CRC for
Water Sensitive Cities

Review of existing Benefit: Cost Analysis (BCA) tools relevant to water-sensitive cities

Milestone Report (Work Package 3.1)

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Australian Government
Department of Industry, Innovation and Science
Business Cooperative Research Centres Programme

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Table of contents

1 Introduction

1.1 Background

Existing literature and relevant stakeholders have been consulted to understand what tools are already being used (and by whom) and the extent of their use in decision-making processes. Existing tools for benefit-cost analysis have been reviewed to determine their suitability for assessing water sensitive systems and practices at different scales and for users of varying capacity (including urban green space, water sensitive urban designs, and other features identified by the IRP2 Project Steering Committee).

1.2 Process

This process had four aims, which were to:

1. Collate information about available tools for Benefit: Cost Analysis (BCA) or related purposes. This was based on:
    - our existing knowledge of available tools;
    - advice from a range of stakeholders who were aware of particular tools, including advice received in one-to-one interviews;
    - responses to a call for input that was publicised throughout the CRCWSC;
    - a web search.
2. Examine each of the relevant tools. Where possible, a copy of each tool was obtained and run on microcomputer. The main characteristics and key strengths and weaknesses were captured for each tool. Some tools identified were more relevant to the Benefit-Transfer Tool and were passed on to that sub-project (WP2).
3. Undertake one-to-one interviews with a wide range of stakeholders. See Appendix A for list of interviewees. Notes were made during each interview, but the material presented here is a synthesis across all the interviews (plus the other information sources).
4. Discuss with tool developers and economists, drawing on experience with developing and applying BCA tools and conducting general BCA studies, to derive lessons for our project. These discussions were held opportunistically in the course of other projects or meetings with people we know have been involved in conducting BCAs or developing tools for the water or environment sectors.

1.3 Tools identified and (where possible) reviewed

The following tools were identified and most were reviewed. More detailed comments on the main relevant tools are provided in Appendix B.

1.3.1 BCA tools reviewed

- Catchment Management Investment Standard (detailed guidelines on investment and a tool)
- INFFER (Investment Framework for Environmental Resources)
- The i-Tree suite of tools
- AWRCoE Recycled Water Economic Assessment Tool
- Blackspot Funding Benefit Cost Ratio tool

1.3.2 Tools examined that are more relevant to the Benefit-Transfer Tool than to the BCA Tool

- CIRIA BeST (Benefits of Sustainable Drainage Systems Tool)
- Natural Capital Coalition
- Social Environmental Tool (SET)

- Ecological Accounting Protocol – A Tool to Calculate the Opportunity Cost of Drainage Infrastructure
- New Jersey developer's green infrastructure guide

1.3.3 Tools we were unable to get a copy of

- MetroNet by the Metropolitan Water Directorate, NSW, https://www.metrowater.nsw.gov.au/
- NRM North WSUD Implementation Decision Support Tool. Benefits assessment is primarily qualitative; water quality improvements are quantified. Designed for local context (Mann, 2016).
- Infrastructure Sustainability Council of Australia (ISCA) Rating tool – seems like it may not be a BCA tool in any case.

1.3.4 Not reviewed in detail due to narrow focus

- Green values national stormwater management calculator (US). Not a BCA.

1.3.5 Guidelines or protocols without tools

- VISES Green Infrastructure Economic Valuation Framework (usefully complements our BCA tool).
- PRINCE2 (https://en.wikipedia.org/wiki/PRINCE2). Too general and comprehensive for our purpose. It is more of a project management method than a BCA tool.

2 Lessons and implications for IRP2

Based on all the information collected, the interviews and discussions, and examination of existing tools, a set of high-level lessons and implications were identified for this project. More specific ideas identified for the tool(s) will be discussed later in the report.

1. Every organisation consulted recognised the important role of economic analysis, including BCA, in building business cases to convince decision-makers about the merits of water-sensitive practices.

2. Some organisations make extensive use of BCAs. These are all larger organisations – water utilities, government agencies, and large councils like Brisbane City Council. Some organisations tend to use Multi-Criteria Analysis instead of BCA when the benefit becomes harder to measure (more social and environmental benefits). The intention in IRP2 is to use BCA even in these cases, using the Benefit-Transfer tool to provide values.

3. Most of the BCAs that are conducted for these organisations are commissioned from outside consultants. In a minority of organisations, some BCAs are conducted using internal expertise, but even most of these organisations also sometimes commission BCAs from external consultants.

