16 Groundwater Quality and Quantity

16.1 Introduction

In this chapter the extent and location of the groundwater resources in the Tarawera River catchment, in particular the lower catchment area are discussed. The chapter does not cover the geothermal resources, which are discussed separately. The Resource Management Act 1991 defines geothermal water as having temperatures equal to or greater than 30°C. Conversely, in the context of this chapter, non-geothermal groundwater is defined as having temperatures less than 30°C.

The chapter also indicates the quality assessments for the groundwater resources and proposes groundwater uses relative to the limitations of those results. Policy considerations arise from the effects of land use activities and industry.

Use of groundwater resources, and waste disposal activities which may influence the groundwater environment, are predominantly exercised in the Lower Tarawera catchment. Since the 1950s, the groundwater resources (mainly springs) of the Lower Tarawera catchment have been a primary source for public water supplies. During the early 1980s, a rapid development in horticulture on the Rangitaiki Plains resulted in an increase in use of borehole groundwaters.

16.2 Groundwater Systems

Groundwater resources in the catchment of the Upper Reach of the Tarawera River are poorly documented mainly because of the low demand for use of groundwater. Surface water supplies suffice for current demand. Most groundwater usage of the Upper Tarawera catchment is within the Kawerau District Council boundary. In the lakes portion of the catchment only two bores have resource consents to take groundwater. Shallow groundwater (6 metres depth) is used in a timber treatment plant at Rainbow Mountain.

The major aquifers in the catchment of the Lower Reach of the Tarawera River are the widespread pumice sand and gravel aquifers, and the largely distributed ignimbrite aquifer. In the north-eastern part of the catchment, ignimbrite seems to be absent. Compared to those of the shallow system (<70 metres), the hydraulic properties of the deep system (70-400 metres) are heterogeneous[111].

The main recharge resources of the shallow groundwater are rainfall and deep groundwater upflow. Ignimbrite groundwater is mainly recharged by rainfall in the mountains and hills surrounding the plains through fractured rock and fault zones.

The regional groundwater flow is from southwest to northeast toward the coast on the plains. In the north-western margin, groundwater flows from northwest to southeast towards the Tarawera River and Rangitaiki Plains.

Changes in shallow groundwater levels basically follow rainfall with various degrees of lag. Groundwater levels in some deep wells display a similar pattern to that of Lake Rotoma water levels, while groundwater levels in some deep wells are very constant. Groundwater levels in shallow bores and some deep bores increased between 1988 and 1990, remained relatively stable between 1990 and 1992, and have decreased since 1992. The 1987 Edgecumbe Earthquake caused an abnormal change in groundwater levels between 1987 and 1988 in both the shallow and deep systems.

[111] Pang, L, Environmental Report 94/3.

16.3 Groundwater Quantity and Allocation

The estimated natural groundwater discharges into the sea are about 19,000 to 41,000 cubic metres per day from the shallow system and 62,000 cubic metres per day from the deep system. The total volume discharged from the major water supply springs into surface channels is about 56,000 cubic metres per day. The groundwater storage within the aquifer systems is inferred as being 5.3x107 to 1.8x109 cubic metres in the shallow system, and more than 2x109 cubic metres in the deep system. However, these estimates have a great degree of uncertainty.

The total consented abstraction of groundwater was 41,381 cubic metres per day by March 1994, including 63% from springs and 37% from boreholes. The largest groundwater consumption (76%) is for public water supply. The second largest use is for irrigation and frost protection (21%). Groundwater for public water supply is predominately ignimbrite groundwater (mainly from the Braemar Springs and Johnson Road bore). Groundwater for non-consented groundwater use is probably less than 1,000 cubic metres per day.

The volume of groundwater abstraction is within the fluctuation of natural discharge. Deep groundwater is believed to have greater water-yielding capacity than that currently abstracted. The future demand for groundwater abstraction from boreholes is unlikely to increase significantly in the near future. However, the Braemar Scheme is likely to expand.

