State of the Streams

A Snapshot of Urban Waterway Management in Queensland

waterbydesign

Water by Design is a program of Healthy Waterways Ltd

HEALTHY WATERWAYS

Acknowledgements:
We would like to acknowledge and thank the following people for their input and assistance during this project:

Ed Kulpa, Cairns City Council
Daniel Snelgrove, Tablelands Regional Council
Peter Bradley, Terrain NRM
Steve Bailey, Terrain NRM
Chris Manning, Townsville City Council and Chair RUSMIG
Jason Lange, Townsville City Council
Jonathan Herron, Rockhampton Regional Council
Leise Childs, Livingstone Shire Council
Elizabeth Bradley, Gladstone Regional Council
Brooke Broadstock, Fraser Coast Regional Council
Shane Westley, Fitzroy Basin Association
Andrew Attewell, City of Gold Coast
DJ Mackenzie, Logan City Council
Luke Galea, Mackay Regional Council
Darleen Irvine, FNQROC
Phil Smith, Ipswich City Council
Natalie Baker, Brisbane City Council
Tony Costantini, SEQ Catchments
Kirsty Cheshire-Brown, Urban Development Institute of Australia
Glenn Browning, Water by Design
Andrew O'Neill, Water by Design
Jack Mullaly, Water by Design
Karen Toms, Healthy Waterways
Des Boulton, Revegetation Contractors
Grant Whitheridge, Catchments and Creeks

Version 1 August 2014
Authors: Steve Skull & Dom Blackham (Alluvium)
Photos: Glenn Browning (except case studies)

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Australian Government

This project is supported by Healthy Waterways, through funding from the Australian Government Reef Programme and was developed in collaboration with the Reef Urban Stormwater Management Improvement Group (RUSMIG). Partial in-kind funding for this project was also recieved from Alluvium.

RUSMIG represents the key urban stakeholders in the Great Barrier Reef catchment, including Local Governments, Regional Natural Resource Management bodies, the Queensland Department of Environment and Heritage Protection, and the Great Barrier Reef Marine Park Authority. The principal role of RUSMIG is an information exchange forum to share experiences and knowledge about urban stormwater management and associated topics.

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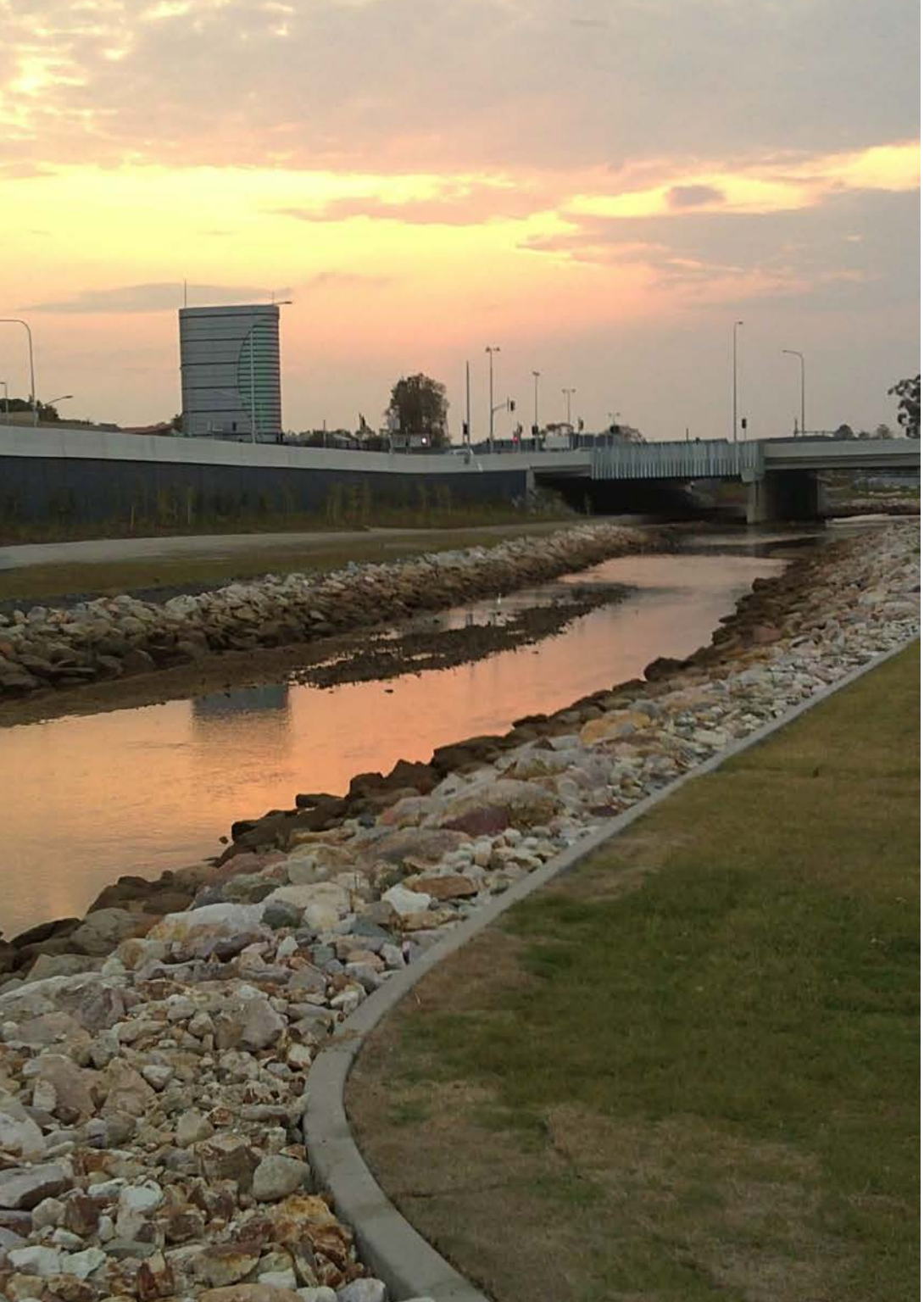


Summary

This project is one of a number that Water by Design have been commissioned to deliver on behalf of councils in reef catchments to help improve water quality flowing to the Great Barrier Reef. Ultimately the project aimed to test the need amongst stakeholders for a new waterway management guideline to be developed. In particular the project sought to:

- Better understand stakeholder objectives and requirements linked to waterway management projects that they deliver

- Use case studies where possible to highlight current issues and opportunities related to waterway management project delivery

- Consider the future scope of any guideline should it be developed.

A number of approaches to stakeholder consultation were utilised during the project including an online survey, targeted meetings and attendance at key stakeholder workshops.

A series of case studies have been developed as part of this project to help explore current waterway management practices and the issues stakeholders face with project planning and delivery.

Most importantly this project has identified broad agreement that a current guideline addressing key stakeholder issues would be highly valuable.

This report therefore outlines the potential steps to deliver such a guideline, as well as its potential scope and format.

Stakeholders now need to be re-engaged with a value proposition focussed on the process of the guideline's (staged) development, with a view to securing sufficient investment to enable the guideline's development to proceed.

Introduction

Project context

Water by Design (WbD) were commissioned to run a number of projects for councils in reef catchments with the aim of improving water quality flowing to the reef. This commission included a scoping investigation for a possible waterway management/natural channel design guideline. The scope for this study was deliberately broad and the Waterway Management Guideline could include: full reconstruction, watercourse relocation, reforming the channel cross section in its current location, rehabilitating only the channel bed, adding minor features to the existing channel, erosion control of the bed and/or banks and revegetation. It is also anticipated that the guideline would cover the full life cycle of waterway management projects, including:

- Planning – objectives, principles and consideration of key emerging policy areas such as stormwater offsets, social amenity of urban waterways and river health

- Design – informative and pragmatic documentation and guidance to inform good design development (rather than extensive sets of detailed design drawings). There is also a need for this element to consider potential training needs in relation to the implementation/engagement associated with the guideline

- Construction and Establishment – ensuring key issues are considered to effectively and efficiently deliver waterway management initiatives on the ground

- Maintenance – critical issues linked to the ongoing management of constructed/rehabilitated waterways including costs, levels of service, location of the asset and their perceived role in amenity and public safety

- Repair – including rectification works to ensure longevity and success of waterway management initiatives.

The guideline will also need to consider key threats to waterways (for example, land use changes and the subsequent alterations to hydrology and geomorphology, sediment, nutrients, other pollutants) and the precautions and mitigation options that water management initiatives can utilise (across the urban and rural landscape) to address those threats.

Should a guideline be developed, it is envisaged that the guideline could have a similar structure and focus to Water by Designs's current Waterbody Management Guideline (WbD 2013). Most importantly this means having sections of the guideline dedicated/targeted to specific stakeholders needs. Decisions about potential guideline content will require further consultation with stakeholders in the future.

Project objectives

This scoping study had two key objectives:

- To better understand stakeholder objectives and requirements in relation to waterway management (in particular their rehabilitation) in this area

- To canvas the types of projects that are currently being undertaken with respect to waterway management and develop a selection of these into case studies

Stakeholder Consultation

Consultation	Location/Date	Stakeholders
Stakeholder forum	Bundaberg 3 June 2014	Reef Urban Stormwater Management Improvement Group (RUSMIG)
Stakeholder survey	Online via Survey Monkey Survey created June 10 and remained open until submission of this report	Broad invitation to local governments, NRM groups, Urban Development Institute of Australia
Meeting	Cairns 19 June 2014	Cairns City Council Tablelands Regional Council
Meeting	Central Queensland 26 June 2014	Rockhampton Regional Council Livingstone Shire Council Gladstone Regional Council Fitzroy Basin Association
Meeting	Brisbane 3 July 2014	SEQ Catchments Brisbane City Council Ipswich City Council City of Gold Coast Logan City Council Urban Development Institute of Australia
Meeting	Townsville/Cairns 8 July 2014	Townsville City Council Terrain NRM
Direct contact (phone)	Various dates	Fraser Coast Regional Council Cassowary Coast Regional Council

Table 1: *Stakeholder consultation*

Consultation process

To deliver against the first project objective a number of approaches to stakeholder consultation were adopted. These included:

- Utilising existing stakeholder forums to raise awareness of the scoping study

- Meetings with individuals or groups – these were conducted in person wherever possible or via video conferencing/phone if face-to-face meetings were not feasible due to time and/or other constraints.

- A survey using the online survey software program Survey Monkey.

For the online survey, a series of questions were developed based on previous surveys conducted successfully by Water by Design. These were then modified based on Alluvium's experience with both technically and socially focussed surveys across a broad range of issues and projects linked to waterway health. A total of 16 questions were then put to participants focussed on gaining a better understanding of the following:

- The relative importance of threats to waterways and receiving environments

- Objective setting for waterway management programs

- Current barriers experienced in the development and delivery of waterways programs and projects, as well as how they might be overcome

- The relative benefits of a range of waterway management actions

- The types of waterways management projects undertaken by stakeholders and their role in those projects

- Current use of guideline type documents by stakeholders in the development and delivery of waterway management projects

- The merit of developing a current waterway management guideline focussed on stakeholders needs.

A copy of the survey provided to stakeholders can be provided upon request. A summary of all the consultation activities undertaken for this study is provided in Table 1

Summary of process

Following the initial presentation at the RUSMIG meeting in Bundaberg, the consultation process resulted in four direct meetings with stakeholder groups across Queensland. Coupled with the 22 responses received via the online survey, the consultation process obtained significant feedback from all targeted stakeholder groups, particularly from local government.

Each of the key areas of interest identified during the scoping study consultation is considered in more detail below. The next section of this document considers results from the online survey, while the remainder considers other issues stakeholders wished to be considered, including the potential scope of a future guideline.

Water Quality

Infiltration

Flow Management

Habitat

What do we value about waterways?

To succeed in waterway management it is important to understand how waterways function and the core values and services they provide for society. This then enables a better understanding of the factors which impact (threaten) and influence waterways, particularly their capacity to absorb and assimilate sediments, nutrients and pollutants and to provide the safe, natural and enjoyable aquatic environments necessary for resilient and healthy ecosystems and local communities.

Maintenance of waterway values is critically dependant on the maintenance of healthy natural landscapes and the processes connecting upslope landscapes with waterways and wetlands along their full length to the lower catchment. This includes managing vegetation, soils and water in the landscape as well as habitats within streams.

Water quality

Good water quality, along with hydrology and habitat structure, is one of the most fundamental elements to waterway health. Clean natural waters are essential to support the biological and ecological processes critical to survival of aquatic plants and animals. Minimum water quality requirements and standards are recognised for these environmental values and for human uses, including drinking water supplies, recreation and amenity, stock and irrigation, etc. These apply to surface waters and groundwater, as articulated in the Queensland Water Quality Guidelines (EPA 2009) and Environmental Values and Water Quality Objectives for particular streams scheduled in the *Environmental Protection (Water) Policy 2009*. Water quality parameters that influence these values include temperature, conductivity, dissolved oxygen, pH, turbidity, sediments, nutrients, pollutants, heavy metals and toxins.

Groundwater

Groundwater is a hidden but critical component of the natural water cycle. It contributes to natural flows and chemistry of surface water bodies, provides water for drinking, stock and irrigation, and supports biodiversity that has only recently become recognised for its potential values. Waterways are usually linked to numerous natural groundwater dependant ecosystems (GDEs) such as springs, soaks and streams. Alluvial and artesian groundwater sources feeding these ecosystems help to ensure continued water supplies for environmental and human uses during periods of minimal rainfall. Condition and longevity of groundwater systems change with decadal cycles in rainfall and are further influenced by human extractions and manipulations.

There are a range of risks to groundwater availability and quality including over extraction. Other activities such as mining, landfills, septic tanks and industrial and agricultural land use processes and discharges have the potential to contaminate groundwater, limiting its range of suitable uses.

Flow dynamics

To support healthy ecosystems, waterways need a certain amount of flow at certain times. For example, wetlands need overbank flow events to ensure delivery of water from the channel to the wetland, and the river needs overbank events to deliver biotic resources from the floodplain to the river channel. Fish need certain depths of water over a riffle to migrate upstream during particular seasons or life cycle periods. Generally the more diverse the channel form (i.e. pools, riffles, bars, large wood etc.), the more diverse the flow habitats (i.e. fast flowing water, resting pools etc.) for a given flow event. Diverse flow habitats are important for a range of instream biota.