4. Smaller organisations, particularly local governments, generally lack economics expertise, and tend to make much less use of BCA in their existing processes (relative to the larger organisations). The need for support with economics is greatest for these organisations. Some of the larger organisations also lack internal economics expertise. For the organisations with low internal economics expertise (both small and large), even relying on external consultants for their economics information can be problematic, as some level of economics expertise is needed to commission appropriate BCAs and interpret their results.

5. The level of expertise to successfully undertake a high-quality BCA is high. Experienced economists highlighted that there are risks in making a user-friendly BCA tool available to non-expert users. Even with the best designed and most user-friendly tool, experience shows that users need active support during the conduct of a BCA if the quality of the resulting analysis is to be assured. One tool, INFFER, includes, built into the tool itself, facilities to facilitate review of assumptions (a system for reviewers to comment on assumptions and for project developers to reply explaining their changes, and for reviewers to provide an overall stamp of approval on the process and the assumptions made).

6. There are various existing BCA tools that could be relevant to water-sensitive projects, as well as related tools, guidelines and protocols, and there are some training materials.

7. The existing BCA tools vary widely in their user-friendliness, structure, comprehensiveness and level of support. Most tend to be focused on a relatively narrow context, such as projects for catchments, urban trees, urban drainage or water recycling, each of which has a dedicated BCA tool, from somewhere in the world.

8. There is no existing BCA tool that is usable across a broad range of investment types (i.e. all of the above project types and more) and is specifically designed for projects with a focus on water-sensitive outcomes. CIRIA BeST is designed to deal with a wide-ranging set of benefits that are relevant to water-sensitive cities projects, but it does not provide a full BCA. INFFER is broadly relevant and is the most user-friendly of the tools, but it is not specifically designed for water-sensitive cities projects. There are good ideas to be obtained from the various tools.

9. There was incomplete information available about the levels of usage of the various tools, but overall it seems clear that most existing tools are used much less than hoped or expected. For example, the Catchment Management Investment Standard (and its spreadsheet tool Catchment Investment Analysis

Tool, CIAT) were commissioned by the Water Services Association of Australia, but has had limited usage since.

10. A particularly interesting experience in this regard is INFFER. This tool was carefully designed with the intent that it would be used by non-expert users. Recognising the risks in that approach, it was supported by a two-day training program (which was considered to be essential before an organisation should use the tool), extensive online documentation at various levels of detail, a system for expert review of assumptions and a help-desk facility. It was believed that, with sufficient effort and support, non-expert users can conduct good quality BCAs, and a good number (dozens) have done so. Nevertheless, the way that INFFER has evolved over time is for its delivery to be increasingly done by consultants. There are still non-expert users adopting it in the originally intended way, but most recent BCAs done using INFFER have been led by consultants, and in most cases those consultants have included the team that originally developed INFFER. The developers found that this was actually a more efficient approach all round than attempting to impart sufficient expertise to non-economists for them to be fully independent users. Consistent with this, Mann (2016) concluded that, although a BCA tool is considered very useful, at least in the context of South Australia, “The tool is most likely to be used by consultants on behalf of developers and local councils, regulated water businesses, and by state government to inform policy development” (Mann, 2016, p. ix).

11. Some experienced economists do not support the idea of producing a standardised BCA tool and prefer to develop a custom BCA spreadsheet for each analysis. Such economists highlight the high level of heterogeneity between cases and feel that any tool needs to be adapted to suit particular circumstances for each analysis (or that the tool needs to be sufficiently flexible). For experienced economists, developing a custom spreadsheet for each analysis is not difficult and allows the highest level of flexibility. Some experienced economists were also reticent about allowing inexpert users to conduct BCAs without sufficient support.

12. On the other hand, there was support from some economists for a tool that could become a standard for the water sector, particularly if it was seen to be endorsed by the CRCWSC and perhaps departments of treasury. A standardised tool has the advantage of reducing the risk of error (which is always present in a custom-developed spreadsheet), of being relatively accessible to non-expert users (even if they don’t end up using the tool themselves) and of supporting better standardisation of the approach used for BCA in the sector. The experience of INFFER shows that there can be value in developing a standardised tool even if it is not used by non-expert users. A comment made about the routine use of consultants was that people inside the organisation don’t necessarily learn much from the arms’-length process. An additional feature of INFFER that has helped ensure its continuing use is well-designed participatory and elicitation approach that it includes.

