SOURCE CATCHMENTS AS WATER QUALITY TREATMENT ASSETS

Industry best practices and triple bottom line cost evaluation of catchment management practices

Synthesis Report

WATER SERVICES ASSOCIATION OF AUSTRALIA

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Overview of WSAA

WSAA is the industry body that supports the Australian Urban Water Industry

WSAA members provide water and wastewater services to over 20 million Australians and many of Australia's largest industrial and commercial enterprises.

The Association facilitates collaboration, knowledge sharing, networking and cooperation within the urban water industry. It is proud of the collegiate attitude of its members, which has led to industry-wide approaches to national water issues.

WSAA can demonstrate success in the standardisation of industry performance monitoring and benchmarking, as well as many research outcomes of national significance. The Executive of the Association retains strong links with policy-makers and legislative bodies and their influencers, to monitor emerging issues of importance to the urban water industry. WSAA is regularly consulted and its advice sought by decision makers when developing strategic directions for the water industry.

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A note from the project Steering Committee

Water utilities undertake catchment management for a variety of reasons. Catchment management programs may be a regulatory requirement or an economically sound option to complement conventional water treatment, or they may be voluntary and considered an investment that can provide non-traditional and often additional non-monetised environmental and social benefits. Regardless of the driver, utilities need to understand how catchment management programs can be incorporated into an infrastructure investment decision making process.

Urban water utilities operate in an economically regulated environment where consumer affordability is paramount and where the regulator puts the burden of proof on the water provider to illustrate successful mitigation of water quality risk. In this environment there are two critical challenges:

- *How can a sound business case be made for investment in catchment management as a water quality 'treatment' option, using best practice approaches in triple bottom line cost benefit evaluation?*

- *How can it be demonstrated, in the geographic context of the catchment under consideration, that mitigation measures can be successfully implemented and water quality improvement achieved?*

With these challenges in mind, WSAA and WRF have undertaken the Source Catchments as Water Quality Treatment Assets project on behalf of their members.

A note from the project Steering Committee

The key product from the project is the Catchment Management Investment Standard which has been prepared to assist water utilities make the case for catchment management for drinking water supply. It was developed in close collaboration with water utilities from Australia and the United States to enable stronger business cases for catchment management as a viable alternative to more capital intensive (traditional) investments. To inform its development a high level assessment of key lessons from catchment management initiatives and programs in the United States and Australia including case studies of issues such as land use planning, legislation and connecting with customers was undertaken.

The Catchment Management Investment Standard provides users with a summary of the key steps and practices that need to be completed to develop a robust and evidence based investment in source catchment management activities. It provides a practical tool to conduct screening level evaluations initially, and can facilitate follow-on, in-depth triple bottom line analyses by utilities. We look forward to its widespread adoption into decision-making in urban water utilities around Australia and the United States and of course to its progressive improvement over time.

The Steering Committee.

About this project

This project is a joint Water Services Association of Australia (WSAA) and Water Research Foundation (WRF) initiative. It has developed, in consultation with the water industry and key stakeholders, a new benchmark for source catchment investment.

The benchmark is specifically aimed to support water utilities in Australia and the US make stronger, evidence-based business cases for source water catchment management as a viable alternative to more capital intensive investments, especially in impaired multi-use source catchments.

The project has the following key outputs:

- This **Synthesis Report** which aims to synthesise the main outputs of the project into one easy to read report.
- A **Catchment Management Investment Standard (CMIS**) to provide users with a summary of the key steps that need to be completed to develop a robust and evidence based investment in source catchment management activities.
- A supporting **toolkit** of background information to aid the development of a business case with the CMIS, including:
  - The **Rapid Stocktake and Case Studies** report: a literature review and other stakeholder consultation resulted in the development of an internationally researched evidence base. A critical component of this was a Stakeholder Influence Matrix. Three case studies explored key elements of this Matrix: land-use planning; water customer engagement; and source catchment protection related legislation at the national, state and local jurisdiction level.
  - A **Catchment Investment Assessment Tool** to help users prepare financial and economic analyses of source catchment investments that they are considering.
  - The **Source Value Transfer Database** - a searchable database of more than 200 estimates of the economic and financial benefit values of source catchments as water treatment assets.

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About the Rapid Stocktake

This review delivers a high level assessment of key lessons from catchment management initiatives and programs in the United States and Australia including case studies of key issues linked to stakeholder influence.

The Rapid Stocktake focused on source catchment management in impaired multi-use catchments, and catchments that were expected to inform the development of the CMIS for this project.

Information was drawn from published documentation on source catchment management schemes, initiatives and programs, and, where appropriate, conversations with participants involved in developing the source catchment management policies and frameworks sitting behind them, and managers responsible for delivering programs.

Critical elements from the Rapid Stocktake are explored in subsequent slides. **For the full Rapid Stocktake report, please refer to the project toolkit.**

Defining source catchments

To provide a common basis for understanding, at the outset of this document we define key terms and what we see as the scope of source catchment management activities.

Source water is untreated water from rivers, streams, lakes, reservoirs or aquifers that supplies the public with water for all kinds of uses, including water for drinking (drinking water systems and private wells), recreation and the maintenance of aquatic ecosystems. The land area that provides this source water is the **source catchment**.

Catchment is a term used to describe land areas that drain into a river basin, reservoir or replenish an aquifer. The term **watershed** used in the American context provides basically the same meaning. The term catchment is used predominantly in this report, except in the US context e.g. US elements of case studies.

A waterbody (i.e. stream reaches, lakes, waterbody segments) with chronic or recurring monitored violations of the applicable numeric and/or narrative water quality criteria is referred to as **impaired water**.

The protection of source water, in terms of its quality, quantity, timing of flows and associated benefits at the water's source, is source water protection (Gartner et al. 2013).

Importantly the Australian Drinking Water Guidelines (2011) (ADWG) indicate that the most important barrier in water quality protection is the effective protection of the source or catchment. Source water protection can therefore play a highly significant role in relation to the maintenance of appropriate public health standards.

Defining source catchments *(cont)*

Where source water is to be used for drinking, the Australian Drinking Water Guidelines (ADWG) (NHMRC/NRMMC, 2011) and the US standards established under the *Safe Drinking Water Act* recommend a **multiple barrier (or multi-barrier)** catchment-to-customer approach to providing safe drinking water. The multiple barrier approach refers to the various components in the train of providing safe drinking water to the customer—from the source (whether ground or surface water), to a water treatment facility, through a distribution systems, and ultimately to the customer at the tap (Gartner et al. 2013).

