FRESH WATER RESOURCES

Fresh water – the national context

Water management has become a very topical and controversial issue in recent years because of tremendous pressure and competition between water-users, such as fishers, power-generation companies and irrigators, in some parts of New Zealand.

In some districts water resources are now over-allocated, while at the same time there is a dearth of knowledge of the amount of water actually used. This situation has largely arisen due to rapid large-scale land use change, particularly dairy conversion, and also vineyards. This intensification in land-use has occurred on (predominantly) coarse soil types with high infiltration rates, and consequently low moisture-holding capacity. New vineyards tend to be situated in the drier regions where irrigation is required.

Intensification of land means not only escalating requirements for water, but increased demand for energy and fertiliser. Any increase in fertiliser application, particularly of nitrogen, in turn raises water quality concerns.

Principal findings

- In October and November of 2005, Gisborne District experienced 'one-in-forty-year' and 'one-in-ten-year' flood events,
- 2006 was unusually wet from March through to August with numerous severe rainfall events resulting in cumulative damage
- Gisborne is fortunate: unlike some other regions we do not have over-allocated fresh water supplies, and our climate does provide rain at intervals over summer
- Current levels of groundwater abstraction are believed to be sustainable
- Levels of bacteria in rivers peak, as expected, within two days of significant rainfall
- The Makauri Aquifer and Waipaoa River remain the major sources of irrigation water on the Poverty Bay flats
- Shingle can be sustainably taken from several aggrading river beds

The Gisborne fresh water scene

The situation in the Gisborne District is fortunately far from critical, however we need to be vigilant of the signals that could change our circumstances.

Gisborne District Council is particularly fortunate to have historic data on water-use during the 'kiwifruit boom' of the 1980's. The (former) East Cape Catchment Board introduced compulsory metering of all consented water-takes, and set water-allocation thresholds. A significant volume of data was collected on how much water was abstracted, and the responses of our rivers and aquifers.

The soils of the Poverty Bay flats (aside from a sandy band running parallel to the coastline) generally comprise quite fine-textured silts and clays. These soils retain sufficient water to allow crops such as grapes to thrive locally without irrigation. On the flip side, the same soils, having high water-holding capacities, are therefore prone to ponding during wet weather, when heavy classes of stock, such as dairy cattle, would cause serious pugging and compaction.

It is therefore fortunate that dairy conversion, while happening apace in other regions, is unlikely to occur here. In fact dairy farm numbers have declined locally (to just three) due to land values and land parcel sizes making conversions unattractive.

In fact, Gisborne District has a limited amount of flat land suitable for irrigation, and irrigation-takes are currently limited to the Poverty Bay Flats.

Above: The Karakatuwhero River.

Above: The Waipaoa River is the main river entering Poverty Bay, and drains a 2,200km^2 catchment.

The Waipaoa and Waiapu River catchments include tributaries originating in high-rainfall areas that replenish river flows. Some smaller coastal catchments are not replenished in the same manner.

The use of k-line irrigation (for watering summer pastures) has at this stage not gained widespread popularity in this district. Several wetter-than-normal summers, combined with high energy costs and declining stock prices make irrigating pasture uneconomic at the present time.

The Poverty Bay Flats currently comprise a patchwork of land use: some crops that require high volumes of water at regular intervals (vegetables), interspersed with those requiring no irrigation at all (grapes and maize), and some that need continuous application of water only at crucial times (kiwifruit). The combined effect of this mixture of land uses does not currently over-tax our fresh water resources. However it is essential for Council to monitor trends and be prepared to act on any upsurge in water demand.

Addressing the national issues

The government is developing strategies to improve the management of freshwater throughout New Zealand, and provide ongoing protection of the resource into the future.

The government's initial strategy is a National Environmental Standard for water measuring devices (meters). This will set out minimum requirements for all measuring devices and define situations where such devices are compulsory.

Gisborne District Council made a submission supporting water measuring devices and their calibration, but requested that Council retain the flexibility to exempt some takes. The submission also opposed the requirement for devices to have data-storage capabilities, and suggested data storage is best left to Council.