13. Any new BCA tool produced would need to be flexible. It needs to be able to capture a wide range of benefit types.

14. Strong support emerged for a different type of BCA tool – a BCA support tool that would help an organisation in planning and preparing for a BCA. It was felt that it would be of benefit to all organisations, and that there is no existing tool of this type, whereas a traditional BCA quantitative tool would only benefit a minority of organisations and is competing with a number of existing tools or with the option of a custom-developed BCA spreadsheet. It was felt by some that this could actually be a higher priority than development of a new BCA quantitative tool per se.

3 Ideas for IRP2

3.1 Ideas for BCA quantitative tool

Based on observations of the various existing tools, and experience using INFFER in various contexts, a range of ideas for the BCA tool are provided.

Given the wide range of benefit types that can be generated by water-sensitive projects, and the wide range of contexts around Australia where these projects will be implemented, it is unrealistic to aim to create a system where the quantitative estimates of all the benefits are built into the tool. This has been attempted in the CIRIA BeST tool, specifically for drainage-related projects in the UK, and even in that relatively narrow context, the information requirements were great.

The strategy of this project is to have two different tools: one related to BCA and one to assist people to estimate the more difficult-to-quantify benefits (the Benefit-Transfer Tool). This review focuses on the BCA aspect. The Benefit-Transfer Tool will need to generate values in form that are usable within the BCA tool.

For the BCA tool, it is important to be able to represent benefits that are structured in different ways. Possible benefit structures for inclusion in the tool are listed here:

- Benefit per person (on average) for a particular population (e.g., heat, health, amenity, biodiversity/ecology, recreation, tourism)
- Benefit per unit of action or area (e.g. biodiversity/ecology)
- Benefit per unit of abatement (e.g., CO_2 emissions, air pollution, water pollution)
- A total or aggregate benefit per year (e.g. development, other economic benefit, groundwater recharge, rainwater harvest, tourism, carbon storage)
- Delay or reduction in a cost (e.g. water treatment plant construction or upgrade)
- Improved condition of an environmental or community asset, expressed as a benefit for the asset as a whole (e.g. biodiversity/ecology, water quality)
- Reduced probability of a risky event that could occur with a specified probability in any year (e.g. flood, treatment plant failure)
- Custom benefits, specified year by year

The tool will be structured to capture benefits under any or all of these structures. Each of them implies a different way of calculating the benefits, and requires different parameters depending on which structure is used (e.g. the number of people affected, the number of units of pollution abatement, the number of years by which a cost is deferred).

It is important to capture that each project is likely to generate multiple benefits. The benefits may be of different structures (from the above bullet list) or there may be multiple benefits with the same structure (e.g., various benefits measured as a benefit per person).

Some of the benefits may be downstream or off-site from the location where the project actions are undertaken (e.g., effects of water pollution on a downstream water body).

Some benefits may be able to be represented by more than one of the above structures. For example, the benefits of reducing water pollution might be measured per person, or per unit of pollutant, or as the aggregate impact on a downstream water body. The user would be able to choose the structure that works best for a particular analysis. This may depend in part on the way that the information about the benefits has been estimated.

The timing of benefits is important. The tool will require users to specify a year to commence transition (i.e. benefits start to grow from zero), a year when transition is complete (benefits reach their maximum), a year when the maximum benefit finishes, and a year when the benefit fades out to zero. It would be possible to allow the user to specify the same time profile for each of the benefits, or to customise the profile for each benefit. The tool will use standard approaches to economic discounting of future benefits and costs.

Some projects rely on behaviour change. Without sufficient behaviour change, the benefits are not fully realised. Most tools do not include this explicitly, but there is value in the INFFER approach of making assumptions about behaviour change explicit. This uses a simple but effective approach of defining a variable representing how much behaviour change the project is expected to generate, as a proportion of the level of change that would be needed to fully deliver the target level of benefits, and scaling the benefits accordingly. As with issues of timing, the tool could allow the user to specify the same behaviour-change parameter for each of the benefits, or to customise the parameter for each benefit.

The INFFER approach to capturing project risk will be adopted. This defines three or four risk parameters that define the probability of the project failing to deliver its intended benefits for various reasons:

- **Technical risk**: the probability that the project will fail to deliver outcomes for technical reasons. For example, it may be that management actions are implemented but they fail to work because of equipment failure, newly planted vegetation dies, there was a miscalculation when designing the actions, or there is a natural event that makes the actions ineffective.
- **Social/political risk**: the probability that social or political factors will prevent project success. For example, a project might rely on another government agency to enforce existing environmental regulations, but that agency is unfortunately not prepared to enforce them because of the likelihood of a political controversy. A community protest, or perhaps legal action to stop the project, may also be other associated risks.
- **Financial risk**: the probability that essential funding from partner organisations, or long-term funding for maintenance of benefits, will not be available. Many projects require ongoing funding for physical maintenance, or for continuing education or enforcement, without which the benefits would be lost. Sometimes the decision to provide ongoing funding is made independently of the decision to fund an initial project, and hence this can be a risk, from the perspective of the funders of the initial project.
- **Management risk**: if different projects are managed by different organisations, there are likely to be differences in the risk of failure related to management. These risks might include poor governance arrangements, relationships with partners, capacity of staff in the organisation, specification of milestones and timelines, or project leadership.

