Waterbody Management Guideline

Module 5

Extension and Engagement

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waterbydesign

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Healthy Waterways

Healthy Waterways is a not-for-profit, non-government organisation working to protect and improve waterway health in South East Queensland (SEQ). We facilitate careful planning and coordinated efforts among a network of member organisations from government, industry, research, and the community to achieve our shared vision for healthy waterways.
For more information, visit www.healthywaterways.org.

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5.1.1 Purpose of module 5

The purpose of this module, *'Extension and Engagement'*, is to provide local government extension officers with practical and relevant information and resources to use when engaging landholders about waterbody management on private property.

5.1.2 How to use module 5

This module is divided into seven key sections. Figure 5.1 describes how to use each section. Section 5.8 is the worked example, an easy to follow step by step layout of all the information presented in this module.

Figure 5.1 How to use module 5

Section 5.2	
Local Government Extension Programs	This section explains what an extension program is and the benefits it can provide as well as outlining a generic process for an extension program.
Section 5.3	
Secure Participation	This section outlines a process for engaging and motivating landholders to join an extension program.
Section 5.4	
Site Assessment	This section provides guidance on how to carry out the first site visit and assessment including a list of useful questions to ask the landholder.
Section 5.5	
Identify the Issues and Actions	This section outlines the common issues found in waterbodies and provides advice on how to identify the source of the issue and how to choose the most appropriate management action.
Section 5.6	
Set Priority Issues and Actions	This section provides some practical advice for how to set priority issues and actions.
Section 5.7	
Implement Waterbody Plan	This section advocates a long term adaptive management approach to the implementation of the waterbody management plan.
Section 5.8	
Worked Example	This section uses a hypothetical example to demonstrate the process of managing waterbodies on private property through an extension program.

5.2 LOCAL GOVERNMENT EXTENSION PROGRAMS

5.2.1 Introduction

Local government extension programs are an effective way to build a relationship between the community and their local government. These relationships form the foundation for collaboratively working towards the common goals of improved property health and therefore improved catchment health. Extension programs support landholders by providing access to helpful, experienced and skilled officers who can deliver practical advice based on best available scientific knowledge and local experience. Extension officers support landholders from the start of a project through to completion. A 'learning by doing' approach to waterbody management is adopted that is easy to understand and implement.

Extension programs can deliver **multiple benefits** to both the landholder and local government such as to:

- build relationships and trust between local government and the community
- improve community education, understanding and engagement with waterways and the environment
- empower landholders and communities to implement proactive and practical solutions to conserve, protect and improve their properties
- provide cost effective strategies that support local economic growth
- maximise efficiency of local government resources.

5.2.2 Establishing an extension program

Although extension programs may vary in scope and structure, at the core of all programs is the fundamental principle of building partnerships between local governments and landholders to enable and empower the conservation, protection and enhancement of ecosystems on privately owned properties. It is important that a holistic view is taken when designing a program that addresses both land and waterbody based environmental issues. It is also important to link the benefits of the extension program to the bigger picture of the local government's strategic objectives and goals, for example, Waterway Recovery Goals, Water Quality Objectives or Ecosystem Health Monitoring Program Report Card Grades. Linking the outputs of the extension program to these bigger strategic goals will aid the building of a business case for the continuation and expansion of the extension program. The following sections provide examples of how extension programs incorporate a waterbody focus into their work.

Waterways Extension Program – Redland City Council

Redland City Council established the Waterways Extension Program (WEP) in response to the poor ecological health grades received by Redland's waterways in the Healthy Waterways Ecosystem Health Monitoring Program (EHMP, 2008). The WEP has a unique focus on water and delivers stream bank, farm dam and wetland enhancement projects. The WEP uses water quality monitoring data to focus work in the high priority areas.

For more information, visit: www.redland.qld.gov.au

Backyards for Wildlife – Moreton Bay Regional Council

The Moreton Bay Regional Council Backyards for Wildlife Program recognises the collective impact that smaller properties can have on surrounding and downstream environments. This program supports landholders of smaller properties (less than one hectare) which have high conservation values such as a waterbody located on or adjoining the property.

For more information, visit: www.moretonbay.qld.gov.au/backyardsforwildlife

Land for Wildlife – South East Queensland

Land for Wildlife originated in Victoria in 1981. In South East Queensland, Land for Wildlife is hosted by the community based, not for profit organisation 'SEQ Catchments'. This program has produced the Land for Wildlife Notes which include information on 'Healthy Dams' and 'Wildlife Friendly Dams' (Land for Wildlife Notes, 2011). The SEQ Catchments Water Quality Monitoring Team encourages Land for Wildlife members to get involved with monitoring the water quality of their waterbodies by supplying equipment and providing technical advice.

For more information, visit: www.seqcatchments.com.au/programs/land-for-wildlife

Southern Rivers Catchment Management Authority (SRCMA) – New South Wales

The Bega Dairy Partnerships Program aims to improve the environmental sustainability of dairy operations in the Bega River Catchment. Bega Cheese and SRCMA have worked cooperatively with farmers on a voluntary basis to implement a diverse range of initiatives. Key environmental benefits of this project include improved river health via enhanced water quality, environmental flows and habitat restoration. Benefits to farmers include financial gains through improved soil health, water use efficiency and pasture productivity. Each of these practices provides a mix of environmental and business benefits. More than 85% of Bega Cheese suppliers are participating in at least one aspect of the Bega Cheese Environmental Management System initiative.

For more information, visit www.southern.cma.nsw.gov.au

Fish Friendly Farms – New South Wales

Fish Friendly Farms is a New South Wales Department of Primary Industries program that encourages farmers to protect fish habitat on and off their properties through sustainable agricultural practices. Through educational field days, workshops and publications the program encourages the following seven actions for enhancing waterway health:

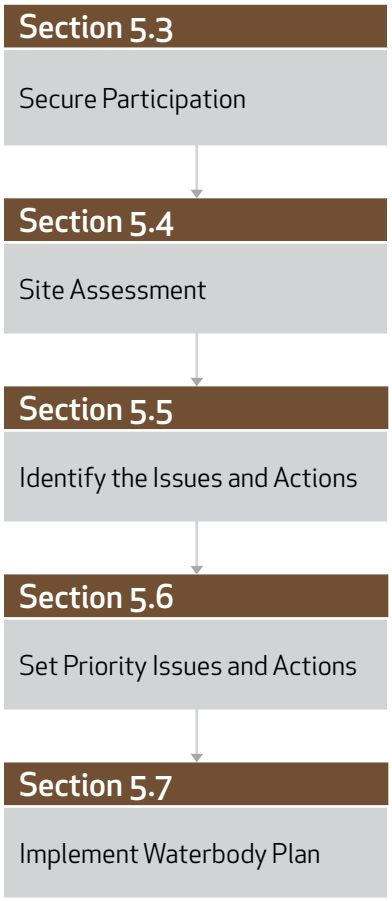
1. have large woody debris (snags) in streams
2. grow native vegetation on the stream bank
3. install fish friendly crossings
4. control or treat agricultural runoff
5. provide water for stock off-line
6. control the opening of floodgates
7. protect wetlands.

For more information, visit www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/fish-friendly-farms

5.2.3 The extension program process

The first step of any extension program is to secure participation from landholders. Once a landholder has signed up to an extension program, a plan for that property and waterbody must be created. The waterbody plan will begin with a site visit and assessment where the issues will be identified and possible management actions noted. This assessment will result in a list of issues and actions for the property. It is important to work through this list with the landholder and set both short term and long term priorities to enable implementation of the plan. This process is shown in Figure 5.2.

