Riverside Rescue

Solutions for Riparian Land in Victoria

Victorian National Parks Association

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About this report

The report is a synthesis and consolidation of a number of specialist reports. Chapter 2 is a paper prepared for the VNPA from the School of Biological Sciences, at Monash University and Arthur Rylah Institute, Department of Sustainability & Environment. Chapter 3 is base on Human Health Risk From Crown Water Frontage Licences Monash University Water Studies Centre September 2009 ISBN: 978-1-875100-26-2, and Chapter 4 is based on specialist legal advice from the not-for-profit specialist law organisation the Environment Defenders Office (Vic).

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Copies of this report are available at www.riparianland.vnpa.org.au.

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The Victorian National Parks Association (VNPA) was established in 1952 and is Victoria's leading nature conservation organisation. We share a vision of Victoria as a place with a diverse, secure and healthy natural environment cared for and appreciated by all. VNPA is an independent, non-profit, membership-based group, which exists to protect Victoria's unique natural environment and biodiversity through the establishment and effective management of national parks, conservation reserves and other measures. VNPA seeks to achieve our vision by facilitating strategic campaigns and education programs, developing policies, through hands-on conservation work, and by running bushwalking and outdoor activity programs which promote the care and enjoyment of Victoria's natural heritage.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Victoria's rivers and streams, and the land adjoining them, are in a state of decline despite years of efforts by governments, communities and landholders to improve their condition.

Water quality, biodiversity, aquatic habitats and amenity are some of the important values of land that abuts rivers, streams and creeks. Victoria is unique in that it still has significant areas of riparian land in public ownership. Riparian land is defined as any land that adjoins, directly influences, or is influenced by a body of water, which can be a creek or stream, a river, a lake or a wetland. In Victoria, public riparian land is often also known as Crown Water Frontage (CWF).

There is a total of over 30,000 km of publicly owned riparian land, or CWF, across Victoria. Around 80% of the total length of Victoria's rivers is in very poor condition, with only 14% rated as being in excellent condition.

About half (53%) of Victoria's total river length has riparian land that has been substantially or severely modified, to the extent that very little native vegetation is left. Riparian land plays a vital role in influencing river health, water quality and biodiversity across landscapes. It filters nutrients and sediments from water, buffers adjoining land uses, and provides shade, habitat and breeding for native fauna. Intact native riparian land also offers immense benefits by controlling erosion and maintaining river bank structure. On top of all that, good quality riparian land looks good and adds value to the landscape and for the community.

Policy reform by successive governments has failed to deliver broad public-good outcomes for public riparian land, despite significant environmental risks relating to riparian land having been identified to governments for decades by government agencies, scientific experts and conservation groups.

This report includes a new scientific review from Monash University which looks at the massive amount of research in this area from across the world. It finds that well-managed riparian land has a range of benefits for:

- water quality
- aquatic biodiversity
- terrestrial biodiversity
- resistance and resilience of plant and animal populations
- conservation of threatened species.

This new information reaffirms what many reports and publications published for, and often by, the Victorian Government have previously stated. Most recently, the Victorian Environmental Assessment Council, Victoria's key independent statutory conservation advisory body, highlighted the importance of better managing public riverside land by fencing it off from domestic stock.

The human health implications of the pollution of waterways cattle are well known. These heath risks have been identified by both the Department of Human Services and urban water authorities.

Monash University and others have identified clear risks to human health associated with cattle in proximity to waterways. The Department of Human Services is seeking progressive policy responses to address the risks to human health.

For many decades, land managers, governments and policy makers have been aware of the clear and substantial evidence of degradation of publicly owned riparian land by inappropriate management. So far, however, they have offered only inconsistent and piecemeal approaches to landscape-scale solutions.

It should be acknowledged that some landholders and local catchment management authorities have recognised the importance of riparian land and started the process of looking after it more effectively. There are many positive examples of how better management can be a win for rivers and nature as well as for local land holders. This report highlights some of these examples. These trailblazers have shown that with the right support, significant improvements can be made that benefit landholders and the environment alike.

This document summarises both the problems and the solutions to an issue that successive governments have failed to resolve. It reaffirms scientific data that has been known for some time by water experts, decision makers and governments. The report also offers clear policy solutions and timelines that will assist the Victorian Government to deliver sound public policy which, in turn, will deliver clear public-good outcomes on some of the most important environmental, community and amenity assets across the State of Victoria.

The VNPA has a five-point plan to address problems relating to current CWF condition and management.

This plan would see these key public assets improved over the long term.

1 Assistance program for licence holders

Government to develop a 'special offer' to

Section 8 of the Water Act

Under Section 8 of the Water Act, a licence to access a Crown frontage for livestock grazing provides access to water at no cost. There is no requirement to fence the boundary between private land and the Crown frontage unless stock have unlicensed access to the Crown land. On private frontages the right to water stock under s8 is not affected by the presence of a fence.

Recent changes to the Act have made the issue of a 'take and use' licence for domestic and stock purposes for a Crown frontage licensee undertaking fencing as part of riparian protection or restoration works an 'as of right' and with no charge for the water itself. However, licence costs (both application and annual renewal) currently still need to be met.

licence holders for boundary fencing /off-river watering in return for improved management and environmental outcomes.

2 Waterway guardian/stewardship program

Establish a program for landholders with significant conservation assets adjacent to crown river frontages, and offer incentives for complementary conservation management.

3 Conservation Licences

For areas identified as being in moderate to good condition, a new conservation licence for those Crown Water Frontages should be implemented.

4 Additions to the National Reserve System

This would protect high conservation value riparian land and help Victoria meet its nationally agreed targets for threatened species protection. This is particularly important for areas adjacent to, or linking, existing reserves.

5 Immediately double current expenditure on public riparian land programs to $20 million per year for the next four years.

This would accelerate the implementation of good management and conservation outcomes, and assist landholders to take positive steps to repair, restore and protect riparian land.

1 INTRODUCTION

More than 30,000 km of Victoria's publicly-owned land abuts inland waterways. These thin strips of native vegetation, which both protect and nurture our creeks, rivers, and wetlands, are called 'riparian zones' and are exceptionally rich in native biodiversity.

They have many critically important ecological roles, including providing food and habitat for native plants and animals, and creating wildlife corridors and refuges, a role that is becoming increasingly important in heavily cleared landscapes, during drought, and under climate change.

They are also essential to keeping stream temperatures under control and in moderating the flow of sediment and nutrients into our waterways, a key determinant of water quality.

Yet despite the fact that riparian land is widely recognised as critical to biodiversity and river health by land managers, catchment management authorities and a range of government agencies, in many cases they continue to be neglected.

Nearly 80% of the total length of Victoria's rivers is in very poor condition, with just 14% rated as being in excellent condition. Approximately half (53%) of Victoria's river length contains riparian vegetation that has been substantially or severely modified, to the extent that very little native vegetation is left.

Major drivers of this degradation are land clearance, alterations to hydrology, altered stream flow and salinity, invasive species and stock access.

Governments recognise the importance of riparian land. A new report1 by the Victorian Government's key environmental advisory body, the Victorian Environmental Assessment Council, recommended that within ten years, at least 75% of public stream frontages abutting private land should be managed, under grazing licence or other arrangements, primarily for biodiversity and water quality, by undertaking:

a) fencing to control stock grazing, where appropriate.

b) revegetation and habitat restoration of cleared frontages through measures such as incentives, including those for reviewing Crown land licences and converting them to conservation licences.

Victoria's 2008 State of the Environment Report highlighted problems associated with current management arrangements on public riparian land, known as Crown Water Frontages, and recommended phasing out cattle grazing licences.

A Monash University report commissioned by the VNPA identified serious health impacts from allowing stock access to rivers and streams. This issue must be addressed as a priority.