Some of these risks relate to all-or-nothing outcomes (e.g. there either is successful legal action against the project or there isn't), while others relate to continuous variables (e.g. maintenance funding might be deficient but not zero, resulting in some reduced level of ongoing benefits). Representing risks for continuous variables is possible, but it requires fairly detailed information. Given the quality of information that is normally available about these risks, representing full probability distributions is probably not warranted.

The proposed approach instead is to approximate each of the risks as the probability of a binary (all-or-nothing) variable turning out badly, and to treat the different project risks as independent, not correlated. The risks are sufficiently different in nature from each other for this assumption of independence to be reasonable.

The above risks all relate to the probability of a project failing to deliver its intended benefits. Another type of risk is one that creates an additional cost, unrelated to the intended benefits of the project. For example, a project to decentralise water supplies might result in a risk of adverse health impacts amongst water consumers. This could either be represented quantitatively or captured qualitatively and reported to decision-makers.

The way that costs are broken down in the CIAT tool (part of the Catchment Management Investment Standard) is effective. As well as the initial project costs, CIAT allows users to specify maintenance/operating costs as a % of capex, or as a fixed annual amount. It also allows for contingency costs.

Inclusion of a system for recording data sources for each number used will be further considered. So too will a system for allowing users to specify different stakeholder groups (whole community, industry, a particular business) and to allocate a share of costs and benefits to each. This would allow a BCA from the perspective of each stakeholder group. While this would provide additional information, it would also increase the complexity of the tool.

A system for the various project options to be compared (similar in spirit to part of CIRIA BeST) will be provided. The numbers assumed for each project could be compared and checked for consistency, and the overall results (in terms of Benefit: Cost Ratio or Net Present Value) could be compared.

People will be required to register to access the tool, providing email, name and organisation. The tool would be free to access for registered users.

Treasury (and other relevant regulatory agencies) will be consulted to ensure that are satisfied that the tool meets requirements.

Further issues that will need to be resolved:

- Where to aim on the continuum between a very simple tool and a highly detailed and sophisticated tool
- Whether the tool should be designed for non-economists or for experienced economists
- Whether the tool should be flexible and easily adapted or more rigid in its structure
- Whether it should be implemented in a spreadsheet or in an online web page (spreadsheet more flexible, online means updating is automatic and allows collection of data about usage).

3.2 Ideas for BCA support tool

The objective for this tool is that it will help an organisation with the process of planning and preparing for the conduct of a BCA. It would be useful both to organisations that intend to conduct a BCA themselves, and also to organisations that intend to engage consultants to do a BCA. In the latter case, it would help the organisation with their decisions about purchase of consulting services, and should reduce the cost of engaging the consultants (as a significant part of the work would already have been done).

Unlike the BCA quantitative tool, there are no examples to get ideas from for this tool. Based on discussions with stakeholders and experience working with various organisations, the following steps or stages could be considered for inclusion.

- List what the BCA can provide as well as what it is unable to provide, and the possible uses of results.
- Screen for whether it is worth doing a BCA of the project. This could involve responding to a checklist addressing issues such as: the scale or importance of the project; whether a decision about funding of the project is likely to be influenced by a BCA; whether it is sufficiently clear what the project would involve – what specific actions or changes would occur; whether there is likely to be sufficient data and scientific understanding to underpin a worthwhile BCA; and whether the project is sufficiently likely to pass a BCA test for it to be worth conduction the BCA. If it is concluded that a BCA should not be conducted, alternative suggestions should be provided, e.g. a qualitative BCA. This tool could help to deliver that.
- The following steps could help to formulate the problem and think clearly about it. They would also save some time (and so cost) of consultants.

