Our**Water**Security

CAIRNS REGIONAL COUNCIL
WATER SECURITY STRATEGY
FINAL REPORT

DATE
MARCH 2015

CAIRNS WATER SECURITY STRATEGY – At a glance

Situated between the World Heritage Listed Great Barrier Reef and Wet Tropics rainforest, Cairns City and the surrounding region offers attractive places to live, visit and holiday. Underpinned by the expansion of industries including agriculture, fisheries, and tourism, the population of the region continues to increase steadily year by year. The proposed integrated resort development *Aquis Resort at The Great Barrier Reef* (Aquis Resort) is expected to add a further increase to population growth in the region. With such development and population growth comes resource management challenges including the management of one of our most precious resources – water.

In late 2013, Cairns Regional Council started a resource planning project called *Our Water Security*. Between April 2014 and March 2015, a community-based *Water Security Advisory Group* (WSAG) met on a regular basis to consider the water supply needs of the Cairns region and, ultimately, to formulate a preferred water supply strategy for consideration by the Council. The strategy plans to meet the needs of the Cairns region for the next 30 years.

Numerous water supply options were considered by the WSAG:

- Potable water demand reduction strategies
- Enhancement of the bulk water supply system
- New bulk water sources
- New bulk water treatment and reuse plants

Over twelve months, the WSAG considered technical reports detailing the current water supply chain, possible alternatives, supply enhancements and the implications of each option for the community. The frequently robust discussions resulted in a highly rigorous assessment process. Following a comprehensive examination of numerous options, the WSAG settled on a preferred strategy to be presented to Council to consider. In accordance with the group's terms of reference, Council will make the final decision on the future water supply strategy for Cairns.

Short-term initiatives

The following short-term initiatives were adopted within the WSAG's preferred strategy to be implemented over the next 5 years:

1. Implement Stage 1 of the Draper Road Water Treatment Plant and augmentations of the supply pipeline from Behana Creek Intake to achieve a treatment capacity of 40 ML/day and increase in scheme yield of 1000 ML/annum.
2. Develop Stage 1 of the Mulgrave River water source to increase the overall yield combined with Copperlode Falls Dam and Behana Creek by at least 5,000 ML/a, including an additional stage of the Draper Road Water Treatment Plant to achieve further treatment of at least 19 ML/d.
3. Develop and implement a Demand Management Strategy with defined targets and actions based on considering the applicability to Cairns of initiatives identified during the WSAG process. The demand management initiatives identified are categorised based on the estimated water savings and implementation timeframes of the component initiatives, as follows:

a. Part A, to be implemented over a 5-year period with estimated savings of 465 ML/a, consisting of:
   - Water Efficiency Labelling and Standards (WELS) – Total Program Savings
   - Community Education Programs

b. Part B, to be implemented over a 10-year period with estimated savings of 2,152 ML/a, consisting of:
   - Water efficient appliances for new residential developments
   - Water efficient appliances for new non-residential developments
   - Water system pressure reduction
   - Future leakage management
   - Large water users audit and retrofit program

c. Part C, to be implemented over a 5-year period with estimated savings of 269 ML/a, consisting of:
   - Residential retrofit program
   - Tourist accommodation water efficiency retrofit program
   - School water efficiency program
   - Commercial kitchen 'Smart Rinse' fixtures retrofit

d. Part D, to be implemented over a 5-year period with estimated savings of 140 ML/a, consisting of:
   - Commercial cooling tower tune-up
   - Rainwater tank information
   - Waterless urinal retrofit
   - Sub-metering of new multi-family dwellings

4. Develop the business case and implement an intelligent water network involving implementation of 'smart meters' to achieve additional savings and provide real time water consumption data to individuals, thereby allowing identification and resolution of inefficient water use behaviours.

Medium-term initiatives

The preferred medium-term strategy (up to 10 years) includes the following initiatives:

5. Complete the comparative assessment between a further stage of the Mulgrave River (Stage 2) and an initial stage of the Barron River (Stage 1) to inform a decision over the preferred option to provide further water security.

Should the development of the Aquis Resort proceed and the additional growth in population is realised, the following additional options should also be implemented in an order guided by the outcomes of the comparative assessment (Item 11 above):

6. Develop an initial stage of the Barron River to access an unsupplemented reserve to increase the overall yield of the water supply scheme by 5,500ML/a. This will involve construction of the Kamerunga Water Treatment Plant to a capacity of 25 ML/day.

7. Develop a further stage of the Mulgrave River to increase the overall yield of the water supply scheme by 8,500 ML/a. This will involve a further stage of the Draper Road Water Treatment Plant to increase the treatment capacity by 33 ML/d.

Long-term initiatives

The following initiatives are recommended for investigation to confirm the best initiative for implementation over the long-term (between 10 and 30 years):

8. Subject to outcomes of negotiations with the Mulgrave Mill, enter into a commercial arrangement in relation to its water entitlement on the Mulgrave River. This could involve purchasing and utilisation of part of the 19,000 ML/a entitlement and augmenting the Draper Road WTP to accommodate the respective capacity.
9. Further develop the Mulgrave River water source, ensuring that the cumulative capacity of the Mulgrave River water source is less than 14,600 ML/a, with contingent augmentation of the Draper Road WTP.
10. Economically stage the modernisation of the Mareeba Dimbulah Water Supply Scheme to enable a conversion of operational losses to an urban use by Cairns. This would involve additional augmentation of the Kamerunga WTP.
11. Access water from a future regional dam (e.g. Nullinga Dam) and, if it proceeds, with contingent augmentation of the Kamerunga WTP.

With each of these initiatives, further investigations of the respective impacts and costs are required before implementation.

These short, medium and long-term initiatives form the WSAG's preferred Water Security Strategy for the Cairns region. The final outcome represents the culmination of more than 12-months' of direct community consultation and technical investigations to arrive at a strategy that is affordable, practical and acceptable to the Cairns community. Above all, it will guarantee reliable and safe supplies of water to the growing community.

This report outlines the investigations and consultation process undertaken by the WSAG, the Project Team and Council to define the 30-year Water Security Strategy for Cairns.

CONTENTS

1 Our Water Security

1.1 Cairns Region

The Cairns Regional Council local government area encompasses some 1,687 square kilometres of land. The Council area is bound by the Eubenangee Swamp to the south through to the Macalister Range in the north. To the east lies the Coral Sea and Great Barrier Reef whilst the Wet Tropics rainforest lies to the west.

Both the Great Barrier Reef and Wet Tropics rainforest are World Heritage listed sites. Together with these attractions, the Cairns region boasts some of the most beautiful beaches and parklands in Australia. Far North Queensland is renowned nationally and internationally as a premier tourist destination that attracts more than two million visitors each year: the majority of which are concentrated in the Cairns and Port Douglas areas.

1.2 Cairns Water Supply Scheme

The Cairns water supply scheme consists of two main sources:

- Copperlode Falls Dam on Freshwater Creek, forming Lake Morris, is the major water supply reservoir for Cairns. Water is released from Copperlode Falls Dam into Freshwater Creek with the intake located at Crystal Cascades Weir. Raw water is extracted at the intake and treated at the Freshwater Creek Water Treatment Plant (WTP).
- Behana Creek is located south of Gordonvale within the World Heritage listed Wet Tropics Rainforest. Water is extracted directly from a small weir within the creek, with extraction rates depending on flow conditions.

1.3 Why we need a new water supply strategy

Cairns City and the surrounding regions offer attractive places to live and population numbers are steadily increasing each year. Underpinned by the expansion of industries including agriculture, forestry, fisheries and tourism, this steady population growth is predicted to continue in the short to medium-term. The population is projected to increase from approximately 157,123 in 2013 to 210,745 by 2031 – an increase of approximately 34%.[1]

In addition to this identified population increase, the proposed integrated resort development *Aquis Resort at The Great Barrier Reef* (Aquis Resort) is expected to stimulate further growth requiring substantial additional volumes of water. Accordingly, these requirements must be considered for water supply planning.

In late 2013, Council resolved to review and update its water supply strategy of 2009 with the aim of developing a strategy for the next 30 years. This would ensure that residents, industry and visitors can continue to enjoy a safe and reliable water supply as they have in the past.

To ensure the strategy reflected the community's needs and desires, Council elected to form the *Water Security Advisory Group* (WSAG) inviting key stakeholder groups from the Cairns region to participate and contribute.

Based on the three key drivers of demand, supply and performance, the WSAG has now formulated a Water Security Strategy that it proposes is affordable, practical, and acceptable to the Cairns community and, above all, will guarantee a reliable and safe supply of water to the growing Cairns region.

This report outlines the investigations and consultation process undertaken by the WSAG, a separately appointed Project Team and Council itself to define the 30-year Water Security Strategy for Cairns.

[1] Cairns Regional Council – profile.id.com.au

2 The WSAG process

In late 2013, Cairns Regional Council started a water resource planning project called *Our Water Security*. The project included a community-based *Water Security Advisory Group* (WSAG), together with experienced Council officers and a technical Project Team. With technical input from the Project Team, the WSAG was tasked with guiding the development of the strategy for consideration by Council.

At its core, the strategy was designed to achieve the following outcome:

> Development of a long term water supply strategy that identifies a program of supply augmentations and demand management initiatives to ensure that Cairns has sufficient water to meet demand under normal and adverse environmental conditions.

Between April 2014 and February 2015, the WSAG and Project Team met on a regular basis to consider the key issues influencing the water supply needs of Cairns region.

At each meeting, the WSAG was presented with a series of technical reports and assessments of current water supply system and possible alternatives for increasing the supplies, as well as direct responses to requests made during previous meetings.

Water supply options within the Cairns Regional Council local government area were considered, as well as opportunities in adjacent catchments and areas that could provide a regional benefit. At each meeting the WSAG members often engaged in robust discussions about the issues. This in turn resulted in a rigorous planning process with the development of a robust strategy.

From this process, seven alternative water supply strategies were defined and assessed in total through a two-phase process of Normalised Multiple Objective Analysis (NMOA) and a Cost Assessment.

On the basis of these assessments, two preferred strategies were selected and optimised to ultimately define the preferred water supply strategy for the Cairns region.

2.1 WSAG Meeting outcomes

- WSAG agrees on *Terms of Reference*.
- WSAG considers the *Discussion Starter Paper* and the context of water supply planning.
- WSAG discusses the history of water supply operation and planning in Cairns.

- WSAG considers market research as an avenue to gain direct feedback from the community about preferred water supply options.
- Project Team presents information on:
  - Population and demand forecasting.
  - Source yield and performance.
  - Levels of Service (LoS).

- WSAG and Project Team discuss the importance of LoS.
- WSAG agrees that maintenance of the region's aesthetic assets (such as parks and gardens) may be allowed for in the defined LoS of the water supply strategy.
- WSAG discusses and agrees upon the objectives the *Water Supply Strategy* should aim to achieve.

- WSAG agrees upon preliminary LoS criteria, for the purposes of preliminary scoping of water supply options.
- WSAG agrees that a high-growth scenario should be considered in a preliminary report on the population forecast. The high-growth rate would reflect the consequential and cumulative impacts of the Aquis Resort.
- WSAG discusses various options for reducing the annual demand on the water supply system.
- WSAG provided with instructions and *Objective Weighting Forms* to rank the adopted objectives in terms of relative importance.

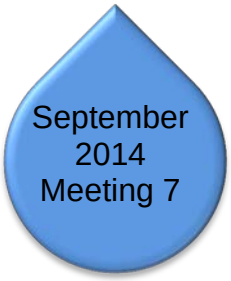
July 2014
Meeting 5

- Project Team presents information on the *Normalised Multiple Objective Analysis* (NMOA) approach and *Objective Weightings* supplied by WSAG members.
- WSAG adopt the 'mean' as the most representative description of the groups *Consensus Weightings*.
- WSAG determined that the Aquis Resort be captured in the baseline demand forecast.
- Project Team presents further information on *Demand Management Strategies* (DMS).
- WSAG adopts the proposed DMS.
- WSAG discusses potential for enhancing existing water sources, such as increasing storage volume at Copperlode Falls Dam.
- WSAG carries out group activity to identify potential options from the collective and local knowledge of the members.

- WSAG considers potential options arising from group activity:
  - Repurpose existing sources or allocations:
    - Lake Mitchell (Quaid Dam)
    - Accessing flows emanating from Stanwell Power Station
    - Mulgrave Mill Entitlement
    - Babinda Mill Entitlement
    - Acquire existing or unused entitlements from Mareeba Dimbulah Water Supply Scheme (MDWSS)
    - Conversion of MDWSS losses to water entitlements for Cairns
  - New surface water sources:
    - Regional dam - Nullinga Dam
    - Russell River
    - North Johnstone River inter-catchment transfer
    - Flaggy Creek Dam
  - Groundwater resources:
    - Mulgrave Aquifer
    - Managed aquifer recharge
  - Substitution:
    - Mulgrave River environmental flow substitution or augmentation
    - Dual reticulation to all new subdivisions

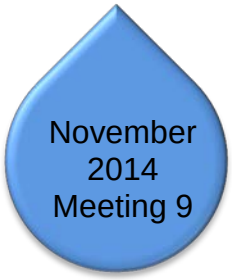
August 2014
Meeting 6

- Demand management:
  - Automated meter reading, or *Smart Metering*
  - Tighter LoS and enforcement
- WSAG selects options to be investigated further.



- WSAG considers the potential for new source and treatment options, including:
  - Barron River (environmental flow substitution with recycled water)
  - Kamerunga WTP
  - Mulgrave River
  - Mulgrave Aquifer
  - Draper Road WTP
  - Desalination
- WSAG considered outcomes of further investigation into selected options identified by the group activity:
  - Mulgrave Mill entitlement
  - Babinda Mill entitlement
  - Conversion of MDWSS losses to water entitlements for Cairns
  - Regional dam – Nullinga Dam
  - Lake Mitchell (Quaid Dam)
  - Russell River
  - Managed aquifer recharge using recycled water and/or purified recycled water
  - Mulgrave River environmental flow substitution
  - Mulgrave River flow augmentation
  - Smart metering
- WSAG considered five potential strategies involving various options for guidance as a discussion starter for further development at the next meeting.

- WSAG received presentation from group member representing Mulgrave River Aquifer Community Reference Panel about their general views of the potential groundwater resource.
- Project Team presents further information on LoS and contingency supply planning.
- WSAG instructed the Project Team to proceed with the assessment of potential strategies based on the existing LoS.
- WSAG supported proposal to incorporate contingency planning in the development of strategies at a conceptual level: 'a contingency measure is triggered at 40% of Copperlode Falls Dam which provides 100 L/p/d within 12 months of commencement'.
- WSAG confirmed five water supply strategies involving various options for comparative assessment.



- Group member and Independent Chair of the Mulgrave River Aquifer Community Reference Panel presented the Panel's views of the potential groundwater resource following completion of the Phase 3 engagement process carried out with Council.
- Group member representing Mulgrave Mill presented its views and experience with the Mulgrave River.
- Group member representing Queensland Department of Natural Resources and Mines presented information relevant to the Barron Water Resource Plan area, including the Mareeba Dimbulah Water Supply Scheme and related information available on the Nullinga Dam proposal.
- Project Team presents detailed information on the potential water supply strategies chosen for assessment describing the LoS yield and timing of options comprising each strategy.
- Preliminary NMOA results for the five potential strategies were presented to the WSAG and discussed.

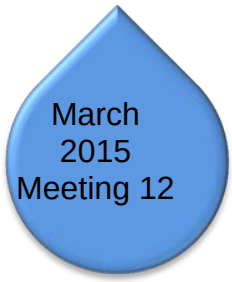
- Project Team presents information on the hydro-economic assessment, itemised NMOA results and the strategy refinement process.
- WSAG members individually provide feedback and articulate their views about various water supply initiatives from the perspective of their respective stakeholder groups.
- Based on views articulated by the WSAG, strategy elements were categorised into their ability to be delivered into the near term (within 5 years) and provide security, their merit for further investigation and progression in the mid-term (more than 5 years), their ability to provide contingency supply, and those to

be re-considered in the mid to long-term.

- Based on the categorisation of options and analysis outcomes of the initial five strategies, WSAG agreed on two refined strategies for further analysis.

- Project Team presented direct comparison of key features and outcomes of the two strategies in cost terms and non-cost (NMOA) terms.
- WSAG members individually provide feedback and articulate their views about preferred first source and subsequent source(s) in the context of longer term strategy outcomes.
- WSAG reached consensus agreement of preferred strategy.

- Final WSAG meeting held on 17 March 2015
- WSAG unanimously resolved to recommend the strategy report and recommendations to Council for endorsement.



3 Principles and objectives of the preferred strategy

3.1 Principles

The key principles to underpin the preferred strategy were formulated, circulated and then discussed at the first WSAG meeting and were defined as illustrated in Figure 1.

