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REGIONAL PLAN FOR THE TARAWERA RIVER CATCHMENT

1 February 2004

Environment Bay of Plenty
Bay of Plenty Regional Council

RESOURCE MANAGEMENT ACT 1991

ENVIRONMENT BAY OF PLENTY
BAY OF PLENTY REGIONAL COUNCIL

REGIONAL PLAN FOR THE TARAWERA RIVER CATCHMENT

The Regional Plan for the Tarawera River Catchment was prepared by the Bay of Plenty Regional Council under the Resource Management Act 1991.

It is hereby certified that this is the Regional Plan for the Tarawera River Catchment approved by resolution of the Council on the 11th day of December 2003.

The Common Seal of the **BAY OF PLENTY REGIONAL COUNCIL** was affixed hereto this 11th day of December 2003, in the presence of:

THE BAY OF PLENTY REGIONAL COUNCIL
The Common Seal of

John Cronin
Chairperson

J A Jones
Chief Executive

READER'S GUIDE

There may be some parts of this regional plan that you are interested in reading. To find these parts quickly, the following guide gives a brief summary of what each chapter is about.

Chapter 1 - Introduction:

Names the regional plan, outlines its purpose and aims, discusses topics and issues to be managed, the geographical area of the plan, and sets its duration.

Chapter 2 - Preparation of the Regional Plan for the Tarawera River Catchment:

Provides a summary of how the regional plan was prepared, research undertaken and the people and organisations consulted.

Chapter 3 - Statutory Framework:

Outlines the primary parts or sections of the Resource Management Act 1991 relevant to the preparation of the regional plan. It also includes definitions of "Issues", "Objectives", "Policies", and "Methods".

Chapter 4 - Policy Framework:

Establishes how this regional plan relates to other planning documents at the national, regional and district level.

Chapter 5 - Responsibilities:

Identifies the principle local body and governmental organisations with resource management responsibilities, and gives a brief resume of their primary functions and duties.

Chapter 6 - Physical Description of the Tarawera Catchment:

Provides background information on the area covered by the regional plan. Discusses the Tarawera River catchment in four sub-areas, namely the Tarawera Lakes and their catchments, the catchment of the Upper Reach of the Tarawera River, the catchment of the Lower Reach of the Tarawera River, and the Tarawera River mouth.

Chapter 7 - Community Attitudes and Perceptions:

Details issues relating social and economic wellbeing, and local attitudes and perceptions towards the environment.

Chapter 8 - Resource Management Issues of Significance to Iwi:

Outlines the primary resource management issues of concern or interest to tangata whenua iwi who have rohe within the regional plan area.

Chapter 9 - Summary of Issues:

Lists issues relating to each of the policy chapters.

Chapter 10 - Public Access:

Outlines issues relating to public access to and long water bodies in the catchment.

Chapter 11 - Land Use:

Details the geology, soils, and vegetative cover of the Tarawera River catchment and provides an account of inappropriate land uses and land use practices.

Chapter 12 - River and Lake Beds:

Deals with issues relating to management of the beds of the catchment's river, lakes, and wetlands, including issues relating to the location of structures, sedimentation, and the reclaiming and draining of beds of river, lakes and wetlands.

Chapter 13 - Freshwater Ecology:

Details the fresh water ecology of the catchments water bodies, focusing especially on the main stem of the Tarawera River.

Chapter 14 - Surface Water Quantity:

Outlines the primary causes and effects of changing river flows and lake and wetland levels in the catchment.

Chapter 15 - Surface Water Quality:

Identifies the primary factors of water quality in the Tarawera River catchment.

Chapter 16 - Groundwater Quality and Quantity:

Deals with both groundwater quality and quantity, especially with regard to the Rangitaiki Plains, and the disposal of contaminants to land.

Chapter 17 - Geothermal Resources:

Identifies and assesses the geothermal fields in the Tarawera River catchment.

Chapter 18 - Resource Consent Process:

Outlines the information required with an application for a resource consent for activities identified in this regional plan.

Chapter 19 - Monitoring and Plan Review:

Specifies how Environment Bay of Plenty intends to monitor the performance of the regional plan, and the procedure for its review.

Chapter 20 – Summary of Rules:

All plan rules brought together on blue paper for your convenience.

Appendices:

Contain more detailed information and data related to the above mentioned Chapters, as well as references and a detailed glossary.

Advisory Note:

Throughout the plan reference is made to specific pulp and paper mills at Kawerau. Over time the names have changed. At the time the plan was made operative the original Tasman Pulp and Paper Company Limited had been divided into Norske Skog Tasman and Carter Holt Harvey Tasman. Likewise the original Caxton became Carter Holt Harvey Tissue and then Carter Holt Harvey Consumer Brands. It is to be expected that the names of companies will change over time.

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1 Introduction

1.1 Citation

This regional plan may be cited as the *Regional Plan for the Tarawera River Catchment*, and is referred to as "this regional plan" or "the regional plan" or "Tarawera River Catchment Plan" throughout this document.

Any reference in this regional plan to Environment Bay of Plenty is to be read as a reference to the Bay of Plenty Regional Council. Any reference to "the Council" refers, unless the context requires otherwise, to Environment Bay of Plenty.

1.2 Purpose and Aim

The purpose of this regional plan is to assist Environment Bay of Plenty to promote the sustainable management of natural and physical resources within the Tarawera River catchment. The definition of "sustainable management" is contained within section 5 of the Resource Management Act 1991 (the Act) as meaning:

> *Managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while-*
>
> *(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
>
> *(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
>
> *(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.*

The aim of this regional plan is to achieve the purpose by ensuring that:

(a) There is integrated management of the natural and physical resources of the Tarawera River catchment;

(b) The high quality water in the catchment of the Upper Reach of the Tarawera River is maintained, and improved where appropriate;

(c) The water quality in the Lower Reach of the Tarawera River is managed to ensure that the effects of industrial discharges are substantially reduced;

(d) The community remains involved in the management process;

(e) There is reduction in the discharge of contaminants into the Tarawera River;

(f) The Mauri of the Tarawera River is restored and the balance maintained.

1.3 Justification for the Regional Plan for the Tarawera River Catchment

The preparation of this regional plan was considered desirable because a number of circumstances or conditions, as listed in section 65(3) of the Resource Management Act 1991, were present or likely to arise. The circumstances or conditions listed in section 65(3) are as follows, not all of which relate to the preparation of this regional plan:

(a) Any significant conflict between the use, development, or protection of natural and physical resources or the avoidance or mitigation of such conflict:

(b) Significant community demand for the protection of the Tarawera River by reduction in the discharge of contaminants into the river.

(c) Significant tangata whenua demand for the elimination of discharges of contaminants into the river.

(d) Any foreseeable demand for or on natural and physical resources;

(e) Any significant concerns of tangata whenua for their cultural heritage in relation to natural and physical resources:

(f) The restoration or enhancement of any natural and physical resources in a deteriorated state or the avoidance or mitigation of any such deterioration:

(g) The implementation of a national policy statement or New Zealand coastal policy statement:

(h) Any use of land or water that has actual or potential adverse effects on soil conservation or air quality or water quality:

(i) Any other significant issue relating to any function of the regional council under this Act.

After assessing all the issues raised in consultation with the community, Environment Bay of Plenty decided that with respect to the criteria set out in section 65(3) of the Resource Management Act, it was desirable to proceed with the preparation of the regional plan for the Tarawera River catchment. In reaching this decision Environment Bay of Plenty identified:

(a) Significant conflicts in terms of differences in attitude between industry and community groups as to the level of protection required for Tarawera River water quality.

(b) Significant community demand for the protection of the Tarawera River by a continued reduction in the discharge of contaminants into the river.

(c) Significant concerns expressed by tangata whenua on the effects of contaminant discharge to the river.

(d) The need expressed by community survey to actively restore the deteriorated state of water quality in the Lower Reach of the Tarawera River.

1.4 Area Coverage

This regional plan covers the area of the Tarawera River and all its sub-catchments, including the lakes in the Tarawera Lakes and their catchments, but excluding Lake Rerewhakaaitu and its catchment[1].

In the catchment of the Lower Reach of the Tarawera River the eastern margin of the regional plan area is the western bank of the Rangitaiki River. The western margin of the regional plan is the watershed of the Manawahe hills and includes the Matata Lagoon and its catchment.

This regional plan extends to the landward edge of the line of mean high water springs. In the Lower Reach of the Tarawera River the line of mean high water springs is the Thornton Road Bridge just east of the settlement of Matata.

For the purposes of description and discussion, this regional plan is divided into three distinct areas, referred to as:

- The Tarawera Lakes and their catchments
- The catchment of the Upper Reach of the Tarawera River
- The catchment of the Lower Reach of the Tarawera River

1.5 Topic Coverage

The following resource management issues are addressed in this regional plan:

(a) Surface water and groundwater quality parameters, including odour, colour, temperature, dissolved oxygen and chemistry, including geothermal discharges;

(b) Surface and groundwater quantity;

(c) Land Management, more specific to matters covered in the *Operative Regional Land Management Plan* including sludge and spoil disposal to land;

(d) Freshwater ecology and wetlands;

(e) Public access;

(f) Issues of particular significance to tangata whenua;

(g) River and lake beds management.

Associated resource management issues also covered include:

(h) Community attitudes and perceptions;

(i) Matters of resource management significance to iwi authorities.

In addition, the plan deals with matters of process including, but not limited to:

(j) Information to be submitted with applications for resource consent;

(k) Integrated management;

[1] Lake Rerewhakaaitu is thought to have a subsurface flow to Lake Rotomahana, it was not considered to be an integral part of the wider catchment. Resource management issues associated with Lake Rerewhakaaitu and its catchment are likely to be the subject of a separate catchment plan.

(l) Cross-boundary issues;

(m) Monitoring and review of the plan.

The plan excludes a range of resource management issues, some of which will be dealt with in other regional or district plans. These include:

(n) Air management;

(o) Geothermal field management;

(p) On-site effluent treatment;

(q) Coastal marine area and environment management;

(r) Contaminated sites management;

(s) Sand, shingle and mineral extraction;

(t) Hazardous substances management;

(u) Direct land use control (such as zoning), except on the beds of rivers and lakes;

(v) Subdivision control;

(w) Noise control;

(x) Drainage and flood control on the Rangitaiki Plains;

(y) Animal and Plant Pest control;

(z) Natural hazards avoidance and mitigation.

(aa) Heritage values of the Upper Tarawera Lakes.

1.6 Duration of the Regional Plan for the Tarawera River Catchment

This regional plan will have a life of ten years. A full review of the regional plan will begin nine years from the date it became operative. The plan may be changed, under the process laid down in the Resource Management Act 1991, at any stage in the intervening period.

Map 1

Regional Plan for the Tarawera River Catchment

Regional Overview

LEGEND

- Town, Locality
- State Highway
- Environment Bay of Plenty Regional Boundary
- Regional Catchment Boundary
- Tarawera River Catchment

STATISTICAL INFORMATION

Total Area (A)

1. Bay of Plenty Region	12,480 km²
2. Tarawera River Catchment	984 km²

Total Population (B)

1. Bay of Plenty Region	224,571
2. Tarawera River Catchment	14,652

A: 1, 2 B: 1, 2

C1623-1

2 Preparation of the Regional Plan for the Tarawera River Catchment

2.1 Introduction

This regional plan has been prepared by Environment Bay of Plenty under Part V of the Resource Management Act 1991. The preparation of this regional plan has involved extensive liaison with the local community, local iwi, special interest groups, and organisations with an interest in the Tarawera River catchment.

In May 1991 a public meeting attended by approximately 250 people was held in Whakatane to discuss the community's resource management concerns with regard to the Tarawera River and its catchment. Many issues were raised at that meeting, in particular major concerns as to the continuing degraded state of the river below Kawerau. In November 1991 Environment Bay of Plenty announced its intention to prepare the *Regional Plan for the Tarawera River Catchment* (then referred to as the Tarawera River Regional Plan) in the *Tarawera Bulletin*, a news sheet sent to homes in the majority of the wider Tarawera River catchment area.

As a result of the November 1991 *Tarawera Bulletin*, which also called for submissions on topics and issues which should be covered in the regional plan, ten submissions were received from industry, environmental and recreational organisations. These submissions, together with the issues covered in the earlier *Tarawera River Management Plan*[2], formed the basis for initial discussions and technical investigations undertaken by, or on behalf of, Environment Bay of Plenty.

Throughout the plan preparation period, Environment Bay of Plenty has provided information to the public on issues relating to the preparation of the regional plan. Environment Bay of Plenty made information from investigations and research available to the public in editions of *the Tarawera Bulletin*, advertisements in local newspapers, press releases, presentations at agricultural shows and so on.

2.2 Plan Programme Outline

The *Tarawera River Regional Plan Programme Outline* was prepared and adopted by Environment Bay of Plenty in early 1993. The outline identified the issues to be covered in this regional plan and detailed a timetable for the preparation of work modules. The report identified eleven modules specifying investigation, research and analysis required as part of the preparation of the plan, and giving an indication of the resources required in order to deliver the specified outputs.

2.3 Liaison Groups

2.3.1 Technical Liaison Group

In late 1992, Environment Bay of Plenty initiated a Technical Liaison Group with industry and crown research institute representatives, to review issues related to water quality in the Lower Reach of the Tarawera River. This group has been responsible for providing direction for research and further investigation especially the effects of industrial discharges on the quality of water in the Lower Reach of the Tarawera River, and associated wetlands.

[2] Tarawera River Management Plan prepared in 1985 by the Bay of Plenty Catchment Commission.

2.3.2 Tarawera River Liaison Group

The Tarawera River Liaison Group was formed in mid-1993 by Environment Bay of Plenty. The group brought together some twenty representatives from iwi authorities, industry, environmental groups, community groups and local authorities. Membership of the Tarawera River Liaison Group is shown in Appendix 9. Representatives on the Liaison Group provided a series of presentation on resource management issues facing the Tarawera catchment. The Liaison Group also received technical presentations from scientists, from Council staff and a range of research agencies. These presentations concentrated more specifically on water quality related issues in the catchment of the Lower Reach of the Tarawera River. Before the release of the draft regional plan, the Liaison Group was involved in a series of 15 workshop and discussion sessions, focusing in particular, but not solely on dissolved oxygen, toxicity and colour in the Lower Reach of the Tarawera River.

2.4 Plan Project Team

The Tarawera River Regional Plan Project Team was formed in late 1992 to assist in the preparation of the regional plan. The multi-disciplinary team included staff from Environment Bay of Plenty's planning, environmental monitoring, and operations departments. The project team met regularly to ascertain progress on work modules and identify areas where additional research was required.

2.5 Contact with External Organisations

In addition to the formation of the liaison groups, Environment Bay of Plenty staff were involved in extensive contact with staff from other organisations, most significantly staff from the Department of Conservation, the Eastern Regional Fish and Game Council, the National Institute for Water and Atmospheric Research (NIWA), Tasman Pulp and Paper Company Limited, Caxton Paper Limited (which became Carter Holt Harvey Tissue), Works Geothermal Limited, Tasman Forestry Limited (now Fletcher Challenge Forestry Limited), iwi authorities, and a number of environmental organisations. In some cases this resulted in the formation of small review teams to investigate specific matters, such as the protection of wetlands.

2.6 Research/Investigative Reports

In the course of the preparation of this regional plan, Environment Bay of Plenty prepared, or commissioned, a series of research and investigation reports into a range of issues. These reports included:

- A survey of community attitudes and perceptions,
- Assessments of dissolved oxygen levels and toxicity in the Lower Reach of the Tarawera River,
- River flow analysis,
- Groundwater and geothermal resource assessments,
- Investigations into colour and visual clarity,
- Land use capability,
- Pulp and paper production processes,
- Resource management investigations.

Research and investigative reports prepared as part of the preparation of this plan are listed in Appendix 2.

2.7 Section 32 Requirements

Section 32 of the Resource Management Act 1991 requires Environment Bay of Plenty to assess the extent to which an objective, policy, rule, or other method is necessary in achieving the purpose of the Act. It also requires other alternatives to be assessed, and costs and benefits weighed up.

Environment Bay of Plenty considers that it has fulfilled its duties under section 32 of the Resource Management Act 1991 with the establishment of the Tarawera River Liaison Group and the detailing of the principal reasons for adopting objectives, policies and rules, as outlined throughout this regional plan. The Tarawera River Liaison Group was established as a "think-tank" to provide a forum for alternatives to be presented and discussed and the necessity of objectives, policies, and rules established. The Liaison Group was provided with working drafts of the regional plan to which members made extensive comments.

3 Statutory Framework

3.1 Introduction

This regional plan is prepared under the Resource Management Act 1991. Regard has been had to other statutes where these have a bearing on the issues addressed in this regional plan. The purpose of, and process for, the preparation of this regional plan is set out in Part V of the Act.

As well as those matters indicated in Part V of the Act, Environment Bay of Plenty had regard among other parts and sections of the Act to section 30, the provisions of Part II, its duties under section 32, and the relevant schedules of the Act.

The First Schedule of the Resource Management Act sets out how this regional plan is to be prepared, changed and reviewed. The Second Schedule (Part I) of the Act outlines the matters that may be provided for in regional plans.

3.2 Activity Classes

The Resource Management Act 1991 recognises that the magnitude of adverse effects differs from activity to activity. These effects may be far greater for some activities than they would be in the case of others. Accordingly, the Act sets a number of activity classes. Each of these classes relates to the anticipated magnitude of effects which will result from the proposed activity. All activities which are regulated within this regional plan have been grouped into one or other of these classes. Activity classes (as set by section 2 of the Act) are as follows:

3.2.1 Permitted Activity:

If an activity is described in this Act, regulations, or a plan or proposed plan as a Permitted Activity, a resource consent is not required for the activity if it complies with the standards, terms, or conditions, if any, specified in the plan or proposed plan.

3.2.2 Controlled Activity:

If an activity is described in this Act, regulations, or plan or proposed plan as a controlled activity, -

(a) a resource consent is required for the activity, and the consent authority has no power to decline that resource consent; and

(b) the consent authority must specify in the plan or proposed plan matters over which it has reserved control; and

(c) the consent authority's power to impose conditions on the resource consent is restricted to the matters that have been specified under paragraph (b); and

(d) the activity must comply with the standards, terms, or conditions if any, specified in the plan or proposed plan.

3.2.3 Discretionary Activity:

If an activity is described in this Act, regulations, or a plan or proposed plan as a discretionary activity, -

(a) a resource consent is required for the activity; and

(b) the consent authority may grant the resource consent with or without conditions or decline the resource consent; and

(c) the activity must comply with the standards, terms, or conditions, if any, specified in the plan or proposed plan.

3.2.4 Non-Complying Activity:

If an activity is described in this Act, regulations, or a plan or proposed plan as a non-complying activity, -

(a) a resource consent is required for the activity; and

(b) the consent authority may grant the resource consent with or without conditions or decline the resource consent.

3.2.5 Prohibited Activity:

If an activity is described in this Act, regulations, or plan as a Prohibited Activity, no application may be made for that activity and a resource consent must not be granted for it.

The order in which these activities has been placed above generally signifies their corresponding level of anticipated adverse environmental effects, from low for permitted activities up to unacceptable for prohibited activities.

3.3 Restriction on Discharge Permits

Section 107 of the Resource Management Act 1991 sets out what is in effect an "environmental bottom line" with regards the discharge of contaminants that would (or are likely to) give rise to specified effects after reasonable mixing. Any discharge activity that would be non-complying because its effects exceeded classification parameters set by a regional plan would be assessed according to the criteria of section 107 of the Act. Section 107(2) enables a consent to be granted for an activity that would otherwise contravene section 107(1), if the consent is subject to conditions that require the staged achievement of remedial actions resulting in compliance with section 107(1) effects criteria and any further requirements of relevant regional rules.

3.4 Issues, Objectives, Policies and Methods

This regional plan contains the means by which Environment Bay of Plenty will be managing the requirements of Part II and the restrictions of sections 13, 14 and 15 of the Resource Management Act 1991, and having regard to its functions under section 30. These means are prioritised in the form of objectives, policies and methods of implementation and stem from issues identified through liaison with other organisations and the community and by Environment Bay of Plenty. Figure 1 shows the relationship between objectives, policies and methods.

3.4.1 Issues

An issue is defined as a matter of concern identified by the region's community regarding activities affecting some aspect of natural and physical resources and the environment in the region. Issues raised in this regional plan have been identified through extensive public participation and professional/technical debate. For efficiency, issues have been grouped where practicable.

3.4.2 Objectives

An objective is a desirable and achievable condition or position towards which effort is to be directed. Progress towards an objective needs to be regularly evaluated.

3.4.3 Policies

Policies define the boundaries within which decisions can be made, and they guide they development of courses of action directed towards the accomplishment of objectives. They are guides to action.

3.4.4 Methods

Methods (of implementation) describe or prescribe the procedure or course of action to be followed, in accordance with the policies, in order to achieve the objective. They detail what is to be done and by whom. Methods of implementation may include the provision of information, services, or incentives, and the levying of charges, as well as rules.

Methods may include the making of rules. Rules are regulatory instruments used to promote the sustainable management of natural and physical resources. Rules have the force of regulations which may prevent, regulate or allow activities. Rules include terms, conditions, classification standards, matters to which regard shall be had, and defined activity classes (discretionary, non-complying, prohibited) for specified activities.

Figure 1

AN EXAMPLE OF THE INTER-RELATIONSHIP BETWEEN OBJECTIVES, POLICIES, AND METHODS OF IMPLEMENTATION

Objectives

Desirable and achievable condition towards which effort is directed.

Example: The protection of outstanding geothermal features.

Policies

Guide the development of courses of action directed towards the accomplishment of the objectives.

Example: Geothermal fields that contain geothermal features that are outstanding features will be preserved and protected from exploitation.

Methods

Describe courses of action directed towards the accomplishment of the

Examples of Types of Methods

Provision of Information
Environment Bay of Plenty will map and provide information on outstanding geothermal features

Research
Environment Bay of Plenty will analyse the importance of various geothermal features in the Bay of Plenty, in particular, to determine which features are outstanding

Rule
A geothermal mass abstraction exclusion zone exists within a radius of 1.5kms from the centre of Pohutu Geyser

Incentives etc
Environment Bay of Plenty will provide funding assistance for the fencing off of geothermal features

3.5 Principal Reasons, Anticipated Environmental Results, Reviewing and Monitoring

The regional plan sets forth a series of principal reasons, and anticipated environmental results sections, based on the objectives, policies and methods of implementation contained in this regional plan.

3.5.1 Principal Reasons

The principal reasons sections identify the primary reason for adopting the various objectives, policies and methods of implementation contained in this regional plan. The principal reasons justify the position Environment Bay of Plenty has taken on the variety of issues covered in this regional plan. Principal reasons are a requirement of section 67(1)(e) of the Resource Management Act 1991.

3.5.2 Anticipated Environmental Results

The anticipated environmental results describe in a succinct fashion the intended outcomes of the policies and methods of implementation adopted, and are closely related to the relevant objective(s). An assessment of environmental results anticipated are a requirement of section 67(1)(g) of the Resource Management Act 1991.

3.5.3 Reviewing and Monitoring

Chapter 19 – *Monitoring and Plan Review* sets out the means by which progress towards achieving the purpose and aims of the regional plan can be tested relative to the objectives, policies and methods of implementation established in each chapter. Also measured is the effectiveness with which the plan is achieving the anticipated environmental results. Chapter 20 also lays down when the regional plan will be reviewed. Reviewing and monitoring of this regional plan are required by section 67(1)(i) of the Resource Management Act 1991.

4 Policy Framework

4.1 Introduction

This regional plan fits into a hierarchy of policy statements and plans required or allowed for under the Resource Management Act 1991. The regional plan may not be inconsistent with other Bay of Plenty regional plans, the *Operative Bay of Plenty Regional Policy Statement*, and national policy statements.

4.2 National Policy Statements

National policy statements on matters of national significance that are relevant to achieving the purpose of the Resource Management Act 1991 are prepared by the Minister for the Environment. The only exception is the New Zealand Coastal Policy Statement, produced by the Minister of Conservation. National policy statements must be prepared in the manner set out in Part V of the Act. There were no national policy statements prepared, other than the New Zealand Coastal Policy Statement, at the time this regional plan was publicly notified.

4.3 Operative Bay of Plenty Regional Policy Statement

Regional policy statements are a requirement of the Resource Management Act 1991 (section 60). The *Operative Bay of Plenty Regional Policy Statement* provides an overview of the resource management issues of the Bay of Plenty and promotes the sustainable and integrated management of the natural and physical resources of the region. The regional policy statement includes a series of objectives and policies relating to resource management issues in the Bay of Plenty. It should be noted that the regional policy statement cannot contain rules. They are explicitly limited to regional plans.

The regional policy statement contains a series of sections dealing with resource management issues which will be addressed in this regional plan, including land management, water quality and quantity management, and sections relating to natural character. The regional policy statement has a bearing on this regional plan and the two should be read together. Due consideration of the contents in the Regional Policy Statement was applied in the formulation of the Regional Plan for the Tarawera River Catchment.

4.4 The Regional Coastal Environment Plan

The *Bay of Plenty Regional Coastal Environment Plan* covers the coastal marine area (below the mean high water springs mark) as well as coastal hazards and natural character issues on the landward edge of the coastal marine area (the coastal environment). The quality of water discharged from the Tarawera River to the Pacific Ocean means that there is a close relationship between water classifications and rules in the regional coastal environment plan and this regional plan.

4.5 Bay of Plenty Regional Plans and Strategies

Environment Bay of Plenty is preparing a set of core regional plans covering the broad issue areas of water, air, land management and coastal management over the whole of the Bay of Plenty Region. These plans will be supported by a set of regional resource management strategies to cover specific issue areas such as the integrated management of the Rotorua lakes, flood and drainage control, and river gravel management. As regional resource management strategies develop, any

resultant policy requirements will be incorporated into the core regional plans. Regional plans cannot be inconsistent with each other and Environment Bay of Plenty considers that the core plan structure, reinforced with resource management strategies, will best enable the effective and integrated management of the region's resources, while minimising the possibility of policy conflicts.

4.6 District Plans

The purpose of district plans is to assist territorial local authorities to carry out their functions in order to achieve the purpose of the Resource Management Act 1991. The preparation of district plans is compulsory for territorial authorities. These district plans cover those functions set out in section 31 of the Act.

When both Environment Bay of Plenty and territorial local authorities are obligated to have regard to the same issues, Environment Bay of Plenty will generally only cover those issues of regional significance, while the district plans have regard to both the regionally significant issues and those identified as being of district importance. For example, district plans are likely to cover landscape and heritage values more comprehensively than covered in this regional plan. District plans may need to be reviewed as the result of the preparation of this plan to ensure that they are not inconsistent with this regional plan.

It is important to note that district plans, including those for Whakatane, Rotorua and Kawerau, cannot be inconsistent with the Operative Bay of Plenty Regional Policy Statement or any regional plan for the Bay of Plenty region, including this Regional Plan for the Tarawera River Catchment.

4.7 Management Plans and Strategies Prepared under other Acts

Section 66(2)(c)(i) of the Resource Management Act 1991 requires that in preparing or changing a regional plan, Environment Bay of Plenty must have regard to management plans and strategies prepared under other Acts. At the time this regional plan was prepared the following management plans and strategies has been identified to Environment Bay of Plenty as relevant management plans and strategies prepared under other statutes:

- *Waimangu Scenic Reserve Management Plan* – (Department of Conservation)
- *Okareka Scenic Reserve Management Plan* (draft) – (Department of Conservation
- *Matata Wildlife Management Reserve Management Plan* (draft) – (Department of Conservation)
- *Draft Conservation Management Strategy* – (Department of Conservation)
- *Western Whakatane Coastal Recreation Reserves Management* – (Whakatane District Council)
- *Game Management Plan* – (Eastern Region Fish and Game Council)
- *Fisheries Management Plan* – (Eastern Region Fish and Game Council)
- *Bregman Wildlife Management Plan* – (Department of Conservation)

4.8 Relevant Planning Documents Recognised by Iwi Authorities

Section 66(2A) of the Resource Management Act 1991 requires that in preparing or changing this regional plan, Environment Bay of Plenty take into account relevant planning documents recognised by iwi authorities affected by the regional plan. The iwi authorities considered to be directly affected by this regional plan are:

Ngati Awa
Ngati Rangitihi

Ngati Tuhourangi
Ngati Tuwharetoa ki Kawerau

Relevant planning documents recognised by iwi authorities and identified to Environment Bay of Plenty, and which Environment Bay of Plenty consequently had regard to during the preparation of this regional plan, are as follows:

- *Tuwharetoa Ki Kawerau Strategic Plan* – Te Runanga o Tuwharetoa Ki Kawerau

- *Issues for Ngati Awa regarding participation in Statutory Resource Management Planning* – Te Runanga o Ngati Awa Trust Board

- *Ngati Awa Policy Statement – Tarawera River* – Te runanga o Ngati Awa Trust Board

- *Ngati Tikanga Tiaki I Te Taiao* – Maori Environmental Management in the Bay of Plenty; consultants report for the *Operative Bay of Plenty Regional Policy Statement*

4.9 Other Legislation

In addition to the Resource Management Act 1991, in preparing this regional plan, regard has been had to other legislation, including but not limited to:

- Land Drainage Act 1908
- Soil Conservation and Rivers Control Act 1941
- Wildlife Act 1953
- The Tasman Pulp and Paper Company Enabling Act 1954
- The Tasman Pulp and Paper Company Enabling Amendment Act 1986 (No.29)
- Conservation Act 1987
- Building Act 1991
- Freshwater Fisheries Regulations 1983
- Historic Places Act 1993
- Biosecurity Act 1993

5 Responsibilities

5.1 Introduction

There are a range of public organisations charged with managing the natural and physical environment for a number of different purposes. The primary resource management agencies found in the Bay of Plenty include Environment Bay of Plenty, district councils, the Department of Conservation (DOC), and the Eastern Region Fish and Game Council. The large number of organisations with interests in resource management requires considerable coordination between Environment Bay of Plenty and these other organisations.

Under the Resource Management Act 1991 and other relevant legislation, the following general responsibilities apply:

5.2 Individuals

All people have responsibilities under the Resource Management Act 1991. Section 17(1) sets out a general duty of care as follows:

Every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity … whether or not the activity is in accordance with a rule in a plan, a resource consent, … or section 20 certain existing lawful activities allowed.

The responsibilities of individuals form an essential part of resource management.

5.3 Environment Bay of Plenty

Environment Bay of Plenty has the responsibility of implementing the integrated management of the land and water resources in the Tarawera River catchment area (refer to section 30 of the Resource Management Act 1991). Environment Bay of Plenty has established objectives, policies and methods to achieve this in the Tarawera River Catchment Plan. Methods to achieve any regionally identified objectives for land management issues outside the scope of the plan are the responsibility of district councils.

5.4 District Councils

The Tarawera catchment includes part of two district councils - Whakatane and Rotorua, and wholly includes the Kawerau District (Map 3). The Whakatane District has jurisdiction over the catchment of the Lower Reach of the Tarawera River and the majority of the catchment of the Upper Reach of the Tarawera River except for the area within the Kawerau District. These two territorial authorities encompass most of the population within the catchment, and the bulk of the area in pastoral agriculture and production forestry. The Rotorua District Council spans the Tarawera Lakes catchment.

Section 31 of the Resource Management Act 1991 specifies the functions of district councils under the Act including among other functions, subdivision control, land use planning, noise control and the control of recreation on the surface of water bodies. Some functions, such as natural hazards avoidance and mitigation, can be, or are, shared between district councils and Environment Bay of Plenty.

5.5 Department of Conservation (DOC)

The Tarawera River catchment is in DOC's Bay of Plenty Conservancy. Under section 6 of the Conservation Act 1987, DOC is responsible for managing for conservation purposes, all land and other natural and historic resources held under the Conservation Act 1987, and all other land and natural resources whose owner agrees with the Minister that they should be managed by the Department. Sections 6(a) and (b) of the Conservation Act 1987 require DOC to "Preserve so far as is practicable all indigenous freshwater fisheries, and protect recreational freshwater fisheries and freshwater fish habitats". Section 6(e) requires "… that to the extent that the use of any material or historic resource for recreation or tourism is not inconsistent with its conservation, to foster the use of natural and historic resources for recreation, and to allow their use for tourism".

The Department is also responsible for advocating the conservation of natural and historic resources generally, and promoting the benefits to present and future generations of conservation of natural and historic resources. DOC also administers the Freshwater Fisheries Regulations 1983, and the Wildlife Act 1953. An important role of the Department of Conservation is to foster the use of natural and historical resources for reactions, and to allow their use for tourism. The Department proposes management strategies for areas of Crown land, to which the councils must have regard as detailed in clause 4.6.

The Bay of Plenty Conservation Board has responsibilities for the environment under the provisions of sections 6m(c) and 6(n) of the Conservation Act 1987.

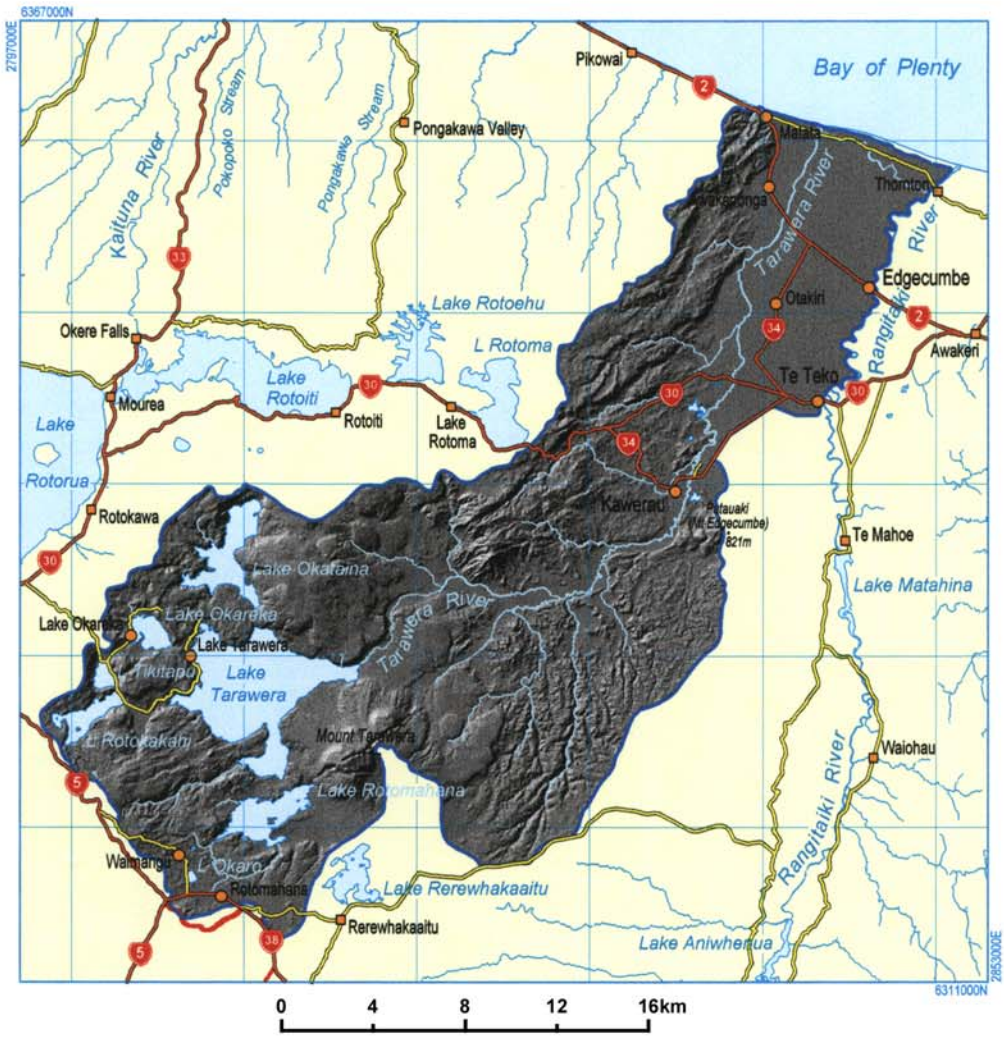
5.6 Eastern Region Fish and Game Council

The Eastern Region Fish and Game Council was established under section 26B of the Conservation Act 1987. Its purpose is to represent the interests of anglers and hunters and manage, maintain and enhance the sports fish and game resource. The Fish and Game Council regulates the taking of a number of species of fish and game through licences.

Map 2

Regional Plan for the Tarawera River Catchment

Topography



LEGEND

- Land Relief
- Lake
- River, Stream
- Township within Tarawera River Catchment
- Township outside Tarawera River Catchment
- Tarawera River Catchment Boundary
- Environment Bay of Plenty Regional Boundary
- State Highway
- Main Road

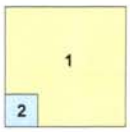
STATISTICAL INFORMATION

Tarawera River

Length *(from L Tarawera Outlet to the Sea)*	58.5 km
Mean Flow into the Sea	30,694 l/s

Tarawera River Catchment

1. Total Catchment Area	98,367 ha
2. Lake Surface Area	7,149 ha



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6 Physical Description of the Tarawera River Catchment

6.1 Introduction

The Tarawera River catchment has an area of approximately 984 km^2 outlined in Map 1. Volcanic and tectonic activity associated with the Taupo Volcanic Zone has heavily influenced the topography of the Tarawera River catchment. The geology is dominated by an active complex system of interdependent features including faults, rhyolitic volcanoes and geothermal fields, all of which are geologically recent in origin.

The Tarawera River catchment rises in the south-west around a series of volcanically formed lakes. The catchment's high point is Mt Tarawera (1,111 metres). The Okataina Volcanic Centre to the northeast of Lake Tarawera represents a significant area of high ground, mostly above 600 metres. Below the Tarawera Falls, the Tarawera River enters a steep-sided valley known as the Tarawera Valley which quickly fans out into rough but undulating country of between 150 metres and 300 metres in height. The topography of catchment within this regional plan is shown in Map 2.

Putauaki (Mt Edgecumbe), a dormant volcano, rises to 821 metres in the east of the catchment. The Rangitaiki Plains, also geologically known as the Whakatane Graben, are the delta for the Tarawera, Rangitaiki and Whakatane Rivers. The Rangitaiki Plains which begin just south of Kawerau township, slope gently from approximately 30m above sea level in the Te Teko – Kawerau area down to just below seal level in parts of the catchment behind the coastal foredunes. The coastal foredunes rise to a height of approximately 6 metres on average. The Rangitaiki Plains are bordered in the west by the Manawahe Hills which rise to a height of approximately 300 metres above sea level.

The Tarawera River catchment has a temperate maritime climate. It is characterised by relatively high rainfall. Kawerau had an average annual rainfall of 1,676mm (1984-1992), while Waiotapu Forest had an average annual rainfall of 1,352mm for the same period[3]. The rain falls relatively evenly throughout the year with a small decrease in summer and increase in winter of the order of 5% to 10% either side of the mean monthly value. The mean daily temperature in winter (August) for the Tarawera Forest is 8.6°C, while the mean daily summer temperature (February) is 18.4°C. In Kawerau the mean daily temperature in winter is 9.0°C, while the summer daily average is 19.7°C. Whakatane, approximately 25kms to the east of Matata records an average of 2,329 hours of bright sunshine per year.

For the purposes of description, the area covered by this regional plan is divided into three distinct geographical areas:

- The Tarawera Lakes and their catchments
- The catchment of the Upper Reach of the Tarawera River
- The catchment of the Lower Reach of the Tarawera River

A brief overview is also given of the Tarawera River mouth, which although in the coastal marine area and therefore dealt with in the regional coastal environment plan, is often affected by natural and physical resource management decisions and actions made within the Tarawera River catchment.

[3] Quayle, A M, 1984.

6.2 The Tarawera Lakes and their Catchments

The Tarawera Lakes and their catchments, shown in Map 2, is characterised by seven small to medium sized lakes, and dominated by Mt Tarawera, (1,111 metres) an active rhyolite/basaltic volcano. Lake Tarawera, from which the Tarawera River originates, is the biggest of the lakes. Lake Tarawera is generally believed to be fed by five other lake catchments within the Lake Tarawera system. Lake Rotokakahi (Green Lake) drains into Lake Tarawera via the Te Wairoa Stream while Lake Okareka does so via the Waitangi Spring and over ground via a man-made overflow structure. Lakes Tikitapu (Blue Lake), Okataina and Rotomahana have no visible outlets, but are believed to drain by sub-surface flow to Lake Tarawera. Lake Okaro drains via a surface flow into Lake Rotomahana[4]. Part of the water draining from Lake Rerewhakaaitu is understood to flow through the crater basin to Kaue Springs and then into Lake Rotomahana. The ecology of the Upper Reach of the Tarawera River catchment is likely to be moving closer to that of its original state before the loss of indigenous forest following the eruption of Mount Tarawera in 1886.

All the lakes are of volcanic origin. The lakes have been formed by one of, or a combination of, the following three processes:

- Local explosive eruptions producing small circular craters. Many of these small craters have resulted from hydrothermal eruptions;
- Massive eruptions producing large collapse calderas. Calderas are usually associated with explosive rhyolite volcanoes which frequently subside with the withdrawal of magma following eruptions. This leaves behind large depressions in which lakes can form;
- Blocking of valleys by lava flows or other volcanic material.

The water quality of each lake is closely associated with the nature of its immediately catchment. The Tarawera Lakes catchments (Map 4) is a mixture of indigenous forest, pasture, and exotic forestry scrub, with some bare ground and scrub in and around Mt Tarawera. With the exception of the Lake Okataina catchment, there has been significant catchment modification in all the Tarawera Lakes catchments.

Before the 1960s much of this modification was the result of changing land use from indigenous forestry to pastoral agriculture, and in the past twenty to thirty years a marked move from scrub, pastoral, and bare land to exotic plantation forestry. There is some indication that changing land use to exotic production forestry may be resulting in fewer nutrients being discharged to water bodies in the catchment of the Tarawera River, affecting the ecology of the river and downstream environments.

Lake Okataina is the most oligotrophic of the lakes due to its catchment being composed almost entirely of native forest. The available storage in the Tarawera Lakes catchments and the permeable nature of the predominant pumice soils within the catchment combine to maintain relatively steady flow characteristics in the Tarawera River[5].

Significant geothermal activity occurs at Lakes Rotomahana, Tarawera and Okataina. The Tarawera Lakes catchments also includes the Waimangu/Rotomahana geothermal field, part of which is a significant tourist attraction.

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[4] Lake Rerewhakaaitu, which is outside the plan area, is also considered to drain, via a sub-surface flow, to Lake Rotomahana.

[5] More detailed information on the lakes in the catchment of the Upper Reach of the Tarawera River is contained in reports published by Environment Bay of Plenty and listed in the References to this plan.

The volcanic formed lakes in the catchment of the Tarawera River have unique heritage values, which include the natural character of the wetlands, lake and rivers and their margins, natural features and landscapes, indigenous ecosystems, intrinsic values, and resources of cultural importance. These components are all interrelated and their high degree of intactness contributes to the national significance of the Tarawera Lakes and their catchments. Objectives and policies have been included in this plan to ensure that the inherent attributes of the area do not become eroded, either in character or in degree.

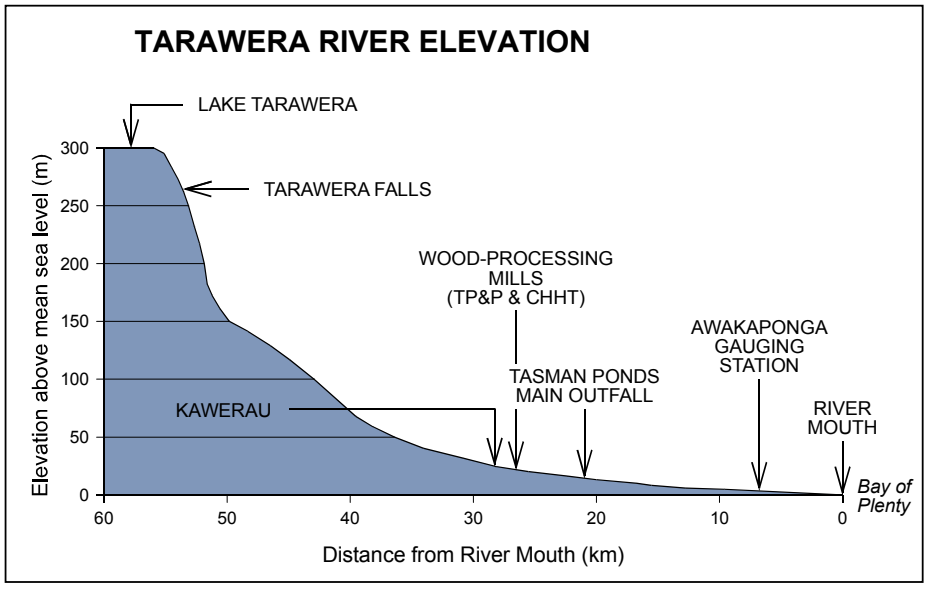
6.3 The Catchment of the Upper Reach of the Tarawera River

For the purposes of this regional plan the catchment of the Upper Reach of the Tarawera River is that area of the Tarawera River catchment from the outlet of Lake Tarawera to the Kawerau Road bridge over the Tarawera River, just north of Kawerau township at Grid Reference: Map Series 260, V15 – 357404.

The Tarawera Valley floor is covered with recent pumiceous alluvium and debris flow deposits produced by the Kaharoa Ash eruption approximately 700 years ago. The terrace on which Kawerau township is sited is composed of this material. Further up the valley, Kaharoa Ash material and Tarawera Lapilli produced by the 1886 eruption of Mt Tarawera are mixed together. This mixture is probably a consequence of a major flood in 1904 which resulted from the failure of a natural debris dam formed at the outlet of Lake Tarawera by the 1886 eruption. To the east of the Tarawera Valley, Matahina Ignimbrite occurs and extends to the Rangitaiki Valley. Rising above the ignimbrite sheet is Putauaki (Mt Edgecumbe), (821 metres), an andesitic volcano with a main cone and subsidiary centres around it. The volcano is traversed by a number of lineaments considered to be faults.

The Tarawera River begins at the Lake Tarawera Outlet. The majority of the catchment of the Upper Reach of the Tarawera River is in exotic production forestry, with some of the upper reaches of the tributaries and the eastern side of the Tarawera River in indigenous forest. The river is fed by a number of small tributaries as it flows north-eastwards towards Kawerau (Appendix 7, Figure 2). Three and a half kilometres from the Lake Tarawera outlet, the Tarawera River enters a subterranean chamber, exiting at the Tarawera Falls. The Falls sees the Tarawera River drop a total of 65 metres into the Tarawera Valley. From the Falls the river continues on a relatively steep grade to Kawerau township.

Figure 2



The Upper Reach of the Tarawera River and its tributaries contain organisms and plants indicative of a clean water environment. The water quality of the catchment of the Upper Reach of the Tarawera River, especially above the Tarawera Falls, can generally be described as being close to its natural state. This is supported by the high dissolved oxygen concentration, low water and sediment BOD and general high visual clarity of the water. The Upper Reach of the Tarawera River and its tributaries are spawning grounds for trout and habitats for a range of indigenous adult fish species.

The catchment of the Upper Reach of the Tarawera River is recognised as having important natural character and amenity values, such as trout fishing, canoeing and hiking. The quality of water from the Tarawera Falls to Kawerau and in the tributaries in the catchment of the Upper Reach of the Tarawera River is influenced to some extent by adjacent exotic plantation forestry operations, though it is still of high quality. There is some natural geothermal fluid discharge along the Tarawera River upstream of Kawerau, as well as geothermal inputs along the Managakotukutuku and Waiaute tributary streams.

The Tarawera River is characterised by relatively steady flows due to the effect of storage of Lake Tarawera and its tributary lakes and the "sponge" effect of the pumice soils in the catchment. The quantity of water in the Upper Reach of the Tarawera River has dropped over the past two decades. Changing vegetation cover from scrub, pasture and bare land to exotic plantation forestry, especially in the catchment of the Upper Reach of the Tarawera River, along with natural re-growth, and a regional rainfall decline, has resulted in reduced flows in the Tarawera River. This reduction has affected the ecology of the river and its tributaries and wetlands. Any reduction in water flow will place constraints on downstream users, especially iwi and also recreational and industrial users. Due to the wholistic view held by iwi with regards to the protection of the river, they feel constrained in their ability to abstract water upstream of the mills recognising that this would affect the assimilative capacity of the river downstream.

Although afforestation has had a negative impact in reducing water yield, it has at the same time had the positive effect of reducing the potential of flooding in the Lower Reach of the Tarawera River. Afforestation is thought to have reduced flood flows more than low flows. The Tarawera River now exhibits few peaks in its flows and smaller variations. In other words, the river flow has become steadier, but at lower levels[6]. Large scale exotic forestry planting has also had the beneficial effect of stabilising erosion on the light volcanic ash soils. In a number of areas significant tributary stream wash-outs have been extensively controlled as a result of exotic forestry plantation.

As well as diffuse geothermal discharges to the river and some of its tributaries, the catchment of the Upper Reach of the Tarawera River includes one significant geothermal field, the Rotoma/Tikorangi (Puhipuhi), which, by September 1996 had not been commercially exploited. Kawerau township which was built in the 1950s to house employees at the two pulp and paper mills is located at the northern edge of the catchment of the Upper Reach of the Tarawera River.

6.4 The Catchment of the Lower Reach of the Tarawera River

For the purposes of this regional plan the catchment of the Lower Reach of the Tarawera River is the catchment area downstream from the Kawerau Road Bridge across the Tarawera River to the Thornton Road Bridge across the Tarawera River, which is the Coastal Marine Area boundary with the Pacific Ocean, as shown in Map 2. The main stem of the Ruruanga Stream is included in the catchment of the Lower Reach of the Tarawera River, from its confluence with the Waikanapiti Stream to its confluence with the Tarawera River. The watershed of

[6] Pang, L, 1993, Report 93-2.

the Manawahe Hills marks the western extremity of the catchment of the Lower Reach of the Tarawera River, while the eastern side of the catchment of the Lower Reach of the Tarawera River abuts the western banks of the Rangitaiki River.

The Lower Reach of the Tarawera River flows past the farming communities of Otakiri and Awakaponga, before flowing into the Pacific Ocean just east of Matata township. Several tributaries and drains feed into the river near the mouth of the river, contributing agricultural point-source and diffuse discharges to the Tarawera River. Edgecumbe township has been included in the coverage of this regional plan as both town stormwater and treated sewage run into the Omeheu/Awaiti Canal system that drains into the Tarawera River. Although effluent whey from the Bay Milk Products Limited (Bay Milk) is spray irrigated onto land that drains towards the Tarawera River, all direct production effluent and stormwater drainage from that plant goes into the Rangitaiki River catchment.

The geology of the Rangitaiki Plains includes river transported pumice and silts interspersed with wetland materials (peats) and old beach and sand dune deposits. The plains are flanked on the east by the greywacke basement rocks of the Raungaehe Ranges and in the west by the volcanic/sedimentary sediments of the Kaharoa Plateau and Manawahe Hills. Geological investigation suggests that the Whakatane Graben that underlies the Rangitaiki Plains is subsiding at 2 to 3 mm a year, while the hills to both the east and the west are being forced upwards some indeterminate millimetres each year[7].

In addition to this subsidence and uplift, according to geodetic surveys, the land surface within the Rangitaiki Plains was extended horizontally at a steady rate of 7 millimetres a year over a forty-year period before 1987. Further evidence of the uplift and subsidence has been provided by the discovery of marine fossils both in the hills surrounding the Rangitaiki Plains and in bore holes drilled within the plains. The marine sand of the Rangitaiki Plains is overlain by volcanic ash deposits from the Taupo, Kaharoa and Tarawera eruptions[8].

The catchment of the Lower Reach of the Tarawera River is largely low-lying former wetlands, the Rangitaiki Plains, which are intensively farmed for dairying in particular. The Rangitaiki Plains are characterised by high groundwater levels and a large portion of the area is artificially drained for agricultural purposes. In this reach river gradient is low and the river moves relatively slowly. The current (1984-92) mean annual flow of the Tarawera River at Awakaponga is 26.2 cubic metres per second. The 7 day low flow (1984-92) is 20.9 cubic metres per second.

At Kawerau, approximately 10% of the mean annual flow of the Tarawera River is abstracted for use by Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue[9]. The water quality and biological conditions of the river are significantly different below the wastewater discharge points of the Tasman Pulp and Paper Company Limited[10] and Carter Holt Harvey Tissue[11] pulp and paper mills. The water below the discharge points is now significantly discoloured and gives off an odour typical of that associated with chemical pulp and paper mills. The Lower Reach of the Tarawera River and the remaining associated wetlands are characterised to varying degrees by low concentrations of dissolved oxygen,

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7 Gibbons, 1990.

8 Gibbons, 1990.

9 Kawerau township takes its water from local bores.

10 The Tasman Pulp and Paper Company Limited discharges its waste to the Tarawera River under conditions granted by the Water Resources Council in terms of the Tasman Pulp and Paper Company Limited Enabling Act 1954. The Enabling Act expired in 1995.

11 Carter Holt Harvey Tissue pulp and paper wastewater treatment facilities also process and discharge sewage from Kawerau township to the Tarawera River.

increased temperature, increased chemical and microbial contaminants, and a highly mobile bed.

The drainage of the Rangitaiki Plains in the early 1900s and the decision to locate major pulp and paper industries in Kawerau in the early 1950s have made significant changes to the Lower Reach of the Tarawera River in the last century. The effluent discharged from the pulp and paper mills has had a significant impact on traditional Maori food sources in the river. Mill effluent makes the river unavailable for traditional Maori food gathering. The effluent, combined with geothermal discharges and a highly mobile pumice riverbed, cause a restricted aquatic environment. There is little or no benthic vegetation in this section of the river and the fauna that is present consists principally of types indicative of reduced in-river aquatic habitat. This makes the river unattractive for recreation and traditional Maori food gathering. Extensive willow growth alongside and in the Lower Reach of the Tarawera River also acts as a barrier to public access and use. The water quality in the Lower Reach of the river is improving but there remains a belief that the health and safety of the local inhabitants and visitors who use the river is at risk.

The catchment of the Lower Reach of the Tarawera River includes a number of small lakes and wetlands areas associated with the Tarawera River (Appendix 6, Map 6). The biggest of these is the Matata Lagoon at the mouth of the Tarawera River. These wetlands are the last remaining (1-2%) wetland land areas of what was previously a continuous wetland on the Rangitaiki Plains. The wetlands are important for cultural, traditional, ecological, aesthetic, historical and recreation reasons. Some of these are also in danger of being perched, or left dry due to an inadequate water supply from the Tarawera River or canals on the Rangitaiki Plains. Point and diffuse discharges to the Tarawera River and canals on the Rangitaiki Plains result in significant pollution of the wetlands associated with the Tarawera River.

The Kawerau Geothermal Field, centred just north of Kawerau township, supplies steam to the Tasman Pulp and Paper Company Limited mill for process heat and power generation. Steam condensate provides a source of boiler feed water and is not discharged to the river under normal conditions. Heat energy is extracted from the waste geothermal water for power generation by a number of small power plants. The water is further cooled before discharge into the Tarawera River. Natural geothermal inflows occur in the Ruruanga Stream and the Tarawera River as it passed through Kawerau, contributing to the geothermal constituents already present in the river.

A 30 square kilometres mesotrophic peat deposit containing some 18 million cubic metres of mineralised deposits, Tarawera and Kaharoa ash with white pumiceous Taupo pumice at depth, is considered to exist in the lower reaches of the Tarawera River. Smaller outcrops occur to the east in the vicinity of Edgecumbe and Awakeri. There is ongoing debate over the impact of peat deposits on the river. Overall it is likely that peat would have some minor effect on the oxygen levels, colour and clarity of the river.

The soil patterns of the Rangitaiki Plains are based on the infill of pumiceous material, carried and deposited by a partially-locked river system. Infilling, wetland growth, subsidence and more infill behind the coastal sand dunes have been continuing for thousands of years. The mobile pumice bed of the Tarawera River results in significant siltation in the lower river, which has raised the bed so that it is higher than the surrounding land. Today the country surrounding the Tarawera and Rangitaiki Rivers is protected from flooding by a network of stopbanks. Drains and canals have been constructed to take surface runoff to outlets close to the Tarawera River mouth at Matata.

In the past fifteen years horticultural development has taken place with the introduction of kiwifruit, citrus orchards and vegetable crops, especially in the northern Rangitaiki Plains. Horticulture has led to demand for an increased depth

of drainage on some parts of the Rangitaiki Plains to a horticultural standard. In the Manawahe Hills (coastal hill country) production forestry and woodlot planting have been increasing, replacing sheep and beef farming[12]. It can be expected that, as in the past, fluctuations in international trading conditions will continue to cause medium term "fashion" changes in land use.

6.5 The Tarawera River Mouth

The Tarawera River mouth is that area downstream of the Thornton Road bridge across the Tarawera River east of Matata. This area falls within the coastal marine area and its management is covered by the *Bay of Plenty Regional Coastal Environment Plan*.

The present river channel to the Pacific Ocean was constructed in 1917 for drainage purposes. The Tarawera River previously flowed through the Matata Lagoon then out to sea at a portage situated opposite the old Matata Post Office. The channelling of the river directly to the Pacific to bypass the lagoon, the build-up of sediment from the steep surrounding catchments, the discharge of solids in the mill effluent and the lack of flushing due to the reduction of river flow volume has ultimately resulted in the Matata Lagoon becoming silted. The channelling has eroded and continues to erode an urupa on the eastern side of the current river channel near the river mouth that is of significant cultural importance to Tuwharetoa and related iwi. The pollution of the river water also contributes to the degradation of the urupa.

Tidal influence on water level is noticeable for approximately two kilometres upstream of the river mouth. The degree of saltwater penetration is expected to be variable, with the greatest penetration occurring on spring tides under conditions of low river flow.

The Tarawera River mouth shows very few estuarine characteristics. It is considered that the largely freshwater environment, with only temporary incursion of saline waters, is too unstable for the establishment of estuarine organisms. The rush *Juncus maritimus var australiensis* is the only 'estuarine' plant growing in the estuary.

[12] Groundwater Consultants, 1984, 1.

7 Community Attitudes and Perceptions

7.1 Introduction

This chapter sets the social and economic context of the Tarawera River catchment and provides an indication of community attitudes and perceptions about the state of catchment water quality. The issues, objectives and policies give direction that in promoting the sustainable management of natural and physical resources in the catchment, regard be had to the social, economic and cultural wellbeing of the local community, and that changes required to promote the aims of the plan be made in ways or at rates that enable the community to pursue their social and economic aspirations.

7.2 The Social and Economic Context

A number of social and economic matters are affected by decisions on how natural and physical resources are managed. The effects of resource management on social and economic aspirations should be taken into account in a holistic approach to managing the environment[13].

7.2.1 Population Distribution

Approximately 14,900 (1991 Census)[14] people live within the Tarawera River catchment. Seventy-eight percent of the catchment's population live in settlements of more than 500 people. The largest settlement in the catchment is Kawerau (population 8,136) (Table 1). Kawerau is the centre of wood processing in the Bay of Plenty, with two pulp and paper plants and a lumber plant. The next biggest town is Edgecumbe (population 1,782), which straddles the Rangitaiki River on the eastern side of the Tarawera River catchment. Edgecumbe is the focus of the dairy processing industry for the Bay of Plenty. (See Map 3).

Other smaller settlements in the catchment are Matata and Te Teko. Both settlements have populations of just over 600. The Okareka and Tarawera settlements were originally subdivided around 1938-1943 and 1948-1950 respectively. Holiday baches and houses have been established in the Settlements and over time the permanent resident population has increased. Okareka is within comfortable commuting distance of Rotorua. In 1999 some 70% of the property owners at Okareka and a Rotorua address and it was estimated that the permanent resident population was approximately 534. Some 40% of the property owners at Tarawera had a Rotorua address and it was estimated that the permanent resident population was approximately 471. These populations increase during holiday periods (For further information see Appendix 3 – Population Statistics for the Tarawera River Catchment).

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13 It should be noted section 2 of the Resource Management Act 1991, defines "environment" to include:
- *(a) Ecosystems and their constituent parts, including people and communities; and*
- *(b) All natural and physical resources; and*
- *(c) Amenity values; and*
- *(d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.*

14 The statistical areas for population and demographic figures, as defined by Statistics New Zealand, do not directly coincide with the catchment of the Tarawera River.

Table 1

MAJOR SETTLEMENTS IN THE TARAWERA CATCHMENT 1991 CENSUS

Settlement	Total Population (1991)	% of Total Catchment Population (14,877)
Kawerau	8,136	57.75%
Edgecumbe	1,782	11.97%
Matata	612	4.11%
Te Teko	606	4.07%
Other Rural	3,285	22.08%
Total Population	**14,877**	**100.00%**

Statistics NZ, 1991

7.2.2 Ethnic Composition

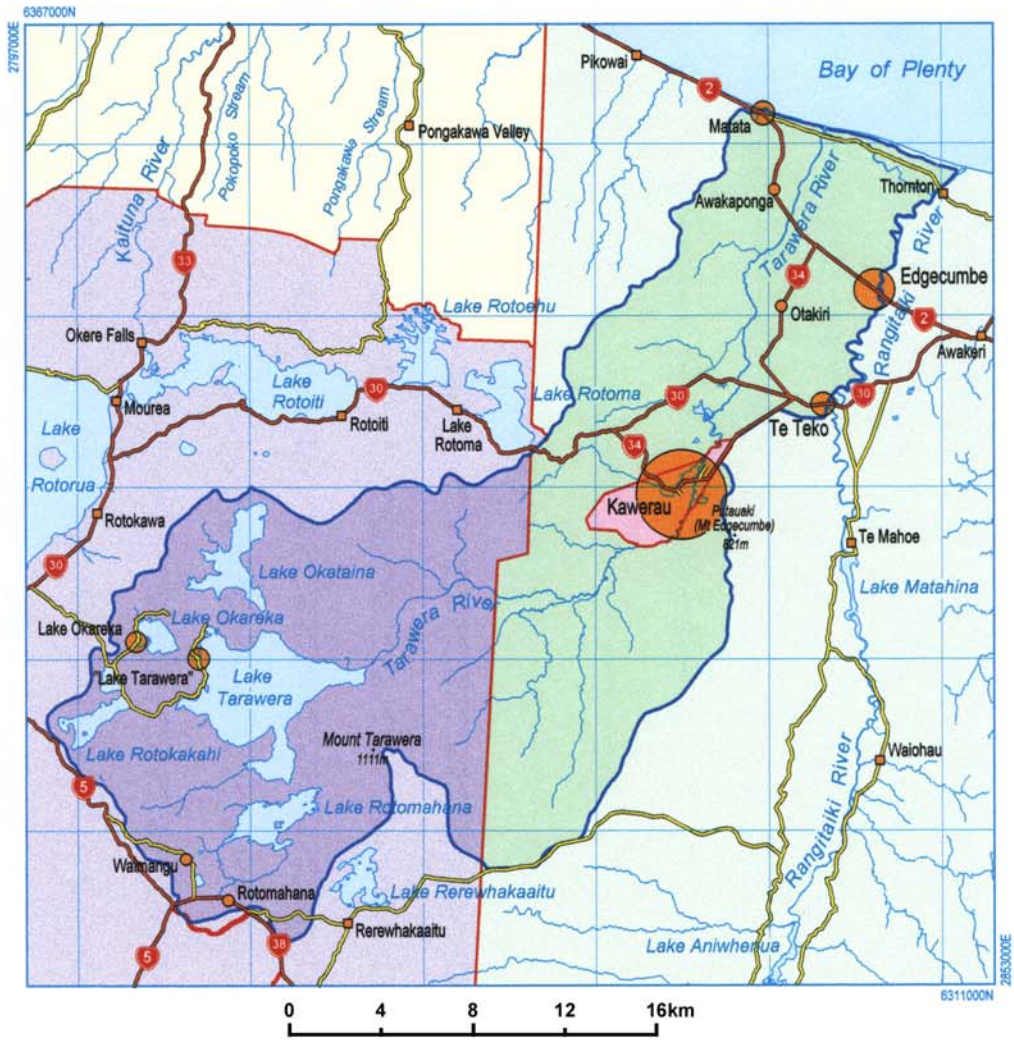
The Tarawera River catchment includes a very high percentage of Maori (45.9% or 6,369 persons) compared with both the Bay of Plenty (25%) and New Zealand (13%) total populations (Figure 3).

Prior to the establishment of the mills, tangata whenua of the district relied on the resources of the river for trade, transport and sustenance, both physical and cultural. The previous existence of a large area of swamp, and the river itself contributed to a thriving pre industry community but these had been displaced by government sponsored farm development schemes prior to the mills being built. More recently tau iwi and taura here have moved to the area to work in the forestry and wood processing sectors. A higher population growth rate among Maori is likely to result in the Maori population in the Tarawera River catchment exceeding that of the non-Maori population in the foreseeable future.

Map 3

Regional Plan for the Tarawera River Catchment

Territorial Local Authorities and Townships



TERRITORIAL LOCAL AUTHORITY

- Kawerau District
- Rotorua District
- Western Bay of Plenty District
- Whakatane District
- District Boundary
- Environment Bay of Plenty Regional Boundary
- Tarawera River Catchment Boundary
- State Highway
- Major Road

POPULATION *(1996 Census)*

8592	Kawerau
1782	Edgecumbe
612	Matata
606	Te Teko
504	"Lake Tarawera"
464	Lake Okareka
<100	Other, eg. Otakiri
	Township outside Tarawera River Catchment

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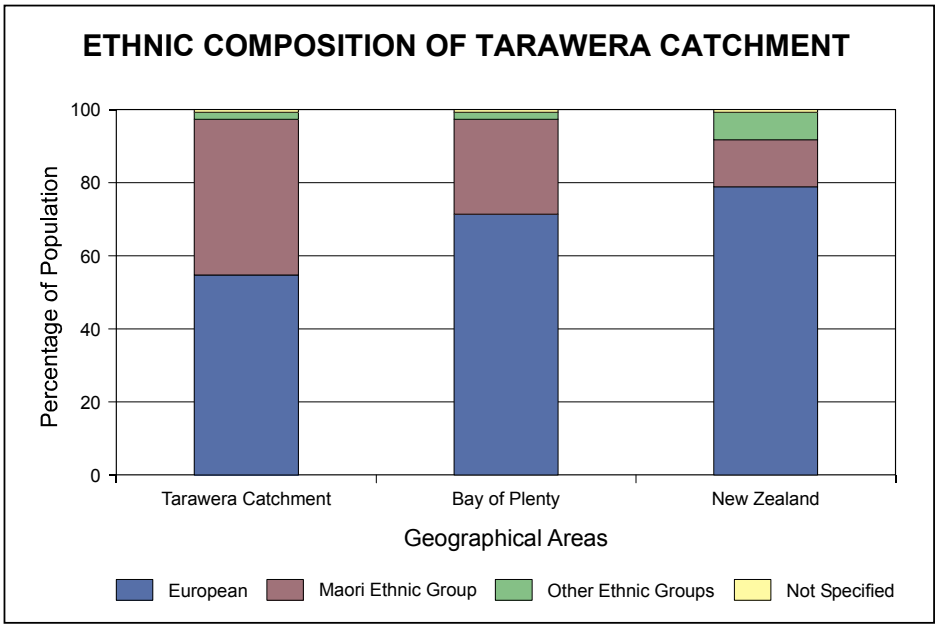
Figure 3



Statistics NZ 1991

7.3 Community Surveys

Community attitudes and perceptions can act as an important guide to how communities relate to and value their local environment. They provide an indication of issues and act as a barometer for measuring the strength of community attitudes toward matters. In an effort to gain a better understanding of attitudes and perceptions towards the environment, Environment Bay of Plenty commissioned three community surveys between June 1992 and March 1993[15].

Results from the 1992 survey, *Attitudes Towards the Bay of Plenty Environment*[16] highlighted the Tarawera River as the cause of greatest concern in the Eastern Bay of Plenty when survey respondents were asked to name any particular lakes or rivers which they considered to be polluted (Figure 4). Nearly 38% of Eastern Bay of Plenty respondents considered the Tarawera River to be polluted. The Rangitaiki and Whakatane Rivers were also indicated as polluted rivers, but to a much lesser extent than Tarawera. The survey also indicated that nearly 20% of Eastern Bay of Plenty respondents considered polluted waterways to be a primary contributing factor to the "poor" or "very poor" environmental state of the Bay of Plenty. Eastern Bay of Plenty[17] respondents considered pollution from pulp and paper mills[18] to be the biggest factor contributing to the region's "poor" or "very poor" environmental health[19].

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15 Ponter, D M and Doorman, P J, 1992; Research Solutions, 1992; Research Solutions, 1993.

16 Ponter, D M and Doorman, 1993.

17 Including the Whakatane, Kawerau, and Opotiki District Council area, but excluding Rotorua (the Upper Lakes catchment).

18 The three mills in the Eastern Bay of Plenty are Tasman Pulp and Paper Company Limited (Kawerau), Carter Holt Harvey Tissue (Kawerau), and Carter Holt Harvey Packaging – Whakatane Mill (Whakatane).

19 No distinction was made between air and water pollution.

In a mid-1992 survey commissioned by Environment Bay of Plenty, Community Attitudes to the Rotorua Lakes[20] of 330 residents in the Rotorua Lakes catchment[21], Lakes Tarawera, Blue (Tikitapu), Green (Rotokakahi), and Okataina were identified as being in a good environmental condition. The more common reasons given for these lakes being chosen are indicated in Table 2. In comparison, Lake Rotorua, which is not within the Tarawera River catchment, was judged, by 88% of respondents, the worst lake environmentally.

Table 2

ATTITUDES AND PERCEPTIONS TO LAKES IN THE TARAWERA LAKES CATCHMENTS

(10 = Excellent 1 = Poor)

Lake	Rating for Environmental Condition (out of ten)	Reasons
Lake Tarawera	24% rated this lake the best with a score of 7 out of 10	• Lack of pollution • Quality of the water • The visual beauty of the lake
Lakes Tikitapu and Rotokakahi	24% rated these lakes best with a score of 6.9 out of 10	• Lack of pollution • Few people, buildings or noise • Visual beauty
Lake Okataina	21% rated this lake as best with a score of 7.5 out of 10	• Lack of people, noise or buildings • Lack of pollution • Bush setting • Unspoilt, natural, pristine state
Lake Rotorua	88% rated this lake as the worst, with a score of 1.9 out of 10	• Poor water quality seen as a health hazard • Lake week seen as an indicator of poor health

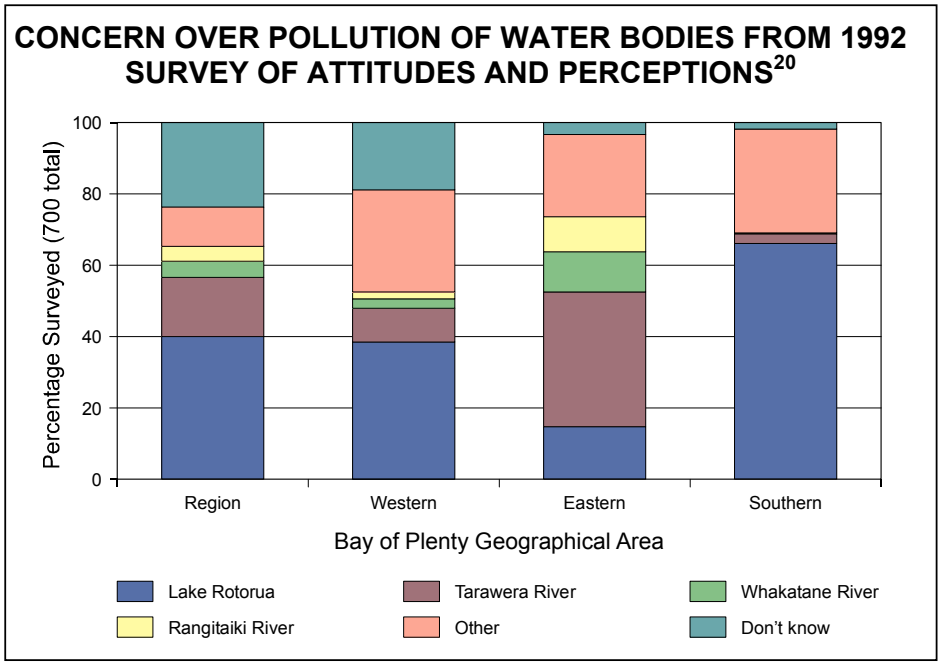
Research Solutions 1992

Of the 300 people surveyed in the Community Attitudes Towards the Tarawera River and its Catchment Survey, 46% considered the environmental state of the catchment of the Lower Reach of the Tarawera River area to be good or very good. A further 30% felt it was average, with only 15% rating the environmental state as poor (10%) or very poor (5%) (Figure 5). Kawerau residents gave a slightly higher rating to their environment, 48% rating it as good/very good, compared with 12% rating it as poor/very poor, than did those living in the Tarawera, Edgecumbe, or Matata wards. Those aged 45 or older tended to be more divided in their opinions than the younger residents.

[20] Research Solutions, 1992.

[21] This encompasses the Tarawera Lakes catchment of the regional plan.