Our submission therefore supported business-as-usual for local water-users, since all consented takes are required to be metered anyway, as part of the conditions of the consent. This has been the case locally even before the inception of the Resource Management Act 1991.

There will be further steps in the Government's strategy, and the Water Resources section of Council will work to ensure that our local needs are considered in the development of National Environmental Standards for water resources.

Rivers of Poverty Bay

The Waipaoa River is the main river entering Poverty Bay, draining a catchment of approximately $2,200km^2$. It is a high sediment-yielding river, annually depositing 15 million tonnes of sediment into Poverty Bay.

The Waipaoa River is by far the most significant source of irrigation water for the Poverty Bay flats. Abstraction occurs mainly over summer, but some irrigation does occur in spring and autumn, and even over the spring months for the purpose of frost protection.

The other main rivers of Poverty Bay are the Waimata and Taruheru Rivers, which are extensively used for recreation, and merge only 1,200m from the sea, to become the Turanganui River, the shortest named river in New Zealand. These three all flow through Gisborne City and are used to launch boats, paddle waka and kayaks, as well as for swimming and fishing. The Council monitors bacteria-levels in the City rivers (and Wherowhero Lagoon) every two weeks during the summer bathing season, and monthly for the remainder of the year.

Levels of bacteria peak within around two days of a significant rainfall event, especially if rain follows an extended dry spell. After two days, even if rainfall continues, bacterial counts begin to drop. This means peak bacterial loads do not always exactly coincide with peak rainfall.

Aquatic life

In Gisborne District 9 of New Zealand's 36 indigenous fresh-water fish species are found, and 2 exotic (of 16 found nationally). Some indigenous freshwater fish seem to be highly flexible in habitat and are found at wide-ranging altitudes and water temperatures, while others are more limited in habitat. Several species populate Gisborne District's silt-laden rivers, mainly those with very short larval intervals, able to complete their lifecycle during the short periods of relatively clear flow.

The greatest diversity of aquatic species is found in clear-flowing streams, such as the Wharekahika River, which has the lowest sediment yield of the rivers of Gisborne District, and a high aesthetic value.

Some fish and invertebrates show a definite preference for water below 16 to 18oC, and become vulnerable if shading vegetation is lost from stream banks, or if water flows drop to very low levels due to drought, or demand for irrigation water.

Around 25oC seems to be a critically warm temperature for much aquatic life. It is not unusual for fresh surface water, especially streams flowing through farmland, to reach 25oC for periods during summer and several dramatic changes can occur. One noticeable effect is overgrowth of algae.

Fresh water above 25oC is lethal for significant algal grazers, freshwater snails *Potamopyrgus antipodarum.* In their absence algae grow on ungrazed. The effect can be further exacerbated for streams in farmland, which may be over-enriched with nutrients.

As well as keeping run-away algal growth in check, *Potamopyrgus* is an important food source for fish.

Surface water abstraction

All water permits require resource consent, and these are notified. Conditions are always attached to minimise environmental impacts. One significant condition is the requirement that abstraction is at the discretion of the District Conservator, should the flow in the Waipaoa River drop to below 1,300 litres per second. This minimum value has been set primarily to safeguard aquatic life, however it is also important that water is able to infiltrate the underground aquifer system, since this is how recharge occurs.

Another condition of abstraction, already mentioned, is the requirement for all takes to be metered. This allows the Council to collect data on actual volumes abstracted, which are generally well below permitted volumes: the Gisborne climate normally does provide rainfall at intervals over the growing season, and an extended dry spell is actually rare.

Surface water bacterial monitoring results	**2005 sample compliance***		**2006 sample compliance***	
	All year	**Bathing season**	**All year**	**Bathing season**
Turanganui River	19 of 29	10 of 15	23 of 29	13 of 15
Waipaoa River	13 of 17	7 of 10	16 of 16	8 of 8
Wherowhero Lagoon	18 of 18	11 of 11	16 of 16	9 of 9

*MoH single-sample limit of 280 *enterococci* per 100ml

**Results are displayed as number of complying samples out of total number of samples taken.

Groundwater abstraction

A consent is required to drill any bore, no matter how shallow, and a permit and water meter are required for abstraction of volumes greater that 10 cubic metres of water per day.