- Establish the time frame for the BCA. Is it to compare benefits and costs over the next 10, 20, 50 years, or some other time frame? The tool can provide advice on pros and cons of the options.
- Establish the baseline scenario for the BCA. This is the business-as-usual scenario, describing what would happen if the project was not funded. It is not necessarily a continuation of the current pre-project conditions. The status of each of the relevant benefits over the relevant time frame might be expected to worsen or improve in the absence of the project.
- Identify alternative strategies or projects. Describe in detail the various options. Each strategy or project would become a BCA. Evaluating different versions of the project (e.g. different scales or intensity or location) would be encouraged.
- Identify benefit types for each project. A checklist of benefit types to be considered (e.g., amenity, biodiversity, temperature, carbon sequestration, flood mitigation, etc.) would be developed. Perhaps advice about relevant experts who could advise on the likely levels of these benefits for particular projects, would be beneficial.
- Identify data needs for each project. This would explain the specific information needed to underpin the BCA, for each of the project options, and advise how to deal with data gaps.
- Identify risks for each project. This could involve a qualitative assessment of the project risks for each of the INFFER categories or perhaps a selection of risk levels from scales provided. Similarly, off-site or downstream risks could also be elicited qualitatively.
- Identify stakeholders. Elicit the nature of their interests in the project. Elicit qualitative information about the likelihood of stakeholders supporting, cooperating with or complying with the project, or perhaps of opposing it.
- Consider behaviour change. Identify who, if anyone, would need to change their behaviour in order for the project to succeed. Identify the mechanisms in the project that would be used to encourage this behaviour change.
- Consider the risk of double counting benefits. CIRIA BeST includes a simple matrix that shows which pairs of benefits are likely to overlap. This could be adapted for the CRC's tool.
- Plan the process of expert review for the BCAs. Who would be approached to be an independent expert reviewer? Which aspects of the BCAs would most need expert review?
- Maybe the process could lead to a simple qualitative BCA in cases where a full BCA is not needed or justified.

There are quite a few questions to resolve about the design of such a tool. Would it work best as a document, a spreadsheet, a website, or some other medium? Should the tool be designed for an individual to use, or should it be designed as a group process? What level of support should be presumed? Would we expect organisations to use the tool on their own, or with expert support? How extensive can the work required by the tool be before it gets too onerous for people? Can it be designed in a modular way, such that an organisation does as little or as much of it as they feel the need and have the ability? What training would be required to support the use of the tool?

3.3 Ideas to encourage adoption of either tool

Provide simple case studies showing how tools have been used to make better decisions, decide about distribution of costs or bring people together.

- Provide training programs for each tool. Ensure that a full case study is completed during the training.
- Provide informative online training modules and manuals.
- Perhaps have different training for people at different levels of expertise.
- Make sure there is high-level buy-in in organisations.
- Get endorsement from senior officers in relevant agencies or utilities.
- Run several shorter workshops rather than one big workshop.
- Allow free access to the tool.
- CRCWSC provides an award for best use of the tool(s) by a local government.

- Get training courses accredited.
- Create a forum for users to provide feedback and share thoughts and ideas. This will also help identify gaps and provide suggestions for improvements.
- Ensure that the regulators and financial decision-makers in utilities are targeted as well (not just engineers who submit proposals).
- Show that BCAs influence real decisions.

4 Key decisions for IRP2 before proceeding

The key decision required (at this stage) is how to balance effort between developing a BCA quantitative tool and a BCA support tool. To seed the discussion with the Project Steering Committee, here are a range of relevant considerations.

The approved project proposal states that a BCA quantitative tool is to be developed. The idea of developing a BCA support tool had not emerged when the proposal was developed.

Consultations revealed mixed views about whether it is worth developing a new BCA quantitative tool. Most experts felt that it was not realistic to expect organisations to conduct BCAs internally if they lack strong economics expertise within their staff. Some external consultants may use such a tool, but others would prefer to build their own for each BCA. Also, there are various BCA tools already available that can be adapted by those with sufficient expertise. Alternatively, a customised BCA spreadsheet can be developed for each BCA.

On the other hand, various benefits of a standardised BCA tool were identified: standardisation of the approach used for BCA in the sector; reduced risk of error relative to a custom-developed spreadsheet; accessibility of the tool to non-expert users (even if they don’t end up using the tool themselves); and codification of a strong participatory and elicitation approach.

There was universal support for the idea of developing a BCA support tool. The details were not clear or well developed, but the idea was supported by all members of the Steering Committee. It would be useful to all stakeholders, not just those with relatively low economics expertise. It could increase the quality of BCAs conducted, and also reduce the cost of engaging consultants, by bringing relatively easy aspects of the process in-house.

5 References

Mann, E. (2016). Adoption of tools to assess costs and benefits of Water Sensitive Urban Design in Adelaide, Report Issued to Water Sensitive SA, University of Queensland.