Protection and restoration of riparian vegetation in Victoria has been promoted through a number of means, but so far the intent of policy has not translated into landscape-scale on-ground conservation outcomes.

Fortunately, the decline of Victoria's riparian zones is not yet irreversible, and efforts to restore vegetation have been shown to halt decline and restore some of the ecological functions of riparian zones.

The VNPA commissioned an extensive study into the broader ecological benefits of riparian restoration, with experts from Monash University and the Arthur Rylah Institute producing a compelling report showing that restoring riparian vegetation can halt decline and restore some of the ecological functions of riparian zones.

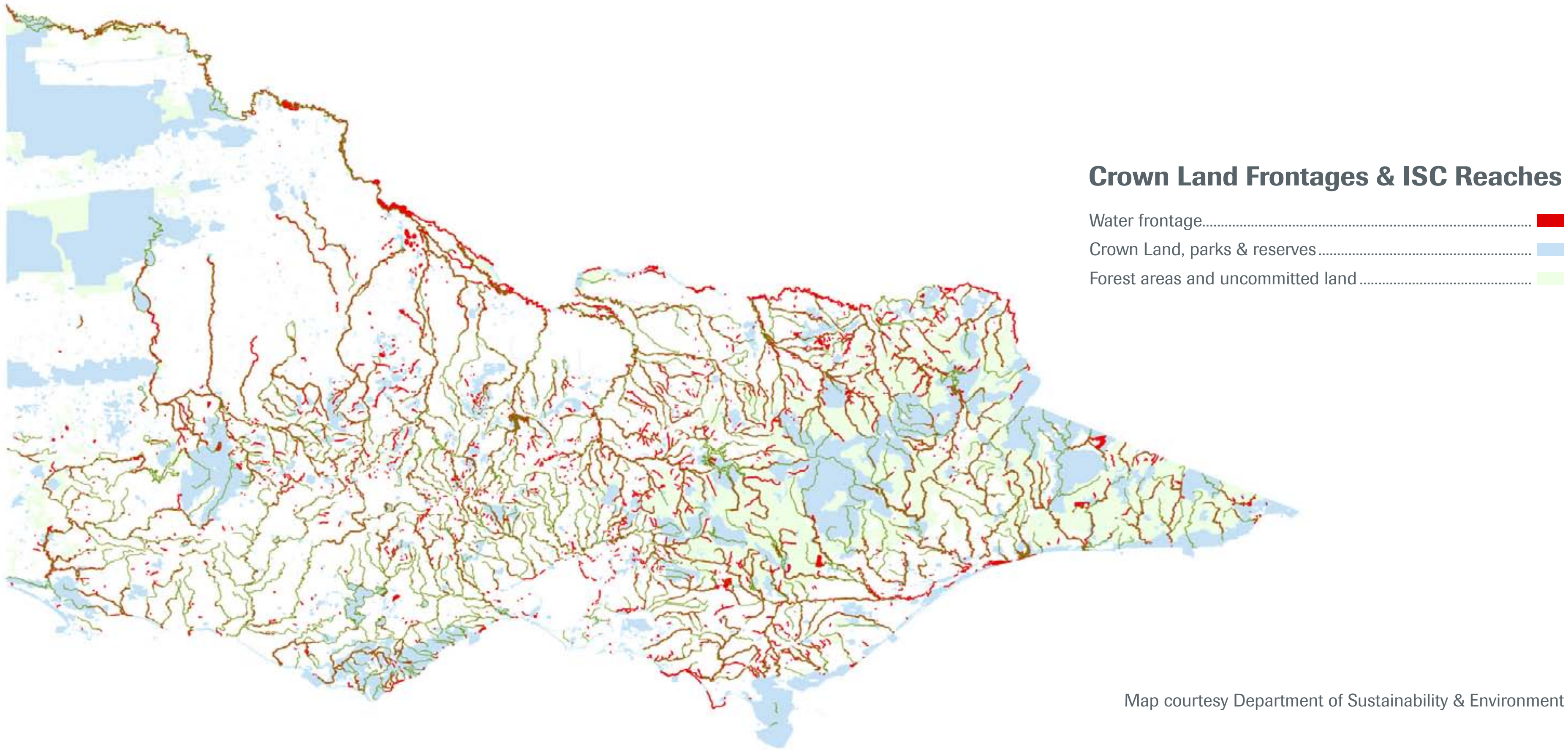
The Victorian Environmental Assessment Council's native vegetation discussion paper, released in 2011, says that "actions to maintain, improve and augment native vegetation on stream frontages are among the most likely to be highly beneficial for improving ecological connectivity and conserving biodiversity".

The significant water, health and conservation problems besetting our riparian zones can be largely addressed over the next five years through increased resourcing and action from the Victorian Government.

1.2 Taking stock of the damage

In Victoria, Crown Water Frontage licences allow landholders to graze and water cattle in rivers and creeks. The widespread environmental degradation this causes is well documented, and the Victorian Government recognises this problem. Cattle cause loss of riparian vegetation, reduction in biodiversity, and increased nutrient inputs into rivers and downstream storages.

Another factor to consider is the potential risk to human health. Cattle faeces contain pathogens that can be transmitted to humans, and uncontrolled access of cattle to rivers and streams in Victoria has the potential to introduce these pathogens into water sources that may be used (untreated or insufficiently treated) by



Map courtesy Department of Sustainability & Environment

Current environmental condition

- The 2004 Index of Stream Condition assessment reported that only 21% of major rivers and tributaries in Victoria were in good or excellent condition. Almost half the basins in Victoria have less than 10% of major rivers and tributaries in good or excellent condition.
- The same assessment also showed 14% of major rivers and tributaries had riparian vegetation in good condition. Uncontrolled stock access to riparian zones continues to be the major pressure on riparian vegetation statewide.
- No catchments in predominantly agricultural regions are in good condition (VCMC, 2002). In the Goulburn Broken catchment, 24% (2300km) of all streams have been classified as being in poor or very poor condition on the basis of riparian vegetation condition and water quality.
- In the Goulburn Broken Catchment, a review of all licensed frontages indicated that only 10% were in near-natural conditions, while more than half were substantially modified.
- A comparison of frontages along the Broken-Boosey system in northern Victoria found that grazed frontages had less groundcover biomass, less regeneration, fewer shrubs, more regionally listed weed species and more bare ground than ungrazed frontages.

humans, leading to outbreaks of waterborne diseases.

1.3 Treating our waterways like cow paddocks

Domestic stock, particularly cattle, favour riparian frontages, and if uncontrolled prefer to spend much of their time along stream banks and in the water. The pressure that uncontrolled domestic stock grazing places on riparian zones has been well documented, but it persists on both public and private land throughout Victoria.

Uncontrolled stock access results in erosion and loss of riparian vegetation, with multiple negative effects on the health of our waterways:

- Trampling and grazing of river and wetland banks destabilises the banks, as bare soil and compacted tracks leave them prone to erosion.
- Uncontrolled stock access to streams favours the introduction and spread of exotic plants, inhibits of native vegetation, prevents or reduces regeneration of native vegetation, damages or destroys the buffering effect of riparian vegetation, and adds unwanted nutrients through dung and urine.
- Degraded riparian vegetation reduces the amount of habitat available for insect-eating birds and insect parasites that protect agricultural land and crops from damage.
- Stock effluent pollutes fresh water, destroys fish-breeding cycles and encourages the proliferation of disease organisms and algae. Water quality is impaired for downstream users and stock. Salt loads in streams may be increased.
- Stream degradation additionally has implications for human health in terms of algae abundance and abundance of faecal coliforms.

1.4 The importance of riparian land

Through much of Victoria, crown frontages and other riparian land represent a substantial proportion of all remaining native vegetation in rural districts. They consequently contribute significantly to the conservation of biodiversity in those districts, with the abundance and diversity of woodland birds and arboreal mammals showing significant positive relationships with streamside vegetation.

