



# Annual hydrology monitoring report for the Wellington region, 2008/09

Quality for Life



greater WELLINGTON  
REGIONAL COUNCIL

Environment





# Annual hydrology monitoring report for the Wellington region, 2008/09

Laura Keenan

Mike Gordon

Environmental Monitoring and Investigations Department

For more information, contact:

Greater Wellington  
Regional Council  
Wellington  
PO Box 11646

T 04 384 5708  
F 04 385 6960  
[www.gw.govt.nz](http://www.gw.govt.nz)

Greater Wellington  
Regional Council  
Masterton  
PO Box 41

T 06 378 2484  
F 06 378 2146  
[www.gw.govt.nz](http://www.gw.govt.nz)

GW/EMI-G-09/233

October 2009



# Contents

<b>1.</b>	<b>Introduction</b>	<b>1</b>
<b>2.</b>	<b>Overview of the hydrological monitoring programme</b>	<b>2</b>
2.1	Hydrometric network changes in 2008/09	5
<b>3.</b>	<b>Overview of hydrological conditions in 2008/09</b>	<b>6</b>
3.1	Rainfall and river flows	6
3.2	Lake Wairarapa and Lake Onoke	10
<b>4.</b>	<b>Heavy rainfall and floods of 2008/09</b>	<b>12</b>
4.1	July 2008	12
4.2	August 2008	12
4.3	October 2008	12
4.4	November and December 2008	13
4.5	February 2009	13
4.6	May 2009	13
<b>5.</b>	<b>Low flows and dry spells of 2008/09</b>	<b>17</b>
<b>6.</b>	<b>Summary</b>	<b>20</b>
	<b>References</b>	<b>21</b>
	<b>Acknowledgements</b>	<b>22</b>
	<b>Appendix 1: Monitoring site details</b>	<b>23</b>
	<b>Appendix 2: Monthly hydrological data summary</b>	<b>26</b>
	<b>Appendix 3: River flood warning alarm levels and occurrences</b>	<b>32</b>



## 1. Introduction

Knowledge of hydrological patterns and trends is vital for achieving sustainable management of water resources. Greater Wellington Regional Council (Greater Wellington) carries out a hydrological monitoring programme that includes a hydrometric network for measuring rainfall, river flows, groundwater levels and lake levels. The information gathered is important for:

- Detecting long and short-term trends in climate and water resources;
- Providing warning of floods and droughts;
- Policy and plan development and review; and
- Resource consent monitoring.

This annual hydrology monitoring report, covering the period 1 July 2008 to 30 June 2009, describes the existing surface water hydrometric network and major changes to the network during the year. It also provides an overview of the trends in rainfall, river flows and lake levels and notable hydrological events of the year. A report containing an analysis of long-term trends is produced every six years (e.g., Watts 2005).

This 2008/09 annual report covers surface water hydrology only; for information on the groundwater monitoring programme and trends in groundwater levels during 2008/09 see McAlister & Tidswell (2009).

## 2. Overview of the hydrological monitoring programme

The objectives of Greater Wellington's hydrological monitoring programme are to:

- Provide information on the baseline quantity of surface water;
- Assist in the detection of spatial and temporal trends in surface water quantity;
- Provide information to help develop policies and plans, and assess resource consent applications; and
- Provide information to help determine the effectiveness of policies and plans.

The current monitoring network consists of 47 automatic rainfall, 40 automatic river level, and 10 automatic lake or wetland level monitoring sites (Figures 2.1 to 2.3; see Appendix 1 for site details). Some of these sites also have equipment that monitors climate and soil parameters (such as air temperature, wind speed, soil temperature and soil moisture), and water quality parameters (such as water temperature).

The 47 rainfall sites shown in Figure 2.1 are those that are operated according to hydrometric standards. Greater Wellington has an additional three rain gauges that are not operated to these standards, which are generally for short-term investigations or indicative rainfall monitoring purposes. These rain gauges are at Papawai (east of Greytown, called 'Tilsons Creek'), Te Horo ('Centrepont') and in the Horokiri catchment ('Snodgrass'). Although the data from these sites are not presented, the data were used in the background analysis for this report.

River level is converted to river flow using a rating curve. However, some of the river level monitoring stations have rating curves that are only accurate for high flows or low flows, as indicated in Appendix 1. NIWA also operates a network of river flow monitoring sites in the Wellington region, some of which are partly funded by Greater Wellington (Figure 2.2). Flow data from the co-funded sites are included in this report where appropriate, to provide an indication of regional river flow patterns.