Appendix A - Stakeholders consulted

One-to-one interviews occurred with a number of key stakeholders during May-June 2017:

1. Ben Fallowfield, Northern Beaches Council, NSW
2. Fiona Chandler, Alluvium
3. Jim Binney, Alluvium
4. Grace Tjandraatmadja, Melbourne Water
5. Greg Finlayson, GHD
6. Karen Campisano, Water Services Association of Australia
7. Kym Whiteoak, RMCG
8. Mellissa Bradley, Water Sensitive SA
9. Ursula Kretzer, Department of Water (WA)
10. Naomi Rakela, Eastern Metropolitan Regional Council (WA)
11. Nick Morgan, Brisbane City Council
12. Anna Roberts, Natural Decisions (co-developer of INFFER)
13. Geoff Park, Natural Decisions (co-developer of INFFER)
14. About 12 Members of the Adaptive Planning and IWM Network (of the Water Services Association of Australia). This network brings together people from water utilities around the country. Sayed Iftekhar and David Pannell met with them in Brisbane on 4 May 2017. There were extensive discussions about our project for half a day, including discussions about its design and how to maximise uptake.

Appendix B – BCA tools examined

1) Catchment Management Investment Standard

Inclusions

- The Standard – a 77-page document that outlines 11 key steps.
- Catchment Investment Analysis Tool (CIAT) – a spreadsheet tool that helps users prepare financial and economic analyses of source catchment investments that they are considering.
- The Source Value Transfer Database – The project developed a searchable database of more than 200 estimates of the economic and financial benefit values of source catchments as water treatment assets.

Developed by
Alluvium and Marsden Jacob Associates (consultants) in Australia

Development supported by
Water Services Association of Australia and Water Research Foundation

Intended usage and context
The developers designed the CMIS to be used by agencies and organisations who are managing source catchments, especially impaired multi-use catchments. To use the CMIS effectively you should have a good level of understanding about source catchments, their processes, and the major components of a source catchment management plan. You should also have a basic understanding of stakeholder engagement and benefit-cost analysis.

Publicly available
Yes.

Existing users
Seems to be not many.

Strengths and good ideas

- The Standard provides a good overall approach to project analysis.
- CIAT can be mined for ideas about categories of costs. Ideas to consider: including contingency costs. Including maintenance/operating costs as a % of capex, or as a fixed annual amount.
- The Source Value Transfer Database may provide studies that can be included in the Benefit Transfer Tool (Work Package 2 of IRP2).

Weaknesses or concerns

- The CIAT spreadsheet is rather generic and only designed for a limited range of benefit types.
- The Source Value Transfer Database was a start but needs further development (which we are doing in the Benefits Transfer Tool sub-project).

Website
https://www.wsaa.asn.au/publication/source-catchments-water-quality-treatment-assets

Is it supported and being maintained and updated?
No. Take it as is.

Do we have a copy?
Yes

2) INFFER (Investment Framework for Environmental Resources)

Inclusions
Extensive documentation for 7-step process for designing and evaluating environmental and natural resource projects.

Frequently asked questions.
- On-line Project Assessment Form for data collection and BCA
- Spreadsheet version of the BCA
- Training materials

Developed by
David Pannell, Anna Roberts and Geoff Park (now of Natural Decisions Pty Ltd)

Development supported by
Future Farm Industries CRC

Intended usage and context
- Originally designed with/for regional catchment management bodies. Also used by government agencies and NGOs.
- Can be used to design and evaluate individual projects, or to evaluate and rank a suite of projects. Can also compare a range of variants of a particular project to help with decision-making about project targets and strategy.

Publicly available
Yes.

Existing users
- Dozens of users in Australia and New Zealand, with some use also in Canada.

Strengths and good ideas
- Was designed as a tool for non-economists to undertake BCA.
- Many ideas from INFFER, and experiences in its development could be drawn on. Key features include:
    - Highly user-friendly online interface with context-sensitive help.
    - System for expert review of assumptions.
    - Support for project design/development, including a number of test of the logical consistency of the project.
    - Training system.
    - Actively supported.
- Well-designed participatory and elicitation approach.
- Includes a number of well-considered simplifying assumptions that ease the data elicitation process to some extent.
- More comprehensive treatment of project risks than the other tools.
- The developers have recently been adapting the spreadsheet BCA to make it more relevant to water projects. The spreadsheet version, though, is not designed as a user-friendly tool for non-experts.

Weaknesses or concerns
- Was originally not specifically designed for the water context.
- Original version does not include a comprehensive range of benefit types.

