Rockhampton

Regional Water Supply Security Assessment

Rockhampton Regional Council

Queensland Government

CS4682 11/15

February 2016

Images courtesy of Rockhampton Regional Council and Tourism and Events Queensland

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

Introduction

Rockhampton is located in Central Queensland approximately 600 km north of Brisbane and has a population of about 84 000 people. While traditionally identified as the beef capital of Australia, Rockhampton has a diverse economy and provides a significant services base for the Central Queensland mining, industrial, and agricultural sectors.

Along with other regional centres in Queensland, Rockhampton and the surrounding urban communities are expected to experience economic and population growth over the coming decades.

Safe, secure and reliable water supplies are an essential resource for supporting this growth, not only providing for the health and wellbeing of the community, but also providing opportunities for economic and community development. Accordingly, the Department of Energy and Water Supply and Rockhampton Regional Council (Council) through Fitzroy River Water have committed to a partnership to investigate and establish a shared understanding of the capabilities of the existing raw water supply and its capability to provide for future growth.

Arising from this partnership, this Regional Water Supply Security Assessment for Rockhampton provides valuable information to the community and water supply planners about the water supply security for Rockhampton and provides a foundation for future water supply planning.

This assessment considers various growth scenarios to determine the timing and magnitude of potential water supply shortfalls under the existing water supply arrangements.

Rockhampton's water supply sources

Rockhampton's primary source of water is the Fitzroy Barrage storage which is located on the Fitzroy River close to the city centre as shown in Figure 1. It is owned by Council and is the sole storage in the Fitzroy Barrage Water Supply Scheme (WSS).

The Fitzroy Barrage WSS is operated in conjunction with the Lower Fitzroy WSS. Eden Bann Weir is the sole storage in the Lower Fitzroy WSS, and is located on the Fitzroy River upstream of the barrage. Eden Bann Weir is owned and operated by SunWater.

Stanwell power station is the primary user of water from the Lower Fitzroy WSS, and takes its water from the scheme via an intake located within the Fitzroy Barrage storage.

Together these two schemes have a combined total storage capacity of about 110 300 Megalitres (ML) (74 400 ML for the Fitzroy Barrage and 35 900 ML for Eden Bann Weir) and a combined total useable storage volume of about 76 100 ML (49 850 ML for the Fitzroy Barrage and 26 250 ML for Eden Bann Weir). These storage volumes incorporate the results of a new survey of the Fitzroy Barrage's storage which was undertaken by Council in 2014. The new volumes are lower than the volumes previously measured and that were used for the Fitzroy Basin Resource Operations Plan (Fitzroy ROP).

Water allocations from the two schemes (established through the *Water Resource (Fitzroy Basin) Plan* (Fitzroy WRP) and Fitzroy ROP) currently total 90 714 ML (76 003 ML of high priority (HP) water allocations and 14 711 ML of medium priority (MP) water allocations). The performance capabilities of the water supply are discussed later in this assessment.

The Fitzroy ROP includes provisions establishing a minimum operating level for the Fitzroy Barrage below which water must not be supplied (unless otherwise authorised by the Department of Natural Resources and Mines (DNRM)). This minimum operating level, EL -1.2 m Australian Height Datum (AHD), was set given the degree of uncertainty relating to potential impacts of operating at lower levels on the quality of water stored in the barrage.

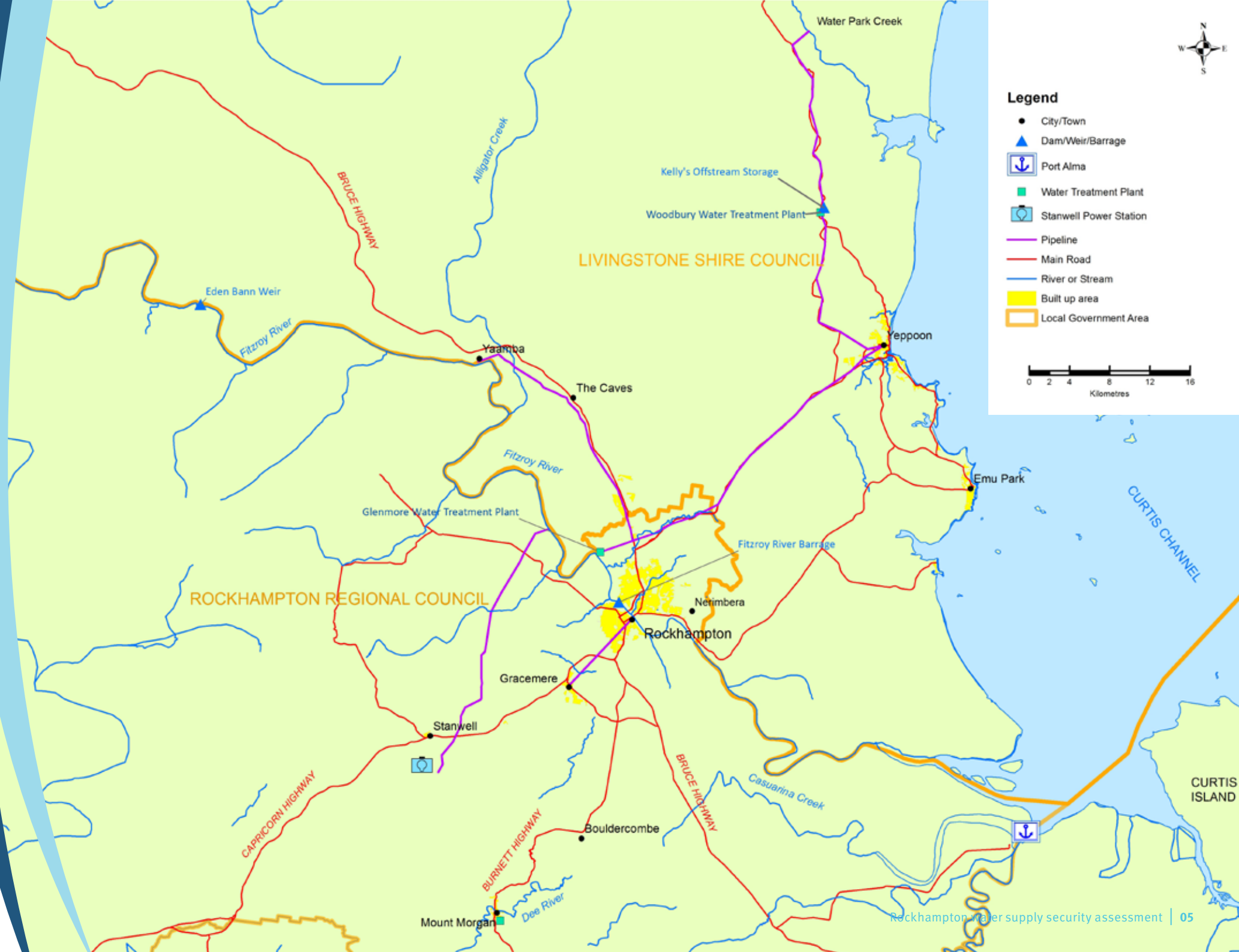
It should be noted that Council's existing intake works are equipped to take water at levels below EL -1.2 m AHD, should DNRM give such authorisation. The volume of water stored below the minimum operating level is currently estimated to be about 20 500 ML. In addition to the water stored below the minimum operating level, some of the water stored within the Fitzroy Barrage storage is also stranded in upstream waterholes and is unable to be accessed at Rockhampton's water supply intake point.