For example, large areas of under-represented Grey Box Grassy Woodland ecosystems can be found along the Broken, Boosey and Nine Mile creeks in northern Victoria.

The remnant vegetation on public water frontages in rural districts is also significant in terms of Victoria's commitments to the National Reserve System. Native vegetation in many of Victoria's rural landscapes is under-represented in the national reserve estate and is mostly classified as threatened. As noted by the Directions for the National Reserve System document, "Public land should be used first for delivering the NRS where possible" (p. 26). These public frontages offer an effective means of improving Victoria's reserve estate and meeting our state, federal and international obligations.

Because of their very nature, riparian lands also contribute significantly to landscape connectivity, for both aquatic and terrestrial fauna and flora. Major stream and river systems supply this connectivity at multiple scales, often linking different bioregions and enabling seasonal movement of species, as well as linking habitat at the local scale to facilitate daily movements and dispersal.

This function will become increasingly important in the context of climate change, and requires these public frontages to be managed to the highest environmental standards possible to maximise their conservation potential.

The refuge potential of riparian land, as a consequence of the availability of more moisture and water, also makes it even more significant for biodiversity conservation in the context of climate change. A recent Federal Government review paper has recommended the protection of such refuges to help ameliorate the impacts of climate change.

Well-managed riparian land is the key to strengthening biolinks and increasing biodiversity in many parts of Victoria. It must be a priority of all governments to vigorously seek to improve the condition of these valuable areas of public land.

2 ECOLOGICAL BENEFITS OF RIPARIAN RESTORATION – WITH PARTICULAR APPLICATION TO VICTORIA

A 2010 report by Laura Williams[1], Robin Hale[1], Paul Reich[1,2] & Sam Lake[1]

1 School of Biological Sciences, Monash University, Clayton 3800, Australia. 2 Arthur Rylah Institute, Department of Sustainability & Environment, Heidelberg 3084, Australia. For the VNPA.

Summary

Riparian zones represent the land abutting Victoria's streams, rivers and creeks, and create an interface between our inland waterways and terrestrial ecosystems.

They are often areas of exceptionally high productivity and biological diversity, and fulfil many key ecological roles integral to the functioning of both aquatic and terrestrial ecosystems, including:

- Moderating stream temperature.
- Moderating the amounts of sediment and nutrients that enter streams—a major determinant of water quality.
- Providing habitat and food sources for aquatic organisms.
- Contributing to terrestrial food webs.
- Providing habitat for obligate and opportunistic riparian biota.
- Acting as dispersal corridors and refuges for terrestrial plants and animals—a role that is amplified in fragmented landscapes, during times of drought, and under forecasted climate change scenarios.

However, riparian zones have been extensively degraded in Victoria:

- Riparian vegetation has been denuded along more than half the length of Victoria's rivers and only 14% remains in excellent condition (Norris et al. 2001; DSE 2005).
- Many ecological functions have been compromised, and in some cases lost.

Case studies from past riparian restoration projects in Victoria and overseas demonstrate that efforts to restore riparian zones—primarily stock exclusion and revegetation—may bring many ecological benefits, including:

- Improved water quality.
- Improved aquatic biodiversity.
- Improved terrestrial biodiversity.
- Improved resistance and resilience of plant and animal populations.
- Better conservation of threatened species.

Evidence suggests that to achieve these benefits, efforts to restore riparian zones must occur at appropriately large spatial scales, and other drivers of degradation (e.g. surrounding land-use, and insufficient or altered water flow) must be addressed.

Past studies and scientific literature offer guidelines for the effective design and implementation of restoration efforts:

- Targets should be set to inform on-ground works.
- Multiple drivers of degradation and potential constraints to recovery should be identified, prioritised and addressed.
- An adaptive monitoring regime should be employed to inform and improve restoration efficiency and effectiveness over time.

Riparian zones are ecologically important environments of exceptionally high biodiversity

Riparian zones are the interface between terrestrial and aquatic ecosystems (Gregory et al. 1991; Naiman and Décamps 1997). They encompass parts of the landscape that exert direct influence on, or receive direct influence from, stream channels. By definition, streams, riparian zones and the surrounding landscape are functionally interconnected (Gregory et al. 1991; Naiman and Décamps 1997).

Riparian zones influence physical and ecological attributes of streams. Characteristics of riparian vegetation affect bank stability, erosion, channel morphology, stream flow, water temperature, and inputs of sediment, nutrients and organic litter, which underpin water quality and aquatic food webs.

Riparian zones also influence the surrounding landscape. Aquatic and riparian communities provide food sources for terrestrial communities (Ballinger and Lake, 2006). For example, Tetrigidae grasshoppers and water birds may graze on algal mats, and emerged aquatic insects are an important food source for populations of birds, bats, ants and spiders (reviewed in Ballinger and Lake 2006). In otherwise highly fragmented landscapes and during drought, riparian zones provide crucial refuge and dispersal habitat.

Riparian zones are important ecosystems in their own right. Usually the most nutrient-rich and dynamic part of a landscape, they are often areas of high productivity, and offer unique habitats for riparian specialist and opportunist plant and animal species.

Consequently, while riparian zones may only represent a small proportion of the landscape, they often have disproportionately high biodiversity values and support distinct communities (Sabo et al. 2005). For example, several ecological vegetation classes in Victoria occur solely in riparian areas (DSE 2009). Several species of birds, other animals and plants specialise on riparian zones; for example, in Victoria, platypus (*Ornithorhynchus anatinus*), water rat (*Hydromys chrysogaster*) and large-footed myotis (*Myotis adversus*) are mammals that are obligate riparian species (Menkhorst, 1995). Other species rely on riparian zones for parts of their lives or for certain activities; for example, some aquatic insects inhabit riparian zones during their adult phase (e.g. Psephenidae beetles), while others depend on these areas for breeding (e.g. Leptoceridae or caddisflies) (Towns 1983).

The capacity to perform these diverse ecological roles within the landscape depends on attributes of the riparian zone. For example, the composition (Read et al. 2008), cover, connectivity (Weller et al. 1998) and width (Hansen et al. 2010) of riparian vegetation all influence the capacity of the riparian zone to filter and process incoming nutrients and sediments, and therefore influence the quality of water entering the stream. Composition, cover, connectivity and width of riparian vegetation will also shape aquatic and terrestrial communities by determining the quality and quantity of habitat and food sources (Reid et al. 2008a,b; Hansen et al. 2010). The interconnectivity of riparian zones, waterways and the surrounding landscape means that the consequences of degrading riparian zones may multiply throughout the landscape.

Most riparian zones in Victoria are degraded

Riparian zones in Australia have been subjected to widespread and severe degradation. Nearly 80% of the total length of Victoria's rivers is in moderate to very poor condition, with just 14% of the riparian zone remaining in excellent condition (DSE 2005).

Approximately half (53%) of the river length measured by the Assessment of River Condition had substantially or severely modified riparian vegetation, to the extent that very little riparian vegetation is left (Norris et al. 2001).

Major drivers of degradation include land clearance; alterations to hydrology, encompassing water extractions, altered stream flow and salinity; stock access; and invasion of exotic plant and animal species (Lovett and Price 1999; Norris et al. 2001). As a result, the ecological functioning of Victoria's riparian zones is degraded: increased sediment and nutrients are being delivered into waterways, water quality has declined, and terrestrial and aquatic biodiversity has been lost, particularly at local and regional scales (Norris et al. 2001; Hansen et al. 2010). With continuing stock access, the condition of Victoria's riparian zones, and the streams to which they are integrally linked, will remain poor or decline further.

Riparian restoration can help restore ecological function and biodiversity

Fortunately, the continual decline of Victoria's riparian zones is not a fait accompli. Efforts to restore riparian vegetation have been shown to halt decline and restore some of the ecological functions of riparian zones.

