Hydrological Summary of Flood Event – 15-16 February 2004

1. Introduction

This report is a hydrology summary of the storm event that resulted in widespread flooding in the Wairarapa on February 15th – 16th 2004.

During February 2004 the weather patterns over New Zealand were very unseasonal. The spring months of 2003 were wetter than normal. December was the only 'summer' month, with warm dry weather and what was beginning to look like a typical Wairarapa summer. This did not last into January 2004 with the onset of wetter autumn-like conditions including an unseasonal south-easterly rain event. During February there were several storms events that affected the lower North Island. The first flood event occurred on 11–12 February. The hydrological aspects of this event are covered in a separate report. This report covers the second and largest event that had the most significant and widespread impact in the Wairarapa. This storm also had impacts of the rest of the Wellington region and was particularly severe in the Wanganui-Manawatu region further north.

2. Meteorology

The following description of the situation during and leading up to the flood event is adapted from a MetService press release.

Friday 13 February: A weak high crossed the North Island. To the south of Tasmania and near the ice shelf a low and a high combined to induce a southerly flow off the ice shelf. This southerly flow became strongest at the 8 to 10km height and moved into the Tasman.

Saturday 14 February: The low that followed Friday's high across the North Island deepened rapidly from around 1000 to 990 hectoPascals travelling at about 40 knots. This bought thundery gales in the morning. This low then slowed down and started to do a clock-wise loop on the dateline east of New Zealand. Meanwhile a small low was moving southwards from the region in the tropics between New Caledonia and Fiji. This low brought with it tropically moist air southward.

Sunday 15 February: The moist air from the tropics was drawn into the now multi-centred low deepening over the North Island. The low only deepened slowly but indications were that its southerly winds had the potential to deliver over 100mm of rain in the next 24 hours onto the southern North Island. Accordingly MetService issued a heavy rain warning soon after 8:00am. This warning mentioned amounts up to 180mm in 28 hours on the Wairarapa hills with intensities reaching 25mm/hr.

During the morning a southerly storm developed in Cook Strait and at 3:30pm the severe weather warning was reissued along with the mention of severe winds continuing until noon on Monday. During the afternoon and evening steady rain started falling over the entire southern half of the North Island.

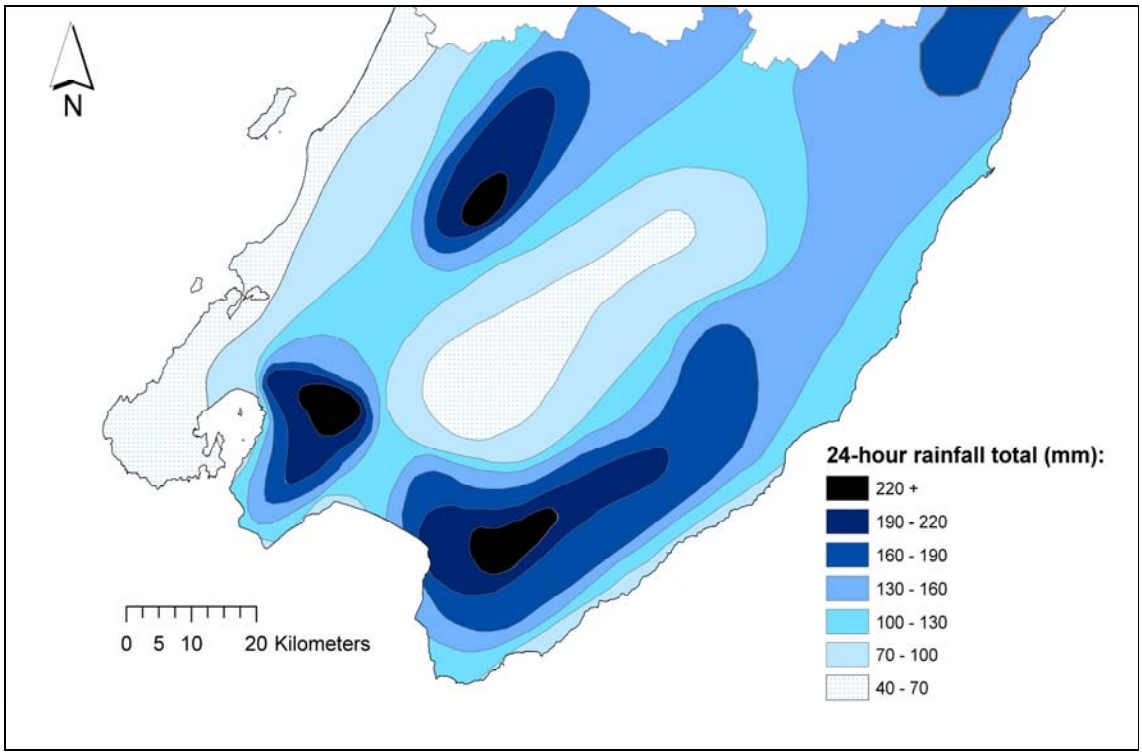
Monday 16 February: Overnight a small but intense low moved in close to the Wairarapa coast and accentuated the wind and rain. Sustained winds over 100km/hr affected Wanganui and Castlepoint. The low responsible for all the wind and rain moved away in the afternoon.

3. Rainfall

On Saturday 14 February there were brief periods of rain in the morning. The rain then ceased (except in the Tararua Ranges), as the low moved away from the North Island. In the afternoon it picked up again for a period overnight easing off in the early hours of Sunday 15 February. The rain then picked up again later in the morning, easing back in the afternoon. On the evening of Sunday the longest and sustained period of rain set in from the southerly direction. This period of rain lasted for nearly 18 hours finally easing off around midday Monday 16 February. It was during this period at around 3–4 am that the heaviest rainfall occurred in the Wairarapa.

The southerly event brought rain to all parts of the Wellington region, including the Wairarapa and further north into southern Hawkes Bay and especially the Manawatu Wanganui area. Figure 1 below is an isohyetal map for the Wellington region of the rainfall volumes for the 24 hour period from 8am on Sunday 15 February. The most rain fell in three areas: the Tararua Ranges, the Rimutaka Ranges, and the Aorangi Ranges. There was also a heavy but to lesser degree area in the upper reaches of the Whareama catchment in the north-eastern corner of the region.