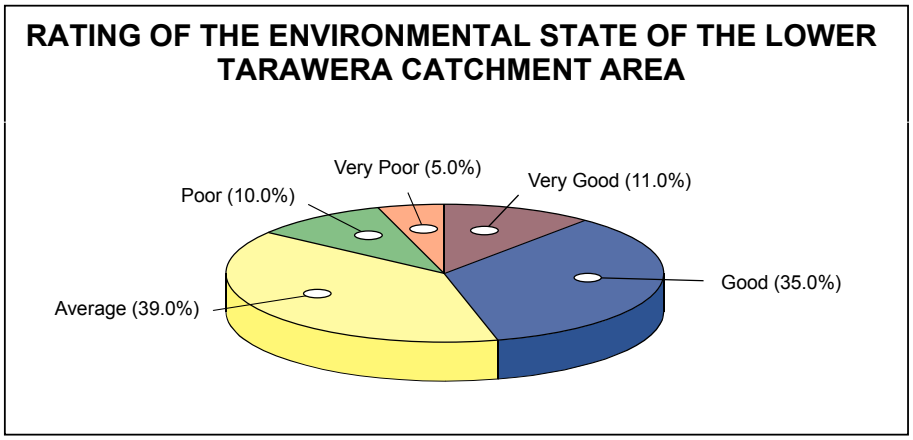
Figure 4



Ponter, D.M. and Doorman, P.J. 1992

When prompted with a series of issues, respondents expressed the highest level of concern for employment opportunities in the area (91% of respondents), followed by the state of the Tarawera River (84%). The greatest level of concern regarding employment opportunities was in the Kawerau Ward (94%), while concern at the state of the Tarawera River was greatest in Matata (95%). The overall ranking of concern of these issues is shown in Figure 6.

Figure 5

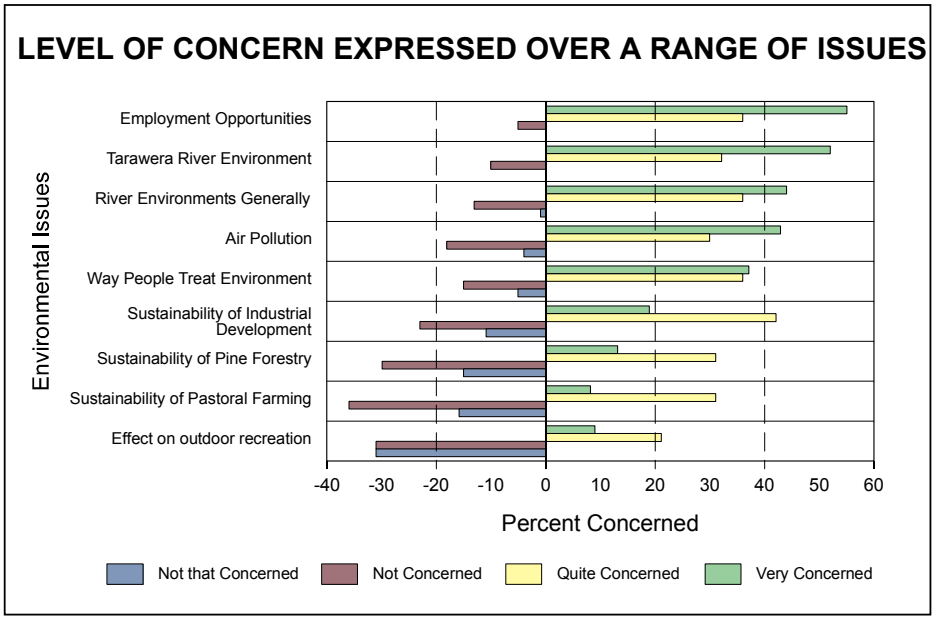


The survey result shows the importance of this regional plan to the community. Of those respondents concerned with the state of the Tarawera River environment, 22% mentioned pollution from the Tasman Pulp and Paper Company Limited mill, 10% noted pollution from the Carter Hold Harvey Tissue mill, and 19% indicated mill pollution (unspecified). Eighty-six percent of residents considered that the environment of the Tarawera River downstream of Kawerau was in need of improvement. Matata and Edgecumbe residents (94%) considered most strongly that the environment of the river was in need of improvement, compared with those in the Tarawera (78%) and Kawerau (82%) wards.

In the mid-1992 survey of *Community Attitudes Towards the Rotorua Lakes*, just under 31% of Rotorua area residents raised a concern about the environmental quality of Lake Okareka. In particular, this was related to the prevalence of lake weed, runoff from farms, the leaching of septic tanks, and the effect of agricultural sprays. Lakes Tarawera and Okataina, and the Blue and Green Lakes, were considered to be in a good environmental state due to their lack of pollution, lack of community settlements, and their beauty. In comparison, Lake Rotorua was highlighted by 88% of respondents as the worst lake environmentally, with a mean rating of 1.9 out of 10.

One in four Rotorua area residents was concerned about some environmental aspect of Lake Tarawera, with lake weed being the predominant issue. As a means of comparison, people in the Rotorua area rated the environmental quality of Lake Tarawera above that of the other lakes which were included in the survey questionnaire (Figure 7).

Figure 6



Research Solutions 1993

In the 1993 survey[22] of residents in the catchment of the Lower Reach of the Tarawera River, 43% of respondents wanted to see the quality of the Tarawera River downstream of Kawerau improved to such an extent as to be similar to upstream water quality. Thirty-nine percent considered that there is an intermediate stage between current downstream water quality and upstream water quality, which would be acceptable.

Sixty-four of respondents thought that improvements to the state of the Lower Reach of the Tarawera River should be made on a user pays basis – that those responsible for the pollution of the river pay for its remediation. Eighteen percent thought that ratepayers should be responsible, while 14% did not think the river needed improving. Thirty-eight percent of respondents thought that the improvement of the river should be undertaken only if it could be done without the risk of job losses. Only slightly fewer, 32%, thought it should be carried out even if the costs resulted in a few job losses. There is little support, only 8%, for improvement, if job losses are significant.

[22] Research Solutions, 1993.

Attitudes and perceptions toward the environment are not necessarily congruent with the definition of 'sustainable resource management' as defined in the Resource Management Act 1991. Indeed, at times the attitudes, values, and concerns of the community may directly conflict with the promotion of the sustainable management of natural and physical resources. This is particularly the case when short to medium term social and economic wellbeing is considered more important than long-term sustainability of natural and physical resources. Therefore, while community attitudes and perceptions can inform how we approach the promotion of the sustainable management of natural and physical resources in general, Environment Bay of Plenty must also take other matters into account, including those specified by tangata whenua.

Further community attitudes and perceptions, specific to certain aspects of the environment such as water quality, are presented in later chapters, most notably the water quality chapter.

7.4 The Economic Context

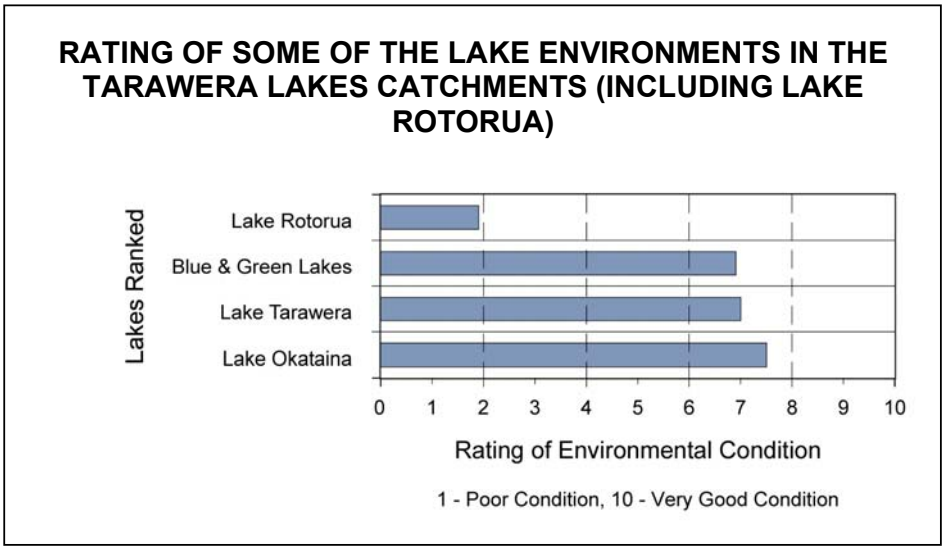
The economy of the Tarawera River catchment is dominated by the forestry/wood processing and dairy/dairy processing sectors. These two sectors are based in geographically discrete areas and result in virtual economic mono-cultures. Both the forestry/wood processing and dairy/dairy processing industries/sectors are well established. Exotic plantation forestry is concentrated in the Tarawera Lakes catchments and the catchment of the Upper Reach of the Tarawera River, with the wood processing industries based at Kawerau.

Wood processing can be divided into two sub-categories: pulp and paper manufacture and timber manufacture. Dairy farming predominates on the Rangitaiki Plains. Dairy processing for the whole of the Bay of Plenty is undertaken in Edgecumbe. District service industries have developed, particularly in Kawerau and Edgecumbe, in conjunction with the forestry/wood processing and dairy/dairy processing sectors (For further information see Appendix 4 – Tarawera Industries).

In addition to dairying, sheep grazing predominates in the coastal high country in the north west of the catchment. There is also some horticultural production of the Rangitaiki Plains. Tourism-related activities occur at various areas around the catchment directly related to the many natural features in the catchment, including the lakes and rivers, geothermal activity, and Mt Tarawera. However, tourism-related activities generally prove difficult to quantify as they belong in a number of different sectors.

The social and economic wellbeing of the local communities depends heavily on the major industries and related primary production. The clear dominance of the forestry/wood processing and dairy/dairy processing industries leaves the local economy and community extremely exposed to any short or long-term downturns in these industries. Any major down-sizing, or closure of either of the two sectors or the major industries would have significant direct adverse effects on the local communities. This needs to be taken into account in planning for the sustainable management of the natural and physical resources of the catchment, but not to the extent that it compromises the definition of sustainable management given in section 5(2) of the Resource Management Act 1991.

Figure 7



Research Solutions, 1992

7.5 Issues, Objective, Policies, Principal Reasons and Anticipated Environmental Results

7.5.1 Issues

Issues relating to community attitudes and perceptions include:

7.5.1(a) Survey results show that a significant proportion of the community is concerned that the Lower Reach of the Tarawera River is degraded by discharges.

7.5.1(b) Employment opportunities are perceived by the community to be linked to the continued operation of industry and primary production in the catchment.

7.5.1(c) Both the community and industry perceive an environmental, economic and employment advantage in the staged enhancement of Tarawera River quality.

7.5.2 Objective

Achieving the desired enhanced life supporting capacity of the Tarawera River at a rate that enables people and communities, including industry to adjust.

7.5.3 Policies

7.5.3(a) To consider the social and economic wellbeing of people and communities when making decisions about the sustainable management of the Tarawera River.

7.5.3(b) To stage the achievement of water quality standards as set out in the methods of Chapter 15 in a way that provides a defined schedule of goals to enable the community including industry to adjust.

7.5.3(c) To have particular regard to Kaitiakitanga when making decisions about the sustainable management of the Tarawera River and its catchment.

7.5.4 Principal Reasons

To limit risk to catchment industries and communities, and to achieve the aim of continued improvement of water quality in the Tarawera River Catchment. There is a need to develop and timetable goals, objectives, policies and methods of implementation in ways and at rates that are achievable and realistic. Without realistic staging to provide reasonable time for the consideration of options and the initiation of relevant capital works, the introduction of classification standards to enhance the quality of water in the Lower Reach of the Tarawera River will be compromised.

It should be noted that section 107 of the Resource Management Act 1991 would prevent Environment Bay of Plenty from granting any resource consent directly under section 15 of the Act that would after mixing cause:

(a) The production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
(b) Any conspicuous change in the colour or visual clarity;
(c) Any emission of objectionable odour;
(d) The rendering of fresh water unsuitable for consumption by farm animals;
(e) Any significant adverse effects on aquatic life.

The attitudes and perceptions of the local and wider community are vitally important when making resource management decisions. At times it is difficult to assess exactly what people want, and how that is to be achieved. However in the independent Tarawera River catchment surveys, the clear message to those composing this regional plan was: clean up the Lower Reach of the Tarawera River but do not compromise our employment opportunities in the process. Both these tasks can, with good cooperation, be achieved. Environment Bay of Plenty will promote the concept of a “win-win” situation by enabling, encouraging and working with industries to ensure that the staged progression of changes needed to clean up the Tarawera River are met, but will also defend those agreed stages with particular vigilance.

It is intended that when appropriate, for some existing resource users, rather than requiring immediate conformity to new resource management standards, new classification requirements will be introduced in stages. This approach is considered the most practicable way to ensure that existing resource users progress to meet the objectives of this regional plan within economic and temporal constraints.

Environment Bay of Plenty considers that, within the bounds of the Resource Management Act 1991 and the Local Government Act 1974, it has a legitimate role in promoting the sustainable use of natural and physical resources. This is especially the case when a resource could be utilised more effectively or for a range of additional purposes. As an example, Environment Bay of Plenty considers that the use of waste geothermal fluid should be promoted for other secondary uses, such as for hothouse production or exotic aquatic farming, providing that such a use does not conflict with the primary goal of limiting the effects of waste discharges on the quality of water resources. Uses that remove heat or nutrients from waste streams before discharge can help minimise adverse effects on the environment.

7.5.5 Anticipated Environmental Results

The anticipated environmental results are:

7.5.5(a) The achievement of continued improvements in waste treatment operations, and in reductions in waste disposal effects on the environment.

7.5.5(b) Both the sustainable management of natural and physical resources and the social and economic wellbeing of the community will be safeguarded and enhanced over time.

7.5.5(c) Ensuring that the community concerns about the degraded state of the Lower Reach of the Tarawera River are remedied.

7.5.5(d) Efficient use and re-use of resources, for example the use of geothermal wastewater, reduces effects on the environment and facilitates new development opportunities.

7.5.5(e) The eventual restoration of the water quality of the Tarawera River to facilitate the exercise of customary use by iwi.

8 Resource Management Issues of Significance to Iwi

8.1 Introduction

This chapter canvases resource management issues of significance raised and presented by tangata whenua and other iwi. The chapter highlights Maori/iwi values toward the environment in general, as well as in some particular areas, such as water quality. The majority of these values complement, rather than contradict, the ethos of sustainable resource management contained in the Resource Management Act 1991. For example, Tuwharetoa ki Kawerau[23] have clearly stated:

> *Sustainability is a modern European catch phrase for something which has been fundamental to Maori for generations – tikanga.*

The Resource Management Act 1991 gives a number of specific directives to take into account or have regard to matters of particular concern to Maori/iwi (sections 6(e), 7(a) and 8 in particular). The *Operative Bay of Plenty Regional Policy Statement* contains discussion on general issues of significance to iwi and Maori. It discusses the Maori resource management system which promotes the sustainability of the mauri of resources. The *Operative Bay of Plenty Regional Policy Statement* should be consulted for a perspective of general Maori/iwi concerns towards the environment, as well as an elaboration of principles of the Treaty of Waitangi.

The Tarawera River catchment overlaps with the rohe of at least four separate iwi authorities. They are Ngati Awa (Mataatua), Ngati Rangitihi (Te Arawa), Tuhourangi (Te Arawa), and Tuwharetoa ki Kawerau (Te Arawa). Tuhourangi cover that area of the Tarawera Lakes catchments, while Ngati Awa and Tuwharetoa ki Kawerau include parts of the Upper and Lower Reaches of the Tarawera River catchment areas. Ngati Rangitihi is concentrated on the western side of the Lower Reach of the Tarawera River, around Matata, and in the upper river and lakes catchments around Lake Tarawera.

A range of traditional and contemporary resource management issues are significant to these iwi authorities. Resource management matters of significance to iwi are based on spiritual and cultural beliefs, understandings of creation by which their role as kaitiaki was created, and the Treaty of Waitangi. Included in their concerns are contemporary issues relating more particularly to the day to day and future social and economic wellbeing of Maori. Many of the contemporary issues raised by iwi are similar to, but often more pressing than, those raised by the wider community, such as concern about unemployment, health and housing.

From a Maori perspective, sustainable management can be achieved only by protecting, preserving, and enhancing the mauri (life force) of natural and physical resources. The correct maintenance of this mauri guarantees the ongoing life and development of that resource. As traditionally practised, it ensures that resources are kept safe for the benefit of future generations. This is often achieved through the use of tapu and rahui. Ultimately, iwi consider that action which causes distress to the mauri of a resource should be stopped or contained[24].

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23 Tuwharetoa ki Kawerau, Background on the Tarawera River, 1994 (May), Unpublished Report.

24 Tuwharetoa ki Kawerau, Background on the Tarawera River, 1994 (May), Unpublished Report.

8.2 Issues

8.2.1 Resource Management Issues Raised by Iwi

The four iwi noted in the introduction to this chapter were all consulted at various times during the preparation of this regional plan. Staff and councillors have had a number of hui and discussions with these iwi relating to the preparation of both this regional plan and the *Operative Bay of Plenty Regional Policy Statement*, as well as more general resource management issues. Four iwi were represented on the Tarawera River Liaison Group and three: Ngati Awa, Tuwharetoa ki Kawerau, and Ngati Rangitihi, made presentations to the Liaison Group on resource management issues of significance to them.

The specific resource management issues identified by the four iwi whose rohe includes areas covered in this regional plan are as follows:

8.2.1(a) Pollution of Water

The traditional Maori belief is that water contains a mauri, a life force, that must be respected and cared for, as one would care for any living thing. Water is considered a cleansing agent, and with the proper karakia will remove tapu. The mauri is directly impacted on when subject to pollution. Any impact on the mauri of the water has an impact on waahi tapu sites, and areas used for healing and cleansing, tohi and purification rites. Local iwi have expressed concern about the adverse effects of discharges to water on aquatic life taken for human consumption, and the degradation of waahi tapu sites alongside polluted water bodies. Any impact on the mauri of the water has an impact on waahi tapu sites, and areas used for healing and cleansing, tohi and purification rites.

A stretch of river or body of water is considered sacred (tapu) if it is guarded by a taniwha (protective spirit) and may only be used for tapu rituals such as purification rites. In effect the taniwha is tapu and the water is noa. There are rituals symbolising both the spiritual and cleansing values of water. These two values are interwoven in the categories or states of water. Traditionally, there are five states or categories of water, which derive from the environmental and social realities in which Maori found themselves. These are:

(a) Waiora:

The purest form of water, like the rain. It has the potential to give life, to sustain the wellbeing of all things and to counteract evil. Waiora is used in sacred rituals to purify and to sanctify. It can remain pure only if contact with humans is protected by appropriate ritual prayers.

(b) Waimaori (fresh water):

Water that has come into contact with human beings. It has become ordinary and has no particularly sacred associations.

(c) Waikino (water containing disease or organisms):

Can be potentially harmful in that it conceals its intention or deceives a user by its habit. This category of water may hide boulders and snags that can cause damage. In a spiritual sense, this is water that has been polluted, debased, spoilt or corrupted.

(d) Waimate (dead poisonous water):

Water that has lost its mauri or life force. The power to rejuvenate itself or any living thing has gone; it is so damaged as to be considered dead.

(e) Waitai (salt water):

The term used for the sea, the surf and the tide. It represents the end of the water cycle from its inception through all states to the sea. From the sea, it is lifted back into the heavens and is purified to fall again as waiora.

Within the Tarawera catchment wastewater is discharged, through point-source outlets, directly to water bodies. This is a common practice sanctioned, through regional plans and resource consents, by Environment Bay of Plenty. These discharges are most evident in the Lower Reach of the Tarawera River and to drains and canals on the Rangitaiki Plains. The discharge of human sewage is considered to be extremely offensive, adversely affecting the mauri of the water. The discharge of dairy shed effluent and industrial wastes has also been expressed as a matter of concern to iwi. These discharges degrade the quality of the water and result in it being considered in a spiritual sense, as Waikino.

All four iwi, in keeping with the Maori philosophies relating to the mixing of waters, consider these practices to be offensive. The concern of local iwi is summed up in a paper presented to the Tarawera River Liaison Group by Ngati Awa[25], which states:

> *Water provides Ngati Awa with food and spiritual resources. These resources are directly impacted on when subjected to various degrees of pollution, especially with regard to the mauri of those resources. Any impact on the above resources seriously restricts Ngati Awa's use of them, e.g. (polluted) cannot be used for hui with respect to manaaki ki nga manuhiri, forcing tangata whenua to buy food for the marae, thus placing an economic burden on tangata whenua to purchase food. Any spiritual impact on mauri of the water has an impact on waahi tapu areas used for healing and cleansing, tohi and purification rites.*

The iwi authorities do not accept that the water bodies should continue to be used to transport or treat contaminants. The iwi in the Lower Reach of the Tarawera River and Rangitaiki Plains areas in particular, namely Tuwharetoa ki Kawerau, Ngati Awa, and Ngati Rangitihi have called for the cessation of the discharge of human bodily waste, either untreated or treated to local water bodies. Human waste is currently discharged into the Lower Reach of the Tarawera River by Carter Holt Harvey Tissue, and on the Rangitaiki Plains, from the Whakatane District Council's Edgecumbe Community Sewage Plant.

The concern of the iwi authorities about the adverse effects of pollution of water bodies for spiritual and human health reasons was mirrored by a high level of concern expressed by Maori who took part in the survey of *Community Attitudes Towards the Tarawera River and its Catchment*, undertaken for Environment Bay of Plenty in March 1993. The survey shows that 23% of Eastern Bay Maori considered the environment as being poor or very poor. The survey indicated that 75% of Maori in the Lower Reach of the Tarawera River catchment were concerned about the colour of the Lower Reach of the Tarawera River, 71% were concerned about the smell of the river, and 80% about possible contamination of the Lower Reach of the Tarawera River. When presented with a range of activities, which did not include the discharge of sewage to water bodies, Maori respondents considered that industrial waste and tree felling operations posed the greatest environmental hazards within the catchment.

Iwi consider that the quantity and quality of fish and shellfish from the Tarawera River, such as kakahi (freshwater mussels), tuna (eel), koura (freshwater crayfish), inanga (whitebait) is poor as a result of the aquatic environment being under severe stress[26]. It is the consideration of iwi that the mauri of the Lower Reach of

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25 Te Runanga o Ngati Awa, Ngati Awa Policy Statement – Tarawera River (1994), Unpublished Report.

26 Tuwharetoa ki Kawerau, Background on the Tarawera River, 1994 (May), Unpublished Report.

the Tarawera River must be restored and balance maintained, and the life supporting capacity of the river returned to its natural state.

The consideration of all iwi, as expressed to Environment Bay of Plenty during the preparation of the *Operative Bay of Plenty Regional Policy Statement* and this regional plan is that the mauri of the water, the ability to harvest kai moana, and human health generally, should not be adversely affected by discharges to water bodies. Iwi are concerned that the integrity of waahi tapu is not compromised. On the whole, the iwi authorities do not consider an ocean outfall to discharge industrial waste and sewage currently being discharged to the Tarawera River, as a practical solution to current discharge problems. Iwi generally consider that while an ocean outfall would result in a cleaner Tarawera River, it would not solve the problem of pollution of the ocean, and the adverse effects on the mauri of ocean waters. Iwi have stated their requirement that the discharge or leaching of industrial pollution into the Tarawera River cease, and have advocated a continued reduction in industrial discharges. The option favoured by iwi authorities for achieving this appears to be the movement to appropriate land based application of wastewater in conjunction with modern environmentally acceptable changes to the production process.

Refer to Chapter 15 (Surface Water Quality) for objectives, policies and methods designed to avoid, remedy or mitigate the above issues.

8.2.1(b) Water Quantity

Iwi have called for the maintenance of water quantity in the Tarawera catchment. For Ngati Rangitihi and Tuwharetoa ki Kawerau in particular this relates to maintenance of appropriate water levels within the lagoons and wetlands on the Rangitaiki Plains. For example, adequate water levels in the Matata Lagoon and other wetlands in the catchment of the Lower Reach of the Tarawera River are crucial for the maintenance of bio-diversity and the control of plant infestation. Ngati Rangitihi also raised the possibility of re-diverting or partially re-diverting the Tarawera River to its original course.

Iwi, in particular Ngati Rangitihi, have also expressed concern about sedimentation in the Lower Reach of the Tarawera River and associated wetlands. Their concern is that such sedimentation will adversely affect fishing grounds and impede boat access from the Tarawera River to the open sea. As a result of these concerns a technical report was prepared by Environment Bay of Plenty dealing with the issue of sedimentation.

Iwi have also raised concerns about the draw-off of water as the result of large scale exotic afforestation across extensive parts of the Upper Reach of the Tarawera River and Tarawera Lakes catchments. This issue was the subject of a report prepared by Environment Bay of Plenty in 1993 entitled *Tarawera River Flow Analysis*[27].

Refer to Chapter 14 (Surface Water Quantity) for objectives, policies and methods designed to avoid, remedy or mitigate the above issues.

Tuwharetoa Ki Kawerau believe they are unable to uptake any of the water above the industrial discharge points due to the need for the river to be at peak assimilative capacity when it reaches the industrial area. As the water quality and quantity is depleted, polluted and under stress along the lower reach of the river, iwi are unable to establish economic activities there and this results in an opportunity cost against iwi.

[27] Pang, L, 1993.

8.2.1(c) Wetlands

Before the draining of the wetlands of the Rangitaiki Plains in the early 1990s, and the subsequent channelling of the Tarawera and Rangitaiki Rivers, the wetland or swamp area on the Rangitaiki Plains was a major source of food for local Maori.

> *Many pa tuna (eel weirs) were situated in the swamp and river. Koura, inanga and other kai [were] to be found in the whole of the surrounding area. The diversity of life found in the swamp is gone, hemmed into the few remaining wetlands and in some cases has disappeared altogether*[28]. [The remaining wetland areas, both private and public, are considered to be of the] *…highest cultural importance, not only for physical aspects but also the spiritual, not only for what lies underneath the surface of the water but also that which grows in and around the water*[29].

A primary concern of iwi, especially Tuwharetoa ki Kawerau and Ngati Rangitihi, is to see the remaining wetlands in the catchment of the Lower Reach of the Tarawera River preserved and protected from any future threats. Protection includes ensuring that water quantity in the wetlands is controlled within appropriate ranges[30].

Refer to Chapter 13 (Freshwater Ecology) for objectives, policies and methods designed to avoid, remedy or mitigate the above issues.

8.2.1(d) Land Management

The iwi authorities within the catchment have expressed concern about land use activities and practices undertaken without concern for the mauri of the resource. The greatest concern expressed by iwi with regard to inappropriate land use activities and practices is their potential effect on degrading food resources and with regard to land clearance and contouring, the potential effect on waahi tapu sites. Plantation forestry practices are a particular activity considered by iwi as leading to erosion and degrading of water quality.

Refer to Chapter 11 (Land Use) for objectives, policies and methods designed to avoid, remedy or mitigate the above issues.

8.2.1(e) Heritage Places

Heritage protection forms one of the key areas of iwi concern. Care for the maintenance of heritage places ensures that Maori people will continue to evolve with an integrity that unites them with their past, and ensure that Maori culture is preserved.

Waahi tapu (sacred sites) form an integral part of Maori life. They give Maori reference points for direction and growth and ensure a stable cultural development. Removal or destruction of waahi tapu causes great concern for iwi and threatens the integrity of that tribal identity and growth. As an example, Tuwharetoa ki Kawerau have expressed particular concern about the ongoing degradation of urupa sited in the Lower Reach of the Tarawera River area as a result of "the plume of pollutants reaching into Te Moana o Toi"[31].

Heritage issues are covered in the *Operative Bay of Plenty Regional Policy Statement*.

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28 Tuwharetoa ki Kawerau, Background on the Tarawera River, 1994 (May), Unpublished Report.

29 Tuwharetoa ki Kawerau, Background on the Tarawera River, 1994 (May), Unpublished Report.

30 Tuwharetoa ki Kawerau, Background on the Tarawera River, 1994 (May), Unpublished Report.

31 Tuwharetoa ki Kawerau, Background on the Tarawera River, 1994 (May), Unpublished Report.

8.2.1(f) Social and Economic Development

All iwi consider that the discharging of contaminants into the environment, particularly those emanating from the pulp and paper mills at Kawerau, needs to be subject to the most stringent environmental standards and an acceptable timetable for elimination, and in the case of human sewage prohibited altogether. There are five marae directly affected by the discharges to the Tarawera River, those marae being the Tuwharetoa marae; Tohia-o-te-Rangi, Hahuru, Umutahi and Tuwharetoa, and the Rangitihi marae; Rangiaohia.

Tuwharetoa Ki Kawerau believe their day to day and future cultural wellbeing as tangata whenua is related to the health of the river. They and other local iwi recognise that the continued operation of industries of the area may affect their social and economic wellbeing. Iwi believe that the implementation of a long term reduction programme aiming to achieve zero contamination effects using environmentally sound alternative treatment options, will assist and ensure social, economic and cultural well being.

Refer to Chapter 7 (Community Attitudes and Perceptions) for objectives, policies and methods designed to avoid, remedy or mitigate the above issues.

8.2.1(g) Ownership and Management

Ownership and management of natural and physical resources are among the greatest concerns continually raised by iwi authorities. The issue of ownership or management usually arises in the context of lands which were, by one means or another, taken from the iwi, and vested with the Crown or sold privately. The concern of iwi authorities is that they either do not have rightful ownership of their resources or that they lack management input into traditional resources.

As the Crown's agent, local government authorities have the responsibility to promote the sustainable management of natural and physical resources, regardless of their ownership. Ownership is an issue which Environment Bay of Plenty considers largely to be between the Crown and Maoridom. The general request to local authorities by iwi is that they become more part of the decision making and management process together with local authorities. Specifically, iwi have requested that local authorities assist them in the development of iwi environmental plans aimed at assessing and prioritising resource management issues within their rohe, including the potential for the sustainable economic use of resources. Iwi have also requested that they be included on hearing panels for resource consents to ensure that their values and taonga are protected. The Maori Regional Representative Committees established by Environment Bay of Plenty in 1993 have requested that Environment Bay of Plenty meet these requests.

Ownership and management issues are considered further in the *Operative Bay of Plenty Regional Policy Statement*.

8.2.2 Actioning Issues

Environment Bay of Plenty has obligations under the Resource Management Act 1991 to ensure that iwi/Maori values and consideration are appropriately reflected in the promotion of the sustainable management of those natural and physical resources which this regional plan deals with. The *Operative Bay of Plenty Regional Policy Statement* has developed objectives and policies relating to issues of concern to Maori. The objectives, policies and methods of implementation developed in this regional plan are consistent with both the requirements of Part II of the Act, and the requirements of the *Operative Bay of Plenty Regional Policy Statement*.

9 Summary of Issues

9.1 Introduction

This chapter sets out a checklist of the main issues identified during the development of the policy chapters of this regional plan. This includes issues relating to the natural and physical resources of the Tarawera River catchment and the concerns of people and communities who live within the catchment.

9.2 Issues

9.2.1 Chapter 7 – Community Attitudes and Perceptions

Issues relating to community attitudes and perceptions include:

9.2.1(a) Survey results show that a significant proportion of the community is concerned that the Lower Reach of the Tarawera River is degraded by discharges.

9.2.1(b) Employment opportunities are perceived by the community to be linked to the continued operation of industry and primary production in the catchment.

9.2.1(c) Both the community and industry perceive an environmental, economic and employment advantage in the staged enhancement of Tarawera River quality.

9.2.2 Chapter 8 – Resource Management Issues of Significance to Iwi

Iwi have identified the following main matters of concern:

9.2.2(a) Pollution of Water: The mauri (life force) that water contains is not being respected and cared for. Wastewater is discharged, through point and diffuse source outlets, degrading the mauri of water bodies. The continued degrading and use of river water to transport or treat contaminants are not acceptable to iwi authorities. The discharge of human bodily waste, either untreated or treated, to local water bodies must cease.

9.2.2(b) Water Quantity: The water quantity in the Tarawera catchment is not being maintained, in particular the water levels within the lagoons and wetlands on the Rangitaiki Plains are not effectively managed.

9.2.2(c) Wetlands: The wetlands and swamp area on the Rangitaiki Plains are being destroyed together with the traditional food values they hold for iwi.

9.2.2(d) Land Management: Land use activities and practices are being undertaken without concern for the mauri of the resource.

9.2.2(e) Heritage Places: Heritage places are not being cared for and maintained to ensure that Maori people will continue to evolve with an integrity that unites them with their past, and that Maori culture is preserved.

9.2.2(f) Social and Economic Development: While industry provides employment for some Maori the long term social and economic wellbeing of tangata whenua is also related to the health of the river.

9.2.2(g) Ownership and Management: Iwi do not have rightful ownership of their resources and lack management (kaitiaki) input into traditional resources including the river itself.

9.2.3 Chapter 10 – Public Access

The issues relating to public access are:

9.2.3(a) Public access to and long river and lake margins may be constrained by a lack of public knowledge, lack of public reserves and unwillingness of landowners to allow access.

9.2.3(b) Public access to and long river and lake margins may in some cases threaten ecological, natural character, intrinsic and heritage values, water and soil resources, and safety and security.

9.2.3(c) There is a risk of water weed transfer between water bodies.

9.2.3(d) Public access to the Tarawera River is limited or prevented along large areas of river bank by nuisance growths of willows.

9.2.4 Chapter 11 – Land Use

Land use issues particular to the Tarawera River catchment are:

9.2.4(a) Removal of vegetation on steep lands, gullies and headwaters can result in erosion.

9.2.4(b) Soils, particularly tephra based soils on steeper slopes, can be particularly vulnerable to soil erosion and sediment and nutrient runoff due to unsustainable land use practices.

9.2.4(c) Inappropriate subdivision, use and development of lake and wetland margins can result in erosion and the runoff of sediment and nutrients.

9.2.4(d) Erosion problems and the discharge of sediment resulting from earthmoving operations on steep-faced tephra based soils.

9.2.4(e) Many wetlands, native forest and shrubland areas are suffering due to a lack of proactive protection, particularly fencing and pest control.

9.2.4(f) The reluctance or lack of awareness of some land users results in continuing unsustainable land use and land use practices.

9.2.4(g) The spread and control of wilding pines, particularly into land administered by Department of Conservation and other reserve land, is a problem.

9.2.4(h) The possible impact on water resources and wider environmental consequences of expanding production forestry is not well understood.

9.2.4(i) Inappropriate subdivision, use and development of river, lake and wetland catchments can result in loss of heritage values, including natural character.

9.2.4(j) The grazing of stock in wetlands and on riparian margins of waterways, including drains and canals, is inappropriate and unsustainable if it causes soil erosion and nutrient runoff.

9.2.5 Chapter 12 – River and Lake Beds

The issues related to the management of river and lake beds are:

9.2.5(a) Activities on, in, under, or over the beds of rivers and lakes, including the location of structures, reclamation works, the grazing of stock, and the draining of beds, can adversely affect water quantity and quality, and contribute to soil erosion and sedimentation.

9.2.5(b) Activities on, in, under, or over the beds of rivers and lakes, including the location of structures, reclamation works, the draining of beds, and the grazing of stock, can variously adversely affect public access and safety, aquatic ecology, significant flora and fauna, natural character, natural features and landscapes, and amenity and heritage values.

9.2.5(c) The introduction or planting of plants (vegetation), has adversely affected the natural character and natural ecology of parts of river, lake, and wetland beds and their environments.

9.2.5(d) The disturbance, removal, damage and destruction of plants (vegetation) have adversely affected the natural character and ecology of parts of river, lake and wetland beds and their environments.

9.2.5(e) Sedimentation, both natural and human-induced, can adversely affect in-stream ecologies and the integrity of flood protection schemes.

9.2.6 Chapter 13 – Freshwater Ecology

The following are considered by Environment Bay of Plenty to be the important ecological issues affecting the water bodies of the Tarawera River catchment (excluding the Tarawera Lakes):

9.2.6(a) Dissolved oxygen depletion is high in the Lower Reach of the Tarawera River.

9.2.6(b) The discharge of coloured effluent decreases light penetration which in turn can limit the growth of aquatic plants.

9.2.6(c) Undesirable biological growths have been a problem downstream from the Carter Holt Harvey Tissue discharge outfall.

9.2.6(d) The ecological impact caused by changes in the technology of industrial discharge treatment cannot be predicted with certainty.

9.2.6(e) Poor water quality in the lower river may be reducing the success of juvenile fish migration to the upper tributaries.

9.2.6(f) Dissolved oxygen concentrations are at present too low to support a viable trout habitat in the Lower Reach of the Tarawera River.

9.2.6(g) Dissolved oxygen concentrations are occasionally too low to sustain a viable trout habitat in the reach of the Tarawera River between Braemar and the river mouth.

9.2.6(h) Eels in the lower river are showing stress symptoms attributed to pulp and paper contaminants.

9.2.6(i) Smelt growth appears to be indirectly enhanced by the industrial inputs.

9.2.6(j) The wetlands of the lower catchment represent 1.7% of those which once covered floodplains of the Tarawera and Rangitaiki Rivers.

9.2.6(k) The botanical and wildlife values of catchment habitats including wetlands and lakes are threatened.

9.2.6(l) Wetlands and lakes are variously threatened by nutrient and contaminant inputs, exotic plant infestation, over drainage, siltation and direct physical damage.

9.2.6(m) Historical pulp and paper industry contaminants in sediments in the eastern part of Matata Lagoon are a concern.

9.2.7 Chapter 14 – Surface Water Quantity

The issues relating to surface water quantity are:

9.2.7(a) Human-induced reductions in river flows and lake and wetland levels, and the containment of water in streams and rivers, can adversely affect:

- aquatic ecology and biodiversity;
- natural character;
- other water body users, such as fishers and canoeists;
- ability to assimilate wastewater.

9.2.7(b) Human-induced reductions in river flows and lake and wetland levels, and containment of water in streams and rivers, can contribute to:

- increases in temperature and reductions in dissolved oxygen;
- increased toxicity in the Lower Reach of the Tarawera River in particular.

9.2.7(c) Human-induced changes in land cover have reduced stream and river flows in large parts of the catchment.

9.2.7(d) Wetlands on the Rangitaiki Plains are threatened by lowering of water tables and drainage.

9.2.8 Chapter 15 – Surface Water Quality

Issues relating to surface water quality are:

9.2.8(a) Degradation of water quality and its adverse effects on the life-supporting capacity, ecosystems, aesthetic, amenity and cultural values, other than those effects resulting from natural occurrences or perturbations, due to:

9.2.8(a)(i) Increased levels of nutrients from land runoff and effluent discharges.

9.2.8(a)(ii) The continued discharge of large quantities of industrial effluents containing a range of contaminants into the Lower Reach of the Tarawera River is a concern to the community.

9.2.8(a)(iii) Inappropriate farming and forestry practices and incompatible land uses.

9.2.8(a)(iv) The discharge of sewage into surface water in the Tarawera River catchment.

9.2.8(a)(v) Low dissolved oxygen levels in the Lower Reach of the Tarawera River and in the canals on the Rangitaiki Plains.

9.2.8(a)(vi) The discharge of toxic substances to the Lower Reach of the Tarawera River.

9.2.8(a)(vii) The discolouration of the Lower Reach of the Tarawera River.

9.2.8(a)(viii) Emission of objectionable odour from the Lower Reach of the Tarawera River.

9.2.8(a)(ix) The existence of undesirable biological growths in parts of the Lower Reach of the Tarawera River.

9.2.8(a)(x) The tainting of water in the Lower Reach of the Tarawera River.

9.2.8(a)(xi) The occasional production of conspicuous foams and scums in the Lower Reach of the Tarawera River.

9.2.8(a)(xii) The raising of the water temperature in the Lower Reach of the Tarawera River, and consequent effects on dissolved oxygen levels.

9.2.8(a)(xiii) The discharge of geothermal wastewaters into the Lower Reach of the Tarawera River.

9.2.8(b) A lack of appropriate water quality standards in the catchment to protect water bodies and the environment from the adverse effects of water degradation.

9.2.8(c) The strong community requirement that the degraded water quality in the Lower Reach of the Tarawera River be managed to avoid, remedy or mitigate unacceptable effects has not been achieved.

9.2.8(d) Degradation of the quality of water in the catchment of the Tarawera Lakes due to inappropriate subdivision, use and development.

9.2.9 Chapter 16 – Groundwater Quality and Quantity

Issues relating to groundwater quality and quantity are:

9.2.9(a) Land use activities can lead to the movement of contaminants into groundwater, particularly over unconfined aquifers.

9.2.9(b) The high quality deep groundwater resource may be over used and become depleted.

9.2.9(c) The scarcity of shallow high quality groundwater may lead to conflict between users.

9.2.9(d) Localised nutrient and faecal contamination of springwater used for domestic and stockwater supply is occurring and could cause health problems.

9.2.9(e) Land based waste disposal systems may have adverse effects on good quality groundwater.

9.2.9(f) The monitoring of groundwater quality beneath surface discharge systems is inadequate.

9.2.10 Chapter 17 – Geothermal Resources

Geothermal issues relevant to this regional plan include:

9.2.10(a) Without sustainable reinjection or treatment of waste geothermal fluid, discharge effects caused by geothermal contaminants entering Tarawera River water are increased.

9.2.10(b) Heat in fluid discharged into the Tarawera River is not being fully utilised for the benefit of the community, particularly for electricity generation, tourism and therapeutic uses, or mineral extraction and as a consequence increases the risk of heat contamination effects on the river water.

9.2.10(c) Inappropriate methods of reinjection may cause the contamination of groundwater.

9.2.10(d) Without ongoing monitoring and assessment the effects of natural geothermal discharges into the Tarawera River, cannot be taken into account.

9.2.10(e) Significant geothermal surface features should be protected.

9.2.10(f) The development of the Kawerau geothermal field may increase the risk of land subsidence and tilt.

9.2.11 Chapter 19 – Monitoring and Plan Review

Issues relating to monitoring and plan review include:

9.2.11(a) Monitoring

9.2.11(a)(i) There is a need to acquire and maintain sufficient information to allow the effective management of natural and physical resources in the Tarawera River catchment.

9.2.11(a)(ii) The understanding of the fate and effect of contaminants in the aquatic environment is continually evolving.

9.2.11(a)(iii) In order to be effective, the review of this plan must have consideration to advances in environmental knowledge, research protocols and the setting of standards for environmental protection.

9.2.11(b) Review

9.2.11(b)(i) Without the review of this regional plan within a realistic time frame, it would be extremely difficult to assess the attainment of the stated objectives or to take account of changes in industrial technology, environmental research and standards, and community aspirations.

9.2.11(b)(ii) Dialogue, information sharing and debate at Tarawera River Liaison Group meetings have greatly contributed to the establishment of standards and goals to focus this regional plan. It would be of benefit if the group would continue to contribute to the development, review and monitoring of the plan.

9.2.11(b)(iii) There needs to be a continued availability of information to the community from both Environment Bay of Plenty and water users on progress with the implementation of plan goals.

10 Public Access

10.1 Introduction

This chapter relates to public access across public land only. It does not advocate public access across private land, including private Maori land. If public access is desirable across private land then the regional plan supports, if there is full consultation with owners, an inquiry into whether such land can be acquired to facilitate access.

Public access to water bodies is a common concern of water sports recreationalists and fishers. Appendix 5 outlines the recreational activities undertaken within the Tarawera River Catchment. The maintenance of public access to and along the coastal marine area[32], lakes and rivers is considered a matter of national importance to be recognised and provided for under section 6(d) of the Act. The Resource Management Act 1991 requires all parties to the Act to recognise and provide for public access. However, the more direct responsibility for achieving public access objectives and policies rests with district councils. District councils are responsible for the provision of esplanade reserves and esplanade strips, and are also responsible for activity, such as water surface recreational opportunities, on rivers and lakes. The Department of Conservation, which administers significant areas of land along rivers and lakes in the catchment, also has a major role to play in ensuring public access.

Public access to and along rivers and lakes includes road or track access to and along river and lake margins. Recognising and providing for public access may also involve the provision of, or allowance for, public structures and facilities such as boat ramps which also facilitate public use and enjoyment of waterways and their margins.

Public access to and along rivers and lakes in the Tarawera River catchment is relatively easy and makes possible the use of lakes and rivers and their margins for a variety of activities, many of them recreational. Public access is often assisted, directly or indirectly, by a network of reserve areas along large stretches of the catchment's rivers and lakes.

Reserves along rivers and lakes serve multiple and sometimes conflicting functions[33]. The primary purpose of some reserves is to allow for the control of soil erosion and the maintenance and enhancement of water quality. In other cases reserves may exist to maintain or enhance aquatic wildlife and freshwater fisheries habitats, or to protect natural and aesthetic character. While most of these reserves are not established primarily for public access, they generally allow for public access, unless that access would be detrimental to the purpose for which the reserves were created. A list of the various types of reserve areas is shown in Table 3.

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[32] Issues relating to public access to the coastal marine area are included in the *Bay of Plenty Regional Coastal Environment Plan*.

[33] The *Bay of Plenty Regional Land Management Plan* deals with riparian management from the perspective of controlling soil erosion and maintaining or enhancing water quality.

Table 3

AUTHORISATION FOR DIFFERENT TYPES OF RESERVES

RESERVE STATUS	ACT OF PARLIAMENT UNDER WHICH RESERVE IS AUTHORISED
Recreation Reserves	Reserves Act 1977 (Section 17)
Historic Reserves	Reserves Act 1977 (Section 18)
Scenic Reserves	Reserves Act 1977 (Section 19)
Scientific Reserves	Reserves Act 1977 (Section 20)
Government Purpose Reserves	Reserves Act 1977 (Section 21)
Local Purposes Reserves	Reserves Act 1977 (Section 22)
Marginal Strips	Conservation Act 1987
Esplanade Reserves and Strips	Resource Management Act 1991 (Part X)
Soil Conservation Reserves	Soil Conservation and Rivers Control Act 1941 (Section 16)
Acquisition of Land for a Government or Local Work	Public Works Act 1991

In some places covenants have been placed across land allowing for public access. Public access to lakes and rivers is also assisted by land administered by the Department of Conservation with associated tracks and accommodation facilities, in the Upper Reach of the Tarawera River and Upper Tarawera Lakes catchment. In the catchment of the Lower Reach of the Tarawera River public access is generally allowed along stopbank areas owned by Environment Bay of Plenty, and marginal strips administered by the Department of Conservation.

The large number of rivers and lakes in the Tarawera River catchment and the unimpeded access to large parts of these water bodies mean there are generally few problems of access. A large proportion of the catchment's river riparian areas are easily accessible and most of lakes have direct road or walking track access, as well as facilities such as boat launching ramps. However, public access to and along the rivers and lakes in the catchment appears to be well catered for.

Concern has been expressed that public access to and along rivers and lakes is often restricted across private land. This has resulted in some calls for local authorities to ensure that private land and road owners make their land and roads more accessible to the public. However, this is not considered a significant public access issue. In many cases private access can be gained with the approval of the landowner.

In addition, within the Tarawera Forest, Fletcher Challenge Forestry Limited maintains a daytime public access corridor through the Tarawera Forest to Lake Tarawera, Mt Tarawera, and the Tarawera Falls, areas which would otherwise be significantly less accessible. Access across this significant area of private land is only restricted at night times and during times, such as high fire risk, when public safety may be compromised. Fletcher Challenge Forestry Limited estimates that more than 300,000 people pass through the permit free zone each year. Approximately 15-20% of those travelling through the permit free zone are thought to be visiting the Tarawera Falls.

The significant existing public access ways to lakes and rivers in the Tarawera River catchment reduces the needs to place pressure on private land and road owners to open their land for public access. Environment Bay of Plenty does not consider it to be one of its functions to dictate public access across private land, unless explicitly stated or provided for in legislation.

However esplanade reserves and strips should still be viewed as important in enhancing the amenity values of lake and river margins. District councils and the Department of Conservation should be encouraged, where appropriate, to secure public access along river to lake margins which would facilitate improved public access.

The provision of access to and along lake and river margins will affect the use of the adjoining water body. For example, increased road access, the sealing of metalled roads and the provision of boat launching facilities are likely to increase public use of the associated water body and are likely to create a demand for land based access and facilities such as camping grounds and car parks.

Although public access may be an issue of national importance, where there is a conflict of interest, public access may need to be discouraged or even prohibited. This may occur in areas which may have sensitive or vulnerable ecological values, sensitive traditional or cultural values, natural character, intrinsic or heritage values, or at times of high fire risk, or when public health and safety may otherwise be at risk. These are areas to which access should be discouraged or limited so as to avoid adverse effects. Where access is provided, it must be in an appropriate and sympathetic manner to the environment. For example, natural areas should not be subjected to extensive car parking, and wide obtrusive walkways.

In addition there is a potential problem of over proliferation of public and private access ways in some areas, such as around parts of Lake Okareka which is quite densely settled. A high proliferation of access ways can destroy vegetation, lead to erosion problems, place a strain on the ecology of an area, and threaten intrinsic and heritage values, and the natural character of an area.

Notwithstanding the damage that off-road vehicles can cause in some environments, this is not generally a problem in the Tarawera River catchment. Formalised off-roading tends to take place in less sensitive environments, such as permitted at the discretion of Fletcher Challenge Forestry Limited in the Tarawera Forest, whilst other activities are generally undertaken so infrequently as to not raise any major resource management concerns. It is, however, important for off-roading to be barred from river and lake beds, since it may disturb local ecology, erosion and siltation or conflict with other activities.

10.2 Issues, Objective, Policies, Methods of Implementation, Principal Reasons and Anticipated Environmental Results

10.2.1 Issues

The issues relating to public access are:

10.2.1(a) Public access to and along river and lake margins may be constrained by a lack of public knowledge, lack of public reserves and unwillingness of landowners to allow access.

10.2.1(b) Public access to and along river and lake margins may in some cases threaten ecological, natural character, intrinsic and heritage values, water and soil resources, and safety and security.

10.2.1(c) There is a risk of water weed transfer between water bodies.

10.2.1(d) Public access to the Tarawera River is limited or prevented along large areas of riverbank by nuisance growths of willows.

10.2.2 Objective

Maintain and enhance public access to and along rivers and lakes while ensuring that threats to natural heritage, safety and security values caused by public access are minimised.

10.2.3 Policies

10.2.3(a) To ensure that public access to and along rivers and lakes is restricted only in circumstances:

(a) Where sensitive ecological, amenity or heritage values may be compromised; or

(b) Where safety or security may be compromised; or

(c) Where the purpose of a designated reserve may be compromised.

10.2.3(b) To encourage the coordination of public access to and along rivers and lakes with district councils, the Department of Conservation and landowners.

10.2.4 Methods of Implementation

Councils are encouraged to:

10.2.4(a) Consider effects on sensitive ecologies, amenity or heritage values, safety and security and the purpose of designated reserves when controlling or providing for access to and along river and lake margins.

10.2.4(b) Monitor activities along river and lake margins to ensure that they do not adversely affect the environment.

10.2.4(c) Coordinate with one another and the Department of Conservation to manage reserves and provide publicly available information about access to and along rivers and lakes.

District councils are encouraged to:

10.2.4(d) Where appropriate, allow public access to water bodies and riparian areas/reserves along rivers and lakes, including esplanade reserves and esplanade strips.

10.2.4(e) Consolidate access ways to rivers and lakes where an over proliferation of such access ways is having, or is likely to have, an adverse effect upon the surrounding environment.

10.2.5 Principal Reasons

The Resource Management Act 1991 cites the maintenance and enhancement of public access to and along the coastal marine area[34], lakes and rivers as a matter of national importance to be recognised and provided for in relation to managing the use, development, and protection of natural and physical resources.

Environment Bay of Plenty considers that there is sufficient public access to rivers and lakes in the Tarawera catchment so as not generally to restrict lakes and rivers and their margins from use by the public. Although not all river and lake margins

[34] Issues relating to public access to the coastal marine area are included in the *Bay of Plenty Regional Coastal Environment Plan*.

are easily accessible to the public Environment Bay of Plenty is satisfied that sufficient access is available to a broad cross-section of river and lake areas.

While Environment Bay of Plenty recognises that substantial tracks of private land often stand between formally designated river and lake margin reserves, access across these lands is considered a matter between those seeking access and the landowner or lessee.

Environment Bay of Plenty considers that current public access rights to public estate should only be restricted in those instances where there are identified risks to:

(a) Sensitive ecological areas or wildlife;

(b) Amenity or heritage values;

(c) Public or private security;

(d) The purpose of a designated reserve;

(e) Health and safety through activities such as poisoning, hunting or pest control using chemicals.

Environment Bay of Plenty considers that public access to and along rivers and lakes does not simply mean access to the water's edge. It also means being aware of opportunities which might encourage the sustainable use of these water bodies. Environment Bay of Plenty considers that local authorities have a role to play in investigating the need and possibilities for the provision of jetties and other similar structures which would be for public use.

Generally people know little about public access to and along rivers and lakes. EBOP considers that increased public information about access areas, walkways and boating, etc, is an important means of promoting public access in a sustainable manner to the catchment rivers and lakes. In addition, it is considered that activities along river and lake margins, such as the construction of walkways, need to be monitored from time to time to ensure that their adverse effects on the environment are minimal.

10.2.6 Anticipated Environmental Results

The anticipated environmental results are:

10.2.6(a) Protection of soil and water resources from unnecessary adverse effects of public access.

10.2.6(b) Continued ease of public access to and along rivers and lakes.

10.2.6(c) Safeguarding of sensitive ecological, natural character, heritage, and similar such areas from the effects of public access.

10.2.6(d) Greater awareness about public access to and along rivers and lakes.

10.2.6(e) Safeguarding of public safety, and property security.

11 Land Use

11.1 Introduction

This chapter addresses particular issues relating to the sustainable use and management of land in the Tarawera River catchment, specifically to avoid and remedy adverse effects on water quantity and quality. The *Operative Bay of Plenty Regional Land Management Plan* addresses regionally evident sustainable land use and practice issues. The objectives, policies and methods of implementation within this chapter should be read in conjunction with the *Operative Bay of Plenty Regional Land Management Plan*. In particular, riparian management issues are addressed in that regional plan. Disposal of effluent onto land, such as from dairy shed and industry, is addressed specifically within Chapter 16 – Groundwater.

A multitude of land uses and land use practices is undertaken in the Tarawera River catchment. These land uses and practices generally have positive environmental benefits.

The sustainability of land depends on a number of factors including geology, soil type, vegetation, slope characteristics and climate, and the type and extent of the land use. Unsustainable land management practices may result in sediment and nutrients being discharged into the natural water, affecting land production and water quality.

Within the Tarawera River catchment vegetation cover and land use generally match land use capability. Most significantly, large areas of steeper land and riparian margins are in native vegetation. This is critical for erosion and sediment control. However, these protected areas may require ongoing management to ensure that their ability to protect the catchment does not deteriorate. This includes stock and animal pest control.

The different soil types in the catchment often have a strong influence on existing and potential problems. Earthworks in the light ash soils and non-cohesive lapilli soils need to be carefully planned and implemented to avoid erosion problems. The pressure for semi-urban development around lake margins often results in earthworks which have a high risk of causing off-site sedimentation problems. In addition there are some areas in pastoral farming that are at risk from stock-induced erosion, particularly sheet erosion.

Environment Bay of Plenty expects that when any land development consent application is evaluated, effects are considered with particular regard to the protection of heritage values. Environment Bay of Plenty recognises that in sensitive environments that have a high degree of natural character, the preservation of that natural character from inappropriate subdivision, use and development is to be required.

11.2 Geology

The land form and topography of the Tarawera River catchment are dictated by geology associated with volcanism, subsidence and faulting. Land form units include:

(a) The Matahina and Kaiangaroa plateaux, which forms the southern and eastern catchment boundaries of the Tarawera Lakes catchments and the catchment of the Upper Reach of the Tarawera River.

(b) Hard volcanic rocks such as the rhyolitic dome of Mt Tarawera and the andesitic/dacitic cone of Putauaki (Mt Edgecumbe)

(c) The western catchment boundary, which is composed of Rotoiti breccia. Breccias are unwelded ignimbrites and also form plateaux.

(d) Many lakes in the Rotorua District occur within calderas or as a result of breccia flows blocking valleys.

(e) Major faulting as a result of tectonics has resulted, particularly along the south west to north east axis. The major feature as a result of tectonics is the Whakatane Graben.

Recent volcanic deposits from the Tarawera eruption of 1886 dominate the surface geology.

Volcanic eruptions over the last 40,000 years but in particular over the last 1,000 years have also had a significant influence on the geology of the catchment. These tephra deposits provide the parent material from which the current soils of the catchment are formed. In addition the volcanic deposits may influence the landscape. Deep layers of volcanic ash are able to soften a broken landscape while some ash deposits may be prone to surface erosion of gullying. In addition the tephra deposits provide a source of volcanic alluvium which is washed down through the catchment and deposited on the lower flood plains.

11.3 Soils

Soils formed from Tarawera Tephra and Rotomahana Mud cover 70% of the Tarawera River catchment. The other main soils in the catchment include alluvial soils on the Rangitaiki Plains and specific soil types near the coast, river channels, and wetlands. (See Table 4).

Where Tarawera Tephra is coarse and thicker than 20 cm, Tarawera soils have been mapped; where it is less than 20 cm, Matahina soils are mapped. Where the Tarawera Tephra is less than 20 cm thick and is fine, the soils are called Manawahe series.

Soils formed from Tarawera Tephra (excluding Manawahe soils) cover approximately 45% of the catchment. They extend from Lake Tarawera through the catchment of the Upper Reach of the Tarawera River area, including the Tarawera Valley, and downstream of Kawerau, on the Rangitaiki Plains. These recent soils are coarsely textured, excessively drained, and generally low in nutrients. In addition, summer ground temperatures may be particularly high because of the high radiation absorbency of the dark-coloured Tarawera Lapilli. This results in severe summer soil moisture deficits. The coarser-textured Tarawera Lapilli are more seriously affected by erosion than areas of finer ash[35]. The characteristics of the Tarawera Ash soils severely restrict their use for a range of agricultural purposes.

Rotomahana soils cover approximately 13% of the Tarawera River catchment. They occur only in the Tarawera Lakes catchment. They have been overlain by the Tarawera Ash, and are therefore not found downstream of the Tarawera Outlet. Rotomahana Mud has a relatively high clay content and nutrient status which are attributed to hydrothermal pre-weathering[36]. The soils have poor internal drainage, are subject to cracking and erosion, and are also slightly susceptible to drought. The soils derived from Rotomahana Mud are important due to their ability to supply nutrients to shallow rooting grasses.

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35 Larger particle size but low weight (bulk density) and little soil structure make for highly erodible soils.

36 Gibbs, 1980.

Table 4

SOIL PARENT MATERIAL TYPES IN THE TARAWERA CATCHMENT

Soil Types	Area in Soil Coverage (ha)	% Coverage
Tarawera Tephra	44,280	45%
Rotomahana Mud	12,800	13%
Tarawera Tephra on Kaharoa Tephra Manawahe Soils)	11,800	12%
Alluvial Soils	14,760	15%
Other Soil Types	14,760	15%
TOTAL	**98,400**	**100%**

(Source: Ngapo, N, Land Resource Assessment – Tarawera Catchment (March 1994))

After the 1886 Tarawera eruption, severe gully erosion occurred on the Rotomahana and Tarawera soils. This erosion is demonstrated by the pattern of rilling that can still be seen in much of the Tarawera Lakes catchments, particularly in the areas that are too steep for cultivation. On steeper land there is a continuing severe erosion potential particularly under pastoral land use.

Tarawera Tephra over Kaharoa Tephra provides the parent material for the Manawahe soils, which cover 12% of the Tarawera River catchment and occur primarily in the western hill country. Kaharoa Ash overlies older ash deposits including buried soils. Kaharoa Ash is a loose white pumice ash, sometimes containing lapilli, dating approximately 770 years before the present (BP) plus or minus 20 years BP[37]. Manawahe soils are coarsely textured, have relatively low fertility and are prone to drought. Because of the recent age and porous nature of Kaharoa Ash it influences soil properties even when present only as a shallow mantle (Map 5).

While the Manawahe soils are not as coarse as the Matahina or Tarawera soils, they have a poor water-holding capacity and are susceptible to surface erosion problems. While pastoral and arable potential is considerably lower on the Manawahe soils, forestry potential is high because tree roots can penetrate to older tephra soils beneath the Kaharoa Ash.

The Rangitaiki Plains consist of a complex series of sand ridges with intervening peat swamps, all partly buried by layers of recent volcanic alluvium. Alluvial soils on the Rangitaiki Plains comprise approximately 15% of the soils in Tarawera River catchment. The parent materials of these soils consist predominantly of tephric alluvium. Wetness is a dominant limitation except on the more free draining terraces. Through extensive artificial drainage, the soils have become moderately well drained.

The alluvial soils are variable in their fertility with their major limitation being their drainage characteristics. Virtually all of the soils on the plains have proved to be suitable for dairy farming, but the soils that are suitable for horticulture occur in a somewhat intricate pattern.

There are a small number of other soil types within the catchment, but they do not cover extensive areas. They include the following:

(a) Organic soils associated with wetlands;

[37] Hogg, A C; McCraw, J D, 1983.

(b) Soils derived from windblown sand found on the dunal systems along the coastline;

(c) Gravels and very recent floodplain soils next to the river systems.

11.4 Vegetative Cover

Approximately 60% of the land area of the Tarawera River catchment is in some form of forestry cover (Map 4 and Table 5). Of this 60%, approximately half is in native forest and half is in exotic plantation forest. The native forest is generally confined to the steeper and more erodible parts of the catchment. Exotic plantation forest has been planted over a wide range of land use capability classes.

Pasture is also found over a wide range of land use capability classes with pastoral farming in the form of dairying the predominant land use on the alluvial flood plains. Where pastoral farming exists on the steeper country it is generally confined to the Rotomahana mud soils in the Tarawera Lakes catchments, and small areas on the steep hill country near Kawerau.

There is likely to be a small increase in the area being planted in production forest. One area where forestry planting is likely to take place is on the western hill country between Lake Rotoma and Matata. This area, which has soils overlaying Kaharoa Ash, is currently predominantly in pasture, but is typical of the country currently being targeted by forestry developers for conversion to plantation forestry.

The indigenous vegetation within the catchment has important heritage values, such as indigenous habitat, and landscape and cultural values. Vegetation also contributes to the natural character of the lakes catchments, and the protection of indigenous vegetation is important in preserving a high degree of natural character. In this context, objectives and policies have been set in this chapter to recognise and provide for the protection and enhancement of heritage values, including natural character, when decisions on development are made. Wider vegetation and land use issues are covered in the *Operative Bay of Plenty Regional Land Management Plan*.

Table 5

LAND COVER IN THE TARAWERA RIVER CATCHMENT

CATEGORY	AREA IN HECTARES	PERCENTAGE OF CATCHMENT
Production Forest	30,624	31.0%
Native Forest (including shrubland)	28,495	29.0%
Pasture	26,193	27.0%
Orchard	406	0.5%
Lakes (including wetlands)	7,657	8.0%
Bare Ground	744	1.0%
Urban	1,513	1.5%
Other	2,800	2.0%
TOTAL	**98,400**	**100%**

(Data derived from November 1992 aerial photography)

In general, the balance of vegetation types and therefore land use within the catchment complements the capability of the land to withstand different uses and practices. There are small areas where some land uses are incompatible with the type of land on which they are located.

11.5 Erosion

The erosion problems in the catchment tend to reflect the geology. In particular, the unconsolidated nature of the Tarawera Tephra and the Kaharoa Ash increases the erosion risk in the catchment. The recent age of the volcanic ash depositions has allowed little time for soil development. The steep slopes in the Tarawera Lakes catchments and Upper Reach of the Tarawera River catchment accentuate the risk of erosion in the catchment. Given these conditions, any loss of vegetation cover can result in major erosion and sediment and nutrient runoff.

Other factors which aggravate erosion include poor grazing practices, particularly on steep slopes or riparian areas, and the timing and magnitude of earthworks operations, notably those which expose large areas of ash soil or concentrate water runoff.

The major types of erosion in the catchment are sheet, gully, slip and stream bank erosion. These occurrences and the effects of these types of soil erosion are detailed in the report of Ngapo, 1994[38].

11.6 Land Use Capability Description

Land use capability (LUC) combines geology, vegetation, slope and climate characteristics to give an indication of the ability of different land classes to sustain different land uses and practices. As described in Appendix 8, the New Zealand Land Use Capability Index divides land into eight general land use categories, each of which requires a different approach to land management. The area covered by these eight land classes in the Tarawera River catchment is indicated on Map 5.

11.7 Land Use/Practice

11.7.1 Pastoral

Within the Tarawera River catchment, approximately 29% of the land area is in pasture. Most of the area in pasture is well suited to that land use. However, there are two aspects of pastoral land use that are of concern. First, in particular sub-catchments, the area in pasture is high, increasing the potential for adverse downstream effects on water quality from nutrient and sediment runoff. The most noticeable example is the Lake Okaro sub-catchment of which 98% is pasture, and the nutrient status of the lake is eutrophic.

Secondly, there are areas in pasture, which show indications of being unsustainable in the long-term, such as the Wairua Stream catchment, areas within the Lake Okareka catchment, and the hill country around Kawerau. All of these areas are class 6e or 7e areas[39] or both.

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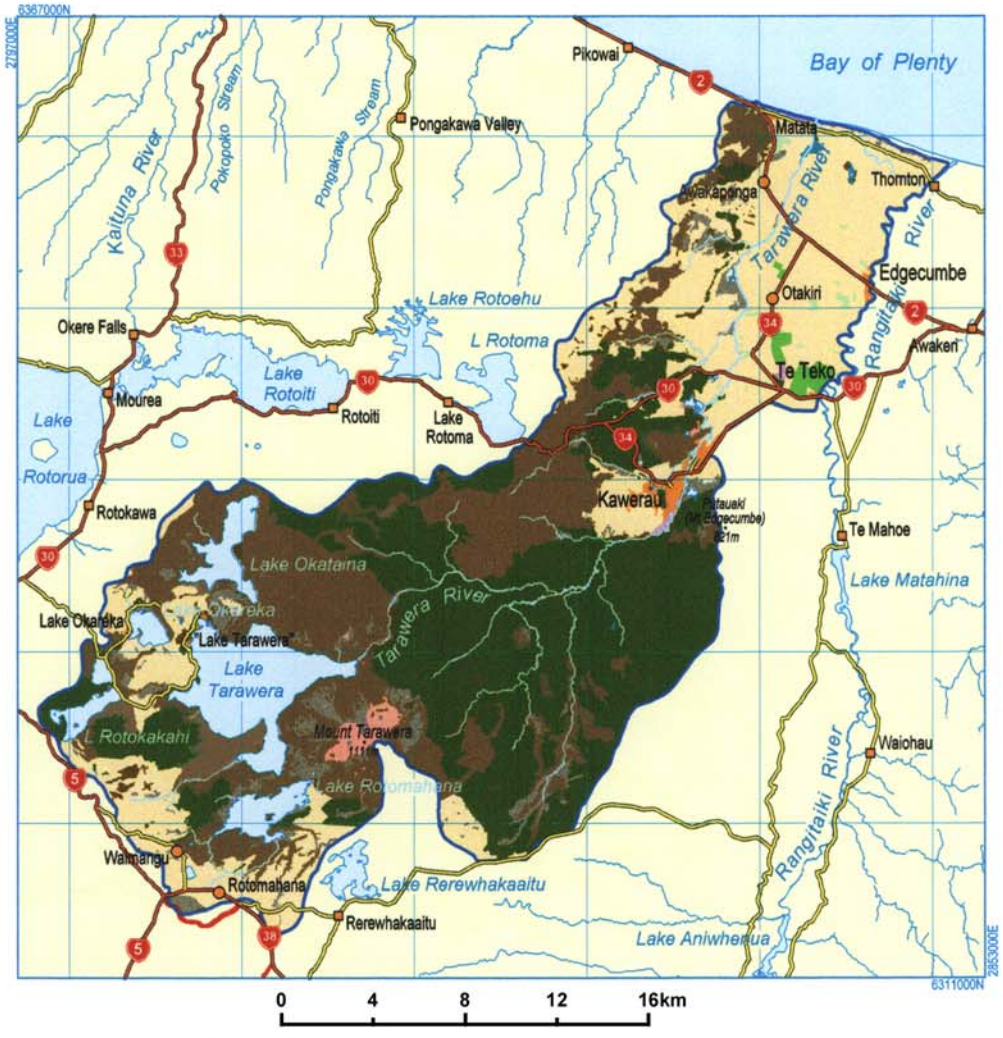
[38] Ngapo, N I, 1994 (April), Operations Report No. 94/2.

[39] See Ngapo, N I, 1994 (April), Operations Report No. 94/2, for a more specific description of landuse classes in the Tarawera catchment.

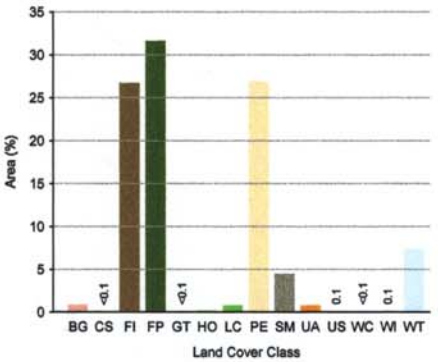
Map 4

Regional Plan for the Tarawera River Catchment

1996 Land Cover



LAND COVER CLASSIFICATION



Class Codes

- BG Bare Ground
- CS Coastal Sand
- FI Indigenous Forest
- FT Exotic Forest
- GT Tussock Grassland
- HO Horticulture
- LC Cropping
- PE Pasture (exotic)
- SM Mixed Scrub
- UA Urban
- US Urban Open Spaces
- WC Coastal Wetland
- WI Inland Wetland
- WT Water

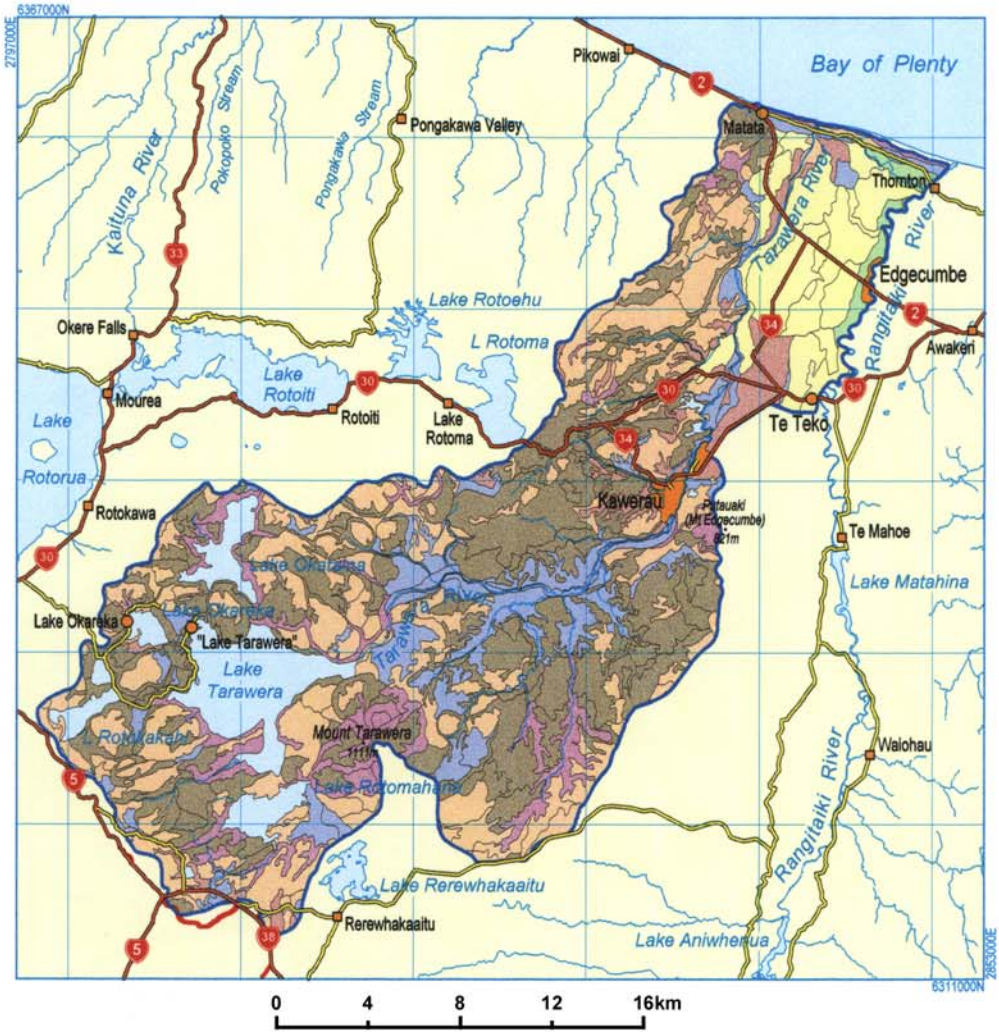
- Tarawera River Catchment Boundary
- Environment Bay of Plenty Regional Boundary
- State Highway
- Main Road
- Land Cover outside Tarawera River Catchment

C1623-4

Map 5

Regional Plan for the Tarawera River Catchment

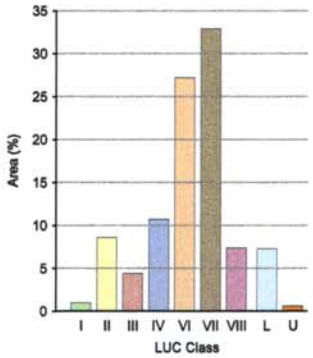
Land Use Capability (LUC) Classification



LAND USE CAPABILITY CLASSIFICATION

- Class I
- Class II
- Class III
- Class IV
- Class VI
- Class VII
- Class VIII
- Lake
- Urban

- LUC Classes outside Tarawera River Catchment
- LUC Class Boundary
- Tarawera River Catchment Boundary
- Environment Bay of Plenty Regional Boundary
- State Highway
- Main Road



C1623-5

Within the Lake Tarawera and Lake Okareka catchments, there are potential problems associated with dairying and cattle rearing on Rotomahana steep land soils. The alternation of winter pugging and summer drying leads to cracking of the fine textured soils. As a general rule, pastoral land use on class 7e3 land (Rotomahana soils on steep land) is considered unsustainable.