Riparian restoration: exclude stock and plant native species

In Victoria, efforts to restore riparian zones typically involve fencing to exclude stock from a buffer of riparian land around the stream, followed by reintroducing native plant species by planting tubestock of trees and shrubs (Brooks and Lake 2007). Restoration efforts will often involve some initial weed control, such as the mechanical removal of woody weeds (e.g. willows, *Salix spp.*) or spraying grassy and broadleaved weeds.

Riparian restoration can improve water quality

Riparian vegetation is critical in maintaining water quality by reducing erosion and intercepting and processing nutrients before they enter the stream. High loads of sediment and nutrients may lead to turbid water, toxic algal blooms, and depauperate (impoverished) aquatic communities. Restoration of riparian vegetation may help maintain water quality through three main pathways.

First, riparian vegetation prevents erosion by stabilising soil and stream banks. Riparian vegetation provides ground cover that limits rainfall and wind erosion, decreases the velocity of overland flow and maintains the stability of stream banks (Gregory et al. 1991; Abernethy and Rutherfurd 1999; Prosser et al. 2001; Parkyn et al. 2003). For example, a study conducted on nine streams in northern New Zealand found that sites with restored or remnant riparian vegetation had more stable banks with less erosion than unfenced and grazed sites on the same streams (Parkyn et al. 2003).

Second, riparian vegetation may act as a buffer to filter and retain incoming sediments and nutrients. Through reducing soil erosion, riparian vegetation is critical in reducing the input of sediment and sediment-bound nutrients into streams. Restoration efforts can improve the capacity of riparian zones to reduce sediment and nutrient input into streams via filtering. For example, six years after fencing to exclude livestock and planting eucalypts in a sub-catchment in Western Australia, suspended sediment concentrations decreased by an order of magnitude (McKergow et al. 2003).

Third, riparian vegetation plays an important role in processing nutrients and reducing their input into streams (Peterson et al. 2001; Fisher et al. 2004; Montreuil et al. 2010). The capacity for riparian zones to retain and process nutrients depends on the concentration of inputs as well as the width, cover and composition of riparian vegetation, soil type, slope, and hydrology (Lowrance et al. 1997; McDowell et al. 2004; Ocampo et al. 2006; Montreuil et al. 2010). Plants and animals can only use nutrients such as nitrogen and phosphorus if they are in certain forms. One major pathway for the conversion of nutrients into bioavailable forms is microbial transformation, which depends largely on the condition of soils—in particular their carbon content (reviewed in Jackson et al. 2008). Riparian restoration creates well-vegetated riparian zones that have more carbon inputs and a greater capacity for processing nutrients than degraded riparian zones (Burger et al. 2010; Case Study 1). Likewise, restoration can increase carbon availability to streams, which improves in-stream nutrient processing and has been shown to decrease nitrate and ammonium levels in streams (Craig et al. 2008).

There are two important caveats on the relationship between riparian vegetation and water quality. First, responses depend on the continuity of riparian vegetation: studies have shown that even small gaps in riparian vegetation along a stream can compromise function (e.g. Weller et al. 1998). Second, responses depend on surrounding land-use: large amounts of nutrients applied onto land adjacent to riparian zones may exceed the amount that can be intercepted or transformed by riparian plants and soils (e.g. Burger et al. 2010; Montreuil et al. 2010).

Riparian restoration can improve in-stream biodiversity

Riparian vegetation is critical to aquatic communities, influencing attributes of water and habitat. Restoration of riparian vegetation may influence aquatic communities in three main ways.

First, as discussed above, riparian vegetation can reduce nutrient and sediment loads in streams. Sediment and nutrient loads in-stream have substantial influences on aquatic communities. By buffering inputs of sediment, nutrients and salt into streams, riparian vegetation may have positive effects on the condition of in-stream communities including macroinvertebrates, aquatic plants and fish (Kauffman and Krueger 1984; Quinn et al. 1993; Growns et al. 1998).

Second, riparian vegetation shades the stream, which moderates water temperature. Removal of vegetation causes increased light and temperature (Quinn et al. 1993; Rutherford et al. 2004). Aquatic organisms may be especially sensitive to elevated water temperatures and associated reductions in the availability of dissolved oxygen. For example, temperatures above 22° C are lethal for mayfly larvae (Davies et al. 2004). Elevated temperatures may reduce the growth and reproduction of some fish species, and reduce their capacity to tolerate other toxicants (Pusey and Arthington 2003). Increased light may also promote algal growth: light, elevated nutrients and an inoculum are the three major ingredients for algal blooms. Restoration of canopy cover may be effective in decreasing stream temperature: as a general guide, 10% increase in riparian cover causes approximately 1° C decrease in water temperature (Davies 2010).

Third, riparian vegetation contributes litter, coarse woody debris and other organic matter into streams. These inputs provide important habitat and food sources for aquatic communities (Cadwallader et al. 1980; Pusey and Arthington 2003; Mac Nally et al. 2002; Reid et al. 2008a,b). Carbon inputs in the form of vegetative litter are a basal resource for stream food webs, influence in-stream nutrient cycling and retention, and determine bioavailability of nitrogen and phosphorus. For example, inputs of leaf litter from river red gums (*Eucalyptus camaldulensis*) contribute food and habitat that structures aquatic food webs in lowland streams in Victoria (Reid et al.

Sampling soil in a riparian zone. Photo: Katherine Rainbow

Riparian restoration and soil condition in central Victoria

Soils play important roles in the functioning of riparian zones. In particular, the condition of riparian soils influences their capacity to retain and/or transform nutrients (Lowrance et al. 1997).

To assess the effects of riparian restoration on soil condition, riparian zones were surveyed in the Victorian Riverina bioregion near Euroa (Burger et al. 2010). Of the eighteen sites surveyed, six sites were in poor condition with stock access and little remaining riparian vegetation, six had remnant riparian vegetation and six were restoration sites that had stock excluded and trees and shrubs replanted six to 12 years ago. In the restored sites, organic litter and carbon content of soils was found to be higher than in poor condition sites. The effect of adjacent land-use on inputs of nutrients was evident, with both poor condition and restoration sites showing significant relationships between nutrient concentrations in the soil of adjacent paddocks and the riparian zone. However, remnant vegetation was able to more effectively process nutrients and buffer the effects of high NO3- and plant-available phosphorus on adjacent land.

For further information: Burger, B., Reich, P. and Cavagnaro, T.R. (2010) Trajectories of change: riparian vegetation and soil conditions following livestock removal and replanting. Austral Ecology.

CASE STUDY 1

2008b). Canopy cover of 50% or more is required to provide a reliable supply of leaf litter to support the aquatic food web (Reid et al. 2008a) and to provide sufficient shading to moderate water temperature in these lowland streams (Davies and Bunn 1999). Coarse woody debris is important in the provision of in-stream habitat and maintenance of microhabitat complexity (Harmon et al. 1986). For example, in forest streams in East Gippsland, coarse woody debris creates debris dams and pool habitats that are especially important for fish species (Webb and Erskine 2001). Furthermore, coarse woody debris creates refuges for aquatic biota during flooding (Mac Nally et al. 2002).

One of the few longer-term studies of aquatic responses to riparian restoration (Becker and Robson 2009) shows that the benefits of riparian restoration to macroinvertebrate communities may be slow or equivocal. Macroinvertebrate communities in the Otway Ranges in Victoria showed little recovery from degradation eight years after restoration activities (Becker and Robson 2009). Response rates are likely to be contingent on width, connectivity and character of riparian vegetation, as well as landscape context. The condition of aquatic communities will influence their capacity to provide food sources for riparian and terrestrial communities, such as birds, bats, spiders and ants (Ballinger and Lake 2006).

Riparian restoration can improve terrestrial biodiversity

Riparian zones are also important areas for terrestrial biodiversity in three main ways, each of which may be enhanced by restoration.