Figure 5.2: Process of an extension program



When carrying out the extension process on a property and creating the waterbody plan it is important to remember the following:

- **Assess each waterbody on a case by case basis**
  Each waterbody is unique with its own characteristics and set of influencing factors.
- **Align the goals for the waterbody with the waterbody's purpose**
  For example, if a waterbody is used for recreation or as a water source for animals then it is necessary to set stringent goals on the health and safety aspects of that waterbody.
- **Consider any downstream impacts when designing the waterbody plan**
  A waterbody is not an individual, isolated ecosystem but sits within a catchment and connects to and influences this much larger system.
- **Be innovative and pragmatic with management actions**
  Landholders are, by and large, resource and time limited and need simple and effective solutions that are practical to implement.
- **Know your limitations**
  Understand what management actions can be feasibly implemented and which management actions are beyond the scope of an extension program and require external expertise. Table 5.1 provides a list of possible scenarios that may fall outside the scope of an extension program and identifies where to direct a landholder for further assistance.

There are very useful resources available that can inform and support extension programs and provide valuable information for managing waterbodies on private properties. These resources include:

- Wetland Management Handbook: Farm Management Systems (FMS) guidelines for managing wetlands in intensive agriculture, 2008
- Grazing for Healthy Coastal Wetlands: Guidelines for managing coastal wetlands in grazing systems, 2011
- Guidelines and template for preparing a wetland management plan: For primary producers (grazing, dryland cropping) in Queensland's inland catchments, 2012

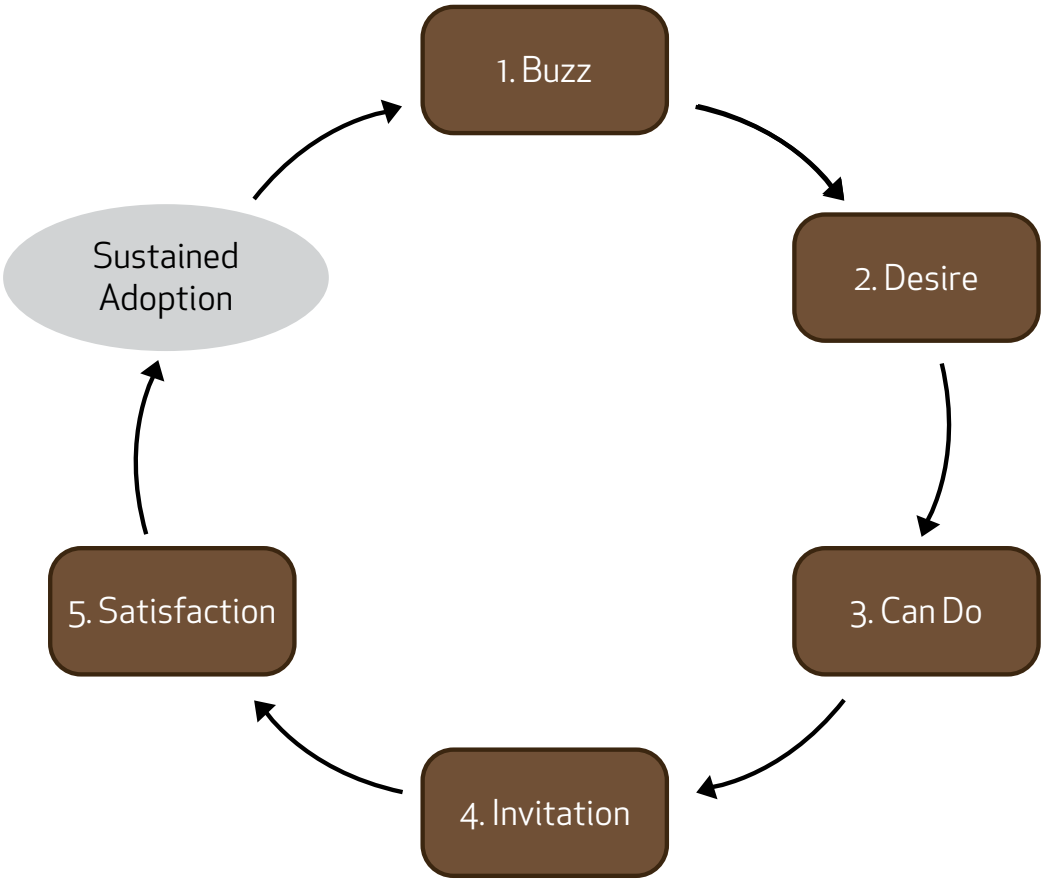
Table 5.1: When and where to go for further help

Scenario	Refer to
Operational works development application required for works such as excavating, landscaping, filling of land etc.	Local government's planning and development area.
Landholder wants to construct a farm dam	Local government's planning and development area.
Structurally damaged waterbody i.e. fractured dam walls	A dam or civil engineer should be consulted.
Waterbody located on acid sulfate soils	State environment departments provide extensive advice on identifying and managing acid sulfate soils. The Queensland Acid Sulfate Soils Investigation Team can provide general and technical advice on acid sulfate soils.
Waterbody located on dispersive clays	The Tasmanian Department of Primary Industries and Water has published *'Dispersive soils and their management: guidelines for landholders, planners and engineers and technical reference manual'.*

5.3 SECURE PARTICIPATION

The first and most important part of an extension program is to engage and motivate the landholders. However, presenting the science, knowledge and logic behind why a landholder should join an extension program will not guarantee buy in and commitment from landholders. Knowing something isn't necessarily enough to cause change and promote participation. Landholders need to feel something to rouse their motivation. Dan and Chip Heath's book *Switch: How to Change Things When Change Is Hard* provides valuable insight into the nature of change and outlines the key factors that an extension program should address in order for change to occur in a community. The Heath brothers explain (using the analogy of a logical rider trying to direct an emotional elephant down a new path) that for a change to have an effect it needs to speak to the logical side (provide the 'rider' with clear direction), speak to the emotional side (motivate the 'elephant' to move) and finally it needs to provide an environment that makes the change easier (shape the 'path' to ease the journey of the 'elephant' and 'rider'). In other words, to encourage participation in an extension program clear direction needs to be provided (e.g. provide horses with off-line watering points), motivation for action roused (Redland's community are proud landholders who cherish their beautiful waterways) and the environment adapted (to join, simply sign this one page form). Les Robinson from Enabling Change builds on the Heath brother's work and elaborates that there are five factors necessary to motivate participation in a new group, activity or behaviour (Robinson, 2009). Figure 5.3 outlines these five factors of buzz, desire, can do, invitation and satisfaction. For sustained participation all five of these factors need to be present.

Figure 5.3 Five factors to create motivation



5.3.1 Buzz

For the most part, conversation is how people make decisions. Peer-peer conversations are vital for triggering change in human behaviour. Nothing happens without conservation, or at least interaction, between peers. What people say about an extension program determines whether their peers believe it is useful, credible and offers advantages over what they currently do. When people experience a new behaviour or program that really works, they talk about it, creating more buzz, increasing other people's desire, lowering their fears, and so creating a virtuous circle. It is therefore important to showcase success stories from extension programs. Field days on working properties are great for this. Similarly, encouraging networks among landholders will help open communication channels and generate 'buzz'. For example, let landholders know if one of their neighbours is participating in an extension program and put them in touch with that neighbour. By encouraging this peer-peer conversation the fears of unconverted landholders will be lowered and their motivation will be spurred.

