Water for our Future

water
FOR OUR FUTURE

Barwon Water

Community Panel 2
Background Report

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Barwon Water

With less rain and a hotter climate, it's time to think differently about how we use water and where it comes from.

How can we create a new water future that balances all our needs?

Welcome back

It is our pleasure to welcome you back to phase two of the *Water for our Future* program.

We once again thank you for the depth of thought and spirit of collaboration you demonstrated during your first round of deliberations.

We now have an inspirational, progressive vision that will guide our work to ensure a secure water future and keep us aligned with the values of our community as we do it.

We also have a robust set of criteria that we have used as the basis for better understanding the hundreds of ideas we've heard for ways we might use and find water now and for the next 50 years.

These two pieces of work are an exceptional achievement and a legacy for which you should be very proud. We certainly are.

As we move into this next phase of *Water for our Future*, we have some big decisions to make.

Our challenge and its complexity remains – to ensure a secure water future for our region we may need to find or save an extra 50,000 million litres of water each year within 50 years' time, under a worst case scenario.

The task ahead of you is to make recommendations about which options can, and which options cannot, help to deliver your vision for the future – *a secure future where our rivers flow, our foods grow and our impact is low.*

As shown during your first phase of deliberations, we are certain that you, the *Water for our Future* Community Panel, are ready for the challenge and skilled to make recommendations to Barwon Water that serve the best interests of our region.

On behalf of the Barwon Water Board and executive team, thank you for partnering with us on this journey and playing such an important role in co-designing our new water future.

We wish you all the best with your next phase of deliberations and look forward to receiving your recommendations in March 2021.

Jo Plummer
Chair

Tracey Slatter
Managing Director

Acknowledgement

We recognise Aboriginal and Torres Strait Islander peoples as the First Peoples of this nation. We proudly acknowledge the Traditional Custodians of the land and water on which we rely, and pay respects to their Elders, past, present and emerging.

We value the continuing cultures and contributions of Aboriginal and Torres Strait Islander peoples to our communities and their ongoing connection to the land and water over thousands of years.

Our challenge

Our challenge

We need to plan and deliver a secure water future for our region. However, our water supply systems currently rely on a variable source – rainfall. We have a challenge ahead of us, if we are to create a new water future that balances all our needs.

Key elements of our challenge include:

Climate

We have seen a reduction in inflows to our storages since the Millennium Drought (1996–2010) – a "step change" of between 30 to 60 per cent reduction in average annual inflows since 1997, compared to the long-term average.

Science is telling us that our climate is becoming warmer and drier, so we need to be prepared for the possibility that this step change will continue or worsen. Climate change will mean less rainfall and more extreme events, such as bushfire, drought, floods and heatwaves. The combined effect will be less water available from traditional, rainfall-dependent sources, yet higher human and environmental demand for water.

Growth

We currently supply about 35,000 million litres of water across our region annually. Since the 1980s, our region's water use has reduced by about 20 per cent despite our population almost doubling in this time, from 163,000 to more than 300,000 people. Improved technology, water efficient appliances, behaviour change, education and awareness campaigns and the introduction of recycled water have all helped to improve our water use efficiency.

However, with more extreme heat events, less rainfall and a growing population, demand for water is increasing. Over the past 10 years, people in the region have increased their use of water from 172 litres per person per day in 2009-10 to 203 litres per person per day in 2019-20. As our region continues to prosper, we expect the population to once again double to 670,000 by 2065. The combined effect of more people using more water will place further pressure on our water supplies.

Affordability

Keeping water prices affordable is important if our region is to prosper. Our region is socially and economically diverse, with some communities in our region among the most disadvantaged in Victoria.

However, different sources of water come at different costs. This is due to the level of treatment required for different types of water and the cost of transporting water across our network.

Environmental needs

The amount of water available in both the Barwon and Moorabool river basins has declined by 11 per cent and 19 per cent respectively since 2005 due to a drying climate[1]. The environment's relative "share" of available water has decreased, whilst the relative share for consumptive use has increased. This means a smaller share of the available water is now set aside for the environment than it was before.

The construction of water supply dams has also irrevocably changed the natural flow regime of the Barwon and Moorabool rivers, with the Moorabool River recognised as one of the most flow-stressed rivers in Victoria[2].

1 Department of Land, Environment, Water and Planning (2020) Long-Term Water Resource Assessment for Southern Victoria – Overview Report, https://www.water.vic.gov.au/__data/assets/pdf_file/0025/457126/DELW0146_LTWRA_OverviewReport.pdf Accessed 6 December 2020.

2 Corangamite Catchment Management Authority (2020) https://ccma.vic.gov.au/what-we-do/waterway management/water-for-the-environment/moorabool-river/ Accessed 6 December 2020.

Our challenge – for Greater Geelong

95% of the water supplied by Barwon Water is used by customers connected to the Greater Geelong system including the Surf Coast and Bellarine Peninsula.

The challenge we face for Greater Geelong is that we may need to find or save an extra 50,000 million litres of water each year within 50 years' time, under a worst case scenario.

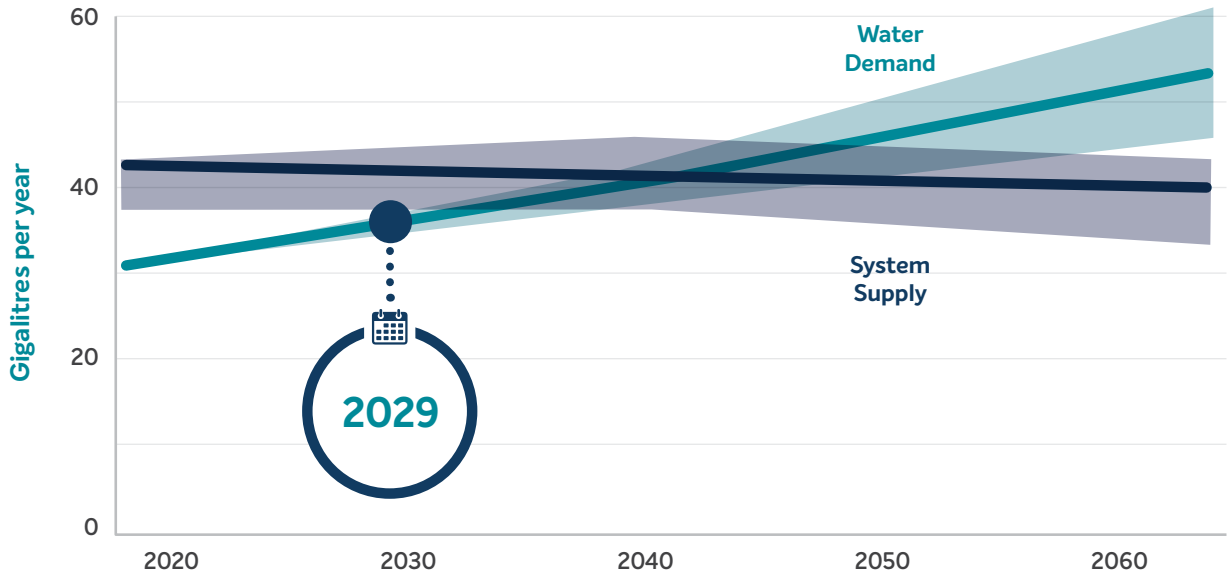


Figure 1. Supply demand projection for Greater Geelong

Three important things to note about our challenge for Greater Geelong:

1. Underlying assumptions are important

Based on current supply and demand assumptions, Figure 1 on the previous page shows Barwon Water may be unable to reliably meet our current level of service for Greater Geelong by 2029 – this means an increased possibility of water restrictions, more often and for longer.

Updated climate change guidelines received from the State Government on 11 December 2020 recommend that different assumptions about climate change should be considered. Water resource modelling experts have also recently completed an independent review of our water demands and recommended that different assumptions about garden and household water usage and population growth should be adopted.

Early indications are that these updated assumptions will bring forward the date at which Barwon Water is unable to reliably meet our current level of service for Greater Geelong by six years, from 2029 to 2023. We will confirm this timing, and the steps we are taking in response, in our 2022 Urban Water Strategy – our actions will be shaped by recommendations from the Water for our Future Community Panel.

2. Future is highly uncertain

Figure 2 below shows Geelong's consumptive demand over the next 50 years under a "high" population growth scenario. It also shows the difference between this demand and the amount of water available from current supplies under a "high" climate change scenario.

Figure 3 below shows the same figures under a "median" population growth scenario and a "median" climate change scenario. You can see that different demand and climate assumptions significantly change the timing and scale of our challenge.

Even more water is required if additional environmental water needs over the next 50 years are taken into account.

	2020	2030	2040	2050	2060	2070
Demand high population growth	**35,100**	**41,300**	**47,600**	**54,800**	**61,900**	**69,100**
Supply availability (+/–) high climate change	+8,200	-800	-9,900	-18,700	-27,500	-36,300

Figure 2. Gap between supply and demand – high population growth, high climate change

	2020	2030	2040	2050	2060	2070
Demand median population growth	**34,900**	**40,100**	**45,300**	**50,400**	**55,500**	**60,600**
Supply availability (+/–) median climate change	+8,200	+2,700	-3,200	-9,200	-15,300	-21,300

Figure 3. Gap between supply and demand – median population growth, median climate change

3. Need an adaptive and flexible approach

Because of these uncertainties, we consider a potential worst case scenario to be that we may need to find or save an extra 50,000 million litres of water each year within 50 years' time – that is 10,000 million litres every 10 years.

This represents the gap between supply and demand under the "high" population growth and "high" climate change scenarios as shown in Figure 2, plus an additional allowance for updated assumptions about population growth, climate change and environmental requirements.

Whilst it is prudent to be prepared for a worst case scenario, it is also important to have an adaptive and flexible approach, so that we can appropriately respond to the future as it unfolds.

Bearing in mind that most options have a very long lead term, we need to err on the side of caution in terms of implementing earlier rather than too late!

Our challenge – for other supply systems

Our other, smaller supply systems face the same challenge, but over different timeframes.

In Apollo Bay, short-term actions are underway to shift the timing of when we may no longer be able to meet our agreed level of service from 2023 to 2033. In Lorne, the earliest year our agreed level of service may no longer be able to be met is 2037. In Colac, the ability to draw on the same water supplies as Geelong provides water security until 2064.

Further information about our challenge is set out in the Background Report prepared to inform the *Water for our Future* Community Panel's first round of deliberations[3].

3 Barwon Water (2020) Water for our Future: Community Panel Background Report https://www.waterfuture.barwonwater.vic.gov.au/61991/widgets/312118/documents/183346/download Accessed 6 December 2020.

Our process – for Panel #2

Our process – for Panel #2

Our decision-making process is shown in Figure 4 below. There are four key steps, which will guide the evaluation and translation of a long-list of options into a robust strategy that clearly sets out the actions we will take in response to our challenge.

We have made the views of our community central to our decision-making process.

The vision and criteria agreed by the *Water for our Future* Community Panel in its first round of deliberations (Panel #1) underpins each of the four steps in our decision-making process. Steps 1 and 2 are the focus of the *Water for our Future* Community Panel in its second round of deliberations (Panel #2).

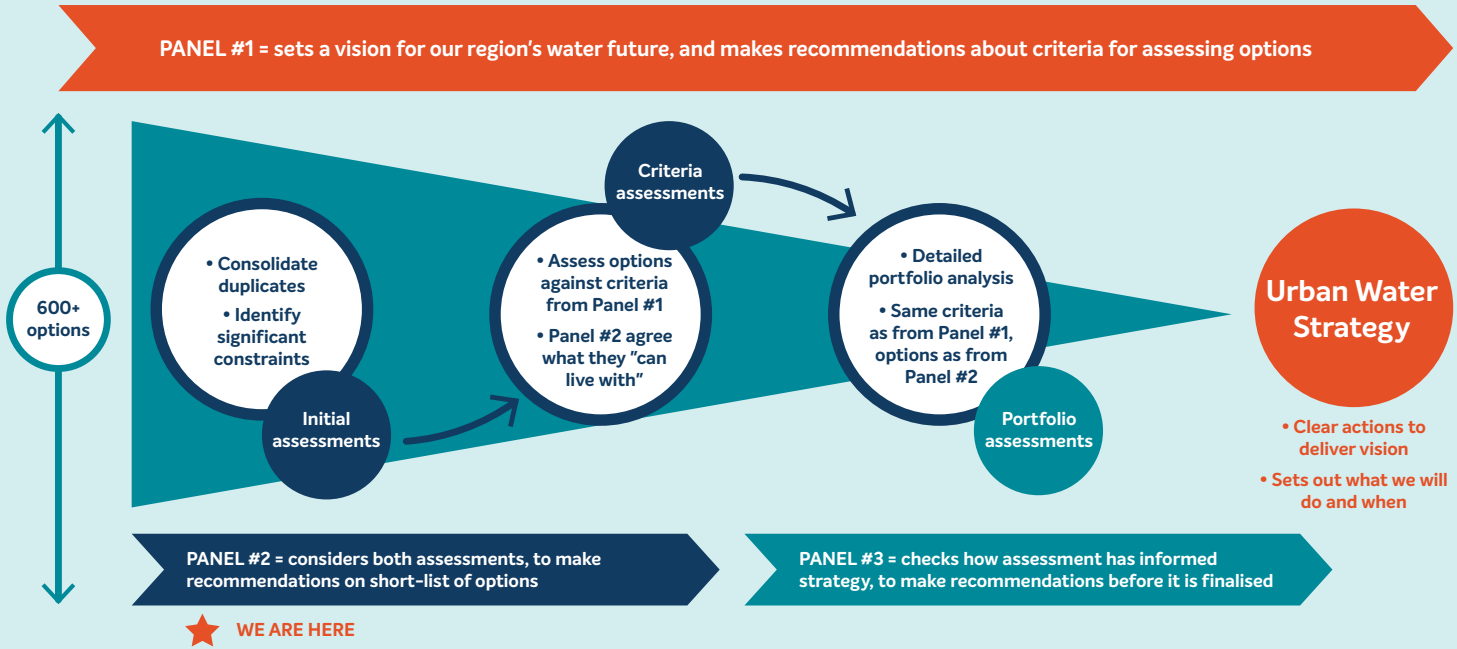


Figure 4. Decision making framework

Step 1 – Initial assessment

The first step was to refine our long-list of over 600 options to a more workable number of options for further assessment.

The purpose of this initial assessment was to strike a balance in the information presented to the *Water for our Future* Community Panel – we want to be open and transparent about the full range of options that have been suggested, but we recognise that assessing and reviewing over 600 options is impractical.

In the initial assessment, we:

- Consolidated duplicates – We grouped ideas that are based on a similar concept, to avoid duplicates and repetition.
- Identified significant constraints – We identified options that are considered highly unlikely or technically infeasible due to significant constraints or hurdles.
- Selected representative options – We selected an option (or handful or options) that is broadly representative of all options in that group.

The process of consolidating duplicates and identifying significant constraints narrowed down our long-list of options from over 600 options to about 200 options.

From these, we selected 52 options that we considered to represent the breadth of different concepts covered across the 200 options. For example, nine of the 200 options related to using recycled water at a localised (suburb) scale. Two of these nine options were selected as representative options because of they differed in terms of scale and volume of water supplied (sewer mining to use recycled water for watering public open space and new dual pipe system to supply recycled water to existing suburbs surrounding the Northern Water Plant). The other seven options were considered similar to one of these two representative options.

These 52 options were taken forward for further assessment in Step 2.

The results of the initial assessment are presented as a separate attachment to this report.

The *Water for our Future* Community Panel can choose to seek further information about any specific option that may have been excluded as a result of the initial assessment, if they wish – i.e. request supplementary criteria assessments beyond those in this Background Report.

Step 2 – Criteria assessment

The second step is to assess the refined list of options, using the criteria agreed by Panel #1.

The purpose of this criteria assessment is to provide the *Water for our Future* Community Panel with detailed information about options and a balanced view of the extent to which different options can achieve your vision.

An explanation of the criteria used for the assessment is provided in pages 23 to 33 of this report.

The results of the criteria assessment are presented in the remainder of this report.

The *Water for our Future* Community Panel will use this information to make recommendations about options that can deliver our vision.

Your task

The task for the *Water for our Future* Community Panel is to review the results of the Initial Assessment and the Criteria Assessment and make recommendations about which options could help to deliver your vision.

Your recommendations will identify which options are taken forward for further assessment and which options are not.

You must ensure your agreed list of options will adequately address our challenge – together, these options must be capable of delivering at least 10,000 million litres of water per year of additional water security within a 10 year implementation timeframe, and a total of 50,000 million litres per year within 50 years.

Your recommendations will help to shape our draft 2022 Urban Water Strategy – our 50-year plan for ensuring a sustainable, affordable and reliable water future for our community and environment, which will be updated every five years to ensure it continues to meet the needs of our region.

Note – You will be considering 52 options that are broadly representative of a longer list of about 200 options. Comparable options on the longer list will be dealt with in the same way as their corresponding representative option. For example, if you recommend an option about stormwater harvesting is taken forward, then all similar stormwater harvesting options from the longer list will be taken forward.

Barwon Water will incorporate the panel's recommendations about options to the maximum extent possible, noting that we must work within broader State Government policy, planning, regulatory and legislative processes (refer page 14 for further information).

Step 3 – Portfolio assessment

The third step involves grouping the agreed list of options into different portfolios.

Instead of each option being considered individually, the performance of different groups of options will be considered together.

A comprehensive evaluation of relative costs and benefits will be undertaken, so that the performance of each portfolio against criteria can be understood in dollar ($) terms. Each portfolio of options will also be considered under a range of possible futures.

We will choose the portfolio that offers the greatest community value under most scenarios.

We note that it is often very difficult to quantify benefits in $ terms with a high degree of accuracy. This is particularly true for broader social and environmental benefits, where benefits can be hard to both objectively measure and translate into $ impacts. Where it is not possible to accurately quantify benefits, qualitative analysis is often used to complement cost–benefit analysis.

Depending on the options that make up this portfolio, final decisions may rest with the State Government. For example, investment in large-scale infrastructure that provides benefits beyond the boundary of any individual water corporation are subject to State Government decision-making processes.

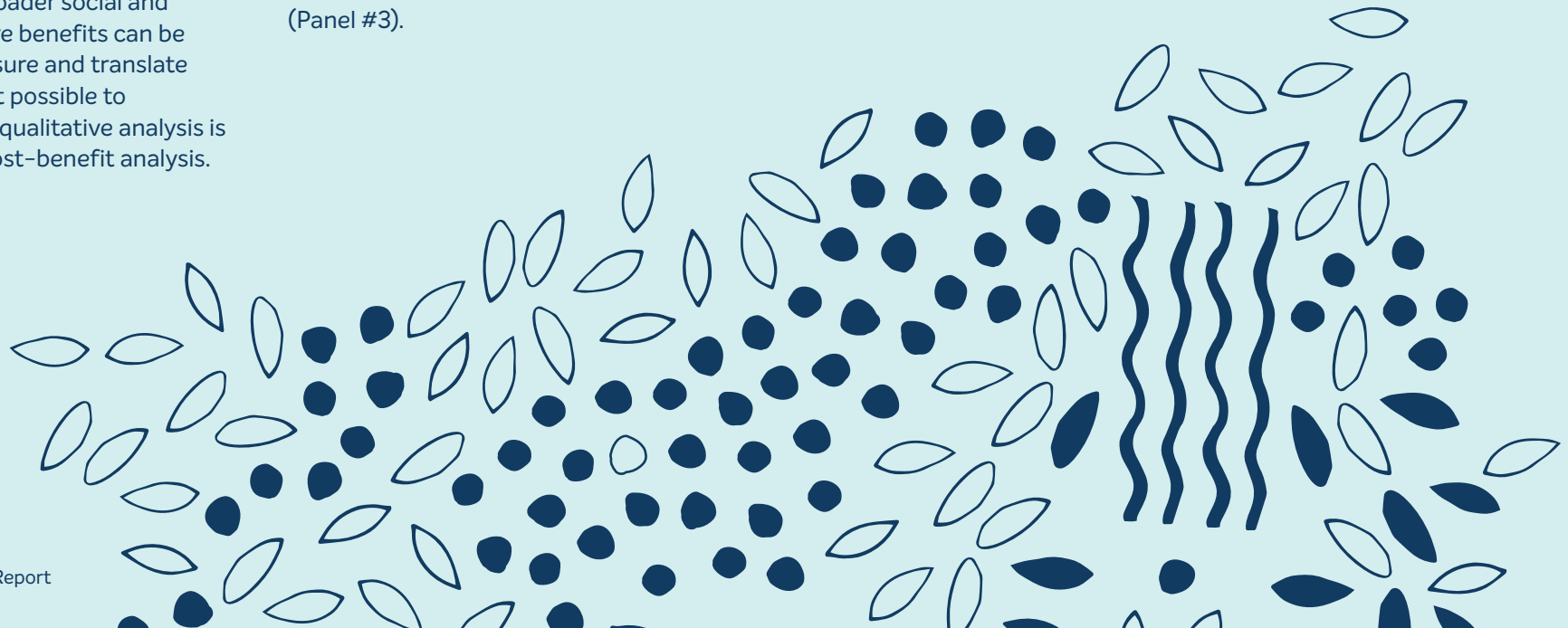
Step 4 – Strategy development

The final step is to develop our 2022 Urban Water Strategy based on the portfolio of options chosen in Step 3.

We will publish a draft of our strategy for our community to review.

The *Water for our Future* Community Panel will consider our draft 2022 Urban Water Strategy, and community feedback on this draft, when it meets for its third and final round of deliberations (Panel #3).

The final task of the *Water for our Future* Community Panel will be to check whether we have appropriately considered community views in developing our draft strategy and make recommendations on the draft strategy before it is finalised by Barwon Water.



Our role – within broader State Government

Our decision-making process is nested within broader State Government policy, planning, regulatory and legislative processes.

For example, the upcoming Central and Gippsland Region Sustainable Water Strategy will consider water security challenges across a broad geographic area that includes our region.

The Central and Gippsland Region Sustainable Water Strategy will consider the needs of all water users, including Traditional Owners and the environment as well as urban cities and towns. It will set out actions to improve river health and address water shortfalls due to the challenges of climate change and population growth. It will also consider opportunities to restore the balance in how water is shared in seven river basins across Victoria – we currently rely on water from four of these seven rivers.

Our 2022 Urban Water Strategy will inform, and must align with, the Central and Gippsland Region Sustainable Water Strategy. Both strategies are currently due to be finalised in early 2022.

The development of these strategies in parallel provides opportunities for the outputs of each step of our decision-making process to be considered in the formulation of broader State Government policy.

It also means that aspects of our 2022 Urban Water Strategy may be subject to decisions and policies set out in the Central and Gippsland Region Sustainable Water Strategy.

We will assist the State Government in keeping our community informed about the development of the Central and Gippsland Region Sustainable Water Strategy as it progresses.

Your vision

Your vision

The *Water for our Future* Community Panel has agreed a shared community vision for our region's water future[4].

It describes what a water future that balances all of our needs looks like and provides a reference point to guide our decision-making over the next 50 years.

We have accepted this vision in its entirety.

4 Water for our Future Community Panel (2020) Barwon Water: Water for our Future : Panel 1 – Day 4 https://www.waterfuture.barwonwater.vic.gov.au/47288/widgets/253338/documents/188656/download Accessed 7 December 2020.

Community Vision

Our water future is ...

A secure water future where our rivers flow, our foods grow and our impact is low.

Resilient, innovative and sustainable, with abundant water from a range of sources and where we actively protect and improve water for the environment.

Ethical, healthy and responsible, with affordable and equitable access for everyone.

A shared responsibility, by valuing and conserving water and respecting the diverse needs of our community, cultures and the environment.

Our criteria

Our criteria

What did you tell us?

The *Water for our Future* Community Panel provided recommendations about a suitable set of criteria to use in our criteria assessment.

In summary, these recommendations included:

- Five overarching, fundamental principles that are "to be applied across each of the criteria"
- Eighteen individual criteria, grouped into six themes:
  - social impact & equity
  - finance & economics
  - environmental
  - community & social outcomes
  - technology, science & innovation
  - sustainability

We have incorporated these recommendations to the maximum extent possible.

How did we use this?

Translated criteria into metrics

To undertake the criteria assessment, we needed to translate the recommended criteria into metrics – i.e. specific things that could be measured to allow the performance of different options to be tracked and compared.

Our metrics are either:

- Qualitative – written description that accompanies a Red / Amber / Green (R/A/G) rating of performance against that criteria
- Quantitative – numerical data that shows relative performance against that criteria

All of the information provided against these metrics should be considered high-level descriptions and/or preliminary estimates, as it was impractical for us to have completed detailed design and comprehensive studies for each of the 52 options assessed. In particular, all cost and yield estimates should be considered to have a large degree of uncertainty.

Adjusted some criteria

Whilst we incorporated your recommendations about criteria to the maximum extent possible, there were some small adjustments we needed to make in addition to translating criteria into metrics.

We found it difficult to develop metrics for three criteria, especially where we were unsure of what to measure or we did not see a measurable difference between options. We were unable to provide any measurable information against these criteria.

We used the same metric for different criteria, where we considered that similar concepts or ideas were being measured – one metric was used across three different criteria, another metric was used across two different criteria.

We also added three criteria to address specific gaps that we identified. These all fell under the "Technology, science & innovation" theme – namely:

- Volume of additional yield – i.e. maximum quantity of water that can reliably be supplied during a critical dry period
- Certainty of yield
- Regulatory, legislative or policy considerations/constraints

Adopted over-arching principles

We have not reflected your recommendations about principles in our criteria assessment. This is not because we don't think the principles are important – rather, it's because we understand them to be over-arching and important to all options.

We understand your principles should be applied equally across all options, rather than treated as criteria that are used to understand the difference between options.

As such, your principles will become fundamental to the next phases of the *Water for our Future* program:

- During Phase 3, we will take the agreed list of options that you develop and package these into different portfolios, with a more comprehensive evaluation of relative costs and benefits. We will keep your principles front-of-mind when undertaking the detailed work necessary to further scope up options (and portfolios of options). This work will then inform the portfolio cost-benefit analysis.
- During Phase 4, we will develop our strategy, which will clearly set out actions we will take over the next five years to deliver the portfolio of options chosen from the cost-benefit analysis. We will again keep your principles front-of-mind when setting these actions and developing our strategy.

Adjusted some principles

Whilst we incorporated your recommendations about principles to the maximum extent possible, there were some small adjustments we needed to make.

1. Amended one principle – Do no harm

We have amended this principle to introduce the concept of "so far as reasonably practicable". This means the risk of harm will be controlled as much as our time, money and resources will reasonably and practically allow.

All options will have some impact on the environment, in the same way that all actions taken by humans have an impact on the environment. For example, collecting rainwater from our roof for consumptive use prevents this water recharging groundwater systems or contributing to environmental flows in creeks and rivers. You could potentially rule out taking any action at all in response to our challenge with a principle that requires you to "Do no harm".

Concern that the principle of "Do no harm" is impractical and/or "physically impossible" was raised as a minority report by some panel members. We have tried to retain the intent of the principle whilst making it practical and realistic to achieve.

2. Added one principle – Care for Country and Connect to Country

We have elevated your "First Nations input" criteria to become an over-arching principle. This is because two key themes have emerged from our recent work with Traditional Owners in our region – Care for Country and Connect to Country. These provide guidance on how our shared commitment to caring for Country could and should be applied to the way we work at Barwon Water.

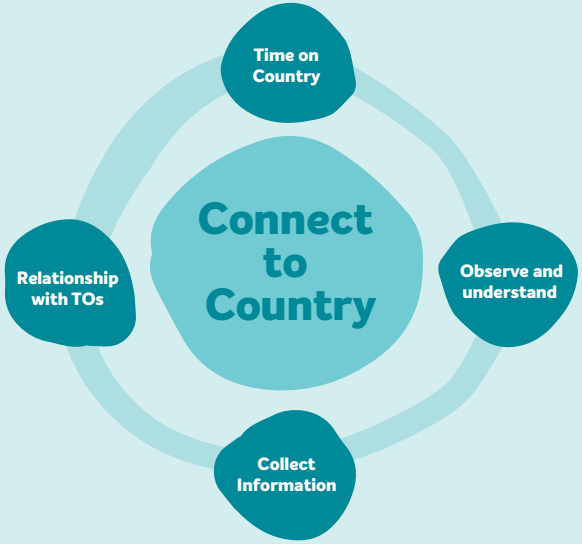
Four key principles about how to care for Country emerged, along with four key principles that provide guidance on how to connect to Country:

This work has shown us that caring for Country is an over-arching philosophy that we must bring to all aspects of our business. It is more than criteria that could be used to assess options – it is a way of thinking and doing.

Based on this work, we have introduced a new principle that we must Care for Country and Connect to Country through all aspects of the *Water for our Future* program.

We plan to honour this principle by spending time on Country with Traditional Owners to listen and learn from their perspectives and knowledge about the options under consideration. In particular, we are keen to understand where there may be opportunities to provide benefits for Traditional Owners – for example, potential alignment with objectives and aspirations of Traditional Owners Country Plans, such as the Wadawurrung's recently released Country Plan 2020-2030.

We propose to invite Traditional Owners to Panel #2 in mid-February to share their views on options with you. We will also continue our discussions with them throughout the next phases of the *Water for our Future* program, so that Traditional Owners' views can shape both our portfolio of options and our strategy. In addition, the upcoming Central and Gippsland Region Sustainable Water Strategy process being led by the State Government will consider opportunities to provide for Traditional Owners cultural values and uses of waterways in the region.



Our final principles

The principles that will guide future phases of the *Water for our Future* program are shown below.

These principles largely reflect those written by the *Water for our Future* Community Panel[5], with the exception of the changes described earlier and some additional, minor grammatical changes.

5 Water for our Future Community Panel (2020) Barwon Water : Water for our Future : Panel 1 – Day 4 https://www.waterfuture.barwonwater.vic.gov.au/47288/widgets/253338/documents/188656/download Accessed 7 December 2020.

Our principles:

Care for Country and Connect to Country, under the guidance of Traditional Owners

Do no harm, as far as reasonably practicable

Protect, preserve and improve the environment

Minimise disadvantage to the community and environment

Establish and monitor baseline social and environmental measures – if offsets are used they need to be treated with caution and closely monitored

Be a good corporate citizen

Our final criteria

The end result is that we have 23 metrics that represent 17 criteria, with three criteria unable to be measured and one criterion elevated to become an over-arching principle – as shown in the following tables.

The headings and descriptions given in these tables are as written by the *Water for our Future* Community Panel - except for the three criteria identified as "new", which have been added by Barwon Water.