Around Kawerau, there are areas of class 6e20 and 7e8 land which are in pasture. Grazing of heavy cattle on these class lands is considered unsustainable due to the high risk of sheet erosion aggravated by stock pressure. Grazing management must be carefully controlled to ensure that a complete pasture cover is maintained[40].

A change of land use from pasture to forestry on 6e20 and 7e8 land generally results in less intensive grazing and less soil compaction. The pasture sward tends to become more dense, and sheet wash problems from stock induced erosion are reduced dramatically. Forestry, either native or exotic, has beneficial effects on class 7e8 land, whereas grazed pasture has adverse effects.

Careful pastoral management practices can reduce erosion problems associated with the soils formed from Kaharoa Ash, Tarawera Tephra and Taupo pumice. Some land uses and land use practices, such as mob stocking, heavy cattle grazing and deer farming, will need to be actively discouraged on steep faces.

Where practical, subdivisional fencing should follow land use capability boundaries, so that steep slopes are fenced off from easy plateau land or valley floors. This would allow for careful management of erosion-prone land units. This is particularly relevant on the highly erodible soils formed from Tarawera Lapilli.

As part of restricting stock access to river and lake margins, it is desirable that natural stock watering areas are replaced with reticulated water supplies. This could be carried out in conjunction with protection of stream banks and retirement from grazing. Care is required in the siting of gates, fences and troughs to minimise stock-induced erosion. Any management practice which minimises the exposure of bare ground should be considered and used if appropriate. Environment Bay of Plenty's soil conservation property plans and environmental plans are considered the most relevant means by which these issues should be dealt with.

11.7.2 Production Forest

Production forest covers 34% of the land catchment. Nearly two thirds of the production forest within the Tarawera River catchment lie within the catchment of the Upper Reach of the Tarawera River area. The production forest is planted on soils derived from Tarawera Tephra and generally includes class 4s1, 6e20 and 7e8 land. In the Tarawera Lakes catchments the production forestry is found on class 6e7 and 7e3 land.

In general terms, exotic plantation forestry on these land classes poses fewer adverse effects than generally result from arable and/or pastoral farming. The soils formed from Tarawera Lapilli are particularly suited to forestry as a land use. This is because the tree roots are able to penetrate to deeper tephra layers with greater water-holding capacity. The coarse Tarawera Lapilli is generally poorly suited to arable or pastoral farming.

On the Rotomahana mud soils, forestry tends to be on the steeper country only. This is because the high fertility of the Rotomahana soils has resulted in intensive pastoral use in the less steep areas. Forestry on steep slopes with Rotomohana

[40] Classes 6e20 and 7e8 occur together, with class 7e8 being steeper. With the slope change from 6 to 7, there is a tendency to get a natural terracing of the slope which appears typical for pumice and light ash soils. The terracing is easily aggravated by stock pressure which opens up the pasture cover, resulting in a loss of the pasture sward.

soils requires careful planning and management to minimise soil and water problems. The high clay content in the Rotomohana soils means that erosion problems result in a high suspended-sediment load in downstream waterways.

On the class 6 and 7 land within the Tarawera River catchment, it is likely that production forestry will slowly replace pastoral farming. This is partly because forestry has such a strong economic base within the Bay of Plenty, and partly because production forestry poses fewer management constraints than other possible land uses.

It is important that forestry operations are carefully planned and carried out, particularly on class 7 land, where the forest fulfils a catchment protection role as well as being a production forest. The plantation management regimes used result in between 3 and 4% of the forested area of the catchment being harvested and replanted each year as exotic plantation forest.

Most of the forests within the Tarawera River catchment are owned by major companies which comply with the New Zealand Forest Code of Practice. This provides a general assurance that major forestry company operations are carefully planned and implemented. In addition, forestry companies are developing new management practices such as over sowing with grasses and legumes following harvesting operations.

Most of the major forestry companies which own or manage forests in the Tarawera River catchment are signatories to either the Tasman Pulp and Paper Company Limited Accord of the New Zealand Forest Owners Accord.

The planting of large tracts of exotic production forests is considered by Environment Bay of Plenty to be linked in part to a reduction in the quantity of water in the Tarawera River. The draw-off of large quantities of water by exotic production forests and the adverse effects on surface water quantity are matters which Environment Bay of Plenty considers are best regulated through controls in district plans, with technical guidance from Environment Bay of Plenty.

11.7.3 Native Vegetation

Approximately 31% of the catchment is in native vegetation. The bulk of this land is held in either private Maori title or Crown ownership. While most of the native vegetation within the Tarawera River catchment, in particular Department of Conservation administered Crown land, is legally protected from development, there is also some native vegetation on freehold land. The extent of native vegetation cover on freehold land is unknown.

Most of the class 8 land within the catchment is either in native vegetation or actively regenerating. Native vegetation covers substantial areas of class 7 and some areas of class 6 country. In general, it is unlikely that these areas of class 6 will ever be developed. This is because they are often within a protected reserve area and tend to be inaccessible. Often, too, they have a high risk of eroding.

Native vegetation is generally found on the steeper areas around the Tarawera Lakes catchments, within the stream gullies and the steep western hill country of both the Upper and Lower Reach of the Tarawera River catchment areas. Native vegetation in these critical areas helps to fulfil a protective function by stabilising steep areas, moderating the effects of rainstorm events and filtering nutrients and sediment from land based activities. Filtering of nutrients and sediments is also an important function of native vegetation in lake, river and wetland riparian areas.

On the slopes and crest of Mt Tarawera, the native vegetation is regenerating slowly, but at an increasing rate. While there are still substantial areas of bare ground (Tarawera Lapilli and Ngauruhoe Ash), pioneer native shrubs and surface plants are becoming more established.

11.7.4 Earthworks

A large proportion of the land surface within the Tarawera River catchment is overlaid by volcanic tephra. While the characteristics of individual tephra layers may vary, they all have one thing in common; they are prone to erosion when disturbed by earthmoving operations. It is, therefore, important that any earthworks on these tephra-based soils need to be well planned, carefully carried out and adequately maintained.

Earthworks operations such as roading or landings are capable of generating high volumes of suspended sediment from the Rotomahan soils. Standard sediment control measures such as soakage pits, silt traps and cutoffs then become less effective, because they do not control suspended sediment.

Many different land uses are capable of affecting waterways through the poor planning and poor implementation of earthworks. Forestry-based earthworks include fire breaks, landings, haulage tracks and land preparation. Usually these are undertaken with minimal impact under various forestry operations guidelines, for example the Forest Operations Guidelines developed by Environment Bay of Plenty in conjunction with the forestry industry, and the New Zealand Forest Code of Practice developed by the forestry industry.

Farm-based earthworks include roading and tracking. Other farm-based activities requiring special attention include the location of farm gates, troughs and fences. Poor sitting of these structures can cause stock-induced problems where extensive areas of bare ground are exposed. Urban earthworks that are capable of causing problems include roading and formation of access driveways for housing. These become particularly important in lakeside development areas such as around Lake Okareka and Lake Tarawera.

All earthworks operations carried out on the tephra-derived soils need to be carefully planned, implemented, and maintained. This is particularly important on steep slopes or very near to natural water, where a land use consent is required under the *Operative Bay of Plenty Regional Land Management Plan*. Earthwork operations are carried out over a wide variety of land uses: urban, forestry, pastoral and cropping.

In all cases, soil disturbance should be minimised. Disturbed areas should be revegetated or stabilised to minimise surface erosion problems. Water control on roads and tracks is paramount.

11.8 Issues, Objective, Policies, Methods of Implementation, Principal Reasons and Anticipated Environmental Results

The following issues, objective, policies and methods should be read in conjunction with the *Operative Bay of Plenty Regional Land Management Plan*. Objectives, policies and methods in this regional plan relating to land use and land practice in the Tarawera River catchment are generally more specific than those included in the *Operative Bay of Plenty Regional Management Plan*.

11.8.1 Issues

Land use issues particular to the Tarawera River catchment are:

11.8.1(a) Removal of vegetation on steep lands, gullies and headwaters can result in erosion.

11.8.1(b) Soils, particularly tephra based soils on steeper slopes, can be particularly vulnerable to soil erosion and sediment and nutrient runoff due to unsustainable land use practices.

11.8.1(c) Inappropriate subdivision, use and development of lake and wetland margins can result in erosion and the runoff of sediment and nutrients.

11.8.1(d) Erosion problems and the discharge of sediment resulting from earthmoving operations on steep-faced tephra based soils.

11.8.1(e) Many wetlands, native forest and shrubland areas are suffering due to a lack of proactive protection, particularly fencing and pest control.

11.8.1(f) The reluctance or lack of awareness of some land users results in continuing unsustainable land use and land use practices.

11.8.1(g) The spread and control of wilding pines, particularly into land administered by Department of Conservation and other reserve land, is a problem.

11.8.1(h) The possible impact on water resources and wider environmental consequences of expanding production forestry is not well understood.

11.8.1(i) Inappropriate subdivision, use and development of river, lake and wetland catchments can result in loss of heritage values, including natural character.

11.8.1(j) The grazing of stock in wetlands and lakes, and on the riparian margins of waterways including drains and canals, is inappropriate and unsustainable if it causes soil erosion and nutrient runoff.

11.8.2 Objective

Mitigation, remediation and avoidance of erosion and the discharge of nutrients and sediment, and of adverse effects on water quality and quantity arising from inappropriate land uses and land use practices.

Recognise and provide for the protection of heritage values, and the preservation of natural character, in decisions on development, including the national significance of the Tarawera Lakes catchments.

11.8.3 Policies

11.8.3(a) To control unsustainable land uses.

11.8.3(b) To remedy those land management practices that are:

11.8.3(b)(i) Unsustainable on more erosion prone classes of land; or

11.8.3(b)(ii) May otherwise adversely affect water quality and quantity.

11.8.3(c) To encourage land users to implement methods that would mitigate, remedy or avoid erosion and the discharge of nutrients and sediment from their land.

11.8.3(d) To encourage landowners who wish to legally and physically protect significant indigenous vegetation and fauna habitat.

11.8.3(e) Any authority assessing a consent application for any activity within the Tarawera Lakes catchments will recognise and provide for the national significance of those catchments with particular regard to heritage values and those matters of national importance specified in section 6 of the Resource Management Act 1991.

11.8.4 Methods

Environment Bay of Plenty will:

11.8.4(a) Coordinate a programme to identify the extent and status of protected areas within the catchment, by June 1997.

11.8.4(b) Coordinate the necessary research to provide information on the problems associated with the grazing of different types of stock, or stocking rates on different classes of land, by June 1999.

11.8.4(c) Coordinate with other relevant organisations and affected landowners to identify and protect areas of significant vegetation that are important for soil conservation, water quality or water quantity.

11.8.4(d) Coordinate the preparation of a rehabilitation plan for Lake Okaro and its catchment by June 1999, with regard to its Recreation Reserve status and the requirements of the Reserves Act 1977.

11.8.4(e) Promote Soil Conservation Property Plans and Environmental Plans to encourage the remedial management of land use activities on:

(i) Steep pastoral land on Rotomahana mud soils;

(ii) Pastoral steep land (particularly class 7e) with soils formed from Tarawera Lapilli, Kaharoa Ash or Taupo pumice;

(iii) Wetlands, riparian and catchment head water areas.

12.8.4(f) Provide education to landowners and developer in lakeside settlement areas about the potential adverse effects of inappropriately planned and implemented earthworks.

12.8.4(g) Participate in the process of developing guidelines for:

(i) The long-term management of retired riparian land;

(ii) The management of wilding pines.

11.8.4(h) Coordinate liaison between district councils and forest industries on the matter of the effects of production forestry on water quantity and quality.

11.8.5 Principal Reasons

Increased awareness by land users of the impact of different land use activities on the hydrological processes within sub-catchments, including the advantages and disadvantages of the interception and detention of rainfall, and effective control to prevent the loss of sediment and nutrients.

The policy and methods proposed are designed to minimise the production and loss of sediment and nutrients from land uses, and their movement and deposition onto land and into water bodies.

11.8.6 Anticipated Environmental Results

The principal anticipated environmental results are:

11.8.6(a) The production of sediment and nutrients and their movement and deposition onto land and into water bodies has been controlled and minimised.

11.8.6(b) Improved water quality, and sustainable water allocation and use in particular parts of the Tarawera River catchment.

11.8.6(c) Protection and enhancement of significant areas of indigenous vegetation that contribute to the natural character of the Tarawera River catchment.

12 River and Lake Beds

12.1 Introduction

This chapter addresses the management of the beds of rivers and lakes[41] (including wetlands[42]). It deals with activities, other than those on the surface of water bodies, which have an adverse effect, or potential adverse effect on the beds of the rivers and lakes and their associated environments. Section 13 of the Resource Management Act 1991 restricts certain uses on, in, under, or over the beds of rivers and lakes (including wetlands) unless expressly allowed by a rule in a regional plan, proposed regional plan, or resource consent. Similarly, section 13 also restricts the introduction or planting of plants or any part of any plant, as well as the disturbance, removal, damage, or destruction of any plant or part of any plant, or of the habitats of any plant, or animals in, on, or under the bed of any lake or river.

The Act (section 30(1)(g)) makes the control of activities in, on, under or over lake and river beds the responsibility of Environment Bay of Plenty. District councils retain responsibility on the beds of rivers and lakes for creating esplanade reserves and strips and subdivision. Section 31 of the Act also makes district councils responsible for the control of any actual or potential effects of activities in relation to the surface of water in rivers and lakes.

The primary resource management issues relating to the beds of rivers and lakes are the location of structures, sedimentation, the reclaiming or draining of beds, other lake and river bed disturbances, and the introduction and removal of vegetation.

12.1.1 Structures

The Resource Management Act 1991 requires that assessments of the use, erection, reconstruction, placement, alteration, extension, removal, or demolition of any structure, or part of any structure, be based on their effects on the environment.

There are a large number (possibly in excess of 4,000) structures located on, in, over, or under the beds of the rivers, lakes, and wetlands in the Tarawera River catchment. These structures range from farmers' stream crossings to industrial outfall pipes. In general, structures on, in, under or over the beds of rivers and lakes of the Tarawera River catchment are concentrated around the Kawerau industrial area and on the shores of Lakes Tarawera and Okareka[43].

There are numerous private boat sheds and ramps around the western shores of Lake Tarawera and around the shores of Lake Okareka. Also around the western shores of Lake Tarawera are a substantial number of small pipes for abstracting water for domestic supply. The structures in, on, under, or over the Tarawera River

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41 The bed of a river is generally that space of land which the waters of the river cover at their fullest flow without overtopping their immediate banks. The bed of a lake is generally that space of land which the waters of the lake cover at its highest level without exceeding its margin.

42 Lakes include fresh water wetland areas which are entirely or nearly surrounded by land.

43 In early 1994, Environment Bay of Plenty prepared a comprehensive inventory of major structures located in, on, under, or over the beds of the lake and rivers within the Tarawera River catchment, using a geographical positioning system to locate the position of the structures accurately. This inventory includes an assessment of the use, condition and hazard potential of the structures. Environment Bay of Plenty has not considered it cost-effective to identify **all** structures in, on, under, or over the beds of river and lakes, since the vast majority have little adverse effect on the environment.

in and around Kawerau industrial area are generally associated with either the abstraction of water or the discharge of contaminated water. The bed of the Lower Reach of the Tarawera River includes a number of flood gates and other water control structures.

The consideration of whether a structure has, or is likely to have, an adverse effect on the environment is dependent on a number of factors, including, but not limited to, ecology, natural character, amenity value and sometimes its purpose. In the past some structures were considered to be inherently positive or negative, based on the activities with which they were associated.

Structures, located in, on, under or over the beds of river and lakes can affect the environment in a variety of ways. Structures located in rivers can alter flows and water levels, diverting and ponding water leading to scouring and erosion of river beds and subsequent sediment build-up downstream. Erosion and disturbance of river and lake beds can threaten in-stream ecosystems by smothering the habitat and food sources of aquatic life. Where river flows are reduced by containment structures and damning, a river may lose its ability to transport heavier sediments, and can also suffer a reduction in the total amount of sediment flushed. Containment structures, such as dams, can also lead to increases in water temperature. Structures can also cause problems if they break free, and can also result in higher water levels when floods come.

Contaminants associated with the construction of structures, such as hydrated lime from the pouring of concrete, can alter the quality of the water and threaten the ecology of the water body. Structures located in water bodies, particularly streams and drains, can also form a barrier obstructing the migration of fish. This matter is discussed further in section 13.4.7, and shown in Map 6.

Structures can also adversely affect natural character and amenity values by being inappropriately located or designed so as to detract from the surrounding environment, or may otherwise obstruct recreational users or put people and ships at risk.

Some structures are associated with the discharge of wastewater, such as those around the Kawerau industrial area. Some of these discharge points are so close to one another that they do not allow for adequate monitoring of the effects of the discharges after reasonable mixing. This is likely to require the relocation or consolidation of some discharge points. Environment Bay of Plenty intends that a resource consent application for intake or outfall structures be processed together with the corresponding take or discharge application.

In regulating structures on the beds of lakes and rivers, regard needs to be had to the Building Act 1991[44]. The Building Act is administered by district councils. The definition of a "building" includes many of those examples commonly found on the beds of rivers and lakes[45]. However, the Third Schedule to the Building Act 1991

[44] The purposes of the Building Act 1991 (Section 6) are to provide for:

(a) Necessary controls relating to building work and the use of buildings, and for ensuring that buildings are safe and sanitary and have means of escape from fire; and

(b) *The coordination of those controls with other controls relating to building use and the management of natural and physical resources.*

[45] The Building Act 1991 (Section 3) definition of "building" is:

…In this Act, unless the context otherwise requires, the term "building" means any temporary or permanent movable or immovable structure (including any structure intended for occupation by people, animals and machinery, or chattels); and includes any mechanical, electrical, or other system, and any utility systems, attached to and forming part of the structure whose proper operation is necessary for compliance with the building code; but does not include:

(a) Systems owned or operated by a network utility operator for the purpose of reticulation of other property; or

(b) …….etc.

provides exemption for certain types of structure which might otherwise require a building consent under the Building Act. Unless new structures are exempt under the provisions of the Building Act and are permitted by this regional plan, they may require both a building consent from the relevant territorial authority and a land use consent from Environment Bay of Plenty, except in the Rotorua District area.

In the Rotorua District, Environment Bay of Plenty has, by mutual agreement, transferred those of its functions relating to the regulation of structures on, in, under or over the beds of rivers and lakes in the Tarawera Lakes catchment, to the Rotorua District Council. The Rotorua District Council will consider and decide on resource consent applications to locate structures on the beds of the lakes and rivers within that part of the Tarawera Lakes catchment that falls within the boundary of the Rotorua District Council. Any decision by the Rotorua District Council will be subject to the provisions of this regional plan[46] and any additional rules contained in the Rotorua District Plan. Environment Bay of Plenty has also transferred the regulation of maimai to the Eastern Region Fish and Game Council[47]. This transfer includes the alteration or disturbance of lake, river or wetland beds.

12.1.1(a) Structures – Selected Management Alternative

Most existing (July 1994) structures located in, on, over or under the beds of rivers, lakes and wetlands located within the Tarawera River catchment, do not have any undue adverse effects on the environment, and indeed may in some cases have a net positive effect by, for instance, encouraging the sustainable use of water bodies, such as public boat ramps. As long as any existing structure meets or betters the standard conditions and relevant rules contained in this regional plan, it should be considered a Permitted Activity. New structures, and the extension or reconstruction of existing structures that exceed specified criteria, will be managed as discretionary activities. Policies and methods have been established to ensure that redundant structures are removed.

12.1.1(b) Structures – Supporting Technical Reports

No specific technical reports, other than geographical positioning of some structures, were undertaken as part of the preparation of this section.

12.1.2 Sedimentation, and Other River and Lake Bed Disturbance

Sedimentation can be both a naturally occurring process or human-induced. Human-induced sedimentation generally occurs as the result of inappropriate land use activities or practices which result in increased erosion and sedimentation loads reaching water bodies.

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[46] Both the Rotorua District Council and the Eastern Region Fish and Game Council, and any other organisation to whom the regulation of structures might be subsequently transferred, are obliged to abide by the objectives, policies and rules contained within this regional plan and within other relevant regional and district plans.

[47] The transfer to the Eastern Region Fish and Game Council is currently in limbo due to new section 418(3) being added to the RMA as a result of Resource Management Amendment Act 1993. Section 418(3) states:

For the purposes of this Act, section 13(1) shall not apply in respect of any activity lawfully being carried out in relation to the bed of any river or lake before the 1st day of October 1991 which did not require any licence or other authorisation relating to such activity under any of the Acts, regulations, or bylaws, or parts thereof, amended, repealed, or revoked by this Act, until a regional plan provides otherwise.

This regional plan remedies this situation.

An excessive concentration of suspended and settleable solids can adversely affect the aquatic environment by:

(a) Smother aquatic fauna;

(b) Altering hydraulic flows and patterns;

(c) Acting directly on fish by killing them or reducing growth rates and disease resistance;

(d) Preventing the successful development of fish eggs and larvae;

(e) Modifying natural movements and migrations of fish;

(f) Reducing the food available to fish.

Increased sedimentation has its greatest effect in the delta of rivers or in places where the gradients are low. The highly-mobile pumice beds of streams and rivers in the Tarawera River catchment and the contribution of natural and human-induced sedimentation raises issues about the effects of sedimentation in the Lower Reach of the Tarawera River.

From time to time sediment builds up in the Lower Reach of the Tarawera River, creating sediment islands, which usually disappear during flood events. However, if vegetation becomes established, the islands become more difficult to move through natural processes. The creation of these islands can at times threaten the integrity of the flood protection works in the Lower Reach of the Tarawera River by altering water flow and raising the bed of the river. The build up of sediment can also result in navigation difficulties.

The Lower Reach of the Tarawera River has been extensively modified over the past thirty years for flood protection and drainage purposes. Realignment works have been designed to accommodate sedimentation loads. Although periods of sedimentation are apparent, these are often followed by periods of scour, leaving the overall effect of sedimentation at zero. While the Lower Reach of the Tarawera River has been extensively modified, the build-up of sediment is still largely a natural occurrence.

Sedimentation and infilling are very real problems in the Matata Lagoon, lowering water depths, decreasing the area of wetland, and encouraging the encroachment of marginal vegetation, particularly raupo[48]. Natural sedimentation occurs in the Lagoon due to the steep catchment which contributes to water in the Lagoon. Wood fibre from the pulp and paper mills at Kawerau was deposited from the Tarawera River into the lower Matata Lagoon during the 1960s. This formed a deep layer of darkly-coloured organic sediments. The Department of Conservation has constructed sediment traps to reduce the amount of sediment entering the Lagoon and has indicated its intention to dredge parts of the Lagoon. Environment Bay of Plenty is concerned that any dredging of the Matata Lagoon take place only after a comprehensive assessment of the environmental effects of such action, and in full consultation with appropriate iwi authorities.

The physical removal of built-up sediment can have adverse effects on in-stream ecologies and habitats. Environment Bay of Plenty recommends that the removal of sediment and in-stream islands should be undertaken only after a full environmental impact assessment has been prepared.

12.1.2(a) Sedimentation, and other River and Lake Bed Disturbance – Selected Management Alternative.

[48] APR Consultants, 1993.

There are two management alternatives relating to sedimentation:

(a) Consideration of sedimentation as a natural process and no action taken; and
(b) Consideration of sedimentation as a natural process which requires management.

Environment Bay of Plenty's selected alternative is to treat sedimentation and other disturbances affecting the beds of rivers and lakes as processes or actions which should, within reason, be designed and regulated. As a result Environment Bay of Plenty proposes that the dredging of the sediment islands in the Lower Reach of the Tarawera River be a Permitted Activity. The control of sediment in all other river and lake beds areas, due to their more sensitive nature, will be discretionary activities and require resource consents.

12.1.2(b) Sedimentation, and other River and Lake Bed Disturbance

The following technical reports and memoranda prepared as part of the preparation of this regional plan contain more detailed information on the control of sedimentation or the chemistry of sediment in the lower ponds of the Matata Lagoon.

Wilkins, A.L, Healy, TR, Leipe, T 1992, Dehydroabietic Acid and Related Organic Components in Sediment from the Matata Lagoon and Tauranga Harbour, Bay of Plenty, New Zealand, (DHAA Report), Departments of Chemistry and Earth Sciences, University of Waikato, Hamilton

Titchmarsh, R 1994 (21 March), Tarawera River Regional Plan – Sedimentation Memorandum from Mr R Titchmarsh (Manager Technical Services) to Mr D Ponter (Regional Planner), Environment Bay of Plenty, *Unpublished*.

12.1.3 Reclaiming and Draining Beds

The drainage of reclamation of the beds of rivers, lakes or wetlands can have significant adverse effects on cultural values, local ecosystems, and the habitats or many native and exotic plants and animal species.

Before the late 1800s the Rangitaiki Plains were one large wetland area, with the Whakatane, Rangitaiki and Tarawera Rivers meandering through it to the Pacific Ocean. The Tarawera, Rangitaiki and Omeheu Rivers jointed together to form a single waterway, which flowed out through a harbour portage at Matata. In the early 1900s, large parts of the Rangitaiki Plains were drained for use as pastoral land. Central government and local authorities were empowered to facilitate the drainage of the wetlands.

The drainage and reclamation of the Rangitaiki wetlands for pastoral agriculture has left approximately 1.7% of the original wetland area remaining. In accordance with section 6(a) of the Resource Management Act 1991 Environment Bay of Plenty will encourage the preservation of the remaining wetlands and other water bodies within the Tarawera River catchment, unless associated with flood protection and control works, or minor reclamations associated with the location of consented structures. Although draining wetland areas could lead to their economic use as pastoral lands, the Resource Management Act 1991 requires, as a matter of national importance, that the natural character of wetlands, lakes and rivers be preserved. Minimum and maximum water levels for the wetlands in the Lower Reach of the Tarawera River are discussed and set in Chapter 14 – Surface Water Quantity

12.1.3(a) Reclaiming and Draining Beds – Selected Management Alternative

There are three alternatives relating to the reclamation and drainage of beds of rivers, lakes and wetlands:

(a) The relative "carte blanche" approach as in the past; or

(b) The effects of reclamation or drainage of wetlands, and lakes and rivers and their margins and beds being managed as discretionary activities requiring resource consents; or

(c) A prohibition, except for defined protection or control works, and minor reclamations associated with the installation of authorised structures.

Environment Bay of Plenty proposes (b); that reclamation and drainage of the beds of rivers, lakes and wetlands, including flood mitigation or installation works, be discretionary activities. Evidence shows that the water bodies of the catchment of the Lower Reach of the Tarawera River, in particular, have already been significantly modified, adversely affecting the natural environment. As a matter of national importance, wetlands, lakes and rivers and their margins and beds require preservation from effects such as reclamation and drainage that may compromise their natural character qualities and values. Environment Bay of Plenty considers that the impact of such effects should be assessed and decided through the formal consent process. Specific flood protection and control works or minor reclamations associated with consented structures should also be managed under this process.

12.1.3(b) Reclaiming and Draining Beds – Supporting Technical Reports

The following technical report written as part of the preparation of this regional plan, contains more detailed information on reclamation and drainage of beds in the catchment of the Lower Reach of the Tarawera River:

Titchmarsh, R 1994, 21 March Tarawera River Regional Plan – Sedimentation, Memorandum from Mr R Titchmarsh (Manager Technical Services) to Mr D Ponter (Regional Planner), Environment Bay of Plenty – *Unpublished*.

12.1.4 Introduction and Removal of Plants

The introduction and removal of plants to the beds of rivers of lakes, rivers and wetlands need to be carefully managed to minimise potential adverse effects on the environment. This relates to plants existing both below and above the water line, but growing on the beds of rivers, lakes and wetlands.

Crack Willows were initially planted in river margin areas for soil conservation purposes. Willows grow prolifically in this environment. While they continue to play an important erosion control function they have also become a nuisance. Unless controlled, they start growing in the water body, altering the flow of the river, and impinging on the ecosystem and natural character. A concern, particularly of canoeists, is the safety hazard presented by willows overhanging the river. Prolific willow growth also restricts reasonable access along the riverbanks for people wanting to get to the river for recreation. Willows are growing in both the upper and lower reaches of the river and have become a particular nuisance in the wetlands in the catchment of the Lower Reach of the Tarawera River, where they ultimately smother native vegetation and threaten the habitat of aquatic and bird life.

Environment Bay of Plenty has an ongoing role in controlling willows along the banks of the Tarawera River and its tributaries under the Rangitaiki-Tarawera Major Scheme. The Department of Conservation and the Eastern Region Fish and Game Council are both involved in willow eradication programmes in the wetlands. Both these two agencies and Environment Bay of Plenty are in favour of planting

native species, to replace willows for erosion control practices, where practicable and given the availability of the right species.

12.1.4(a) Introduction and Removal of Plants – Selected Management Alternative

Environment Bay of Plenty has assessed that the Resource Management Act 1991 requires the control of the introduction and removal of plants in, on or under rivers, lakes and wetland beds. The Act states that unless allowed by a regional plan or otherwise by a resource consent, no introduction or removal of plants is permitted. Environment Bay of Plenty proposes that except in certain instances, as detailed in Rules 12.2.5(j) and 12.2.5(k) the planting or removal of plants or parts of plants, or the habitats of any such plants or animals, in, on, or under the bed of rivers, lakes or wetland should be discretionary activities.

12.1.4(b) Introduction and Removal of Plants – Supporting Technical Reports

Chapter 14 contains references to technical reports written as part of the preparation of this regional plan that give detailed information on habitats and plant life in, on or under the beds of rivers, lakes and wetlands.

12.2 Issues, Objective, Policies, Methods of Implementation, Principal Reasons and Anticipated Environmental Results

The objective, policies, and methods of implementation in this chapter apply to all structures and activities in, on, under or over the beds of rivers, lakes, and wetlands within the Tarawera River catchment.

12.2.1 Issues

The issues related to the management of river, lake and wetland beds are:

12.2.1(a) Activities on, in, under, or over the beds of rivers and lakes, including the location of structures, reclamation works, the grazing of stock, and the draining of beds, can adversely affect water quantity and quality, and contribute to soil erosion and sedimentation.

12.2.1(b) Activities on, in, under, or over the beds of rivers and lakes, including the location of structures, reclamation works, the draining of beds, and the grazing of stock, can variously adversely affect public access and safety, aquatic ecology, significant flora and fauna, natural character, natural features and landscapes, and amenity and heritage values.

12.2.1(c) The introduction or planting of plants (vegetation), has adversely affected the natural character and natural ecology of parts of river, lake, and wetland beds and their environments.

12.2.1(d) The disturbance, removal, damage and destruction of plants (vegetation) have adversely affected the natural character and ecology of parts of river, lake and wetland beds and their environments.

12.2.1(e) Sedimentation, both natural and human-induced, can adversely affect in-stream ecologies and the integrity of flood protection schemes.

12.2.2 Objective

Adverse effects resulting from activities on, in, under or over the beds of rivers and lakes are minimised.

12.2.3 Policies

12.2.3(a) To ensure activities do not disturb river, lake and wetlands beds in a manner which adversely affects the aquatic environment and ecosystems, natural character, natural features and landscapes, and amenity, cultural, traditional and heritage values.

12.2.3(b) To provide control over the planting, disturbance, removal, damaging or destruction of plants in, on, or under river, lake or wetland beds.

12.2.3(c) To encourage a formal maintenance programme for managing willows.

12.2.3(d) To ensure that abandoned structures are removed.

12.2.3(e) To provide relevant assistance to other agencies involved in river, lake and wetland preservation.

12.2.3(f) To preserve the natural character of wetlands, and lakes and rivers and their margins and beds, and protect them from inappropriate subdivision, use and development.

12.2.3(g) To promote the reasonable shared use, including public use, of private structures occupying public space in or on the beds of water bodies.

12.2.4 Methods of Implementation – General

Environment Bay of Plenty will:

12.2.4(a) By 1 July 1997, notify all known owners and/or operators of structures which are not permitted by this regional plan, located in, on, under or over the beds of the lakes, rivers, and wetlands within the catchment as to the requirements for the authorisation of those structures.

12.2.4(b) Require that within one calendar year following the date on which this regional plan becomes operative, resource consent applications pursuant to rule 12.2.5(c) for existing structures for discretionary activities on, in, under or over beds of rivers, lakes and wetlands shall be lodged.

12.2.4(c) Require that within one calendar year following the date on which this regional plan becomes operative, all abandoned structures, and structures with no identified ongoing purpose be removed, at their owners' expense, from the beds of river, lakes and wetlands, except for those structures for which a resource consent application has been lodged but not decided.

12.2.4(d) Where possible, use indigenous plants for soil erosion control purposes alongside the Tarawera River and its tributaries, and in other river, lake, or wetland areas.

12.2.4(e) Where possible use alternative to willow species and associated invasive cultivars for soil erosion and river control purposes.

12.4.4(f) Establish a forum with the Department of Conservation, iwi authorities and other interested parties to investigate alternatives to the use of willow species for soil erosion and river control purposes.

District Councils are encouraged to:

12.2.4(g) Avoid the inappropriate subdivision of land in or adjacent to the beds of rivers, lakes, and wetlands.

12.2.5 Methods of Implementation – Rules

12.2.5(a) For the purposes of this regional plan, any watercourse connecting lakes within the Tarawera River catchment is a tributary stream of the lake into which it flows.

12.2.5(b) The use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure or part of any structure, in, on, under, or over the bed of any river or wetland, within the Tarawera River catchment shall be a Permitted Activity, subject to compliance with all the conditions of Rule 12.2.5(m),

except that:

(i) an overhead cable or transmission line that, when measured at its lowest point above the bed of the waterbody, is greater than 10 metres above the 50 year flood water level for the site, or

(ii) a bridge (including a pipe bridge) spanning the main stem of the Tarawera River that, when measured at its lowest point above the bed of the river, is greater than 1 metre above the 100 year flood water level for the site and has no abutments or supporting structures in, on or under the bed of the river, or

(iii) notwithstanding the requirements of rule 12.2.5(e), a line, cable or pipeline, including any telecommunication line as defined in section 2(1A) of the Telecommunication Act 1987, installed by drilling or tunnelling (including pipe thrusting) under the main stem of the Tarawera River that, when measured at its highest point under the bed of the river is not less than 4 metres below the bed of the river,

shall be a Permitted Activity subject to compliance with conditions (iv), (v), (vii), (viii) and (ix) of Rule 12.2.5(m); and

(iv) The use, erection, reconstruction, placement, alteration, maintenance, extension, removal or demolition of a stream crossing, being any structure supporting a path, road or track over a streambed, including a culvert, single span bridge or ford, located in, on, under or over the bed of any tributary stream of the main stem of the Tarawera River, is exempt from the requirements of this plan.

Advisory Note:

The Operative Bay of Plenty Regional Land Management Plan has requirements relating to the installation and management of stream crossings. Anyone installing a stream crossing of the type described in rule 12.2.5(b)(iv) above would need to comply with the terms and conditions of section 10.5.6 of the Operative Bay of Plenty Regional Land Management Plan.

12.2.5(c) The use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure or part of any structure, in, on, under, or over the bed of any river or wetland within the Tarawera River catchment that does not comply with Rule 12.2.5(b) shall be a Discretionary Activity, and any application for a consent under this Rule shall be considered with regard to the criteria of Rules 12.2.5(m) and 12.2.5(o).

12.2.5(d) Notwithstanding Rule 12.2.5(b), the use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure located in, on, under, or over the bed of any river, lake, or wetland within the Tarawera River catchment that is to be used for a taking or discharge activity from or into the same waterbody for which a water or discharge permit is required is a Discretionary Activity to be considered by Environment Bay of Plenty:

(i) at the same time as any application for the water or discharge permit to which it relates;

(ii) with regard to the requirements of the conditions of the water or discharge permit to which it relates;

(iii) with regard to the criteria of Rules 12.2.5(m) and 12.2.5(o).

12.2.5(e) Subject to Rule 12.2.5(b)(iii), every excavation, drilling, tunnelling, or other disturbance of the bed of any river, lake, or wetland within the Tarawera River catchment is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o).

12.2.5(f) Every reclamation or draining of the bed of any river, lake or wetland is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o).

12.2.5(g) Except as provided by Rule 12.2.5(h), the reasonable ongoing maintenance, of an authorised structure in, on, under or over the bed of any river, lake or wetland is a Permitted Activity, subject to compliance with all the conditions of Rule 12.2.5(m).

12.2.5(h) Maintenance of any structure in, on, under or over the bed of any river, lake or wetland that results in the discharge of waste antifouling paint into water is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o).

In the context of this Rule, waste antifouling paint is any paint or coating substance designed to emit any toxic substance.

12.2.5(i) The uncontrolled grazing of stock on the bed of any river, lake or wetland shall be a Prohibited Activity from 1 July 2005. For the purposes of this Rule, stock is uncontrolled if it is not effectively restrained from entering surface water by a fence or fencing device.

12.2.5(j) The introduction or planting of plants or parts of plants, whether exotic or indigenous, in, on, or under the bed of any river, lake, or wetland, is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o), except that:

(i) planting for soil erosion and river control purposes, excluding the planting of pampas.

(ii) planting of native or indigenous plants as part of the preservation or restoration of the natural values of an environment;

are Permitted Activities, subject to compliance with conditions (i), (ii), (iii), (iv) and (v) of Rule 12.2.5(m); and

(iii) the planting of plants within that part of the area of the Rangitaiki-Tarawera Flood Control Scheme floodway that is within the Tarawera River catchment is a Prohibited Activity, **except that**:

(a) planting in the floodway to enhance habitat values is a Discretionary Activity to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o);

(b) planting of pastoral grasses in the floodway is a Permitted Activity subject to compliance with conditions (i), (ii), (iii), (iv) and (v) of Rule 12.2.5(m).

In the context of this Rule, pastoral grasses are grasses used predominantly for the feeding of stock.

12.2.5(k) Except as provided by Rule 12.2.5(l), every disturbance, removal, damage, or destruction of any plant, or part of any plant (whether exotic or indigenous) or the habitats of any such plants or of animals, in, on, or under the bed of any river, lake or wetland, is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o).

12.2.5(l) The following activities are Permitted Activities, subject to compliance with conditions (i), (ii), (iii), (iv) and (v) of Rule 12.2.5(m):

(i) the removal of plants by tangata whenua for their traditional medicinal or cultural purposes;

(ii) the collection of plant samples for identified scientific purposes;

(iii) the maintenance (including cutting back) of plants planted for soil conservation purposes along river, lake, and wetland margins;

(iv) the removal of plants or part of plants identified as requiring removal in the *Bay of Plenty Regional Council Noxious Plants Authority Regional Programme for the Control of Noxious Plants: 7 May 1992* or equivalent document;

(v) the removal of plants or parts of plants that constitute a hazard to a waterway, or any authorised structure in a waterway, or any water surface recreational activity.

12.2.5(m) Permitted Activity Conditions:

The activity or structure shall:

(i) not cause erosion to the bank or the bed of the waterbody.

(ii) not destroy fish habitat or cause the loss of, aquatic plant or animal species beyond the site.

(iii) not damage or destroy any fish-spawning area, nor impede the free passage of migrating fish.

(iv) not stop or impede authorised public access to or along the waterbody.

(v) not be constructed, installed or sited in contravention of any legislation protecting archaeological or historic sites (see advisory notes below).

(vi) if located in, on, under or over the bed of the Tarawera River,

(a) not obstruct or divert any flood flow and be of a streamlined shape designed to shed flood flow and debris, and avoid scour.

(b) not extend over more than 10% of the horizontal component of the wetted bed of the river under mean flow conditions.

(vii) not:

(a) damage or destroy any other structure.

(b) interfere with any activity.

(c) restrict the drainage of land without the consent of the landowners.

(d) be a hazard to navigation.

(viii) be securely connected into the bank or bed of the river to a standard that will withstand a one in 100 year flood flow event.

(ix) be maintained in a structurally sound condition for the purpose for which it was constructed.

(x) not be painted with any antifouling coating designed to emit any toxic substance.

For the purpose of this rule, "activity" shall be taken to include the use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure or part of any structure, and where an activity is to install a structure at a site, the "site" is deemed to be the whole extend of the bed area covered by the structure.

Advisory notes:

1 Environment Bay of Plenty can provide information on flood and mean water flows and levels and hydrological and hydraulic guidelines, phone 0800 368 267 to enquire. To avoid hazard, any structure within a floodway or bed of a river or stream should be designed and constructed with regard to the publication: "Environment Bay of Plenty Hydrological and Hydraulic Guidelines". Copies of these guidelines are available on request from any Environment Bay of Plenty office.

2 This Permitted Activity rule does not authorise the modification, disturbance or destruction of any archaeological or historic site within the area of an activity or structure. Users of the rule should note that under Sections 98 and 99 of the of the Historic Places Act 1993 offence provisions apply whether or not a site is a recorded archaeological site.

Further advice on the requirements of the Historic Places Act 1993 can be sought from the local office of the Historic Places Trust in Tauranga, phone (07) 578 1219 or the national office of the New Zealand Historic Places Trust in Wellington, phone (04) 472 4341.

12.2.5(n) Every use of wheeled or tracked vehicles in any riparian area, river, lake or wetland, or its margin or bed, is a Permitted Activity, subject to the conditions that the vehicle use shall:

(i) not result in adverse effects from erosion or land instability.

(ii) not damage areas of significant indigenous vegetation.

(iii) not damage habitats of indigenous fauna or trout spawning areas.

(iv) not adversely affect the natural character of wetlands, lakes and rivers, and their margins and beds.

(v) not adversely affect amenity values, being those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

12.2.5(o) When considering a resource consent application pursuant to Rules 12.2.5(c), 12.2.5(d), 12.2.5(e), 12.2.5(f), 12.2.5(h), 12.2.5(j), 12.2.5(k) and 12.2.5(p), Environment Bay of Plenty will have particular regard to, but not be limited to, the following matters:

(i) effects causing erosion or land instability;

(ii) effects on the hydraulic characteristics of any river, stream or wetland;

(iii) effects on the habitat of fish, biota, aquatic plants and wildlife;

(iv) hazards caused to navigation;

(v) effects caused by the occupation of public space;

(vi) effects on the spawning, free passage or migration of fish;

(vii) effects caused to public access to rivers and lakes and along their margins;

(viii) effects on any waahi tapu, urupa, or cultural or heritage place or value;

(ix) effects on natural character and amenity values, including recreation;

(x) effects on any other lawfully-existing structure, or activity;

(xi) effects caused by the use of any antifouling coating designed to emit any toxic substance;

(xii) maintenance requirements;

(xiii) monitoring requirements, including but not limited to the display of weatherproof identification numbers for compliance monitoring purposes;

(xiv) the requirements of Part II of the Resource Management Act 1991;

(xv) the requirements of sections 104 and 108 of the Resource Management Act 1991.

12.2.5(p) Every use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure on the bed of any lake within the Tarawera River catchment is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to:

(a) the matters of Rule 12.2.5(o); and

(b) the following matters, assessed with regard to effects on natural character and amenity values, and public and private security and safety:

(i) whether a structure that occupies public space and is used as a jetty should be required to remain open for public use at reasonable times without fee, charge or hindrance;

(ii) whether a structure that occupies public space and is used as a jetty should be required to be placed or sited so as to facilitate its shared use between neighbours;

(iii) whether the length or the structure, measured from the mean annual highest lake level shore line into the lake, should be limited to not exceed 12 metres;

(iv) whether the size of the structure, measured as the lake water surface area covered, should be limited to not exceed $15m^2$.

(v) whether the structure, in conjunction with adjacent structures, has an adverse effect on the natural character of the lake margin.

In the context of this Rule, a jetty is any structure that is fixed to land on or in the bed or shore of a lake, used principally to moor or service vessels, and includes any raft.

12.2.6 Principal Reasons

In the past the beds of rivers, lakes and wetlands have been managed in a random manner. Section 13 of the Resource Management Act 1991 makes it clear that the management of the beds of rivers, lakes and wetlands is a matter of primary importance. The intent of the Resource Management Act 1991 is most appropriately reflected in the need to avoid, remedy or mitigate adverse effects arising from the inappropriate subdivision, use and development of rivers and lakes. Due to the sensitive nature of river, lake and wetland bed environments in the Tarawera River catchment, Environment Bay of Plenty proposes that it is necessary to actively avoid, remedy or mitigate adverse effects on the aquatic environment and ecosystems, natural character, natural features and landscapes, and to protect amenity and heritage values. This approach is reflected in Rules contained in 12.2.5.

Environment Bay of Plenty proposes that existing structures on, in, under or over the beds of rivers, lakes and wetlands should continue as permitted activities, subject to compliance with a set of standard conditions. In general, existing structures have been previously assessed and do not usually have any significant adverse effects on the environment. Those structures that do have, or cause, any significant adverse effects on the environment, and cannot comply with the standard conditions, will be considered separately as discretionary activities.

The move to make the erection of new structures and excavations (Rules 12.2.5(c)) and 12.2.5(e)) discretionary activities is considered necessary in order to maintain control over the location of structures and minimise the number of additional structures located in, on, under or over the beds of rivers, lakes and wetlands.

This regional plan proposes that the reclamation or draining of river, lake and wetland beds within the Tarawera River catchment become a Discretionary Activity due to the significant localised and widespread effects which such activities cause. Reclamations proposed will be subject to compliance with conditions to ensure any resulting adverse effects on the environment are minimised.

Environment Bay of Plenty proposes that in order to protect the natural character of the environment of the beds of rivers, lakes and wetlands, the planting and removal of plants should be strongly controlled, the control being based on actual or potential effects of such activities. The removal or planting of plants for some purposes, such as soil conservation and weed control purposes, has been permitted, subject to standard conditions, in order to prevent unnecessary bureaucracy in what are generally considered positive or public good activities. A formal willow maintenance control programme is considered necessary in order that such removal is appropriately prioritised. The removal of derelict structures is considered necessary given the number of such structures in or on some parts of the beds or rivers and lakes. The over proliferation of such structures is considered to adversely affect the natural character and amenity value of many river and lake environments.

12.2.7 Anticipated Environmental Results

Anticipated environmental results stemming from the above objective, policies, and methods of implementations are:

12.2.7(a) Minimisation of the deposition of sediment in, on, over or under the beds of rivers and lakes.

12.2.7(b) The maintenance and enhancement of water quality and quantity.

12.2.7(c) The maintenance and enhancement of ecological values.

12.2.7(d) Respect for Maori values and maintenance of traditional rights of access and use.

12.2.7(e) Avoidance and minimisation of the effects of known natural hazards.

12.2.7(f) Avoidance and minimisation of any adverse effects on archaeological or traditional sites.

12.2.7(g) Avoidance and minimisation of the adverse effects of works or activities on natural character and landscape values.

12.2.7(h) The integration of works and activities with the natural character and landscape values of the environment.

13 Freshwater Ecology

13.1 Introduction

Ecology may be broadly defined as the relationship between organisms and their natural environment. The quality of water is generally reflected in the variety and numbers of plants and animals living in it. Through their various functions, organisms modify their aquatic environment by gaseous exchange and by taking up nutrients and other organisms. An understanding of the ecology of the freshwater environment of the lakes, rivers, and wetlands within the Tarawera River catchment is essential in determining how the water resources and their immediate environment will be managed in a sustainable manner.

As indicated in Chapter 7 – *Community Attitudes and Perceptions*, Environment Bay of Plenty proposes that those matters highlighted in section 5(a-c) be tests, all of which must be met in order for an activity to be considered as sustainable. Section 6(a) of the Resource Management Act 1991 specifically charges people to recognise and provide for the preservation of the natural character of wetlands, lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use and development. Section 6(c) of the Act specifically identifies the protection of areas of significant indigenous vegetation and significant habitat of indigenous fauna, to be recognised and provided for as a matter of national importance. Sections 7(d) and 7(h) of the Act require that particular regard be had to the intrinsic values of ecosystems, and the protection of the habitat of trout and salmon.

This chapter outlines those aspects of the freshwater ecology of the rivers, and wetlands within the Tarawera River catchment which has a bearing on the objectives, policies and methods of implementation adopted elsewhere in this regional plan. These are present most notably in the *Surface Water Quantity, Surface Water Quality*, and *River and Lake Beds* chapters. Supporting documents for this chapter are as follows:

Donald, R: 1994 (19 July); Tarawera River Regional Plan Technical Investigations – Freshwater Ecology Component, Environment Bay of Plenty, Whakatane.

McIntosh, J: 1994; Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

13.2 Historical and Cultural Context

Before the 1900s the Tarawera and Rangitaiki Rivers drained extensive wetlands which are now the Rangitaiki Plains. The ecology, value and subsequent loss of this wetland system has been highlighted in a statement by Tuwharetoa ki Kawerau to the Tarawera River Liaison Group[49];

> *Many pa tuna (eel weirs) were situated in the swamp and river. Koura, inanga and other kai was to be found in the whole of the surrounding area. The diversity of life found in the swamp is gone, hemmed into the few remaining wetlands and in some cases has disappeared altogether.*

Well-known sites for the collection of tuna (eel) were at Parawai (Tumurau Lagoon) and Tamurenui Lake[50]. The name of a pa situated on the old riverbank at Onepu,

49 Te Runanga o Tuwharetoa ki Kawerau, 1994.
50 BOPCC, 1985(a).

Te Ahi Inanga, suggests that this is near a site where inanga (whitebait) were collected. While there is less information on the gathering of kai in the upper river catchment it is known that Mangate (or Mangati) Stream was considered a place for eeling. A Maori eeling reserve is present below the Tarawera Falls (Te Tatau a Hape) and large specimens are occasionally collected there to this day.

13.3 Freshwater Ecology in the Water Bodies of the Catchment

For the purposes of this chapter the freshwater ecology of the Tarawera River catchment is discussed in three parts. These cover the Upper Reach of the Tarawera River (upstream of Kawerau Bridge, including the upper tributaries), and the wetlands in the lower catchment.

The ecological information described in this chapter has been collected by Environment Bay of Plenty, external research agencies, and consultants working for industry. Specific environmental investigations, designed to contribute to this regional plan, were carried out by Environment Bay of Plenty between 1991 and 1994. These surveys have concentrated on a number of aspects of the freshwater ecology: undesirable biological growths, macro-invertebrates and fish.

13.3.1 The Upper Reach of the Tarawera River

The water in the Upper Reach of the Tarawera River is generally of a high quality, well oxygenated and of a high visual clarity. Of all the water bodies in the Tarawera River catchment, this can be expected to be the closest to its 'natural' state.

In the Upper Reach of the Tarawera River there is a diverse and abundant aquatic plant community. In 1984 two bryophytes, one fern and eight species of macrophytes were identified[51]. Submerged species (mainly 'oxygen weeds') covered 10-20% of the river bed between the Tarawera Forest and Kawerau. In the same survey a site in the Tarawera Forest was found to support an abundant algal flora. These microscopic plants (mainly diatoms) colonise rocks and plants on the river bed and, where present, form an almost continuous film. A summary of the aquatic plant species found in the Tarawera River is presented in Appendix 13.

The Upper Reach of the Tarawera River supports a diverse and abundant invertebrate community. Invertebrates include the familiar trout nymphs along with other small animals such as snails and worms. Species of mayfly and caddisfly which filter food from the water are the most abundant in the Upper Reach of the Tarawera River while midge-fly larvae (chironomids) make up a small proportion. The mayfly and caddisfly species decline in abundance between the Tarawera Forest and Kawerau. Over this reach the river bed changes from boulders and cobbles to smaller pumice stones and sand which naturally support fewer invertebrates. Koura are present throughout the upper catchment and are particularly abundant in the Lake Tarawera outlet.

The Lake Tarawera outlet if gazetted as a trout-spawning area and plays an important role in the management of the Rotorua District trout fishery. Other fish species which are present at the Lake Tarawera outlet and in the lake are common bully and common smelt. Longfinned eel are present in the lake and are, therefore, likely to be found in the outlet. These eels may have been liberated to the lake or, alternatively, have ascended in the Tarawera Falls as elvers (juveniles). A landlocked population of koaro is present in Lake Tarawera and may also occur in the outlet. This species is assumed to have been liberated to the lake in pre-European times.

[51] Bioresearches, 1987(a).

The Tarawera Falls represent a significant physical barrier to the upstream migration of fish. Longfinned eel, common bully and banded kokopu were found at the base of the falls in 1983[52]. Banded kokopu were not found in a Environment Bay of Plenty survey of 1993 although common bully were recorded along with longfinned eel and abundant elvers. As noted above, it is possible that elvers may negotiate the Tarawera Falls.

Most of the tributary streams of the Upper Reach of the Tarawera River have high water quality and provide ideal fish habitat. Fish species which would be expected to occur in these streams include longfinned eel, rainbow trout, common bully, banded kokopu, koaro, torrentfish and possibly shortjawed kokopu. Of these, only longfinned eel, common bully, a single banded kokopu and rainbow trout have been found.

It is likely that the migration of juvenile native fish to the upper tributaries is hampered by the poorer water quality in the lower river. Iwi have knowledge that since the water quality in the lower river has deteriorated there have been changes to the migration patterns of native fish. Unfortunately the impact of industrial effluent on migration patterns is difficult to assess because there is little information on the tolerances of these species. Other factors such as land use changes (forestry, agriculture and wetland drainage), overfishing (whitebaiting), channelisation and exotic fish introduction may also contribute to the distribution patterns. Research to investigate the health and distribution of native fish is planned.

Between the Tarawera Falls and Kawerau the river supports a regionally important trout fishery. The yield of this fishery is maintained by the high quality of the tributary streams. Of these, Otuhangu (Buddles Creek) is an important spawning stream while the Kaipara Stream appears to be a significant juvenile rearing area.

The 10 kilometres of river downstream of the Tarawera Falls is notable in that it provides habitat for a river resident breeding population of New Zealand Scaup. This is unusual as most scaup populations require a lake habitat for breeding. Other bird species using the river include pukeko, grey and mallard ducks, shags, kingfishers and spotless crake in the swampy areas.

13.3.2 The Lower Reach of the Tarawera River

The Lower Reach of the Tarawera River may be divided into sections upstream and downstream of the Tasman Pulp and Paper Company Limited oxidation pond discharge. Upstream of the discharge area there is a high diversity and cover of aquatic plants. The highest diversity of submerged species has been found just upstream of the Tasman Pulp and Paper Company Limited discharge where they covered up to 35% of the river bed.

Downstream of the Tasman Pulp and Paper Company Limited discharge the aquatic plant communities are significantly altered. The rooted species present in this lower section of the river tend to be those that have the main part of their foliage out of the water. While these 'emergent' species cover up to 25% of the river bed the submerged species cover less than 5%. The algal flora supported downstream of the Tasman Pulp and Paper Company Limited effluent discharge is sparse to absent.

In 1993 a survey[53] documented that undesirable biological growths,[54] composed predominantly of *Ulothrix* and *Thiothrix* species, were identified in the Tarawera

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52 Bioresearches, 1987(b).

53 Donald, R 1994 (May) Tarawera River Regional Plan Technical Investigations – Freshwater Ecology Component, Environment Bay of Plenty, Environmental Report 94/1. 121pp.

54 "Undesirable biological growths" are covered in detail in the Ministry for the Environment publication Guidelines for the control of undesirable biological growths in water (June 1992).

River downstream from the Caxton Paper Limited effluent outfall. From 1995 to July 2001 these species have not been noted.

Industrial discharges have a major impact on the invertebrate communities supported in the Lower Reach of the Tarawera River. An increase in the abundance of pollution-tolerant species between the Tarawera Forest and Kawerau is thought to be due to diffuse stormwater inputs from Kawerau township. Despite this, the communities recorded at Kawerau are typical of clean water conditions, being dominated by species of mayfly, caddisfly and midge larvae. Between the Kawerau Bridge and the Carter Holt Harvey Tissue effluent outfall, a further small increase in the abundance of pollution tolerant midge larvae and worms occurs. Although the groundwater flow into the river contains discharges from the RIB's, the treatment capability of the RIB's has ensured that no significant impact on the river has yet been measured.

Downstream of the industrial discharges, sensitive invertebrate species reduce, being replaced by large numbers of midge larvae, worms and snails. Similar communities are supported down the remaining length of the Tarawera River with little return of the sensitive species. Even if the industrial discharges were not present, the changes in habitat of the Lower Reach of the Tarawera River resulting from the straightening and diverting carried out in the early 1900s, make it less suited to supporting large numbers of the sensitive invertebrate species that occur above Kawerau Bridge.

Freshwater fish communities in the Lower Reach of the Tarawera River have been affected by the drainage and consequential loss of wetlands, the straightening of the river, flood protection works and industrial discharges. Indigenous fish communities may have been affected by the introduction of trout. There is anecdotal evidence that before the construction of the Tasman Pulp and Paper mill in the 1950s the lower river supported a trout fishery along with significant numbers of common smelt and inanga (whitebait). Common smelt have returned and are present in high numbers. Inanga and trout stocks are present. No inanga were recorded during several days of seine nettings in the lower river in 1994. However, adult inanga have been recorded at the Tumurau Lagoon weir and at Kawerau Bridge. Thus it is likely that inanga are using the main river as a migration route to the tributary streams rather than as habitat.

The western tributary streams of the Lower Reach of the Tarawera River have high water quality and provide ideal fish habitat. These streams have been identified as particularly important for the conservation of native fish values in the catchment. As an example, the Mangaone Stream holds nine species of native fish including the only known stream population of koaro in the Tarawera River catchment. It has been suggested that spawning trout in the Mangaone Stream have migrated upstream from the Lower Reach of the Tarawera River. Whether or not this is the case, it is likely that the tributary streams will play an important part in the re-establishment of a trout fishery in the lower river.

Despite major eel kills in the 1970s, the lower river now supports a large population of these tolerant fish, due in part to the reluctance of eel fishers, particularly traditional harvesters Tuwharetoa ki Kawerau, taking eel due to the degraded mauri of the river. Shortfinned eels are known to be ten times more abundant below the Tasman Pulp and Paper Company Limited oxidation pond discharge than in the Kawerau area. These eels appear healthy but those exposed to effluent show a number of stress responses. These include changes in liver structure (enlargement, tissue die-off, fatty changes) and changes in blood chemistry and cell counts.

The productivity of common smelt in the Lower Reach of the Tarawera River appears to be enhanced by the industrial discharges. Compared to smelt in the nearby Rangitaiki River, the Tarawera Smelt are larger and produce more eggs. Diet analysis suggests that these differences are related to food supply. Small crustaceans, the dominant smelt food in the Tarawera River, would be expected to

feed on the high concentrations of bacteria present in and encouraged by the major discharges. Support for this conclusion has come from studies on freshwater mussels and finger-nail clams. These studies have concluded that the growth and reproduction of these animals is increased by inputs of food present in the Tasman Pulp and Paper Company Limited effluent.

The Lower Reach of the Tarawera River is used by a variety of birds including grey and mallard ducks, pukeko, shags, fantail, welcome swallow, kingfisher, gulls, pied stilt, white-faced and white heron. It is not known if these species are affected by the poor water quality, although diving species would have difficulty in obtaining food downstream of the Tasman Pulp and Paper Company Limited discharge due to the discoloured water. No investigations have been undertaken on waterbirds to determine their health in this environment.

Relatively little is known of the ecology of the drainage canals which enter the Lower Reach of the Tarawera River. The Awaiti Canal and the Old Rangitaiki Channel drain immediately upstream of the river mouth and form part of the Rangitaiki Plains drainage system. Water quality in the canals is poor, reflecting the intensive agriculture in their catchments. In particular, dissolved oxygen concentrations and light penetration are low while nutrient concentrations are high. Species of fish tolerant of these conditions include shortfinned eels, goldfish and mosquito fish and these are abundant in both canals. Yelloweyed mullet are known to enter the canals from the sea to feed while inanga and smelt have also been recorded. Hornwort is the dominant aquatic plant forming dense beds in shallow areas where light penetration is adequate for growth.

13.3.3 Wetlands in the catchment of the Lower Reach of the Tarawera River

Wetlands are important due to:

- Their biological productivity;
- The habitat they provide for many species;
- Their role in flood control;
- The recreational opportunities they give;
- Their role in protecting species diversity;
- Their importance as a food source for tangata whenua;
- Their cultural and historical values.

Intentional and inadvertent destruction of many freshwater and coastal wetland systems has occurred throughout New Zealand and is still continuing in some areas today. Recently, the ecological and physical importance of these environments as wildlife habitats, botanical communities, water purification sites and areas for flood control, has been recognised. This has highlighted the significant adverse effects that will result from a failure to preserve and effectively manage remaining wetlands areas.

Plants growing in a wetland habitat are specially adapted to living in wet conditions. Usually there is a gradual transition in plant types, changing from dryland species bordering the wetland fringe, to those which exist completely underwater. Wetlands often form zones of natural succession and ecosystem change (ecoclines) eventually leading to the creation of drylands. The resulting diversity in physical conditions such as water depth, fertility, substrate and temperature ensure the formation of complex and unique plant communities.

These original communities tend to be made up of native species with relatively narrow ecological habitats and specific physical requirements. As a result they are sensitive and vulnerable to long-term environmental changes, particularly to reduced water levels. When put under stress, wetland vegetation communities become susceptible to invasion by introduced plants and usually lose species diversity.

The wetland areas connected to the Lower Reach of the Tarawera River comprise some of the most important wildlife habitat remaining in the lower catchment (Map 6). These wetlands are remnants of the original vegetation which once extensively covered floodplains of the Tarawera and Rangitaiki Rivers. Subsequent river straightening and drainage of the land for agriculture and urbanisation have resulted in a significant loss of wetland habitat leaving only small, relatively isolated patches totalling approximately 1.7% of the original wetlands. Many of these areas of significant indigenous vegetation and provide a significant habitat for indigenous fauna. Thus their protection is to be provided for as required under section 6(c) of the Resource Management Act.

13.3.3(a) Sites of International Botanical Importance

None of the Tarawera wetlands are known to contain any endemic plant species classed as endangered and therefore they cannot be classified as sites of international botanical importance.

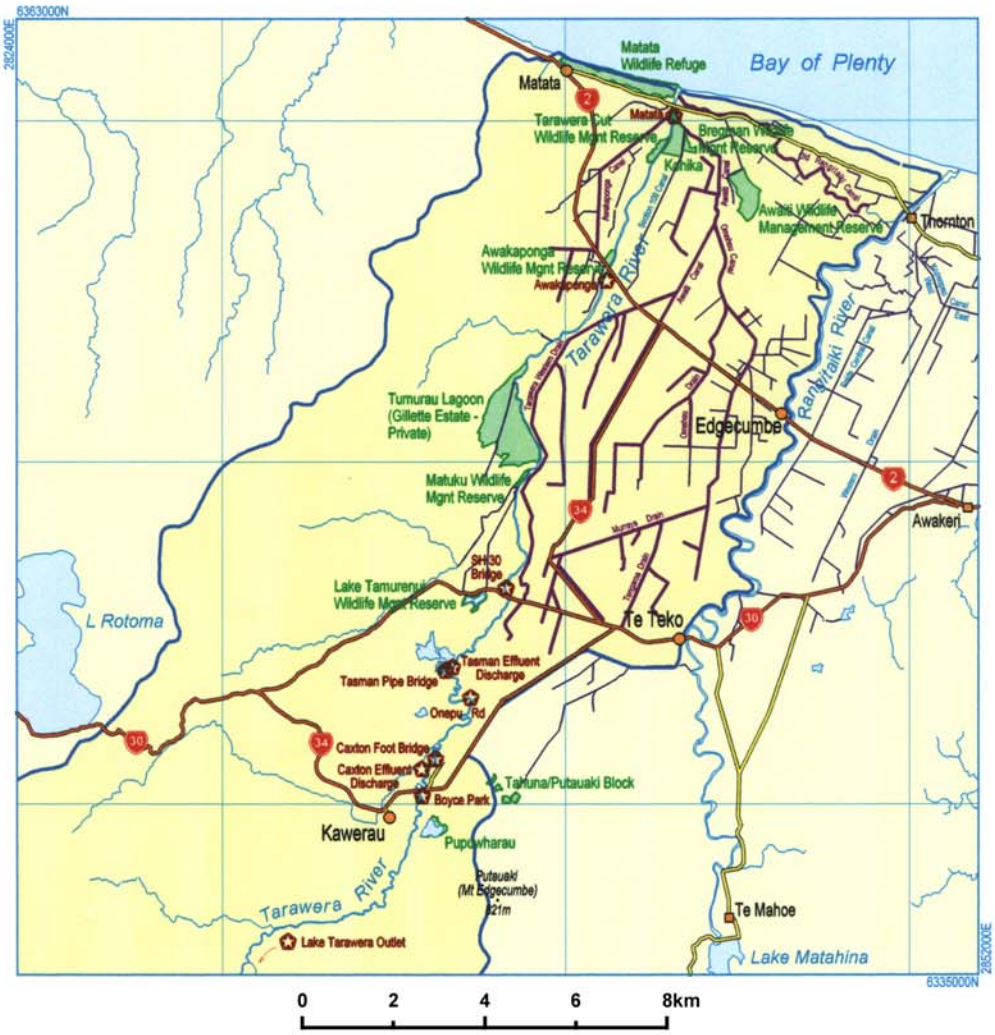
13.3.3(b) Sites of National Botanical Importance

Five of the ten wetlands are known to contain colonies of swamp fern (*Thelypteris confluens*). This species has been variously described as vulnerable, threatened and rare. Colonies of *Cyclosorus interruptus*, another species of fern, are also found in seven of the wetland areas. This species also has a status of rare. *Juncus holoschoenus*, recently reclassified from indeterminant to rare, is found at Lake Tamurenui. This reclassification allows Lake Tamurenui to be classified as a wetland of national botanical importance.

Map 6

Regional Plan for the Tarawera River Catchment

Lower Tarawera Environment



LEGEND

- Labstar Sampling Site
- Artificial Watercourse Open to Fish Passage
- Artificial Watercourse Not Open to Fish Passage
- Natural Watercourse
- Wetland
- Tarawera River Catchment Boundary
- State Highway
- Main Road

C1623-6

Altogether ten sites are known to contain one or several of the above species and so can be classified as wetlands of national botanical importance. These are shown on Table 6.

13.3.3(c) Sites of Regional Botanical Importance

The remaining wetlands in the Tarawera River catchment which are not known to contain threatened plant species are significant as remnants of the original vegetation. Several of these contain species that are uncommon in the area. These features enable all of the remaining wetlands of the Lower Tarawera to be classified as having botanical importance on a regional scale.

13.3.3(d) Botanical Conservation Value

Wetlands can be ranked according to their botanical conservation values. These rankings are arrived at using a set of criteria based on sound conservation values and scientific principles[55]. The criteria include the presence of threatened species but also require judgements on the representativeness of the vegetation on a national and ecological district basis, its degree of modification, the presence of rare communities and the presence or absence of introduced plants. It is, therefore, a more inclusive assessment of the specific botanical importance of a site. Tables 6 and 7 contains a summary of the botanical conservation and protection status values for wetlands in the catchment of the Lower Reach of the Tarawera River.

Table 6

BOTANICAL CONSERVATION VALUES OF WETLANDS IN THE CATCHMENT OF THE LOWER REACH OF THE TARAWERA RIVER

Wetland	Exceptional	Very High	High	Moderate	Low
Lake Pupuwharau		x	x		x
Tahuna-Putanaki		x	x		x
Lake Tamurenui			x	**x**	x
Tumurau Lagoon	x	x			
Awakaponga Wetlands			x	x	x
Awaiti Wetlands		x	x		x
Tarawera Cut		x	x		x
Matata Lagoon	x	x			x
Bregman Lagoon			x	x	x
Matuku Wetlands					x

Matata Lagoon and Tumurau Lagoon[56] have plant communities with exceptional and very high botanical conservation value. This corresponds to Matata Lagoon as one of the best examples of saline wetlands with contiguous freshwater wetland in the Te Teko Ecological District and Tumurau Lagoon as the best example of primary wetland vegetation in the District.

Vegetation of very-high botanical conservation value is also present in the Tahuna-Putanaki Block, Awaiti Wetlands, and Tarawera Cut Wildlife Management Reserve. A very-high botanical conservation value is applied to those wetland sites containing vegetation types which represent the remaining natural vegetation in an ecological district.

Lake Pupuwharau, Awakaponga Wetlands, Lake Tamurenui and Bregman Lagoon all contain vegetation with a high botanical value. This high value applies because

55 Shaw, 1988

56 Also known as Braemar and Gillette Lagoons.

of the presence of secondary vegetation which has developed after disturbance. In ecological districts where there are very few remaining examples of natural vegetation, this secondary vegetation becomes representative of the habitat still remaining.

The following order of comparative wetland value has been established from the information in Table 6:

Highest Value:

- Matata Lagoon
- Tumurau Lagoon
- Lake Pupuwharau, Tarawera Cut, Tahuna-Putanaki Block and Awaiti Wetlands
- Bregman Lagoon and Lake Tamurenui
- Awakaponga Wetlands

Lowest Value:

- Matuku Wetlands

Such a ranking system may be useful when considering conservation priorities. Thus, the highest value sites should have the highest priority for botanical conservation efforts.

13.3.3(e) Wildlife Values

Those wetlands which provide fish access to the Lower Reach of the Tarawera River can be expected to contain a variety of fish species. For example, the Matata Lagoon contains an abundant shortfinned eel population with high numbers of common bully and mosquitofish. A number of species, including inanga, common smelt, banded kokopu and common bully, are thought to spawn in the Lagoon. Estuarine/lowland species which live in the lower Lagoon include giant bully, parore, grey mullet and yelloweyed mullet.

Nearly forty species of waterbirds use the wetlands of the catchment of the Lower Reach of the Tarawera River. Threatened species include New Zealand dabchick and North Island brown kiwi. Both have been reported at Tumurau Lagoon and dabchick have been observed at Matata Lagoon and Lake Tamurenui. Other threatened species include banded dotterel, white heron, reef heron, banded rail, Australasian bittern, and North Island fernbird. The presence of these threatened wildlife species adds to the national and regional importance of the Tarawera wetlands.

The presence of rare waterbirds, common waterfowl and upland game is significant to statutory organisations such as the Eastern Region Fish and Game Council and the Department of Conservation. Wetlands may be used for recreational purposes including bird watching and duck shooting. These pursuits are allowed in some wildlife management reserves such as Lake Tamurenui and Bregman Lagoon.

Unfortunately, recreation and conservation do not always go hand in hand. The Awaiti Wetland has been substantially altered and disturbed by activities such as artificial pond construction, grazing to maintain low vegetation and development of vehicular tracks to allow access. These activities were largely designed to encourage game birds and provide access for hunters. Approximately a third of the Awaiti Wildlife Management Reserve is currently administered on a day to day basis by the Eastern Region Fish and Game Council who encourage development of maimai within the reserve area. It is important to ensure that the recreational use of the wetlands does not unduly compromise their conservation.

Table 7

PROTECTION STATUS, AREA, NUMBER OF THREATENED PLANT SPECIES, AND BOTANICAL IMPORTANCE FOR WETLANDS ASSOCIATED WITH THE LOWER REACH OF THE TARAWERA RIVER

Site	Protection	Area (Ha)	Vulnerable	Rare	Local	Uncommon *	Importance
Lake Pupuwharau	N.F.P.	40		1		6	National
Tahuna-Putanaki Block	N.F.P	?	1				National
Lake Tamurenui	W.M.R.	17					Regional
Tumurau Lagoon	C.C.	140		2		1	National
Awakaponga Wetlands	W.M.R.	8.1		1			National
Awaiti Wetlands	W.M.R.	80		2			National
Tarawera Cut	W.M.R.	14		2			National
Matata Lagoon	W.R.R.	110		1	1	4	National
Bregman Lagoon	W.M.R.	8.6		2			National
Matuku Wetlands	W.M.R.	11		1			National

* Number of species present which are uncommon in the Ecological District
N.F.P. = No Formal Protection
W.M.R. = Wildlife Management Reserve
C.C. = Conservation Covenant under the Reserves Act 1977
W.R.R. = Wildlife Refuge Reserve

13.4 Sustaining Life Supporting Capacity

Aquatic ecosystems often cope with brief environmental changes. However, the ability of organisms to tolerate prolonged changes in factors such as dissolved oxygen, light intensity, toxicity, temperature, pH and obstructions to migration is often limited.

In this section the threats to freshwater ecosystems in the Tarawera River catchment are reviewed. Many of the policies and methods which are expected to mitigate these threats are presented in Chapter 15 – *Surface Water Quality*. They reflect the intimate link between water quality and aquatic ecology. Where appropriate, these policies and methods are cross-referenced and briefly discussed here.