5.3.2 Desire

To stimulate landholder's interest and passion in an extension program, listen to their fears, worries and frustrations and frame the program's activities as solutions to those dissatisfactions. For example, instead of framing the program's message as 'Correctly managing your waterbody will reduce the adverse impacts on downstream environments' frame it as a solution to the landholder's dissatisfactions i.e. 'Join other Redland residents in looking after their farm dams for the wellbeing of their livestock, properties and families'.

5.3.3 Can do

To enable landholders to participate in an extension program it is important that it is simple and easily accessible. The barrier to motivation which encourages change is often a fear of failure, embarrassment, humiliation or losing certainty or control. What often prevents people from participating in new activities is people's fears of perceived risks. It is important to address and mitigate these fears when promoting an extension program to landholders. This relates to the Heath brother's idea of 'Shape the Path'. Create an environment that minimises the barriers and makes change doable.

Quick Tips to minimise the barriers for participants:

- Focus on **do-able** solutions
- Use **positive** proactive language
- Start with projects that are **achievable** in a short time frame
- Choose projects that are **measurable**, easy to understand and do
- Promote the popularity and **inclusion** aspects of the program i.e. the 'good neighbour effect'
- Lower fears by outlining the **supportive** framework of your program i.e. our friendly and experienced extension officers will provide you with all the help and assistance you need
- Encourage participants to have **control** and ownership over the project i.e. involve the landholder in developing the vision, goals, plan and priority activities for their property
- Choose **familiar** and comfortable activities and goals
- **Award** good participants by trusting them with more responsibility and more ambitious project
- **Celebrate** success!

What to avoid:

- Avoid focusing on the issues and problems.
- Avoid using negative language which promotes negative buzz.
- Avoid starting with projects that are overly ambitious or difficult to understand.
- Avoid using language that will exclude and make your participants feel singled out i.e. you should...
- Avoid overly complicated sign up processes and procedures i.e. reduce the red tape.
- Avoid using a compliance approach.
- Avoid forcing your participant to undertake lots of boring tasks like excessive reporting.

5.3.4 Invitation

Even if landholders are interested in an extension program it may only be the enthusiastic few who will take the initiative and participate. To reach beyond these enthusiastic few and engage the 'un-converted' it is necessary to send landholders a personal invitation to join the extension program. Even though landholders may think the program is interesting the majority will still need to be invited, ideally by someone they know.

Consider how best to pitch and deliver the invitation to engage the target audience. An invitation will carry more persuasion if it comes from a credible inviter. Avoid generic invitations that do not come from an identifiable individual. A good inviter wins people's attention and commitment by authentically showcasing the benefits of participating in the program. Testimonials from participants of the program are a good way to achieve this, particularly if the testimonial comes from a well respected, passionate and relatable member of the community.

An invitation should also include a 'hook'. This will be something intriguing or surprising that grabs the audience's attention. This can be achieved by asking an intriguing question or two, or by introducing a surprising element. For example, why not hold a 'DIY Floating Wetlands Construction Competition' or a 'Master Chef - The Bush Tucker Challenge' to engage and excite the community about management of waterbodies.

Les Robinson suggests that an invitation should have the following ten elements:

1. Grab your communities' attention
2. Introduce your credible inviter
3. Hook their motivations with an inspiring personal story
4. Sketch the problem
5. State the vision
6. Sketch how your program will work practically and be supported
7. State how you'll lower their personal doubts and fears
8. Don't forget some enticing instant gratification extras
9. Request a general sign of approval for your program
10. Issue a precise call to action

An Example Invitation:

Are you passionate about the Lockyer Valley? Do you love the land and lifestyle that Lockyer Valley provides you with? G'day, I'm Darren Lockyer and for generations my family have depended on the land and water of the Lockyer Valley for our livelihoods. The farm dams on my land used to provide a secure and healthy source of water to my family. These days though it is a different story. Increasing levels of pollution from land erosion, chemical fertilisers and animal wastes have pushed my farm dams to their tipping point. One day my children will inherit my land, just as I did from my father. I want to make sure that the land they inherit is healthy enough to provide them with the lifestyle and livelihood that I and my fathers have enjoyed. To do this I knew I needed to improve the health of my farm dams. Thankfully, the Waterways Extension Program was there to help with great practical advice and assistance based on sound scientific knowledge. I had access to friendly and experienced officers who were there to help whenever I needed it. Upon joining the Waterways Extension Program I received a free starter's pack with all of the information I needed and I even had some free water sampling of my farm dam carried out! Do you believe we can make a difference today, to provide our children with the future they deserve? Then start by contacting a Waterways Extension Program officer today at: example@email.com

5.3.5 Satisfaction

At each stage of involvement in an extension program, participants should experience satisfactions. It is important that each activity is enjoyable and new behaviours generate satisfactions. It is equally important to publicly acknowledge participants' successes, celebrate their achievements and reward their efforts, no matter how small. Most people are self-doubting so unless attention is drawn to their successes, they often discount them. Never miss a chance to celebrate a success. Name the participant, make sure their peers are listening, and tell them exactly what they did well. If possible provide a small reward or token. Small, frequent satisfactions are better than big infrequent satisfactions. By experiencing satisfaction from participation in an extension program not only will landholders continue to participate but this will also go towards generating more positive buzz for the program through peer-peer conversations.

5.4 SITE ASSESSMENT

During the first site visit, assess the property and waterbody to identify the issues and management actions. The issues and actions can be assessed within the five categories of water quality, biodiversity, health and safety, amenity and aesthetics and hydrology and hydraulics. It is vital to understand the history and current functioning of the waterbody before goals can be set. Therefore, gather as much information as possible during the first site visit to ensure appropriate plans and goals are set. To gather this information, observation will only go so far. Asking the right questions will prove crucial to understanding the waterbody.

Ask the right questions

It is vital to talk to the landholder about both the current and historic landuse of the surrounding waterbody. Similarly, speak to other locals or neighbours who may be aware of past events that might explain the current status of the waterbody. For example, look for stories about localised flooding events, upstream development or interesting past landuse, i.e. was the property previously used as a poultry farm or abattoir? Similarly, ask the landholder how the waterbody functions with seasonal variability. For example, how does it behave during the dry winter months and during wet summer months? A waterbody can rarely be considered as an individual, isolated ecosystem. Rather, waterbodies usually sit within a broader wetland and catchment and are connected to this much larger ecosystem. It is therefore important to identify the catchment and sub-catchment that the waterbody sits in and consider how the waterbody was formed and interacts within these catchments and how it affects the natural hydrology of the catchment.

Questions to ask to understand the waterbody:

- What is the current and past landuse?
- Have there been any significant past events in the surrounding landscape?
- What catchment and sub-catchment does the waterbody sit in?
- How was the waterbody formed?
- What waterway is downstream of the waterbody?
- What features are upstream of the waterbody?
- How does the waterbody behave during dry winter months and drought periods?
- How does the waterbody behave during wet summer months and flooding periods?
- What is the current use of the waterbody?
- What was the waterbody originally used for?

This exercise will not only provide vital information about the waterbody and property but may also build the understanding of the landholder as they seek the answers to these questions.

