CRC for
Water Sensitive Cities

INFFEWS Benefit Cost Analysis Tool: Booklet of applied examples

Prepared by E2Designlab for the CRC for Water Sensitive Cities

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Contents

Introduction

What is the INFFEWS Benefit Cost Analysis Tool?

The INFFEWS Benefit Cost Analysis Tool (the 'BCA Tool') is an Excel-based framework that allows the user to develop a benefit cost analysis (BCA). It was developed in response to industry feedback highlighting that developing a holistic business case is an important factor in delivering water sensitive investments. Accordingly, the BCA Tool is tailored specifically to assessing investments for water sensitive cities. Its contents, framework and assumptions are based on sound economics and the tool is fully consistent with guidelines prepared by Australian state and national governments.

How was the tool developed?

The BCA Tool was developed by the CRC for Water Sensitive Cities (CRCWSC) as part of the Integrated Research Project 2 (IRP2) research program. The IRP2 program's aim was to develop and apply an economic evaluation framework to identify and quantify economic, environmental and community values of investments in water sensitive practices and systems. The program seeks to support users in business case development and decision making at multiple levels in public and private sector organisations.

What is the INFFEWS package?

The BCA Tool is part of a broader package of economic tools and resources, known as INFFEWS (Investment Framework For Economics of Water Sensitive Cities), developed by the IRP2 program. The INFFEWS package also includes the Non-market Value Tool—a key complementary tool to the BCA Tool—and a range of supporting guidance and resources.

What is the Non-market Value Tool?

The other important component of INFFEWS—the Non-market Value Tool (the 'Value Tool')—provides information about monetary-equivalent values of non-financial benefits generated by investments in water sensitive cities. The Value Tool is a comprehensive database of existing non-market values of water sensitive systems and practices that can be used to underpin various benefit transfer methods. The Value Tool is a useful complement to the BCA Tool, because it provides reference data that allow a user to identify possible monetary values for various common benefits of water sensitive projects. It is a custom-built Excel-based database using over 2000 non-market benefit values from Australian studies, arranged for easy and efficient access. The IRP2 program consulted widely with industry partners and non-market value experts on the design and functionality of this database, to ensure its easy maintenance into the future.

What other BCA Tool guidelines and resources are available?

Accompanying the BCA Tool is a set of guidelines and resources for users. This set is available with the INFFEWS package on the CRCWSC website:

1. **Benefit cost analysis and strategic decision making** (PDF document) – This resource covers BCA basics, guidance on strategic issues related to BCAs, and using economic information, including BCAs, in strategic decision making.
2. **Rough BCA Tool guidelines** (Word document) and spreadsheet (Excel) – This document is for a 'rough' BCA, and responds to the need for a very simple tool that captures the essence of BCA. It's also a useful first step towards conducting a full BCA.

3. **BCA Tool guidelines** (PDF document) – This resource explains the structure and elements of the BCA Tool, information requirements and judgements needed to apply the tool, and suggested strategies for obtaining data for different parts of the tool.
4. **BCA Tool user guide** (PDF document) – This document gives the step-by-step process for entering the required information into the BCA Tool, and includes a template for capturing the qualitative aspects of that information.
5. **BCA comparison tool** (Excel) – This resource makes it easy to compare the results from BCAs for multiple projects or different versions of the same project.
6. **BCA Tool training resources** – Presentation slides used at the BCA training sessions. Videos on the basic economics background required to conduct a BCA.
7. **Video guidance** – Links to help videos are provided within the tool.

What is this booklet about?

Some industry partners tested a beta version of the BCA Tool in 2018 before the tool was released for general use in early 2019. The CRCWSC has delivered training courses across Australia to give practitioners an overview of the tool and how it can be used. This booklet demonstrates how the tool can be used, by showcasing a series of case study applications from practitioners who have already put the tool to use.

The booklet has two parts:

- *The importance of a BCA*, which is an overview of why and how a benefit cost analysis can support the delivery of water sensitive investments
- *Applied examples*, which covers three case studies showing how the tool has been applied and how the users found the experience. The case studies are for:
    1. Taralla Creek naturalisation and wetland creation
    2. Oaklands Wetland and stormwater harvesting
    3. Passively irrigated trees for new suburbs in Ballarat.

Who is this booklet for?

The CRCWSC developed the BCA Tool with three different groups of users in mind:

- **Experienced economists** – For this group, the aim is to provide a standard BCA Tool that is flexible, convenient and easy to use. The tool should foster good BCA practice and enhance the comparability of different BCAs.
- **Non-economists who are trained** – For this group, the aim is to put BCA within the hands of sufficiently trained users who lack a previous background in economics. The tool should help them prepare effective business cases to be developed for water sensitive investments and avoid common errors and overcome challenges.
- **Managers who wish to understand BCA better** – For this group, the aim is for them to become well informed and effective purchasers of BCA services.

This booklet was developed for these potential user groups, to give insight into how others have used the tool, their experience using the tool, and the results and outputs of the tool.

The importance of a BCA

Business cases are an important decision making tool. They help in transparently assessing options, to give stakeholders confidence when investing. A common component of a business case is the BCA, because it measures the benefits against the costs to determine whether a project is worthwhile.

Water sensitive investments typically result in vegetated built assets (otherwise known as green infrastructure), which deliver a wider range of environmental and social values than traditional water infrastructure, such as underground pipes and industrial buildings, might. The CRCWSC's partners, including state government agencies, local governments and water utilities, saw that having a greater capacity for economic analysis that recognises these broader benefits was a high priority for developing effective business cases for water sensitive investments.