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 privately–owned bores are monitored. In total there are more than 1,400 bores on the Poverty Bay flats.

Water permit holders are required to read meters fortnightly (for aquifers most under stress) or otherwise monthly, and forward the data to the Council. Currently only a proportion of groundwater allocated is actually being used.

Static water levels in bores are observed to fluctuate seasonally, reaching lowest levels at the end of the irrigation season, and rebounding to peak levels after winter. Recharge is provided by the Waipaoa River, other interconnected aquifers, or by percolation of rainwater into the unconfined aquifers.

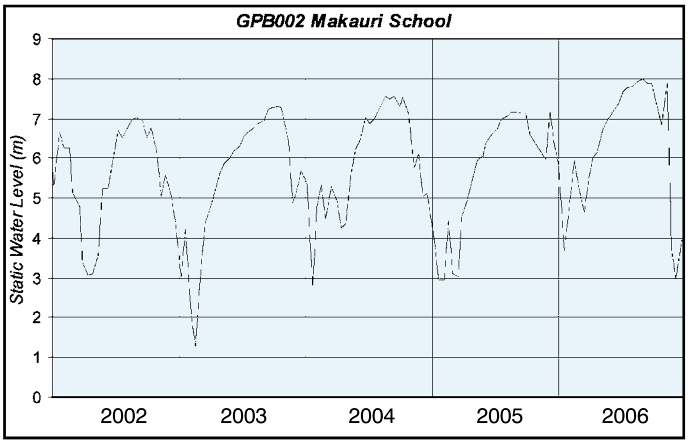
The greatest demand for groundwater in recent years occurred during the dry summer of 2002/03 when 838,146m^3 of water was abstracted (across all bores). Since then summer abstracted volumes have returned to typical levels.

It is by observing draw-down and recharge over time that we can determine whether use of the Poverty Bay aquifers is sustainable over the long term. It is important not to deplete aquifers, as damage could be irreversible in some cases.

Makauri Aquifer

Static water levels are shown for the Makauri Aquifer, which is the most heavily utilised aquifer on the Poverty Bay Flats. The pattern of draw-down/recharge is typical. Of note is the high level of recharge achieved following the very wet winter of 2006, resulting in the highest static water level recorded since monitoring began.

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. Very high levels in recharge in recent years indicate this aquifer is currently being sustainably used.