The metrics and basis of assessment have been set by Barwon Water in response to these criteria.

Our criteria assessment

Our criteria assessment presents high-level, preliminary information only – much of this reflects the best knowledge, assumptions and/or judgements of Barwon Water professionals.

Some options we knew more about compared to other options, because of investigations we had already completed or similar technology or concepts we (or others) had applied elsewhere.

Our aim was to provide a representative, comparative view across options. This means we have tried to show how an option performs against the criteria relative to other options – is it much better, much worse or about the same? We focused on this comparison, as we thought this would be most helpful for your deliberations about options.

The information we provide is intended as a guide only and should not be viewed as definitive or exhaustive. Some options, for example, might cost more or less than we have indicated. Some environmental or social impacts might be scored subjectively in a way that others might disagree with. There may be other publicly available information that we were not aware of when we completed the assessment.

Social Impact & Equity

Heading	Social Impact and Equity (1)
Description	Does this option apportion responsibility fairly and facilitate equitable access to water services across all users?
Metric/s	We have two metrics for this criterion – these are: 1. Extent to which social benefits or impacts are shared across the community 2. Extent of private investment required by the community
Basis of assessment	**Qualitative**
R/A/G ratings	1. Extent to which social benefits or impacts are shared across the community G = Social benefits or impacts are shared equally across our community A = Some social benefits or impacts are borne by a localised part of our community R = Significant social benefits or impacts are borne by a localised part of our community 2. Extent of private investment required by the community G = No private, out-of-pocket expenditure by customers (beyond Barwon Water bill) A = Some private, out-of-pocket expenditure by customers (e.g. may be partially subsidised) R = Full private, out-of-pocket expenditure borne by customers

Heading	Social Impact and Equity (2)
Description	Does an assessment of risks and potential benefits protect social equity?
Metric/s	We don't have a metric for this criterion, because we were unsure what else to measure beyond the metrics above.

Heading	Social Impact and Equity (3)
Description	Is the process transparent? Have expert and community consultation and engagement processes been met?
Metric/s	We don't have a metric for this criterion, because we are still at the early stages of engaging with our stakeholders and community about the broad suite of options that might help to address our challenge. Some statistics about the breadth of our engagement process are shown on the following page. Our process is common across all options at this stage, and so, there is not a measurable difference between options.

Engagement to date

23 events across 16 months

Community & Social Outcomes

Heading	Affordability and Equity
Description	Does the solution deliver secure, affordable access to water for all (business/private/culture) and will the capital and running costs also be affordable?
Metric/s	We have four metrics for this criterion – these are: 1. Average annual bill impact for residential owner-occupier household ($2019-20) 2. Average annual bill impact for residential tenant household ($2019-20) 3. Average annual bill impact for small business customer ($2019-20) 4. Average annual bill impact for large business customer ($2019-20)
Basis of assessment	**Quantitative**
R/A/G ratings	Data is given without R/A/G rating.
Points to note	Average annual bills are made up of water volume charges (these vary based on the amount of water you use), water service charges (these are the same, regardless of how much water you use) and sewerage charges (these are the same, regardless of how much water you use). An average annual residential water bill for our region is based on an approx. 4 person household using 165,000 litres/year. Owner/occupiers pay all of the above charges. Tenants only pay the water volume charge, with landlords only paying the water and sewerage service charges. Business customers pay all of the above charges, but a slightly different rate for each charge. They also pay sewerage volume charges (these vary based on the amount of water used). An average small business customer, like a hairdresser, uses about 300,000 litres/year. An average large business, like a manufacturing plant, uses about 50,000,000 litres/year. The bill impacts we have calculated are estimates only. For ease of calculation and comparison, we have assumed that each option is fully operational next year, so all capital expenditure is spent in one year and a full year of operating expenditure is incurred. Obviously this is not what would happen in reality – and so, the bill impacts are not intended to be a true representation of what might happen to bills in future. They do, however, provide a sense of scale for potential bill impacts across different options. We wanted to provide visibility about the comparison between bill impacts, rather than the bill impact itself. Where bill impacts were calculated as less than $0.50 per annum, a figure of $0 is shown. Baseline average bills for each of the four customer groups used in our metrics are shown below. The bill impacts we have calculated are in addition to these baseline bills.

water FOR OUR FUTURE

	Average Annual Bills (2019-20)			
	Residential owner/occupier	**Residential tenant**	**Small business**	**Large business**
Water Volume Charge	$2.0467/kL x 165 kL/yr = $337.7055	$2.0467/kL x 165 kL/yr = $337.7055	$2.2375/kL x 3,000 kL = $6,712.5	$2.2375/kL x 50,000 kL = $111,875
Water Service Charge	$36.16 per quarter x 4 = $144.64	N/A	$37.97 per quarter x 4 = $151.88	$37.97 per quarter x 4 = $151.88
Sewerage Volume Charge	N/A	N/A	$1.9243/kL x 3,000 kL = $5,772.90	$1.9243/kL x 50,000 kL = $96,215
Sewerage Service Charge	$141.72 per quarter x 4 = $566.88 per year	N/A	$85.75 per quarter x 4 = $343	$85.75 per quarter x 4 = $343
Total Bill	**$1,049.26 per year**	**$337.70 per year**	**$12,980.28 per year**	**$208,584.88 per year**

Heading	**Public Education and Communication**
Description	Does the form of communication and education deliver measurable positive outcomes? These include increased awareness of water issues, a lower average water consumption and positive behavioural changes.
Metric/s	We don't have a metric for this criterion, because we have set a metric elsewhere that is similar/relevant (see "Sustainable Usage" criterion).

Heading	Social Benefits
Description	Does this create a net benefit for the majority of the community? e.g. Health, recreation, social impact, employment, etc.
Metric/s	We have three metrics for this criterion – these are: 1. Health benefits 2. Social and recreational benefits 3. Employment benefits
Basis of assessment	**Qualitative**
R/A/G ratings	1. Health benefits G = Provides known health benefits A = Provides no known health benefits and/or potential health risks can be managed R = Causes negative health impacts and/or potential health risks are difficult to manage 2. Social and recreational benefits G = Provides known social/recreational benefits A = Provides no known social/recreational benefits and/or potential social/recreational risks can be managed R = Causes negative social/recreational impacts and/or potential social/recreational risks are difficult to manage 3. Employment benefits G = Provides direct employment benefits greater than 10 FTE A = Provides direct employment benefits of 10 FTE or less, has the potential to provide direct or indirect employment benefits or employment benefits are unknown R = Provides no direct employment benefits
Points to note	We calculated employment benefits using the Economic Impact Assessment Tool developed by Flinders University. This tool uses the capital expenditure associated with a project to estimate direct and indirect full-time equivalent (FTE) employment created as a result of the project. We used it to calculate direct FTE only, based on high-level assumptions about timeframes required to construct each option (see "Technology and Infrastructure" criterion).

Environmental

Heading	Manage environmental impact
Description	Implement a systematic and regular environmental monitoring program from an established baseline, to understand and monitor the environmental impact. In consultation with all stakeholders, all activities and infrastructure will have a minimal negative impact on the natural environment and where possible a positive impact. Can any unintended negative environmental consequences be remedied or offset?
Metric/s	We have two metrics for this criterion – these are: 1. Potential environmental impacts relating to natural waterways or aquatic environments (such as extractions from or discharge to sea, rivers or other waterways) 2. Potential environmental impacts relating to land or biodiversity (such as construction impacts)
Basis of assessment	**Qualitative**
R/A/G ratings	1. Potential environmental impacts – water G = No known impacts on natural waterways or aquatic environments A = Potential impacts on natural waterways or aquatic environments are either unknown or impacts are expected to be small, limited or can be managed R = Negative impacts due to reliance on additional extraction from natural waterways or aquatic environments 2. Potential environmental impacts – land or biodiversity G = No known impact on land or biodiversity or low impacts expected in an already disturbed environment (e.g. highly modified urban or agricultural landscape) A = Low impacts expected in an area that may be of environmental significance or high impact expected in an already disturbed environment (e.g. highly modified urban or agricultural landscape) R = Impacts expected in an area that may be of environmental significance (e.g. National/State park or sensitive riverine/coastal environment)
Points to note	We considered that potential environmental impacts relating to air would predominantly concern greenhouse gas emissions, which are considered elsewhere (see “Zero Emissions” and “Cost Benefit Analysis” criteria).

Heading	First Nations input
Description	All decisions impacting the environment will be made in consultation with the Traditional Custodians of the land. Being mindful of cultural impact.
Metric/s	We do not have a metric for this criterion, because we have elevated it to be a principle (see page 20).

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Heading	Zero emissions
Description	Do any current and future operational activities aim for zero net emissions and comply with the advancement of technology and most up to date environmental regulation?
Metric/s	Extent to which greenhouse gas emissions associated with energy used by the option can be offset through the creation or purchase of renewable energy (or other means).
Basis of assessment	**Qualitative + Quantitative**
R/A/G ratings	G = Achieves zero net emissions – energy usage is completely offset through the creation or purchase of renewable energy (or other means) A = not used R = Does not achieve zero net emissions – cannot guarantee that energy usage will be completely offset through the creation or purchase of renewable energy (or other means), because the option is managed by a party other than Barwon Water
Points to note	We have given the amount of greenhouse gas emissions that must be offset for each option in the commentary that accompanies the R/A/G ratings. Some options actually cause a reduction in greenhouse gas emissions, because they reduce the amount of demand that must be met from the system. Energy is required to treat and pump each litre of water that Barwon Water delivers to customers and typically, energy generates greenhouse gas emissions. Whilst Barwon Water is committed to achieving zero net emissions by 2030, we wanted to provide visibility about options that reduce our overall energy consumption. We have shown the amount of greenhouse gas emissions that are saved by those options that reduce demand in the commentary that accompanies the R/A/G ratings. Options that can achieve zero net emissions have the cost to create or purchase renewable energy (or other means) factored into the cost of that option (see "Cost Benefit Analysis" criterion).

Heading	Climate change adaptation
Description	To what extent does this option rely on rainwater? Is this option vigilant and proactive to adapt to climate change? Does the feasibility of solutions and environmental outcomes monitor impacts to all water systems and dependent ecosystems as a priority?
Metric/s	Extent of climate/rainfall dependency
Basis of assessment	**Qualitative**
R/A/G ratings	G = Option is independent of climate/rainfall A = Option is somewhat reliant on climate/rainfall R = Option is significantly reliant on climate/rainfall

Sustainability

Heading	Circular economy
Description	All resources for this option should be recycled and reused at an optimal level.
Metric/s	Ability to enable the sustainable use or reuse of resources
Basis of assessment	**Qualitative**
R/A/G ratings	G = Enables the sustainable use of a limited resource or reuse of a wasted resource A = Does not involve use of a limited or wasted resource R = Does not enable the sustainable use of a limited resource or reuse of a wasted resource

Heading	Sustainable usage
Description	Will this option advance the socially and environmentally responsible use of water and other resources?
Metric/s	Ability to promote informed water use, e.g. increases awareness and understanding about where water comes from and/or how it is used
Basis of assessment	**Qualitative**
R/A/G ratings	G = Promotes informed water use by being accessible, visible and/or engaging to our community A = Somewhat promotes informed water use R = Does not promote informed water use

Technology, Science & Innovation

Heading	Technology and Infrastructure
Description	Is it feasible for this to be completed in an appropriate timeframe and have the ability to sustain longevity with the continuing advancements of technology throughout the future?
Metric/s	Time required for delivery/implementation of the option.
Basis of assessment	**Qualitative + Quantitative**
R/A/G ratings	G = Option is fully effective in less than 5 years A = Option is fully effective within 5–10 years R = Option is fully effective in more than 10 years
Points to note	We have given a range for the number of years expected for the option to be fully effective in the commentary that accompanies the R/A/G ratings. Some options are able to generate some benefits early, but take time to realise full benefits – for example, once a dam is built it requires rainfall and runoff to fill. Other options are able to realise full benefits from the time they are completed – for example, a desalination plant.

Heading	*new* – Regulatory, legislative or policy considerations/constraints
Description	Regulatory, legislative or policy constraints at both a state and federal level can significantly influence the feasibility of options and their timeframe for delivery/implementation. For example, construction of a new dam or drinking recycled water are not permitted under current policy, legislative and regulatory frameworks in Victoria. We wanted to provide visibility about the extent to which delivery/implementation timeframes set out above are driven by regulatory, legislative or policy considerations and/or where timeframes may be unachievable due to significant constraints.
Metric/s	Extent of regulatory, legislative or policy considerations/constraints
Basis of assessment	**Qualitative**
R/A/G ratings	G = No regulatory, legislative or policy constraints or requirements are well understood and can be confidently managed A = Significant regulatory, legislative or policy considerations need to be worked through, which require input and/or sign-off by key government stakeholders or regulators R = Not currently permitted under current regulatory, legislative or policy constraints

Heading	new – Volume of Additional Yield
Description	System yield is a theoretical calculation of the maximum quantity of water that can reliably be supplied from a system during a critical dry period. An increase in system yield increases the ability of the system to withstand dry periods and reduces the likelihood of frequent, harsh water restrictions. Options can increase system yield by either reducing the amount of demand that must be met from the system or increasing the available supply. We wanted to provide visibility about the volume of additional yield offered by each option, as your agreed list of options must be capable of delivering at least 10,000 million litres of additional water security within a 10 year implementation timeframe, and a total of 50,000 million within 50 years, in order to meet our challenge.
Metric/s	Volume of additional yield – in ML/year
Basis of assessment	**Quantitative**
R/A/G ratings	Data is given without R/A/G rating.

Heading	*new* – Certainty of Additional Yield
Description	We have varying degrees of confidence in the ability of different options to deliver the volume of additional yield set out above. This may be because the information we currently have about an option may be based on a series of high-level assumptions or estimates, or because there is inherent uncertainty about the application or uptake of the option, or because there is high degree of risk or uncertainty around the source of water that option relies upon. We wanted to provide visibility about the certainty of yield based on our current understanding of options and the expected reliability of the supply source or demand intervention underpinning each option.
Metric/s	Degree of certainty around the additional yield offered
Basis of assessment	**Qualitative**
R/A/G ratings	G = No uncertainty around yield (i.e. option is well understood and/or the expected reliability of the supply source or demand intervention is high) A = Some uncertainty around yield (i.e. option has not yet been rigorously scoped and/or the expected reliability of the supply source or demand intervention is uncertain) R = High degree of uncertainty around yield (i.e. option is speculative or untested as yet and/or the expected reliability of the supply source or demand intervention is low)

Heading	Science and Innovation
Description	Is there a smarter way to do this? Considering innovation, scientific/technological breakthroughs from a range of evidence.
Metric/s	We do not have a metric for this criterion, because we were unsure what to measure. We have commissioned Isle Utilities to complete an independent "technology scan" to help us understand the new and/or emerging options that we have considered. We did not see a measurable difference between options. We can provide a copy of the Isle Utilities report, if you are interested.

Heading	Climate and Population Change
Description	Does this option offer flexibility in water supply in response to population change and to fluctuating rainfall, environmental and weather conditions?
Metric/s	Ability to be scaled up (in terms of size and/or geographic reach) or staged (delivered in increments) over time
Basis of assessment	**Qualitative**
R/A/G ratings	G = Ability to scale up over time to realise greater benefits or potential to deliver via a staged approach in response to uncertainty A = Limited ability to scale up over time to realise benefits or potential to deliver via a staged approach in response to uncertainty R = No ability to scale up over time for any benefit or potential to deliver via a staged approach in response to uncertainty

Finance & Economics

Heading	Cost benefit analysis
Description	Holistic (financial, environmental, social and cultural) cost benefit analysis of projects must be justifiable and transparent in the short, mid and long term to cover expenditure and shared in a fair and balanced way.
Metric/s	We have three metrics for this criterion – these are: 1. Capital expenditure – the up-front cost to construct the option 2. Operating expenditure – the cost to operate the option each year 3. Levelised cost – the total cost of the option over its lifetime, expressed as the present value that each megalitre (million litres) of water that the option can produce (this allows a "bang for buck" comparison across different options)
Basis of assessment	**Quantitative**
R/A/G ratings	Data is given without R/A/G rating.
Points to note	We were unable to complete a holistic cost-benefit analysis for each of the 52 options that were assessed. This will be completed in the next phase of the *Water for our Future* program. Our intent is that only portfolios of options that have a benefit cost ratio of greater than 1 will be chosen. However, we note that it is often very difficult to quantify benefits in $ terms with a high degree of accuracy. This is particularly true for broader social and environmental benefits where benefits can be hard to both objectively measure and translate into $ impacts. Where it is not possible to accurately quantify benefits, qualitative analysis is often used to complement cost benefit analysis. We will do our best to satisfy a criterion of benefit-cost ratio greater than 1, but may rely on qualitative analysis where it is not possible to accurately quantify benefits.

Heading	Economic value
Description	Is this economically viable in terms of cost to our community?
Metric/s	We don't have a metric for this criterion, because we have set a metric elsewhere that is similar/relevant (see "Social Impact and Equity (1)" criterion).

Heading	Economic incentive
Description	To what extent and in what ways does this proposal, both in planning an in regular use, encourage water saving practices and initiatives?
Metric/s	We don't have a metric for this criterion, because we have set a metric elsewhere that is similar/relevant (see "Sustainable Usage" criterion.

Our options

Our options

Where did our options come from?

Over the past year, we have heard more than 600 ideas for the future.

These ideas have come from:

- Our community – contributions at our face-to face and online engagement activities, including our "Ideas Lab" (an online forum that enabled the community to post and discuss new ideas)
- Our staff – ideas from previous strategies and plans together with new ideas from staff who are experts about how our systems operate
- Independent experts – technical reports and gap analysis undertaken by qualified experts.

How have we organised our options?

The different ideas we have heard are grouped under 11 major themes.

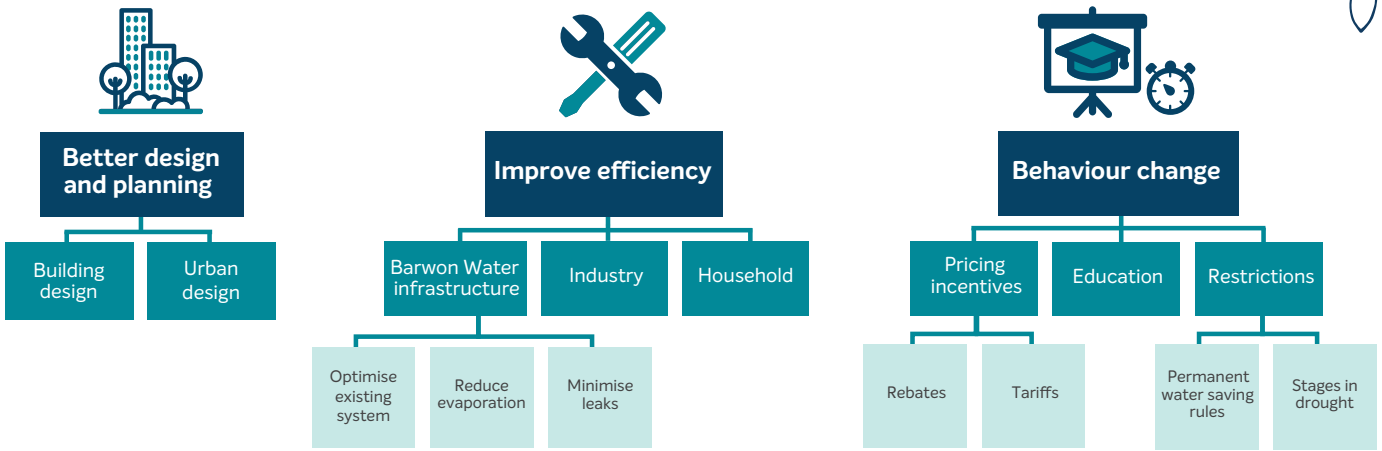
These themes sit under two broad headings – finding more water (supply options) and smarter water use (demand options).

Finding new water includes options such as rainwater, groundwater, seawater, stormwater and recycled water.

Smarter water use includes options such as designing and planning how we use water in our homes or suburbs differently, improving the water use efficiency of our assets or appliances and changing our behaviour to reduce the amount of water we use.

There are a number of variants or individual options relating to each of these high-level ideas. Individual, more specific options may relate to a similar concept but differ in terms of geographic location, size or timing of development.

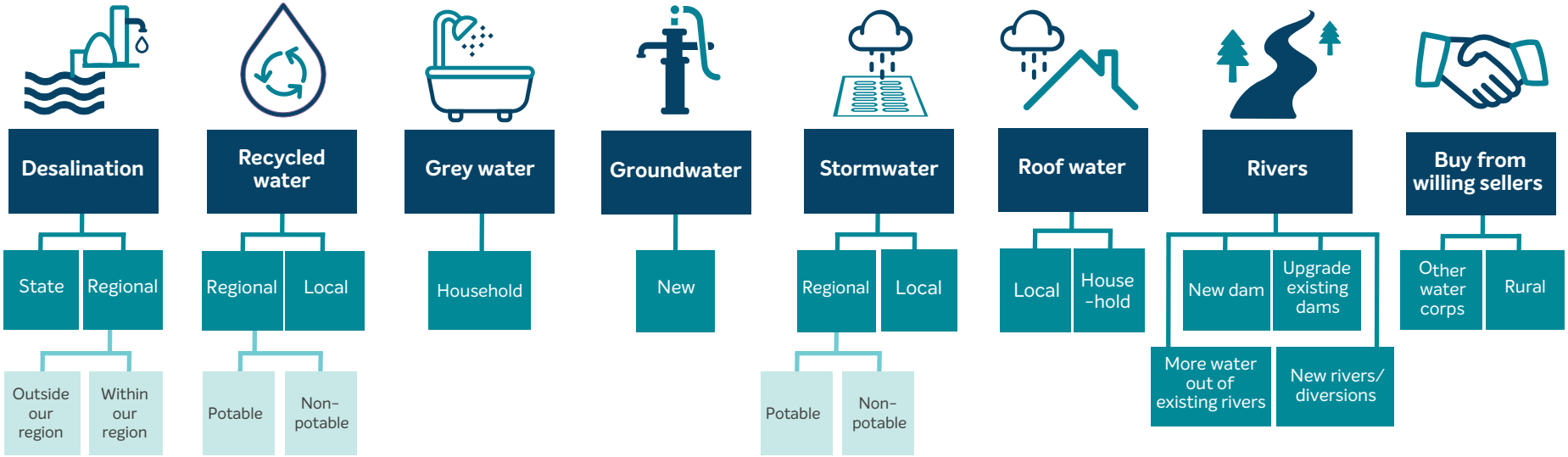
Smarter water use...



Definitions of scale:

- **Regional – whole-of-system scale (e.g. Greater Geelong)**
- **Local – suburb or township scale**
- **Household – building or household scale**

Finding more water...



What have we heard so far?

These 11 themes formed the basis of our engagement with our community, regional leaders and other key stakeholders about options that might be part of our water future.

The purpose of this engagement was to build awareness and understanding of the potential options and seek feedback about the options from a local, regional and technical perspective to help inform our panel's deliberations, and in some instances, our technical assessment.

Our engagement comprises four reports that can be found on the *Water for our Future* website – www.barwonwater.vic.gov.au/future and the *Water for our Future* Community Panel Portal.

All engagement was held online in accordance with Covid-19 restrictions.

Customer Advisory Committee and Environment Advisory Committee Workshop

10 November 2020

Twenty-seven community representatives from Barwon Water's customer and environment advisory committees joined an online workshop to explore the 11 themes and share, from their perspective, what they would like the community panel to know about each theme. The two advisory committees comprise representatives from local environmental groups, welfare agencies, culturally and linguistically diverse communities, welfare agencies and tenants' groups.

Council Working Group Workshop

27 October 2020

Members of the *Water for our Future* Council Working Group – a group of council officers that provide ongoing advice to the *Water for our Future* program – joined with other council officers from planning, environment and engagement departments to provide feedback from a local perspective and technical input into the 11 themes.

Regional Forum

10 December 2020

Thirty-seven leaders from across the region, including local councillors, young people and representatives from businesses and environmental groups attended our online regional forum to discuss the results and implications of the community panel's vision and criteria and provide insights about options.

Phase two wider engagement – 2 December 2020 to 31 January 2021

Our wider community was invited to visit the *Water for our Future* website to learn more about the 11 themes and have their say on which ones should be part of our water future.

Phase one wider engagement - September 2019 to September 2020

Our community shared ideas for our water future during our first phase of community engagement from September 2019 to September 2020. During this time, our community also shared their views around preferences for specific options. These insights were shared in our 'pulse check' online survey, community workshops and independent research, available on the *Water for our Future* website – www.barwonwater.vic.gov.au/future

Quotes from the 'what the community told us' sections of this report feature a selection of comments shared by the wider community during our phase one wider engagement and from the stakeholders who attended the regional forum and advisory committee and Council Working Group workshops in phase two.

Options for smarter water use

Options for smarter water use

Better design and planning

Overview

Better design and planning means improving the way we think about water when designing and planning for new buildings and new urban developments. The impacts of population growth and climate change on the water cycle are complex, so a collaborative approach to water planning is essential.

A key aspect of better design and planning is Integrated Water Management (IWM). IWM is a collaborative approach to water planning and management that brings together organisations with an interest in all aspects of the water cycle.

IWM provides the best opportunity for efficient, effective and meaningful investment in water cycle management. It also supports community outcomes, bolsters the local economy and makes our region greener and more liveable.

Examples of opportunities that can be leveraged by IWM include streetscape renewal, drainage, water–energy–waste initiatives, environmental flows and urban waterway revegetation.

Usually, there is a series of steps to implementing IWM. Organisational leaders come together in collaborative IWM Forums to discuss integrated water management opportunities and priorities for each region. This will inform the formation of working groups to develop IWM Plans for prioritised projects. Participating organisations, such as local government and water utilities, then incorporate relevant elements of IWM Plans in their own planning process.

In our region, IWM is led by the Barwon IWM Forum, which comprises regional leaders representing Traditional Custodians, local governments, statutory authorities and government agencies.

There are two clear advantages of IWM planning:

- Collaborative solutions that bridge siloed water cycle systems, leading to a greater range of solutions.
- IWM provides better value for community investment because of the shared benefits achieved through an integrated solution.

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OPPORTUNITY: Northern and Western Geelong Growth Areas

The Northern and Western Geelong Growth Areas (NWGGA) will re-define the future of Geelong and the surrounding Barwon region, becoming home to over 110,000 new residents and a variety of new businesses and industry. Through an integrated water management (IWM) approach, NWGGA will also be a landmark project for water, driving new economies, building regional water resource resilience and enabling a clever and creative approach to urban design and place-making.

Barwon Water is working with project partners City of Greater Geelong and Department Environment Land Water and Planning (DELWP) to deliver an IWM Plan. The project team includes representatives from across the water cycle, including Corangamite Catchment Management Authority, Southern Rural Water, Victorian Planning Authority, Traditional Owners and developer representatives

Developing an IWM Plan for the growth areas will lead to a resilient and efficient water cycle, healthier waterways and aquifers, healthier landscapes and neighbourhoods and a stronger community, economy and identity.

There are many significant opportunities and options under consideration to reduce water demand and increase yield. This includes recycled water use, stormwater harvesting, rainwater tanks and water sensitive urban design. Options being explored could save up to 7,300 million litres a year at ultimate development.

CASE STUDY: Water Sensitive Bendigo taking pause to improve the partnership

The Co-operative Research Centre for Water Sensitive Cities undertook an extensive collaborative process to develop a vision and transition strategy for Bendigo to become a water sensitive city. Local participants have since acted upon the strategy by establishing a governance structure known as the Water Sensitive Bendigo partnership, and developing a three-year implementation plan[6].

Driving Bendigo's transition to a water sensitive city are population growth and a drying climate; the population is projected to almost double to 200,000 people by 2051, yet rainfall is projected to reduce by a third over the period. This challenge adds to Bendigo's history as a water-stressed city. The community's resourceful and collaborative culture has seen the city continually innovating to deliver smarter water cycle services.

The Water Sensitive Bendigo partnership recently released its first annual report. The partnership took this opportunity to reflect on its successes for the year, identify key learnings from the collaborative process, and improve the partnership. The annual report demonstrates Bendigo's strong commitment to the water sensitive city vision and the need to continually reflect upon how cross-agency partnerships are performing.

What the community told us

"Integrated water management is key, creating green and blue communities will help us adapt to and mitigate against the impacts of climate change."

"Integrated water management projects can also contribute to agriculture, tourism, the economy – investment models should include agencies and decision makers from a much broader sectors to deliver on the vision."

"Collaboration and long term engagement with community, businesses, government, landholders, environmental managers and other stakeholders is vital to create ownership and support for any future use and management of water."

"Provide infrastructure, education and support to the Barwon community for integrated water management. Utilise stormwater, grey water, recycled water and other sources in households, businesses and across the community so that potable water is only used for drinking and cooking, and non-potable water is used for everything else."

"We want to make Integrated Water Management (IWM) to be BAU (Business As Usual) and a 'must have', not as it currently is, which is 'nice to have' and discretionary."

"Strengthen methods for better implementation of integrated water management principles through planning systems for new growth areas (including through precinct structure planning)."

6 CRC for Water Sensitive Cities, 2020.

Sub-option: Building design

One type of better design and planning is designing our buildings differently.

Better design of buildings can enhance liveability and the way water is used and managed in our cities and towns. Most of the water we supply is consumed within the buildings that are our homes, workplaces and commercial and industrial centres. They are also where much of the wastewater and stormwater that must be managed in our urban environments is generated. Buildings can even influence temperatures in our cities because of the way that some materials store and emit heat.

Better building design can reduce the impacts that buildings create, while contributing to greener, more liveable spaces. This is equally true of a growing city, a new subdivision, or an individual household.

The design stage is the opportunity to influence how a building can achieve better environmental, sustainability and liveability outcomes once it is built. It can incorporate water-efficient fixtures, as well as rainwater collection and use, to reduce the building's demand for drinking water.

Incorporating water-sensitive features in building design makes an important contribution to sustainability certification, such as Green Star ratings. Local government planning schemes also typically have minimum requirements that must be met by new development.

Barwon Water can advocate for better building design and work with partner organisations to promote and collaborate on good urban design solutions. But building owners and developers are ultimately responsible for building design. Local government also plays a key role in supporting building design through planning schemes and approvals.

CASE STUDY: Green walls, roofs and facades in the City of Melbourne[7]

Since 2005, the City of Melbourne has initiated activities to encourage green infrastructure – such as green walls, roofs and facades – throughout the municipality. The project aims to create 10 hectares of green infrastructure by 2021, to support a prosperous, healthy, cool and liveable city.