This proactive approach means that if one barrier fails, the effective operation of other barriers will ensure safe drinking water is maintained throughout the water supply. Protection and management of the **source catchment** is the first barrier in protecting water quality; subsequent barriers include water storage, treatment and disinfection.

Built infrastructure, which refers to the human-engineered infrastructure for source water resources such as treatment plants and dams, undoubtedly plays a critical role in water storage and treatment.

Natural infrastructure, which refers to the strategic use of networks of natural lands, working landscapes, and other open spaces to conserve ecosystem values and functions and provide associated benefits to human populations, can be a cost-effective component of an integrated system to provide safe drinking water.

Forests, wetlands, riparian buffers, and other natural elements on the landscape can comprise natural infrastructure when strategically used and managed to provide services for communities, such as through land acquisition and conservation easements, low-impact development, conservation practices on agricultural and forest lands, and even beaver dams (In the North American context). As such, natural infrastructure is commonly referred to as "watershed protection," "integrated catchment management" , "land conservation," or several other more traditional terms.

Defining source catchments (cont)

The scope of catchment management activities.

Source catchment management practice has rapidly advanced over the past three decades, driven by a need to protect and enhance source water that has a high quality and well-regulated flow, as well as protect rural landscapes and other receiving environments from water quality and quantity impacts. There is general agreement that treatment cost efficiencies can be achieved if the source water catchments are either fully protected from human activities and/or water quality risks are actively mitigated.

The most common response to source catchment management challenges has been to increase investment in *conventional* built infrastructure, such as dams, levees, and water treatment plants, and to expand sewerage networks (UNEP, 2014). However, there is an increasing body of evidence that natural (or green) infrastructure can "…reduce or avoid costs and enhance water services and security, serving alongside necessary built infrastructure components as part of an integrated system to cost-effectively deliver safe drinking water…" (Gartner et al., 2013). Recent work in the US also indicates that catchment protection measures are increasingly becoming cost effective (WRF 2015).

Conventional catchment management activities covered in the following pages are:

- Exclusion zones and general land management (including fencing of riparian areas for stock exclusion from waterways) through development planning acts, regulations, policies and community engagement
- Native vegetation or forest conservation; native revegetation efforts or (re-) afforestation.
- Reconnecting rivers to floodplains
- Wetland restoration and conservation
- Riparian buffers

Conventional catchment management activities
exclusion zones and general land management

Benefits of exclusion zones	Co-Benefits	Costs
Water purification • Prohibiting human and stock activity within a catchment area reduces litter and other pollutants.	• Carbon sinks • Pollination • Improved air quality • Preserve biodiversity	Social perception • Lost opportunity for some recreational or ecotourism benefits. Economic • Fencing, signage and enforcement costs • Ongoing maintenance and monitoring.
Soil erosion control • Prohibiting human and stock activity within a catchment area reduces impacts on banks and erosion. • Creating buffers that can act as natural treatment systems which prevents the natural filter system being compromised and saving built infrastructure (treatment) costs		

Conventional catchment management activities

native vegetation or forest conservation; native revegetation efforts or (re-) afforestation

Benefits of forests	Co-Benefits	Costs
Flood control • **Forest areas in upper catchment areas can reduce occurrence and intensity of floods by:** – intercepting rainfall and increasing infiltration–soils in forest areas are able to store more water and release water through evaporation – reducing soil erosion – eroded soil has a diminished water storage/retention capacity.	• Carbon sinks • Pollination • Improved air quality • Regulate local climate (including cooling) • Preserve biodiversity • Tourism and recreation • Opportunities for agroforestry and silvopastoral systems	Water supply • Intensive reafforestation, afforestation or native vegetation establishment may reduce the local total annual runoff and groundwater recharge. Economic • Purchase of land • If not via natural regeneration, purchase of seeds/saplings and labour for tree planting • Ongoing maintenance. Water supply and quality regulation • Time-lag for reafforestation and afforestation to provide benefits (i.e. trees to grow) • Exposure to risks that may compromise the investment–e.g. wildfires, pests and diseases, change in rainfall (climate change).
Water purification • Forests improve water quality by reducing sediment and pollutants in waterways.		
Soil erosion control • Reducing soil erosion and stabilising slopes – trees help to stabilise slopes and reduce frequency of landslides, mudflows and avalanches.		
Water temperature control • Forests provide shade to streams and help to mitigate thermal pollution.		

Conventional catchment management activities

Reconnecting rivers to floodplains

Benefits of reconnecting rivers to floodplains	Co-Benefits	Costs
Water regulation • Longer time period inundation may recharge groundwater, resulting in a 'groundwater bank' during drought.	• More room for natural channel meander • Allows floodplain habitats to be created • Biodiversity habitats • Pollination • Recreational and aesthetic value • Increase resilience to climate change impacts • Income from hunting, fishing, farming, etc. • Avoided cost of flood damage to roads, bridges, buildings	Economic • Construction works • Purchase of title or easements • Lost opportunity of land that is now periodically inundated (although some land areas may still be useable).
Flood control • Increases the river channel's capacity for carrying floodwaters. • Flow of water over floodplains is generally shallower and slower than rivers. • Reduced levee maintenance costs (i.e. levee exposed to lower velocity water).		
Water purification • Improved water quality downstream via: – reduced erosion – sediment transported with floodwaters (and also nutrients such as phosphorus which are largely adsorbed to sediment particles) deposited on the (slower) floodplain – biogeochemical processes within floodplain wetland (e.g. denitrification) can reduce nitrogen loads in river water.		

Conventional catchment management activities

Wetland restoration and conservation

Benefits of wetlands	Co-Benefits	Costs
Water quantity regulation • Wetlands are able to store large amounts of water, and release it slowly, making them natural regulators of water quantity during: – droughts (by acting as retention basis and providing a slow release of stored water) – floods (by slowing flood waters and minimising potential impacts downstream).	• Recreational, aesthetic and health value • Support livelihoods (e.g. fisheries and tourism) • Biodiversity habitat • Pollination • Increase resilience to climate change impacts • Carbon storage and sequestration (e.g. peatlands)	Health • Large areas of standing water can form habitats for the spread of vector-borne diseases (especially in tropics). Economic • Vary depending on the location and level of degradation • Purchase of land • Any foregone economic opportunity to develop the land • Labour and equipment for physical works and replanting • Maintenance costs. • Potential additional treatment issues
Water purification • Natural ability to reduce nutrients and some pollutants in water, as well as trap sediments for improved water quality. • In some instances the generation of organic material from wetlands has been known to cause water supply issue including taste, odour and colour.		

