FRESH WATER RESOURCES

Rivers of Gisborne District

Principal findings

- Many of our rivers are silty and the beds are progressively filling with gravel
- Levels of bacteria in the rivers peak within two days of significant rainfall
- Other river water quality parameters were all within acceptable ranges
- There are approximately 600 ha of wetlands in the district
- The Makauri Aquifer and Waipaoa River are the major sources of irrigation water
- The summer of 02-03 was drier than normal, and an increased volume of water was required for irrigation
- Current levels of groundwater abstraction are believed to be sustainable

The rivers that discharge to the East Coast are predominantly slow-flowing through wide, open valleys, become silt-laden after heavy rain, and experience low summer flows.

Because of their capacity to carry sediment and gravel, the beds of these rivers aggrade (fill up) and are progressively losing capacity, increasing the risk of flooding. Gisborne City and the valuable and versatile soils of the Poverty Bay flats are protected against flooding by stopbanks of the Waipaoa Flood Control Scheme.

The main rivers entering Poverty Bay are the Waipaoa River, draining a catchment of approximately 2,200 km^2, and the Waimata River (catchment of 370 km^2). The Waimata merges with the Taruheru River only 1,200m from the sea, to become the Turanganui River, the shortest named river in New Zealand.

The Waipaoa River enters the sea at the southern end of Poverty Bay. It is a high sediment-yielding river, annually depositing 15 million tonnes of sediment into Poverty Bay. This equates to 33.54 cubic metres of sediment per second, or 5,900 t/km^2/yr for the Waipaoa catchment.

Other water quality parameters are however within acceptable ranges to sustain aquatic life in the Waipaoa.

Surface water bacterial monitoring results

	2003 sample compliance*		2004 sample compliance*	
	All year	Bathing season	All year	Bathing season
Turanganui River	12 of 16**	7 of 10	10 of 17	7 of 10
Waipaoa River	13 of 17	8 of 10	9 of 17	5 of 10
Wherowhero Lagoon	16 of 17	10 of 10	13 of 17	8 of 10

*MoH single-sample limit of 280 *enterococci* per 100ml
** Results are displayed as number of complying samples out of total number of samples taken.

City rivers used for recreation

The Taruheru, Waimata and Turanganui Rivers flow through Gisborne city and are used for launching boats, paddling waka, kayaks, and for swimming and fishing.

High levels of bacteria in these rivers generally follow, but are not directly proportional to, rainfall events.

Long-term monitoring indicates that river bacterial levels peak within approximately two days of a significant rainfall event that follows a reasonable dry period. However if the rain continues beyond two days, bacterial levels within the river begin to decline regardless of the rainfall intensity. This means peak bacteria levels within the rivers do not always coincide with peak rainfall.

In 2003 the highest bacterial levels were recorded in September, when 9mm of rain fell the day before sampling.

Above: The Waipaoa River in low summer flow.

East Coast rivers

Of the East Coast rivers, the Wharekahika River has the lowest sediment loads, a high aesthetic value and would be expected to be rich in aquatic life.

Above: The Mangapoi River, inland from Ruatoria, is an example of a rapidly aggrading river bed.

The Waiapu is the dirtiest river in the region, with an annual suspended sediment load of 36 million tonnes. This equates to an average of 90.47 cubic metres of sediment per second and a catchment yield of 20,520 t/km^2/yr (Hicks et al. 2000).

Although other water quality parameters are within the acceptable range, aquatic species would be restricted to those with very short larval periods able to complete their life cycle during the short periods of relatively clear flow (mayflies, midges and oligochaete worms).

Gisborne District also contains the headwaters of four major rivers flowing into other regions. The Hangaroa flows south into Hawke's Bay; the Motu, Waioeka and Waikura rivers flow into the Bay of Plenty.

These north-flowing rivers are clear, fast-flowing and highly regarded for their recreational value by fishers, canoeists and white-water rafters.

Lakes and wetlands

The region has very few wetlands and only a few minor lakes. Historically around 90% were drained when the land was converted to pasture. Those that remain comprise small farm ponds and dams, however collectively these are significant habitat for waterbirds. Many farmers, recognising the conservation value of wetlands, are now fencing and restoring these areas on their land.

There are an estimated 600 ha of wetlands in the district. Most of these are on private land.