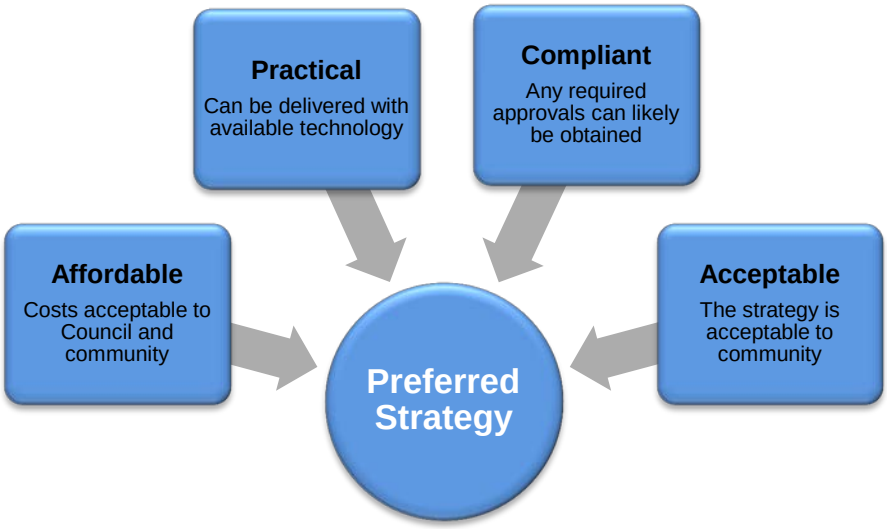


Figure 1: Key principles for water supply strategy

These principles were unanimously adopted by the WSAG and used as the foundation for defining the project objectives and to establish a common understanding of the issues to be addressed by the stakeholders in their eventual strategy.

3.2 Objectives

Underpinning the strategy is a set of objectives selected by the group to be the most important aspects of the strategy. After considerable discussion it was resolved to adopt the following five objective categories:

- Technical
- Environmental
- Social
- Economic
- Human health

The group chose a total of 25 objectives for the strategy, with 10 of these constituting 'compliance' objectives where these formed the minimum requirements to be met by the strategy. That is, these must be met in any case.

With the exception of the compliance objectives, consensus weightings were then assigned based on a survey of the group to rank the relative importance of each objective to their stakeholders. The process by which the WSAG consensus weightings were calculated is detailed in the report *Objectives Weighting* (July 2014).

Table 1 below details the nominated objectives for the Water Security Strategy and the consensus weightings assigned by the group.

Table 1: Water Security Strategy Objectives

Ref.	Objective	Weight
	Environmental Objectives	
En1	Meet all licence conditions	Compliance
En2	Meet all Environmental Flow Objectives under relevant Water Resources Plans	Compliance
En3	Minimise extent of disturbance to World Heritage Areas	8.9
En4	Minimise extent of disturbance to Zone A and Zone B World Heritage Areas	Compliance
En5	Minimise extent of other native forest flooded or disturbed	2.1
En6	Minimise extent of other land flooded or disturbed	0.8
En7	Maintain extent of wetlands	2.7
En8	Minimise carbon emissions	2.2
En9	Minimise disturbance to populations of threatened, endangered, endemic species and/or migratory species	5.1
En10	Maintain or enhance groundwater resources	4.4
En11	Provide additional flow for environmental benefit above the WRP requirements	8.5
	Technical Objectives	
T1	Ensure compliance with defined Levels of Service Criteria	Compliance
T2	Ensure losses within the system are minimised to an optimal level	5.6
T3	Ensure that alternative water sources are identified	9.9
	Social Objectives	
S1	Ensure the serviced community has adequate access to water	11.4
S2	Support community aspirations for sustainability	8.3
S3	Protect culturally significant sites (Indigenous and historical)	Compliance
S4	Consult with relevant parties with respect to Cultural Heritage	Compliance
	Economic Objectives	
E1	Ensure availability of water is not a constraint for new opportunities	13.1
E2	Aim to achieve cost recovery for water services	7.2
E3	Ensure the strategy delivers regional benefit	9.8
E4	Meet all water allocation security objectives	Compliance
	Human Health Objectives	
H1	Ensure water supplied is fit for purpose and poses no risks to human health	Compliance
H2	Preserve absolute minimum availability of water for hygiene and sanitary purposes	Compliance
H3	Minimise risk associated with infrastructure	Compliance
Total weighting		100 points

3.3 Levels of Service criteria and performance targets

Levels of Service (LoS) aspects include the:

- frequency (or probability);
- magnitude (or severity); and
- duration

of important 'events' (e.g. restrictions, supply shortfall).

The following considerations should be made when defining LoS criteria and targets:

- 'Magnitude' (or severity) can generally be controlled. For example, a decision can be made on the restriction severity, or minimum desired supply volume or water level.
- 'Frequency' (or probability) is semi-controllable. For example, decisions can be made that influence frequency, such as selecting operational regimes and performance criteria. But, the frequency of events will also be strongly influenced by the hydrological and infrastructure characteristics of the system.
- 'Duration' is generally uncontrollable. For example, the duration of restrictions will depend ultimately on the length the specific climatic conditions being experienced.

When considering LoS assessments, an important point of understanding is that 'probability' is often defined in terms of Average Recurrence Interval (ARI) as a measure of the estimated frequency of an event. For example, it is very important to note that an event with a '100 year ARI' does not mean that the event will occur once every 100 years. The most accurate way to describe ARI values is as a probability along the line of: 'a 100 year ARI means that there is an estimated 1% chance (i.e. 1 in 100) that this event will occur in any single year'.

It is also important to understand that selection of LoS criteria and performance targets underpins all subsequent options assessment and strategy outcomes. For example, the implications include:

- The required timing of augmentation to the supply system.
- The requirements of a contingency response, or planned response, in an emergency situation.
- The amount of risk and consequence to the community of a drought event.
- Ultimate cost of the day-to-day supply of water.

The group elected to maintain the same LoS currently adopted by Council. The adopted LoS criteria and performance targets are summarised in Table 2.

3.4 LoS Yield Outcome

Table 3 summarises the yield outcomes under the adopted LoS criteria for the existing sources of Copperlode Falls Dam and Behana Creek.

Key points to note regarding the LOS yield outcome for the existing scheme include:

- The available yield from the existing sources under the adopted Level of Service (LoS) criteria is estimated as 26,000 ML/a.
- The Level 1 and 2 restriction criteria are 'limiting' the LoS yield.
- There is a possible redundancy between Levels 1 and 2 in that they are performing a similar role in terms of slowing drawdown of the dam to lower levels.
- The likelihood of 'emergency' measures is estimated to have a 300 year ARI, or approximately 0.3% risk of occurrence in any single year.

Table 2: Adopted LoS criteria and targets

Severity		Frequency	Use types subject to restrictions	
			Residential and 'other'	Commercial, Industrial
Level 1 (80% storage)	10% use reduction	1.5 y ARI	Yes	No
Level 2 (70% storage)	15% use reduction	5 y ARI	Yes	No
Level 3 (60% storage)	20% use reduction	10 y ARI	Yes	Yes
Level 4 (50% storage)	25% use reduction	25 y ARI	Yes	Yes
Emergency (40% storage)	Planned response	100 y ARI	Yes	Yes
Supply shortfall (dead storage)	Supply shortfall	>1000 y ARI (no simulated events)	Yes	Yes

Table 3: LoS Yield Outcome

Severity		Target Frequency	Estimated frequency under LoS Yield of 26,000 ML/a	LOS Yield (ML/a)
Level 1 (80% storage)	10% use reduction	1.5 y ARI	1.5 y ARI	26 000
Level 2 (70% storage)	15% use reduction	5 y ARI	5 y ARI	
Level 3 (60% storage)	20% use reduction	10 y ARI	40 y ARI	
Level 4 (50% storage)	25% use reduction	25 y ARI	110 y ARI	
Emergency (40% storage)	Planned response	100 y ARI	300 y ARI	
Supply shortfall (dead storage)	Supply shortfall	>1000 y ARI (no simulated events)	>1000 y ARI (no simulated events)	

3.5 Emergency Planning

The exceedance of the LoS shows that there is a small chance that in an extreme drought Council would need to take emergency action. The key points to consider in relation to emergency planning are:

- What is our response if an extreme drought continues beyond our accepted LoS?
- At what level of storage do we need to commence planning, design and construction of an emergency supply?

The last point above refers to the level of total system storage at which time some form of infrastructure provision is required to ensure that enough time remains, with a satisfactory level of risk, to have the ability to supply water prior to reaching dead storage. The timeframe for infrastructure provision needs to allow for planning, approvals acquisition, design, construction, and commissioning.

The specific tasks involved in developing an emergency plan include:

- Defining available options to supply water during extended periods of drought. For example, accessing the deeper levels of the Mulgrave Aquifer or the construction of a desalination plant.
- Estimating how long the response takes from:
    - commencement of planning; and,
    - commencement of construction.
- Deciding the acceptable level of risk within the response time prior to reaching the 'dead storage' in Copperlode Falls Dam.

4 Future Water Demand

Future demand for water forms the basis for determining the anticipated requirements for the 30-year term of the strategy. Forecasting future demand is strongly associated with projected population growth and associated economic activity.

The population of Cairns and the surrounding region has steadily increased each year, and is expected to continue into the future. This is associated with expansion of industries, including agriculture, forestry, fisheries and tourism.

The potential development of the Aquis Resort and consequential additional growth also poses unique challenges for Cairns and the Council, including water supply planning and provision.

People living in Cairns and the surrounding region are familiar with the concept of using water wisely. Since 2006, Council has implemented a number of demand management strategies to ensure the more-efficient use of the existing water supplies. Figure 2 illustrates the climate-corrected daily demand of bulk water per resident ('capita') since 1995. The analysis illustrates that implementation of these strategies has stabilised water demand in recent years. However, the projected growth in population and economic activity is expected to have upward pressure in demand resulting in increased water requirements for Cairns.

The WSAG, with guidance from the Project Team, has investigated and discussed the projected population growth figures and the resulting increase in water demand.

4.1 'Aquis Resort at The Great Barrier Reef'

The proposed Aquis Resort – a significant development of its scale and type in the region by any measure – would represent a significant increase in tourist capacity for Cairns. The anticipated staged development of the resort is proposed over a nine-year period commencing as soon as 2016, depending on government approvals.

The current proposal[2] for the resort includes construction of the following facilities:

- Entertainment facilities, including casinos, theatres and an aquarium.
- Convention and exhibition spaces.
- Accommodation for up to 12,000 guests and all associated 'back of house' facilities.
- Ancillary retail and food and beverage outlets.
- Large scale water bodies including feature lakes, swimming lagoons and an aquarium.
- An 18-hole championship golf course, tennis centre and other outdoor sports and recreation facilities.
- Guest/staff car parking.

Although the development has yet to receive final approval for its construction, the WSAG, based on advice from Council and the Project Team, elected to include the consequential impact of the full-scale resort in the forecast of water demand for Cairns.

4.2 Baseline Forecast

The proposed baseline water demand forecast is illustrated below. The key assumptions used in this forecast are:

- Medium population growth forecast, as documented by the Queensland Regional Statistical Information System (QRSIS).
- A total system water demand of 418 litres per resident person per day.
- An allowance for non-residential demand to grow in direct proportion to population growth. This represents the water demand for economic activity associated with the future population.

[2] Flanagan Consulting Group, 2014.

- An allowance for Non-Revenue Water at the current observed rate.

Figure 3 illustrates the baseline drinking water demand forecasts for Cairns, both with and without the consequential impact of the development of the Aquis Resort.

The basis for these demands is detailed in the following reports prepared for and presented to the WSAG:

- Population and Demand Forecasting, June 2014.
- Potable Water Demand Management Strategy, October 2014.

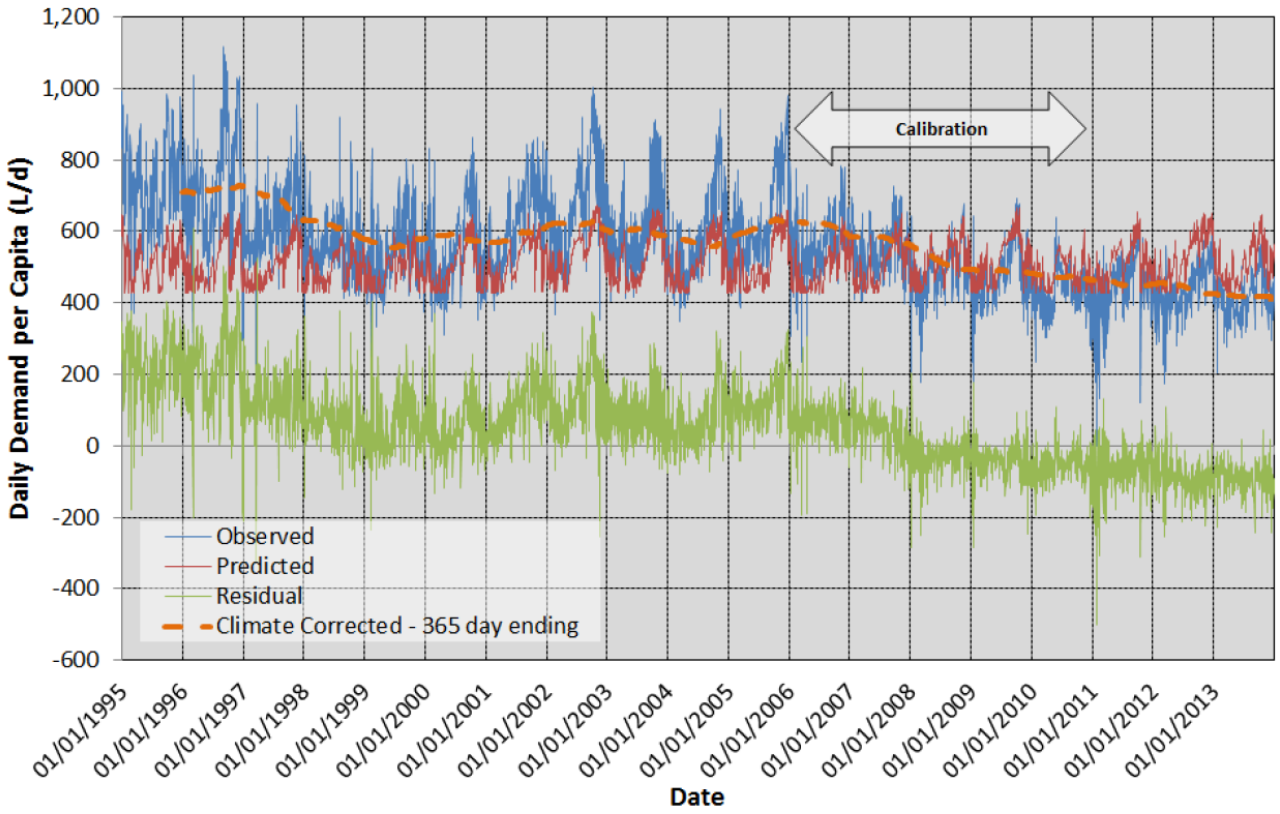


Figure 2: Time Series Analysis of Bulk per Capita Water Production

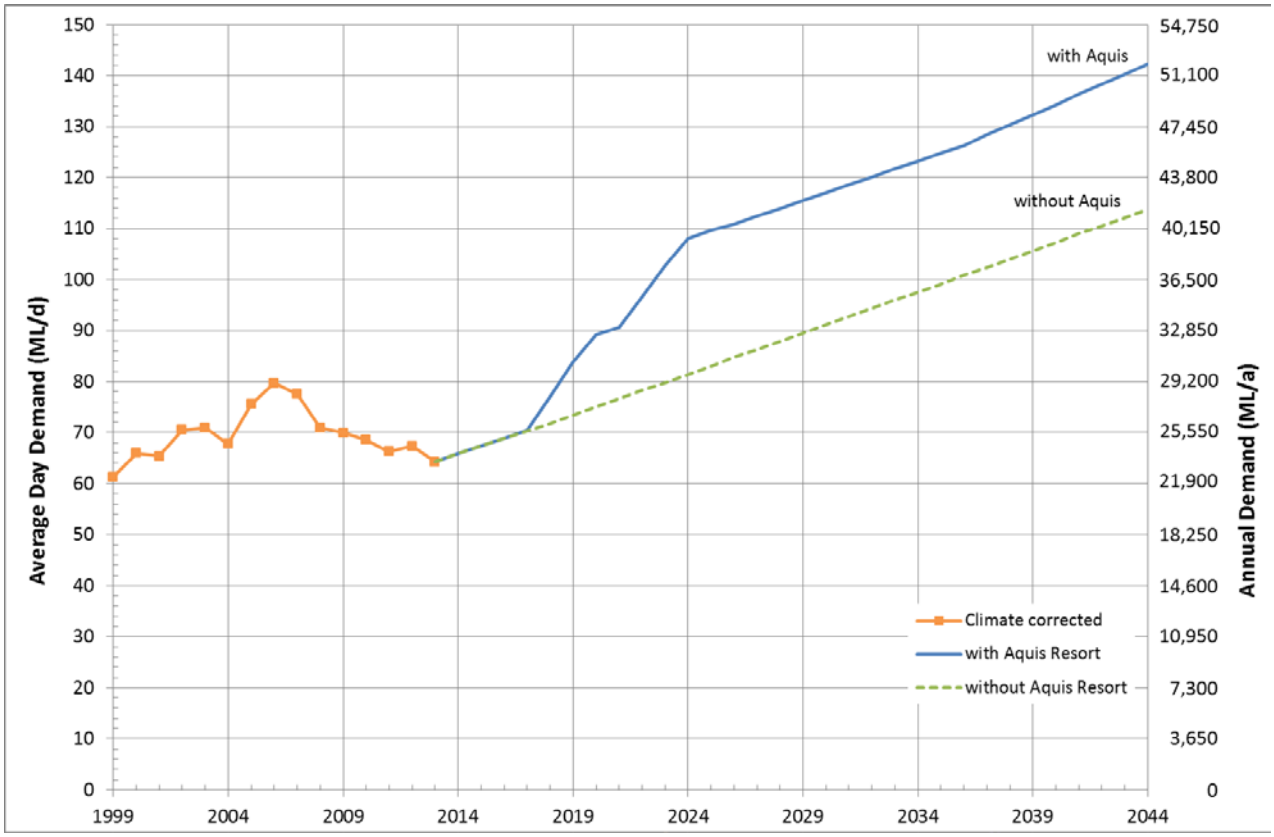


Figure 3: Potable Demand Forecast – Baseline with and without the Aquis Resort

5 Initiatives

Although the existing water supply system is sufficient to meet the current demands of residents, tourists and industry, its capacity must be increased to ensure that growing demand for water can be securely met well into the future.