16.4 Groundwater Quality

Generally, most shallow groundwaters are of poorer quality than the deep ignimbrite groundwater. Levels of iron, dissolved oxygen, pH, and boron in many shallow bores do not comply with potable water guidelines. Of these, boron is health related, while iron, dissolved oxygen and pH are not health related. Some shallow groundwaters, with high boron or dissolved solids, are suitable only for the irrigation of crops which are tolerant to boron or salt. Poor quality shallow groundwater is mainly found in the area between Otakiri Road and Greig Road, coinciding with a boron anomaly which is probably of geothermal origin, from a natural sub-surface outflow from the Kawerau Geothermal Field. This sub-surface outflow is consistent with low resistivity to the north and northeast of the main thermal area. It is important to note that because the net rate of abstraction of fluid from geothermal bores now exceeds the likely deep inflow to the Kawerau Geothermal Field, the sub-surface outflow has probably reduced, and a long-term improvement in groundwater quality may occur. Better water quality shallow groundwaters are found in the peripheral areas of the plains[112].

Deep ignimbrite groundwater contains low concentrations in all chemical compositions. It is generally of good quality for potable water supply, irrigation and most other purposes. This is the source of current public water supplies. Occasionally, bacterial and organic contamination has occurred in the water supplies of the catchment. The Jennings Spring has displayed an increasing trend in concentrations of nitrate, chloride and sulphate. Nitrate in the Pumphouse Spring has also slightly increased. There are commonly low fluoride concentrations (with respect to the recommended desirable levels for potable water supply) in all the water supplies of the catchment.

Both shallow and deep groundwaters have corrosion and encrustation hazards for well and pump components, and reticulation systems. Corrosion can increase concentrations of iron, manganese, zinc, and copper in reticulated waters, and may cause copper stripping problems.

The influence of Tarawera River water on adjacent shallow groundwater occurs only to a shallow depth. Seawater intrusion has occurred near the coast.

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[112] Pang, L, Environmental Report 94/3.

16.5 Impact of Waste Disposal on Groundwater Quality

In general, increase in chemical loadings in the groundwater of disposal areas above background levels cannot be avoided. The purpose of environmental management is to minimise the adverse effects and to control the impact within acceptable levels. Background levels and drinking water standards are commonly used as two baselines for assessment of environmental impact and protection of groundwater quality.

16.5.1 Tasman Pulp and Paper Company Limited Solid Waste Disposal and Effluent Treatment

Of the monitored parameters of COD, BOD_5, colour, chloride, nitrate, nitrite, sodium, sulphate, phosphate, suspended solids, total dissolved solids, pH, iron, manganese, zinc and electrical conductivity, only total dissolved solids have slightly exceeded the drinking water standard in some monitoring bores, resulting from the operation of the Tasman Pulp and Paper Company Limited effluent treatment plant and solid waste disposal activities. High metal concentrations and low pH levels, which do not comply with drinking water standards, in the groundwaters of the disposal area and adjacent area occur naturally in the shallow groundwater.

Except for two bores, water quality of the private supplies in the vicinity of the Tasman Pulp and Paper Company Limited Treatment and Disposal Area is similar to drinking water standards. The poor water quality of the Knight's water supplies is probably caused by local agricultural contamination sources. The deteriorated water quality in the Barkla's bore is believed to be mainly affected by the polluted Tarawera River water.

16.5.2 Tasman Pulp and Paper Company Limited Effluent Irrigation Trials

The concentrations of monitored parameters of sodium, chloride, potassium, calcium, sulphate, and nitrate in the shallow groundwater of the irrigated area were well below the limits of drinking water standards during the trials (1985-1989). The efficiency of contaminant removal was higher at slow irrigation rates than at higher irrigation rates. At high irrigation rates, some chemical components were leached from the soil.

16.5.3 Carter Holt Harvey Tissue Rapid Infiltration Basins

Carter Holt Harvey Tissue's Rapid Infiltration basins (RIB's) are impacted by natural geothermal inflows. Groundwater under the site is sourced locally from rainfall infiltration and discharges into the Tarawera River adjacent the site. The groundwater contains indirect discharges from the RIB's. The edge of the alluvial materials on the western side of the site, marked by a change to hilly terrain, provides a nearby containing boundary to groundwater flow, further containing the extent of down-gradient effects from the basin. The Ruruanga Stream that skirts the foot of the hills is perched in isolation above the groundwater system in the area of the basins.