13.4.1 Dissolved Oxygen Content

Environment Bay of Plenty has identified the dissolved oxygen content of the Tarawera River to be a central issue in the preparation of this regional plan. The lower river is unusual in that at least 90% of the present dissolved oxygen depletion is due to oxygen uptake by bacterial communities present in the sediment. The river bed comprises moving dunes composed of porous pumice sediment. This provides an ideal habitat for oxygen-consuming bacteria which primarily feed on the industrial effluent. Thus, the physical nature and the sediment ecology of the river limit its ability to assimilate effluent without significant depression of oxygen levels.

The oxygen requirements of aquatic organisms have been extensively studied. The United States Environmental Protection Agency[57] stated:

> *There is apparently no concentration level to which the oxygen level of natural waters can be reduced without causing or risking some adverse effect on the reproduction, growth and consequently the production of fishes inhabiting those waters.*

There is relatively little information on the dissolved oxygen requirements of New Zealand's indigenous fish. Generally those species that would be expected to be present in the main stem of the Lower Reach of the Tarawera River tolerate lowered oxygen levels. These species include eels, bullies, smelt and inanga. Dissolved oxygen levels are likely to be most critical to native fish during the upstream and downstream migration of juveniles.

The concept of using a Fish Purpose classification is not on the basis of recreational fishing but on the basis of developing a viable trout fishery that is indicative of a healthy sustainable environment.

While it has been suggested that adult trout are present in the Lower Reach of the Tarawera River, it is considered that dissolved oxygen levels will need to be improved to become consistent with Fish Purpose standards which indicate a health river environment[58]. Environment Bay of Plenty has adopted the approach of the USEPA[59] in setting dissolved oxygen standards for the main stem of the Lower Reach of the Tarawera River. These are intended to provide protection for cold-water fisheries values (e.g. trout) using a staged approach as outlined in Table 8 below (Rule 15.8.4(h)(i)).

Table 8

OXYGEN CLASSIFICATION – FISH PURPOSES LOWER TARAWERA RIVER

Period	Mean of any consecutive 30 days	Mean minimum of any consecutive 7 days	Absolute Minimum
To 31 December 2002	5.0 g/m^3	4.0 g/m^3	3.5 g/m^3
From 1 January 2003	6.0 g/m^3	5.0g/m^3	4.5 g/m^3

Environment Bay of Plenty believes that these standards will provide adequate protection for aquatic life which would normally be expected in the main stem of the Lower Reach of the Tarawera River. The standards for the catchment of the Upper Reach of the Tarawera River and all tributaries of the Tarawera River excluding the drains of the Rangitaiki Plains specify that the dissolved oxygen concentration shall exceed 80% of the saturation concentration (see Chapter 15 – *Surface Water Quality*).

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57 Cited in NWASCO, 1979.

58 The Tarawera River Liaison Group were in general agreement that the re-establishment of a trout fishery was a reasonable restoration goal for the Lower Tarawera River.

59 USEPA, 1986.

13.4.2 Light Penetration (Colour and Clarity)

The major ecological impact of reduced water clarity in the Lower Reach of the Tarawera River is the reduction of submerged aquatic plant communities. Inputs of colour from Tasman Pulp and Paper Company Limited discharge clearly reduce light penetration to the river bed. As a result, the potential habitat available for aquatic plants has been reduced by the Tasman Pulp and Paper Company Limited discharge. Similar lowland systems with adequate light penetration (e.g. the Kaituna and Rangitaiki Rivers) are known to support large areas of aquatic plants. However, there is uncertainty as to whether the mobile bed of the Lower Reach of the Tarawera River would support similarly abundant communities and associated biota.

The feeling of predatory fish which visually search for prey is likely to be affected downstream of the Tasman Pulp and Paper Company Limited outfalls. In particular, the feeding of trout could be impaired because of reductions in the distance at which the prey can be seen. As discussed in section 13.3.2, the ability of smelt to collect food in the lower river does not appear to be significantly impaired. Because of the lower visual clarity it might be expected that these fish are themselves less vulnerable to predation by other fish and waterbirds.

Rules relating to the maintenance of colour and clarity standards in the water bodies of the Tarawera River catchment are given in Chapter 15 – *Surface Water Quality*. With regard to the Lower Reach of the Tarawera River, Rule 15.8.4(h)(ii) states (in part) that there shall be no decrease in visual clarity of the surrounding water upstream of any discharge that would (or may) reduce clarity, in this case water at the Kawerau Bridge monitoring site. In the long-term, this rule is expected to provide an improvement in the visual appearance of the river and enhance aquatic habitat.

13.4.3 Toxicity and Instream Impact

Toxicity testing has been carried out on Tarawera River water and on the major industrial effluents. Tests on a number of organisms showed that toxicity was found to be moderate in undiluted geothermal effluence, slight for the Carter Holt Harvey Tissue CTMP effluent and minimal for the Tasman Pulp and Paper Company Limited[60]. In contrast, the hatching of eggs and larval survival of zebra fish have been found to be severely affected by undiluted Carter Holt Harvey Tissue effluent, indicating high toxicity[61]. Standard toxicity tests have revealed no toxicity in river water collected downstream of the mixing zone[62] of any of the major discharges. This is due to the generally high dilution rates of the toxic effluents, including geothermal discharges and Carter Holt Harvey Tissue CTMP effluent discharges, in the river water.

Environment Bay of Plenty has used aquatic invertebrate communities to assess trends in the water quality and hence the life supporting capacity of the Tarawera River. Invertebrate species vary widely in their tolerance to pollution. For this reason the occurrence of sensitive or tolerant species can be used as an ecological indicator of water quality. Established impact assessment protocols[63] have been applied to the Tarawera River invertebrate data sets. This has allowed the level of industrial impact on the invertebrate communities to be expressed within a scale ranging from no impact to severe impact.

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60 Hickey, 1994.

61 Beresford, 1993.

62 The setting of mixing zones is discussed in the *Surface Water Quality* Chapter.

63 USEPA, 1989.

Since 1983 the ability of the Lower Reach of the Tarawera River to support balanced invertebrate communities has been significantly reduced. In 1983 the Kawerau sewage and Tasman Pulp and Paper Company Limited oxidation pond outfalls caused a moderate level of impact. There was no apparent impact from the Carter Holt Harvey Tissue outfall which at that time discharged clarifier effluent only. By 1991 the impact attributed to the Carter Holt Harvey Tissue effluent had increased to moderate, with a gradual downstream increase leading to severe impact upstream of the Tasman Pulp and Paper Company Limited outfalls. This severe impact caused the near complete loss of sensitive species and a marked increase in the abundance of pollution-tolerant species.

The increase in impact since 1983 is due to the discharge from the Carter Holt Harvey Tissue anaerobic effluent treatment plant which began operation in the early 1990s. As a result the sensitive, and important, mayfly and caddisfly species are not present to colonise in significant numbers downstream of the Carter Holt Harvey Tissue outfall. It is clear that the chemical inputs from the Tasman Pulp and Paper Company Limited and Works Geothermal effluents have been measurably reduced over the past decade. Unfortunately, any reduction in the impact of these effluents is difficult to assess because of the large increase in the impact of the Carter Holt Harvey Tissue effluent.

Within the toxicity literature there is uncertainty regarding the ability of laboratory toxicity tests to predict instream ecological impact. For this reason Environment Bay of Plenty intends to use a number of methods to monitor trends in the environmental performance of industry. Thus, assessments of instream community impact will be carried out in tandem with laboratory toxicity testing procedures (see Chapter 19 – Monitoring and Review). This monitoring may reveal whether instream exposure leads to actual mortality, or if in fact the observed invertebrate impact is due to avoidance of poor water quality or degraded substrate.

Rules relevant to toxicity in the water bodies of the Tarawera River catchment are given in Chapter 15 – *Surface Water Quality*. Environment Bay of Plenty proposes that there shall be no detectable increase in acute and chronic toxicity using a number of defined testing protocols (see section 15.8.4).

13.4.4 Water Temperature

As discussed in the Chapter 15 – *Surface Water Quality*, fish and invertebrates are generally considered to become stressed at temperatures above 25°C. Elevated temperatures are known to increase the amount of oxygen required by fish. Furthermore, the combined effects of heat stress and contamination also appears to increase fish mortality rates[64].

13.4.5 pH

No specific ecological issues have been identified in the Tarawera River catchment as a result of changes in pH. Most of the water bodies in the Tarawera River catchment have pH levels near neutrality (pH 7-8). It is generally accepted that pH levels of 5-9 will not unduly impact on aquatic communities. Environment Bay of Plenty proposes that the sustainable pH in the Lower Reach of the Tarawera River be between 6.5 and 8.5 (Rule 15.8.4(h)(v)). This more restrictive range is appropriate because of the potential for changes in the toxicity of ammonia and hydrogen sulphide with changes in pH.

64 NWASCO, 1979.

13.4.6 Biological Growths

In December 1993, Environment Bay of Plenty carried out a survey[65] of biological growths in the Tarawera River. The survey found undesirable biological growth of genus *Ulothrix* and Thiothrix in parts of the lower river. The impact of these growths on the ecology and water quality of the river is difficult to determine. Generally, New Zealand rivers with similar growths have tolerant invertebrate faunas dominated by snails, worms and midge larvae. Such communities have been recorded below the Carter Holt Harvey Tissue outfall where they replace the more sensitive mayfly and caddisfly species[66].

Rules relating to the restriction of undesirable biological growths in the water bodies of the Tarawera River catchment are given in Chapter 15 – *Surface Water Quality*.

13.4.7 Physical Restrictions to Migration

Flow and flood control structures in the Lower Reach of the Tarawera River system have been identified as the main impediment to fish migration. Most free-swimming species have both seasonal and lifecycle movement patterns, and in some instances are restricted by the physical aperture of flow control structures, or more usually by the fall and velocity of flow across the structure. Map 6 identifies the main known obstructions to fish passage identified in the Lower Tarawera catchment. Most of these are positioned at the ends of drainage systems to prevent the backflow of floodwater, and to maintain water levels during times of low rainfall.

13.4.8 Wetlands in the catchment of the Lower Reach of the Tarawera River

The following are considered to be the major threats to the wetlands of the catchment of the Lower Reach of the Tarawera River.

13.4.8(a) Wetland Desiccation and Lowering of Water Levels

Many of the remaining wetlands are threatened by continued drainage of the surrounding land and steadily dropping water table levels. In certain places weirs have been built (Tumurau Lagoon, Matata Lagoon) and ponds excavated (Awaiti Wetland) to maintain water levels. Despite these measures there are still areas where dryland plants are taking over wetlands.

13.4.8(b) Grazing and Trampling by Livestock

Many of the wetlands are subjected to grazing and trampling damage by livestock. For example, trampling damage to rare swamp ferns (*Thelypteris confluens* and *Cyclosorus interruptus*) has been identified in the Bregman Wildlife Reserve. The trampling of dense vegetation may also reduce the available habitat for secretive waterbirds such as spotless crake and bittern.

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65 Donald, R 1994 (May) Tarawera River Regional Plan Technical Investigations – Freshwater Ecology Component, Environment Bay of Plenty, Environmental Report 84/1. 121pp.

66 "Undesirable biological growths" are covered in detail in the Ministry for the Environment publication Guidelines for the control of undesirable biological growths in water (June 1992).

13.4.8(c) Vehicle Damage and Human Activities

During the duck shooting season, raupo clearance by herbicide spraying and vegetation cutting to clear tracks is carried out at selected sites (Tumurau Lagoon, Tahuna-Putanaki Block). Areas of wetland vegetation around the privately-owned Lake Pupuwharau have been extensively damaged by vehicle tracks.

13.4.8(d) Industrial Contamination

Significant contamination from the pulp and paper industry has been found in sediments from the lower eastern part of the Matata Lagoon. DHAA (dehydroabietic acid) and other resin acids are present at concentrations 10-15 times higher than background levels[67].

13.4.8(e) Agricultural Nutrient Pollution

The Awaiti Wetland is fed by water flowing via the Awaiti Canal. This water can be nutrient rich, due largely to discharge of dairy shed effluent into the canal. The high nutrient load is a cause for concern as it increases the risk of infestation by water net and other aquatic weeds. Aquatic animals and plant life tend to suffocate under these conditions, resulting in less species and invasion by introduced plants.

13.4.8(f) Invasion by Introduced Plants

Declining water levels tend to result in increasing numbers of introduced plants into areas formerly dominated by flax and sedges. A large introduced fern, *Osmundo regalis*, was found in the Bregman Wildlife Reserve in 1983. This plant has the potential to exclude threatened and local wetland plants. Problem plants in many of the wetlands include grey willow, privet, pampas, radiata pine, reed sweetgrass and raupo.

13.4.8(g) Sedimentation and Infilling

Over the past few decades infilling and sedimentation have lowered the depth of water in the Matata Lagoon. This has encouraged invasion by marginal vegetation, particularly raupo. Wood fibre from the pulp and paper mills upstream was deposited during the 1960s when high tides raised the level of the Tarawera River which subsequently flowed into the Lagoon. This formed a deep layer of dark-coloured organic sediments.

13.4.8(h) Lack of Protected Area Status

Lake Pupuwharau and the Tahuna-Putanaki Block are among the most valuable wetlands that are not legally protected. This leaves them vulnerable to private land uses.

13.5 Issues, Objectives, Policies, Methods of Implementation, Principal Reasons and Anticipated Environmental Results

13.5.1 Issues

The following are considered by Environment Bay of Plenty to be the important ecological issues affecting the water bodies of the Tarawera River catchment (excluding the Tarawera Lakes):

[67] Wilkins and others, 1992.

13.5.1(a) Dissolved oxygen depletion is high in the Lower Reach of the Tarawera River.

13.5.1(b) The discharge of coloured effluent decreases light penetration which in turn can limit the growth of aquatic plants.

13.5.1(c) In 1993 undesirable biological growths were recorded in the Tarawera River downstream from the Carter Holt Harvey Tissue discharge.

13.5.1(d) The ecological impact caused by changes in the technology of industrial discharge treatment cannot be predicted with certainty.

13.5.1(e) Poor water quality in the lower river may be reducing the success of juvenile fish migration to the upper tributaries.

13.5.1(f) Dissolved oxygen concentrations are occasionally too low to sustain a viable trout habitat in the reach of the Tarawera River between Braemar and the river mouth.

13.5.1(g) Dissolved oxygen concentrations are occasionally too low to allow the full life cycle of all native fish in the lower reach of the Tarawera River to be completed without effects.

13.5.1(h) Eels in the lower river are showing minor stress symptoms attributed to pulp and paper contaminants.

13.5.1(i) Smelt growth appears to be indirectly enhanced by the industrial inputs.

13.5.1(j) The wetlands of the lower catchment represent 1.7% of those which once covered floodplains of the Tarawera and Rangitaiki Rivers.

13.5.1(k) The botanical and wildlife values of catchment habitats including wetlands and lakes are threatened.

13.5.1(l) Wetlands and lakes are variously threatened by nutrient and contaminant inputs, exotic plant infestation, over drainage, siltation and direct physical damage.

13.5.1(m) Historical pulp and paper industry contaminants in sediments in the eastern part of Matata Lagoon are a concern.

13.5.2 Objectives

13.5.2(a) Protection, maintenance and enhancement of the life supporting capacity of surface water bodies in the Tarawera River catchment.

13.5.2(b) Protection, maintenance and enhancement of the indigenous vegetation, habitat and migration pathways of the remnant wetlands, lakes, rivers and their margins in the Tarawera River catchment.

13.5.3 Policies

Note: *Policies relevant to Objective 13.5.2(a) (life supporting capacity of all surface water bodies) are given in Chapter 15 – Surface Water Quality.*

Policies relevant to Objective 13.5.2(b) (wetlands in the lower catchment) are given below and in Chapter 14 – Surface Water Quantity.

13.5.3(a) To ensure that the natural character of wetlands, lakes, rivers and their margins is not further degraded but is enhanced or protected from inappropriate subdivision, use and development.

13.5.3(b) To ensure that wetland, river and riparian values are provided for when maintaining and establishing drainage systems.

13.5.3(c) To discourage subdivision and development that results in the drainage, fragmentation or destruction of wetlands, riverine and riparian habitats.

13.5.3(d) To discourage the access of stock into wetlands and riparian margins and promote the effective fencing of wetlands and riparian margins.

13.5.3(e) To promote the restoration and enhancement of wetlands, lakes and riverine habitats; and their riparian margins.

13.5.3(f) To promote the creation of new wetlands.

13.5.3(g) To ensure that the existing wetland habitats are preserved and the creation and development of new wetland habitats encouraged.

13.5.3(h) To ensure that wetland and river habitats and migration pathways are conserved and, as appropriate, enhanced.

13.5.4 Methods of Implementation

Note: Methods of Implementation, Principal Reasons and the Anticipated Environmental Results relevant to Objective 13.5.2(a) are given in Chapter 15 – Surface Water Quality.

Methods of Implementation relevant to Objective 13.5.2(b) (wetlands in the lower catchment) are given below and in Chapter 14 – Surface Water Quantity).

Environment Bay of Plenty will:

13.5.4(a) Make appropriate submissions to district councils through the statutory consents process, to discourage the subdivision (resulting in fragmentation), drainage and development of wetlands.

13.5.4(b) Cooperate with relevant organisations and individuals to determine the most appropriate methods for the protection and enhancement of wetlands, river and lake habitats, and their riparian margins.

13.5.4(c) Promote the maintenance of water levels in wetlands within the minimum and maximum levels specified in Rule 14.4.5(a) (Chapter 14 – *Surface Water Quantity*).

13.5.4(d) Research, in conjunction with district councils, tangata whenua, the Department of Conservation, Eastern Region Fish and Game Council, and other relevant organisations and individuals, the importance of the natural values of the wetlands, lake and riverine habitats and riparian margins in sustaining natural habitats and communities.

13.5.4(e) Promote, in conjunction with district councils, the Department of Conservation, Eastern Region Fish and Game Council, and other relevant organisations and individuals, research into the location and significance of the wetland and river habitat and migration pathways of aquatic life, particularly native fish species, and fish food species.

13.5.4(f) Manage its flood control and drainage activities to minimise adverse effects on aquatic habitat and where practicable enhance the natural character and ecological values of the Tarawera River catchment.

13.5.5 Principal Reasons

Much of the lowland Tarawera River has been realigned and channelled for flood control and drainage purposes and there are conflicts between the management of the wetlands and the drained land. Less than 2% of the original Tarawera River catchment wetlands and the habitat they provide remain. These wetlands are important representative remnants of lowland ecosystems and their retention and rehabilitation requires interventional management, including ensuring minimum water levels and reliable water supply. Policy requiring the careful management of drainage and flood control systems is necessary to ensure that the remnant wetlands are not deprived of an adequate water supply. This should ensure that their viability is not placed at risk and their natural values are not damaged.

Subject to the efficient performance of their drainage function, policy is also necessary for the appropriate management of drains and canals to ensure the protection of the natural values they provide. This includes providing for whitebait spawning habitat and migration routes for the native fish.

13.5.6 Anticipated Environmental Results

13.5.6(a) Remaining wetlands are identified and protected.

13.5.6(b) Wetlands, lakes and riverine habitats, and riparian margins are protected and enhanced.

13.5.6(c) The natural values of wetlands, riverine and lake habitats riparian margins are recognised and provided for.

13.5.6(d) Additional wetlands may be identified, created and maintained.

14 Surface Water Quantity

14.1 Introduction

This chapter addresses surface water quantity within the Tarawera River catchment, and discusses factors that may affect surface water quantity availability and allocation. Surface water is that which exists in lakes, rivers and wetlands. Matters related to groundwater are not discussed in this chapter, although it is important to recognise that surface and groundwater systems are interconnected. Groundwater is covered in Chapter 16 – *Groundwater Quality and Quantity*.

The flow of rivers and levels of lakes and wetlands in the Tarawera River catchment is influenced by a number of different factors. Some effects on water flows and levels are naturally occurring, termed natural perturbations, such as long-term and short-term rainfall changes and seasonal fluctuations in rainfall, while others are human-induced, such as abstractions, damming and diversions for agricultural or industrial purposes.

This chapter highlights those human-induced factors which are considered to affect, or have a potential effect, on river flows, and lake and wetland water levels. It concludes with a series of methods of implementation, including rules, aimed at avoiding, remedying or mitigating any actual or potential adverse effects related to the allocation of surface water.

The quantity of water in a water body has a direct bearing on a water body's ecosystem, its potential to flood, its use for a wide variety of purposes including recreational activities, and its ability to assimilate contamination. The main concern with regard to water quantity in rivers and lakes is the abstraction of water, rather than the discharge of water to surface water. In wetlands, the primary concern is the maintenance of water levels within ranges which will ensure the integrity of the natural environment and ecosystems.

In the catchments of the Tarawera Lakes and Upper Reach of the Tarawera River the primary factors contributing to the reduction in water levels and river flows over the last 50 years were the change and maturation of vegetation cover and low rainfall. Changing vegetation cover in these areas has generally been due to a shift from pasture and bare ground to scrub and exotic plantation forestry, resulting in a net reduced quantity of water reaching the Tarawera River and its tributaries. Over time this shift is expected to stabilise into a new hydraulic pattern for the catchment.

14.2 Monitoring River Flows and Water Levels

River flows and water levels in the Tarawera River catchment are continuously recorded at seven lake sites in the Tarawera Lakes catchments[68], and at three sites on the Tarawera River[69], see Table 9. Summarised flow data for river and stream sites is included in Appendix 11, and an outline of water monitoring facilities set out in Appendix 10. In addition, most of the wetlands in the catchment of the Lower Reach of the Tarawera River have a staff gauge to measure water levels.

The Tarawera River and the lakes in the Tarawera Lakes catchments have relatively steady flows or levels. The "sponge-like" pumice soils, combined with the reservoir-like Tarawera Lakes catchments, acts as a buffer to water inputs/outputs and gives the Tarawera River a relatively steady flow throughout the year. There is

[68] Automatic water level recorders located on Lakes Okataina, Rotomahana, Okareka, and Tarawera.

[69] Lake Tarawera Outlet, Pipe Bridge (Onepu), and at Awakaponga.

no significant difference between the winter flow and the spring flow or the summer and autumn flows, on the Tarawera River. However, winter and spring flows are higher than summer and autumn flows.

The "sponge-like" pumice soils retain water during peak rainfall periods and release it gradually. Calculations, based on an average annual mean flow between 1984-1992, show that the Tarawera River flows at 6.4 cubic metres per second at the Lake Tarawera Outlet recording station, 20.6 cubic metres per second at Tasman Pulp and Paper Company Limited Pipe Bridge (Onepu), and 26.2 cubic meters per second, at Awakaponga. Approximately 26-29% of the flow of the Tarawera River, measured at Awakaponga, is fed directly from Lake Tarawera, which provides for a very steady year round flow. As an example of variation in flow rates, for the period 1972-1992, the maximum recorded flow at the Lake Tarawera Outlet recording station was 15.68 cubic metres per second, while the lowest recorded flow was 3.84 cubic metres per second. As a comparison, the maximum recorded flow in the Whakatane River (Valley Road) is 2,314 cubic metres per second, while the lowest recorded flow is 5.75 cubic metres per second. Further information on the flow of the Tarawera River and its major tributaries is displayed in Appendix 11.

The river flow is generally lower between December and May than between June to November. The highest frequency of low flows occurs in December, followed by April; while the highest frequency of flood flows occurs in July. Both floods and low flows can occur in February since the greatest rainfall variability occurs in summer[70].

14.3 Primary Causes and Effects on River Flows and Lake and Wetland Levels

Apart from natural perturbations, such as seasonal rainfall patterns, river flows and lake and wetland water levels are generally only affected by three major human-induced factors: changing vegetation, point-source abstraction, and the diversion of water from wetlands.

The adverse effects of these activities in reducing water quantity variously include a reduction in the area of habitat available to aquatic life, changes in the nature of the stream (variations in the combination of pools and riffles), and changes in the river bed. There is also the possibility of changes in competition or predation opportunities and availability of cover, decreases in flow velocity or flow depth, and increases in water temperature with resultant decreases in the concentration of dissolved oxygen in the water. During low flows that pose an unacceptable threat to the ecology of a watercourse, Environment Bay of Plenty may decide to issue a water shortage direction under section 329 of the Resource Management Act 1991 to apportion, restrict or suspend the taking, use, damming or diversion of water, and/or the discharge of any contaminant into water.

14.3.1 Changing Vegetation

A significant change in vegetation has occurred in the catchment since the mid-1960s. When combined with a regional rainfall decline over the past three decades, the effect on water flows in the Tarawera River has been significant. Compared with the annual mean flow for the period 1949-1963, the annual mean flow at Awakaponga decreased by 13% for the period 1964-1983, and by 25% for the period 1984-1992. Similarly, the 7 day low flow at Awakaponga reduced by 10% between 1964-1983 and by 21% between 1984-1992.

Significant vegetation changes are the result of large-scale exotic plantations, the regrowth of native forest, and reversion of areas from bare ground to scrub and native vegetation. Most of these vegetation cover changes have occurred in the catchments of the Tarawera Lakes and Upper Reach of the Tarawera River.

[70] Pang, 1993, xiii.

Large-scale afforestation occurred between 1962 and 1984. By late 1992 approximately 31% of the catchment was planted in exotic production forestry, predominantly in the catchment of the Upper Reach of the Tarawera River. Water balance modelling and statistical analysis undertaken by Environment Bay of Plenty[71] were two methods used to distinguish the effect of changing vegetation cover in the catchment on water flows in the Tarawera River, as distinct from those reductions resulting from the decline in regional rainfall[72].

The general decline in the flow of the Tarawera River is indicated in Tables 9 and 10.

Table 9

REDUCING FLOW IN THE TARAWERA RIVER (1949-1992)

Location	Period	Mean Annual Flow (m^3/s)	Mean Annual 7 day low flow (m^3/s)	5 year return, 7 day low flow (m^3/s)
Awakaponga	1949-1963	35	26.5	
	1964-1983	30.5	23.8	
	1984-1992	26.2	20.9	19.28
Pipe Bridge	With abstraction of 2.7 m^3/s by Tasman Pulp and Paper Company Limited			
	Oct. 1991-Mar. 1993	19.8	16.58	
	1984-1992 (predicted)	20.6	17.4	16.54
Lake Tarawera Outlet	1972-1983	7.0	5.4	
	1984-1992	6.4	4.7	4.41

From Pang L, 1993, Report 93-2

The reduced flow in the Lower Reach of the Tarawera River has reduced the ability of the river to assimilate major wastewater discharges downstream of Kawerau.

Table 10

REDUCTION IN THE FLOW OF THE TARAWERA RIVER RESULTING FROM CHANGING VEGETATION COVER AND RAINFALL DECLINE

(Measured at Awakaponga, compared with the period 1954-1963)

Period	1964-1983		1984-1992	
Flow Reduction	**%**	**m^3/s**	**%**	**m^3/s**
Due to Rainfall Decline and Vegetation Changes	14	5.1	26	9.4
Due only to Vegetation Changes	9	3.2	18	6.4

From Pang L, 1993, Report 93-2

Vegetation cover changes are considered to have largely stabilised since 1984, due in large part to production forests reaching a sustained yield position. Future planting of production forest in the catchment will generally be in presently

71 Pang, L, 1993.

72 The Tarawera catchment is under the same rainfall regime as adjacent catchments. The long-term trends in regional rainfall are: increasing between 1954 and the mid-1960s, decreasing between the late 1960s and the early 1980s, and increasing between the mid 1980s and 1992.

afforested areas, with some additional planting expected in the Manawahe Hills, in the north-west of the catchment of the Lower Reach of the Tarawera River.

The future flow regime will generally be affected by the age of the exotic production forestry pine trees, the rainfall regime, and the natural growth of native forest and other vegetation cover. The effect of afforestation on water flows is expected to reach its peak and stabilise in the 1990s. Final stabilisation of the impact of changing vegetation cover on river flow is expected to occur around the end of the century.

14.3.1(a) Changing Vegetation – Selected Management Alternative

Environment Bay of Plenty recognises that reduction in surface water levels and flows can result from extensive changes in vegetation cover along with long term changes in climate. Land use control (vegetation cover) is a matter over which both district and regional councils have responsibility. Environment Bay of Plenty's selected alternative is to encourage and work together with district councils to apply land use consents which take account of the consequences that a proposed land use is likely to have on catchment hydrology, and in particular any subsequent net reductions in surface water resources that may compromise the levels of lakes and wetlands and the flow of streams and rivers.

14.3.1(b) Changing Vegetation – Supporting Technical Reports

The following technical reports, written as part of the preparation of this regional plan, contain more detailed information on changing vegetation and its effect in the Tarawera River catchment:

Ngapo, N 1994(May), Land Resource Assessment – Tarawera Catchment, Environment Bay of Plenty, Whakatane.

Pang, L 1993 (October), Tarawera River Flow Analysis, Environment Bay of Plenty, Whakatane.

14.3.2 Point-Source Abstraction

In May 1994 there were 39 resource consents (water permits) to take surface water in the Tarawera River catchment. This water is used for a range of purposes, including agricultural and industrial purposes, and for the maintenance of water levels in wetlands. A list of current consents relating to the Tarawera River catchment is available from Environment Bay of Plenty on request. There are an unknown number of small individual takes, primarily for domestic supply[73], especially around the shores of Lakes Tarawera and Okareka, which at the time this regional plan was publicly notified, were permitted activities under Environment Bay of Plenty's general authorisation[74], or are activities otherwise allowed for in the Resource Management Act 1991.

The total consented abstractions from the Tarawera River, by May 1994, were 278,300 cubic metres per day. The biggest single abstractions from the Tarawera River, by May 1994, were 278,300 cubic metres per day. The biggest single abstractions from surface water in the Tarawera River catchment are by the pulp and paper mills which in total had consents (by May 1994) to abstract a combined total of 267,000 cubic metres per day (combined maximum of 4.078 cubic metres per second) from the Lower Reach of the Tarawera River. Immediately upstream of the pulp and paper water abstraction points (Kawerau Bridge) the average mean annual flow of the Tarawera River is 20.6 cubic metres per second.

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[73] Section 14 of the RMA allows, where there are no adverse effects on the environment, for the taking of water for the reasonable needs of individuals or stock drinking water, without the need of a resource consent.

[74] Included in the *Transitional Bay of Plenty Regional Plan*.

By 24 August 1994, Caxton Paper Limited (now Carter Holt Harvey Tissue) advised it was taking approximately 10,000 cubic metres of water per day and Tasman Pulp and Paper Company Limited advised taking 165,000 cubic metres of water per day, a combined take of 175,000 cubic metres per day, which is approximately 65% of their combined abstraction consent allocations. Both companies have programmes to actively reduce water use in their production systems.

Regardless of new technologies, the pulp and paper mills are going to continue to require large quantities of water. However, to achieve the aims of this regional plan, industry will be encouraged to investigate and apply new efficient water use options, together with impact minimising wastewater disposal options, such as land application, evaporation, or ocean outfalls, or other new or in-plant contaminant reduction technologies. In time these will result in a reduction in the quantity both of water used and contaminated water to be discharged. It is an important goal of this regional plan that total consumptive abstraction is kept to a minimum and efficiency in water utilization promoted.

There are few abstractions for domestic supply, stock watering, or irrigation from the Tarawera River downstream of the main pulp and paper mill and geothermal industry wastewater discharges. This is due to a number of factors, including the pollution of the river by pulp and paper effluent, and higher concentrations of minerals and heavy metals arising from natural and human-induced geothermal discharges. The diminished quality in the lower river limits the use of the water for activities sensitive to low water quality.

Downstream of their abstraction points, various users, most notably the pulp and paper mills and a geothermal energy producer, have combined consent allocations to discharge up to 341,224 cubic metres per day of contaminated water to the Lower Reach of the Tarawera River. These discharges replace a significant proportion of the water abstracted from the Tarawera River upstream for the pulp and paper production.

14.3.2(a) Point-Source Abstraction – Selected Management Alternative

There are two policy alternatives for the control of the effects of point-source abstraction of surface water within the Tarawera River catchment, the continuation of the status quo, or the limiting of abstractions from the Tarawera River.

Due to the minimal effect on water levels of current abstraction from the lakes in the Tarawera Lakes catchments, and no significant foreseeable increase in demand, there is no need to impose policies or rules which restrict the abstraction of water from the lakes. However the taking of amounts exceeding 15 cubic metres per day will require a resource consent.

With regard to the Upper Reach of the Tarawera River and its tributaries, the selected policy alternative is to limit the taking of water by:

a) Prohibiting any new consumptive abstraction over 5,000 cubic metres per day;

b) Fixing the cumulative total of all consumptive abstraction within the reach of the Lower Reach of the Tarawera River at not greater than 200,000 cubic metres per day;

c) Prohibiting any additional rates of consumptive abstraction by resource consent holders abstracting water at the time this regional plan was publicly notified; and

d) Making the non-consumptive taking of water (where the full volume of water taken is returned to the river) a Discretionary Activity.

This is considered necessary to protect the contaminant assimilative capacity of the Lower Reach of the Tarawera River, and to protect and enhance the freshwater habitat, and associated wetlands, for fish purposes. The taking and discharging of water to maintain wetland levels, the taking of water for domestic use, stock watering, and fire-fighting purposes will continue as permitted activities. The need to maintain the assimilative capacity in the river water effects the ability of other water abstractors from taking the resource upstream from the mills, in particular iwi.

14.3.2(b) Point-Source Abstraction – Supporting Technical Reports

No specific technical reports were written as part of the preparation of this regional plan, relating to the control of point-source abstractions from surface water in the Tarawera River catchment. However, Environment Bay of Plenty maintains a hydrology (river flow) database and a database containing abstraction allocation information relating to all resource consents granted within the Tarawera River catchment area.

14.3.3 Water Levels in Wetlands

Water diverted into and from wetlands represents the third major surface water quantity issue in the Tarawera River catchment. Most of the original wetlands on the Rangitaiki Plains have been lost through extensive drainage for agriculture and urbanisation. Approximately 1.7% of the original wetlands remain. Many of those remaining are threatened by continued drainage of surrounding land, resulting in dropping water table levels. The network of canals, channels, ditches and pumping schemes that criss-crosses the Rangitaiki Plains has increased the rate of runoff, reducing the amount of water that collects in wetland depressions. As a result there is a major problem of low water levels in wetlands resulting in dryland plants encroaching and smothering native wetland vegetation.

Most of the wetlands, apart from the Kohika wetland, are under Crown partnership, managed by the Department of Conservation. The Department of Conservation has appointed the Eastern Region Fish and Game Council to control and manage Awakaponga, Matuku and the southern half of Bregman and has assigned to it day to day management responsibilities for the southern half of the Awaiti Reserve.

Water levels in the wetlands are generally maintained by weir structures and flap gates. A number of the water inlet structures need repair, while in some, wetlands, such as the Tarawera Cut Wildlife Management Reserve, have no water inlets.

All of the major wetlands in the catchment of the Lower Reach of the Tarawera River were surveyed in early 1994 by Environment Bay of Plenty and the Department of Conservation. Staff gauges, to measure water levels, were installed and discussion held on the setting of appropriate water levels for the wetlands. In all cases, it was recommended that water levels be increased, though some of the desired maximum water levels have since been reduced in order to avoid any adverse effects, such as high water tables inducing drainage problems for surrounding areas. The effect of increasing the minimum water levels will be to sustain significant indigenous vegetation and ecosystems, and the natural character of these environments.

Considerable work will be required in many of the wetlands to ensure that water levels are maintained within their minimum and maximum water level ranges. This includes the upgrading and repair of water control structures, and in some cases minor stopbanking works.

As noted in Chapter 12 – *River and Lake Beds*, barriers to water passage, such as dams and inappropriately designed fords, can lead to a reduced ability of river and tributary channels to flush heavier sediments, and reduce the amount of total sediments flushed. Dams and weir structures can also lead to increases in water temperature. The regulation of these structures is dealt with in Chapter 12.

14.3.3(a) Water Level Control – Selected Management Alternative

Environment Bay of Plenty has considered two alternatives for the control of water levels in the wetlands in the lower river catchment: to remain with the status quo, or to take action to arrest the continued lowering of the wetland water levels. To remain with the status quo would create a real possibility that a number of existing wetlands will be drained in the medium term, with little possibility of the habitat which they support ever returning.

Environment Bay of Plenty's selected alternative is to set minimum and maximum water levels in the wetlands, at levels which will sustain the life-supporting capacity of the wetlands yet not significantly adversely affect the water tables of surrounding country, in particular farm land. In addition, Environment Bay of Plenty proposes to continue assisting financially with initial capital works directed at maintaining water levels in wetlands within determined minimum and maximum values. This action is considered necessary due to:

- The national importance of the natural character of wetlands;
- The significant number of wetlands in the lower catchment;
- Current (June 1994) low water levels in a number of the wetlands;
- The poor state of repair of a number of the water control structures; and
- A lack of prioritisation for wetland protection works by other wetland management organisations.

14.3.3(b) Water Level Controls – Supporting Technical Reports

The following technical reports and memorandums, written as part of the preparation of this regional plan, contain more detailed information on the control of wetland water levels:

Donald, R 1994 (May), Tarawera River Regional Plan Technical Investigations – Freshwater Ecology Component, Environment Bay of Plenty, Whakatane

Titchmarsh, R 1994 (21 March), Tarawera River Regional Plan – Wetlands. Memorandum from Mr R Titchmarsh (Manager Technical Services) to Mr D Ponter (Regional Planner), Environment Bay of Plenty – *Unpublished*

14.4 Issues, Objective, Policies, Methods of Implementation, Principal Reasons and Anticipated Environmental Results

It should be noted that all works associated with structures related to the taking or discharge of water or wastewater to surface water, are to be undertaken according to the rules contained in Chapter 12 – *River and Lake Beds*.

Apart from the policy relating to the management of the discharge of waste geothermal fluid, the management of geothermal resources (surface features, field reservoir management, abstracted fluid and heat) is not considered in this regional plan. Objectives, policies and methods of implementation relating to the management of geothermal resources will be the subject of a separate geothermal regional plan to be prepared by Environment Bay of Plenty.

When rules in this chapter conflict with those in the *Bay of Plenty Transitional Regional Plan*, or where there is some ambiguity, the rules in this Regional Plan for the Tarawera River Catchment will take precedence.

14.4.1 Issues

The issues relating to surface water quantity are:

14.4.1(a) Human-induced reductions in river flows and lake and wetland levels, and the containment of water in streams and rivers, can adversely affect:

- aquatic ecology and biodiversity;
- natural character;
- other water body users, such as fishers and canoeists;
- ability to assimilate wastewater.

14.4.1(b) Human-induced reductions in river flows and lake and wetland levels, and containment of water in streams and rivers, can contribute to:

- increases in temperature and reductions in dissolved oxygen;
- increased toxicity in the Lower Reach of the Tarawera River in particular.

14.4.1(c) Human-induced changes in land cover have reduced stream and river flows in large parts of the catchment.

14.4.1(d) Wetlands on the Rangitaiki Plains are threatened by lowering of water tables and drainage.

14.4.2 Objective

Effective management of the surface water resources of the Tarawera River catchment to sustain and enhance life supporting capacities and natural character, while providing for a wide range of efficient uses and avoiding, remedying and mitigating adverse effects.

14.4.3 Policies

14.4.3(a) To ensure that people and communities continue to have access to sufficient water to provide for their wellbeing.

14.4.3(b) To ensure that the integrity of aquatic ecosystems and habitats is not adversely affected as the result of water allocation decisions.

14.4.3(c) To ensure that the natural character of water bodies is not adversely affected by water allocation decisions.

14.4.3(d) To ensure that the taking of water from surface water bodies does not adversely effect water quality to the extent that fisheries, wildlife and aquatic life are threatened.

14.4.3(e) To promote the conservation and efficient use of surface water by existing and future resource consent holders, and those taking water as a Permitted Activity.

14.4.3(f) To protect the assimilative capacity of the surface water resources of the Tarawera River catchment by considering in particular the cumulative effects of abstractions.

14.4.3(g) To provide water quantity information where available.

14.4.3(h) To promote land uses which do not adversely affect stream and river flows or lake and wetland levels.

14.4.4 Methods of Implementation – General

Environment Bay of Plenty will:

14.4.4(a) Promote the maintenance of water levels in wetlands within established minimum and maximum levels, and promote water levels that ensure the integrity of natural ecosystems and natural character.

14.4.4(b) Contribute financial assistance for capital works associated with the initial restoration and development of wetland water level control structures, on the basis specified in Appendix 12, and consider funding on a case by case basis for the initial restoration and development of wetland water level control structures for other wetlands.

14.4.4(c) Promote the conservation and sustainable use of surface water resources.

14.4.4(d) Environment Bay of Plenty will assist district councils in identifying land uses that cause significant reduction in water surface resources and threaten to reduce water levels and flows, and in developing effective methods for controlling such land uses or promoting alternative ones.

14.4.5 Methods of Implementation – Rules

14.4.5(a) The taking, diverting or damming of surface water, or the discharging of water into surface water for the purpose of maintaining the levels of those wetlands indicated below, or for the express purpose of facilitating fish passage in and out of wetlands, or for controlling plant pest in wetlands, is a Permitted Activity, subject to compliance with the following minimum and maximum levels:

Wetland	Minimum Level (Metres Moturiki Datum)	Maximum Level (Metres Moturiki Datum)
Tarawera Cut Wildlife Mgmt Res	00.50 metres	00.90 metres
Bregman's Wildlife Mgmt Res	00.20 metres	00.60 metres
Awaiti Wildlife Management Res	-0.20 metres	-0.06 metres
Lake Tamurenui	11.93 metres	12.43 metres
Tumurau Lagoon	06.50 metres	06.80 metres
Matata Lagoon	00.55 metres	00.80 metres

subject to the water being taken, diverted, dammed or discharged in the same manner as it was when this regional plan was publicly notified.

Note: The above rule relates to the taking, diverting, damming and discharge of water. Rules relating to the placement and maintenance of control structures are contained in Chapter 12 – River and Lake Beds.

14.4.5(b) Except as provided by Rule 14.4.5(a), the taking, diverting, damming, or discharging of surface water into or out of any wetland is a Discretionary Activity restricted to the following activities:

(i) For the purpose of achieving and maintaining the water levels of wetlands specified in Appendix 6 of this regional plan; or

(ii) For the express purposes of facilitating fish migration; or

(iii) For controlling noxious plants in any wetland.

14.4.5(c) Except as provided by Rules 14.4.5(a) and 14.4.5(b), the discharge of water into, or taking of water, from surface water in those wetlands specified in Appendix 12 of this regional plan, is a Discretionary Activity.

14.4.5(d) Except as restricted by Rules 14.4.5(a), 14.4.5(b) and 14.4.5(c), the taking of surface water at a volume equal to or less than 15 cubic metres per day for any purpose is a Permitted Activity, subject to the following condition:

(i) The abstraction rate shall not exceed 5% of flow above the abstraction point or 10 litres per second whichever is the lesser, and the taking does not, or is not likely to, have an adverse effect on the ecology or habitat values of the water body.

Environment Bay of Plenty may determine that an adverse effect on the ecology or habitat values of a water body is occurring if the sum of abstraction rates on a water body exceeds 10% of the 5 year low flow at any point.

The 5 year low flow is defined as a flow equivalent to the lowest seven day mean flow statistically probable once in every five years.

14.4.5(e) Except as provided by Rule 14.4.5(f), the consumptive taking of water from the Upper Reach of the Tarawera River, the tributary streams of the Upper Reach of the Tarawera River, and the reach of the river from Kawerau Road Bridge across the Tarawera River to the Tasman Pulp and Paper Company Limited effluent outfall pipe at Grid Reference NZMS V15 365438 at a volume exceeding 5,000 cubic metres per day is a Prohibited Activity, and the cumulative total of all abstraction within this reach shall not exceed 200,000 cubic metres per day. The non-consumptive taking of water (where the full volume of water taken is returned to the river) shall be a Discretionary Activity that shall be assessed with particular regard to the protection of the assimilative capacity of the Lower Reach of the Tarawera River.

14.4.5(f) The taking of water from the Upper Reach of the Tarawera River, the tributary streams of the Upper Reach of the Tarawera River, and the reach of the river from the Kawerau Road Bridge across the Tarawera River to the Tasman Pulp and Paper Company Limited outfall pipe at Grid Reference NZMS V15 365438 for which a water permit was held on the date of the public notification of this regional plan may continue as a Discretionary Activity, and on expiry may be replaced as a Discretionary Activity, provided that the original volume allocated shall not be increased.

14.4.5(g) Except as provided by Rules 14.4.5(a) and 14.4.5(b) and restricted Rules 14.4.5(c) and 14.4.5(e), the taking of surface water within the Tarawera River catchment at a volume exceeding 15 cubic metres per day is a Discretionary Activity.

14.4.5(h) The damming of water in any river or stream shall be a Discretionary Activity, **except** that while the damming of water in any river or stream complies with the following conditions, it is a Permitted Activity:

(a) the dam was constructed between 1 October 1990 and 1 October 1991 and was notified to Environment Bay of Plenty under General Authorisation No 7;

or

(b) the dam was constructed after 1 October 1991 and was notified to Environment Bay of Plenty under the provisions of the Bay of Plenty Transitional Regional Plan;

or

(c) the dam complies with all of the following conditions:

(i) the damming does not adversely affect an existing wetland, Rules 14.4.5(a) and 14.4.5(b) have precedence.

(ii) Environment Bay of Plenty is notified of the location and dimensions of the dam before construction commences.

(iii) the mean annual flow of the river or stream dammed does not exceed 300 litres per second.

(iv) the dam does not impound more than 5,000 cubic metres water and the lowest point in the dam crest does not exceed 1.8 metres vertical height relative to the natural bed of the river or stream in which the dam is sited.

the dam does not impound more than 10,000 cubic metres water and the lowest point in the dam crest does not exceed 1.5 metres vertical height relative to the natural bed of the river or stream in which the dam is sited.

(v) the dam is designed, constructed and maintained to ensure that its structural integrity is not compromised, and incorporates spillway and erosion protection devices to safely return surplus water to the natural bed of the river or stream in which the dam is sited.

(vi) the dam does not adversely affect fisheries, fish passage, wildlife and aquatic life.

(vii) the dam does not adversely affect the use or supply of water downstream.

(viii) the impoundment of water upstream of the dam does not affect land owned or occupied by another person.

Note: Environment Bay of Plenty Engineering staff are available to advise on the design and installation of small dams.

14.4.5(i) When considering a resource consent application to take, discharge, dam or divert water within the Tarawera River catchment, Environment Bay of Plenty shall have particular regard to, but not be limited to, the following matters:

(i) The requirements of Part II of the Resource Management Act 1991; and

(ii) The requirements of sections 104 and 108 of the Resource Management Act 1991; and

(iii) Any effects the proposal may have on riparian, shoreline or bed erosion; and

(iv) The conservation and efficient use of water; and

(v) The capacity of the water body to assimilate contaminants and any resulting or accentuated cumulative effects.

14.4.5(j) Any existing activity authorised by a resource consent, which, due to this regional plan becoming operational contradicts rules relating to maximum or minimum levels or flows or rates of use of water, or minimum standards of water quality ranges of temperature, may, after a period of six months after this regional plan becomes operational, be reviewed by Environment Bay of Plenty, pursuant to section 128(1)(b) of the Resource Management Act 1991, in any case where in the regional council's opinion it is appropriate to review the conditions of the permit in order to enable the levels, flows, rates, or standards set by a rule to be met.

Section 20(2) of the Resource Management Act 1991 shall apply where, as a result of a rule in this regional plan becoming operative, an activity that formerly was a Permitted Activity or which otherwise could have been lawfully carried out without a resource consent requires a resource consent.

14.4.6 Principal Reasons

Water is essential to life. The life-supporting capacity of water and ecosystems and the wellbeing of individuals and communities are closely affected by the availability of sufficient quantities of clean water. This regional plan recognises the importance of safeguarding sufficient quantities of water in the surface water bodies of the Tarawera River catchment.

Protection of the assimilative capacity (the ability of a water body to absorb and treat contaminants without degradation) of the Lower Reach of the Tarawera River affects the social and economic wellbeing of local communities that both use and live with the river. It also affects the economic viability of local industries that wish to take water from the river for production, yet also want to use the river water for waste disposal. The protection of the assimilative capacity of the river is of prime concern to tangata whenua who see this as an opportunity cost set against them. They are unable to abstract water if the abstraction would exceed the plan requirements on assimilative capacity and this contradicts their duty as kaitiaki for the river. Ensuring sufficient water quantity is also important for the wide range of water-related recreation activities in which New Zealanders take part.

The maintenance of appropriate water levels and flows is of greatest concern in the Lower Reach of the Tarawera River and in the wetlands on the Rangitaiki Plains. Environment Bay of Plenty proposes that where possible it is appropriate to set minimum and maximum water levels in wetlands in order to ensure that natural character, amenity values and the life-supporting capacity of the water and ecosystems are adequately safeguarded. Limitations on abstraction from the Upper Reach of the Tarawera River and its tributaries are aimed at protecting the assimilative capacity of water in the Lower Reach of the Tarawera River. In order to ensure that these limitations will not always be necessary, Environment Bay of Plenty promotes the conservation and efficient use of water, and does not intend allowing increases in either the net amounts of water abstraction, or the effects of contaminant discharges.

Due to the large quantity of water in the catchment lakes, minimal current abstraction of lake water, and the unlikelihood of significant future abstraction, Environment Bay of Plenty does not consider it necessary to unduly restrict abstraction from lakes at this time.

The promotion of land uses which do not adversely affect stream and river flows or lake and wetland levels is considered an appropriate response to the significant effect which some land uses can have on water levels and flows. Due to the many positive benefits which these land uses can otherwise bring, it is not considered appropriate to prohibit them. The promotion of gradual changes through land use controls in district plans is considered the most appropriate means of reducing those adverse effects which some high water-consumption land uses have on water levels and flows.

14.4.7 Anticipated Environmental Results

The anticipated environmental results are:

14.4.7(a) Protection of the assimilative capacity of the Lower Reach of the Tarawera River.

14.4.7(b) Enhancement and protection of the natural character and life-supporting capacity of wetlands on the Rangitaiki Plains.

14.4.7(c) Protection of the life supporting capacity of water bodies in the Tarawera River catchment.

14.4.7(d) Rivers, lakes and wetlands are kept available for a wide variety of amenity activities requiring sufficient water quantity.

14.4.7(e) Water is utilised in an efficient manner and the need for large amounts of water is reduced.

15 Surface Water Quality

15.1 Introduction

This chapter sets out the primary issues relating to water quality in the catchment. It includes a series of objectives and policies, and methods of implementation. The methods of implementation include water quality classifications and related rules.

The water bodies of the Tarawera River catchment exhibit a wide range of water quality, from what can be described as pristine, such as in the Upper Reach of the Tarawera River above Kawerau and in Lake Okataina, to the degraded, in the Lower Reach of the Tarawera River, downstream of Kawerau. Water quality is influenced by a number of factors, some naturally occurring. The main degradation of the quality of water in the Tarawera River below Kawerau results from industrial processing and discharges from geothermal sources.

In the *Tarawera River Management Plan* of 1985, the three main water quality issues in the Lower Reach of the Tarawera River were colour, dissolved oxygen and toxicity. There has been no change in the three main issues since that time. However, the high adverse impact that low dissolved oxygen has on river ecology is now better understood. As a result, this regional plan has specific policy to ensure that remedial action takes place to enhance dissolved oxygen content in the lower river.

The primary water quality issue in the Tarawera Lakes and their catchments is the impact of development on water quality and quantity. In both the lakes and upper river catchments a major cause for concern is the effect of removing vegetation cover, primarily from pasture, scrub and exotic plantation forestry areas. Increased water flow and changes in nutrient balance are possible outcomes. Potential adverse effects from forestry logging operations have generally been minimised due to the adoption of forestry codes of practice, the establishment of riparian margins and other related measures.

Water quality in the Lower Reach of the Tarawera River is adversely affected by the pulp and paper industry and geothermal discharges from both natural and industrial sources (Map 7). In addition there are diffuse and point-source discharges associated with agriculture which adversely affect water quality in the drains and canals on the Rangitaiki Plains. These discharges contribute to water discolouration, significant reductions in dissolved oxygen content, objectionable odour and increases in temperature in the drains and associated wetlands.

These concerns all have an adverse effect on the environment. They can cause adverse effects on ecosystems and their constituent parts, including people and communities; natural resources; amenity values; and related social, economic, aesthetic and cultural conditions.

15.2 Values Associated with Water Quality

It is not so long ago that large water bodies were considered as convenient sinks for the disposal of treated and untreated industrial, agricultural, and municipal effluent. This was an adopted practice and little concern was raised about small streams and rivers being used for the disposal of agricultural wastewaters, and the effects on aquatic ecosystems.

As the effects of contamination on the environment, particularly of water bodies, have become more apparent over the past thirty years, attitudes have changed significantly. As a result, the discharge of sewage (treated or untreated) and industrial and agricultural effluent, into rivers and coastal waters is now much less

acceptable. Changes in public attitude towards the environment have led to higher standards of wastewater treatment and the investigation of alternative disposal methods (e.g. land based spray irrigation). These changes have been reflected in the Resource Management Act which adopts a sustainable and holistic approach to environmental management and recognises traditional Maori attitudes and values towards resource management.

Tangata whenua values associated with water are intrinsically woven into their culture including passive, recreational, religious, food harvesting, clothing, transport, physical and spiritual activities. Water in the catchment is valued by agricultural, horticultural, industrial, and domestic consumers. Their uses of the water include drinking supplies for households and stock, irrigation supplies for pasture and crops, and a means of disposal of treated farm and industrial effluent. Stock owners require water to be of a suitable standard for farm animals to drink. Large amounts of water are essential for pulp and paper production. Recreational use of the lakes, rivers and wetlands in the Tarawera River catchment includes primary contact with water such as fishing, canoeing, boating, water skiing and swimming. For activities such as picnicking and sightseeing, water bodies form part of the landscape to be enjoyed.

It should be noted that the Health Department advises people not to use the water from the Rotorua Lakes, or their tributaries or outflow rivers, for consumption without first purifying it. The reason for this is that the catchment of the lakes and their streams is uncontrolled, with access by domestic and feral animals, waterbirds, and farm runoff. Some lake environments are also receiving waters for domestic effluent treatment systems. The lakes are known to contain the *Giardia* organism.

More specific information relating to community attitudes and perceptions is contained in Chapter 7 – *Community Attitudes and Perceptions*. Community attitudes and perceptions are particular to certain aspects of water quality in the Tarawera River catchment and are discussed under the relevant sub-headings below.

15.3 Water Quality Monitoring

Environment Bay of Plenty is the primary agency responsible for promoting the sustainable management of surface water quality within the catchment. Since its inception as a regional council, Environment Bay of Plenty has significantly increased its sampling and investigation of water quality related factors within the Tarawera River catchment. Sampling and investigation work have been concentrated in the Lower Reach of the Tarawera River.

As part of its Natural Environment Regional Monitoring Network, Environment Bay of Plenty maintains nine lake water quality monitoring sites. There are also six river sites; three gauged water quality monitoring sites in the Lower Reach of the Tarawera River, two water quality sites with flow recorders (one each in the Upper and Lower Reach of the Tarawera River) and one water quality monitoring site in the Matata Lagoon (Map 6). NIWA also maintains water quality monitoring sites in the Upper and Lower Reaches of the Tarawera River[75].

Information from the water quality monitoring sites is used to maintain a constant record of water quality, particularly of dissolved oxygen content in the Lower Reach of the Tarawera River. As well as undertaking extensive testing of water quality at its Whakatane headquarters, Environment Bay of Plenty also contracts specialist agencies such as NIWA, ESR[76] and university research centres to provide more specific information relating to toxicity and water chemistry. Environment Bay of Plenty maintains a compliance monitoring programme aimed at ensuring that the taking and discharging of water and contaminants are within the limits specified in

[75] Part of the National Monitoring Network.
[76] Institute for Environmental Health and Forensic Science Limited.

the respective consents, or as other permitted by Environment Bay of Plenty's various regional plans, or the Resource Management Act 1991.

Environment Bay of Plenty will seek to use accepted contemporary research standards and protocols to provide comparable high quality research results. To achieve quality and comparable results, Environment Bay of Plenty may adopt international or agency standards or protocols, including those developed and used by OPEC, USEPA, ANZEC or any other national standard. When considering the benefits of adopting any new standard or protocol, Environment Bay of Plenty will have regard to the need to relate results over time so that comparisons can be made and changes validly detected.

15.3.1 Effects on Water Quality

Water quality in the Tarawera River catchment can be adversely affected by natural or human-induced occurrences. Increased siltation due to increased river flows or flooding is an example of a natural occurrence (natural perturbation). In assessing the effect of human-induced discharges to water bodies, regard must be had to natural occurrences, such as natural changes in water temperature, and the occurrence of natural geothermal discharges. There is ongoing debate over the impact of peat deposits on the river. Overall it is likely that peat would have some minor effect on the oxygen levels, colour and clarity of the river.

Adverse effects on water resulting from human-induced activities can occur through both point-source and diffuse discharges. There are a number of point-source discharges in the Tarawera River catchment which have an adverse effect on water quality. A list of current consents relating to the Tarawera River catchment is available from Environment Bay of Plenty on request.

Non-point source discharges primarily relate to runoff from agricultural and afforested areas and urban settlements and leachate from septic tanks and rubbish dumps. These sources of contaminants are more difficult to quantify. Discharges, either individually or cumulatively, point-source or diffuse, can adversely affect water quality, for a number of different water quality factors, as discussed in section 15.4 of this plan.

15.4 Water Quality Factors

15.4.1 Oxygen Content

The concentration of oxygen in water is a primary factor which determines the life-supporting capacity of a water body. Dissolved oxygen (DO) levels vary depending on temperature, the biochemical oxygen demand (BOD_5) load and the rate at which water re-aerates from the atmosphere.

The upper reaches of rivers commonly exhibit a high dissolved oxygen content of about 10 grams per cubic metre or more than 80% of the saturated concentration. The concentration can be reduced in the lower reaches of rivers, due to greater biochemical oxygen demand, a lower re-aeration rate and increased water temperature. Commonly, oxygen concentrations rise during the day as a result of the photosynthetic activity of aquatic plants and fall at night as a result of plant (including algal) respiration. This is termed diurnal dissolved oxygen fluctuation[77].

In the Upper Reach of the Tarawera River and its tributaries, the concentration of dissolved oxygen is usually greater than 9 grams per cubic metre, or above 80% saturation. At this level the existence of all indigenous and exotic fish species is considered to be sustainable. In particular, this level is considered important for

[77] The diurnal variation in the lower Tarawera River caused by aquatic plants averages 1 grams per cubic metre although at times it reaches 1.5 grams per cubic metre (Rutherford, J C 1993(a) and (b), April and September).

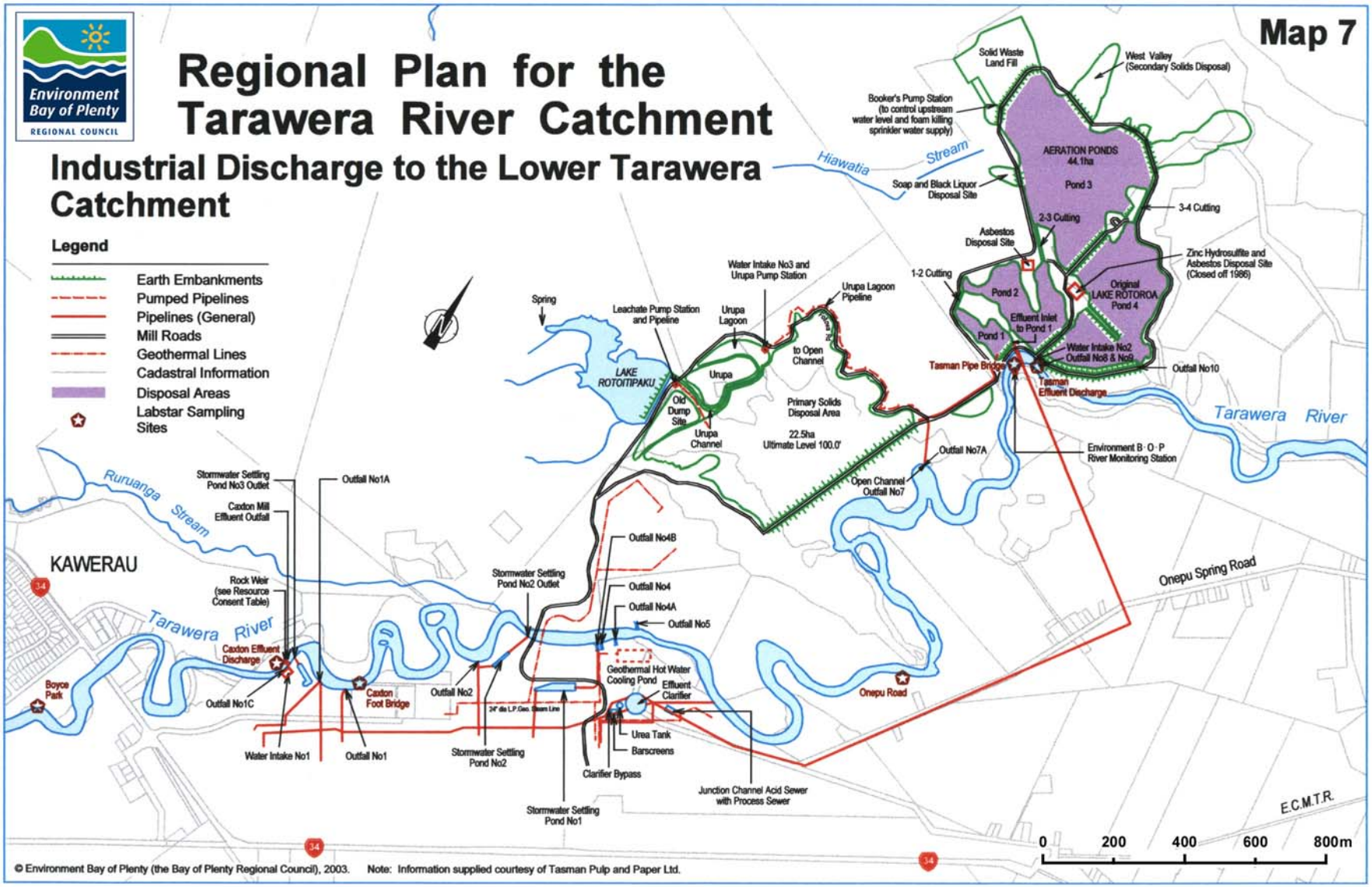
trout spawning, having regard to the lower levels of dissolved oxygen that occur in river gravels. Significant parts of the Upper Reach of the Tarawera River and its tributaries are trout spawning areas.

Dissolved oxygen reduces in a systematic pattern in the Lower Reach of the Tarawera River, as shown in Figure 8. The lowest dissolved oxygen level is always at Matata. In 1994, the lowest recorded level at Matata for a 15 minute interval recording was 2.5 grams per cubic metre, while the highest levels recorded at the same site were between 7 and 8 grams per cubic metre. The pattern of dissolved oxygen depletion was nevertheless always as shown in Figure 8. Trout are known to show a reduction in growth rate when dissolved oxygen concentrations average less than 6 grams per cubic metre. [78]

Awakaponga has been the long-term site for flow measurement in the lower reaches of the Tarawera River because it is above the influence of the tidal rise and fall in water level. Originally, because of security and to make use of already installed telemetry equipment, dissolved oxygen and temperature monitoring equipment was installed at the same site as the flow recorder. However, it was found that the dissolved oxygen continued to decrease beyond Awakaponga and the concentration at Matata was always the lowest in the river. To gather technical data for this regional plan, a dissolved oxygen and temperature monitoring site was established at Matata. The dissolved oxygen modelling of Dr J Rutherford and the revised BOD_5 limits are based on dissolved oxygen levels at Matata, where the situation was worst.

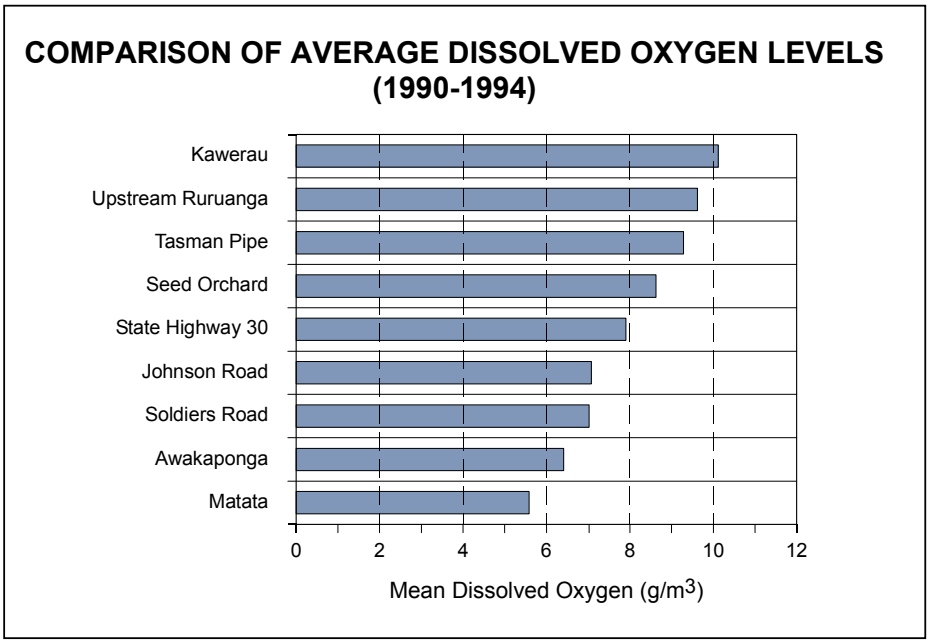
The low levels of oxygen in the Lower Reach of the Tarawera River are directly attributable to the discharge of effluents containing high BOD_5 loads. The notable discharges are from the Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue pulp and paper making facilities. The combined BOD_5 of the discharges is of the order of 5 to 7 tonne per day (Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue 1993 average). A list of current consents relating to the Tarawera River catchment is available from Environment Bay of Plenty on request. The breakdown of organic matter BOD_5 in these discharges by micro-organisms utilises the dissolved oxygen of the river at a rate faster than natural re-aeration replenishes dissolved oxygen.

[78] USEPA 1986.


Map 7
Regional Plan for the Tarawera River Catchment
Industrial Discharge to the Lower Tarawera Catchment
Environment Bay of Plenty
REGIONAL COUNCIL
Legend
Earth Embankments
Pumped Pipelines
Pipelines (General)
Mill Roads
Geothermal Lines
Cadastral Information
Disposal Areas
Labstar Sampling Sites
Solid Waste Land Fill
West Valley (Secondary Solids Disposal)
Booker's Pump Station (to control upstream water level and foam killing sprinkler water supply)
Hiawatia Stream
Soap and Black Liquor Disposal Site
AERATION PONDS 44.1ha
Pond 3
3-4 Cutting
2-3 Cutting
Asbestos Disposal Site
Zinc Hydrosulfite and Asbestos Disposal Site (Closed off 1986)
1-2 Cutting
Pond 2
Original LAKE ROTOROA Pond 4
Effluent Inlet to Pond 1
Pond 1
Water Intake No2 Outfall No8 & No9
Outfall No10
Tasman Pipe Bridge
Tasman Effluent Discharge
Water Intake No3 and Urupa Pump Station
Urupa Lagoon Pipeline
Spring
Leachate Pump Station and Pipeline
Urupa Lagoon
to Open Channel
LAKE ROTOITIPAKU
Urupa
Old Dump Site
Urupa Channel
Primary Solids Disposal Area
22.5ha Ultimate Level 100.0'
Outfall No7A
Open Channel Outfall No7
Environment B·O·P River Monitoring Station
Tarawera River
Ruruanga Stream
KAWERAU
Stormwater Settling Pond No3 Outlet
Outfall No1A
Caxton Mill Effluent Outfall
Rock Weir (see Resource Consent Table)
Caxton Effluent Discharge
Boyce Park
Outfall No1C
Caxton Foot Bridge
Water Intake No1
Outfall No1
Outfall No2
Stormwater Settling Pond No2
Stormwater Settling Pond No1
Stormwater Settling Pond No2 Outlet
Outfall No4B
Outfall No4
Outfall No4A
Outfall No5
Geothermal Hot Water Cooling Pond
Effluent Clarifier
Urea Tank
Barscreens
Clarifier Bypass
Junction Channel Acid Sewer with Process Sewer
Onepu Spring Road
Onepu Road
E.C.M.T.R.
0 200 400 600 800m
© Environment Bay of Plenty (the Bay of Plenty Regional Council), 2003. Note: Information supplied courtesy of Tasman Pulp and Paper Ltd.

C1623-7

Figure 8



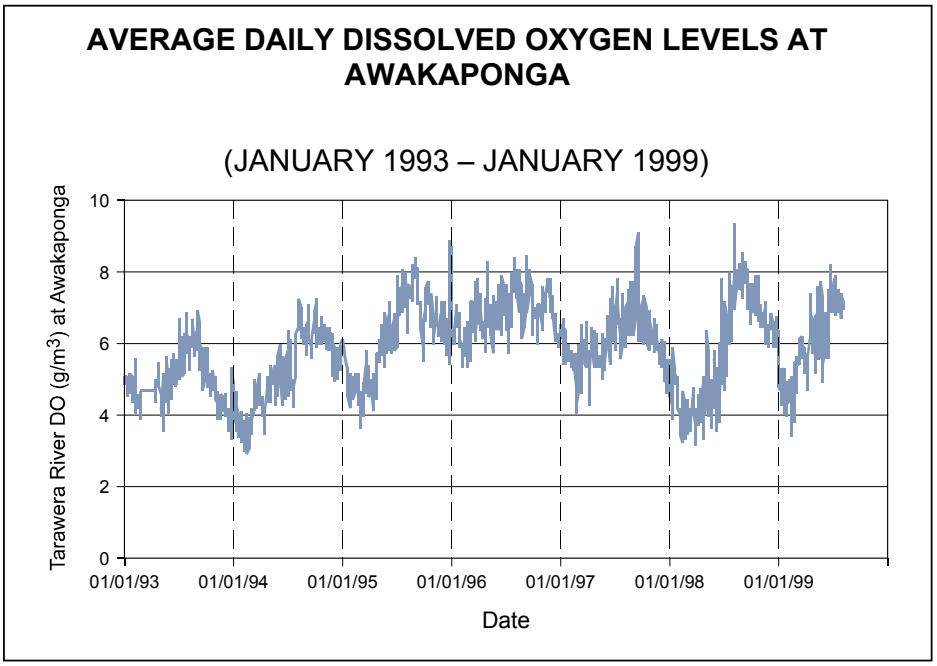
The adverse effect of the discharge of industrial effluent to the Lower Reach of the Tarawera River is exacerbated by the highly-mobile pumice bed which acts as a medium supporting a large active biological community. The rate of consumption of oxygen by this huge biomass has been found to greatly exceed that of previously studies rivers.

The industrial discharges lead to an increase in the temperature of the Lower Reach of the Tarawera River of about 2°C. This temperature increase on its own would have the effect of decreasing the dissolved oxygen content of the Lower Reach of the Tarawera River[79], by a factor of approximately 0.4 grams per cubic metre.

The averaged dissolved oxygen content of the Lower Reach of the Tarawera River has dropped since 1985, when the former *Tarawera River Management Plan* was introduced by the then Bay of Plenty Catchment Commission. In that plan the Bay of Plenty Catchment Commission established a dissolved oxygen standard of 5 grams per cubic metre. It recognised that this standard may be breached for short periods during a "two year surveillance period". The plan recommended that on each occasion that the dissolved oxygen level fell below 5 grams per cubic metre at the Awakaponga gauging site *"a comprehensive report shall be prepared by each company and be submitted to the Regional Water Board"* (now part of Environment Bay of Plenty). The 5 grams per cubic metre standard has generally been breached during summer months, as indicated by Figure 9.

[79] It is estimated that for every 1°C increase in temperature, the dissolved oxygen content in water reduces by approximately 0.2 g/m^3.

Figure 9



The annual mean dissolved oxygen content of the Lower Reach of the Tarawera River has been declining since 1991 and during the 1991, 1992 and 1993 summer periods, the dissolved oxygen concentration reached critical levels on several occasions. The annual mean dissolved oxygen content improved during 1995 and 1996. During the summer of 1998 and 1999 very low oxygen levels were measured in the lower river. Oxygen injection was not used continuously during the 1998 and 1999 summers. In previous years it had been used continuously. Effluent treatment strategies to reduce the summer BOD load on the river are planned by the pulp and paper companies.

Through evaluation and research into effects, Environment Bay of Plenty believes that the low dissolved oxygen levels in the Lower Reach of the Tarawera River are the most significant issue requiring remedial action.

Environment Bay of Plenty identified four primary alternatives for dealing with dissolved oxygen:

1 Retain the status quo within the catchment but maintain the absolute minimum dissolved oxygen level at 5.0 grams per cubic metre in the Lower Reach of the Tarawera River.

2 Have no specific classification.

3 Establish lower or higher dissolved oxygen content standards.

4 Establish dissolved oxygen classification standards specific for fish purposes in the Lower Reach of the Tarawera River.

15.4.1(a) Oxygen Content – Selected Management Alternative

Environment Bay of Plenty selects the fourth alternative, to establish dissolved oxygen classification standards specific for Fish Purposes in the Lower Reach of the Tarawera River.