It was established earlier that the combined yield from the existing sources of Copperlode Falls Dam and Behana Creek is estimated as 26,000 ML/a. This is defined as the available yield under the adopted Level of Service (LoS) criteria.

The historic annual water demands illustrated Figure 3 show that in some past years the demand exceeded the LoS yield. Implementation of demand management strategies since 2006 has reduced and maintained water demand below the LoS yield. However, the anticipated population growth is expected to result in upward pressure on water demand and exceed the LoS yield in the near future. The baseline forecasts in Figure 3, both with and without the consequential impact of the Aquis Resort, indicate this could occur by 2017.

The group considered a wide variety of possible initiatives to further manage demand and provide supply of additional water. In this report, these are discussed under the following categories:

- Additional potable water demand reduction strategies.
- Enhancing the existing water supply system.
- Additional new water sources.
- Additional new water treatment plants.

5.1 Demand reduction strategies

The reduction in the total demand for potable water is a key initial step in achieving the balance between demand and supply. For this purpose, the group elected to recommend that Council pursue a number of possible initiatives as part of its Demand Management Strategy.

Demand Management Strategy would define targets and actions based on considering the applicability to Cairns of the identified initiatives, as follows:

- Continue and enhance Council's existing Demand Management Strategy (DMS) programs, including the Water Efficiency Labelling and Standards (WELS) Scheme and Community Education programs (these initiatives have been grouped as 'Part A').
- Water efficient appliances for new residential and non-residential developments, water system pressure reduction, system leakage management, and carrying out large water user audits and retrofit programs (called 'Part B').
- Residential water efficient appliance retrofit and school water efficiency programs (called 'Part C').
- Commercial Cooling Tower Tune-up and Waterless Urinal Retrofit (called 'Part D').
- Substitution of drinking water with recycled water to meet the demands of suburban irrigation and toilet flushing in new residential developments (requiring dual reticulation).
- Provide education and information to encourage all new residential developments to install rainwater tanks.
- Implementing Intelligent Water Network using advanced 'smart meters' to provide short time-step, near real-time water use readings. Such a program would involve the installation of approximately 50,000 smart meters at homes and businesses.

5.2 Enhancing the existing water supply system

There is some potential to increase the volume of water yielded by Copperlode Falls Dam and Behana Creek by a relatively small amount.

Increasing the volume of water supplied by the Copperlode Falls Dam could be achieved by raising the

height of the embankment and spillway to achieve an increase in water depth of some 1.5 metres.

Although Copperlode Falls Dam is a dam for water supply and not flood mitigation purposes, its capability to safely handle and pass extreme flood events is required to be improved before 2035. This is to keep in line with contemporary meteorological methods and techniques for forecasting extreme rainfall events in the tropical areas of Australia.

Extraction from Behana Creek is constrained by existing treatment processes and pipeline capacity constraints. Upgrading these facilities would allow an increase in the volume of water available from this source within the limits of Council's existing water licence.

5.3 New bulk water sources

As previously outlined, a large number of additional water sources were investigated by the group:

- Barron River at Lake Placid – accessing a small strategic reserve for Cairns.
- Conversion of losses from the Mareeba Dimbulah Water Supply Scheme (MDWSS) to an entitlement for Cairns Regional Council.
- Development of a regional dam – nominally the Nullinga Dam proposed to be located in the Walsh River catchment to the south-west of Mareeba.
- Lake Mitchell[3] – an existing impoundment located on private property to the north west of Mareeba. Raw water could be transferred by a pipeline to the Barron River for conveyance to Lake Placid
- Mulgrave River – a 'run of river'[4] extraction opportunity located at Gordonvale.
- Mulgrave Aquifer – utilisation of a small part of the aquifer system in the Mulgrave River valley.
- Mulgrave Mill entitlement – a large entitlement on the Mulgrave River currently held by the Mulgrave Mill at Gordonvale. This entitlement could be traded with Council.
- Managed Aquifer Recharge – extraction of groundwater from the Mulgrave Aquifer with recharge back into the underground system with high quality recycled water or very high quality purified recycled water.
- Environmental Flow Substitution – release of recycled water to the Mulgrave River to allow raw water extraction of the same volume.
- Babinda Mill entitlement – a 'run of river' entitlement on Babinda Creek associated with the closed sugar mill at Babinda. This entitlement could be purchased by Council.
- Russell River – a 'run of the river' extraction opportunity, located near the township of Bartle Frere south of Babinda.
- Desalination – a desalination plant possibly located on Council land at Kamerunga with the intake situated within the Trinity Inlet.

5.4 New bulk water treatment plants

Raw water must be treated to the required standard prior to entering the urban water distribution system. Increasing the volume of water supplied to Cairns will necessitate the construction of one or more new Water Treatment Plants (WTPs). The options for the likely WTPs are:

- A new WTP on Council land near Draper Road, Gordonvale.
- A new WTP on Council land at Harvey Road, Kamerunga.
- A desalination plant, also at Harvey Road, Kamerunga.

As part of Council's previous water supply planning activities, Council has committed to construction

[3] The inclusion of a privately held water sources does not indicate that Cairns Regional Council will acquire the source. The WSAG is simply considering the source to determine if it combines with other initiatives to produce a worthwhile strategy.
[4] Run of river means taking water from a river where the amount is related to the flow in the river.

of Stage 1 of the Draper Road WTP to improve the treatment of water sourced from Behana Creek.

With further upgrade, the new Draper Road WTP would be able to treat water from the potential source options located south of Cairns City and generally in the Mulgrave and Russell River catchments. These would include:

- Mulgrave River
- Mulgrave Aquifer
- Mulgrave Mill entitlement (Mulgrave River)
- Babinda Mill entitlement (Babinda Creek)
- Russell River
- Managed aquifer recharge using recycled water (Mulgrave Aquifer)
- Managed aquifer recharge using purified recycled water (Mulgrave Aquifer)
- Mulgrave River environmental flow substitution
- Augmentation of Mulgrave River flows.

The new Kamerunga WTP would treat water from sourced from the Barron River at Lake Placid. A new intake at Lake Placid would be the collection point for water originating in the Barron River catchment west of Cairns City and generally on the Tablelands. These would include:

- Barron River unsupplemented supply – essentially 'run of river' flows and not supplemented by releases from Tinaroo Falls Dam.
- Conversion of MDWSS losses to Cairns Regional Council entitlements.
- Regional dam, nominally Nullinga Dam.
- Lake Mitchell.

A desalination treatment plant is both a source and treatment facility. It involves significant capital costs and intensive ongoing energy requirements, operating costs and environmental impacts associated with brine disposal (a by-product of the desalination process). For these reasons, a desalination plant is considered under the preferred water supply strategy to be a last resort and potentially implemented as an emergency action.

The next section discusses development of the preferred strategy in further detail.

6 Strategy Development

A water security strategy is essentially a collection of water saving programs, water supply initiatives, and operational responses (including water restrictions), with an underlying emergency plan. There is no one 'silver bullet' – a successful strategy must be a combination of demand and supply-side initiatives, rather than relying on a single, often risky, measure.

The initiatives need to ensure that:

1. Supply capacity is always more than demand.
2. Sources and savings are not double-counted.
3. Sources are not over-allocated.

In reality, these requirements must be achieved with acceptable environmental impact and an affordable cost to the local community.

The WSAG took the approach to compile alternative strategies of various shortlisted options that would all achieve a balance of demand and supply over the 30-year strategy period. The purpose of the alternative strategies was to investigate and understand the benefit and cost of different notions or ideas that aligned with the group's objectives.

The initial strategies compiled for discussion were themed:

- 'New Regional Dam'
- 'Regional Water Efficiency'
- 'Cost Efficiency'
- 'Storage'
- 'Adaptability'
- 'Environment'
- 'Distributed Infrastructure'

Further consideration by the group rationalised the list by combining notions or ideas of some themes:

- 'New Regional Dam' (Strategy A) – examines the idea of pursuing a regional dam, nominally Nullinga Dam.
- 'Repurposing Existing Sources' (Strategy B) - examines a greater focus on repurposing and reusing existing water resources. This strategy incorporates shared elements from the initial strategies themed 'Regional Water Efficiency' and 'Environment'.
- 'Cost Efficiency' (Strategy C) – examines a greater focus on a 'least cost' strategy.
- 'Adaptability' (Strategy E) - examines the idea of *adaptability* in terms of developing different source types across different catchments. This strategy incorporates shared elements from the initial strategy themed 'Storage'.
- 'Distributed Infrastructure' (Strategy G) - examines the concept of building flexibility to cater for unknown development patterns within the water supply scheme.

The initial five strategies are discussed in detail below.

6.1 Common Elements

The WSAG agreed that each strategy should have a number of 'common elements'. The agreed common elements involves Council's plan to provide additional treatment of raw water sourced from Behana Creek, which adds yield to the existing scheme. The WSAG also agreed to include the demand management strategies identified as a key step to achieve a balance between demand and supply.

The agreed common elements of each strategy are:

- Implementation of Draper Road WTP Stage 1, requiring augmentation of Behana Creek Intake pipeline.
- Demand Management Strategy Part A, B and C.
- 'Smart metering'

6.2 Strategy A – New Regional Dam

This bulk water supply strategy examines the idea of pursuing a regional dam, nominally Nullinga Dam, to supplement water in the MDWSS to enable releases from Tinaroo Falls Dam via the Barron River to Cairns. No other interim supply initiatives are investigated. It also involves developing a new treatment facility at Kamerunga, north of Cairns City.

In addition to the initiatives common to all of the strategies ('common elements'), Strategy A also included the elements outlined in Table 4.

Table 4: Key elements in Strategy A

Aspect	Amount of water	Completed by
Common elements	Refer previous description	
Barron River	5,500 ML/a	2018
Kamerunga WTP - Stage 1	50 ML/d	2018
Nullinga Dam	Allocation of 20,367 ML/a (high priority)	2020
Kamerunga WTP - Stage 2	45 ML/d	2023

Figure 4 illustrates the LoS yield for Strategy A to meet demand over the 30-year period of the strategy.

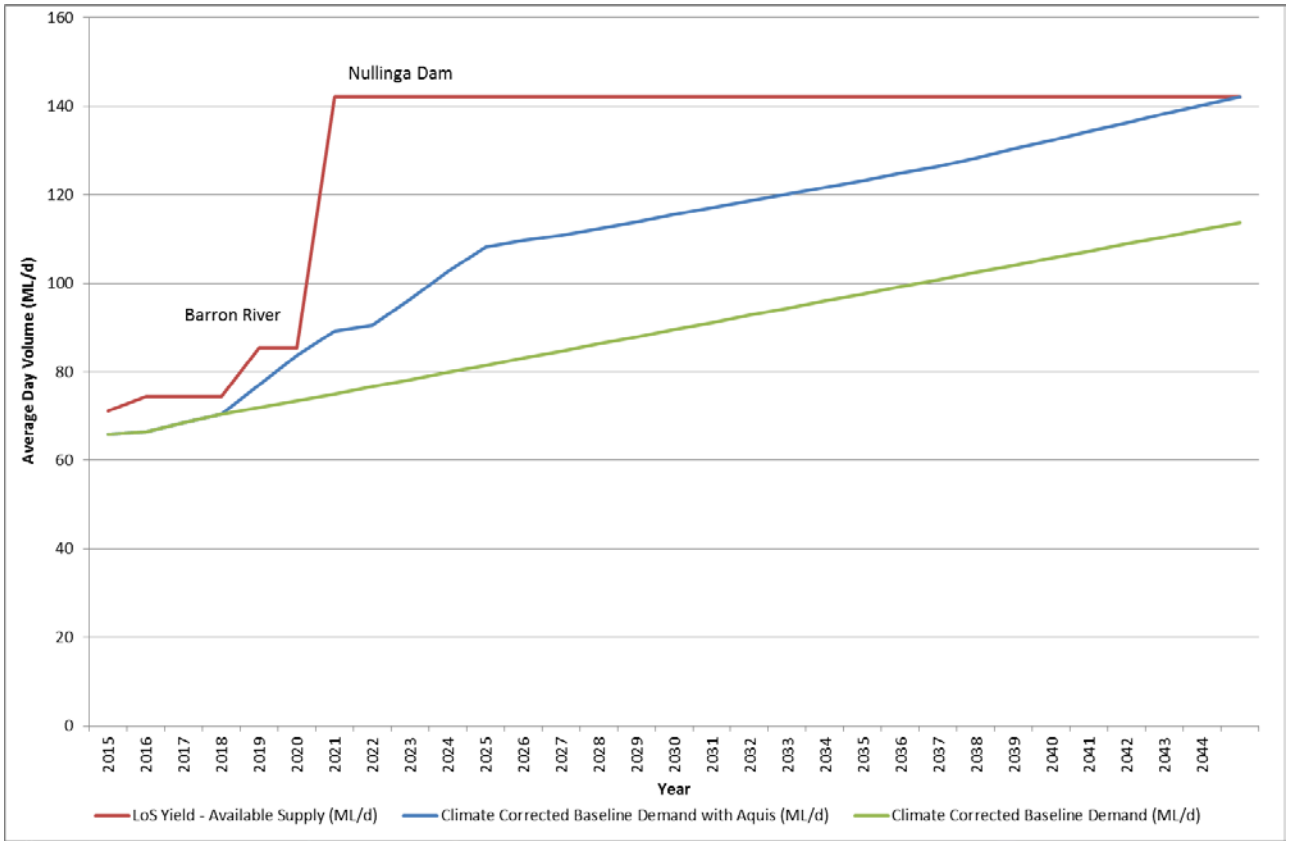


Figure 4: Strategy A – Forecast Demand and LoS Yield

6.3 Strategy B – Repurposing Existing Water Sources

This bulk water supply strategy examined a greater focus on repurposing and reusing existing water resources. This included greater efforts to reduce potable water use, broader substitution of potable water with recycled water, efficiency gains by modernising the MDWSS, and utilising an existing water body in Lake Mitchell.

As well as the common elements, Strategy B also included the elements outlined in Table 5.

Table 5: Key elements in Strategy B

Aspect	Amount of water	Completed by
Common elements	Refer previous description	
Additional demand management actions	140 ML/a	2021
Barron River	5,500 ML/a	2018
Kamerunga WTP - Stage 1	55 ML/d	2018
Dual reticulation – all new subdivisions	7,300 ML/a	2020-2041
Conversion of Irrigation losses	9,850 ML/a high priority allocation	2020
Kamerunga WTP - Stage 2	32 ML/d	2024
Lake Mitchell	8,359 ML/a	2030

Figure 5 illustrates the LoS yield for Strategy B to meet demand over the 30-year period of the strategy.