First, riparian zones may be composed of distinctive plant communities not found elsewhere (e.g. DSE 2009). For example, Victoria's cool temperate rainforest communities of myrtle beech (*Nothofagus cunninghamii*) and southern sassafras (*Atherospermum moschatum*) may persist primarily as gallery forests within riparian zones, contingent on appropriate disturbance regimes (Simkin and Baker 2008). As a consequence, riparian zones can contribute to regional and catchment scale biodiversity (Sabo et al. 2005). However, degradation by livestock has been shown to compromise riparian plant communities (Robertson and Rowling 2000). Riparian zones that are grazed have less regeneration of trees, fewer shrubs and less biomass of groundcover species compared with ungrazed sites (Kauffman and Krueger 1984; Fleischner 1994; Robertson and Rowling 2000; Case Study 2). Restoration can improve the condition of riparian vegetation. For example, where sources of seed or vegetative propagules are present, the exclusion of stock from riparian zones may facilitate the regeneration of trees, shrubs and ground layer vegetation, leading to increased shading and litter inputs into streams (Kauffman and Krueger 1984; Fleischner 1994; Robertson and Rowling 2000; Case Study 2).

Second, riparian zones are mesic (moderately wet) and highly productive parts of the landscape. These conditions mean that trees tend to be larger, flowering may be more regular and the growth of plants and invertebrates may be more reliable in riparian systems (Bennett et al. 1994; Catterall et al. 2007). As a consequence, riparian areas may provide some of the most favourable environments within a landscape for the restoration of terrestrial biodiversity (Thomson et al. 2009). For example, bird assemblages were more species rich in riparian restoration sites than in comparable non-riparian restoration sites (Munro et al. 2010).

Third, riparian zones provide refuge, foraging and breeding habitat for species that specialise on riparian zones or use riparian zones opportunistically. For example, riparian sites support significantly greater abundance and species richness of birds than non-riparian sites (Palmer and Bennett 2006) and several studies have shown that riparian zones contribute to landscape-scale bird diversity (Mac Nally et al. 2000; Palmer and Bennett 2006; Johnson et al. 2007; Munro et al. 2010). The importance of riparian zones for bird communities is further amplified in degraded environments (Jansen and Robertson 2001; Palmer and Bennett 2006; Johnson et al. 2007). For example, riparian zones provide especially important habitat for bird populations in highly modified, agricultural landscapes in central Victoria (Johnson et al. 2007). However, degradation by livestock compromises the capacity for riparian zones to provide habitat for a wide range of animals including amphibians (Healey et al. 1997), freshwater crayfish (March and Robson 2006) and birds (Jansen and Robertson 2001). Some terrestrial habitat may be restored rapidly with restoration efforts, particularly in rainforest-dominated systems. For example, efforts to restore rainforest riparian zones provided habitat for bird species within three years of planting on the Atherton Tablelands in Queensland (Jansen 2005) and in East Gippsland in Victoria (Case Study 3).

Riparian restoration can increase community resistance and resilience

Riparian zones may provide corridors for dispersal and habitat for the persistence of wildlife and plant

species. In Victoria, remnant patches of intact vegetation often exist as isolated fragments in landscapes that have otherwise been highly altered by agriculture or urbanisation. As a consequence, the role of riparian zones as habitat and as corridors for dispersal is increasingly important.

Riparian zones may also provide refuge for species during drought. By acting as biolinks through the landscape, restored riparian zones may increase the capacity of populations to persist through unfavourable periods and in otherwise unfavourable landscapes. Restoration can enhance or facilitate the capacity of riparian zones to act as refuges and dispersal corridors by augmenting habitat and improving connectivity among remnant riparian zones and intact fragments of vegetation.

Improving habitat and landscape connectivity is especially pertinent given projected climate change, whereby the capacity for species to adapt and persist depends on the sustenance of sufficient population size, connectivity among populations and the capacity to migrate (Seavy et al. 2009). In instances where species cannot migrate due to immutable geographical barriers (e.g., ocean, desert or urbanisation), restoration of riparian zones might also be used to improve the resilience of populations to climate change. For example, restoring or augmenting canopy cover may help mitigate the effects of increased stream temperatures and allow freshwater species to persist (Davies 2010).

Riparian restoration can help to conserve some threatened species

Restoration of riparian vegetation may provide important habitat for some threatened species and reduce the risk to others by providing improved habitat and habitat connectivity. Riparian land has particular significance to many rare and threatened species in Victoria. Many species and communities listed under the Flora and Fauna Guarantee Act 1988 depend in part on riparian zones (DSE 2010). Of these species, several are directly threatened by degradation of riparian habitats including Bibron's toadlet (*Pseudophryne bibronii*), the growling grass frog (*Litoria raniformis*) and swamp skink (*Egernia coventryi*) (Ecology Australia 2009).

In addition, riparian restoration may play a pivotal role in ameliorating several threatening processes that are listed under the Flora and Fauna Guarantee Act 1988, including: alteration to the natural temperature regimes of rivers and streams; alteration to the natural flow regimes of rivers and streams; degradation of native riparian vegetation along Victorian rivers and streams; and removal of wood debris from Victorian streams (DSE 2010).

Ecological benefits depend on riparian attributes and catchment context, but 'some is better than none'.

The ecological benefits are achieved by riparian restoration depend on:

1. Catchment context.
2. Large-scale factors that may override restoration efforts.
3. Time.
4. Attributes of the restored vegetation.

Catchment context, in particular the land-uses upstream and adjacent to the waterway, will influence the effectiveness of riparian restoration. Despite efforts to restore riparian zones, adjacent land-uses may continue to damage ecosystems or limit their recovery (Kauffman et al. 1997). For example, agricultural activities may persist and continue to contribute pollutants, excess nutrients and sediments into the stream, or alter local hydrology through impoundments.

In addition to catchment context, large-scale factors that might override the ecological benefits of restoration efforts include hydrology (Stromberg et al. 2007a,b), drought (Bond and Lake 2005; Case Study 4) and fire (Simkin and Baker 2008). Studies from overseas and Australia have shown that the effectiveness of restoration efforts depends on identifying and addressing the drivers of degradation rather than simply the symptom. For example, flow regimes drive the relative recruitment success of native trees and exotic trees along streams in western North America (Stromberg et al. 2007a). Efforts to increase native tree populations by removing exotics and planting natives have been ineffective, while efforts that address the large-scale constraint by reinstating flow-regimes have been effective (Stromberg et al. 2007b). Many studies have shown the fundamental influence of flow regimes on riparian vegetation dynamics in Australia and show changes to the structure, composition and function occur when flow regimes are altered (e.g., Bren 1988; Bren 1992; Kingsford 2000; Capon 2005; Horner et al. 2009).

To effectively restore riparian zones, the multiple drivers of degradation need to be addressed in unison. Even then, removing the drivers of degradation may not always be sufficient to assure full recovery of a system. The challenge is to identify the relative importance of the different drivers of degradation and prioritise the order of interventions

View of the landscape in the Goulburn Broken Catchment near Euroa (left) including a site with recent stock exclusion and planting (right). Photos: Paul Reich

Stock exclusion improves riparian condition in the Goulburn-Broken

The Goulburn-Broken catchment covers 10.5% of the area of Victoria and accounts for 11% of the water resources in the Murray Darling Basin (GBCMA 2010). Overall, 83% of the total length of streams in the Goulburn-Broken catchment is in moderate to poor condition, ranking the catchment as in slightly worse condition than the state average (DSE 2005). Across the catchment, threats to riparian and stream condition come from forestry and farming practices, with grazing a dominant driver of degradation in lowland areas.