Environment Bay of Plenty proposes that the dissolved oxygen in waters being managed in their natural state in the Tarawera Lakes catchments, excluding Lake Okaro, should be maintained at above eighty percent saturation. These standards

apply after allowing for reasonable mixing and natural perturbations (see Rule 15.8.4(b)). Environment Bay of Plenty does not consider it appropriate to establish a dissolved oxygen classification for Lake Okaro, which is being managed for contact recreation purposes, due to the significant naturally occurring fluctuation in dissolved oxygen.

Environment Bay of Plenty proposes that the waters of the Upper Reach of the Tarawera River, the tributaries of the Tarawera River (excluding the drains and canals on the Rangitaiki Plains, but including the tributaries of the Lower Reach of the Tarawera River) and the tributaries of the Tarawera Lakes catchments, be managed for fish spawning purposes, with dissolved oxygen concentrations maintained at above eighty percent saturation (see Rule 15.8.4(f)(i)).

Taking into account the aspirations of the community and the Tarawera River Liaison Group, Environment Bay of Plenty proposes that the oxygen content in the Lower Reach of the Tarawera River should be maintained at a level that ensures that stress on fish in the river is kept to a minimum (to meet the FPLT classification standard). In this context, fish purposes criteria are established in water quality classification standards for the Lower Reach of the Tarawera River. The classification standards promote limits required for the health and fertile wellbeing of those fish species that could be expected to freely inhabit the Tarawera River. Consequently, dissolved oxygen concentrations for the Lower Reach of the Tarawera River are to be introduced in three stages. These will require:

(a) That until 31 December 2002 the dissolved oxygen be maintained at or above 5.0 grams per cubic metre for the mean of any consecutive 30 days, 4.0 grams per cubic metre for the mean minimum of any consecutive seven days and 3.5 grams per cubic metre as an absolute minimum;

(b) That from 1 January 2003 the dissolved oxygen be maintained at or above 6.0 grams per cubic metre for the mean of any consecutive 30 days, 5.0 grams per cubic metre for the mean minimum of any consecutive seven days and 4.5 grams per cubic metre as an absolute minimum;

Introducing standards over two stages is considered to be necessary to allow current dischargers to implement alternatives and put in place new technology, procedures, agreements etc. (See Rule 15.8.4(h)(i)).

15.4.1(b) Oxygen Content – Supporting Technical Reports

The following technical reports, prepared as part of the preparation of this regional plan, contain more detailed information on oxygen content in the Tarawera River:

Dell, P M 1993, Tarawera River: Dissolved Oxygen Levels, A report to the Chairman and members of the Environmental Monitoring Committee meeting of 16 March 1993, Environment Bay of Plenty.

Environment Bay of Plenty 1994 (February), Oxygen Summary for Tarawera River Produced by Environment Bay of Plenty for the Tarawera River Liaison Group meeting – *Unpublished*.

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

Rutherford, J C 1993 (September), Revised BOD Limits for the Tarawera River, Prepared for Environment Bay of Plenty by NIWA Ecosystems, Hamilton.

Rutherford, J C 1994 (July), Tarawera River Management Plan, Revised BOD loads based on USEPA dissolved oxygen criteria, NIWA.

15.4.2 Colour and Clarity

The principal water quality concerns of the local community are the colour and clarity of the water in the Lower Reach of the Tarawera River. Colour and clarity describe two main aspects of water appearance, and relate directly to the visual and aesthetic values of water. Colour is the effect on the human eye of reflected light energy. Visual clarity relates to the maximum distance at which objects can be viewed through the water. Variations in colour and clarity are caused by dissolved, colloidal and suspended material in the water.

The protection of the optical properties of aquatic ecosystem waters is required for three main reasons:

(i) A number of predatory fish, such as trout and smelt, rely upon the clarity of the water to be able to see their prey.

(ii) A reduction in the light penetration into a water body will have harmful effects on phytoplankton, macrophytes, and benthic plants, ultimately adversely affecting biodiversity. The colour of water may also affect aquatic ecosystems by influencing the spectral distribution of underwater light available for photosynthesis and illumination.

(iii) The discolouration of water bodies is often considered aesthetically displeasing, being associated with contamination, and inhibits people from bathing or enjoying other recreational pursuits. In the 1993 survey of *Attitudes and Perceptions Towards the Tarawera River and its Catchment*, the colour of the Lower Reach of the Tarawera River was raised as an issue of concern by 27% of respondents. When prompted, 72% of respondents said they were concerned about the colour of the river.

The dark colour of the Lower Reach of the Tarawera River is caused by the discharge of lignin and carbohydrate degradation products from pulp and paper production. Much of the colour produced in the pulping process is recycled and combusted during the kraft chemical recovery cycle. Most of the colour which appears in mill effluent comes from the bleaching process, which produces the white paper product demanded by consumers. Removal of colour from mill discharges is a worldwide problem. There is ongoing debate over the impact of peat deposits on the river. Overall it is likely that peat would have some minor effect on the oxygen levels, colour and clarity of the river.

The 1985 *Tarawera River Management Plan* introduced a timetable for the removal of colour from the Lower Reach of the Tarawera River, staged in five-year intervals. Platinum-cobalt units were adopted as the measure for assessing colour. The 1985 plan required a decrease from 80 platinum cobalt units in 1985 to less than 10 units by 2005. The colour reduction to date has been in line with this timetable.

The Tasman Pulp and Paper Company Limited, in particular, have made significant advances over the past ten years to reduce the colour content of their effluent. This has included the introduction of oxygen delignification, chlorine dioxide substitution and a bleaching sequence change that has substantially reduced the colour load. Unfortunately, by 1994, the major reductions in the discharge of colour made by Tasman Pulp and Paper Company Limited were not obvious or striking to the eye, due to the large percentage of colour which needs to be removed before a change becomes evident.

In order to produce a noticeable improvement in colour, more than 90% of the colour must be removed from the wastewater stream[80]. For a high volume dilute effluent such as that produced by Tasman Pulp and Paper Company Limited, 90% colour removal would require significant capital expenditure to achieve. In-mill modifications to bleaching processes may be the most cost-effective means of colour abatement, with "end-of-pipe" effluent treatments used as back-up.

Many parameters are involved in determining and describing the colour and clarity of natural waters. Following Ministry for the Environment guidelines[81], Environment Bay of Plenty has used black disc, Munsell Hue, and absorption measurements.

15.4.2(a) Black Disc (Visual Clarity)

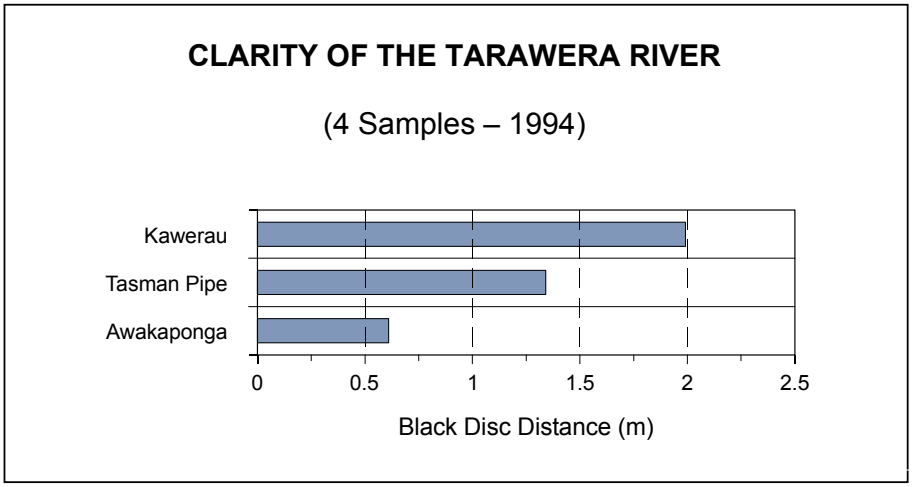
Visual clarity has been measured in the Tarawera River by means of the sighting distance of a black disc. The disc is viewed horizontally under water through an inverted periscope. The black disc distance in metres at which the disc just disappears from sight.

In the lakes of the upper catchment, black disc measurements are commonly in the range of 5 to 10 metres, dependent on the lake being surveyed.

Black disc readings from the Tarawera River indicate that clarity is much reduced with distance downstream. For example, at the Lake Tarawera outlet, black disk clarity averages 6.6 metres, more characteristic of lake water than of river water at this site. At the Kawerau Bridge site the range reduces to an average of 2.7 metres, which is more characteristic of river water (Figure 10). The change in clarity between these two locations is primarily attributed to natural occurrences, such as the cumulative effects of natural erosion and biological matter entering the waterway.

The Tasman Pulp and Paper Company Limited Pipe site shown on Figure 10 is below the effluent discharge point from Carter Holt Harvey Tissue and geothermal inputs, but upstream of the Tasman Pulp and Paper Company Limited effluent discharge.

Figure 10



At the State Highway 30 Bridge and at Awakaponga, below all the major discharges to the Tarawera River, the visual clarity of the water averages 0.7 metres when the black disc technique is used. While there may be some natural

[80] Davies-Colley *et al*, 1994.

[81] Resource Management Water Quality Guidelines No. 2: "Guidelines for the Management of Water Colour and Clarity, MfE, June 1994.

influences such as leaching from peat soils, changes to colour and visual clarity in most of the Lower Reach of the Tarawera River are primarily attributable to the discharge of pulp and paper mill effluent.

15.4.2(b) Munsell Hue (Colour Measurement)

Hue describes the colour of the water. Environment Bay of Plenty has chosen to use the Munsell Colour Units to describe hue. The Munsell technique compares water colour with an extensive chart of graded colour variants[82]. The hue of water depends on the wavelength of light back scattered within the water. The Munsell Hue scale is broadly defined in Table 11.[83]

Table 11

MUNSELL HUE SCALE AND SUITABILITY OF WATERS FOR BATHING

Munsell-Hue Units	Munsell-Hue Colour	Suitability for Bathing Purposes
50-60	Blue-Green	Eminently suitable for use
40-50	Green	Suitable for use
30-40	Green-Yellow	Marginally suitable for use
20-30	Yellow	Unsuitable for use
10-20	Orange	Totally unsuitable for use

Davies-Colley, R J et al., 1994 (August)

As another example pristine waters, such as some very clear lakes often appear blue-green. At the other end of the scale humic substances, which are contained in pulp and paper wastewaters, give a yellow/orange hue due to the absorption of blue light. In the Tarawera River so little light is reflected that the water appears black.

Munsell colour assessments were carried out on the Tarawera River in January 1990[84] and March 1994[85]. The findings of these surveys are recorded in Table 12. The same pattern of colour and clarity is apparent in the three surveys. The 1994 surveys were undertaken after Tasman Pulp and Paper Company Limited's bleaching processes had been altered to decrease chlorine bleaching and include oxygen-delignification. The increase in Munsell Hue at SH 30 between January 1990 and March 1994 may be an indication of colour improvement in the Tarawera River as a result of the Tasman Pulp and Paper Company Limited bleaching process changes.

82 Not unlike a colour charge one would use when buying paint.

83 Davies-Colley, R J et al, 1994 (August), Consultancy Report No. BRP 007.

84 Assessment detailed in Davies-Colley, 1990.

85 Assessment detailed in Davies-Colley *et al*, 1994.

Table 12

COLOUR (MUNSELL HUE) AND CLARITY (BLACK DISC)

(Comparative measurements made at three sites on the Tarawera River, on three different days)

Measurement Method	Kawerau Bridge (Boyce Park)	Tasman Pulp and Paper Company Limited Pipe Bridge	State Highway 30
10 January 1990 *			
Munsell Hue	50.0	42.5	20.0
Black Disc (m)	1.9	1.1	0.47
14 March 1994			
Munsell Hue	47.5	42.5	27.5
Black Disc (m)	3.25	2.2	0.67
16 March 1994			
Munsell Hue	45.0	41.3	26.3
Black Disc (m)	2.5	1.8	0.62

Davies-Colley (1990)

15.4.2(c) Absorption Coefficient (Light Absorption)

This is a calculation based on the amount of light absorbed when a beam of light is shone through a sample. Environment Bay of Plenty will utilise the absorption of coefficient of a filtered sample measured at a wavelength of 440 nanometres (nm) on a spectrophotometer as a suitable measure of colour in the Tarawera River[86].

The absorption coefficient is a more precise and convenient method to perform than other measurements, such as the platinum-cobalt method, and it relates more directly to the actual appearance of the water[87].

Figure 11 plots mean absorption coefficients at 440nm for filtered samples on six sites on the Tarawera River. The data are expressed in more detail in Table 13.

Two major discharges add substantial colour to the Tarawera River. Carter Holt Harvey Tissue discharges effluent into the river between the Kawerau Bridge and Upstream Ruruanga sites. Tasman Pulp and Paper Company Limited discharges effluent to the river downstream of the Tasman Pulp and Paper Company Limited Pipe site. The absorption response of river water can be clearly seen in Figure 11.

86 Davies-Colley *et al*, 1994.

87 Davies-Colley, 1990.

Figure 11

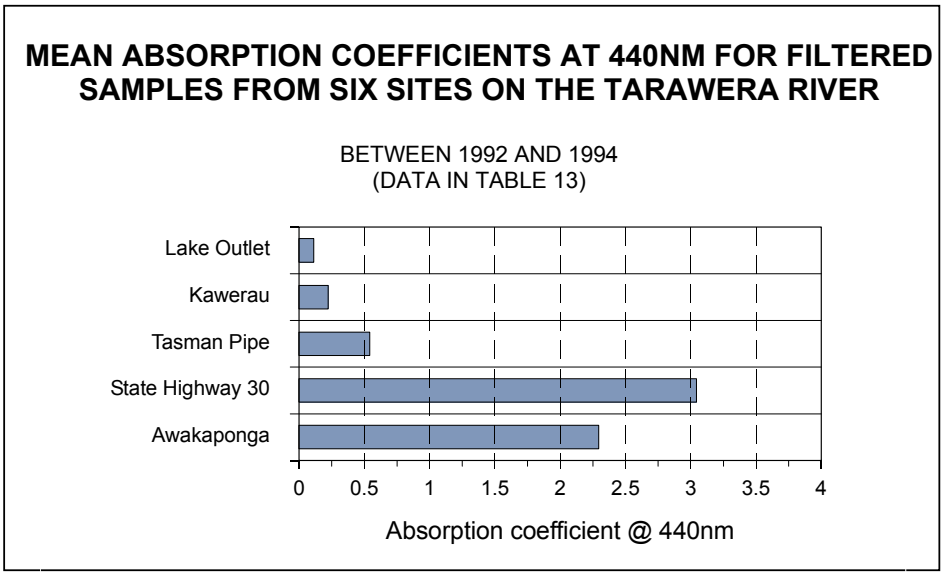


Table 13

ABSORPTION COEFFICIENT AT 440NM FOR TARAWERA RIVER SITES AND TWO EFFLUENT DISCHARGES BETWEEN 1992 AND 1994

(FOR FILTERED SAMPLES)

Site	Mean	Minimum	Maximum
Lake Outlet	0.11	0.00	0.23
Kawerau	0.22	0.00	0.50
Tasman Pulp and Paper Company Limited Pipe	0.54	0.00	2.13
SH 30	3.05	0.30	6.74
Awakaponga	2.30	0.30	6.05

15.4.2(d) Colour and Clarity – Selected Management Alternatives

Except in defined circumstances[88], sections 70(1)(d) and 107(1)(d) of the Resource Management Act 1991 restrict Environment Bay of Plenty from granting discharge permits which, after allowing for reasonable mixing, are likely to give rise to a conspicuous change in the colour or visual clarity of the receiving water (refer to section 15.7.1).

Environment Bay of Plenty proposes to develop quantitative standards for most of the water bodies in the catchment due to the subjectivity of purely visual assessments.

Environment Bay of Plenty has interpreted "conspicuous change in the colour or visual clarity of the receiving water" into those specific standards outlined in Rules

[88] Section 107(2) allows Environment Bay of Plenty to grant a discharge permit to do something that may allow for a conspicuous change in colour or visual clarity, if it is satisfied that:
(a) exceptional circumstances justify the granting of the permit; or
(b) the discharge is of a temporary nature; or
(c) that the discharge is associated with necessary maintenance work.

15.8.4(b), 15.8.4(d), 15.8.4(f), and 15.8.4(h). These standards apply after allowing for reasonable mixing of discharges and disregarding any natural perturbations, and have been set with regard to the purposes for which these water bodies are intended to be managed. These standards have been adopted in order to ensure the protection of the aesthetic quality of these water bodies and to protect aquatic life, including the food which trout feed upon.

In the Lower Reach of the Tarawera River, Environment Bay of Plenty has adopted quantitative standards in this regional plan which it considers will lead, in time, to discharges being visibly inconspicuous after allowing for reasonable mixing and natural perturbations.

Environment Bay of Plenty proposes that the discolouration of the Lower Reach of the Tarawera River caused by discharges from the Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue plants to be considered as an exceptional circumstance under section 107(2), of the Resource Management Act 1991, and be subject to compliance with staged standards designed to result in time in the reduction of colour, having regard to the colour standards of the former *Tarawera River Management Plan*, and supporting evidence from the companies.

15.4.2(e) Colour and Clarity – Supporting Technical Reports

The following technical reports were prepared and used to provide information for the development of this regional plan, and contain more detailed information on colour and clarity of water in the Tarawera River catchment:

Davies-Colley, R J	1990, Colour and Clarity Studies on the Tarawera River – New Methods applied to an Old Problem, Prepared for the Bay of Plenty Regional Council by the DSIR Water Quality Centre, Hamilton.
Davies-Colley, R J et al	1994 (August), Water Discolouration of the Tarawera River, Consultancy Report BPR 007 NIWA-Ecosystems Hamilton.
Donald, R	1993 (July), Bay of Plenty Regional Council, Natural Environment Regional Monitoring Network Freshwater Ecology Programme – Lakes Component 1991/92, Environment Bay of Plenty, Whakatane.
McIntosh, J J	1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.
Ministry for the Environment	1994(June), Resource Management Water Quality Guidelines No.2: "Guidelines for the Management of Water Colour and Clarity", Ministry for the Environment.

15.4.3 Toxicity

Concerns have been expressed about the toxic effects of industrial and natural discharges to the Tarawera River. In the previous Tarawera River Management Plan these concerns were not addressed. Over the last two years the technical investigations leading up to this regional plan have involved extensive scientific research into the toxicity of discharges to the river and the toxic effects in the river.

The findings were publicised and discussed over a two-day workshop held in Whakatane in May 1994[89].

In summary, the workshop showed that significant investigations had been performed in the last few years and were still being undertaken. It was made apparent that there was a natural change in water quality and ecology along the course of the river between the lake outlet and the river mouth at Matata.

Changes in mill processes at Tasman Pulp and Paper Company Limited were shown to have reduced the discharge of bioaccumulative chlorinated organic compounds markedly over the course of the two-year investigation. The levels of bioaccumulative compounds in sentinel mussels, caged eels and the eel populations of the Tarawera River were discussed in various presentations at the workshop. The effects of the river water at the coastal margin on marine shellfish and fish species were also presented. When Carter Holt Harvey Tissue commences sending its mill effluent to its spray irrigation disposal system, there is expected to be a measurable improvement in the dissolved oxygen levels in the Lower Reach of the Tarawera River.

The concerns of people in the Lower Reach of the Tarawera River who wish to irrigate pasture with river water were addressed in a presentation of the inorganic contaminants discharged to the river, mainly from geothermal sources. Elements of geothermal origin were not considered to be limiting with respect to pasture irrigation in the Lower Reach of the Tarawera River.

Constituents of the geothermal water can compromise aquatic ecosystems if present in sufficient concentration. Toxicity tests were carried out in a laboratory on three test species (an aquatic invertebrate, an alga and a bacterium), using geothermal wastewater diluted with river water[90]. The results showed that the concentration of geothermal wastewater necessary to produce a toxic effect in the three species is greater than would be found in river water. Arsenic and boron in the geothermal effluents were thought to be responsible for the observed toxicity[91].

Tarawera River water was also tested for toxic effects on the embryonic and larval stages of zebrafish in a laboratory situation. The water was aerated so that dissolved oxygen deficiency was not a factor in the test. Results showed no effects on the hatching success of newly fertilised eggs or on larval mortality in waters from effluent impacted sites. The experiments were repeated on 100% effluents and dilutions of the effluents. This study did not focus on the long-term sub-lethal effects of effluents. In Tasman Pulp and Paper Company Limited effluent the mortality of zebrafish eggs and larvae was unaffected at all concentrations. However in Carter Holt Harvey Tissue effluent, hatching and mortality were severely affected.

Recently developed scientific techniques were carried out by researchers into the sub-lethal effects of contaminants on the eel populations of the Tarawera River. The use of 'biomarkers' was explained to the Tarawera River Liaison Group during the Toxicity Workshop and the results of tests on Tarawera River eels was reported. Eels from the Tarawera River have not been found to exhibit external signs of stress relating to the industrial discharges to the river. Careful pathological examination showed that the internal organs of the eels from effluent-impacted sites did reveal adverse effects. Blood plasma enzyme levels suggested liver function abnormalities while urea and potassium levels indicated that kidney function was affected by effluent exposure. Red and white blood cell counts were marginally affected. The appearance of the liver of eels from effluent affected sites

89 Donald, R, 1994 (August), Proceedings of a Toxicity Workshop held in Whakatane 17-18 May 1994, Environmental Report 94/15.

90 Hickey, 1994.

91 Hickey, 1994.

differed in a way that suggested disturbed lipid metabolism. Despite these sub-lethal effects the eel population displays average growth rates but lower condition factors in the effluent affected waters of the Tarawera River[92].

Together with the study of pathology of the eels was the analysis of the 'biomarker' enzyme, ethoxyresorufin-o-deethylase (EROD). This enzyme has been widely used as a biomarker (indicator) of pulp and paper effluents. Increased EROD activity was detected in the livers of eels from impacted and unimpacted sites on the Tarawera River and from impacted and unimpacted sites throughout New Zealand. Significant increases in EROD activity were observed in both caged and feral eels at sites below the Tasman Pulp and Paper Company Limited effluent outfall. In the future this type of analysis could be used to assess the effect of reductions in toxic compounds being discharged to the river. In addition, the analysis could be performed in conjunction with blood chemistry analysis and liver examination.

With respect to the human health issues and the consumption of foodstuffs contaminated with dioxins, pentachlorophenol and 2,4,6-trichlorophenol, Dr Michael Bates, Epidemiologist of ESR Health, used a safety-factor approach and a risk assessment approach to determine the potential effects on human health due to the organochlorine contamination of eels in the Tarawera River.

The safety factor approach used a dioxin toxic equivalent factor (TEF) of 10 picograms (10^{-12} grams) per kilogram of human body weight per day (pg/kg/day) as the tolerable daily intake (TDI) or acceptable daily intake (ADI). Using the safety-factor approach, Dr Bates calculated that if a person ate eel flesh from eels caught in the Lower Reach of the Tarawera River at the estimated per capita quantity for fish consumption by New Zealanders, (which the NZ Department of Statistics[93] calculates is 31 grams of fish per person per day) then for a person of 'average' (60 kg) body weight, Lower Reach of the Tarawera River eel flesh would comprise 25% of their TDI (or ADI).

The risk assessment approach determines an estimated maximum possible excess numbers of cancers that might occur if a million people ate Lower Reach of the Tarawera River eel flesh for a lifetime at the specified levels of eel consumption every day. Dr Bates used two different 'risk-specific doses' that have been proposed by different US Government agencies for dioxin (USEPA, USFDA[94]). At a 'risk-specific dose' of 0.0064 pg/kg/day, he calculated there would be an estimated additional 402 cancers for every million people who were exposed to a lifetime of consuming eel flesh from eels caught in the Lower Reach of the Tarawera River at the estimated per capita quantity of 31 grams of eel flesh per person per day. At a 'risk-specific dose' of 0.12 pg/kg/day, there would be an estimated additional 21 cancers for every million people who were exposed to a lifetime of consuming eel flesh from eels caught in the Lower Reach of the Tarawera River at the estimated per capita quantity of 31 grams of eel flesh per person per day. It is stressed that these figures are upper-bound statistically derived estimates.

Dr Bates calculated that the direct consumption of water from the Lower Reach of the Tarawera River by humans was not restricted by current dioxin levels.

Overall, the discharges were considered to have impacted river ecology in a severe manner but that these effects were not due primarily to toxicity. Historically, the community had focused on dissolved oxygen, colour and toxicity as the major concerns regarding the Tarawera River. This was brought out in the first Tarawera River Management Plan. Studies over recent years demonstrate that these are still the priorities. The extensive research into toxicity of river water and discharges to

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92 Environment Bay of Plenty Report 98/19 Fish Health in the Lower Tarawera River and Rangitaiki River.

93 NZ Department of Statistics Food Balance Sheets for year ending June 1991.

94 USEPA – United States Environmental Protection Agency.
USFDA – United States Food and Drug Administration.

the river shows that the primary concerns with Tarawera River water are still dissolved oxygen and colour, with toxicity of lesser concern. Immediate attention needs to be focused on dissolved oxygen. However, colour and toxicity need also to be regulated tightly and the dischargers to the river encouraged to reduce over time their discharge of materials that contribute to colour and toxicity. The classification standards set in the plan will require reduction of discharge effects.

Ongoing monitoring should be conducted to assess reductions to toxic effects in the river. The concept of impairment has been explored with respect to dissolved oxygen levels in waterways by the USEPA. Different dissolved oxygen standards have been recommended by USEPA to achieve moderately-impaired waters, slightly-impaired waters and non-impaired waters. The bioassessment of the Tarawera River in 1993 demonstrated 'moderate impairment' below the Carter Holt Harvey Tissue discharge and 'severe impairment' downstream of the Tasman Pulp and Paper Company Limited discharge. This type of assessment allows future changes in effluent treatment and the effects on the Tarawera River to be compared to a fixed point in time.

The evidence of Dr Michael Bates, using USEPA standards, showed that there was a very small likelihood of human health being compromised by current levels of contaminants discharged into the Lower Reach of the Tarawera River. It should be noted, however, that USEPA has the guidelines for dioxins, in particular, under review. With this uncertainty in mind it is considered better to encourage industrial dischargers to the river to reduce their discharge of chlorinated compounds in the future from the present low levels rather than set some arbitrary bottom line. The Tarawera River Liaison Group came to the opinion that there should be reduction of all contaminants, including toxic substances, in the water resources of the Tarawera River catchment.

This philosophy was contrasted with the stance of Greenpeace who believe that the time has come for a zero discharge policy for dangerous chemicals (dioxins and organochlorines) entering the environment. Their paper to the Environment Bay of Plenty Toxicity Workshop concludes: "As a critical first step chlorinated chemical use must be investigated in this country and plans for its reduction and elimination rapidly progressed".

Environment Bay of Plenty does not consider it appropriate to specify discharge parameters for toxic compounds for which effects based evidence has not been established for the Tarawera River. However, a classification parameter designed to detect change in toxic effects from discharges is warranted. It is often appropriate to measure the overall toxicity of an effluent, in addition to testing for specific toxic substances. This is whole effluent toxicity (WET) testing, and can be usefully applied to a range of potentially toxic discharges, including those from industry, farms and urban stormwater systems. It is a useful test because it avoids the need to specify and quantify every potential toxic compound, a requirement that is currently unachievable. The interaction of chemicals (synergistic effects) also cannot be accounted for with single numerical standards. Protocols for acute and chronic testing have been specified in Rule 15.8.4(i).

15.4.3(a) Toxicity – Selected Management Alternative

Environment Bay of Plenty proposes that regardless of the purpose for which a water body is being managed, there should be no detectable increase in acute and chronic toxicity of any water body in the Tarawera River catchment. This applies to all water bodies in the catchment regulated by this regional plan, as well as the wetlands and drains and canals on the Rangitaiki Plains. Environment Bay of Plenty believes this precautionary approach to be necessary given that there is international uncertainty about the effects of toxic compounds. Regular monitoring of appropriate flora and fauna is required to identify toxicity in the Tarawera River catchment.

15.4.3(b) Toxicity – Supporting Technical Reports

The following technical reports, prepared or had regard to as part of the preparation of this regional plan, contain more detailed information on toxicity, especially related to the Lower Reach of the Tarawera River:

Bates, Dr M — 1994, Health Aspects of Tarawera River Contamination. A report prepared for Environment Bay of Plenty Tarawera River Regional Liaison Group Toxicity Workshop 17-18 May 1994, NIWA Ecosystems, Hamilton.

Beresford, D L — 1994, Investigation into the Effects of Geothermal and Pulp and Paper Mill Effluent on the Health of Fish Living in the Tarawera River (Bay of Plenty, New Zealand), in two volumes; Progress Report, December 1991 – June 1993 (22pp), and Final Report, November 1991 – April 1994 (44pp), School of Biological Sciences, University of Auckland.

Dell, P M — 1993, Pulp and Paper Industry Study Tour: July 1993. Environment Bay of Plenty Environmental Report 93-4. 73pp.

Donald, R C — 1994, Environment Bay of Plenty Tarawera River Regional Plan Technical Investigations Freshwater Ecology Component, Environment Bay of Plenty Environmental Report 94/1.

Hickey, C W — 1994, An Assessment of the Toxicity of Tarawera River: Effluent Discharges and Receiving Waters and Assessment of Geothermal Discharges. NIWA Ecosystems, Hamilton, Consultancy Report No. SCJ008/2461.

Hickey, C W — 1994, Mussel Biomonitoring in the Tarawera River 1991 and 1992. A report prepared for Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994, NIWA Ecosystems, Hamilton.

Jackman, G — 1994, Greenpeace: Toxic Chemicals – The Time for Zero Discharge Has Arrived. A report presented at the Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994.

McIntosh, J J — 1994, Inorganic Contaminants. A report prepared for Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994, Environment Bay of Plenty.

Park, S — 1991-92, Bay of Plenty Regional Council Monitoring Network – Coastal and Estuarine Ecology Monitoring Programme, Environment Bay of Plenty.

Park, S — 1994, Influence of the Tarawera River on the Naturally Occurring Marine Communities in the Vicinity of the River Mouth, Draft Discussion Paper, Environment Bay of Plenty.

Power, F A — 1994, Organic Contaminant Inputs/Dioxins and Organics in Foodstuffs. A report prepared for Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994, Environment Bay of Plenty.

Wilkins, A 1994, Chemical Investigations of some Tarawera River Water, Sediment and Mussel Samples. A report prepared for Environment Bay of Plenty Tarawera River Regional Plan Liaison Group Toxicity Workshop 17-18 May 1994. Published by the Chemistry Dept, University of Waikato.

15.4.4 Water Temperature

Changes in receiving water temperature caused by a discharge that adds or removes heat is considered to be a contaminant under the Resource Management Act 1991. Changes in temperature can change the physical, chemical and biological condition of water. While there is a general lack of information on the effect of changes in water temperature on individual species, changes in water temperature can adversely affect the habitats and functioning of aquatic ecosystems and the physiology of river life. Changes in the ambient water temperature may adversely affect the growth, metabolism, timing and success of reproduction, mobility and migration patterns of river life. The effect of changes in the water temperature depends on the sensitivity of organisms.

Temperature changes also affect the ability of water to hold oxygen. In natural waters the decrease in temperature in winter is accompanied by an increase in dissolved oxygen. With warm summer temperatures dissolved oxygen levels tend to fall. These changes are generally within the range tolerated by fish and invertebrates.

In addition to the effect that temperature has on waters ability to hold oxygen, it also has several important effects on organisms. Increases in temperature within the ambient range for New Zealand waters tend to increase the metabolism and respiration of organisms. This has the effect of increasing the amount of oxygen an aquatic community will remove from the water. Within the Tarawera River, increases in temperature most likely result in increases in the total oxygen requirement of biological communities. Also, increases in water temperature and hence biological metabolism can result in an increased sensitivity of organisms to toxic contaminants and low dissolved oxygen levels.

In this regional plan, human-induced changes in water temperature are generally considered to be an issue only in the Lower Reach of the Tarawera River, to which heated waters are discharged. Increases in temperature resulting from discharges to the Lower Reach of the Tarawera River exacerbate the problem of low dissolved oxygen levels, and the adverse effects this has on the aquatic environment. The average summer temperature of the Lower Reach of the Tarawera River is 19.3°C (Awakaponga), while the winter average is 13.9°C (Awakaponga). In comparison, the summer temperature in the Upper Reach of the Tarawera River (Kawerau Bridge site) averages 16.6°C. In the Lower Reach of the Tarawera River the average increase in water temperature between Kawerau Bridge and Awakaponga sites is approximately 2.7°C. Of this increase, 1.2°C (45% of the overall increase) is attributed to the effect of natural temperature increases in the river. The remaining 1.5°C is attributed to wastewater discharges from the pulp and paper mills and human-induced geothermal discharges.

The primary adverse effect of these discharges is on the ability of the Lower Reach of the Tarawera River to carry oxygen. This is of critical importance in a water body where dissolved oxygen levels are often already low, due to the high biological demand created by the discharge of pulp and paper effluent. An increase in water temperature of 1°C will lower the dissolved oxygen content by approximately 0.2 grams per cubic metre.

Trout and invertebrates are generally considered to become stressed at temperatures above 25°C. Wastewater discharges to the Lower Reach of the Tarawera River do not generally result in temperatures of this level. However, trout, other fish species, and invertebrates, can still be indirectly affected by the lowering of the dissolved oxygen content (see sub-section 15.4.1 – *Oxygen Content*).

15.4.4(a) Surface Water Temperature – Selected Management Alternative

The Resource Management Act 1991 defines contaminants as including heat that, when discharged into water, changes or is likely to change the physical, chemical or biological condition of the receiving water. Increases in river water temperature can result directly from heat in discharges, and indirectly due to minor increases in solar absorption. Environment Bay of Plenty is of the opinion that a lack of control of temperature results, or is likely to result, in adverse effects on other water quality parameters, most notably in decreasing dissolved oxygen levels. Fluctuations in temperature are also likely to have an adverse effect on aquatic life.

Environment Bay of Plenty proposes that for the purposes of maintaining water in the Tarawera Lakes catchments, except Lake Okaro, in their natural state, water temperature should not be allowed to increase above its ambient (surrounding unaffected) level (see Rule 15.8.4(d)). Environment Bay of Plenty also proposes that for the purposes of maintaining Lake Okaro for contact recreation purposes, temperature should not be allowed to increase more than 3°C, with a maximum not to exceed 25°C (see Rule 15.8.4(d)(iii)).

For the purposes of protecting water for fish spawning purposes and allowing for maximum assimilative capacity for discharges to the Lower Reach of the Tarawera River, Environment Bay of Plenty proposes that the temperature in the Upper Reach of the Tarawera River, the tributaries of the Tarawera River, and tributaries of the lakes in the Tarawera Lakes catchments should not be allowed to increase, after allowing for reasonable mixing and disregarding any natural perturbations (see Rule 15.8.4(f)(iv)).

To manage water for fish purposes in the Lower Reach of the Tarawera River, and in order to minimise adverse effects of temperature increases on dissolved oxygen levels, and having regard to the need of industry to discharge reasonable amount of heat to surface water, Environment Bay of Plenty proposes that at no time should temperature be allowed to increase by more than 3°C, with a maximum not to exceed 25°C as a result of discharges after allowing for reasonable mixing and disregarding any natural perturbations (see Rule 15.8.4(h)(iv)).

Providing that it would not affect the requirement to achieve optimal reinjection of geothermal fluid back into the Kawerau Geothermal Field, the further recovery and use of heat for ancillary enterprises, such as prawn farming, are supported by Environment Bay of Plenty. This would be a way to further dissipate heat and lessen the movement of thermal energy into the river.

15.4.4(b) Surface Water Temperature – Supporting Technical Reports

The following technical reports, prepared as part of the preparation of this regional plan, contain more detailed information on water temperature and the effects of changes in water temperature in the Lower Reach of the Tarawera River in particular:

Vedder, I 1994 (May), Tarawera River Heat Balance (Revised May 1994), prepared for Tasman Pulp and Paper Company Limited, Caxton Paper Limited, and Geothermal Trading, by Works Consultancy, Wairakei.

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

15.4.5 pH

pH is a measure of how acid or alkaline a solution is. The pH index has a scale of 1 to 14. An acidic solution ranges from pH1 to below pH7. Most natural fresh waters have a pH close to 7. In natural conditions the pH of water bodies is influenced by the soil type and vegetation cover of the land through which drainage water passes. Aquatic vegetation can also affect pH as gas exchange between plants and water takes place. Point-source or diffuse contaminant discharges into a drainage catchment and landuse practices, such as long-term fertiliser applications, can make a water body unnaturally acidic or alkaline.

It is generally accepted that a pH range of 5-9 will not adversely affect trout, invertebrates or other aquatic life. For example, adverse effects on eggs and the fry of sensitive fish species generally occur in waters with a pH of less than 5.0. However, the toxicity of several contaminants, such as ammonia and hydrogen sulphide, can be markedly affected at pH in the extremes of this range (i.e. pH5 to pH9)[95]. The pH in the lakes, wetlands, the Tarawera River and its tributaries, and in most of the canals on the Rangitaiki Plains, naturally falls between pH6.5 and pH8.5.

The discharge of geothermal sulphide and ammonia produces some potential for pH-related toxic effects. Undissociated (gaseous) hydrogen sulphide and ammonia are toxic to aquatic life. An acidic discharge into the river would push the river hydrogen sulphide equilibrium towards the production of toxic undissociated hydrogen sulphide. Conversely, an alkaline discharge would push the ammonium equilibrium towards the production of toxic ammonia.

15.4.5(a) pH – Selected Management Alternatives.

Environment Bay of Plenty has assessed that a sustainable pH range in the water bodies of the Tarawera River catchment is between 6.5 and 8.5. This is considered an appropriate range for sustaining aquatic ecosystems. It also takes into account potential toxic effects of ammonia discharges associated with natural and human-induced discharges of geothermal fluids. This range will be applied to all water bodies in the catchment, excluding the wetlands and drains and canals on the Rangitaiki Plains. Changes in the pH in wetlands, drains and canals as a result of discharges will be regulated through the resource consent process.

15.4.5(b) pH – Supporting Technical Report

The following technical report, prepared as part of the preparation of this regional plan, contains more detailed information on pH values in the Tarawera River.

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

15.4.6 Sewage Discharges

The discharge of sewage to water bodies has traditionally been considered offensive by Maori, and is also considered offensive by many others in the community. The discharge of sewage is considered to degrade the mauri of the water and in turn adversely affect waahi tapu areas used for healing and cleansing, tohi and purification rites, as well as having an effect on taiapure and kaimoana.

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95 Australia & New Zealand Environment and Conservation Council, 1992, page 2024.

Ngati Awa, Tuwharetoa ki Kawerau, Ngati Rangitihi and Tuhourangi iwi have rohe within the Tarawera River catchment and have all at various times expressed deep concern at the continued discharge of sewage, treated and untreated, to water bodies, both within and outside the Tarawera River catchment. They do not accept that water bodies should continue to be used as waste disposal systems, to transport and treat effluents and wastes, particularly sewage. While some liquid wastes, including sewage, may be treated to a high degree before being discharged, this does not overcome the adverse effect of these discharges on the mauri life force of a water body, unless the waste has first been passed through the cleansing properties of earth. Maori cultural values with regard to the direct discharge of human sewage into water are discussed in greater detail in Chapter 8 – *Resource Management Issues of Significance to Iwi Authorities*.

The two biggest point-source discharges of human sewage into water bodies in the catchment of the Tarawera River are from the combined Kawerau town and Carter Holt Harvey Tissue outfall which discharges to the Lower Reach of the Tarawera River[96], and the outfall of the Edgecumbe sewage treatment ponds, which discharges to the Omeheu Canal on the Rangitaiki Plains. Treated sewage effluent from the Edgecumbe sewage treatment oxidation ponds discharges into the Omeheu canal which has a low flow. The effluent exacerbates the low dissolved oxygen levels in the canal and increases the nutrient load.

As well as being culturally offensive and a social and health concern for the wider community, the discharge of human sewage into water bodies also has the effect of lowering dissolved oxygen content and is the principal source of *Giardia* contamination in the Lower Reach of the Tarawera River. Since Carter Holt Harvey Tissue has treated both its mill effluent and Kawerau town sewage together in its anaerobic digesters, there has been a resulting small measurable net improvement recorded in the dissolved oxygen content of the Tarawera River downstream from the outfall, relative to the previous discharge of separate waste streams. However, the combined discharge of industrial and town effluent from the Carter Holt Harvey Tissue outfall still contributes to a drop in dissolved oxygen of approximately 0.5 grams per cubic metre between Kawerau Bridge site and upstream of the Ruruanga Stream confluence (Figure 8).

When considering the effects of sewage discharges, Environment Bay of Plenty needs to balance immediate and longer term costs and benefits within the constraints of statutory, community and cultural requirements. Any action goals designed to result in the reduction or eventual removal of sewage discharges will need to be structured into a realistic timeframe.

15.4.6(a) Sewage Discharge – Selected Management Alternatives

Environment Bay of Plenty has considered alternatives to manage domestic and municipal sewage within the catchment of the Tarawera River.

Policies and methods of implementation regarding the on-site treatment of human sewage, such as septic tank and soakage field systems, are contained within Environment Bay of Plenty's *Operative On-Site Effluent Treatment Regional Plan*. For effective on-site treatment of human sewage, the requirements and Rules of that regional plan will take precedence.

The following alternatives apply to the disposal of all municipal, industrial and domestic sewage that cannot be efficiently disposed onto or into land on-site.

(i) **Alternative 1**: Retain the status quo and permit existing discharge and disposal methods through resource consents issued under section 15 of the Resource Management Act 1991 .

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96 Carter Holt Harvey Tissue utilises sewage from Kawerau Township to assist the breakdown of pulp and paper mill effluent in its anaeraobic treatment process.

(ii) **Alternative 2**: Retain and permit existing discharge and disposal methods as discretionary activities, but require that effluent discharged into the Tarawera River or any catchment lake or tributary be treated to a defined tertiary level before discharge, using BPO (Best Practicable Option) criteria.

(iii) **Alternative 3**: Retain and permit existing discharge and disposal methods as discretionary activities, but require that effluent discharged into the Tarawera River or any catchment lake or tributary be treated to an environmentally acceptable level using BPO criteria that achieve a treatment efficiency equivalent to that of an efficient land based system acceptable to iwi.

(iv) **Alternative 4**:

(a) Until 31 December 2002 the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment can continue as a Discretionary Activity, subject to compliance with classification standards.

(b) From 1 January 2003 the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment will be limited to exceptional circumstances, provided that this limitation shall be suspended until 12 months past the date on which an application by Carter Holt Harvey Tissue to discharge AWWTP wastewater and sanitary wastewater from Kawerau township by spray irrigation to land has been decided and any appeals determined.

(c) Until 30 June 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment can continue as a Discretionary Activity subject to compliance with consent conditions.

(d) From 1 July 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment can continue as a Discretionary Activity subject to compliance with defined effluent quality standards measured in the effluent stream prior to discharge.

(e) Subject to the provisions of the Operative On-Site Effluent Treatment Regional Plan, and the provisions set out in (a) to (d) above, and the provision for exceptional circumstances, all other new or existing unauthorised discharges of human sewage into the Tarawera River or any catchment lake or tributary will become a Prohibited Activity on the date on which this regional plan becomes operative.

Environment Bay of Plenty has selected **Alternative 4**:

(a) Existing sewage discharges into the Tarawera River aggravates the existing unacceptable adverse effects on water quality and river ecology caused by the low dissolved oxygen content in surface water and needs to be made to comply with classification standards.

(b) With respect to Maori cultural and traditional values, there should be no sewage effluent discharges into the surface water of the Tarawera River, except under exceptional circumstances, for a limited duration, where no other practicable options are available.

(c) Until 30 June 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment can continue as a Discretionary Activity subject to compliance with consent conditions.

(d) From 1 July 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment can continue as a Discretionary Activity subject to compliance with defined effluent quality standards measured in the effluent stream prior to discharge.

(e) A reasonable time is set to enable the transition from existing sewage treatment and discharge quality to new classification or defined standards (see Rule 15.8.4(r)).

15.4.6(b) Sewage Discharges – Supporting Reports

The following reports and those indicated in subsection 15.4.1(b), *Oxygen Content – Supporting Technical Reports*, written as part of the preparation of this regional plan, contain more detailed information on concerns relating to the discharge of sewage to the Tarawera River and its tributaries:

Te Runanga o Tuwharetoa ki Kawerau:	1994, Tuwharetoa ki Kawerau – Background on the Tarawera River, Te Runanga o Tuwharetoa ki Kawerau, Kawerau – *Unpublished Paper*.
Te Runanga o Ngati Awa Trust Board:	1994 (March), Ngati Awa Policy Statement – Tarawera River, Te Runanga o Ngati Awa Trust Board, Whakatane – *Unpublished Paper*.

15.4.7 Dairy Shed Discharges

Environment Bay of Plenty is encouraging the disposal of dairyshed effluent to land. Guidelines that cover agricultural discharges are currently operating, and these are generally accepted by the dairy farming community and are having good results. The *Guidelines for Agricultural Discharges in the Tarawera and Rangitaiki Catchments – September 1992* will be used to establish conditions on resource consents granted for the spray irrigation of dairyshed effluent onto land.

With respect to the cumulative impact of land based effluent treatment, there is no evidence that shallow groundwater is being unacceptably contaminated by dairyshed or other agricultural discharges[97]. There are specific high risks, however, for example where the on-farm management of a spray irrigation system is not adequate, where local water tables are high or where the irrigation of effluent is up-slope of springs used for community or household supply. For these reasons the spray irrigation of dairyshed effluent will remain an activity requiring a resource consent.

The surface drain water on the lower plains is usually slow moving and considered to be of generally low quality. Test results show that surface drain water over most of the plains is characterised by high nutrient concentrations, poor clarity, a wider range of pH values that can change rapidly (diurnal fluctuations), higher ambient water temperature and low dissolved oxygen. Setting unreasonable stringent controls is unlikely to result in any measurable increase in drain water quality over the short to medium term. However, the effective management of fertiliser use and effluent spray systems, together with the promotion of nutrient recovery, may, over time, improve dissolved oxygen levels and general water quality in the summer months.

Dairy shed effluent disposal will be managed in accordance with the *Guidelines for Agricultural Discharges in the Tarawera and Rangitaiki Catchments - September 1992*, and controlled in accordance with the requirements of Rule 16.8.5(b) in Chapter 16 – *Groundwater Quality and Quantity*.

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97 Pang, L, Groundwater Resources of the Lower Tarawera Catchment, Environmental Report 94/3.

15.4.8 Odour

This regional plan is concerned with odour emission effects resulting from the discharge of effluent into water within the catchment of the Tarawera River. Odour emission effects resulting from the discharge of contaminants directly into air, or into or onto land, are dealt with by separate consents and may be dealt with in the *Operative Bay of Plenty Regional Air Plan* and *Operative Bay of Plenty Regional Land Management Plan.*

In its natural state, water in a water body gives off an odour consistent with the biological matter and chemical compounds found in it. For example, a stagnant stream, with a lot of decaying vegetation and micro-organisms will often have a 'rotten' odour associated with it. Human-induced discharges to water bodies can also result in the emission of odours, many of which are objectionable.

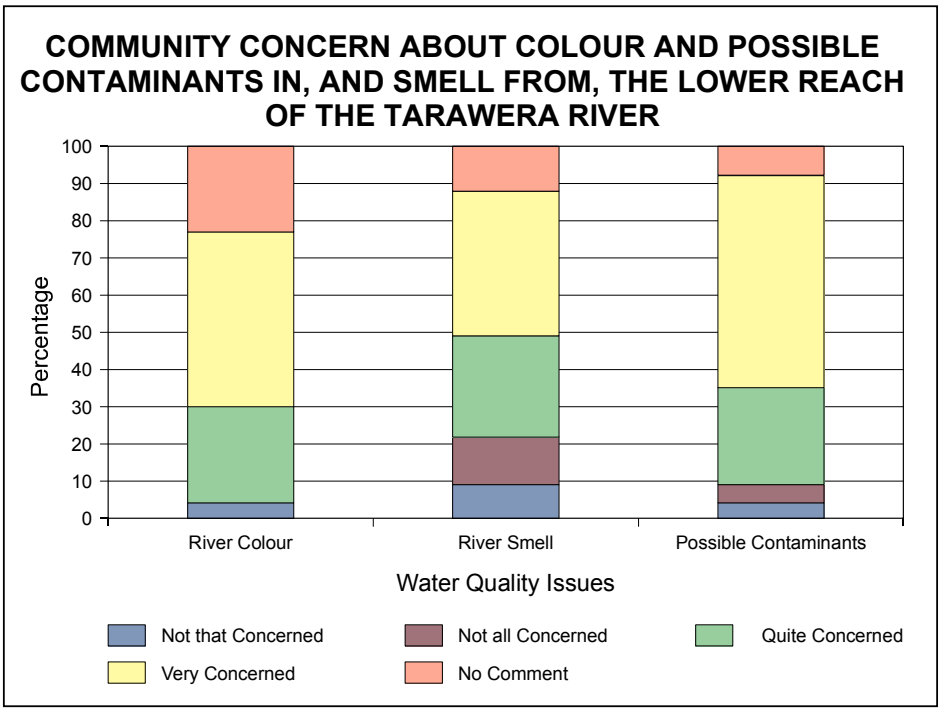
Within the catchment of the Tarawera River, the emission of objectionable odours is generally considered a problem only in the Lower Reach of the Tarawera River and to a lesser extent in the drains and canals on the Rangitaiki Plains. The main source of the odours is air discharges from the pulp and paper plants and their treatment ponds. Environment Bay of Plenty will continue to encourage industry to remove odour-causing compounds from their waste streams. This applies in particular to volatile organic compounds in the foul condensate generated at the Tasman Pulp and Paper Company Limited plan. Environment Bay of Plenty is requiring through air emission resource consents that by 31 December 1996 foul condensates are to be removed from the Tasman Pulp and Paper Company Limited discharge waste stream.

A study of the sources of odour in the Lower Reach of the Tarawera River carried out by the Water Quality Centre[98] in 1984 concluded that the presence of sulphureous compounds in the Lower Reach of the Tarawera River at the SH 30 bridge was the result of the discharge of sulphureous compounds with effluent from the wood pulping process. The study did not identify the particular substances responsible for the emission of the odour.

The measurement of the objectionable odour in the Lower Reach of the Tarawera River is complicated by natural geothermal discharges along the river which give off the characteristic "rotten egg" smell of hydrogen sulphide.

[98] A division of the former Ministry of Works and Development.

Figure 12



In the 1993 survey of *Attitudes and Perceptions Towards the Tarawera River and its Catchment*, smell from the Lower Reach of the Tarawera River was raised as an issue by 22% of respondents. Concern was lowest in Kawerau (19%). Matata ward residents indicated the highest level of concern about the smell of the river (52%). When prompted about the smell emanating from the Tarawera River, 68% of the respondents said they were concerned or very concerned (Figure 12).

The canals and drains on the Rangitaiki Plains typically emit a smell associated with rotting biological matter and a high concentration of biological organisms, especially during summer months. Environment Bay of Plenty attributes this in part, to the discharge of treated Edgecumbe sewage to the Omeheu Canal, and of dairy shed effluent to canals on the Rangitaiki Plains.

15.4.8(a) Odour – Selected Management Alternatives

The Resource Management Act 1991 (sections 70(1)(e) and 107(1)(e)) restricts Environment Bay of Plenty, except in special circumstances[99], from granting discharge permits, which after allowing for reasonable mixing, are likely to give rise to any emission of objectionable odour.

Environment Bay of Plenty does not consider that the narrative standard of 'no increase in the emission of objectionable odour' requires quantifying further. This narrative standard will be applied to all water bodies in the catchment. The standard will be regulated by a requirement that industry emissions will be remedied by the adoption of 'best practicable options' in terms of technical means to decrease the emission of objectionable odours.

Environment Bay of Plenty recognises that major industrial discharges to the Lower Reach of the Tarawera River and agriculture discharges into the drains and canals

[99] Section 107(2) allows Environment Bay of Plenty to grant a discharge permit to do something that may result in the emission of objectionable odour if it is satisfied that:
(a) exceptional circumstances justify the granting of the permit; or
(b) the discharge is of a temporary nature; or
(c) that the discharge is associated with necessary maintenance work.

of the Rangitaiki Plains currently can result in objectionable odours. Environment Bay of Plenty will continue to encourage all dischargers to remove or neutralise odour-causing compounds from discharge streams. With regard to statutory limits, Environment Bay of Plenty will require as a minimum that the emission of objectionable odour resulting from the discharge of effluent into water be remedied by the adoption of an ongoing programme to apply the best practicable options for odour removal from waste streams.

15.4.8(b) Odour – Supporting Technical Reports

Regard was had to the following technical reports:

Graham B W and Bingham A G	1991, Report on Odour Testing, Tarawera River, 31 July and 1 August 1991, NECAL Service Report S9/969.
Kevern R P H	1994, Evidence Report prepared for Discharge Application 03 0068, Tasman Pulp and Paper Company Limited, (June 1994).
Agricultural Engineering Institute	1993, Recommendations to the Ministry for the Environment: Odour Nuisance Control, AE1 2496/1, (September 1993).

15.4.9 Suspended Materials

Suspended materials are solids transported by moving water in the zone of turbulent flow. They are commonly fine soil or pumice particles, or living or dead biological material that can be supported by the river water.

Suspended material arises from both point and diffuse source discharges. The levels of suspended materials can vary dramatically at different times of the year and increase dramatically following heavy rainfall events which increases the amount of sediment washed into water bodies. The levels of suspended solids can also vary with turbulence as deposited sediment is resuspended. Resuspension of material in the Tarawera River is particularly marked, as a result of its highly mobile pumice bed.

Concentrations of suspended materials in the lakes in the upper lakes catchment are less than 2.0 grams per cubic metre (1992/93 data). In the Upper Reach of the Tarawera River concentrations of suspended solids under normal conditions average less than 5.0 grams per cubic metre (1992/93 data).

High suspended material levels can adversely affect aquatic ecosystems both when in suspension and when the material settles out. In suspension, the main impact of particulate matter is optical, as it can reduce light penetration and thus affect primary production. As discussed in sub-section 15.4.2 – *Colour and Clarity*, reduced light penetration caused by suspended material can adversely affect stream ecology. High levels of suspended solids can also interfere with the feeding mechanisms of filter-feeding organisms. Further, particulate matter may smother immobile organisms, change the nature of the substrate on settling, or do both.

In the Upper Reach of the Tarawera catchment, the bulk of suspended material in water bodies is considered to result from natural erosion from areas in native forest, exotic production forest and farm land. The suspended materials, along with bed-load, ultimately contribute to sedimentation in the lower reaches of the Tarawera River, associated wetlands, the Tarawera River estuary and the coast. Inappropriate land uses and land practices are discussed in Chapter 11 – *Land Use*. Effluent discharges from the pulp and paper mills, and from agricultural

activities on the Rangitaiki Plains, also contribute to increased suspended material levels.

15.4.9(a) Suspended Material – Selected Management Alternatives

The alternatives relating to suspended solids are limited by statue. Sections 70 and 107(1)(c) of the Resource Management Act 1991 restricts Environment Bay of Plenty, except as allowed by section 107(2)[100], from granting discharge permits, which after allowing for reasonable mixing, are likely to give rise to the production of conspicuous suspended materials in the receiving water body. The setting of defined standards for colour and visual clarity will provide an appropriate means of measuring and limiting unsustainable levels of suspended materials in the Tarawera River.

15.4.9(b) Suspended Material – Supporting Technical Reports

The following technical reports written as part of this regional plan, contain more detailed information on suspended materials in the catchment of the Tarawera:

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

15.4.10 Nutrients

Nutrients are substances which provide nourishment to plants and animals. Nutrient levels strongly influence the growth of organisms, and in large quantities can be undesirable. Nitrogen and phosphorus levels in water bodies depend on a number of factors including direct discharges to the water and the rate of removal of these nutrients from the water by absorption into sediment or uptake by aquatic biota.

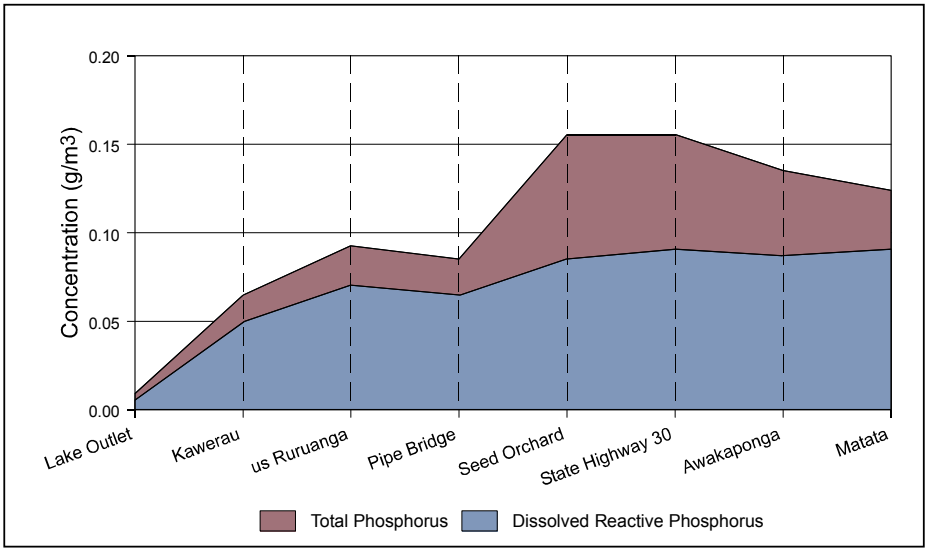
[100] Section 107(2) allows Environment Bay of Plenty to grant a discharge permit to do something that may allow the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials if it is satisfied that:

(a) exceptional circumstances justify the granting of the permit; or
(b) the discharge is of a temporary nature; or
(c) that the discharge is associated with necessary maintenance work.

Figure 13

THE MEDIAN CONCENTRATION OF DISSOLVED REACTIVE PHOSPHORUS (DRP) AND TOTAL PHOSPHORUS (TP) AT EIGHT SITES ON THE TARAWERA RIVER

(mean number of samples per site = 14) (effluent from Carter Holt Harvey Tissue and Kawerau District Council, discharges to the Tarawera River between 'Kawerau' and 'us (upstream) Ruruanga'; effluent from Tasman Pulp and Paper Company Limited, discharges to the Tarawera River between 'Pipe Bridge' and 'Seed Orchard')



The addition of plant nutrients such as nitrogen and phosphorus from sewage and agricultural runoff can create an imbalance by stimulating the excessive growth of aquatic plants. These plants are normally a natural and important component of a stream. They provide habitat areas, food for other aquatic life, and contribute to re-aeration through photosynthetic production of oxygen. However, excessive summer growth due to nutrient enrichment can choke water bodies that have low flow rates. Seasonally, when plants die off, oxygen depletion occurs as they are decomposed by bacteria.

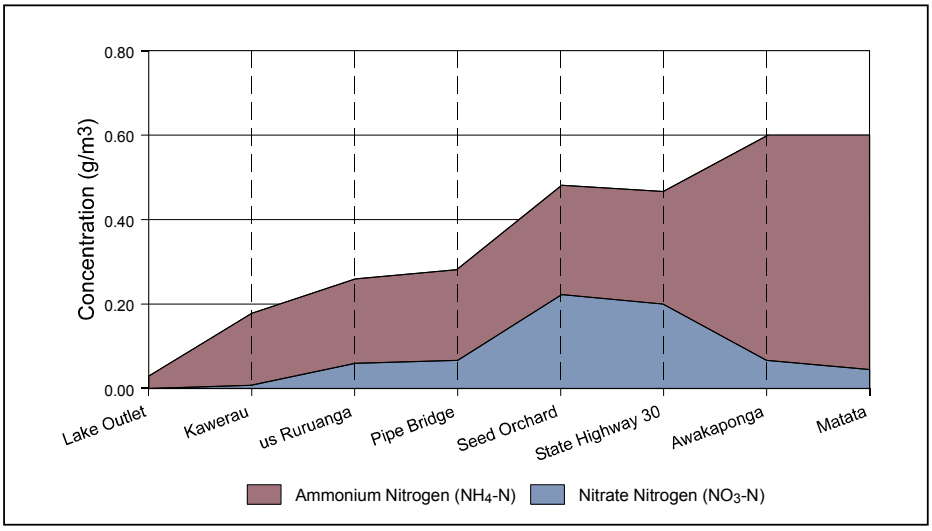
Figure 13 shows the median dissolved reactive phosphorus (DRP) and total phosphorous (TP) levels in the Tarawera River from 1992 to 1994. Figure 14 displays the medium ammonium nitrogen (NH_4-N) and nitrate nitrogen NO_3-N) concentrations in the Tarawera River between 1992 and 1994.

At the Lake Tarawera outlet very low nutrient levels are evident. This is consistent with lake nutrient chemistry for oligotrophic (very clean) waters. As the Tarawera River moves through the Tarawera Forest, spring-fed tributaries contribute geologically-derived nutrients to the phosphorus and nitrogen load. The median dissolved reactive phosphorus and nitrate nitrogen concentrations at Kawerau are much higher than at the Lake Tarawera outlet (Figures 13 and 14).

Figure 14

THE MEDIAN CONCENTRATION OF AMMONIUM NITROGEN (NH_4-N) AND NITRATE NITROGEN (NO_3-N) AT EIGHT SITES ON THE TARAWERA RIVER FOR 1992-1994 DATA

(mean number of samples per site = 14) (effluent from Carter Holt Harvey Tissue and Kawerau District Council, discharges to the Tarawera River between 'Kawerau' and 'us (upstream) Ruruanga'; effluent from Tasman Pulp and Paper Company Limited, discharges to the Tarawera River between 'Pipe Bridge' and 'Seed Orchard')



Downstream of the industrial discharges, nutrient levels increase in the Tarawera River (Figures 13 and 14). Between the Kawerau Bridge and Tasman Pulp and Paper Company Limited Pipe Bridge sites, Carter Holt Harvey Tissue effluent and geothermal discharges contribute to the nutrient levels.

Kawerau District Council sewage is a large contributor of nutrients to the Tarawera River. Since 1990 Kawerau's sewage has been diverted to the anaerobic treatment plant of Carter Holt Harvey Tissue, and is used as a nutrient source. This has altered the nutrient balance in the river. A greater proportion of phosphorus from sewage sources is now discharges in the dissolved form. The Carter Holt Harvey Tissue plant also utilises significant quantities of ammonium nitrogen from the sewage to break down its carbonaceous effluent. This has resulted in a reduction in the levels of ammonium nitrogen discharges to the Tarawera River from this source. However, over the same period, ammonium nitrogen levels have increased in the Tasman Pulp and Paper Company Limited discharge. This change has occurred at a time when the rate of dissolved oxygen consumption appears to have increased.

Figure 14 shows that the ammonium nitrogen component of the nutrient discharge is the most highly-utilised nutrient species in the Lower Reach of the Tarawera River. It also shows that the major source is the discharge from the Tasman Pulp and Paper Company Limited treatment ponds. The high rate of biological activity in the Lower Reach of the Tarawera River, with consequent severe oxygen depletion, is driven by the discharge of carbonaceous effluents. Ammonium nitrogen is consumed as a major nutrient source by this biological activity. It is apparent, therefore, than any effluent treatment measures that reduce the discharge of dissolved nutrients, particularly ammonium nitrogen to the Tarawera River, will benefit the oxygen supply of the Lower Reach of the Tarawera River.

15.4.10(a) Nutrients – Selected Management Alternatives

Increases in nutrients to the Lower Reach of the Tarawera River result from both point-source and diffuse discharges. Environment Bay of Plenty does not consider it necessary to establish water quality standards for nutrients. Nutrient discharges are likely to be significantly reduced by encouraging the land disposal of dairy shed, piggery and sewage effluent.

The control of nutrients and chemical inputs from diffuse agricultural sources is more difficult. This relies largely upon farmers and foresters minimising the spread of the main pollution sources, for example erosion, fertilisers and chemicals[101] to local water bodies. With diffuse discharges, the control of diffuse runoff will be most effectively controlled through buffering and education.

The provision of advice and a demonstration of alternatives to traditional application methods of fertiliser and nitrogen, are important means by which phosphate and nitrogen levels in water bodies can be reduced. Means of enhancing the containment of nutrients in soils can also benefit farmland.

15.4.10(b) Nutrients – Supporting Technical Report

The following technical report, written as part of the preparation of this regional plan, contains more detailed information on nutrients:

McIntosh, J J 1995, Tarawera River Regional Plan Technical Investigations – Water Quality Component, Environment Bay of Plenty, Whakatane.

15.4.11 Tainting

Tainting refers to the contamination of water or aquatic life so as to make it unsuitable for a specified purpose, such as stock watering or human consumption. The Resource Management Act 1991 stipulates (sections 70(1)(f) and 107(1)(f)) that except as allowed by section 107(2) of the Act, discharges of contaminants or water into water cannot be granted, if after reasonable mixing, they are likely to render fresh water unsuitable for consumption by farm animals.

No surface water in the Lower Reach of the Tarawera River, outside the reasonable mixing zones of point-source discharges, and excluding the canals and drains on the Rangitaiki Plains, is considered to be unsuitable for stock watering purposes. In the 1993 survey *Community Attitudes Towards the Tarawera River and its Catchment*[102], inedibility of fish taken from the Lower Reach of the Tarawera River was raised as an issue by a small percentage of respondents. Furthermore, when prompted, 83% of respondents said they were concerned about the possible contamination of the river.

No surface water bodies in the catchment are considered to have water quality which renders their aquatic food resources unsuitable for human consumption although eels taken in the Lower Reach of the Tarawera River may need to be swum in clear water for a time to improve their taste. However, water in the Lower Reach of the Tarawera River and the drains and canals on the Rangitaiki Plains is generally considered unsuitable for human consumption, largely due to foul taste and smell, but also for health reasons.

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101 NWASCO, 1982, No. 29.

102 Research Solutions Limited, 1993 (March).

15.4.11(a) Tainting – Selected Management Alternatives

Alternatives for the management of tainting are limited by statute. Except as allowed by section 107(2), sections 70(1)(f) and 107(1)(f) of the Resource Management Act 1991 restrict Environment Bay of Plenty from granting discharge permits, which, after allowing for reasonable mixing, are likely to render fresh water unsuitable for consumption by farm animals. This standard will apply to all water bodies in the catchment. However, due to the tainting of water for human consumption in the Lower Reach of the Tarawera River and in the drains and canals on the Rangitaiki Plains, Environment Bay of Plenty will advise against taking water from these water bodies for human consumption purposes.

15.4.11(b) Tainting – Supporting Technical Reports

No specific technical reports were prepared on tainting as part of the preparation of this regional plan.

15.4.12 Conspicuous Oil, Grease Films, Scums or Foams, or Floatable Material

Foam is a mass of small bubbles of gas formed on the surface of a liquid. Foam can occur naturally due to natural carbohydrates washed from forested areas. Many substances in water will cause foaming when the water is agitated or air is entrained. It can also occur as the result of the discharge and mixing of contaminants. Scums are layers of matter that form on the surface of a liquid, such as the greenish film of algae and similar vegetation on the surface of a stagnant pond. Like foams, scums can and do occur naturally. They also arise from point-source contaminant discharges. Floatable materials are materials which have not dissolved in the water body concerned after allowing for reasonable mixing, and float on the surface. This is distinct from suspended solids as discussed in sub-section 15.4.9 – *Suspended Materials*.

While the production of conspicuous scums or foams has occurred in the Lower Reach of the Tarawera catchment in the past, the relocation of discharge points from above-surface to sub-surface discharge has largely overcome these problems.

15.4.12(a) Conspicuous Oil, Grease Films, Scums or Foams, or Floatable Material – Selected Management Alternatives

Alternatives for the management of the discharge of conspicuous oil or grease films, scums or foams, or floatable or suspended materials are limited by statute. Sections 70(1)(c) and 107(1)(c) of the Resource Management Act 1991 restrict Environment Bay of Plenty, except as all allowed by section 107(2)[103], from granting discharge permits, which after allowing for reasonable mixing, are likely to produce any conspicuous oil or grease films, scums or foams, or floatable or suspended materials.

Environment Bay of Plenty does not consider that the term 'conspicuous[104]', as used in sections 70(1)(c) and 107(1)(c) of the Act, requires quantifying.

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[103] Section 107(2) allows Environment Bay of Plenty to grant a discharge permit to do something that may allow the production of conspicuous oil or grease films, scums or foams, or floatable or suspended materials if it is satisfied that:
(a) exceptional circumstances justify the granting of the permit; or
(b) the discharge is of a temporary nature; or
(c) that the discharge is associated with necessary maintenance work.

[104] For the purposes of clarification, Environment Bay of Plenty considers the term "conspicuous" in relation to sections 70 and 107 of the RMA to mean:

15.4.12(b) Conspicuous Oil, Grease Films, Scums or Foams, or Floatable Material – Supporting Technical Reports

No specific technical reports were prepared on the production of conspicuous oil, grease films, scums or foams, or floatable material as part of the preparation of this regional plan.

15.4.13 Biological Growths

There are two main categories of biological growths which can proliferate in response to organic or nutrient-rich discharges to the water to such an extent that they become undesirable. These are heterotrophic slimes, commonly referred to as "sewage fungus", and phototropic organisms, including planktonic and benthic algae and large aquatic plants. They occur in most surface water bodies, including shallow areas of lakes.

Heterotrophic slimes (or sewage fungus) are proliferations of bacteria or fungi, or both that may form feathery, cotton-wool-like growths in streams with high concentrations of dissolved organic compounds from, for example, effluent discharges. Sewage fungus growths aesthetically degrade rivers, make the river bed unsuitable for fish spawning and many species of invertebrates and can cause severe oxygen depletion. The growth rate of bacteria or fungi that can form sewage fungus changes with the season and the flow of a river. Slower growth in winter is also caused by physical factors, such as lower temperatures, and scouring by floods.

Benthic algae, generally referred to as periphyton, grow on the river bed and other solid surfaces in rivers such as logs. They provide a food source for instream invertebrates, remove nutrients from the water and increase dissolved oxygen by photosynthesis during the day. The key nutrients promoting periphyton growth are dissolved inorganic nitrogen, ammonia and nitrate, and dissolved reactive phosphorous (see sub-chapter 15.4.10 – *Nutrients*). Excessive growth of periphyton due to nutrient enrichment of the water can have the following effects:

- severe night-time depletion of dissolved oxygen and high day-time pH;
- smothering of the river or beds, severely reducing invertebrate habitat; and
- visual degradation of the river.

In waters not polluted by nutrient enrichment the periphyton is almost invisible on stones and rocks but, with increasing pollution, it can form a thick mat covering the river bed. Its composition can be diatoms, which are brown or yellow algae which cover the stones with films or turfs, or filamentous green or blue-green algae, or a mixture of both.

From 1995 and up until July 2001, undesirable biological growths were not present in the lower Reach of the Tarawera River.

15.4.13(a) Biological Growths – Selected Management Alternatives

Environment Bay of Plenty has adopted quantifiable standards across three of the four water quality classes for the catchment of the Tarawera River (see Rules 15.8.4(b), 15.8.4(d), 15.8.4(f) and 15.8.4(h)). These standards are aimed at minimising increases in phytoplankton and benthic algae. For the Natural State (NS) water quality class, Environment Bay of Plenty proposes to adopt as its standard no change in the net volume of biological growths, after allowing for

"After allowing for reasonable mixing (a question of fact and degree in each particular case), the extent or magnitude that the issue in question is clearly visible, obvious or striking to the eye of a reasonable person observing the receiving water."

reasonable mixing and disregarding the effect of any natural perturbations (see Rule 15.8.4(b)(vii)).

15.4.13(b) Biological Growths – Supporting Technical Reports

The following technical report on biological growths was written as part of the preparation of this regional plan:

Donald, R 1994, Environment Bay of Plenty Tarawera River Regional Plan Technical Investigations – Freshwater Ecology Component, Environment Bay of Plenty Environmental Report – 94/1, July 1994.

Also referenced was:

Ministry for the Environment 1992 (June), Water Quality Guidelines No 1 – Guidelines for the Control of Undesirable Biological Growths in Water, Ministry for the Environment, Wellington.

15.5 Water Quality Standards

The Third Schedule of the Resource Management Act 1991 outlines a range of water quality classes which include standards for the management of surface water bodies for different purposes. These standards provide 'bottom lines' above which the water quality of the respective water bodies is to be managed. While specific water quality standards do not have to be established, they are useful in indicating to current and potential resource consent holders the use for which a water body is being managed.

Section 69(1) of the Act states that where water quality standards exist in a plan, any Rules relating to water quality must comply with the respective standards, unless, in the Council's opinion, those standards are not adequate or appropriate in respect of those waters in which case the Rules may state standards that are more stringent or specific.

Having regard to existing water quality standards in the Tarawera River catchment, and to discussions with the Tarawera River Liaison Group on desired water quality standards in the Tarawera catchment, Environment Bay of Plenty has decided to adopt the following water quality standards. As allowed by section 69(2) of the Act, in many cases these standards have been altered to make them more explicit in their intent, or to allow for the special character of the environment in which they are being applied.

15.5.1 Class NS Water (Natural State)

Class NS water is applied for the management of water bodies in their natural state. This water quality standard applies to all lakes in the Tarawera Lakes catchments, except Lake Okaro.

For the purposes of the Class NS classification, Environment Bay of Plenty defines natural state to mean that the water quality in the total water column of a lake should remain at 1994 water quality standards or better. The class NS water standards have been made more explicit than those contained in the Third Schedule of the Resource Management Act 1991. The standards apply after allowing for reasonable mixing of any contaminant or water with the receiving water and disregarding the effect of any natural perturbations that may affect the lakes.