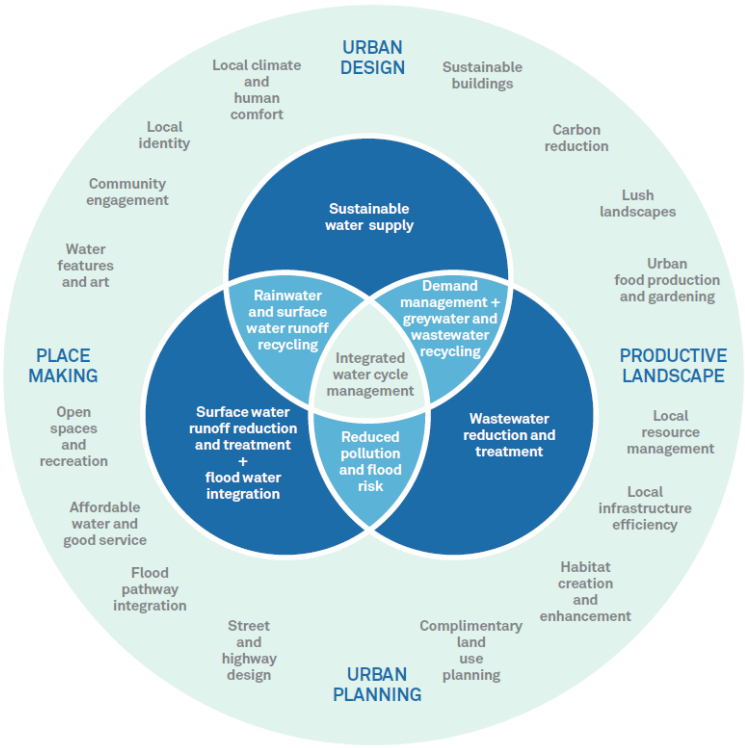

Figure 1: The broad reach of integrated water management with urban design and placemaking

BCA and integrated water management and shared investments

Integrated water management typically involves multiple stakeholders and beneficiaries, including local government, state government, developers, landowners, water utilities, waterway managers, and the broader community. These stakeholders and beneficiaries are likely to have differing priorities and expectations for water sensitive projects, and therefore it is important to develop an early understanding of the proposed water sensitive investment and to explore the roles and responsibilities of each organisation in delivering and managing the investment.

A BCA can be a useful tool in this process. By allocating costs and benefits to different stakeholders in the analysis, it is possible to produce a benefit cost ratio for each organisation. Also, by understanding the relative distribution of costs and benefits, a BCA can become a platform for funding contribution discussions and a clear structure for partnerships and co-investments.

Example of stakeholders who may accrue costs or benefits

Proposal: A stormwater harvesting system from a wetland in a new subdivision

Possible contributors to costs:

- A developer may construct a water sensitive urban design (WSUD) asset such as a wetland as part of their requirements to manage stormwater quality.
- A local council may contribute funds for a localised storage to harness treated stormwater for irrigation of nearby public spaces.
- A local water utility may invest in stormwater harvesting as part of its commitments to reduce potable water demands and to invest in alternative water sources.
- A waterway manager may contribute to harvesting, recognising the benefits that removal of stormwater may have on a sensitive downstream environment.
- A local council or waterway manager may adopt the asset from the developer and become responsible for ongoing maintenance costs.

Possible recipients of benefits:

- A waterway manager may benefit from additional removal of pollutants in stormwater, and possibly from the removal of erosive flows.
- A local council, with responsibility for local stormwater management, may benefit from enhanced stormwater management, contributing to their targets for pollution reduction.
- A local council may benefit from alternative water supplies to public open space, resulting in a direct financial benefit from potable water savings and a contribution towards the council's target for alternative water supply delivery and reduction in potable consumption. Alternative supplies may also safeguard against the impacts of water restrictions in times of drought.
- A water utility may benefit from the delivery of alternative water supplies in their service area, reducing pressures on bulk potable supplies, and from delivery of broader services supporting liveability.
- A developer and landowners may benefit from elevated property prices or quicker sales as a result of enhanced green spaces.
- The local community may benefit from the creation of a local wetland and enhanced green spaces, via improved health, access to recreation and improved amenity.
- The broader community may benefit from healthier ecosystems and waterways.

BCA and non-market values

Water sensitive investments will commonly generate environmental and social benefits, to which it's challenging to assign a monetary value. This is because these broader benefits, unlike commodities such as energy and water, are not traded in markets and their economic value (how much people would be willing to pay for them) is not revealed in market prices. But, undoubtedly, society values these non-market benefits, such as clean air, healthy waterways, and happier, healthier people. Excluding these benefits in a BCA can lead to poor decision making outcomes that don't reflect a community's priorities and needs.

The challenge for a comprehensive BCA is to evaluate these non-market values in a credible manner. Economists typically use non-market valuation methods to address this challenge. These valuation methods generally fall into one of two categories:

- **revealed preference methods** – undertaking studies to observe purchasing decisions and other behaviour to estimate non-market values. For example, the:
    - *travel-cost method* uses recreation expenditure and travel time to impute the value people place on visiting a specific site (such as a national park)
    - *hedonic pricing method* attempts to isolate the influence of non-market attributes (such as proximity to parks) on the price of goods (such as houses)
- **stated preference methods** – surveying communities to determine their 'willingness to pay', or the dollar amount they would theoretically contribute, for certain benefits to be delivered, which gives an indication of their monetary value.[1]

Accessing the non-market values from previous studies of other relevant water sensitive investments, to inform BCAs where these analyses are not undertaken, uses a process known as 'benefit transfer'. But benefit transfer must be used responsibility, with care to ensure there is a high degree of similarity between the 'study' and 'policy' contexts (in terms of the environmental features, policy outcomes and population characteristics) of the reference study and the project proposal. The Value Tool is designed to support using benefit transfer to evaluate non-market benefits in a BCA. It is a collated database of non-market valuation studies relevant to water sensitive investments.

The BCA Tool and water sensitive investments

The basic role of a BCA is to compare the benefits of a project or policy with its costs, to assess whether it is worthwhile. It can make the decision making process a structured and systematic one, leading project stakeholders through key steps to define the project, identify project options, identify information requirements and gaps, and undertake the BCA assessment.

The BCA Tool supports stakeholders in applying a BCA for water sensitive investments and allows them to incorporate many non-market social and environmental values in monetary-equivalent terms. It also identifies different stakeholders in terms of who pays and who benefits, to support decisions around shared investments.