River quality monitoring results – average values

River / sample location	Suspended solids[1] g/m^3 2005/2006		pH[2] –log (H+) 2005/2006		BOD[3] g/m^3 2005/2006		Dissolved oxygen[4] g/m^3 2005/2006		Ammonia[5] $g\ NH_3/m^3$ 2005/2006		Temperature °C min 2005/2006		Temperature °C max 2005/2006	
Waipaoa@ Matawhero Bridge 19700005	407 high ×	449 high ×	8.1 mod ✓✓	7.9 mod ✓✓	0.36 low ✓✓	0.45 low ✓✓	9.3 high ✓✓	9.3 high ✓✓	0.012 low ✓✓	0.026 low ✓✓	7.3	8.2	22.4	20.8
Waimata @ Monowai Bridge 19600056	14 low ✓✓	27 low ✓✓	8.1 mod ✓✓	8.1 mod ✓✓	0.42 low ✓✓	0.58 low ✓✓	9.0 high ✓✓	10.0 high ✓✓	0.010 low ✓✓	0.013 low ✓✓	7.3	7.3	21.7	19.4
Taruheru @ Lytton Rd Bridge 19603015	38 low ✓✓	101 high ×	7.7 mod ✓✓	7.8 mod ✓✓	1.49 low ✓✓	2.30 mod ✓	6.5 mod ✓	7.2 high ✓✓	n/a	n/a	10.0	11.0	21.8	21.7
Turanganui @ Gladstone Rd Bridge 19600020	40 low ✓✓	75 mod ✓	7.9 mod ✓✓	7.9 mod ✓✓	0.74 low ✓✓	0.82 low ✓✓	7.8 high ✓✓	7.9 high ✓✓	n/a	n/a	9.7	8.3	21.0	20.7
Wharekahika @ u/s Wharf Rd Br. 17600004	124 high ×	81 mod ✓	7.7 mod ✓✓	7.6 mod ✓✓	0.51 low ✓✓	0.52 low ✓✓	9.2 high ✓✓	9.5 high ✓✓	0.020 low ✓✓	0.008 low ✓✓	12.4	10.2	20.4	17.4
Awatere @ SH35 Bridge 17900002	653 high ×	538 high ×	8.1 mod ✓✓	8.1 mod ✓✓	0.63 low ✓✓	0.43 low ✓✓	9.5 high ✓✓	10.1 high ✓✓	0.020 low ✓✓	0.018 low ✓✓	12.4	8.8	19.4	17.8
Waiapu @ SH35 Bridge 18300003	104 mod ✓	651 high ×	8.1 mod ✓✓	8.1 mod ✓✓	0.25 low ✓✓	0.34 low ✓✓	8.9 high ✓✓	9.8 high ✓✓	0.009 low ✓✓	0.009 low ✓✓	12.3	7.9	21.5	17.5
Mata @ Pouturu Bridge 18300004	558 high ×	950 high ×	8.2 mod ✓✓	8.2 mod ✓✓	0.77 low ✓✓	0.92 low ✓✓	9.8 high ✓✓	9.5 high ✓✓	0.041 low ✓✓	0.023 low ✓✓	9.0	8.0	18.8	18.9
Hikuwai @ Willow Flat Bridge 18900003	246 high ×	164 high ×	8.0 mod ✓✓	8.0 mod ✓✓	0.40 low ✓✓	0.47 low ✓✓	8.6 high ✓✓	9.4 high ✓✓	0.013 low ✓✓	0.015 low ✓✓	9.9	8.9	22.5	21.3
Pakarae @ Pakarae Rd Bridge 19100001	97 mod ✓	28 low ✓✓	8.0 mod ✓✓	8.0 mod ✓✓	0.91 low ✓	0.51 low ✓✓	9.8 high ✓✓	9.4 high ✓✓	0.018 low ✓✓	0.014 low ✓✓	13.5	9.3	25.1	21.7
Waiomoko @ SH35 19200001	21 low ✓✓	96 mod ✓	8.0 mod ✓✓	8.0 mod ✓✓	0.53 low ✓✓	0.73 low ✓✓	8.9 high ✓✓	9.6 high ✓✓	0.014 low ✓✓	0.014 low ✓✓	14.0	9.1	20.8	22.3
Ihungia @ Ihungia Rd Bridge 18326002	183 high ×	527 high ×	8.2 mod ✓✓	8.2 mod ✓✓	0.63 low ✓✓	1.59 low ✓✓	9.9 high ✓✓	9.7 high ✓✓	0.015 low ✓✓	0.029 low ✓✓	8.4	7.1	20.2	17.3

Key to symbols	✓✓ good	✓ acceptable	mod moderate	× unacceptable	n/a Not available

1. Suspended silt, sand and clay. May suffocate eggs of aquatic organisms and clog gills of fish. Low, mod, high values are relative to the local environment.
2. Aquatic life will tolerate a pH range fromn 5 to 9.
3. BOD = biochemical oxygen demand, which indicates the amount of oxygen consumed by organic processes. Requirement for aquatic life. For fish must be over 3g/m^3.
5. Should not exceed 0.9g/m^3. Sources include stock effluent, fertilisers, breakdown of organic matter in water.