Council currently holds 50 383 ML per annum (ML/a) of the 50 483 ML/a of HP water allocations from the Fitzroy Barrage WSS and the Stanwell Corporation holds a HP water allocation of 24 000 ML/a from the Lower Fitzroy WSS for the Stanwell power station.

SunWater also holds 1503 ML/a of HP water allocations in the Lower Fitzroy WSS, 1275 ML/a of which caters for losses associated with supplying water via the pipeline to Stanwell power station.

The 14 711 ML/a of MP water allocations supplied from the schemes are principally used for irrigation. The bulk of this, 11 610 ML/a, is associated with the Fitzroy Barrage WSS. Access to MP water is cut off when the water level in the barrage falls below EL 0.75 m AHD as specified in the Fitzroy ROP to ensure security for HP water allocations. The Fitzroy ROP also provides for conversion of MP water allocations to HP water allocations and HP water allocations to MP water allocations subject to maximum and minimum volumes of HP water allocation volumes in each scheme being maintained.

Figure 1 Rockhampton region water supply system


Legend
City/Town
Dam/Weir/Barrage
Port Alma
Water Treatment Plant
Stanwell Power Station
Pipeline
Main Road
River or Stream
Built up area
Local Government Area
0 2 4 8 12 16
Kilometres
N
S
W
E
Water Park Creek
Alligator Creek
BRUCE HIGHWAY
Kelly's Offstream Storage
Woodbury Water Treatment Plant
LIVINGSTONE SHIRE COUNCIL
Eden Bann Weir
Fitzroy River
Yeppoon
Yaamba
The Caves
Fitzroy River
Emu Park
CURTIS CHANNEL
Glenmore Water Treatment Plant
Fitzroy River Barrage
ROCKHAMPTON REGIONAL COUNCIL
Nerimbera
Rockhampton
Gracemere
Stanwell
CAPRICORN HIGHWAY
BRUCE HIGHWAY
Casuarina Creek
CURTIS ISLAND
Boulder combe
BURNETT HIGHWAY
Dee River
Mount Morgan

Existing water use

Rockhampton's reticulation network

The Rockhampton reticulation network currently provides drinking water supply services to Rockhampton city and a number of adjacent communities. These include in the Council area, Gracemere, and in the adjacent Livingstone Shire, the Capricorn Coast and The Caves. The supply to the Capricorn Coast occurs via the Rockhampton to Yeppoon pipeline which supplements the coast's local Water Park Creek supply source.

In total approximately 108 000 people, including around 24 000 on the Capricorn Coast, access drinking water supplies sourced from the Fitzroy Barrage via the Rockhampton reticulation network.

Figure 2 shows the total annual water extractions from the Fitzroy Barrage for the period 2008–09 to 2013–14 as well as the volume of water extracted for supply to the Capricorn Coast (including the volume supplied via the Rockhampton to Yeppoon pipeline).

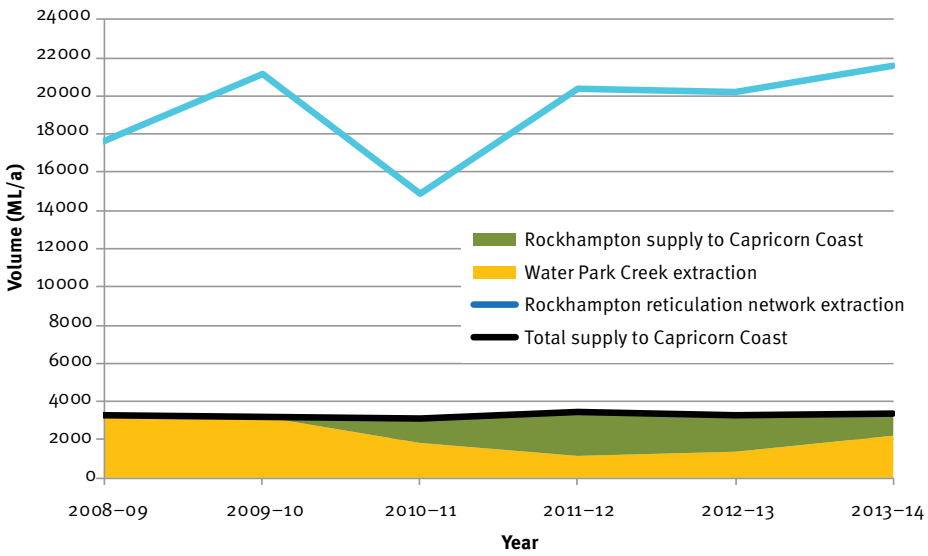


Figure 2 Total volume of water extracted from the Fitzroy Barrage storage (2008–09 to 2013–14)

The total annual volume of water sourced from the Fitzroy Barrage for the Rockhampton reticulation network between 2008–09 and 2013–14 averaged about 19 300 ML/a, ranging between a high of 21 600 ML in 2013–14, and a low of 14 917 ML in 2010–11.