Note: While a BCA is an important input for water sensitive investment decision making, it is not a substitute for decision making. It can help make transparent use of the best available data and test the sensitivity of the results to different assumptions. In some circumstances, decision makers may want to consider factors that are not captured in the BCA. In these circumstances, their ranking of projects may be a little different from the ranking implied by the BCA but ideally the reasons for this difference should be transparent.

[1] Baker, R. & Ruting, B. (2014). 'Environmental policy analysis: a guide to non-market valuation'. In *Productivity Commission Staff Working Paper*. Canberra, ACT: Productivity Commission.

Applied examples

Taralla Creek naturalisation and wetland creation

Case study categories

Solutions	Benefits	Enabling structures
Creek naturalisation	Amenity and urban greening	Business case
Stormwater harvesting	Ecological health	
	Alternative water resources	

INSIGHT

This project used the BCA Tool to understand how benefits and costs were distributed to different stakeholders, helping to support investment decisions and collaboration.

PROJECT DESCRIPTION

The BCA Tool[2] was applied to the Taralla Creek Project in Victoria. The project is a proposal to convert a section of Taralla Creek, which is currently a combination of concrete-lined channel and grassed channel, into a naturalised waterway while also enhancing adjacent natural habitat and open space. The project also uses constructed wetland areas to treat stormwater and harvest some stormwater for irrigation of adjacent open space.

Figure 2: Taralla Creek location and proposals

[2] The analysis was originally completed in 2018 with a beta version of the BCA Tool and the accompanying 2018 version of the Value Tool. The BCA Tool was subsequently updated to the March 2019 version.

THE DRIVERS

Why did the project use the BCA Tool?

The project group became aware of the BCA Tool at the point where the design and evaluation process for the Taralla Creek project were completed, and the stakeholder group was beginning to consider how the project could be delivered, including possible funding sources and contributions from various stakeholders. The project group felt the BCA Tool may help them better understand the range of project benefits and how these benefits align with stakeholder objectives.

'We were aware that the project was potentially delivering a while range of benefits, but these wider benefits weren't getting as much attention as waterway health. By broadening the assessment, we could demonstrate the wider benefits to council and the community.' Rita Chandra, Yarra Valley Water

THE OUTCOMES

Benefit cost ratio: The analysis demonstrated an overall benefit cost ratio of 1.30, meaning the estimated benefits outweighed the expected costs (see 'Business case' section for more details).

What the results did for the project

The analysis results gave stakeholders confidence the project is worth pursuing further. The project benefits that the tool evaluated are now summarised and with the stakeholder group, and they will use them in discussions around joint funding and project delivery.

'It's great that the tool is able to show benefit and costs to multiple partners. This means that stakeholders can go back with a tailored pitch to their organisation.' Rita Chandra, Yarra Valley Water

BUSINESS CASE

Total benefits (net present value)	$20,264,000
Total costs (net present value)	$15,607,000
Benefit cost ratio	1.30 (min: 0.49; max: 2.53)

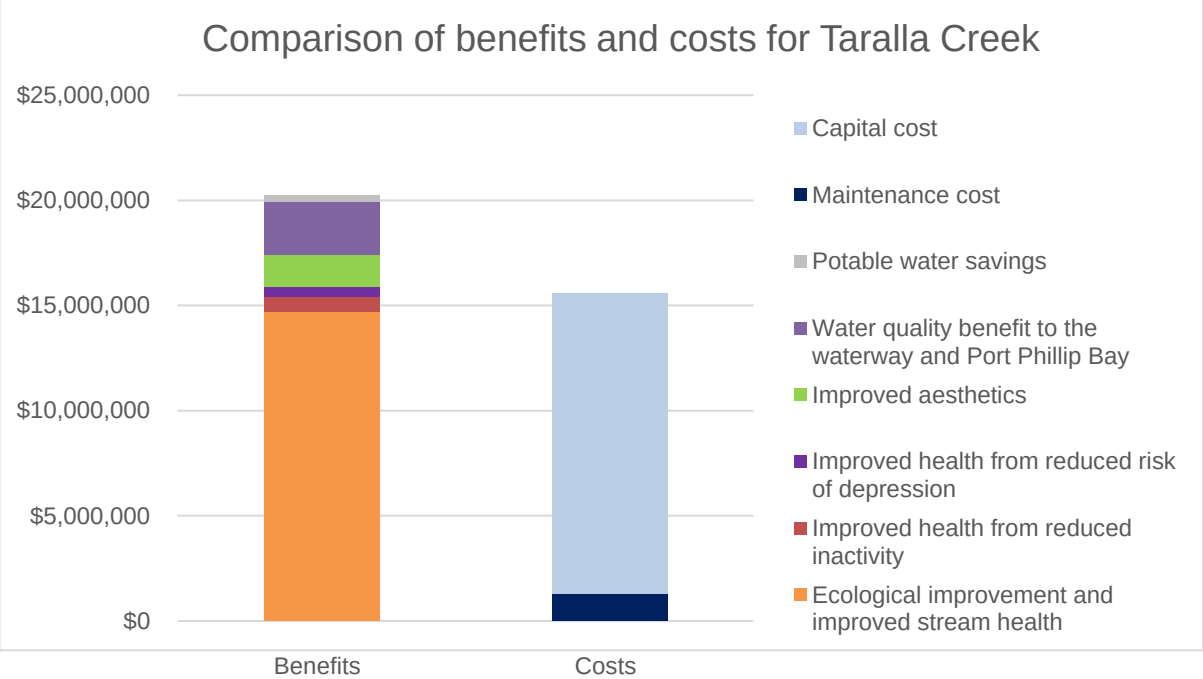

Figure 3: Comparison of benefits and costs for Taralla Creek

Summary of benefits

Six benefits were identified in the analysis, and all of these were monetised using direct economic benefits or value transfer from reference studies.