The effect of livestock grazing on riparian condition was assessed across 473 sites—a total of 365 km of creekline—in the riverine plains region of the Goulburn-Broken catchment (Robinson and Mann 1996a, 1996b, 1998). This survey corroborated the negative effects of grazing on the condition of riparian vegetation. Grazed sites had fewer trees, less biomass, more bare ground and an altered composition of ground layer vegetation. Riparian condition did improve with stock exclusion. Sites that were fenced to exclude stock had less bare ground, more recruitment of trees and increased biomass of ground layer vegetation. This survey shows that some attributes of riparian vegetation may have the capacity to passively recover when stock are excluded.

For further information: Robinson, D. and Mann, S. (1998) Effects of grazing, fencing and licencing on the natural values of crown land frontages in the Goulburn-Broken catchment. Report to Goulburn-Broken Catchment Management Authority. Goulburn Valley Environment Group, Shepparton.

CASE STUDY 2

Bank erosion at Bridles Bend on the Lower Genoa River, East Gippsland in 1989, and right, Bridles Bend after after stock removal and habitat restoration, 2009.

(Stewart-Koster et al. 2010).

For example, in riparian forest on the Barmah-Millewa floodplain, Lunt et al. (2007) found little effect of long-term grazing exclusion on the condition of herbaceous plant communities. This lack of response may be attributable to the overriding effects of past land-use intensity, low site productivity and drought, and indicates that, on its own, removing grazing may be insufficient to ensure full ecosystem recovery. In addition to stock exclusion, highly degraded environments may require substantial interventions for successful recovery. For example, locally extirpated biota may be unable to recolonise sites and may require active reintroduction—this appears to be the case for restoring riparian vegetation along degraded streams in central Victoria, where the soil seed bank possesses only a limited suite of native species and shows little potential to aid self-recovery (Williams et al. 2008).

Some benefits of riparian restoration may occur quickly, while others may take considerable time. For example, bare ground can show rapid decline with stock exclusion (Robertson and Rowling 2000; Case study 4). In contrast, there may be significant time lags between restoration efforts and the development of habitat that is required for some biodiversity benefits; for example, between planting trees and their maturation to produce hollows (Vesk et al. 2008; Mac Nally 2008; but cf. Case Study 3).

Ecological benefits of riparian restoration are contingent upon the width and connectivity of riparian vegetation (Weller et al. 1998; Hansen et al. 2010). The interconnectivity between riparian zones and the surrounding landscape means that the restoration of narrow riparian buffers may not bring the full ecological benefits of an intact riparian zone in an intact landscape. In catchments with major and ongoing degradation from farming or urbanisation, it may be necessary to have riparian buffers that are wider than natural riparian zones to protect streams from catchment pressures. Nevertheless, the available evidence suggests that the restoration of some riparian land will achieve some benefits (Hansen et al. 2010).

Not all Victorian riparian zones are the same. Riparian zones and their waterways may differ in size, altitude, soil, climate, adjacent land-use and catchment inputs, condition prior to restoration, and more. These differences will influence the response of sites to restoration efforts and the ecological benefits that are achieved. Furthermore, these differences suggest that the nature of restoration efforts will need to vary (Stewart-Koster et al. 2010). However, virtually all efforts to restore riparian zones will require initial exclusion of livestock on both banks (Hansen et al. 2010). In addition, both local case studies and global literature show that efforts to restore riparian zones will confer some ecological benefits.

Conclusions and future recommendations

- Riparian zones fulfil important ecological roles for both aquatic and terrestrial ecosystems, but they have been extensively degraded in Victoria.

- Past research from Australia and overseas shows the considerable potential for riparian restoration to mitigate damage to riparian ecosystems and to the streams and terrestrial landscapes with which they are integrally linked.
- Overwhelming evidence shows that stock access in waterways leads to progressive and continued damage, while excluding stock halts decline and some passive recovery is possible.
- Active restoration shows further potential in re-establishing the structure and composition of plant communities and capacity to recover broader ecological functions of riparian zones.
- Riparian zones are among the most effective and efficient parts of the landscape to target for restoration and riparian restoration can help improve water quality, aquatic biodiversity, terrestrial biodiversity and the resistance and resilience of populations to stressors including climate change.
- The capacity for restoration efforts to reinstate the ecological benefits of intact riparian zones depends on identifying and addressing the multiple drivers of degradation and potential constraints to recovery (e.g., altered flow, site context and disturbance history).
- Targets for restoration outcomes should be set and used to inform on-ground works and monitoring.
- An adaptive monitoring regime should be implemented, which both informs and improves restoration techniques over time to develop increasing efficiency and effectiveness of restoration methods.
- Restoration is a timely issue considering the current state of Victoria's riparian zones and rivers, their pivotal role in maintaining the function of both aquatic and terrestrial systems, the time-lags likely to be involved in restoring habitat, and future stressors such as climate change.

Restoration of riparian rainforest in East Gippsland

The East Gippsland catchment region covers approximately 10% of Victoria and, overall, the condition of its rivers is among the best in Victoria (DSE 2005). However, agriculture and associated threats, including land clearance, grazing and introduction of exotic species, have degraded the condition of some riparian zones in the region. Some riparian zones have been denuded of their native rainforest vegetation and instead become dominated by exotic species in particular willows (Salix spp.) and kikuyu (*Pennisetum clandestinum*). Resultant effects of these changes in vegetation composition and structure proliferate throughout the ecosystem, influencing water quality and the condition of in-stream and terrestrial communities (Greenwood et al. 2004; Holland Clift and Davies 2007).

Efforts to restore rainforest communities have been undertaken at several riparian sites dominated by exotic vegetation in East Gippsland (Peel 2010). An approach has been developed and implemented across these sites, which exploits principles of vegetation dynamics to restore plant communities. For example, initial species are selected that will cast shade sufficient to outcompete exotic ground-layer species such as kikuyu. These efforts have been successful in restoring native vegetation and providing biodiversity benefits. Restoration sites have been documented as approaching remnant, intact forests in terms of the richness of native plant species and specialist bird species—both established indicators of ecosystem condition and function (Croonquist and Brooks 1991; Hooper et al. 2005; Sekercioglu 2006). Rapid benefits to terrestrial biodiversity have also been recorded. For example, bird habitat has developed within three years and natural regeneration—indicative of a persistent and self-sustaining plant community—has been recorded after five years.

For further information: Peel, B. (2010) Rainforest restoration manual for south-eastern Australia. CSIRO.

CASE STUDY 3

Faithful Creek control site (left) and treatment site (right) in winter 2009, four years after stock exclusion and planting at the treatment site. Photos: Matthew Johnson

Riparian restoration in the southern Murray Darling Basin

To examine the ecological effects of riparian restoration, an experiment has been established to monitor ecological responses to restoration efforts on lowland streams in the southern Murray Darling Basin. Paired sites, each approximately 1 km in length, were established on each of five streams; on each stream, one site was fenced and planted with native tube-stock on both sides of the stream, whilst land-management and stock access was unchanged on the other site to provide a control.

Here we will discuss results from the first site to undergo restoration treatment. This site was established in 2004 and restoration efforts were undertaken in 2005. The site is on Faithful Creek in the Goulburn-Broken Catchment and prior to degradation represented an endangered Ecological Vegetation Class—Creekline Grassy Woodland—that has been reduced to 16% of its area since European settlement (DSE and GBCMA 2005). Some responses to stock exclusion were rapid despite the below average rainfall and drought conditions that have prevailed across the study region for the past 12 years. For example, bare ground decreased at the restoration site by 13% in three years and by 15% in five years, whilst at the paired control site, bare ground increased (by 31% after 3 years and 10% after five years). Successful natural recruitment of river red gums (*Eucalyptus camaldulensis*), a keystone species in lowland riparian ecosystems, has also been observed at the treatment site, whilst low rates of germination and survival have continued at the control site. However, other responses have been hampered by the drought. For example, the abundance and diversity of macrophytes and aquatic fauna has declined steadily over time at both the control and treatment sites due to drought conditions.