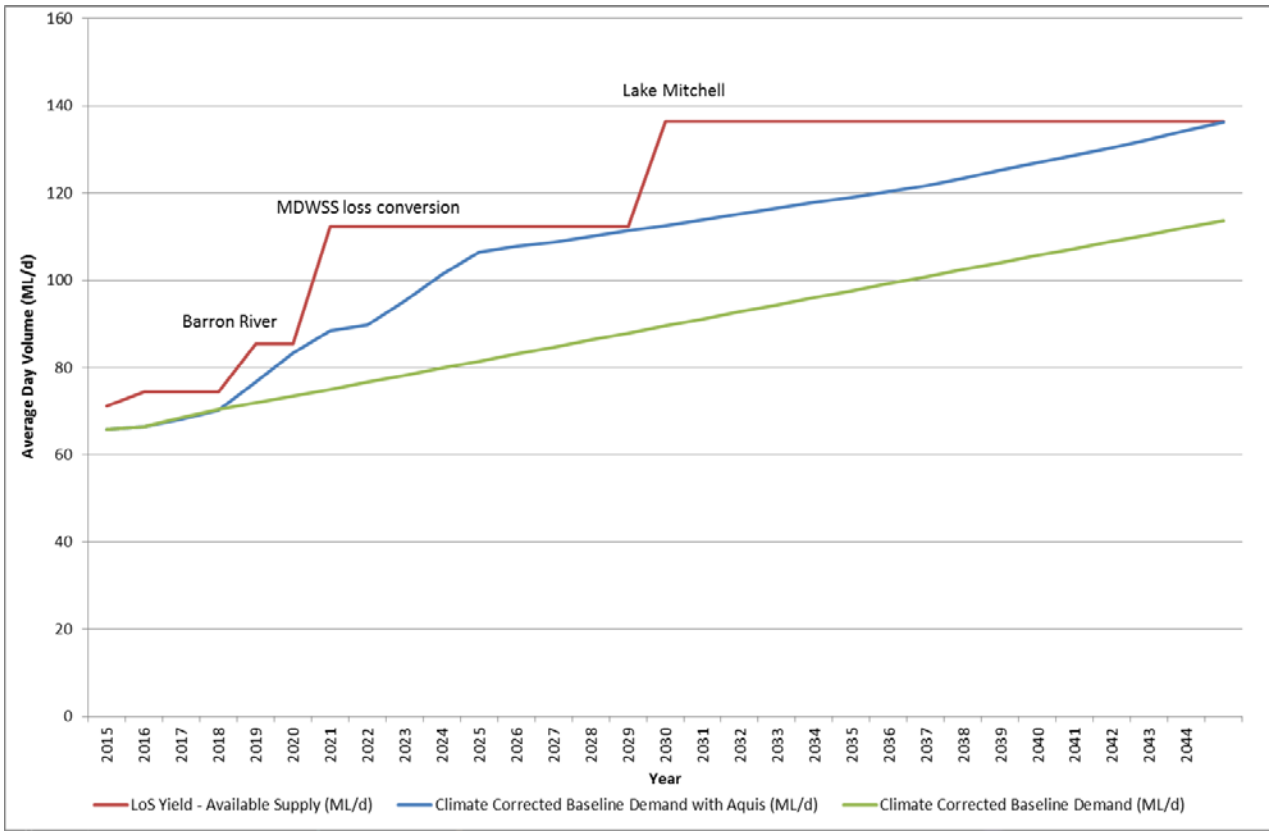


Figure 5: Strategy B – Forecast Demand and LoS Yield

6.4 Strategy C – Cost Efficiency

This bulk water supply strategy focused on achieving a cost efficient strategy for the community. It consists of known options that present the least capital investment and operating cost requirements, and leverages off existing and committed infrastructure capacity.

Again, as well as the common elements, Strategy C also included the elements outlined in Table 6.

Table 6: Key elements in Strategy C

Aspect	Amount of water	Completed by
Common elements	Refer previous description	
Mulgrave River	13,500 ML/a	2018
Upgrade Draper Road WTP - Stage 2	45 ML/d	2018
Upgrade Draper Road WTP - Stage 3	20 ML/d	2025
Mulgrave Mill Entitlement	12,374 ML/a high priority allocation	2025
Upgrade Draper Road WTP - Stage 4	30 ML/d	2033

Figure 6 illustrates the LoS yield for Strategy C to meet demand over the 30-year period of the strategy.

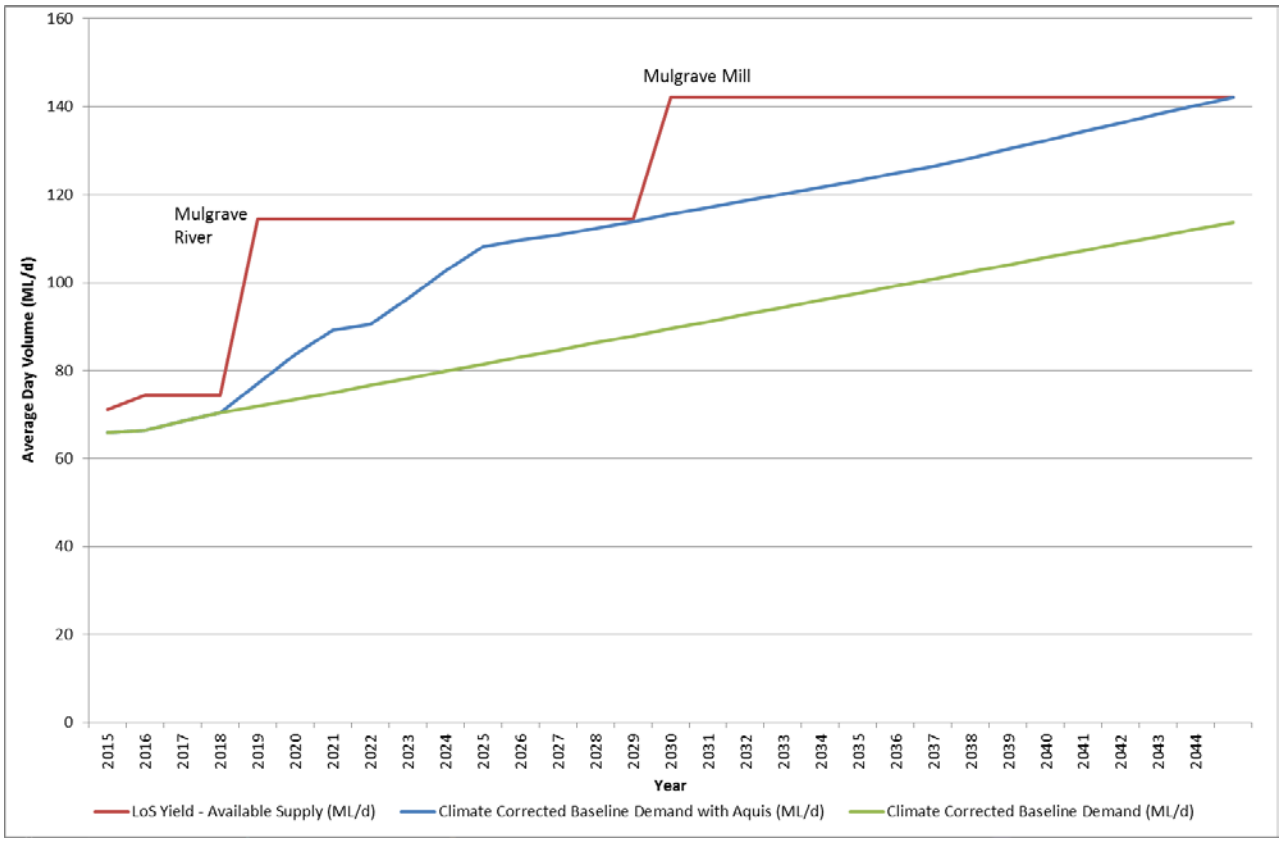


Figure 6: Strategy C – Forecast Demand and LoS Yield

6.5 Strategy E – Adaptability

This bulk water supply strategy examines the idea of adaptability in terms of developing different source types across different catchments. It also tested the notion of early development of an identified contingency supply option (e.g. groundwater storage in the Mulgrave Aquifer) as part of the water supply scheme, rather than reserving it for emergency implementation. As well as the common elements, Strategy E also included the elements outlined in Table 7.

Table 7: Key elements in Strategy E

Aspect	Amount of water	Completed by
Common elements	Refer previous description	
Mulgrave Aquifer	5,000 ML/a	2018
Upgrade Draper Road WTP - Stage 2	50 ML/d	2018
Mulgrave River	9,600 ML/a	2020
Draper Road WTP - Stage 3	25 ML/d	2023
Mulgrave Mill Entitlement	11,790 ML/a	2026
Draper Road WTP - Stage 4	20 ML/d	2029
Barron River	5,500 ML/a	If required

Figure 7 illustrates the LoS yield for Strategy E to meet demand over the 30-year period of the strategy.

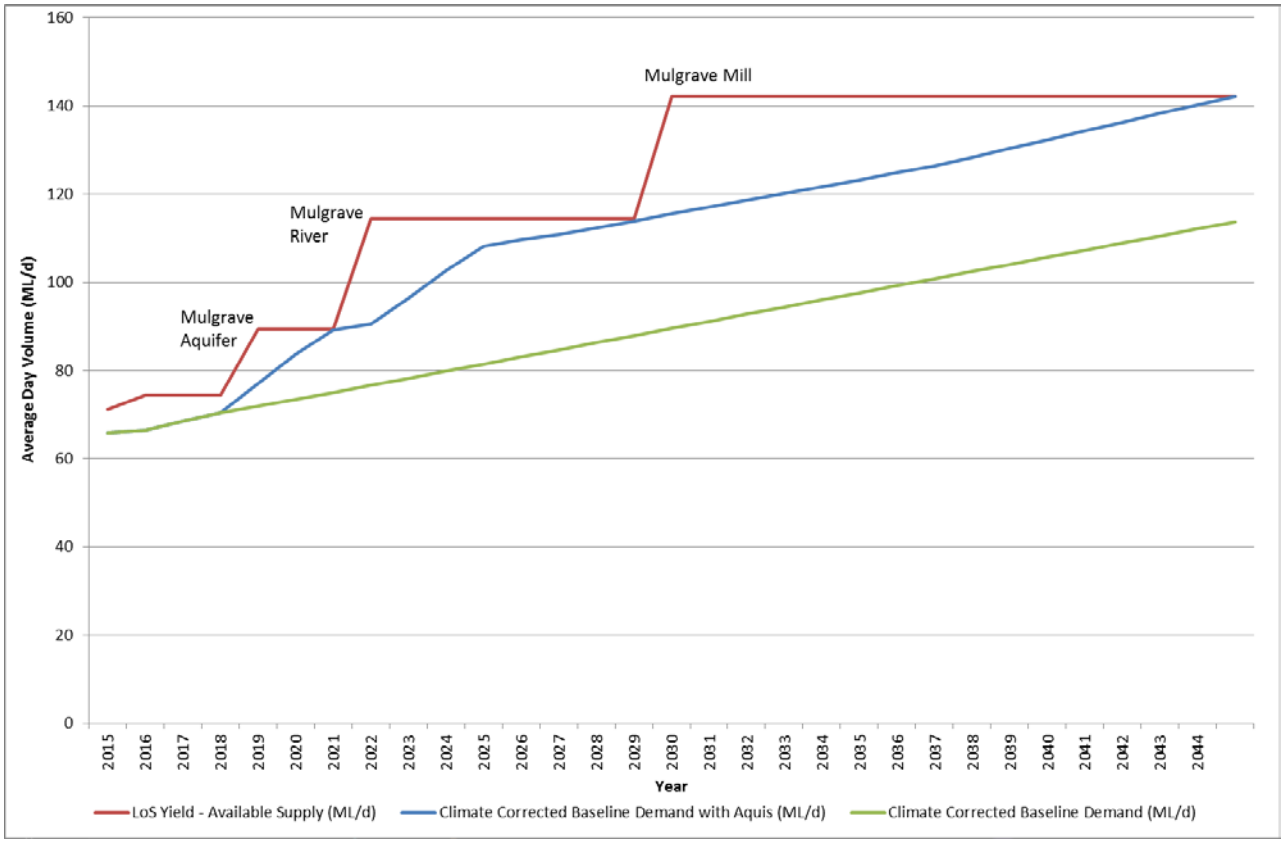


Figure 7: Strategy E – Forecast Demand and LoS Yield

6.6 Strategy G – Distributed Infrastructure

This bulk water supply strategy focused on distributed infrastructure to access and integrate identified sources in the northern and southern areas of Cairns. As well as the common elements, Strategy G also included the elements outlined in Table 8.

Table 8: Key elements in Strategy G

Aspect	Amount of water	Completed by
Common elements	Refer previous description	
Mulgrave River	9,600 ML/a	2018
Draper Road WTP - Stage 2	35 ML/d	2018
Mulgrave Aquifer	5,000 ML/a	2023
Draper Road WTP - Stage 3	20 ML/d	2023
Barron River	5,500 ML/a	2027
Kamerunga WTP - Stage 1	50 ML/d	2029
Nullinga Dam	6,278 ML/a high priority allocation	2036

Figure 8 illustrates the LoS yield for Strategy G to meet demand over the 30-year period of the strategy.

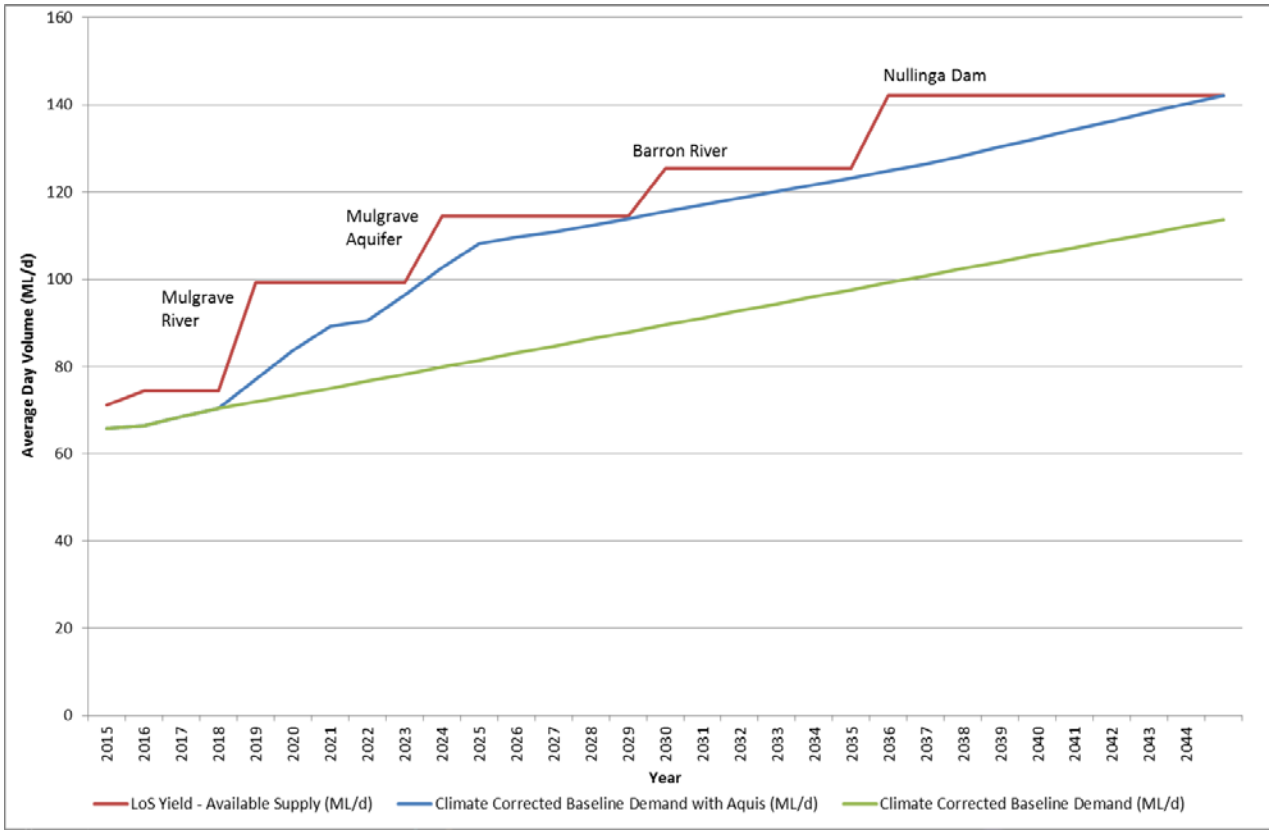


Figure 8: Strategy G – Forecast Demand and LoS Yield

7 Assessment methodology

To inform the group's decisions in respect of its preferred strategy, the Normalised Multiple Objective Analysis (NMOA) methodology was adopted together with a Cost Analysis. With the usual multiple criteria analysis, there are inherent issues such as stakeholder bias and a perennial problem with aggregating values that use different units of measurement. The group adopted a methodology that successfully avoided those issues.

7.1 NMOA process

The NMOA process designed for this exercise adopted specific techniques within the method to minimise the normal issues with multiple criteria analysis.

In the end, a process that was transparent, reproducible and with the active participation of a broad group of stakeholders that form the WSAG group underpinned the results gained. The process is described in the next sections.

7.1.1 Assigning and weighting objectives

As described earlier and listed in Table 1, a total of 25 objectives were chosen for the strategy – ten of these constitute 'compliance' objectives. In order to rank the relative importance of the objectives, each WSAG member was requested to assign a 'weighting' to each objective using an allocation of 100 points. Each member weighted the objectives based on the following guidelines:

- Assign a weighting to each objective based on its importance, or relevance, to the stakeholder group being represented.
- A greater number of points indicates higher importance.
- The total number of points assigned to all objectives must equal 100.
- This means that as points are allocated to an objective it diminishes the points available for others, therefore capturing the principle of consequence for action.