Website
www.inffer.com.au

Is it supported and being maintained and updated?
Yes. Support by Natural Decisions http://www.naturaldecisions.com.au/

Do we have a copy?
Yes

3) The i-Tree suite of tools

Inclusions

- A broad suite of tools, including a module on Benefit: Cost Analysis.
- It is a custom-written program, not a spreadsheet or a web page.
- Extensive documentation is available.

Developed by
USDA Forest Service.

Development supported by
USDA Forest Service.

Intended usage and context

- i-Tree is a software suite from the USDA Forest Service that provides urban and rural forestry analysis and benefits assessment tools. The i-Tree Tools quantify the structure of trees and forests, and the environmental services that trees provide.
- i-Tree is used to report on individual trees, parcels, neighborhoods, cities, and states. By understanding the local, tangible ecosystem services that trees provide, i-Tree users can link forest management activities with environmental quality and community livability. Whether your interest is a single tree or an entire forest, i-Tree provides baseline data that you can use to demonstrate value and set priorities for more effective decision-making.
- The tool includes default values for the US and the UK.

Publicly available
i-Tree Tools are in the public domain and are freely accessible.

Existing users
Since the initial release of the i-Tree Tools in August 2006, thousands of communities, non-profit organizations, consultants, volunteers and students have used i-Tree.

Strengths and good ideas

- This is an extremely detailed and sophisticated system. The investment to create this has been enormous.
- The system of registering and downloading is well designed. Users can access documentation freely without registering, but are required to register and confirm their email address before being given access to the download page.
- The focus is specifically on trees. The represented set of benefits from trees is comprehensive. It includes carbon storage/sequestration, effect on building energy use and associated CO_2 emissions, reduced stormwater runoff (although the reason for this being a benefit is not teased out), oxygen production, pollution removal (NO_2, SO_2, O_3, CO, PM2.5), UV reductions, wildlife habitat.
- It also represents emissions by trees of volatile organic compounds, which may have adverse effects, including increased ozone and increased particulate matter, depending on the species of tree.
- Data for the technical aspects (for the US and UK) are built in.

Weaknesses or concerns

- The Benefit: Cost Analysis part of the system is a very small part of the package.
- The handling of costs is limited.
- The focus is only on urban trees.

Website
https://www.itreetools.org/

Is it supported and being maintained and updated?
Yes.

Do we have a copy?
Yes.

4) CIRIA BeST (Benefits of Sustainable Drainage Systems Tool)

Inclusions
Two Excel tools and two sets of guidelines:

- W045aBeST: Evaluation Tool: supporting practitioners evaluate benefits for a drainage proposal
- W045bBeST: Options Comparison Tool: Tool to compare more than one drainage proposal
- W045cBeST Technical Guidance: Provides technical information behind the tools
- W045dBeST User manual: Provides an overview of how to use the tools W045a and W045b

Developed by
Prof. Christopher Digman and Dr Bruce Horton (MWH), Prof Richard Ashley (EcoFutures) and Elliot Gill (CH_2) in the UK

Development supported by
CIRIA. CIRIA is the construction industry research and information association in the UK. As a neutral, independent and not-for-profit body, CIRIA links organisations with common interests and facilitates a range of collaborative activities that help improve the industry.

Intended usage and context

- Supports practitioners estimate the impacts that drainage schemes can create.
- BeST provides a structured approach to evaluating a wide range of benefits (in the table right), often based upon the drainage system performance overall. It follows a simple structure, commencing with a screening and qualitative assessment to identify thebenefits to evaluate further. Where possible, it provides support to help quantify and monetise the benefit. For some benefits, it provides a structured approach to qualify the impact they may have. The tool creates summary tables presented under both an Ecosystem Services (ESS) and Triple Bottom Line (TBL) framework. It automatically generates a series of graphs for use in reports. An Option Comparison Tool enables data from more than one 'simulation' of BeST to be copied and compared with the overall net present cost, benefit and value.

Benefit category	Monetised?
Amenity	Yes
Biodiversity and ecology	Yes
Building temperature	Yes
Carbon reduction and sequestration	Yes
Crime	No

Economic growth	No
Education	Yes
Enabling development	Yes / No
Flexible infra./climate change adaptation	To be developed
To be developed	Yes
Flooding	Yes
Groundwater recharge	Yes
Health	Yes
Pumping wastewater	Yes
Rainwater harvesting	Yes
Recreation	Yes
Tourism	No
Traffic calming	No
Treating wastewater	Yes
Water quality	Yes

Publicly available
Yes. Free to download.

Existing users
Yes, but not clear from website how many or who they are.