Average ground water quality monitoring results 2005-2006

Key to symbols	✓✓ good	✓ acceptable	× unacceptable	mod moderate	n/d not done

Aquifer (bore) and location	Nitrates g NO_3/m^3 2005/2006		Salinity ppt 2005/2006		pH -log(H^+) 2005/2006		Iron g/m³ 2005/2006		Manganese g/m³ 2005/2006		Hardness g/m³ 2005/2006	
Te Hapara Sands Aquifer (GPB099) at Cameron Road	0.001 low ✓✓	0.003 low ✓✓	0.2 low ✓✓	0.2 low ✓✓	8.0 mod ✓✓	7.97 mod ✓✓	0.09 low ✓✓	0.09 low ✓✓	0.02 low ✓✓	0.02 low ✓✓	203 mod ✓	213 mod ✓
Te Hapara Sands Aquifer (GPC030) at McDonald's Road	0.137 low ✓✓	0.801 low ✓✓	0.2 low ✓✓	0.2 low ✓✓	8.37 mod ✓✓	7.43 mod ✓✓	0.21 low ✓✓	0.19 low ✓✓	0.05 low ✓✓	0.04 low ✓✓	263 mod ✓	272 mod ✓
Te Hapara Sands Aquifer (GPA004) at Childers/Stanley Road	0.501 low ✓✓	0.092 low ✓✓	0.2 low ✓✓	0.16 low ✓✓	7.53 mod ✓✓	7.53 mod ✓✓	0.48 mod ✓	0.55 mod ✓	0.10 low ✓✓	0.11 low ✓✓	253 mod ✓	224 mod ✓
Shallow fluvial Deposit (GPC051) at Dunstan Road	0.001 low ✓✓	0.001 low ✓✓	1.3 high ×	1.23 high ×	7.0 mod ✓✓	7.1 mod ✓✓	24.1 v.high ×	24.67 v.high ×	1.72 high ×	1.74 high ×	767 high ×	677 high ×
Makauri Gravel Aquifer (GPH008) at Lavenham Road	n/d	n/d	0.23 low ✓✓	0.2 low ✓✓	7.25 mod ✓✓	7.25 mod ✓✓	1.61 mod ✓	2.25 high ×	0.64 high ×	0.62 high ×	330 mod ✓	309 mod ✓
Makauri gravel Aquifer (GPG058) at Caesars Road	n/d	n/d	0.7 low ✓✓	0.7 low ✓✓	7.07 mod ✓✓	7.1 mod ✓✓	13.2 v.high ×	13.05 v.high ×	1.67 high ×	1.85 high ×	507 high ×	471 high ×
Makauri gravel Aquifer (GPB002) at Makauri School	n/d	n/d	0.5 low ✓✓	0.5 low ✓✓	7.05 mod ✓✓	7.03 mod ✓✓	7.45 high ×	6.04 high ×	0.73 high ×	0.78 high ×	445 mod ✓	421 mod ✓
Makauri gravel Aquifer (GPB135) at Cameron Road	n/d	n/d	1.9 high ×	1.9 high ×	6.96 mod ✓✓	6.93 mod ✓✓	15.13 v.high ×	17.13 v.high ×	1.04 high ×	0.97 high ×	947 high ×	965 high ×
Waipaoa Gravel Aquifer (GPG059) at Caesars Road	n/d	n/d	0.53 low ✓✓	0.6 low ✓✓	7.07 mod ✓✓	7.0 mod ✓✓	6.86 high ×	8.26 high ×	0.85 high ×	0.97 high ×	657 high ×	669 high ×
Waipaoa Gravel Aquifer (GPE040) at Waerenga a hika	n/d	n/d	0.43 low ✓✓	0.45 low ✓✓	7.23 mod ✓✓	7.25 mod ✓✓	9.58 high ×	6.54 high ×	0.48 mod ✓	0.53 high ×	360 mod ✓	385 mod ✓
Matokitoki Gravel Aquifer (GPB102) at Cameron Road	n/d	n/d	0.5 low ✓✓	0.5 low ✓✓	7.53 mod ✓✓	7.4 mod ✓✓	6.65 high ×	6.07 high ×	0.14 low ✓	0.13 low ✓	393 mod ✓	377 mod ✓
Matokitoki Gravel Aquifer (GPB126) at Kings Road	n/d	n/d	0.5 low ✓✓	0.5 low ✓✓	7.25 mod ✓✓	7.27 mod ✓✓	2.02 high ×	2.16 high ×	0.35 mod ✓	0.37 mod ✓	400 mod ✓	403 mod ✓
Matokitoki Gravel Aquifer (GPD111) at Bushmere	n/d	n/d	0.5 low ✓✓	0.5 low ✓✓	7.23 mod ✓✓	7.07 mod ✓✓	33.77 v.high ×	15.97 v.high ×	0.39 mod ✓	0.38 mod ✓	433 mod ✓	436 mod ✓

