1 Introduction

Water is an essential element for all life and is valued by all cultures. It is of special significance to Maori who believe that all elements of the environment, including water, possess a life force or mauri. A waterway with an intact, healthy mauri can be identified by the healthy ecosystems that it supports. Our native plant and animal communities in streams, rivers and lakes need clean unpolluted water. While humans require clean water for domestic and industrial supplies and for many recreational activities. The farming community relies on water for stock and irrigation. Yet rural development and urbanisation have increased the amount of contaminants reaching our waterways and have degraded associated habitats (Smith et al, 1993).

Farmers[1] are becoming increasingly aware of the impacts that their land management practices are having and how these impacts can affect others in the wider community. Many are changing the way they manage their land to reduce these impacts. But others are yet to make the positive changes needed, so many of our streams, rivers and lakes continue to degrade. This problem is such that that some lowland streams are not only unsuitable for us to drink or swim in, they are unsafe for livestock to drink.

There are many reasons why some farmers have not yet acted to improve the management of land next to their waterways. Retirement fencing and tree planting are seen by many landowners and advisers as expensive with little apparent productive benefit. In times when there is generally decreasing financial support from local and central government for erosion control and riparian retirement and farm profitability is falling, capital improvements of this kind are less likely to occur. It is important, therefore, that such management practices are cost-effective.

Perhaps the greatest reason for inaction is a lack of understanding about the impact of farming activities, such as the source of farm-generated contaminants and how they enter streams, rivers and drains. Without that understanding, landowners and technicians are neither motivated nor equipped to apply appropriate management techniques that are necessary to make a difference. Where the knowledge does exist, extraordinary progress has been made by individual landowners, often at little or no net cost to the farming operation. Increasingly, we see that more sustainable land and water management can contribute to, rather than contradict, increased farm profitability.

This publication is aimed at those who provide advice to farmers about how they manage their land, and to those farmers who wish to enhance their properties and reduce the impacts of their farming operations. We hope it will be used by field officers, consultants, farmers, landcare group members, and hapu and whanau who have practical involvement "on the ground". This publication seeks to provide some background information about the sources, causes and processes involved with the deterioration of streams in farmed catchments and the consequences of that

[1] We have adopted a broad interpretation of "farmers" as including all those who farm the land, including pastoral farmers, arable croppers, foresters, market gardeners, and fruit growers. Similarly, "farms" include dairy farms, wheat fields, commercial forests, etc.

deterioration. Readers can thus better understand the problems and, as a consequence, be better equipped to manage the problems.

The 16 case studies cover farms from Northland to Southland, dry and wet, cattle, sheep, and deer, orcharding and market gardening, community initiatives and individual achievements. Good ideas and good practices are highlighted, the costs and benefits of actions are analysed, and future management options are proposed.

1.1 Understanding riparian areas

The extent of riparian land is most clearly defined in natural unmodified areas by the existence of **riparian vegetation**, a distinct assemblage of plants uniquely suited to the zone between aquatic and terrestrial ecosystems. The plant and animal communities naturally occurring in riparian margins to a large extent owe their existence to the conditions created by the waterway; equally, the health and condition of the waterway, and its water and its inhabitants, can be significantly affected by the plants and the animals occurring along the riparian margin.

Gregory et al (1991) define riparian zones as "three-dimensional zones of direct interaction between terrestrial and aquatic ecosystems". This definition emphasises the importance of the riparian area as a link and a buffer between the terrestrial and the aquatic zones, and its role in this regard is an important component of effective riparian management.

This link is important to Maori, who believe that when links between the various components of the catchment are broken, damage spreads through a catchment to the detriment of all those depending on the resource. In many parts of the world, including New Zealand, this intimate relationship between land and water has been interrupted and degraded.

For practical management, the best definition of the riparian zone is:

> *Any land that adjoins or directly influences, or is influenced by, a body of water or an area where water accumulates periodically. It includes:*

- *the land immediately alongside streams and rivers, including the riverbank itself*
- *areas immediately surrounding lakes*
- *river floodplains and associated wetlands and seepage zones which interact with the river permanently or in times of flood*
- *estuarine margins especially where streams and rivers exit.*[2]

1.2 Why manage riparian areas?

Many of the reasons for riparian management revolve around the desire to improve aspects of water quality. Land that has a significant influence on waterways can

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[2] Modified from "Managing Riparian Land", Riparian Management 1, LWRRDC, Australia.

extend well beyond the narrow strip along each riverbank. While the condition of the riparian zone will have a strong impact on the quality of water in a waterway, it is important to understand that some of the more effective water quality and stream health management practices may require good management practices beyond riparian zone.