Benefit	Benefit value used	Multiplier for project	Value source
Ecological improvement and improved stream health	Willingness to pay value of $37 per person for ecological improvement	The project team determined 32,000 people in the catchment will benefit from ecological improvement.	INFFEWS Non-market Value Tool
Improved health from reduced inactivity	Change in disease burden as a result of activity benefits to healthcare costs equating to $49.57 per person	The project team determined 1,181 people in the immediate vicinity could benefit from improved mental health.	'Quantifying liveability health benefits of water industry investments in Integrated Water Management', prepared by Frontier Economics for WSAA
Improved health from reduced risk of depression	Reduced healthcare costs and improved productivity benefits equating to $124.28 per person	The project team determined 295 people in the immediate vicinity could benefit from improved mental health.	'Quantifying liveability health benefits of water industry investments in Integrated Water Management', prepared

			by Frontier Economics for WSAA
Improved aesthetics	Uplift in property value due to proximity to a wetland. The user sourced a value of a 0.14% uplift in the value of nearby properties	1,886 properties were deemed to be in close enough proximity to benefit from the project. The median property price in the area was $770,000.	The wetlands value function within the Value Tool which derives property value uplifts based on distance to a wetland. Data for the function is sourced from Pandit et al. (2014)[3]
Water quality benefit to the waterway and Port Phillip Bay	$6,645/kg N (per kilogram of annual total nitrogen load). This value is capitalised (a one-off benefit recognised in the first year the stormwater treatment occurs)	The works will reduce nitrogen loads to the environment by 504.71kg per year.	Water quality offset value based on the cost of construction of urban wetlands in Melbourne to reduce pollution by the same amount. Sourced from Melbourne Water
Potable water savings	$2529/ML. This was used as an annual benefit, accrued every year from when the scheme becomes operational for the lifetime of the analysis.	Stormwater harvesting will reduce potable water consumption by 11.97ML per year.	Long run marginal cost (LRMC) of potable water supply in Melbourne. Sourced from Melbourne Water

Summary of costs

A concept design report, including an estimate of costs, was developed for the project proposal and these costs were used for the analysis. The total cost estimates were:

- capital cost: $15,265,000
- operating cost: $101,000 per year.

Analysis parameters

A BCA was conducted using the BCA Tool, with the following key parameters in place:

[3] Pandit, R., Polyakov, M. & Sadler, R. (2014). 'Valuing public and private urban tree canopy cover'. In *Australian Journal of Agricultural and Resource Economics*, 58(3), pp. 453–70.

Key parameters	Value
Discount rate	6.7%
Length of analysis	40 years
Adoption	N/A – No private adoption required (all investments are made by infrastructure managers)
Project risk	LOW – 6–25% of project failure

Sensitivity testing

The project used the sensitivity analysis within the BCA Tool to examine the impact on the overall result of changing key assumptions. This analysis determined there was an overall probability of 0.7 that the benefit cost ratio would be greater than 1.

THE LESSONS

Who used the BCA Tool?

Rita Chandra from Yarra Valley Water, a water corporation responsible for water supply and wastewater management in Melbourne's north east, used the tool. Rita has used several cost benefit tools before, including tools developed by the Victoria State Government and Yarra Valley Water. Rita has a background in integrated water management and describes herself as familiar but not expert in BCA, with no specific economics training.

What was the user's experience of the tool?

Rita found the tool intuitive and relatively easy to use compared with other tools she had experienced. The Excel base for the tool is familiar, and the locked cells make clear what the user must input. Rita found she needed to consult the guidance to fully understand how to use the tool, and she found the online videos connected to each section very helpful for understanding each specific section of the tool.

In Rita's experience, the greatest advantage of the tool is the simple way it breaks down the process and the transparency this provides, which allows stakeholders to openly discuss assumptions and see the impact of these assumptions. For the Taralla Creek project, the project group workshopped all key assumptions and the benefit values used.

'It's one of the better benefit cost analysis tools I've used. The biggest advantage is that it clearly steps through the process you need to go through and facilitates discussion at key points.' Rita Chandra, Yarra Valley Water

Rita also found the tool's adoption and project risk sections useful, since these show the inherent variability in the benefit cost and emphasise that the benefit cost ratio shouldn't be viewed as an absolute or static number. Rita also found the Value Tool very useful for sourcing data and references for benefits that were more difficult to quantify. Since the Value Tool is set up as a simple filtered database, Rita found it easy to filter by benefit or subject matter to find relevant material, but she said it's the user's responsibility to check the referenced source to make sure it is relevant and transferable.

Rita found the tool's reporting format to be its weakest element. The version of the tool used by Rita grouped benefits into categories rather than reporting the individual benefits. The tool has now been updated to report on individual benefits.

TRANSFERABILITY

This case study used benefit values transferred from Australian studies that are likely to also apply to creek restoration projects elsewhere. The water quality benefits (measured by kilogram of nitrogen removed) and the potable water savings were evaluated using values specific to Melbourne, and these will need to be tailored to the local context. The aesthetic value is also locally specific and depends on the wetland size, the median house price in the area, and the distance from properties to the wetland. This value can be calculated within the Value Tool.

PROJECT COLLABORATORS

- Yarra Valley Water – the water retailer responsible for water supply and wastewater services
- Melbourne Water – the waterways and major drainage manager
- Maroondah City Council – the local drainage and open space manager

MORE INFORMATION

https://yoursay.melbournewater.com.au/reimagining-tarralla-creek/design-proposals

Oaklands Wetland and stormwater harvesting

Case study categories

Solutions	Benefits	Enabling structures
Water sensitive parks and open spaces Stormwater harvesting	Amenity and urban greening Ecological health Alternative water resources	Business case (to be added)

INSIGHT

This project used the BCA Tool to recognise a range of benefits that a landmark project had delivered to the community.

PROJECT DESCRIPTION

The BCA Tool[4] was applied to the Oaklands Wetland and stormwater harvesting project in South Australia. The project has transformed a disused former driver education centre site into a beautiful new habitat where people can appreciate the year-round open water and connect directly with nature. The Oaklands Wetland and the adjacent Oaklands Estate Reserve now form one of the City of Marion's most highly valued recreational and biodiverse destinations. The local community and visitors can walk or run along the paths, relax with a picnic, have a barbecue, watch the birds or explore the wetland.