For the Rockhampton WSS (that is, the area serviced by the Rockhampton reticulation network excluding the Capricorn Coast), the total annual volume of water sourced from the Fitzroy Barrage between 2008–09 and 2013–14 averaged about 18 200 ML/a, or in per capita terms about 625 Litres per capita per day (L/c/d).[1] This included a high of about 750 L/c/d in 2009–10. Between 2008–09 and 2013–14 the volume of water extracted from the Fitzroy Barrage for residential uses averaged about 330 Litres per person per day (L/p/d).

For the Capricorn Coast, the combined total annual volume of water sourced from Water Park Creek and the Rockhampton reticulation network between 2008–09 and 2013–14 averaged about 3280 ML/a, or in per capita terms about 410 L/c/d. During this period the volume of water supplied via the Rockhampton to Yeppoon pipeline averaged about 1670 ML/a, or about 200 L/c/d, including a high of 2317 ML in 2011–12. The estimated volume of water extracted for residential uses on the Capricorn Coast averaged about 350 L/p/d.

While residential water use in Rockhampton and on the Capricorn Coast is comparable, the higher per capita use in Rockhampton reflects its larger industrial and other non-residential uses.

The National Water Commission's *National Performance Report 2013–14 Urban Water Utilities* reports Fitzroy River Water recorded the second highest annual consumption per connected property out of 18 water service providers in the same size category across Australia. Annual water consumption per connected property was also greater for Fitzroy River Water than four out of five other regional Queensland centres included in this report.

[1] L/c/d water use is the mean daily volume of water sourced divided by the serviced population. The volume of water sourced includes residential, commercial, industrial and municipal uses along with any system losses. For clarity, the volume of water used includes water use associated with transient populations such as tourists and temporary workforces, however the serviced population figure used in the calculation does not include the transient population.

Similarly, the L/p/d residential water use figures are calculated by taking the mean daily residential water use divided by the serviced population. For clarity, the residential water use volume does not include water use by the transient population, and similar to the L/c/d calculation, the serviced population figure used in the calculation does not include the transient population.

Other existing uses of the bulk water supply sources

Urban

No other urban communities access water directly from the Fitzroy Barrage WSS or Lower Fitzroy WSS.

Industry

In recent years Stanwell power station has typically used between 18 000 ML/a and 20 000 ML/a of its 24 000 ML/a HP water allocation from the Lower Fitzroy WSS.

Apart from industrial users accessing water via the Rockhampton reticulation network, there are no other industrial users of water from the Lower Fitzroy WSS or Fitzroy Barrage WSS.

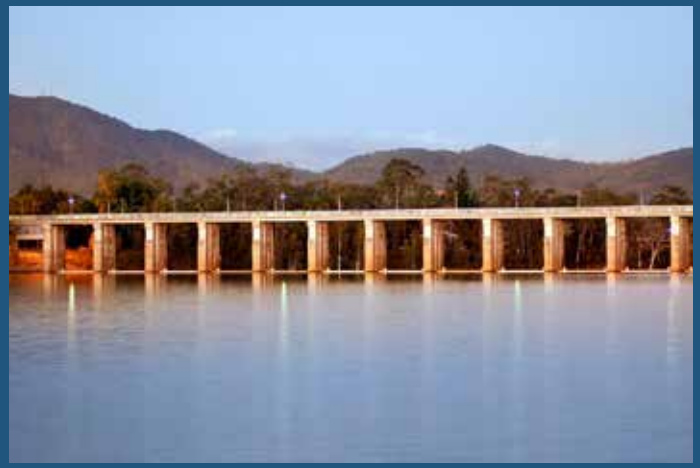
Agriculture

Agricultural water use from the Lower Fitzroy and Fitzroy Barrage WSSs between 2006–07 and 2013–14 has averaged about 5000 ML/a, including a high of 8300 ML/a in 2006–07.


Stanwell Power Station

Future water use

Well-founded water supply planning requires an understanding of the likely and possible changes in water demand into the future. Because Eden Bann Weir and the Fitzroy Barrage are operated in conjunction, it is important to understand how water use by the agricultural and industrial sectors, in particular Stanwell power station, may impact on water availability during critical dry periods.



Rockhampton's reticulation network

The population serviced by the Rockhampton reticulation network, including the Capricorn Coast, is projected to grow from the current population of about 108 000 people to about 164 000 by 2036. For the Rockhampton WSS, it is projected that the serviced population will increase from the current 84 000 people to about 116 000 by 2036, while for the Capricorn Coast, the serviced population of about 24 000 people is projected to increase to about 48 000 people by 2036.

Figure 3 shows a dry condition water demand projection for the Rockhampton reticulation network, which includes demand for water within the Rockhampton WSS (including The Caves and Gracemere) and water demands within the Capricorn Coast WSS. This demand projection considers, among other things, the population projections for each centre, assumptions regarding per capita water consumption, and the supplies available to the Capricorn Coast from Water Park Creek.

Water demands that might occur in drier years, rather than just the water demands that might occur in average rainfall or even wetter years is an important planning consideration for Rockhampton's supply. During drier years, water demands will typically be higher, such as for outdoor residential use. On some occasions this could coincide with occurrences of low inflow to the Fitzroy Barrage and Eden Bann Weir, which require regular seasonal inflows in order for water supplies to the Rockhampton reticulation network to be maintained.