Impoundments, barriers and water extraction can substantially alter the flow regime and connectivity in waterways, which can have significant ecological impacts. Seasonal and long-term dynamics in freshwater flows are also important to downstream water supplies, water quality and several other geomorphological and biological processes. Elements to flow dynamics important to environmental flows and waterway health include: flow volumes, rates, duration and frequency.

Channel form

Channel form describes the morphology of the bed and banks and instream features, which could include benches, bars and riffles. Channel form in waterways is a product of geology, sediment supply, rainfall and riparian vegetation condition. The channel form determines the ability of the stream to convey both flow and sediment. Channel form also influences water quality and habitat availability for both aquatic and terrestrial species. When channel form is under threat due to accelerated rates of bed and bank erosion nearly all facets of waterway health are impacted. Adverse impacts on channel form can affect stream stability and conditions for aquatic life as well as potential human uses of the waterway.

Community Interest

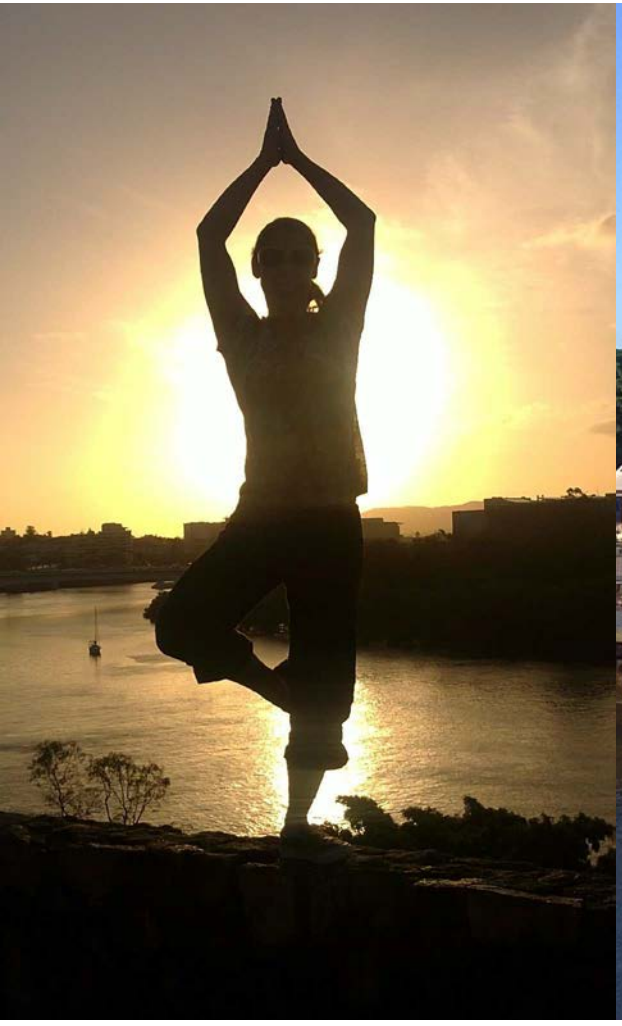
Landscape Amenity

Microclimate

Passive Recreation

Social (amenity and recreation)
Community knowledge, perceptions and attitudes to the values of waterways are crucial to how they use and support wise management of them. Ignorance of waterway ecological and water quality values has historically led to deterioration of waterways. Recent changes in social understanding and values have assisted efforts to improve waterway conditions. Ecologically healthy, aesthetically healthy, clean and safe waterways are vital elements of attraction for locals and visitors to waterways, thus contributing to local economies.

Cultural heritage
Cultural heritage values attached to waterways also affects our willingness to maintain waterway condition. Waterways were critical to the successful European settlement and growth of the many Queensland towns and cities. For Aboriginal and European communities, local historical and cultural knowledge is strongly tied to heritage sites and structures that have been retained along the waterways. Cultural sites, pathways, artefacts and archaeological materials are central to ongoing stories, knowledge and spiritual connections with aquatic and terrestrial landscapes. In addition to existing sites and artefacts, new discoveries provide greater insights into historical and cultural values for local Aboriginal communities as well as mainstream society.

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Wetlands

Wetlands include springs, soaks, marshes, swamps, ponds, lakes and streams which are periodically or permanently wet. Healthy wetlands play a crucial role in assimilating and buffering sediment and nutrient loads on downstream waterways. Palustrine wetlands (swamps) in particular provide this function through abundant vegetation, which acts as a mechanical and biological filter as sediment and nutrient laden waters pass through. Swamp, lake and riverine wetland environments support a high diversity of habitats and niches, high primary productivity and productive food webs.

They provide food, shelter and breeding habitat for complex communities, native species and populations of macroinvertebrates, fish, frogs, reptiles, birds and mammals. Wetlands are important in buffering and mitigating the large pulses of floodwaters during high rainfall events, particularly after extended dry periods.

Losses in area and condition of wetland habitats can lead to losses in aesthetic
values, ecological processes (biological and physical), and create enormous costs downstream in terms of flood damage, water quality controls, river repair, etc.

Riparian zone

Riparian habitats provide essential ecological roles in maintaining stream bank stability, sources of snags for instream habitat, shading and temperature stability for aquatic fauna (Davies et al 2004), and habitat and wildlife corridors to support regional biodiversity. Loss of riparian habitat leads to loss of these functions, with deterioration in water quality, aquatic life and fisheries values, declines in recreational and aesthetic amenity, and may increase problems in other parts of the waterway system.

Fish diversity and abundance

Native fish populations serve a number of ecological roles in the wetland, small stream, riverine and estuarine waterway environments. Small native fish help to control mosquito larvae in swamps and ponds, larger fish support recreational fishing in freshwater and estuarine areas, and fish of many types are food for fish-feeding waterbirds. The recreational fishing and natural amenity values attached to healthy fish populations are directly important in attracting locals and visitors to a region. As such, they support several components of local economies.

Macroinvertebrates

Macroinvertebrates are essential components in aquatic food webs, supporting native fish, frogs, and ultimately waterbirds and other fauna populations. They provide crucial roles such as leaf litter decomposition for aquatic habitat health and other ecological processes. Macroinvertebrate species richness and abundance also depend on good water quality, flow regimes, intact riparian and instream habitats, and are key indicators of waterway health.

What are the biggest threats to waterway values?

Nine threats to waterways were identified in the survey and are considered as significant by the respondents (Figure 1). Diffuse pollution and fish barriers ranked as the highest perceived threat, whilst exotic species and construction stage erosion and sediment control ranked the lowest. Point source pollution and clearing of the riparian zone also ranked highly.

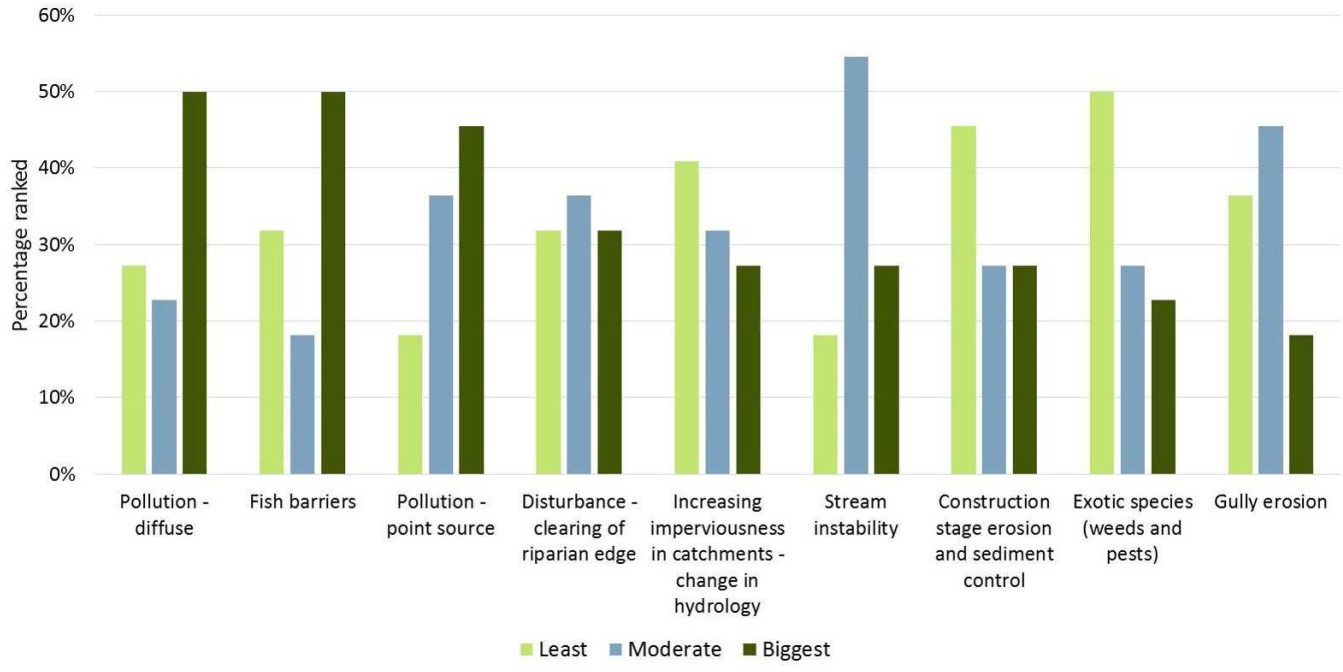

Figure 1. *Survey responses for the relevant importance of different waterway threats. Chart shows the percentage of respondents who ranked each waterway threat as least threat (rank 1-3), moderate threat (rank 4-6) and biggest threat (rank 7-9)*


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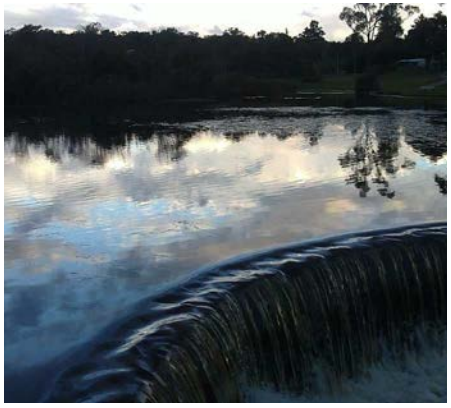
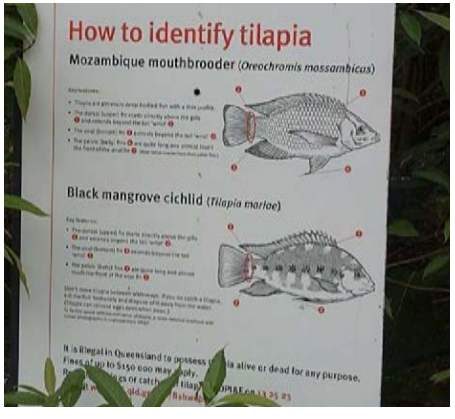
TOXIC ALGAE CONCENTRATIONS IN THIS LAGOON EXCEED SAFE LEVELS.
• DO NOT ENTER OR COME IN CONTACT WITH WATER.




How to identify tilapia
Mozambique mouthbrooder (Oreochromis mossambicus)
Black mangrove cichlid (Tilapia mariae)

Flooding

While on one hand flooding is a natural process and can provide much needed nutrients to the floodplains. On the other hand it can add to the pressures faced by local ecosystems. What happens in the catchment in terms of land use and housekeeping will inevitibly influence the toxicity of a given flood.

Increasing climate variability will also add to these pressures by increasing the frequency and destructiveness of weather events.

Potential waterway projects therefore need to provide sufficient space for floods. They need to provide for stability of the system gaurding against catastrophic scour events. They need to ensure adequate riparian coverage to filter and take up nutrients. Waterway projects need to build up the resilience of the natural systems against these unpredictable flood and drought events.

How do we manage these threats?