5.5 IDENTIFY THE ISSUES AND ACTIONS

For a waterbody to be healthy and provide value, it needs to have good:

- water quality
- biodiversity
- health and safety
- amenity and aesthetics
- hydrology and hydraulics.

The following sections discuss each of these five areas in detail describing indicators to look out for and providing case studies to showcase some of the different management actions available. Module 4 *Maintenance and Operations* also provides further detail on issues and management actions for waterbodies.

5.5.1 Water quality

Good water quality is fundamental to all other elements of a waterbody functioning well. For example, good water quality tends to be clear and weed free which improves the waterbody's aesthetics, promotes biodiversity and prevents occurrence of algal and cyanobacterial blooms therefore improving the health and safety of the waterbody. High levels of sediment and nutrients in waterbodies are the two major causes of poor water quality.

Sediment

High sediment loads entering a waterbody cause high turbidity. High turbidity blocks sunlight reaching submerged vegetation and causes difficulties for animals which rely on sight to feed (Figure 5.4). High turbidity encourages the growth of floating vegetation and can lead to the occurrence of problematic algal blooms and weed infestation (Figure 5.5). If the waterbody is used for watering stock, high turbidity and poor water quality can reduce the health of livestock. Research (Petty and Poppi, 2008) has shown that cattle grazing in muddy paddocks have a lower live weight gain and spend less time grazing than those in dry paddocks. Research in Canada by Willms (2002) has also shown that animals gained up to 23% more weight drinking clean water compared to dam water.

Resuspension of sediment from the bottom of a waterbody can also cause turbidity issues. Resuspension can occur for a number of reasons for example rain events or lack of submerged vegetation to stabilise the sediment. Aquatic animals which feed from the bottom sediments of a waterbody may also disturb and resuspend the sediment. An example is the introduced Carp species. Carp increase the water's turbidity by uprooting vegetation and stirring up sediments during feeding. This in turn reduces light penetration, which can make it difficult for native fish that rely on sight to feed. Reduced light can also decrease plant growth, and suspended sediments can smother plants and clog fishes' gills. Carp feeding habits can also undermine banks leading to the collapse of banks and vegetation. However, factors such as hoof erosion or exposed banks are much more important factors in bank erosion and should be prioritised before Carp control measures. Protection and restoration of riparian vegetation can minimise the risk of damage by Carp.

High sediment loads are a relatively easy issue to identify because muddy, brown water is easy to recognise. The turbidity of a waterbody can be measured using a turbidity sensor or the water's clarity can be measured using a Secchi disc.

Erosion of surrounding soil is a significant source of sediment to waterbodies. Erosion can occur via:

- upstream erosion of gullies lacking vegetation with exposed and unstable banks (Figure 5.6)
- hoof erosion both upstream and around the waterbody (Figure 5.7)
- sheet erosion from exposed soil on surrounding land (Figure 5.8)
- erosion of the waterbody's banks through trampling or exposed soil (Figure 5.9).

Figure 5.10 outlines where these types of erosion occur within the landscape.

Figure 5.4 High turbidity makes it difficult for animals that rely on sight to feed

Photo: Jack Mullaly, Healthy Waterways

Figure 5.5 A waterbody with high turbidity and floating waterplants

Photo: Jack Mullaly, Healthy Waterways

Figure 5.6 Upstream gully erosion

Photo: Lockyer Valley Regional Council

Figure 5.7 Hoof erosion

Photo: Lockyer Valley Regional Council

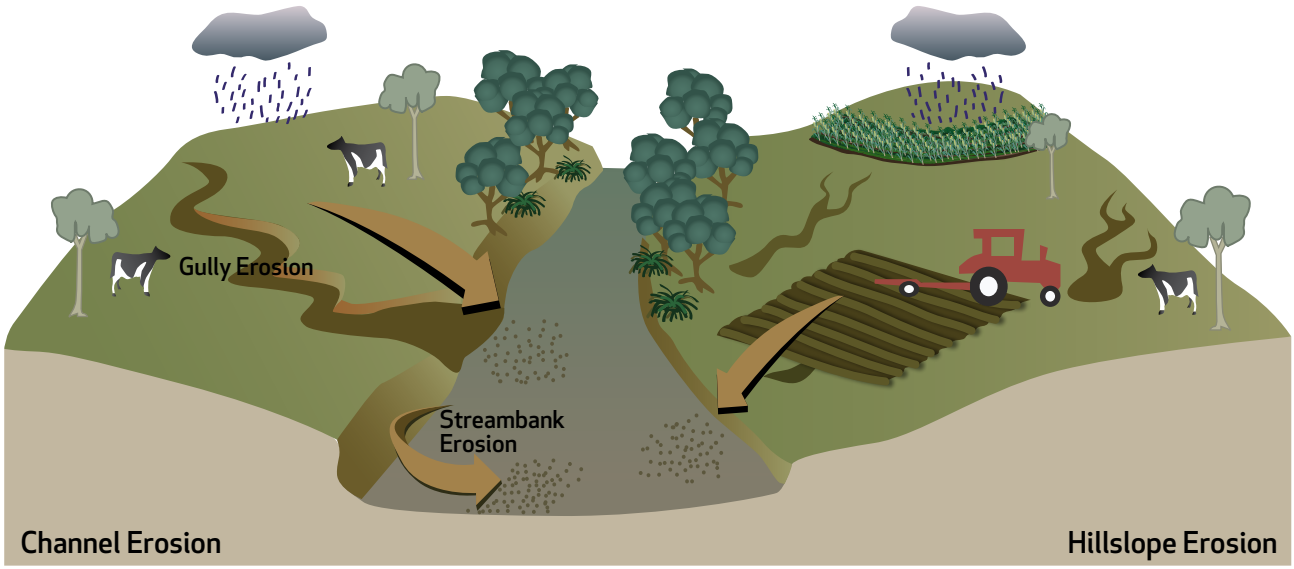
Figure 5.8 Hill slope and sheet erosion

Photo: Sunshine Coast Council

Figure 5.9 Waterbody bank erosion

Photo: Healthy Waterways

Figure 5.10 Types of erosion



Practical and Innovative Solutions: DIY floating wetlands to remove nutrients and sediment

Floating wetlands are a relatively new technology for removing pollutants from the water column. They work by providing a floating surface for plants and vegetation to grow upon (Figure 5.11). The plants in a floating wetland have their roots suspended in the water column where a biofilm forms (Figure 5.12). It is within these biofilms that microbes and bacteria trap and digest organic matter and nutrients including suspended solids, nitrogen and phosphorus. Floating wetlands can be an expensive option if an expert is consulted. Owing to the simplicity of the concept of floating wetlands it is possible to build a 'DIY' (do it yourself) version for implementing on a private property (Figure 5.13). Relatively cheap and easily available materials such as stormwater pipes, wire netting and cable ties can be used to build a floating wetland. DIY floating wetlands provide a practical and cost effective option for landholders. In addition DIY floating wetlands can be an effective way to engage community through organising workshops and demonstrations (Figure 5.14). To learn how to build a floating wetland visit www.redland.qld.gov.au

Figure 5.11 The plants of a DIY Floating wetland

Photo: David Brown, Redland City Council

Figure 5.12 The roots of a DIY Floating wetland

Photo: David Brown, Redland City Council

Figure 5.13 DIY Floating wetland with protective bird netting

Photo: Jack Mullaly, Healthy Waterways

Figure 5.14 DIY Floating Wetlands can provide opportunity for community engagement

Photo: David Logan, Healthy Waterways

Case Study – Upstream gully erosion in Redlands Catchment

The landuse of this rural property is predominately grazing of horses. A small farm dam is located on the property and lies directly downstream of a well-used gully crossing for the horses.