The dry condition water demand projection shown in Figure 3 includes the application of an assumed per capita rate of consumption of 700 L/c/d for the serviced population associated with Rockhampton and 455 L/c/d for the serviced population associated with the Capricorn Coast. These consumption rates are based on the recent levels of annual water use, with adjustments to account for higher water demands during drier years.

Figure 3 also shows demand projections with average water use for the Rockhampton and Capricorn Coast WSSs. These projections are based on maintaining the recent levels of average annual water use; 625 L/c/d for the Rockhampton WSS and 410 L/c/d for the Capricorn Coast WSS.

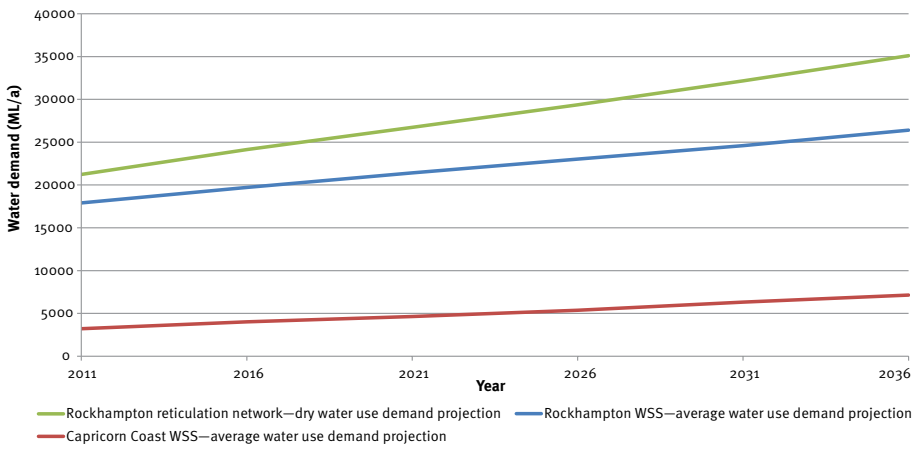
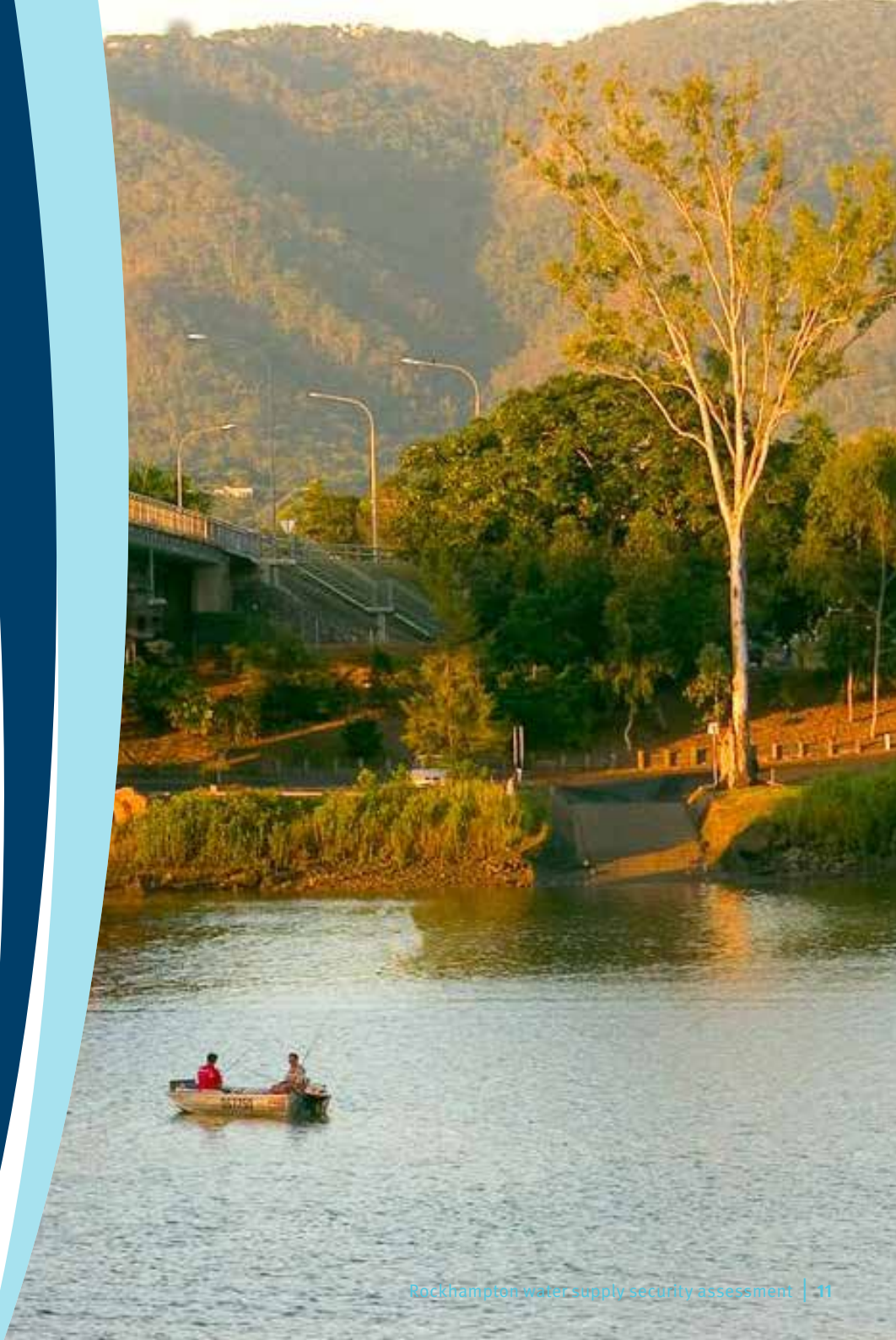


Figure 3 Rockhampton reticulation network — proposed demand projections

As indicated previously, the Rockhampton reticulation network supplements the water supply for the Capricorn Coast depending on the volume that can be supplied to the Capricorn Coast from Water Park Creek. Livingstone Shire Council has a 4400 ML/a water entitlement from Water Park Creek which is subject to a 17 ML/d extraction limit. Previous analysis undertaken for Livingstone Shire Council suggests that Water Park Creek may have been able to yield at least 2400 ML/a in all years over the period of the historical records.