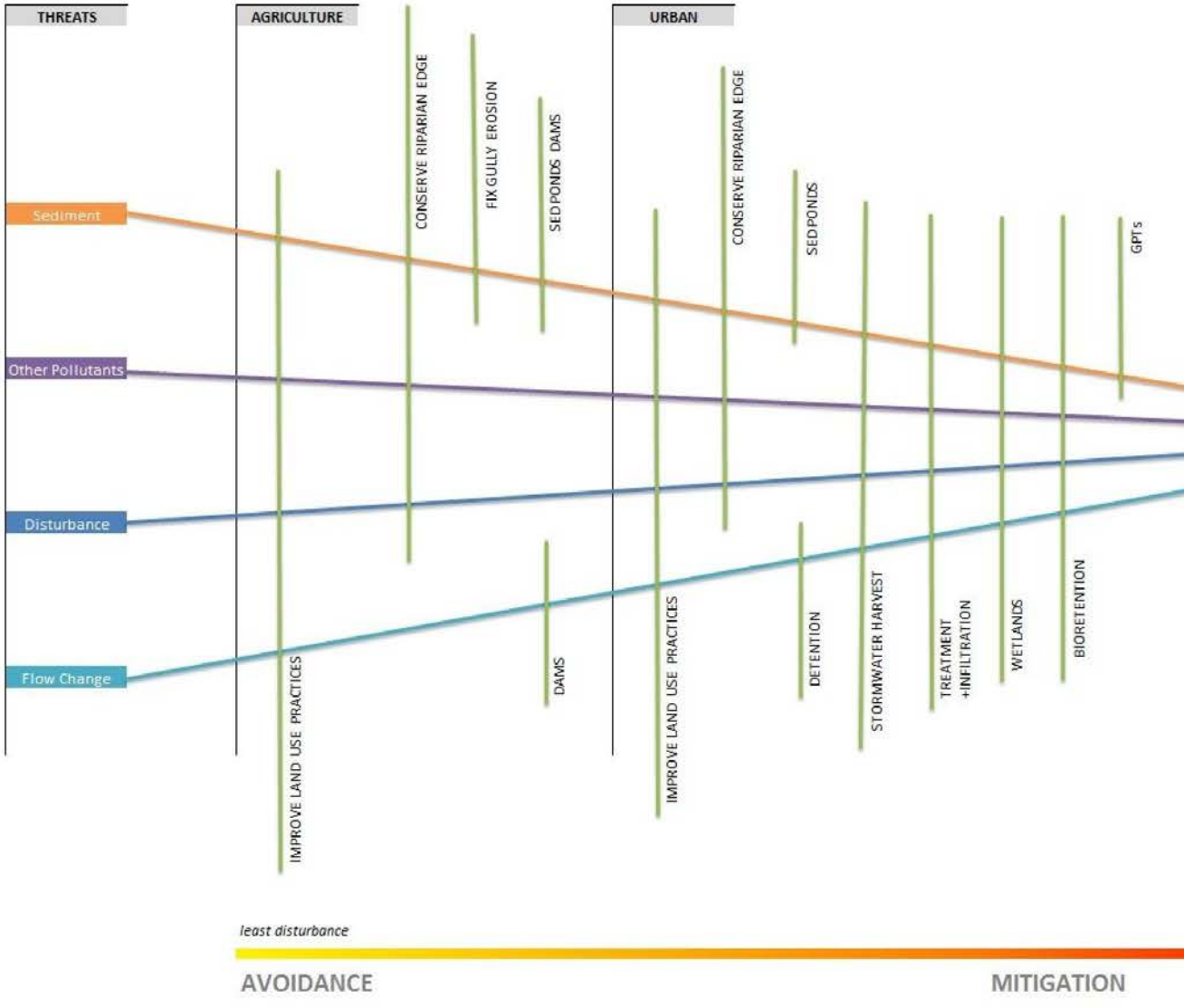
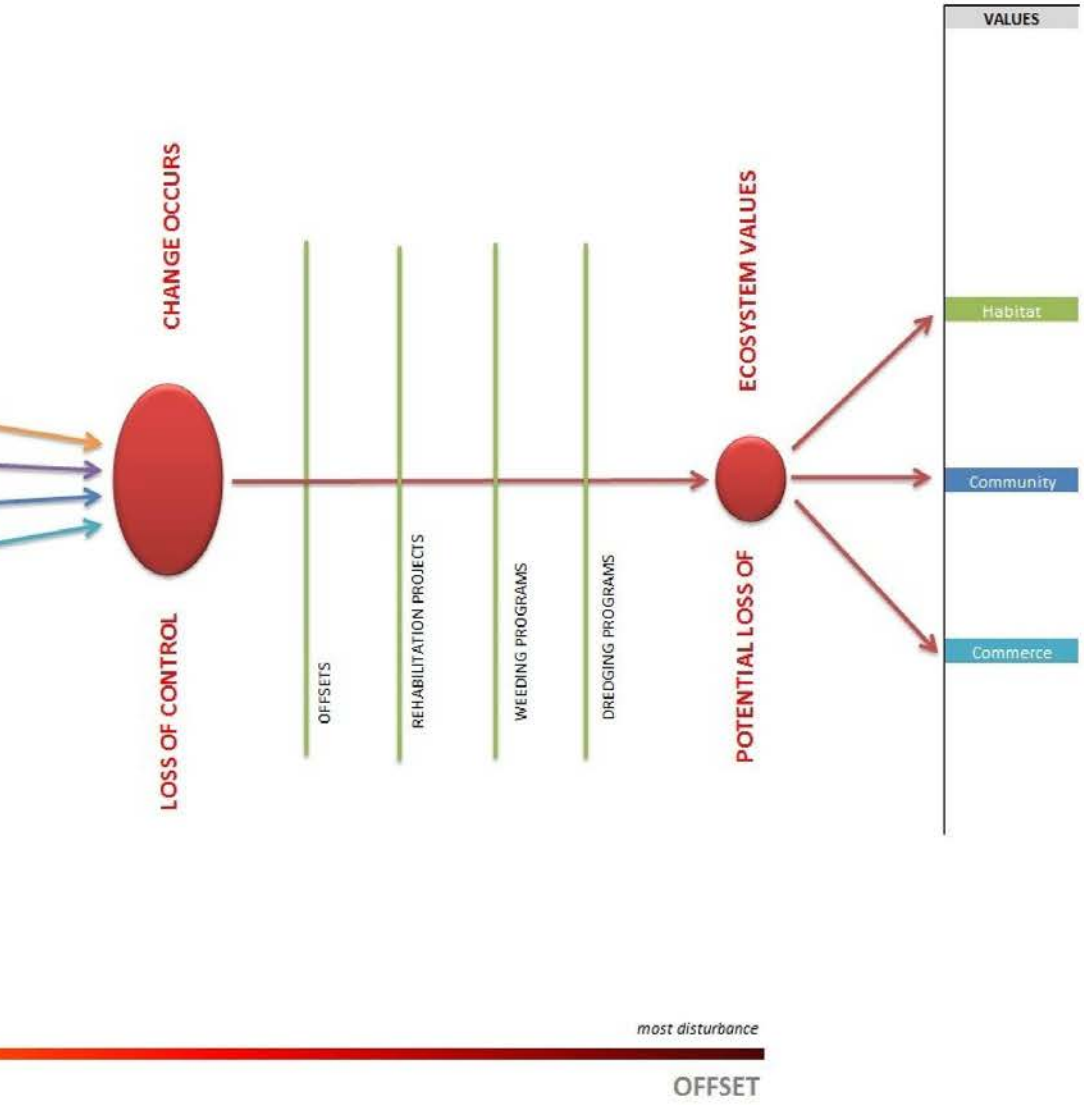


Figure 2. *Threat / barrier diagram for waterways*



There are many potential tools available that waterway managers can use to guard against threats to waterways.

The selection criteria for the managment tools will largely depend on the unique conditions for each catchment however preference should be towards management actions that can avoid impacts (e.g. conservation, low impact design etc) (Figure 2).

Once pressures have been created it potentially becomes more and more expensive to provide a management response to completely guard against impacts. And once pollutants or disturbance or flowchange reaches the creek (i.e the loss of control point) there is inevitably impacts on the waterway. Efforts can be made to rehabilitate creeks after this point however it is likely that the biodiversity will not return to the same level.

What should be the priorities?

The respondents identified a number of activities that should be carried out. An important activity was setting objectives for waterway management programs and projects.

Respondents to this survey question indicated that improved urban design, conservation of riparian ecosystems and improved water quality were the highest rated objectives for waterway management projects (Figure 3). These were closely followed by increasing stream resilience (particularly stream stability) and reducing maintenance levels and, as a result, project life cycle costs.

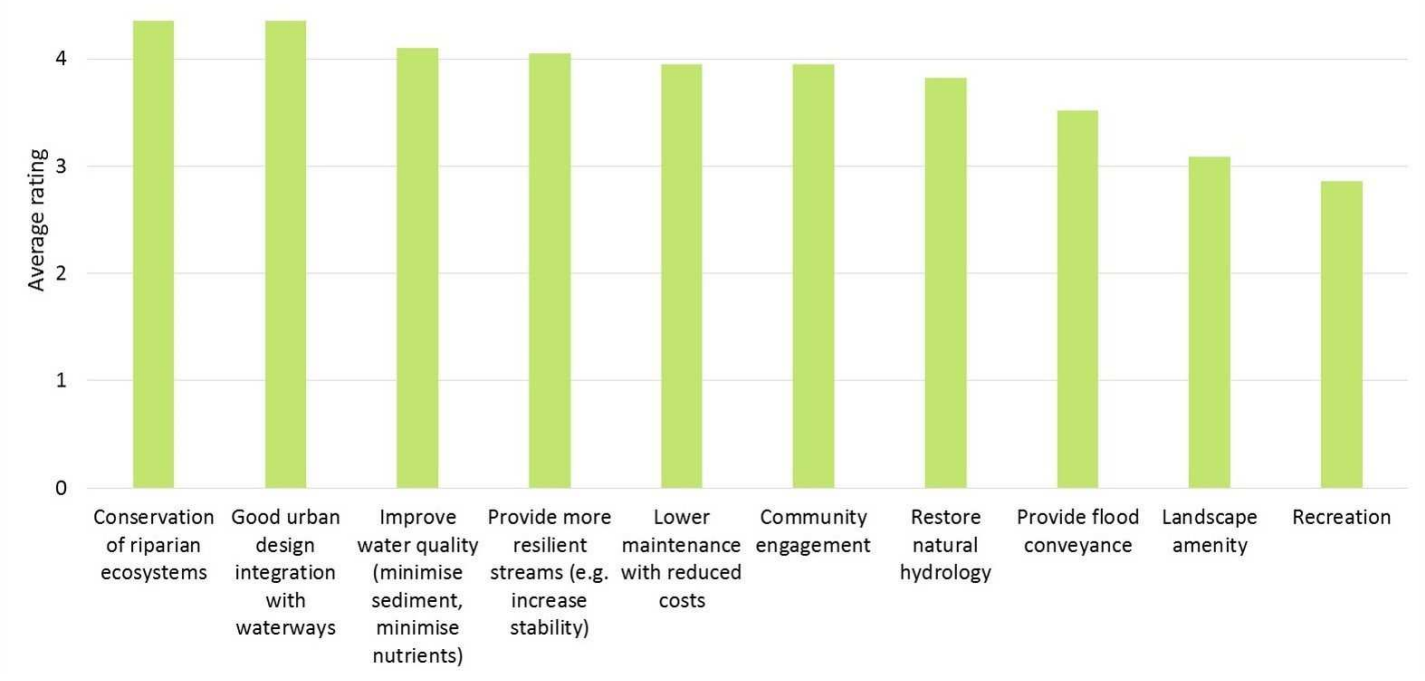
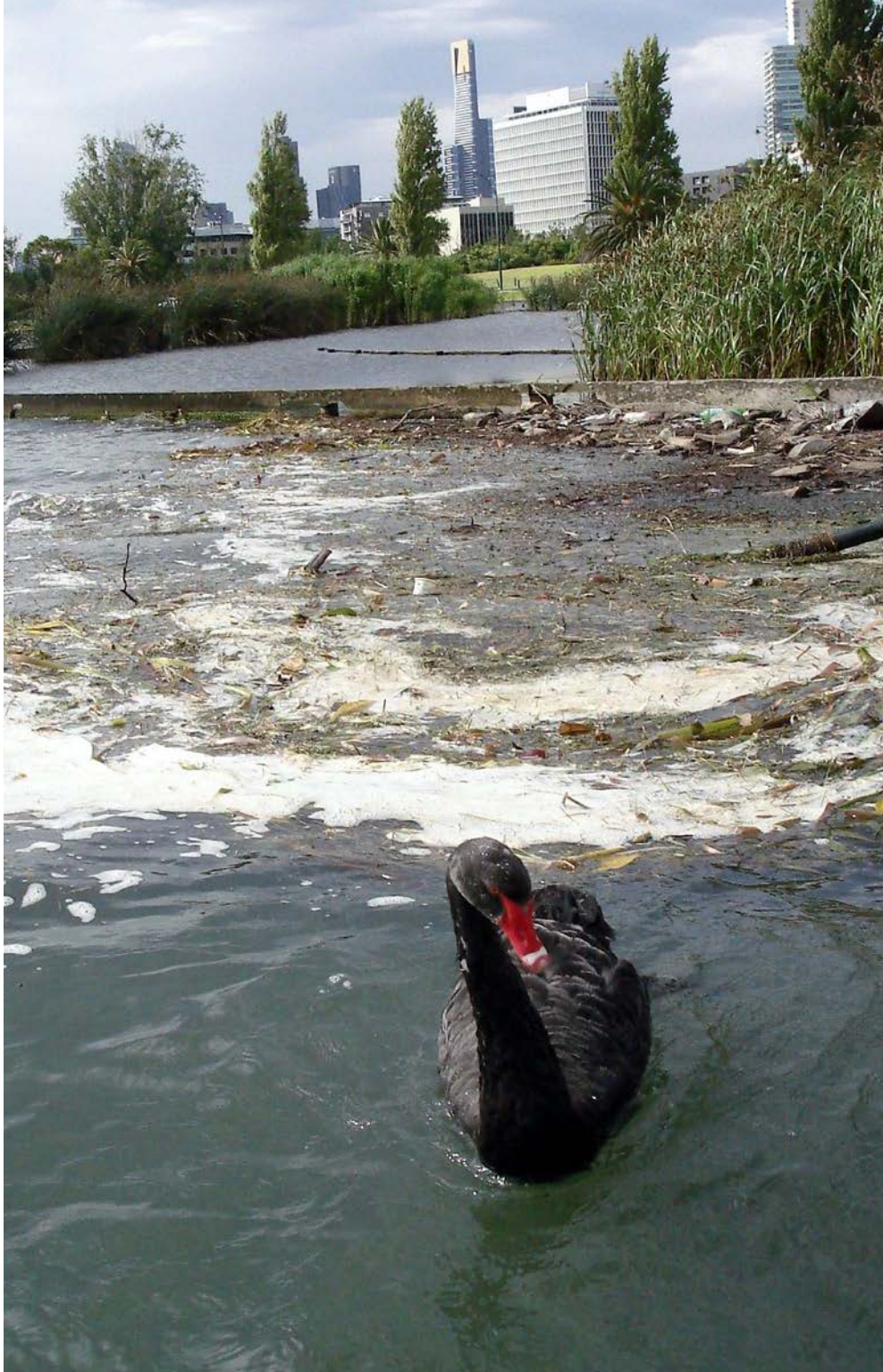
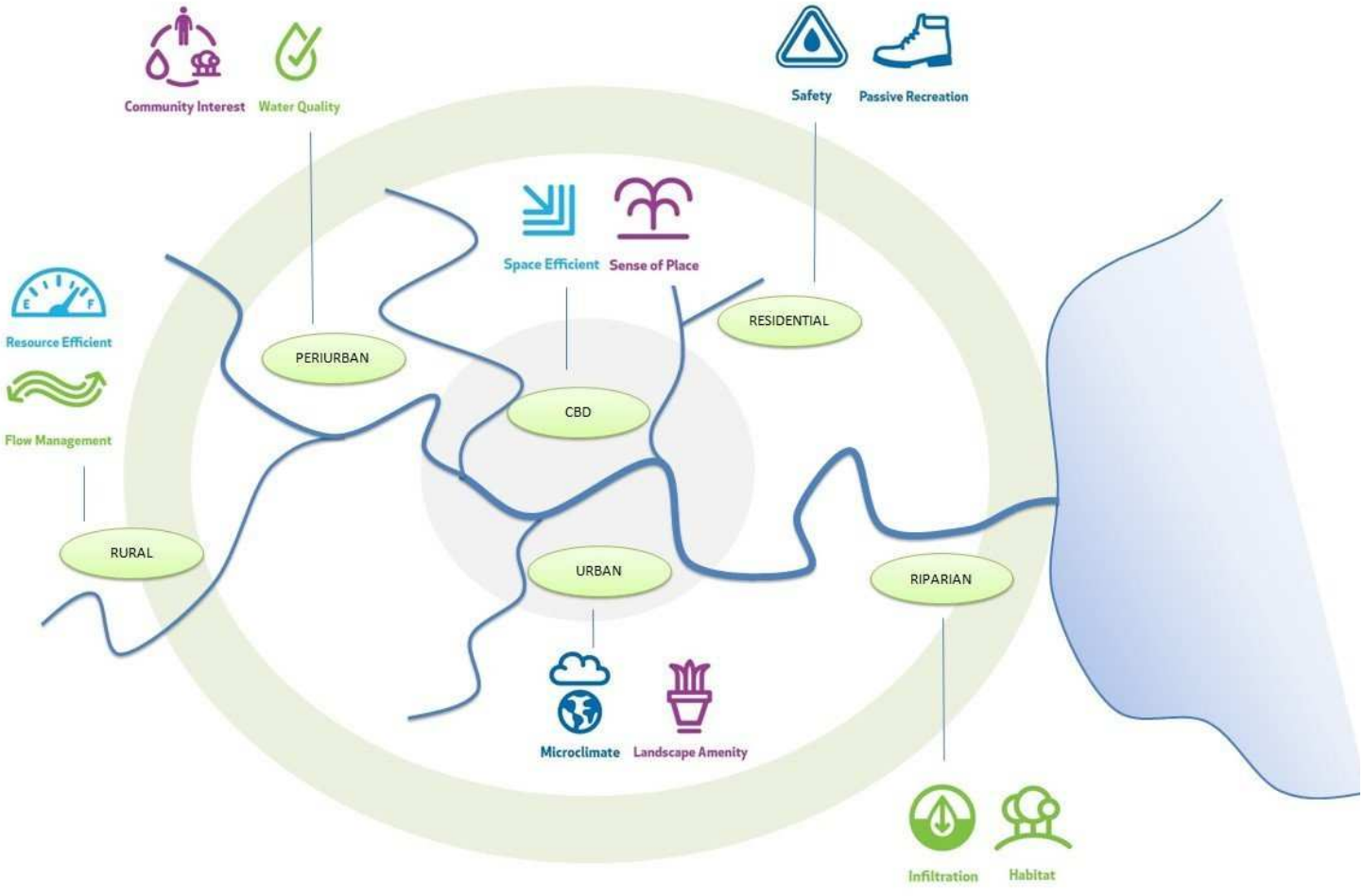