Issue

The frequent use and trampling by the horses had caused the gully crossing to become degraded and eroded (Figure 5.15). The gully crossing was particularly vulnerable to erosion following wet weather when the horses caused significant damage and hoof erosion to the wet ground (Figure 5.16). The gully crossing was polluting the downstream dam with sediment and nutrient loads as well as lessening the aesthetics of the property.

Action

The Redland City Council Waterways Extension Program provided the landholder with materials and expert advice to help with the construction of a permanent pipe crossing and a gravel path for the horses to cross the gully without causing erosion.

Why?

In rain events, soil disturbed by horses would be transported into the dam and eventually into the creek adjoining the property. The permanent pipe crossing and gravel path covers exposed soil (Figure 5.17) and allows the flow of water in a rain event (Figure 5.18).

Outcome

Environmentally, there was a significant reduction in sediment entering the dam and hence the waterway. Aesthetically, the construction of the pipe crossing and path improved the visual look of the property.

Figure 5.15 Before - hoof erosion caused by the horses

Photo: Danielle Crawford, Redland City Council

Figure 5.16 Before - gully crossing is eroded and degraded

Photo: Danielle Crawford, Redland City Council

Figure 5.17 After - exposed soil is covered reducing erosion

Photo: Dale Watson, Redland City Council

Figure 5.18 After - pipe allows flow of water without causing erosion

Photo: Dale Watson, Redland City Council

For further information on sustainable horse management see:

- The Horse Management on Small Properities booklet J, Myers and S, Myers, (2010).

For more information on managing stock water see:

- Property planning: Using off-stream watering points, Fitzroy Basin Association. Peck, G. (2006).
- Stock and Waterways: a manager's guide, Land and Water Australia. Staton, J. and O'Sullivan, J. (2006).

Nutrients

The two key nutrients in waterbodies are nitrogen and phosphorus. These nutrients occur naturally in the environment but when found in high levels they can cause a multitude of problems in a waterbody. High nutrient levels can increase the occurrence of algal blooms (Figure 5.19). Algal blooms cause aesthetic, health and safety problems (particularly if toxic in nature) and lower water quality when they start to die and decay (Figure 5.20). As decaying blooms are broken down by organisms, the increase in respiration to achieve this breakdown will exert a significant demand on the dissolved oxygen supply of the water. This can lower dissolved oxygen levels to the point where fish kills may occur. Fish kills bring a range of problems such as lowered biodiversity, public complaints and disposal issues.

Sources of nutrients to a waterbody may include:

- fertilisers
- animal wastes (Figure 5.21)
- on-site sewage treatment facilities (i.e. septic systems)
- sediment (nutrients in particulate form).

Algal blooms and weed infestations indicate high nutrient levels. Discoloured water and floating scum signifies the occurrence of an algal bloom. Multiple management actions such as aeration and recirculation systems, floating wetlands, enzymes to kick start nutrient cycling and chemicals that bind and settle out nutrients can be used directly on a waterbody. However, these are reactive management actions and should only be used in the short term. To effectively address high nutrient levels the issue must be combated at its source. Actions such as best management practice of animal waste, repairing of leaky septic systems and sewer pipes and appropriate application of fertilisers will be of greater effect for managing nutrients in a waterbody. For further information on management actions to improve water quality see Section 4.3.2 of Module 4 *'Maintenance and Operations'.*

Figure 5.19 A waterbody experiencing an algal bloom

Photo: Kate MacKenzie, Sunshine Coast Council

Figure 5.20 An algal bloom caused by high nutrient levels

Photo: Karen Waite, Moreton Bay Regional Council

Figure 5.21 Manure is a common source of nutrients on farm properties

Photo: David Brown, Redland City Council

Case Study – Nutrient source control through correct animal waste management in the Redlands Catchment

A waterbody is located adjacent to a property which has a large number of horses on it. A drainage line runs through the property and feeds directly into the waterbody.

Issue

The landholder was struggling to completely manage the large volume of horse manure produced by the horses. Some manure was being bagged and sold but not on a large enough scale to manage all of the manure. The remaining manure was left unmanaged and served as a pollution source to the adjacent waterbody (Figure 5.22).

Action

The Redland City Council Waterways Extension Program worked with the landholder to improve his pasture and significantly improve the water quality of the waterbody. In the short term a manure compound was provided for the property to contain and control the manure (Figure 5.23). In the long term the landholder was trained in how to compost his manure and reapply it to the pasture.

Why?

One major issue for any horse owner on a small acreage property is manure management. Providing a designated site to store the manure and training the landholder in how to compost manure enabled the landholder to effectively manage the manure and improve the pasture coverage and health.

Outcome

There has been a significant reduction in nutrients entering the waterbody adjoining the property. An additional benefit was the improvement of the landholder's pasture. This has encouraged the landholder to continue working with the Waterways Extension Program.

Figure 5.22 Before - unmanaged manure left in exposed stockpiles

Photo: Dale Watson, Redland City Council

Figure 5.23 After - a manure compound for storing and composting manure

Photo: Danielle Crawford, Redland City Council

5.5.2 Biodiversity

Diverse habitat supports high biodiversity (Figure 5.24). Waterbodies with low biodiversity are less stable and more vulnerable to weed infestation (Figure 5.25).

Creating diverse habitats within waterbodies can be achieved through simple actions. A study of wetlands in Delaware, US showed that adding woody logs to waterbodies increased the diversity of insect communities (Alsfeld, 2009). A diverse insect community will provide a food source for a wider range of predators such as waterfowl and frogs. The same study also showed the benefits of varied microtopography (small scale variations in the height and roughness of the ground and vegetation). Providing ridges or furrows in the surrounding land as opposed to flat surfaces will enhance the landscape. Similarly, the addition of rocks or pontoons will promote a more dynamic habitat for encouraging biodiversity. Planting native vegetation around a waterbody with rocks interspersed will create habitat for animals, particularly frogs. Frogs eat lots of insects and can help reduce the number of problematic insects such as mosquitoes.

Quick tips for promoting waterbody biodiversity

- **Plants** - Planting a mixture of native vegetation in and around a waterbody will create a diverse ecological community
- **Trees** - Planting native trees provide shade and habitat for animals
- **Logs** - Introduce coarse woody debris such as hard woody logs to waterbodies
- **Rocks** - Create frog friendly habitat by placing rocks around waterbodies
- **Ridges and furrows** - Create a variety of microtopography features such as land surface ridges and furrows
- **Buffer** - Create a buffer zone around the waterbody to protect and enhance biodiversity, refer to the Queensland Wetland Buffer Planning Guideline,2011, for information on how to design an appropriate buffer zone
- **Fencing** - Fencing around a waterbody and native vegetation will exclude feral pests who prey on native species and will also exclude domestic animals who can trample and damage important habitat
- **Nest boxes** - Provide safe nesting areas for wildlife species that depend on tree hollows for shelter
- **Shallow water** - Shallow water areas are ideal bird and fish feeding habitats

Figure 5.24 A high biodiversity waterbody

Photo: Julian Wakefield, Sunshine Coast Council

Figure 5.25 A low biodiversity waterbody

Photo: Karen Waite, Moreton Bay Regional Council

Case Study – Increasing biodiversity by revegetating a drainage line in the Redlands Catchment

A drainage line runs along this rural grazing property before crossing the property to flow into a waterbody adjoining the property.