Strengths and good ideas
- It is generally well designed.
- Comprehensive documentation.
- For each type of benefit, it shows the potential stakeholders and schemes to discuss the benefits with.
- Flags risk of double counting between different types of benefits.
- Comprehensive list of benefit types.
- Outputs are a mix of monetised values and qualitative values.
- Includes sensitivity analysis.
- Builds in a set of suggested monetary values for particular impacts (a values library).
- It uses economic discounting.

Weaknesses or concerns
- It's not a full BCA. Only estimates benefits. More relevant to the Benefit Transfer tool than to the BCA.
- Discounts benefits according to "confidence". The way they have done this seems inconsistent with standard decision theory.
- It provides structure around how the benefits are specified, but in some cases this may be overly constraining.
- To keep things simple it often breaks options down into a few categories, like area being small, medium or large. It is not clear what quantitative levels (e.g. areas) would correspond to those categories.

Website
http://www.ciria.org/News/CIRIA_news2/New-tool-assesses-the-benefits-of-SuDS.aspx

Is it supported and being maintained and updated?
It has had updates, most recently in March 2016.

Do we have a copy?
Yes

5) AWR CoE Recycled Water Economic Assessment Tool

Inclusions

- The Recycled Water Economic Assessment Tool is a free Excel-based system that allows users to undertake a cost benefit analysis to quantify a range of economic, social and environmental benefits, and costs for recycled water schemes.
- Also includes several supporting documents, available from http://www.australianwaterrecycling.com.au/research-publications.html.
- Marsden Jacob Associates (2014), Economic Viability of Non-Potable Recycled Water Schemes, Australian Water Recycling Centre of Excellence.
- Marsden Jacob Associates (2014), Value of recycled water infrastructure to the residents of Rouse Hill, Australian Water Recycling Centre of Excellence.
- Marsden Jacob Associates (2014), Community values for recycled water in Sydney, Australian Water Recycling Centre of Excellence.
- Marsden Jacob Associates (2014), Environmental and Social Values Associated with Non-potable Recycled Water, Australian Water Recycling Centre of Excellence.

Developed by
Marsden Jacob Associates, Project led by Phil Pickering, in Australia

Development supported by
Australian Water Recycling Centre of Excellence

Intended usage and context
It is designed as an easy-to-use system to assess alternative water recycling options, primarily for non-potable purposes. The tool uses information entered by the user on the likely costs and benefits of a particular water recycling initiative. While the tool is designed to be relatively easy to use, users should familiarise themselves with the *Economic Viability of Recycled Water Schemes* framework by the Australian Water Recycling Centre of Excellence, which is also available for download, to ensure an understanding of the context and application of the information that is to be entered.

Publicly available
Yes

Existing users
Developers advise that they have processed 168 requests for copies of the model. They do not collect feedback from users but they understand it has been used successfully multiple times.

Strengths and good ideas

- Designed specifically for water recycling projects. This allows it to represent a number of issues that are specific to this context.
- Includes a check list of logical points, such as whether the first year of properties being connected is at or after the final year of capex.
- Detailed breakdown of costs, including capital costs, operating costs, environmental/community costs (e.g. CO_2 emissions).
- Includes a range of benefits: avoided potable water cost, avoided waste water cost (e.g. disposal), wider community willingness to pay (including non-use benefits), reduced probability of water restrictions, and avoided cost of rainwater tanks.

- Represents benefits and costs for up to 100 years, but user specifies time frame.
- Generally is quite a good tool. Fairly simple and able to be comprehensive within a relatively narrow scope.

Weaknesses or concerns

- Narrow scope – recycled water projects only.
- Limited support for non-expert users. Assumes a reasonably high level of economic expertise.

Website
http://www.marsdenjacob.com.au/recycled-water-economic-assessment-tool/

Is it supported and being maintained and updated?
Not clear. Possibly.

Do we have a copy?
Yes

6) Blackspot Funding Benefit Cost Ratio tool

Inclusions
A spreadsheet tool.

Developed by
Australian Government?

Development supported by
Australian Government?

Intended usage and context
Provided to local-government applicants for funding to address traffic accident black spots.

Publicly available
Yes.

Existing users
Yes. Presumably, all applicants to the Blackspot program.

Strengths and good ideas
Builds in specific benefits for particular actions. All the numbers are standardised.

Weaknesses or concerns
Strictly limited to investments in reducing traffic accidents.

Website
http://www.dpti.sa.gov.au/towardszerotogether/safer_roads/black_spot_program_2

Is it supported and being maintained and updated?
Probably.

Do we have a copy?
Yes.

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