Shingle extraction

Most of the rivers of Gisborne District are aggrading, and accumulated bedloads of gravel allow for sustainable shingle extraction.

Gisborne District Council, roading contractors and the major forestry companies hold shingle extraction consents. The majority of extracted material is used in road construction and maintenance.

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

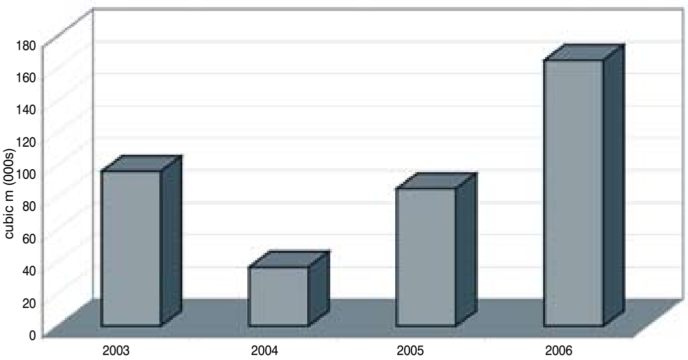
	Volume of shingle removed in cubic metres	
Source	**2005**	**2006**
Waiapu River	71,894	61,787
Mata River	128	30,550
Aorangiwai River		23,177
Mangaoporo River		13,468
Waipaoa River	1,196	11,404
Raparapaririki Stream		8,593
Karakatuwhero River	12,000	7,000
Taurangakautuku River		6,797
Other	104	2,244
Total	85,322	165,020

The drop in extracted volumes in 2004 reflected a downturn in forestry (and hence construction of roads for harvesting) in that year.

The large increase in extraction in 2006 reflects the commencement of a general regional road upgrade, removal of large rocks for use in coastal and river bank protection works, and on top of that, the enormous repair effort on the district's roads following severe wet weather and storms in 2006.

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.

Shingle - extracted volumes



Extreme rainfall - 2005

Rainfall data is recorded continuously at 37 sites throughout Gisborne District. A selection of data is shown over leaf, from gauge sites selected to give a geographical spread of rainfall information. Both years covered by this report were remarkably wet.

During Labour weekend, October 2005, the first of two significant rainstorms drenched Gisborne District.

The Waipaoa River (as measured at Kanakanaia, Te Karaka) peaked at 10.55m, only 56cm below the 1988 Cyclone Bola peak. This ranks the Labour weekend flood in the Waipaoa as a 'one-in-forty-year' event, the second highest on record for Te Karaka and the Waipaoa River Flood Control Scheme, and certainly the largest flood since Bola.

Surprisingly, no bridges were lost or had major damage, although many received damage to railings and captured large amounts of debris.

Another storm event on November the 28th resulted in a significantly lower flood-peak, reaching 8.4m at Kanakanaia, ranking it as a 'one-in-ten-year' event.

However, the timing of this event could not have been worse, because the soil was still waterlogged. In many instances damage from this second deluge was even worse than the Labour weekend event.

The western area (hill country inland of Gisborne and the Poverty Bay Flats) was hardest hit, with the northern area (the East Coast) mainly requiring mopping up, although further damage was inflicted by the Waiapu River the river at Waiomatatini Road.

Wet autumn and winter 2006

Heavy rainfall events in April and May almost duplicated the effect of the 2005 storms. Once again, several high-intensity events followed one another, compounding damage.

Above: Puha Bridge with captured debris after the 2005 Labour Weekend flood.