Significant wetlands of Gisborne District

Tiniroto Lakes	10 small lakes, ponds and wetlands (53ha) on private land.
Emirau Wetlands, Tolaga Bay	15ha of small ponds with diverse vegetation, on private land
Wherowhero Lagoon	200ha of estuary south of Waipaoa River mouth comprising tidal mud flats, lagoon, dunes and sandspit. Part is on private land, the central 69ha protected by a QEII open space covenant.
Motu Wetland	24.5 ha on alluvial terraces of the Motu River. Some vegetation modified, some areas of primary vegetation with kahikitea on the margins.
Repongaere Lakes	70 ha of private land, including Repongaere Lake, Tuhoe and Dods lakelets
Matawhero Loop	Oxbow lagoon isolated by completion of the Waipaoa Flood Control Scheme. Wildlife reserve of 48 ha.

Above: A fenced and replanted farm wetland.

Shingle extraction

Aggradation (accumulation of gravel) and high bedload levels in most of the rivers of Gisborne District allow for sustainable shingle extraction.

Shingle quality varies significantly with geology throughout the region. Areas that contain hard basement rocks such as greywacke, volcanic basalt and hard argillite generally provide good quality shingle, while mudstones and siltstones provide poorer quality soft material which weathers rapidly to fine particles of silt and clay.

Shingle is predominantly used in road construction and maintenance. The Gisborne District Council, roading contractors and the major forestry companies hold shingle extraction consents for potentially large volumes, and the amount of shingle allocated increases annually.

However actual volumes extracted have been significantly less. There has been a recent downturn in forestry and shingle extraction volumes have decreased. However an increase in log prices could reverse this trend.

Approximately 96,000 cubic metres of material was taken in 2003 and 36,700m^3 in 2004, mainly from the Waiapu, Mangaoporo, Karakatuwhero and Waipaoa River systems.

The actual volume of material accumulating within the river systems is presently unknown. Data collection is ongoing and we will build up a clearer picture over time.

Groundwater aquifers

Groundwater aquifers are permeable geological formations, often gravel or sand, which hold water and will release it at rates fast enough to be useful. Rainwater and infiltration from rivers and streams recharge the aquifer.

The aquifers beneath the Poverty Bay flats comprise buried sediments left by the Waipaoa River as it meandered across the basin over many thousands of years. There are over 1,400 bores on the flats.

There are shallow unconfined sand aquifers at Tolaga Bay, Tokomaru Bay and beneath the river flats and terraces of the Waiapu River at Ruatoria and at Tikitiki.

Unconfined aquifers may be perched on top of an impermeable layer, but are not confined by a top layer.

Confined aquifers are sandwiched between impermeable layers and this can protect the water against bacterial contamination. Water in the confined aquifers has a longer 'residence time' beneath the ground, and so becomes enriched in dissolved minerals, making the water hard.

The Poverty Bay aquifer system is 'leaky' in that groundwater aquifers interact with each other and with river water.

Over 60% of the groundwater drawn from the aquifers is used for irrigation. Industry and the community supply for Te Karaka use less than 2% of allocated groundwater. The remainder is used for stock water and domestic supply.

Makauri aquifer

The Makauri aquifer is the most productive and extends under most of the Poverty Bay flats. It yields large quantities of water and is extensively used for irrigation. The amount of water abstracted has varied over the years as horticulture and crop types change. The greatest demand placed on this aquifer so far was during the kiwifruit boom of the early eighties. The area of kiwifruit on the flats is expanding once again.

Iron levels range from 2.0 g/m^3 in the Hexton area up to 12.0 g/m^3 around Makaraka (the New Zealand drinking standard for iron is just 0.2g/m^3). Dissolved iron is not a health risk but creates an unpalatable taste and would stain laundry, toilets and hand-basins.

Te Karaka and Whatatutu residents do use water from the Makauri aquifer to top up domestic rainwater tanks; it is filtered by the Council to reduce the levels of iron (and manganese) in the water to acceptable levels.

