

Agriculture

Council is currently promoting growth in the regions' agricultural sector through a strategic marketing plan being undertaken through the Mount Isa to Townsville Economic Development Zone which promotes irrigated cropping along the Burdekin River. Any future undertakings that significantly increase activity in the agricultural sector will likely result in increased demand for agricultural water.

Currently, there are existing water allocations already held within the sector which may be capable of meeting some level of increased water demand, depending on demand location and seasonal assignment availability. In addition to existing water entitlements, the Burdekin Basin Resource Operations Plan shows that there is a 'general reserve' of 10 000 ML, and a 'strategic reserve for State purposes' of 10 000 ML, that could potentially be used to meet any significant increases in water demand. It is therefore anticipated that any future increase in water demand from the agricultural sector will not negatively impact on urban supplies for Charters Towers.



Industry and mining

Council is pursuing investment for a new meat processing facility at Charters Towers, among other enterprises. The water demand from agricultural industries such as this, based in or in close proximity to Charters Towers city, have the potential to place additional pressure on the water resources currently supplying Charters Towers' reticulation network, depending on how their water supply is managed.

The requirement for an additional, say, 2 ML/day for a processing plant can significantly increase the overall demand placed on the storage capacity of Charters Towers Weir, depending on how it is supplied. As previously mentioned, the combined demand from urban use, agriculture, industry and mining is only around 1 per cent of the mean annual flow over the Charters Towers Weir. However, the weir's storage capacity is relatively small, so any impact from demand is realised to the greatest extent for the periods when demand continues but flows over the weir cease.

Other industrial activity centred in Charters Towers is generally of a smaller scale, consistent with most urban areas. Existing water demand from local industry is currently met through the reticulated system. Any future growth in this demand is expected to be approximately proportionate to population growth and, as such, growth in demand from industry is reflected in the growth figures for urban demand.

Council is currently developing land to allow expansion of the industrial area adjacent to the existing Cunningham Industrial Estate. At this stage there are no industrial developments anticipated that are likely to significantly impact on Charters Towers' water demand.

It is anticipated that the mining industry is likely to continue to be a significant contributor to Charters Towers' economy, particularly through the provision of employment. Mining activity in and around Charters Towers fluctuates to some extent with changes in the global demand for resources, and is likely to continue to do so. Given the nature of mining in the region, it is not expected that future mining operations themselves will result in any significant change or impact on the water supplies for Charters Towers. However, there is potential for new mining and industrial activity to increase the population of Charters Towers, the impact of which is reflected through the projected high-growth water demand scenario figures for Charters Towers' reticulation network.

Water supply system capability

Hydrologic assessment of Charters Towers’ water supply system

Hydrologic assessments have been undertaken to ascertain the capability of Charters Towers’ existing water supply system (including existing operational arrangements and water entitlements) to meet current and projected future water demands.

Both historical and stochastic modelling techniques were used to simulate the performance of Charters Towers’ water supply sources. Stochastic modelling involves generating data sequences that incorporate key statistical indicators from the historical record. Stochastic modelling 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 Charters Towers Weir. The results were aggregated and the median output used to identify the likelihood of water supply shortfalls for the system. 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 median is used as it is always representative of the centre of the data, whereas the mean (average) is only representative if the distribution of the data is symmetric.

Table 2: Water restriction levels and assumed water demand reduction

Water restriction level	Trigger level in weir (m AHD)*	Target demand reduction*	Effect on per capita water consumption (Based on average demand)
Level 0 (permanent)	231.0 (Weir full)	Nil	1522 L/c/d
Level 1	230.9 (0.1 m below weir crest)	15%	1294 L/c/d
Level 2	230.4 (0.6 m below weir crest)	27%	1111 L/c/d
Level 3	229.9 (1.1 m below weir crest)	39%	928 L/c/d
Level 4	228.9 (2.1 m below weir crest)	45%	837 L/c/d

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

The hydrologic assessments assumed that all existing water entitlements accessing water from the weir or watercourses supporting the system were fully developed and operational, with the exception of the water entitlements used to supply the Charters Towers reticulation network. Charters Towers’ demands were represented at various total annual demand levels to reflect the impact of population growth (or other causes of) increasing demand.

Council currently has in place a framework of permanent water conservation measures and water restrictions to reduce water consumption and maximise water use efficiency. Under the Charters Towers Regional Council Drought Management Plan, Council can impose a staged water restriction regime across the Council area in response to drought or other temporary water shortage events. The hydrologic assessments included the application of water restriction regimes for Charters Towers’ reticulation network as shown in table 2. These restrictions are designed to reduce urban demand and prolong the supply capability of the system.