Figure 3. *Survey responses for the relevant importance of different waterway program/project objectives*





How do objectives change across the catchment?

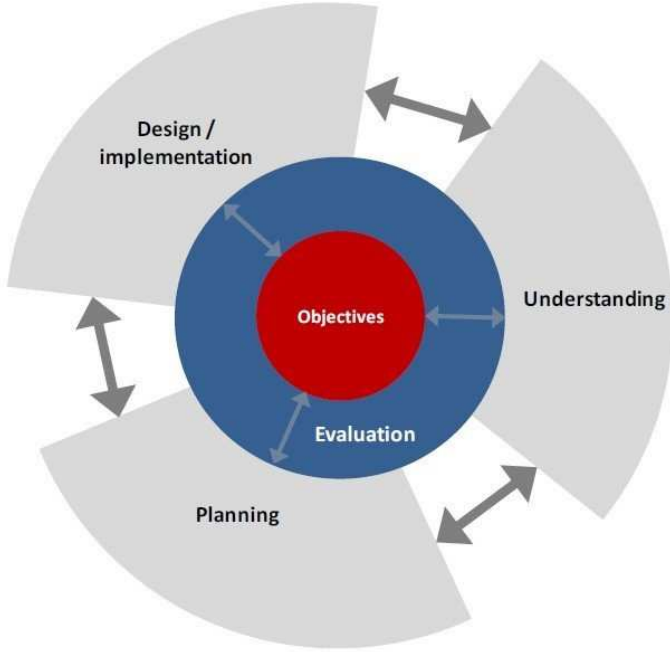


Figure 4. *Stream restoration planning framework*

Setting specific, measureable, and clear objectives is critical for any waterway project. The guideline could provide guidance on this aspect. Evidence from over 25 years of Australian stream and floodplain restoration demonstrates a sound planning framework is essential for effective waterway project planning, design and implementation. A planning framework articulates clear objectives, identifies key risks in the study area, guides assessment of condition and future trajectory, and ultimately allows for effective restoration prioritisation. An effective planning framework allows comparison of different management options and the design, implementation and monitoring of restoration works. One such framework that we use is based on the one developed by Ross Hardie for the Technical Guidelines for Waterway Management (Vic. Dept of Sustainability and Environment, 2008) and applied in more than 300 projects across eastern Australia. The proposed framework is presented graphically in Figure 4

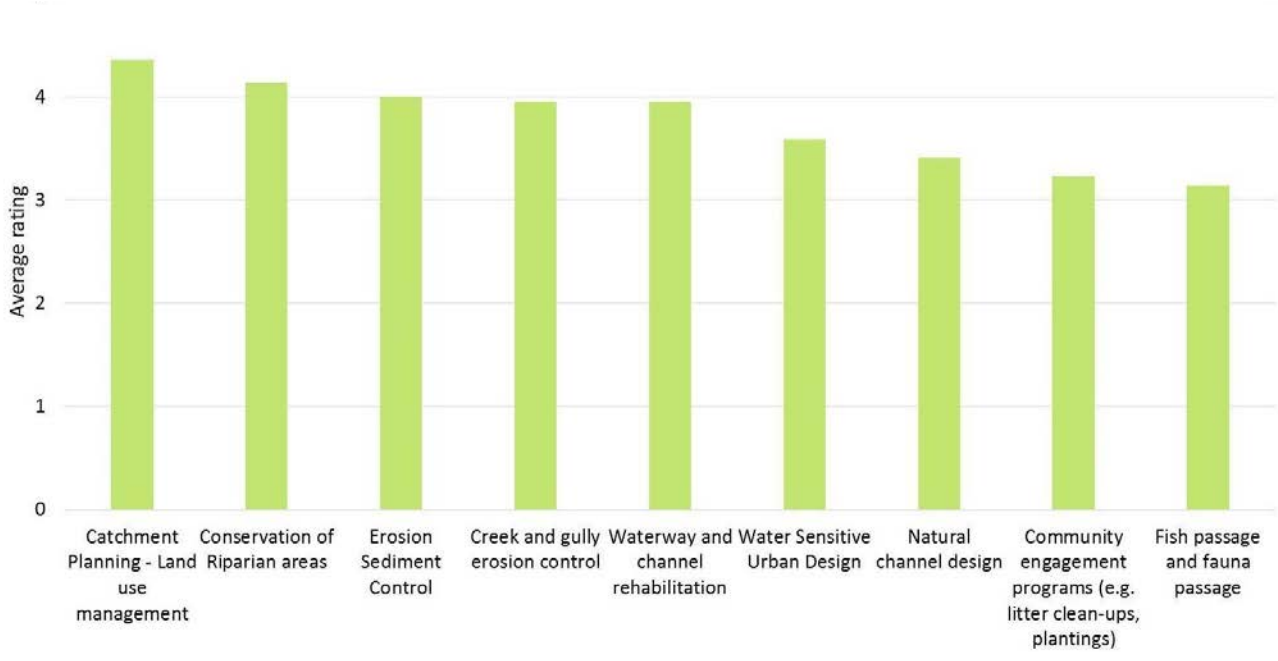


Figure 5. *Survey responses for the relevant importance of different waterway management actions that would most benefit future health of the reef.*

Effective waterway management programs can protect and improve the waterway and receiving ecosystems. Waterways in the reef catchments all ultimately drain to the reef, so respondents were asked which waterway management activities would most benefit the future health of the reef.

The activities identified by the respondents were improved catchment planning (landuse), riparian ecosystem conservation, and waterway/channel rehabilitation and erosion management in gullies and during the construction phase of urban development (Figure 5). This recognises the importance of strategic landuse planning initiatives recognising key issues such as preservation of remnant habitats (not clearing unnecessarily) and preservation of adequate riparian buffers, slope and soil type.

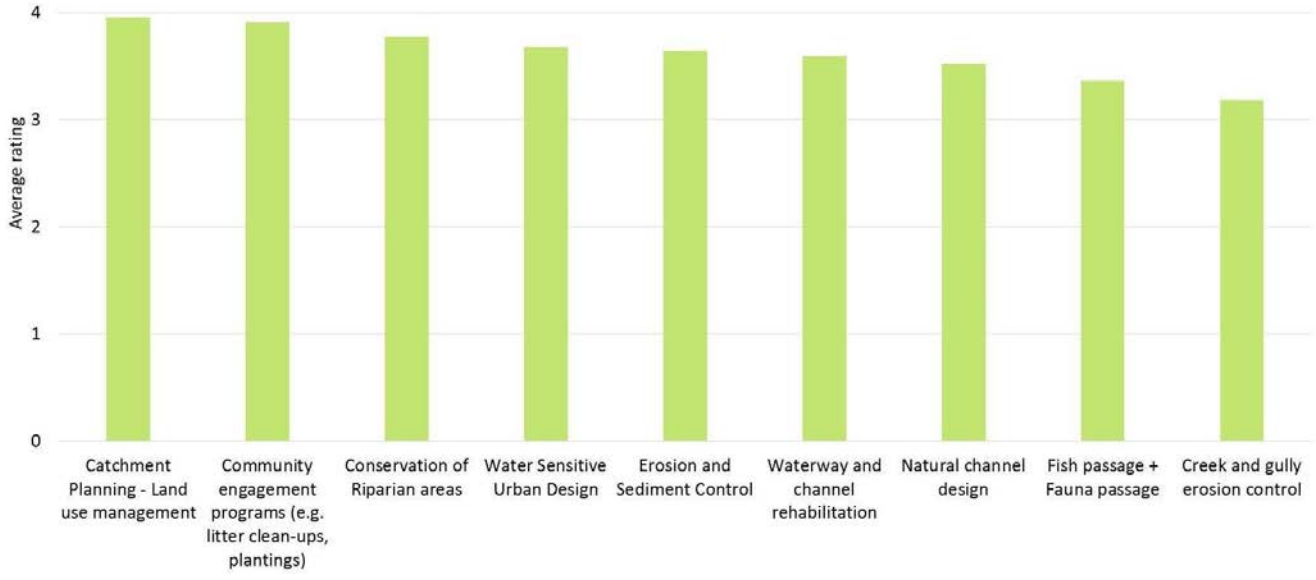


Figure 6. *Survey responses for the relevant importance of different waterway management actions that would most benefit the community*

Waterways in urban areas are important community assets. Respondents were asked to consider which activities would most benefit the community. Here the responses were relatively evenly spread across the nine categories (Figure 6). Perhaps not surprisingly community engagement rated very highly, and in follow-up conversations with respondents it was generally viewed that this was required across many aspects of waterway management projects to help communities better understand them (planning processes, costs, timeframes linked to the need for approvals, management actions etc.). Other issues that rated highly here were once again landuse planning in the catchment and riparian ecosystem conservation.

What are we doing well?

Assuming that the objectives for a waterway management initiative are well understood, some important additional context for successful waterway management programs and projects relates to our current state of knowledge in two additional areas: system understanding and management intervention. A short summary of this knowledge is provided below (sourced in part from Hardie 2013).

- We know floods will continue to drive channel change in alluvial stream systems across Australia and we have the ability to predict the scale and likelihood of these floods

- We also know that ongoing flood related channel change will impact on private and public assets (including the health of riverine, estuary and coastal systems)

- We have the technology and capacity to predict, manage and prevent accelerated rates of channel change with confidence. This comes from utilising highly developed tools (e.g. hydraulic, hydrologic and water quality related geomorphic assessments) and an understanding of key hydro-geomorphic criteria (channel velocity, channel shear stress, sediment transport capacity and specific (unit) channel stream power)

- We know that the protection and/or establishment and management of native riparian vegetation is the key to many waterway management solutions. Riparian revegetation can provide the critical influence on whether a stream is subject to flood related channel change, the greatest influence occurs in streams and events where stream powers (and other parameters) are within identified bounds. Vegetation must be of remnant quality and diversity and this may take some years to establish.

- In urbanised areas we have a very well developed understanding of management intervention approaches linked to Water Sensitive Urban Design (WSUD) to assist with the improved management of urban stormwater in a range of settings (roads, channels, waterbodies etc.)

- We also know that projects that tend to succeed are those where a good system understanding has been developed before management intervention.

Case Studies

The second objective for this scoping study was to canvas the types of projects that are currently being undertaken by stakeholders and develop a selection of these into case studies. The purpose of the case studies was to help explore current waterway management practices and the issues stakeholders face with project planning and delivery. The information sought for case study sites identified by stakeholders included the following:

- Size/type of project
- Project site context
- An outline of any issues and/or constraints encountered during the project
- Key practices
- Project costs
- Any planned project monitoring approaches and/or results
- Lessons learned during the project's life cycle.