River quality monitoring results – average values

River	Suspended solids[1] (g/m³) 2003 / 2004		pH[2] -log (H⁺) 2003 / 2004		BOD[3] g/m³ 2003 / 2004		Dissolved Oxygen[4] g/m³ 2003 / 2004		Ammonia[5] g/m³ 2003 / 2004		Temperature °C min 2003 / 2004		max 2003/2004	
Waipaoa	1579 v.high ✕✕	166 high ✕	8.1 ✓✓	8.1 ✓✓	1.25 low ✓✓	0.75 low ✓✓	9.7 high ✓✓	9.4 high ✓✓	0.01 low ✓✓	0.01 low ✓✓	7.7	7.4	22.5	20.5
Waimata	70 mod ✓	16 low ✓✓	8.0 ✓✓	7.9 ✓✓	0.97 low ✓✓	0.73 low ✓✓	9.1 high ✓✓	8.7 high ✓✓	0.02 low ✓✓	0.08 low ✓✓	9.1	8.6	23.3	25.0
Taruheru	32 low ✓✓	18 low ✓✓	7.8 ✓✓	7.7 ✓✓	4.10 mod ✓	1.2 low ✓✓	7.1 high ✓✓	7.0 high ✓✓	0.06 low ✓✓	n/a	9.2	10.1	20.9	23.4
Turanganui	29 low ✓✓	37 low ✓✓	8.0 ✓✓	7.9 ✓✓	1.08 low ✓✓	0.76 low ✓✓	8.1 high ✓✓	8.0 high ✓✓	0.02 low ✓✓	0.01 low ✓✓	8.8	9.7	21.6	21.8
Wharekahika	6 low ✓✓	5 low ✓✓	7.6 ✓✓	7.5 ✓✓	0.52 low ✓✓	0.5 low ✓✓	9.5 high ✓✓	9.0 high ✓✓	0.01 low ✓✓	0.01 low ✓✓	9.9	8.7	19.8	17.0
Awatere	121 high ✕	91 mod ✓	7.9 ✓✓	8.0 ✓✓	0.54 low ✓✓	0.5 low ✓✓	9.7 high ✓✓	9.9 high ✓✓	0.01 low ✓✓	0.01 low ✓✓	9.1	9.1	18.5	16.9
Waiapu	1816 v..high ✕✕	516 high ✕	8.0 ✓✓	8.1 ✓✓	0.93 low ✓✓	0.57 low ✓✓	9.5 high ✓✓	9.7 high ✓✓	0.06 low ✓✓	0.01 low ✓✓	8.1	8.5	19.4	19.8
Mata	426 high ✕	246 high ✕	8.2 ✓✓	8.3 ✓✓	0.74 low ✓✓	0.73 low ✓✓	8.9 high ✓✓	9.6 high ✓✓	0.02 low ✓✓	0.02 low ✓✓	5.9	5.3	19.3	17.9
Hikuwai	75 mod ✓	275 high ✕	8.0 ✓✓	8.1 ✓✓	0.76 low ✓✓	0.82 low ✓✓	9.3 high ✓✓	9.4 high ✓✓	0.01 low ✓✓	0.02 low ✓✓	7.4	9.1	22.4	22.2

1: Suspended silt, sand and clay. May suffocate fish eggs and clog gills.
2: Aquatic life will tolerate a range from pH 5 to 9.
3: Biochemical oxygen demand – indicates bacterial load in water. If too high, oxygen in water depleted.
4: Requirement for aquatic life. For fish must be over 3g/m³
5: Should not exceed 0.9g/m³. Sources include stock effluent, fertilisers, breakdown of organic matter in water.
n/a: not available.

mod moderate	✓✓ good	✓ acceptable	✕ unacceptable	✕✕ very poor

Matokitoki gravel aquifer

The Matokitoki gravel aquifer is found beneath Gisborne city at depths below 34m. It extends out beneath the Poverty Bay flats, however it becomes deeper with distance from the coast, and by Kings Road is 135m below the surface; too deep to be extensively used for irrigation.

The water is very old and very hard, making it unsuitable for use without treatment. A large volume of water is allocated as an emergency supply for Gisborne City, but has not been needed since Cyclone Bola in 1988.

Waipaoa gravel aquifer

This aquifer is found at depths of 15 to 20m below ground, is semi-confined to confined, and has direct connections to the Waipaoa River. The water is hard, though suitable for stock use, for irrigation, and for domestic use if treated.

Above: 'Artesian' water is under pressure and flows to the surface unaided.