Examples include constructing an extensive green roof on Council House 2 and implementing demonstration projects such as 'Green Our Rooftop' and 'Green Your Laneway'.

The council is using green infrastructure to help manage the impacts of climate change, rapid population growth and urban development on Melbourne's liveability and resilience. Green walls and roofs help to:

- mitigate the urban heat island and insulate buildings throughout the year
- provide new urban habitats for rare or important species of plants or animals
- absorb and retain rainwater and filter particulates and pollutants, improving the quality of stormwater reaching waterways
- manage the peak stormwater flows that can contribute to localised flooding
- foster water sensitive communities and improve water awareness, health and wellbeing.

7 Cooperative Research Centre for Water Sensitive Cities, Green walls, roofs and facades in the City of Melbourne

What the community told us

"We must educate the population re how to have sustainable gardens and also provide sufficient well planned and maintained green space in our new developments [...]"

"Start now by harnessing the rainfall instead of watching it go down the drain [...] Reduce costs or reimburse use of water tanks [...] Catch water off all large roofs like schools, industry and housing estates [...]"

"Mandate installation of dishwashers in all new builds. Dishwashers are substantially more efficient than washing dishes in the sink."

"Work to implement policies for every new build to require the use of grey water for gardening."

Sub-option: Urban design

Another type of better design and planning is designing our suburbs and urban spaces differently.

The way we design our urban spaces has a major influence on the sustainability and liveability of the places where we live, work and play. The interaction between the water cycle and the built environment is central to this.

Good urban design can occur on any scale. Individual households and businesses can adopt water sensitive features, whether part of initial construction, renovations, or simply retrofitting (see the "Building design" sub-option). On a larger scale, better urban design of the major growth areas that will develop over many years to accommodate our growing population can ensure that "green" infrastructure (our parks, trees and gardens) and "blue" infrastructure (water in the urban environment) are planned in an integrated way.

We can design our urban spaces not only to make better use of available water sources, but also to protect our environment from impacts such as stormwater pollution and be more resilient to the effects of climate change. This practice is commonly referred to as Water Sensitive Urban Design (WSUD).

WSUD comes in many forms and can be seen in many places. Common examples include rainwater tanks, raingardens, sediment ponds, constructed wetlands and swales. Replacing hard surfaces with such designs increases pollution removal and absorption of rainwater into the ground.

In natural environments, rainwater is mostly absorbed into the ground, used by plants or evaporates back into the atmosphere. In urban areas, hard surfaces such as roads, roofs, driveways and paths stop water being absorbed by the ground and create what is known as stormwater runoff. Trucks, cars and industry in urban areas create high levels of pollutants that settle on these hard surfaces and, when it rains, stormwater carries the polluted water down drains and eventually to creeks and rivers[8].

WSUD works best when stormwater is treated close to its source – for example, a raingarden or wetland in a park collecting and treating stormwater from local streets before that water enters a creek or river.

Application of these principles provides a cost-effective way to minimise impacts of development on waterways, provide places that are cooler and greener, and engage communities that are healthier and more connected to their waterways[9].

By retaining rainwater and stormwater closer to its source to help keep our urban spaces green, we can also reduce the reliance on our precious drinking water supplies for this purpose.

Green-blue infrastructure can be delivered at a range of scales, from building scale initiatives to precinct scale or regional features. These systems will all typically have the following characteristics in common:

- vegetation, providing amenity and habitat
- soil, of adequate volume, nutrient content and drainage characteristics
- a link to rainwater, stormwater or recycled water supply, with a frequency and quantity sufficient to support vegetation and soil health.
- In addition, some systems may provide additional water management functions:
- water treatment capacity, utilising natural process to filter local water supplies and reduce pollutants entering local waterways
- water storage capacity, using volumes within soils or above ground space to provide detention of stormwater.

8 Sydney Water, Water Sensitive Urban Design

9 Water by Design, Water Sensitive Urban Design

CASE STUDY: The South Bank Rain Bank – urban stormwater irrigating Brisbane's iconic parkland

The South Bank Parklands in Brisbane is a 17.5-hectare public parkland created for people to enjoy the local environment. The parklands' lush sub-tropical landscape and water features are a key attraction for visitors all year round, so maintaining these landscapes through all climate conditions is critical.

A stormwater harvesting system, Rain Bank, was selected as a practical and cost-effective water supply solution, as well as helping to educate the community on water sensitive urban design.

Rain Bank diverts and treats stormwater runoff generated from a highly developed urban catchment in the heart of Brisbane, which is a mix of commercial, industrial and residential land uses. It has provided Brisbane with an alternative water supply scheme for irrigation and toilet flushing by utilising harvested stormwater and filtered backwash from pools and water features.

The ability of the stormwater harvesting scheme to reduce flood risk from the nearby Brisbane River and capture and divert polluted stormwater runoff are major benefits. Highlighting its significance, Rain Bank was officially opened in 2011 by Queen Elizabeth II.

What the community told us

"Use stormwater differently and look at new design and planning targets. Use stormwater in the subdivisions and new estates."

"New sub-developments to meet more stringent building standards for water efficiency."

"I would like to see businesses and public institutions being encouraged and supported to harvest rainwater for use. I want to see more rain gardens in our region particularly in our coastal towns and around our river systems to reduce the pollution that is seeping into our natural waterways."

"We must educate the population re how to have sustainable gardens and also provide sufficient well planned and maintained green space in our new developments as we currently just cram more people in with no regard to our need to connect to nature for wellbeing needs."

"I would like Barwon Water to consider creating pathways along the rivers for pedestrians and cyclists enabling access to the green environment, which we know is critical for mental health. Accessibility to our rivers will also help us to acknowledge, appreciate and respect the vital role our rivers play in our life and will enable us to better connect to Country."

1. Better Design and Planning

Option 1: Using water smarter – Better design & planning – Building design – **Improved plumbing standards and house efficiency star ratings.**

Description: By requiring new home designs to incorporate efficient fixtures and rainwater harvesting, there can be a 10% reduction in potable demand within new residential developments.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Benefits some customers across our region – only new houses; water security benefits shared across region.
Extent of private investment required	R	Full private investment required – borne by developers or builders, but passed on to new home buyers through house price.
Community & Social Outcomes		
Bill impact - household owner/occupier	$0	
Bill impact - household renter	$0	
Bill impact - small business	$0	
Bill impact - large business	$0	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefits.
Employment benefits	G	Provides direct employment benefit – up to 125 full time positions from capital investment
Environmental		
Environmental impacts – water	G	No new negative impacts on aquatic environments. Reduction in rain runoff may be beneficial for streams, rivers and bays.
Environmental impacts – land & biodiversity	G	Limited construction impacts on already disturbed areas.
Zero net emissions	R	3,000 kWh/ML required to be offset – responsibility of private entity, Barwon Water cannot guarantee offset will occur.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to fill rainwater tanks.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Promotes informed water use behaviour – visible and present in the community, but at a localised scale (building industry and new home owners).
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	R	Significant regulatory, legislative and policy constraints – relies on changes to planning and building regulations and/or plumbing and building standards.
Near-term yield (in 10 years)	544 ML/year	
Long-term yield (in 50 years)	544 ML/year	
Certainty of yield	A	Uptake reliant on construction uptake, type of building stock and water use behaviour.
Scalability	A	Potential to stage program over time.
Finance & Economics		
Capex	$67.2M	
Opex	$600/ML	
Levelised cost	$7,805/ML	

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1. Better Design and Planning

Option 2: Using water smarter – Better design & planning – Urban design – **Northern & Western Growth Area IWM Plan**

Description: A water cycle masterplan developed collaboratively with project partners for a future major growth area of Geelong that will ultimately house 110,000 residents. The plan seeks to maximise net community benefit by including: recycled water supply for residential use, local industry, open spaces and environmental flows; utilising stormwater for irrigating landscapes, enhanced infiltration billabongs improving quality and quantity of runoff, and providing cooler and more liveable urban environments. The plan caters for population growth and urban development with a reduced reliance on using drinking water for purposes where a lower quality water would be acceptable.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Social/recreational benefits provided to part of community, water security benefits shared across Greater Geelong water supply system – excludes smaller supply systems.
Extent of private investment required	A	Some private investment required by new customers living in these growth areas through lot price.
Community & Social Outcomes		
Bill impact - household owner/occupier	$64	
Bill impact - household renter	$21	
Bill impact - small business	$105	
Bill impact - large business	$12,510	
Health benefits	G	Provides health benefit through improved urban liveability/urban cooling associated with provision of blue-green infrastructure such as enhanced canopy from passively irrigated trees, swales and enhanced billabongs.
Social and recreational benefits	G	Naturalisation and rehabilitation of 3.7km of the concreted reaches of the Moorabool River. Revegetation and stabilisation of 15km of major waterways in the growth areas to restore waterway connectivity and enhanced biodiversity. These enhanced natural spaces will be provided for the local and regional community to enjoy.
Employment benefits	G	Provides direct employment benefit – up to 1,030 full time positions from capital investment
Environmental		
Environmental impacts – water	G	Enhances environmental water flows in the Moorabool River, restores/naturalises a section of the Moorabool that is concrete lined. Vegetation and biodiversity enhancement of Barwon, Cowies and Moorabool major waterways. Swales, passive tree irrigation and enhanced infiltration billabongs will hold more water in the landscape and will help manage stormwater and flooding while also filtering and recharging waterway base flows.
Environmental impacts – land & biodiversity	G	Limited additional construction impacts on already disturbed areas.
Zero net emissions	G	2,600 kWh/ML required to be offset - built into the cost of option.
Rainfall dependency	A	Recycled water elements not reliant on rainfall, stormwater elements reliant on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Promotes the use of a wasted resource.
Promotes informed water use	G	Presence of water conservation and alternate water supply infrastructure promotes awareness and understanding in residents and visitors.
Technology, Science & Innovation		
Time required to implement	5-40 years	Progressively implemented as these areas develop over the next 40 years
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints – IWM supported by current planning provisions.
Near-term yield (in 10 years)	300 ML/year	
Long-term yield (in 50 years)	7,300 ML/year	Yield represents the volume of potable water being substituted with alternative water sources – significant additional volumes of alternative water is also provided for other uses such as for environmental and enhanced urban landscape purposes, which do not substitute potable water use.
Certainty of yield	G	High level of confidence in yield benefits due to the diversity of supply and conservation options.
Scalability	A	Able to scale up and apply across new urban developments, but is tied to the timing of the roll out of new development.
Finance & Economics		
Capex	$540M	
Opex	$2,226/ML	
Levelised cost	$7,947/ML	

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Improve efficiency

Overview

Water is a limited resource. This means we need to be smart in the way we use it.

Water efficiency programs aim to reduce wastage and encourage sustainable water use. This could be at a household, business or industrial scale. It also applies to water providers, like Barwon Water, who can improve their systems and infrastructure to be as efficient as possible.

Everyone can contribute when it comes to saving water. Water saving devices in our homes or businesses can improve water efficiency. For households, this could mean installing water efficient showerheads and appliances or fixing leaking taps. Water efficient showerheads and appliances have the added benefit of saving energy as well as water.

Workplaces also can do their bit by eliminating wastage, installing more water efficient appliances, better monitoring or changing inefficient processes. From farming and agriculture to cafes and restaurants, from laundromats to manufacturing plants, nearly all businesses can be more water-wise.

A great example of how better monitoring can save water is Barwon Water's on-farm leak detection program. Following a highly successful trial with the Irrewarra Farm Care Group in 2013, Barwon Water expanded the program to approximately 80 farms across the Colac district. Using "Taggle" technology, a receiver attaches to existing water meters and transmits usage data hourly, allowing farmers to view their daily water use online and identify water leaks quickly. The program saved an estimated 20 million litres of drinking water in 2019/20.

What the community told us

"Such a precious resource must never be wasted by consumers or suppliers."

"I think we need to start saving more water."

"Water as a resource is 'finite', not 'infinite.'"

"Reduce evaporation losses."

"Encourage people to use water more responsibly and efficiently."

Sub-option: Improve efficiency of Barwon Water infrastructure

As the organisation responsible for the management of our region's urban water supply, we are continually looking for ways to improve the efficiency of our water systems – from collecting, storing, treating and distributing water through our supply network.

There are three main ways we can improve efficiency:

1. Optimise existing sources

We rely on water from a variety of different sources, and the "blend" of water we supply to customers is influenced by a number of factors including water demand, volume of water stored, the time of the year and the climatic forecast. We are always looking for opportunities to optimise the use of the water that we can sustainably access, while limiting financial costs and environmental impacts.

Future opportunities may include changing the time of the year that we harvest water from our surface and groundwater supplies, changing the size of pumps that we use to move water throughout our pipe network or creating greater interconnection of our pipe network across the Barwon Water service region.

OPPORTUNITY: Extending the reach of the Melbourne to Geelong Pipeline

Barwon Water is entitled to take up to 16,000 million litres a year from the Melbourne water supply system. Water from this entitlement is delivered to the northern part of Geelong via the Melbourne to Geelong pipeline, which was completed in 2012. Extending the reach of the Melbourne to Geelong pipeline further into Geelong would provide greater flexibility in the way that we supply water and result in us being able to access larger volumes of water from our Melbourne system entitlement.

This opportunity requires limited investment in new infrastructure, but there would be ongoing costs associated with pumping more water from the Melbourne water supply system.

2. Reduce evaporation

Being large, open water bodies, our water storages are impacted by evaporation. As a result, we lose large amounts of water to the atmosphere. This problem is common to water storages around the world, especially in warmer regions.

A number of different technologies have been developed to reduce evaporation in water storages and, therefore, conserve water. This includes chemical treatments that place a film on the water surface, physical barriers like shade cloths, plastic covers and floating objects, incorporating solar panels.

CASE STUDY: Shade balls

Made of food grade plastic, millions of floating shade balls have been used in Los Angeles, United States of America, as an evaporation barrier. Slightly larger than a cricket ball, floating shade balls are distributed across the surface of a water storage where they provide a flexible cover that can handle wave and wind impacts.

Water providers in Los Angeles have covered their major reservoir with 96 million plastic balls to limit evaporative losses.

What the community told us

"Shade balls... the claim was they reduce evaporation."

"It should be a priority to pipe water from West Barwon rather than lose it to evaporation and leakage from the existing channel. A result of this there might be the piping of water directly to Wurdee Buloc treatment plant rather than in to the evaporation pond of the reservoir itself. The evaporation losses I understand are significant and there is no reason they should be accepted."

3. Minimise leaks

As the predecessor to Barwon Water, the Geelong Municipal Waterworks Trust was placing infrastructure in the ground from 1908. Currently, we are responsible for the management of 6,866 kilometres of pipes so it's not surprising that, from time to time, we, like other water corporations, experience leaks in our system. About 5 per cent of the water we supplied through our system in 2019–20 was lost due to leakage (about 1,750 million litres) According to the Bureau of Meteorology, such losses average at around 10 per cent across Australia[10].

We use a variety of approaches to identify and reduce leaks in our system, including proactively replacing old infrastructure, using new technologies like digital meters and responding quickly to the information and feedback provided by our community. Prevention and early detection of leaks means water that would have otherwise been lost is retained in our system.

10 Barwon Water 2020, Annual Report 2019–20, https://www.barwonwater.vic.gov.au/__data/assets/pdf_file/0029/187409/Annual-Report-2019-2020.pdf

OPPORTUNITY: Open channels

Barwon Water transfers large amounts of water from West Barwon Reservoir near Forrest in the Otways to Wurdee Boluc Reservoir located near Geelong. Water is stored at Wurdee Boluc Reservoir before it is treated and distributed to customers in Geelong and surrounding areas.

Water is transferred between the two reservoirs by approximately 50 kilometres of channel. Completed in 1928, the channel is now made up of a combination of closed pipe, open concrete and clay lined sections. There is an opportunity to upgrade the channel to ensure that leaks are minimised and water being transferred between reservoirs is conserved.

What the community told us

"As much water as possible that enters the system should be used and not lost to evaporation or leakage from the pipes and channels that transport water from West Barwon Reservoir to Wurdi Bulok."

"Barwon Water reducing evaporation and leakage from supply system. Losses / leakage from Barwon Water channels and evaporation from Wurdee Boluc are issues that need to be addressed."

"Leak reduction."

"Lots of interest in our region to pilot new/ innovative approaches."

Sub-option: Improve household efficiency

We are all reliant on high quality reliable water supplies for everyday activities within our homes. In addition to drinking, water is used for a variety of purposes including cooking, cleaning, garden watering, bathing and toilet flushing.

In our region, residential households use around 70 per cent of our drinking water supply. If we use water more efficiently within households we can significantly impact our overall water demand.

Modern households contain a number of appliances that use water. This includes dishwashers, washing machines, toilets and fixtures such as taps and showerheads. Technological advancements mean these appliances are constantly evolving and becoming more efficient from a water and energy use perspective. As individuals, we can prioritise the purchase of water saving appliances and have a beneficial impact on our region's collective water consumption.

Digital meters can also help to improve water efficiency by providing households with greater visibility about water usage, thereby encouraging behaviour change, and identifying household water leaks.

CASE STUDY: WaterAssist Home

Barwon Water's WaterAssist Home Program helps homeowners with high water use to save water and save on their water bills.

The program includes a home water use assessment and a reliable, affordable plumbing service to repair or replace inefficient water fittings valued at $360.

A homeowner in Highton participated in the program in November 2019. Two toilet cistern leaks were repaired and a leak detection test undertaken as part of the audit. Following the repairs, the homeowner's water consumption reduced by 37,000 litres for quarter three compared to the same quarter the previous year.

CASE STUDY: Birregurra Sustainable Community – Water

Barwon Water and the Birregurra Community Group have teamed up to explore opportunities for sustainable water use.

The first stage of the project focuses on understanding how customers use water. To support this, water meters were replaced with digital meters as part of our regular meter replacement program, at no cost to customers.

Within days of installing 401 digital meters in late November 2020, we identified water leaks across this network of 17,000 to 20,000 litres per day, which equates to up to 7.3 million litres per year, or about three Olympic swimming pools. To put this in context, Birregurra used 71 million litres of potable water in 2019–20 so the early potential saving equates to approximately 10 per cent of the town's annual water use.

18 properties have been identified as having likely water leaks. In dollar terms, the leaks equate to $12,818 to $14,941 for the 18 customers combined (based on our current residential prices).

What the community told us

"Water wise shower heads."

"Discourage and eventually ban use of shower heads that are the size of dinner plates."

"Encourage use of drought resistant plants requiring less water."

"Consumers need to be empowered to innovate at home, and learn from each other's successes".

"Barriers to composting toilets should also be eased for those who want to install them".

"Investigate and promote toilet systems where hand washing water is saved for toilet flushing."

"Using technology to help inform people planning or where water is going, use of hand held sensors to monitor what is happening in real time (such as moisture sensors). Install digital water meters for all homes."

Sub-option: Improve industry efficiency

Industry represents a significant proportion of water use in Australia. In the same way that households can aim to use water more efficiently, it is important that industry is also using water wisely.

Non-residential customers include business, industrial, commercial and institutional customers. Non-residential customers account for about 25 per cent of total demand for water in Victorian cities. About 8 per cent of Barwon Water's customers are non-residential but they use almost 30 per cent of the water that we supply each year[11]. Many of these customers are already becoming increasingly water efficient to reduce operating costs and contribute to the financial sustainability of their business.

Industry use water in many ways, which means that different types of water-saving solutions may be possible. Often, water used in industrial processes does not need to be the same quality as the water we drink, which means that alternative supplies – such as roofwater, treated stormwater or recycled water – can be used instead. For example, Barwon Water's Northern Water Plant provides recycled water to the Viva Refinery in Corio. Using recycled water means the refinery does not need to use up to 2 billion litres of drinking water a year.

Industrial sites can often make changes on their own site to reduce their water needs. They may be able to invest in more efficient equipment, improve the way they operate, reuse water within their processes, capture water onsite, or treat and reuse wastewater they produce.

Barwon Water works closely with its industrial customers to help them identify ways in which those who have particularly high water consumption can potentially reduce their demand for drinking water.

11 Department of Environment, Land, Water and Planning, 2020.

CASE STUDY: Water savings for CSR Ethanol[12]

The area serviced by City West Water includes a large proportion of Melbourne's industry. Working with its larger industrial customers, City West Water helped identify opportunities to reduce their demand for drinking water. Cooling towers, a common feature for many industrial sites, are one area of high water use that present opportunities for potential water savings.

CSR Ethanol is one of Australia's largest producers of sugar and ethanol products. Upgrades to the cooling towers at their Yarraville Distillery achieved savings of 18 million litres per year.

What the community told us

"Industry is a big player in water... we need to be careful about growth in terms of impact on water consumption and other environmental constraints."

"The focus is always on demand management. Households and public spaces require very little water relative to agriculture and industry. With relatively marginal improvements in efficiency in agriculture and industry, combined with more reuse, households and public spaces should have access to abundant and very affordable water."

12 https://www.citywestwater.com.au/business/saving_water_energy/cooling_tower_efficiency

2. Improve Efficiency

Option 3: Improve efficiency – Barwon Water infrastructure – Optimising current water resources – **Reallocate Ballan Channel bulk entitlement to Bostock Channel**

Description: Amend the existing bulk entitlement (the amount of water we are legally entitled to access) to access more from the Bostock channel, resulting in an increase of approximately 100 ML/y which reduces the likelihood of water spilling at Bostock Reservoir. The upper Ballan Channel would therefore no longer be used to transfer water from Korweinguboora to Stony Creek Reservoirs. Water will instead flow to Bostock Reservoir via the East Moorabool River and the Bostock Channel to the Upper Stony Creek Reservoirs. Bostock Channel has an existing bulk entitlement to transfer 27 ML/d, however this could be comfortably increased up to 35 ML/d to accommodate the extra water available to be captured at Bostock Reservoir by this reallocation.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Social/recreational benefits provided to small part of community, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact – household owner/occupier	$0	
Bill impact – household renter	$0	
Bill impact – small business	$0	
Bill impact – large business	$8	
Health benefits	A	No known health benefit.
Social and recreational benefits	G	Provides social/recreational benefit to small part of the community – limited recreational benefit for fishing at Stony Creek Reservoir and along reaches of the East Moorabool River.
Employment benefits	R	Provides no employment benefit.
Environmental		
Environmental impacts – water	A	More water retained in storage beyond current operating practice, some additional flows along East Moorabool River.
Environmental impacts – land & biodiversity	G	No additional disturbance in an area that has already been highly disturbed – channels and storages already in existence.
Zero net emissions	G	No greenhouse gas emissions required to be offset.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall and runoff to fill Korweinguboora Reservoir.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Water from rainfall and runoff is a limited resource.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	<3 years	
Regulatory, legislative or policy constraints	A	Some legislative and policy constraints – requires amendment to existing bulk entitlement.
Near-term yield (in 10 years)	100 ML/year	
Long-term yield (in 50 years)	100 ML/year	
Certainty of yield	A	Good basis of evidence but amendment of bulk entitlement may not be forthcoming.
Scalability	R	Localised option – unable to be scaled or staged.
Finance & Economics		
Capex	$0	
Opex	$250/ML	
Levelised cost	$250/ML	

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2. Improve Efficiency

Option 4: Improve efficiency – Barwon Water infrastructure – Optimising current water resources – **Optimise use of Anglesea Borefield within existing entitlement constraints**

Description: Operate Anglesea Borefield constantly at 5,000 ML/y instead of current intermittent operation. Groundwater is accessed from the Lower Eastern View Aquifer in conjunction with an extensive environmental monitoring program, including community oversight via a dedicated working group.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Anglesea community may have concerns that long-term, ongoing use of the borefield could potentially impact the environment, water security benefits shared across Greater Geelong water supply system (including Anglesea).
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$3	
Bill impact - household renter	$1	
Bill impact - small business	$6	
Bill impact - large business	$664	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	R	Provides no employment benefit.
Environmental		
Environmental impacts – water	R	Removes additional water from groundwater resource beyond current operating practice but within entitlement limits.
Environmental impacts – land & biodiversity	G	No additional disturbance in an area that has already been highly disturbed – bores are already in existence, with environmental monitoring program in place to minimise harm to groundwater dependent ecosystems.
Zero net emissions	G	Some greenhouse gas emissions from additional pumping would be required to be offset – would be built into cost of option
Rainfall dependency	A	Somewhat dependent on rainfall – recharge rates likely to be slow.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Groundwater is a limited resource – current entitlement terms and conditions are aimed at the sustainable use of this resource.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	1-3 years	
Regulatory, legislative or policy constraints	G	Would be accessed in accordance with current entitlement terms and conditions – e.g. compliant with maximum volume, pumping rates and environmental triggers.
Near-term yield (in 10 years)	2,700 ML/y	
Long-term yield (in 50 years)	2,700 ML/y	
Certainty of yield	A	Comprehensive monitoring and assessment program supports compliance with the terms and conditions of the bulk entitlement, issued by the Victorian Government – operation must cease under certain environmental triggers.
Scalability	A	Limited by current entitlement terms and conditions. There may be an opportunity for future expansion or application of the approach in an alternate area.
Finance & Economics		
Capex	$0	
Opex	$805/ML	
Levelised cost	$805/ML	

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2. Improve Efficiency

Option 5: Improve efficiency – Barwon Water infrastructure – Optimising current water resources – **Optimise use of Melbourne to Geelong Pipeline within existing entitlement constraints**

Description: Barwon Water holds a 16,000 million litres a year water entitlement in the Yarra and Thomson rivers in Melbourne and Gippsland, including access to store the water allocated under this entitlement in the Melbourne system reservoirs. The optimum use of the water allocated and held in storage by Barwon Water in Melbourne is currently constrained by the transfer capacity of the Melbourne to Geelong Pipeline (MGP) and the limited areas of Geelong that can currently be supplied with water from the MGP. By constructing a booster pumping station on the MGP and extending the reach of the MGP into the southern zones of Geelong and the Bellarine, the transfer constraint to maximise the use of this water source will be removed, and an increased supply yield of 2,800 ML/yr can be achieved.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact – household owner/occupier	$4	
Bill impact – household renter	$1	
Bill impact – small business	$7	
Bill impact – large business	$859	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides employment benefit – up to 22 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	Does not have significant additional impacts on aquatic environments – water is already held in storage in Melbourne.
Environmental impacts – land & biodiversity	G	Limited construction activity in already impacted areas.
Zero net emissions	G	216 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall and runoff to Melbourne storages, but ability to store water in multi-year storages in Melbourne provides some buffer against dry years.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of a resource.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	G	Would be accessed in accordance with current entitlement terms and conditions – e.g. compliant with maximum volume and pumping rates.
Near-term yield (in 10 years)	2,822 ML/year	
Long-term yield (in 50 years)	2,822 ML/year	
Certainty of yield	G	High level of confidence in the ability of this option to deliver the estimated yield.
Scalability	A	Limited by current entitlement terms and conditions – may be an opportunity to stage over time.
Finance & Economics		
Capex	$12.2M	
Opex	$460/ML	
Levelised cost	$548/ML	

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2. Improve Efficiency

Option 6: Improve efficiency – Barwon Water infrastructure – Minimising leaks – **Reduce losses along Wurdee Boluc Inlet Channel**

Description: With investment in replacing the existing West Barwon to Wurdee Boluc channel with a pipeline over a 50 km section of open transfer infrastructure, water losses of approximately 400 ML/y can be recovered. The predominantly earthen-lined channel loses water due to seepage over the seasonal operating period.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$39	
Bill impact - household renter	$13	
Bill impact - small business	$64	
Bill impact - large business	$7,605	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides employment benefit – up to 371 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	Does not have significant additional impacts on aquatic environments.
Environmental impacts – land & biodiversity	A	Some limited construction activity in potentially sensitive environments.
Zero net emissions	G	No greenhouse gas emissions required to be offset.
Rainfall dependency	A	Ultimately dependent on rainfall for there to be water to transfer via the channel.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Provides a more efficient use of a limited resource – less water lost via seepage and leakage.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	10–20 years	
Regulatory, legislative or policy constraints	G	Does not have regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	400 ML/year	
Certainty of yield	G	High level of confidence given existing infrastructure, history of use in the area and ongoing need to transfer water.
Scalability	A	Limited opportunities to apply in other areas to receive similar benefit but works could be staged over time.
Finance & Economics		
Capex	$200M	
Opex	$200/ML	
Levelised cost	$35,679/ML	

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2. Improve Efficiency

Option 7: Improve efficiency – Barwon Water infrastructure – Reducing evaporation – **Shade balls at Wurdee Boluc Reservoir**

Description: This option involves floating millions of food grade plastic shade balls on the surface of Wurdee Boluc Reservoir to reduce losses that occur via evaporation and wind generated wave action. A 70 per cent surface area coverage has been assumed with 75 per cent efficiency, resulting in approximately 2,730 ML/yr of water gained. Given the size, wind and wave action of such a large storage, the use of floating shade balls would create a flexible, modular barrier to the elements.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$25	
Bill impact - household renter	$8	
Bill impact - small business	$41	
Bill impact - large business	$4,874	
Health benefits	A	No known health benefit.
Social and recreational benefits	R	Reduces existing social/recreational benefit to the community - installation of shade balls would prevent current approved recreational fishing at the reservoir.
Employment benefits	G	Provides employment benefit – up to 226 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	Does not have additional impacts on the aquatic environment.
Environmental impacts – land & biodiversity	G	Does not have additional impacts on land and biodiversity. No construction required.
Zero net emissions	G	No greenhouse gas emissions required to be offset.
Rainfall dependency	A	Ultimately dependent on rainfall for there to be water in Wurdee Boluc Reservoir.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Provides a more efficient use of a limited resource – less water lost via evaporation.
Promotes informed water use	A	May provide some interest and visual engagement.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	A	Some regulatory constraints – would require environmental and health approvals.
Near-term yield (in 10 years)	2,730 ML/year	
Long-term yield (in 50 years)	2,730 ML/year	
Certainty of yield	R	Approach has not been applied in our region. Currently a low certainty of yield – risk that shallow nature of storage and high winds at Wurdee Boluc Reservoir mean this technology is not applicable or feasible.
Scalability	R	Not scalable for Wurdee Boluc Reservoir – potential to apply across other, smaller water storages but yield would be less.
Finance & Economics		
Capex	$122M	
Opex	$300/ML	
Levelised cost	$5,095/ML	

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2. Improve Efficiency

Option 8: Improve efficiency – Household – **Water efficient showerhead program**