Conventional catchment management activities

Riparian buffers

Benefits of riparian buffers	Co-Benefits	Costs
Flood control • Absorb water and slow down runoff during flood events, reducing peak flows. **Water purification** • Improve water quality, by reducing sediments and pollutants including a reduction of pathogens entering waterways • Falling leaves and debris provides food for aquatic species (which may provide water quality benefits). **Water temperature control** • Provide shade to streams and help to mitigate thermal pollution. • Reduces temperature fluctuations, important for the survival of many aquatic species. • Reduces levels of light, to protect invertebrate species composition (e.g. high light levels can increase in-stream primary production and change composition). • Reduces frequency of algal blooms.	• Maintain soil productivity on nearby land (by stabilising soils) • Biodiversity habitat and movement corridors • Pollination • Offer shade and weather (including wind) protection • Aesthetics and recreation	Water supply and quality regulation • Exposure to risks (in particular during droughts) that may reduce benefits–e.g. pests and diseases, wildfires. Water purification • Excess dead leaves and debris entering the waterway can make the water toxic to fish and aquatic species (e.g. if the organic matter becomes hypoxic, with decreased pH and high concentrations of tannin and lignin) • Good design is critical – water quality benefits depend on the width, cover and longitudinal connection of buffers relative to pollution sources. Economic • Purchase of land (and any foregone economic opportunity to develop the land) • If not via natural regeneration, purchase of seeds/saplings and labour for tree planting • Ongoing maintenance and monitoring.

Water industry drivers for source catchment management

We identify drivers for investment in successful catchment management programs.

Driver	Description
Regulatory requirements	This is a core driver. Minimum regulatory requirement(s) that codify catchment management as a key driver for water source protection need to be in place. The US Federal Clean Water Act and other heads of power to implement and enforce source protection. Regulatory compliance and pre-compliance are key drivers identified for business, local government, state/provincial government and drinking water utilities in the US (WRF 2015, Bennett and Carroll, 2014)). The Australian Drinking Water Guidelines (2011) (ADWG) on the other hand does not set mandatory standards. Source water protection regulations should be formulated in a way that ensures their effective implementation and enforcement. Regulations must clearly identify objectives of source water protection – drinking water protection, recreation, the maintenance of aquatic and land ecosystems, etc. Clear and applicable numeric and/or narrative water quality criteria should support the regulatory requirements.
Multiple-barrier approach	This is a core driver. Water management organisations have long recognised the importance of a multiple barrier, risk management approach to protecting drinking water quality from contaminants (Deere et al., 2008). The ADWG indicate that the most important barrier in water quality protection is the effective protection of the source or catchment. Effective source protection can mitigate significant cost and reliance on fallible downstream barriers such as water treatment and disinfection (Ford, 2008). Source water protection can therefore also play a highly significant role in relation to the maintenance of appropriate public health standards. The concept of water safety planning, i.e. greater emphasis on source catchment as the first step in ensuring safe drinking-water, is to select and protect reliable, high quality source water, and is a key driver supporting action.

Water industry drivers for source catchment management (cont)

We identify drivers for investment in successful catchment management programs.

Driver	Description
Evidence that built infrastructure is not infallible	This is a core driver. There is evidence that technological solutions (engineered water treatment) are not a panacea. Prevention of contamination provides greater surety than the removal of contaminants. No single barrier is completely effective, technological solutions cannot be solely relied upon and need to be complemented by catchment management initiatives. For example, management of the water supply catchments of Sydney changed significantly after the 1997 Royal Commission into the Cryptosporidium and Giardia crisis. The Commission found that Sydney's drinking water catchments were seriously compromised, that a modern water treatment plant was not a substitute for proper catchment management, and that a strong and effective response was required (Warner, 2013).
Comprehensive overarching strategy and management framework	This is a supporting driver. There must be a clear, overarching, structured management framework. The strategy should confirm the importance of water source protection and clearly articulate management objectives, obligations and responsibilities of key parties managing and impacting on water sources. The strategy and management framework should be integrated and align the source water management framework into high priority initiatives such as stormwater management and land conservation. The strategy must be developed and supported across agencies, levels of Government (federal, state, local) and stakeholders involved in catchment management.

Critical catchment management program success factors

In addition to key drivers, several reports have identified critical success factors for (source) catchment programs. We discuss these attributes.

Make source water protection a high priority. Articulate the benefits of source water protection, including financial benefits, and demonstrate how successful protection can cap or reduce treatment costs over time. Ensure that source water protection planning and action is important even in the absence of regulatory requirements to do so, and that water suppliers become active leaders in their catchments.

Clearly identify the most critical threats to source water and share that information to involve and motivate a broad constituency (i.e. risk based approach). Adequately identify the threats to the water supply. Obtain and use technical data to show where the problems are.

Articulate a clear vision for source water protection, and support it with sufficient resources to accomplish the vision. Be sure to target the most important priorities and those program components which have the greatest chance for success.

Develop a constituency to champion the cause, and provide resources and technical support to ensure sustainability.

Partner with those who have the authority to make change such as elected officials and agricultural and industry representatives. Have early involvement of the relevant stakeholders in developing the vision, goals, plan and implementation of the program.

Understand that it takes time to get people to understand and want to address the problem. Understand that it takes people seeing progress and believing in the cause to keep things moving forward. Source water protection can be a long and continuous process, so maintain patience and perseverance.

Build on and integrate with existing issues and programs, integrating source water protection into high priority initiatives such as stormwater management and land conservation.

Create a viable action plan that guides and motivates implementation. Continue to develop and implement partnerships, coordination and collaboration throughout the development and implementation of the program.

Actively promote successful source water protection efforts to build momentum and encourage replication. Study other successful source water protection programs to learn from their successes and failures.

Create financial and regulatory incentives to build commitment of local stakeholders, especially around multi-jurisdictional or resource-based planning efforts. Support or create public funding programs broad enough to include source water protection, and make funding easy to find.

Barriers to catchment management implementation

The literature also identifies that catchment management and water source protection programs face a range of barriers to implementation.