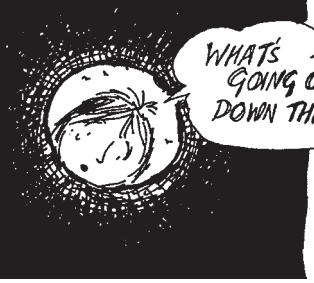
Shallow fluvial deposits

These are located near the surface and down to depths of 20m. They comprise semi-confined to confined pumice, volcanic sand deposits and former channels of the Waipaoa River and are recharged by rainwater and the river. The water is suitable for irrigation and stock water.

Te Hapara sands aquifer

This is the most extensive unconfined shallow aquifer system, composed of ancient beach sands and dunes up to 20 metres thick extending several kilometres inland. Water quality varies from one location to another.

Unconfined aquifers may potentially become contaminated by bacteria from stock or septic tanks, particularly after rainfall. For this reason the Te Hapara sands aquifer is not considered a potable supply, but can be used for irrigation, and by city residents for watering gardens and lawns.



A hidden resource

The extent, depth and quality of water within the Poverty Bay aquifers were unknown until people began to drill bores to look for water. We now have a three-dimensional concept of the aquifer system that has been built up over time, and information is added when new bores are drilled in new locations.

It is necessary to obtain a permit from the Council to drill a well or bore, and the water resources section can give some advice on where to drill based on information from neighbouring bores. Every bore is however exploratory as the precise location of the 'edges' of the aquifers are unknown; the picture is slowly becoming more complete.

Ongoing monitoring is used to assess sustainability of groundwater resources. Keeping records of bore pressures/levels is the only way to fine-tune the volumes we believe the aquifers can sustainably yield. It is a case of looking at the data over time to ensure that complete recharge is achieved between irrigation seasons.

Above: Drilling a groundwater bore is a specialist job.

Currently only a fraction of allocated groundwater is actually used, and Gisborne's climate normally provides rain at intervals over the summer: An extended drought is very rare here. Growers are able to monitor soil moisture levels and will irrigate only when necessary and beneficial to the crop, which improves efficiency of water (and power) use. Even though permits state a daily allocated amount and rate of water, in reality irrigation is always intermittent, and naturally only some users will be irrigating on a particular day.

There are many variables in groundwater use. Ongoing monitoring will ensure the resource is managed sustainably.

Water permits and abstraction

All groundwater takes in the Gisborne District greater than 10 cubic metres of water per day require a water permit and installation of a water meter. Council sends out a letter to all water-permit holders prior to the irrigation season notifying the dates when water meters are to be read: fortnightly for the aquifer systems under the most stress and monthly for the others. The permit holder is required to fax, phone or email the information to the Council.

The greatest demand for groundwater in recent years occurred during the dry summer of 2002/03 when 838,146m^3 of water was abstracted (across all bores). The following summer, 2003/04, was wetter and abstracted volumes returned to typical levels, a total of 547,935m^3.

Groundwater draw-down and recharge

The Council monitors water levels in aquifers used for irrigation via a network of 51 Council-owned monitoring bores, and in addition a further 39 private bores are monitored.

Water levels are observed to fluctuate seasonally. There is a period of draw-down during the summer when bores are being used for irrigation, followed by an increase in water levels after irrigation ceases and the aquifers are recharged by the Waipaoa River, other interconnected aquifers, or by percolation of rainwater into the unconfined aquifers.

The Makauri aquifer is the most heavily utilised water resource, mainly for irrigation of summer crops on the Poverty Bay flats. January 2003 was particularly dry and as expected there was a corresponding dramatic fall in water pressure/level in the aquifer.

January and February 2004 were wetter months than normal, and there was a reduced demand for irrigation water. March 2004 was however very dry, and the plot reveals a late dip in water level following the demand for irrigation water towards the end of the season.

Prior to 1997, water levels in the Makauri Aquifer appeared to be declining. Climatic conditions have been wetter since 1997 and this situation has reversed. The aquifer recharged fully after each of the 02-03 and 03-04 irrigation seasons, and in fact recharged to its highest level in recent years. We therefore believe this aquifer is currently being sustainably used.