Figure 1 - 24 Hour rainfall totals for period beginning 15 February 2004, 8:00am



Although rain totals over central Wairarapa were not as great, the amount received was still significant for these areas. This was reflected in the high river flows in lower altitude catchments and lower reaches of the Tararua catchments. These led to the record high flow in the Ruamahanga River collecting most of the runoff from the central Wairarapa valley.

Table 1 summarises the rainfall in a number of Wairarapa locations from the Tararuas, foothills, Wairarapa valley and eastern hill country. The table lists the maximum intensities for periods from 1 hour to 2 days. Also included in the table are the Return Periods of the rainfall where available.

Of note is the return periods are most significant for the 12 – 24 hour duration. This is reflected in significant high flows for the larger catchments with higher time of concentration.

The Council does not have rain gauges in the foothills of the Rimutaka Ranges. There is one rain gauge in the upper reaches of the Huangarua catchment but at the time of writing this report this data had not been collected. Indications from the tributaries of the Rimutakas on the eastern side and the high flow in the Huangarua River are that there was significant rainfall intensities over a shorter duration.

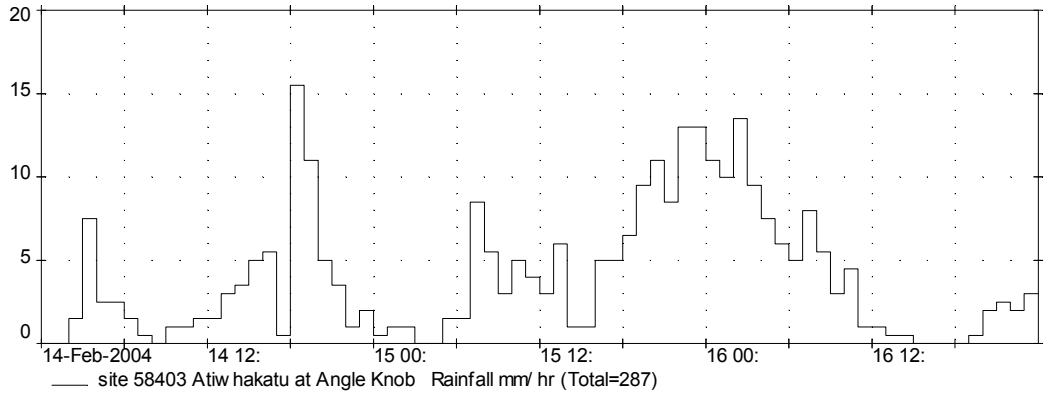
Figure 2 is a series of hourly rainfall hyetographs for the 3 day period from February 14 – 17.

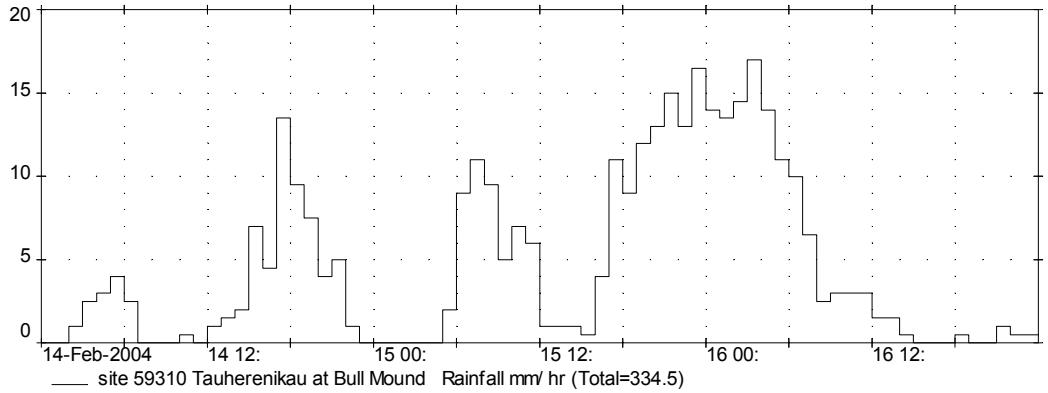
Table 1 Rainfall

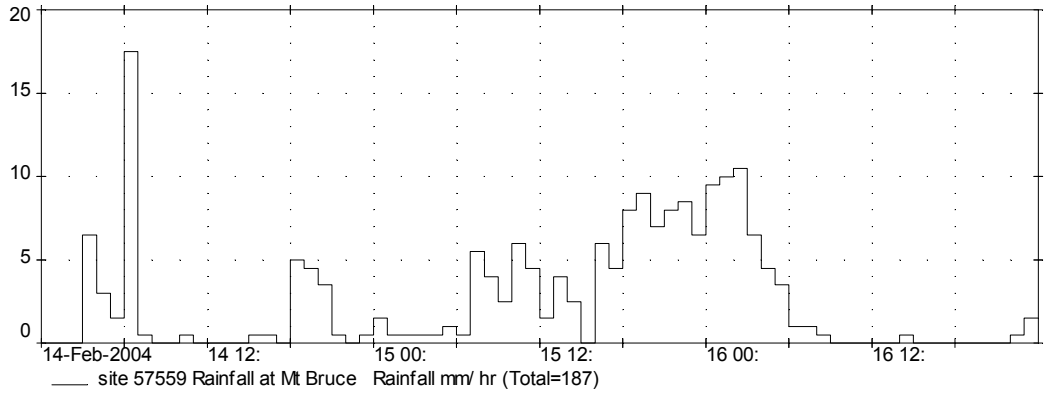
Site	1hr	2hr	3hr	4hr	6hr	12hr	24hr	48hr
Angle Knob	14.5	26.5	37.5	47.5	70.5	119	171	256.5
Return Period	< 2	< 2	< 2		< 2	< 2	< 2	< 2
Bannister	11	21	30	38	55	93	129.5	217.5
Return Period	< 2	< 2	< 2		< 2	< 2	< 2	< 2
Carkeek	15	27	40	53	77	127	189	252
Return Period	< 2	< 2	< 2		< 2	< 2	< 2	< 2
Bull Mound	17.5	33	46	61	90	165	232	316
Return Period	< 2	< 2	< 2		< 2	**5**	**5**	**7**
Mt Bruce	11.5	21.5	30.5	38	54	95	134	155.5
Return Period	< 2	< 2	< 2		< 2	< 2	3	3
Waingawa	13	25.5	35.5	44.5	59.5	100	135.5	155.5
Return Period	< 2	< 2			3	**7**	**5**	< 2
Mangatarere[1]	16.5	28.5	41.5	50.5	68	110.5	147.5	190
Masterton	13	21.8	30.2	35.2	43.8	69.8	90.2	104.6
Return Period	< 2	3			**8**	**12**	**9**	**5**
Wai Coll	11.4	19.6	28	28	40.2	63.6	81.8	94.4
Return Period	< 2	< 2			**5**	**9**	**5**	3
Alloa	7.4	14.2	20.6	27.6	34.8	50.2	70.6	84.2
Tanawa	20.5	33.5	42.5	49.5	66.5	116	168.5	179
Return Period	3	4	4	3	2	**15**	**18**	**7**
CastleHill	15.5	27	36.5	44.5	56	94	128.5	140.5
Waihi	14.4	24.8	31.8	36.2	55	87	113	139
Ngaumu	16.6	31.2	43.4	54.4	71	111.6	144.4	159
Stoney creek	15.2	30	44	57	76	120.4	153	173
Taueru	12.8	21	30	35	45	72	89	104.6