Description: By operating a showerhead replacement program, 10,000 existing showerheads will be targeted for replacement with efficient showerheads (rated at 4L/min) in existing homes. This is estimated to reduce demand by 140 ML/yr.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Benefits all of our region – all residential customers in existing homes could access the program; water security benefits shared across the region.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$0	
Bill impact - household renter	$0	
Bill impact - small business	$1	
Bill impact - large business	$61	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	R	Provides no employment benefit – exchange program does not require plumbing services.
Environmental		
Environmental impacts – water	G	No additional impacts on the aquatic environment.
Environmental impacts – land & biodiversity	G	No additional impacts on land and biodiversity as no construction is required.
Zero net emissions	G	No greenhouse gas emissions required to be offset. Water savings may have a positive impact on energy consumption.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Creates conversation and engagement with water related issues across households.
Technology, Science & Innovation		
Time required to implement	1-5 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	140 ML/year	
Long-term yield (in 50 years)	140 ML/year	
Certainty of yield	A	Yield is reliant on sustained behavioural change – i.e. long-term participation of individuals by retaining/maintaining showerhead and length of showers.
Scalability	A	Able to be scaled up or staged, but will reach limits in terms of maximum water savings.
Finance & Economics		
Capex	$600,000	
Opex	$892/ML	
Levelised cost	$690/ML	

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2. Improve Efficiency

Option 9: Improve efficiency – Household – **Waterwise gardens**

Description: Waterwise gardens use less water and are low maintenance through the selection of plants that have low watering needs. By initiating a program that requests properties in new developments to landscape front gardens with native or drought tolerant vegetation that does not require watering, a reduction in demand of up to 350 ML/yr could be realised.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Benefits some of our region – only some residential customers could access the program (e.g. not suitable for apartments); water security benefits shared across region.
Extent of private investment required	R	Full private investment required.
Community & Social Outcomes		
Bill impact - household owner/occupier	$unknown	
Bill impact - household renter	$unknown	
Bill impact - small business	$unknown	
Bill impact - large business	$unknown	
Health benefits	G	Provides known physical and mental health benefits of green urban spaces.
Social and recreational benefits	G	Provides direct social and recreational benefits of green urban spaces.
Employment benefits	A	Potentially provides employment benefit – unknown at time of assessment.
Environmental		
Environmental impacts – water	G	No additional impact on the aquatic environment.
Environmental impacts – land & biodiversity	A	Depends on the garden planted – may result in greater native vegetation, but may also result in reduced biodiversity in urban areas.
Zero net emissions	G	No greenhouse gas emissions required to be offset.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Creates conversation and engagement with water related issues across households.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	350 ML/year	
Long-term yield (in 50 years)	350 ML/year	
Certainty of yield	A	Yield is reliant on sustained behavioural change – i.e. long-term participation of individuals.
Scalability	A	Able to be scaled up or staged to appropriate households (e.g. not suitable for apartments) but will reach limits in terms of maximum water savings. Housing stock may change over time.
Finance & Economics		
Capex	$unknown	
Opex	$unknown	
Levelised cost	$unknown	

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2. Improve Efficiency

Option 10: Improve efficiency – Household – **Smart networks (digital meters) across Geelong system**

Description: At every property mechanical water meters are replaced with a smart meter, which is a digital water meter which enables real-time monitoring of water consumption. Homeowners use the smart meter data to identify inefficient fixtures and leaks in plumbing, and can help infrastructure networks management to identify supply zones that are at higher risk of water mains leaks, by analysing water demand trends. Smart networks can also be coupled with other water conservation activities such as gamification, education programs and commercial/industrial water conservation programs. The costs to fix leaks have not been included in the table below.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system – technology could be applied anywhere.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$7	
Bill impact - household renter	$2	
Bill impact - small business	$11	
Bill impact - large business	$1,350	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit – although some individuals may experience positive impact on their mental health and wellbeing due to perception of helping the environment.
Employment benefits	G	Provides direct employment benefit – up to 59 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	No additional impact on the aquatic environment.
Environmental impacts – land & biodiversity	G	No additional impacts on land and biodiversity.
Zero net emissions	G	Very minimal greenhouse gas emissions required to be offset. Water savings may have a positive impact on energy consumption.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Promotes informed water use behaviour – provides real-time information about water usage to customers.
Technology, Science & Innovation		
Time required to implement	3-10 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	840 ML/year	
Long-term yield (in 50 years)	840 ML/year	
Certainty of yield	A	A large amount of information has been collected in relation to metering programs. Barwon Water is currently initiating trials within our region.
Scalability	G	Can be applied across the region and integrated into a variety of other opportunities or programs.
Finance & Economics		
Capex	$32M	
Opex	$536/ML	
Levelised cost	$5,485/ML	

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2. Improve Efficiency

Option 11: Improve efficiency – Household – **WaterAssist Home program**

Description: This option expands our existing WaterAssist Home Program that offers homes a plumbing audit to identify leaks when bills are higher than residential trends (>250 kL/y). The program aims to increase water efficiency in the home wtih repairs up to the value of $360 (this is co-funded – Barwon Water $260 and customer $100). This option is based on 10,000 customers taking up this offer with a total reduction in losses of up to 450 ML/y.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Benefits some customers across our region – only some residential customers could access the program as it targets high water users; water security benefits shared across region.
Extent of private investment required	A	Some private investment required ($100 per customer) – part funded / subsidised by Barwon Water.
Community & Social Outcomes		
Bill impact - household owner/occupier	$7	
Bill impact - household renter	$2	
Bill impact - small business	$11	
Bill impact - large business	$1,331	
Health benefits	A	No known social/recreational benefit – although some individuals may experience positive impact on their mental health and wellbeing due to perception of helping the environment.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	A	Provides limited employment benefit – up to 9 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	No additional impact on the aquatic environment.
Environmental impacts – land & biodiversity	G	No additional impacts on land and biodiversity.
Zero net emissions	G	No greenhouse gas emissions required to be offset. Water savings may have a positive impact on energy consumption.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Promotes cooperation and communication between the community and Barwon Water.
Technology, Science & Innovation		
Time required to implement	1-5 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	450 ML/year	
Long-term yield (in 50 years)	450 ML/year	
Certainty of yield	A	Yield is reliant on sustained behavioural change – i.e. long-term participation of individuals.
Scalability	A	Limited ability to expand the program given its focus on high water users – but could be staged over time.
Finance & Economics		
Capex	$5M	Yield is reliant on sustained behavioural change – i.e. long-term participation of individuals.
Opex	$8,300/ML	
Levelised cost	$8,300/ML	

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2. Improve Efficiency

Option 12: Improve efficiency – Business – **Farm leakage detection program**

Description: Some customers that use drinking water to support agricultural and farming practices have digital meters fitted and with a website portal they can monitor water use. Alerts can be sent to customers to detect leaks when data indicates increased usage or constant flows during low-use periods. Applying the assumption that this program has the potential to expand to up to 2,000 farmers, it is expected to reduce losses by 420 ML/y.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Benefits small minority of customers across our region – targets agricultural customers only; water security benefits shared across the region.
Extent of private investment required	A	Some private investment required – meter is funded / subsidised by Barwon Water but private investment required by customer to find and fix leaks identified.
Community & Social Outcomes		
Bill impact - household owner/occupier	$1	
Bill impact - household renter	$0	
Bill impact - small business	$2	
Bill impact - large business	$218	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	A	Provides limited employment benefit – up to 2 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	No additional impact on the aquatic environment.
Environmental impacts – land & biodiversity	G	Low impacts expected in already highly disturbed environment – i.e. agricultural land.
Zero net emissions	G	Very minimal greenhouse gas emissions required to be offset. Water savings may have a positive impact on energy consumption.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Provides greater awareness of water usage behaviours – but for a small number of non-residential customers, since targets agricultural customers only.
Technology, Science & Innovation		
Time required to implement	1-5 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	420 ML/year	
Long-term yield (in 50 years)	420 ML/year	
Certainty of yield	A	Yield benefits is reliant on participation of individuals – but previous experience and information mean option is well understood.
Scalability	A	Some opportunity to scale up or stage this option – but limited number of agricultural users.
Finance & Economics		
Capex	$1M	
Opex	$1,400/ML	
Levelised cost	$1,100/ML	

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Behaviour change

Overview

The way we use water is shaped by our behaviour.

Our behaviour can be influenced by a range of factors, including how knowledgeable we are about using water wisely, our cultural and demographic backgrounds and approaches to water pricing and water policy.

Behaviour change can be driven by our customers and community (how they choose to use water) or by Barwon Water (how we regulate water use or set prices).

Changing behaviours can reduce the total volume of water used and, by extension, the requirement to find new supplies of water, although the savings can be unpredictable and are not guaranteed.

Sub-option: Pricing incentives

We make decisions every day about the things that we purchase. Often, those decisions are influenced by the price of the good or service that we are buying. Changing the price of something tends to impact the amount that we want to consume.

Increasing the price for something (such as water) can reduce demand for that product. Water is also essential to our existence, so not all our water consumption will be influenced by price. But we often use more than we absolutely need to, and it is this part of demand that can be influenced by the price we pay for water.

On the other hand, rebates effectively lower the price for a good or service so that people are more inclined to purchase them. Rebates for water saving products, such as a rainwater tank or a more efficient showerhead, can encourage more customers to invest in those products.

1. **Rebates for water efficiency products and services**

Rebates are a partial or full refund paid to customers who purchase a good or service. Rebates are provided as an incentive for customers to buy something they may otherwise not have.

During the Millennium Drought, rebates were offered for a wide range of products to help conserve water, such as dual flush toilets and water-efficient shower heads.

Customers may have to meet certain criteria to be eligible for a rebate. If eligible, the customer will usually need to complete an application (including proof of purchase).

Another approach is an exchange program, where residents can swap their old appliance (e.g. shower head) for a more water-efficient version. An exchange program is essentially providing a full rebate. They may be more effective for less expensive products where customers are less inclined to spend time to pursue a small rebate after purchase.

Rebates can help accelerate the transition to more widespread water-efficient fixtures and appliances, by providing enough incentive for customers to make a change in their household. Upgrades are most useful in older homes as new builds require installation of products that meet minimum water efficiency ratings.

CASE STUDY: Rockhampton Regional Council rebates for water-efficient products[13]

Like much of Australia, Rockhampton is prone to drought. Being a regional community with a relatively small population, certain parts of the Rockhampton region may only have one source of water. This exposes residents to greater risk of water shortages.

To encourage its residents to use water efficiently, the Rockhampton Regional Council offers a rebate scheme for water-efficient products. Under the scheme, residents in the Rockhampton region who purchase and install water efficient products can apply to receive rebates. Rebates offered include:

- $25 for a shower head with a WELS (Water Efficiency Labelling and Standards) rating of three or more stars
- $50 for a dual flush toilet
- $100 for a washing machine with a WELS rating of four or more stars
- $250 for a stand-alone rainwater tank (5,000 litres or more)
- $500 for an integrated rainwater tank (5,000 litres or more) that is connected to household appliances (toilet, washing machine, hot water system etc.).

What the community told us

"Like the solar rebate scheme, there may be opportunity to do something similar for grey water systems."

"Charge people higher rates for excessive water consumption. [Offer] rebates for people who install water reserving means (i.e. water tanks)."

"Tiered pricing structure to encourage behaviour change and efficiency. Incentives for behaviour change (financial and others). Changing the customer, incentivise how customers use water."

"Using pricing structure to change behaviour can lead to perverse outcomes and don't be equitable (people can continue bad behaviours if they can afford to."

13 Rockhampton Regional Council, Water saving rebates

2. Tariffs

Tariffs are the prices customers pay for water and wastewater services. Tariffs that Barwon Water charges for water have two components:

1. A water service charge, which is a fixed fee each billing period
2. A water usage charge, which is the price per kilolitre of water consumed

Charging customers for their water connection and use is necessary to cover the cost of delivering the service.

The economic regulator, the Essential Services Commission, makes sure that our prices are set efficiently. This means that we can only set our prices to generate enough revenue to cover the costs we incur to deliver the services customers want. However, within the limits set by the Essential Services Commission, we do have the flexibility to change the way we structure our tariffs.

Tariffs are designed to cover the cost of supplying water to customers while ensuring water remains affordable for all members of the community. Every five years, the Essential Services Commission approves the maximum prices Barwon Water can charge its customers.

Based on preferences articulated by customers in the past, Barwon Water has a single tier water usage charge. Residents currently pay service charge of $36.16 per quarter and $2.05 per kilolitre of water used. Businesses pay marginally more with a service charge of $37.97 per quarter and $2.24 per kilolitre of water used[14].

While prices have been kept relatively flat overall, in 2018, Barwon Water responded to community feedback about pricing by lowering fixed service charges and increasing water volume charges. The community told us this was one was we could encourage people to be more conscious of their water usage.

In theory, increasing the water usage charge may encourage customers to use less water. However, customers may not always respond to a price change if the difference it makes to their bill is not enough to influence their behaviour. Some customers, such as large families, may also be unable to reduce their consumption and end up facing higher bills if prices increase. Tariff design needs to consider these types of issues.

Higher usage charges can be implemented by either simply increasing the current rate, or by introducing additional tiers. Stepped, or 'inclining block' tariffs, are used in some places and set an incrementally higher price as consumption increases. But sometimes they can make tariffs more confusing for customers, without necessarily influencing customer behaviour, and also adversely impact some customer segments (e.g. large families).

14 Barwon Water website, fees and charges

CASE STUDY: Drought-dependent usage charge in New South Wales[15, 16]

The Independent Pricing and Regulatory Tribunal (IPART) in NSW introduced a drought price for the first time on 1 July 2020. This means the water usage charge will increase if water storages drop below 60 per cent of total capacity. The drought price will remain in place until 31 days after water storages have risen above 70 per cent of total capacity. The 2020/2021 drought price is $3.18 per kilolitre (up from $2.36 per kilolitre) for Sydney Water customers and $2.90 per kilolitre (up from $2.46 per kilolitre) for Hunter Water customers. The drought price is intended to provide a stronger incentive for customers to conserve water when water is scarce, without locking customers into higher prices when the region's dams are full.

The change coincided with IPART deciding against a multi-tiered water usage charge and endorsing a reduction in the fixed service charge to maintain affordability for customers.

Because water storage levels are currently above 60 per cent, the impact of the drought price on water consumption is yet to be observed.

What the community told us

"Multi-tiered tariffs should be considered."

"Increase the price to $10 per 1,000 litres (the price in Europe) and reduce/remove the service charge. Increased prices will show consumers how valuable water is."

"Lower the service charge and increase water usage charge. This will promote lower water usage. Based on the current fee structure, the motivation is to use more water to get value for money out of the service charge."

"Change the water bill to reflect less of service costs & more for water usage because there is no deterrent to conserve water because the costs each quarter for myself & those I talk to are nearly all for service costs."

"[have] a flexible pricing structure that reflects the amount of water per person and the current level of storage, i.e. below 50% in storage there is a levy put in place of 5% to encourage more efficient use"

"[The] price for water should encourage water saving [...]"

"Two tier pricing system – sensible way to go if using lots more they should pay extra. If hosing down driveways should pay."

15 Independent Pricing and Regulatory Tribunal, Prices for Sydney Water Corporation from 1 July 2020

16 Hunter Water, Residential pricing, fees and charges

Sub-option: Education

Building community understanding about all aspects of the water cycle can help influence the way we think about, value and use water.

Education helps to build an appreciation of the vital importance of water to the liveability, sustainability and productivity of our region.

While education programs can address any subject, they are often implemented with the aim of influencing people to use water more efficiently.

There are many ways for the government and water utilities to educate the community about water and water efficiency. Education initiatives are commonly implemented as part of primary and secondary school programs, as well as through awareness campaigns for the wider community. Education can also target certain customer groups, such as industry or large water users, to promote the measures those customers can take to reduce their drinking water consumption.

Awareness campaigns that introduce a new behaviour or goal typically require a sustained message to achieve and then maintain the desired outcome, until the behaviour becomes the norm. Education about more water efficient practices usually involves learning from observation as well as instruction. The encouraged behaviour can then become routine with repeat application over time.

Customer and community education has traditionally taken place through face-to-face engagement, television and print advertising (including on water bills). However, online engagement is now a major way to reach the community, through social media, water utility websites, and emails. Most water utilities across Victoria use social media platforms to educate their customers about current water saving initiatives. More innovative approaches, such as online games and rewards programs, can also help influence change.

CASE STUDY: Schools Water Efficiency Program[17]

The Schools Water Efficiency Program enables schools to track their water usage with data logger technology and a dedicated website. By monitoring water usage, schools can detect and rectify leaks, saving water and money. The program also provides students with an opportunity to learn about water efficiency and conservation through program specific curriculum resources.

Since 2012, participating schools in the Barwon Water region have saved more than 1,100 million litres of water. There are currently 74 schools (which is more than half the schools in the region) signed up to the program. In 2019–20, participating schools saved a combined $250,000 through early leak detection. With funding assistance from Barwon Water and the Victorian Government, there is no cost for schools to join up to the three-year program.

Details of other education programs delivered by the Victorian Government, such as ResourceSmart Schools, Smart Water Advice and Waterwatch Victoria Program, can be found here: https://www.water.vic.gov.au/liveable/water-education

CASE STUDY: 'Target 155' campaign

'Target 155' is a water efficiency campaign, implemented by the metropolitan water corporations, that encourages Melburnians to limit water consumption to 155 litres per person per day. Regional Victoria has a 'Target Your Water Use' campaign, which is not tied to a volumetric target, in recognition that regional communities live differently to those in metropolitan Melbourne.

Each water corporation website explains the target to their customers and outlines simple ways to reduce water use in the home. South East Water, as an example, also reports each household's water consumption against the target on customer water bills.

This campaign echoes the approach that was adopted during the Millennium Drought, when heightened awareness contributed to Victorians significantly reducing the amount of water each person used on average each day. As evidence of the way education can permanently influence behaviour, levels of per person consumption are today still much lower than they were before the drought.

What the community told us

"More community education on the benefits of water restrictions – now and in the future [...]"

"We must educate the population regarding how to have sustainable gardens and also provide sufficient well planned and maintained green space in our new developments [...]"

"Educate people about how precious water is including ground water. We need to value these resources as essential to our ongoing health and wellbeing [...]"

"Increased education on planting drought tolerant gardens [...]"

"[...] Previously the State Govt had a target of 155L per person per day during the last drought. It would seem beneficial for this to now be a permanent target in today's climate and put a friendly reminder to consumers each bill."

"Education and incentive for people to use water wisely."

"Continual education (not just in times of drought), for all members of the community. Remind new and existing residents of the region of the Permanent Water Saving Rules."

17 DELWP, Water education

Sub-option: Restrictions

Water restrictions can influence water use behaviour by setting rules about how water can be used. For example, how and when you can water a garden.

There are two type of restrictions. Permanent Water Savings Rules (PWSR) apply all the time, but tougher restrictions can be introduced in four levels of increasingly stricter rules, if and when needed.

1. Permanent water saving rules

Victoria's permanent water saving rules are a set of common-sense rules to make sure we use water efficiently.

The permanent water saving rules apply at all times, are uniform across Victoria and are included in Barwon Water's permanent water saving plan (PWSP)[18].

The permanent water saving rules apply to drinking water only and are enforced under the Water Act (1989). They do not apply to greywater, tank water (rainwater), bore water or recycled water[19].

Barwon Water's PWSP measures include four key rules:

- Hand-held hoses must be fitted with trigger nozzles and be free of leaks.
- Gardens and lawns may be watered with a hand-held hose or watering can anytime and sprinklers and watering systems may be used after 6pm and before 10am.
- Fountains and water features can be used provided they recirculate water.
- Paved areas and hard surfaces should only be washed if required after an accident, for safety reasons, to remove stains yearly or during building work[20].

The rules are in place to help us use water more efficiently and encourage all Victorians to value this precious resource for the long term.

You can read useful actions here: https://www.barwonwater.vic.gov.au/water-and-waste/saving-water/summer

Hand watering

Any time, any day

Spinklers and watering systems

After 6pm / before 10am

Fountains and water features

Must recirculate water

Hard surfaces

Use a broom instead

18 DELWP website, Using water wisely, Advice and rules

19 Barwon Water website, Water and waste, Permanent water saving rules

20 Barwon Water, Urban Water Strategy. Copied from page 121

CASE STUDY: Water Wise Rules (Sydney Water)

From late 1996 to mid-2010, much of Australia experienced a prolonged period of dry conditions, known as the Millennium Drought[21]. In 2009, when the drought broke, the New South Wales government introduced the Water Wise Rules to replace drought restrictions for Sydney, Illawarra, and the Blue Mountains (areas serviced by Sydney Water).

Like Victoria's Permanent Water Saving Rules, the Water Wise Rules are simple, common sense behaviours aimed at permanently reducing the community's water use. The main rules are: fitting hand-held hoses with trigger nozzles; watering gardens in the early morning and evening and no hosing of hard surfaces.

Since their introduction, the Water Wise Rules have proved successful in keeping residential water consumption per capita relatively stable at around 200 litres per day. This is around 50 litres per day less than before the Millennium drought[22]. Thanks to the water wise efforts of homes and businesses, Greater Sydney is using around the same amount of water now as in the 1970s – despite an extra 1.4 million people[23].

What the community told us

"[...] Previously the State Government had a target of 155L per person per day during the last drought. It would seem beneficial for this to now be a permanent target in today's climate and put a friendly reminder to consumers each bill."

"There would be benefit in publicising the details of 'permanent water restrictions' more vigorously [...]"

21 Bureau of Meteorology, 'Recent rainfall, drought and southern Australia's long-term rainfall decline'

22 Sydney Water, Water Conservation Report 2018-2019, Page 12

23 WaterNSW website, Using less water

2. Staged water restrictions

Water restrictions are a way to lower demand for water when a region is facing an impending water shortage.

Generally, the introduction of water restrictions is a 'last resort' as they can have a profound impact on a community's liveability. For example, water restrictions in our region in 2007 allowed for one in four sporting fields and public sporting facilities to be watered, leading some facilities to become dusty and weathered.

Water restrictions impose rules on the ways people and businesses are permitted to use water. Limiting the use of water for some activities reduces total demand for water during periods of shortage. Each stage of restrictions imposes additional rules to further reduce demand.

Water restrictions are only applicable to customers on a drinking water supply. They do not apply to the use of recycled, rain or grey water, unless supplemented/topped up by drinking (potable) water.

Each stage of restriction is set out in Barwon Water's water restriction by-law and implementation of these restrictions is guided by our Drought Preparedness Plan.

There are exemptions from restrictions in certain situations. Water can be used at any time for human health requirements, stock and animal health requirements, firefighting, and for safety reasons.

Water restrictions can prolong dwindling water supplies and allow more time for water storages to recover under extended dry conditions. For example, water restrictions during the Millennium Drought saved close to 34,000 million litres of water at a time when Geelong's storages were precariously low. However, water restrictions can impact how water is used for human health, commercial, community or environmental benefits. For example, while water restrictions can save a lot of water, during the Millennium Drought they resulted in reduced watering of highly valued trees, parks and sporting fields.

Water restrictions are closely linked with levels of service, or service standards, which are performance measures and targets that drive the operation of Barwon Water's business. We have an agreed level of service that assesses the reliability of water supply we provide to our customers.

Importantly, implementing restrictions in line with our agreed level of service means we can avoid expensive investments in infrastructure that would potentially sit idle when not in drought. Instead, we plan on the basis of what is understood to be an acceptable level of water restrictions, (in Barwon Water's case, no more than five per cent of the time). This is measured in how often water restrictions are likely to be imposed, how severe water restrictions will be when they are needed (from stage 1 through to stage 4) and for how long water restrictions will be required. We try and set service standards that, on balance, deliver best value to our customers.

Barwon Water publishes an Annual Water Outlook each year to assess whether Barwon Water's supply systems can provide sufficient water security in the short-term (i.e. the next two years), or whether action needs to be taken, including any likelihood of water restrictions – so that our customers are informed.

CASE STUDY: Goulburn Valley Water 2019/2020 Stage 2 Restrictions[25]

In April 2019, due to low storage volumes and persistent dry and warm weather, Goulburn Valley Water announced Stage 2 water restrictions for the Kilmore district, Euroa, and Violet Town.

The restrictions remained in place until November 2019 for the Kilmore district and May 2020 for Euroa and Violet town, until the water outlook had improved.

Under the Stage 2 restrictions, residents and businesses in the affected regions could not water their lawns, were restricted in watering their gardens and could not fill up pools. Goulburn Valley Water also encouraged residents to voluntarily change their behaviour by taking 'that extra step' to reduce water consumption in the home. The restrictions proved successful with Euroa and Violet Town residents reducing their water use for the 2019/2020 summer by 29 per cent compared to the previous year.

In addition to asking residents to conserve water, Goulburn Valley Water increased its water supply by sourcing some water from Yarra Valley Water and pumping water from nearby Broadford.

25 Goulburn Valley Water, Media releases

What the community told us

"[...] Soft water restrictions could be implemented as standard for the region or more broadly [...]"

"[...] more community education on the benefits of water restrictions – now and in the future – tips for water saving/usage (safely) – how to safely recycle water (household/businesses) – to help the environment and support green spaces."

"People are not always the "best" at policing themselves, following rules or "doing the right thing". Which in turn makes it harder to realise water savings."

"Restrictions are equitable to the whole community and can be applied across all members of the community."

3. Behaviour Change

Option 13: Using water smarter – Behaviour change – Education – **Work with schools to help educate young people**

Description: Educating our youth on water literacy and sustainable water practices; a multi-layered approach that includes a program targeting education institutions and leveraging the Schools Water Efficiency Program (SWEP) to encourage sustainable water use through the provision of educational materials as well as offering grants and rebates to identify and repair leaks resulting in water savings.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Benefits all of our region – customers could access the program regardless of geography; targets schools but with intended broader reaching community benefit.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$0	
Bill impact - household renter	$0	
Bill impact - small business	$1	
Bill impact - large business	$70	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	A	Potentially provides employment benefit – unknown at time of assessment.
Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts. Increase in environmental awareness.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts. Increase in environmental awareness.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Promotes a high level of awareness and understanding in the community by working with school aged children.
Technology, Science & Innovation		
Time required to implement	0 years	Program underway
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints – but dependent on State Government continuing to support program.
Near-term yield (in 10 years)	80 ML/year	
Long-term yield (in 50 years)	80 ML/year	
Certainty of yield	R	Yield is reliant on sustained behavioural change – the behaviour of individuals can change over short and long term periods.
Scalability	A	Opportunity to increase reach of program across our region – but there are limits to the amount of savings that can be made.
Finance & Economics		
Capex	$0M	
Opex	$2,875/ML	
Levelised cost	$2,875/ML	

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3. Behaviour Change

Option 14: Using water smarter – Behaviour change – Education – **Gamification / competitive water use (via smart meters and apps)**

Description: Gamification can increase interaction with water users through the use of a mobile or online game to promote water saving. Gamification was trialled in Europe and Asia, where participants competed against other customers or communities to reduce their water use. The trials were incentivised by small prizes, and a reduction in overall water use by up to eight per cent was observed. A reliable smart network to record real time water usage is required to feed into a gaming platform. Note the cost to install digital meters are not included below.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Benefits all of our region – all customers could access the program, regardless of geography; water security benefits shared across the region.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$1	Dependent on digital meters already being in place.
Bill impact - household renter	$0	Dependent on digital meters already being in place.
Bill impact - small business	$1	Dependent on digital meters already being in place.
Bill impact - large business	$153	Dependent on digital meters already being in place.
Health benefits	A	No known health benefit.
Social and recreational benefits	G	Potentially provides social benefit – through increased online community connection.
Employment benefits	A	Potentially provides employment benefit – unknown at time of assessment.
Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts. Increase in environmental awareness.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts. Increase in environmental awareness.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Promotes a high level of awareness and understanding by engaging with members of the community.
Technology, Science & Innovation		
Time required to implement	5–10 years	Contingent on smart networks (digital meters) already being place.
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints that cannot be managed. Would need to ensure that personal information and confidentiality are protected.
Near-term yield (in 10 years)	750 ML/year	
Long-term yield (in 50 years)	750 ML/year	
Certainty of yield	R	Yield is reliant on sustained behavioural change – the behaviour of individuals can change over short and long term periods.
Scalability	A	Opportunity to increase reach of program across our region – but there are limits to the amount of savings that can be made.
Finance & Economics		
Capex	$0	
Opex	$666/ML	
Levelised cost	$666/ML	

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3. Behaviour Change

Option 15: Using water smarter – Behaviour change – Education – **Tourist education program**

Description: Educating and informing visitors to our region about water literacy and sustainable water practices; a multi-layered approach that includes programs to make water efficiency upgrades at their sites, identify and fix leaks and educate visitors to promote water efficient behaviour and our Permanent Water Saving Rules. Potential to reduce demand by 35 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Benefits some of our region – would target high tourism areas, e.g. coastal towns; water security benefits limited to these parts of the region.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$0	
Bill impact - household renter	$0	
Bill impact - small business	$1	
Bill impact - large business	$86	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	A	Potentially provides employment benefit – unknown at time of assessment.
Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts – reach and benefits may go beyond our region.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts – reach and benefits may go beyond our region.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Promotes a high level of awareness and understanding by engaging with members of the community – reach and benefits may go beyond our region.
Technology, Science & Innovation		
Time required to implement	0 years	Program underway
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	35 ML/year	
Long-term yield (in 50 years)	35 ML/year	
Certainty of yield	R	Yield is reliant on sustained behavioural change – transient nature of tourists and the potential for tourist numbers to fluctuate reduces confidence in yield estimates.
Scalability	A	Opportunity to increase reach of program across our region – but there are limits to the amount of savings that can be made.
Finance & Economics		
Capex	$0M	
Opex	$8,000/ML	
Levelised cost	$8,000/ML	

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3. Behaviour Change

Option 16: Using water smarter – Behaviour change – Pricing incentives – Rebates – **Subsidies for rainwater tanks**

Description: Residential rainwater tank rebate scheme that is jointly funded by Barwon Water ($1,500 subsidy) and property owner (balance of investment variable depending on tank size and other plumbing needs) with the potential to reduce demand by 220 ML/yr dependent on uptake.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Benefits all of our region – all residential customers with suitable houses could access the program, regardless of geography; water security benefits shared across the region.
Extent of private investment required	A	Some private investment required – part funded/subsidised (customer investment will vary depending on individual property tank size and other plumbing needs)
Community & Social Outcomes		
Bill impact - household owner/occupier	$17	
Bill impact - household renter	$5	
Bill impact - small business	$27	
Bill impact - large business	$3,209	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	A	Potentially provides employment benefit – unknown employment benefit at time of assessment.
Environmental		
Environmental impacts – water	G	Reduces impacts on downstream waterways.
Environmental impacts – land & biodiversity	G	Limited construction impact on already disturbed areas.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to fill rainwater tanks.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Promotes the use of a potentially wasted resource.
Promotes informed water use	G	Greater visibility and engagement of customers with water infrastructure.
Technology, Science & Innovation		
Time required to implement	>10 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	221 ML/year	
Certainty of yield	A	Yield is reliant on climatic conditions and water use behaviour.
Scalability	G	Opportunity to increase scale of program across our region.
Finance & Economics		
Capex	$0	
Opex	$47,511/ML	
Levelised cost	$2,768/ML	

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3. Behaviour Change

Option 17: Using water smarter – Behaviour change – Pricing incentives – Rebates – **Water efficiency grant program for major water users**

Description: A flexible grant program to fund cost to improve water efficiency practices by major water users, estimated to reduce demand by 350 ML/yr dependent on uptake.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Benefits all of our region – all business customers could access the program, regardless of geography; water security benefits shared across the region.
Extent of private investment required	A	Some private investment required – part funded/subsidised (customer investment will vary depending on business needs)
Community & Social Outcomes		
Bill impact - household owner/occupier	$4	
Bill impact - household renter	$1	
Bill impact - small business	$7	
Bill impact - large business	$854	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	A	Potentially provides employment benefit for major water users through reallocation of cost savings from water savings – unknown at time of assessment.
Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts. Increase in environmental awareness.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts. Increase in environmental awareness.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Provides opportunities for water conservation and efficiency opportunities to be demonstrated in areas with large numbers of employees.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	355ML/year	
Long-term yield (in 50 years)	355ML/year	
Certainty of yield	A	The diversity of commercial operations and the potential for change over time introduce some uncertainty to the yield estimates. Some relevant historic information is available to support estimates.
Scalability	A	Some opportunity to scale up or stage this option – but limited number of major water users.
Finance & Economics		
Capex	$0	
Opex	$7,873/ML	
Levelised cost	$573/ML	

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3. Behaviour Change

Option 18: Using water smarter – Behaviour change – Pricing incentives – Tariffs – **Reduced fixed service charge but higher volume charge**

Description: Barwon Water's pricing structure for water supply is comprised of two components, a water volume charge which is a usage charge based on the amount of water used, and a fixed service charge which is the same every quarter regardless of how much or little water is used. This option is based on the concept of reducing the fixed water service charge and increasing water volume charges – that is a higher proportion of customer bills will be variable (thereby providing a financial incentive to save water and/or a financial reward for any water savings made). The estimated reduction in demand is 960 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Tariff changes would be implemented across the region; water security benefits shared across the region.
Extent of private investment required	R	No private investment required by customers, option would be implemented via Barwon Water bills – but bill impacts will differ significantly for the average owner-occupier versus tenant, i.e. assuming the same volume of water is used, tenant bills will go up whereas owner-occupier bills will stay the same – a large proportion of financially vulnerable customers are tenants, large households will pay more, high discretionary water users have more capacity to reduce water usage than financially disadvantaged.
Community & Social Outcomes		
Bill impact - household owner/occupier	-$5	
Bill impact - household renter	$139	
Bill impact - small business	$44	
Bill impact - large business	$32,473	
Health benefits	R	Potential for negative physical and mental health impacts – private and public green spaces may be watered less due to cost.
Social and recreational benefits	R	Potential for negative physical and mental health impacts – as high water using facilities such as sportsgrounds, parks, pools etc. may be watered/filled less due to cost.
Employment benefits	R	Provides no employment benefit.
Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Introduction of stronger pricing signals increases community awareness of water use behaviours.