Capital bias: A Capex bias exists in funding decisions that is relevant to catchment management (OFWAT, 2012). *Capex* is defined as expenditure on productive capacity and usually refers to hard assets such as built infrastructure.

Off-balance sheet bias: Catchments can be regarded as the most important asset in supply business yet are often not included in the financial calculations of the business. Non-recognition of the catchment as a formal asset leads to a reluctance to invest in its protection and maintenance in a similar fashion to a hard asset such as a filtration plant. Often catchments have multiple owners, and expenditure on third party land to protect water quality further challenges the flexibility and utility of accounting and financial standards (Bennett and Carroll, 2014; WRF, 2015).

The engineering culture: Organisational structures in water utilities are dominated by engineers with limited exposure to and understanding of catchment management issues (Ofwat, 2012). Engineering solutions provide a well-recognised certainty of outcomes in terms of water quality, while the results of catchment management are by their nature uncertain and potentially difficult to quantify to the same extent.

Knowledge and skill gaps: Many utilities face knowledge gaps among key constituents and internal decision makers. There is a lack of financial resources or technical knowledge needed to advance catchment management programs (Gartner et al., 2013). In many instances, there is a lack of regulatory clarity regarding water utility involvement in catchment management and confusion over jurisdictional and leadership roles in catchments (Bennett and Carroll, 2014; WRF, 2015).

Long and lagged timeframes: The timeframes associated with catchment management are also a key barrier. Natural infrastructure tends to provide benefits over a very long time period (decades or longer), whereas man-made capital provides benefits in the near term (years to decades). Natural infrastructure appreciates in value over a long period of time whereas built capital depreciates relatively rapidly (Gartner et al., 2013).

Stakeholder participation Influence Matrix

A common theme throughout the literature and stakeholder interviews was the importance of influencing key decision makers and communities of practice to engender support for water source catchment protection and management. An Influence Matrix (shown over the next two pages) was developed to summarise these findings.

	Influence level		Why influence?
Politico economic context	Policy makers	–	Successful programs have had a policy champion and high-level policy support to achieve their aims. Establishment of roles, responsibilities and lead agencies vital.
	Legislators	Federal	Significant difference between the US and Australia is the existence of the Federal Clean Water Act and other heads of power to implement and enforce source protection in the US. Australia does not have an equivalent.
		State	Each State in the Australian context has differing legislative approach to source protection. Most planning in some areas focused on quantity not quality. Limited regulatory support for source protection in some states. Reliance on guidelines with limited statutory impact.
		Local	Local Government identified as a key land use regulator. Wide variety of engagement identified however it is mostly reactive. Several areas identify limited influence over planning schemes and development patterns.
	Regulators	Financial	Financial regulators need to be influenced to provide appropriate financial signals. Currently a Regulated Asset Base and CAPEX bias against source protection exists.
		Health	Identified support for multi barrier approach. Establishment of guidelines needs to be supplemented by risk reduction requirements.

Stakeholder participation

Influence Matrix (cont)

	Influence level	Why influence?
Organisational context	Board	High level board support and resourcing required. Most boards are dominated by financial/legal/engineering considerations with few source protection subject experts.
	Executive	Executive must be fully engaged and supportive for program to succeed. Strong leadership required particularly in relation to expenditure on third party land or assets with a willingness to embrace innovative solutions and methods.
	Middle management	In some organisations there is an opportunity to improve the level of understanding within middle management of the potential benefits of source water protection programs. These programs challenge business as usual approaches – many decisions needed for successful catchment management programs will not progress beyond this level in organisations unless this is addressed.
	Staff	Staff across all elements of water businesses need to understand the importance of source protection and long term planning across all spheres of operation.
Catchment context	Catchment organisations	In many catchments, numerous organisations identified with no clear leader and in competition for funds and recognition. Where no appropriate organisations exist, water utilities have found it highly beneficial to support their establishment.
	Catchment industries	Industries operating within water supply catchments can have tremendous influence over producers. Need to engage industry to promote source protection goals.
	Landholders	In open catchments, the majority of on ground works need to occur on private land.
Community context	Catchment community	Influencing catchment communities to be supportive of source protection programs is vital. Top down approach of water industry identified as barrier to successful engagement.
	Drinking water customers	Drinking water customers of source catchments need to understand role of catchments, source protection and long term program benefits if long term success and support is to occur.

Building the business case

Governance and institutional contexts and associated regulatory requirements needed to get a business case to the table

The regulatory frameworks and property right arrangements, and to a lesser extent policy, that govern drinking water quality provide the foundation for source catchment investment decisions.

Regulations provide the baseline for how source catchments must be protected and managed under Federal/Commonwealth, State, and Local Laws. The business case for source catchment investments needs to prove additionality—that is, net beneficial impacts over and above the regulatory minimum requirement for source management protection (Mulligan, 2013). As previously noted, in Australia, NSW, Victoria and South Australia have some limited regulation-based exclusion zones applied around dams where no development is permitted and public access is restricted. Many US municipalities' regulation requires setbacks and buffers between development areas and water bodies in source catchments. Therefore, a business case needs to be additional to this.

Regulatory flexibility allows a natural infrastructure business case to get to the table. Many of the regulations governing water resources take a flexible approach and allow the regulated community (including water utilities and others) to use natural infrastructure to achieve compliance in ways that reduce cost and may achieve greater environmental benefits than are possible under a traditional regulatory approach. Where such a flexibility approach is allowed, natural infrastructure approaches can be a cost-effective alternative or complementary strategy to built infrastructure in achieving compliance (Mulligan, 2013).

Clearly defined property rights and policy demarcate responsibility for source catchment management, and the extent to which source catchments are open or closed, can impact on a business case getting to the table. Most often, source catchments that are characterised by low development or (recreational) use are often owned and/or managed by Government. In contrast, source catchments that are not owned by the implementing agency, or only partially owned, will struggle harder to get a business case to the table, because investments that occur on private land don't accrue to the implementing agency's balance sheet.

Clear agency responsibility for delivery makes the case easier to get to the table. Multiple agencies with inconsistent objectives obscure line of site to the business case argument.