This time the hardest hit were western areas including Tiniroto, Pehiri, Te Karaka, Otoko, and the East Coast, particularly around Ruatoria.

Autumn set the pattern for winter: rain continued to fall at frequent intervals giving little opportunity for soils to dry out.

At Ruatoria, March-to-July rainfall in 2006 was 150% of normal. Severe gravel aggradation occurred in several streams, compounded by forestry slash (branches, off-cuts and tree stumps) clogging bridges, watertables and culverts.

Refer to the 'Land, Soil & Biodiversity' pamphlet for more information on the damage inflicted by the extremely wet conditions in 2005 and 2006.

Only minor damage to Flood Control Scheme

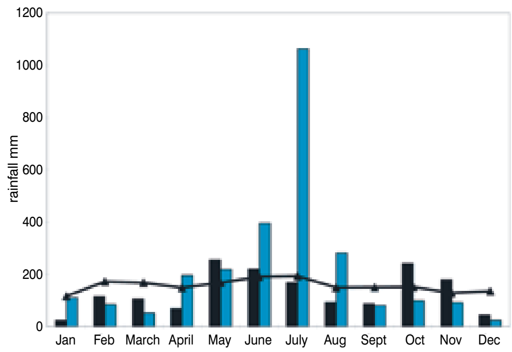
The relatively small $115,000 damage bill for the two flood events 2005 may be attributed to improvements made to the Waipaoa River Flood Control Scheme since Bola. Several critical bends now have robust rock protection (rather than the former anchored bank protection or tree works). The peak flood flows occurred for four hours in 2005, whereas during Bola peak flows were maintained for 24 hours, resulting in significant riverbed and bank erosion.

Ten low-spots on the flood control scheme had been raised between 1992 and 1998, giving, upon completion of the works, a capacity equal to the peak Bola flood. However, due to bed changes that have occurred since, the 'upstream' end of the scheme now has a capacity of approximately 95% of Bola, while the lower end has equal or even greater-than-Bola flood-carrying capacity.

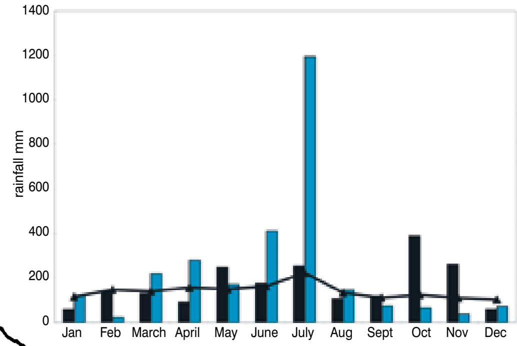
Te Karaka, following stopbank raising in 2002/03, has a better level of protection than the Waipaoa scheme – equivalent to "Bola + 10%" or a "one-in-200-year" event.

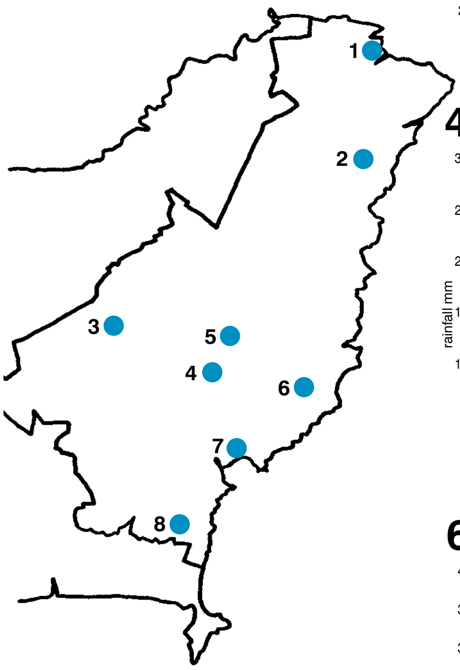
Rainfall at selected gauge sites, 2005-2006