Effective stream management can and should include the management of land in the wider catchment, the management of groundwater, and the management of the waterway itself including the water and associated instream values. This equates to catchment management; the management of all of the sources of water to a waterway.

An intact, healthy mauri depends on the status of all components of the catchment. Consequently, a sound understanding of how water and land interact across the catchment, and the riparian zone is essential to sound management.

1.3 What is a healthy waterway?

1.3.1 The way it used to be

Before human settlement, the water of most of New Zealand's streams, rivers, wetlands and lakes passed for a substantial part of its journey through forest before entering the sea. The riparian zones alongside those waterways were typically covered by luxuriant and diverse riparian forest that extended from the stream edge across the plains and hills. On higher or drier land, where forests did not exist, the riparian zones and stream margins were characterised by weeping tussocks and sedges and seepage zones occupied by flax, sedge and cabbage trees.

Most small streams were heavily shaded (over 90 percent shade), and the plant and animal life within the stream was specifically adapted to high shade, low temperature waters, and an array of organic matter (leaves and wood) delivered to the stream from the surrounding vegetation. Larger rivers were less well-shaded as channel width opened a gap in the forest canopy, but they remained relatively cool, because of shading in their headwaters.

Unencumbered by high sediment input, the stream channels in forested catchments meandered more than pasture streams do today, and there were low levels of algae and aquatic plant growths because of shading and low nutrients input from the land. The waters were clear, cool and almost free of pathogens. Forested upper catchments intercepted a significant portion of the rain, so that floods were less frequent than they are today. Due to substantial vegetation cover, there was considerably less soil and streambank erosion.

Riparian zones were favoured habitat and dispersal areas for birds, insects, amphibians and other animals because of the easy topography and abundance of food and water. Plant diversity was readily maintained, thanks to the seeds brought by animals (especially birds), winds and waters.

Photograph 1: In pre-human times the majority of New Zealand's lowland streams were heavily shaded by thick riparian vegetation. They were cool, meandering, stony bottomed and contained abundant invertebrate and fish life.

1.3.2 Riparian and stream fauna

Our waterways and riparian zones are used by a wide array of native species including over 450 species of insects, giant snails and worms, freshwater fish, frogs and 88 terrestrial bird species. A large percentage are not found anywhere else in the world, and many are threatened.

1.3.3 Riparian vegetation

Over much of New Zealand native riparian vegetation has been cleared and replaced with agricultural pastures and exotic forestry or developed for human occupation and recreation. Consequently, the buffering and habitat functions of those riparian areas have, in many situations, been lost or seriously compromised.

The composition and extent of vegetation influences how well the riparian area functions. Consequently the condition of the riparian zone greatly influences the state of the waterway. For Maori, the riparian vegetation within a catchment was also important in determining the special and unique characteristics of a catchment, which in turn influenced the abundance and diversity of mahinga kai species that were present. Where the extent and type of vegetation has changed it is likely that the composition of mahinga kai species and their abundance will have changed.

1.3.4 Riparian zone function

Healthy, functional riparian areas (including riparian vegetation) provide three important benefits:

- They reduce or buffer the impact of land-based processes (natural and human-induced) on waterways by:
  - reducing erosion by slowing down the speed of overland water flow before it reaches the stream
  - filtering inputs of nutrients, soil, microbes and agricultural chemicals in overland flow
  - denitrifying groundwater
  - utilising some nutrients for plant growth before they enter the stream.
- They reduce or buffer the impact of water-borne processes (natural and human-induced) on adjacent land by:
  - protecting banks from erosion
  - buffering channels from localised changes in morphology
  - buffering the impacts of floods.
- They promote and sustain instream plants and animals by:
  - reducing fine sediment levels
  - maintaining water clarity
  - providing instream food supplies and habitat
  - preventing nuisance plant growths
  - maintaining lower summer maximum temperatures
  - reducing light levels
  - maintaining natural food webs.