Given the Rockhampton reticulation network's dependence on regular seasonal inflows to the Fitzroy Barrage and Eden Bann Weir in order to maintain supplies, the dry condition demand projection for the Rockhampton reticulation network gives consideration to the potential demands which might occur from the Capricorn Coast on the network during critical periods. For this purpose, it has been assumed that the Water Park Creek supply could be limited to 2400 ML/a in critical periods, and as such the Capricorn Coast is highly likely to be dependent on supply from the Rockhampton reticulation network at these times.

Growth in demand for water for industrial development and commercial business throughout the Rockhampton and the Capricorn Coast regions is expected to remain proportional to respective residential growths. The dry condition and average water use demand projections will of course be subject to ongoing monitoring of actual growth and any variations in water use trends.



Other future uses of the bulk water supply sources

Industry

It is expected that Stanwell Corporation will continue to operate Stanwell power station within its existing 24 000 ML/a water allocation.

The Gladstone Area Water Board (GAWB) currently has contracted commitments for supply of around 60 000 ML/a of water from Awoonga Dam to regionally significant heavy industry located around Gladstone, to the Callide power stations, and to Gladstone and surrounding communities. As part of its strategic plan, GAWB has identified the Fitzroy River as its next preferred water supply source. Immediate pressures for GAWB to access water supplies from the Fitzroy River have been alleviated in recent years by, among other things, deferral of major new industrial developments and the filling of Awoonga Dam after its recent major raising. However, investigations have continued to be progressed to ensure the necessary infrastructure can be developed in a timely manner when needed.

The Fitzroy ROP includes a process for granting to GAWB up to 30 000 ML of the 76 000 ML strategic water infrastructure reserve for the Fitzroy River identified in the Fitzroy WRP. Under the GAWB proposal, access to supplemented water allocation in the lower Fitzroy River is dependent on development of supporting water supply infrastructure on the Fitzroy River. However, the Fitzroy ROP also provides for granting to GAWB (in advance of the development of the supporting infrastructure) a water licence subject to, among other things, a flow condition equivalent to at least 432 ML/d passing the Fitzroy Barrage.

Agriculture

There is an identified potential for agricultural expansion to occur along the Fitzroy River and in adjacent areas. This includes potential development within the Fitzroy Agricultural Corridor, such as intensive livestock and horticultural enterprises, as well as the potential expansion of existing enterprises. It is expected that water needs will be met through improvements in water use efficiency, trading of water allocations, increased utilisation of water entitlements and development of additional water supply infrastructure.

Water supply system capability

Hydrologic assessments have been undertaken to ascertain the capability of Rockhampton's existing water supply system to meet current and projected future water demands. Both historical and stochastic modelling were 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 the Fitzroy Barrage would have been during years prior to its completion in 1970. 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.

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 method, one hundred sequences of 10 000 years of stochastic data were generated for the Fitzroy River 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 from the Fitzroy Barrage. 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 undertaken assumed that all existing water entitlements in the Fitzroy Basin were fully developed and operational, with the exception of those used to supply the Rockhampton reticulation network and Stanwell power station. The entitlements used to supply the Rockhampton reticulation network and the power station were represented at various demand levels up to full entitlement to enable the performance of the water supplies at each demand level to be assessed.

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

As indicated earlier, Rockhampton obtains its water supply from the Fitzroy Barrage WSS which is operated in conjunction with the Lower Fitzroy WSS from which Stanwell power station sources its supply. The modelling approach treats both Rockhampton and Stanwell's water allocations equally.

In addition, the new Fitzroy Barrage storage curve generated by Council has been used for this assessment, and the hydrologic outputs presented in this assessment are based on scenarios without any water restrictions being applied. The new storage curve is being used by Council as part of a review of Rockhampton's *Drought Management Plan*, which includes consideration of potential water restriction measures and/or other demand management measures.

Historical performance of the Fitzroy Barrage and Eden Bann Weir

Figure 4 shows the simulated storage behaviour of the Fitzroy Barrage over the historical period from 1889 to 2007, with Figure 5 showing in more detail how the barrage may have performed in the critical period between 1901 and 1903. The modelling results shown in Figure 4 and in Figure 5 assume, among other things, that the storages are operated in accordance with the current operating arrangements and water demands of 25 000 ML/a by the Rockhampton reticulation network and 20 000 ML/a by Stanwell power station. The Fitzroy Barrage's minimum operating volume (24 570 ML) comprises the water stored in the barrage below the minimum operating level (EL -1.2 metres AHD) and the water stranded in the barrage's upstream waterholes which are unable to be accessed at Rockhampton's water supply intake point.

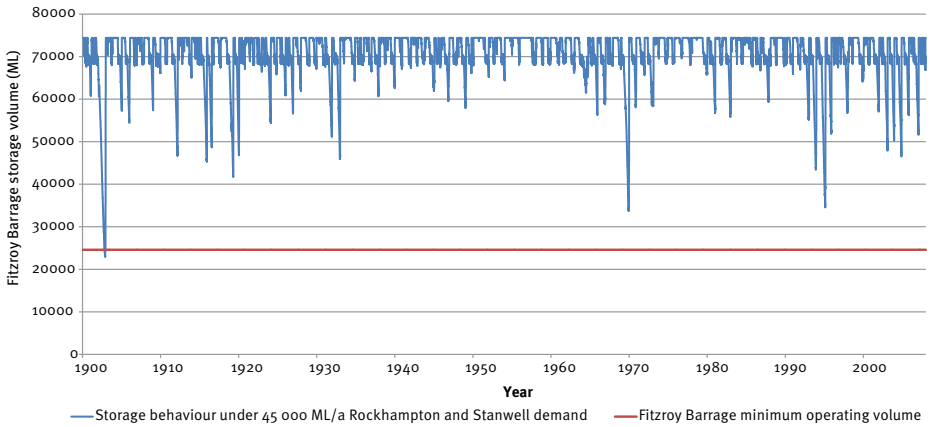


Figure 4 Fitzroy Barrage — Simulated historical storage behavior at current water demand (1889–2007)

In most years, flows in the Fitzroy River far exceed that required to fill both the Eden Bann Weir and Fitzroy Barrage storages. However, as can be seen from the simulated storage behaviour shown in Figure 4, water levels in the Fitzroy Barrage would have fallen to relatively low levels on a number of occasions over the last 100 years.