The 12-hectare wetland is part of an integrated water recycling system helping to keep reserves green across the City of Marion, reducing the use of mains water, and protecting natural groundwater reserves. A small portion of the water flowing in the adjacent Sturt River is diverted into the wetland, where natural processes clean it. Cleaned water is injected into the deep aquifer under the wetland for storage over winter. In summer, the stored, treated water is pumped out to irrigate 30 council reserves through a dedicated underground pipe network.

[4] The analysis was originally completed in 2018 with a beta version of the BCA Tool and the accompanying 2018 version of the Value Tool. The BCA Tool was subsequently updated to the March 2019 version.

Figure 4: Oaklands Wetland
(Photo source: M Mullan)

THE DRIVERS

Why did the project use the BCA Tool?

Seeing the release of the BCA Tool, Water Sensitive SA was eager to determine how it could be applied to projects in South Australia, what outputs it offers, and how it compares to other tools available. Natural Resources Adelaide had been trialling another benefit cost analysis tool for WSUD and was interested in seeing how the BCA Tool compared.

Oaklands Park Wetland and stormwater harvesting scheme was selected as a test case project for the tool, because it was operational and well-studied (and therefore the costs and benefits were quite certain), and it was a relatively large-scale project where distinct benefits had been achieved. Stakeholders had anecdotal evidence from local community members that the project had made a real difference, and they wanted to use the tool to capture the broad range of benefits.

'We had a good feeling about the community benefits that had been delivered through amenity and improvement of the quality of open space. A neighbour of the site told our team that prior to the improvements, when the site was derelict, she would call the police at least once a week due to anti-social behaviour. Now that the parkland has been delivered, she hardly needs to call. It's an example of urban greening making a real impact.' Mellissa Bradley, Water Sensitive SA

THE OUTCOMES

Benefit cost ratio: The analysis demonstrated an overall benefit cost ratio of 1.96 meaning the estimated benefits outweigh the expected costs (see 'Business case' section for more details).

What the results did for the project

Water Sensitive SA used the BCA Tool as a test case, to demonstrate how a business case analysis can evaluate a range of benefits. At the time of writing, the example had not yet been distributed to industry.

BUSINESS CASE

Total benefits (net present value)	$27,465,354
Total costs (net present value)	$12,302,000
Benefit cost ratio	2.23 (min: 0.84; max: 4.18)

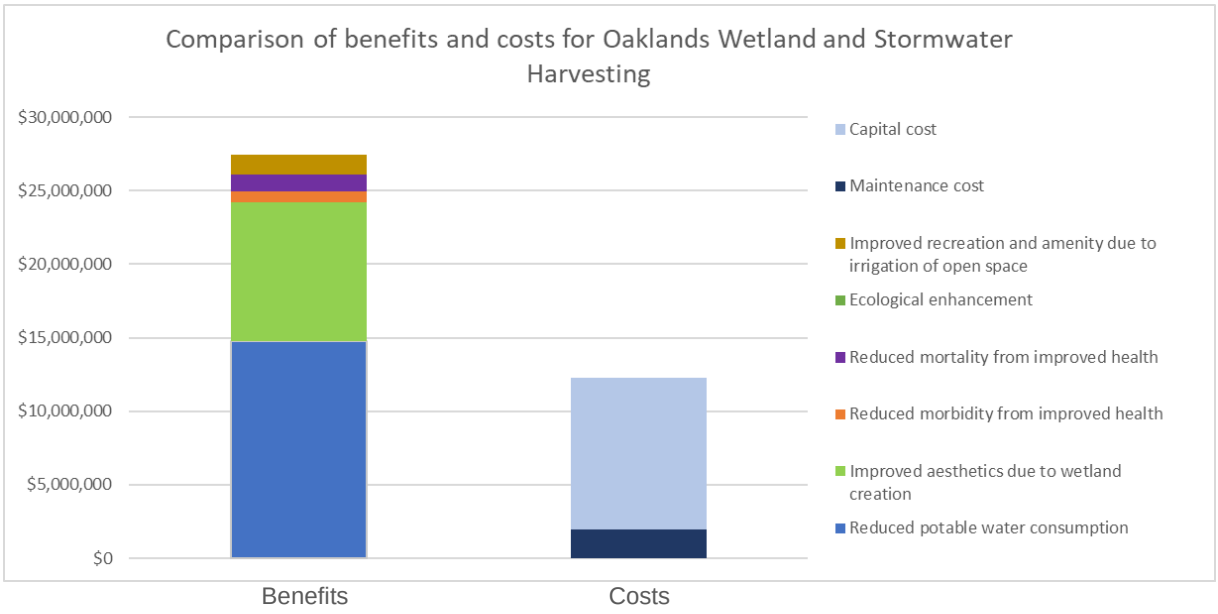

Figure 5: Comparison of benefits and costs for Oaklands Wetland and stormwater harvesting

Summary of benefits

The analysis identified 11 benefits, six of which were monetised using direct economic benefits or value transfer from reference studies.