[1] Return periods for Mangatarere are not available as the record is too short

Figure 2 Rainfall







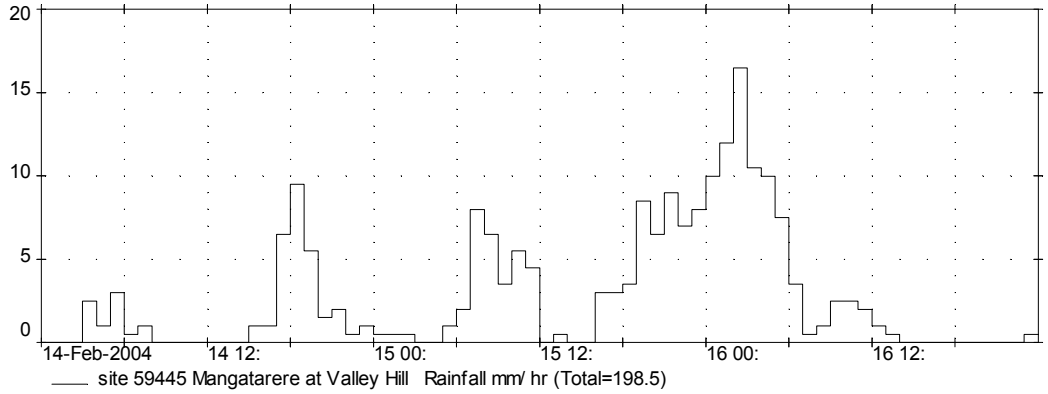
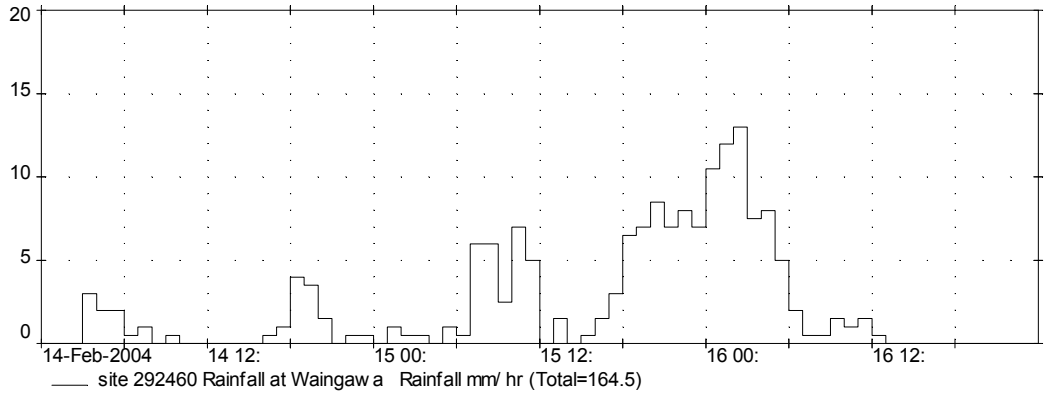
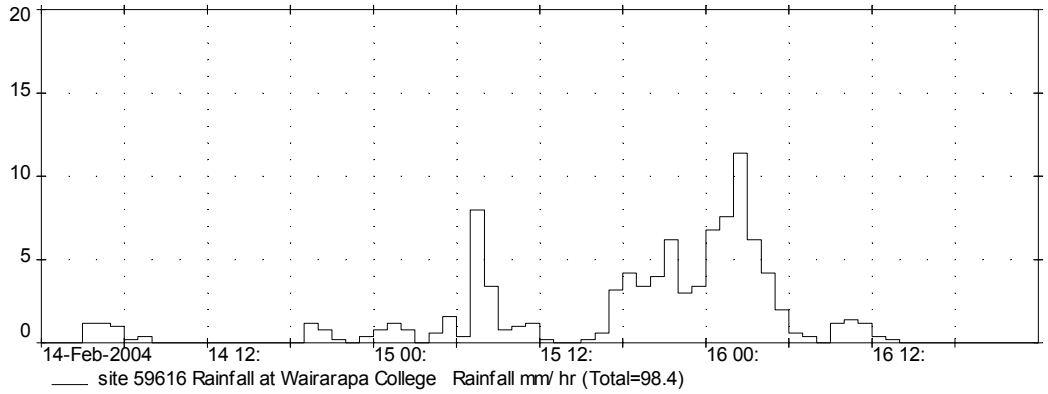
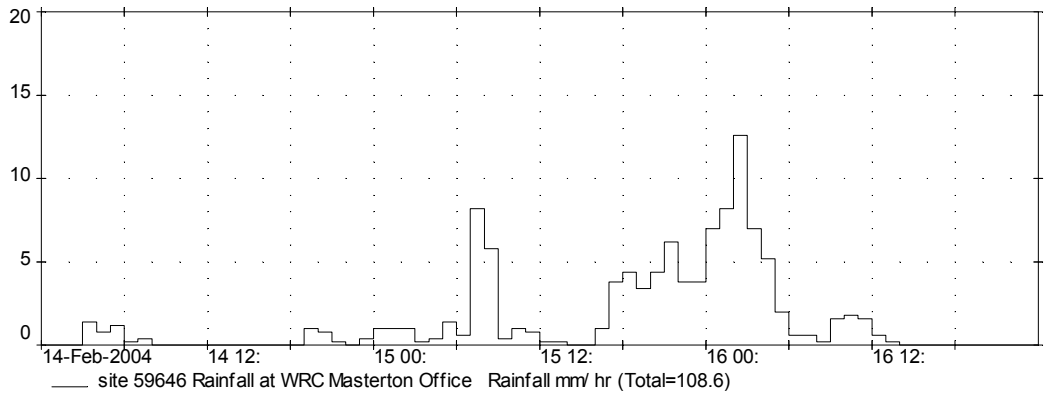
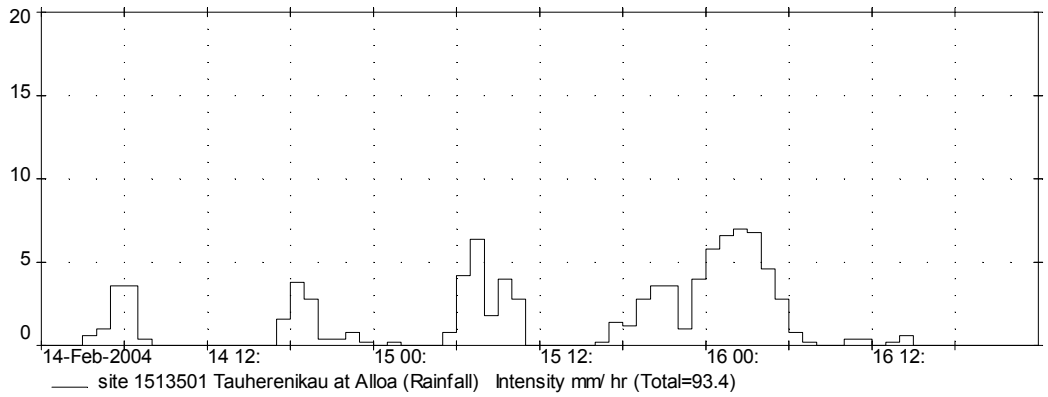