The specific water quality standards of class NS water are stated in Rule 15.8.4(b).

15.5.2 Class CR Water (Contact Recreation)

Class CR water is applied for the management of water bodies for contact recreation purposes. Within the Tarawera catchment the Class CR water is applied in respect of Lake Okaro only. Environment Bay of Plenty has interpreted the standards for class CR water to mean the application of standards which will not render the water quality in the total water column of Lake Okaro unsuitable for bathing. The standards apply after allowing for reasonable mixing of any contaminant or water with the receiving water and disregarding the effect of any natural perturbations that may affect lake Okaro.

The specific water quality standards of class CR water are stated in Rule 15.8.4(d).

15.5.3 Class FSUT Water (Fish Spawning – Upper Tarawera)

The class FSUT water is applied for the purpose of managing water quality to a level suitable for trout spawning purposes. This is because the specific requirements of trout are well documented and it is assumed for the purposes of this regional plan that the classification criteria will also allow for the requirements of indigenous fish and other aquatic life. Class FSUT applies in respect of the Upper Reach of the Tarawera River, the tributaries of the Tarawera River (excluding the drains and canals on the Rangitaiki Plains, but including the tributaries of the Lower Reach of the Tarawera River), and the tributaries of the Tarawera Lakes. Class FSUT water applies regardless of whether streams or rivers are trout spawning grounds. The standards apply after allowing for reasonable mixing of any contaminant or water with the receiving water and disregarding the effect of any natural perturbations that may affect the above mentioned water bodies.

The specific water quality standards of class FSUT water are stated in Rule 15.8.4(f).

15.5.4 Class FPLT Water (Fish Purposes – Lower Tarawera)

Class FPLT is applied for the purpose of managing water quality in the Lower Reach of the Tarawera River at a level equivalent to that required by trout, and thereby also allowing for the survival of a range of indigenous fish species that would normally be in the river in the absence of discharges. Class FPLT water relates to the main stem of the Lower Reach of the Tarawera River only, this being the reach from the Kawerau Road Bridge across the Tarawera River to the Thornton Road Bridge across the Tarawera River. The standards apply after allowing for reasonable mixing of any contaminant or water with the receiving water and disregarding the effect of any natural perturbations that may effect the Lower Reach of the Tarawera River.

The specific water quality standards of class FPLT water are stated in Rule 15.8.4(h).

15.5.5 Drains and Canals and Wetlands on the Rangitaiki Plains

Environment Bay of Plenty does not consider that the water quality of the wetlands in the lower river catchment, or the drains and canals on the Rangitaiki Plains, require managing through the imposition of water quality standards. Environment Bay of Plenty favours the prohibition of all discharges to wetlands, other than those associated with controlling wetlands water levels, facilitating fish passage, and eradicating plant pests.

15.6 Overall Options to Achieve Water Quality Standards

During the preparation of this regional plan a number of alternatives were raised as to how industry might apply new techniques or technology to achieve the new water quality standards. An investigation commissioned by the pulp and paper companies[105], primarily focused on means to increase dissolved oxygen levels in the Lower Reach of the Tarawera River, though other important water quality factors, such as colour and clarity, and toxicity, were also considered.

It should be noted that the options do not form part of this regional plan but simply indicate the combination of approaches, which costs, time and technology permitting, may be available to industry to reduce some of the current adverse effects of discharges on the Lower Reach of the Tarawera River.

LOX (short for liquid oxygen) refers to the method of increasing the dissolved oxygen levels in the river water through the addition of water supersaturated with oxygen. In the following options the use of LOX forms either a main or ancillary means of boosting river oxygen levels. Environment Bay of Plenty particularly supports and encourages the use of LOX both as a short term option to achieve a direct remedial increase in river oxygen levels while other methods to reduce organic loads are put in place, and as a river oxygen buffering system in the longer term.

15.6.1 Options Proposed by Industry for Achieving Water Quality Standards

The options made available to the Tarawera Liaison Group and discussed as possibilities for achieving the new water quality standards for the Lower Reach of the Tarawera River were as follows:

(a) Separate Mill Treatment Systems plus LOX;

(b) Combined Mill Treatment Systems plus LOX;

(c) Changes to In-Plant Production Processes plus LOX;

(d) Extended Combined Mill Treatment Systems plus LOX;

(e) Land Application plus LOX;

(f) Reduction of Effluent Impact using LOX;

(g) Gravity Pipeline to Matata;

(h) Pumped Ocean Outfall;

(i) Reinjection of Geothermal Fluid or, if feasible, removal of contaminants in geothermal fluid before discharge.

It is noted that full investigation may result in variations or combinations of these options being adopted to achieve the best overall outcomes.

15.6.1(a) Separate Mill Treatment Systems

Each mill would improve its waste effluent separately of the other. At Tasman Pulp and Paper Company Limited it was assumed that these improvements would come from:

(a) A significant reduction of in-mill water usage;

[105] CH2M Hill, Confidential Report, 1994 (May).

(b) Revising the current foam control sprayers to use effluent water;

(c) Installing a screw press for primary solids handling to eliminate or significantly reduce water drainage and runoff BOD_5;

(d) Substantial dredging of secondary solids build-up in the effluent treatment ponds;

(e) Analysing adequacy of current effluent treatment ponds aeration system; and

(f) Providing additional nutrients and macronutrients to the waste effluent.

At Carter Holt Harvey Tissue's mill it was assumed that efficiencies could be gained from the current Anaerobic Wastewater Treatment Plant (AWTP), increasing the organic loading in the effluent by supplementing some sewage inputs with Tasman Pulp and Paper Company Limited low strength condensates. In addition it is considered that BOD_5 load to the Lower Reach of the Tarawera River would decrease if the use of the RIBs was expanded and direct discharges suspended.

It has been estimated that, in total, changes to the separate in-mill treatment systems would result in a reduction of 3.7 tonnes per day of BOD_5 discharged to the Lower Reach of the Tarawera River.

15.6.1(b) Combined Mill Treatment Systems

This option proposes taking advantage of the efficiencies and economies that could be gained in combining, in total or in part, Tasman Pulp and Paper Company Limited's and Carter Holt Harvey Tissue's treatment systems. This would involve combining Carter Holt Harvey Tissue's medium to high strength wastewaters with Tasman Pump and Paper Company Limited's low strength wastewaters.

It has been estimated that in total, the appropriate combination of Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue mill effluent would result in a reduction of 4.0 tonnes per day of BOD_5 discharged to the Lower Reach of the Tarawera River. This option would also have the significant beneficial effect of reducing the toxicity of Carter Holt Harvey Tissue's effluent. In January 1999 Tasman Pulp and Paper Limited began to take the Carter Holt Harvey Tissue mill clarifier effluent into their effluent treatment system. This has the ability to reduce the BOD_5 load on the river by approximately one tonne per day.

15.6.1(c) Changes to In-Plant Production Processes

This option was raised by the Tarawera River Liaison Group on a number of occasions. All the major dischargers to the river have been looking at new technology which would limit the amount or type of effluent discharged to the Tarawera River. In the case of the Tasman Pulp and Paper Company Limited, oxygen delignification has been introduced, reducing the need for chlorine compounds in the bleaching process. New colour reduction technology processes have also been introduced, which have enabled the company to reduce its colour loading to the Lower Reach of the Tarawera River quite substantially.

At this stage closed-cycle mills were seen as experimental and prone to major problems. However, the Liaison Group was concerned that the major industrial dischargers take steps to explore new pollution reduction technologies in their pulp and paper making processes. Environment Bay of Plenty will advocate, and encourage the adoption of, new technology aimed at reducing the adverse environmental effects of discharges to the Tarawera River.

15.6.1(d) Extended Combined Mill Treatment Systems

This option encapsulates four sub-options. The first sub-option is the extension of the retention time of wastewater through Tasman Pulp and Paper Company Limited's aerated sludge basins (ASBs) by a combination of raising the pond surface and deepening the ponds. The first sub-option also suggests the development of an ASB by Carter Holt Harvey Tissue. The second sub-option involves converting Tasman Pulp and Paper Company Limited's current Pond No. 2 to an activated sludge basin, while Carter Holt Harvey Tissue would develop a second activated sludge basin. It is proposed that these new ASBs would be unlined, fulfilling some of the functions of the current Carter Holt Harvey Tissue RIBs.

Sub-option three would involve combining and extending the Carter Holt Harvey Tissue and Tasman Pulp and Paper Company Limited pond systems resulting in additional retention time in the ponds. Sub-option four is effectively a combination of sub-options two and three. Of these sub-options the report favoured sub-option three as providing the most effective BOD_5 removal of the four sub-options. It is estimated in the report that this option could lead to the removal of approximately 0.8 tonnes per day more soluble BOD_5 than those options discussed in sub-sections 15.6.1(a) and 15.6.1(b). The additional BOD_5 removed would be a high marginal cost.

15.6.1(e) Land Application

The report divides this option into five sub-options. Each sub-option involves the combining of Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue effluent and pumping to the land application site. It was assumed that land application would be seasonal with 100 per cent application during summer months and 50 per cent of wastewater effluent applied to land during winter months.

The sub-options relate to the extension of rapid infiltration basins (RIBs), the development of artificial wetlands, and spray irrigation to pasture land, forest land, and hilly forest land. Of these sub-options the report favours the application of wastewater to hilly forest land as the most cost-effective and readily implementable of the five sub-options. This sub-option could lead to an estimated 85 per cent reduction in summer waste loads. It is estimated that BOD_5 would reduce by approximately 4.5 tonnes per day below the current discharge allowances. Carter Holt Harvey Tissue have undertaken to shift to a full land based effluent irrigation system. This will significantly reduce the impact of their mill effluent on the river. This initiative should result in the recovery of the river water over the (approximately) six kilometres above the Tasman Pulp and Paper Limited main effluent discharge outfall. Tasman Pulp and Paper limited are also considering a land based irrigation system for paper machine wastewater. If implemented this would further reduce the BOD_5 loading on the river.

15.6.1(f) Reduction of Effluent Impact on the Lower Reach of the Tarawera River

The report shows that the uptake of oxygen in the Lower Reach of the Tarawera River as a result of the BOD_5 load discharged by the pulp and paper mills, could be largely overcome by the implementation of one of three sub-options. Sub-option one involves the oxygenation of the Lower Reach of the Tarawera River with liquid oxygen via diffusers placed below the main discharge. Sub-option two would involve the planting of poplars along the river banks of the Lower Reach of the Tarawera River to provide shading and reduce diurnal temperature swings. The third sub-option, a radical option, would involve isolating the water in the Lower Reach of the Tarawera River from the pumice bed by using groat mats.

The report favours sub-options one and two, sub-option three being considered to require more development and having a high cost. It is estimated that sub-options one and two would result in reductions of BOD_5 below the current discharge allowance by 5.2 and 1.5 tonnes per day.

The discharge of liquid oxygen, either alone or in combination with other waste-stream alterations, would provide a rapid means to enhance the levels of dissolved oxygen in the river. The system for delivery of LOX could be automated to react to a dissolved oxygen meter, so providing an immediate and effective response system.

15.6.1(g) Gravity Pipeline to Matata

This option is intended to by-pass the problems associated with discharges to the Tarawera River by discharging the treatment effluent in the river mouth. As proposed, this option would involve the construction of a gravity pipeline to the mouth of the Tarawera River and then discharge to the river mouth[106] by a 1.8 metre multi-port diffuser across the river's width, or alternatively discharge into the canal alongside Sutherland Road (known as the 109 canal). This option would completely remove mill effluent BOD_5 and colour, and other constituents associated with the mill discharges, from the bulk of the Tarawera River.

During the preparation of this regional plan consultation with iwi authorities showed that they considered the direct discharge of effluent via a pipeline into the river mouth coastal marine area culturally offensive. In addition, the pulp and paper companies indicated that the cost of a pipeline to the river mouth may be prohibitive.

15.6.1(h) Pumped Ocean Outfall

This option is intended to by-pass the problems associated with discharges to the Tarawera River by discharging the treated effluent via an ocean outfall directly to the Pacific Ocean. Effluent would be moved by a gravity pipeline to the coast, from where it would be pumped through an ocean outfall into the Pacific Ocean. Many pulp and paper mills around the world discharge their effluent through ocean outfalls.

This option takes advantage of the large assimilative capacity of the Pacific Ocean and would completely remove mill effluent BOD_5 and colour, and other constituents associated with the mill discharges, from the Tarawera River. It is estimated that this option would result in a total reduction of BOD_5 into the river.

During the preparation of this regional plan consultation with iwi authorities showed that they considered the discharge of effluent to the coastal marine area also culturally offensive. In addition, the pulp and paper companies indicated that the cost of a pipeline and ocean outfall may be prohibitive.

15.6.1(i) Reinjection of Geothermal Fluid

In terms of the management of the field pressures and fluid levels in the Kawerau Geothermal Field, and the requirement to limit the impact of the discharge of geothermal fluid into the Tarawera River, the reinjection of geothermal fluid to a sustainable level will be encouraged. The mass, location and depth of reinjection will need to be carefully considered and the discharge monitored and controlled to limit the potential for any consequent adverse effect on the geothermal resource or on the potable groundwater resources of the catchment.

15.6.1(j) Options Proposed by Industry – Supporting Technical Reports

The following technical reports, written or referred to as part of the preparation of this regional plan, contain more detailed information on Options Proposed by Industry:

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106 It should be noted that the Tarawera River mouth falls within the coastal marine area. Discharges to the coastal marine area are subject to rules in the Bay of Plenty Coastal Marine Area and would require consent from both Environment Bay of Plenty and the Minister of Conservation.

Clark, T et al — 1993, Report for the Bay of Plenty Regional Council: The Pulp and Paper Industry and the Environment – An Overview, Contract Report No. 93/46, PAPPRO, Rotorua.

Dell, P — 1993 (November), Pulp and Paper Industry Study Tour: July 1993, Environment Bay of Plenty Environmental Report 93-94, Whakatane.

CH2M Hill International — 1994 (May), Effluent Reduction Study – Tarawera River, prepared for Caxton Paper Limited and Tasman Pulp and Paper Company Limited, CH2M Hill. Confidential Report (released to the Tarawera Liaison Group for their information and discussion).

15.6.2 Options Proposed by Other Parties

The following options are the view of Greenpeace NZ.

15.6.2(a) Totally Chlorine-Free Conversion of Mill

A totally chlorine-free bleaching process that would replace the use of chlorine and chlorine dioxide with hydrogen peroxide or “oxygen” bleaching, or thermophillic enzymes or “ozone” bleaching. None of these systems produce chlorine containing contaminants.

15.6.2(b) Totally Effluent-Free Conversion of Mill

A totally effluent-free or closed loop system that would release no discharges to water.

15.7 Reasonable Mixing Zones

The Resource Management Act 1991 (e.g. section 107(1)) requires that the effect of discharges on surface water bodies be measured only after allowing for reasonable mixing. The Act does not define the term “reasonable mixing”.

In order to be able to measure the effects of discharges to water bodies reasonable mixing zones need to be established for each discharge. Environment Bay of Plenty considers that this can be done in one of two ways:

(i) One approach is to establish, through rules in this regional plan, a formula by which specific reasonable mixing zones can be applied to each discharge. This approach enables the setting of quantitative mixing areas measured from the point of discharge, as a resource consent condition.

(ii) Alternatively reasonable mixing zones can be established on the basis of ratio of discharge to receiving waters. Environment Bay of Plenty suggests that this blanket method of calculating reasonable mixing discharges, while relatively simple is too coarse to apply across different types and sizes of discharges, which have different “effects”.

15.7.1 Reasonable Mixing Zones – Selected Management Alternatives

Environment Bay of Plenty’s selected approach is (i) above: to establish reasonable mixing zones, via a formula, case by case, based on a number of guiding criteria, as outlined in Policy 15.8.3(f) and Rule 15.8.4(s).

15.7.2 Reasonable Mixing Zones – Reference

In assessing the criteria related to reasonable mixing zones Environment Bay of Plenty had regard was had to the following document:

Ministry for the Environment	1994 (August), Resource Management Ideas No. 10 "A Discussion on Reasonable Mixing in Water Quality Management", MfE.

15.8 Issues, Objective, Policies, Methods of Implementation, Principal Reasons and Anticipated Environmental Results

15.8.1 Issues

Issues relating to surface water quality are:

15.8.1(a) Degradation of water quality and its adverse effects on the life-supporting capacity, ecosystems, aesthetic, amenity and cultural values, other than those effects resulting from natural occurrences or perturbations, due to:

15.8.1(a)(i) Increased levels of nutrients from land runoff and effluent discharges.

15.8.1(a)(ii) The continued discharge of large quantities of industrial effluents containing a range of contaminants into the Lower Reach of the Tarawera River is a concern to the community.

15.8.1(a)(iii) Inappropriate farming and forestry practices and incompatible land uses.

15.8.1(a)(iv) The discharge of sewage into surface water in the Tarawera River catchment.

15.8.1(a)(v) Low dissolved oxygen levels in the Lower Reach of the Tarawera River and in the canals on the Rangitaiki Plains.

15.8.1(a)(vi) The discharge of toxic substances to the Lower Reach of the Tarawera River.

15.8.1(a)(vii) The discolouration of the Lower Reach of the Tarawera River.

15.8.1(a)(viii) Emission of objectionable odour from the Lower Reach of the Tarawera River.

15.8.1(a)(ix) The existence of undesirable biological growths in parts of the Lower Reach of the Tarawera River.

15.8.1(a)(x) The tainting of water in the Lower Reach of the Tarawera River.

15.8.1(a)(xi) The occasional production of conspicuous foams and scums in the Lower Reach of the Tarawera River.

15.8.1(a)(xii) The raising of the water temperature in the Lower Reach of the Tarawera River, and consequent effects on dissolved oxygen levels.

15.8.1(a)(xiii) The discharge of geothermal wastewaters into the Lower Reach of the Tarawera River.

15.8.1(b) A lack of appropriate water quality standards in the catchment to protect water bodies and the environment from the adverse effects of water degradation.

15.8.1(c) The strong community requirement that the degraded water quality in the Lower Reach of the Tarawera River be managed to avoid, remedy or mitigate unacceptable effects has not been achieved.

15.8.1(d) Degradation of the quality of water in the catchment of the Tarawera Lakes due to inappropriate subdivision, use and development.

15.8.2 Objective

Enhance surface water quality in the Tarawera catchment to a level which safeguards the life supporting capacity of the water and meets the reasonable needs of people and communities, especially:

(a) Reduction in the production of waste and discharge of contaminants throughout the catchment; and

(b) The maintenance of "Fish Spawning" water quality standards in the Upper Reach of the Tarawera River and its tributaries; and

(c) The establishment of "Fish Purposes" water quality standards in the Lower Reach of the Tarawera River; and

(d) The conservation of lakes and tributaries in their Natural State; and

(e) The enhancement of the water quality in Lake Okaro to that suitable for contact recreation; and

(f) To recognise that staged changes in industrial processes and waste treatment systems will be necessary to achieve the water quality goals of this regional plan.

(g) Unless there are exceptional circumstances there shall be not discharge of sewage into the surface water of the Tarawera River.

15.8.3 Policies

15.8.3(a) To establish a range of surface water quality classes that provide standards for the management of surface water bodies in the catchment. The purposes of these classifications are as follows:

(i) The quality of water in the lakes in the catchments of the Tarawera Lakes, excluding Lake Okaro, will be managed to retain its Natural State (NS) (see Rule 15.8.4(b)). For the purposes of the Class NS classification, Environment Bay of Plenty defines natural state to mean that the water quality in the total water column of a lake should remain at 1994 water quality standards or better.

(ii) The quality of water in Lake Okaro will be managed for Contact Recreation (CR) purposes (see Rule 15.8.4(d)).

(iii) The quality of water in the tributaries of the Tarawera Lakes, the tributaries of the Tarawera River, excluding the canals and drains and wetlands on the Rangitaiki Plains, and the Upper Reach of the Tarawera River will be managed for fish spawning purposes (FSUT) (see Rule 15.8.4(f).

(iv) The quality of water in the Lower Reach of the Tarawera River will be managed for fish purposes (FPLT) (see Rule 15.8.4(h)).

15.8.3(b) To promote reduction of contaminant discharges into the Tarawera River.

15.8.3(c) To reduce the discharge of contaminants into wetlands, canals and drains on the Rangitaiki Plains.

15.8.3(d) To advocate that the discharge of dairy shed effluent is in accordance with guidelines agreed between Environment Bay of Plenty and the agriculture industry.

15.8.3(e) To encourage dischargers to avoid, remedy or mitigate any actual or potential adverse effects arising from their direct or indirect discharge of contaminants into water by:

(a) Limiting and reducing quantities and concentrations of discharged contaminants, in particular, contaminants which can reduce the life supporting capacity of aquatic ecosystems.

(b) Promoting dischargers to land in preference to discharges into water in areas of the catchment of the Tarawera River where groundwater is not vulnerable to adverse effects from resulting contaminants and where runoff of contaminants into water can be controlled.

(c) Reducing adverse effects from non- point-source discharges of contaminants to water bodies by supporting and promoting appropriate land and riparian management practices, and discouraging the application of sprays and fertilisers adjacent to or over surface water bodies.

15.8.3(f) To establish reasonable mixing zones for all authorised discharges, excluding permitted activities, within the Tarawera River catchment, on a case by case basis, relative to but not limited to specified criteria (15.8.4(s)).

15.8.3(g) To promote the efficient use of water.

15.8.3(h) To enable public access to available water quality information.

15.8.3(i) To encourage discharge permit holders to conduct appropriate tests and monitoring of the toxic effect of their effluent.

15.8.3(j) To allow for the discharge of uncontaminated stormwater (15.8.4(q)).

15.8.3(k) To promote the guidelines and principles of the *Operative Bay of Plenty Regional Land Management Plan* with regard to the management of land use activities that aggravate soil erosion, and the subsequent sediment contamination of surface water sources.

15.8.3(l) To ensure the reduction in discharges with BOD loading into the Lower Reach of the Tarawera River to achieve dissolved oxygen standards required for Fish Purposes.

15.8.3(m) To encourage the reduction of colour to achieve Fish Purpose standards for the Lower Reach of the Tarawera River.

15.8.3(n) To encourage a reduction in human sewage discharges into the Tarawera River or its tributaries.

15.8.3(o) To discourage and eventually prevent the degrading of the purity of water caused by the discharge of human sewage by:

(a) encouraging the use of sewage treatment systems designed in consultation with tangata whenua to enhance or restore the mauri of receiving water;

(b) prohibiting any new sewage discharges to surface water;

(c) encouraging a shift to land based sewage treatment and disposal systems;

(d) requiring any discharge of human sewage from Kawerau township into the Tarawera River to comply with the Fish Purposes classification standards;

(e) requiring any discharge of human sewage from the Edgecumbe township sewage system into the Omeheu Canal to comply with defined effluent quality standards.

15.8.3(p) To encourage communities to develop land based treatment systems for sewage disposal.

15.8.3(q) To encourage the grant of consents for the discharge of treated sewage to land.

15.8.3(r) To allow the discharge of sewage to the Tarawera River and to its tributaries only in exceptional circumstances where no other practicable options are available, but limited in time to the duration of those circumstances.

15.8.3(s) To require a management plan to accompany consent applications; identifying the measures considered appropriate for avoiding the discharge of sewage to the river.

15.8.4 Methods of Implementation – Rules

15.8.4(a) All water within Lakes Tarawera, Rotomahana, Okataina, Okareka, Tikitapu, and Rotokakahi in the Tarawera Lakes catchment, excluding Lake Okaro, is classified to be managed in its Natural State (NS), and any discharge permit granted for the discharge of contaminants into these waters shall be subject to conditions ensuring compliance with the classification standard in Rule 15.8.4(b) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(b) The standards for **Class NS**, that apply after reasonable mixing of any contaminant or water with the receiving surface water and disregard the effect of any natural perturbation that may affect the water body, are:

(i) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(ii) No increase in colour as assessed by measurement on the Munsell Hue scale, and no decrease in visual clarity as assessed by black disc measurement[107].

(iii) No detectable increase in acute and chronic toxicity between a reference water sample and a sample of the discharge diluted with that water at the specified mixing ratio.

(iv) No increase in temperature.

(v) No change in pH.

(vi) No production of conspicuous oils and grease films, scums or foams, or floatable or suspended materials.

(vii) No conspicuous increase in biological growths.

(viii) Aquatic food resources shall not be rendered unsuitable for human consumption, nor water rendered unsuitable for stock watering.

(ix) No increase in the emission of objectionable odour.

(x) No increase in nitrogen and phosphorus levels relative to the total nitrogen and total phosphorus levels measured in the lake in 1994.

[107] Includes Lakes Tarawera, Rotomahana, Okataina, Okareka, Tikitapu, and Rotokakahi. Does not include Lake Okaro.

Class NZ Tarawera River Catchment Lakes – 1994 Nutrient Quality			
Lake	**Total Phosphorus mg/m^3**	**Total Nitrogen mg/m^3**	**Trophic Lake Index**
Tarawera	6.6	119	2.6
Okataina	5.7	113	2.6
Tikitapu	3.1	185	2.7
Okareka	5.1	221	3.0
Rotokakahi	6.4	217	3.1
Rotomahana	41.1	247	3.9

15.8.4(c) All surface water within Lake Okaro is classified to be managed for Contact Recreation (CR), and any discharge permit granted for the discharge of contaminants into the water of Lake Okaro shall be subject to conditions ensuring compliance with the classification standards in Rule 15.8.4(d) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(d) The standards for **Class CR**, that apply after reasonable mixing of any contaminant or water with the receiving surface water and disregard the effect of any natural perturbation that may affect the water body, are:

(i) No decrease in visual clarity below 1.6 metres as measured by the black disc technique.

(ii) No detectable increase in acute and chronic toxicity between a reference water sample and a sample of the discharge diluted with that water at the specified mixing ratio.

(iii) No increase in temperature of more than 3°C, and maximum no to exceed 25°C.

(iv) pH shall remain within the range of 6.0 to 9.0.

(v) No production of conspicuous oils or grease films, scums or foams, or floatable or suspended materials.

(vi) No conspicuous increase in biological growths.

(vii) The median concentration of enterococci of at least 5 samples taken throughout the bathing season[108] shall not exceed 33 enterococci per 100 millilitre, nor shall any single sample exceed 107 enterococci per 100 millilitre.[109].

(viii) No increase in the emission of objectionable odour.

15.8.4(e) All surface water within the Upper Reach of the Tarawera River, including the reach from the Lake Tarawera River Outlet to the Kawerau Road Bridge across the Tarawera River, and also including all tributaries of the Tarawera River (other than the drains and canals on the Rangitaiki Plans) and tributaries of the Tarawera Lakes are classified to be managed for Fish Spawning Purposes Upper Tarawera River (Class FSUT), and any discharge permit granted for the discharge of contaminants into these waters shall be subject to conditions ensuring compliance with the classification standards in Rule 15.8.4(f) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

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[108] The bathing season is defined as the period from 1 November to Easter inclusive.

[109] McIntosh, J J 1993, Bay of Plenty Regional Council Regional Monitoring Network Bathing Suitability Survey 1993, Environment Bay of Plenty Environmental Report 93/1, 76pp.

15.8.4(f) The standards for **Class FSUT**, that apply after reasonable mixing of any contaminant or water with the receiving water and disregard the effect of any natural perturbation that may affect the water body, are:

(i) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(ii) No increase in colour as assessed by Munsell Hue colour units measurement, and no decrease in visual clarity as assessed by black disc measurement[110].

(iii) No detectable increase in acute and chronic toxicity between a reference water sample and a sample of the discharge diluted with that water at the specified mixing ratio.

(iv) No increase in temperature of more than 3°C, and maximum not to exceed 25°C.

(v) pH shall remain within the range 6.5 to 8.5.

(vi) No production of conspicuous oils or grease films, scums or foams, or floatable or suspended materials.

(vii) The seasonal maximum cover of stream and river beds by periphyton as filamentous growths or mats (<ca.3 millimetres thick) shall not exceed 40 percent, and/or biomass shall not exceed 100 milligram chlorophyll-*a* per square metre or 40 gram AFDW per square metre of exposed surface area, and any change in bacterial and/or fungal slime growths shall not be conspicuous.

(viii) Aquatic food resources shall not be rendered unsuitable for human consumption.

(ix) No increase in the emission of objectionable odour.

15.8.4(g) All water within the main stem of the Lower Reach of the Tarawera River, that being the reach from the Kawerau Road Bridge across the Tarawera River and the Thornton Road Bridge across the Tarawera River (excluding the tributaries of the Lower Reach of the Tarawera River and the drains and canals on the Rangitaiki Plains), is classified to be managed for Fish Purposes Lower Tarawera (FPLT), and any discharge permit granted for the discharge of contaminants into these waters shall be subject to conditions ensuring compliance with the classification standards in Rule 15.8.4(h) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(h) The standards for **Class FPLT**, which apply after allowing for the reasonable mixing of any discharge of contaminants or water to surface water, and disregard the effect of any natural perturbation that may affect the water body, are:

(i) The concentration of dissolved oxygen shall not at any time fall below:

Until 31 December 2002:

5.0 grams per cubic metre for the mean of any consecutive 30 days;
4.0 grams per cubic metre for the mean minimum of any consecutive 7 days;
3.5 grams per cubic metre as an absolute minimum.

[110] Utilising protocol laid down in Smith, D G et al, 1989.

From 1 January 2003:

6.0 grams per cubic metre for the mean of any consecutive 30 days;
5.0 grams per cubic metre for the mean minimum of any consecutive 7 days;
4.5 grams per cubic metre as an absolute minimum.

(ii) Above the Tasman Pulp and Paper Company Limited effluent outfall pipe at Grid Reference NZMS V15 365438, no decrease in visual clarity of more than 20% of the ambient black disc measurement measured at the Kawerau Bridge site.

Below the Tasman Pulp and Paper Company Limited effluent outfall pipe at Grid Reference NZMS V15 365438, colour, as measured by the absorption coefficient of a 0.45 micron filtered sample at 440nm on a spectrophotometer, shall not exceed:

(a) To 31 December 2000:

The 6 month mean shall not exceed 3.8 (equivalent to 50 platinum-cobalt units).

(b) From 1 January 2001:

The 6 month mean shall not exceed 2.3 (equivalent to 30 platinum-cobalt units).

(c) From 30 December 2005:

The 6 month mean shall not exceed 0.8 (equivalent to 10 platinum-cobalt units).

(iii) No detectable increase in acute and chronic toxicity between a reference river water sample taken from the Kawerau Bridge site and a sample of the discharge diluted with that water at the specified mixing ratio.

(iv) No increase in temperature of more than 3°C, and maximum not to exceed 25°C.

(v) The pH shall remain within a range of 6.5 to 8.5.

(vi) No production of conspicuous oils and grease films, scums or foams, or floatable or suspended materials.

(vii) From 1 July 2000, the seasonal maximum cover of stream and river beds by periphyton as filamentous growths or mats (>ca.3 millimetres thick) shall not exceed 40 percent, and/or biomass shall not exceed 100 milligram chlorophyll-*a* per square metre or 40 gram AFDW per square metre of exposed surface area, and any change in bacterial and/or fungal slime growths shall not be conspicuous.

(viii) Aquatic food resources shall not be rendered unsuitable for human consumption, nor water rendered unsuitable for stock watering.

(ix) No increase in the emission of objectionable odour.

15.8.4(i) Relative to the acute and chronic toxicity standards for NS, CR, FSUT and FPLT classifications as detailed in Rules 15.8.4(b)(iii), 15.8.4(d)(ii), 15.8.4(f)(iii) and 15.8.4(h)(iii), the toxicity of effluent shall be tested over a standard geometric dilution series factor of 0.5 which encompasses the mixing ratio. Four different species of freshwater organisms will be tested as per the following protocols:

(i) For Acute Testing:

Environment Canada (1990). Biological test method. Reference method for determining acute lethality of effluents to rainbow trout. Conservation and Protection, Ottawa, Ontario. EPS 1/RM/13.

(ii) For Chronic Testing:
OECD (1981). Chronic reproduction test using a cladoceran (*Daphnia magna*). Test Method 211 (adopted 21 September 1998), or the most up to date equivalent of Test Method 211, In: "OECD Guidelines for the testing of chemicals", Organisation for Economic Cooperation and Development, Paris.

Environment Canada (1992). Biological test method. Toxicity test using luminescent bacteria (*Photobacterium phosphoreum*). Conservation and Protection, Ottawa, Ontario. Report EPS 1/RM/24.

Environment Canada (1992). Biological test method. Growth inhibition test using the freshwater alga *Selenastrum capricornutum*. Conservation and Protection, Ottawa, Ontario. Report EPS 1/RM/25.

To comply with the classification standards, chronic tests shall show no detectable toxicity at the specified mixing ratio.

15.8.4(j) Relative to the acute and chronic toxicity standards for NS, CR, FSUT and FPLT classifications as detailed in Rules 15.8.4(b)(iii), 15.8.4(d)(ii), 15.8.4(f)(iii) and 15.8.4(h)(iii), the specified mixing ratio shall be determined for each discharge permit on a case by case basis by dividing(÷) the maximum permitted effluent flow by the mean annual 7 day low flow statistic recorded nearest to the discharge point.

e.g. A permitted discharge with a maximum flow of 2 cubic metre per second occurs at Pipe Bridge.

The mean annual 7 day low flow at Pipe Bridge is 16.6 cubic metre per second.

$\therefore$ The mixing ratio = 2 : 16.6 = 0.12

15.8.4(k) Relative to the acute and chronic toxicity standards for NS, CR and FSUT classifications as detailed in Rules 15.8.4(b)(iii), 15.8.4(d)(ii) and 15.8.4(f)(iii), the site of reference water collection shall be determined on a case by case basis. Reference (or diluent) water will be collected directly upstream of the discharge or, in the case of a lake, from a site not influenced by the discharge.

15.8.4(l) Any discharge to water that contravenes or causes contravention of any Rule, standard or term of this regional plan, in particular any classification standard of Rules 15.8.4(b), 15.8.4(f) or 15.8.4(h), shall be a Non-Complying Activity.

15.8.4(m) Any discharge to water that:

(a) is within a water classification area defined in this regional plan, and does not contravene or cause contravention of any classification standard for that water classification area, and any other Rule, standard or term in this regional plan; or

(b) is outside a water classification area defined in this regional plan, and does not contravene or cause contravention of any Rule, standard or term in this regional plan;

shall be a Discretionary Activity unless otherwise specifically provided for in a Rule in this regional plan.

15.8.4(n) Subject to the provisions of Rule 15.8.4(t), the classification standards set in Rules 15.8.4(b), 15.8.4(d), 15.8.4(f), and 15.8.4(h), shall apply to all existing and new consents.

15.8.4(o) The discharge of aerated and/or oxygenated water or oxygen into the Tarawera River for the purpose of increasing the dissolved oxygen content of the river water shall be a Discretionary Activity.

In considering an application for a discharge consent pursuant to this Rule, Environment Bay of Plenty shall have particular regard to:

(a) Whether the applicant is taking action to reduce the total mass of biochemical oxygen demand (BOD_5) in the discharge that is causing the need for oxygen injection into the river water.

(b) Whether the applicant is installing capital works to achieve compliance with the FPLT classification standard.

(c) Whether the oxygen injection proposed is a means to remedy the effect of inadequate effluent management or an inadequate primary effluent treatment system.

(d) Whether the location, design, construction and installation of the structure for the oxygen discharge is adequate to ensure optimal oxygenation with minimum adverse effect on river ecology.

(e) Whether the proposal to inject oxygen is the more effective method to increase the dissolved oxygen levels in the river water relative to other methods.

(f) Whether the discharge will have a net adverse effect on the environment.

(g) Whether the discharge will adversely affect other users of the Tarawera River.

(h) Whether the time periods during which discharges are to occur are adequately managed and effective.

15.8.4(p) The discharge of contaminated stormwater is a Discretionary Activity, and shall be considered with particular regard to:

(i) The installation and maintenance of effective traps or other spillage retention devices.

(ii) The effective sealing and bunding of contaminant storage and transit areas.

(iii) The production and implementation of chemical spillage prevention, retention and disposal protocols (contingency plans).

15.8.4(q) The discharge of uncontaminated stormwater into water within the Tarawera River catchment is a Permitted Activity, subject to the following requirements:

(i) The maximum discharge shall not exceed the flow from a 300 millimetre pipe on a flat grade or equivalent of 80 litres per second.

(ii) The suspended solids concentration of the water discharged does not exceed 150 grams per cubic metre.

(iii) The water discharged is substantially free of grease and oil;

(iv) The works shall be designed, constructed and maintained in such a manner so as not to cause erosion or flooding or to adversely affect any land or property owned or occupied by another person.

For the purposes of this Rule, uncontaminated stormwater includes stormwater runoff from roofs, sealed and unsealed roads and streets, hard stand areas, yards and grassed areas and the like.

15.8.4(r) Except for the provisions of the Operative On-Site Effluent Treatment Regional Plan, and for the provisions for Kawerau township and Edgecumbe township set out in (a) to (d) of this rule, and the provisions of rule 15.8.4(x), all new or existing discharges of human sewage or contaminants derived from human sewage into surface water within the Tarawera River catchment will become a Prohibited Activity on the date on which this regional plan becomes operative.

(a) Until 31 December 2002 the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment shall be a Discretionary Activity, subject to the discharge complying with all rules, standards and terms in this regional plan and meeting or bettering the receiving water classification.

(b) From 1 January 2003, the discharges of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment will be limited to the provisions of rule 15.8.4(x), provided that this limitation shall be suspended until 12 months past the date on which an application by Carter Holt Harvey Tissue to discharge AWWTP wastewater and sanitary wastewater from Kawerau township by spray irrigation to land has been decided and any appeals determined.

(c) Until 30 June 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment shall be a Discretionary Activity subject to compliance with consent conditions.

(d) From 1 July 2005, the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township shall be a Discretionary Activity limited to discharge that complies with all rules, standards and terms in this regional plan and meets or betters effluent quality standards of:

(i) BOD<10 milligrams per litre,
(ii) Suspended Solids<15 milligrams per litre,
(iii) Total N<25 milligrams per litre,
(iv) Faecal Coliform<10^4/100 millilitre,

measured in the effluent stream prior to discharge, and produced by a treatment and disposal system that has been designed in consultation with affected iwi.

15.8.4(s) Except for the discharge of uncontaminated stormwater in compliance with Rule 15.8.4(q), every discharge permit granted to discharge contaminants from a point-source outfall into any water body within the Tarawera River catchment shall have a condition defining a reasonable mixing zone, stated as a classification non-compliance zone defined as a distance or radium measured from the outfall point. Each non-compliance zone shall be the minimum practicable relative to the relevant classification standards and assessment criteria. In establishing a non-compliance zone for a discharge, Environment Bay of Plenty will consider the following assessment criteria.

(i) Relevant classification standards;

(ii) The flow regime of the receiving water;

(iii) The ambient concentrations of contaminants in the receiving water;

(iv) Effluent discharge flow rate and contaminant concentrations;

(v) Cumulative and other effects;

(vi) Existing discharge and abstraction consents;

(vii) Fish migration and instream ecosystems requirements;

(viii) Maori cultural values;

(ix) The location of the discharge and position of the outfall;

(x) Outfall diffuser design criteria;

(xi) Information provided by the applicant;

(xii) Any other relevant information.

15.8.4(t) The discharge of a dye or gas into water for scientific or investigation purposes is a Permitted Activity subject to the following conditions:

(i) Environment Bay of Plenty is given at least ten working days notice prior to the discharge.

(ii) Details of the proposed discharge are publicly notified at least one week prior to the discharge.

(iii) Any person or persons likely to be affected by the presence of dye or gas in water used for recreational, consumption or other uses is notified of the proposed discharge at least one week prior to the discharge.

(iv) The dye or gas used shall not exceed a concentration that is proven to be inert and non-toxic in effect.

15.8.4(u) Environment Bay of Plenty will support education programmes as a means of encouraging the development of buffer zones and other methods to prevent land discharge of contaminants from reaching surface water.

15.8.4(v) The discharge of dairy shed effluent into unclassified water shall be a Discretionary Activity managed in accordance with guidelines including "Guidelines for Agricultural Discharges in the Tarawera and Rangitaiki Catchments, September 1992".

15.8.4(w) Environment Bay of Plenty will provide available water quality test information on request.

15.8.4(x) Notwithstanding all other rules in this plan, the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment in exceptional circumstances and when no other practicable options are available, shall be a non-complying activity. Any application made shall be accompanied by a management plan that identifies the measures considered appropriate for avoiding the discharge of sewage to the river.

15.8.5 Principal Reasons

The aim of this regional plan, as set out in clause 1.2, is sustainable management of the Tarawera River catchment by ensuring that:

(a) There is integrated management of the natural and physical resources of the Tarawera River catchment;

(b) The high quality water in the catchment of the Upper Reach of the Tarawera River is maintained and improved where appropriate;

(c) The water quality in the Lower Reach of the Tarawera River is managed to ensure that the effects of industrial discharges are substantially reduced;

(d) The community remains involved in the management process;

(e) There is reduction in the discharge of contaminants into the Tarawera River;

(f) The Mauri of the Tarawera River is restored and the balance maintained.

This chapter makes operative a major part of the means to achieve these requirements. There will be ongoing debate on exactly how and when remedial activities should take place. However, in general, the consultation process to develop the chapter have resulted in:

(a) Clear goals being set;

(b) A staged agenda developed to provide achievable goals within a reasonable and realistic time-frame;

(c) The determination of all those involved towards achieving those goals;

(d) A qualified willingness between many of those involved to work together rather than as adversaries in order to make clear progress towards realising the goals set.

The Tarawera Lakes and the catchment of the Upper Reach of the Tarawera River are in a reasonably clean state and the classifications proposed should protect and maintain if not improve their existing high water quality.

The Lower Reach of the Tarawera River still has degradation due primarily to the discharges of the pulp and paper industries in Kawerau. The three main contamination effects – low dissolved oxygen, colouration and toxicity – are the same three identified 10 years ago during the development of the 1985 *Tarawera Management Plan*. Of the three, low dissolved oxygen is found to have the major effect on river ecology. The classification proposed in Rule 15.8.4(h)(i) stages an increase in the 30 day average dissolved oxygen concentration to 6.0 grams per cubic metre from 1 January 2003, the minimum amount necessary for Fish Purposes.

The problem of colour reduction is acknowledged to be a significant one for the pulp and paper industry to solve. However, the community desires that the visual appearance (colour and clarity) of the Tarawera River be improved. Rule 15.8.4(h)(ii) sets out a staged requirement which will ensure that from 1 January 2005 the visual colour and clarity of the river water will be considerably improved.

The amounts of toxic compounds, including organochlorine compounds, discharged from the Tasman Pulp and Paper Company Limited outfall have diminished over time. This regional plan will encourage further reduction in the discharge of toxic contaminants by establishing a classification standard for all water bodies in the Tarawera River catchment stating: “No detectable increase in acute and chronic toxicity”. The progress of industry in achieving further reductions

in toxic compounds will be measured using the toxicity, water quality and ecological monitoring programmes described in section 19.2.5 of this regional plan.

15.8.6 Anticipated Environmental Results

15.8.6(a) Retention and protection of the high quality water in the Tarawera Lakes and the catchment of the Upper Reach of the Tarawera River.

15.8.6(b) Continued improvement in the quality of water in the Lower Reach of the Tarawera River so that it will reach a quality sufficient for fish purposes by 1 January 2003 for dissolved oxygen and 1 January 2005 for colour.

15.8.6(c) Reduction in the effects caused by the discharge of contaminants into the Tarawera River and its catchment tributaries and lakes.

15.8.6(d) The enhancement of habitat and the return of more indigenous species into the waters of the Lower Reach of the Tarawera River.

15.8.6(e) The Lower Reach of the Tarawera River becoming an asset to the people of the region and a testament to the determination of industry to resolve difficult contaminant disposal issues.

15.8.6(f) The mauri of the Lower Reach of the Tarawera River is enhanced.

16 Groundwater Quality and Quantity

16.1 Introduction

In this chapter the extent and location of the groundwater resources in the Tarawera River catchment, in particular the lower catchment area are discussed. The chapter does not cover the geothermal resources, which are discussed separately. The Resource Management Act 1991 defines geothermal water as having temperatures equal to or greater than 30°C. Conversely, in the context of this chapter, non-geothermal groundwater is defined as having temperatures less than 30°C.

The chapter also indicates the quality assessments for the groundwater resources and proposes groundwater uses relative to the limitations of those results. Policy considerations arise from the effects of land use activities and industry.

Use of groundwater resources, and waste disposal activities which may influence the groundwater environment, are predominantly exercised in the Lower Tarawera catchment. Since the 1950s, the groundwater resources (mainly springs) of the Lower Tarawera catchment have been a primary source for public water supplies. During the early 1980s, a rapid development in horticulture on the Rangitaiki Plains resulted in an increase in use of borehole groundwaters.

16.2 Groundwater Systems

Groundwater resources in the catchment of the Upper Reach of the Tarawera River are poorly documented mainly because of the low demand for use of groundwater. Surface water supplies suffice for current demand. Most groundwater usage of the Upper Tarawera catchment is within the Kawerau District Council boundary. In the lakes portion of the catchment only two bores have resource consents to take groundwater. Shallow groundwater (6 metres depth) is used in a timber treatment plant at Rainbow Mountain.

The major aquifers in the catchment of the Lower Reach of the Tarawera River are the widespread pumice sand and gravel aquifers, and the largely distributed ignimbrite aquifer. In the north-eastern part of the catchment, ignimbrite seems to be absent. Compared to those of the shallow system (<70 metres), the hydraulic properties of the deep system (70-400 metres) are heterogeneous[111].

The main recharge resources of the shallow groundwater are rainfall and deep groundwater upflow. Ignimbrite groundwater is mainly recharged by rainfall in the mountains and hills surrounding the plains through fractured rock and fault zones.

The regional groundwater flow is from southwest to northeast toward the coast on the plains. In the north-western margin, groundwater flows from northwest to southeast towards the Tarawera River and Rangitaiki Plains.

Changes in shallow groundwater levels basically follow rainfall with various degrees of lag. Groundwater levels in some deep wells display a similar pattern to that of Lake Rotoma water levels, while groundwater levels in some deep wells are very constant. Groundwater levels in shallow bores and some deep bores increased between 1988 and 1990, remained relatively stable between 1990 and 1992, and have decreased since 1992. The 1987 Edgecumbe Earthquake caused an abnormal change in groundwater levels between 1987 and 1988 in both the shallow and deep systems.

[111] Pang, L, Environmental Report 94/3.

16.3 Groundwater Quantity and Allocation

The estimated natural groundwater discharges into the sea are about 19,000 to 41,000 cubic metres per day from the shallow system and 62,000 cubic metres per day from the deep system. The total volume discharged from the major water supply springs into surface channels is about 56,000 cubic metres per day. The groundwater storage within the aquifer systems is inferred as being 5.3x107 to 1.8x109 cubic metres in the shallow system, and more than 2x109 cubic metres in the deep system. However, these estimates have a great degree of uncertainty.

The total consented abstraction of groundwater was 41,381 cubic metres per day by March 1994, including 63% from springs and 37% from boreholes. The largest groundwater consumption (76%) is for public water supply. The second largest use is for irrigation and frost protection (21%). Groundwater for public water supply is predominately ignimbrite groundwater (mainly from the Braemar Springs and Johnson Road bore). Groundwater for non-consented groundwater use is probably less than 1,000 cubic metres per day.

The volume of groundwater abstraction is within the fluctuation of natural discharge. Deep groundwater is believed to have greater water-yielding capacity than that currently abstracted. The future demand for groundwater abstraction from boreholes is unlikely to increase significantly in the near future. However, the Braemar Scheme is likely to expand.

16.4 Groundwater Quality

Generally, most shallow groundwaters are of poorer quality than the deep ignimbrite groundwater. Levels of iron, dissolved oxygen, pH, and boron in many shallow bores do not comply with potable water guidelines. Of these, boron is health related, while iron, dissolved oxygen and pH are not health related. Some shallow groundwaters, with high boron or dissolved solids, are suitable only for the irrigation of crops which are tolerant to boron or salt. Poor quality shallow groundwater is mainly found in the area between Otakiri Road and Greig Road, coinciding with a boron anomaly which is probably of geothermal origin, from a natural sub-surface outflow from the Kawerau Geothermal Field. This sub-surface outflow is consistent with low resistivity to the north and northeast of the main thermal area. It is important to note that because the net rate of abstraction of fluid from geothermal bores now exceeds the likely deep inflow to the Kawerau Geothermal Field, the sub-surface outflow has probably reduced, and a long-term improvement in groundwater quality may occur. Better water quality shallow groundwaters are found in the peripheral areas of the plains[112].

Deep ignimbrite groundwater contains low concentrations in all chemical compositions. It is generally of good quality for potable water supply, irrigation and most other purposes. This is the source of current public water supplies. Occasionally, bacterial and organic contamination has occurred in the water supplies of the catchment. The Jennings Spring has displayed an increasing trend in concentrations of nitrate, chloride and sulphate. Nitrate in the Pumphouse Spring has also slightly increased. There are commonly low fluoride concentrations (with respect to the recommended desirable levels for potable water supply) in all the water supplies of the catchment.

Both shallow and deep groundwaters have corrosion and encrustation hazards for well and pump components, and reticulation systems. Corrosion can increase concentrations of iron, manganese, zinc, and copper in reticulated waters, and may cause copper stripping problems.

The influence of Tarawera River water on adjacent shallow groundwater occurs only to a shallow depth. Seawater intrusion has occurred near the coast.

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[112] Pang, L, Environmental Report 94/3.

16.5 Impact of Waste Disposal on Groundwater Quality

In general, increase in chemical loadings in the groundwater of disposal areas above background levels cannot be avoided. The purpose of environmental management is to minimise the adverse effects and to control the impact within acceptable levels. Background levels and drinking water standards are commonly used as two baselines for assessment of environmental impact and protection of groundwater quality.

16.5.1 Tasman Pulp and Paper Company Limited Solid Waste Disposal and Effluent Treatment

Of the monitored parameters of COD, BOD_5, colour, chloride, nitrate, nitrite, sodium, sulphate, phosphate, suspended solids, total dissolved solids, pH, iron, manganese, zinc and electrical conductivity, only total dissolved solids have slightly exceeded the drinking water standard in some monitoring bores, resulting from the operation of the Tasman Pulp and Paper Company Limited effluent treatment plant and solid waste disposal activities. High metal concentrations and low pH levels, which do not comply with drinking water standards, in the groundwaters of the disposal area and adjacent area occur naturally in the shallow groundwater.

Except for two bores, water quality of the private supplies in the vicinity of the Tasman Pulp and Paper Company Limited Treatment and Disposal Area is similar to drinking water standards. The poor water quality of the Knight's water supplies is probably caused by local agricultural contamination sources. The deteriorated water quality in the Barkla's bore is believed to be mainly affected by the polluted Tarawera River water.

16.5.2 Tasman Pulp and Paper Company Limited Effluent Irrigation Trials

The concentrations of monitored parameters of sodium, chloride, potassium, calcium, sulphate, and nitrate in the shallow groundwater of the irrigated area were well below the limits of drinking water standards during the trials (1985-1989). The efficiency of contaminant removal was higher at slow irrigation rates than at higher irrigation rates. At high irrigation rates, some chemical components were leached from the soil.

16.5.3 Carter Holt Harvey Tissue Rapid Infiltration Basins

Carter Holt Harvey Tissue's Rapid Infiltration basins (RIB's) are impacted by natural geothermal inflows. Groundwater under the site is sourced locally from rainfall infiltration and discharges into the Tarawera River adjacent the site. The groundwater contains indirect discharges from the RIB's. The edge of the alluvial materials on the western side of the site, marked by a change to hilly terrain, provides a nearby containing boundary to groundwater flow, further containing the extent of down-gradient effects from the basin. The Ruruanga Stream that skirts the foot of the hills is perched in isolation above the groundwater system in the area of the basins.

Two parameters, sodium and BOD_5, have been monitored in the shallow groundwater around the RIB's. Since the RIB's were commissioned, the levels of sodium and BOD_5 have increased by 27-87 times and 26-238 times respectively. Sodium levels now exceed the drinking water guideline by up to 4 times. At present there are no known drinking water supply bores in the vicinity of the RIB effluent plume.

16.5.4 Spray Irrigation of Dairy Factory Effluent

Of the monitored parameters of pH, BOD_5, electrical conductivity, total kjeldahl nitrogen, nitrate, total phosphorus, sodium, potassium, calcium, and magnesium, only calcium and nitrate have slightly exceeded the drinking water standards in two monitoring bores. The low pH dairy factory effluent has slightly increased the acidity of the local shallow groundwater.

The spray irrigation system which is operated at a slow irrigation rate has demonstrated very high efficiency (94-99.9%) in removal of BOD, total kjeldahl nitrogen, potassium, and calcium, and high efficiency (74-85%) in removal of sodium and nitrate.

The down-gradient private borehole groundwaters sampled during 1987-1989 did not show detectable impact from the irrigation system. The current impact is unknown since there are no recent monitoring data. However, groundwater flow is very slow at this area due to the presence of peat deposits.

16.5.5 Kawerau Landfill

The Kawerau Landfill, because it is located up-gradient, may cause the occasional organic and bacterial contamination of the Pumphouse Spring. Other contamination sources could also be agricultural activities and changes in land use.

16.5.6 Reinjection of Geothermal Water

Geothermal water contains naturally occurring arsenic, boron, ammonium, chloride and sodium at concentrations which exceed the potable water guidelines.

Currently geothermal effluent is being reinjected into the Kawerau geothermal reservoir at 100-330 metre depth. Reservoir pressures have not changed significantly and it is, therefore, unlikely that reinjection has had any major influence on the natural sub-surface outflows, as discussed in 16.4.

Further investigations are needed into the possible link between the geothermal field and the groundwater wells to the north. These investigations should precede any significant increase in the reinjection programme so that any effects on groundwater resources can be assessed.

At this stage, Environment Bay of Plenty believe there is not an immediate threat to the Otakiri water supplies because of the low transport velocity of the reinjected fluid and possible retardation of contaminant in the aquifer.

16.5.7 Supporting Technical Report

The following technical report, written as part of the preparation of this *Regional Plan for the Tarawera River Catchment*, contains more detailed information on the groundwater resources in the Tarawera River catchment:

Pang, L 1994 (July), Groundwater Resources of the Lower Tarawera Catchment, Environment Bay of Plenty Environmental Report 94/3.

16.6 Future Use of Groundwater Resources

Good quality groundwater is expected to be obtained in the following areas:

(a) West of the Tarawera River for both the shallow and deep groundwaters, outside the geothermal areas;

(b) South of the Kawerau Geothermal Field for both the shallow and deep groundwaters;

(c) Between north of the Kawerau Geothermal Field and south of Otakiri Road for deep ignimbrite groundwater.

Future development of groundwater use could be proposed in these areas. The full utilization of the natural discharge of springs could be encouraged.

The areas which are not recommended for future development of both the shallow and deep groundwaters for potable water supply and irrigation purposes are:

(d) The coast area, due to the potential for seawater intrusion;

(e) Between Otakiri Road and Greig Road, due to the naturally high boron concentrations in the groundwater; and

(f) The Kawerau Geothermal Field, due to possible geothermal water influence. However, some shallow groundwaters in the field have not significant geothermal influence and can still be used for potable water supply and irrigation purposes.

16.7 Future Waste Disposal and Monitoring Requirements

The Bay Milk Products spray irrigation system and Tasman Pulp and Paper Company Limited irrigation trials have suggested that the land spray irrigation system under slow irrigation rates is a desirable option in disposal of treated industrial effluent. Provided that the concentrations of applied chemical compositions in groundwater outside the disposal area are within the acceptable levels (e.g. drinking water standards), such a system should be encouraged. The system must be associated with a comprehensive monitoring programme which includes indicators of potential contamination from the system.

A site for land disposal of wastes should be located in an area where physical factors are suitable for the treatment and assimilation of contaminants in the waste. In particular this would be an area away from surface water bodies where the risk of contaminating ground and surface water could be largely negated by the treatment capacity of soil and the uptake of nutrients by plants. Key factors would include a low site slope angle to limit the possibility of overland flows, vegetation cover able to reach and take up nutrients from the waste, and the ability of soils and ground strata under the site to enable the biological breakdown of nutrients and the retention of elements.

The selection of steeper forest land as a disposal site would require sufficiently low groundwater table and be at an adequate distance from surface water sources. The mountains and hills surrounding the plains are the recharge area of the high quality ignimbrite groundwater. Groundwater monitoring in such an area must be strictly monitored to ensure no breaching of drinking water standards occurs.

Waste disposal activities in the up-slope areas of water supply catchments should be strictly controlled or prohibited.

The area north of Otakiri Road is recommended as an optional area for irrigation of effluent due to the following facts:

(a) Organic-rich peat deposits have a strong attenuation capacity to take in contaminants;

(b) The area is near the coast which is the final groundwater discharge base;

(c) Naturally, shallow groundwater in this area is not suitable for potable water supply and only suitable for irrigation or boron tolerant crops.

16.8 Issues, Objective, Policies, Principal Reasons, Methods of Implementation and Anticipated Environmental Results

16.8.1 Issues

Issues relating to groundwater quality and quantity are:

16.8.1(a) Land use activities can lead to the movement of contaminants into groundwater, particularly over unconfined aquifers.

16.8.1(b) The high quality deep groundwater resource may be over used and become depleted.

16.8.1(c) The scarcity of shallow high quality groundwater may lead to conflict between users.

16.8.1(d) Localised nutrient and faecal contamination of springwater used for domestic and stockwater supply is occurring and could cause health problems.

16.8.1(e) Land based waste disposal systems may have adverse effects on good quality groundwater.

16.8.1(f) The monitoring of groundwater quality beneath surface discharge systems is inadequate.

16.8.2 Objective

Protect the quality and quantity of the groundwater resources of the Tarawera River catchment.

16.8.3 Policies

16.8.3(a) To protect groundwater recharge zones form contamination.

16.8.3(b) High quality water in the deep aquifers should only be used for activities that require high quality water.

16.8.3(c) Non-potable water in the shallow aquifers under the Tarawera River catchment should be used in preference to high quality water for activities which do not require the use of high quality water.

16.8.3(d) To require the return of construction, installation and yield test information from production bores or wells.

16.8.3(e) To discourage the contamination of shallow unconfined aquifers from land based effluent disposal systems.

16.8.3(f) To advocate that the discharge of dairy shed effluent is in accordance with guidelines agreed between Environment Bay of Plenty and the agricultural industry.

16.8.3(g) To protect the quality of spring water from land use activities that result in contamination through stormwater runoff.

16.8.3(h) To promote the use of land based contaminant disposal systems over areas sufficient and appropriate to the long-term treatment capacity of substrata.

16.8.3(i) To encourage land based contaminant disposal systems that involve effective nutrient uptake.

16.8.3(j) To ensure effective monitoring of the effects that land based contaminant disposal systems may have on both ground and surface water resources.

16.8.3(k) To provide, following an initial operation and monitoring period, for long-term discharge consents for land based contaminant disposal systems that effectively dispose waste without significantly adversely affecting water resources.

16.8.3(l) To require the efficient use of groundwater resources.

16.8.4 Methods of Implementation – Information

16.8.4(a) Information held by Environment Bay of Plenty relating to aquifer water quality and quantity will be made readily available to any interested person.

16.8.4(b) Environment Bay of Plenty will actively discourage and advocate against land use activity that causes or has the potential to cause the contamination of spring water used for domestic or municipal supply.

16.8.4(c) Environment Bay of Plenty will advise and advocate that the installation and management of on-site (sewage) effluent treatment systems within the Tarawera River catchment be in accordance with the policies and rules of the *Operative On-Site Effluent Treatment Regional Plan*.

16.8.4(d) Any application to take and use groundwater shall include information describing the efficient use of the groundwater allocation sought relative to the activity proposed.

16.8.5 Methods of Implementation – Rules

16.8.5(a) Any discharge of waste onto or into land in a way or at a rate that may result in the percolation or movement of contaminants into groundwater shall be a Discretionary Activity provided:

(a) This rule does not apply to the on-site discharge of domestic sewage regulated under the "*Operative On-Site Effluent Treatment Regional Plan for the Bay of Plenty*", and

(b) Any application for the land treatment of effluent originating form dairy sheds shall be subject to conditions made with regard to the "*Guidelines for Agricultural Discharges to the Tarawera and Rangitaiki Catchments* – September 1992".

16.8.5(b) A discharge permit granted pursuant to Rule 16.8.5(a) shall be subject to conditions that limit the land application discharge rate of effluent relative to disposal site constraints, to provide for the protection of groundwater and surface water resources from contamination.

16.8.5(c) Except as provided for in Rule 17.4.4(d), the direct point-source injection of contaminants into a groundwater aquifer is a Prohibited Activity.

16.8.5(d) A resource consent granted under Rule 16.8.5(a) for a discharge permit authorising an efficient land based treatment system, designed and managed to ensure minimal long-term effects on surface and groundwater quality and quantity, may be granted for a period up to the maximum provided by statute, subject to performance review conditions.

16.8.5(e) The taking of underground water at a volume equal to or less than 15 cubic metres per day shall be a Permitted Activity.

16.8.5(f) The taking of underground water at a volume exceeding 15 cubic metres per day shall be a Discretionary Activity.

16.8.5(g) A resource consent granted pursuant to Rule 16.8.5(f) for a water permit for which a new bore or well is to be installed shall be subject to the following condition:

Bore Log and Test Information

The consent holder shall, within one month from the day on which their consent is granted, return the following information to Environment Bay of Plenty:

(a) The name and address of the bore driller, the final location of the bore, its construction method and liner material.

(b) The dimensions of the bore; diameter and depth.

(c) A log of the bore installation showing the depth and extent of intercepted strata (lithology), geologic layers, water bearing aquifers and water access screens.

(d) A copy of bore pump test results, including information on; sustainable bore yield, water level drawdown, static water level and transmissivity data.

16.8.6 Principal Reasons

There are extensive groundwater resources within the catchment of the Lower Reach of the Tarawera River. Of particular value is the deeper (70-400 metre) aquifer system which has high quality water and is yet to be used to any extent, and is a valuable future resource to be protected. Usually deep aquifers are naturally buffered from contaminants. However, the quality of water in deeper aquifers is not immune to longer term effects such as nitrate contamination from extensive farming activities and decreased inflows due to natural and artificial alternations to catchment hydrologies, and to rainfall.

Shallower aquifers, particularly those that are unconfined form surface influences, are more directly and substantially exposed to degradation from the surface disposal of contaminants. If these shallow resources are to be used, even if that use is restricted to agricultural irrigation, extra quality protection measures will be required. The Tarawera River catchment also has geothermal influences, both natural and artificial, that have the potential to change the chemical composition of groundwater. The placement of geothermal reinjection bores is a particular concern.

The policies set out in this chapter are designed to encourage those who manage the disposal of effluents and contaminants to do so with understanding of the consequences on groundwater resources. Even the more desirable methods of disposing of nutrient rich effluent, such as land based spray irrigation systems, can pose a threat to the quality of groundwater if not managed in a way that recognises soil absorption limitations.

The taking and use of deeper potable groundwater for domestic and production purposes will be encouraged, as will the use of lower quality shallower groundwater for pasture and crop irrigation. Environment Bay of Plenty will make available to users any physical and chemical groundwater and aquifer information it has to help users make good decisions about groundwater use. In return, users who drill bores to tap and use groundwater will be required to provide details of underground strata and aquifers intercepted, to increase understanding for the future.

16.8.7 Anticipated Environmental Results

16.8.7(a) A better community understanding of the potential groundwater resources of the catchment of the Lower Reach of the Tarawera River.

16.8.7(b) Safeguarding of the quality of groundwater resources for future generations.

16.8.7(c) Efficient land based disposal systems, designed and managed to ensure minimal long-term effects on surface and groundwater quality and quantity will be encouraged.

16.8.7(d) Limited agricultural and domestic use if provided for.

16.8.7(e) Knowledge of aquifer configurations and groundwater chemical composition will be enhanced.

17 Geothermal Resources

17.1 Introduction

This chapter explains management options of ways to protect freshwater resources in the Tarawera River catchment from unnecessary contamination from the disposal of geothermal wastewater into the environment. Rules to minimise the effects of geothermal wastewater discharges into fresh surface and groundwater are established.

Geothermal resources include groundwater systems heated by volcanic (hot magma) heat sources to a temperature of 30°C or more. They include, also, any hot rock and aquifer systems and any associated surface features. Although such systems may be interconnected at depth, where they have a limited known surface extent and an identified area of pressurised capping layers, they are referred to as a geothermal field. Each geothermal field is defined by the boundary between the area of low resistivity within the field and the higher resistivity of the surrounding groundwater.

There are four major geothermal fields in the catchment of the Tarawera River. These are the Rotomahana-Waimangu, Tikorangi, Puhi Puhi, and Kawerau geothermal fields. Only the Kawerau Geothermal Field has been utilised, resulting in effects on catchment water resources.

Surface geothermal activities are present at Waimangu, western shore of Lake Rotomahana, and the southern shore of Lake Tarawera. Minor geothermal inflow also occurs on the eastern shore of Lake Okataina. Other Tarawera Lakes have no significant thermal inflow.

Two areas of warm springs are found in the Mangakotukutuku and Waiaute Streams. A thermal infra-red survey along the Tarawera River between Lake Outlet and Kawerau indicates that thermal anomalies occur almost continuously between Lake Outlet and the confluence of Mangakotukutuku Stream with the river.

The area of the Kawerau Geothermal Field is about 19-35 square kilometres at 500 metres depth. Natural thermal activities include hot springs, seepages, steaming ground and hot ground. Surface thermal activities have declined significantly in this century, even before exploration of the field. The heat sources of the Kawerau field are probably from Putauaki (Mt Edgecumbe) and the vicinity of Mt Tarawera. The temperatures of the geothermal borehole waters in the Kawerau field range from 250-315°C. The recharge source of the Kawerau field water is thought to be mainly from the colder local shallow groundwater[113].

The rules in this regional plan apply only to activities relating to the Kawerau Geothermal Field. The management of the Rotomahana-Waimangu, Tikorangi and Puhi Puhi geothermal fields is in the policy of the *Operative Bay of Plenty Regional Policy Statement* and the *Regional Water and Land Plan*.

[113] Pang, L, Environmental Report 94/4.

17.2 Discharge of Geothermal Water

In 1994, the total authorised abstraction of the geothermal water from the Kawerau Geothermal Field was about 29,914 tonnes per day. After reinjection of about 6,240 tonnes per day is subtracted, the net abstracted geothermal water requiring discharge calculates to about 23,674 tonnes per day.

Measured pressure drawdown of the reservoir is not significant. The deep inflow of 290°C water into the field has been calculated to be between 6,000 and 7,200 tonnes per day. The subsidence rates in the production field are greater than in the background area. Subsidence rates were greater in the pre-1987 earthquake period that in the post-earthquake period. In recent years, subsidence rates have reduced. The relevance of subsidence to this regional plan relates to the effect on groundwater levels and the potential for flooding as a result of lowered ground surfaces. Subsidence has little effect compared with the down-cutting of the Tarawera River.

About 6,240 tonnes per day of geothermal wastewater is being injected into the shallow strata at 100-200m depth. This is 21% of the total withdrawal of geothermal fluid from the Kawerau Geothermal Field.

In 1993 the mean daily discharge of separated geothermal wastewater was being discharged into the Tarawera River from the two geothermal outfalls. The river also intermittently received a small amount of condensate waste and effluent associated with drilling of geothermal wells. The Ruruanga Stream received about 714 cubic metres per day of warm geothermal water discharged from the Kawerau Swimming Pool and the Kawerau Thermal Motel[114].

The quantity discharged into the Tarawera River from the two principal geothermal outfalls had obviously decreased since 1990. Consequently, the chemical loadings into the river from the geothermal discharge had reduced. This was due to the disposal of geothermal wastewater by reinjection trials in recent years. The cooling channel had also reduced the discharge of heat and hydrogen sulphide.

The mass flow, chemical fluxes and heat flow of the geothermal wastewater discharged to the river from the two outfalls have been below the discharge limits required by consent No. 2635.

17.3 Natural Geothermal Inputs to the Tarawera River

The most significant geothermal inputs are evident in the Mangakotukutuku Stream, the entire length of the Tarawera River, and Tarawera Western Drain. The latter contains largely Tarawera River water.

With various degrees of dilution, geothermal influence is also identified in Awaiti Canal, Omeheu Drain, Omeheu Canal, Waiaute and Waiwhakapa Streams, Ruruanga Stream, Awatarariki Stream Waitepuru Stream, Mangaone and Karaponga Streams. The geothermal components in Awaiti Canal, Omeheu Drain, and Omeheu Canal coincide with the presence of the boron anomaly in the shallow groundwater of the Rangitaiki Plains on the Lower Tarawera catchment. This suggests a hidden geothermal source underneath this area, possibly a sub-surface outflow path from the Kawerau field.

The Kaipara, Korutu, Mangawhio, Otuhangu (Buddles), Mangate, Waikamihi Streams, Awakaponga Canal, and Wilson's Creek show no significant geothermal inputs.

[114] Pang, L, Environmental Report 94/4.

Estimate of heat flow and C1 flux balance of the Tarawera River suggests that Lake Tarawera contributes the highest heat flow (28%) and C1 flux (34%) into the Tarawera River. A large amount of geothermal inputs into the river is from seepages or unidentified warm springs present under the riverbanks. The area for hidden heat and C1 reservoir lies between Lake Outlet and Edwards Road Bridge, and is derived from the Tikorangi Geothermal Field. The Tarawera River gains the majority of heat flow and C1 flux upstream of Kawerau.

17.3.1 Supporting Technical Report

The following technical report, written as part of the preparation of this *Regional Plan for the Tarawera River Catchment*, contains more detailed information on the groundwater resources in the Tarawera River catchment:

Pang, L 1994 (July), Geothermal Water Resources of the Tarawera Catchment, Environment Bay of Plenty Environmental Report 94/4.

17.4 Issues, Objective, Policies, Principal Reasons, Methods of Implementation and Anticipated Environmental Results

17.4.1 Issues

Geothermal issues relevant to this regional plan include:

17.4.1(a) Without sustainable reinjection or treatment of waste geothermal fluid, discharge effects caused by geothermal contaminants entering Tarawera River water are increased.

17.4.1(b) Heat in fluid discharged into the Tarawera River is not being fully utilised for the benefit of the community, particularly for electricity generation, tourism and therapeutic uses, or mineral extraction and as a consequence increases the risk of heat contamination effects on the river water.

17.4.1(c) Inappropriate methods of reinjection may cause the contamination of groundwater.

17.4.1(d) The effects of natural geothermal discharges into the Tarawera River cannot be understood or taken into account without ongoing monitoring and assessment of those effects.

17.4.1(e) Significant geothermal surface features and associated biota should be protected.

17.4.1(f) The development of the Kawerau geothermal field may increase the risk of land subsidence and tilt.

17.4.2 Objective

Protecting freshwater resources from unnecessary contamination from geothermal fluid while maximising the utilization of geothermal waste streams.

17.4.3 Policies

17.4.3(a) To limit the effects of fluid discharge on the Tarawera River by encouraging reinjection of waste geothermal fluid into the Kawerau field.

17.4.3(b) To restrict and limit the discharge of waste geothermal contaminants into the Tarawera River.

17.4.3(c) To encourage the use of residual heat and minerals from geothermal discharges, providing the requirement to achieve sustainable reinjection is not compromised.

17.4.3(d) To monitor the effects that the use of the Kawerau Geothermal Field may have on surface and groundwater resources, and land subsidence and tilt.

17.4.3(e) To monitor and assess the effects of natural geothermal fluid discharges and changes inflows of fluid into the Tarawera River.

17.4.3(f) To discourage the adverse effects of development on significant geothermal surface features.

17.4.4 Methods of Implementation – Rules

17.4.4(a) The taking of geothermal mass, water, heat or energy from the Kawerau Geothermal Field shall be a Discretionary Activity.

17.4.4(b) The discharge of geothermal water to the Lower Reach of the Tarawera River for which discharge permits were held on the date of public notification of this regional plan and the replacement of any of those consents for equivalent or lesser allocations shall be a Discretionary Activity.

17.4.4(c) The discharge of geothermal water to the Lower Reach of the Tarawera River resulting from any new geothermal resource use activity shall be a Discretionary Activity.

17.4.4(d) The reinjection of geothermal fluid into the Kawerau Geothermal Field shall be a Discretionary Activity.

17.4.4(e) Resource consent applications under Rules 17.4.4(b), 17.4.4(c), and permits authorising the taking, discharge and reinjection of geothermal mass, water, heat or energy from the Kawerau Geothermal Field may be considered together. Consents granted will be subject to conditions to ensure the protection of groundwater and surface water quality from geothermal contamination, and land subsidence and tilt.

17.4.4(f) Authorised users of geothermal resource from the Kawerau Geothermal Field shall be required to develop and implement a wastewater management strategy for their existing geothermal discharges, with particular regard to:

(i) The efficient utilization of the heat and mineral content of the wastewater; and

(ii) The classification standards of Rule 15.8.4(h).

17.4.4(g) The use of heat from waste geothermal fluid shall be a Permitted Activity, provided that the use activity, or the requirement for heat, shall not limit the sustainable reinjection of geothermal fluid.