Seven sites were chosen as case study sites and each of these is outlined in more detail in the following sections

One:
Currumbin Creek

Two:
Slacks Creek

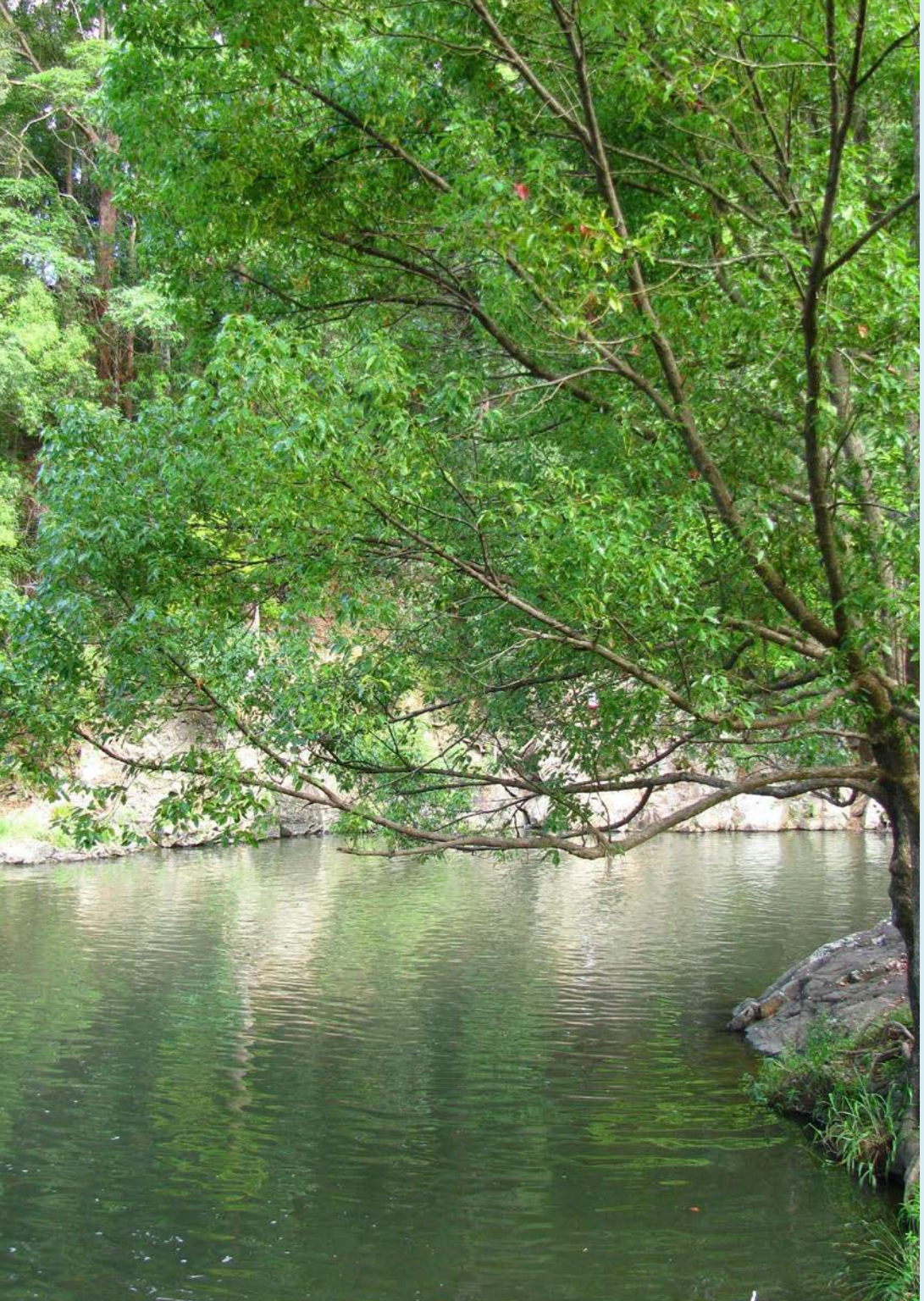
Three:
Gustav Creek

Four:
Moores Gully

Five:
Gunambi Creek

Six:
Moores Creek

Seven:
Louisa Creek



Case Study One: Currumbin Creek Rehabilitation

Project Summary
In 2004 the City of Gold Coast carried out a Catchment Study for Currumbin Creek that examined the extent of catchment modification with a focus on geomorphic, riparian and aquatic ecological condition. A subsequent rehabilitation plan was developed in 2006 for the lower freshwater section of creek, identified as a high priority due to unstable streambed and banks and poor riparian vegetation. Recommended works include bank stabilisation, in-stream structures and a high flow bypass structure along with revegetation of the riparian zone Implementation of the plan is being undertaken in stages, with the highest priority works completed in 2008 and 2010

Project scale and objectives
The study area consisted of a 2.4 km stretch of Currumbin Creek's lower freshwater reach, which was divided into five reaches based on geomorphic classification. Three of these reaches were identified as requiring rehabilitation. To better manage rehabilitation more detailed assessments were undertaken to identify stream segments and prioritise implementation of works (Figure 7).

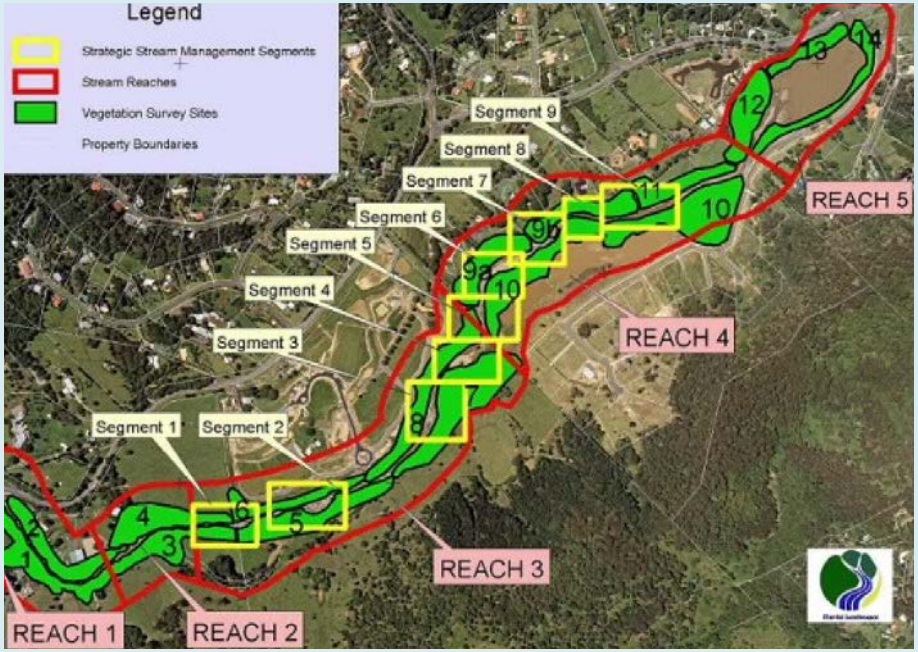


Figure 7. *Area covered by rehabilitation plan*

This project is based on environmental and community objectives:
- Protect land and assets through actively involving stakeholders in the planning process and incorporating their land use requirements into the plan
- Restore riparian corridor connectivity
- Improve ecological health and geomorphic stability of the lower freshwater reaches of Currumbin Creek
- Implement rehabilitation works in a way that will not create any adverse effects on flooding

Site Context
The lower freshwater system is approximately 5 km in length, separated from the estuary by a tidal barrage. Its meandering reaches having been extensively developed for rural and residential use with urbanisation denser along the elevated northern ridges than the flood plain.

Many stream banks have experienced undercutting and are vulnerable to erosion as a result of the clearing of riparian vegetation and historical sand and gravel extraction, which has substantially modified the channel alignment.

Issues and Constraints
During the construction phase of the project, a Social Impact Study was carried out to address the impacts of these works on nearby residents. Overall, the community had a positive response to the works and its long term objectives. The main concerns involved restricted access to the creek and high levels of noise and dust pollution.

Key Practices
The restoration works combine a range of in-stream hard (rock) and soft engineering structures (large wood) that aim to improve the ecological health, geomorphic stability and riparian connectivity of Currumbin Creek. This project showcases a broader Council objective to limit the use of conventional rock armouring of creek banks, which provides limited habitat value and in some instances may initiate other problems.

Rehabilitation works to date have included battering of banks, revegetation with native species (Figure 8) and the construction of rock vortex weirs, flow deflectors and log/rock groynes to provide benefits such as grade control, bank protection and the creation of habitat structure

Construction and ongoing costs
Construction costs for the works completed to date were approximately $900, 000 over 3 years. Biocondition monitoring surveys to be undertaken at 5 yearly intervals will be approximately $30, 000 per survey. Restoration and other maintenance costs are approximately $50,000 over 5 years. Assistance in revegetation planting and weed management was provided by a separate Council department.

Monitoring
A baseline ecological assessment was undertaken at four sampling sites in 2008, prior to rehabilitation works, to assess water quality and record instream flora and fauna assemblages. Photo points were also established at each site and the monitoring repeated in 2009 after completion of in-stream works, and again in 2013.

The 2013 assessment showed that aquatic habitat condition was good to excellent at all sites, with slightly better condition within the rehabilitation area than upstream and downstream. A greater diversity of aquatic plants, macro-invertebrates and fish was recorded in the 2013 assessment than the two assessments that were conducted immediately before and after the rehabilitation works.

Lessons learned

The importance of working collaboratively with all stakeholders throughout every stage of the project was fundamental in achieving a positive outcome and allowing for future management and maintenance of the area. This type of rehabilitation assessment was identified as an important resource for CoGC to construct future in-stream works for Currumbin Creek with increased clarity and understanding from an environmental, economic and social aspect. It can also be used as a template for the rehabilitation of other waterways within Gold Coast's LGA and surrounding LGAs that have similar stream systems and stream impacts.

Reference: All material supplied by City of Gold Coast.

Figure 8. *Before and after example of in-stream rehabilitation works*

Case Study Two: Slacks Creek Rehabilitation

Project Summary
Community concerns led to Logan City Council commissioning the Slacks Creek Catchment Futures Study in 2012, which outlined a long-term approach to catchment recovery that is built around community partnerships. The Slacks Creek Catchment Recovery Project was a pilot initiative founded on strong community partnerships and guided by an 'activate, beautify and clean' (A.B.C) approach to improve waterway health and return valuable community space. The project included community tree plantings, cleanup activities, art installations and environmental enhancement. Council's Project won the title of Best Government Project and was a finalist in the Urban Renewal Award Category at the 2014 Healthy Waterways Awards.

Project scale and objectives
The project comprises six sites, with the aim at each site to restore a section of Slacks Creek to increase habitat for wildlife, improve habitat quality and reconnect areas of riparian vegetation. The works aim to improve water quality, bank stability and pollutant mitigation while increasing the knowledge and engagement of the community to better conserve, manage and protect natural resources.

The project will deliver improvements in riparian function, reduce pollutant runoff, improve habitat values and connectivity and improve recreational opportunities. Key to the success of the A.B.C approach is the focus on achieving a clean, healthy creek which supports and is supported by active and vibrant open spaces. The project will run from 2014 to 2018 and will involve a number of community events and activities.

Site Context
Slacks Creek flows through the heart of Logan City and has suffered significantly from changes in catchment land use. Development has urbanised the catchment including reshaping some of the smaller tributaries. Slacks Creek is under pressure from erosion and pollution from unfiltered stormwater from urban areas. The creek and catchment still supports large wildlife areas and possesses enduring ecological and community values.

Issues and Constraints
Over the past 50 years the catchment has changed from forested landscapes to urban uses and the impacts this change brings has significantly compromised the creek's ability to support biodiversity as well as recreational and social amenity values. The extent and types of rehabilitation works are constrained by available space and access. Rehabilitation measures must look beyond restoring the original creek to accommodate past alterations to creeks and increased rates of runoff as a result of urbanisation.

Construction and ongoing costs
The Slacks Creek Recovery Project has driven an increase in Council investment and significant funding from both the State and Federal governments. Ongoing maintenance will be required, however a key aspect of the recovery project is to enhance resilience through the establishment of vegetation to reinstate the riparian zone and thus minimise the cost and requirement of future maintenance.

Monitoring
Visual inspections are undertaken as part of regular maintenance operations; however there is no regular monitoring program.

Above. *ABC Framework*

Lessons learned
The project's collaborative approach to urban creek renewal has led to increased funding and generated widespread community support. Creating places for people and nature allows for multiple benefits to be achieved, drives investment from multiple sources and encourages stewardship from residents, businesses and the broader community.

A cleaner creek improves ecological conditions and more active parklands create a sense of place for everyone to enjoy. Coupled with opportunities for residents and businesses to be an active part of the recovery process, the collaborative approach drives improved stewardship leading to reduced pollution, healthier creeks and a healthier community.

Reference: Material supplied by Logan City Council (and their website, www.logan.qld.gov.au).

Images: LCC, Lat27 and E2DesignLab

Above. *Rehabilitation templates for various landuses*

Case Study Three: Gustav Creek Rehabilitation - Magnetic Island

Site description/Project Background
Gustav Creek runs through an urbanised area of Nelly Bay on Magnetic Island. The creek was historically well utilised by the surrounding community who swam, fish and recreated in and along its banks. In recent years the creek became clogged with sediment and weeds which led the local residents and a local environment group to approach Townsville City Council with an idea to return flows back to the creek by removing the weeds and sediment. In response TCC worked closely with the community and successfully returned Gustav Creek to a functioning waterway.

Key Practices:
- Developed a Catchment Scale Management Plan, and a Reach Scale Works Management Plan
- Acquired government funding and permits to undertake the work
- Mechanically removed weeds and sediment and reformed a low flow channel with deep pools along a 1km section of creek
- Revegetated the creek banks

C**ommunity Engagement**
The community engagement process was the key to the success of this project and involved:
- Community engagement through meetings, workshops, and planning activities,
- Community and stakeholder involvement in the development of the management plan
- Community participation in weed management and revegetation activities
- Community workshops on property scale weed management and bank stabilisation techniques
- Establishment of a Creekwatch Group with local residents and the school to continue water quality monitoring activities, post rehabilitation
- Installation of educational signage to promote the project to residents and Island visitors.

Outcomes & Success:
- Gustav Creek Management Plan was successfully developed and implemented
- Aquatic habitat values were restored
- Hydrological flows were restored
- Community participation was successful and contributed over 1000 volunteer hours. As a result the community continues to care for the creek.

Project costs
– approximately $100,000

Issues and/or constraints,
A culvert at the mouth of Gustav Creek, where it enters Nelly Bay harbour, led to the restriction of water flows and sediment movement. It was not able to be moved as part of this project as it would have resulted in saltwater intrusion into a creek that is now predominately freshwater. It would have also created an unacceptable flooding risk. It continues to create a barrier to sediment movement and as a result this system will require continued maintenance to keep sediment from accumulating and weeds from re-establishing.

Project monitoring A fish survey was undertaken by James Cook University Ecologists before and after the works. The results found an increase in fish abundance and diversity after the restoration works were completed. The local Creekwatch Group also continue to monitor water quality and report results to Council on an on-going basis.

Source: Townsville City Council

Above. *Gustav Creek before rehabilitation*

Above. *Gustav Creek during rehabilitation*

Above. *Gustav Creek after rehabilitation*

Case Study Four:
Moores Gully - Cairns

Above. *Moore's Gully post works (Source: Brown Consulting, 2014)*

Project Summary

Moore's Gully sits within a 180 Ha multi-stage residential development south of Trinity Beach. Moore's Gully is a tidally influenced waterway in its lower reaches that channels water from the nearby Macalister Range and outlets through the adjoining Marina.

Moore's Gully was previously a highly disturbed watercourse as a result of sugar cane farming, sand extraction and more recently as a spoil site for Acid Sulphate Soils (ASS) and Potential Acid Sulphate Soils (PASS) from the nearby marina land development. Key aims for the project included providing improved conveyance capacity and flood immunity to the development as well as existing land owners. As a result of employing the philosophy of maintaining and enhancing existing environmental values, Moore's Gully provides increased ecological diversity and habitats as well as passive recreational facilities.