Challenges in preparing the business case

Challenges in preparing the business case include:

- Uncertainty around relationships and lack of biophysical production relationships. Optimistically, even the best models often do not capture 20–40% of variation for annual prediction (Schmidt & Mulligan, 2013)
- Difficulties in estimating the likelihood of occurrence of low probability events. There is limited understanding of the transport and fate mechanisms which determine the concentrations and duration of pollutants in the environment (Guice et al., 2009)
- Substantial and cross-disciplinary resources needed in the form of both expertise and personnel hours are still required to rigorously apply the most useful modelling systems and investment tools
- Methods for conducting uncertainty analyses abound and are well developed; however, there is no standardised set of analysis tools built into modelling systems or even applied in modelling studies across the board.
- Integration between source catchment biophysical and economic systems. Evaluations often operate at different spatial and temporal scales, use different units of measurement, and different performance metrics, therefore, alignment is challenging
- Evaluation approaches use a number of different economic methods to assess natural infrastructure, including avoided cost, replacement cost, or project benefits. However, there is often low transferability of values between sites and issues
- Risk aversion and regulations requiring redundancy (i.e. built infrastructure even if natural infrastructure should be sufficient). Redundancy, or having two or more natural infrastructure elements included to achieve the same outcome, is one way to reduce risk and uncertainty in the design of natural infrastructure investment portfolios
- Full range of benefits not quantified; full range of costs not quantified
- Lack of a common framework and approach makes assembling a united front difficult.

Rapid Stocktake summary

The following provides a synthesis of the key findings from this rapid stocktake:

1. Most responses to catchment challenges have involved increased expenditure on traditional engineered or built infrastructure assets.
2. Evidence is emerging of the efficiency of complimentary or alternative expenditure on water supply catchment natural infrastructure.
3. Responses to catchment challenges have included management of human and stock activity, reforestation, river and wetland restoration and floodplain management.
4. Drivers for the water industry to invest in catchment management have been regulatory compliance, adoption of a multiple barrier approach, declining raw water quality driven by land-use intensification and recognised cost efficiencies.
5. Critical success factors for catchment management programs are water industry leadership and prioritisation, identification of key threats, clear vision, partnerships, viable action planning, financial and regulatory incentives and monitoring.
6. Influencing of internal and external stakeholders is a core requirement.
7. Key external stakeholders are policy makers, legislators, regulators, catchment organisations and industries, landholders, catchment communities and customers.
8. Significant barriers to catchment management programs are a bias toward projects which can be capitalised and included in water pricing, non inclusion of catchment assets on formal water provider balance sheets, a dominant engineering culture, lack of knowledge and long time frames for outcomes.

Rapid Stocktake summary (cont)

9. Business cases for catchment management depend on the relevant regulatory frameworks ability to provide service baseline and additionality requirements, allow sufficient flexibility, deal with third party ownership and identify clear agency responsibility.
10. Challenges in preparing business cases include complex biophysical relationships, resource requirements, uncertainty in terms of risk and consequence modelling, lack of integration between biophysical and economic modelling, risk aversion and a lack of benefit and cost quantification and common framework approaches.
11. Tools for supporting business case development are risk based assessment, financial analysis, cost benefit analysis, cost effectiveness analysis, economic impact analysis, incidence analysis, multiple objective planning and green grey analysis.
12. Evidential requirements of business cases will be driven by the degree of associated risk.
13. Monitoring of program outcomes is crucial.
14. Monitoring of catchment programs is challenging because of varying spatial scales, multiple influences, the high variability of natural systems, time lag effects, contested definitions of success and the impact of climactic events.

2. Case Studies

Showcasing source catchment management successes

Landuse Planning in Open Catchments

Engaging with Customers about Catchments

Source Catchment Legislation in the US and Australia

About the case studies

A key component of this project was the identification of case studies that could help water utilities develop make stronger and evidence-based business cases for source water catchment management.

The **Rapid Stocktake** component of the project identified the importance of influencing key decision makers and communities of practice to engender support for water source catchment protection and management. An **Influence Matrix** was developed to summarise these findings.

Some key elements of this Influence Matrix are explored further in **three case studies** that cover:

- *Land use planning in open catchments*
- *Engaging with customers about catchments*
- *Source Catchment Legislation in the United States and Australia*

To access the full case studies, please refer to the Rapid Stocktake and Case Studies report in the project toolkit.

Land use planning in open catchments

This case study examined the land use planning activities in the water supply catchments of New York and Sydney.

A fundamental learning from water utilities that have avoided expensive technological solutions to drinking water quality is the importance of acting to protect critical catchment lands from inappropriate development. The business case for effective landuse planning rests not only on the potential cost saving in terms of water treatment but also on the fact that in most instances over the longer term the opportunity costs of catchment protection are rising as the value of land and the worth of foregone land-uses increases. Delaying action can make catchment protection prohibitively expensive. Water utilities in some jurisdictions can capitalise land purchases and include these costs in overall water price charged to consumers.

In most cases outright purchases of catchment land are not feasible due to scale and cost factors. Several water utilities have been identified as completely owning their catchments or having highly forested catchments with limited development pressures. Foresight from previous generations have identified the value in protecting catchments to preserve water quality, e.g. Melbourne Water.

The New York and Sydney case studies show that often water utilities are not in charge of landuse planning and are one of a number of competing interests. Local government plays a critical role in landuse planning and have a number of capacity constraints that limit their capacity to fulfil their role. In both instances examined the water utilities have provided extensive guidance material and resources to better inform future landuse planning. In the Sydney example a major water quality incident prompted reform of the water management system and the approach to land use planning in the supply catchment.

The Sydney guideline is only triggered by new development applications and many activities such as an intensification of existing agricultural production are not impacted by the development application process. The New York case study regulation provides a far broader range of land uses and industries and regulates existing as well as proposed pollution sources. The strong regulatory basis within the New York source catchments towards existing and proposed land uses has enhanced the adoption of associated programs such as best management practice.

Landuse planning in open catchments (cont)

Key Success Factors

The key success factors identified in terms of land use planning are:

- Strong engagement with local government.
- Provision of extensive guidance material and support services.
- Significant internal resourcing to manage land use impacts.
- Resourcing of external agencies to manage land use impacts appropriately.

Recommendations

1. On the basis of the case studies examined it is recommended that where statutory obligations do not exist, water utilities engage with local governments to manage threats to water quality from existing and proposed land uses.

2. Water utilities should pursue or seek to enhance powers that ascribe them a formal role in strategic and statutory land use and the ability to address or influence existing and emerging sources of pollution.

3. Water utilities need to resource internal and external activities to manage water quality threats from land use and proactively influence strategic landuse planning processes.