It can also be seen from both Figure 4 and Figure 5 that the water levels in the barrage can fall quite rapidly. Eden Bann Weir and the Fitzroy Barrage are heavily reliant on seasonal inflows from the Fitzroy River — in particular the occurrence of annual wet season events — to maintain continuity of supply. It is estimated that at current levels of demand the storages could fall from full to empty in about 16 months (this assumes no further inflows to the storages during this period and minimal groundwater contributions from the surrounding area to the storage). Given the potentially short duration of available supplies, careful consideration of triggers for the implementation of restrictions and also the time required to plan and implement contingency supply arrangements is required.

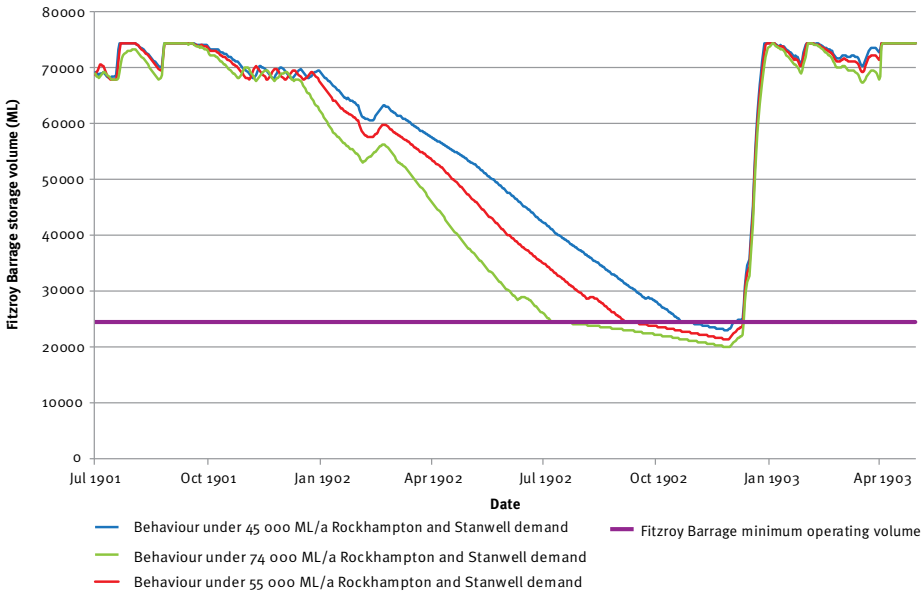


Figure 5 Fitzroy Barrage — Simulated historical storage behaviour for range of water demands (1901–1903)

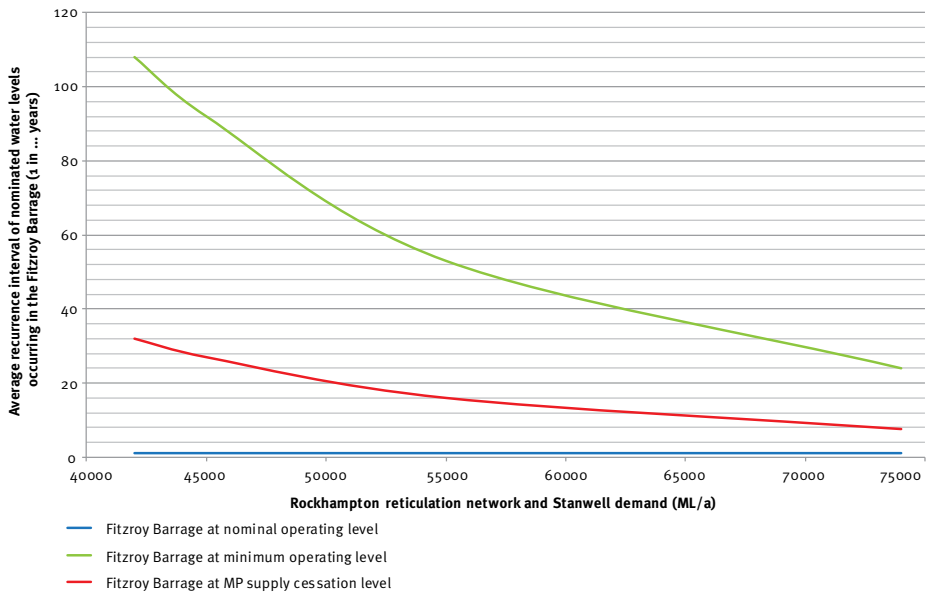


Figure 6 Frequency of Fitzroy Barrage storage falling below nominated water levels for a range of total water demands

Frequency of low water levels occurring in the Fitzroy Barrage and supply failure

Figure 6 shows, for a range of water demands and with no water restrictions applied, the frequency that water levels in the Fitzroy Barrage could be expected to fall below the following levels if all other water allocations in the Fitzroy Basin are fully utilised:

- the minimum operating level EL -1.2 metres (minimum level above which water is authorised to be taken (unless otherwise authorised by DNRM))
- the MP supply cessation level EL 0.75 metres (the trigger for cessation of supplies for MP water allocations). Depending on groundwater contributions to the barrage, this represents at current levels of demand about four to five months supply remaining for Rockhampton and Stanwell power station without further inflows, and
- the nominal operating level EL 3.38 metres, (the barrage will fall below the nominal operating level, which is 0.4 metres below the full supply level of the barrage, when supplies in Eden Bann Weir have fallen to low levels and releases to the barrage from Eden Bann Weir have ceased). Depending on groundwater contributions to the barrage, this represents at current levels of demand potentially about nine months supply remaining without further inflows.