Nitrates in groundwater

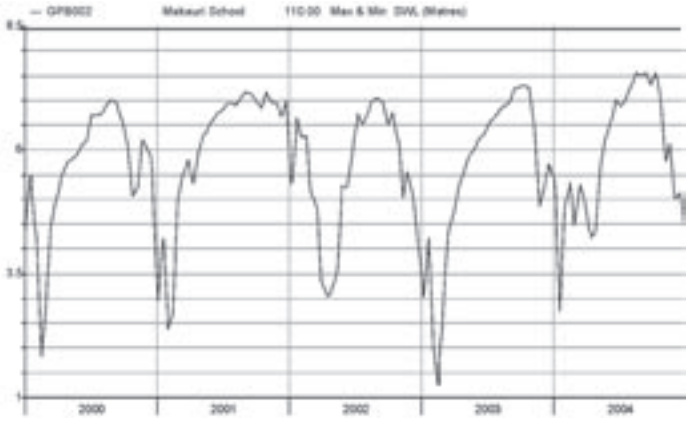
An increase in levels of nitrates in groundwater is a serious concern in some regions of New Zealand, particularly in dairy farming areas. Dairying is only a very minor land use in Gisborne District; there are only four dairy farms.

The spreading of manures and nitrogen fertilisers is a permitted activity in Gisborne District, however an upper limit has been set at 200kg/ha total nitrogen.

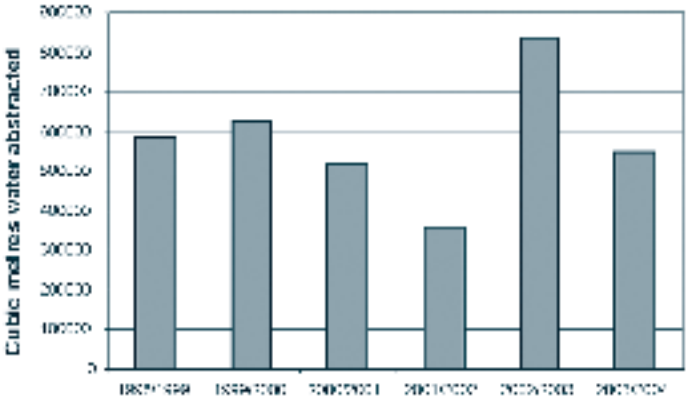
Localised sources of nitrogen which can enter groundwater include fertiliser storage sheds and seepage from septic tanks.

The Gisborne District Council tests for nitrates in the shallow aquifers of the Poverty Bay flats. Nitrates do occur at low levels, but are presently of no consequence to human health if the water is consumed.

Makauri Aquifer static water levels



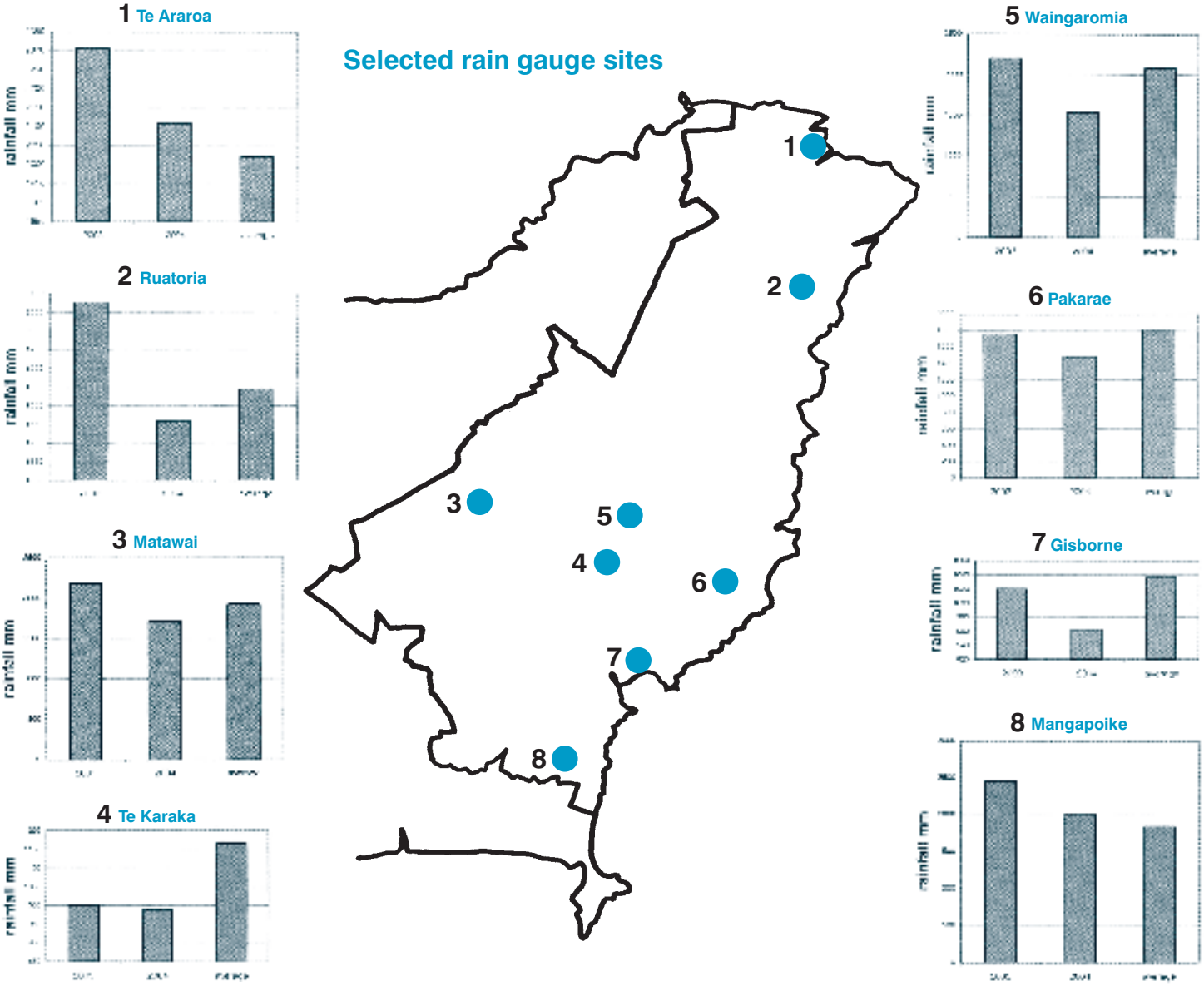
Summer groundwater abstraction comparisons