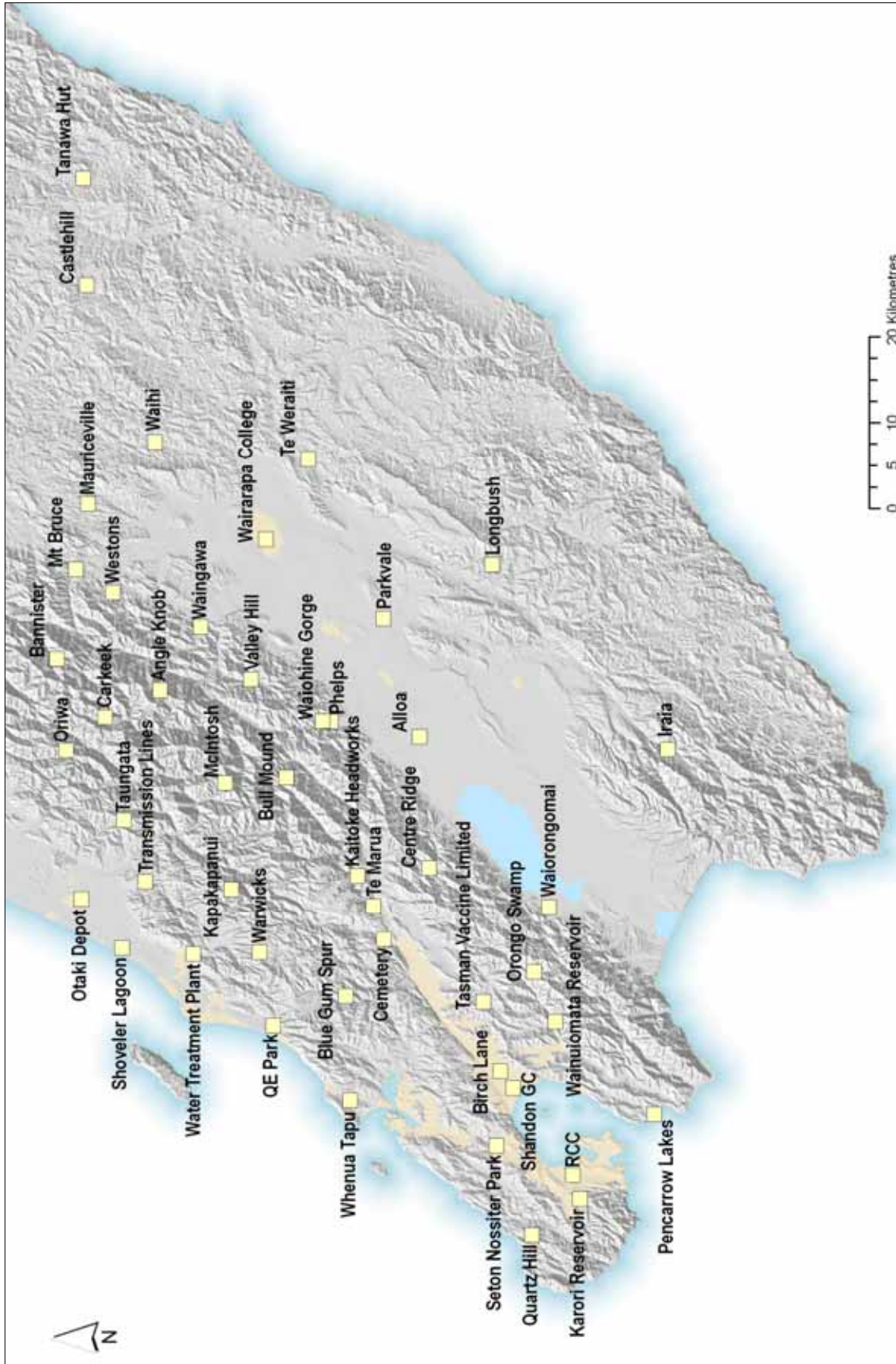


Figure 2.1: Location of Greater Wellington's automatic rainfall monitoring sites

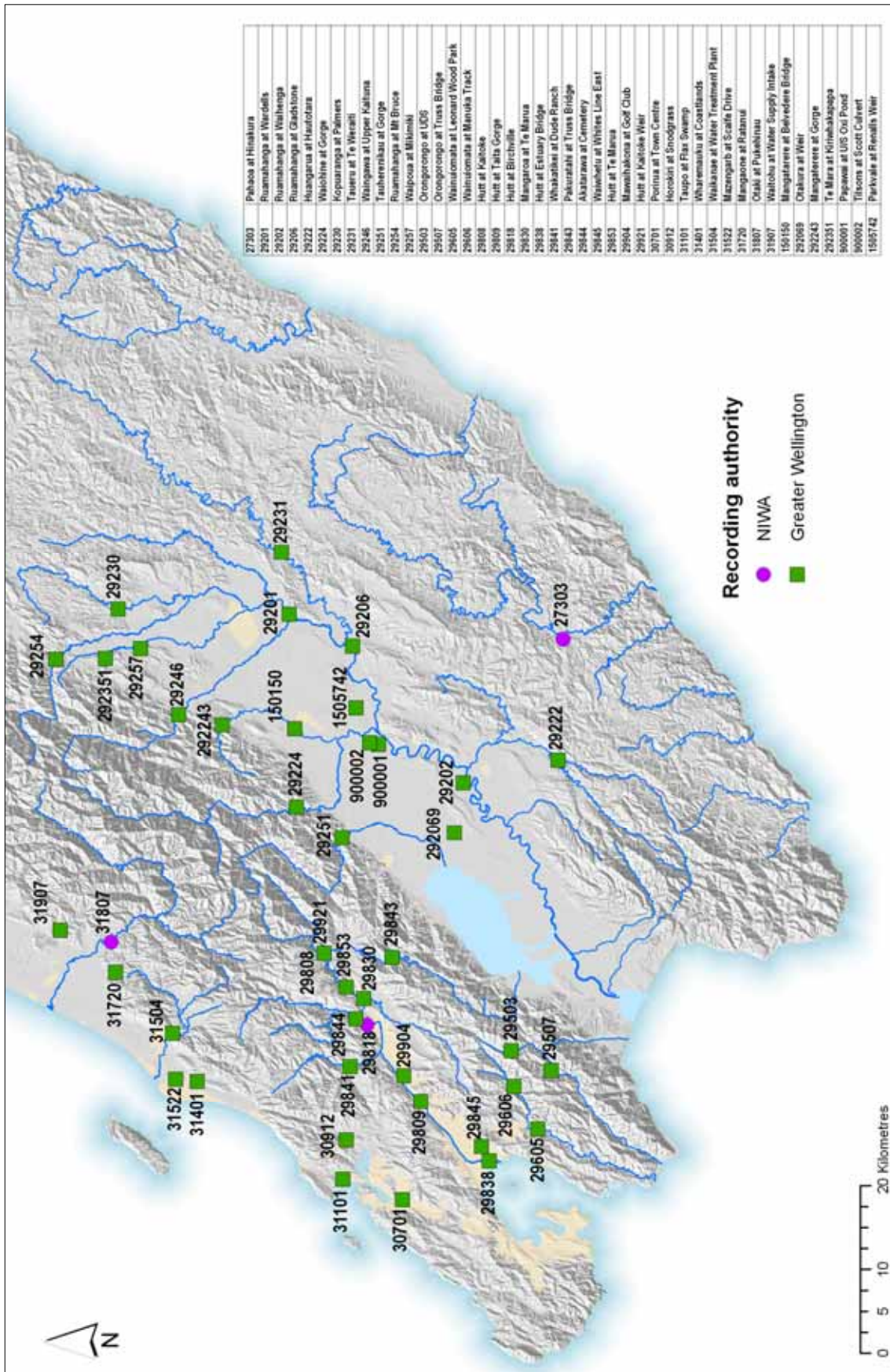


Figure 2.2: Location of automatic river level monitoring sites

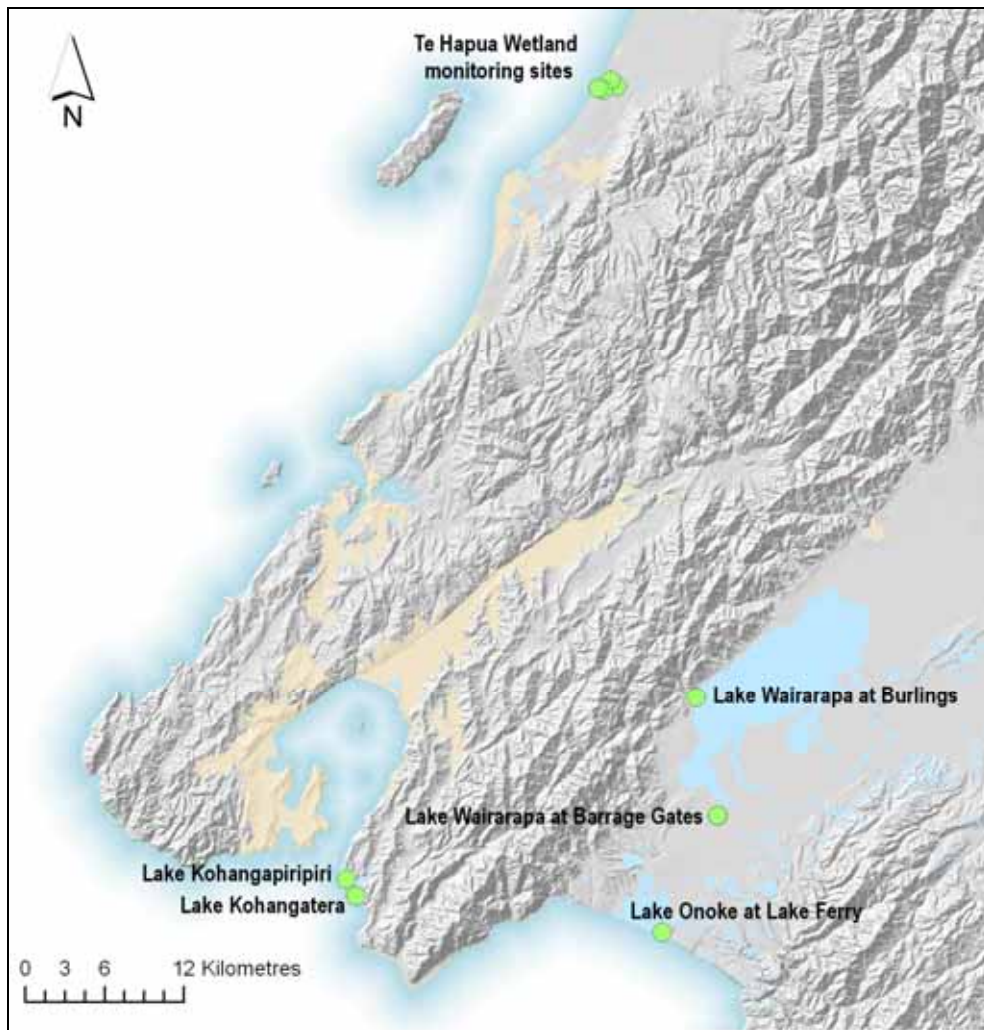


Figure 2.3: Greater Wellington's automatic lake/wetland level monitoring sites

## 2.1 Hydrometric network changes in 2008/09

The following major changes<sup>1</sup> to Greater Wellington's surface water hydrometric network were made in 2008/09:

- The 'Transmission Lines' rainfall site that was temporary closed in 2007 was reinstated;
- New rainfall sites were installed in the Waiorongomai catchment (to the south-west of Lake Wairarapa) and 'Shoveler Lagoon' in the Te Hapua wetland complex near Te Horo;
- Automatic water level monitoring sites were installed in four lagoons in the Te Hapua wetland complex (see McAlister & Tidswell 2009); and
- A new stream flow monitoring site was installed on Te Mara Stream, a tributary of the Waipoua River.

<sup>1</sup> Major changes are sites being opened or closed. Other changes such as equipment replacements are not listed here.

### **3. Overview of hydrological conditions in 2008/09**

Overall, 2008/09 was an 'average' hydrological year, with no particularly significant region-wide droughts or floods. To indicate how hydrological conditions varied over the