A majority of the WSAG members submitted weightings for the objectives based on the views of their respective stakeholder groups. The weightings were then statistically analysed by the Project Team to suggest one set of 'consensus weightings' that would provide a broad and inclusive measure of the WSAG's combined views.

The nominated objectives and consensus weightings are provided in Table 1 of Section 3.

7.1.2 Indicator analysis

An 'indicator' was developed and assigned to each of the WSAG objectives. An indicator is a measure of objective achievement and must be:

- Quantifiable – must be defined and measurable.
- Observable – must be directly linked to the definition.
- Measurable – must have a unit of measure, for example: cost ($), volume (ML), length (metres), area (hectares), duration (hours).

Each water security strategy was assessed against the indicators to obtain a score of objective achievement.

7.1.3 Normalisation of results

To allow a total score to be obtained for each strategy, the results of the indicator analyses were 'normalised' to a dimensionless value.

A 'large' indicator goal means the larger the result the better the objective has been achieved. If the goal is 'large', scores are normalised by the following equation:

$$Normalised\ score = \frac{Option\ Score}{Largest\ Score}$$

A 'small' indicator goal means the smaller the result, the better the objective has been achieved. If the goal is 'small', scores are normalised by the following equation:

$$Normalised\ score = \frac{1}{Option\ score\ \div lowest\ score}$$

Following normalisation, the results were multiplied by the consensus weightings assigned by the WSAG to each of the objectives. In essence, the strategy that achieves the highest overall score is the strategy that best achieves the WSAG's nominated objectives.

7.1.4 Sensitivity analysis

A common criticism of Multiple Criteria Analyses, such as the NMOA process, is the impact of stakeholder bias and consequently a perceived lack of objectivity in the outcomes. To assess the affects of stakeholder bias, a sensitivity analysis was conducted using the weightings defined by each stakeholder group.

The outcomes of the NMOA achieved using the stakeholder weightings were then compared with the outcomes obtained using the consensus weightings. Any identified biases can then be resolved if necessary.

7.2 Cost Analysis

The cost of each strategy was estimated by identifying the required infrastructure for each initiative and then estimating the capital cost and operating cost (fixed and variable) to develop the infrastructure. This estimate included costs for items such as:

- raw water intakes (Mulgrave River, Barron River) including the required pumping infrastructure;
- borefields including bores, bore pumps, distribution pipes, balancing storages and pumps;
- pipelines from the intake or borefields to the WTPs;
- new WTPs, in appropriately-sized stages;
- pipelines and pumps to transfer water from the WTPs to the distribution network;
- upfront costs to convert strategic reserves provided for in a *Water Resource Plan* to an allocation;
- cost associated with conversion of a high priority allocation to a medium priority allocation;
- dam construction costs (prorated based on the ratio of allocation required compared to the full allocation);
- estimated cost to acquire, or trade, existing entitlements, such as the Mulgrave Mill entitlement on the Mulgrave River;
- demand management activities; and,
- relocation of in-river infrastructure, as necessary.

The costs also include for 'on-costs' such as survey, design, contract administration and commissioning, as well as a contingency amount.

The following cost indices were produced to inform the comparison of each strategy:

- Capital cost
- Fixed operating cost
- Variable operating cost
- Net present value (NPV)

The net present value method allows a direct comparison between strategies as each feature differences in timing of capital costs and recurrence of annual operating and maintenance costs. This was applied over the 30-year period of the strategy.

7.2.1 Modelling Frameworks

Two separate but related approaches were developed and applied to integrating outputs from the hydrology modelling with assessing the economic costs associated with the potential strategies.

The first model (Portfolio Assessment Tool) was used to evaluate the five strategies developed and described in Section 6. The second model (Stochastic Assessment Model) was used to assess the refined two strategies emanating from the WSAG's meeting on the 25 November 2014 and the subsequent preferred strategy. Features of each model are described below.

Portfolio Assessment Tool

The Portfolio Assessment Tool (PAT) is designed to facilitate the rapid assessment of different

strategy combinations of future water supply options and/or sequences.

The model links directly with capital and operating costs associated with the alternative options and assumes the LoS yield associated with each individual option based on outputs from the LoS hydrology modelling.

Accordingly, the PAT model is able to assess the present value cost of alternative strategies from a long-term water security perspective in that each strategy is capable of meeting the defined LoS performance criteria and targets.

The PAT model is based on annual time steps and evaluates each strategy over the 30-year period. The model also incorporates the agreed demand-side options.

Stochastic Assessment Model (SAM)

The Stochastic Assessment Model (SAM) provides valuable insights into the differing economic risks associated with alternative strategies beyond the PAT model.

The SAM provides not only an appreciation of the expected (average) present value cost of a particular strategy to be assessed, but also an understanding of the distribution of scenario costs associated with an individual strategy and across alternative strategies. The model integrates actual monthly outputs from the stochastic hydrology model with an economic model incorporating the incremental costs associated with the existing supply infrastructure with the future costs of strategy options.

Outputs from each individual hydrology sequence of the stochastic dataset form inputs to the economic model to derive a stochastic dataset of economic outputs for analysis.

For example, two strategies may have similar average present value costs, but one strategy may have a much higher present value cost at, say, the 95th percentile compared with an alternative strategy due to hydrology.

Because the SAM is based on monthly outputs of the hydrology modelling, it is also possible to quantify the economic cost of restrictions to customers (based on studies undertaken within the water industry) and also take into account the additional costs to Council during periods of restrictions (e.g. cost of media campaigns).

8 Assessment Outcomes

8.1 Normalised Multiple Objective Analysis

The analysis method described in Section 7 was used to measure the achievement of the group's objective by each of the five strategies. This section describes how the objectives were met and recorded for each strategy.

8.1.1 Compliance objectives

Each compliance objective was assessed against the nominated indicators. All strategies were found to satisfy the requirements of these objectives, or were considered likely to satisfy the requirements following future detailed assessments.

8.1.2 Scored objectives

Each weighted objective was assessed against the nominated indicator. Results were normalised through the process described in in Section 7.1.3 and multiplied by the consensus weightings detailed earlier. The total score for each objective was then tallied to provide an overall score for each strategy.

8.1.3 Outcomes

The relative scores achieved by each strategy are summarised in Table 9. The following comments may be made:

- Strategy B received the highest NMOA score, indicating that this combination of initiatives best achieved the nominated objectives.
- Strategies A and C received similar scores and are thus ranked equally in terms of objective achievement.
- Strategies E and G received similar scores and are thus ranked equal lowest in terms of objective achievement.

8.1.4 Sensitivity analysis

To assess the effects of stakeholder bias, a sensitivity analysis was conducted using the weightings defined by each stakeholder group. The NMOA outcomes achieved using the stakeholder weightings were then compared with the outcomes obtained using the consensus weightings.

The sensitivity analysis showed that the strategies were ranked similarly amongst the different stakeholder groups. Approximately 76% of stakeholder groups ranked Strategy B as the strategy most suited to achieving the nominated objectives.

Strategy C was most commonly ranked as second best.

Table 9: NMOA Scores for Initial Strategies

Strategy	Title	Total NMOA Score (rounded)
A	New Regional Dam	67
B	Repurposing Existing Water Resources	78
C	Cost Efficiency	65
E	Adaptability	62
G	Distributed Infrastructure	61

8.2 Cost Assessment

The outcomes of hydro-economic assessment using the Portfolio Assessment Tool (PAT) are presented in Table 10. The following comments may be made:

- Strategy C, as would be expected, has the lowest estimated present value cost.
- Strategy B has the highest estimated present value cost, followed closely by Strategy A.
- Strategy C and Strategy E had comparable cost.
- Strategies with the most water sources located to the south of Cairns City exhibited lower costs and slower cumulative capital expenditure.
- Strategies with sources utilising the Barron River had higher upfront costs due to the requirements of constructing the Lake Placid Intake and associated pipeline to Kamerunga WTP.

Table 10: Cost Assessment Outcomes for Initial Strategies

Cost Element	Strategy				
	A New Regional Dam	**B Repurposing existing water resources**	**C Cost Efficiency**	**E Adaptability**	**G Distributed Infrastructure**
	$M	**$M**	**$M**	**$M**	**$M**
Capital	488.1	366.4	277.2	286.8	437.1
Fixed Operating	58.9	164.7	32.9	35.7	55.0
Variable Operating[1]	39.0	35.0	19.4	19.8	28.0
Additional Demand management[2]		58.8			
Total (NPV)	586.0	624.1	329.6	342.3	520.1

Notes:
1. Consists of energy and chemical costs.
2. Includes capital and operating costs associated with a dual reticulation system – a component of Strategy B only, which also acts to further reduce the demand under Strategy B compared with the other strategies.

9 Strategy Refinement

Insight into the advantages and disadvantages presented by each of the five potential strategies was provided to the WSAG by the NMOA assessment together with the hydro-economic (cost) assessment process described above. This assisted with informing a further refinement process and to realise the importance of developing a strategy around long-term goals and short-term needs, with the embedment of key decision points to guide its implementation over time.

With this view in mind, the WSAG members categorised strategy elements into their:

- ability to be delivered in the near term (within 5 years) and certainty to Cairns in providing water supply security;
- merit for further investigation and progression in the mid-term (between 5 years and 10 years);
- ability to provide contingency supply; and,
- merit for consideration, or re-consideration, in the mid to longer term.

In light of the above categorisation and insights from the assessment process, two strategies were developed for comparison that either started at the Mulgrave River or the Barron River.

9.1 Start at the Mulgrave River

This strategy starts at the Mulgrave River. As there is anticipated to be a significant near-term increase in demand due to the Aquis Resort, a second stage of the Mulgrave River source would be developed. When the water demand meets the LoS yield of the scheme, the Barron River source would be developed.

As well as the common elements, this strategy also included the elements outlined in Table 11.

Table 11: Key elements of 'Start at Mulgrave'

Aspect	Amount of water	Completed by
Common elements	Refer previous description	
Mulgrave River	5,000 ML/a	2017
Draper Road WTP - Stage 2	19 ML/d	2017
Mulgrave River	8,500 ML/a	2019
Draper Road WTP - Stage 3	33 ML/d	2019
Barron River	5,500 ML/a	2024
Kamerunga WTP - Stage 1	25 ML/d	2024
Conversion of MDWSS losses	7,000 ML/a high priority allocation	2034
Kamerunga WTP - Stage 2	25 ML/d	2034

Figure 9 illustrates the LoS yield for this strategy to meet demand over the 30-year period.

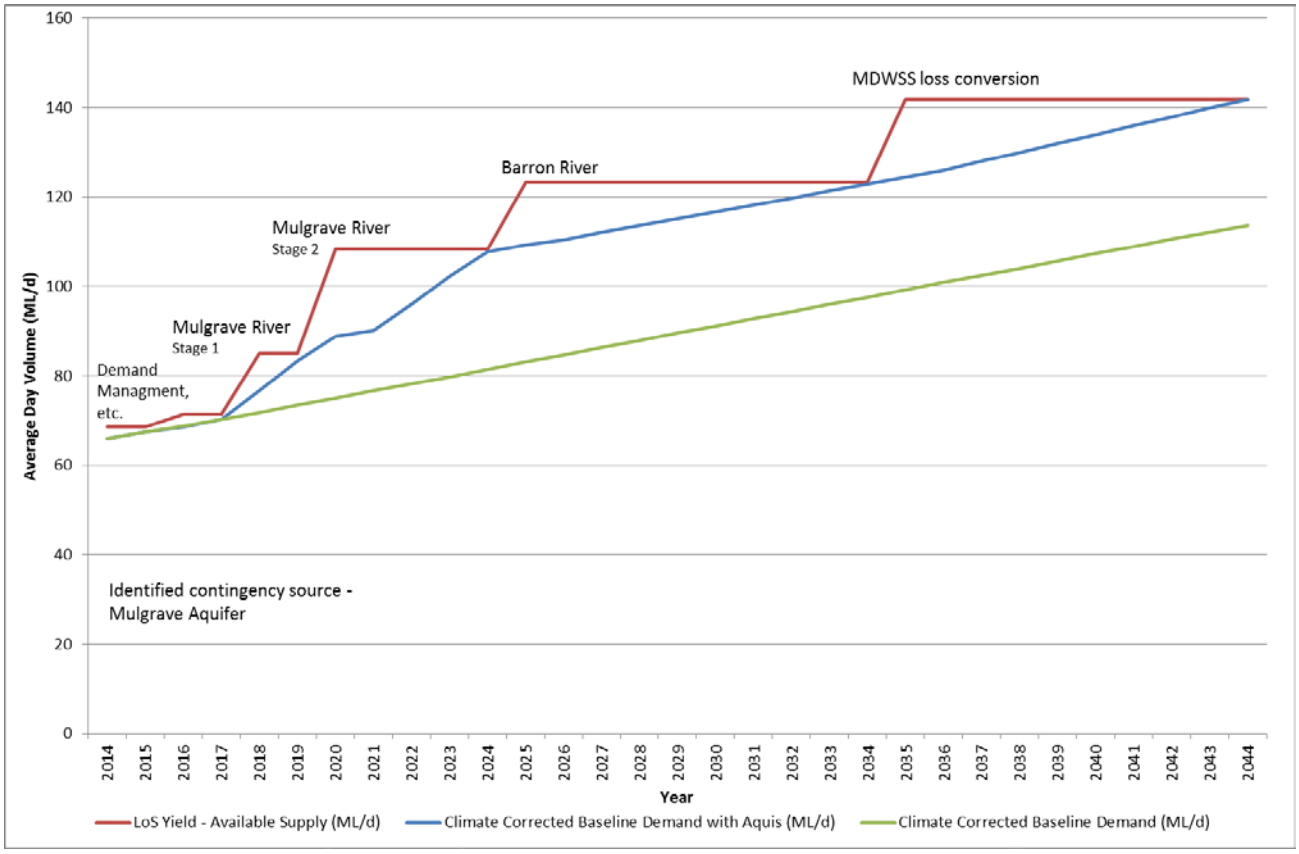


Figure 9: Start at the Mulgrave River – Forecast Demand and LoS Yield

9.2 Start at the Barron River

This strategy starts at the Barron River and accesses the existing strategic reserve allocated to Cairns Regional Council under the *Barron Water Resource Plan*. As there is anticipated to be a significant near-term increase in demand due to the Aquis Resort, there would be urgency for another water source to be developed soon after.

The other identified sources in the Barron River catchment are not yet proven and under the influence and control of entities other than Cairns Regional Council. Consequently, the strategy reverts to developing the Mulgrave River source. As the water demand increases over time and the feasibility and support for Nullinga Dam is advanced, this is accessed and treated at a new stage of the Kamerunga WTP.

As well as the common elements, this strategy also included the elements outlined in Table 12.

Table 12: Key elements of 'Start at Barron'

Aspect	Amount of water	Completed by
Common elements	Refer previous description	
Barron River	5,500 ML/a	2017
Kamerunga WTP - Stage 1	25 ML/d	2017
Mulgrave River – Stage 1	5,000 ML/a	2019
Draper Road WTP - Stage 2	19 ML/d	2019
Mulgrave River – Stage 2	8,500 ML/a	2024
Draper Road WTP - Stage 3	33 ML/d	2024
Nullinga Dam	7,000 ML/a high priority allocation	2034
Kamerunga WTP - Stage 2	25 ML/d	2034

Figure 10 illustrates the LoS yield for this strategy to meet demand over the 30-year period.