Size/Type of Project

The project involved realigning and regrading a length of 2.3 km of Moore's Gully. The design incorporated elements of a natural stream, including sinuosity, low velocity zones and vegetation scour protection, reducing the need for engineered scour protection works. The lower sections of the waterway were re-profiled to increase bank stability and conveyance area.

Substantial revegetation works were undertaken, with the planting of 30,000 native trees, hydroseeding and grass sprigging. Erosion matting was also used in areas of high flow velocities to reduce erosion during the vegetation establishment phase. The revegetation was irrigated and maintained for a period of three years by the developer.

Site Context

The site is within the Bluewater Residential Development, approximately 15 km north of Cairns. The waterway traverses the low lying Moore's Gully and drains into the Moon River estuary. The lower reaches are estuarine and lie within a Marine Zone (prescribed tidal works area). The site is located in the wet tropics and thus experiences summer dominated rainfall. Flows in the creek range from periods of no-flow to flows of up to 150 m3/s in a 100 year Average Recurrence Interval event. Historically, flooding through the Trinity Beach area in larger rainfall events has been an issue.

Issues and Constraints

A constraints analysis was undertaken resulting in a constraints map. The map was used to optimise the design. The major design and construction issues and constraints included:

- The original design for the development included the construction of a 10 ha lake and major flood retention system. It was recognised that whilst these systems work effectively in temperate areas it was unsuitable to the wet tropics climate. As a result, a whole of catchment approach was undertaken and a flood conveyance solution was identified

- The presence of a Major Services Corridor traversing the Moores Gully site. This included a sewer pressure main, a water distribution main and fibre optic telecommunication cables. These limited potential realignment options for the site

- The presence of a fauna corridor between the tidal zone and the existing Trinity Beach Road crossing. Design and implementation of the landscape and revegetation plan was undertaken in close consultation with the Department of Natural Resources and Water

- There were several deep burial pits and surface spoil for dredged material from the nearby material which contained ASS/PASS material. Approximately 24,000 m3 of PASS was treated and reused within the development, whilst 6,000 m3 was removed from site as it was not suitable for reuse

Key Practices

- The design incorporated elements of a natural stream, including sinuosity, low velocity zones and vegetation scour protection

- Extensive revegetation was undertaken and included erosion protection during the vegetation establishment phase (Figure 9)

Figure 9. *Revegetation works along Moore's Gully (Source: Brown Consulting, 2014)*

- The design integrated urban features including cycle and pedestrian paths

- Designers worked closely with the environmental authority to ensure environmental integrity was maintained and improved. For example, design criteria included; banks to have at least five mixed native species, with tree species at 2 metre spacing and beds or benches are to have at least 3 mixed native tree species at 10 metre spacing

- Flood conveyance system tailored for the For North Queensland climate

Costs

The residential area will be developed by private developers. All infrastructure will become donated asset to Council. There will be no direct costs for the development borne by Council.

Ongoing maintenance of the waterway once fully developed will be undertaken by the Council's Northern maintenance depot. Any maintenance costs will be part of their general budget, with as yet no plans for a specific budget just to maintain the Gully.

Monitoring

Monitoring includes the standard construction monitoring for any development occurring within the Cairns Region. Works around the watercourse will be referred to DNRM as a referral agency.

Sources:

Cairns Regional Council

JCU, 2014: James Cook University, Tropical Sustainable Design Case Studies – Moore's Gully, viewed 21/08/2014, (http://www.jcu.edu.au/tsd/static/56_Template_PDF_Moores_Gully_ss02072014_Latest_JCU_138636.pdf

Brown Consulting, 2014: Brown Consulting, 2014, Key Projects: Water and Environment Projects Moore's Gully, Cairns, viewed 21/08/2014

Case Study Five:
Gunambi Creek -
Newcastle

Above. *Before construction*

Above. *After construction*

Project Summary

Newcastle City Council (NCC) initiated a rehabilitation program for an existing open urban drainage channel located in Gunambi Reserve, Wallsend, NSW. The drainage line extended for 224m between Gunambi and Irrawang Street and Irrawang and Bousfield Street. The two drain alignments were identified as requiring rehabilitation due to accelerated bed erosion and opportunities to enhance the geomorphic diversity and aesthetics.

The drainage line conveys impermanent stormwater flows sourced from upslope residential subdivisions, the road surfaces of Gunambi and Irrawang streets and the adjacent floodplain. These waters enter and exit the two alignments through concrete headwalls. Prior to works being undertaken the flow exhibited poor geomorphic/habitat representation and a linear alignment lacking in sinuosity resulting in increased channel slope and active bed erosion. Flows were also mainly contained within the channel as floodplain connectivity was limited owing to the existing valley slope.

Key Practices:
- removal of vegetation (largely exotic, invasive species),
- construction of temporary access road,
- regrading and shaping of eroded banks,
- reshaping and rehabilitation of the creek bed,
- installation of rock bed control measures within the rehabilitated creek channel; and installation of erosion control measures such as jute and mulch.

Objectives
- To reduce the rate of active bed and bank erosion and limit the downstream transport of sediment to Ironbark Creek.

- Increase the geomorphic and riparian habitat representation existing within Gunambi Reserve through construction of natural creek geomorphic features such as cascades, pools and waterfalls.

- Improve the amenity of Gunambi Reserve by way of introducing a natural creek feature to a disused open stormwater drain that will be utilised by the community in a recreational setting.

Costs
Total cost $268,210 ($978 per linear meter)

Project Outcomes Works were completed in late 2013. The pictures show an addition to geomorphic and habitat diversity within an existing NCC reserve. Community feedback since construction has been positive with anecdotal evidence suggesting an increase in recreational use by local residents. The works have replaced an open stormwater drain that was both a pollution source when erosion occurred and a haven for exotic and noxious weeds. Habitat diversity will continue to improve and increase over time as revegetation within the riparian zone matures. The project has also increased the public amenity of the site, with the nature of construction allowing for safer pedestrian entry/exit in comparison to the failing log pin controls.

Source:
Soil Conservation Service
NSW Government

Above. *Before construction*

Above. *After construction*

Above. *Before construction*

Above. *After construction*

Case Study Six: Moores Creek Fishway

Project Summary

This project involved constructing a fishway on Moores Creek, Rockhampton, to expand the territory available for 29 species of juvenile fish. The area of Moores Creek and its tributaries affected by the fishway provides a nursery habitat for juvenile fish.

The Department of Agriculture, Fisheries and Forestry (DAFF) and the Fitzroy Basin Association (FBA) worked collaboratively along with the local council (Rockhampton Regional Council) to undertake the project. The selection of Moores Creek was based on identification in a prioritisation report carried out for the entire FBA area.

Project scale and objectives

Installation of the Moores Creek fish ladder involved the construction of a series of 16 rock ridges set into concrete at regular intervals, over a distance of 30m. Installation of the Moores Creek fish ladder has opened up 1.52 km of fish habitat and provides many benefits:

- The successful migration of diadromous fish species in high priority aquatic habitats

- Allowing juvenile fish species to migrate to upstream nursery habitats so they can successfully complete their life cycle and maintain healthy fish populations

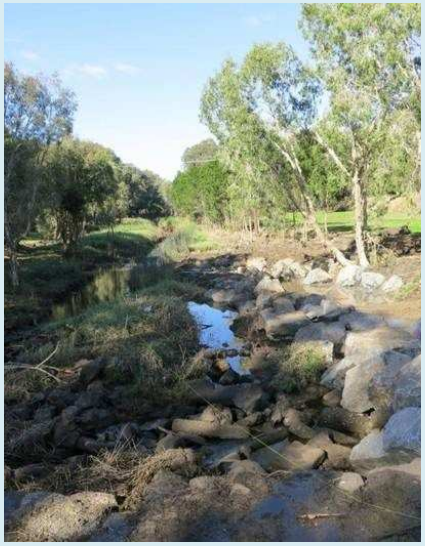
- Maintenance and enhancement of fish communities and overall aquatic eco-system health

- The migration of adults to access habitats for feeding and reproduction purposes

- Raising public awareness of the detrimental effects barriers have on fish populations and the biological, social and economic benefits of improving fish passage through the construction of fishways

Site Context

Road culverts under Moores Creek created a barrier to many fish, especially juveniles, due to the high velocity water passing through the pipes. Moores Creek commences in Archer National Park and is one of the most intact tributaries to the lower reaches of the Fitzroy River, which provides one of the largest estuary systems in Australia and is known to contain many different species of fish.



Issues and Constraints
The purpose of the fishway is to allow juvenile fish to migrate to the freshwater upstream where they have a better chance of surviving as there is less chance of predation by larger fish. Providing fish access to the freshwater wetlands upstream is necessary for some of the species to complete their life cycles. Installation of the fish ladder provides variations in flow conditions which enable the fish to migrate upstream beyond the pipes. The design needs to strike a balance between providing pools suitable for fish to rest and avoiding backing up flows which may affect the crossing and culvert performance and impact on established vegetation. Design and installation were also planned to avoid disrupting traffic flow.

Key Practices
The Moores Creek fishway is a highly efficient structure. By retrofitting a structure to existing culverts the project was able to improve fish passage at low cost and with minimal interruption to vehicle traffic. The simple rock ridge structure has been designed to minimise the trapping of debris and sediment while providing conditions suitable to a wide range of fish species. Use of readily available materials will also make maintenance works quick and cost effective.

Construction and ongoing costs
Design costs were kept low at around $8,000 with materials costs approximately $29,000. Monitoring has been undertaken in-kind at a cost of $5,000.
Rockhampton Regional Council owns the structure and maintain its operation through removal of sediment and debris following flow events or as otherwise required. The structure has survived some of the most significant flow events in Moores Creek's recorded history.

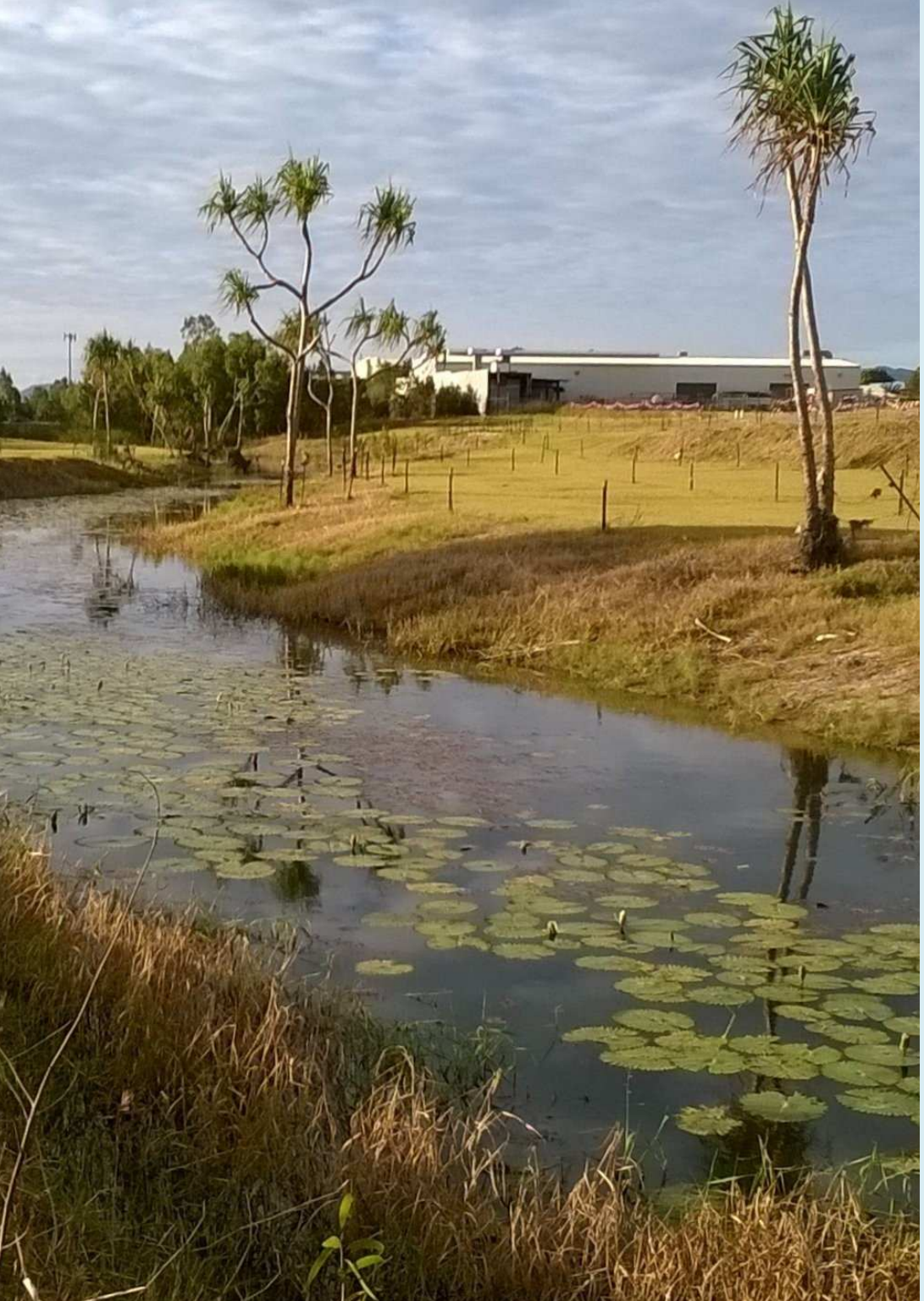
Monitoring
FBA and Fisheries Queensland staff undertook fish sampling in early 2013 following construction in July 2012. Results from the sampling serve as a baseline for what species, sizes and numbers were able to use the fish ladder. The recording of Sea mullet as small as 24mm using the fish ladder is excellent as this suggests larger fish will also utilise the structure. The amount and size of fish that reached the top of the fish ladder indicates the velocity of water has been reduced and the fish are able migrate as intended.

It is anticipated that additional species will be found during other times of the year as different species have different migratory patterns.

Lessons learned
Careful considerations of the objectives and potential impacts of the project play a key role in successful design and implementation.

A simple and low cost solution can be very effective with good planning and construction technique. Keeping the community informed has garnered support from a range of stakeholders.

Reference: All material supplied by Fitzroy Basin Association (and their website, www.fba.org.au).



Case Study Seven: Louisa Creek - Townsville

Project Summary
Louisa Creek, located in dry tropical Townsville, is a locally important freshwater environment which flows into regionally significant wetlands and coastal environments. It has been impacted over the years by urban/commercial runoff, habitat removal, and more recently watercourse relocation. However efforts have been made by the Council for over fifteen years to retain its ecological values, and improve aesthetics, community use and hydraulic capacity. These efforts continue today and will continue into the future through the implementation of the Louisa Creek Waterway Management Plan (2011).