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3. Behaviour Change

Option 18: Using water smarter – Behaviour change – Pricing incentives – Tariffs – **Reduced fixed service charge but higher volume charge (CONTINUED)**

Description: Barwon Water's pricing structure for water supply is comprised of two components, a water volume charge which is a usage charge based on the amount of water used, and a fixed service charge which is the same every quarter regardless of how much or little water is used. This option is based on the concept of reducing the fixed water service charge and increasing water volume charges – that is a higher proportion of customer bills will be variable (thereby providing a financial incentive to save water and/or a financial reward for any water savings made). The estimated reduction in demand is 960 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Technology, Science & Innovation		
Time required to implement	2–7 years	
Regulatory, legislative or policy constraints	A	Some regulatory and policy constraints – changes to tariff structures require support of customers and approval of the Essential Services Commission, additional financial support likely to be required for vulnerable users.
Near-term yield (in 10 years)	964 ML/year	
Long-term yield (in 50 years)	964 ML/year	
Certainty of yield	R	Yield is dependent on individual responses to pricing signals – diversity of residential, commercial and residential users means it is difficult to be certain of the outcomes over the long-term.
Scalability	A	There is potential to make future adjustments to the tariff structure.
Finance & Economics		
Capex	$0	
Opex	$0	
Levelised cost	$0/ML	

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3. Behaviour Change

Option 19: Using water smarter – Behaviour change – Pricing incentives – Tariffs – **Scarcity pricing tariff structure**

Description: This option is based on the concept of charging a higher price for the usage charge (the amount of water used that is billed to the customer) when water supply is scarce due to dry conditions. This option is mutually exclusive with the application of water restrictions in dry times – i.e. this option would be implemented instead of water restrictions.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Tariff changes would be implemented across the region; water security benefits shared across the region.
Extent of private investment required	R	No private investment required by customers, option would be implemented via Barwon Water bills – but bill impacts will differ significantly for owner-occupiers versus tenants, i.e. for the same volume of water used, tenant bills will go up significantly whereas owner-occupier bills will stay the same – a large proportion of financially vulnerable customers are tenants, large households will pay more, high discretionary water users have more capacity to reduce water usage than financially disadvantaged.
Community & Social Outcomes		
Bill impact - household owner/occupier	$169	
Bill impact - household renter	$169	
Bill impact - small business	$336	
Bill impact - large business	$55,938	
Health benefits	R	Potential for negative physical and mental health impacts – private and public green spaces may be watered less due to cost.
Social and recreational benefits	R	Potential for negative physical and mental health impacts – as high water using facilities such as sportsgrounds, parks, pools etc. may be watered/filled less due to cost.
Employment benefits	R	Provides no employment benefit.

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3. Behaviour Change

Option 19: Using water smarter – Behaviour change – Pricing incentives – Tariffs – **Scarcity pricing tariff structure**

Description: This option is based on the concept of charging a higher price for the usage charge (the amount of water used that is billed to the customer) when water supply is scarce due to dry conditions. This option is mutually exclusive with the application of water restrictions in dry times – i.e. this option would be implemented instead of water restrictions.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Cont...

Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts. Aims to limit use of water from stressed areas in times of low water availability.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	A	Water security benefits are only realised in times of low rainfall – scarcity price charged when resource is scarce.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Introduction of stronger pricing signals increases community awareness of water use behaviours and status of current water supply/availability.
Technology, Science & Innovation		
Time required to implement	7-12 Years	
Regulatory, legislative or policy constraints	A	Some regulatory and policy constraints – changes to tariff structures require support of customers and approval of the Essential Services Commission, additional financial support likely to be required for vulnerable users.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	1,172 ML/year	
Certainty of yield	R	Yield is dependent on individual responses to pricing signals – diversity of residential customers means it is difficult to be certain of the outcomes over the long-term.
Scalability	A	There is potential to make future adjustments to the tariff structure.
Finance & Economics		
Capex	$0	
Opex	$0/ML	
Levelised cost	$0/ML	

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3. Behaviour Change

Option 20: Using water smarter – Behaviour change – Pricing incentives - Tariffs – **Social allocation of water**

Description: Provides a per capita daily allocation of 100 litres of water at a low cost. This volume is estimated to be adequate for individuals to meet basic health and hygiene requirements. Additional water use is then charged at a significantly higher rate. The intended benefits of this approach is that it is an affordable allocation for all, and a disincentive to use large volumes of water for non-essential uses. The estimated reduction to demand is 580 ML/yr. A reliable smart network to record real time water usage and access to data about household numbers is required. Note the cost to install digital meters is not included below.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Tariff changes would be implemented across the region; water security benefits shared across the region.
Extent of private investment required	A	No private investment required by customers, option would be implemented via Barwon Water bills – but large households will pay more, high discretionary water users have more capacity to reduce water usage than financially disadvantaged.
Community & Social Outcomes		
Bill impact - household owner/occupier	$1	
Bill impact - household renter	$0	
Bill impact - small business	$1	
Bill impact - large business	$115	
Health benefits	R	Potential for negative physical and mental health impacts – private and public green spaces may be watered less due to cost.
Social and recreational benefits	R	Potential for negative physical and mental health impacts – as high water using facilities such as sportsgrounds, parks, pools etc. may be watered/filled less due to cost.
Employment benefits	Y	Additional resources (approx. 2.5 FTE) would be employed by Barwon Water to administer the scheme.
Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Introduction of stronger pricing signals increases community awareness of water use behaviours.
Technology, Science & Innovation		
Time required to implement	7-12 years	
Regulatory, legislative or policy constraints	A	Some regulatory and policy constraints – changes to tariff structures require support of customers and approval of the Essential Services Commission, additional financial support likely to be required for vulnerable users.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	586 ML/year	
Certainty of yield	R	Yield is dependent on individual responses to pricing signals – diversity of residential customers means it is difficult to be certain of the outcomes over the long-term.
Scalability	A	There is potential to make future adjustments to the tariff structure.
Finance & Economics		
Capex	$0	
Opex	$640/ML	
Levelised cost	$640/ML	

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3. Behaviour Change

Option 21: Using water smarter – Behaviour change – Restrictions – Stages in Drought – **Review the restriction curve**

Description: Water restrictions are short-term measures imposed in times of drought or emergency to reduce demand and conserve remaining water supply for essential needs. In our region, we can, if necessary, implement water restrictions which build on the Permanent Water Saving Rules that are always in place. There are four stages of water restrictions that progress in severity and are designed to be successively triggered if dry conditions continue and water storage levels decline.

Currently, the operating rules we have in place for our water supply systems means that water restrictions are very unlikely to be triggered (i.e. much less than five per cent as per the agreed level of service). By changing our operating rules to align closer to our agreed service level of restrictions no more than five per cent of the time, there is ability to increase the overall system yield by 1,000 ML/yr. Noting that the Geelong system requires two years of contingency storage because sourcing additional water for such a large population requires a longer period of time to address the complexity of providing the large volume of water required.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Restriction changes would be implemented across the region; water security benefits shared across the region.
Extent of private investment required	G	No private investment required by customers.
Community & Social Outcomes		
Bill impact - household owner/occupier	$0	
Bill impact - household renter	$0	
Bill impact - small business	$0	
Bill impact - large business	$23	
Health benefits	R	Potential for negative physical and mental health impacts – private and public green spaces would be watered less under restrictions.
Social and recreational benefits	R	Potential for negative physical and mental health impacts – as high water using facilities such as sportsgrounds, parks, pools etc. would be watered/filled less under restrictions.
Employment benefits	R	Provides no employment benefit.
Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts. Aims to limit use of water from stressed areas in times of low water availability.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Introduction of stronger restrictions increases community awareness of water use behaviours and status of current water supply/availability.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	A	Some policy and legislative constraints – Uniform Water Restrictions By-Law set by Government for all water corporations (currently under review) but local variations are possible.
Near-term yield (in 10 years)	1,000 ML/year	
Long-term yield (in 50 years)	1,000 ML/year	
Certainty of yield	A	Yield is dependent on the water usage patterns of individuals – their adherence to rules, extent of water efficient behaviour already hard-wired etc.
Scalability	A	Whilst there is potential revisit the restriction curves in the future, the ability to obtain future savings is limited.
Finance & Economics		
Capex	$0	
Opex	$75/ML	
Levelised cost	$75/ML	

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3. Behaviour Change

Option 22: Using water smarter – Behaviour change – Restrictions – Stages in Drought – **Tighten permanent water saving rules**

Description: Permanent water saving rules are simple, common-sense rules that apply every day of the year to reduce demand and make sure we all use water wisely. By assuming that the permanent water saving rules tightens to the same rules that are under stage 1 water restrictions, then a demand reduction in the order of 700 ML/yr would be realised

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	PWSR changes would be implemented across the region; water security benefits shared across the region.
Extent of private investment required	G	No private investment required by customers.
Community & Social Outcomes		
Bill impact - household owner/occupier	$0	
Bill impact - household renter	$0	
Bill impact - small business	$0	
Bill impact - large business	$23	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	R	Provides no employment benefit.
Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts.
Zero net emissions	G	410 kWh/ML of energy saved – reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Introduction of stronger PWSR increases community awareness of water use behaviours.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	A	Some policy and legislative constraints – Uniform Water Restrictions By-Law set by Government for all water corporations (currently under review).
Near-term yield (in 10 years)	700 ML/year	
Long-term yield (in 50 years)	700 ML/year	
Certainty of yield	A	Whilst reliant on the practices of individuals, historic information means that we are confident that the proposed yield benefits would be met.
Scalability	A	Whilst there is potential to further revisit PWSR in the future, the ability to obtain additional savings is considered limited.
Finance & Economics		
Capex	$0	
Opex	$107/ML	
Levelised cost	$107/ML	

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3. Behaviour Change

Option 53: Using water smarter – Behaviour change – Education – **General water literacy**

Description: Educating the broader community about the water cycle - including where our water comes from - to encourage a better understanding of the water cycle and responsible water use at home. A broad-reaching and sustained campaign (running throughout the year) would include a combination of community events, online and print advertising, printed promotional and educational materials and media at a cost of $1 million per annum. Assumed savings are based on recent insights from Yarra Valley Water around their Target 155 / Make Every Drop Count campaign.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Wide reach across the community with the benefit shared by all.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$2	
Bill impact - household renter	$1	
Bill impact - small business	$3	
Bill impact - large business	$306	
Health benefits	A	No known health benefits or risks.
Social and recreational benefits	A	No known social/recreational risk.
Employment benefits	A	Additional resources (approx. 2.5 FTE) would be employed by Barwon Water to run the campaign.
Environmental		
Environmental impacts – water	G	Water conservation approach, no additional water supply impacts. Increase in environmental awareness.
Environmental impacts – land & biodiversity	G	Water conservation approach, no additional water supply impacts. Increase in environmental awareness.
Zero net emissions	G	410 kWh/ML of energy saved - reduction in demand means Barwon Water uses less energy to supply water.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Aims to reduce water demand – promotes more sustainable use of existing resources.
Promotes informed water use	G	Promotes a high level of awareness and understanding in the community.
Technology, Science & Innovation		
Time required to implement	<2 years	Limited lead time required to start implementing program. Program operating in less than two years.
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints – advertising spend is subject to broader State Government support.
Near-term yield (in 10 years)	1,035 ML/year	
Long-term yield (in 50 years)	1,035 ML/year	
Certainty of yield	R	Yield is reliant on sustained behaviour change – the behaviour of individuals can change over long and short periods of time.
Scalability	A	Some opportunity for program scope and influence to evolve over time, based on learnings – but there are limits to the amount of savings that can be made.
Finance & Economics		
Capex	$0	
Opex	$966/ML	
Levelised cost	$966/ML	

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Options to find more water

Options to find more water

Desalination

Overview

Desalination is a treatment process used widely around the world to create a reliable water supply that is not dependent on rainfall.

Desalination involves removing salt from seawater to make it drinkable. Seawater is pumped to the desalination plant where water is passed through a membrane filter at high pressure to remove salts and minerals. A concentrated brine (salt) waste is a by-product of this process and returned to the ocean.

A desalination plant is typically located on the coast. The drinking water produced by the plant is pumped to a location where it can be blended with the surface water supply. Desalination plants are able to be expanded to meet growing water demands. Power supply and carbon emissions are important considerations with the desalination process requiring significant energy to produce drinking water. Most desalination plants in Australia offset their energy use by creating or purchasing new renewable energy.

There are currently six major desalination plants operating in Australia (>45,000 million litres a year) including Sydney, Melbourne, Adelaide and Gold Coast, with many more plants servicing smaller townships and communities. More than 200,000 million litres of desalinated water has been introduced into Melbourne's water supply network from the Victorian Desalination Plant at Wonthaggi since 2016-17.

Sub-option: State desalination plant

While not currently planned, or part of government policy, as Victoria experiences the impacts of climate change and population growth there is a possibility that additional volumes of desalinated sea water could be considered across our state.

Hypothetically, there are two ways a large desalination plant, which is capable of providing state-wide benefits, could also benefit our region. These hypothetical options are subject to separate government decision-making processes.

1. Desalination plant located outside our region

Victoria currently has one desalination plant – the Victorian Desalination Plant, located at Wonthaggi, approximately 140 km southeast of Melbourne.

It can currently produce up to 150,000 million litres a year of desalinated water, but is capable of being upgraded to produce 200,000 million litres a year. The Minister for Water announced a 125,000 million litre water order on 27 March 2020 for the 2020-21 supply period[26].

The Greater Geelong system is connected to the Victorian Water Grid via the Melbourne to Geelong Pipeline.

If the Victorian Desalination Plant was upgraded or another desalination plant was built to service Melbourne, it is possible this additional desalinated water could be accessed for use by Barwon Water customers via the grid.

Access to additional water supply volumes via the Melbourne to Geelong Pipeline would require upgrades to existing pipe and pump infrastructure.

26 DELWP 2020, Desalination Essentials : Desalination water order 2020-21 https://www.water.vic.gov.au/water-grid-and-markets/desalination Accessed 20 December.

2. Desalination plant located within our region

The Wonthaggi site was chosen for the Victorian Desalination Plant after a feasibility study reduced nine possible sites to four short-listed locations. One of the other short-listed locations was the Surf Coast[27].

If a new desalination plant was to be built within our region, the possibility exists for it also to service other parts of the state that do not have access to a coastal area for desalination processes.

Supporting infrastructure like pipes and pumps would have to be constructed and agreements with other water corporations made for the regular supply of water sourced from our region.

Sharing the costs of the desalination plant with customers of other water corporations may lead to reduced water prices compared to a plant that only serves our region. Keeping construction to one site instead of many would also minimise any physical environmental impacts.

What our community told us

"There is active consideration of climate change, use alternative water sources and use the Victorian Water Grid. I envisage a future that keeps all the water in our rivers and relies on alternative sources to meet our consumptive needs, including desalination that is powered on renewable energy."

"Could water be piped inland to others that need water (more than just for our region)?"

"Good option as it relieves pressures on other sources, expandable, environmental good provided outfall is appropriately designed. Like to see Barwon Water ambitious...potentially supplying other water corps."

"Desalination might be popular, but very hard to find a site supported by local community & high energy use, and high cost."

Sub-option: Regional desalination plant

A small desalination plant could also be constructed within the Barwon Water region to meet our future water needs.

Under this concept, the desalination plant would only service the needs of our customers. As a result, it would be smaller than other desalination plants servicing urban centres in Australia, such as the Victorian Desalination Plant at Wonthaggi.

Additional infrastructure would be needed to connect the desalination plant to our existing water supply system. Desalination also has and significant energy requirements.

What the community told us

"Investigate the possibility of desalination plants linked into the water storage system."

"Purify ocean water."

"We live near ocean waters, so I think a desalination plant makes sense. We can access salt water and turn it into water to be used for day to day life."

"Opportunities for partnerships with renewable energy providers."

27 DELWP 2020 Desalination Background https://www.water.vic.gov.au/water-grid-and-markets/desalination/desalination-background Accessed 20 December.

4. Desalination

Option 23: Finding more water – Desalination – **Regional desalination plant for Geelong**

Description: A reverse-osmosis seawater desalination plant, situated somewhere within our region's coastline that is fully offset by renewable energy sourced from the grid. This option is based on a plant capacity to produce up to 50 GL/yr but is scalable dependent on need. Estimate includes transfer infrastructure of up to 30 km, utilising existing distribution networks to reach customers. Note this hypothetical option is not currently planned, or part of government policy.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Local coastal community likely to have concerns about visual amenity and some sites would be more sensitive than others, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$513	
Bill impact - household renter	$165	
Bill impact - small business	$839	
Bill impact - large business	$99,676	
Health benefits	A	No known health benefits or risks – beyond physical and mental health benefits of water security.
Social and recreational benefits	A	Potential negative impact on coastal recreation activities due to visual amenity but possible to ameliorate this at some sites, small potential recreational benefit from fishing at outlet.
Employment benefits	G	Provides direct employment benefit – up to 3,526 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Brine discharge to high mixing zone: 60 ML/Day means impacts will not be significant, salt going back to where it came from with high dilution rate
Environmental impacts – land & biodiversity	A	Significant construction footprint in coastal area already heavily disturbed. Impacts can be offset by revegetation
Zero net emissions	G	6,373 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	A	Seawater is neither a limited resource nor a wasted resource.
Promotes informed water use	A	Plant would be largely isolated from community and visitors – opportunity for education through visitor centre.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	A	Given scale, a number of regulatory requirements would need to be satisfied for the project to progress - investment would need to be approved by State Government; environmental and planning regulations would need to be met and approved by State and Federal Governments etc.
Near-term yield (in 10 years)	50,000 ML/year	
Long-term yield (in 50 years)	50,000 ML/year	
Certainty of yield	G	Proven technology – high level of confidence in yield.
Scalability	G	Inlet/outlet and transfer pipelines would be sized at ultimate capacity, reverse osmosis plant can be upgraded to larger capacity over time.
Finance & Economics		
Capex	$1,900M	
Opex	$1,810/ML	
Levelised cost	$4,488/ML	

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4. Desalination

Option 24: Finding more water – Desalination – **New State desalination plant, shared between Geelong and Melbourne**

Description: A reverse-osmosis seawater desalination plant, situated somewhere within our region's coastline that is fully offset by renewable energy sourced from the grid. This option is based on a plant capacity to produce up to 150 GL/yr providing enough drinking water to service Geelong (50 GL/yr) and Melbourne's western suburbs (100 GL/yr) and is scalable depending on need. Estimate includes transfer infrastructure of up to 90 km to connect in with Melbourne and a large storage basin, utilising existing distribution networks to reach both Geelong and western Melbourne customers. Note this hypothetical option is not currently planned, or part of government policy.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Local coastal community likely to have concerns about visual amenity and some sites would be more sensitive than others, water security benefits shared across Greater Geelong and Melbourne water supply systems.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$473	
Bill impact - household renter	$152	
Bill impact - small business	$774	
Bill impact - large business	$91,946	
Health benefits	A	No known health benefits or risks – beyond physical and mental health benefits of water security.
Social and recreational benefits	A	Potential negative impact on coastal recreation activities due to visual amenity but possible to ameliorate this at some sites, small potential recreational benefit from fishing at outlet.
Employment benefits	G	Provides direct employment benefit – up to 3,137 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Brine discharge to high mixing zone: 60 ML/Day means impacts will not be significant, salt going back to where it came from with high dilution rate.
Environmental impacts – land & biodiversity	A	Significant construction footprint in coastal area already heavily disturbed. Impacts can be offset by revegetation.
Zero net emissions	G	6,569 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	A	Seawater is neither a limited resource nor a wasted resource.
Promotes informed water use	A	Plant would be largely isolated from community and visitors – opportunity for education through visitor centre.
Technology, Science & Innovation		
Time required to implement	5–10 years	
Regulatory, legislative or policy constraints	A	Given scale, a number of regulatory requirements would need to be satisfied for the project to progress - investment would need to be approved by State Government; environmental and planning regulations would need to be met and approved by state and federal governments etc.
Near-term yield (in 10 years)	50,000ML/year	
Long-term yield (in 50 years)	50,000ML/year	
Certainty of yield	G	Proven technology – high level of confidence in yield.
Scalability	G	Inlet/outlet and transfer pipelines would be sized at ultimate capacity, reverse osmosis plant can be upgraded to larger capacity over time.
Finance & Economics		
Capex	$1,690M	
Opex	$1,825/ML	
Levelised cost	$4,205/ML	

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4. Desalination

Option 25: Finding more water – Desalination – **Access desalinated water from additional 50GL upgrade of Victorian Desalination Plant at Wonthaggi**

Description: An additional 15 GL/yr is supplied to Geelong from the Melbourne system. This additional supply would be made available through the 50 GL upgrade of the existing Victorian Desalination Plant (VDP) located at Wonthaggi.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Plant already in existence, water security benefits shared across Greater Geelong and Melbourne water supply systems.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$174	
Bill impact - household renter	$56	
Bill impact - small business	$284	
Bill impact - large business	$33,809	
Health benefits	A	No known health benefits or risks – beyond physical and mental health benefits of water security.
Social and recreational benefits	G	Site design and the creation of new ecological reserve has improved visual amenity and attracts many recreational visitors.
Employment benefits	G	Provides direct employment benefit – up to 1,281 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Brine discharge to high mixing zone: 60 ML/Day means impacts will not be significant, salt going back to where it came from with high dilution rate
Environmental impacts – land & biodiversity	G	Some construction in already highly disturbed areas – also relies on existing infrastructure (inlet/outlet tunnels, transfer pipelines)
Zero net emissions	G	6,140 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	A	Seawater is neither a limited resource nor a wasted resource.
Promotes informed water use	A	Plant is largely isolated from community and visitors – opportunity for education through visitor centre.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	G	Not regulatory or legislative restrictions facing this option.
Near-term yield (in 10 years)	15,000 ML/year	
Long-term yield (in 50 years)	15,000 ML/year	
Certainty of yield	A	Proven technology – but negotiation required with other parties to guarantee supply.
Scalability	R	Limited from a scalability perspective – existing inlet/outlet and transfer pipelines have been built to maximum 200 GL/year capacity.
Finance & Economics		
Capex	$690M	
Opex	$1,670/ML	
Levelised cost	$4,189/ML	

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4. Desalination

Option 54: Finding more water – Desalination – Regional – **Modular desalination plants**

Description: Smaller desalination plants located to service individual coastal communities instead of a single large centralised desalination plant. These modular desalination plants would supply potable water direct to the drinking water supply tanks servicing the coastal communities such as Anglesea, Torquay, Ocean Grove and Bellarine Peninsula coastal towns. Where possible, deeper ocean sites chosen in preference over bay sites due to better quality intake seawater and easier dispersal of brine discharge.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Local coastal community likely to have concerns about visual amenity and some sites would be more sensitive than others, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$135	
Bill impact - household renter	$43	
Bill impact - small business	$221	
Bill impact - large business	$26,240	
Health benefits	A	No known health benefits or risks – beyond physical and mental health benefits of water security.
Social and recreational benefits	A	Potential negative impact on coastal recreation activities due to visual amenity but possible to ameliorate this at some sites.
Employment benefits	G	Provides direct employment benefit – up to1,232 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	Brine discharge to high mixing zone due to access to open ocean (with exception of Bellarine Peninsula) and small discharge rate (approx. 5 ML/Day per plant) means impacts will not be significant, salt going back to where it came from with high dilution rate.
Environmental impacts – land & biodiversity	R	Some construction in already highly disturbed areas – also relies on existing infrastructure (inlet/outlet tunnels, transfer pipelines)
Zero net emissions	G	6,373 kWh/ML to be offset – built into cost of option.
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	A	Seawater is neither a limited resource nor a wasted resource.
Promotes informed water use	A	Plants would be largely isolated from community and visitors – opportunity for education through visitor centres.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	R	Four different locations means regulatory requirements and approval processes would need to be satisfied for each individual project to progress. Investment would need to be approved by State Government; environmental and planning regulations would need to be met and approved by State and Federal Governments etc.
Near-term yield (in 10 years)	2,700 ML/year	
Long-term yield (in 50 years)	2,700 ML/year	
Certainty of yield	A	Impacted by coastal population fluctuations – because the desalinated water is being fed directly into the drinking water network (i.e. not stored), its production rate depends on seasonal demand in the network.
Scalability	A	Potential to install more modular plants over time – as population and demand in coastal communities grow.
Finance & Economics		
Capex	$664M	
Opex	$1,300/ML	
Levelised cost	$15,892/ML	

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Recycled water

Overview

Recycled water is wastewater that has been treated to a safe standard to allow fit-for-purpose use.

Wastewater is collected from homes, businesses and industry, and treated to a standard appropriate for its intended use at a large scale wastewater treatment plant, or more locally at a small on-site treatment plant.

Historically, wastewater in towns and cities has historically been removed from populated areas as quickly and efficiently as possible in order to limit environmental and human health impacts. As technologies have advanced, environmental regulations have become stricter and our recognition of the value of water has increased, so has the level of wastewater treatment and the desire to beneficially reuse it.

Now, with the ability to treat wastewater to any desirable quality, there is a diversity of opportunities for the use of recycled water.

What our community told us

"It's time to use recycled water to supplement existing resources."

"Re-use and recycling should be the focus."

"We seriously need to start the conversation around Class A potable re-use. It's a long journey but the sooner we start the sooner we get there."

"We need better use of recycled water for drinking."

"I want to see much more use of recycled water in our region."

"Aquifer recharge with recycled water is now happening in Perth and has been in Orange County in California for decades. The same could be happening with water [from] Black Rock and other wastewater plants in the region."

"Can trade waste be managed for better recycled water outcomes? Consider opportunities such as the Northern Water Plant for other industries / parks/ open spaces.... Also for agriculture."

"Year round, reliable supply – can predict with confidence how much you get and how much you have."

Sub-option: Regional recycled water

Recycled water could be used on a large scale in one of two ways.

1. Non-Potable Use

In Victoria, recycled water is only used for non-potable (or non-drinking water) purposes, in line with current State Government policy.

Recycled water is classified into four classes, depending on the level of treatment and its suitability for end use. Class A is the classification for the highest treatment level.

Class A recycled water is suitable for non-drinking purposes such as toilet flushing, garden watering, car washing and industrial applications.

It can be piped to households via a dual-pipe reticulation system ("purple pipes"), direct to public open spaces such as golf courses or sporting ovals, or for large scale agricultural irrigation and industrial use to be used instead of drinking water.

Class A purple pipe schemes are generally associated with new housing developments where the urban spaces and houses are designed to support recycled water infrastructure. Retrofitting existing neighbourhoods and homes with recycled water comes with significant additional costs in comparison to new developments.

Class B and C recycled water is commonly associated with irrigation projects for agricultural or open space requirements.

CASE STUDY: Black Rock Recycled Water Plant

Class A recycled water is produced at our Black Rock Recycled Water Plant located between Torquay and Barwon Heads. Water is being transferred to customers in Armstrong Creek and Torquay North via a dedicated purple pipe. The highly treated water is appropriate for watering gardens, washing cars, flushing toilets and irrigating community open space, including parks and sporting ovals.

2. Potable Use

Advances in wastewater treatment technologies have made it possible to treat wastewater beyond Class A standards. In some places, the combination of modern technologies, thorough management practices and immediate monitoring of water quality has allowed wastewater to be treated to a standard where it can be reused for purposes including drinking.