Two parameters, sodium and BOD_5, have been monitored in the shallow groundwater around the RIB's. Since the RIB's were commissioned, the levels of sodium and BOD_5 have increased by 27-87 times and 26-238 times respectively. Sodium levels now exceed the drinking water guideline by up to 4 times. At present there are no known drinking water supply bores in the vicinity of the RIB effluent plume.

16.5.4 Spray Irrigation of Dairy Factory Effluent

Of the monitored parameters of pH, BOD_5, electrical conductivity, total kjeldahl nitrogen, nitrate, total phosphorus, sodium, potassium, calcium, and magnesium, only calcium and nitrate have slightly exceeded the drinking water standards in two monitoring bores. The low pH dairy factory effluent has slightly increased the acidity of the local shallow groundwater.

The spray irrigation system which is operated at a slow irrigation rate has demonstrated very high efficiency (94-99.9%) in removal of BOD, total kjeldahl nitrogen, potassium, and calcium, and high efficiency (74-85%) in removal of sodium and nitrate.

The down-gradient private borehole groundwaters sampled during 1987-1989 did not show detectable impact from the irrigation system. The current impact is unknown since there are no recent monitoring data. However, groundwater flow is very slow at this area due to the presence of peat deposits.

16.5.5 Kawerau Landfill

The Kawerau Landfill, because it is located up-gradient, may cause the occasional organic and bacterial contamination of the Pumphouse Spring. Other contamination sources could also be agricultural activities and changes in land use.

16.5.6 Reinjection of Geothermal Water

Geothermal water contains naturally occurring arsenic, boron, ammonium, chloride and sodium at concentrations which exceed the potable water guidelines.

Currently geothermal effluent is being reinjected into the Kawerau geothermal reservoir at 100-330 metre depth. Reservoir pressures have not changed significantly and it is, therefore, unlikely that reinjection has had any major influence on the natural sub-surface outflows, as discussed in 16.4.

Further investigations are needed into the possible link between the geothermal field and the groundwater wells to the north. These investigations should precede any significant increase in the reinjection programme so that any effects on groundwater resources can be assessed.

At this stage, Environment Bay of Plenty believe there is not an immediate threat to the Otakiri water supplies because of the low transport velocity of the reinjected fluid and possible retardation of contaminant in the aquifer.

16.5.7 Supporting Technical Report

The following technical report, written as part of the preparation of this *Regional Plan for the Tarawera River Catchment*, contains more detailed information on the groundwater resources in the Tarawera River catchment:

Pang, L 1994 (July), Groundwater Resources of the Lower Tarawera Catchment, Environment Bay of Plenty Environmental Report 94/3.

16.6 Future Use of Groundwater Resources

Good quality groundwater is expected to be obtained in the following areas:

(a) West of the Tarawera River for both the shallow and deep groundwaters, outside the geothermal areas;

(b) South of the Kawerau Geothermal Field for both the shallow and deep groundwaters;

(c) Between north of the Kawerau Geothermal Field and south of Otakiri Road for deep ignimbrite groundwater.

Future development of groundwater use could be proposed in these areas. The full utilization of the natural discharge of springs could be encouraged.

The areas which are not recommended for future development of both the shallow and deep groundwaters for potable water supply and irrigation purposes are:

(d) The coast area, due to the potential for seawater intrusion;

(e) Between Otakiri Road and Greig Road, due to the naturally high boron concentrations in the groundwater; and

(f) The Kawerau Geothermal Field, due to possible geothermal water influence. However, some shallow groundwaters in the field have not significant geothermal influence and can still be used for potable water supply and irrigation purposes.

16.7 Future Waste Disposal and Monitoring Requirements

The Bay Milk Products spray irrigation system and Tasman Pulp and Paper Company Limited irrigation trials have suggested that the land spray irrigation system under slow irrigation rates is a desirable option in disposal of treated industrial effluent. Provided that the concentrations of applied chemical compositions in groundwater outside the disposal area are within the acceptable levels (e.g. drinking water standards), such a system should be encouraged. The system must be associated with a comprehensive monitoring programme which includes indicators of potential contamination from the system.