Benefit	Benefit value used	Multiplier for project	Value source
Reduced potable water consumption	City of Marion saved $300,000 on water costs in 2018. This equates to 82,147kL of potable water saved per year.	This was used as a direct monetary saving that was accrued to council as a benefit in the analysis.	City of Marion records
Improved aesthetics	Uplift in property value due to proximity to a wetland. The user sourced a value of a 2.31% uplift in the value of nearby properties (within an average distance of 225m). The wetland covers 12 hectares.	870 properties were deemed to be within 450m of the wetland and receiving benefit from its proximity. The median property price in the area was $514,000.	The wetlands value function within the Value Tool which derives property value uplifts based on distance to a wetland. Data for the function sourced from Pandit et al. (2014)[5]
Increased CO_2 sequestration		The new wetland will sequester carbon emissions. This was not monetised in the analysis.	
Reduced morbidity from improved health	Estimate of reduced healthcare costs for the local population due to increased physical activity equating to $9.85 per year per person	A local population of 1,590 people above the age of 18 living within 450 metres of the wetland	Reduction in health costs estimated using the WSAA[6] tool
Reduced mortality from improved health	Reduced mortality was evaluated based on the decrease in likelihood of death due to improved physical activity, and this was equated using the value of a life. The user calculated this to be equivalent to a $15 per year benefit per person in the local area.	A local population of 1,590 people above the age of 18 living within 450 metres of the wetland	Reduction in deaths equated using the ABS value of a life, using the WSAA[7] tool
Reduced crime due to increased community cohesion		This benefit was not monetised in the analysis because a suitable reference couldn't be found to evaluate the benefit in monetary terms. But there is	

[5] Pandit, R., Polyakov, M. & Sadler, R. (2014). 'Valuing public and private urban tree canopy cover'. In *Australian Journal of Agricultural and Resource Economics*, 58(3), pp. 453–70.

[6] Frontier Economics. (2019). *Quantifying the liveability health benefits of water industry investments in integrated water management*. Melbourne, Vic: Water Services Association of Australia.

[7] Frontier Economics. (2019). *Quantifying the liveability health benefits of water industry investments in integrated water management*. Melbourne, Vic: Water Services Association of Australia.

		anecdotal evidence from a neighbour that police call-outs for anti-social behaviour at the site have significantly reduced, bringing considerable benefit to the community.	
Ecological enhancement	Willingness to pay of $4.57 per person (one-off payment) for ecological improvement	A local population of 2,036 people within 450m of the wetland	Sourced from the Value Tool
Improved recreation and amenity due to irrigation of open space	Willingness to pay of $58.26 per person (per year) for irrigation of parks year round and in drought using harvesting stormwater	A local population of 2,036 people within 450 metres of the wetland	Sourced from the Value Tool[8]
Increased tourism and visitation to the area		This benefit was not monetised in the analysis.	
Improved water quality in waterways and receiving environments		This benefit was not monetised in the analysis.	
Groundwater recharge (via aquifer storage and recovery)		This benefit was not monetised in the analysis.	

Summary of costs

City of Marion provided the actual costs of the project:

- capital cost: $9,600,000
- operating cost: $140,000 per year.

Analysis parameters

A BCA was conducted using the BCA Tool, with the following key parameters in place:

Key parameters	Value
Discount rate	6.7%
Length of analysis	30 years
Adoption	N/A – no private adoption needed
Project risk	0% risk of project failure, since project has been delivered

[8] Brent, D.A., Gangadharan, L., Lassiter, A., Leroux, A. & Raschky, P.A. (2017). 'Valuing environmental services provided by local stormwater management'. In *Water Resources Research* (53), pp. 4907–4921.

THE LESSONS

Who used the BCA Tool?

Anastasia Martinez used the tool on behalf of Water Sensitive SA. She used cost data provided by City of Marion, the local council who delivered the project, and evaluated some benefits using data from the Value Tool and other benefits using data from a cost benefit tool developed by the SA Government for WSUD projects. Anastasia has a research background in ecological economics, but she does not have specific expertise in economics relating to integrated water management.

What was the user's experience of the tool?

Anastasia worked through the tool using its accompanying guide. She noted it would have been easier had she attended a training session before using the tool.

'The tool seemed overwhelming at first, but once I read through the guide it made a lot of sense. The embedded videos within each section of the tool really helped.' Anastasia Martinez

In Anastasia's experience, the greatest advantage of the tool is the ability to integrate a wide range of benefits that the user can define and reference from various external sources. Anastasia was comparing the tool to another tool being used within SA State Government to evaluate WSUD projects. This other tool included only five pre-set benefits, which was limiting for some projects, and as such Anastasia found the BCA Tool very flexible. But she recommended that users apply the tool primarily to large-scale projects because a lot of detail and effort go into completing the analysis. For small-scale projects, a higher level, less detailed, analysis may be more appropriate.

TRANSFERABILITY

This case study used benefit values transferred from Australian studies that are likely to also apply to wetland and stormwater harvesting projects elsewhere. But all sources should be checked for relevance and tailored to the project using project performance data (e.g. local population, wetland area etc.). The potable water savings are specific to this case study and based on SA Water rates.

PROJECT COLLABORATORS

- City of Marion – the local drainage and open space manager
- Natural Resources Adelaide and Mt Lofty Ranges: - the state government organisation responsible for managing of natural resources.
- Water Sensitive SA

MORE INFORMATION

https://www.marion.sa.gov.au/things-to-do/wetlands/oaklands-wetland

https://www.naturalresources.sa.gov.au/adelaidemtloftyranges/water/managing-water/stormwater/oaklands-wetland

https://www.makingmarion.com.au/4884/documents/11795

https://www.watersensitivesa.com/wp.../Oaklands-Park-Wetland-case-study-FINAL.pdf

Passively irrigated street trees for new suburbs in Ballarat

Case study categories

Solutions	Benefits	Enabling structures
Water sensitive streets and carparks	Amenity and urban greening Ecosystem health Urban heat island mitigation	Business case

INSIGHT

This project used the BCA Tool to understand how a BCA could support water sensitive investment prioritisation.

PROJECT DESCRIPTION

This project applied the BCA Tool[9] to the alternative of including passively irrigated trees as an integrated water management option in Ballarat, Victoria. An integrated water management plan was developed for the City of Ballarat, and was underpinned by analysis of a wider range of options at a range of scales. One of the options was to introduce passively irrigated trees to new development areas, by lowering grass verges around each tree and allowing stormwater from the kerb and channel system to enter the tree growing area via a gap in the kerb. This differs from 'standard' practice in new developments in the area where street trees are included but not provided with an irrigation source.

Providing passive irrigation can increase the health of the tree and increase canopy cover while also managing stormwater. The proposal included one passively irrigated tree outside every new home, equating to approximately 45,500 street trees with passive stormwater irrigation to offset the impacts of increased runoff to waterways and deliver thermal comfort for new residents and workers. Trees were estimated to provide a canopy cover of 15m^2 per tree as a result of passive irrigation and the provision of good growing conditions, and give an additional 670,000m^2 of total canopy cover to Ballarat compared with standard practice.