Engaging with customers about catchments

From the literature examined the need to engage and influence the drinking water customer as part of a catchment management program was identified.

Engagement has mainly focussed on communities living in catchments, which have a variety of drivers rather than specifically targeting the drinking water customer.

The lack of engagement with customers reflects the dominant cultural, technical and managerial approach to water management identified in the rapid stocktake assessment. The need to inform and engage drinking water customers in the production and management of their water supply is, however, now becoming an industry imperative. This is in part because regulators are requiring utilities to better demonstrate how they are managing this highly important relationship. This case study reports examples in which drinking water customers have been engaged by source catchment management programs and investments.

The detailed case study reports on examples in which drinking water customers have been engaged as part of catchment management programs and investments.

- The City of Whitefish used a proactive community engagement program (including social media) was to gain support for a resort tax and bond to raise additional revenues to buy land.

- Melbourne Water used an innovative willingness to pay survey technique to help identify waterway investment priorities for the next five years, and the overall level of investment supported by its customers.

Engaging with customers about catchments

A highly successful community engagement strategy resulted in an 83% level of support in the City of Whitefish for increased taxes to pay for improved source protection management actions

Source catchment legislation in the United States and Australia

One of the key issues identified in the broader project is the importance of influencing key decision makers and communities of practice to engender support for water source catchment protection and management.

In the politico-economic context one of these issues is the influence of legislators at the federal, state and local government level. At the federal level significant differences were identified between the US and Australia. This case study sought to explore those differences as well as any that are relevant at the state and local government levels in the two countries.

Key success factors

- A national legislative head of power for source protection activities provides the necessary framework to enable source protection by water utilities and agencies
- Clear state based planning and enforcement powers for water utilities enable increased control over existing and emerging development in open catchments
- Recognition early in planning processes for source water catchment protection

Recommendations

1. That water utilities continue to advocate for source water protection within Australian legislation and policy frameworks, particularly for:
    - Further recognition of source catchment protection and management programs in the ADWG.
    - A potential legislative mechanism to set minimum regulatory water quality objectives and requirement(s) for source catchment protection at a federal level.
    - Regulatory powers available at the state level in Australia to address non-point source pollution.
2. In the US there is an opportunity to build on the emerging work by organisations to leverage the strengths of both the Clean Water Act and Safe Drinking Water Act to help protect drinking water.

3. Catchment Management Investment Standard

Building robust and evidence based business cases for source catchment management investments

What is the CMIS?

The Catchment Management Investment Standard (CMIS) provides users with a summary of the key steps and practices that need to be completed to develop a robust and evidence based investment in source catchment management activities. It will meet regulatory investment standards and align with investment prioritization frameworks commonly applied within water businesses. The standard has been developed and tested through consultation with water businesses, catchment management organisations and the project steering team. The CMIS will support water utilities to:

- design new catchment management investments to maximize public health benefits through economic, social and environmental outcomes
- prioritise catchment investment proposals
- develop new catchment management policy
- monitor and measure the delivery of catchment management benefits and costs
- validate and verify the efficacy, robustness and reliability of catchment interventions

This will help water utilities across the US and Australia:

- clearly articulate why a source catchment management intervention is needed, and why it is needed now
- demonstrate the investment logic - the economic, environmental and social costs and benefits of source catchment management measures, and the level of certainty of these benefits and costs
- show how these costs and benefits change under different conditions
- show how source catchment measures compliment built infrastructure, and provide goods and services beyond this
- show the distribution of costs and benefits between stakeholders
- identify the best delivery mechanism, and demonstrate the project will be delivered within the time and cost expectations
- identify regulatory, institutional and / or stakeholders that need to be addressed to implement the delivery mechanism
- identify the investor(s) who need to be engaged

The eleven key CMIS steps are explored in the next few pages. **To access the full CMIS and supporting templates, please refer to the separate Catchment Management Investment Standard report.**

Key Steps in the CMIS

1. Identify significant assets and target Levels of Service (LOS)

Clearly articulate the need and develop key message

2. Clearly articulate need → 3. Identify funder(s) and stakeholder(s) → 4. Agree evidence required with funder(s)

Assemble evidence base

5. Build evidence base → 6. Show customer support and willingness to pay → Interim briefing with investor

Develop preferred approaches and filter

7. Investment logic map → 8. Strategic response and delivery identification → 9. First pass filtering of options

10. Prepare the compelling investment case

Benefit valuation → Uncertainty and scenario evaluation → Implementation and monitoring plan

Communication of results

Funder preliminary findings workshop → Investment brief → Funder review and feedback

Final report

11. Monitor, evaluate, adapt and optimise

Implement monitoring and evaluation plan

Reporting

Indicates steps involving the funder

Step 1. Identify significant assets and target Levels of Service

A Strategic Asset Management Plan (SAMP) that defines asset performance requirements, what is being done to meet these requirements, and how service levels will be sustained. The SAMP includes Levels of Service (LOS) for drinking water and other asset objectives (for example other values of water may also be appropriate e.g. ecological needs, waterway condition). For each of these key assets, a SAMP should clearly distinguish between LOS and their drivers (McInnes, de Groot, Plant, Chong, & Olszak, 2010):

- regulatory or operating license drivers that are in place to meet minimum standards and obligations with respect to service provision (e.g. water quality standards)
- broader environmental or social requirements or constraints associated with the delivery of minimum services (e.g. other catchment and river health obligations) and
- the provision of services to a standard exceeding a minimum regulatory requirement where there is evidence that this is efficient / customers are willing to pay for this higher level of service (see ESC 2004; IPART 2008).

The SAMP identifies both minimum LOS and desired LOS. Where the desired LOS exceeds the minimum LOS it makes it clear why this is the case. This SAMP includes (or references where appropriate) the core information that justifies the recommended source catchment asset management activities so that:

- each source catchment can meet its specific levels of service.
- managers can manage asset risks for each source catchment to a reasonably practicable and acceptable level.
- managers can endeavour to optimise investments in its source catchment assets.
- managers can meet legislative, customer, and stakeholder requirements.

For

Step 2. Clearly articulate the need

Initial mapping of the issue from brainstorming. Answer and document the 16 key questions that will rapidly provide decision-makers who we need to convince with confidence that:

- there is a real problem and it needs to be addressed at this time
- there is a clear mandate for us addressing the problem (regulatory, customer or organisational targets)
- there is evidence to confirm the cause and effect of the problem
- there is evidence that the benefits that would be provided by successfully addressing the problem are of high value
- the solution can't be delivered through existing programs
- the solution is likely to be delivered within the time set and will be cost effective compared to other options.