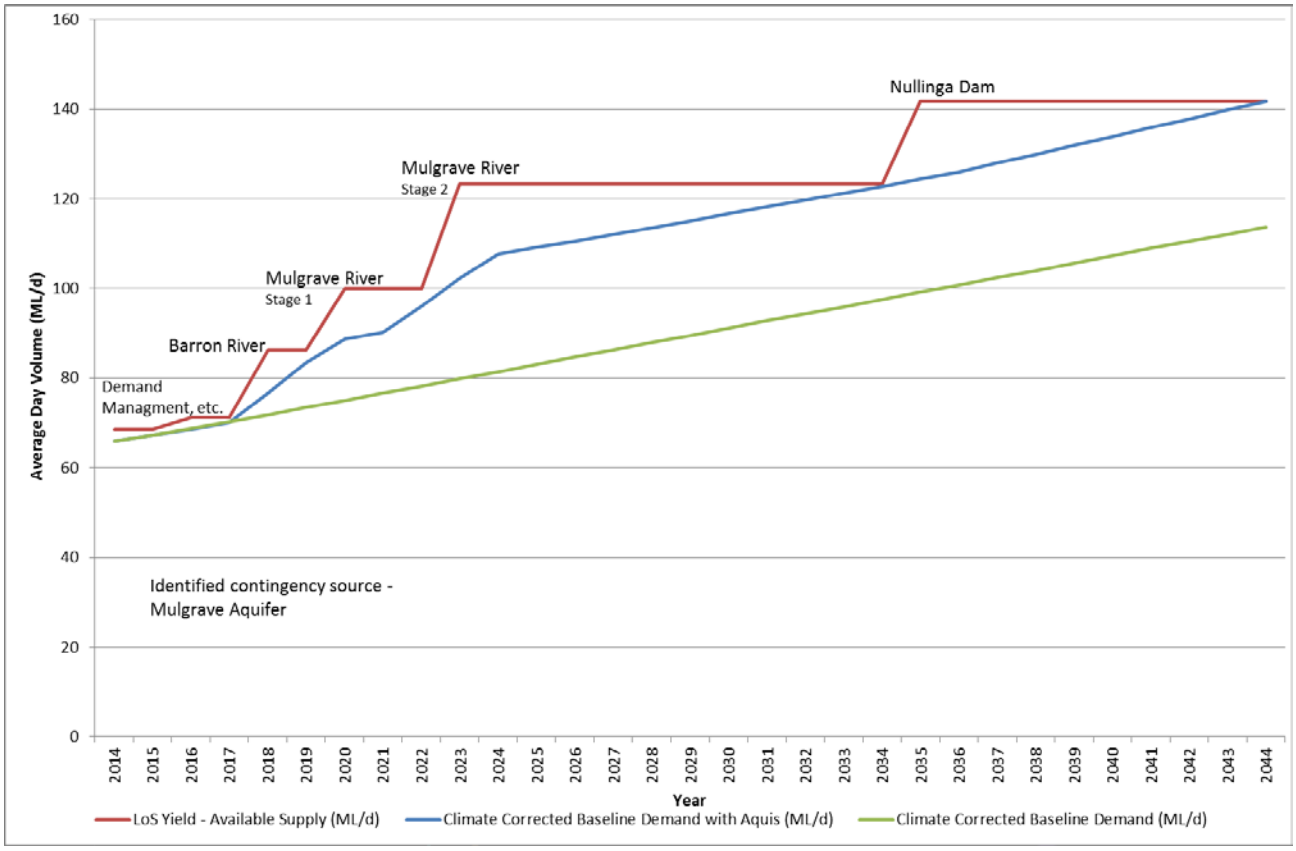


Figure 10: Start at the Barron River – Forecast Demand and LoS Yield

9.3 NMOA Analysis

The relative scores achieved by each of the two strategies are summarised in Table 13. The following comments may be made:

- Both strategies receive the same NMOA score, as they both generally involve the same elements over the 30-year strategy period.
- Starting at the Mulgrave River receives slightly better scores in the categories of 'Environmental', 'Technical', and 'Social', than starting at the Barron River.
- Starting at the Barron River receives a better score in the category of 'Economic' than starting at the Mulgrave River due to the development of large sources in the Barron River catchment (e.g. a regional dam) being perceived as an economic benefit to the broader region.
- Both strategies received a similar total score to Strategy C 'Cost Efficiency' and Strategy E 'Adaptability'.

Table 13: NMOA Scores for Refined Strategies

NMOA Category	Start at Mulgrave R	Start at Barron R
Environmental	20	18
Technical	14	10
Social	17	13
Economic	11	21
Total score (rounded)	62	62

9.4 Cost Analysis

The outcomes of hydro-economic assessment are presented in Table 14. In addition, Figure 11 and Figure 12 compare the accumulation of present value costs and capital costs between the two refined strategies.

Table 14: Cost Assessment Outcomes for Refined Strategies

Cost element	Start at Mulgrave R	Start at Barron R
	$M	$M
Capital	269.1	319.4
Fixed Operating	57.5	32.3
Variable Operating	68.8	58.7
Total (NPV)	$395.4	$410.4

The following comments may be made:

- Both strategies represent different timing of elements from both the Mulgrave and Barron River and have similar present value costs.
- The strategy commencing with the Mulgrave River has a significantly lower capital cost over the next 10 years.

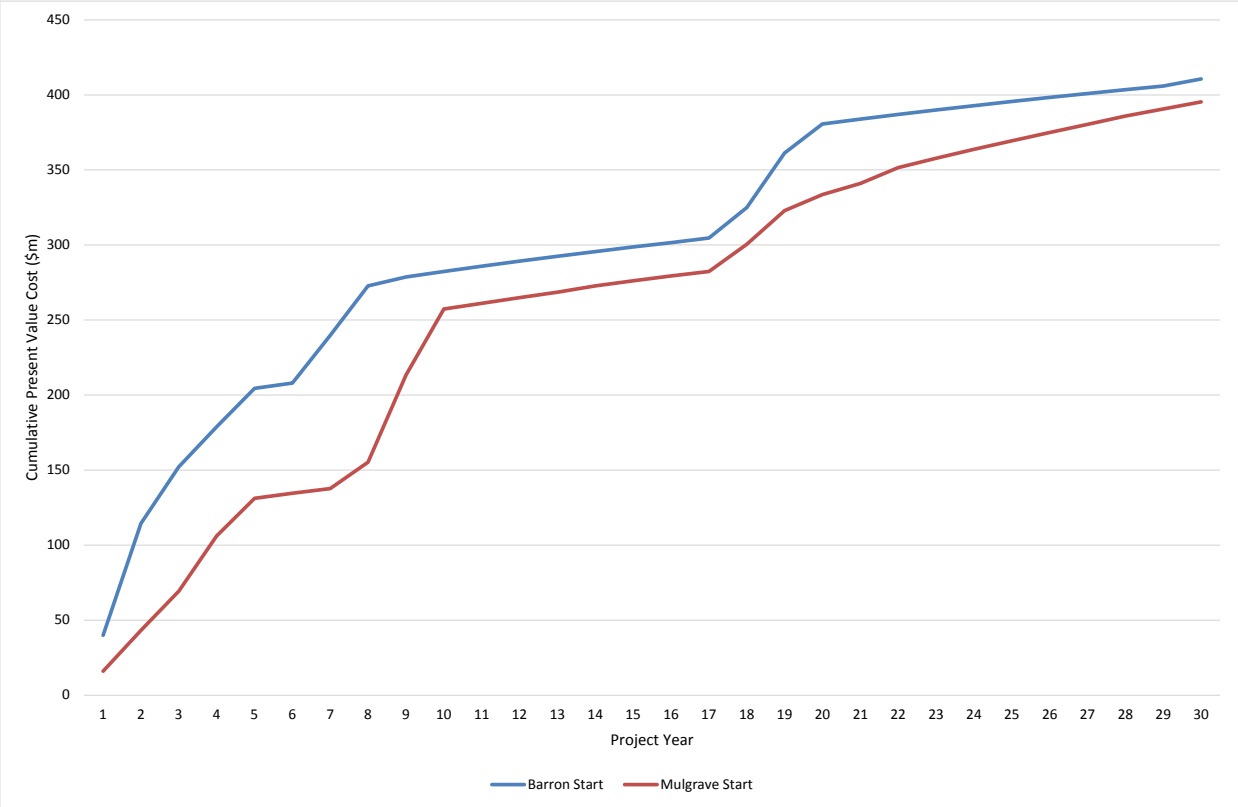


Figure 11: Comparison of cumulative present values

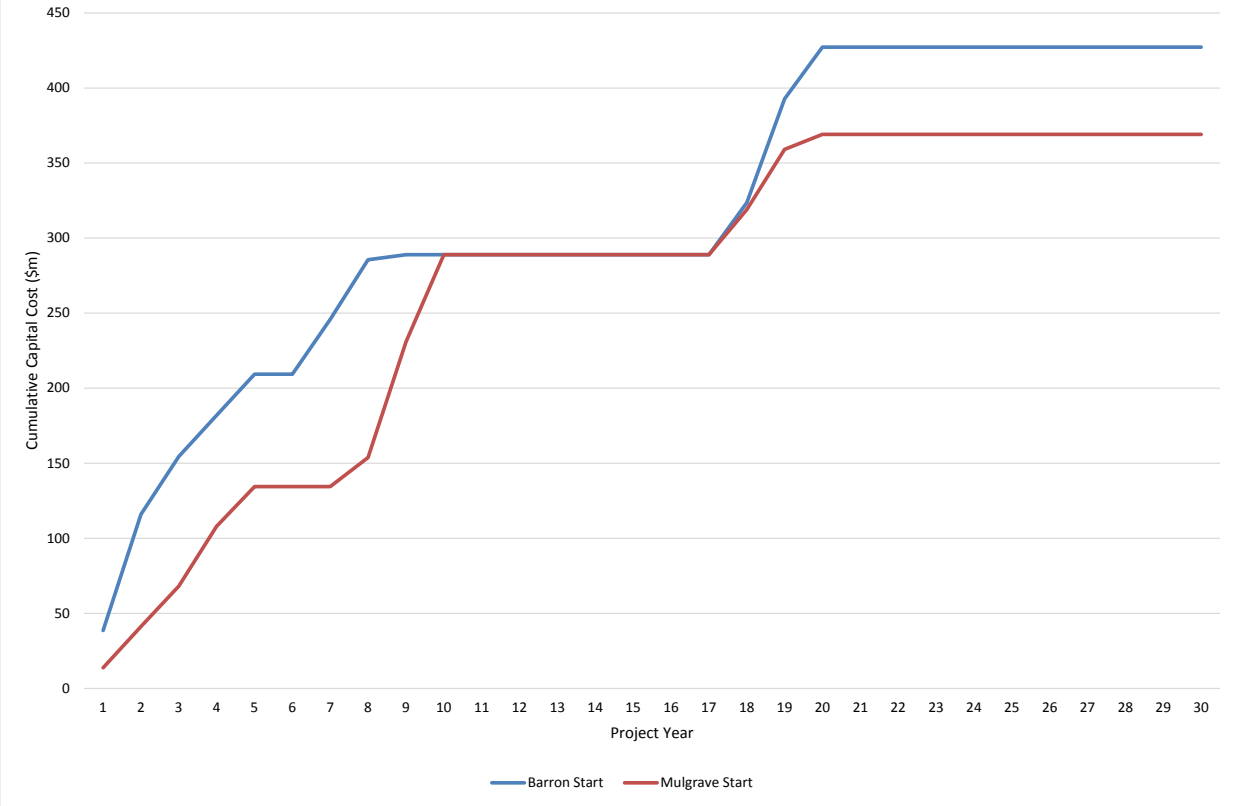


Figure 12: Comparison of cumulative capital expenditure

10 Preferred Strategy

At the WSAG meeting on 9 December 2014, the group considered the outcomes of the NMOA and cost assessments of the two refined strategies to arrive at a preferred strategy. The preferred strategy is described in Table 15.

Table 15: Preferred Strategy

Source and Treatment	Aspect	Notes
Copperlode Falls Dam	Existing	
Freshwater Creek WTP		
Behana Creek Intake		
Draper Road WTP Stage 1	Planned	
Augment Behana Creek Intake		
Demand Management Strategy Parts A, B, C and D	Commence as soon as practicable	
Smart Metering		
Mulgrave River Stage 1 Associated WTP: Draper Road WTP Stage 2	1st additional source	Further assessment and monitoring
Barron River Associated WTP: Kamerunga WTP Stage1	2nd / 3rd additional source	Requires further investigation before development proceeding including a comparative study regarding Barron River, Mulgrave River Stage 2 and Mulgrave Mill entitlement sources
Mulgrave Mill entitlement or Mulgrave River Stage 2 Associated WTP: Draper Road WTP Stage 3		Requires further investigation Only after environmental concerns investigated and resolved
Conversion of MDWSS Losses (Priority), Nullinga Dam Associated WTP: Kamerunga WTP Stage 2	Further investigation as soon as possible	WSAG forum continues
To be determined, that allows for agreed minimum requirements (100 L/p/d)	Emergency Sources	Requires Community involvement

As indicated above, development of the preferred strategy was based on the water demand growth in Cairns assuming the inclusion of the full development and consequential impact of the 'Aquis Resort at The Great Barrier Reef'. To be consistent with the approach of considering longer-term issues and shorter-term needs in developing the strategy, it is relevant to unpack the preferred strategy for the scenario that the Aquis Resort does not proceed. This information is presented below.

10.1 Medium-term strategy – without the Aquis Resort

The preferred medium-term strategy (up to 10 years) for the water demand associated with Cairns growth *not including* the Aquis Resort is:

- The development of Mulgrave River Stage 1 source and the development of the associated water treatment plant at Draper Road (being Stage 2 of that plant).
- In all situations (other than emergencies), no other sources are required during this time period.

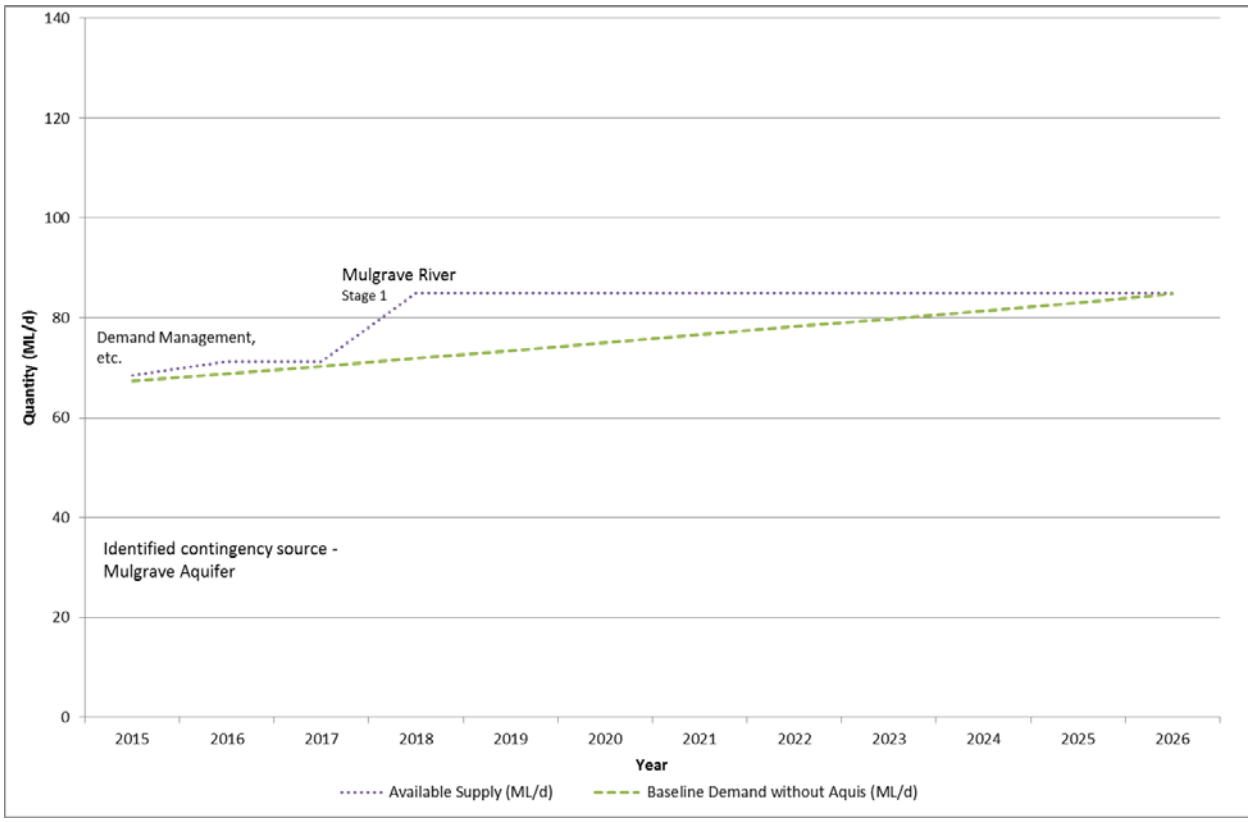


Figure 13: Preferred medium-term strategy based on the water demand for Cairns excluding the Aquis Resort

10.2 Medium-term strategy – with the Aquis Resort

The preferred medium-term strategy (up to 10 years) for the water demand associated with Cairns growth *including* the Aquis Resort is:

- The development of Mulgrave River Stage 1 source and the development of the associated water treatment plant at Draper Road (being Stage 2 of that plant).
- The development of Barron River strategic reserve source and the development of its associated new water treatment plant at Kamerunga.
- The development of Mulgrave River Stage 2 source and the development of its associated water treatment plant at Draper Road (being Stage 3 of that plant). This further development of the Mulgrave River would also consider the Mulgrave Mill entitlement.

Note that the development of the Barron River strategic reserve and the Mulgrave River Stage 2 source can occur in either order, and would be subject to a further specific comparative assessment.