17.4.5 Principal Reasons

Geothermal mass is removed from the Kawerau Geothermal Field by production bores used in the paper industry and in electricity generation. Waste from this use is both discharged into the Tarawera River and reinjected. Also, continuing natural fluid outflow from the field has an impact on surface water resources.

Users of the geothermal field have a high investment interest in using and sustaining the productive potential of the field. It is acknowledged that the extent and location of reinjection do affect the production potential of the field. However the management of waste geothermal fluid and the contaminants it contains also affects the quality of water in the Tarawera River. Environment Bay of Plenty must ensure that the level of reinjection of geothermal mass condensates from the

production system is balanced in such a way that the field production capacities are not reduced on one hand, yet on the other the geothermal wastes form field production do not have an unnecessarily high effect on water quality in the Tarawera River.

To achieve this balance, Environment Bay of Plenty will work together with the industry managers and users of the Kawerau geothermal resource to ensure that best practicable options to minimise effects are achieved. This will be managed at this time through the resource consent process. In the future the geothermal resources of the Kawerau field are likely to be managed by a regional plan specifically designed for geothermal resources.

Environment Bay of Plenty will also encourage the further use of both the energy (heat) and mineral recovery potentials in waste geothermal fluid. The removal of excess heat and valued minerals could considerably reduce the impact of geothermal discharge and provide further employment for the people of Kawerau.

17.4.6 Anticipated Environmental Results

17.4.6(a) Uncontrolled discharges of waste geothermal fluid into the Tarawera River will be avoided.

17.4.6(b) Actual and potential effects on the quality of water in the Tarawera River resulting from discharges of waste geothermal fluid will be minimised.

17.4.6(c) Activities that would remove residual heat and contaminating minerals will be encouraged, lessening impact on the Tarawera River.

18 Resource Consent Process

18.1 Making an Application

18.1.1 Introduction

Resource consents to undertake an activity described in this regional plan must be obtained from Environment Bay of Plenty. These consents are either for discretionary, controlled or non-complying activities. If a Permitted Activity is allowed by rules in this plan, no resource consent is required. Prohibited activities are not allowed. Environment Bay of Plenty cannot grant a resource consent for any Prohibited Activity.

18.1.2 Statutory Requirements

Each application for a resource consent will need to contain information details as required by section 88 of the Resource Management Act 1991. In particular, regard must be had to the requirement for an application to contain *such detail as corresponds to the scale and significance of the actual or potential effects that the activity may have on the environment; and shall be prepared in accordance with the Fourth Schedule.*

If, on assessment, Environment Bay of Plenty finds that an application does not contain sufficient information to enable it to be satisfactorily processed, an applicant may be requested under Section 92 of the Act to provide further information or evidence to support their application. To prevent this occurring, an applicant would be wise to consult staff as to the adequacy of information before lodging their application. Even is such consultation is made, further information details may still be required from an applicant as the processing of their application proceeds.

18.1.3 Forms and Details

Application forms for the various activities requiring consent are available from any Environment Bay of Plenty office.

These application forms are designed to comply with (be very similar to) the details to be provided by an applicant as listed in Form 5 of the Schedule to the Resource Management (Forms) Regulations 1991.

18.2 Information Requirements

An application must contain sufficient specific detail to allow any person to understand what resource use activity is proposed, and any ancillary information that Environment Bay of Plenty may need to process the application effectively.

The information required with any resource consent application should comply with the Fourth Schedule of the Resource Management Act as already outlined. However, due to the variety of resource consents which may be obtained and the variation in scale of likely activities, it is not possible to give a single comprehensive checklist of information required with applications. Environment Bay of Plenty has specific application forms for the following activities:

(a) Discharge permit
(b) Water permit
(c) Land use consent
(d) Coastal permit

Attached to each of these specific application forms are explanatory notes on the preparation of an assessment of effects on the environment. Applicants should use these notes as guidance to what information is required for any application.

19 Monitoring and Plan Review

19.1 Introduction

The Resource Management Act establishes a general duty for Environment Bay of Plenty to monitor the suitability and effectiveness of this regional plan (section 35(2)(b)). The Act also requires regional councils to gather such information as is necessary to carry out its resource management functions effectively. It further requires regional councils to monitor the state of the environment and the exercise of resource consents.

19.2 Monitoring Programmes

Environment Bay of Plenty has been involved in extensive monitoring of water quality and quantity in the Tarawera River. This has included detailed studies of water chemistry, toxicology, ecology, oxygen content, colour and clarity.

Monitoring activities which Environment Bay of Plenty carries out in the Tarawera River catchment include the following:

19.2.1 Natural Regional Monitoring

Environment Bay of Plenty has established an effective monitoring system in the form of its Natural Environment Regional Monitoring Network (NERMN)[115]. The goal of this network is:

> *To provide scientifically defensible information on the important physical, chemical and biological characteristics of the Bay of Plenty region as a basis for the preparation of Council policy statements and management plans and the monitoring of the suitability and effectiveness thereof.*

This network includes ongoing investigations into the natural and physical resources of the Bay of Plenty, with regular reporting on both status and trends. A summary of the NERMN sites in the Tarawera River catchment and the parameters measured is described in Appendix 10.

19.2.2 Compliance Monitoring

Compliance monitoring takes place through self-monitoring by the consent holder and additional monitoring by Environment Bay of Plenty. Under this regional plan any discharge of a contaminant to surface water must comply with rules given in Chapter 15 – *Water Quality*. In addition, certain consents may include specific conditions which will require compliance monitoring.

19.2.3 Impact Monitoring

Monitoring of the environmental impact of specific consents (particularly discharges) will be carried out by Environment Bay of Plenty. This monitoring is not necessarily directly related to compliance with the rules presented in this regional plan.

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[115] Environment Bay of Plenty, 1993.

19.2.4 Dissolved Oxygen Monitoring

Dissolved oxygen and temperature are at present monitored at 15 minute intervals by recording instruments at Pipe Bridge, Awakaponga and Matata. This monitoring assesses both the impact of the organic discharges at Kawerau and compliance with dissolved oxygen standards. River flow is monitored at Pipe Bridge and Awakaponga.

Environment Bay of Plenty intends to rationalise its permanent sites by discontinuing intensive dissolved oxygen monitoring at Pipe Bridge and Awakaponga. It is considered that the extra cost of maintaining these sites outweighs the benefit of the additional information. Dissolved oxygen levels are always lowest at Matata and this is therefore the logical site to maintain intensive monitoring.

Numerical modelling has allowed the relationship between the discharge of BOD at Kawerau and dissolved oxygen depletion in the lower Reach of the Tarawera River to be calculated. Discharge load for BOD from Tasman Pulp and Paper Company Limited and Carter Holt Harvey Tissue are to be calculated from the river temperature at Matata and the river flow recorded at Awakaponga. The continued existence of the flow recording site at Awakaponga and the dissolved oxygen and temperature monitoring site at Matata is therefore essential for the operation of this regional plan. This information will provide feedback to Environment Bay of Plenty and industry on the efficacy of the dissolved oxygen model.

19.2.5 Toxicity and Ecological Monitoring

Extensive baseline toxicity and ecological monitoring was carried out during the technical investigations that preceded the compilation of this regional plan. These investigations provide details of the state of the Tarawera River between 1990 and 1994. Environment Bay of Plenty intends to carry out similar toxicity and ecological investigations in 1997/98 and 1999/2000 to monitor the success of this regional plan. The following methods of investigation will be undertaken.

- Instream macroinvertebrate monitoring;
- Resin acid content of effluents and river water;
- Chlorinated organic compounds in effluents and feral eels;
- Blood plasma enzymes, blood chemistry and liver inspection of feral eels;
- EROD activity in feral eel livers;
- Chronic and acute toxicity testing.

The results of the above investigations should reflect the classification of the river and satisfy the requirement that there shall be no detectable increase in toxicity as a result of any discharge of a contaminant into the water.

19.2.6 Other Monitoring

Environment Bay of Plenty also has access to information on land management practices through the use of aerial photography, soil conservation assessments, the preparation of Farm Environment Plans and the issuing and the monitoring of landuse consents. In addition Environment Bay of Plenty collates social and economic information, as well as conducting surveys on community perceptions and issues relating to resource management.

There are a number of areas, such as the preservation of natural character, the protection of flora and fauna, recreational opportunities, and natural hazard avoidance and mitigation on which Environment Bay of Plenty is developing monitoring strategies. These additions to Environment Bay of Plenty's monitoring programmes are important for evaluating the effectiveness of the objectives, policies and methods of implementation contained within this regional plan.

Finally, it is emphasised that the purpose of monitoring is to assist in decision making as well as to ensure that provisions within this regional plan or conditions on consents are appropriate. In addition to Natural Environment Monitoring, there may be circumstances in which monitoring will be contracted out to other agencies or set as a requirement on a consent. In some cases it may be appropriate for iwi and community groups to be involved with monitoring.

19.2.7 Environmental Standards and Research Protocols

When testing and assessing the physical, ecological and chemical effects of discharges into the Tarawera River or its tributary lakes and streams, Environment Bay of Plenty will seek to use accepted contemporary environmental standards and research protocols to provide comparable environmental protection and high quality research results. Environment Bay of Plenty may also choose to adopt, as appropriate, any research standards or protocols in order to further national or international understanding of the impact and consequences that discharges may have on surface and groundwater quality. In its investigations, Environment Bay of Plenty may also include research into effects of particular compounds or components in a discharge, or any synergistic or cumulative effects resulting from the mixing of discharged contaminants. To achieve quality and comparable results, Environment Bay of Plenty may adopt international or agency standards or protocols, including those developed and used by OPEC, USEPA, ANZEC or any other recognised standard.

19.3 Issues, Objective, Policies, Methods of Implementation and Principal Reasons

19.3.1 Issues

Issues relating to monitoring include:

19.3.1(a) There is a need to acquire and maintain sufficient information to allow the effective management of natural and physical resources in the catchment of the Tarawera River.

19.3.1(b) The understanding of the fate and effect of contaminants in the aquatic environment is continually evolving.

19.3.1(c) In order to be effective, the review of this plan must have consideration to advances in environmental knowledge, research protocols and the setting of standards for environmental protection.

19.3.2 Objective

Effectively monitor the natural and physical resources of the catchment of the Tarawera River and the effects of activities upon these.

19.3.3 Policies

19.3.3(a) To acquire and maintain sufficient information on natural and physical resources through:

- Natural Environment Regional Monitoring;
- Compliance monitoring;
- Impact monitoring;
- Other monitoring as required.

19.3.3(b) To maintain sufficient monitoring facilities and programmes to ensure the adequate monitoring of the resource management issues addressed in this regional plan.

19.3.3(c) To ensure that monitoring of natural and physical resources is oriented to provide information for the evaluation of the objective and policies of this regional plan.

19.3.3(d) To use accepted contemporary environmental standards and research protocols to provide comparable high quality environmental and research results, including, as appropriate, any national, international or agency standards of protocols.

19.3.4 Methods of Implementation

Environment Bay of Plenty will:

19.3.4(a) Maintain the present Natural Environment Regional Monitoring programme within the Tarawera River catchment in order to provide baseline data and trend monitoring of natural and physical resources.

19.3.4(b) Document and report on the natural and physical resources of the catchment of the Tarawera River and the effects of the use, development and protection of these resources.

19.3.4(c) Assess information needs and undertake or require special investigations and/or research as is appropriate within the catchment of the Tarawera River.

19.3.4(d) Adopt or use, as appropriate to circumstances, accepted contemporary or comparable national, international or agency accepted environmental standards or research protocols, including those standards or protocols developed by OPEC, USEPA and ANZEC.

19.3.4(e) Require, as appropriate, self-monitoring by resource consent holders as a condition of consent.

19.3.4(f) Maintain a database of all resource consents granted by Environment Bay of Plenty or its predecessors.

19.3.4(g) Maintain a compliance and impact monitoring programme to ensure that consent conditions on resource consents and activities permitted by Environment Bay of Plenty, are met and that no unanticipated adverse environmental effects are occurring.

19.3.4(h) Maintain a database of structures located on, in, under or over the beds of rivers and lakes in the Tarawera River catchment.

19.3.5 Principal Reasons

This regional plan is intended to ensure the monitoring of the state of the catchment of the Tarawera River. It has the dual role of establishing the evaluation of the effectiveness of objectives, policies and methods contained within this regional plan. It refers primarily to both natural and physical resource management issues, as well as related social, economic and public perceptions monitoring.

The policies are intended to ensure that there is adequate information to allow the ongoing evaluation of the effectiveness of this regional plan. In addition, Policy 19.3.3(a) promotes the setting of monitoring priorities.

The principal reasons for the methods of implementation relate to the need to maintain continuous or regular monitoring and investigation of the state of the catchment of the Tarawera River and provide baseline data and trend monitoring. In addition, impact and compliance monitoring is essential to the continued assessment of the effects of activities.

19.4 Plan Review

Environment Bay of Plenty is required to begin a full review of this plan no later than ten years after the regional plan becomes operative. The Resource Management Act 1991 requires that Environment Bay of Plenty state the procedures to be used to review the matters set out in section 62(a)-(h) of the Act, which are dealt with in this regional plan. The decision to review this regional plan after ten years is based on a number of factors including:

- The current and future likely effects of wastewater discharges to the Lower Reach of the Tarawera River.
- Changing production demands and processes, including the planned construction of recycled paper processing facility by the Tasman Pulp and Paper Company Limited.
- The development and installation of enhanced wastewater treatment systems.
- Changing public perceptions about environmental standards.
- The need to analyse the effectiveness of the policies and methods contained in this regional plan, some of which deal with complex issues.

The review of the regional plan must be carried out in accordance with the procedures in Part 1 of the First Schedule to the Resource Management Act 1991. The review process needs to focus on resource management issues, and on whether the policies and methods contained within this regional plan are effective or still appropriate, and the objectives are realistic and achievable. All reviews and any intermediary changes to the regional plan must be undertaken in consultation with iwi authorities and all relevant agencies and interest groups, regardless of whether they are specifically noted in the First Schedule to the Act.

To provide continuity and a wide consultation and perception base from which to assess the effectiveness of the plan, Environment Bay of Plenty supports the continuation of the Tarawera River Liaison Group. The group has contributed valuable information, perspectives and problem resolution ideas and means during the process of developing this regional plan. Although it is recognised and respected that there are and remain philosophical differences of opinion between members of the group, and that these differences will probably need to be assessed through a judicial process, the constructive consultation and debate at group meetings have resulted in the setting of definitive goals for the plan. Environment Bay of Plenty will support extending the representation base of the group as appropriate.

19.5 Issues, Objective, Policies and Methods

19.5.1 Issues

Issues relating to plan review include:

19.5.1(a) Without the review of this regional plan within a realistic time frame, it would be extremely difficult to assess the attainment of the stated objectives or to take account of changes in industrial technology, environmental research and standards, and community aspirations.

19.5.1(b) Dialogue, information sharing and debate at Tarawera River Liaison Group meetings have greatly contributed to the establishment of standards and goals to focus this regional plan. It would be of benefit if the group would continue to contribute to the development, review and monitoring of the plan.

19.5.1(c) There needs to be a continued availability of information to the community from both Environment Bay of Plenty and water users on progress with the implementation of plan goals.

19.5.2 Objective

Continued improvement of objectives, policies, and methods of implementation that ensure the sustainable management of natural and physical resources within the Tarawera River catchment.

19.5.3 Policies

19.5.3(a) To commence a review of this regional plan within ten (10) years of it becoming operative.

19.5.3(b) To assess the effectiveness of the policies and methods in achieving the objectives and stated environmental outcomes.

19.5.3(c) To inform the community of the effectiveness of the policies and methods in achieving the objectives and stated environmental outcomes.

19.5.3(d) To continue the Tarawera River Liaison Group as a consultative organisation.

19.5.3(e) To promote reports from nominated industries that use the water of the Tarawera River catchment for supply of discharge purposes, as part of the liaison process.

19.5.3(f) To produce annually a report on the effectiveness of achieving the aims, objectives,, policies and implementing methods in this regional plan.

19.5.4 Methods of Implementation

Environment Bay of Plenty will:

19.5.4(a) Initiate a full review of this regional plan not later than nine (9) years from the date the plan became operative.

19.5.4(b) Operate a register of matters that may require consideration in any review of the regional plan, including but not limited to the following:

19.5.4(2)(i) Matters of concern, data, or information provided by any person;

19.5.4(2)(ii) The results of Environment Bay of Plenty's Natural Environment Regional Monitoring Network;

19.5.4(2)(iii) The results of monitoring activities undertaken by resource consent holders;

19.5.4(2)(iv) The results of monitoring activities undertaken by Environment Bay of Plenty;

19.5.4(2)(v) The results of ecology and toxicity monitoring carried out in 1997/98 and 1999/2000;

19.5.4(2)(vi) The results of monitoring activities or evaluations undertaken by other agencies;

19.5.4(2)(vii) The results of periodic monitoring of the views and aspirations of the regional or local community with regard to the management and use of natural and physical resources;

19.5.4(2)(viii) Other monitoring or research results which have relevance to the regional plan.

19.5.4(c) In viewing this regional plan, determine:

19.5.4(3)(i) Whether or not the policies and methods are achieving the objectives;

19.5.4(3)(ii) Whether or not the policies and methods are achieving the anticipated environmental results;

19.5.4(3)(iii) Whether or not the objectives continue to be realistic or achievable;

19.5.4(3)(iv) The relevance of issues;

19.5.4(3)(v) Whether new or additional issues have arisen which require attention in the regional plan;

19.5.4(3)(vi) The necessity of the objectives, policies, and methods of implementation to continue to reside within this regional plan or to form part of a separate regional plan or plans.

19.5.4(d) In reviewing this regional plan, make an assessment of the degree to which the relevant policies and methods are reflected in district plans.

19.5.4(e) Initiate meetings of the Tarawera River Liaison Group as required, to consider matters arising from the performance monitoring of the regional plan, or any other relevant matter relating to the Tarawera River catchment.

19.5.4(f) Produce for public information an annual Status Report on the effectiveness of the aims, objectives, policies and methods in this regional plan.

20 Summary of Rules

20.1 Chapter 12 – River and Lake Beds

12.2.5(a) For the purposes of this regional plan, any watercourse connecting lakes within the Tarawera River catchment is a tributary stream of the lake into which it flows.

12.2.5(b) The use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure or part of any structure, in, on, under, or over the bed of any river or wetland, within the Tarawera River catchment shall be a Permitted Activity, subject to compliance with all the conditions of Rule 12.2.5(m),

except that:

(v) an overhead cable or transmission line that, when measured at its lowest point above the bed of the waterbody, is greater than 10 metres above the 50 year flood water level for the site, or

(vi) a bridge (including a pipe bridge) spanning the main stem of the Tarawera River that, when measured at its lowest point above the bed of the river, is greater than 1 metre above the 100 year flood water level for the site and has no abutments or supporting structures in, on or under the bed of the river, or

(vii) notwithstanding the requirements of rule 12.2.5(e), a line, cable or pipeline, including any telecommunication line as defined in section 2(1A) of the Telecommunication Act 1987, installed by drilling or tunnelling (including pipe thrusting) under the main stem of the Tarawera River that, when measured at its highest point under the bed of the river is not less than 4 metres below the bed of the river,

shall be a Permitted Activity subject to compliance with conditions (iv), (v), (vii), (viii) and (ix) of Rule 12.2.5(m); and

(viii) The use, erection, reconstruction, placement, alteration, maintenance, extension, removal or demolition of a stream crossing, being any structure supporting a path, road or track over a streambed, including a culvert, single span bridge or ford, located in, on, under or over the bed of any tributary stream of the main stem of the Tarawera River, is exempt from the requirements of this plan.

Advisory Note:

The Operative Bay of Plenty Regional Land Management Plan has requirements relating to the installation and management of stream crossings. Anyone installing a stream crossing of the type described in rule 12.2.5(b)(iv) above would need to comply with the terms and conditions of section 10.5.6 of the Operative Bay of Plenty Regional Land Management Plan.

12.2.5(c) The use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure or part of any structure, in, on, under, or over the bed of any river or wetland within the Tarawera River catchment that does not comply with Rule 12.2.5(b) shall be a Discretionary Activity, and any application for a consent under this Rule shall be considered with regard to the criteria of Rules 12.2.5(m) and 12.2.5(o).

12.2.5(d) Notwithstanding Rule 12.2.5(b), the use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure located in, on, under, or over the bed of any river, lake, or wetland within the Tarawera River catchment

that is to be used for a taking or discharge activity from or into the same waterbody for which a water or discharge permit is required is a Discretionary Activity to be considered by Environment Bay of Plenty:

(i) at the same time as any application for the water or discharge permit to which it relates;

(ii) with regard to the requirements of the conditions of the water or discharge permit to which it relates;

(iii) with regard to the criteria of Rules 12.2.5(m) and 12.2.5(o).

12.2.5(e) Subject to Rule 12.2.5(b)(iii), every excavation, drilling, tunnelling, or other disturbance of the bed of any river, lake, or wetland within the Tarawera River catchment is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o).

12.2.5(f) Every reclamation or draining of the bed of any river, lake or wetland is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o).

12.2.5(g) Except as provided by Rule 12.2.5(h), the reasonable ongoing maintenance, of an authorised structure in, on, under or over the bed of any river, lake or wetland is a Permitted Activity, subject to compliance with all the conditions of Rule 12.2.5(m).

12.2.5(h) Maintenance of any structure in, on, under or over the bed of any river, lake or wetland that results in the discharge of waste antifouling paint into water is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o).

In the context of this Rule, waste antifouling paint is any paint or coating substance designed to emit any toxic substance.

12.2.5(i) The uncontrolled grazing of stock on the bed of any river, lake or wetland shall be a Prohibited Activity from 1 July 2005. For the purposes of this Rule, stock is uncontrolled if it is not effectively restrained from entering surface water by a fence or fencing device.

12.2.5(j) The introduction or planting of plants or parts of plants, whether exotic or indigenous, in, on, or under the bed of any river, lake, or wetland, is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o), except that:

(i) planting for soil erosion and river control purposes, excluding the planting of pampas.

(ii) planting of native or indigenous plants as part of the preservation or restoration of the natural values of an environment;

are Permitted Activities, subject to compliance with conditions (i), (ii), (iii), (iv) and (v) of Rule 12.2.5(m); and

(iii) the planting of plants within that part of the area of the Rangitaiki-Tarawera Flood Control Scheme floodway that is within the Tarawera River catchment is a Prohibited Activity, **except that**:

(a) planting in the floodway to enhance habitat values is a Discretionary Activity to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o);

(b) planting of pastoral grasses in the floodway is a Permitted Activity subject to compliance with conditions (i), (ii), (iii), (iv) and (v) of Rule 12.2.5(m).

In the context of this Rule, pastoral grasses are grasses used predominantly for the feeding of stock.

12.2.5(k) Except as provided by Rule 12.2.5(l), every disturbance, removal, damage, or destruction of any plant, or part of any plant (whether exotic or indigenous) or the habitats of any such plants or of animals, in, on, or under the bed of any river, lake or wetland, is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to the matters of Rule 12.2.5(o).

12.2.5(l) The following activities are Permitted Activities, subject to compliance with conditions (i), (ii), (iii), (iv) and (v) of Rule 12.2.5(m):

(i) the removal of plants by tangata whenua for their traditional medicinal or cultural purposes;

(ii) the collection of plant samples for identified scientific purposes;

(iii) the maintenance (including cutting back) of plants planted for soil conservation purposes along river, lake, and wetland margins;

(iv) the removal of plants or part of plants identified as requiring removal in the *Bay of Plenty Regional Council Noxious Plants Authority Regional Programme for the Control of Noxious Plants: 7 May 1992* or equivalent document;

(v) the removal of plants or parts of plants that constitute a hazard to a waterway, or any authorised structure in a waterway, or any water surface recreational activity.

12.2.5(m) Permitted Activity Conditions:

The activity or structure shall:

(i) not cause erosion to the bank or the bed of the waterbody.

(ii) not destroy fish habitat or cause the loss of, aquatic plant or animal species beyond the site.

(iii) not damage or destroy any fish-spawning area, nor impede the free passage of migrating fish.

(iv) not stop or impede authorised public access to or along the waterbody.

(v) not be constructed, installed or sited in contravention of any legislation protecting archaeological or historic sites (see advisory notes below).

(vi) if located in, on, under or over the bed of the Tarawera River,

(a) not obstruct or divert any flood flow and be of a streamlined shape designed to shed flood flow and debris, and avoid scour.

(b) not extend over more than 10% of the horizontal component of the wetted bed of the river under mean flow conditions.

(viii) not:

(e) damage or destroy any other structure.

(f) interfere with any activity.

(g) restrict the drainage of land without the consent of the landowners.

(h) be a hazard to navigation.

(viii) be securely connected into the bank or bed of the river to a standard that will withstand a one in 100 year flood flow event.

(ix) be maintained in a structurally sound condition for the purpose for which it was constructed.

(xi) not be painted with any antifouling coating designed to emit any toxic substance.

For the purpose of this rule, "activity" shall be taken to include the use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure or part of any structure, and where an activity is to install a structure at a site, the "site" is deemed to be the whole extend of the bed area covered by the structure.

Advisory notes:

3 Environment Bay of Plenty can provide information on flood and mean water flows and levels and hydrological and hydraulic guidelines, phone 0800 368 267 to enquire. To avoid hazard, any structure within a floodway or bed of a river or stream should be designed and constructed with regard to the publication: "Environment Bay of Plenty Hydrological and Hydraulic Guidelines". Copies of these guidelines are available on request from any Environment Bay of Plenty office.

4 This Permitted Activity rule does not authorise the modification, disturbance or destruction of any archaeological or historic site within the area of an activity or structure. Users of the rule should note that under Sections 98 and 99 of the of the Historic Places Act 1993 offence provisions apply whether or not a site is a recorded archaeological site.

Further advice on the requirements of the Historic Places Act 1993 can be sought from the local office of the Historic Places Trust in Tauranga, phone (07) 578 1219 or the national office of the New Zealand Historic Places Trust in Wellington, phone (04) 472 4341.

12.2.5(n) Every use of wheeled or tracked vehicles in any riparian area, river, lake or wetland, or its margin or bed, is a Permitted Activity, subject to the conditions that the vehicle use shall:

(i) not result in adverse effects from erosion or land instability.

(ii) not damage areas of significant indigenous vegetation.

(iii) not damage habitats of indigenous fauna or trout spawning areas.

(iv) not adversely affect the natural character of wetlands, lakes and rivers, and their margins and beds.

(v) not adversely affect amenity values, being those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

12.2.5(o) When considering a resource consent application pursuant to Rules 12.2.5(c), 12.2.5(d), 12.2.5(e), 12.2.5(f), 12.2.5(h), 12.2.5(j), 12.2.5(k) and 12.2.5(p), Environment Bay of Plenty will have particular regard to, but not be limited to, the following matters:

(i) effects causing erosion or land instability;

(ii) effects on the hydraulic characteristics of any river, stream or wetland;

(iii) effects on the habitat of fish, biota, aquatic plants and wildlife;

(iv) hazards caused to navigation;

(v) effects caused by the occupation of public space;

(vi) effects on the spawning, free passage or migration of fish;

(vii) effects caused to public access to rivers and lakes and along their margins;

(viii) effects on any waahi tapu, urupa, or cultural or heritage place or value;

(ix) effects on natural character and amenity values, including recreation;

(x) effects on any other lawfully-existing structure, or activity;

(xi) effects caused by the use of any antifouling coating designed to emit any toxic substance;

(xii) maintenance requirements;

(xiii) monitoring requirements, including but not limited to the display of weatherproof identification numbers for compliance monitoring purposes;

(xiv) the requirements of Part II of the Resource Management Act 1991;

(xv) the requirements of sections 104 and 108 of the Resource Management Act 1991.

12.2.5(p) Every use, erection, reconstruction, placement, alteration, extension, removal or demolition of any structure on the bed of any lake within the Tarawera River catchment is a Discretionary Activity, to be considered by Environment Bay of Plenty with regard to:

(a) the matters of Rule 12.2.5(o); and

(b) the following matters, assessed with regard to effects on natural character and amenity values, and public and private security and safety:

(i) whether a structure that occupies public space and is used as a jetty should be required to remain open for public use at reasonable times without fee, charge or hindrance;

(ii) whether a structure that occupies public space and is used as a jetty should be required to be placed or sited so as to facilitate its shared use between neighbours;

(iii) whether the length or the structure, measured from the mean annual highest lake level shore line into the lake, should be limited to not exceed 12 metres;

(iv) whether the size of the structure, measured as the lake water surface area covered, should be limited to not exceed $15m^2$.

(v) whether the structure, in conjunction with adjacent structures, has an adverse effect on the natural character of the lake margin.

In the context of this Rule, a jetty is any structure that is fixed to land on or in the bed or shore of a lake, used principally to moor or service vessels, and includes any raft.

20.2 Chapter 14 – Surface Water Quantity

14.4.5(a) The taking, diverting or damming of surface water, or the discharging of water into surface water for the purpose of maintaining the levels of those wetlands indicated below, or for the express purpose of facilitating fish passage in and out of wetlands, or for controlling plant pest in wetlands, is a Permitted Activity, subject to compliance with the following minimum and maximum levels:

Wetland	Minimum Level (Metres Moturiki Datum)	Maximum Level (Metres Moturiki Datum)
Tarawera Cut Wildlife Mgmt Res	00.50 metres	00.90 metres
Bregman's Wildlife Mgmt Res	00.20 metres	00.60 metres
Awaiti Wildlife Management Res	-0.20 metres	-0.06 metres
Lake Tamurenui	11.93 metres	12.43 metres
Tumurau Lagoon	06.50 metres	06.80 metres
Matata Lagoon	00.55 metres	00.80 metres

subject to the water being taken, diverted, dammed or discharged in the same manner as it was when this regional plan was publicly notified.

Note: The above rule relates to the taking, diverting, damming and discharge of water. Rules relating to the placement and maintenance of control structures are contained in Chapter 12 – River and Lake Beds.

14.4.5(b) Except as provided by Rule 14.4.5(a), the taking, diverting, damming, or discharging of surface water into or out of any wetland is a Discretionary Activity restricted to the following activities:

(i) For the purpose of achieving and maintaining the water levels of wetlands specified in Appendix 6 of this regional plan; or

(ii) For the express purposes of facilitating fish migration; or

(iii) For controlling noxious plants in any wetland.

14.4.5(c) Except as provided by Rules 14.4.5(a) and 14.4.5(b), the discharge of water into, or taking of water, from surface water in those wetlands specified in Appendix 12 of this regional plan, is a Discretionary Activity.

14.4.5(d) Except as restricted by Rules 14.4.5(a), 14.4.5(b) and 14.4.5(c), the taking of surface water at a volume equal to or less than 15 cubic metres per day for any purpose is a Permitted Activity, subject to the following condition:

(i) The abstraction rate shall not exceed 5% of flow above the abstraction point or 10 litres per second whichever is the lesser, and the taking does not, or is not likely to, have an adverse effect on the ecology or habitat values of the water body.

Environment Bay of Plenty may determine that an adverse effect on the ecology or habitat values of a water body is occurring if the sum of abstraction rates on a water body exceeds 10% of the 5 year low flow at any point.

The 5 year low flow is defined as a flow equivalent to the lowest seven day mean flow statistically probable once in every five years.

14.4.5(e) Except as provided by Rule 14.4.5(f), the consumptive taking of water from the Upper Reach of the Tarawera River, the tributary streams of the Upper Reach of the Tarawera River, and the reach of the river from Kawerau Road Bridge across the Tarawera River to the Tasman Pulp and Paper Company Limited effluent outfall pipe at Grid Reference NZMS V15 365438 at a volume exceeding 5,000 cubic metres per day is a Prohibited Activity, and the cumulative total of all abstraction within this reach shall not exceed 200,000 cubic metres per day. The non-consumptive taking of water (where the full volume of water taken is returned to the river) shall be a Discretionary Activity that shall be assessed with particular regard to the protection of the assimilative capacity of the Lower Reach of the Tarawera River.

14.4.5(f) The taking of water from the Upper Reach of the Tarawera River, the tributary streams of the Upper Reach of the Tarawera River, and the reach of the river from the Kawerau Road Bridge across the Tarawera River to the Tasman Pulp and Paper Company Limited outfall pipe at Grid Reference NZMS V15 365438 for which a water permit was held on the date of the public notification of this regional plan may continue as a Discretionary Activity, and on expiry may be replaced as a Discretionary Activity, provided that the original volume allocated shall not be increased.

14.4.5(g) Except as provided by Rules 14.4.5(a) and 14.4.5(b) and restricted Rules 14.4.5(c) and 14.4.5(e), the taking of surface water within the Tarawera River catchment at a volume exceeding 15 cubic metres per day is a Discretionary Activity.

14.4.5(h) The damming of water in any river or stream shall be a Discretionary Activity, **except** that while the damming of water in any river or stream complies with the following conditions, it is a Permitted Activity:

(a) the dam was constructed between 1 October 1990 and 1 October 1991 and was notified to Environment Bay of Plenty under General Authorisation No 7;

or

(b) the dam was constructed after 1 October 1991 and was notified to Environment Bay of Plenty under the provisions of the Bay of Plenty Transitional Regional Plan;

or

(c) the dam complies with all of the following conditions:

(i) the damming does not adversely affect an existing wetland, Rules 14.4.5(a) and 14.4.5(b) have precedence.

(ii) Environment Bay of Plenty is notified of the location and dimensions of the dam before construction commences.

(iii) the mean annual flow of the river or stream dammed does not exceed 300 litres per second.

(iv) the dam does not impound more than 5,000 cubic metres water and the lowest point in the dam crest does not exceed 1.8 metres vertical height relative to the natural bed of the river or stream in which the dam is sited.

the dam does not impound more than 10,000 cubic metres water and the lowest point in the dam crest does not exceed 1.5 metres vertical height relative to the natural bed of the river or stream in which the dam is sited.

(v) the dam is designed, constructed and maintained to ensure that its structural integrity is not compromised, and incorporates spillway and erosion protection

devices to safely return surplus water to the natural bed of the river or stream in which the dam is sited.

(vi) the dam does not adversely affect fisheries, fish passage, wildlife and aquatic life.

(vii) the dam does not adversely affect the use or supply of water downstream.

(viii) the impoundment of water upstream of the dam does not affect land owned or occupied by another person.

Note: Environment Bay of Plenty Engineering staff are available to advise on the design and installation of small dams.

14.4.5(i) When considering a resource consent application to take, discharge, dam or divert water within the Tarawera River catchment, Environment Bay of Plenty shall have particular regard to, but not be limited to, the following matters:

(i) The requirements of Part II of the Resource Management Act 1991; and

(ii) The requirements of sections 104 and 108 of the Resource Management Act 1991; and

(iii) Any effects the proposal may have on riparian, shoreline or bed erosion; and

(iv) The conservation and efficient use of water; and

(v) The capacity of the water body to assimilate contaminants and any resulting or accentuated cumulative effects.

14.4.5(j) Any existing activity authorised by a resource consent, which, due to this regional plan becoming operational contradicts rules relating to maximum or minimum levels or flows or rates of use of water, or minimum standards of water quality ranges of temperature, may, after a period of six months after this regional plan becomes operational, be reviewed by Environment Bay of Plenty, pursuant to section 128(1)(b) of the Resource Management Act 1991, in any case where in the regional council's opinion it is appropriate to review the conditions of the permit in order to enable the levels, flows, rates, or standards set by a rule to be met.

Section 20(2) of the Resource Management Act 1991 shall apply where, as a result of a rule in this regional plan becoming operative, an activity that formerly was a Permitted Activity or which otherwise could have been lawfully carried out without a resource consent requires a resource consent.

20.3 Chapter 15 – Surface Water Quality

15.8.4(a) All water within Lakes Tarawera, Rotomahana, Okataina, Okareka, Tikitapu, and Rotokakahi in the Tarawera Lakes catchment, excluding Lake Okaro, is classified to be managed in its Natural State (NS), and any discharge permit granted for the discharge of contaminants into these waters shall be subject to conditions ensuring compliance with the classification standard in Rule 15.8.4(b) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(b) The standards for **Class NS**, that apply after reasonable mixing of any contaminant or water with the receiving surface water and disregard the effect of any natural perturbation that may affect the water body, are:

(i) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(ii) No increase in colour as assessed by measurement on the Munsell Hue scale, and no decrease in visual clarity as assessed by black disc measurement[116].

(iii) No detectable increase in acute and chronic toxicity between a reference water sample and a sample of the discharge diluted with that water at the specified mixing ratio.

(iv) No increase in temperature.

(v) No change in pH.

(vi) No production of conspicuous oils and grease films, scums or foams, or floatable or suspended materials.

(vii) No conspicuous increase in biological growths.

(viii) Aquatic food resources shall not be rendered unsuitable for human consumption, nor water rendered unsuitable for stock watering.

(ix) No increase in the emission of objectionable odour.

(x) No increase in nitrogen and phosphorus levels relative to the total nitrogen and total phosphorus levels measured in the lake in 1994.

Class NZ Tarawera River Catchment Lakes – 1994 Nutrient Quality			
Lake	**Total Phosphorus mg/m^3**	**Total Nitrogen mg/m^3**	**Trophic Lake Index**
Tarawera	6.6	119	2.6
Okataina	5.7	113	2.6
Tikitapu	3.1	185	2.7
Okareka	5.1	221	3.0
Rotokakahi	6.4	217	3.1
Rotomahana	41.1	247	3.9

15.8.4(c) All surface water within Lake Okaro is classified to be managed for Contact Recreation (CR), and any discharge permit granted for the discharge of contaminants into the water of Lake Okaro shall be subject to conditions ensuring compliance with the classification standards in Rule 15.8.4(d) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(d) The standards for **Class CR**, that apply after reasonable mixing of any contaminant or water with the receiving surface water and disregard the effect of any natural perturbation that may affect the water body, are:

(i) No decrease in visual clarity below 1.6 metres as measured by the black disc technique.

(ii) No detectable increase in acute and chronic toxicity between a reference water sample and a sample of the discharge diluted with that water at the specified mixing ratio.

(iii) No increase in temperature of more than 3°C, and maximum no to exceed 25°C.

(iv) pH shall remain within the range of 6.0 to 9.0.

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[116] Includes Lakes Tarawera, Rotomahana, Okataina, Okareka, Tikitapu, and Rotokakahi. Does not include Lake Okaro.

(v) No production of conspicuous oils or grease films, scums or foams, or floatable or suspended materials.

(vi) No conspicuous increase in biological growths.

(vii) The median concentration of enterococci of at least 5 samples taken throughout the bathing season[117] shall not exceed 33 enterococci per 100 millilitre, nor shall any single sample exceed 107 enterococci per 100 millilitre.[118].

(viii) No increase in the emission of objectionable odour.

15.8.4(e) All surface water within the Upper Reach of the Tarawera River, including the reach from the Lake Tarawera River Outlet to the Kawerau Road Bridge across the Tarawera River, and also including all tributaries of the Tarawera River (other than the drains and canals on the Rangitaiki Plans) and tributaries of the Tarawera Lakes are classified to be managed for Fish Spawning Purposes Upper Tarawera River (Class FSUT), and any discharge permit granted for the discharge of contaminants into these waters shall be subject to conditions ensuring compliance with the classification standards in Rule 15.8.4(f) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(f) The standards for **Class FSUT**, that apply after reasonable mixing of any contaminant or water with the receiving water and disregard the effect of any natural perturbation that may affect the water body, are:

(i) The concentration of dissolved oxygen shall exceed 80% of saturation concentration.

(ii) No increase in colour as assessed by Munsell Hue colour units measurement, and no decrease in visual clarity as assessed by black disc measurement[119].

(iii) No detectable increase in acute and chronic toxicity between a reference water sample and a sample of the discharge diluted with that water at the specified mixing ratio.

(iv) No increase in temperature of more than 3°C, and maximum not to exceed 25°C.

(v) pH shall remain within the range 6.5 to 8.5.

(vi) No production of conspicuous oils or grease films, scums or foams, or floatable or suspended materials.

(vii) The seasonal maximum cover of stream and river beds by periphyton as filamentous growths or mats (<ca.3 millimetres thick) shall not exceed 40 percent, and/or biomass shall not exceed 100 milligram chlorophyll-*a* per square metre or 40 gram AFDW per square metre of exposed surface area, and any change in bacterial and/or fungal slime growths shall not be conspicuous.

(viii) Aquatic food resources shall not be rendered unsuitable for human consumption.

(ix) No increase in the emission of objectionable odour.

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[117] The bathing season is defined as the period from 1 November to Easter inclusive.

[118] McIntosh, J J 1993, Bay of Plenty Regional Council Regional Monitoring Network Bathing Suitability Survey 1993, Environment Bay of Plenty Environmental Report 93/1, 76pp.

[119] Utilising protocol laid down in Smith, D G et al, 1989.

15.8.4(g) All water within the main stem of the Lower Reach of the Tarawera River, that being the reach from the Kawerau Road Bridge across the Tarawera River and the Thornton Road Bridge across the Tarawera River (excluding the tributaries of the Lower Reach of the Tarawera River and the drains and canals on the Rangitaiki Plains), is classified to be managed for Fish Purposes Lower Tarawera (FPLT), and any discharge permit granted for the discharge of contaminants into these waters shall be subject to conditions ensuring compliance with the classification standards in Rule 15.8.4(h) and the requirements of Rules 15.8.4(l) and 15.8.4(m).

15.8.4(h) The standards for **Class FPLT**, which apply after allowing for the reasonable mixing of any discharge of contaminants or water to surface water, and disregard the effect of any natural perturbation that may affect the water body, are:

(i) The concentration of dissolved oxygen shall not at any time fall below:

Until 31 December 2002:

5.0 grams per cubic metre for the mean of any consecutive 30 days;
4.0 grams per cubic metre for the mean minimum of any consecutive 7 days;
3.5 grams per cubic metre as an absolute minimum.

From 1 January 2003:

6.0 grams per cubic metre for the mean of any consecutive 30 days;
5.0 grams per cubic metre for the mean minimum of any consecutive 7 days;
4.5 grams per cubic metre as an absolute minimum.

(ii) Above the Tasman Pulp and Paper Company Limited effluent outfall pipe at Grid Reference NZMS V15 365438, no decrease in visual clarity of more than 20% of the ambient black disc measurement measured at the Kawerau Bridge site.

Below the Tasman Pulp and Paper Company Limited effluent outfall pipe at Grid Reference NZMS V15 365438, colour, as measured by the absorption coefficient of a 0.45 micron filtered sample at 440nm on a spectrophotometer, shall not exceed:

(a) To 31 December 2000:

The 6 month mean shall not exceed 3.8 (equivalent to 50 platinum-cobalt units).

(b) From 1 January 2001:

The 6 month mean shall not exceed 2.3 (equivalent to 30 platinum-cobalt units).

(c) From 30 December 2005:

The 6 month mean shall not exceed 0.8 (equivalent to 10 platinum-cobalt units).

(iii) No detectable increase in acute and chronic toxicity between a reference river water sample taken from the Kawerau Bridge site and a sample of the discharge diluted with that water at the specified mixing ratio.

(iv) No increase in temperature of more than 3°C, and maximum not to exceed 25°C.

(v) The pH shall remain within a range of 6.5 to 8.5.

(vi) No production of conspicuous oils and grease films, scums or foams, or floatable or suspended materials.

(vii) From 1 July 2000, the seasonal maximum cover of stream and river beds by periphyton as filamentous growths or mats (>ca.3 millimetres thick) shall not exceed 40 percent, and/or biomass shall not exceed 100 milligram chlorophyll-*a* per square metre or 40 gram AFDW per square metre of exposed surface area, and any change in bacterial and/or fungal slime growths shall not be conspicuous.

(viii) Aquatic food resources shall not be rendered unsuitable for human consumption, nor water rendered unsuitable for stock watering.

(ix) No increase in the emission of objectionable odour.

15.8.4(i) Relative to the acute and chronic toxicity standards for NS, CR, FSUT and FPLT classifications as detailed in Rules 15.8.4(b)(iii), 15.8.4(d)(ii), 15.8.4(f)(iii) and 15.8.4(h)(iii), the toxicity of effluent shall be tested over a standard geometric dilution series factor of 0.5 which encompasses the mixing ratio. Four different species of freshwater organisms will be tested as per the following protocols:

(i) For Acute Testing:
Environment Canada (1990). Biological test method. Reference method for determining acute lethality of effluents to rainbow trout. Conservation and Protection, Ottawa, Ontario. EPS 1/RM/13.

(ii) For Chronic Testing:
OECD (1981). Chronic reproduction test using a cladoceran (*Daphnia magna*). Test Method 211 (adopted 21 September 1998), or the most up to date equivalent of Test Method 211, In: "OECD Guidelines for the testing of chemicals", Organisation for Economic Cooperation and Development, Paris.

Environment Canada (1992). Biological test method. Toxicity test using luminescent bacteria (*Photobacterium phosphoreum*). Conservation and Protection, Ottawa, Ontario. Report EPS 1/RM/24.

Environment Canada (1992). Biological test method. Growth inhibition test using the freshwater alga *Selenastrum capricornutum*. Conservation and Protection, Ottawa, Ontario. Report EPS 1/RM/25.

To comply with the classification standards, chronic tests shall show no detectable toxicity at the specified mixing ratio.

15.8.4(j) Relative to the acute and chronic toxicity standards for NS, CR, FSUT and FPLT classifications as detailed in Rules 15.8.4(b)(iii), 15.8.4(d)(ii), 15.8.4(f)(iii) and 15.8.4(h)(iii), the specified mixing ratio shall be determined for each discharge permit on a case by case basis by dividing(÷) the maximum permitted effluent flow by the mean annual 7 day low flow statistic recorded nearest to the discharge point.

e.g. A permitted discharge with a maximum flow of 2 cubic metre per second occurs at Pipe Bridge.

The mean annual 7 day low flow at Pipe Bridge is 16.6 cubic metre per second.

$\therefore$ The mixing ratio = 2 : 16.6 = 0.12

15.8.4(k) Relative to the acute and chronic toxicity standards for NS, CR and FSUT classifications as detailed in Rules 15.8.4(b)(iii), 15.8.4(d)(ii) and 15.8.4(f)(iii), the site of reference water collection shall be determined on a case by case basis.

Reference (or diluent) water will be collected directly upstream of the discharge or, in the case of a lake, from a site not influenced by the discharge.

15.8.4(l) Any discharge to water that contravenes or causes contravention of any Rule, standard or term of this regional plan, in particular any classification standard of Rules 15.8.4(b), 15.8.4(f) or 15.8.4(h), shall be a Non-Complying Activity.

15.8.4(m) Any discharge to water that:

(a) is within a water classification area defined in this regional plan, and does not contravene or cause contravention of any classification standard for that water classification area, and any other Rule, standard or term in this regional plan; or

(b) is outside a water classification area defined in this regional plan, and does not contravene or cause contravention of any Rule, standard or term in this regional plan;

shall be a Discretionary Activity unless otherwise specifically provided for in a Rule in this regional plan.

15.8.4(n) Subject to the provisions of Rule 15.8.4(t), the classification standards set in Rules 15.8.4(b), 15.8.4(d), 15.8.4(f), and 15.8.4(h), shall apply to all existing and new consents.

15.8.4(o) The discharge of aerated and/or oxygenated water or oxygen into the Tarawera River for the purpose of increasing the dissolved oxygen content of the river water shall be a Discretionary Activity.

In considering an application for a discharge consent pursuant to this Rule, Environment Bay of Plenty shall have particular regard to:

(a) Whether the applicant is taking action to reduce the total mass of biochemical oxygen demand (BOD_5) in the discharge that is causing the need for oxygen injection into the river water.

(b) Whether the applicant is installing capital works to achieve compliance with the FPLT classification standard.

(c) Whether the oxygen injection proposed is a means to remedy the effect of inadequate effluent management or an inadequate primary effluent treatment system.

(d) Whether the location, design, construction and installation of the structure for the oxygen discharge is adequate to ensure optimal oxygenation with minimum adverse effect on river ecology.

(e) Whether the proposal to inject oxygen is the more effective method to increase the dissolved oxygen levels in the river water relative to other methods.

(f) Whether the discharge will have a net adverse effect on the environment.

(g) Whether the discharge will adversely affect other users of the Tarawera River.

(h) Whether the time periods during which discharges are to occur are adequately managed and effective.

15.8.4(p) The discharge of contaminated stormwater is a Discretionary Activity, and shall be considered with particular regard to:

(i) The installation and maintenance of effective traps or other spillage retention devices.

(ii) The effective sealing and bunding of contaminant storage and transit areas.

(iii) The production and implementation of chemical spillage prevention, retention and disposal protocols (contingency plans).

15.8.4(q) The discharge of uncontaminated stormwater into water within the Tarawera River catchment is a Permitted Activity, subject to the following requirements:

(i) The maximum discharge shall not exceed the flow from a 300 millimetre pipe on a flat grade or equivalent of 80 litres per second.

(ii) The suspended solids concentration of the water discharged does not exceed 150 grams per cubic metre.

(iii) The water discharged is substantially free of grease and oil;

(iv) The works shall be designed, constructed and maintained in such a manner so as not to cause erosion or flooding or to adversely affect any land or property owned or occupied by another person.

For the purposes of this Rule, uncontaminated stormwater includes stormwater runoff from roofs, sealed and unsealed roads and streets, hard stand areas, yards and grassed areas and the like.

15.8.4(r) Except for the provisions of the Operative On-Site Effluent Treatment Regional Plan, and for the provisions for Kawerau township and Edgecumbe township set out in (a) to (d) of this rule, and the provisions of rule 15.8.4(x), all new or existing discharges of human sewage or contaminants derived from human sewage into surface water within the Tarawera River catchment will become a Prohibited Activity on the date on which this regional plan becomes operative.

(e) Until 31 December 2002 the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment shall be a Discretionary Activity, subject to the discharge complying with all rules, standards and terms in this regional plan and meeting or bettering the receiving water classification.

(f) From 1 January 2003, the discharges of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment will be limited to the provisions of rule 15.8.4(x), provided that this limitation shall be suspended until 12 months past the date on which an application by Carter Holt Harvey Tissue to discharge AWWTP wastewater and sanitary wastewater from Kawerau township by spray irrigation to land has been decided and any appeals determined.

(g) Until 30 June 2005 the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township into unclassified surface water within the Tarawera River catchment shall be a Discretionary Activity subject to compliance with consent conditions.

(h) From 1 July 2005, the discharge of human sewage or contaminants derived from human sewage from Edgecumbe township shall be a Discretionary Activity limited to discharge that complies with all rules, standards and terms in this regional plan and meets or betters effluent quality standards of:

(i) BOD<10 milligrams per litre,
(ii) Suspended Solids<15 milligrams per litre,
(iii) Total N<25 milligrams per litre,
(iv) Faecal Coliform<10^4/100 millilitre,

measured in the effluent stream prior to discharge, and produced by a treatment and disposal system that has been designed in consultation with affected iwi.

15.8.4(s) Except for the discharge of uncontaminated stormwater in compliance with Rule 15.8.4(q), every discharge permit granted to discharge contaminants from a point-source outfall into any water body within the Tarawera River catchment shall have a condition defining a reasonable mixing zone, stated as a classification non-compliance zone defined as a distance or radium measured from the outfall point. Each non-compliance zone shall be the minimum practicable relative to the relevant classification standards and assessment criteria. In establishing a non-compliance zone for a discharge, Environment Bay of Plenty will consider the following assessment criteria.

(i) Relevant classification standards;

(ii) The flow regime of the receiving water;

(iii) The ambient concentrations of contaminants in the receiving water;

(iv) Effluent discharge flow rate and contaminant concentrations;

(v) Cumulative and other effects;

(vi) Existing discharge and abstraction consents;

(vii) Fish migration and instream ecosystems requirements;

(viii) Maori cultural values;

(ix) The location of the discharge and position of the outfall;

(x) Outfall diffuser design criteria;

(xi) Information provided by the applicant;

(xii) Any other relevant information.

15.8.4(t) The discharge of a dye or gas into water for scientific or investigation purposes is a Permitted Activity subject to the following conditions:

(i) Environment Bay of Plenty is given at least ten working days notice prior to the discharge.

(ii) Details of the proposed discharge are publicly notified at least one week prior to the discharge.

(iii) Any person or persons likely to be affected by the presence of dye or gas in water used for recreational, consumption or other uses is notified of the proposed discharge at least one week prior to the discharge.

(iv) The dye or gas used shall not exceed a concentration that is proven to be inert and non-toxic in effect.

15.8.4(u) Environment Bay of Plenty will support education programmes as a means of encouraging the development of buffer zones and other methods to prevent land discharge of contaminants from reaching surface water.

15.8.4(v) The discharge of dairy shed effluent into unclassified water shall be a Discretionary Activity managed in accordance with guidelines including "Guidelines for Agricultural Discharges in the Tarawera and Rangitaiki Catchments, September 1992".

15.8.4(w) Environment Bay of Plenty will provide available water quality test information on request.

15.8.4(x) Notwithstanding all other rules in this plan, the discharge of human sewage or contaminants derived from human sewage from Kawerau township into surface water within the Tarawera River catchment in exceptional circumstances and when no other practicable options are available, shall be a non-complying activity. Any application made shall be accompanied by a management plan that identifies the measures considered appropriate for avoiding the discharge of sewage to the river.

20.4 Chapter 16 – Groundwater

16.8.5(a) Any discharge of waste onto or into land in a way or at a rate that may result in the percolation or movement of contaminants into groundwater shall be a Discretionary Activity provided:

(a) This rule does not apply to the on-site discharge of domestic sewage regulated under the "*Operative On-Site Effluent Treatment Regional Plan for the Bay of Plenty*", and

(b) Any application for the land treatment of effluent originating form dairy sheds shall be subject to conditions made with regard to the "*Guidelines for Agricultural Discharges to the Tarawera and Rangitaiki Catchments* – September 1992".

16.8.5(b) A discharge permit granted pursuant to Rule 16.8.5(a) shall be subject to conditions that limit the land application discharge rate of effluent relative to disposal site constraints, to provide for the protection of groundwater and surface water resources from contamination.

16.8.5(c) Except as provided for in Rule 17.4.4(d), the direct point-source injection of contaminants into a groundwater aquifer is a Prohibited Activity.

16.8.5(d) A resource consent granted under Rule 16.8.5(a) for a discharge permit authorising an efficient land based treatment system, designed and managed to ensure minimal long-term effects on surface and groundwater quality and quantity, may be granted for a period up to the maximum provided by statute, subject to performance review conditions.

16.8.5(e) The taking of underground water at a volume equal to or less than 15 cubic metres per day shall be a Permitted Activity.

16.8.5(f) The taking of underground water at a volume exceeding 15 cubic metres per day shall be a Discretionary Activity.

16.8.5(g) A resource consent granted pursuant to Rule 16.8.5(f) for a water permit for which a new bore or well is to be installed shall be subject to the following condition:

Bore Log and Test Information

The consent holder shall, within one month from the day on which their consent is granted, return the following information to Environment Bay of Plenty:

(a) The name and address of the bore driller, the final location of the bore, its construction method and liner material.

(b) The dimensions of the bore; diameter and depth.

(c) A log of the bore installation showing the depth and extent of intercepted strata (lithology), geologic layers, water bearing aquifers and water access screens.

(d) A copy of bore pump test results, including information on; sustainable bore yield, water level drawdown, static water level and transmissivity data.

20.5 Chapter 17 – Geothermal Resources

17.4.4(a) The taking of geothermal mass, water, heat or energy from the Kawerau Geothermal Field shall be a Discretionary Activity.

17.4.4(b) The discharge of geothermal water to the Lower Reach of the Tarawera River for which discharge permits were held on the date of public notification of this regional plan and the replacement of any of those consents for equivalent or lesser allocations shall be a Discretionary Activity.

17.4.4(c) The discharge of geothermal water to the Lower Reach of the Tarawera River resulting from any new geothermal resource use activity shall be a Discretionary Activity.

17.4.4(d) The reinjection of geothermal fluid into the Kawerau Geothermal Field shall be a Discretionary Activity.

17.4.4(e) Resource consent applications under Rules 17.4.4(b), 17.4.4(c), and permits authorising the taking, discharge and reinjection of geothermal mass, water, heat or energy from the Kawerau Geothermal Field may be considered together. Consents granted will be subject to conditions to ensure the protection of groundwater and surface water quality from geothermal contamination, and land subsidence and tilt.

17.4.4(f) Authorised users of geothermal resource from the Kawerau Geothermal Field shall be required to develop and implement a wastewater management strategy for their existing geothermal discharges, with particular regard to:

(i) The efficient utilization of the heat and mineral content of the wastewater; and

(ii) The classification standards of Rule 15.8.4(h).

17.4.4(g) The use of heat from waste geothermal fluid shall be a Permitted Activity, provided that the use activity, or the requirement for heat, shall not limit the sustainable reinjection of geothermal fluid.

21 Appendix 1 – Glossary

The definitions given below refer to the usage in this report and are not necessarily of general application:

Abiotic	The non-living components of a system (see biota).
Absorption	In chemistry, the penetration of one substance into the body of another.
Acidity	The amount of acid present in a solution. Acids are substances that dissociate in water to yield a sour corrosive solution containing hydrogen ions.
Act, the Act	Unless otherwise indicated, all references to the Act in the regional plan are to be read as references to the Resource Management Act 1991.
Active fault	A fault that has undergone repeated movement in the past 500,000 years and is considered likely to undergo renewed movement within a period of concern to humans.
Acute toxicity	Rapid adverse effect (e.g. death) caused by a toxic substance. Acute toxicity tests can be used to define either the exposure or the response to an exposure (effect).
Aeration	Any process in which a substance becomes permeated with air or oxygen. The term is usually applied to aqueous liquids being brought into intimate contact with air or oxygen by spraying, bubbling or agitating the liquid.
Aerobic	With oxygen.
Aggradation	Deposition within a river channel arising from an increase of sediment load (supplied from upstream) relative to the transporting capacity.
Agricultural waste	Generally wastes which are produced by agricultural practices which are based on livestock.
Algae	Comparatively simple chlorophyll-bearing plants, most of which are aquatic and microscopic in size.
Alkalinity	The ability of soluble bases in water to neutralise acidity. It is usually expressed as calcium carbonate equivalents.
Alluvial material	The sedimentary deposits resulting from the action of rivers.
Ambient	Surrounding, background conditions in the environment, including natural perturbations, but not the effects of discharges.
Anaerobic	Without oxygen.
Andesitic	A fine grained volcanic rock.
AFDW	Ash Free Dry Weight. A measure of organic matter in relation to biological growths.
Assimilation	The incorporation of substances into cellular material.
Assimilative capacity	With regard to water, refers to the ability of water to sustainably accommodate wastewater without having any significant adverse effect on water quality, or resulting in any of those adverse effects noted in section 107(1) of the Resource Management Act 1991.

Backwater effects	The effect of water flows or depths on hydraulic conditions upstream; backwater effects can only occur in sub-critical flow.
Bankfull discharge	Discharge which fills a channel without overtopping the banks. It is an intermediate discharge which is considered to be a critical or dominant channel forming event in natural rivers.
Basaltic eruption	An eruption containing fine grained, usually dark coloured igneous rock.
Baseflow	Flow that derives from groundwater.
Baseline surveys	Accumulation of data relating to various environmental parameters before a scheme begins.
Bed	*(a) In relation to any river:* *(i) For the purposes of esplanade reserves, esplanade strips, and subdivision, the space of land which the waters of the river cover at its annual fullest flow without overtopping its banks;* *(ii) In all other cases, the space of land which the waters of the river cover at its fullest flow without overtopping its banks; and* *(b) In relation to any lake, except a lake controlled by artificial means:* *(i) For the purposes of esplanade reserves, esplanade strips, and subdivision, the space of land which the waters of the lake cover at its annual highest level without exceeding its margin;* *(ii) In all other cases, the space of land which the waters of the lake cover at its highest level without exceeding its margin; and* *(c) In relation to any lake controlled by artificial means, the space of land which the waters of the lake cover at its maximum permitted operating level.* (Section 2 of Resource Management Act 1991).
Bedforms	These range from pool-riffle features in cobble bed streams to due forms in sand bed streams and are formed by the interaction of flow with bed material.
Bed load	The coarser fraction of a river's total sediment load, which is carried along the bed. It constitutes 5 to 10 per cent of the total load.
Benthos (benthic)	The organisms living in, or on, the beds of aquatic habitats (lakes, river, ponds, etc).
Best Practicable Option (BPO)	In relation to a discharge of a contaminant or an emission of noise, means the best method for *preventing or minimising adverse effects on the environment having regard, among other things, to:* *(a) the nature of the discharge or emission and the sensitivity to the receiving environment to adverse effects;* *(b) the financial implications, and the effects on the environment, of that option when compared with other options; and* *(c) The current state of technical knowledge and the likelihood that the option can be successfully applied.* (From Section 2 of the Resource Management Act 1991).

Bioaccumulation	General term describing a process by which chemical substances are accumulated by organisms directly or through consumption of food containing the chemicals.
Bioassay	Biological test used to evaluate the relative potency of a chemical.
Biochemical Oxygen Demand (BOD)	The amount of oxygen taken up by micro-organisms that decompose organic waste matter in water.
BOD_5	The result of testing BOD carried out in a laboratory over 5 days at 20°C.
Bioconcentration Factor BCF	A unitless value describing the degree to which a chemical can be concentrated in the tissues of an organism in the aquatic environment.
Biomass	The living weight of a plant or animal population, usually expressed on a unit area basis.
Biota	The sum total of the living organisms in any designated area.
Bloom	An unusually large number of organisms per unit of water, usually algae, made up of one or a few species.
BSCTMP	Bleached Sulphonated Chemi-Thermo Mechanical Pulp.
Buffering	The use of a zone or zones which protect an area or areas from the adverse effects of surrounding activities and environmental fluctuations.
Caddisflies	Insects of the order Trichoptera with aquatic larvae.
Caldera	A large depression formed from the collapse of magma chambers following ignimbrite eruptions.
Catchment	The area from which rainfall flows into a river or stream.
CHHT	Carter Holt Harvey Tissue
Channel pattern	The pattern of a river channel. A distinction exists between single-thread (straight and meandering) and multi-thread (braided or anastomosing), channels. Synonymous term is plan geometry.
Chemical Oxygen Demand (COD)	The quantity of a chemical agent required to oxidise organic and inorganic material in a water sample.
Chlorination	(1) The process of introducing one or more chlorine atoms into a compound. (2) The application of chlorine to water, sewage or industrial wastes for disinfection of other biological or chemical results.
Chronic	Involving a stimulus that is lingering or continues for a long time; often signifies periods from several weeks to years, depending on the reproductive life cycle of the organism. Chronic toxicity tests can be used to define either the exposure of the response to an exposure (effect).
Concentration	A weight/volume measurement of a chemical substances in a medium (e.g. water, food, sediment).
Conspicuous	As used in sections 70 and 107 of the Resource Management Act 1991: After allowing for reasonable mixing (a question of fact and degree in each particular case), the extent or magnitude that the issue in question is clearly visible, obvious or striking to the eye of a reasonable person observing the received water.

Contaminant	*Includes any substances (including gases, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that either by itself or on combination with the same, similar, or other substances, energy, or heat, when:* *(a) discharged into water, changes or is likely to change the physical, chemical, or biological condition of the water; or* *(b) discharged onto or into land or into air, changes of is likely to change the physical, chemical, or biological condition of the land or air onto or into which it is discharged.* (Section 2 of Resource Management Act 1991).
Contingency plans	Plans which prepare for the response to potential or actual disasters.
Convergency-divergence	Unsteady river or stream, non-uniform flow criteria characteristic of natural channels. At high discharges scour in stream channels is associated with convergence of flow and deposition is correlated with divergence of flow.
Convolution	The mathematical conversion of rainfall to flows by means of a hydrograph.
Cost-benefit analysis	A method of economic analysis in which all identifiable costs and benefits of alternatives are quantified (if possible) and compared.
Cost effectiveness	Evaluation of the main tangible benefits of a project are evaluated to ensure that the expenditure is worthwhile.
Crossing	A place where a water body is artificially joined by way of a structure such as a bridge or ford.
CTMP	Chemi-Thermo Mechanical Pump
Culvert	A pipeline, drain or covered channel designed to permit access over a watercourse.
Cumulative	Brought about, or increased in strength, by successive additions at different times or in different ways.
Dacite	An extrusive igneous rock of which the principal minerals are quartz plagioclase and hornblende.
Daphnia	Small crustaceans found in open waters, weedy edges and bottom deposits of lakes and ponds and quiet backwaters of streams.
Degradation	Down cutting of channel-bed arising from increased transport capacity relative to sediment load supplied to reach from upstream.
Derelict structure	A structure that no longer serves the function for which it was constructed and has not been used or maintained for a period exceeding five years.
Designated riparian area	A water body margin identified for an established purpose by statue or statutory process.
Detritus	The waste products or dead tissues of organisms.
Diffuse discharge	Discharge which is not related to a specific discharge point.
Discharge	*Includes emit, deposit, and allow to escape.* (Section 2 of Resource Management Act 1991).
Diurnal	Daily
DO	Dissolved Oxygen, the measured amount of oxygen dissolved in a solution.

Effects	In this regional plan, the definition of the term 'effect' is the same as that of the Resource Management Act 1991, and includes: *(a) any positive or adverse effect; and* *(b) any temporary or permanent effect; and* *(c) any part, present, or future effect; and* *(d) any cumulative effect which arises over time or in combination with other effects –* *regardless of the scale, intensity, duration, or frequency of the effect, and also includes:* *(e) any potential effect of high probability; and* *(f) any potential effect of low probability which has a high potential impact.*
Effluent	A waste material (e.g. liquid industrial discharge or sewage) that may be discharged into the environment.
Environmental Plan	A voluntary programme prepared by a landowner to deal with a range of environmental issues relating to their property. In adopting an Environmental Plan, a landowner is able to be supported by a number of organisations, including Environment Bay of Plenty, the District Council and the Department of Conservation.
Ephemeroptera	An order of the Class Insecta, commonly known as mayflies.
Epicentre	The point at which the shock waves from an earthquake reach the earth's surface.
Epilimnion	The upper, warm, circulating water in a thermally stratified lake in summer. Usually it forms a layer that is thin compared to the underlying hypolimnion.
Eutrophic	Abundant in nutrients and having high rates of productivity frequently resulting in oxygen depletion below the surface layer of a water body.
Eutrophication	Enrichment of waters with nutrients, (e.g. nitrogen and phosphorus).
Evaporation	The conversion of liquid water to vapour.
Evapotranspiration	The combined loss of water from a given area by evaporation from soil, water or plant surface and by transpiration from plants.
Extension of structures	Minor extensions to a structure which constitute no greater than a 10% increase in the overall size and volume displaced by that structure, in any given five-year period.
Fault or Fault line	A fracture zone along which there has been displacement of the sides relative to one another.
Finished ground levels	The level of the building platform on which buildings sit.
Finished floor levels	The level of the lower floor of a building.
Flocculation	The process by which suspended colloidal or very fine particles coalesce and agglomerate into well-defined hydrated floccules of sufficient size to settle rapidly.
Flood risk areas	Areas of a catchment that are or are going to be developed and may be under risk of flooding.
Floodplain	River valley apart from the river channel which is inundated only in flood events and which gives rise to discharge attenuation.

Flow monitor	The instrument used to measure and record the flow of water or liquid.
Fluvial system	The pathways by which water flows through the soil and open channels.
Ford	A natural shallow area in a river, lake or wetland able to be crossed on foot, by car etc, or an artificially built-up bed designed to facilitate the crossing of a river, lake, or wetland.
Free surface flow	Flow conditions which include a water surface subject to atmospheric pressure.
Geomorphology (Fluvial)	The study of the form and processes of the fluvial system.
Geothermal wastewater	Geothermal water separated from the steam phase and having no further use for the purpose for which it was abstracted.
Government purpose reserve	Reserves classified by Government for the purpose of *providing and retaining areas of such Government purpose or purposes as are specified in any classification of the reserve.* (Section 22 Reserves Act 1977).
Graben	A block of the earth's crust that has dropped relative to the blocks on either side.
Gulley	A structure, usually incorporating a grating and a grit trap, to permit the entry of surface runoff into a sewer system.
Gully erosion	A type of erosion which occurs where water runoff has been concentrated into ephemeral watercourses.
Half-life	Times required to reduce by one-half the concentration of a material in a medium (e.g. soil or water) or organism (e.g. fish tissue) by transport, degradation, transformation or depuration.
Hard stand area	Compacted all-weather working area.
Historic reserve	*A reserve with the purpose of protecting and preserving in perpetuity such places, objects, and natural features, and such things thereon or therein contained as are of historic, archaeological, cultural, educations, and other special interest.* (Section 18 Reserves Act 1977).
Human-induced	Caused by the activity of people.
Hydraulic gradient	The gradient of interconnected water between two defined points.
Hydraulic model	Physical model or numerical calculation simulating the principal significant forces controlling flow in a river network.
Hydrograph method	A computer-based method to give details of a discharge hydrograph through a system.
Hydrograph	A series of values, in either numerical or graphical form, of flow rate varying with time.
Hydrology	The study of the cycle of water movement on, over and through the surface of the earth.
Impermeable, impervious	Description of a surface type which resists the infiltration of water; in practice some infiltration occurs through pores and cracks.
Infiltration	(1) To the ground means the loss of rainwater into the ground. (2) To sewers means the entry of groundwater into sewers.
Inflow	Surface runoff entering a sewered system serving an area of urbanization. Can also refer to tributary streams entering the main branch of a river.

Intangible	Description of costs or benefits to be considered in an economic evaluation, which cannot be directly expressed in monetary terms.
Invertebrates	Animals lacking a dorsal column of vertebrae or a notochord.
Kai moana	Sea food.
Kaitiaki	A person or agent who cares for taonga.
Kaitiakitanga	The exercise of guardianship; and in relation to a resource, includes the ethic of stewardship based on the nature of resource itself.
Kawerau Bridge site	The Tarawera River monitoring site 200 metres upstream of the Kawerau Road bridge, at Grid Reference: Map Series NZMS 260 V15 – 358402.
Lake	*A body of fresh water which is entirely or nearly surrounded by land.* (Section 2 of Resource Management Act 1991).
Land Information Memoranda	Certain information identifying each special feature of the land concerned, information in terms of any other Act, details of any existing stormwater or wastewater utility systems and details of each authorisation in respect of the Building Act 1991.
Leaching	The washing out of dissolved or suspended material from a permeable mass.
Lethal	Causing death by direct action. Death of aquatic organisms is the cessation of all visible signs of biological activity.
Limited discretionary activity	Refers to an activity which is subject to the same tests as a Discretionary Activity but is not publicly notified.
Lower river catchment	The distinct geographical area of the catchment of the Lower Reach of the Tarawera River, including the area downstream of the Kawerau Road Bridge, across the Tarawera River to the coastal marine area boundary with the Pacific Ocean.
LOX	Liquid Oxygen
Macrophytes	All plants excluding fungi, mosses, lichens and algae.
Maintenance	In relation to structures and works in, on, under or over beds, means the painting and cleaning of structures and works, and any repairs that may be necessary from time to time.
Mauri	The essential life force or principle. A metaphysical quality inherent in all things.
Mayflies	Of the order Ephemeroptera. Insects with aquatic larvae.
MCI	Macro-invertebrate Community Index. A system of scoring species according to their sensitivity to degraded water quality.
Mean High Water Springs Line	The average line of a spring high tide.
Meander	Broad, looping bend in a stream or river channel.
Median	Central positioned value in a listing of values by magnitude.
Medium, mean	Average value of a group of data.
Mesotrophic	Intermediate between oligotrophic and eutrophic.
Meterological hazard	A weather induced natural hazard event, such as a cyclone or tornado.
Modified Mercelli Scale	A measure of earthquake intensity.
Mollusc	Of the phylum Mollusca. Include snails and slugs which can be terrestrial.