From the outset of a proposal, water utilities need to be able to articulate a clear vision of why the decision to fund a catchment management activity is being considered. The 16 questions set out in the CMIS are a useful way to be able assess whether the vision is clearly defined. The 16 questions address four areas – *problem*, *benefits*, *strategic response* and *solution*

Step 3. Identify the funder(s) and stakeholder(s)

Clearly identify the funder(s) and stakeholder(s) who need to be engaged for the catchment management proposal, why they need to be engaged, how to engage them and when to engage them.

Develop a stakeholder engagement matrix and management plan.

An investment concept brief targeted at the funder should be developed – a one page summary of the investment vision that captures the investment story on a single page using language and concepts that are understandable to a layperson.

Step 4. Agree the level of evidence required with funder(s)

It is well understood that sources and their associated risk to value of assets vary greatly. The level of evidence required for the investment case should align with the value at risk.

In short not all source catchment investment assessments need to be complex and resource intensive. Different stakeholders can have different views on what is required. The key requirement and need for agreement comes from the funder – i.e. the agent who holds the purse strings. The level of evidence that will be required by this funder needs to be agreed and documented.

In the past, source catchment investments have not succeeded because evidence requirements and methods of verifying the achievement of regulatory objectives have not been fully defined and agreed at the outset (McInnes, de Groot, Plant, Chong, & Olszak, 2010)

Step 5. Build the evidence base

The steps required here are to:

- Describe and document the source water system, assets possible sources of contamination and the nature of barriers present.
- Construct and validate a schematic diagram for the source water system that defines catchment risk endpoints for water. For large catchments or groundwater areas, breaking the source water system down into sub-catchments may be advantageous.
- Clearly identify high value assets that you are aiming to maintain, protect or enhance (environmental, social, and economic).
- Describe and document the source water system to develop an understanding of the impacts seen in the catchment, identify possible causes and sources of the impacts, and subsequently quantify the pollutant loads.
- Characterize the watershed, its problems, and pollutant sources. This provides the basis for developing effective management strategies to meet catchment objectives as water quality treatment assets.

Step 6. Show customer support and willingness to pay

This requires customer consultation that shows customers support the investment case and are willing to pay for the benefits that are created by catchment investments.

This step is critical if the catchment investment is delivering LOS for drinking water and other asset objectives (for example other values of water may also be appropriate e.g. ecological needs, waterway condition) that go beyond regulatory / legislative minimum requirements. For these investments the catchment manager should demonstrate that there is evidence that the customer supports and is willing to pay for this higher level of service (see ESC 2004; IPART 2008).

Step 7. Prepare an investment logic map

An investment logic map for the proposed catchment management activity is required. It shows the four primary elements of an investment proposal (problem, benefit, strategic response and solution) are connected in a logic stream.

The Investment Logic Map communicates the investment story in a single page using language and concepts that are understandable to funder(s). The one-pager is equivalent to the elevator pitch when you are asked to describe your investment.

Step 8. Identify strategic responses and delivery identification

Strategic Response Options Analysis, which documents the output of these steps and allows investment decision makers to confidently respond to the strategic response questions in the 16 questions checklist.

Clear articulation of how the utility has identified the strategic responses proposed are the most efficient for the given issues. This will involve identifying how water utility has considered

- **existing asset options:** i.e. using or improving existing Government assets to address the issues
- **new assets:** developing and investing in new assets / infrastructure to address the service need
- **non-asset options:** for example changing regulation or policies to deliver sought outcomes
- **market based solutions:** using market mechanisms such as pricing, property rights and competition to address the service need.

Most catchment management interventions are focussed on (hard or soft) infrastructure investment. Other interventions e.g. non-asset solutions can be used, and delivery mechanisms should be fully mapped out. Strategic response analysis needs to:

- identify the range of interventions (existing asset options, new assets, non-asset options, market based solutions) that could deliver the benefits identified
- decide how the interventions can be packaged and sequenced into sensible strategic options
- evaluate the strategic options to determine relative merit. Merit is based on benefits, costs, timelines, risks and dis-benefits.

Step 9. Do a first pass filtering of the long list of strategic responses and get funder sign-off on the short list

The number of ways that a catchment management issue can be addressed is potentially extremely large. Even limiting the focus to assets of high significance still leaves a long list of possibilities.

The strategic options analysis tool can be used to document the options and assess their first pass feasibility using five basic criteria: benefits to high value assets, costs, timelines, capacity, risks, and dis-benefits.

The step is useful to complete an early elimination of potential source catchment investments before going into a more detailed quantitative assessment. Typically, catchment managers are time constrained and can only do so many detailed assessments. The aim of this filtering step is to eliminate options that fall short on one or more of the key criteria.

By the end of this step you should have a shortlist of significant assets that have significant value at risk and meet initial criteria for more detailed benefit-cost and risk assessment.

Step 10. Prepare the compelling investment case

A compelling investment case sets out the solution consistent with the strategic response, the benefits and costs of these, the delivery mechanisms, key stakeholders, risk management plan and the next steps.

This step provides what is often a 'missing link' – an activity where policy and strategy are directly translated into a balanced set of actions and investments. This is then used to mobilise the preferred investments. It should answer the question:

What set of initiatives will be most effective at implementing the strategic interventions and delivering the expected benefits?

The main elements that the investment case must address are:

- there is a real problem and it needs to be addressed
- the problem needs to be addressed by the funder because of:
    - regulatory or operating license drivers that are in place to meet minimum standards and obligations with respect to service provision (e.g. water quality standards)
    - broader environmental or social requirements or constraints associated with the delivery of minimum services (e.g. other catchment and river health obligations) and
    - services should be provided to a standard exceeding a minimum regulatory requirement because there is evidence that this is efficient / customers are willing to pay for this higher level of service
- the benefits that would be provided by the investment successfully addressing the problem are of high value
- the way the problem will be addressed is strategic, cost effective, and takes into account existing programs
- the solution is likely to be delivered within the time and cost expectations.

Step 11. Monitor, evaluate, adapt and optimise

This requires the development of a strategic asset register and associated asset management plan.

Typically, all 'hard' infrastructure assets of a water utility have been included in asset registers and associated asset management plans. Asset condition and risk assessment are frequently used to assist in managing assets and in investment planning and prioritisation and to guide the implementation of asset maintenance and replacement programs.

