
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 ash³⁵. 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-weathering³⁶. 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.

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 BP³⁷. 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, 1994³⁸.

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 areas³⁹ or both.

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

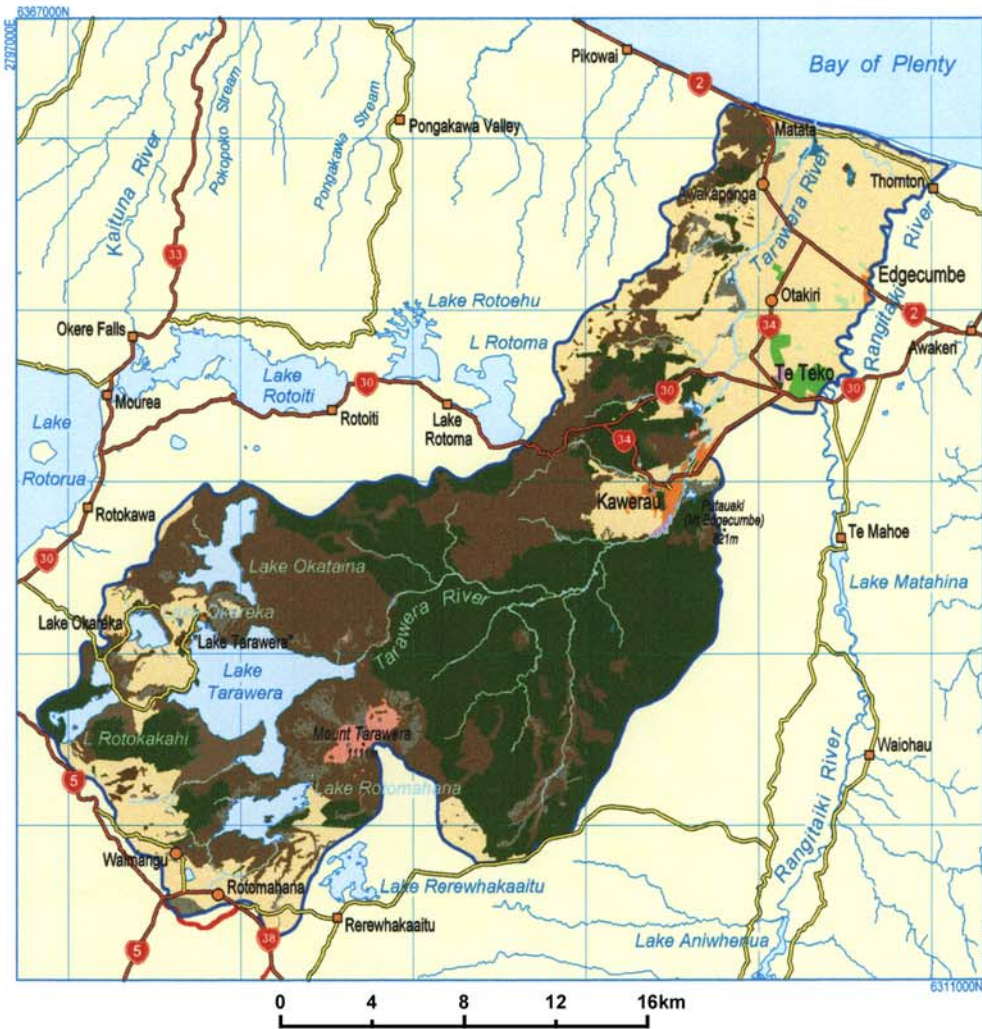
³⁹ See Ngapo, N I, 1994 (April), Operations Report No. 94/2, for a more specific description of landuse classes in the Tarawera catchment.