For further information: http://www.mdba.gov.au/riparian-restoration-experiment/

CASE STUDY 4

3 HUMAN HEALTH IMPLICATIONS

A SUMMARY OF FINDINGS FROM A REPORT BY MONASH UNIVERSITY HEALTH RISK FROM CROWN WATER FRONTAGE LICENCES MONASH UNIVERSITY WATER STUDIES CENTRE, SEPTEMBER 2009.

In 2009 the Victorian Government missed a once in five years opportunity to get cattle out of our river systems when it renewed grazing licences along the state's publicly-owned riparian land.

At the time a group of concerned scientists wrote to then Victorian Premier John Brumby urging him to reconsider re-issuing the licences.

Spokesman for the scientists, Dr Doug Robinson, said the State Government needed to act responsibly.

"Re-issuing these grazing licences flies in the face of the scientific evidence and will continue to degrade Victoria's rivers. The latest scientific report from Monash University highlights the need for change, particularly in relation to human health impacts."

The Monash University report identified serious human health impacts from giving stock access to rivers and streams that must be addressed as a priority. It found that:

- Cattle faeces contain pathogens (infectious agents or germs) that can be transmitted to humans.
- These pathogens can survive long periods in water.
- Transmission to humans can occur directly by ingesting contaminated water.
- Allowing cattle uncontrolled access to water has multiple impacts that increase the likelihood of pathogens entering the water supply.
- Nutrients from cows increase the potential for toxic algal blooms.
- Uncontrolled water access by cattle leads to increased costs of water treatment for human consumption, due to an increased risk of pathogen contamination and an increase in suspended solids.

Contrary to all available scientific and legal advice, including a 2008 State of the Environment Report recommendation that cattle licences should be phased out from Crown Water Frontages, all licences were renewed in October 2009.

Human health risk from Crown water

There are several pathogenic micro-organisms that can be transmitted from cattle faeces to humans via contaminated water. The two most common are Cryptosporidium and Giardia, both of which cause gastroenteritis (commonly known as gastro), a disease of the stomach and intestines that is characterised by diarrhoea, vomiting and other gastric complaints[1]. Cryptosporidium and Giardia generally cause short-term illnesses in otherwise healthy people, but can have severe and sometimes fatal effects in patients with compromised immune systems, such as those suffering from AIDS[2]. Both of these organisms may be found in cattle, with the highest concentrations usually found in juveniles, especially juvenile dairy cows[1,4]. Cattle faeces and/or urine can also contain a variety of potentially harmful bacteria, such as Escherichia coli (E. coli), Salmonella, Campylobacter and Leptospira[3], which can cause a variety of diseases, such as gastro and septicaemia (blood poisoning)[1].

Protected catchments = less reliance on water treatment

Most of Melbourne's drinking water comes from protected catchments, where few pathogens are found in the water supply[5]. This water is therefore minimally treated, with chlorination but no filtration[6]. The cost of water treatment increases as

1 Anon. Better Health Channel. 2008 November 2008 [cited 2009 14 September]; Available from: http://www.betterhealth.vic.gov.au/.

2 Rose, J.B., Environmental ecology of Cryptosporidium and public health implications. Annual Review of Public Health, 1997. 18(1): p. 135-161.

3 Nader, G., et al., Water quality effect of rangeland beef cattle excrement. Rangelands, 1998. 20: p. 19-25.

4 Payment, P. and P.R. Hunter, Endemic and epidemic infectious intestinal disease and its relationship to drinking water, in Water quality - Guidelines, standards and health: Assessment of risk and risk management for water-related infectious disease, L. Fewtrell and J. Bartram, Editors. 2001, WHO.

5 Hansen, J.S. and J.E. Ongerth, Effects of time and watershed characteristics on the concentration of Cryptosporidium oocysts in river water. Appl. Environ. Microbiol., 1991. 57(10): p. 2790-2795.

6 Anon. Water Treatment. [Accessed 15/09/2009]; Available from: http://www.melbournewater.com.au/content/water_storages/water_treatment/water_treatment.asp.

the quality of the water entering it decreases. Cattle access to streams has multiple impacts on water quality, from increased sedimentation to increased pathogen loads. In 1994, the Tarago Reservoir was disconnected from Melbourne's water supply due to water quality concerns. Unlike most of Melbourne's water catchments, the Tarago catchment contains areas where cattle have direct access to streams[7,8]. It is only after the completion of a $97 million treatment plant in July 2009 that this water is again being used to supply water to Melbourne.

In Victoria, many communities rely on drinking water from rivers into which cattle are allowed access. Rural water companies mostly take water from open catchments, and so full treatment – including filtration – is required. Vigilance by water companies ensures that the potential for contamination of drinking water is low; however, the negative impact of any contamination is likely to be large. This is because pathogens entering water supplies will rapidly disperse, and disease outbreaks are often characterised by infection across an entire community[9] [18]. The lack of an effective barrier to faecal contamination of waterways increases this risk.

Risks from untreated water

While most water supplied to residents is fully treated, some communities receive water that has only had basic disinfection (e.g. Molesworth and Strathbogie in the Goulburn valley[10]). As mentioned, disinfection does not effectively remove Cryptosporidium or Giardia and though this water is regarded as non-potable, there is always a risk of unintentional consumption.
The use of water bodies for recreation that are downstream of cattle access points is another cause for concern. Also, while direct ingestion of contaminated water can lead to illness, so too can indirect contact with contaminated water, such as consumption of fruit and vegetables watered or washed with untreated water[11,12].

Removing cattle from streams greatly reduces the risk of contamination

Direct access to streams increase the risk of contamination of water in two ways. Firstly, cattle spend large parts of their time close to water bodies, and large quantities of faeces are deposited near or in streams that they have access to[13,14,15]. For example, cattle have direct access to much of the Rous River catchment in NSW, and one study found that 89% of the waterways were not suitable for use as potable water, and 24% were designated not suitable for primary contact[16]. Secondly, cattle trample and eat vegetation around stream access points, creating bare ground[17,18]. Pathogens from faeces deposited away from the stream can be washed over bare ground much more readily than over vegetated ground[19,20]. It has been demonstrated that a vegetated buffer strip 3m wide will remove 99.9% of Cryptosporidium spores from agricultural runoff after a rainfall event[21]. Other authors note that faeces deposition outside of riparian areas is unlikely to cause problems from

7 Anon., The Tarago Project Newsletter. Winter 2008. 2008, Melbourne Water.

8 Anon., Report on land use detrmination in the Tarago River catchment. . 1973, Soil Conservation Authority, Preparted for consideration by the Land Conservation Council.

9 NHMRC and NRMMC, Australian Drinking Water Guidelines 6. 2004, National Health and Medical Research Council, Natural Resource Management Ministerial Council, Australian Government.

10 Anon. Non-potable supplies. [Accessed 15/09/2009]; Available from: http://www.gvwater.vic.gov.au/my_town/water/nonpotable.asp.

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21 Atwill, E.R., et al., Transport of Cryptosporidium parvum oocysts through vegetated buffer strips and estimated filtration efficiency. Applied and Environmental Microbiology, 2002. 68(11): p. 5517-5527.

either pathogens or nutrients[22,23,24].

Cattle increase risk of algal blooms

An indirect health risk from cattle access to streams is that cattle increase nutrients entering waterways – through their excrement and increased erosion – which leads to an increased risk of toxic algal blooms[23,25,26]. Also, increased sedimentation from cattle activity puts a strain on water treatment plants, which may fail or be forced to shut down after heavy rain, for example[27].

The case for protecting waterways from cattle

The Australian Drinking Water Guidelines state that pathogenic micro-organisms are the greatest risk to consumers of drinking water. These guidelines strongly recommend a multiple barrier approach, protecting water from contamination at each step from catchment to tap. While water treatment is one effective barrier, the guidelines explicitly state, however, that:

"Prevention of contamination provides greater surety than removal of contaminants by treatment, so the most effective barrier is protection of source waters to the maximum degree practical".