1. Te Araroa

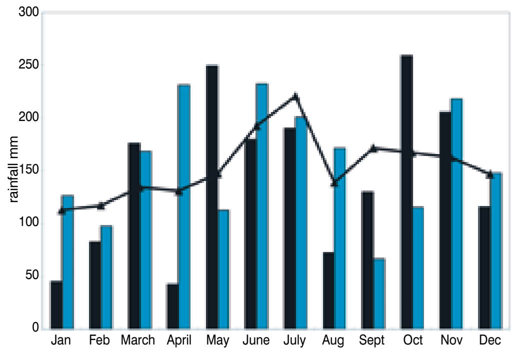


2. Ruatoria

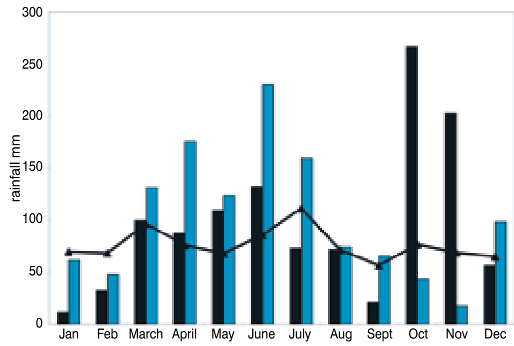




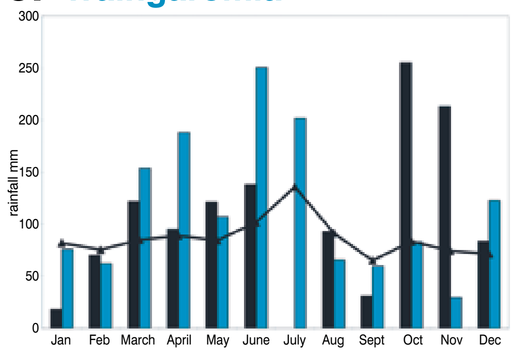
3. Matawai



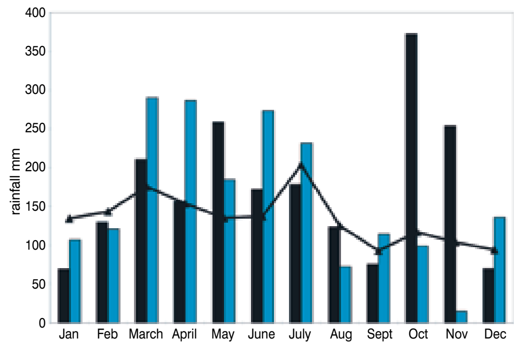
4. Te Karaka

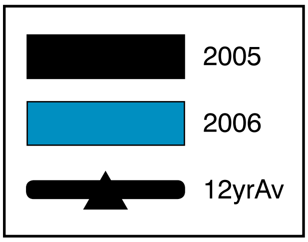


5. Waingaromia

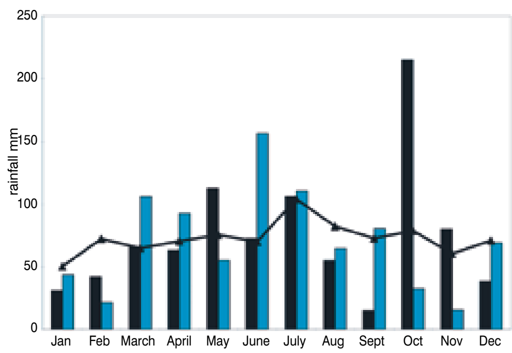


6. Pakarae

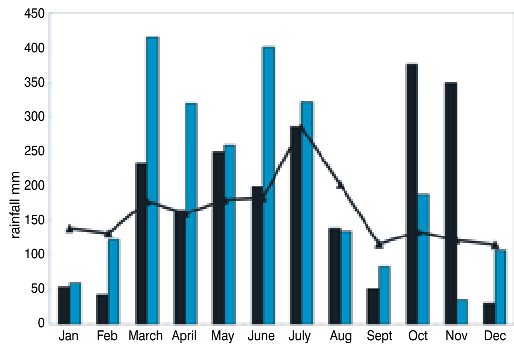




7. Gisborne



8. Mangapoike



Te Rau Print, Gisborne