[9] The analysis was originally completed in 2018 with a beta version of the BCA Tool and the accompanying 2018 version of the Value Tool. The BCA Tool was subsequently updated to the March 2019 version.

Figure 6: Typical integration of trees in new development in region (without passive irrigation) compared with passive irrigation proposal

Providing passive irrigation to street trees is shown to deliver a range of benefits, and the BCA sought to capture as many of these as possible:

- achieve or exceed stormwater water quality objectives[10]
- reduce irrigation need in dry times[11]
- increase lifespan of urban trees from 13 to 50 years[12]
- reduce frequent flows and deliver potential flood risk benefits[13]
- increase canopy cover and associated amenity[14]
- improve microclimate due to increased shade and evapotranspiration[15]
- double the trees' growth rate.[16]

THE DRIVERS

Why was the BCA Tool used?

Economist RMCG conducted an independent BCA for the Ballarat integrated water management plan. The BCA Tool was then applied to the passively irrigated trees option to test and compare the BCA Tool with the RMCG results. E2Designlab, which developed the integrated water management plan, worked through the tool as part of a demonstration of how tools from the CRCWSC could be applied to real-life projects. E2Designlab presented the demonstration at a CRCWSC Roadshow in 2018.

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[10] E2Designlab modelling of passive irrigation systems for street trees spaced 20m apart.

[11] E2Designlab modelling of passive irrigation systems for street trees spaced 20m apart.

[12] Skiera, B. & Moll, G. (1992). 'The sad state of city trees'. In *American Forests*, pp. 61–64.

[13] Armson, D., Stringer, P. & Enno, A.R. (2013). 'The effect of street trees and amenity grass on urban surface water runoff in Manchester, UK'. In *Urban Forestry & Urban Greening*, 12 (3), pp. 282–286.

[14] Hitchmough, J. (1994). *Urban landscape management*. Sydney, NSW: Inkata Press.

[15] Coutts, A. et. al. (2014). *The impacts of WSUD solutions on human thermal comfort*. Clayton, Vic: Cooperative Research Centre for Water Sensitive Cities.

[16] Grey, V. et. al. (2018). 'Establishing street trees in stormwater control measures can double tree growth when extended waterlogging is avoided'. In *Landscape and Urban Planning*, 178, pp. 122–129.

THE OUTCOMES

Benefit cost ratio: The analysis demonstrated an overall benefit cost ratio of 4.21, meaning the estimated benefits significantly outweigh the expected costs (see 'Business case' section for more details).

What the results did for the project

E2Designlab presented the BCA Tool results to practitioners during a 2018 CRCWSC Roadshow. The case study raised awareness of the tool and led to a healthy discussion about how benefits can be evaluated.

BUSINESS CASE

Total benefits (net present value)	$165,039,000
Total costs (net present value)	$39,209,000
Benefit cost ratio	4.21 (min: 1.59; max: 8.17)

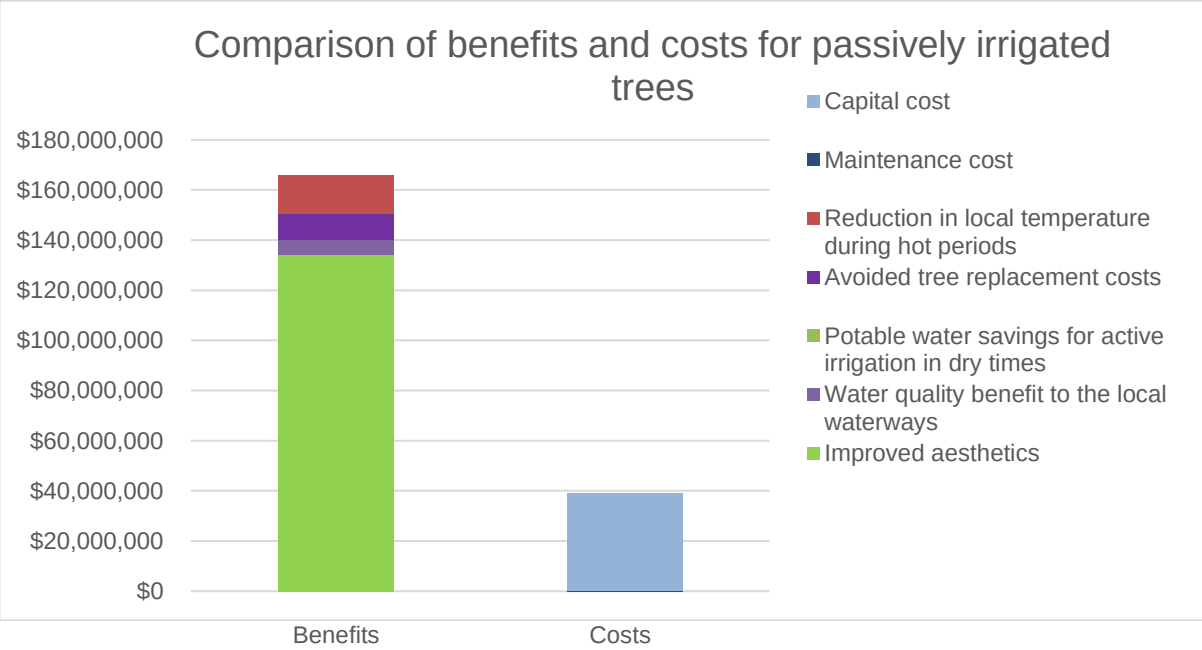

Figure 7: Comparison of benefits and costs for passively irrigated trees

Summary of benefits

The analysis identified seven benefits, five of which were monetised using direct economic benefits or value transfer from reference studies.