Size/Type of Project
The Louisa Creek Waterway Management Project involves the management of over 6km of water course to:

1. Improve the quality of water
2. Maintain and improve hydraulic capacity of the system
3. Increase ecological values within the catchment including improved fish passage
4. Prioritise management options that will have the maximum net benefit to the system
5. Engage community through activation of community groups
6. Encourage passive recreation and custodianship in key areas
7. Establish and enhance terrestrial connectively for fauna passage

Site Context
Louisa Creek runs from Mount Louisa (a mixture of urban and green space landuse) to the floodplain of the Town Common Conservation Park – a wetland with regionally significant environmental values. Louisa Creek eventually discharges into the Bohle River which then meets the sea at Bushland Beach.

The region experiences a typical dry tropical climate, characterised by a hot, humid and wet summers (December to March) followed by a prolonged but cooler dry season with lower humidity levels (April to November).

Solodic soils are predominant, with some grey clay and alluvial deposits, and in general the heavy clay subsoils are very poorly drained, have poor physical structure and are low in fertility (McNamara, 1981). Saline duplex soils also appear in the lower catchment where the water table rises to about 600mm below the surface (McNamara 1981). Acid sulphate soils are also prevalent in the lower catchment.

The upper part of the catchment is predominately urban, and the mid-catchment has commercial/light industrial landuse.

Issues and Constraints
Over recent years commercial/light industrial development has increased adjacent to Louisa Creek. To provide adequate space for this development parts of Louisa Creek were relocated, while other sections were narrowed and constrained. This development also contributed large amounts of sediment and litter and ultimately changed the hydrology of the system. Roads, bridges, crossings and culverts added over the years have also impacted on the hydrology and created barriers to fish passage.

One of the main constraints to undertaking works in and around Louisa Creek is the presence of highly dispersive soils and, in some sections, the presences of acid sulphate soils. Also high salt concentrations and high ph levels in soils.

Key Practices

The following management measures have been implemented over a 15 year period and continue to be applied today:

- Installation and retrofitting of several gross pollutant traps at key points to treat gross pollutants from surrounding commercial/light industrial areas

- Water course relocation was undertaken using natural channel design principals by including meanders, deep pools, riffles and revegetation. The design also incorporated maintenance and community access points.

- Development of project sites for youth and community activation programs such as Greencore, Job Futures, Conservation Volunteers Australia and the Green Army

- Involvement of the local community via Louisa Creek Watch. The volunteers undertake regular water quality monitoring, litter and weed removal activities and report results back to Council.

- Sediment and weed removal activities

- Revegetation with naturalised species that have high broadleaf densities to suppress weeds and to reduce maintenance

- Strategic machine access for weed and sediment removal

- Use of ESC during watercourse relocation activities involving extensive soil science/amelioration, use of probiotics and design outcomes outside of typical engineering scope to deal with the dispersive soils

Successes:

- Use of broadleaf species to reduce maintenance and strategic machine access points have been very successful

- Pools and riffle designs have demonstrated increased fish and macroalgal diversity and concentrations

- Design for appropriate depth of water can effectively suppress challenging aquatic weeds

- Effective erosion and sediment control

can significantly improve functionality of natural channels and greatly reduce operational maintenance costs

- Activation of community groups can improve asset custodianship whilst also leverage funding to reduce ongoing maintenance

- Collaboration between eventual asset managers and planning officers during design stages can provide long term environmental and financial outcomes.

Monitoring

The Louisa Creek Watch volunteers regularly monitor water quality including: temperature, DO, pH, and conductivity, and macroinvertebrates. The Council undertake regular inspections and maintenance activities.

Lessons learned

Relocating and modifying a natural system inevitably requires more ongoing intervention, maintenance and management than would be required for a natural system. Despite incremental modifications over the years and ongoing impacts from the surrounding landuse, Louisa Creek is still an important aquatic environment in the Townsville landscape. It is one of the few smaller order freshwater streams which runs for most of the year, and as such it still provides important habitat for birds, fish, and other aquatic flora and fauna. As it discharges into an important wetland (Town Common and Bohle River), improving its water quality is seen as a priority by the Council and the local community. Efforts from the Council to treat and remove pollutants and manage weeds have led to the creeks preservation so far; however the recent realignment, dredging, installation of culvert crossings and new commercial development could see it decline further. In response to this risk Council produced a plan in 2011 to guide the future management of Louisa Creek. This plan is being progressively implemented with the aim of managing this waterway for the protection of environment, community and infrastructure.

Further information on this project can be obtained by contacting Townsville City Council: 1300 878 001

What other projects might we be doing in future?

Increasingly Councils and other stakeholders involved in waterway management are investing in the renewal and revitalisation of urban waterways. These projects can provide a range of highly significant benefits for a range of waterway values including water quality, habitat reinstatement, aesthetics, environmental education and the provision of new recreational opportunities.

Left: *Cairns Regional Council are planning to upgrade a popular park on the banks of the Baron River*

Right: *Townsville City Council are in the process of reshaping and rehabiliting a section of creek at North Shore*

Right: *Brisbane City Council are investigating bank improvements*

Where are we struggling?

Respondents identified that all the barriers in the survey (project costs, gaps in technical knowledge and workloads for staff) as important barriers to effective waterway management (Figure 10). The responses to both these questions highlight some important considerations for a future waterway management guideline. Given the strength of the funding response in both questions, any future guideline should include information that supports stakeholders to secure funding both internally and externally. Inclusion of a highly robust business case would be critical and reflected in the responses to survey question 12 (Figure 11). Additionally, many other barriers could be better overcome if a guideline was accompanied by appropriate training targeted at the various needs of waterway management project practitioners.

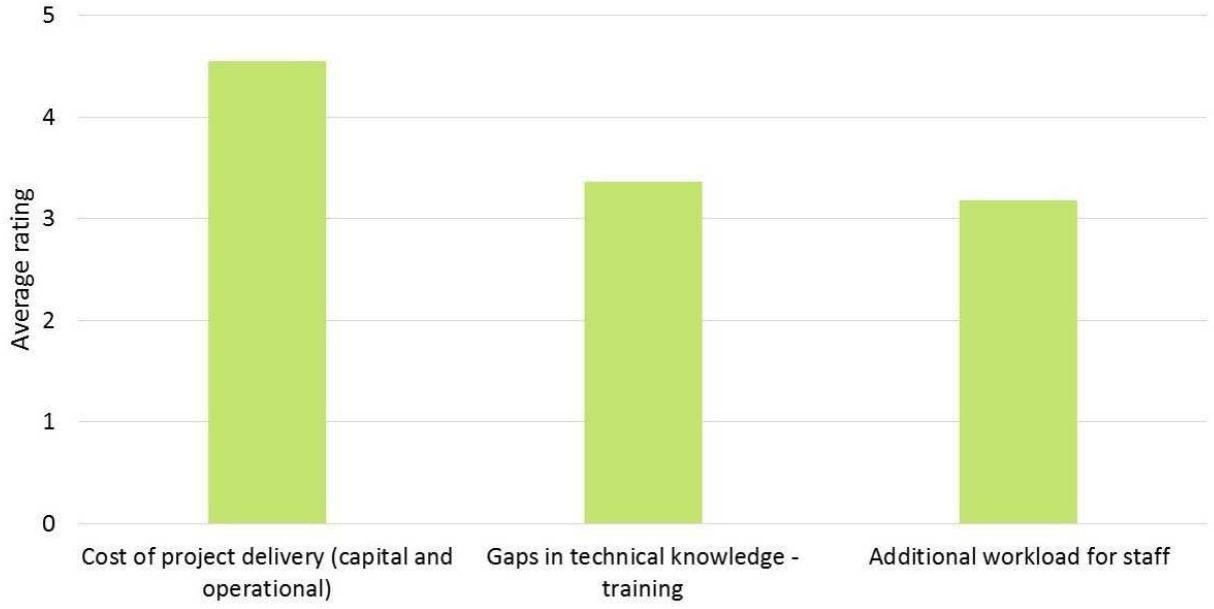


Figure 10. *Survey responses for the relevant importance of three waterway management project barriers*

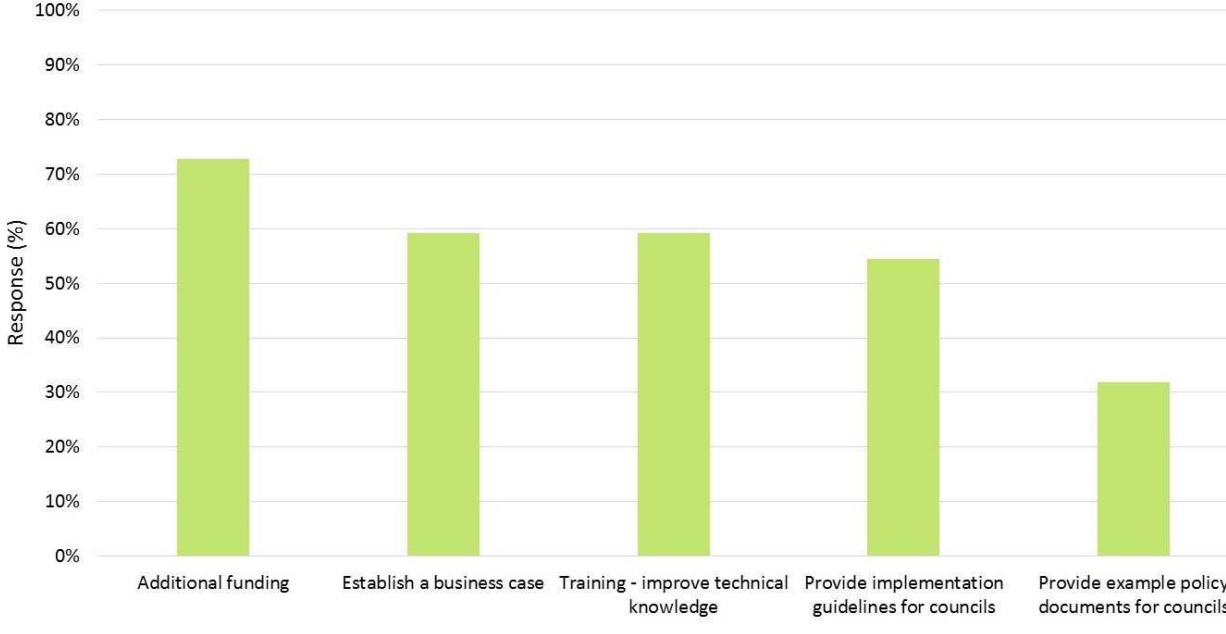
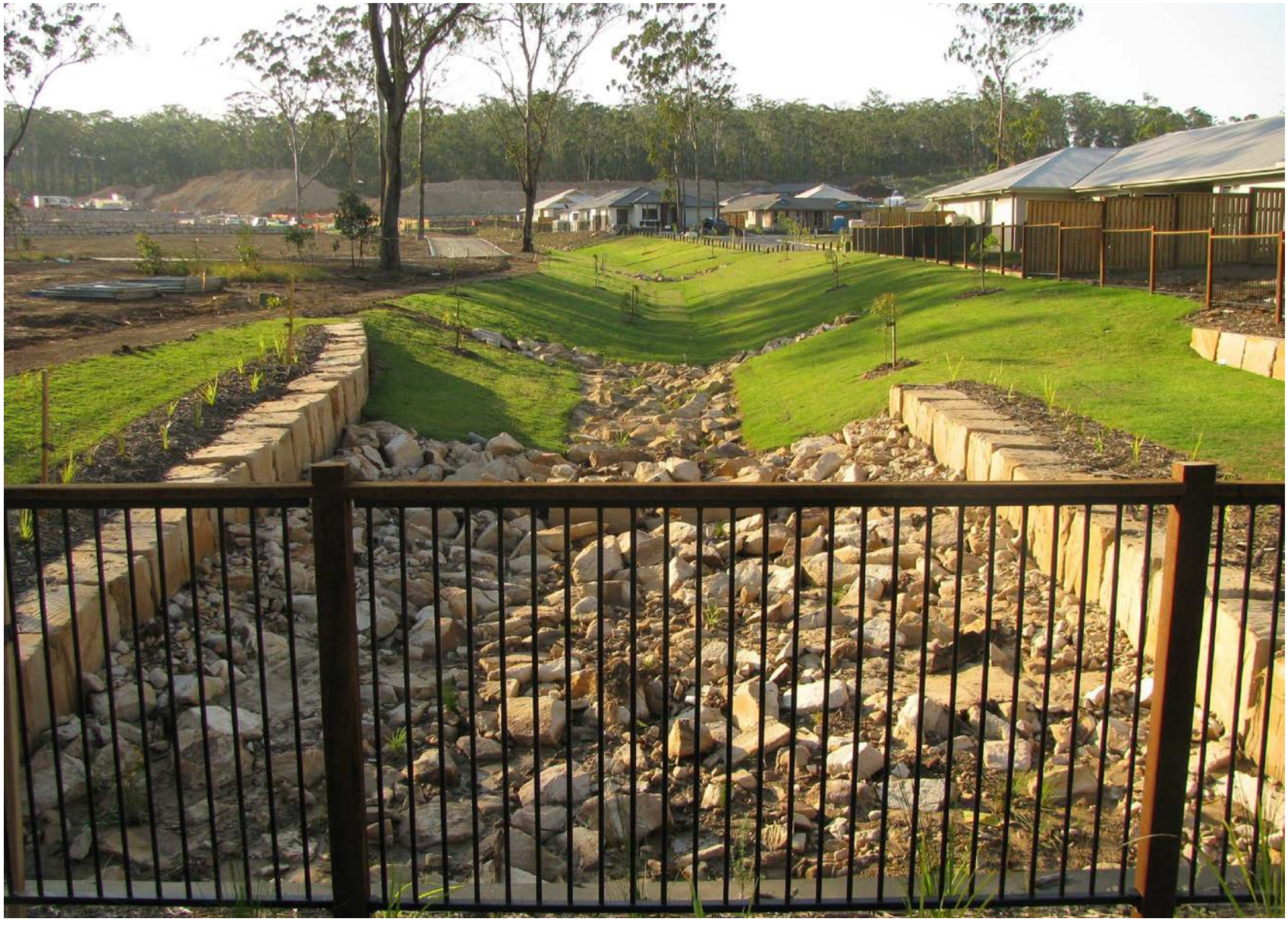


Figure 11. *Survey responses for the relevant importance of how barriers to waterway management projects might be overcome.*



How can we improve?