The Rockhampton reticulation network currently takes up to about 22 000 ML/a from the Fitzroy Barrage, while Stanwell power station currently takes up to about 20 000 ML/a. From Figure 6, it can be seen that at this combined level of use, that is 42 000 ML/a, it is anticipated that the barrage storage could be below the MP supply cessation level on average about once in 32 years, and be below the minimum operating level on average about once in 108 years.

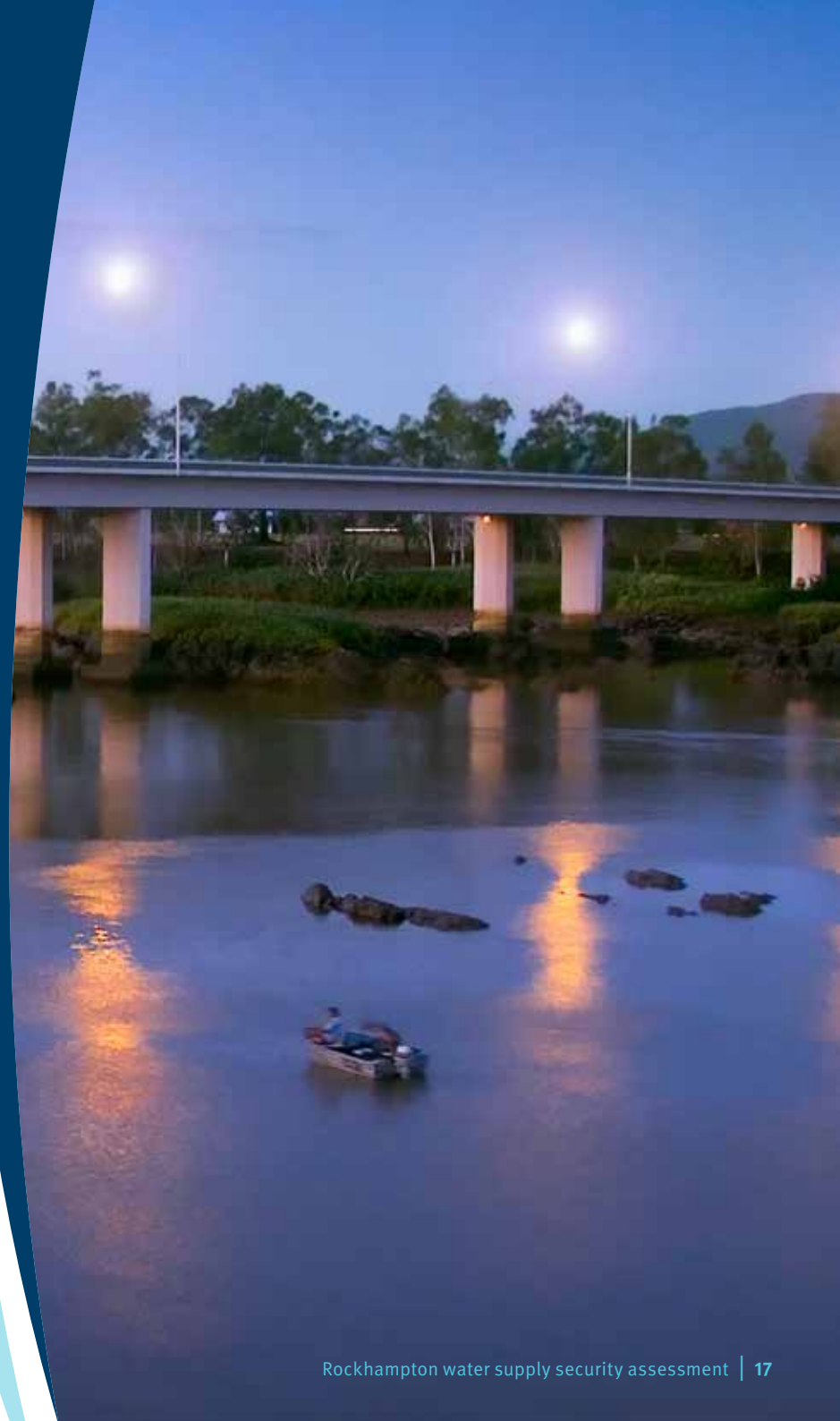
However, as water demand increases, the frequency at which these levels are reached will also increase. For example, if the combined Rockhampton reticulation network and Stanwell power station demand increases to about 55 000 ML/a, it is anticipated that the barrage storage could on average be below the MP supply cessation level about once in 16 years, and below the minimum operating level about once in 53 years.

This level of water demand is currently projected to occur in about 2035 if Stanwell power station water usage is maintained at the current 20 000 ML/a, however could occur by about 2027 if the power station's usage was to increase to the level of its water allocation of 24 000 ML/a.

Should both the Council's and Stanwell power station's existing water allocations be fully used, the barrage storage could on average be below its minimum operating level about once in 24 years.

In all cases, the implementation of restrictions or other measures to reduce the water demand on the Fitzroy Barrage would reduce the likelihood of the storage falling to its minimum operating level. The effect of any restriction regime will be dependent on, among other things, the level or levels in the barrage at which restrictions are applied and their severity.

Considerations such as determining acceptable frequency of falling below certain levels in the barrage, and any associated actions, 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 Council, and generally by councils across Queensland.



Duration that the Fitzroy Barrage may be below specified levels

Figure 7 indicates, for a range of water demand levels, the likelihood of the water level in the barrage being below the minimum operating level for continuous durations of longer than one month, longer than six months and longer than twelve months.