Figure 2 Rainfall (Continued)









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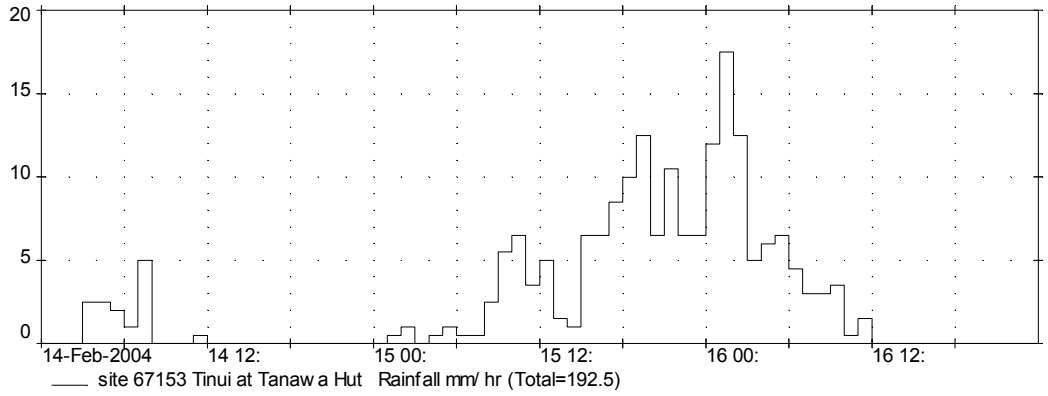
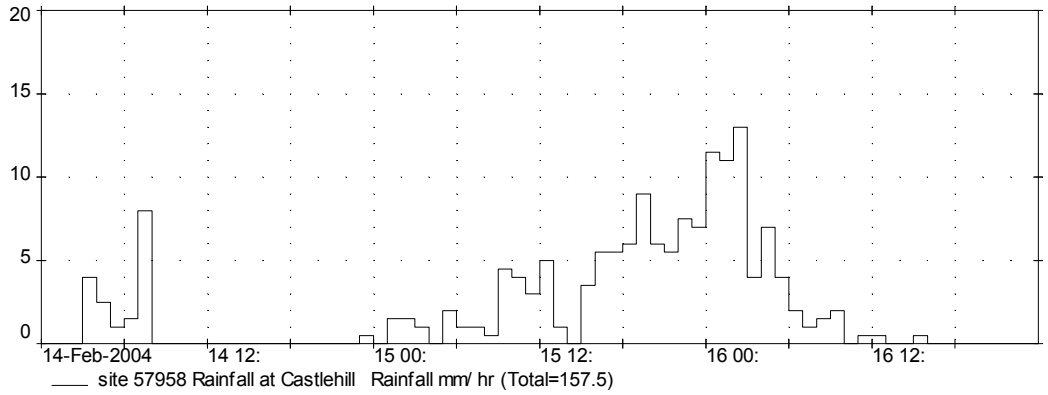
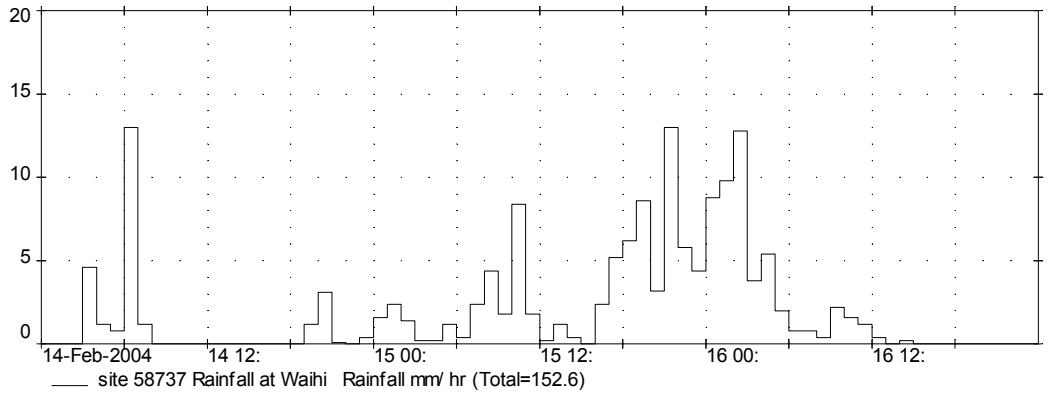
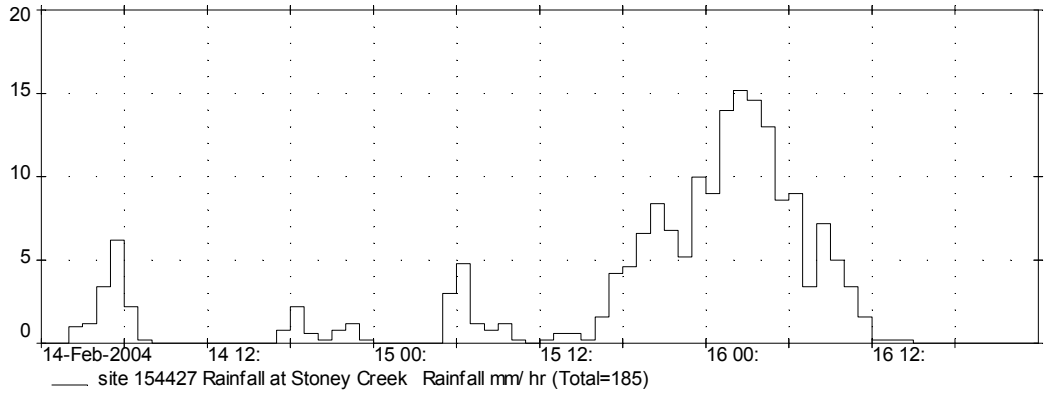