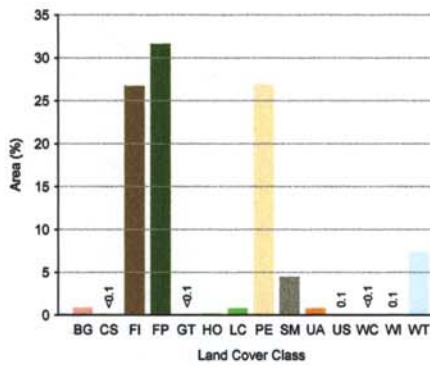
Map 4

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

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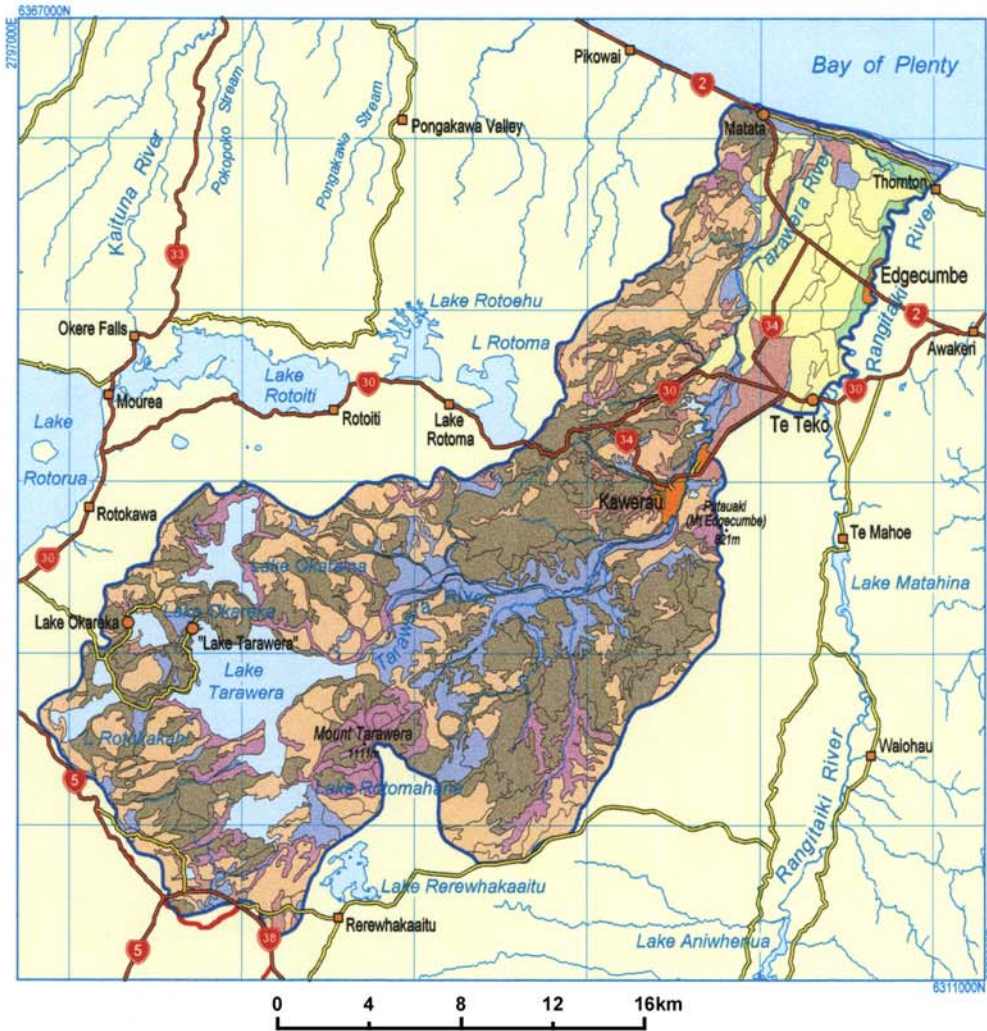
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Map 5

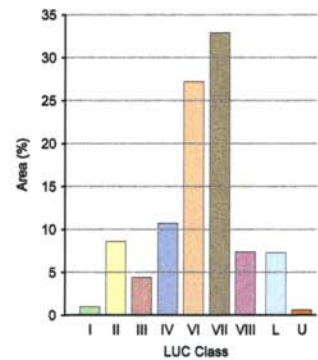
Regional Plan for the Tarawera River Catchment

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



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 maintained⁴⁰.

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 Rotomahana

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 or 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 siting 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.