Benefit	Benefit value used	Multiplier for project	Value source
Increased amenity from greater street tree canopy cover	Benefit transfer from a study of public and private tree canopy that found that increasing street tree canopy from a starting point of 20 per cent of coverage by a further 10 per cent produced a property price increase of around 1.8 per cent of the median property price	There are 45,500 homes in the development area, with a median property price of $400,000. This uplift was applied 15 years after planting.	Value Tool for reduced heat benefit[17]
Reduced pollution to local waterways	$3,613/kg N (per kilogram of annual total nitrogen load). This value is capitalised (a one-off benefit recognised in the first year the stormwater treatment occurs).	The works will reduce nitrogen loads to the environment by 1,978kg per year.	Water quality offset value based on the cost of construction of urban wetlands in Melbourne to reduce pollution by the same amount. Sourced from Melbourne Water. A 50% value has been adopted to transfer the assumption to the Ballarat context.
Reduced potable water use for irrigation in dry times	The local value of a megalitre of potable water substitution in Ballarat is $630/ML	Passive irrigation results in the use of 140ML per year of stormwater being used for tree irrigation. It is assumed this results in the avoidance of 5% of this amount of potable water being used for irrigation in dry times.	The value of the replacement of a megalitre of potable water from the mains system was calculated by Central Highlands Water.
Avoided tree replacement costs	Using the data that urban trees without support of good growing conditions require replacement after 13 years, the replacement cost of $500 per tree was included three times over	45,500 trees were included	The cost of a semi-mature tree was provided by City of Ballarat.

[17] Brent, D.A., Gangadharan, L., Lassiter, A., Leroux, A. & Raschky, P.A. (2017). 'Valuing environmental services provided by local stormwater management'. In *Water Resources Research* (53), pp. 4907–4921.

	the lifetime of the analysis.		
Reduction in local temperature during hot periods	Benefit transfer from a willingness to pay study that found the value of decreasing the local temperature by 2 degrees on hot summers day in Melbourne was $47.16 per household per year	There are 45,500 homes in the development area which will benefit from the shade of street trees. This benefit was applied 15 years after planting.	Value Tool for urban tree canopy cover.[18] Assuming the increase in canopy will equate to a 2 degree temperature reduction on a hot day
Enhanced biodiversity provided by larger trees		This benefit was not monetised in the analysis.	
Reduced flow to local drains reducing nuisance flooding		This benefit was not monetised in the analysis.	

Summary of costs

A concept design report, including an estimate of costs, was developed for the project proposal. These costs were used for the analysis. The total cost estimates were:

- capital cost: $39,157,000 total for 45,500 trees provided with passive irrigation ($860 per tree for a sunken verge and a dropped kerb). It is assumed the cost of the tree, soil, and the back of kerb road drainage is included within standard development
- operating cost: $34,000 per year based on $750 per kilometre per year maintenance cost for scraping out sediment every 10 years. Maintenance of the tree itself (e.g. pruning) is included as part of the base case.

Analysis parameters

A BCA was conducted using the BCA Tool, with the following key parameters in place:

Key parameters	Value
Discount rate	5%
Length of analysis	50 years
Adoption	N/A – no private adoption required (all investments are made by infrastructure managers)
Project risk	LOW – 6–25% of project failure

[18] Pandit, R., Polyakov, M. & Sadler, R. (2014). 'Valuing public and private urban tree canopy cover'. In *Australian Journal of Agricultural and Resource Economics*, 58(3), pp. 453–70.

Distribution of benefits to stakeholders

The costs and benefits were attributed to various stakeholders in the analysis. Most benefits accrue to the local community, but it could be argued the developer partially accrues those benefits (in land and property sales upfront) and council too (council's remit is to deliver services to improve liveability).

	Developer	Council	Local community	Waterway manager
Benefits accrued	$0	$10,334,000	$149,228,000	$6,075,000
Costs accrued	$39,157,000	$658,000	$0	$0
Benefit cost	– $39,157,000	$9,676,000	$149,228,000	$6,075,000

THE LESSONS

Who used the BCA Tool?

Celeste Morgan from E2Designlab, a practitioner who works with stakeholders to develop integrated water management strategies across Victoria, used the BCA Tool. Celeste had never used a ready-made BCA tool before, but she regularly works alongside economists and understands the common assumptions used to evaluate water sensitive investments.

What was the user's experience of the tool?

Celeste found the tool intuitive to use, drawing on her experience with integrating economic assessments into integrated water management plans. She was able to use the tool without formal training, using its accompanying guide. While the tool allows the user to include a range of benefits, Celeste also found it useful for identifying the gaps in the business case. By including the 'easy' benefits to evaluate first, the tool can act as a platform to back calculate the shortfall, which needs to be made up through evaluation of non-market benefits in order for a project to stack up. This is helpful for project planning, because it focuses attention on project investigations into benefits that are likely to 'tip the balance'.

'I see the real value of the tool as being a conversation starter amongst stakeholders. It's possible to work through the inputs to the tool in a workshop environment, so everyone can agree on the assumptions, and where there is a shortfall in benefits that we can evaluate, the group then knows where to focus their attention.' Celeste Morgan, E2Designlab

When the same benefits were included, the BCA Tool produced similar results to those from economist RMCG (2.71 vs 2.21 BCR, where the small difference is likely due to differences in cost and benefit timing and a more conservative benefit transfer of the property price uplift by the economist). This coherence gave Celeste confidence in using the tool in the future.

TRANSFERABILITY

Since the case study considers passively irrigated trees, which are a delivery focus for many councils and developers, this case study is likely to have broad relevance. It uses data and modelling for passively irrigated trees in a central Victorian residential street context. These input figures would need to be adjusted for other rainfall regions or substantially different designs.

PROJECT COLLABORATORS

- E2Designlab – the design consultant for the Ballarat integrated water management plan, and user of the BCA Tool
- RMCG – the project economist for the Ballarat integrated water management plan
- City of Ballarat – the local drainage and street tree manager
- Central Highlands Water – the water authority who led the development of the integrated water management plan.

MORE INFORMATION

https://www.chw.net.au/news/ballarat-city-integrated-water-management-plan

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