Issue

The drainage line had been cleared of vegetation (Figure 5.26). This meant that there was no natural barrier to pollutants, such as manure and sediment, being washed from the property directly into the waterbody.

Action

In the short term, manure compounds were constructed and erosion control measures put in place. In the long term, the drainage line was revegetated with native vegetation (Figure 5.27).

Why?

Addressing the manure and sediment source directly reduces the pollutant loads entering the waterbody. The vegetated drainage line now acts as a filter for nutrients and sediments contained in runoff from the surrounding land, preventing them from entering the waterbody.

Outcome

There has been a significant reduction in nutrients and sediment entering the waterbody adjoining the property. In addition to the water quality improvements, the established native vegetation along the drainage line provides habitat for a number of small birds and reptiles. This builds the resilience of the waterbody and improves the aesthetics of the property.

Figure 5.26 Before - unvegetated drainage line with exposed soil

Photo: Danielle Crawford, Redland City Council

Figure 5.27 After - revegetated drainage line

Photo: Dale Watson, Redland City Council

5.5.3 Health and safety

Health and safety issues will vary in concern depending on the location and purpose of a waterbody. If a waterbody is used for primary contact recreation, such as swimming, or for watering animals then it is vital that any potential risks are managed and minimised.

The most common health and safety risks associated with waterbodies are:

- contact with cyanobacteria
- contact with microbial pollution
- injury or drowning.

Ask the landholder questions to indicate the presence of toxic blooms or microbial pollution. Questions could include 'have any livestock that access the waterbody shown signs of illness?' or 'have any family members who use the waterbody for swimming shown symptoms of illness such as vomiting or skin rashes?'

Cyanobacteria

Certain species of cyanobacteria produce toxins that are harmful to humans and animals. These toxins are a potential hazard in waters used for human and animal drinking water supplies, aquaculture, agriculture and recreation (Ressom *et al.*, 1993). Production of toxins is unpredictable, making it difficult to identify the toxicity of waters (Falconer *et al.*, 1999). The most common toxic cyanobacteria species in Australia are:

- *Microcystis aeruginosa, Anabaena circinalis, Cylindrospermopsis raciborskii,* and *Aphanizomenon ovalisporum* in fresh water
- *Nodularia spumigena* and *Lyngbya majuscula* in estuarine and coastal marine water.

Table 5.2 provides a list of potentially toxic types of cyanobacteria and how they affect mammals.

The following advice, as adapted from the National Health and Medical Research Council *Guidelines for Managing Risks in Recreational Water*, should be provided to the landholder if a cyanobacterial bloom is identified on the property:

- Avoid areas with visual signs of cyanobacterial or algal blooms for example if the water is discoloured or floating scum is present.
- Where scums and discoloured water are both present, avoid waterskiing because of the potential for substantial exposure to sprays containing algae and cyanobacteria.
- Wetsuits may result in a greater risk of rashes, because cyanobacterial or algal material trapped inside the wetsuit will be in contact with the skin for long periods.
- After coming ashore, shower or wash yourself down to remove any cyanobacterial or algal material.
- Wash and dry all clothing and equipment with clean water after any contact with cyanobacterial or algal blooms and scum.
- If you experience any health effects, whatever the nature of your exposure, seek medical advice promptly.

Reactive management actions such as introducing algaecides to a waterbody, for example barley straw or copper-based algaecides, or introducing activated carbon for toxin removal will only manage the current bloom and will not prevent the reoccurrence of a bloom in the future. Preventative management actions will be far more beneficial. Techniques to prevent cyanobacterial blooms should focus on the two main drivers of blooms; high nutrient levels and low flows or flushing. Refer to Section 4.3.2 of Module 4 *'Maintenance and Operations'* for further information on reactive and preventative management actions for cyanobacterial blooms.

Table 5.2 General cyanobacterial related illness (NHMRC, 2008)

Cyanobacteria type	Primary area effected in mammals
Microcystis, Anabaena, Planktothrix (Oscillatoria), Nostoc, Hapalosiphon, Anabaenopsis, Nodularia, Aphanizomenon, Cylindrospermopsis, Umezakia, Raphidiopsis	Liver
Anabaena, Aphanizomenon, Lyngbya, Cylindrospermopsis, Planktothrix (Oscillatoria), Aphanizomenon	Nervous system
Lyngbya, Schizothrix, Planktothrix (Oscillatoria)	Skin and gastrointestinal tract

Microbial pollution

A microbe is a tiny life form or microscopic organism that cannot be seen by the human eye. Microbial pollution is the presence of harmful microbes in water at levels which can produce undesirable effects to human health. Poor animal waste management and leaky septic systems or sewer pipes can be a source of microbial pollution to a waterbody. Exposure to pathogens in waterbodies can occur through direct contact with polluted water during recreation, accidental ingestion of polluted water or the inhalation of small water droplets. Polluted water can cause a variety of gastrointestinal diseases, collectively known as gastroenteritis. Symptoms of gastroenteritis may include vomiting, diarrhoea, stomach-ache, nausea and headaches. Diseases and conditions affecting the eyes, ears, skin and the upper respiratory tract can also be contracted when certain pathogens come into contact with broken skin or the delicate membranes in the ear, nose, and lungs. Refer to Table 5.3 for some common illnesses associated with pathogens.

Studies (Journeaux, 2005) have shown that cattle are five times more likely to defecate in waterbodies than surrounding paddocks and the concentration of sediment, nitrogen and *E. Coli* bacteria have been shown to be 20 to 30 times higher downstream of stock access sites than upstream.

If a waterbody is used for recreation it is important to ensure that microbial pollution is prevented.

Top tips for preventing microbial pollution:

1. Make sure manure stockpiles are safely secured and are not located adjacent to or upstream of a waterbody.
2. Prevent animals such as cows or horses from having direct access to the waterbody (this stops the animals from defecating directly into the waterbody).
3. Test on-site sewerage facilities, such as sewer pipes and septic tanks, regularly for leaks and illegal connections.

Injury or drowning

If a waterbody is easily accessible and/or used for recreational proposes then water depth is something that needs to be considered, particularly if small children reside on the property. Water depth coupled with poor water clarity has contributed to drowning and near-drowning (Quan *et al.*, 1989). This is particularly evident if there is a significant increase in water depth from the edge of a waterbody. Shallow edges around a waterbody, which gradually increase in depth, reduce risk of drowning and injury and also have the added benefit of providing important feeding habitat for fish and birds and encouraging growth of submerged vegetation.

Table 5.3: Pathogens, illnesses and symptoms

Pathogen	Common illnesses and symptoms
Bacteria (e.g. *Campylobacter, Escherichia coli)*	Infections of cuts and wounds, gastroenteritis (including diarrhoea and abdominal pain)
Viruses (e.g. Rotaviruses, Hepatitis A)	Gastroenteritis, respiratory infections
Parasites (e.g. *Cryptosporidium, Giardia)*	Gastroenteritis, (including dysentery, diarrhoea and abdominal pain)

Case Study – Barley straw trial for treating toxic cyanobacterial bloom in the Redlands Catchment

A horse riding property with a large farm dam (approximately 1300 m²) which is used as a water source for the horses.