Frequency of water supply shortfalls and water restrictions

A water supply shortfall is defined as an event where water supply is unable to meet water demand. Therefore, if water demand is 10 ML for a particular day and, due to limited availability or operational constraints the system is only able to supply 8 ML, this would be identified as a supply shortfall.

Stochastic modelling results indicate that, at current and projected future demands to the year 2036, Charters Towers’ reticulation network should not experience a water supply shortfall. These assumptions are based on the assumptions that the restriction regime listed in table 2 is implemented, water demand reductions are achieved and that current patterns of water use and rainfall continue to be experienced.

As indicated earlier, Charters Towers’ urban water is supplied from Charters Towers Weir. Council has recently revised its water restrictions regime, which is based on water levels in the weir, water demands and time of year. These restrictions are intended to reduce water use during drier periods and thereby extend the duration of the available water supply.

Figure 5 provides an indication of the likelihood that water restriction levels one to four, as described in table 2, could be expected to be triggered for Charters Towers’ reticulation network.

As illustrated by figure 5, as Charters Towers’ water demand increases, the frequency at which trigger levels for water restrictions are reached will also increase, with the consequent potential effects on the community. For example, the average recurrence interval of Level 4 water restrictions (represented by the purple line) being imposed at a water demand level of 4500 ML/a is 11 years, whereas at a demand level of 5500 ML/a it is 8.3 years.

Considerations such as what is 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 Charters Towers Regional Council and generally by councils across Queensland.

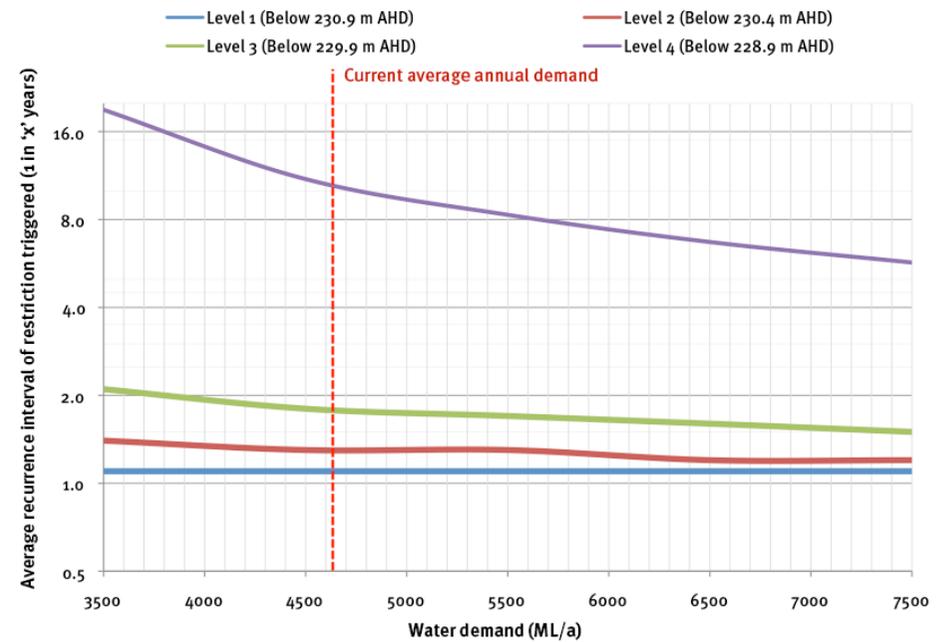


Figure 5: Frequency of water restrictions against total annual demand

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 water restrictions for short durations (e.g. one month) even if they occur more frequently, than to experience water restrictions for longer durations (e.g. three or six months) even if they occur far less frequently. Similarly, experiencing less severe restriction levels that occur more frequently may be more acceptable than experiencing more severe restrictions that occur less frequently.

With increasing water demand there is not only an increase in the likely frequency of water restrictions, but there is an increase in both the likely duration and likely severity ('level') of those restrictions.

Figure 6 shows, for a range of water demand levels, the predicted frequency of level 2 water restrictions lasting for longer than one month, and the proportion of those periods that last for more than 3 months and more than 6 months. It can be seen from figure 6 that, with an increasing level of water demand, there is generally not only an increase in the predicted number of occurrences of water restrictions being imposed, but the relative proportion of those occurrences that last for longer than three months and six months is also increased. Figure 7 shows this same effect for level 3 water restrictions.

As with the acceptable frequency of the various restriction levels being applied, the acceptable duration and severity of the restrictions being imposed are fundamental parts of water supply planning. Together, these three aspects (frequency, severity and duration), along with the ability to maintain a minimum supply during drought, comprise the long term reliability of the system and are referred to as the 'level of service'. The level of service for Charters Towers is a matter that Council determines, considering factors such as water availability, customer needs, liveability and affordability.