While the use of treated wastewater presents risks to human health that need to be managed, it has the advantage over other recycled water approaches in that it doesn't require separate piped infrastructure for delivery to households.

Using recycled water for drinking purposes is not permitted under current policy and regulatory frameworks in Victoria.

CASE STUDY: Singapore

With no access to groundwater and a large population relative to its size, the residents of Singapore have turned to drinking recycled water to meet their needs. In 2003, the country opened the first of its advanced wastewater treatment systems. After treatment, the water is introduced into reservoirs before it is distributed to homes and businesses.

Currently, Singapore has five treatment plants supplying up to 40 per cent of its water needs. It is expected that by 2060, 55 per cent of Singapore's water demand will be met by appropriately treated recycled water.

CASE STUDY: Orange County, United States

Located on the south-west coast of the United States of America, Orange County historically relied on groundwater bores and surface water from the Colorado River to meet the drinking water requirements of its community. Seawater seepage into groundwater bores was first identified as an issue in the 1930s. This problem was largely attributed to the over-extraction of groundwater.

In 1965, pilot testing was undertaken to investigate the potential to slow or reverse the seawater seepage by injecting appropriately treated wastewater into groundwater system. After this initial testing, a scheme consisting of 23 injection and 31 monitoring bores started operating in 1972. The system has since undergone several upgrades.

The scheme's approach mixes recycled wastewater with deep bore water before it is reinjected into the ground. Once in the ground it mixes again with the local groundwater prior to extraction and use. The scheme currently produces 380 million litres per day, which is set to grow to 492 million litres in 2023. The scheme has implemented a water testing approach that measures a large number of parameters including chemicals and bacteria.

Sub-option: Local recycled water

Water can also be recycled on a smaller scale – for example, large office blocks or close to industrial facilities, parks, golf courses or agricultural properties. The practice of extracting, treating and reusing wastewater close to the point of use is called sewer mining.

While sewer mining provides flexibility in terms of the level of treatment that is undertaken, it is almost always treated to a Class A standard making it appropriate for unrestricted irrigation of open space, toilet flushing and food production.

The production of recycled water close to the point of use saves energy and costs associated with transporting water. However, there are significant financial impacts to access, treat and store the water before use. There are also stringent controls in place to ensure that risks to human and environmental health are limited.

CASE STUDY: Office Block – Workplace 6

Located on Sydney's waterfront in New South Wales, Workplace 6 is a contemporary office building that has achieved national and international environmental standards. A key feature of the development is its onsite Recycled Water Factory, which provides recycled water for building amenities and irrigating plants and a neighbouring community park.

CASE STUDY: Sewer mining – MCG

The Melbourne Cricket Ground constructed an underground water recycling facility in Yarra Park in 2012. The treatment plant treats wastewater from the local sewerage network to a Class A standard. The treatment plant produces more than 180 million litres of recycled water each year, which reduces drinking water demand by half.

The treatment plant was funded by the Melbourne Cricket Club ($18 million) and the Victorian Government ($6 million).

5. Recycled Water

Option 26: Finding more water – Recycled water – Regional – Potable – **Direct potable re-use from Black Rock Water Reclamation Plant to storage basins**

Description: Expansion of the Black Rock Water Reclamation Plant (recycled water plant) from approximately 7 ML/d to 30 ML/d to produce recycled water that is of a drinking water quality standard. This high quality recycled water would be pumped to Pettavel Basin via a dedicated pipeline and blended with water sourced from the Barwon catchment as well as the Anglesea Borefield (if needed) prior to distribution to the Greater Geelong region. Estimated increase in supply of 9,400 ML/

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$46	
Bill impact - household renter	$15	
Bill impact - small business	$75	
Bill impact - large business	$8,870	
Health benefits	R	Potential health risks around introduction of treated wastewater directly into drinking water network – would require careful management.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides direct employment benefit – up to 204 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Utilises a wastewater supply and reduces the volume of water going to the receiving environment.
Environmental impacts – land & biodiversity	G	Construction would primarily occur in already highly disturbed environments – i.e. urban environments, agricultural land.
Zero net emissions	G	6,078 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises an existing waste stream.
Promotes informed water use	R	Does not promote informed water use – infrastructure would be isolated from the community.
Technology, Science & Innovation		
Time required to implement	10-20 years	
Regulatory, legislative or policy constraints	R	Significant regulatory and policy constraints – not consistent with State Government policy, not enabled by current health regulations.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	9,400 ML/year	
Certainty of yield	G	High certainty of yield – both the supply and demand are well understood.
Scalability	G	This approach can be applied at a variety of locations and scales.
Finance & Economics		
Capex	$110M	
Opex	$1,636/ML	
Levelised cost	$2,102/ML	

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5. Recycled Water

Option 27: Finding more water – Recycled water – Regional – Potable – **Indirect potable re-use from Black Rock Water Reclamation Plant via Anglesea Aquifer Storage & Recovery to Wurdee Boluc**

Description: Black Rock Water Reclamation Plant recycled water capacity is upgraded from 5 ML/d to 40 ML/d to produce recycled water that is of a drinking water quality standard. This high quality recycled water is pumped to a new aquifer storage and recovery (ASR) site near Anglesea. Recycled water is injected into the aquifer and then recovered some distance away. Recovered water is pumped to Wurdee Boluc Reservoir and blended with water sourced from the Barwon catchment as well as the Anglesea Borefield (if needed). This water undergoes treatment again to drinking water standard at the Wurdee Boluc Water Treatment Plant prior to distribution to the Greater Geelong region. Estimated increase in supply of 6,580 ML/yr.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$60	
Bill impact - household renter	$19	
Bill impact - small business	$98	
Bill impact - large business	$11,675	
Health benefits	A	Potential health risks around introduction of treated wastewater indirectly into drinking water network – could be readily managed.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides direct employment benefit – up to 399 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	Utilises a wastewater supply and reduces the volume of water going to the receiving environment. Would be informed by current environmental monitoring, compliance and risk mitigation.
Environmental impacts – land & biodiversity	G	Limited additional disturbance. Would be informed by current environmental monitoring, compliance and risk mitigation.
Zero net emissions	G	4,412 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises an existing waste stream.
Promotes informed water use	R	Does not promote informed water use – infrastructure would be isolated from the community.
Technology, Science & Innovation		
Time required to implement	10-20 years	
Regulatory, legislative or policy constraints	R	Significant regulatory and policy constraints – not consistent with State Government policy, not enabled by current health regulations.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	6,580 ML/year	
Certainty of yield	A	Some certainty of yield – further assessment of hydrogeological conditions would provide greater certainty.
Scalability	G	Can be staged and scaled up subject to availability of recycled water from Black Rock.
Finance & Economics		
Capex	$215M	
Opex	$1,753/ML	
Levelised cost	$3,643/ML	

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5. Recycled Water

Option 28: Finding more water – Recycled water - Local – Non-potable – **Northern Water Reclamation Plant dual-pipe system to existing suburbs**

Description: Supply of Class A recycled water from the existing Northern Water Plant in Corio via a new dual pipe reticulation network to surrounding northern Geelong suburbs.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Additional recycled water service provided to only some customers; water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	A	Some private funding required – as per current connection practices, properties would be serviced to boundary then internal plumbing at owners expense.
Community & Social Outcomes		
Bill impact - household owner/occupier	$23	
Bill impact - household renter	$7	
Bill impact - small business	$38	
Bill impact - large business	$4,482	
Health benefits	G	Indirect health benefit – through irrigation of green spaces for recreation purposes.
Social and recreational benefits	G	Provides direct social/recreational benefit – water available for recreational green spaces.
Employment benefits	G	Provides direct employment benefit – up to 200 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Utilises a wastewater supply and reduces the volume of water going to the receiving environment. Potential benefit from provision of additional flows to Moorabool River.
Environmental impacts – land & biodiversity	G	Construction would primarily occur in already highly disturbed environments – i.e. urban environments, agricultural land.
Zero net emissions	G	4,158 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises an existing waste stream.
Promotes informed water use	G	Promotes informed water use behaviour – "purple pipe" infrastructure visible and present in the community, but at a localised scale.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	700 ML/year	
Long-term yield (in 50 years)	700 ML/year	
Certainty of yield	G	High certainty of yield – both the supply and demand are well understood.
Scalability	A	Some opportunity to stage the option but limited opportunity to scale up – limited by infrastructure constraints (e.g. capacity of and proximity to treatment plant).
Finance & Economics		
Capex	$108M	
Opex	$1,814/ML	
Levelised cost	$12,250/ML	

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5. Recycled Water

Option 29: Finding more water – Recycled water - Regional – Non-potable – **Recycled water for agricultural use**

Description: A new 4 ML/d recycled water plant constructed on the Bellarine to provide low salinity recycled water for agricultural/ horticultural use that substitutes some existing potable water use by existing farms.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Additional recycled water service provided to only some customers; water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	A	Some private funding required – as per current connection practices properties would be serviced to boundary then internal plumbing at owners expense.
Community & Social Outcomes		
Bill impact - household owner/occupier	$2	
Bill impact - household renter	$1	
Bill impact - small business	$4	
Bill impact - large business	$446	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides direct employment benefit – up to 20 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Utilises a wastewater supply and reduces the volume of water going to the receiving environment.
Environmental impacts – land & biodiversity	G	Construction would primarily occur in already highly disturbed environments – i.e. urban environments, agricultural land.
Zero net emissions	R	Responsibility of private entity, Barwon Water cannot guarantee offset will occur
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises an existing waste stream and nutrients for agricultural production.
Promotes informed water use	G	Application of recycled water in urban agriculture will promote informed water use behaviour in some industries and parts of the community.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints – beyond current, well understood requirements associated with environmental and human health.
Near-term yield (in 10 years)	80 ML/year	
Long-term yield (in 50 years)	80 ML/year	
Certainty of yield	R	Low certainty of yield – supply is well understood but may be diversity in demand over the long term due to industry development and short term due to seasonality.
Scalability	A	There may be some opportunity for scalability or application in other areas.
Finance & Economics		
Capex	$11M	
Opex	$1,169/ML	
Levelised cost	$9,121/ML	

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5. Recycled Water

Option 30: Finding more water – Recycled water – **Recycled water for river environmental flows**

Description: Provision of high quality, low salinity, low nutrient recycled water to assist in meeting environmental water flow shortfalls in the Barwon River (5.5 GL/y) and the Moorabool River (6.5 GL/y). Includes major recycled water treatment upgrade at Black Rock, 140 km of pipelines, pumping stations and 4 GL of recycled water storages. Designed to provide for the highest priority low flow and freshes needed to support environmental values in the rivers.

This option was not recommended by Water for our Future Community Panel. Visit www.barwonwater.vic.gov.au/future to read the panel's report.

Social Impact & Equity		
Extent of shared social benefits/costs	G	Additional environmental benefits for our region; no water security benefits unless this avoids reduction of urban surface water entitlements to meet the same environmental water needs
Extent of private investment required	G	No private investment required.
Community & Social Outcomes		
Bill impact - household owner/occupier	$91	If full cost borne by BW customers
Bill impact - household renter	$29	If full cost borne by BW customers
Bill impact - small business	$148	If full cost borne by BW customers
Bill impact - large business	$17,624	If full cost borne by BW customers
Health benefits	G	Potential indirect health benefit – through access to improved natural environment
Social and recreational benefits	G	Provides direct social/recreational benefit – healthier water ways, more recreational access, notion of returning water to environment.
Employment benefits	A	Potentially provides employment benefit for construction and operation – to be confirmed
Environmental		
Environmental impacts – water	G	Contributes to meeting highest priority scientific environmental flow shortfalls in the Moorabool and Barwon Rivers
Environmental impacts – land & biodiversity	A	Pipeline and storages constructed mainly on already disturbed agricultural land, however there could be low impacts to isolated areas of more environmental significance.
Zero net emissions	G	Quantity of greenhouse gas emissions that need to be offset
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises an existing waste stream.
Promotes informed water use	R	Does not promote informed water use – infrastructure would be isolated from the community.
Technology, Science & Innovation		
Time required to implement	5-10 years	Due to significance of infrastructure and complexity of environmental approvals
Regulatory, legislative or policy constraints	A	Complex environmental approvals and challenges in regulatory recognition of this as beneficial environmental flow and part of environmental water reserve.
Near-term yield (in 10 years)	0 ML/year	12 GL/year of environmental flows – but no additional system yield.
Long-term yield (in 50 years)	0 ML/year	12 GL/year of environmental flows – but no additional system yield.
Certainty of yield	G	Recycled water is a reliable source once treatment, transfer and storage infrastructure is provided.
Scalability	A	Some opportunity to stage the option but limited opportunity to scale up to more than the available recycled water volumes produced at Black Rock
Finance & Economics		
Capex	$465M	
Opex	$1,192/ML	$14.3M pa
Levelised cost	Not Applicable	Levelised cost only applies if recycled water is used to offset potable water otherwise used for environmental flow entitlement.

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5. Recycled Water

Option 31: Finding more water – Recycled water - Local – **Dual pipe recycled water to major future urban growth areas**

Description: A water reclamation plant built to produce Class A recycled water for supply through a dual-pipe network, for residential use in gardens, washing machines and toilet flushing. At full capacity, this option is expected to reduce potable water demand by 3,400 ML/y.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Additional recycled water service provided to only some customers; water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	A	Some private funding required – as per current connection practices, properties would be serviced to boundary then internal plumbing at owners expense.
Community & Social Outcomes		
Bill impact - household owner/occupier	$63	
Bill impact - household renter	$20	
Bill impact - small business	$103	
Bill impact - large business	$12,281	
Health benefits	G	Potential indirect community health benefit – through considered urban design, e.g. public and private green spaces, water bodies.
Social and recreational benefits	G	Direct social/recreational benefit – through availability and accessibility to public and private green spaces, water bodies
Employment benefits	G	Provides direct employment benefit – up to 612 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Utilises a wastewater supply and reduces the volume of water going to the receiving environment.
Environmental impacts – land & biodiversity	G	Construction would primarily occur in already highly disturbed environments – i.e. urban environments, agricultural land.
Zero net emissions	G	4,500 kWh/ML required to be offset - built into cost of option
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises an existing waste stream.
Promotes informed water use	G	Promotes informed water use behaviour – "purple pipe" infrastructure visible and present in the community, but at a localised scale.
Technology, Science & Innovation		
Time required to implement	10-20 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints – beyond current, well understood requirements associated with environmental and human health.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	3,400 ML/year	
Certainty of yield	A	Certainty of yield is reliant on development uptake and housing construction.
Scalability	A	Some opportunity to stage the option but limited opportunity to scale up – limited by infrastructure constraints (e.g. capacity of and proximity to treatment plant).
Finance & Economics		
Capex	$400M	
Opex	$3,780/ML	
Levelised cost	$12,361/ML	

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5. Recycled Water

Option 32: Finding more water – Recycled water – Local – Non-potable – **Sewer mining for public open space or industry**

Description: Sewage is pumped from the sewer main and treated on-site at a small localised water reclamation plant; could be implemented at a golf course, recreation reserve or industrial site and owned privately. Sewage is treated to a standard fit for purpose for the recycled water – e.g. Class C for golf course irrigation. This is estimated to supply up to 180 ML/yr depending on uptake.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Benefits all of our region – all eligible customers could access the program, regardless of geography; water security benefits shared across the region.
Extent of private investment required	R	Full private investment required to implement.
Community & Social Outcomes		
Bill impact - household owner/occupier	$2	
Bill impact - household renter	$1	
Bill impact - small business	$3	
Bill impact - large business	$369	
Health benefits	G	Indirect health benefit – through irrigation of green spaces for recreation purposes.
Social and recreational benefits	G	Provides direct social/recreational benefit – water available for recreational green spaces.
Employment benefits	G	Provides direct employment benefit – up to 15 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	Utilises a wastewater supply and reduces the volume of treated wastewater going to the receiving environment.
Environmental impacts – land & biodiversity	G	Construction would primarily occur in already highly disturbed environments – i.e. urban environments, recreational reserves.
Zero net emissions	R	5,500 kWh/ML required to be offset – responsibility of private entity, Barwon Water cannot guarantee offset will occur.
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises an existing waste stream.
Promotes informed water use	G	Promotes informed water use behaviour – visible and present in the community, but at a localised scale.
Technology, Science & Innovation		
Time required to implement	1-3 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints – existing environmental and human health requirements are well understood.
Near-term yield (in 10 years)	180 ML/year	
Long-term yield (in 50 years)	180 ML/year	
Certainty of yield	G	High certainty of yield – both supply and demand are well understood.
Scalability	G	Could be applied at a variety of locations across our urban areas.
Finance & Economics		
Capex	$7.5M	
Opex	$1,540/ML	
Levelised cost	$4,035/ML	

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5. Recycled Water

Option 55: Finding more water – Recycled water – Local - Non-potable – **Small Decentralised New Suburb Dual-Pipe**

Description: A small-scale waste water treatment plant is used to treat sewage from a new small suburb development and treated to Class A recycled water (for example, Lara West subdivision). Recycled water is then provided to houses within the development via a dual-pipe system similar to the existing larger-scale Armstrong Creek growth area.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	A	Social/recreational benefits provided to part of community, water security benefits shared across water supply system option is implemented in.
Extent of private investment required	A	Some private investment required by new customers living in these growth areas through lot price.
Community & Social Outcomes		
Bill impact - household owner/occupier	$13	
Bill impact - household renter	$4	
Bill impact - small business	$21	
Bill impact - large business	$2,467	
Health benefits	G	Potential indirect community health benefit – through considered urban design, e.g. public and private green spaces, water bodies due to availability of recycled water.
Social and recreational benefits	G	Direct social/recreational benefit – through availability and accessibility to public and private green spaces, water bodies.
Employment benefits	G	Provides direct employment benefit – up to 98 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	Utilises a wastewater supply and reduces the volume of water going to the receiving environment.
Environmental impacts – land & biodiversity	G	Construction would primarily occur in already highly disturbed environments – i.e. urban environments, cleared land.
Zero net emissions	G	4,500 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	G	Technology is climate independent – not reliant on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises an existing waste stream.
Promotes informed water use	G	Promotes informed water use behaviour – treatment plants and "purple pipe" infrastructure is visible and present in the community, but at a localised scale.
Technology, Science & Innovation		
Time required to implement	10-20 years	
Regulatory, legislative or policy constraints	A	No regulatory, legislative or policy constraints – existing environmental and human health requirements are well understood.
Near-term yield (in 10 years)	270 ML/year	
Long-term yield (in 50 years)	400 ML/year	
Certainty of yield	A	Certainty of yield is reliant on development and uptake of housing construction.
Scalability	A	Some opportunity to apply across other new developments.
Finance & Economics		
Capex	$53M	
Opex	$3,750/ML	
Levelised cost	$14,497/ML	

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Grey water

Overview

Grey water is the household wastewater from showers, baths, washing machines and some sinks, which normally flows into the sewerage system. It makes up a significant volume of the wastewater generated in our homes each day.

Grey water does not include kitchen sink or toilet wastewater, which means the treatment requirements are not as complex and there is an opportunity to treat, and reuse on site.

Due to public health risks, direct use of grey water without first treating it is not recommended.

A range of different grey water treatment systems are available and can be applied to single households or apartment blocks. A number of different treatment approaches can be applied to ensure the treated water is fit for reuse.

Reuse applications are limited to non-drinking purposes such as clothes washing, toilet flushing and irrigation. Given the limited options for reuse, greywater treatment systems in household environments are generally capable of treating more water than they can use. To use a greywater treatment system, you need an EPA approved system and a permit from your local council.

In addition to the cost of purchasing and running a greywater treatment system, significant plumbing costs may be incurred for the separation of pipework in homes for both the collection of the greywater and the return of the treated water for reuse. The costs are greatly reduced when greywater treatment systems are installed in new developments where separate pipework can be installed during building construction, rather than already constructed dwellings where pipes are located in existing walls, floors or below concrete slabs.

Diverting grey water for immediate use on the garden does not require permission. Under these circumstances care should be taken to minimise potential impacts to your garden, children and pets. Untreated grey water should not be stored for more than 24 hours.

On-site grey water systems have the added benefit of reducing the volume of wastewater sent to the sewerage system, reducing sewerage system costs.

Onsite collection, treatment and reuse of wastewater from industrial or manufacturing processes is considered local-scale recycled water, rather than greywater, as the characteristics of this wastewater is generally different to grey water.

What our community told us

"All new housing areas MUST be required to utilise grey water for gardens/toilets."

"Normalise the use of grey water on gardens and lawns over the warmer months."

"Utilise stormwater, grey water and other sources in households."

"Fund grey water use."

"Subsidise homes for set up of plumbing for grey water to be used in gardens."

"Greywater and roof water is an aspect of the solution but not the sole solution."

"Could we mandate water tanks, greywater capture? Can this be incentivised?"

CASE STUDY: K2 Sustainable Housing Project

Located in the Melbourne suburb of Windsor, the K2 Sustainable Housing Project consists of 96 apartments in four buildings. The social housing project set out to limit its environmental impact by pursuing ambitious environmental targets including using less than 50 per cent less mains water than a standard apartment each year.

The K2 development collects water from showers and hand basins and uses it for toilet flushing and irrigation.

6. Grey Water

Option 33: Finding more water – Grey water – **Household On-site treatment for garden and toilet use**

Description: Greywater collected from showers, baths, sinks and washing machines is treated via an on-site system to a safe standard using filter technology for outdoor irrigation purposes. Does not include toilet wastewater recycling. Estimated reduction in demand of 1,300 ML/yr.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Benefits all of our region – all residential customers could access the program; water security benefits shared across the region.
Extent of private investment required	A	Some ongoing private investment required by customers – pumping costs etc.
Community & Social Outcomes		
Bill impact - household owner/occupier	$94	
Bill impact - household renter	$30	
Bill impact - small business	$153	
Bill impact - large business	$18,192	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides direct employment benefit - up to 858 full time equivalent positions from capital investment – but given the preliminary nature of this option this value is uncertain
Environmental		
Environmental impacts – water	G	Reduces wastewater volume being discharged to the environment.
Environmental impacts – land & biodiversity	G	Limited construction impact on already impacted areas.
Zero net emissions	R	6,000 kWh/ML required to be offset – responsibility of private entity, Barwon Water cannot guarantee offset will occur.
Rainfall dependency	G	Water security benefits are not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises an existing waste stream.
Promotes informed water use	G	Creates conversation and engagement with water related issues across households.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	1,300 ML/year	
Long-term yield (in 50 years)	1,300 ML/year	
Certainty of yield	A	Yield is reliant on sustained behavioural change – i.e. initial household uptake and ongoing maintenance.
Scalability	A	Able to be scaled up or staged, but will reach limits in terms of maximum water savings.
Finance & Economics		
Capex	$462M	
Opex	$1,715/ML	
Levelised cost	$24,274/ML	

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Groundwater

Overview

When it rains, some water seeps into the ground, filling the spaces between soil and rock – this is known as groundwater.

It collects underground in storages called aquifers and eventually flows into rivers, lakes or oceans. Some ecosystems depend on groundwater to meet all or some of their water requirements. Globally, groundwater provides around a third of the world's total water consumption.

Groundwater is accessed by drilling a bore into the ground. The targeted aquifer generally has sandy or gravel type soil that easily stores water. A pipe is inserted into the hole to access the aquifer and a pump brings the water to the surface. Groundwater may be tens or hundreds of metres below the surface.

Groundwater may require treatment before it enters the water supply network depending on its quality. The potential for impacts on groundwater dependent ecosystems can limit the use of groundwater at some locations.

What our community told us

"Explore other underground water sources."

"Need multiple water sources including stormwater, water reuse and groundwater with active recharge."

"Offshore groundwater – What is the potential to access offshore groundwater as an alternative water supply? What studies have been undertaken in this area? What are the risks and opportunities? It has been done overseas, could be a suggestion!"

"Be careful with groundwater extraction."

"Don't want to upset the delicate balance of groundwater dependent ecosystems – both upstream and downstream impacts are worrying."

"The problem with aquifers are they are dependent on rainfall for recovery – we've learnt that we can take water out but it can take some time for water to replenish what we take out."

"Increasingly less rainfall to replenish the groundwater that is extracted."

CASE STUDY: Ballarat West borefield

The Ballarat water supply system comprises a number of elements, including the Ballarat West groundwater borefield. The borefield draws on groundwater stored in a fractured volcanic (basalt) rock known as the Cardigan Aquifer. The site encompasses three production bores and is limited to extract 9.3 million litres per day.

The Cardigan Aquifer was investigated and successfully used to supply potable water during an extended dry period between July 2007 and December 2009. The site was commissioned by Central Highlands Water (CHW) to supplement Ballarat and the District Water Supply System with up to 1,700 million litres a year of groundwater, with the potential to supply up to 3,000 million litres a year in drought subject to ministerial approval.

The water from the borefield is extracted and stored at Lake Wendouree before being treated at the Ballarat West treatment plant and incorporated into the border Ballarat water supply network. In addition, the potential for harvesting storm and wastewater and injecting into the aquifer (where losses via evaporation are reduced) is currently being assessed as a method of increasing the sustainability of the aquifer.

7. Groundwater

Option 34: Finding more water – Groundwater – **Access to the Upper Eastern View Formation groundwater**

Description: Groundwater would be sourced from the Upper Eastern View Formation aquifer. Two new groundwater bores would be constructed along with a connecting main to the existing Anglesea Borefield collection main. Groundwater would then be treated at the Anglesea Groundwater Pre-treatment Plant prior to pumping to Wurdee Boluc Reservoir where groundwater would be blended with surface water from the Barwon catchment and treated at the Wurdee Boluc Water Treatment Plant to drinking water standard. Any extension of the borefield would be subject to the same stringent environmental monitoring program currently in place, with community oversight from a dedicated working group. Estimated increase in yield is 2,000 ML/yr.

This option was not recommended by Water for our Future Community Panel. Visit www.barwonwater.vic.gov.au/future to read the panel's report.

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local Anglesea community may have concerns about potential environmental impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$4	
Bill impact - household renter	$1	
Bill impact - small business	$7	
Bill impact - large business	$795	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides direct employment benefit – up to 15 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	R	Removes additional water from groundwater resource beyond current operating practice.
Environmental impacts – land & biodiversity	A	Limited additional disturbance – environmental monitoring would be required to understand potential impacts to groundwater dependent ecosystems.
Zero net emissions	G	1,980 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	A	Somewhat dependent on rainfall – recharge rates likely to be slow.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	A	Some legislative and policy constraints – would require a new bulk entitlement to demonstrate a sustainable yield exists, within Permissible Consumptive Volume.
Near-term yield (in 10 years)	2,000 ML/year	
Long-term yield (in 50 years)	2,000 ML/year	
Certainty of yield	R	Approval of new bulk entitlement may not be forthcoming – groundwater licences to the Upper Eastern View formation already exist.
Scalability	R	Localised option – unable to be scaled or staged.
Finance & Economics		
Capex	$8M	
Opex	$804/ML	
Levelised cost	$1,035/ML	

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7. Groundwater

Option 35: Finding more water – Groundwater – **Newlingrook groundwater bores**

Description: Up to seven groundwater bores constructed within the Newlingrook Groundwater Management Area south-west of Colac. Groundwater would be pre-treated and pumped via a pipeline to the Wurdee Boluc Inlet Channel where it would be blended with surface water from the Barwon catchment and the Anglesea Borefield (if required). Groundwater would be treated to drinking water standard at the Wurdee Boluc Water Treatment Plant prior to distribution to the Greater Geelong region. Estimated increase in yield is 2000ML/yr.

This option was not recommended by Water for our Future Community Panel. Visit www.barwonwater.vic.gov.au/future to read the panel's report.

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local Colac community may have concerns about potential environmental impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$23	
Bill impact - household renter	$8	
Bill impact - small business	$38	
Bill impact - large business	$4,543	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides direct employment benefit – up to 199 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	R	Removes additional water from new groundwater resource – albeit within Permissible Consumptive Value.
Environmental impacts – land & biodiversity	A	Construction would occur across highly disturbed environments (i.e. agricultural land) and impacts in any area of potential environmental significance could be managed/offset.
Zero net emissions	G	1,955 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	A	Somewhat dependent on rainfall – recharge rates likely to be slow.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	A	Some legislative and policy constraints – requires approval of a new bulk entitlement within Permissible Consumptive Volume.
Near-term yield (in 10 years)	2,000 ML/year	
Long-term yield (in 50 years)	2,000 ML/year	
Certainty of yield	A	Some evidence but level of uncertainty associated with the long-term reliability of groundwater.
Scalability	R	Localised option – unable to be scaled or staged.
Finance & Economics		
Capex	$107M	
Opex	$797/ML	
Levelised cost	$3,891/ML	

High-level, preliminary information provided as a guide only - represents views of Barwon Water professionals and should not be viewed as definitive or exhaustive

Roof water

Overview

Roof water involves the capture of rainwater from the rooftops of buildings. Water can be stored either on-site in tanks or pumped to a larger storage for wider uses.

Capturing roof water provides the added environmental benefit of reducing the volume of urban runoff that drains into waterways during storms and floods.

What our community told us

"Harvest every bit of rainwater possible, starting with suburban houses, shopping centres etc. where there are huge roof areas."

"Encourage residential homes to have their own water tanks collecting water from rainfall."

"Capture roof top rain run-off."

"Many hands make light work; while roof/storm/grey water maybe comparatively small, the economy of scale would mitigate this."

Sub-option: Local roof water

Suburban roof water harvesting refers to the practice of capturing rain water from roofs in new residential or industrial subdivisions and moving it via pipes to a water storage. Water can then be treated and utilised for drinking water at a central location.

By capturing the water on roofs, and not after it has been collected in roadside gutters as is the common practice with stormwater harvesting systems, the water remains isolated from a number of potential pollutants, including car oils, garden fertilisers, herbicides and animal waste.

A benefit of this approach is a reduced volume of urban stormwater entering local waterways, while negative aspects include its reliance on rainfall and the costs associated with the pipework to collect water from the houses and move it to the water treatment plant.

CASE STUDY: Warrnambool Roof Harvesting Scheme

Implemented as a pilot in 2011, the Warrnambool Roof Harvesting Scheme was initially applied to 250 house lots. The scheme collects and diverts rain water from roofs into an existing untreated water storage where it is then treated to drinking water standard before being used within the City of Warrnambool.

Since its inception, the pilot has been expanded to utilise an additional 580 houses and industrial sheds from a neighbouring business park. Fully developed, it is estimated that the system will capture water from 3,000 homes and contribute 471 million litres of water to Wannon Water's water supply system every year.