Motor vehicle	An on-road or off-road vehicle that is motor driven.
Munsell Scale	A means of expressing the colour of a soil or of water by matching it against a colour chart.
Natural hazard zones	An area identified as being at a certain degree of risk from one or more natural hazards.
Natural perturbations	Naturally occurring changes affecting the environment, such as annual rainfall patterns, droughts etc.
Nature reserves	A reserve with the purpose of *protecting and preserving in perpetuity indigenous flora or fauna or natural features that are of such rarity, interest or importance, or so unique that their protection and preservation are in the public interest.* (Section 20 of the Reserves Act 1977).
NIWA	National Institute of Water and Atmospheric Research.
nm	Nanometres, a unit of measurement (10^{-9} metres).
Non-linear	A description of the relationship between two or more variables which has the form of a power law rather than a straight line.
Normal fault	A fault at which the hanging wall has moved down relative to the footwall. The rock immediately above and below a non-vertical fault plane is known respectively as the hanging wall and the footwall.
Not detectable	Below the limit of detection of a specified method of analysis.
Oligotrophic	Low in nutrients and having low rates of productivity, with little oxygen depletion below the surface layer of a water body.
Oligochaetes	Of the class Oligochaeta. Includes earthworms and many freshwater worms.
Organic	Of or formed from living things.
Organism	Any living individual consisting of a single cell or group of cells.
Overflow chamber	A chamber incorporated in some designs of storm overflow.
Overland flow	Flow over the ground surface, including both paved and unpaved surfaces and roofs.
Overspill weir	A weir constructed within the retaining structure of a flood storage pond at its downstream extremity to permit the spill of high flows into a relief channel.
Oxidation	The combination of oxygen with a substance, or the removal of hydrogen from it or, more generally, any reaction in which an atom loses electrons.
Oxygenation	The process of adding oxygen to a solution.
Pathogen	An organism capable of eliciting disease symptoms in another organism.
Peaky	A description of a sharp and intense rainfall event producing a flow duration profile of high gradient and short duration.
Peat deposit	Accumulation of semi or undecomposed organic matter, usually occurring in wetland environments.
Penetrometer	A device to measure the cohesiveness of soils.
Percentage runoff	The percentage of the rainfall volume falling on a specified area which enters the stormwater drainage system.
Percolation	Deep infiltration normally referring to infiltration into the groundwater zone below the soil zone.

pH	Value taken to represent how acid or alkaline a solution is. It is defined as the negative logarithm of the hydrogen ion acidity of the solution.
Plankton	Plants (phytoplankton) and animals (zooplankton), usually microscopic, drifting or floating in aquatic systems.
Point-source discharge	A discharge from a specific and unidentifiable outlet, onto or into land, air, a water body or the sea.
Potable water	Water suitable, on the basis of both health and aesthetic considerations, for drinking and culinary purposes.
Production forestry	Means native or exotic forest planted primarily for the production of timber. It does not include areas of naturally regenerating or growing native forest.
Project Information Memoranda	See definition for Land Information Memoranda.
Pugging	The destruction of the soil surface by a large number of animals in wet conditions.
Pump station	A structure included within a sewerage or drainage system to pump water when drainage cannot be achieved by gravity.
Rain gauge	An instrument used to measure rainfall.
Reaeration	The process by which air or oxygen is reincorporated into a liquid.
Recharge	The percolating of water from the surface to the groundwater zone.
Reclamation	A part of the foreshore that has been raised by impoundment, infilling or both.
Recreational reserve	A reserve which has the purpose of *providing areas for the recreation and sporting activities and the physical welfare and enjoyment of the public, and for the protection of the natural environment and beauty of the countryside, with emphasis on the retention of open spaces and on outdoor recreational activities, including recreational tracks in the countryside*. (Section 17 Reserves Act 1977).
Reservoir storage	The phenomenon by which a volume of flow has to be stored temporarily on a surface or in a length of pipes or channel as the depth and rate of flow increase; the storage is depleted during the recession.
Return period	The average length of time separating events of a similar magnitude.
RIB	Rapid Infiltration Basins. Effluent disposal basins with infiltration rates of 200-500 millimetres per day. These are designed to utilise the physical and biological characteristics of the soil zone above the water table to remove contaminants.
Rilling	A process of soil erosion resulting from the action of running water. The process creates numerous tiny channels (rills), a few centimetres deep which are gradually enlarged leading to gully and ultimately severe erosion.
Riparian area	A strip of land bordering river and lakes (including wetland) where activities will have a direct and significant effect on the water. Also known as “Riparian Zones” and “Streamside Management Areas”.
Riprap	Stones placed against stream banks as protection against erosion.

River	*A continually or intermittently flowing body of fresh water; and includes a stream and modified water course; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of electricity power generation, and farm drainage canal).* (Section 2 of Resource Management Act 1991).
River corridor	That area of land (and water) affecting or affected by a river.
Rohe	A territory or boundary which defines the area within which a tangata whenua group claims traditional association and mana whenua.
Roughness	Frictional drag exerted on water as it flows in contact with the bed and banks of a channel. This drag depends on roughness which is determined by characteristics of perimeter sediment, channel sinuosity, shape, size and the amount of aquatic plant growth.
Runoff	Overland flow produced by rainfall.
Scenic reserve	A reserve with the purpose of: *(a) Protecting and preserving in perpetuity for their intrinsic worth and for the benefit, enjoyment, and use of the public, suitable areas possessing such qualities of scenic interest, beauty, or natural features or landscape that their protection and preservation are desirable in the public interest.* *(b) For the purpose of providing, in appropriate circumstances, suitable areas which by development and the introduction of flora, whether indigenous or exotic, will become of such scenic interest or beauty that their development, protection, and preservation are desirable in the public interest*. (Section 19 Reserves Act 1977).
Scientific reserve	A reserve with the purpose of *protecting and preserving in perpetuity for scientific study, research, education, and the benefit of the country, ecological associations, plant or animal communities, types of soil, geomorphological phenomena, and like matters of special interest.* (Section 21 Reserves Act 1977).
Scour	Erosive action of flowing water on the bed and banks of a channel.
Segregation	The concentration of coarse particles at the base of the active layer in response to degradation.
Sensitivity analysis	An investigation of the effects of changing the factors subject to uncertainty.
Sheet erosion	A type of erosion initiated by the impact of rainfall which causes the initial dispersion of soil particles. This result in soil splash and tends to move topsoil in thin sheets. Sheet erosion is a problem on the ash soils and can be aggravated by stock.
Simulation	The representation of specified conditions in a sewer system using a rainfall-runoff model.
Sinuosity	Degree of meandering in a channel. Defined here as the ratio of channel to valley length.
Slip erosion	A type of erosion which refers to the rapid down slope movement of soil and underlying material. Slip erosion is usually roughly parallel to the surface and the depth is usually less than 1 metre. The nature of slipping is through to relate to changes in permeability between relatively permeable and impermeable horizons.

Soakaway	A pit, usually filled with large stones, into which surface water is drained to infiltrate into the ground.
Soil Conservation	The management of land to maintain New Zealand's soil and water resources to provide the widest range of sustainable benefits for the needs and aspirations of present and future generations.
Soil Conservation Property Plan	A property-based programme of soil conservation works, prepared by Environment Bay of Plenty in conjunction with the landowner. The plans are initiated at the landowner's request, and soil conservation works with high off-site benefit are eligible for funding assistance.
Soil moisture deficit	A measure of soil wetness, indicating the capacity to absorb further rainfall. The difference between current soil moisture content and field capacity which is achieved two days after total saturation.
Storage tank	A tank constructed within a sewerage system to store temporarily a volume of water during peak flows (see also detention tank, off-line tank, on-line tank).
Storm profile	A series of values of rainfall intensity varying with time, which may be expressed in terms of percentile peakedness.
Storage	Retention, normally temporary, of flood water on flood plains or in depressions.
Structure plans	The strategic development plans required by Town and Country Planning Act 1977 to be prepared by County Councils.
Structure	*Any building, equipment, device, or other facility made by people and…fixed to land; and includes any raft or pipe.* (Section 2 of Resource Management Act 1991).
Sub-catchment	A defined geographic area in which water from rainfall collects to form the supply to a specified channel length within a catchment area.
Surface water	Water in surface water bodies such as lakes, river, wetlands and drains.
Surface runoff	Surface water flows entering a drainage system or natural water course.
Suspended solid	Particulate matter carried in suspension by a fluid.
Suspended constituent	The constituents of a water sample (the residue) that are retained on a filter medium. The type of filter must be specified.
Suspension	A system in which very small particles (solid, semi-solid, or liquid) are more or less uniformly dispersed in a liquid or gaseous medium.
Synergism	Action together with another substance or organism to achieve or enhance a given effect. A phenomenon in which the toxicity of a mixture of chemicals is greater than that to be expected from a simple summation of the toxicities of the individual chemicals present in the mixture.
Taiapure	A local fishery declared under the Maori Fisheries Act 1989, Part IIIA.
Taupo Volcanic Zone	A narrow complex volcano-tectonic depression, extending some 240 km from White Island in the Bay of Plenty to Mt Ruapehu on the central plateau.

Tephric alluvium	Alluvially redeposited volcanic material.
Toxic substance	Any substance (including any contaminant), capable of causing adverse effects to organisms.
Total population	The total population of an area is based on the 'population present' at the place of enumeration on census night. Visitors from overseas in the area on census night are included.
Toxicity	The potential or capacity of a material to cause adverse effects in a living organism.
TP & P	Tasman Pulp and Paper Company Limited
Transpiration	The release of water vapour from the aerial parts of a plant.
Turbulence	Unorganised movement in liquids and gases resulting from eddy formation.
USEPA	United States Environment Protection Agency
Usually resident population	Those who usually reside in a given area.
Waahi tapu	Sacred site. This is defined locally by the hapu and iwi, who are the kaitiaki of the waahi tapu.
Water body	*Means fresh water or geothermal water in a river, lake, stream, pond, wetland, or aquifer, or any part thereof, that is not located within the coastal marine area.* (Section 2 Resource Management Act 1991).
Water table	The surface within soil or rock strata at which ground water saturation occurs.
Water yield	The ability of a catchment to produce water.
Watershed	The elevated line of division in a catchment area between two separate river systems.
Weir	A device to control flows so that flow depth is above a pre-set level.
Wetland	*Includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions.* (Section 2 of Resource Management Act 1991).
Whakatane Graben	A structurally defined block of land down thrown between parallel faults. The Whakatane Graben is on the Rangitaiki Plains down thrown between the Edgecumbe and Matata faults.

22 Appendix 2 – References

During the preparation of the Regional Plan for the Tarawera River Catchment special research was undertaken to investigate resource issues. This research and other investigations were prepared and presented to the Council of Environment Bay of Plenty and the Tarawera River Liaison Group as a series of reports. These research reports have been highlighted in **bold** in this listing of references. Copies of these reports are available for inspection at Environment Bay of Plenty's Whakatane, Tauranga, and Rotorua offices.

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23 Appendix 3 – Population Statistics for the Tarawera River Catchment

23.1 Population by District Council Area

Three territorial local authorities, either partially or wholly within the Tarawera River catchment (Map 2). The Kawerau District Council, which includes the Kawerau township and its immediate environs, has the highest percentage (57.75%) or 8,592 people of the catchment population. With an area of 25.7 km^2, Kawerau District has a population density of 334.3 persons per km^2.

The part of the Whakatane District within the catchment of the Tarawera River, encompassing the Rangitaiki Plains, and the settlements of Edgecumbe, Matata, and Te Teko, has the second largest population (5,265 or 35.4% of the catchment's population) of the three districts which fall within the catchment. The inclusion of the sparsely populated area of the Upper Reach of the Tarawera River catchment within the Whakatane District results in a population density of 10.7 persons per square kilometre for the Whakatane District Council area within the catchment of the Tarawera River. The smallest percentage of the catchment population is in the Rotorua District Council area (1,020 people or 6.85%), with 2.2 persons per km^2 (Table 14).

The average population density of the catchment of the Tarawera River is 15.11 persons per km^2. This compares with a population density of 16.0 per km^2 for the Bay of Plenty as a whole, and 12.8 per km^2 for New Zealand.

Table 14

TOTAL POPULATION OF TARAWERA CATCHMENT BY DISTRICT 1991 CENSUS

District/Catchment	Population (1991)	% Catchment Population	Land Area (Km^2)	People per Km^2
Kawerau District	8,592	57.75%	25.7	334.21
Whakatane District	5,265	35.39%	488.5	10.77
Rotorua District	1,020	6.85%	469.8	2.17
Tarawera River Catchment	14,877	100%	984.0	15.11

23.2 Age

The population of the catchment of the Tarawera River is disproportionately young, in comparison with both the Bay of Plenty and New Zealand populations. As a comparison, approximately 31% of the catchment of the Tarawera River population is under 15 years of age compared with 25% for the Bay of Plenty and 23% for New Zealand. At the other end of the spectrum, only about 5% of the catchment of the Tarawera River population are aged 65 and over, compared with 12% for the Bay of Plenty and 11% for New Zealand as a whole (Table 15).

Table 15

AGE OF POPULATION (Total Population) 1991 CENSUS TARAWERA CATCHMENT/BAY OF PLENTY NEW ZEALAND

Age Groups	Total Tarawera Population	% Tarawera Population	% Bay of Plenty Population	% New Zealand Population
Under 15	4,563	30.67%	25%	23%
15-24	2,427	16.31%	15%	16%
25-44	4,560	30.65%	29%	30%
45-64	2,490	16.74%	19%	19%
65 and over	753	5.06%	12%	11%
TOTAL	14,877	100%	100%	100%

Statistics NZ, 1991

The communities living around Lake Okareka, the western shores of Lake Tarawera, and at Matata are more likely to reflect the age composition for the Bay of Plenty as a whole. The young population of Kawerau township influences the high percentage of the total catchment population under the age of 24. The significantly higher percentage of the catchment of the Tarawera River population under the age of 15, as compared with the percentages for the Bay of Plenty and New Zealand, could have grave implications for the Kawerau, Matata and Te Teko communities in the coming twenty years in terms of employment opportunities. It is likely that a higher percentage of the young age population will move out of this area in search of employment, or remain unemployed.

The significantly lower percentage of the catchment population in the over 65 age group is a reflection of the young age population of Kawerau township. It is a reflection of a township which grew as the result of extensive in-migration from outside the greater Eastern Bay of Plenty area. Other likely contributory factors to the catchment's, and in particular Kawerau's, high percentage of people under 15, are high fertility and birth rates.

23.3 Population Projections

Population forecasts for the catchment of the Tarawera River are not easily obtainable as its boundary does not coincide with those of territorial authorities, nor with identified statistical areas. However, based on the medium projected population growth rates for the districts within the catchment, the catchment population is conservatively estimated to increase to approximately 15,997 by the year 2016, a growth rate of approximately 7.0% (Figure 15) on the 1991 population.

For the Kawerau District, the predicted population growth between 2001 and 2016 is 4.8%. By 2016, Kawerau is projected to have a population of approximately 9,004. However, downsizing of its work force by Tasman Pulp and Paper Company Limited has resulted in approximately 400 fewer staff and this has led to a slight reduction in Kawerau's population. For that part of Whakatane District which lies within the catchment some short to medium term growth is expected.

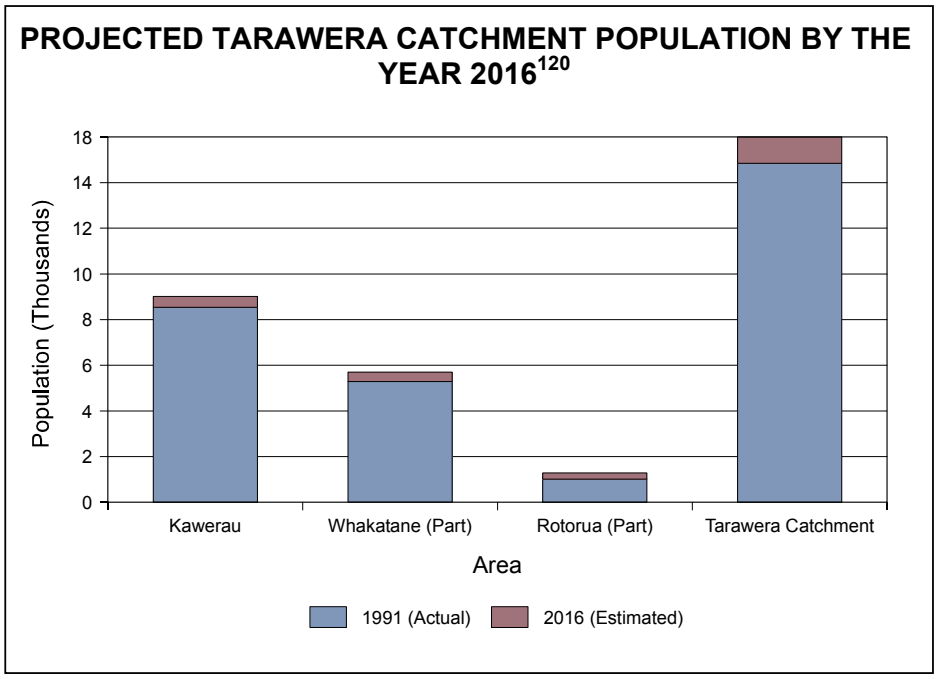
The centralisation of Bay Milk's operations may result in population growth, additional to natural population increase in Edgecumbe. The smaller Matata and Te Teko communities are expected to have quite high population growth, due largely to their high Maori populations, and in the case of Matata, its increasing prominence as a retirement centre.

While the Tarawera Lakes catchments will retain its overall low population density, the lakeside settlements around Lakes Tarawera and Okareka are likely to experience increased pressure for development from retirees and people working in Rotorua.

23.4 Employment

In 1991, 6,300 of the catchment's 14,877 residents were in the labour force. There is no accurate information on unemployment for the area of the catchment of the Tarawera River. Our understanding through liaison with the employment services is that 80% of the 1350 unemployed within the Kawerau District alone class themselves as Maori and as mentioned in 7.2.4 Ethnic Composition, 45.9% or 6,369 Maori reside within the catchment of the Tarawera River.

Figure 15



Statistics NZ 1991

[120] The Western Region includes people living in the Tauranga and Western Bay of Plenty districts. The Eastern Region covers the Opotiki, Whakatane and Kawerau districts, while the Southern Region covers the Rotorua district.

24 Appendix 4 – Tarawera Industries

24.1 Forestry/Wood Processing

24.1.1 Silviculture Industry

The exact contribution of the silviculture industry, involving the planting, growing, and harvesting of trees, is difficult to quantify. Fletcher Challenge Forestry Limited manages the largest area of exotic plantation forestry in the catchment. Fletcher Challenge Forestry Limited harvests approximately 700 hectares of pinus radiata from the Tarawera Forest per annum, which is a sustained yield position, relative to a rotation age of 30 years. Any change in forest area or clearfell age will alter this limit (Figure 16).

Fletcher Challenge Forestry Limited employs some 45 staff in the catchment of the Tarawera River, and contracts a further 350 for planting, pruning, harvesting, and related transport operations. The total domestic sales by Fletcher Challenge Forestry Limited (Bay of Plenty District) are 1.6 million cubic metres per annum, while a further 900,000 cubic metres per annum is exported overseas.

There are also other significant forestry operators in this catchment.

24.1.2 Pulp and Paper and Timber Processing

There are presently three primary processors of exotic plantation forest in the catchment of the Tarawera River, all located at Kawerau. They are the Tasman Pulp and Paper Company Limited pulp and paper products mill, Carter Holt Harvey Tissue pulp and paper products mill and the saw milling operation of Fletcher Challenge Forestry Limited. There is a small but nevertheless significant engineering and service industry located at Kawerau providing service support to these operations. Industries were encouraged to locate in Kawerau by the Government of the time who passed special legislation to enable them to take advantage of natural resources such as water supply, wood supply and geothermal resources.

The Tasman Pulp and Paper Company Limited mill operates two kraft pulp mills, producing 200,000 tonnes of market kraft pulp each year, 95% of which is exported, primarily to Australia and Asia. It operates three paper machines producing 400,000 tonnes of newsprint a year that is 60% of the total newsprint production in Australasia. Approximately one third of the newsprint production goes to Australia, a third to Asia, while the remaining third is consumed domestically.

The Tasman Pulp and Paper Company Limited operation at Kawerau runs 24 hours a day and directly employs approximately 1,300 people. A 1992 report by Hughes[121] detailing the economic impact of the Tasman Pulp and Paper Company Limited Kawerau operation indicates that a further 4,466 people are estimated to be employed indirectly in the Bay of Plenty as a result of Tasman Pulp and Paper Company Limited's Kawerau operation. Direct and indirect employment resulting from Tasman Pulp and Paper Company Limited's Kawerau operation is estimated to contribute to 8.6% of those employed in the Bay of Plenty. The report also indicates that for every additional 100 jobs at Tasman Pulp and Paper Company Limited's Kawerau mill, there would be a flow on of 231 jobs in other sectors.

[121] Hughes, W R, 1993.

Data from the 1992 Hughes report show that the company's 1992 sales of $547.9 million led to a further $367.8 million sales for the Bay of Plenty. A further $76.4 million sales flowed into New Zealand for a total value of $992.1 million nationwide.

Table 16

MACROECONOMIC IMPACT OF TASMAN PULP AND PAPER COMPANY LIMITED

INDICATOR	TASMAN PULP AND PAPER COMPANY LIMITED	BOP ECONOMY		NZ ECONOMY	
	Value $M	Value $M	Percent	Value $M	Percent
Gross Regional Turnover on Sales 1992	547.9	915.7	13.9	992.1	1.1
Gross Regional/Domestic Product 1992	421.2	512.1	13.8	761.0	1.1
Gross Household Income 1992	114.3	240.8	11.6	395.9	0.9
Employment 1987/92	1,573/1,611 BOP/NZ	6,039	8.6	11,248	0.8

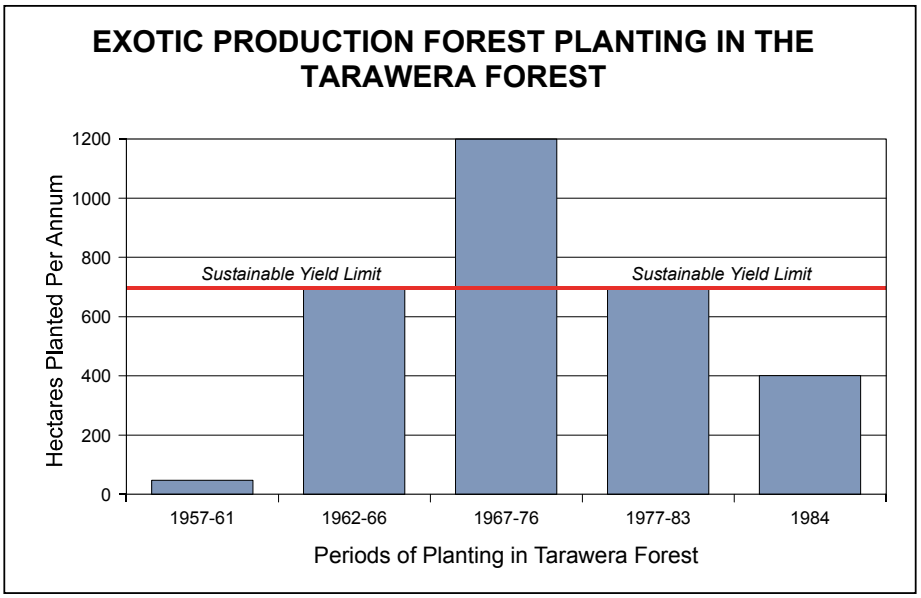
Hughes, W R 1993

The data in the columns headed BOP Economy and NZ Economy shown in Table 16 provide an indication of the contribution that Tasman Pulp and Paper Company Limited makes to the Bay of Plenty and New Zealand as a whole. The 1992 Tasman Pulp and Paper Company Limited Economic Report estimates that for every $1,000 in extra Tasman Pulp and Paper Company Limited outputs, there is a $1,590 increase in New Zealand's output, $830 of which is in the Bay of Plenty. The 1992 economic report prepared for Tasman Pulp and Paper Company Limited shows that the value of logging output would need to be approximately five times that of Tasman Pulp and Paper Company Limited to yield comparable economic and social benefits to the Region.

Carter Holt Harvey Tissue operates a bleached sulphonated chemi-thermo mechanical pulp (BSCTMP) mill, producing manufactured crepe and flat tissue on three tissue paper machines. Carter Holt Harvey Tissue employs 280 people in a 24 hour operation. It had a rated capacity (1994) to produce 50,000 tonnes per annum of tissue papers and 75,000 tonnes per annum of BSCTMP pulp. The Carter Holt Harvey Tissue operation is therefore significantly smaller than that of Tasman Pulp and Paper Company Limited, though in a more specialised field of paper manufacture. Approximately 25% of the company's production is exported overseas, primarily to Pacific rim countries. Very little precise economic information is available about the economic contribution of the Carter Holt Harvey Tissue mill to the local and Bay of Plenty economies. The company has not released any detailed economic analysis of its contribution to the local, regional or national economy, but the effects of any down sizing or closure of the company's operations can be expected to be similar, though reduced in scale to those of Tasman Pulp and Paper Company Limited.

Fletcher Challenge Forestry Limited is the third of the major wood processing plants in the Tarawera River catchment, also located at Kawerau. The Fletcher Challenge Forestry Limited Kawerau sawmill operation processes radiata pine for a variety of end uses which can be divided into four categories: furniture, componentry and joinery, building and construction, outdoor woods and packaging. The Fletcher Challenge Forestry Limited Kawerau operation includes sawing, grading, kiln drying and preservative treatment. Fletcher Challenge Forestry Limited directly employs 180 people.

Figure 16



Tasman Forestry Limited, 1994

24.2 Dairy Industry

Dairying is the predominant form of agriculture on the flat, low lying and fertile Rangitaiki Plains. At the turn of this century the Rangitaiki swamp was drained, removing wildlife habitat and the food basket for many local iwi, yet transforming the plain into prime dairy land.

Bay Milk Products Limited (Bay Milk) is the major milk processing company in the Bay of Plenty. At the end of the 1992/93 milk season Bay Milk completed the centralisation of its main production processes, other than town milk supply, in Edgecumbe. Bay Milk makes a range of dairy products, many of which are destined for the export market. These include casein, whey powder, anhydrous milk fat, butter and aqueous and anhydrous fat mixes. In the 1990/91 season, Bay Milk processed 485 million litres of milk, growing 11% to 537 million litres in the 1992/93 season and a further 11% to 603 million litres by the end of the 1993/94 season. Bay Milk employs approximately 420 people at its Edgecumbe processing plant. It is the biggest industry in Edgecumbe, with most other smaller industries and business providing ancillary services to the company or dairy industry as a whole.

25 Appendix 5 – Recreational Activities

This appendix provides information relating particular recreational activity types undertaken on and in various parts of the Tarawera River catchment to demographical and geographical groups.

RECREATIONAL ACTIVITIES UNDERTAKEN IN THE CATCHMENT OF THE TARAWERA

Recreational Activity	
Passive Recreation	Passive Recreation generally consists of those activities that involve using the environment for its visual attraction. Such activities can be placed under the headings of 'tourism' and include sightseeing and to a limited extent, picnicking. There are a number of easily accessible scenic areas, especially in the catchments of the Tarawera Lakes and the Upper Reach of the Tarawera River, and most notably at the Tarawera Falls and Lake Tarawera Outlet.
Motor boats and jet boats	Boatable to Kawerau under ideal conditions but seldom used. The river has a willow problem much like the Rangitaiki. There are numerous shallows and the polluted water may deter boaters.
Canoes/ kayaks	Most canoeing activity is centred below the falls to Kawerau. A slalom competition course at Kawerau gets a great deal of use. The 15 km above Kawerau are the most frequently used and is a popular trip. Access in summer is often restricted when there is a fire risk in the forest. Not undertaken below Kawerau where the water is relatively flat.
Drift boats, rafts	Used from the foot of Tarawera Falls downs to Kawerau and it is a popular trip. Not undertaken below Kawerau township.
Swimming	Considerable use at many points on the lakes and points down to Kawerau.
Hunting	Pigs and deer, and some small game (e.g. wallaby). In most cases the right to hunt in the catchment has to be secured through the landowner or lessee. As an example, the right to hunt in the Tarawera Forest is exclusive to Tarawera Hunting club members. The Department of Conservation restricts access to hunters in the majority of DOC reserves, largely as a means of protecting indigenous bird life.
Motor X	Motor cross riding is a popular activity through forestry areas.
Fishing	Trout fishing in the Tarawera Lakes and Tarawera River and their tributaries.

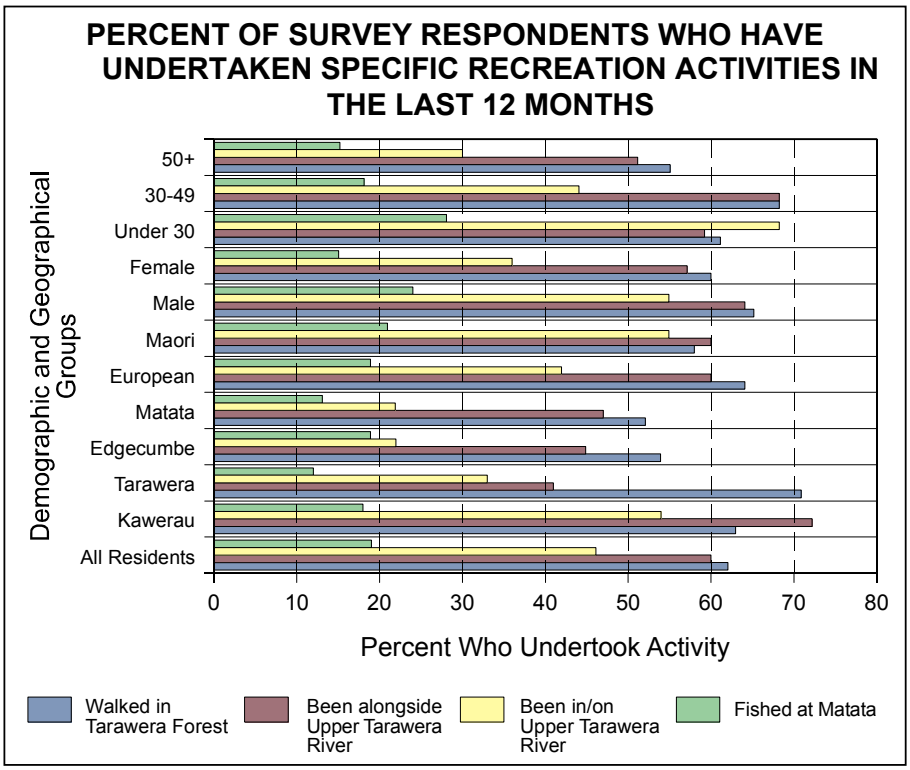
25.1 Recreational Use Survey

According to the survey of *Community Attitudes Towards the Tarawera River and its Catchment*[122], 60% of the 300 respondents in the catchment area, said they had walked, tramped, or picnicked along part of the river in the previous twelve months. Forty-six percent of respondents said they had swum, fished, rafted or otherwise been in the Tarawera River upstream of Kawerau.

The respondents indicated having undertaken little recreational activity downstream of Kawerau, in the twelve months prior to the survey. Only 11% of respondents had said that they had walked, tramped, or picnicked along the Tarawera River downstream of Kawerau. One if five of the respondents said they had gathered shellfish at the Tarawera River mouth just east of Matata. It should be noted that there are few places to walk, tramp or picnic downstream of Kawerau. Irrespective of the water quality in the Lower Reach of the Tarawera River, the Upper Reach of the Tarawera River is always likely to be the preferred recreational area.

122 Research Solutions Ltd, 1993 (March).

Figure 17



The survey results indicate that Kawerau residents are more likely to use the Tarawera River upstream of Kawerau for recreation than are residents of the other areas, with 72% reporting they had been alongside this part of the river in the last 12 months, and 54% saying they had been **in or on** the river.

Similarly, Tarawera Ward and Kawerau residents are more likely to have been in the bush or forest during the last year than are those people living further away in the Edgecumbe and Matata Wards. Maori are significantly more likely to have been in or on the river upstream of Kawerau, 55%, than are European, 42%.

The older age group, the over 50 years olds, tend to make somewhat less recreational use of the River than do their younger counterparts, particularly when it comes to being in or on the river itself. Only 30% of this older group reported actually being in or on the river in the last year compared with 68% of the under 30 years olds.

26 Appendix 6 – Wetlands and Lakes in the Tarawera River Catchment

This appendix lists and describes wetlands within the Tarawera River catchment.

LAKES AND WETLANDS IN THE TARAWERA RIVER CATCHMENT

Lakes/Wetlands	Location	Altitude (metres above sea level)	Land Catchment Area (km^2)	Lake Water Surface Area (km^2)	Max Depth (m)	Lake Water Volume ($m \times 10^6$)	Description
Tarawera	U16:095284	298	110.1	40.70	87.5	2,300	Large mostly unmodified lake with some sedge-rush-raupo vegetation. Willow invasive. Two rainbow trout spawning streams. Large numbers of coot and scaup; dabchick and other waterfowl breeding.
Upper Tarawera Wetlands	V16:186327	approx 280					Kamahi dominated riparian forest and river. Water-fowl breeding, especially scaup. Fernbird present. Common field birds.
Okareka	U16:045313	353	16.7	3.40	33.5	62	Moderate sized lake with pockets of raupo-rush vegetation. Good numbers of dabchick, spotless crake, fernbird and coot. Bittern present. Part of scenic reserve.
Rotokakahi (Green Lake)	U16:007264	396	15.1	4.40	32.5	77	Mestrophic lake, with narrow raupo-flax-rush patches and surrounded by exotic forestry. Spotless crake, marsh crake, scape and dabchick present. Trout spawning.
Tikitapu (Blue Lake)	U16:017286	418	4.3	1.50	27.5	28	Oligotrophic lake with narrow vegetated margins. Rainbow and brook trout. Waterfowl include dabchick.
Okataina	U16:088358	311	55.4	10.90	78.5	477	Oligotrophic lake with some sedge-rush vegetation. Surrounded by native forest and scrub. Dabchick and shag colony present.
Okaro	U16:069171	423	3.58	0.33	18.0		Eutrophic lake fringed by shrubland; willows and paddock. Moderate number of waterfowl species, including dabchick. Shoveler present.

Lakes/Wetlands	Location	Altitude (metres above sea level)	Land Catchment Area (km^2)	Lake Water Surface Area (km^2)	Max Depth (m)	Lake Water Volume ($m \times 10^6$)	Description
Rotomahana	V16:165172	341	77.4	8.50	125	482	Moderate sized lake, sedge and broadleaved shrubs limited by geothermal activity. Rainbow trout. Bittern, banded dotteral, and NZ scaup present. Little black shag colony. Common waterfowl, water, and field bird.
Pupuwharau	V16:444352			0.30			Flax-raupo-rush wetland with manuka-broadleaved scrub/shrubland. 85% open water. Fieldbirds Private lake.
Lake Tamurenui Wildlife Wetland Reserve	V15:372459			approx 0.08			Raupo-rush-sedge wetland with scrub and willow. Dabchick present.
Tumerau/Braemar Lagoon and Matuku Wildlife Management Lagoon (Wetland)	V15:385514			approx 0.16			Large raupo-flax-rush wetland with extensive willow and exotic grasses. Extensive species list includes dabchick, fernbird, spotless crake, NZ shoveler and NZ scaup. Paradise duck moulting site. Kiwi reported.
Matata Lagoon (Wetland)	V15:390621			approx 0.17			Raupo-sedge wetland with 70% open water. Lupin invasive. Various wader and field bird species.
Rotoitipaku	V15:359428			approx 0.09			Raupo-sedge wetland with manuka and willow. 95% open water. Small fish; carp and bullies. Dabchick present. Shags and waterfowl.
Kawerau Road Pond	V15:332410						Rush wetland with 75% open water. Manuka surrounding, waders and field species present.
Awakaponga Stream Wetland	V15:366554						Raupo-rush wetland with manuka and cabbage tree. No open water. Fernbird present.
Tarawera Cut and Bregmans Wildlife Reserve and Associated Wetlands	V15:428590						Raupo-rush-sedge with 20% open water. Large number of waders including bittern, banded dotteral, and spotless crake. Fernbird present.
Awaiti Wildlife Reserve and Associated Wetlands	V15:451576						Raupo-sedge willow weed wetland with scrub and willow. Dabchick present.

27 Appendix 7 – Main Rivers and Streams in the Tarawera Catchment

This appendix shows catchment size and flow details of parts of the Tarawera River catchment.

THE TARAWERA RIVER AND SOME OF ITS LARGER TRIBUTARIES AND STREAMS

Rivers	Location	Approximate Length (kms)	Volume (litres/sec)	Sub-catchment Area (km^2)
TARAWERA LAKES CATCHMENTS				327
CATCHMENT OF THE UPPER REACH OF THE TARAWERA RIVER				383
Tarawera River (outlet to Kawerau)		33.2		
Waiaute Stream	V16:252326	16.1	875 (21/01/75)	35.84
Mangakokutuku Stream	V16:210343	8.1	92 (16/03/93)	39.31
Waiwhakapa Stream	V16:262282	18.1	1165 (07/01/75)	35.22
Managawhio Stream	V16:300339	20.2	1291 (16/03/93)	49.71
Kaipara Stream	V16:223347	9.4	756 (16/03/93)	16.49
Mangate Stream	V16:308353	9.8	126 (16/03/93)	30.17
LOWER TARAWERA RIVER CATCHMENT		24.9		
Ruruanga Stream	V16:361416	19.1	985 (16/03/93)	43.84
Mangaone Stream	V15:367468	15.0	1389 (16/03/93)	22.70
Waikamihi Stream	V15:392537	11.8	291 (16/03/93)	21.39
Awakaponga Canal	V15:413558	11.1	417 (16/03/93)	33.00
Awaiti Canal	V15:428541	8.6	37 (16/03/93)	83.00
Tarawera West Drain	V15:393505	?	73 (16/03/93)	
Omeheu Canal	V15:444505	7.1	635 (16/03/93)	

Note: More detailed information on rivers and canals in the Tarawera River Catchment is contained in Pang, L, 1993 (October).

28 Appendix 8 – Land Use Capability Description – Tarawera Catchment

Land use capability (LUC) is a classification of the land to show the potential for sustainable use. Initially a survey is carried out mapping geology, soils, slope erosion and vegetation. The land use capability is then derived by considering management constraints that would apply to any particular area of land. The LUC system has a range of 8 classes of land. Classes of 1-4 are arable and classes 5-8 are non-arable. Class 1 is potentially the most productive and versatile land. Management constraints increase with each class up to class 8 which has such severe physical for use and management that it is considered to have no inherent productive potential. The broad LUC units of classes of 1-8 are subdivided to their dominant limitation. These limitations include erosion (e), wetness (w), soils (s), or climate (c). The LUC for the Tarawera catchment has been adapted from a national survey carried out in the mid 1970s by the Water and Soil division of Works and Development. The scale of mapping carried out was 1:63360. While the mapping was carried out nearly 20 years ago, the land use capability classification is still valid. The only inventory factors that will have changed over that period are erosion and vegetation. Within the Bay of Plenty region, a further refinement of the LUC system has been developed. This refinement involves the grouping of LUC units which occur together into suites. The primary factor used to delineate these LUC sites is soil parent material. The major suites within the Tarawera catchment are as below.

- Alluvium
- Tarawera Tephra over Kaharoa Tephra (Manawahe Soils)
- Deep Kaharoa Ash
    - Kaharoa Ash over lapilli
- Recent tephras
    - Tarawera Tephra
    - Rotomahana Mud
- Steep lands
- Other suites
    - Windblown sand
    - Taupo Pumice

Through the use of LUC suites the management constraints of different classes of land have been tied back to the soils and ultimately to the geology of the catchment.

In general terms, the alluvial soils are found on the Rangitaiki Plains area. The Manawahe soils are found on the hill country to the west of the Rangitaiki Plains. The Tarawera soils are found in the catchment of the Upper Reach of the Tarawera River, and the Rotomahana soils are found in the catchments. The steep lands suite is found scattered throughout the western hill country, catchments of the Upper Reach of the Tarawera River and the Tarawera Lakes. This suite is often associated with gullies and steep stream margins as well as steep head water areas.

The other suites are less prevalent; windblown sand is associated with the coastal sand dunes, Taupo Pumice is found in parts of the Tarawera Lakes.

While it is convenient to use LUC suites to give an understanding of the Tarawera catchment, it is also necessary to understand the increasing constraints to management as you progress form class 1 land through to class 8 land. The following is a brief class by class description of LUC within the catchment using the broad LUC classes only.

LAND CLASSES IN THE TARAWERA CATCHMENT

Class 1 Land, 963 hectares (1% of land area)

This is versatile multiple use flat land which may have a slight wetness limitation. This class of land is used for horticulture, cropping, and dairy farming.

Class 2 Land, 8,450 hectares (9% of land area)

This land is flat or gently undulating with fertile soils that have had moderately high winter water table and a slight wetness limitation after drainage. These soils have imperfect to poor natural drainage which limits their versatility for arable use. The predominant present land use is intensive dairying and maize cropping, but diversification towards horticulture is occurring.

Class 3 Land, 4,307 hectares (4% of land area)

This land is flat to gently undulating with wetness limitation due to a high water table or soil limitations due to coarse textured ash soils, however this class of land is still versatile and is used mainly for dairying.

Class 4 Land, 10.532 hectares (11% of land area)

This class of land has severe limitations to arable use. It occurs on flat to undulating slopes generally with coarse textured soils formed on deep Tarawera ash and lapilli. While arable use is marginal present and potential erosion under pastoral and forestry use is assessed as negligible. The dominant land use is exotic forestry.

Class 6 Land (27% of land area)

Class 6 land is stable hill country where soil erosion can be minimised by sound management practices. Within the Tarawera catchment this class requires careful grazing management under a pastoral land use and is well suited to forestry.

Class 7 Land, 32,346 hectares (33% of land area)

This land class is unsuited to arable use and has severe limitations or hazards under a perennial vegetation. It is not well suited for grazing although in some cases it may be moderately well suited to forestry but with a reasonable protective function.

Class 8 Land, 7,264 hectares (7% of land area)

This land class includes both very steep or wetland that has such unfavourable characteristics and severe limitations to use that it is unsuitable for grazing or commercial forestry.

This land will not yield significant long-term on site benefits from management for harvesting of crops, grass or trees within the limits of present knowledge. Its use is restricted to that of catchment protection, recreation and habitat protection.

Balance of Catchment Area, 7,737 hectares (8% of catchment area)

The balance of the catchment area includes lakes and urban areas.

29 Appendix 9 – Representation on the Tarawera River Liaison Group

The Tarawera River Liaison Group was formed in June 1993 to act as a think tank in the development of the Plan. The Liaison Group met fourteen times during 1993 and 1994 to consider reports prepared as part of the development of the plan and discuss various alternatives relating to the management of natural and physical resources in the catchment. Representatives on the Tarawera River Liaison Group were as follows:

ORGANISATIONS REPRESENTED ON THE TARAWERA RIVER LIAISON GROUP

REPRESENTATIVE ORGANISATIONS	INDIVIDUALS
Caxton Paper Limited	Kevin Wilson
Department of Conservation	Gavin Williamson and Chris Richmond
Environment Bay of Plenty	Bill Tait (Chairperson of Environment Bay of Plenty and the Tarawera River Liaison Group)
Eastern Regional Fish and Game Council	Dave Stack
Federated Farmers	Phil Withy
Greenpeace	Gordon Jackman
Kawerau District Council	Councillor Bob Manihera
Maruia Society	Lyle Miller
Matata Community Board	Colin Carter
Ngati Awa	John Hohapata
Ngati Rangitihi	Reuban Perenara
NZ Forest and Bird	Mark Fort
Onepu Residents	Doug Knight
Tasman Forestry Limited	Paul Ainsworth
Tasman Pulp and Paper Company Limited	Peter Sligh and Rob Hunter
Tuhourangi	Rangi Maika
Tuwharetoa ki Kawerau	Huia Pacey and Tai Whakaruru
Whakatane District Council	David Bewley
Works Geothermal	David Wigley

30 Appendix 10 – Water Monitoring Facilities in the Tarawera Catchment

This appendix outlines the types of water monitoring undertaken at specified sites within the Tarawera River catchment.

WATER MONITORING FACILITIES IN THE TARAWERA RIVER CATCHMENT (Existing on 16 November 1992) (Unless otherwise indicated each tick (√) refers to one (1) monitoring facility)									
Location	**Lake Level Recorders**	**Water Quality**	**Bathing Beach**	**Telemetered Water Level Recorders (inc flood monitoring)**	**Rainfall Recorders/ Readers**	**Automatic/ Manual Groundwater Level Monitoring Sites**	**Groundwater Chemistry Sites**	**Groundwater and Chemistry and Level Monitoring Site**	**Streamflow Monitoring Site**
Groundwater (Rangitaiki Plains)						√ (2 Automatic) √ (5 Manual)	√ (3)	√	
Tarawera River Estuary		√							
Upper Tarawera River Catchment		√ (with recorder) √ (Niwar)			√ (1 – Daily manual raingauge reader)				
Lower Tarawera River Catchment		√ (3 – gauged) √ (with recorder) √ (Niwar)		√ (2)	√ (1 – Telemetered located on Rangitaiki Plains)				√
Lakes									
Tarawera	√ (Niwar)	√	√						
Okataina	√	√	√						
Rotomahana	√	√							

Location	Lake Level Recorders	Water Quality	Bathing Beach	Telemetered Water Level Recorders (inc flood monitoring)	Rainfall Recorders/ Readers	Automatic/ Manual Groundwater Level Monitoring Sites	Groundwater Chemistry Sites	Groundwater and Chemistry and Level Monitoring Site	Streamflow Monitoring Site
Rotokakahi	√ (Niwar)	√							
Tikitapu	√ (Niwar)	√	√		√ (1 – Daily manual raingauge reader)				
Okareka	√	√	√ (3)						
Okaro	√								

More detailed information on the above sites, including frequency of monitoring and parameters monitored are included in Environment Bay of Plenty's most up to date publication of *Regional Monitoring Network Natural Environment Monitoring*. Environment Bay of Plenty also maintains a variety of coastal monitoring sites also identified in the above mentioned publication.

31 Appendix 11 – Flow Measurement Data for the Tarawera River System

This appendix provides information on recorded flow measurement data at sites within the Tarawera River catchment.

FLOW MEASUREMENT DATA FOR THE TARAWERA RIVER SYSTEM

RIVER SYSTEM	LOCATION	MAP REFERENCE	SITE No. Refer to Pang, L, 1993	Catchment Area* (km^2)	Date	Flow (l/s)	Specific discharge ($l/km^2/s$)
(1) Tarawera River							
Tarawera	Awakaponga	V15:412557	2	829.84	741023	33006.0	39.77
				829.84	751008	28415.0	34.24
				829.84	830329	18583.0	22.39
				829.84	830520	19426.0	23.41
				829.84	831130	27910.0	33.63
				829.84	840307	26570.0	32.02
				829.84	850314	22132.0	26.67
				829.84	860926	31340.0	37.77
				829.84	930316	18485.0	22.28
Tarawera	Pipe Bridge	V15:366438	17		930316	17900.0	
Tarawera	Kawerau Bridge	V15:356403	16	780.00	741021	26636.0	34.15
				780.00	751008	23994.0	30.76
				780.00	830329	14750.0	18.91
				780.00	830520	16768.0	21.50
				780.00	831130	21564.0	27.65
				780.00	840307	20710.0	26.55
				780.00	850314	19094.0	24.48
				780.00	860926	23330.0	29.91
Tarawera	Edwards Rd Bridge	V16:259336	73	370.10	741021	15347.0	41.47
				370.10	751007	14167.0	38.28
Tarawera	Lake Tarawera Outlet	V16:174303	41	300.40	741021	8689.0	28.92
				300.40	751007	7680.0	25.57
				300.40	930316	5260.0	17.51
(2) Tributaries							
Awatariki	Moores Bridge	V15:396617	53	4.14	741023	101.0	24.40
				4.14	751007	63.0	15.22
Awatariki	SH Bridge	V15:397617		4.14	930316	46.0	11.11
Awakaponga	Manawahe Road	V15:387573	54	12.17	741023	267.0	21.94
				12.17	751007	135.0	11.09

RIVER SYSTEM	LOCATION	MAP REFERENCE	SITE No. Refer to Pang, L, 1993	Catchment Area* (km^2)	Date	Flow (l/s)	Specific discharge ($l/km^2/s$)
Waikamihi	Bridge at Braemar Rd	V15:392537	12	21.39	741021	643.0	30.06
				21.39	751007	424.0	19.82
				21.39	830329	204.0	9.54
				21.39	830520	240.0	11.22
				21.39	831130	523.0	24.45
				21.39	840307	400.0	18.70
				21.39	850314	322.0	15.05
				21.39	860926	552.0	25.81
				21.39	930316	291.0	13.60
Braemar Spring	Braemar Rd	V15:388529	37	Spring	741021	281.0	
					751007	318.0	
					830329	127.0	
					830520	170.0	
					831130	133.0	
					840307	225.0	
					850314	192.0	
					860926	108.0	
Mangaone	Braemar Rd	V15:367468	13	22.70	741021	2251.0	99.16
				22.70	751007	1916.0	84.41
				22.70	830329	1256.0	55.33
				22.70	830520	1086.0	47.84
				22.70	831130	2189.0	96.43
				22.70	840307	1765.0	77.75
				22.70	850314	1457.0	64.19
				22.70	860926	2451.0	107.97
				22.70	930316	1389.0	61.19
Eastern Omeneu	Otakiri Rd	V15:453504	56		741021	51.2	
					751007	20.4	
Karaponga	Junction	V15:323481	57	15.54	741023	594.0	38.22
				15.54	751008	419.0	26.96
				15.54	9004	340.0	21.88
Karaponga	McIvor Rd	V15:309473	58	1.81	741023	92.5	51.10
				1.81	751008	78.0	43.09
Karaponga	Bluegums	V15L354482	30	18.00	9204	430.0	23.89
Ruruanga	Kawerau Loop Rd	V16.345389	59	33.67	741023	1306.0	38.79
				33.67	751008	1186.0	35.22
				33.67	830329	608.0	18.06
				33.67	830520	581.0	17.26
				33.67	831130	1215.0	36.09
				33.67	840307	1246.0	37.01
				33.67	850314	809.0	24.03
				33.67	860926	1320.0	39.20
		V16:361416		43.84	930316	985.0	22.47
Waikanapiti	Water race (Spring fed)	V15:273414	40	0.78	741021	0.0	0.00
				0.78	751007	406.0	520.51
Centre stream	Putauaki Rd	V16:356361	60	29.52	741021	0.0	0.00
				29.52	751006	0.0	0.00

RIVER SYSTEM	LOCATION	MAP REFERENCE	SITE No. Refer to Pang, L, 1993	Catchment Area* (km^2)	Date	Flow (l/s)	Specific discharge ($l/km^2/s$)
Centre stream	Titri Rd	V16:358329	61	11.65	741021	0.0	0.00
				11.65	751006	0.0	0.00
Buddles stream	Fenton Mill Rd	V16:307365	62	11.10	741023	372.0	33.51
				11.10	751007	372.0	33.51
				11.10	930316	297.0	26.76
Mangate stream	Tarawera Rd	V16:308353	36	30.71	741021	485.0	15.79
				30.71	751006	450.0	14.65
				30.71	930316	126.0	4.10
Mangate stream	Putauaki Rd	V16:317320	63	18.13	741021	363.0	20.02
				18.13	751006	356.0	19.64
Mangawhio	Tarawera Rd	V16:300339	64	49.17	741021	2125.0	42.75
				49.17	751007	1733.0	34.86
				49.17	930316	1291.0	25.97
Mangawhio	Cuming Rd	V16:289307	65	37.81	741021	1695.0	44.83
				37.81	751006	1416.0	37.45
Korutu stream	Homestead Rd	V16:292342	66	8.29	741023	118.0	14.23
				8.29	751007	90.0	10.86
				8.29	930316	77.0	9.29
Waiaute + Waiwhakapa	Old Footbridge	V16:255328	67	102.02	741021	5427.0	53.20
				102.02	751007	4905.0	48.08
				102.02	930316	4199.0	41.16
Waiaute	Edwards Rd	V16:252326	68	35.84	741021	875.0	24.41
				35.84	751007	647.0	18.05
Rusty Creek	Edwards Rd	V16:218293	69	10.36	741021	530.0	51.16
				10.36	751007	460.0	44.40
Waiwhakapa	Junction	V16:262282	70	35.22	741021	1380.0	39.18
				35.22	751007	1165.0	33.08
Pancake stream	Junction	V16:261281	71	17.61	741021	884.0	50.20
				17.61	751007	835.0	47.42
Waiwhakapa	American Rd	V16:248239	72	16.57	741021	267.0	16.11
				16.57	751007	195.0	11.77
Wiki's creek	Tarawera Rd	V16:242335	74	4.92	741021	0.0	0.00
				4.92	751007	0.0	0.00
Kaipara	Fenton Mill Rd	V16:223347	75	16.49	741021	1029.0	62.40
				16.49	751007	847.0	51.36
				16.49	930316	756.0	45.85
Mangakotukutuku	Pukemaire Rd	V16:210343	76	39.31	741021	984.0	25.03
				39.31	930316	868.0	22.08

RIVER SYSTEM	LOCATION	MAP REFERENCE	SITE No. Refer to Pang, L, 1993	Catchment Area* (km^2)	Date	Flow (l/s)	Specific discharge ($l/km^2/s$)
Tarawera Peak	Campsite	V16:125240	77	2.33	741023	92.0	39.48
				2.33	751006	97.0	41.63
Spring	Water fall	V16:124235	32	Spring	741023	221.0	
					751006	250.0	
Wash	Borehole 1	V16:116229	79	2.33	751006	1.1	0.47
Wairua	Hut	V16:098235	80	18.19	741023	278.0	15.28
				18.19	751006	238.0	13.08
Oneroa	Oneroa	V16:089250	81	5.18	741023	0.0	0.00
				5.18	751006	0.0	0.00
Te Puroku No.2	Te Puroku	V16:080254	83	4.92	741023	432.0	87.80
				4.92	751006	435.0	88.41
Putauaki	Putauaki	V16:075266	84	2.85	741023	0.0	0.00
				2.85	751006	0.0	0.00
Wairoa	Walking track	V16:057272	85	8.87	741024	665.0	74.97
				8.87	751008	503.0	56.71
Spring	Te Wairoa wharf	V16:057273	86	0.26	741023	39.0	150.00
				0.26	751008	33.9	130.38
Spencer Rd stream	Tracks End	V16:058275	87	3.37	741023	15.2	4.51
				3.37	751008	17.7	5.25
Waitangi stream	Lake	V16:069303	88	Spring fed	741023	260.0	
					751006	236.0	
Okareka	Lake Okareka Outlet	V16:059304	43	19.81	741024	228.0	11.51
				19.81	751008	203.0	10.25
North inflow	Miller Rd	V16:035323	89	4.66	741024	40.2	8.63
Te Whekau	McMillans	V16:074317	90	Spring fed	741023	19.5	
					751008	22.5	
Soda Spring	Humphrey's Bay	V16:069318	42	Spring	741023	0.0	
Te Kautu	Lake Okataina	V16:109385	91	2.85	741023	0.0	0.00
				2.85	751008	0.0	0.00
Haumingi	Old Coach Rd	V16:082334	92	2.85	741023	0.0	0.00
				2.85	751008	0.0	0.00
Motuwhetero	Clearing	V16:064346	93	3.88	741021	33.5	8.63
				3.88	751007	22.5	5.80
Kaikakahi	Sand Bar	V16:070363	94	2.85	741021	57.0	20.00
				2.85	751007	42.5	14.91

RIVER SYSTEM	LOCATION	MAP REFERENCE	SITE No. Refer to Pang, L, 1993	Catchment Area* (km^2)	Date	Flow (l/s)	Specific discharge ($l/km^2/s$)
Omania	Mokoroa Bay	V16:081365	95	5.18	741021	48.0	9.27
				5.18	751007	18.6	3.59
Hauni stream	Lake Rotomahana	V16:086195	96	23.31	741021	381.0	16.34
				23.31	751007	343.0	14.71
Hot water creek	Waimangu	V16:072188	51	0.52	741021	110.0	211.54
				0.52	751007	90.0	173.08
Lake Okaro	Lake Outlet	V16:072170	97	4.09	741021	54.3	13.28
				4.09	751007	45.0	11.00
Okaro stream	Okaro Rd Bridge	V16:066175	58	2.33	741021	25.3	10.86
				2.33	751007	22.1	9.48
Rotomahana stream	Swamp	V16:129187	1	9.06	741021	70.0	14.23
				9.06	751007	64.0	13.01
Tunoa	Sanctuary	V16:129187	1	9.06	741021	36.8	4.06
				9.06	751007	39.0	4.30
Cauae stream	Ford	V16:136196	78	8.55	741021	237.0	27.72
				8.55	751007	261.0	30.53
Orbrick stream	Lake Rotomahana	V16:086195	4	0.52	741021	56.0	107.69
				0.52	751007	51.0	98.08
Wilson's creek	Edg – Matata Rd	V15:404580	5		83029	279.0	
					830520	292.0	
					831130	502.0	
					840307	277.0	
					850314	365.0	
					860926	678.0	
		V15:405582			930316	138.0	
Waitepuru stream	Edg Rd Bridge	V15:408614	6		930316	7.0	
(3) Drains							
Awakaponga Canal	Edg – Matata Rd	V15:413558	7	33.00	930316	417.0	12.64
Tumurenui drain		V15:409562			83029	90.0	
					830520	66.0	
					831130	98.0	
					840307	104.0	
					850314	49.0	
					860926	146.0	
Omeheu Canal	Otakiri Rd	V15:444505	55		741021	635.0	
					751007	402.0	
Omeheu Canal	Edg – Matata Rd	V15:450523	9		930316	148.0	
Omeheu Adjunct Canal	Edg – Matata Rd	V15:454520	8		930316	2.0	

RIVER SYSTEM	LOCATION	MAP REFERENCE	SITE No. Refer to Pang, L, 1993	Catchment Area* (km^2)	Date	Flow (l/s)	Specific discharge ($l/km^2/s$)
Omeheu Drain	Edg – Matata Rd	V15:443530	10		930316	35.0	
Tarawera West Drain	McNivens	V15:393505	11		930316	73.0	
Tarawera West Drain	Edg – Matata Rd	V15:422545	14		930316	157.0	
Awaiti Canal	Edg – Matata Rd	V15:428541	15	83.00	930316	37.0	0.45

* The catchment areas for the major tributaries have been amended by BOPRC, 1993.
The catchment area for Awakaponga was amended by the engineering drainage system.
1974 and 1975 data: from M.W.D. (1982).
1983-1986 data: from W.Q.C. (Nagels et al, 1986).
1990-1992 data: from BOPRC (1992).
1993 data: gauged by BOPRC.

32 Appendix 12 – Maintaining Water Levels in Wetlands

This appendix identifies work required, as at March 1994, to ensure the maintenance of wetland water levels within the minimum and maximum ranges specified in Rule 14.4.5(a). It also signals the percentage of capital works expenditure that Environment Bay of Plenty is amenable to given that the respective third party has first indicated through its financial statements, its intention to fund the balance of the cost of the respective capital work(s).

WORKS REQUIRED TO MAINTAIN WATER LEVELS IN WETLANDS

WETLAND	WORK REQUIRED	PERCENTAGE (%) FUNDING AVAILABLE FROM Environment Bay of Plenty	PROPOSED TIMETABLE FOR COMPLETION OF WORKS
Tarawera Wildlife Management Reserve	Design and construction of in flow structure either culvert/stop logged weir or small pumping station.	50:50	By 30.06.96
Bregman's Wildlife Management Reserve	Design and rebuilding of control structure, and some stopbanking.	50:50	By 30.06.96
Awaiti Wildlife Management Reserve	Possible redesign of Awaiti and floodgates, upgrading intake structure, a new outlet structure, stopbanking and pumping.	50:50	By 30.06.98
Lake Tamurenui	Control structure requires repair.	Nil	By 30.06.97
Tumarau Lagoon	Nil works required.	Nil	Not applicable
Awakaponga	Water Reticulation.	Nil	By 30.06.96
Matuku	Nil works required.	Nil	Not applicable
Matata Lagoon	Design and construction of upgraded weir structure.	50:50	By 30.06.96

33 Appendix 13 – Freshwater Ecology Data

INVENTORY OF THE MACROFLORA RECORDED IN THE TARAWERA RIVER IN DECEMBER 1983
(Bioresearches 1987(a))

GROUP	SPECIES	COMMON NAME
CYANOPHYTA MYXOPHYCEAE	Hormogonales *Nostoc* sp *Oscillatoria* sp	Blue-green algae
CHLOROPHYTA CHLOROPHYCEAE	Ulotrichales *Microspora* sp	Green algae
	Zygnematales *Mougeotia* sp *Spyrogira* sp	
	Cladophorales *Cladophora* sp	
CHRYSOPHYTA XANTHOPHYCEAE	Heterosiphonales *Vaucheria* sp	
BACILLARIOPHYCEAE	Centrales *Melosira varians*	Diatoms
RHODOPHYTA RHODOPHYCEAE	Compsopogonales *Compsopogon* sp	Red Algae
BRYOPHYTA HEPATICAE	Jungermanniales *Jungermannia orbiculata*	Liverworts
ANTHOCEROTAE	Anthocerotales *Anthoceros laevis*	Hornworts
MUSCI	Bryales *Drepanocladus aduncus* *Fissidens rigidulus*	Mosses
FILICOPSIDA	Salviniales *Azolla rubra*	Ferns
SPERMATOPSIDA ANGIOSPERMAE		
DICOTYLEDONES	Polygonales *Polygonum decipiens*	Willow weed
	Lythrales *Callitriche stagnalis*	Starwort
	Cruciales *Nasturtium officinale*	Watercress
	Personales Glossostigma elatinoides *Mentha* sp	Mint
	Ranales *Ranunculus fluitans*	Water Buttercup
MONOCOTLYLEDONES	Butomales *Elodea canadensis*	Canadian Pondweed
	Potamogetonales *Ruppia* sp	Horse's mane weed
	Arales *Lemna minor*	Duck weed
	Cyperales *Cyperus ustulatus* *Scirpus lacustris*	
	Typhales *Typha orientalis*	Bulrush
	Graminales *Glyceria fluitans* *Glyceria maxima*	Floating sweet grass

AQUATIC MICROFLORA RECORDED IN THE TARAWERA RIVER (1983-84) Bioresearches 1987(a).

Tarawera River
Cocconeis placentula
Navicula sp.
Gomphonema sp.
Rhoicosphenia curvata
Epithemia sp.
Anabaena sp.
Nitzschia sp.
Fragilaria sp.
Synedra ulna
Tabellaria sp.
Oscillatoria
Gomphoneis herculeana
Surirella sp.

Donald, R, 1994

TARAWERA RIVER MACROINVERTEBRATES

Species list, feeding groups and assigned MCI scores (* after Stark 1993).
NB: F = Filters, CB = Collector-Browsers, P = Predators

GROUP	SPECIES	MCI*	FEEDING MODE
Ephemetoptera	*Coloburiscus humeralis Mauiulus luma*	9	F
	Austroclima sepia	5	CB
	Austroclima jollae	9	CB
	Neozephlebia scita	9	CB
	Zephlebia dentata	7	CB
	Zephelebia spectabilis	7	CB
	Croyophlebia aucklandensis	7	CB
	Deleatidium spp.	8	CB
			CB
Trichpotera	Aoteapsyche colonica	4	F
	Orthopsyche fimbriata	9	F
	Orthopsyche thomasi	9	F
	Hydrobiosis umbripennis	5	P
	Hydrobiosis parumbripennis	5	P
	Neurochorema confusum	6	P
	Neurochorema forsteri	6	P
	Psilochorema bidens	8	P
	Psilochorema nemorale	8	P
	Costachorema xanthoptera	7	P
	Costachorema brachyptera	7	P
	Oxyethira albiceps	2	Piercer
	Beraeoptera roria	8	CB
	Pycnocentrodes spp.	5	CB
	Pycnnocentrai evecta	7	CB
	Pycnocentrai funerea	7	CB
	Confluens hamiltoni	5	CB
	Olinga feredayi	9	CB
	Hudsonema amabilis	6	P
	Oecitis unicolor Triplectides	5	CB?
	obsoleta	9	Shredder
	Pycnocentrella eruensis	8	CB
	Ecnomina zealandica		CB
Plecoptera	Megaleptoperla diminuta	9	CB
	Megaleptoperla grandis	9	P
	Zelandobius furcillatus	5	CB
	Acroperla trivacuata	5	CB
	Zelandoperla decorata	10	CB

GROUP	SPECIES	MCI*	FEEDING MODE
Diptera	Aphrophila neozelandica	5	CB
	Austrosimulium spp.	3	F
	Anthomyiidae	3	P
	Empididae	3	P
	Ephydridae	4	CB
	Eulimnia sp.	3	P
	Ceratopogonidae	3	C
	Muscidae	3	P
	Polypedilum spp.	3	CB
	Orthocladiina	2	CB
	Maoridiamesa sp.	3	CB
	Tanypodinae	5	CB
	Tanytarsus vespertinus	3	CB
Coleoptera	Elmidae	6	CB
Hemiptera	Mesovelidae	5	Piercer
Megaloptera	Archicauliodes diversus	7	P
Hydracarina		5	P
Decapoda	Paratya curviorstris	5	CB
Ostracode	Herpetocypris pashceri	3	F
Amphipoda		5	F
Copepoda		5	F
Cladocera		5	F
Oligochaeta		1	CB
Hirudinea	Glossiphonia multistriata	3	P
Turbellaria	Curapinguis	3	P
Collembola		6	CB
Gastropoda	Potamopyrgus antipodarum	4	CB
	Ferrissia sp.	3	CB
	Latia neritoides	3	CB
	Sphaerium novaezelandiae	3	CB
	Hyridella menziesi	3	F
	Gyraulis kahuica	3	CB
	Physa acuta		CB
Nematoda		3	CB
Nematomorpha		3	CB
Nemertea		3	CB
Coelenterata	Hydra	3	F

FRESHWATER FISH SPECIES REPORTED IN THE TARAWERA RIVER SYSTEM SINCE 1970

SPECIES NAME	COMMON NAME
Geotria australis	Lamprey
Anguilla deiffenbachii	Longfinned eel
Anguilla australis	Shortfinned eel
Retropinna retropinna	Common smelt
Galaxias argenteus	Giant kokopu
Galaxias brevipinnis	Koara
Galaxias fasciatus	Banded kokopu
Galaxias maculatus	Inanga
Gobiomorphus huttoni	Redfinned bully
Gobiomorphus gobioides	Giant bully
Gobiomorphus cotidianus	Common bully
Cheimarrichthys fosteri	Torrent fish
Aldrichetta fosteri	Yelloweyed mullet*
Mugil cephalus	Greymullet*
Girella tricuspidata	Parore*
Arippis trutta	Kahawai*
Introduced	
Oncorhynchus mykiss	Rainbow Trout
Gambusia affinis	Mosquito fish
Carassius auratus	Goldfish

*Predominantly Estuarine/Marine species

FISH SPECIES RECORDED IN THE TARAWERA RIVER AND ITS TRIBUTARIES

Note: River distance refers to the upstream distance of the confluence of each system from the river mouth at Matata.

System	River Distance (km)	Species Present
Awatarariki Stream	0.5	Longfinned Eel, Shortfinned Eel, Banded Kokopu, Inanga, Redfinned Bully, Common Bully
Waitepuru Stream	0.5	Longfinned Eel, Shortfinned Eel, Redfinned Bully
Matata Lagoon and Estuary	0.5	Longfinned Eels, Shortfinned Eel, Common Bully, Giant Bully, Giant Kokopu, Banded Kokopu, Inanga, Common Smelt, Yelloweyed Mullet, Parore, Grey Mullet, Goldfish, Mosquitofish
Omeheu Canal	0.6	Giant Bully, Shortfinned Eel, Goldfish, Redfinned Bully, Common Bully, Mosquitofish
Awakaponga Canal and Stream	0.7	Giant Bully, Shortfinned Eel, Goldfish, Longfinned Eel, Mosquitofish, Inanga, Common Bully, Redfinned Bully, Torrentfish, Lamprey, Rainbow Trout
Tarawera River at Awakaponga	6.0	Longfinned Eel, Shortfinned Eel, Common Bully, Redfinned Bully, Goldfish, Giant Bully, Mosquitofish
Waikamihi Stream	9.0	Redfinned Bully, Rainbow Trout, Longfinned Eel, Shortfinned Eel, Giant Kokopu, Giant Bully, Common Bully, Inanga, Torrentfish
Braemar Spring	10.0	Shortfinned Eel, Mosquitofish
Karaponga Stream	14.2	Longfinned Eel, Redfinned Bully, Banded Kokopu, Torrentfish, Rainbow Trout
Mangaone Stream	14.2	Torrent Fish, Redfinned Bully, Inanga, Common Bully, Koaro, Lamprey, Shortfinned Eel, Longfinned Eel, Banded Kokopu, Rainbow Trout
Ruruanga Stream	24.5	Longfinned Eel, Rainbow Trout
Tarawera River at Kawerau Bridge	27.0	Longfinned Eel, Shortfinned Eel, Common Bully, Inanga, Rainbow Trout
Overflow Stream	33.6	Shortfinned Eel, Banded Kokopu
Buddles Stream	34.5	Longfinned Eel, Rainbow Trout
Mangate Stream	36.0	Longfinned Eel, Shortfinned Eel, Rainbow Trout
Korutu Stream	36.2	No fish found (Culvert!)
Mangawhio Stream	38.0	Shortfinned Eel, Banded Kokopu
Waiaute Stream	40.0	Longfinned Eel, Rainbow Trout
Kaipara Stream	46.6	Longfinned Eel, Rainbow Trout
Mangakotukutuku Stream	47.9	No fish found
Tarawera Falls	52.5	Longfinned Eel, Common Bully, Banded Kokopu
Tarawera Outlet	55.6	Longfinned Eel, Commong Bully, Common Smelt, Rainbow Trout, Koaro

SUMMARY OF THE BOTANICAL AND ECOLOGICAL CHARACTERISTICS OF WETLANDS ASSOCIATED WITH THE LOWER TARAWERA RIVER

	WETLAND	BOTANICAL AND/OR ECOLOGICAL CHARACTERISTICS
1	Lake Pupuwharau	62 indigenous plant taxa, including one rare* - *Thelypteris confluens* (best known population in the District) and six uncommon in the district – *Sparganium subglobossum, Tetraria capillaris, Drosera Binata, Epilobium chionanthum, Ranunculus amphitrichus and Eleocharis gracilis*. Wetlands are in good condition and indigenous species form the dominant cover over much of the area. Generally flax-raupo-rush wetland with manuka broadleaved scrub/shrubland. 85% open water. Field birds.
2	Tahuna-Putanaki Block	71 indigenous plant taxa including relatively common wetland and early successional species. No threatened or local taxa.
3	Lake Tamurenui	57 indigenous vascular taxa, mostly common wetland species but *Juncus holoschoenus* (a species of rush), classed as vulnerable, was also found. Largely raupo-rush-sedge wetland with scrub and willow. Dabchick present.
4	Gillette/Braemar/ Tumurau Lagoon	84 indigenous plant taxa and 48 adventive species, including *T. confluens* (rare), *Cyclosorus interruptus* (rare) and 6 species uncommon in the district – *Empodisma minus* (wirebrush), S. *Subglobossum, E. Chinonanthum, Nertera scapanioides, Leptocarpus similis* (oioi), and *Baumea juncea*. Extensive threatened bird species include: dabchick, fernbird, spotless crake, NZ shoveler and NZ scaup. Paradise duck moulting site and kiwi reported.
5	Awakaponga Wetlands	38 indigenous plant species of a total of 83 higher plant species. *C. interruptus* (rare) was present in a relatively healthy state. Vegetation has been severely modified by exotic species, encouraged by low water levels and disturbance.
6	Awaiti Wetlands	56 indigenous species of 114 higher plant species. Both *C. interruptus* (rare) and *T. confluens* (rare). Vegetation has strong adventive element and shows signs of intervention by humans, but is a valuable remnant of once extensive wetland. Largely raupo-sedge-willow weed wetland with willows and exotic grasses. 20% open water. Threatened wildfowl include white heron, reef heron, banded rail and bittern.
7	Tarawera Cut	55 indigenous plant species including *T. confluens* and *C. interruptus*. Declining water levels has caused infestation of willow, but vegetation retains a high percentage of wetland flora, and is therefore important as a remnant. Large numbers of waders including bittern, banded dotterel, and spotless crake. Fernbird also present.
8	Matata Lagoon	81 out of the 185 higher plant species were indigenous. Threatened species present include *C. Interruptus* (rare), and *Desmoschoenus spiralis* (local), commonly called pingao. Unique and complex dune-wetland-open water system on the freshwater-saltwater interface. Willow invasive, but relatively unmodified. Large number of threatened birds including banded rail, dabchick, spotless crake, bittern, white heron, reef heron and fernbird.
9	Bregman Lagoon	55 out of 112 higher plants were indigenous. Both species of threatened ferns, *C. interruptus* and *T. confluens* were present. Small, highly modified wetland but because it supports threatened species and contains a certain native element it is valuable (see Tarawera Cut for bird species present).
10	Matuku Wetlands	42 indigenous plant species. Although no threatened plant species were present, *C. interruptus* was found just outside the reserve boundary. Vegetation is extensively modified with a high percentage of exotic cover. Threatened wildfowl similar to Gillette Lagoon found adjacent.
11	Kawerau Road	Rush wetland with 75% open water. Manuka surrounding. Waders and field species present.
12	Lake Tahuna	Raupo-sedge-rush wetland with willow and manuka. Little open water. Spotless crake, bittern and fernbird present.
13	Matata Dump	Raupo-sedge-rush wetland with 70% open water. Lupin invasive. A few wader and field bird species.
14	Awakaponga Stream	Raupo-rush wetland with manuka and cabbage tree. No open water. Fernbird present.

	WETLAND	BOTANICAL AND/OR ECOLOGICAL CHARACTERISTICS
15	Mangaone Two	Raupo-rush wetland with some exotics. Well used by a few waterfowl species. Fernbird present.
16	Lake Rotoitipaku	Raupo-rush wetland with manuka and willow. 95% open water. Small fish; carp and bullies. Dabchick present. Shags and water fowl.
17	Lake Rotorua/Tasman Pulp and Paper Company Limited Oxidation Ponds	Previously, rush-raupo vegetation with 98% open water, dabchick present, common water fowl breeding. However now used as an oxidation pond and although rumours that there ma fishery, unlikely that it has significant ecological or botanical value.
18	Mangaone Lake	Very small raupo-rush wetland with 60% open water. Field species and low water fowl numbers.

* Classification of threatened plant taxa according to Cameron et al (1993).