In a typical farm waterway with little or no riparian vegetation, or subsurface drainage (eg, Mole and tile or Novaflow), the ability of the riparian vegetation to filter contaminants, provide shading, bank stability and organic inputs is greatly reduced.

However, well-vegetated riparian areas can also have negative impacts. They can:

- be habitat and dispersal corridors for animal pests, including the possum, ferret, stoat, feral cat, rat and mouse
- provide habitat for exotic weed species, but usually only when the riparian area has been poorly revegetated or managed
- harbour residual populations of problem insects.

Figure 1 compares a natural stream with intact riparian area and a typical farm drain.

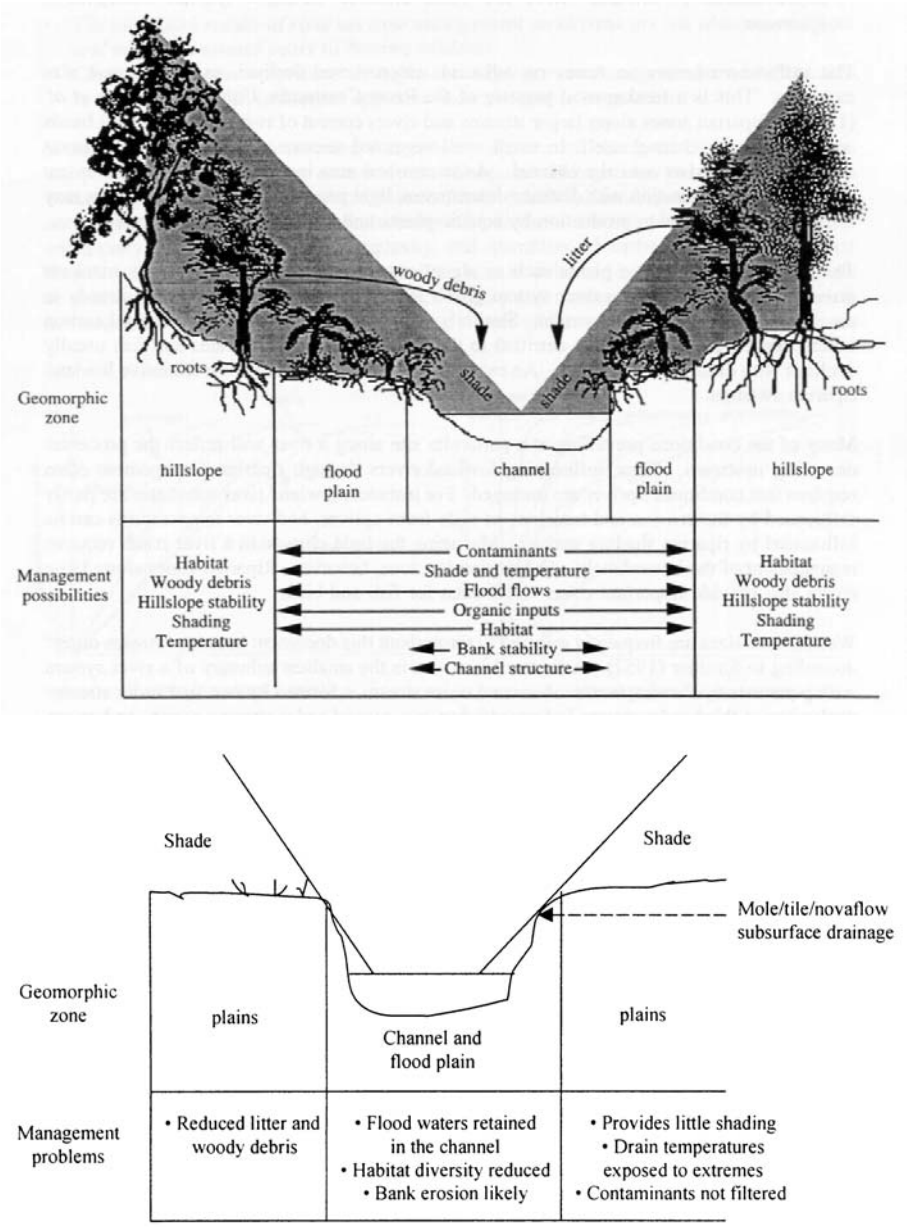

Figure 1: Conceptual diagram comparing the geomorphic zones and management issues of a typical drain and a natural stream *(modified from Collier et al., 1995)*