The success of this system has been recognised by the Australian Water Association's Victorian Water Awards, where it was a finalist in the 2018 'Infrastructure Project Innovation Award'.

Sub-option: Household roof water

The practice of capturing rainwater from household roofs and collecting in tanks has been broadly applied across Australia. Tanks come in a variety of shapes and sizes and can be placed above or below ground.

The effectiveness of rainwater tanks as a water source is influenced by a number of local factors, including climate, water demand, the rainfall collection area of the roof and the tank size.

At various times in Australia, the application of household rainwater tanks has been supported through rebate programs.

In urban areas where highly quality and reliable mains water is readily available, rainwater tanks are generally installed as an additional supply to mains water for non-drinking purposes, such as garden watering, clothes washing and toilet flushing.

Given the captured rainwater is limited, there are only a small number of urban water uses for the volume it provides. This is even more so the case when rainwater tanks are prioritised for plant watering, as the need for irrigation water decreases during the cooler months.

The utilisation of rainwater tanks for selected household uses comes with a plumbing cost for existing homes. This cost can be significantly reduced for new homes, where the installation of a tank is considered prior to construction.

What our community told us

"Harvest every bit of rainwater possible, starting with suburban houses, shopping centres etc. where there are huge roof areas."

"Encourage residential homes to have their own water tanks collecting water from rainfall."

"Capture roof top rain run-off."

"Houses store water and run-off."

"Encourage rainwater tank use in residential situations."

"Start now by harnessing the rainfall instead of watching it go down the drain".

CASE STUDY: Aquarevo

South East Water Corporation is a key partner in the Aquarevo residential housing development in Lyndhurst to the south east of Melbourne. Households within the development utilise a rain to hot water process to maximise the benefits of roof derived rainwater.

The approach utilises a number of physical barriers and disinfection steps to make water from the rainwater tank available for hot water uses, including showers, washing machines and laundry taps. An important element of this approach is to ensure that the water exceeds a temperature of 60 degrees Celsius, a critical control for some pollutants that can impact human health.

This scheme system is also largely automated, providing the homeowner with an understanding of how water is being used within the home.

8. Roof water

Option 36: Finding more water – Roof water – Household – **Residential rainwater tanks to garden and toilet**

Description: Rainwater tanks progressively fitted to new and existing households to irrigate gardens as well as toilet flushing. This assumes tanks are fitted to 26,000 existing homes with a reduction in demand of approximately 1,400 ML/yr, dependent on uptake.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Benefits all of our region – all residential customers could access the program; water security benefits shared across the region.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills – both capital and ongoing operating costs.
Community & Social Outcomes		
Bill impact - household owner/occupier	$36	
Bill impact - household renter	$12	
Bill impact - small business	$59	
Bill impact - large business	$7,053	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides direct employment benefit – up to 327 full time equivalent positions from capital investment.
Environmental		
Environmental impacts – water	G	Reduces stormwater impacts on downstream waterways.
Environmental impacts – land & biodiversity	G	Limited construction requirements in areas that are already highly disturbed – i.e. urban environments.
Zero net emissions	G	3,000 kWh/ML required to be offset – built into cost of option (since Barwon Water responsible for ongoing operating costs).
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to fill rainwater tanks.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises water that would otherwise be discharged as stormwater into downstream waterways.
Promotes informed water use	G	Greater visibility and engagement of customers with water infrastructure.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	1,400ML/year	
Long-term yield (in 50 years)	1,400ML/year	
Certainty of yield	A	The effectiveness of rainwater tanks is largely dependent on household water use practices, climatic factors and building sizes as well as take up of the technology by households. Under this model it would be supported by the water corporation resulting in high uptake. There is still some uncertainty about how much water saving this would provide.
Scalability	G	Opportunity to stage or increase scale of program over time.
Finance & Economics		
Capex	$176M	
Opex	$893/ML	
Levelised cost	$8,510/ML	

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8. Roof water

Option 37: Finding more water – Roof water – Local – **Roof water harvesting scheme for suburb**

Description: Rainwater collected from the roofs of houses in the Northern and North Western Growth Area (NNWGA) is piped via a dedicated network and pumped to an existing water treatment plant to treat it to potable standard prior to it entering the potable supply network.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system – approach could be applied anywhere.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills – both capital and ongoing operating costs.
Community & Social Outcomes		
Bill impact - household owner/occupier	$10	
Bill impact - household renter	$3	
Bill impact - small business	$17	
Bill impact - large business	$2,019	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides direct employment benefit – up to 95 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Reduces stormwater impacts on downstream waterways.
Environmental impacts – land & biodiversity	G	Limited construction requirements in areas that are already highly disturbed – i.e. urban environments.
Zero net emissions	G	3,000 kWh/ML required to be offset – built into cost of option (since Barwon Water responsible for ongoing operating costs).
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to fill rainwater tanks.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises water that would otherwise be discharged as stormwater into downstream waterways.
Promotes informed water use	G	Greater visibility and engagement of customers with water infrastructure.
Technology, Science & Innovation		
Time required to implement	10–20 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	562 ML/year	
Certainty of yield	G	High certainty of yield – good basis of evidence and a central management model.
Scalability	G	Opportunity to stage or increase scale of program over time.
Finance & Economics		
Capex	$51M	
Opex	$502/ML	
Levelised cost	$9,767/ML	

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Stormwater

Overview

Stormwater is rainwater that runs off roads, buildings and other impervious surfaces. In urban areas, stormwater runs through gutters and into street drains, leading to stormwater drainage systems that discharge to our waterways.

The increased coverage of impervious surfaces means that more water remains above ground than it occurs in undisturbed environments.

Stormwater drainage systems are planned to reduce potential flooding damage by draining water away from properties and important infrastructure such as roads.

Stormwater ultimately ends up in our creeks, rivers, bays and oceans and can impact on the environment depending on the quality and volume of flow of the stormwater. In order to limit these impacts, new building subdivisions within Victoria are required to meet stormwater management objectives in the planning process.

Local councils have responsibility for local stormwater drains, road networks and street and property drainage. Stormwater is not transported in the same pipes as sewage, but if harvested from drains, it can be treated to improve its quality so it is suitable for re-use.

Stormwater harvesting involves collecting, treating, storing and using stormwater run-off from urban areas. It differs from rainwater harvesting as the run-off is collected from drains rather than roofs and needs large storage infrastructure.

Approaches for treating stormwater vary in size. Small raingardens can treat stormwater from a number of car parks, while constructed wetlands are capable of treating and storing stormwater from hectares of urban development. The size and type of the treatment system is largely dictated by local conditions, including size of urban catchment, climatic conditions, the amount of storage space available, grade of space and local water demands.

What our community told us

"Harvest stormwater run-off from streets and buildings."

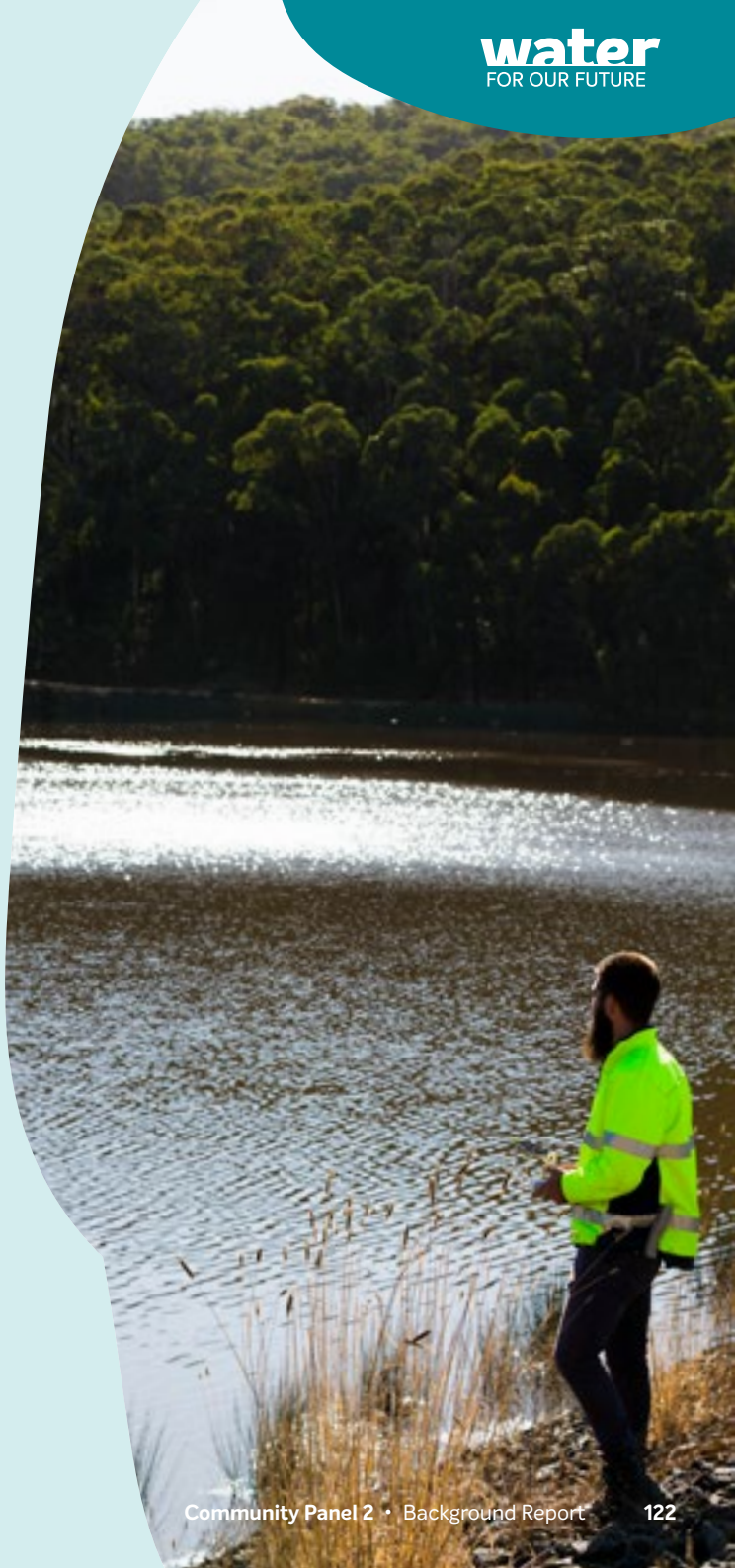
"Harvest all our wasted stormwater in underground tanks."

"We need to re-use and harvest stormwater."

"Stormwater harvesting and re-use can be one of many ways that local communities can contribute to water conservation."

"Stormwater used for open space and public assets."

"How important is stormwater to nourish natural ecosystems suffering from lower rainfall?"



Sub-option: Regional stormwater

While it is far more common to see stormwater harvested and reused at a small local scale, under some conditions it is possible to collect and reuse stormwater from a larger catchment.

A large urban catchment coupled with regular rainfall can provide significant volumes of water close to the point of demand.

The value of a large volume of water may outweigh the additional costs of treating the stormwater that is carrying impurities from the urban environment. The level of treatment required will be driven by the final end use, but it could be used on a large scale in one of two ways.

1. Non-potable use

Similar to recycled water schemes, stormwater could be collected, treated and used for non-drinking purposes such as toilet flushing, garden watering, car washing and industrial applications.

2. Potable use

Stormwater could also be used for drinking purposes. In this case, the harvesting system may consist of a natural treatment system, such as a constructed wetland or raingarden in a treatment train, with a number of other physical, chemical and disinfection steps to ensure the treated water meets drinking water quality guidelines.

CASE STUDY: Orange, New South Wales

In Orange, New South Wales, the city's rainwater was provided by rainwater storages that received runoff from rural areas. Despite this, in 2007 its water storages fell below 40 per cent and it was recognised that they were running out of water to meet current needs, without considering potential growth.

In 2008, level 5 water restrictions were implemented and the council had to do something to provide more water to the city. During this time, it was observed that rainfall on the rural catchments largely failed to feed the supply dams, while rainfall falling on the impervious urban areas ran off into local waterways.

The council worked with the community and stakeholders to implement two stormwater harvesting schemes that directed urban runoff into the city's water supply system. Stormwater was also made available for non-drinking water purposes, including irrigation and toilets through a dual reticulation system that services new residential homes in Northern Orange.

In addition to providing improved stormwater quality outcomes for local waterways, the scheme is capable of delivering up to 2,000 million litres of water per year1, providing 25 per cent of Orange's drinking water supply requirements and replacing 29 per cent of drinking water demands through the dual reticulation substitution.

Sub-option: Local stormwater

With stormwater treatment a planning requirement for new developments, there is an opportunity to combine storage and reuse of stormwater to maximise local benefit. Stormwater harvesting systems can also be retrofitted into existing urban areas where it can be intercepted close to a significant demand.

Typically for a local stormwater harvesting system, water will be directed from roofs, roads, carparks and footpaths via gutters to a constructed wetland or a raingarden system, which are planted with native vegetation. These systems rely on natural processes to slow the flow of the water and collect pollutants. Storage in the form of an open water feature or a tank can be added to these systems to allow storage prior to reuse. For small systems, treated stormwater is used for non-drinking water purposes with the main use being for the irrigation of adjoining parks and open spaces.

In addition to providing reuse water, stormwater harvesting systems can provide landscape, amenity and recreational benefits in urban landscapes.

CASE STUDY: Johnstone Park Raingarden

Located in central Geelong, the Johnstone Park Raingarden harvests, treats and stores stormwater for local irrigation purposes. The landscaped raingarden receives stormwater from neighbouring hard services before being directed through several terraced ponds. Collected stormwater is then stored in a 250,000 litre underground tank. The system has the capacity to meet up to 60 per cent of Johnstone Park's annual irrigation requirements.

CASE STUDY: Royal Park Stormwater Harvesting Scheme

Located four kilometres from Melbourne's centre, the Royal Park Stormwater Harvesting Scheme has been providing reuse water to surrounding areas since it was developed as part of the 2006 Commonwealth Games.

Royal Park consists of 170 hectares of native vegetation, sporting fields and parkland. A five-hectare constructed wetland located at the western end of the park collects stormwater from surrounding suburbs, cleans it and then stores it within the wetland and adjoining below ground tanks prior to being used for irrigation. The constructed wetland also provides a natural habitat for plants and animals.

The system is capable of collecting up to 160 million litres of stormwater per year, equating to approximately 90 per cent of the park's irrigation requirements.

9. Stormwater

Option 38: Finding more water – Stormwater – Local – **Recover stormwater for industrial estate**

Description: Collection of stormwater run-off from industrial estate. Stormwater sediments captured in a stormwater retarding wetland prior to storage in an earthen balancing storage. Captured water then treated at an on-site treatment plant, disinfected and stored in a treated water storage tank. Treated water pumped to a dedicated dual-pipe network within the industrial estate for non-potable purposes. Estimated reduction in demand of 158 ML/yr, dependent on uptake.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system – approach could be applied anywhere.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills – both capital and ongoing operating costs.
Community & Social Outcomes		
Bill impact - household owner/occupier	$2	
Bill impact - household renter	$1	
Bill impact - small business	$3	
Bill impact - large business	$338	
Health benefits	A	Potential health risks around introduction of treated stormwater into dual pipe network – could be readily managed.
Social and recreational benefits	G	Potential recreational benefits – depending on design of stormwater retarding wetland (could include walking trails).
Employment benefits	G	Provides direct employment benefit – up to 15 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Reduces stormwater impacts on downstream waterways – removes pollutants.
Environmental impacts – land & biodiversity	G	Limited construction in areas that are already highly disturbed – i.e. urban environments. Treatment system utilises local vegetation and provides habitat.
Zero net emissions	G	1,200 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to generate stormwater.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises water that would otherwise be discharged as stormwater into downstream waterways.
Promotes informed water use	G	The stormwater collection, treatment and reuse infrastructure will be present in places where people live, work and recreate. This will enhance community understanding of the source of water.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints – stormwater treatment is a requirement in large greenfield areas under current planning provisions.
Near-term yield (in 10 years)	158ML/year	
Long-term yield (in 50 years)	158ML/year	
Certainty of yield	A	Some uncertainty of yield – good evidence base, but uptake and local conditions will be specific to different regions, which may have a small impact on the projected yield.
Scalability	R	Limited ability to scale up – size and effectiveness of the system is limited by local demand and catchment area. No benefit in a staged approach.
Finance & Economics		
Capex	$7.7M	
Opex	$966/ML	
Levelised cost	$3,904/ML	

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9. Stormwater

Option 39: Finding more water – Stormwater – Local – **Divert stormwater to recreational facilities or public open spaces**

Description: Collection of stormwater from localised run-off. Stormwater sediments captured in a stormwater retarding wetland. Once sediments are captured water is then pumped to a water storage tank. Stored water is then pumped to public open spaces for non-potable purposes. Estimated reduction in demand of 60 ML/yr, dependent on uptake.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system – approach could be applied anywhere.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$3	
Bill impact - household renter	$1	
Bill impact - small business	$6	
Bill impact - large business	$656	
Health benefits	G	Direct health benefit – enables public green spaces to be irrigated. Potential health risks around use of treated stormwater for irrigation – could be readily managed.
Social and recreational benefits	G	Direct social/recreational benefit – from access to public green spaces.
Employment benefits	G	Provides direct employment benefit – up to 32 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	G	Reduces stormwater impacts on downstream waterways – removes pollutants.
Environmental impacts – land & biodiversity	G	Limited construction in areas that are already highly disturbed – i.e. urban environments. Treatment system utilises local vegetation and provides habitat.
Zero net emissions	G	1,200 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to generate stormwater.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises water that would otherwise be discharged as stormwater into downstream waterways.
Promotes informed water use	G	The stormwater collection, treatment and reuse infrastructure will be present in places where people live, work and recreate. This will enhance community understanding of the source of water.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	G	No regulatory, legislative or policy constraints – stormwater treatment is a requirement in large greenfield areas under current planning provisions.
Near-term yield (in 10 years)	60ML/year	
Long-term yield (in 50 years)	60ML/year	
Certainty of yield	A	Some uncertainty of yield – good evidence base, but uptake and local conditions will be specific to different regions, which may have a small impact on the projected yield.
Scalability	R	Limited ability to scale up – size and effectiveness of the system is limited by local demand and catchment area. No benefit in a staged approach.
Finance & Economics		
Capex	$17M	
Opex	$632/ML	
Levelised cost	$17,600/ML	

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9. Stormwater

Option 40: Finding more water – Stormwater – Regional – **Corio Bay dam**

Description: Stormwater from the Geelong's urban catchments is collected in existing stormwater drains and directed to a marine reservoir located in Corio Bay. It is then stored, treated to drinking water quality and distributed to customers via the existing water supply infrastructure.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$unknown	The preliminary nature of this option means that cost impacts are not well understood.
Bill impact - household renter	$unknown	The preliminary nature of this option means that cost impacts are not well understood.
Bill impact - small business	$unknown	The preliminary nature of this option means that cost impacts are not well understood.
Bill impact - large business	$unknown	The preliminary nature of this option means that cost impacts are not well understood.
Health benefits	A	Potential health risks around introduction of treated stormwater into drinking water supply – could be readily managed.
Social and recreational benefits	R	No known social/recreational benefit – could potentially limit recreational activities in Corio Bay.
Employment benefits	A	Potentially provides employment benefit – unknown at time of assessment.
Environmental		
Environmental impacts – water	A	Reduces stormwater impacts on downstream waterways – removes pollutants. Some construction impacts on marine environment required to be managed.
Environmental impacts – land & biodiversity	A	Limited construction in areas that are already highly disturbed – i.e. urban environments. Some construction impacts on coastal environment required to be managed.
Zero net emissions	G	The preliminary nature of this option means that the energy requirements are not well understood. Any impacts will be offset to ensure a net zero energy impact. .
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to generate stormwater.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises water that would otherwise be discharged as stormwater into downstream waterways.
Promotes informed water use	G	The stormwater collection, treatment and reuse infrastructure will be present in places where people live, work and recreate. This will enhance community understanding of the source of water.
Technology, Science & Innovation		
Time required to implement	10-20 years	
Regulatory, legislative or policy constraints	R	Significant regulatory and policy constraints – construction in a highly urbanised area, with shipping traffic and coastal sensitivities would require a significant number of approvals, current State regulations and policy do not contemplate this option.
Near-term yield (in 10 years)	Unknown	The preliminary nature of this option means that the yield benefits are not well understood.
Long-term yield (in 50 years)	Unknown	The preliminary nature of this option means that the yield benefits are not well understood.
Certainty of yield	R	Low certainty of yield – option is highly speculative, whilst the yield is based on reasonable assumptions additional work would be required to understand with certainty.
Scalability	R	Localised option – unable to be scaled or staged.
Finance & Economics		
Capex	$unknown	The preliminary nature of this option means that cost impacts are not well understood.
Opex	$unknown	The preliminary nature of this option means that cost impacts are not well understood.
Levelised cost	$unknown	The preliminary nature of this option means that cost impacts are not well understood.

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9. Stormwater

Option 41: Finding more water – Stormwater – Regional – **Stormwater to Wurdee Boluc Reservoir**

Description: Treated stormwater is harvested from 37 wetlands in the Northern and Western Geelong Growth areas and pumped to a 150 ML open storage and then on to the existing Wurdee Boluc water supply reservoir via a 30 km long major transfer main. Estimated increase in supply of 5,300 ML/yr.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$73	
Bill impact - household renter	$23	
Bill impact - small business	$119	
Bill impact - large business	$14,136	
Health benefits	A	Potential health risks around introduction of treated stormwater into drinking water supply – could be readily managed. Potential indirect health benefit – urban cooling effect of wetland areas.
Social and recreational benefits	G	Direct social/recreational benefit – community/recreational uses of wetland areas.
Employment benefits	G	Provides direct employment benefit – up to 650 full time positions from capital investment
Environmental		
Environmental impacts – water	G	Reduces stormwater impacts on downstream waterways – removes pollutants.
Environmental impacts – land & biodiversity	G	Limited construction in areas that are already highly disturbed – i.e. urban environments.
Zero net emissions	G	900 kWh/ML required to be offset - built into cost of option
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to generate stormwater.
Sustainability		
Ability to enable the sustainable use or reuse of resources	G	Utilises water that would otherwise be discharged as stormwater into downstream waterways.
Promotes informed water use	G	The stormwater collection and treatment system will be present in places where people live, work and recreate. This will enhance community understanding of the source of water.
Technology, Science & Innovation		
Time required to implement	10–20 years	
Regulatory, legislative or policy constraints	A	Some regulatory and policy constraints – environmental and health approval processes to ensure drinking water quality would need to be adhered to.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	5,300 ML/year	
Certainty of yield	A	Some uncertainty of yield – good evidence base but highly dependent on rainfall.
Scalability	A	Some opportunity to scale up over time.
Finance & Economics		
Capex	$350M	
Opex	$537/ML	
Levelised cost	$9,194/ML	

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Rivers

Overview

Rivers are relied upon for water supply world-wide in areas where rainfall is reliable. The most significant drinking water source across Victoria comes from rivers. In the Barwon region, water is sourced from rivers and reservoirs across seven different catchment areas.

Rivers are diverted and water is stored in a dam, weir or constructed water basin before it is treated and transferred by pipeline into a reticulated water system. In most cases, some water is required to continue to pass along the river, downstream of the dam, weir or basin, to ensure water is available downstream to support the environment and provide for other users of the river water.

However, relying on rivers for water supply irrevocably changes the natural flow regime in rivers and so, can have significant negative impacts on the environment.

The construction of new water supply dams is not permitted under current policy frameworks in Victoria.

What our community told us

"Plan to collect and store water during times of high rainfall by building more dams in the region."

"Just build dams to secure our water future."

"I would like to see more dams and storage facilities built to accommodate heavy rainfalls."

"We need to harvest the rain when it comes so build another dam."

"Keep it simple. Harvest rain and excess water from rivers. We will continue to have rain and floods."

"It is important to share water with the environment."

"Provision of water for the health of waterways and wetlands should not be compromised to provide water for human consumption."

"Rivers are already so stressed; we don't need to take any more – we should be trying to increase environmental flow."

"Build new dams to increase capacity for supply and storage – tried and tested approach – could use for renewable energy, too."

"Robbing Peter to pay Paul" – not actually creating any new water, taking it from somewhere / someone else – e.g. the environment."

Sub-option: New dams

Dams store river water so it can be used when it is needed, rather than being pumped directly from the natural supply of a river to meet demand.

In particular, during dry periods, there may be less water available than what is necessary. Dams can be used to help build up a reserve of water during wet years, for use during dry periods when rainfall and river flows are low.

A dam is a wall that holds back water to form a basin, lake or reservoir. Dams are typically made of earth, rock or concrete and they can be privately owned, owned by a business or owned by a government agency. Some of their uses include storing water for drinking, industry or farming, protecting property from flooding or facilitating recreational activities.

Building a new dam is a delicate process which must involve significant planning and assessment of the potential impacts on people and the environment. Depending on their location, new dams can help to provide increased water security and improved flood protection.

However, there are major environmental impacts associated with dams. There is both a reduction in the volume of river flows and a change in the seasonality of river flows downstream of a dam. This can reduce the connectivity between sections of a river and interrupt life cycle processes of aquatic life by obstructing aquatic animal movement, affect the health of aquatic plants and animals, alter natural sediment and seed dispersal processes, and affect water quality downstream.

In addition, most of the rivers in our region are already fully allocated across consumptive, environmental, recreational and other purposes. Using more water from rivers for urban consumption takes it away from other users. New dams do not create more water, they just hold it in a different part of the landscape for different uses. This can have significant negative implications for other users in systems.

CASE STUDY: Thomson Dam

The Thomson Dam – delivered in July 1984 – is the most recent major dam constructed in Victoria. The dam is located in the West Gippsland region about 130 km east of Melbourne, along the Thomson River.

The capacity of the reservoir held behind the dam is approximately 1,068 billion litres, and it makes up 60 per cent of Melbourne's total storage capacity. The objective of the dam construction was to improve the security of Melbourne's water supply by boosting water reserves in wet years for use in dry years. This objective was tested during the Millennium Drought when the reservoir was depleted from almost full in 1996 to 16 per cent in 2006–2007. Thomson Dam has not been full since 1996.

Factors that influenced the decision to go ahead with a new dam included the need for an additional source of water supply, high water quality upstream of the dam, elevation sufficient to provide water via gravity flow, and large flows upstream of the dam.

The Thomson Dam is currently owned by Melbourne Water and provides water for the Thomson River, agriculture, and hydroelectric generation in addition to its role in supplying water to Melbourne residents and businesses.

Sub-option: Upgrade existing dams

Upgrades of existing dams are often necessary for safety reasons but do not always involve increasing the dam capacity. However, when the objective is to improve water security for a community, upgrades can involve increasing the height or volume of the dam.

One benefit of upgrading an existing dam is that a large section of the infrastructure is already in place. However, it is important to assess the strength and stability of the dam to make sure it can support the added water volume.

An important consideration when deciding the feasibility of a dam upgrade is understanding whether the water downstream will have enough flow, and whether the water from upstream will be enough to fill the upgraded dam.

For example, Environmental FLOWS studies completed by the Corangamite Catchment Management Authority have found that there is insufficient natural flow and environmental water to achieve all the recommended watering actions for the Barwon and Moorabool rivers[28]. Upgrading existing dams on these rivers would further reduce natural flows.

Safety is also a critical consideration, and there are guidelines published by ANCOLD (Australian National Committee on Large Dams) that outline the process for undertaking a dam upgrade to ensure the safety of people in the area and mitigate the risk of loss of life[29]. These guidelines address aspects such as drainage requirements, strength requirements, spillway requirements, and even road access requirements. A spillway is an area designed to receive excess water from a dam to prevent flooding in sensitive areas.

28 CCMA 2020, Upper Barwon River, https://ccma.vic.gov.au/what-we-do/waterway-management/water-for-the-environment/upper-barwon-river/ and Moorabool River https://ccma.vic.gov.au/what-we-do/waterway-management/water-for-the-environment/moorabool-river/ Accessed 21 December.

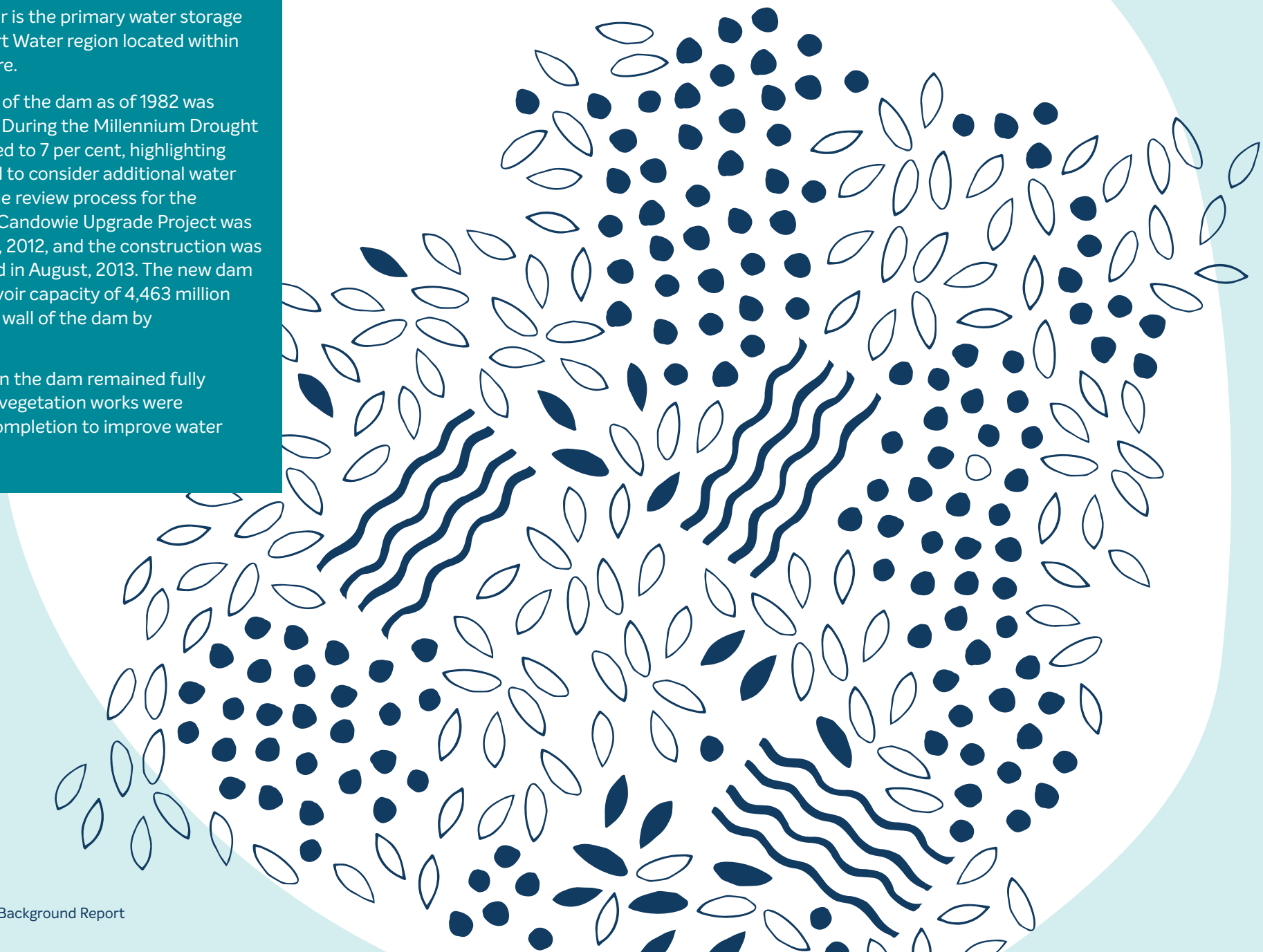
29 https://www.ancold.org.au/?product=construction-flood-risk-strategies-for-dam-upgrades

CASE STUDY: Candowie Reservoir upgrade

Candowie Reservoir is the primary water storage for the Westernport Water region located within the Bass Coast Shire.