Cattle enter the Goulburn River directly opposite the pipeline take-off for Melbourne's water supply.

22 (11) Nader, G., et al., Water quality effect of rangeland beef cattle excrement. Rangelands, 1998. 20: p. 19-25.

23 (29) Anon., Dryland diffuse source nutrients for Goulburn Broken catchment. 1995, Goulburn Broken water quality working group.

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4 LEGAL ISSUES

4.1. State of the Environment Report

In 2008 the first-ever Victorian State of the Environment Report recommended a number of changes to the way we manage riparian zones.

It recommended that:

- The Victorian Government consider progressively extending VEAC recommendations on phasing out uncontrolled grazing of domestic stock on Crown land water frontages to the rest of Victoria, beginning with the 2009 licence renewal process
- The Victorian Government update and streamline governance arrangements to facilitate protection and restoration of Crown Land water frontages.
- The Victorian Government and catchment management authorities should consider regional-scale connectivity of riparian vegetation in the prioritisation of rehabilitation projects, as part of forming an integrated habitat network across the state.

4.2 Legal analysis and obligations for the Victorian Government

The Environment Defenders Office (EDO) recently considered the statutory, common law and policy arguments that would support better management of riparian land in Victoria.

The EDO concluded:

- There is a robust, if sometimes complex, legal framework for the protection of riparian land, waterways and human health in Victoria. Some legislation creates penalties for polluting water and/or for damaging human health as a result of polluted waterways. Other legislation provides avenues for judicial review, or the recovery of damages, in the case of a breach of duty of care by a public authority.
- There is now a significant body of evidence in Victoria, in scientific literature, expert panel recommendations and government policies and reports that link uncontrolled stock access in riparian zones to very poor water quality in the local waterway and potentially downstream. This has potential human health impacts.
- This evidence is or ought to be well known to the Victorian government and those involved and responsible for riparian land management. Further, it has recognised the importance of good management of Crown water frontages, and riparian land in general, in a way that minimises negative impacts on water quality and river health. In spite of this knowledge and recognition, it has failed to act, or at best has only responded in a limited way.
- Allowing waterways to be polluted by cattle which result in damage to human health creates a legal liability risk. The five-year license renewal process is due to commence in October 2009. Reissuing cattle grazing licences for Crown water frontages in a "business as usual" manner may increase this risk.
- Apart from the public health implications and the liability risk, there are strong scientific, environmental, policy and legal arguments in favour of amending the current licensing process to address this risk. The Victorian government has a unique opportunity to act strategically to introduce a new system of management of riparian land which would improve the environment and correspondingly provide them with greater legal protection.

4.3 Victorian Government policy – baby steps in the right direction

The Victorian Government's land and biodiversity White Paper, published in 2010, suggests that improvements to riparian land management will be rolled out progressively over the next two decades.

The report, Securing Our Natural Future, recommends that at each five year Crown frontage license renewal, goals will be set for the number and location of licences to be inspected and brought up to new management standards.
An equal priority is to identify parcels of Crown riparian land that are being used for activities that require licensing, but are not yet licensed or appropriately managed.

The clear policy intention is that by 2029, all public riparian lands will be managed to the new standards. The Victorian Natural Resource Management Plan will reflect these new arrangements.

White paper actions for public riparian land

6.4.1 Complete the current review of licensing arrangements for high priority Crown frontages, in consultation with licensees, by 2010.

6.4.2 Reform administrative and legislative arrangements to enable enhanced riparian land management by 2014.

6.4.3 Identify high-priority Crown frontages that are occupied but not licensed. Negotiate management agreements and license these areas by 2014.

6.4.4 Complete the Riparian Management Framework and incorporate standards for managing riparian lands by 2014.

6.4.5 Bring all riparian lands up to the new management standards with robust licensee or landholder agreements in place by 2029.

5 CONCLUSIONS

If the Victorian Government is to improve biodiversity and protect water quality and river health for the state's rivers and their communities, major increases in funding for riparian works must be made over the next four years.

Our plan for action will deliver much-needed improvements and see Victoria's public riparian land become some of the best managed in Australia. These changes will also help the Victorian Government meet many of its obligations under national and state agreements and legislation.

An unacceptably long proposed timeline to implement the Victorian Government's land and biodiversity White Paper would see biodiversity, water quality and river health decline for another 20 years. Changes to the way we manage public riparian land should be rapidly accelerated over the next five years.

Victoria should aim to have the best river reserve system in the world operating under world's best management. To do this the Victorian Government must commit to aRiverside Repair and Rescue package of an additional $80 million over four years, which includes the following:

- Immediately double current expenditure on public riparian land programs to $20 million per year for the next four years.
- Replace Victorian Crown water frontage licences with Riparian Conservation Licences by 2012.
- Initiate a Waterway Guardian/Stewardship Program to assist landholders by 2012
- Initiate a voluntary program for licence holders in lower priority river reaches by 2012.
- Protect all priority river reaches by 2014.
- Identify and complete strategic additions to the National Reserve System by 2014.
- Remove all unauthorised activities from water frontages by 2014.
- Bring all riparian lands up to new management standards with robust licensee or landholder agreements in place by 2016.

5.1 Policy solutions

The VNPA proposes a five-pronged approach, which would deliver large scale and clear improvements to river health, while engaging landholders in varying degrees of active conservation management.

1) Assistance program for licence holders

Under this program, government would make landowners a 'special offer' for boundary fencing /off-river watering in return for improved management and environmental outcomes.

Once this period has expired, fencing of unfenced crown land boundaries would revert to landholder responsibility. If the new rules are not adhered to, the grazing licence would be cancelled and the landholder would be responsible for boundary fencing. Where licences are cancelled, a committee of management could be appointed. This may consist of any of the following: DSE, Parks Victoria, Catchment Management Authorities, local government, NGOs or adjacent landholders.

2) Waterway guardian/stewardship program

A program should be established for landholders with significant conservation assets adjacent to crown river frontages and incentives provided for complimentary conservation management.

New agreements could be established with adjoining landholders to improve the condition of river frontages and landholders could nominate to either:

- Fence the frontage and manage their grazing regime in accordance with ecological outcomes, via a management plan, or
- Transfer the grazing licence to a 'conservation' licence with a reduced cost and management in accordance with ecological objectives.

3) Conservation Licences

For areas identified as not suitable for addition to the reserve system but that are in moderate to good condition, a conservation licence on that Crown Water Frontage should be implemented:

- The conservation licence should specify minimum management actions, such as fencing, stock removal/grazing regimes, weed control, and would be offered at a peppercorn rent based on delivery of conservation activities.
- Priority should be given to identified priority river reaches, Heritage Rivers and river reaches where other riparian improvements are taking place.

4) Additions to the National Reserve System:

Identify conservation significance of riparian land based on:

- JANIS criteria and national commitments.
- Connectivity.
- Management integrity (eg adjacent to existing conservation reserves).

Land identified as suitable for addition to the reserve estate should be re-classified as protected areas e.g Nature Conservation Reserve, or State Park, and reserved accordingly to help Victoria meet national commitments for reservation

5) Unlicensed frontages

Consistent with Victorian legislation, all unauthorised activities on any piece of riparian public land should cease immediately.

The VNPA recommends in cases where there is evidence of no improvement or action to improve condition, licences should be permanently cancelled.

5.2 Resourcing

There should be a significant increase in resourcing for riparian land management over the next four years. This requires a doubling of current expenditure to $20 million a year, and would include ten new full-time riparian land officers to be created between DSE and Catchment Management Authorities (CMAs) per current CMA regions to assess, monitor and enforce these new arrangements.

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