Rainfall in 2003-04

Rainfall data is continuously recorded at 37 sites within Gisborne District. During 2003 and 2004, rainfall distribution was very varied. Some areas were much wetter, and others much drier than average.

Rainfall for 2003 and 2004 was below average for all of Poverty Bay (see Gisborne and Te Karaka graphs). Rainfall was close to average for inland hill-country areas. However, on the East Coast (Ruatoria and Te Araroa graphs), 2003 was a very wet year. These sites received around double the average annual rainfall. In 2004, Te Araroa recorded slightly above average rainfall, and Ruatoria experienced drier than normal conditions.



Fresh water resources used for irrigation 03/04 season	Number water permits held	Active users	Irrigation water abstracted in typical season* (m^3)	Typical % water used compared with permitted amount
Makauri aquifer	23	14	434,000	20
Waipaoa River	34	10	400,400	5
Te Hapara sand aquifer	21	14	115,100	16
Shallow fluvial deposit	21	16	85,700	17
Waipaoa gravel aquifer	9	9	79,700	17
Wharekopae River	2	1	82,300	18
Matokitoki gravel aquifer	8	7	65,200	7
Te Arai River	8	4	52,500	12
Whakaahu Stream	4	1	17,400	14
Waikohu Stream	3	1	10,700	6.6
Taruheru River	1	0	0	-
Maraetaha Stream	1	0	0	-

* The irrigation season is taken as 181 days from October to March.

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Average ground water quality monitoring results 2003-2004

Key to symbols	✓✓ good	✓ acceptable	× unacceptable	mod moderate	n/d not done	* low bacterial count indicates suitability for stock water