A site for land disposal of wastes should be located in an area where physical factors are suitable for the treatment and assimilation of contaminants in the waste. In particular this would be an area away from surface water bodies where the risk of contaminating ground and surface water could be largely negated by the treatment capacity of soil and the uptake of nutrients by plants. Key factors would include a low site slope angle to limit the possibility of overland flows, vegetation cover able to reach and take up nutrients from the waste, and the ability of soils and ground strata under the site to enable the biological breakdown of nutrients and the retention of elements.

The selection of steeper forest land as a disposal site would require sufficiently low groundwater table and be at an adequate distance from surface water sources. The mountains and hills surrounding the plains are the recharge area of the high quality ignimbrite groundwater. Groundwater monitoring in such an area must be strictly monitored to ensure no breaching of drinking water standards occurs.

Waste disposal activities in the up-slope areas of water supply catchments should be strictly controlled or prohibited.

The area north of Otakiri Road is recommended as an optional area for irrigation of effluent due to the following facts:

(a) Organic-rich peat deposits have a strong attenuation capacity to take in contaminants;

(b) The area is near the coast which is the final groundwater discharge base;

(c) Naturally, shallow groundwater in this area is not suitable for potable water supply and only suitable for irrigation or boron tolerant crops.

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

16.8.1 Issues

Issues relating to groundwater quality and quantity are:

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

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

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

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

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

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

16.8.2 Objective

Protect the quality and quantity of the groundwater resources of the Tarawera River catchment.

16.8.3 Policies

16.8.3(a) To protect groundwater recharge zones form contamination.

16.8.3(b) High quality water in the deep aquifers should only be used for activities that require high quality water.

16.8.3(c) Non-potable water in the shallow aquifers under the Tarawera River catchment should be used in preference to high quality water for activities which do not require the use of high quality water.

16.8.3(d) To require the return of construction, installation and yield test information from production bores or wells.

16.8.3(e) To discourage the contamination of shallow unconfined aquifers from land based effluent disposal systems.

16.8.3(f) To advocate that the discharge of dairy shed effluent is in accordance with guidelines agreed between Environment Bay of Plenty and the agricultural industry.

16.8.3(g) To protect the quality of spring water from land use activities that result in contamination through stormwater runoff.

16.8.3(h) To promote the use of land based contaminant disposal systems over areas sufficient and appropriate to the long-term treatment capacity of substrata.

16.8.3(i) To encourage land based contaminant disposal systems that involve effective nutrient uptake.

16.8.3(j) To ensure effective monitoring of the effects that land based contaminant disposal systems may have on both ground and surface water resources.

16.8.3(k) To provide, following an initial operation and monitoring period, for long-term discharge consents for land based contaminant disposal systems that effectively dispose waste without significantly adversely affecting water resources.

16.8.3(l) To require the efficient use of groundwater resources.

16.8.4 Methods of Implementation – Information

16.8.4(a) Information held by Environment Bay of Plenty relating to aquifer water quality and quantity will be made readily available to any interested person.

16.8.4(b) Environment Bay of Plenty will actively discourage and advocate against land use activity that causes or has the potential to cause the contamination of spring water used for domestic or municipal supply.

16.8.4(c) Environment Bay of Plenty will advise and advocate that the installation and management of on-site (sewage) effluent treatment systems within the Tarawera River catchment be in accordance with the policies and rules of the *Operative On-Site Effluent Treatment Regional Plan*.

16.8.4(d) Any application to take and use groundwater shall include information describing the efficient use of the groundwater allocation sought relative to the activity proposed.