4. Rivers

High river flows occurred in nearly all the rivers in the Wairarapa.

There had been a smaller flood in the Wairarapa only 4 days previously on the 11-12 February, which meant the rainfall for this event produced more runoff than it would have under dry antecedent conditions.

Table 2 shows the peak flow and times for recorder sites in the Wairarapa. The table also includes estimates of the flood peak return periods[1]

Table 2 - Rivers

Site	Peak Stage metres	Peak flow m^3/sec	Peak Time	Peak Date	Return Period[1]
Ruamahanga at Waihenga	5.36	2000	12:15	16-Feb-2004	50+
Ruamahanga at Wardells	5.1	800	09:30	16-Feb-2004	35
Ruamahanga at Gladstone	3.698	1008	10:15	16-Feb-2004	n/a
Ruamahanga at Mt Bruce	2.516	163	04:00	16-Feb-2004	< 2
Waingawa at Gorge	2.423	215	04:30	16-Feb-2004	< 2
Waiohine at Gorge	3.343	522	05:15	16-Feb-2004	< 2
Mangatarere at Gorge	2.393	120	05:00	16-Feb-2004	15[2]
Waipoua at Mikimiki	2.654	254	03:30	16-Feb-2004	20[3]
Kopuaranga at Palmers	4.897	60	06:15	16-Feb-2004	20 - 30
Tauherenikau at Gorge	2.546	209	05:45	16-Feb-2004	< 2
Huangarua at Hautotara	5.225	450	05:00	16-Feb-2004	n/a
Taueru at Te Weraiti	12.464	425	16:30	16-Feb-2004	20
Kaiwhata at ?	3.996	336	05:45	16-Feb-2004	20
Pahaoa at ?	9.056	1024	09:00	16-Feb-2004	30
Whareama at Waiteko	13.65	680	13:30	16-Feb-2004	12
Whangaehu at Waihi	4.123	60	06:00	16-Feb-2004	27

Rainfall in the tops of the upper Tararua catchments was not significant for the shorter durations (1-3 hours) and this was reflected in the non-significant peak flows at the Council's Wairarapa Tararua flow recorder sites. (Waiohine River at Gorge, Tauherenikau River at Gorge, Ruamahanga River at Mt Bruce)

The rainfall was however significant for the longer durations. This resulted in the flows for those rivers with longer times of concentrations to rise to significant levels. This included the Wairarapa's eastern catchment rivers and the rivers in the main valley. In addition, the sustained nature of the event contributed to the high peak flows. The rainfall throughout 15 February caused river levels to gradually rise so that the flood peaks that resulted from the heaviest rainfall early on 16 February were higher than if the event had been shorter.

Figure 3 is a pair of plots showing the flows hydrographs. The first plots the Ruamahanga and its major tributaries. The second plot is for some of the smaller contributing tributaries. Hydrographs of the eastern hill country