Similarly, Figure 8 indicates the likelihood of the water level in the barrage being below the MP supply cessation level for more than one, six and twelve months continuous durations, and Figure 9 indicates the likelihood of the water level in the barrage being below its nominal operating level for these same continuous durations.

Figures 7, 8 and 9 show that a significant proportion of the occasions that the water level in the barrage could fall below the minimum operating level, the medium priority supply cessation level and the nominal operating level for more than one month may be for periods of less than six months. However, it is also evident that at times the barrage could potentially be below these levels for extended periods.

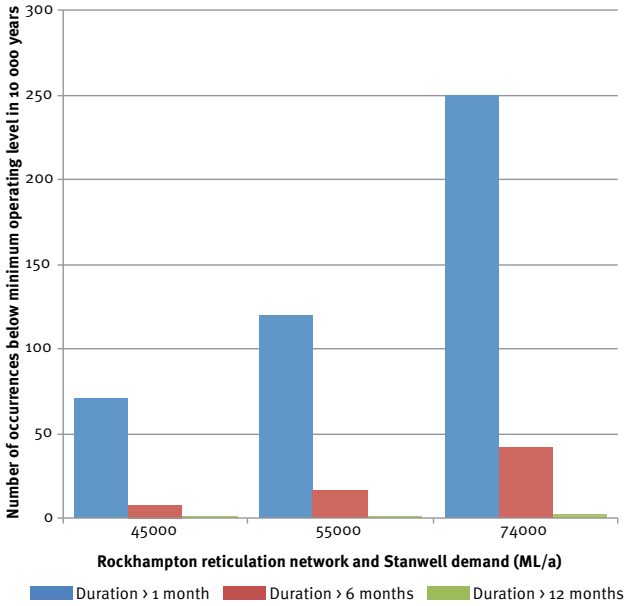


Figure 7

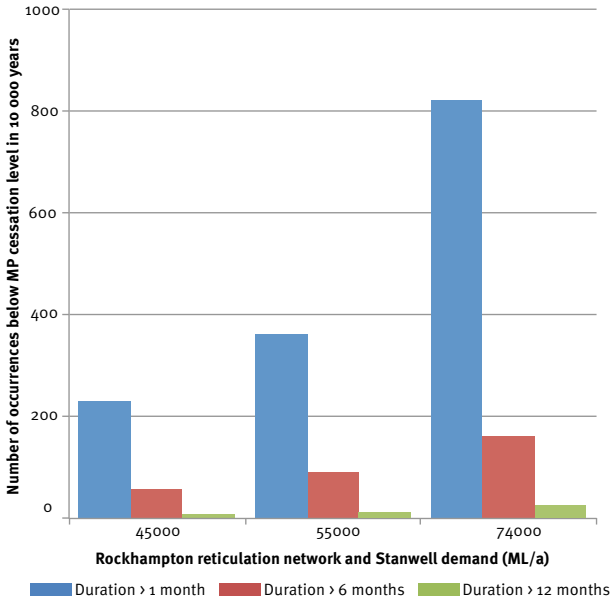


Figure 8

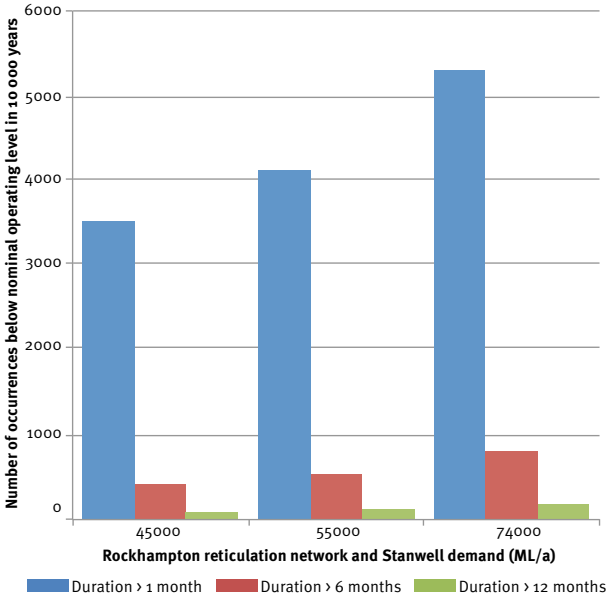


Figure 9

Figure 7, 8 and 9 Simulated number and duration of occurrences Fitzroy Barrage storage below specified levels at various annual water demands

Moving forward

Rockhampton has a proud history of having an abundant and affordable water supply to meet the needs of the community. As the Rockhampton and surrounding community continues to develop and grow, it is important to ensure that this abundant and affordable water supply is sustained.

Council is committed to undertaking a range of activities towards achieving long-term water security for this growing region. The types of activities underway include, the continued promotion of waterwise behaviours and water efficiency within the community to reduce per capita consumption to a long-term sustainable level, further reduction in water losses associated with the operation of the water reticulation systems, and replacing the use of potable water with the use of recycled water where this represents a feasible and appropriate use. Council continues to carefully monitor water demand patterns across the community to help ensure demand management strategies can meet the seasonal and other changes to water usage.

A number of other significant opportunities for increasing water security are currently being assessed by Council. These opportunities include:

- changes to the way in which the Fitzroy Barrage is operated to increase water security
- improved relationships with key large-scale water users towards a shared demand management strategy for the Fitzroy Barrage storage
- interacting with key agencies and proponents involved in identifying and constructing future water storages in the Fitzroy Basin that have the potential to improve Rockhampton's water security
- ongoing development and refinement of modelling tools/techniques to enable water supply decisions for the Lower Fitzroy to be informed with the best available information.
- investigation of alternative water supply sources such as desalination.

With this measured approach to managing water security, the significant potential for further population growth as well as the growth and development of key industries including agriculture, can be realised. In this way, ensuring water security will underpin the future growth and prosperity of this great region.

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

Queensland Government