The initial capacity of the dam as of 1982 was 2,263 million litres. During the Millennium Drought water levels dropped to 7 per cent, highlighting an immediate need to consider additional water storage options. The review process for the business case of a Candowie Upgrade Project was approved in March, 2012, and the construction was officially completed in August, 2013. The new dam allowed for a reservoir capacity of 4,463 million litres by raising the wall of the dam by three metres.

During construction the dam remained fully operational, and revegetation works were undertaken post completion to improve water quality inflows.



Sub-option: More water out of existing rivers

Water can be harvested from rivers via pipes, channels or other means of excavation and transportation. These are collectively referred to as river diversions. Along rivers with existing diversions there are two ways to extract water – by building new diversion infrastructure, or by upgrading/increasing the yield of existing infrastructure.

One of the benefits of extracting more water from a river via existing diversion infrastructure is it will not further alter the course of the river. The main concern is the capability of the river system to cope with the increased water stress, and the flow on effects that will occur downstream.

In instances where a new diversion must be created, information about the impacts to the area need to be understood. Rivers that already have diversions along their path will have undergone previous evaluation based on prior entitlement commitments, and both the increase in water stress and new flow path impacts, must be considered.

Sub-option: New river diversions

Rivers are formed over very long periods of time and they tend to follow the cracks and folds in the natural landscape from high to low elevations. Although populations will generally settle along waterways for convenience, there are times when the required water cannot be sourced locally. One solution to this problem is identifying rivers that are further away and diverting a portion of their flows towards the areas in need of more water.

Unregulated rivers will need to have enough information gathered to meet regulations and ensure the environment can cope with the effects of the diversion.

Another aspect of new river diversion is the lack of existing infrastructure. This can lead to more flexibility however is also more expensive to construct.

CASE STUDY: Goulburn River

New diversions from natural river systems have occurred since the early settlement of Australia, as rivers with reliable flows were often the first point of settlement. As such, there remain few examples of such diversions in recent history.

For example, diversion of the Goulburn River occurred between 1887 and early 1891 through the construction of the Goulburn Weir. It was the first major diversion structure built for irrigation development in Australia and also forms Lake Nagambie. The weir allows water to be diverted by gravity via the Stuart Murray Canal and Cattanach Canal for off-river storage in the Waranga basin, for later use in irrigation.

The weir is 209 metres long and about 16 metres high. The structure also contained one of the first hydro-electric turbines in the southern hemisphere, used to supply power for lifting and lighting. After more than 90 years of continuous service, many of the weir's components were in urgent need of replacement and stabilisation works were done in 1983 and in 1987. Approval for this diversion required the establishment of its own act in parliament, titled "The River Goulburn Weir Act 1886".

10. Rivers

Option 42: Finding more water – Rivers – More water out of existing rivers – **West Gellibrand Reservoir to West Barwon Reservoir via Olangolah tunnel**

Description: Excess water from West Gellibrand and Olangolah Reservoirs is diverted via tunnels to the upper catchment of West Barwon Reservoir. Only water that flows over the spillways at each reservoir is diverted. Diverted water is stored at West Barwon Reservoir for transfer to Wurdee Boluc Reservoir and treated to drinking water standard at Wurdee Boluc Water Treatment Plant. Water stored at West Barwon could also be used to supply Colac. Estimated increase to supply of 7,200 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local Gellibrand community likely to have concerns about potential environmental impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$24	
Bill impact - household renter	$8	
Bill impact - small business	$38	
Bill impact - large business	$4,568	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	G	Provides direct employment benefit – up to 197 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	R	Reduces the volume of water flowing down river systems at a point high in the catchment.
Environmental impacts – land & biodiversity	R	Considerable construction works in environmentally sensitive areas including access and tunnelling requirements.
Zero net emissions	G	Low or no energy option utilising gravity flow and solar powered operation.
Rainfall dependency	R	Highly dependent on rainfall – relies on heavy rainfall to generate high river flows.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	A	Some regulatory, legislative and policy constraints – requires planning, environmental and cultural heritage approval processes.
Near-term yield (in 10 years)	7,200 ML/year	
Long-term yield (in 50 years)	7,200 ML/year	
Certainty of yield	A	Some uncertainty of yield – good evidence base but highly dependent on rainfall.
Scalability	R	Limited scalability. There is little flexibility in sizing and staging.
Finance & Economics		
Capex	$106M	Construction costs only - does not include cost to ameliorate environmental, social or cultural impacts
Opex	$250/ML	
Levelised cost	$1,101/ML	

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10. Rivers

Option 43: Finding more water – Rivers – More water out of existing rivers – **Colac Pipeline to Wurdee Boluc Inlet Channel via Barwon-Colac Transfer Main**

Description: Transfer water from the upper Gellibrand water supply system to the Wurdee Boluc Inlet Channel using the existing Colac Pipeline. This would only occur at times when it is not required for supply of Colac.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local Gellibrand community likely to have concerns about potential environmental impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$1	
Bill impact - household renter	$0	
Bill impact - small business	$1	
Bill impact - large business	$111	
Health benefits	A	No known health benefit.
Social and recreational benefits	R	No known social/recreational benefit, potential negative social/recreational impact for the West Gellibrand River and Olangolah Creek.
Employment benefits	A	Provides direct employment benefit – up to 2 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	A	Utilising additional water at a high point in the catchment, water only taken during high flow events.
Environmental impacts – land & biodiversity	A	New pipeline construction will occur in largely disturbed land. There may be some limited works in areas consisting of existing native vegetation.
Zero net emissions	G	Low energy demand as water can be transferred via gravity.
Rainfall dependency	R	Highly dependent on rainfall – relies on heavy rainfall to generate high river flows.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	R	Significant regulatory, legislative and policy constraints – requires approval of a new bulk entitlement and planning, environmental and cultural heritage approval processes.
Near-term yield (in 10 years)	1,200 ML/year	
Long-term yield (in 50 years)	1,200 ML/year	
Certainty of yield	A	Some uncertainty of yield – good evidence base but approval of new bulk entitlement may not be forthcoming and highly dependent on rainfall.
Scalability	R	Limited flexibility for scaling. Construction would occur once at the maximum capacity.
Finance & Economics		
Capex	$0.5	Construction costs only - does not include cost to ameliorate environmental, social or cultural impacts
Opex	$250/ML	
Levelised cost	$274/ML	

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10. Rivers

Option 44: Finding more water – Rivers – More water out of existing rivers – **Barwon River weir and pump station at Winchelsea**

Description: A weir and pump station would be constructed on the Barwon River near Winchelsea to divert water to Wurdee Boluc Reservoir. Water would only be diverted during high flow or flood events in the Barwon River. Water would then be treated to drinking water standard prior to entering the potable supply network.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local Winchelsea community likely to have concerns about potential environmental impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$5	
Bill impact - household renter	$2	
Bill impact - small business	$9	
Bill impact - large business	$1,026	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	Potential social/recreational benefit upstream of weir (picnic area next to weir dam) and potential negative social/recreational impact downstream of the weir (river activities).
Employment benefits	G	Provides direct employment benefit – up to 35 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	A	Diverts water during times of high flow, reducing the net environmental impact on the downstream environment.
Environmental impacts – land & biodiversity	A	Limited construction activity in an already disturbed environment.
Zero net emissions	G	300 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	R	Highly dependent on rainfall – relies on heavy rainfall to generate high river flows.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	3-5 years	
Regulatory, legislative or policy constraints	R	Significant regulatory, legislative and policy constraints – requires approval of a new bulk entitlement and planning, environmental and cultural heritage approval processes.
Near-term yield (in 10 years)	3,000 ML/year	
Long-term yield (in 50 years)	3,000 ML/year	
Certainty of yield	R	Low certainty of yield – approval of new bulk entitlement unlikely to be forthcoming, given Barwon River already flow stressed, also highly dependent on rainfall.
Scalability	R	Limited flexibility for scaling. Construction would occur once at the maximum capacity.
Finance & Economics		
Capex	$19M	Construction costs only - does not include cost to ameliorate environmental, social or cultural impacts
Opex	$334/ML	
Levelised cost	$700/ML	

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10. Rivers

Option 45: Finding more water – Rivers – New dam – **Small dam behind Barwon weirs (Callahan, Dewings etc)**

Description: A small dam to be built on the south branch of Callahan's Creek (a tributary of the Barwon River). Callahan's Creek has an existing diversion weir that can transfer up to 100 ML/d to the Wurdee Boluc Inlet Channel. The dam would capture any high creek flows and store the water until creek flows reduce enough to allow the stored water to be released to the existing diversion weir. The stored water would then be diverted into the existing Callahan's Channel, continuing to Wurdee Boluc Reservoir via the Wurdee Boluc Inlet Channel. Estimated increase to supply of 1,500 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local community likely to have concerns about potential environmental impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$8	
Bill impact - household renter	$3	
Bill impact - small business	$14	
Bill impact - large business	$1,631	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	Potential social/recreational benefit upstream of dam wall (picnic area, walking trails around dam) and potential negative social/recreational benefit downstream of dam (river activities).
Employment benefits	G	Provides direct employment benefit – up to 74 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	R	Collection of water high in the catchment which reduces downstream flows.
Environmental impacts – land & biodiversity	R	Considerable construction in a sensitive environment.
Zero net emissions	G	Low energy demand as water can be transferred via gravity.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to generate runoff to dam.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	10-20 years	
Regulatory, legislative or policy constraints	R	Significant regulatory, legislative and policy constraints – requires approval of a new bulk entitlement and planning, environmental and cultural heritage approval processes.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	1,500 ML/year	
Certainty of yield	R	Low certainty of yield – approval of new bulk entitlement unlikely to be forthcoming, given Barwon River already flow stressed, also highly dependent on rainfall.
Scalability	R	Limited flexibility for scaling. Construction would occur once at the maximum capacity.
Finance & Economics		
Capex	$40M	Construction costs only - does not include cost to ameliorate environmental, social or cultural impacts
Opex	$250/ML	
Levelised cost	$1,792/ML	

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10. Rivers

Option 46: Finding more water – Rivers – New dam – **Lardner Creek dam with pipeline to Wurdee Boluc Inlet Channel**

Description: A 22,000 ML dam on Lardner's Creek (downstream of the East & West branches); the water is pumped to the West Barwon Reservoir upper catchment as required. The water stored in the West Barwon Reservoir would be released into the Wurdee Boluc Inlet Channel to Wurdee Boluc Reservoir for treatment to drinking water standard prior to distribution to the Greater Geelong region. Estimated increase to supply of 8,976 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local community likely to have concerns about potential environmental impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$48	
Bill impact - household renter	$15	
Bill impact - small business	$78	
Bill impact - large business	$9,288	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	Potential social/recreational benefit upstream of dam wall (picnic area, walking trails around dam) and potential negative social/recreational benefit downstream of dam (river activities).
Employment benefits	G	Provides direct employment benefit – up to 306 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	R	Reduces the volume of water flowing down river systems at a point high in the catchment.
Environmental impacts – land & biodiversity	R	Considerable construction works in environmentally sensitive areas.
Zero net emissions	G	1,011 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to generate runoff to dam.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	10-20 years	
Regulatory, legislative or policy constraints	R	Significant regulatory, legislative and policy constraints – requires approval of a new bulk entitlement and planning, environmental and cultural heritage approval processes.
Near-term yield (in 10 years)	0 ML/year	
Long-term yield (in 50 years)	8,976 ML/year	
Certainty of yield	A	Some uncertainty of yield - a new bulk entitlement is required to pursue this option, which may not be forthcoming due to competing needs, also highly dependent on rainfall.
Scalability	R	Limited flexibility for scaling. Construction would occur once at the maximum capacity.
Finance & Economics		
Capex	$204M	Construction costs only - does not include cost to ameliorate environmental, social or cultural impacts
Opex	$567/ML	
Levelised cost	$1,594/ML	

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10. Rivers

Option 47: Finding more water – Rivers – New rivers/diversions – **Coastal river diversion to Barwon System**

Description: A diversion weir would be constructed on a south-flowing coastal river (Kennett River used as the example here). A tunnel from the diversion weir would transfer water to the upper catchment of the West Barwon Reservoir for storage. Water released into the Wurdee Boluc Inlet Channel as required to Wurdee Boluc Reservoir for treatment to drinking standard water. Estimated increase to supply of 1,800 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local coastal community likely to have concerns about potential environmental impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$17	
Bill impact - household renter	$6	
Bill impact - small business	$29	
Bill impact - large business	$3,397	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	Potential social/recreational benefit upstream of dam wall (picnic area, walking trails around dam) and potential negative social/recreational benefit downstream of dam (river activities).
Employment benefits	G	Provides direct employment benefit – up to 160 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	R	Reduces the volume of water flowing down river sensitive river systems.
Environmental impacts – land & biodiversity	R	Considerable construction works in environmentally sensitive areas.
Zero net emissions	G	Low energy demand as water can be transferred via gravity.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to generate runoff and river flow to weir.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	R	Significant regulatory, legislative and policy constraints – requires approval of a new bulk entitlement and planning, environmental and cultural heritage approval processes in a sensitive coastal environment.
Near-term yield (in 10 years)	1,800 ML/year	
Long-term yield (in 50 years)	1,800 ML/year	
Certainty of yield	A	Some uncertainty of yield – approval of new bulk entitlement may not be forthcoming and highly dependent on rainfall.
Scalability	R	Limited flexibility for scaling. Construction would occur once at the maximum capacity.
Finance & Economics		
Capex	$86M	Construction costs only - does not include cost to ameliorate environmental, social or cultural impacts
Opex	$250/ML	
Levelised cost	$3,142/ML	

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10. Rivers

Option 48: Finding more water – Rivers – Upgrade existing dams – **West Gellibrand enlargement and diversion**

Description: Enlargement of West Gellibrand Reservoir by 5,000 ML, increasing capacity from 1,800 ML to 6,800 M. Diversion tunnel constructed from West Gellibrand to transfer additional stored water to West Barwon Reservoir to supply Geelong. Remainder of storage water retained for Colac supply system. Estimated increase to supply of 4,500 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local Gellibrand community likely to have concerns about potential environmental impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$30	
Bill impact - household renter	$10	
Bill impact - small business	$49	
Bill impact - large business	$5,878	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	Potential social/recreational benefit associated with West Barwon (picnic area, walking trails around dam) and potential detrimental social/recreational impact. downstream of West Gellibrand dam (river activities).
Employment benefits	G	Provides direct employment benefit – up to 271 full time equivalent positions from capital investment
Environmental		
Environmental impacts – water	R	Reduces the volume of water flowing down river systems at a point high in the catchment.
Environmental impacts – land & biodiversity	A	Considerable construction works in environmentally sensitive areas that has experienced previous disturbance.
Zero net emissions	G	Low energy demand as water can be transferred via gravity.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall to generate runoff to dam.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	A	Some regulatory, legislative and policy constraints – requires planning, environmental and cultural heritage approval processes.
Near-term yield (in 10 years)	4,500 ML/year	
Long-term yield (in 50 years)	4,500 ML/year	
Certainty of yield	A	Some uncertainty of yield – good evidence base but highly dependent on rainfall.
Scalability	R	Limited scalability. There is little flexibility in sizing and staging.
Finance & Economics		
Capex	$146M	Construction costs only - does not include cost to ameliorate environmental, social or cultural impacts
Opex	$250/ML	
Levelised cost	$2,126/ML	

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Buy from willing sellers

Overview

Water trading allows users to move water in connected systems to where it is most needed. This provides greater flexibility in balancing water supply and demand.

Water markets have operated in Victoria since 1991, with trading rules evolving as markets have expanded. The overarching objective of water trading is to ensure improved environmental and economic conditions by allowing water to be allocated to the use where it will be most highly valued.

Many of Victoria's water systems are already connected through a network of rivers, channels, pipes and storages. Projects undertaken during the Millennium Drought – for example, the Goldfields Superpipe and Melbourne Geelong Pipeline – further linked water systems across Victoria through the construction of connections and pipelines, creating Victoria's water grid.

Victoria's water grid works much like our road network, connecting sources such as dams, reservoirs and the desalination plant via infrastructure, including pipes and pumps and natural elements like rivers. If a business or water corporation is connected to Victoria's water grid, they can purchase water from willing sellers on the water market. This enables buyers and sellers to manage their water needs and financial outcomes in the best way for them.

Like any marketplace, there are rules to ensure water is traded fairly. Buying water from willing sellers requires arrangements that all parties understand. Transactions also need to be consistent with government policy.

Trades occur via the Victorian Water Register, which records all water-related entitlements, including any trades. Market participants include water corporations, the Victorian and Commonwealth Environmental Water Holders, irrigators, and commercial and industrial users of water, all of whom can buy and sell entitlements and allocations on a permanent or temporary basis.

Most water trade occurs in northern Victoria, where large volumes of water and many buyers and sellers mean there are the right conditions for a functional market. In 2018–19, a total of 2,813,000 million litres of water was traded in northern Victoria. By comparison, a total of 30,500 million litres of water was traded in southern Victoria in 2018–19[30].

30 DELWP 2019, Victorian Water Trading: 2018–19 Annual Report, https://waterregister.vic.gov.au/images/documents/Victorian-Water-Trading-Annual-Report_2018-19-.pdf Accessed 21 December.

What the community told us

"[Water] is a public asset and should never be put into the hands of private investors who will make water scarce and expensive."

"Farmers access to water is a priority to ensure we can provide enough produce to feed our country and should not be a commodity that is sold off to overseas investors."

"Use the pipe from Eildon. Don't discharge excessive flows during summer, regardless of the excuse."

"Support for an independent system to move water around when we need it – a functional water grid like the electricity grid."

"If the water is available elsewhere, and we desperately need it, we should look to buy it and bring it in as an option."

"Water trade not very secure – within Victoria, if our region is dry others likely to be as well, also if our region is growing and needs more water others likely to be as well."

"Water should not be a commercially tradable commodity."

Sub-option: Buy water from other Water Corporations

Victoria has 19 water corporations that provide a range of water-related services to customers and communities across the state. Each water corporation services a different geographic region.

Victoria's water grid means that the four metropolitan water corporations – Melbourne Water, City West Water, South East Water and Yarra Valley Water – are now connected to each other and to surrounding regional water corporations, like Barwon Water.

Trading water between urban water corporations is enabled under current legislative frameworks in Victoria. However, these trades are relatively infrequent and generally involve small volumes of water.

Sub-option: Buy water from rural users

Increased water efficiency and changing agricultural practices is altering the way we use water on farms. Simple practices such as the conversion of open and unlined channels to closed pipes can provide significant water savings, freeing up water to be put to other uses.

If desirable for both buyers and sellers, water can be transferred from one user to another, with the financial benefits being provided to the seller. Water can be traded on a temporary or a permanent basis.

The sale of water also needs to be supported by appropriate infrastructure to ensure that the water can be physically transferred from the seller to buyer.

Trading water from rural users to urban communities in southern Victoria is not permitted under current policy frameworks in Victoria.

CASE STUDY: The Goldfields Superpipe

The Goldfields Superpipe was constructed in 2008. It enables water to be transferred from the Goulburn system to Bendigo and Ballarat.

Overseen and managed by a joint venture between Coliban Water and Central Highlands Water, it was essential for ensuring Bendigo did not run dry in 2009.

Costing $290 million, the project required around 147 km of pipeline, five major pumping stations and an upgrade to an existing pumping station. It can supply 150 million litres per day to Bendigo, and 55 million litres per day on to Ballarat[31].

The Goldfields Superpipe minimises the risk of drought for Bendigo and Ballarat by providing the communities with ability to access water when they need it.

31 PBJ & Associates, Goldfields Superpipe

11. Buy water from willing sellers

Option 49: Finding more water – Buy water from willing sellers – **Purchase water from Northern Victoria, trade by substitution with Central Highlands Water**

Description: This option is achieved through water purchase and substitution – Barwon Water purchases water from the Ballarat Super Pipe and transfers to White Swan Reservoir for Central Highlands Water; Central Highlands Water substitutes the water Barwon Water has purchased with their water entitlement from Lal Lal Reservoir resulting in an increase to Barwon Waters allocation in Lal Lal reservoir (ML for ML trade arrangement). Estimated increase to supply of 5,000 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	R	Local northern Victoria community likely to have concerns about potential social equity impacts, water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$5	
Bill impact - household renter	$2	
Bill impact - small business	$8	
Bill impact - large business	$954	
Health benefits	A	No known health benefit.
Social and recreational benefits	R	Potential social risks associated with trading water from rural users to urban communities in southern Victoria.
Employment benefits	R	Provides no direct employment benefit.
Environmental		
Environmental impacts – water	G	Potential environmental benefit through increased flows in Moorabool River – water released from Lal Lal Reservoir delivers environmental benefits en-route for consumptive use.
Environmental impacts – land & biodiversity	G	No further disturbance – relies on existing infrastructure.
Zero net emissions	G	245 kWh/ML required to be offset – built into cost of option.
Rainfall dependency	R	Highly dependent on rainfall – relies on rainfall for water to be available for trade in northern Victoria.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of a resource.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	R	Significant policy constraints – not consistent with State Government policy.
Near-term yield (in 10 years)	5,000 ML/year	
Long-term yield (in 50 years)	5,000 ML/year	
Certainty of yield	R	Low certainty of yield – concept is well understood but highly dependent on rainfall and requires negotiations with other parties.
Scalability	R	Localised option – unable to be scaled or staged.
Finance & Economics		
Capex	$0.2M	Does not include any headworks contribution to the Ballarat Superpipe infrastructure that may be payable.
Opex	$619/ML	
Levelised cost	$621/ML	

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11. Buy water from willing sellers

Option 50: Finding more water – Buy water from willing sellers – **Purchase unutilised water from existing allocations from the Victorian Desalination Plant at Wonthaggi**

Description: Purchase existing unutilised water allocations from the Victorian Desalination Plant – i.e. purchase other Water Corporations allocations. Estimated increase to supply of 1,000 ML/yr but will largely be dependent on climate as to the availability and willingness to sell allocations.

*This option was recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report."*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Melbourne and Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	$6	
Bill impact - household renter	$2	
Bill impact - small business	$10	
Bill impact - large business	$1,221	
Health benefits	A	No known health benefit.
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	R	Provides no direct employment benefit.
Environmental		
Environmental impacts – water	A	Brine discharge to high mixing zone: 60 ML/Day means impacts will not be significant, salt going back to where it came from with high dilution rate
Environmental impacts – land & biodiversity	G	No further disturbance – relies on existing infrastructure.
Zero net emissions	G	6,400 kWh/ML required to be offset - built into cost of option
Rainfall dependency	G	Technology is climate independent – not dependent on rainfall.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the sustainable use or reuse of a resource.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	1-2 years	
Regulatory, legislative or policy constraints	G	No regulatory or legislative constraints beyond existing water trading rules.
Near-term yield (in 10 years)	1,000 ML/year	
Long-term yield (in 50 years)	1,000 ML/year	
Certainty of yield	A	Proven technology – but negotiation required with other parties to guarantee supply.
Scalability	R	Localised option – unable to be scaled or staged.
Finance & Economics		
Capex	$0	
Opex	$3,995/ML	
Levelised cost	$3,660/ML	

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Other options

Other options

Overview

Of the more than 600 ideas we heard, some did not fit neatly under the 11 major themes outlined on the previous pages.

Many of these ideas rely on emerging or unproven technology and, while we've done our best to assess them against the criteria, there are some information gaps that we were unable to fill.

12. Others

Option 51: Finding more water – Other – **Tow ice bergs from Antarctica to Corio Bay**

Description: Identified as large sources of freshwater, the concept of towing icebergs to water scarce regions originated in the 1950s. While it has received international interest, financial and technological limitations have obstructed attempts to utilise this resource, but with increased demand and reduced supply there are stronger incentives to realise this water supply option. The concept is reliant on the isolation and transport of an iceberg to a populous region where it can then be utilised as a water supply. The ice resource associated with the Australian Antarctic Territory is approximately 2,825 km from the south-west coast of Australia. Estimated increase to supply is in the order of 3,500 ML/yr.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Bill impact - household renter	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Bill impact - small business	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Bill impact - large business	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Health benefits	A	No known health benefit
Social and recreational benefits	A	No known social/recreational benefit – could potentially limit recreational activities in Corio Bay
Employment benefits	A	Potentially provides employment benefit – unknown at time of assessment.
Environmental		
Environmental impacts – water	R	Relies on utilisation of a new freshwater source.
Environmental impacts – land & biodiversity	R	Removal of ice may have biodiversity impacts.
Zero net emissions	G	Energy impacts associated with towing and pumping water into storages. Difficult to quantify at this point but assumed offset.
Rainfall dependency	A	Not dependent on rainfall, but long term sustainability of this option will be influenced by the future climate.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable or promote the long term sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	>10 years	>10 years required to implement. This is assumed to be largely due to regulatory requirements and approvals.
Regulatory, legislative or policy constraints	R	Significant regulatory, legislative or policy constraints – current State regulations and policy do not contemplate this option, assume National and International laws and approvals processes must also be met.
Near-term yield (in 10 years)	Unknown	The preliminary nature of this option means that the yield benefits are not well understood – could be in the order of 3,500 ML/year.
Long-term yield (in 50 years)	Unknown	The preliminary nature of this option means that the yield benefits are not well understood – could be in the order of 3,500 ML/year.
Certainty of yield	R	Low certainty of yield – option is highly speculative,
Scalability	R	The scalability of this option remains unknown.
Finance & Economics		
Capex	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Opex	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Levelised cost	Unknown	The preliminary nature of this option means that cost impacts are not well understood.

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12. Others

Option 52: Finding more water – Other – **Cloud seeding**

Description: Using the practice of cloud seeding in catchment areas to promote increased rainfall for water supply purpose. Cloud seeding is the practice of intentionally adding aerosols (e.g., silver iodide, common salt) or even ice itself (or dry ice) with the intent of changing the development of a cloud and is often undertaken by air seeding (flying a plane through the cloud) or ground based (using projectiles). Estimated increase to supply is unknown.

*This option was not recommended by Water for our Future Community Panel. Visit **www.barwonwater.vic.gov.au/future** to read the panel's report.*

Social Impact & Equity		
Extent of shared social benefits/costs	G	Water security benefits shared across Greater Geelong water supply system.
Extent of private investment required	G	No private investment required by customers, cost of option would be passed on via Barwon Water bills.
Community & Social Outcomes		
Bill impact - household owner/occupier	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Bill impact - household renter	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Bill impact - small business	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Bill impact - large business	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Health benefits	R	No known health benefit – potential health risk from long-term exposure from resulting rainfall
Social and recreational benefits	A	No known social/recreational benefit.
Employment benefits	A	Potentially provides employment benefit – unknown at time of assessment.
Environmental		
Environmental impacts – water	R	Impact on freshwater resources remains unknown. Therefore, the precautionary principle is applied.
Environmental impacts – land & biodiversity	R	Impact on land and biodiversity remains unknown. Therefore, the precautionary principle is applied.
Zero net emissions	G	Greenhouse gas emissions associated with the option are assumed to be offset.
Rainfall dependency	R	Reliance of cloud seeding on natural climatic systems in our region is not well understood.
Sustainability		
Ability to enable the sustainable use or reuse of resources	R	Does not enable the long sustainable use or reuse of resources.
Promotes informed water use	R	Water would be delivered to and used by customers in the same way as now.
Technology, Science & Innovation		
Time required to implement	5-10 years	
Regulatory, legislative or policy constraints	R	Regulatory, legislative or policy constraints remain unknown.
Near-term yield (in 10 years)	Unknown	The preliminary nature of this option means that the yield benefits are not well understood.
Long-term yield (in 50 years)	Unknown	The preliminary nature of this option means that the yield benefits are not well understood.
Certainty of yield	R	Low certainty of yield – option is highly speculative,
Scalability	R	The scalability of this option remains unknown.
Finance & Economics		
Capex	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Opex	Unknown	The preliminary nature of this option means that cost impacts are not well understood.
Levelised cost	Unknown	The preliminary nature of this option means that cost impacts are not well understood.

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What happens next?

What happens next?

In an uncertain future, it is important that we make the right decisions at the right time.

And, as the events of the last twelve months attest, not all of our future challenges can be predicted.

The recommendations of the *Water for our Future* Community Panel will help to shape our 2022 Urban Water Strategy – our 50-year plan for ensuring a sustainable, affordable and reliable water future for our community and environment.

Our 2022 Urban Water Strategy will adopt an adaptive planning framework to ensure we are prepared to act decisively when conditions require. This will be underpinned by detailed modelling of a wide range of future scenarios, which help us understand potential consequences.

The community will be invited to review and provide feedback on our draft 2022 Urban Water Strategy in mid-September 2021.

We will also bring the *Water for our Future* Community Panel back together in December 2021 to consider all views from the wider engagement and the draft 2022 Urban Water Strategy and make recommendations based on their review (Panel #3).

We will consider their feedback and use it to develop our final 2022 Urban Water Strategy, which will clearly say what work needs to be done to secure our region's water future.

These actions will be reflected in the development of our 2023 Price Submission – our process for determining what our customers pay for water across a five year period.

Every year, we will provide updates on the status of actions, progress and the work to be done for the following 12 months. Every five years, we will review and update our Urban Water Strategy to ensure it continues to meet the needs of our region

water
FOR OUR FUTURE