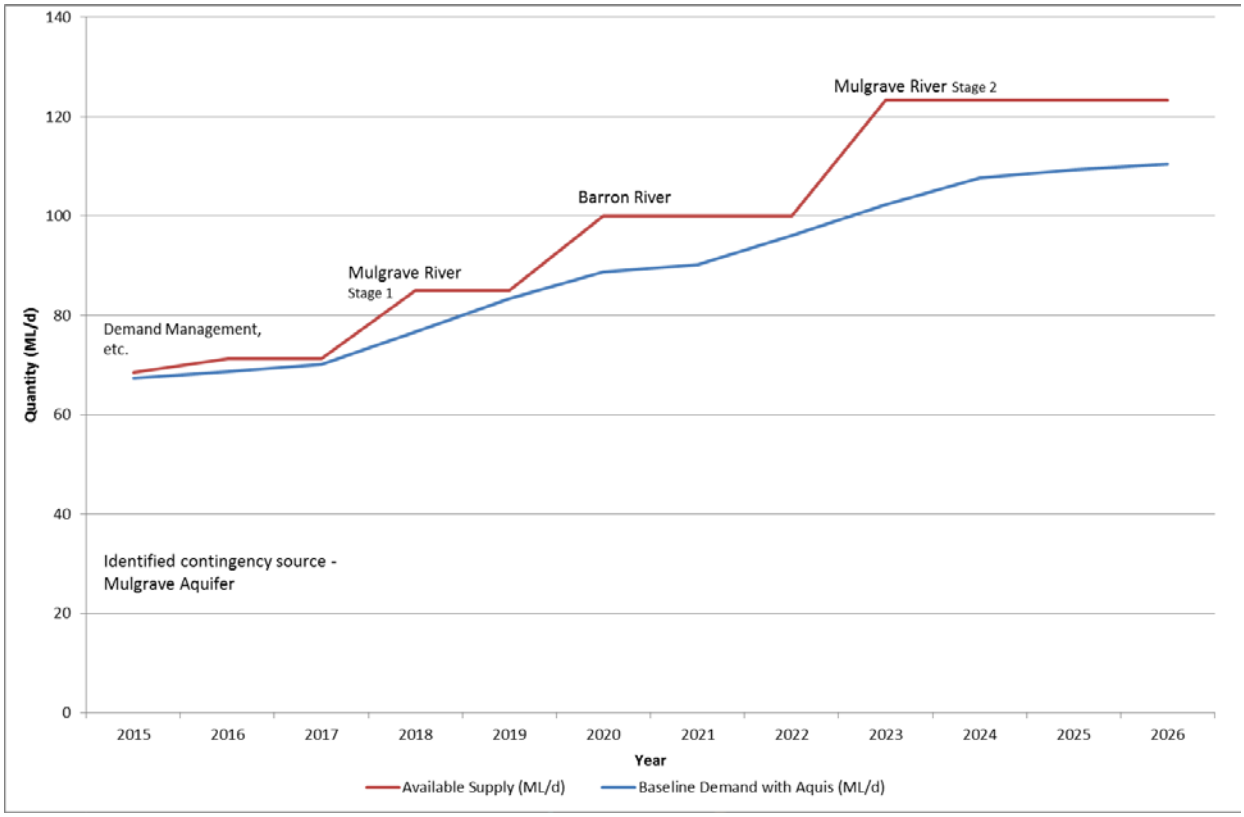


Figure 14: Preferred medium-term strategy based on the water demand for Cairns including the Aquis Resort

10.3 Longer-term strategy

All sources associated with the preferred longer-term strategy outcomes of both scenarios (with or without the Aquis Resort) necessarily require additional investigation about their availability, impact and costs.

The sequence of the longer-term sources preferred by the group are:

- Conversion of irrigation losses for the Mareeba Dimbulah Water Supply Scheme (MDWSS); and,
- Nullinga Dam.

10.4 Summary of Strategy Elements

The indicative water supply quantities required from the bulk water sources and capacities of the water treatment plants are detailed (in megalitres) in Table 16.

Table 16: Indicative amounts and capacities of sources and associated WTPs

Aspect	Amount of water
Mulgrave River	5,000
Draper Road WTP Stage 2	19 ML/d
Barron River	5,500
Kamerunga WTP Stage 1	25 ML/d
Mulgrave River (part of Mill entitlement or stage 1 river extraction)	8,500
Draper Road WTP Stage 3	33 ML/d
Conversion of MDWSS losses or Nullinga Dam	7,000 ML/a high priority allocation
Kamerunga WTP Stage 2	25 ML/d

The capital and operating costs of the various preferred strategy initiatives are detailed in Table 17.

Table 17: Summary of capital and operating costs

Element	LoS yield / capacity (ML/a)	Capital Cost ($M)	Fixed Cost ($M/a)	Variable Cost ($/ML)
Behana Creek Intake	1,000	6.9	0.44	
Draper WTP Stage 1	14,600	77.8	0.55	45
Mulgrave River Stage 1	5,000	14.3	0.10	80
Draper WTP Stage 2	6,935	40.6	0.29	40
Barron River	5,500	108.4	0.76	12
Kamerunga WTP Stage 1	9,125	46.1	0.32	62
Mulgrave River Stage 2	8,500	10.4	0.07	80
Draper WTP Stage 3	12,045	69.2	0.49	40
MDWSS loss conversion	7,000	30.1	7.86	12
Kamerunga WTP Stage 2	9,125	50.1	0.35	62

11 Implementation

11.1 Actions

The group was charged with formulating a water security strategy that was required to be flexible enough to accommodate increasing demand including that from the Aquis Resort. To meet this requirement, a series over near-term actions need to be completed.

The suggested immediate actions include the following:

- Finalisation of the Demand Management Strategy, including smart metering, and commencement of its implementation.
- Commencing the augmentation of raw water pipelines supplying the new Draper Road WTP from Behana Creek intake as soon as practicable.
- Commencing the Draper Road WTP facility, with capacity for both the Behana Creek source and Stage 1 of the Mulgrave River source as soon as practicable.
- Commencing the Mulgrave River Intake and associated pipeline to the Draper Road WTP facility as soon as practicable, including acquisition of regulatory and legislative approvals.
- Completing negotiations with the Mulgrave Mill regarding the transfer or trade of Mulgrave River water entitlements with Cairns Regional Council.
- Developing an emergency bulk water supply plan.
- Regular updating of water demand forecasts and timing, including for the Aquis Resort.

Medium-term actions include:

- Investigation and design of the Barron River Intake at Lake Placid and pipeline.
- Secure a water entitlement from the Strategic Reserve identified for Cairns Regional Council in the Barron Water Resource Plan.
- Design of Stage 1 of the Kamerunga WTP.
- Additional investigation of the potential cumulative impacts on the Mulgrave River ecosystem from additional extractions.
- Conducting a trial loss reduction program on the Mareeba Dimbulah Water Supply Scheme.
- Further consideration and investigation for the construction of the Nullinga Dam.

11.2 Review

The flexibility required within the strategy means that there should be a regular review of supply and demand factors. This assessment should be completed by Cairns Regional Council.

The continuing implementation of the Water Security Strategy could be reviewed periodically. This should occur at a frequency of one year or greater. At this forum, the Council team could present any updated data, the revised program and engage in relevant discussion with the WSAG. The group has indicated that it would be willing to reconvene to perform this function.

The period between overview forums would be no longer than every four years, and would be determined by the amount of change that has occurred relative to the base situation. That is, as the need for a new water source approaches, meetings may occur annually, whereas after the commissioning of a new source the forums would occur less frequently – potentially once every four years.

12 Recommendations

These recommendations represent the sum of the technical investigations, discussions and consensus views of the advisory group.

The Water Security Advisory Group recommends that Council endorse and adopt each of the following recommendations as a result of the Water Security Strategy consultative process.

The Cairns Water Security Strategy

1. Adopt the following objective for the Cairns Water Security Strategy:

   'Development of a long term (30+ years) water supply strategy that identifies a program of supply augmentations and demand management initiatives to ensure that Cairns has sufficient water to meet demand under normal and adverse environmental conditions.'

   whilst acknowledging the preferred strategy defined in Section 10 of this report.

2. Adopt the following key principles which underpin our Strategy
   - **Affordability** – Costs must be acceptable to Council and the wider community.
   - **Practicality** – initiatives can be delivered with available technology or achievable innovations.
   - **Compliant** with all applicable legislation.
   - **Acceptable** to the wider Cairns community.
   - **Is secure** in that it provides water security for the Cairns Regional Council Local Government Area.

3. Adopt the following minimum requirements for the Strategy:
   - Meet all licence conditions.
   - Meet all Environmental Flow Objectives under the relevant Water Resource Plans.
   - Minimise extent of disturbance to Zone A and B World Heritage Areas.
   - Ensure compliance with defined Levels of Service performance criteria.
   - Protect culturally significant sites (Indigenous and historical).
   - Consult with relevant parties with respect to all Cultural Heritage aspects.
   - Meet all Water Allocation Security Objectives under the relevant Water Resource Plans.
   - Ensure water supplied is fit for purpose and poses no risks to human health.
   - Preserve absolute minimum availability of water for hygiene and sanitary purposes.
   - Minimise risk associated with infrastructure.

Levels of Service

4. Reaffirm the existing Levels of Service – consisting of a four-tiered system of water use restrictions – within the Strategy.

Restriction levels	Frequency (Average Recurrence Interval)
Level 1 restrictions (80% storage)	1.5yr ARI
Level 2 restrictions (70% storage)	5yr ARI
Level 3 restrictions (60% storage)	10yr ARI
Level 4 restrictions (50% storage)	25yr ARI

Water demand

5. Adopt the water demand projections on the basis of:

- The 'medium' population growth forecast including the projected impacts of the proposed development of the 'Aquis Resort at the Great Barrier Reef'.
- A total baseline per capita water use of 418 litres per capita per day (L/c/d).

Financial implications of the strategy

6. Acknowledge that implementation of the Strategy will lead to an increase in:
   - rates and charges, which are paid by the entire community; and,
   - water and wastewater infrastructure charges, which are paid by way of developer contributions.
7. Acknowledge that increases to water and wastewater rates and charges also reflect the benefit of water security that the strategy provides to residents and economic prosperity.
8. Undertake detailed economic analyses to determine an appropriate mix of increased:
   - infrastructure charges
   - water and wastewater rates and charges

   with the aim of minimising the financial impacts on the ratepayers over the strategy timeframe.
9. Acknowledge the key decision point at years three or nine regarding further investigation and triple bottom line assessment (social, environmental, economic) between initial implementation of the Barron River and a further stage of the Mulgrave River.
10. Acknowledging the regional benefits of the preferred strategy, immediately commence negotiations with the State and Commonwealth Government to fund a proportion of the capital works and further assessment programs.
11. Acknowledging the technical and regulatory constraints, commence an assessment of the availability of the purchase of the Mill of entitlements to provide a supplementary water source.

Short-term initiatives

12. Implement Stage 1 of the Draper Road Water Treatment Plant and augmentations of the supply pipeline from Behana Creek Intake to achieve a treatment capacity of 40 ML/day and increase in scheme yield of 1000 ML/annum.
13. Develop Stage 1 of the Mulgrave River source to increase the LoS yield by at least 5,000 ML/a, including an additional stage of the Draper Road Water Treatment Plant to achieve a corresponding increase in treatment capacity of at least 19 ML/day.
14. Develop and implement a Demand Management Strategy with defined targets and actions based on considering the applicability to Cairns of initiatives identified during the WSAG process. The demand management initiatives identified are categorised based on the estimated water savings and implementation timeframes of the component initiatives, as follows:
    a. Part A, to be implemented over a 5-year period with estimated savings of 465 ML/a, consisting of:
       - Water Efficiency Labelling and Standards (WELS) – Total Program Savings
       - Community Education Programs

b. Part B, to be implemented over a 10-year period with estimated savings of 2,152 ML/a, consisting of:
   - Water efficient appliances for new residential developments
   - Water efficient appliances for new non-residential developments
   - Water system pressure reduction
   - Future leakage management
   - Large water users audit and retrofit program

c. Part C, to be implemented over a 5-year period with estimated savings of 269 ML/a, consisting of:
   - Residential retrofit program
   - Tourist accommodation water efficiency retrofit program
   - School water efficiency program
   - Commercial kitchen 'Smart Rinse' fixtures retrofit

d. Part D, to be implemented over a 5-year period with estimated savings of 140 ML/a, consisting of:
   - Commercial cooling tower tune-up
   - Rainwater tank information
   - Waterless urinal retrofit
   - Sub-metering of new multi-family dwellings

15. Develop an intelligent water supply and distribution network involving implementation of smart grid technologies and 'smart meters' to provide real time water consumption data with consequential operational benefits and water savings.

Medium-term initiatives

16. Complete a further investigation and triple bottom line comparative assessment of Mulgrave River Stage 2 and Barron River Stage 1.

Should the Aquis Resort proceed, and dependent on the outcomes of the comparative assessment of Mulgrave River Stage 2 and Barron River Stage 1, the following additional medium-term initiatives may also be implemented:

17. Develop the Barron River strategic reserve source to increase the LoS yield by 5,500 ML/a. This will involve construction of the Kamerunga Water Treatment Plant to a capacity of 25 ML/day; and/or,
18. Develop Stage 2 of the Mulgrave River water source (either part of the Mulgrave Mill entitlement or Stage 1 River extraction) to increase the LoS yield by 8,500 ML/a. This will involve a further stage of the Draper Road Water treatment Plant to achieve a further treatment capacity of 33 ML/day.

Long-term initiatives

Depending on the sequence of implementing the previous initiatives, the following initiatives are recommended for concurrent investigation to confirm the best initiative for implementation over the long-term (10 to 30 years). Further investigation into their availability, impact and cost is required prior to implementation:

19. Purchase and utilise part of the 19,000 ML/a Mulgrave Mill water entitlement and augmenting the Draper Road WTP to accommodate the corresponding capacity.
20. If required, further develop the Mulgrave River water source, ensuring that the cumulative capacity of the Mulgrave River water source is less than 15,000 ML/a.
21. Economically stage the modernisation of the Mareeba Dimbulah Water Supply Scheme to enable a conversion of the operational losses for urban use by Cairns. This would involve additional augmentation of the Kamerunga WTP.
22. Investigate the possibility of the use of appropriately-treated water for other purposes, such as environmental flow substitution.

23. Access water from a future regional dam (e.g. Nullinga Dam) and, if it proceeds, with contingent augmentation of the Kamerunga WTP.

Implementation

24. Pursue regulatory and legislative approvals to support implementation of the preferred water security strategy.
25. Acknowledge the level of investigation and consultation that has been invested in development of the Strategy and endeavour to implement each recommendation to ensure the objectives of the Strategy are met.
26. Invest in ongoing communication of strategy milestones and achievements to engage the community and encourage awareness, ownership and confidence in the Cairns water supply scheme.

Strategy Review

27. Council to seek ongoing support from the Water Security Advisory Group and wider region as the water supply strategy is implemented and as the further recommended assessments are made.
28. Annually review the fundamental assumptions that underpin the strategy to ensure water supply planning remains on track to meet demand. The review should consider:
    - Unexpected changes in water requirements
    - Amendments to Water Resource Plans
    - Climatic conditions
    - Economic assumptions
    - Significant advances in emerging technologies or changes in community attitudes.
29. Formally review the Cairns Water Security Strategy every 4 years, or when there are sufficient changes in the fundamental assumptions that underpin the Strategy.

13 Acknowledgements

Water Security Advisory Group – Full Members		Meeting Attendance
Independent Chairperson	Paul Gregory	12/12
Cairns Regional Council – Mayor	Cr. Bob Manning (Neil Quinn)	12/12
Mareeba Shire Council – Mayor	Cr. Tom Gilmore	8/12
Cairns Regional Council - Chair Water & Waste Committee - Councillor Division 5	Cr. Richie Bates	12/12
Cairns Regional Council - Councillor Division 1	Cr. Steve Brain	3/12
Cairns Regional Council – Chief Executive Officer	Peter Tabulo	11/12
Cairns Regional Council – Water & Waste, General Manager	Paul Utting (Alex Ung - Acting)	12/12
Department of Natural Resources and Mines	Shannon Dempster (Glynis Or)	11/12
Department of Energy and Water Supply	Kirsten Shelly (Darren Thompson)	10/12
Advance Cairns	Trent Twomey (Mark Matthews)	11/12
Cairns and Far North Environment Centre	Angelika Ziehrl	12/12
Cairns River Improvement Trust	Rob Lait	9/12
Cairns Youth Engagement and Action (YEA!)	Yuriko Nakachi-Monaei Mani Sunai-Norris	3/12
Community member	Allan Dale	10/12
Community member	Jeff Pezzuti	12/12
Community member	Suzanne Gibson	10/12
Mareeba Dimbulah Irrigation Area Council	Joe Moro	12/12
Mulgrave River Aquifer Community Reference Panel	Bruce Corcoran	12/12
Rainforest Aboriginal Peoples Alliance	Steve Purcell	12/12
Urban Development Industry Association	Adam Gowlett	12/12
Wet Tropics Management Authority	Andrew Maclean (Bruce Jennison)	12/12

Associate Members		Meeting Attendance
Canegrowers	Richard Hesp	1/12
Great Barrier Reef Marine Park Association	Phil Laycock	0/12
Mulgrave Mill	Peter Flanders	6/12
Queensland Health	Andrew D'Addona	0/12
Stanwell – Barron Hydro	Michael Sinclair	0/12
Sunwater	Charlie Martens	6/12

Project Team	
Executive Engineer – Planning (Project Manager)	Ben Millar (Cairns Regional Council, Water & Waste)
Manager Infrastructure	Jon Turner (Cairns Regional Council, Water & Waste)
Regulatory & Systems Support	Mark Wuth (Coordinator), Toni Veronese (Cairns Regional Council, Water & Waste)
Administration Officers	Nardia Trevenen, Tash Glaskin (Cairns Regional Council, Water & Waste)
Strategic Programs Unit	Eriks Zesers, Lia McDonald (Cairns Regional Council, Water & Waste)
Principal Water Resources Engineer	Pat Nixon (Jacobs Pty Ltd)
Principal Agricultural & Environmental Scientist	Neil Sutherland (Gilbert & Sutherland)
Principal Agricultural Scientist	Dr. Phillip Matthew (Gilbert & Sutherland)
Senior Environmental Scientist & Engineer	Erin Holton (Gilbert & Sutherland)
Principal Water Resources Engineer	Owen Droop (OD Hydrology)
Financial Analyst	Peter Jacob (Marsden Jacobs)

14 References

The following material was considered during the course of the *Water Security Strategy* and in the development of this report. The material is available upon request from Cairns Regional Council.