Aquifer (bore)and location	Nitrates g/m³ 2003 / 2004		Bacteria cfu/100ml 2003 / 2004		Salinity ppt 2003 / 2004		PH -log(H⁺) 2003 / 2004		Iron g/m³ 2003 / 2004		Manganese g/m³ 2003 / 2004		Hardness g/m³ 2003 / 2004	
Te Hapara sands aquifer (GPB099) at Cameron Road	0.067 low ✓✓	0.004 low ✓✓	1.0 low* ✓	1.0 low* ✓	0.2 low ✓✓	0.2 low ✓✓	7.95 mod ✓✓	8.0 mod ✓✓	0.085 low ✓✓	0.063 low ✓✓	0.02 low ✓✓	0.019 low ✓✓	220 mod ✓	226 mod ✓
Te Hapara sands aquifer (GPC030) at McDonald's Road	0.871 low ✓✓	0.307 low ✓✓	1.0 low* ✓	2.0 low* ✓	0.2 low ✓✓	0.2 low ✓✓	7.4 mod ✓✓	7.3 mod ✓✓	0.15 low ✓✓	0.12 low ✓✓	0.03 low ✓✓	0.03 low ✓✓	303 mod ✓	286 mod ✓
Te Hapara sands aquifer (GPA004) at Childers/Stanley Rd	0.023 low ✓✓	0.012 low ✓✓	1.0 low* ✓	1.0 low* ✓	0.2 low ✓✓	0.2 low ✓✓	7.6 mod ✓✓	7.5 mod ✓✓	0.40 mod ✓	0.48 mod ✓	0.09 low ✓✓	0.09 low ✓✓	240 mod ✓	250 mod ✓
Shallow fluvial deposit at Dunstan Road	n/d	n/d	1.0 low* ✓	2.0 low* ✓	1.02 high ×	1.3 high ×	7.03 mod ✓✓	7.03 mod ✓✓	17.7 v.high ×	24.43 v.high ×	1.41 high ×	1.82 high ×	653 high ×	810 high ×
Makauri gravel aquifer (GPH008) at Lavenham Road	n/d	n/d	n/d	n/d	0.3 low ✓✓	0.3 low ✓✓	7.2 mod ✓✓	7.2 mod ✓✓	0.73 mod ✓	1.8 mod ✓	0.62 high ×	0.56 high ×	327 mod ✓	326 mod ✓
Makauri gravel aquifer (GPG058) at Caesars Road	n/d	n/d	n/d	n/d	0.7 low ✓✓	0.7 low ✓✓	6.96 mod ✓✓	7.03 mod ✓✓	13.5 v.high ×	12.4 v.high ×	1.72 high ×	1.67 high ×	507 high ×	517 high ×
Makauri gravel aquifer (GPB002) at Makauri School	n/d	n/d	n/d	n/d	0.5 low ✓✓	0.5 low ✓✓	7.07 mod ✓✓	7.07 mod ✓✓	11.1 v.high ×	12.6 v.high ×	0.74 high ×	0.78 high ×	450 high ×	447 mod ✓
Makauri gravel aquifer (GPB135) at Cameron Road	n/d	n/d	n/d	n/d	1.2 high ×	1.9 high ×	6.9 mod ✓✓	6.93 mod ✓✓	15.85 v.high ×	13.9 v.high ×	0.87 high ×	0.925 high ×	965 high ×	930 high ×
Waipaoa gravel aquifer (GPG059) at Caesars Road	n/d	n/d	n/d	n/d	0.6 low ✓✓	0.56 low ✓✓	7.1 mod ✓✓	7.0 mod ✓✓	7.86 high ×	7.44 high ×	0.94 high ×	0.89 high ×	670 high ×	680 high ×
Waipaoa gravel aquifer (GPE040) at Waerenga a hika	n/d	n/d	n/d	n/d	0.5 low ✓✓	0.5 low ✓✓	7.2 mod ✓✓	7.17 mod ✓✓	5.97 high ×	9.91 high ×	0.56 mod ✓	0.55 mod ✓	450 high ×	427 mod ✓
Matokitoki gravel aquifer (GPB102) at Cameron Road	n/d	n/d	n/d	n/d	0.5 low ✓✓	0.5 low ✓✓	7.3 mod ✓✓	7.43 mod ✓✓	2.65 high ×	4.94 high ×	0.12 low ✓✓	0.13 low ✓✓	385 mod ✓	396 mod ✓
Matokitoki gravel aquifer (GPB126) at Kings Road	n/d	n/d	n/d	n/d	0.5 low ✓✓	0.5 low ✓✓	7.23 mod ✓✓	7.23 mod ✓✓	2.13 high ×	2.05 high ×	0.36 mod ✓	0.366 mod ✓	420 mod ✓	340 mod ✓
Matokitoki gravel aquifer (GPD111) at Bushmere	n/d	n/d	n/d	n/d	0.5 low ✓✓	0.5 low ✓✓	7.16 mod ✓✓	7.0 mod ✓✓	27.79 high ×	23.1 v.high ×	0.35 mod ✓	0.399 mod ✓	443 mod ✓	433 mod ✓