Such robust asset management approaches should equally be applied to catchment assets such as land and water to help demonstrate that they are being comprehensively and consistently managed (McInnes, de Groot, Plant, Chong, & Olszak, 2010).

Key documents produced

Investment concept brief
A no more than three-page depiction of the logic that underpins a catchment investment. It represents an 'agreed investment story' that is created in an informed discussion between the investor and project team. It is written in plain English in a way that will allow a layperson to understand the language and the concepts. It provides the core focus of an investment and is modified to reflect changes to the logic throughout its lifecycle.

Investment Logic Map
The Investment Logic Map (ILM) communicates the investment story in a single page using language and concepts that are understandable to investor(s). The one-pager is equivalent to the elevator pitch when you are asked to describe your investment. It builds on the investment concept brief and is written after the evidence base is assembled and solutions are better defined. The primary intent of the ILM is to get a clear understanding of the:

- problem or opportunity impacting the investor
- strength of available evidence to confirm both the cause and effect of the problem
- benefits that can be expected in successfully responding to the problem

Strategic options analysis
A document that explains the logic used to identify which strategic response would best address the identified problem and deliver the expected benefits. This will describe the strategic interventions that were considered, how these were grouped to form a range of strategic options and why the preferred option was selected.

The investment case
The document that is put forward to the investor recommending the investment. It should contain all the information that the investor needs to support your investment with confidence. It should contain all of the evidence that you agreed to include in the investment case with the investor (see 'Agree the level of evidence the investor wants to improve the investment'). The investment case builds on the structure and evidence assembled in the investment concept brief and the strategic options analysis.

The investment case is written in plain English in a way that will allow a layperson to understand the language and the concepts. It provides the rationale for the investment, a clear justification of the driver for the investment, a clear evidenced based accounting of the benefits and costs of the investment, and a clear assessment of contingencies, constraints, risks, and uncertainties

4. Catchment Investment Assessment Tool

Supporting decision makers to evaluate and identify the most cost effective and beneficial catchment investment options

What is the Catchment Investment Assessment Tool

What is the Catchment Investment Assessment Tool?

The Catchment Investment Assessment Tool helps users to prepare financial and/or economic analysis of source catchment investments that they are considering. It can be used to help quantify a wide range of financial, economic, social and environmental benefits and costs of source catchment investments. It is designed to be an easy to use, excel-based system that can be customised to assess alternative source catchment investments.

Who is the Catchment Investment Assessment Tool meant for?

The tool has been built for water utilities who need to demonstrate that catchment management activities deliver social, economic and environmental benefits, and that these benefits have economic value.

The tool can support water utilities across Australia to make a stronger business case to decision makers (and regulators) for catchment management as a viable alternative to more capital intensive (traditional) investments, especially in impaired multi-use catchments.

To get started, refer to the Catchment Investment Assessment tool in the project toolkit.

Using and linking to the tool

What can the Catchment Investment Assessment Tool be used for?

The tool can be used as part of long term planning processes to assess the likely economic, social and environmental benefits associated with options to deliver planning outcomes through source catchment activities (e.g. meeting water quality objectives through a program of source catchment management activities as part of a multiple barrier approach).

The economic tool can also be used to undertake cost benefit analysis of specific catchment management project options that have social, economic and / or environmental impacts (e.g. prioritising source catchment investments based on estimates of the economic, social and environmental benefits each create).

Understanding the extent to which economic, social and environment costs and benefits of source catchment investments may be expected to differ between alternative proposals can help water utilities make a stronger business case to decision makers for catchment management by:

- identifying the likely 'economically, socially and environmentally optimal' project
- identifying social, economic and environmental trade-offs of each option.

Important!

The economic and financial assessment calculators in this analysis tool are designed to give you an initial order of magnitude estimate of the likely costs and benefits of source catchment management actions. As you progress your investment you should verify the benefit and cost assessment with people that have experience in financial and/or economic cost benefit analysis.

5. Source Value Transfer Database

Supporting decision makers to articulate the economic value of catchment investment options

About the Source Value Transfer Database

The Source Value Transfer Database (The Source) is a searchable database of more than 200 estimates of the economic and financial benefit values of source catchments as water quality treatment assets. The Source compliments traditional financial benefit cost analysis of source catchment investment projects and programs. It does this by identifying studies that have estimated the financial, economic, environmental and social impacts that can be associated with source water investments in dollar terms, and by presenting these estimates in a common format in the database.

The Source has been built for water utilities and catchment managers who need to demonstrate that catchment management activities deliver social, economic and environmental benefits, and that these benefits have economic value. It does this by filling an information gap that has been identified as a significant barrier to getting source catchment investments approved – being able to estimate defensible and evidence based dollar values to the benefits of catchment management actions that improve source catchments' water quality treatment capacity (Schmidt & Mulligan, 2013).

The Source can be used as part of long term planning processes to assess the likely economic, social and environmental benefits associated with options to deliver planning outcomes through source catchment activities (e.g. meeting water quality objectives through a program of source catchment management activities as part of a multiple barrier approach). The benefit value studies in The Source can also be used to support evaluation processes and/or to undertake cost benefit analysis of specific catchment management project options that have social, economic and / or environmental impacts (e.g. prioritising source catchment investments based on estimates of the economic, social and environmental benefits each create). Understanding the extent to which economic, social and environment costs and benefits of source catchment investments may be expected to differ between alternative can help water utilities and catchment managers make a stronger business case to decision makers for catchment management.

To get started, refer to the Source Value Transfer Database in the project toolkit.

6. Next steps

Next steps

During the project three key topics of interest have emerged that may be considered further at some stage. These are:

1. **Continue knowledge transfer between project participants** This would aim to enable utilities to have ongoing access to advice relevant to the implementation of the project tools.

2. **Developing an accepted/recognised Australian set of values/methodologies** for key catchment management activities, for example based on those developed by the Federal Emergency Management Agency in the US. A set of such Australian values could prove invaluable to utilities during the development of business cases for source catchment protection initiatives.

3. **The development of further case studies** linked to each of the key project outputs. These would provide valuable insights for other utilities building business cases, help to ensure the tools are readily applied and enable the outputs from the project to be continually improved into the future.

It is also considered that to maintain best practice the project outputs (supporting tools and documentation) should be reviewed and updated on a regular basis.

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