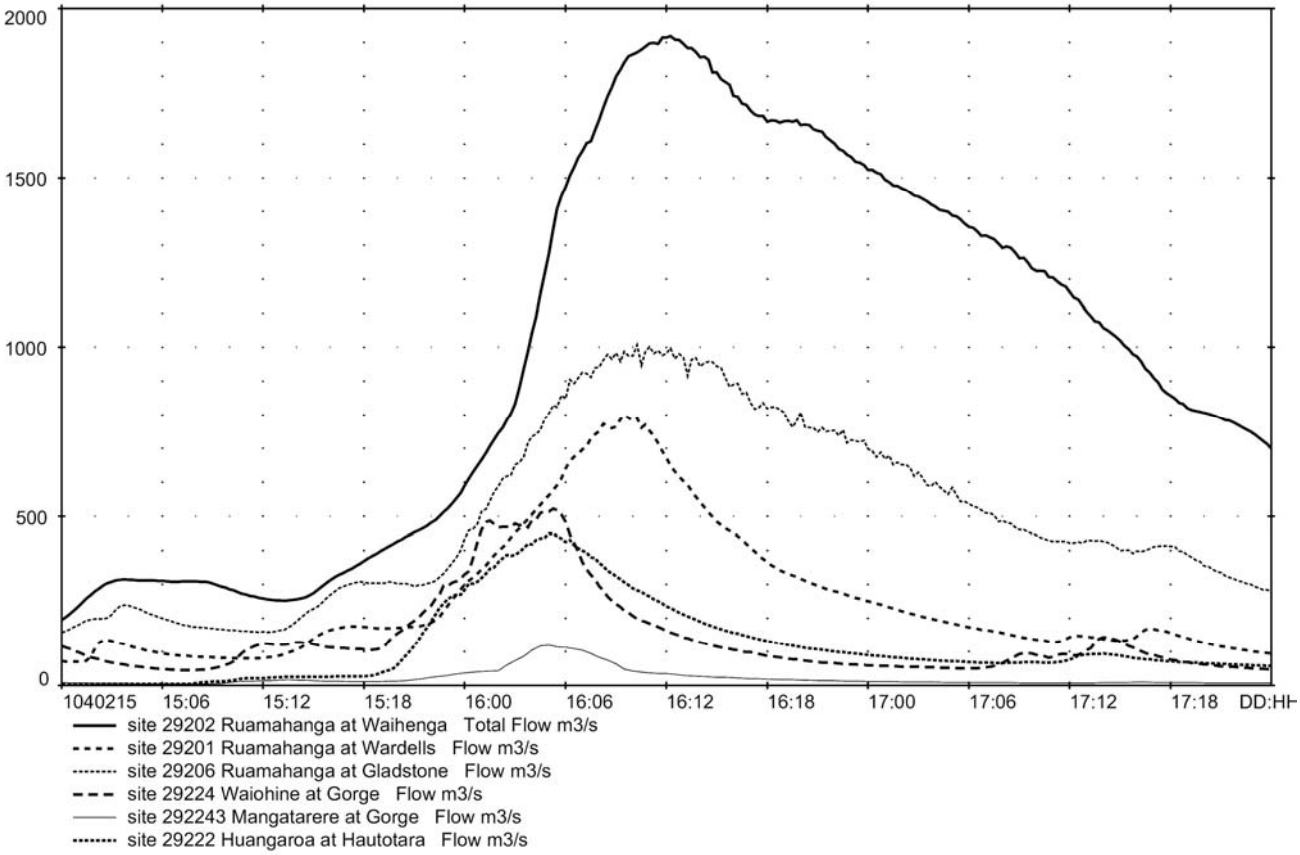
1 Return periods are provisional and may be subject to change

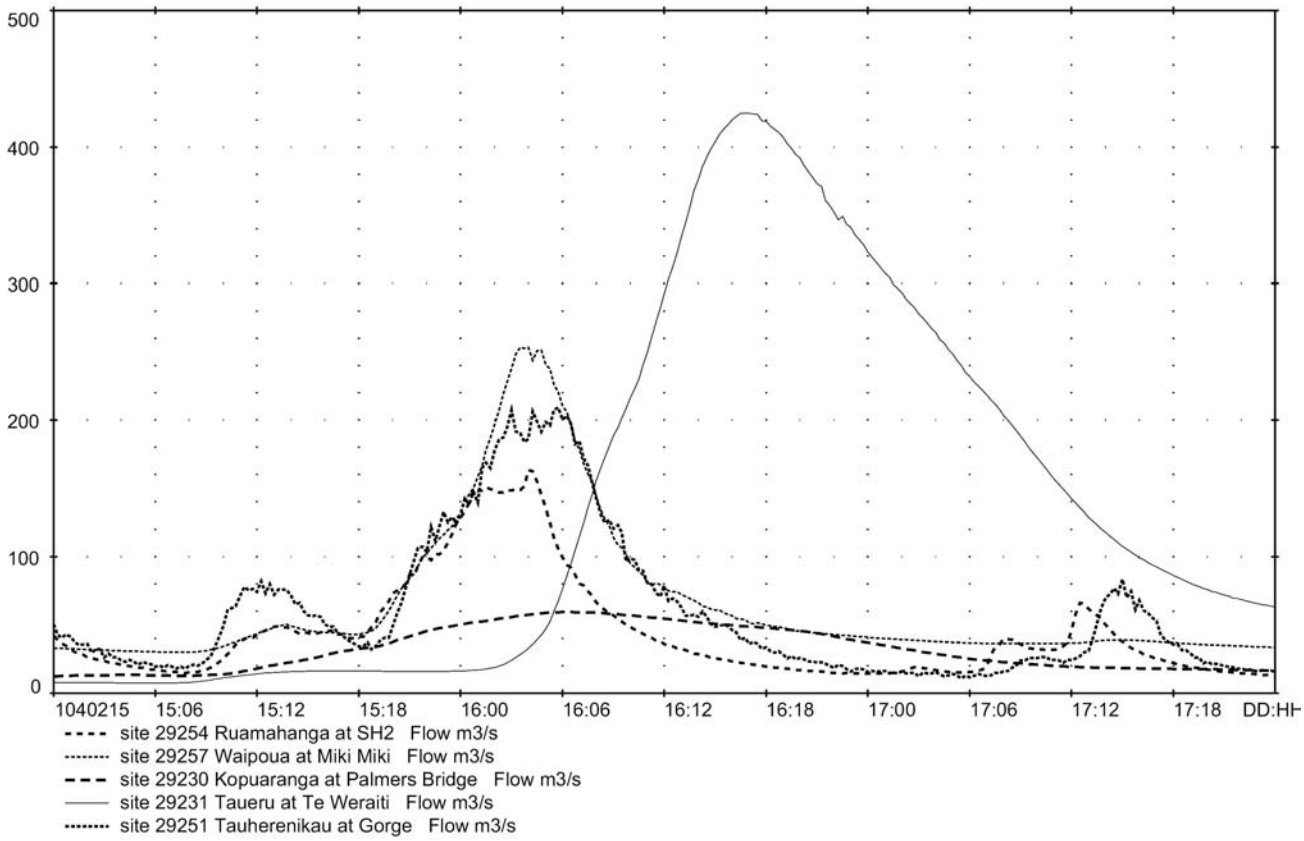
2 Empirically derived due to shortness of flow record

3 Empirically derived and may be too high

catchments are not available at the writing of this report. The stage/flow record for these sites is not collected by the Regional Council but is done so by NIWA. Flood peak data was provided by NIWA.