Issue

Due to high nutrient levels in this dam, cyanobacterial blooms occur regularly throughout the year (Figure 5.28). These potentially toxic blooms prevent the landholder from using the dam to water the horses. This lack of a safe water source on the property adds to the running cost of the business as the landholder needs to buy water from external sources.

Action

The Redland City Council Waterways Extension Program is working with the landholder to reduce sediment and nutrients entering the dam. In the short term barley straw is being trialled as an algaecide so that the landholder might be able to use the water for his business (Figure 5.29).

Why?

Studies from Britain have shown barley straw to be an effective method of algal control. Rotting barley straw has been shown to produce a natural algaecide that prevents growth of certain algae and cyanobacteria. However, Australian studies have generally not supported the original research in Britain. This property provides a good location to trial the barley straw method. Barley straw is a cost effective and practical option for the landholder.

Outcome

Although the results of the barley straw trial have not been analysed, the anecdotal evidence would suggest that the barley straw has reduced the reoccurrence of toxic cyanobacterial blooms (Figure 5.30, 5.31). Prior to using the water for horses it should be tested for toxins.

Figure 5.28 Before - waterbody experiencing cyanobacterial blooms

Photo: Vianne Law, Redland City Council

Figure 5.29 Installation of barley straw

Photo: Vianne Law, Redland City Council

Figure 5.30 Waterbody with barely straw

Photo: David Brown, Redland City Council

Figure 5.31 Six months after installation of barley straw

Photo: David Brown, Redland City Council

5.5.4 Amenity and aesthetics

The profile and amenity of a waterbody plays an important role in how the community will perceive and value it. Community will take pride and ownership of a healthy waterbody that delivers values. Generally the community will assess the health of a waterbody based on its visual aspects. It is therefore important for a waterbody to be free of any issues such as weed infestation (Figure 5.32) and litter (Figure 5.33) that will degrade the waterbody's profile and amenity.

Not all factors degrading a waterbody's amenity are visual. Other factors like odour and pests (e.g. mosquitoes) will also cause the community to devalue a waterbody. Visual indicators (e.g. litter) and community complaints are common indicators of amenity and aesthetic issues.

Figure 5.32 Weeds in a waterbody

Photo: Maree Manby, Redland City Council

Figure 5.33 Litter in a waterbody

Photo: Colin Bridges, Gold Coast City Council

Case Study – Profile and amenity in the Redlands Catchment

This case study presents a unique situation, in that there is a dam surrounded by four properties, with each property having a land area of 2051 m². The dam is not connected to a natural drainage line and surface runoff from the surrounding four properties is the dam's main source of water.

Issue

The dam does not get flushed out during heavy rainfall events. As a result, any nutrients or sediment that enter the dam during the rain event will remain within the dam until they have been utilised. High nutrients and turbidity have made the dam vulnerable to weed infestation (Figure 5.34). The invasive weed Mexican waterlily had become dominant in the dam.

Action

Over the past few years the Redland City Council Waterways Extension Program (WEP) has been reactively treating the Mexican waterlily (Figure 5.35).

As a long term action WEP has worked with all the landholders to revegetate the dam edge and introduce floating wetlands to the dam (Figure 5.36).

Why?

Mexican waterlily is a notoriously hard plant to completely eradicate from a waterbody. Like most weeds high nutrients accelerate the growth rate of Mexican waterlily allowing it to quickly reach levels that are difficult to control. Revegetating the dam edges will help to reduce the nutrients within and entering the dam in the long term. The biofilms present on the roots of the floating wetland remove nutrients and sediment from the water column of the dam (Figure 5.37).

Outcome

The dam's nutrient levels are reducing which will help reduce the spread of the Mexican waterlily.

The collaborative working relationship between the WEP officer and the landholders has resulted in a positive outcome around education and capacity building on aquatic weeds. As a result, one of the landholders spotted *Salvinia molesta* and manually removed it whilst it was at a controllable stage.

The landholders continue to work with WEP to improve water quality in the dam. In the future more planting will be carried out on the dam edges. Water sampling has been undertaken over a ten month period and will continue into the future. In addition, depending on future monitoring results and funding, more floating wetlands may be deployed.

Figure 5.34 Before – Mexican waterlily infestation

Photo: David Brown, Redland City Council

Figure 5.35 After – Mexican waterlily removed

Photo: Dale Watson, Redland City Council

Figure 5.36 After - installation of floating wetlands with protective bird netting

Photo: David Brown, Redland City Council

Figure 5.37 After - floating wetlands with bird netting removed

Photo: David Brown, Redland City Council

5.5.5 Hydrology and hydraulics

Hydrology and hydraulics refers to how water behaves and moves within a waterbody. The volume and frequency of water moving into and out of a waterbody and how long the water resides in the waterbody are important determining factors of the functioning of a waterbody. The hydrology and hydraulics of a waterbody is largely a function of:

- the size, shape, landuse and topography of the catchment
- the design of the waterbody (e.g. size, shape, construction type, inlet and outlet arrangement).

There are very limited numbers of practical, easy to achieve methods of improving hydrologic and hydraulic function within a waterbody. More intensive fixes do exist and are discussed in Section 4.3.4 of Module 4 *'Maintenance and Operations'.*

Practical and Innovative Solutions:

Solar water circulation system

Low flows in and out of a waterbody can result in thermal stratification particularly during the warmer seasons. See Section 1.4.2 of Module 1 *'Waterbodies in Our Landscape'* for further information on thermal stratification. Stratification favours cyanobacteria that are able to regulate their buoyancy and move between the stratified layers. Stratification can also result in significant release of phosphorus from sediments increasing the nutrient levels in the waterbody. Encouraging water circulation within a waterbody is one way to combat thermal stratification. Aeration systems are often used to introduce oxygen into the water column and promote circulation of the water. However, these systems can be costly to run if powered by fuel. Solar powered water circulation systems provide a more sustainable solution
(Figure 5.38, 5.39).

Figure 5.38 Solar water circulation system from behind

Photo: Karen McNeale, Redland City Council

Figure 5.39 Solar water circulation system

Photo: Karen McNeale, Redland City Council

5.6 SET PRIORITY ISSUES AND ACTIONS

Having carried out a site assessment, identified the issues and then mapped out all of the practical management actions that need to be implemented, the result may be a colossal 'to-do' list. The trick here is to divide and conquer. Work with the landholder to discuss what actions they would most like to start with. Be sure to start with actions that can be achieved in the short term and can show some real tangible outcomes. Every time an action is completed and ticked off the list be sure to acknowledge and celebrate this achievement with the landholder. This can be accomplished through achievement certificates or even a simple verbal well-done. This will motivate the landholder to continue with the 'to-do' list.