- Terms of Reference for the Water Security Advisory Group
- Meeting Minutes and Presentation Slides:
    - Meeting No. 1, 1 April 2014
    - Meeting No. 2, 29 April 2014
    - Meeting No. 3, 27 May 2014
    - Meeting No. 4, 24 June 2014
    - Meeting No. 5, 16 July 2014
    - Meeting No. 6, 19 August 2014
    - Meeting No. 7, 16 September 2014
    - Meeting No. 8, 14 October 2014
    - Meeting No. 9, 11 November 2014
    - Meeting No. 10, 25 November 2014
    - Meeting No. 11, 9 December 2014
    - Meeting No. 12, 17 March 2015
- Reference Papers prepared for the Water Security Advisory Group meetings:
    - *Discussion Starter*, March 2014
    - *Normalised Multiple Objective Analysis* – Dr. Philip Matthew, April 2014
    - *Meeting No. 3 – Reference Paper*, May 2014
        - Levels of Service – Introduction
        - Potable Water Demand Reduction
    - *Meeting No. 4 – Reference Paper*, June 2014
        - Levels of Service
        - Population and Demand Forecasting
        - Potable Water Demand Reduction (Updated)
        - Group Activity
    - *Meeting No. 5 – Reference Paper*, July 2014
        - Enhancement of Existing Sources
    - *Weighting of Project Objectives*, July 2014
    - *Group Activity - Options Identification*, August 2014
    - *New Source and Treatment Options*, September 2014
    - *Additional Options Development*, September 2014
    - *Description of Strategies*, November 2014
    - *Normalised Multiple Objective Analysis Results*, November 2014
    - *Description of Schemes Starting at the Mulgrave River or Barron River*, December 2014

- Supporting Technical Documents
  - Cairns Regional Council 2009, *Overall Water Supply Strategy for Cairns – Planning Report*.
  - Department of Energy and Water Supply 2013, *Regional Water Supply Security Assessment – Cairns*, Department of Energy and Water Supply, Queensland.
  - Department of Environment and Resource Management 2010, *Far North Queensland Regional Water Supply Strategy*, Department of Environment and Resource Management, Queensland.
  - GHD Pty Ltd 2000, *Barron River Water Supply System - Planning Report*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2004a, *Barron River Water Supply Scheme, Pipeline Route Selection Review - Tunnel Hill to Kamerunga*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2004b, *Cairns Water Supply Source Options Review - Augmentation of the Behana Water Supply System*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2004c, *Cairns Water Supply Source Options Review - Augmentation of Copperlode Falls Dam Water Supply Scheme*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2004d, *Cairns Water Supply Source Options Review - Mulgrave River Aquifer Water Supply Scheme*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2004e, *Cairns Water Supply Source Options Review - Mulgrave River Water Supply Scheme*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2007a, *Barron River Water Treatment Plant - Raw Water Supply to Kamerunga Treatment Plant*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2007b, *Mulgrave River Aquifer Project - Aquifer Abstraction Feasibility Study*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2007c, *Strategic Plan for Recycled Water Use in Cairns*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2008, *Barron River Water Treatment Plant - Process Selection*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2009, *Mulgrave River Aquifer Feasibility Study - Public Environment Report*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2011a, *Report for Behana Water Treatment Plant - Siting Options Study*, report prepared for Cairns Regional Council.
  - GHD Pty Ltd 2011b, *Report for Mulgrave River Aquifer Scheme Stage 1 - Numerical Modelling and Ecological Investigations*, report prepared for Cairns Regional Council.
  - Gilbert & Sutherland Pty Ltd 2012a, *Level of Service (LoS) Analysis for Cairns Water Supply: Report One - Development of Modelling Tools to Analyse Copperlode Falls Dam and Behana Creek*, report prepared for Cairns Regional Council.
  - Heritage Computing 2011, *Independent Review of Groundwater Modelling for the Mulgrave River Aquifer Project*, report prepared for Cairns Regional Council.
  - Jacobs Pty Ltd 2014a, *Potable Water Demand Management Strategy*, report prepared for Cairns Regional Council.

- Jacobs Pty Ltd 2014b, *Cairns Water Security Strategy – Supply Side Options*, report prepared for Cairns Regional Council.
- MWH Pty Ltd 2005a, *Least Cost Planning Study - Analysis of Demand and Supply Management*, report prepared for Cairns Regional Council.
- MWH Pty Ltd 2005b, *Least Cost Planning Study - Addendum to Water Resources Options Review*, report prepared for Cairns Regional Council.
- SKM Pty Ltd 2004, *Kamerunga WTP - Desalination Feasibility Study*, report prepared for Cairns Regional Council.

15 Glossary

Term	Meaning
Allocation	A water allocation is an authority to take water in areas covered by a Resource Operations Plan.
Aquifer	An underground layer of water-bearing rock, sediment or soil.
Blackwater	Wastewater from toilets and possibly also from kitchen garbage disposal units.
Buffer storage	Storage provided in the dam to provide additional supply security: the minimum level that the dam will be drawn down to.
Bulk water source / Bulk supply	Point of supply of a significant source of water to a local authority. May be a treated water source or a raw water source (e.g. dam).
Capital cost	Cost to build and set up the infrastructure for the water services.
Climatic risk	Risk associated with the inherent variability of climate, and the impact that it may have on dam operation (e.g. the risk of experiencing a drought worse than any on record).
Demand	Total water use requirements for a designated area/community; a measure of the need for water.
Demand reduction technique	A technique used to reduce water demand and improve water use efficiency.
Desalination	Process of converting saline water to drinking (potable) water.
Drought management techniques	Measures available to water service providers when water resources are particularly low—for example, water restrictions are considered a drought management technique.
Dual reticulation	Two separate pipe networks for the supply of water of different qualities for different purposes e.g. drinking water and recycled water.
Entitlement	A water entitlement is the general term used to describe water authorities granted under the *Water Act 2000*; this can be either a water allocation, interim water allocation or a water licence.
Environmental flows	Flow requirements necessary to maintain and support aquatic biota and ecosystem processes.
Fit-for-purpose water	Water supplied with a level of quality that is suitable for its intended use.
Greenhouse gases	Various gases responsible for warming the Earth's atmosphere. The most common is carbon dioxide, a product of burning fossil fuels.
Greywater	Water discharged from bathrooms, laundries and kitchens *excluding* toilet waste
Groundwater	Underground water which is defined in the *Water Act 2000* as artesian and subartesian water.
Levels of Service (LoS)	The security afforded to an urban water supply scheme expressed as the maximum frequency, duration and severity of restrictions imposed on water users.
LoS Yield	The quantity of water that can be collected for a given use from a supply source or supply option with a specified degree of certainty (LoS) and predictability, which is determined through analysis.
Loss reduction	Mechanisms that reduce the amount of water lost through the delivery of water to a water user.
Megalitre (ML)	One million litres

Term	Meaning
Net present value (NPV)	Net value of all costs and income, whether incurred now or in the future, expressed as a single investment required now, calculated using a nominated discount rate.
Non-potable reuse	Use of recycled water for purposes that do not require drinking water; for example toilet flushing and irrigation of gardens and lawns.
Non-potable supply	A supply of water that is not suitable for drinking.
Non-revenue water (NRW)	The volume of water entering the system that does not produce revenue.
Operating and maintenance costs	Ongoing costs associated with operating and maintaining infrastructure (including labour, material and energy costs).
Potable water	Water treated to a standard suitable for consumption (i.e. drinking and cooking).
Raw water	Natural water found in the environment such as rainwater, groundwater and water from lakes and rivers. It is considered to be 'raw' as it has not undergone any form of water treatment or purification.
Recycled water	Highly treated wastewater suitable for use for specific purposes: for example toilet flushing and irrigation of gardens and lawns.
Recycled Water Treatment Plant	A facility that processes treated water from a wastewater treatment plant to a higher quality for reuse in the community.
Reservoir	Tank designed for short-term storage of water within the water supply network.
Reuse	The beneficial use of recycled water.
Reverse osmosis	A filtration process commonly used for desalination that removes dissolved salts and metallic ions from water by forcing it through a semi-permeable membrane.
'Smart Sewers'	Wastewater systems constructed using superior materials and practices that reduce the amount of stormwater and groundwater entering the wastewater system.
Source substitution	The substitution of drinking water of a different quality suitable for an appropriate use (eg. use of recycled water for toilet flushing).
Stormwater	Rainfall that runs off roofs, roads and other surfaces and is collected in the stormwater pipe network.
Sustainable development	Activities that can be maintained over the long-term, while achieving a balance between the environment, the economy and society.
Total Present Value Cost	Current value of future costs including capital costs and operating and maintenance costs.
Trunk network	Parts of the water supply network that transfer potable water from a treatment plant to distribution reservoirs (including larger diameter pipes, pump stations and some reservoirs, and not including pipes that transfer water to individual houses).
Wastewater	The used water from the community and/or industry – also referred to as sewage.
Wastewater system	System of pipes and pumping stations that collect and transport wastewater to a wastewater treatment plant – also referred to as a sewerage system.
Wastewater Treatment Plant (WWTP)	A facility that treats wastewater to remove pollutants and produce treated water and biosolids.
Water cycle	Continuous cycle of water movement through the environment, including the

Term	Meaning
	oceans, the atmosphere, surface water systems and groundwater.
Water quality	Physical, chemical and biological measures of water.
Water Resource Planning	Planning process being undertaken by Government to determine management strategies, including allocations, for river catchments throughout Queensland.
Water supply system	System of water sources, treatment plants, pump stations, reservoirs and distribution pipes designed to supply potable water to the community on demand.
Water Treatment plant (WTP)	A facility that treats wastewater to remove pollutants and produce treated water.
Waterways	All streams, creeks, rivers, estuaries, inlets and harbours.
Whole-of-life	Relating to the entire useful life of an asset. Whole-of-life costs, therefore, include both capital costs and operating and maintenance costs for the useful life of the asset.

FAQ's

- General information about the temporary intake on the Mulgrave River
- Pilot Water Treatment Plant

Q: Is Council still planning on taking water from the Mulgrave Aquifer?

A: No. The water security strategy does not identify or include taking groundwater from the Mulgrave Aquifer for town water supply purposes.

Q: Why don't you take water from the Barron River or somewhere else instead?

A: The Barron River and other options were all considered by the WSAG. While it was not recommended to be the next source, the Barron River is part of Council's medium-term water supply strategy. Depending on population growth, taking water from the Barron River is not planned within the next ten years.

Q: Why is a temporary intake required?

A: A temporary intake is required to provide a continuous, but low, flow of water from the Mulgrave River to better understand its quality and how best to treat it for drinking. The temporary intake will operate for at least one year to experience the water quality during all seasons of the year.

Q: What is a pilot plant and why?

A: The temporary intake will supply a pilot water treatment plant. The pilot plant is a small scale water treatment plant to essentially determine the most efficient and optimal process for treating water to ensure it is fit for drinking.

Q: How will this impact fishing in the river?

A: The temporary intake is a very low flow of about 2 litres per second and will not impact on reducing levels in the river, the ability to fish, or the habitat for fish.

Q: How much water will be extracted from the river?

A: The temporary intake will take up to 2 litres per second from the river. If it operates for 20 hours a day, this will equate to approx. 21 Olympic-size swimming pools in one year.

Q: How long will it operate, and then what?

A: The pilot plant and temporary intake will operate for a period of between 12 and 18 months. It will then be decommissioned and removed from the site.

What's Next?

While the CWSS has many aspects, the following key initiatives are planned over the short term:

- Receive approval to extract small volumes of water from the Mulgrave River
- Design and construct a small pilot water treatment plant
- Continue concept planning for a major new water treatment plant
- Present a new Communications and Marketing Strategy for CWSS

For more information: Please go to our website

http://www.cairns.qld.gov.au/water-waste-roads/water/security

Or email us at **OurWaterSecurity@cairns.qld.gov.au**

Or phone **4044 3044**

Cairns Regional COUNCIL

OUR WATER SECURITY

Water is our most valuable resource and securing adequate water supplies to meet growing demand over the next 30 years is a priority for Cairns Regional Council.

Cairns Water Security Strategy (CWSS)

DEVELOPMENT

Of long term water security strategy to ensure Cairns has sufficient water to meet demand over the next 30 years

2009 - **Water Supply Strategy**

2013 - **"Our Water Security"**

Long Term View 30yr Strategy

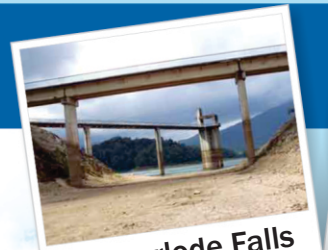
2014 - **Water Security Advisory Group (WSAG)**

Stakeholder Engagement

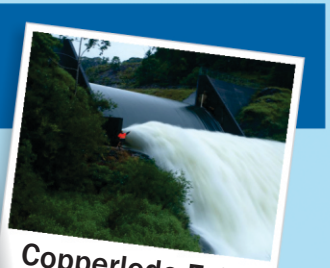
2015 - **WSAG's Final Report**

2015 - **Cairns Water Security Strategy (CWSS)**

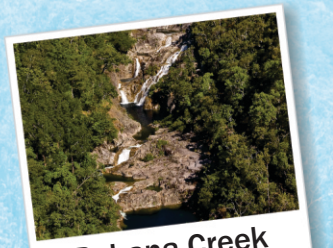
Council Endorsed



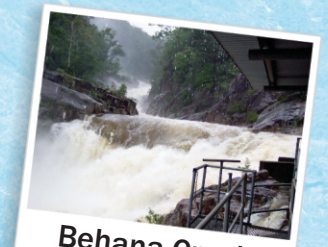
Copperlode Falls Dam in drought



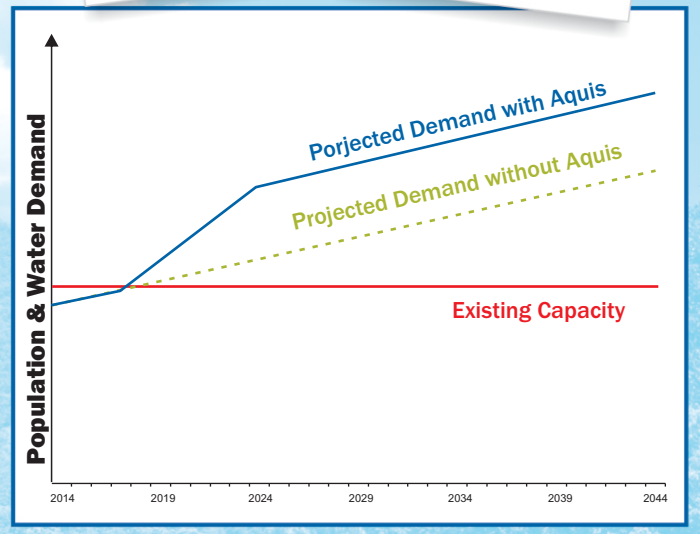
Copperlode Falls Dam in flood



Behana Creek in drought



Behana Creek in flood



Demand Management

Doing more with less

We will -

- work with communities to reduce demand
- install Smart Water Meters across communities and large water users
- use Intelligent Water Networks to improve water efficiency
- work with large water users to improve their water use efficiency using methods such as audits and communications strategies

Supply Augmentation

Sourcing water from Mulgrave River

We are -

- planning a small pilot water treatment plant in Gordonvale
- sampling and testing the quality of water from the Mulgrave River
- commencing survey and geotechnical investigations at Council land on Draper Rd for a new Water Treatment Plant
- investigating how to improve the treatment and reliability of water currently sourced from Behana Creek