Figure 3 - Rivers





5. Western Tararua and Rimutaka Ranges

As stated above although rainfall volumes were higher in the Tararua and Rimutaka Ranges than in the Wairarapa plains, the shorter duration rainfall that reflects the peak flows in the upper part of the catchments where the Council records the flows was not significant. However downstream where a greater portion of the flow comes from the lower, larger areas, indications were that the flow was more significant.

5.1 Waipoua

The flood peak for this event (2.65m 254m^3/sec on 16th) was less than the flood peak the previous week (3.12m 316m^3/sec on 12th). However flood levels indicate that lower down the catchment the flow was greater. This was probably due to the antecedent conditions from the previous flood giving raised base flows combined with the higher rainfalls in the catchment below the recorder site contributing extra flow.

5.2 Mangatarere

The flood peak for this event (2.39m 120m^3/sec on the 16th) was almost the same magnitude as that from the week before (2.41m 122m^3/sec on the 12th). Downstream however flooding in this later event was greater. As in the Waipoua River above, antecedent conditions combined with higher flows in the lower part of the catchment would have raised the downstream flow. Flows in

the lower tributaries, Kaipatangata, and Enaki Streams were also believed to be higher in this event.

5.3 Tauherenikau

Even though the peak flow reached at this site was not significant in terms of return period there was overtopping of stopbanks further downstream. Also the flood peak for this event (2.55m 209m^3/sec) was lower than for the 'smaller' flood the week before (2.72m 266m^3/sec on the 12th). Again as in the Mangatarere an Waipoua paragraph above antecedent conditions and higher rainfalls in the catchment below the recorder site contributing extra flow.

5.4 Rimutaka Ranges

The Council does not have flow recorders in the Rimutaka Ranges but flood damage indicated the streams south and on the western side of Lake Wairarapa reached very high levels.

6. Eastern Rivers

Wairarapa eastern hill country rivers reached flow peaks estimated between 20 – 30 year return periods. These included the Whareama, Pahaoa, Kaiwhata Rivers as well as the Whangaehu, Kopuaranga and Taueru Rivers which are tributaries of the Ruamahanga River.

6.2 Whareama

This flood was the largest since October 1992, April 1991 was higher again. Both these floods in the early 90's flooded the Tinui township including the pub. For this flood levels got to within 125mm of the floorboards at the house next door to the shop and 400mm from entering the pub.

Table 3 is a summary of the flood levels and times manually recorded upstream of the Tinui township on each of the two Whareama River tributaries. An estimate of the peak time of the flood at Tinui village was about 0900 NZDT.

Table 3: Whareama tributary flood levels

Date/time NZDT	**Taipos** Stage	**Eastwoods** Stage
Sun 15th 2000	1/3 to 1/2 bankfull	4.6
Sun 15th 2030		5.0
Sun 15th 2100	2.3	
Sun 15th 2130		5.4
Sun 15th 2220	2.9	
Sun 15th 2230		5.7
Mon 16th 0400	4.7	6.55
Mon 16th 0600		5.9
Mon 16th 0730	6.0	
Mon 16th 0730 - 0900	Peaked at approx 6.2	5.4 at 0800hrs

6.3 Whangaehu River

The flood peak flow of 60m^3/sec is the second highest on record. The flood peak in April 1991 was estimated at 80m^3/sec.

6.4 Kopuaranga River

The flow figure of 60m^3/sec derived from the rating curve is for the bridge flow only and does not include the overflow that 'outflanked' the bridge. This is the highest recorded flood at this site since records began in 1985.

6.5 Taueru River

This is the highest flood level recorded since October 1992. Back in the early 1990's a flood of this magnitude would have caused significant flooding in the Te Whiti area. The willow clearing from the river channel carried out in the mid 90's has been shown to have made a big difference. There was nowhere near as much flooding this time around.

6.6 Huangarua River

The flood peak of 5.2m at Hautotara bridge is the highest flood peak since the early 80's (May 1981 was around 4.3m). It is worth noting that there was a 4.4m peak in June 2003 and a 4.1m in January this year. The estimated flow peak of this event was 450m^3/sec (May 1981 on the rating curve was 270m^3/sec). At this time we do not have an estimate of the return period but it is likely to be at least 30yrs.

The river flow overtopped the Ponatahi bridge just north of Martinborough closing the road.

Just upstream from the confluence with the Ruamahanga River the left stopbank was overtopped and scoured a hole through the bank. The flow through this breach caused extensive flooding to the area south towards SH2. The floodwaters ponded till the water escaped over SH2, closing the State Highway.

The Council does not have flow recorders and other catchments in the Aorangi Ranges but flood damage indicated the Taunui and Turanganui Rivers reached very high levels.

7. Ruamahanga River

7.1 Wardells

This flood peak of 5.069m is the highest flood level on record, just above the previous high in October 1998 (5.024m)

Gaugings carried out during this event indicate the flow was well below that from the existing flow rating curve. A high gauging in October 2000 also indicated lower flows but the curve was not changed. After modifying the rating curve, using the latest gaugings, an estimate of the peak flow for this event is

around 800m^3/sec, with the October 1998 now about 780m^3/sec (previously 1024m^3/sec). The return period on this event is estimated to be 35 years.

7.2 Waihenga

The peak stage for this event at Waihenga bridge was 5.36m, the highest on record since the stage recorder was installed in the mid 1950's. The previous high was November 1994 (5.146m, 1800m^3/sec).