Stakeholders provided a range of important feedback in relation to improving future waterway management programs and projects. For Council stakeholders a clear need to better coordinate the sections of council that are ultimately responsible for waterway management was articulated. In particular this related to the early involvement of the ultimate asset owners and managers within council from early project inception including planning, design and construction. This would help to ensure that key issues linked to asset maintenance are considered and addressed during the project. Linked to this was the need to ensure that where council lacks adequate technical expertise, that this is appropriately funded and sourced during the relevant stages of the project.

In addition the following issues were raised to improve future waterway management projects:

- Better understanding of why particular projects are identified as priorities. This is linked to understanding the value a particular threat is placing pressure on and the relative agreed priority of that value.

- Sourcing local knowledge (including appropriate species for use in revegetation) and/or study local dynamics rather than implementing measures that work elsewhere either in Queensland or interstate.

- More industry education, including communication with contractors who have little experience with, or understanding of, waterway management.

- Improved leveraging of funding to support the project delivery, particularly in urban environments where other funding sources may be available, for example park improvement, urban improvement, recreational funding, offsets and waterway/environment funds.

- Improved policy and legislation to ensure better practices are adopted.

How can a guideline help?

Stakeholders were effectively split on the extent to which they use existing guidelines and other technical documents in their planning and delivery of waterway management projects. Approximately half of the survey respondents indicated they did not utilise such material because they either had sufficient internal expertise or they complimented their existing skill/experience with expert input as required. The other half of the respondents indicated they do use such material, including the BCC Natural Channel Design Guidelines (BCC, 2003) and the Victorian Department of Environment and Sustainability's Technical Guidelines for Waterway Management (DSE, 2007). One council stakeholder indicated that there was perhaps already sufficient information in existence from around Australia, and that it would help to compile this into management themes and intervention approaches rather than develop any new documents.

In these questions several respondents identified a critical issue for any future guideline to acknowledge. Waterway management practitioners require locally relevant information and this often includes engaging with landholders to make the most of their extensive knowledge base. A guideline developed across the state has a real risk of being generic and therefore viewed as of little use by some practitioners. It will be important for any guideline to recognise this, account wherever possible for regional variations (especially climate) and be positioned clearly in the overall approach to water management projects i.e. not attempting to take the place of, or the need for, local site based plans for individual projects.

In relation to gaps in current information, respondents indicated that whilst there are many existing guidelines already available, many of them are dated, not widely known about and often developed interstate. There was recognition that a new guideline that considers integrating a range of issues would be beneficial as a reference for instream health (including a focus on pest management), natural channel design, soft and hard engineering solutions to address erosion/instability, vegetation and the links to hydrology and cost effective management responses. Importantly any guideline would also need to ensure that it adequately conveys existing success stories so that they can be utilised to leverage community/political interest towards resolving the wider catchment management challenges. This would need to be accompanied by appropriate information of risks, costs and benefits of waterway management project interventions. Finally, there was support for information that was tailored to specific needs including sections on successful project implementation at a work crew level (practical, cost effective techniques) and on successful landholder engagement.

Most stakeholders engaged during this scoping project were supportive of the development of a new waterway management guideline. Key considerations linked to this support included:

- For council stakeholders the need to ensure that projects could be delivered in a cost effective manner (not all high cost) and that the document was appropriately targeted to different internal council sections appropriately (much like the current WbD Waterbody Management Guideline) and the broader community.

- Any document produced needed to be of a high standard

- Any document produced should not be highly scientific and, as a result, impractical for use.

One interesting argument put forward was that there are already a plethora of guidelines and other relevant documents currently available publicly, and that perhaps an alternative focus of any future project could be to synthesise these based on the types of management interventions waterway projects encompass.

During the consultation process a wide range of views were encountered on the potential scope of any future guideline. Firstly, in term of geographic coverage there is broad agreement that any guideline developed should cover all of Queensland, although this may make it more challenging for some partners to invest. Feedback was clear that the information presented should not be "SEQ centric", and must account appropriately (from a technical viewpoint) for the unique conditions experienced in tropical environments (both wet and dry tropics). This largely relates to accounting for regional rainfall differences, but where possible recognition of other key regional variables (soil types, catchment topography etc.). Conversely, some councils indicated it would be more difficult to gain support (funding) for a statewide guideline, as opposed to region-specific products.

A range of views were put forward in relation to the landuse coverage of the guideline within a given catchment. Some stakeholders were keen to see a guideline cover rural, urban and peri-urban waterway management issues, as this would best reflect the extent of their roles and the locations of projects they worked on within their respective organisation. Others were of the view that such a document would potentially become unwieldy, and that when compared with projects delivered in urban environments, rurally based projects faced different funding realities (less funding sources and more costly given project scale, location, transportation costs, establishment issues etc.), different risk profiles (most often less risk) and targeted a completely different audience requiring "tailor made" information packages. It was also argued that projects in these different landuse types have very different drivers and objectives, so care would need to be taken to ensure that these differences were understood and accommodated if the guideline covered different landuse types.

Other key scope issues raised by stakeholders included the need for a guideline to include the following:

- Consideration of the current legislative and planning frameworks that are relevant to the planning and delivery of waterway management projects

- A carefully considered business case for documenting the risks and cost-benefits associated with investment in waterway management projects

- A risk-based decision making framework to assist with appropriate project determinations (for example "go/no go" decisions, identifying key project risks and key considerations to help determine the nature and scale of intervention that may be required, etc.)

- Sections dedicated to potential legal issues and key financial issues associated with waterway management projects. These issues were raised in the context of being better able to demonstrate to other internal and external stakeholders that the relevant issues had been considered and to provide

justifications for upfront and ongoing maintenance costs (in particular the value of investing an appropriate level of funding to ensure project success e.g. tree planting)

- A guideline needed to assist councils with a "technical defence" for approaches adopted during the lifecycle of waterway management projects (especially where assets are inherited and may then need to be modified based on design performance and funding issues, despite community expectations that there will be no change to the original design/maintenance program associated with the asset)

- Need to include waterway retrofitting in any guideline - for some stakeholders the concept of urban waterway retrofitting is too expensive and other projects have much higher priority. For some councils, however, there are potential opportunities to significantly improve urban amenity in key locations. For example, the right information could help enable waterway management projects such as a potential renewal of some Cairns CBD urban drains (old cane farm drains that are now a major feature of some parts of the inner urban frame).

Finally several respondents to the survey indicated that it was also important for a guideline to acknowledge that several key challenges related to the success of waterway management projects throughout their life cycle (politics, the need for internal change management processes etc.) could either only be partially addressed, or not addressed at all, by such a document. Wherever possible, however, opportunities to help meet these challenges should be addressed throughout the guideline e.g. use of a business case approach to justify appropriate information for asset owners and managers etc.

Future Considerations

There are a range of future considerations for Water by Design should the decision be made to proceed with the development of a new Waterway Management Guideline. These are discussed briefly in the following sections of this report.

Potential steps towards a new guideline

The steps that could lead towards the production of a waterway management guideline are outlined in Figure 12. As discussed previously there is a need to carefully consider the scope of any future guideline. The scope will have a bearing on the scale of the project and the ability to attract investment from Healthy Waterways partners. Once the scope has been settled, defining and agreeing upon a vision, values, outcomes and objectives for the in-scope waterways is an important initial step in developing the guidelines, as these will all impact on the elements that need to be included.

A number of stream management and rehabilitation manuals and guidelines have been developed in Victoria and Australia including the Rehabilitation Manual for Australian Streams (Rutherford et al, 2000), the River Restoration Framework (Koehn et al, 2000) and the Technical Guidelines for Waterway Management (DSE 2007). The first step recommended in each of the guidelines, and core to the design of any stream management activity, is the establishment of an agreed vision and set of objectives for management.

A critical component of the process will be the development and implementation of a knowledge and adoption strategy for stakeholders. This will be designed to ensure that any guideline that is developed is taken up by industry.

Figure 12. *Suggested steps to develop a waterway management guideline*

Equally important will be the monitoring and review of the guideline to ensure that feedback can be captured, and that new standards and techniques are included where appropriate, both of which will help to ensure ongoing relevance and support for the guideline.

How can Water by Design help?

It is suggested that three documents be developed that together will comprise a Waterway Management Guideline:

1. A concise, easy to ready summary document (essentially in a similar format to the existing Waterbody Management Guideline by WbD)

2. A detailed design manual providing site analysis and design procedures (an update to the BCC Natural Channel Design Guideline) which can reflect regional climatic differences

3. A technical reference document that provides the technical justification for the selection of particular design methods (for example)

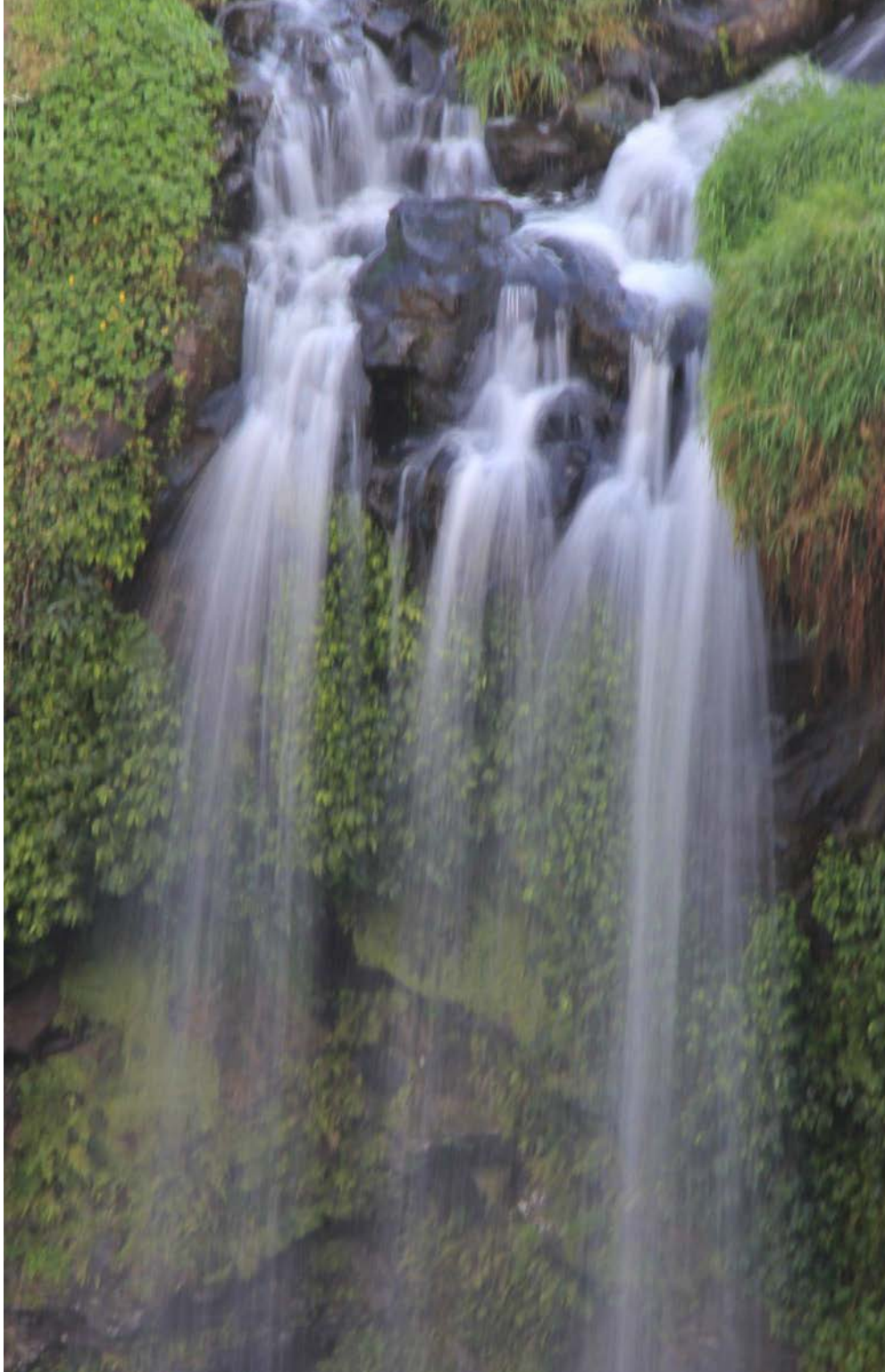
Several additional suggestions for the successful development of a new guideline were also raised by stakeholders. These are considered briefly in turn below.

Staged approach to guideline development

Some stakeholders supported a staged approach to the development of a guideline to address each of the key elements or phases of waterway asset management as indicated in Figure 13 (over page). Such an approach would, for example, first address the relevant issues linked to strategic planning for waterway assets. This would include reviewing the adequacy of the current legislative, policy and planning mechanisms (e.g. mapping of waterways within local government planning schemes) in place to protect waterways across the full spectrum of planning and development processes. Historically this has been problematic for local governments and many waterways (particularly higher order streams) have been lost or unnecessarily degraded during development processes. Once the issues linked to strategic planning had been adequately addressed, other phases of the asset management process could be tackled, including development assessment, design, implementation and maintenance.

Develop a business case to demonstrate the value in more effective waterway management.

The need for a clearly articulated business case to be developed to support waterway management projects has already been discussed as a key issue for stakeholders (see “How can a guideline help?”) projects. This document alone, if well presented, could be pivotal in terms of many stakeholders being able to gain support for additional investment in both internal and external waterway management projects across rural and urban environments. It was also identified that the financial viability (full life cycle costs) of waterway improvement projects (both CAPEX and OPEX) needed to be better understood to support the breadth of change management required within stakeholder organisations (especially councils) to take these projects forward utilising current best practice approaches.



Carry out focussed consultation to identify a simple, clear set of objectives for waterways across the region
WbD might choose to pilot this process in a single LGA area to test the process. The objectives should reflect any national, state or local objectives around (for example) flood risk, channel stability, social amenity, water quality and sediment loads to the reef.

Figure 13. *Suggested stages of the waterway asset management lifecycle to be addressed by a guideline*

How do we make the guideline a reality?

To ensure that the guideline's development enters the next phase, Healthy Waterways would like to initiate conversations with partner organisations about potential investment in a Waterway Management Guideline. These conversations would cover the key deliverables to be produced and which of those deliverables partners are able to support going forward.

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