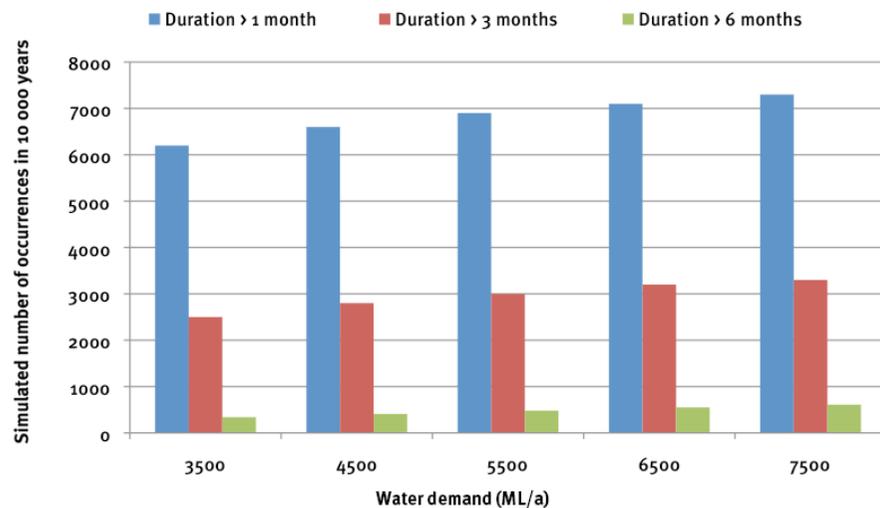


Figure 6: Number and duration of Level 2 water restriction events occurring at various annual water demands

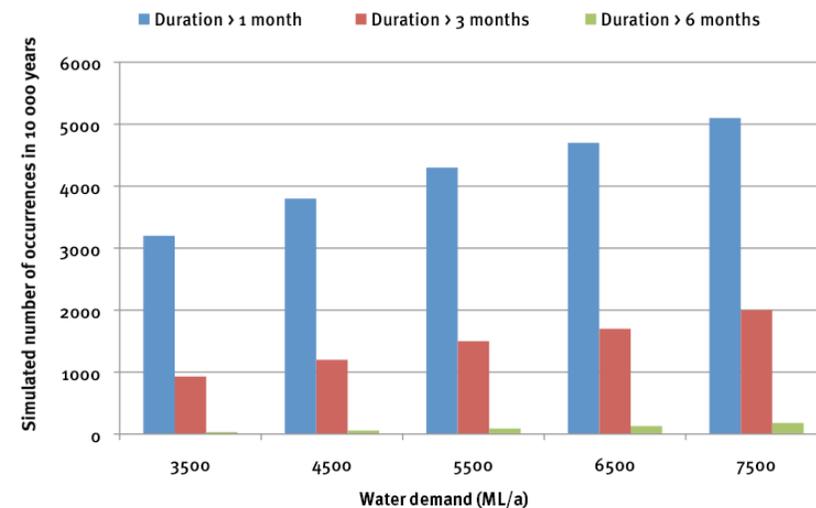


Figure 7: Number and duration of Level 3 water restriction events occurring at various annual water demands

Moving forward

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

Charters Towers Regional Council recognises the importance of ensuring the future security of the water supply to the Charters Towers Region. This RWSSA identifies, for the community of Charters Towers, an average daily demand for water during recent dry periods of 1522 litres per capita per day. Council considers this demand to be unsustainably high on a long term basis. Consequently, Council will investigate, develop and implement solutions to manage demand and maintain water supply security for Charters Towers.

Increasing water supply security from the region's finite resources will ensure an ongoing reliable supply of drinking water for Charters Towers.

Some of the areas of ongoing investigation may include:

- Demand management through optimisation of the reticulation system, education of the community on water saving measures and appropriately applied tariffs.
- Significant water infrastructure upgrade programs over the next 3–4 years, which will review existing assets and operational parameters, achieve efficiency gains and identify any needs for new infrastructure.
- Improvements in the operation of the effluent reuse system and increasing its distribution network for fit for purpose use, which will further reduce reliance on potable water supplies for some irrigation.
- Increased storage capabilities in the form of a new upstream weir, which could provide extra water for agriculture and increased security for residential demand.

Identifying what is an appropriate level of service for water supply security in Charters Towers will involve balancing an acceptable water demand and supply against the lifestyle and expectations of residents, particularly considering the dry climate of Charters Towers. Levels of service and performance targets will determine when restrictions will be applied, how often restrictions may occur and how long restrictions may last. Council will manage this process and establish with the community an acceptable level of risk to ensure an adequate water supply from the Burdekin River into the future.





**For more information on the
Regional Water Supply Security Assessment
program please visit www.dews.qld.gov.au**