The estimate of the peak flow under Waihenga bridge is 1150 – 1200m^3/sec. Flood levels at Jenkins dip indicate the peak level was about 0.08m above the peak level for November 1994 at our upstream measuring point. From the floodway rating curve this gave a peak flow of about 750m^3/sec. Taking into account the small portion of the peak flow that went through the breach in the Huangarua stopbank, this gives a combined flow for the river and floodway of about 2000m^3/sec. The return period of 2000m^3/sec is now just over 50yrs.

A gauging carried out during the flood event and in October 2003 indicates that the rating curve has shifted upward, giving less flow for the stage height. This is a trend that has been observed since at least the early 1980's when the major stopbanking was carried out as part of the Lower Wairarapa Valley Development Scheme. Studies are currently being carried out to try to identify the cause, with bed aggradation of the riverbed downstream is likely to be a major candidate. The above peak flow estimate in the river takes into account the rating change.

The underside of Waihenga bridge's soffit is at a level below the peak stage of 5.36m The floodwaters were being 'sucked' under the bridge.

8. Lower Valley Floodways and Stopbanks

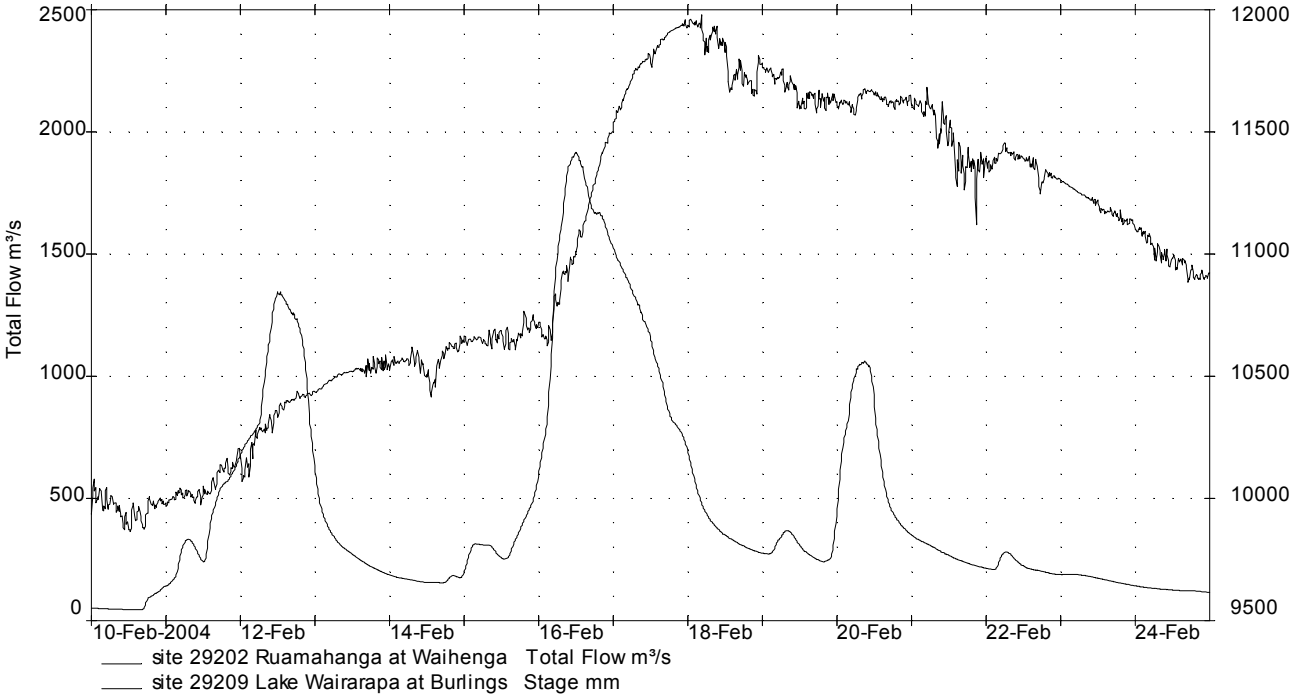
All the floodways in the Lower Valley operated during this event. The scheme floodways were designed back in the early 1980's for a 20 year return period flood which at that time was 1500m^3/sec. This flood exceeded that flow by a fair margin. There was overtopping of the stopbanks at a number of locations as well as along the river channel. Apart from the breach in the Huangaroa stopbank near the Ruamahanga River confluence, the floodways worked well as expected.

9. Lake Wairarapa

Lake Wairarapa received the floodwaters from the Tauherenikau River and also Rimutaka Range tributaries along its western side. The floodway system from the Ruamahanga River also discharged large volumes of water into the lake. The lake level reached a level of 11.98m, just under 2m above its normal level of 10.0m. This was the highest it has been since the Lower Wairarapa Valley Development Scheme was built in the mid 1970's. The high lake level was actually the cumulative volume from this flood and the previous flood event on 12th February. Figure 4 is a plot of the flow and stage hydrograph of Waihenga's flow vs Lake Wairarapa lake level. Note the third spike. There was another small event on the night of the 19 – 20 February that on its own would probably not have been as large. The catchments were still partially saturated after the

first event and base flows were up. This extenuated the second event and the same was true for the third.

Figure 4 - Ruamahanga River – Lake Wairarapa Level



10. Summary

On Sunday 15 February a low pressure weather system centred to the east of the Wairarapa giving a strong southerly moist flow over the lower North Island. This resulted in widespread rain to all areas in the Wairarapa, the heaviest falls around the ranges, but with significant falls also in the lower hill country and valley areas. The event was characterised by a long duration of sustained rainfall, rather than intense rainfall. There were some areas of high rainfall in the southern Rimutaka and Aorangi Ranges.

Antecedent conditions from the flood the previous week, the wet catchment, and the higher base flows helped to raise rivers in the Wairarapa rose to high levels. Significant flood levels were reached in the all the eastern hill large catchment rivers with flood peak return periods reaching at least 30 year values. Smaller catchments in the Aorangi Ranges, the Huangarua and also the Turanganui and Taunui also reached very high levels.

The Ruamahanga River reached a 35 year return period at Wardells bridge and at least a 50 year flood at Waihenga. The floodways were ‘stretched’ but managed overall to cope with the floodwaters.