16.8.5 Methods of Implementation – Rules

16.8.5(a) Any discharge of waste onto or into land in a way or at a rate that may result in the percolation or movement of contaminants into groundwater shall be a Discretionary Activity provided:

(a) This rule does not apply to the on-site discharge of domestic sewage regulated under the "*Operative On-Site Effluent Treatment Regional Plan for the Bay of Plenty*", and

(b) Any application for the land treatment of effluent originating form dairy sheds shall be subject to conditions made with regard to the "*Guidelines for Agricultural Discharges to the Tarawera and Rangitaiki Catchments* – September 1992".

16.8.5(b) A discharge permit granted pursuant to Rule 16.8.5(a) shall be subject to conditions that limit the land application discharge rate of effluent relative to disposal site constraints, to provide for the protection of groundwater and surface water resources from contamination.

16.8.5(c) Except as provided for in Rule 17.4.4(d), the direct point-source injection of contaminants into a groundwater aquifer is a Prohibited Activity.

16.8.5(d) A resource consent granted under Rule 16.8.5(a) for a discharge permit authorising an efficient land based treatment system, designed and managed to ensure minimal long-term effects on surface and groundwater quality and quantity, may be granted for a period up to the maximum provided by statute, subject to performance review conditions.

16.8.5(e) The taking of underground water at a volume equal to or less than 15 cubic metres per day shall be a Permitted Activity.

16.8.5(f) The taking of underground water at a volume exceeding 15 cubic metres per day shall be a Discretionary Activity.

16.8.5(g) A resource consent granted pursuant to Rule 16.8.5(f) for a water permit for which a new bore or well is to be installed shall be subject to the following condition:

Bore Log and Test Information

The consent holder shall, within one month from the day on which their consent is granted, return the following information to Environment Bay of Plenty:

(a) The name and address of the bore driller, the final location of the bore, its construction method and liner material.

(b) The dimensions of the bore; diameter and depth.

(c) A log of the bore installation showing the depth and extent of intercepted strata (lithology), geologic layers, water bearing aquifers and water access screens.

(d) A copy of bore pump test results, including information on; sustainable bore yield, water level drawdown, static water level and transmissivity data.

16.8.6 Principal Reasons

There are extensive groundwater resources within the catchment of the Lower Reach of the Tarawera River. Of particular value is the deeper (70-400 metre) aquifer system which has high quality water and is yet to be used to any extent, and is a valuable future resource to be protected. Usually deep aquifers are naturally buffered from contaminants. However, the quality of water in deeper aquifers is not immune to longer term effects such as nitrate contamination from extensive farming activities and decreased inflows due to natural and artificial alternations to catchment hydrologies, and to rainfall.

Shallower aquifers, particularly those that are unconfined form surface influences, are more directly and substantially exposed to degradation from the surface disposal of contaminants. If these shallow resources are to be used, even if that use is restricted to agricultural irrigation, extra quality protection measures will be required. The Tarawera River catchment also has geothermal influences, both natural and artificial, that have the potential to change the chemical composition of groundwater. The placement of geothermal reinjection bores is a particular concern.

The policies set out in this chapter are designed to encourage those who manage the disposal of effluents and contaminants to do so with understanding of the consequences on groundwater resources. Even the more desirable methods of disposing of nutrient rich effluent, such as land based spray irrigation systems, can pose a threat to the quality of groundwater if not managed in a way that recognises soil absorption limitations.

The taking and use of deeper potable groundwater for domestic and production purposes will be encouraged, as will the use of lower quality shallower groundwater for pasture and crop irrigation. Environment Bay of Plenty will make available to users any physical and chemical groundwater and aquifer information it has to help users make good decisions about groundwater use. In return, users who drill bores to tap and use groundwater will be required to provide details of underground strata and aquifers intercepted, to increase understanding for the future.

16.8.7 Anticipated Environmental Results

16.8.7(a) A better community understanding of the potential groundwater resources of the catchment of the Lower Reach of the Tarawera River.

16.8.7(b) Safeguarding of the quality of groundwater resources for future generations.

16.8.7(c) Efficient land based disposal systems, designed and managed to ensure minimal long-term effects on surface and groundwater quality and quantity will be encouraged.

16.8.7(d) Limited agricultural and domestic use if provided for.

16.8.7(e) Knowledge of aquifer configurations and groundwater chemical composition will be enhanced.