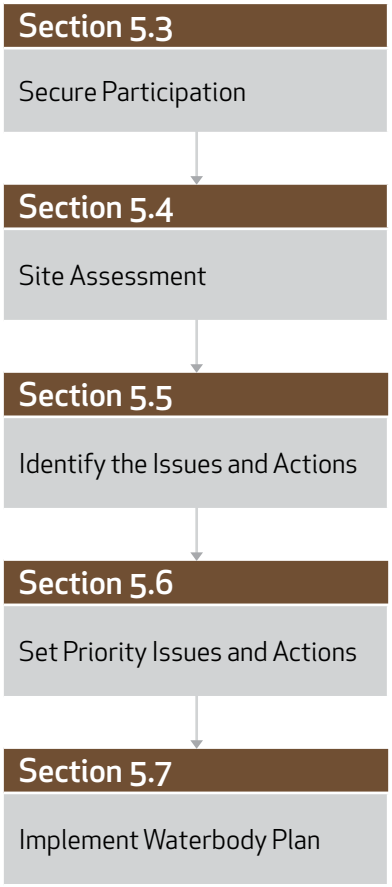
5.7 IMPLEMENT WATERBODY PLAN

Considering restraints in resources of both the extension program and the landholder, full implementation of the waterbody plan may take some time. It is therefore important to take a long term approach to managing waterbodies. Observe the waterbody and the effectiveness of the management actions over time. Learn from successes and failures, and tailor future management actions accordingly. Keep the landholder engaged and encouraged throughout this time by celebrating successes and acknowledging hardwork. Working together, the goal of a healthy waterbody and improved property and ecosystem will be achieved.

5.8 WORKED EXAMPLE

This worked example outlines the practical application of an extension program process (Figure 5.40) to a hypothetical local government area and landholder's property.

Figure 5.40 Extension program process



5.8.1 Setting

Sunnyside Council manages the Sunnyside Catchment. The lower reaches of this catchment are urban with the upstream reaches of the catchment being predominantly rural with some conservation and forested areas. The farming practices include equine, dairy, beef, poultry and crop. A large number of waterbodies exist across the Sunnyside Catchment. Over 70% of these waterbodies are located on private property, mainly in the upper catchment. During high rainfall events the majority of the waterbodies reconnect to the Sunnyside River which discharges into Sunnyside Bay. The Sunnyside Council 'Rural Waters Extension Program' works with landholders in the upper catchment to improve the health of their waterbodies and minimise the downstream impacts on Sunnyside Bay.

5.8.2 Securing participation

Sunnyside Council 'Rural Waters Extension Program' understands that a landholder's land is their business. The extension program therefore describes its work as 'giving landholder's the edge in their business'. The program promotes the environmental and business benefits gained from the practices they encourage. This promotes positive buzz around the program. The program also establishes networks and partnerships among their participants. This includes pairing suitable landholders together which generates discussion and promotes sharing of knowledge and experiences. By creating these partnerships the landholders have access to a peer support network which lowers the landholder's fears about participating and shows that the program is doable and beneficial. Each year the Program runs the 'People's Choice Awards' to celebrate successes and acknowledge the hard work of the participants. The program participants nominate and vote for landholders within different categories, such as, 'Most Supportive Neighbour' or 'Newcomer of the Year'. To keep satisfaction ongoing throughout the year, the Program also has a 'Landholder of the Month' award where the winner receives a token certificate and polo shirt with the Program's name and logo embroidered, as well as being acknowledged in the Program's monthly newsletter.

5.8.3 Site assessment

Charlie Smith, a cattle farmer, was tired of seeing the productivity of his land steadily decline. He heard from a neighbour that the 'Rural Waters Extension Program' had really experienced and friendly staff who might be able to provide some ideas on how to solve Charlie's problem. Charlie looked up the Program online and called the number on the website. He was put through to a friendly extension officer who arranged with Charlie an appropriate time and date to visit Charlie on his property. The site visit took place within a few days of Charlie making the call. Charlie gave Sarah, the extension officer, a tour of his property. Charlie lamented that his land just wasn't the same as it used to be. Charlie pointed out the sparse pasture and bare exposed soil and complained that his water supply had an unnatural green glow and wasn't fit for watering his animals. Sarah listened attentively to Charlie's frustrations and asked lots of practical and insightful questions about his property. After Charlie had concluded his property tour, Sarah and Charlie sat down together and talked about their shared vision for Charlie's property.

5.8.4 Identify issues and actions

Once Charlie and Sarah had set the goals and vision for the property, they discussed all the steps they would need to take to reach this vision. From Charlie's property tour and the answers he provided, Sarah had compiled a list of issues and actions. Sarah recognised the visual indicators of an algal bloom in Charlie's waterbody. From investigating the waterbody and property Sarah discovered stockpiles of manure located near the waterbody. From asking Charlie the right questions Sarah had also discovered that in previous years the fields adjacent to the waterbody had been ploughed perpendicular to the waterbody. Sarah therefore identified that the waterbody was suffering from a legacy issue of high nutrient and sediment loading from the ploughing and also had an ongoing constant supply of nutrients from the upstream manure stockpiles. Sarah would therefore need to think of both long term and short term actions to address the issues. Table 5.4 shows the list of issues and actions that Sarah created for the property.

Table 5.4 List of issues and actions

Issue	Short Term		Long Term	
	Action	Expected Outcome	Action	Expected Outcome
High nutrient levels	Compound the manure stockpiles	Manure is no longer a source of nutrients to the waterbody	Create and introduce DIY floating wetlands to the waterbody	Nutrient and sediment uptake from the waterbody
High sediment levels	Prevent stock access to the waterbody	Reduced hoof erosion and reduced nutrient supply from animals defecating into the waterbody	Revegetate the waterbody edge with native vegetation	Vegetation acts as a filter for sediment protecting the waterbody and improves biodiversity
Erosion	Reapply composted manure to the sparse pasture	Improved pasture cover and less exposed soil	Revegetate the drainage line that runs into the waterbody	The vegetation will slow and filter the water running off the property and reduce erosion and capture sediment
Cyanobacterial blooms	Add a solar powered recirculation system to the waterbody	Prevents stratification and encourages flushing of the waterbody preventing build up of cyanobacterial cells	Plant tall native vegetation around the waterbody to shade the waterbody	The shade will regulate the waterbodies temperature preventing stratification and will reduce the sunlight and hence photosynthetic activity of algae and cyanobacteria

5.8.5 Set priority issues and actions

Sarah and Charlie worked through the list in Table 5.4 and discussed resources, capacity and what issues were of most importance to Charlie. Sarah kept in mind to focus on short term actions in the initial stages so that Charlie could see tangible benefits within short time periods and be encouraged to continue with the list. From listening to Charlie, Sarah knew that his biggest frustration was that his pasture was not as productive as it used to be and that it would be beneficial to focus on actions that would address this frustration. Together Sarah and Charlie made a short list of three key priorities that they would focus on (Table 5.5).

Table 5.5 Priority actions

Charlie's Top Three Priorities
1. Compound the manure stockpiles
2. Reapply composted manure to the sparse pasture
3. Prevent stock access to the waterbody

5.8.6 Implement waterbody plan

Charlie and Sarah set to work on completing their priority tasks. The 'Rural Waters Extension Program' supported Charlie by having Sarah as his dedicated extension officer and by financially supporting Charlie to purchase the manure compound and fencing supplies. Charlie was also teamed up with another like minded landholder who had experienced similar issues with livestock waste management. As each action was completed Sarah congratulated Charlie and complemented his dedication and hard work. Charlie even won 'Newcomer of the Year' at the annual awards and upon his completion of an off-line watering system was awarded 'Landholder of the Month'. Together Sarah and Charlie have completed their first three priorities and have already moved onto tackling bigger actions like revegetating the waterbody edge and constructing DIY Floating Wetlands.

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