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.

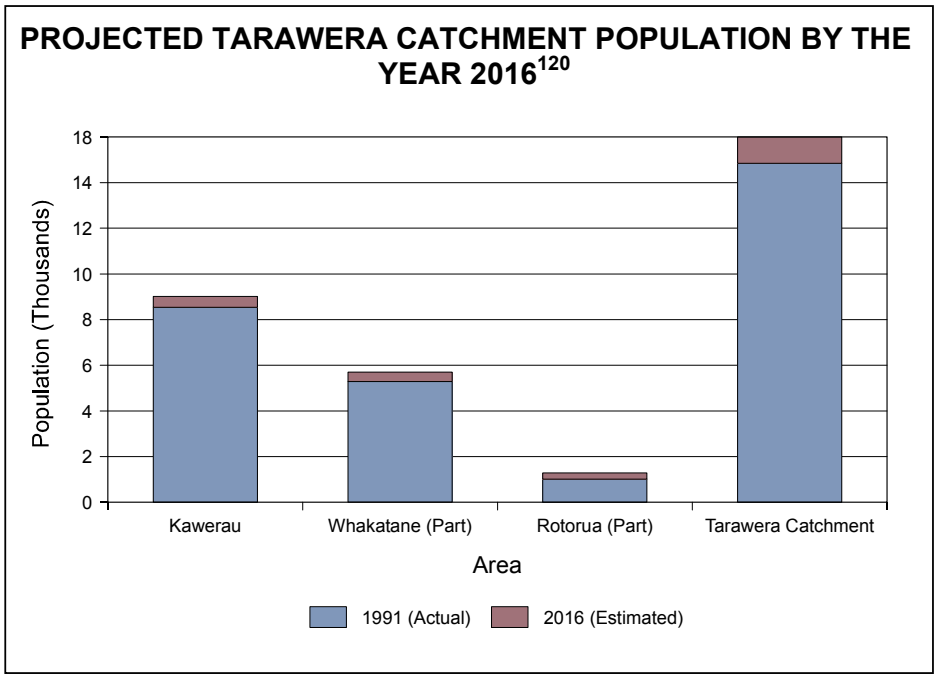
The centralisation of Bay Milk's operations may result in population growth, additional to natural population increase in Edgecumbe. The smaller Matata and Te Teko communities are expected to have quite high population growth, due largely to their high Maori populations, and in the case of Matata, its 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

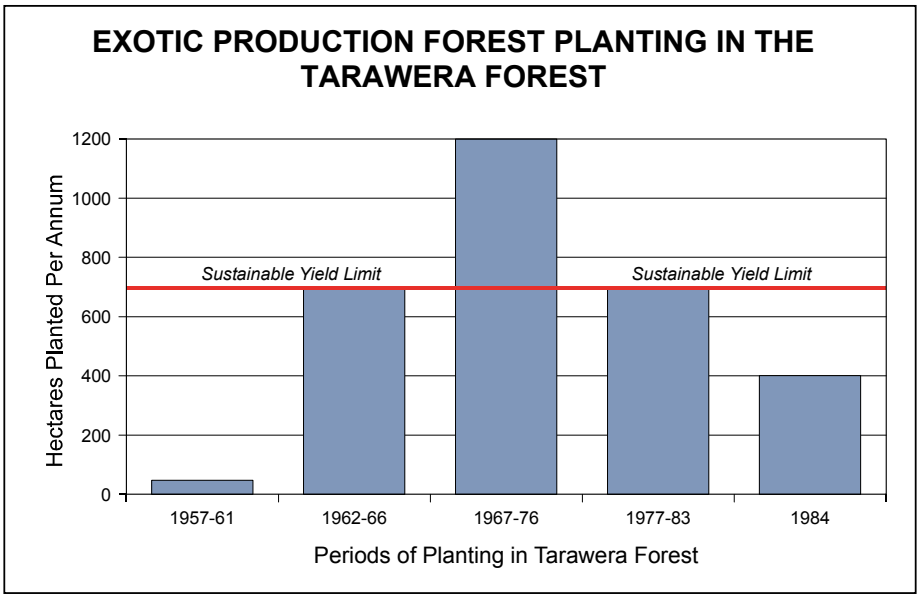
Hughes, W R 1993

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.

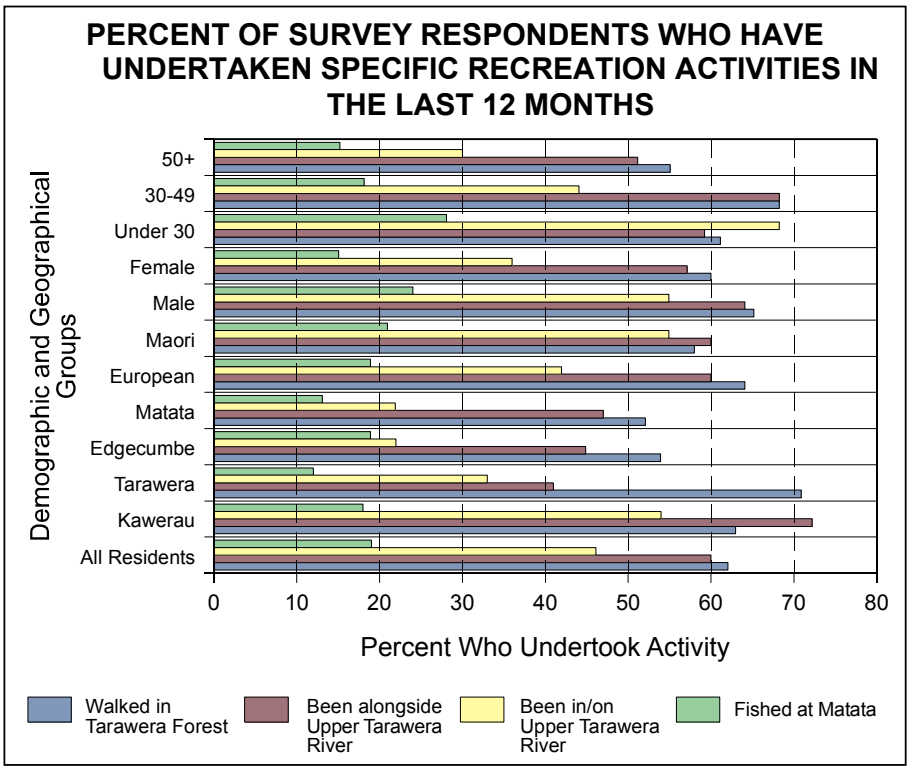
25.1 Recreational Use Survey

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