year compared to average, the monthly rainfall totals and monthly mean river flows and lake levels are tabulated along with the long-term means in Appendix 2. The graphs in Figures 3.1 to 3.3 summarise the results for selected monitoring stations.

#### **3.1 Rainfall and river flows**

Following the region-wide 2007/08 summer drought that was particularly significant in eastern Wairarapa where it persisted into autumn, winter 2008 was wet throughout the Wellington region. July 2008 had up to double the average rainfall in the Hutt Valley, southern Wairarapa and on the Kapiti Coast. Frequent storms throughout the month brought regular rainfall to the region, including a relatively significant easterly storm on 30 July (see Section 4). August 2008 was another stormy month, with well above average rainfall in Masterton, Wellington City and the northern Kapiti Coast. As a result of the stormy period, river flows were the highest, or near-highest, average monthly flows on record for July and August.

After the period of very unsettled winter weather, September 2008 was unusually dry in most parts of the Wellington region. North-eastern Wairarapa had less than half the average rainfall for September, and rivers fed from the Tararua Range had below average flows for the time of the year. However, October 2008 saw a return to stormy weather, with typical spring northwesterly airflows over the region. Rainfall was high in the Tararua Range and northern Kapiti Coast, and river flows were above average for October. Many rivers experienced the most significant flood of the 2008/09 year on 7 October (Section 4).

The variable pattern of the year continued into November, which, like September, saw a return to settled weather conditions. The Wairarapa plains and eastern Wairarapa had particularly low rainfall for November; it was the driest November in the last 20 years in Masterton, with only 14 mm recorded at our monitoring site at Wairarapa College.

December 2008 was characterised by average to above average rainfall in the west of the region, and relatively dry conditions in eastern Wairarapa. Storms on two occasions during the month triggered heavy rainfall alarms for the Tararua Range and Hutt Valley.

Settled weather in January 2009 meant low rainfall and monthly average river flows throughout the Wellington region, and by the end of the month the rivers in the western part of the region were approaching 'mean annual low flow' conditions (Section 5). Following on from the dry November and December, Wairarapa river flows for January were particularly low for the time of the year. However, the dry summer was short-lived. February was a stormy month with higher than average rainfall and river flows; there was up to double the long-term average rainfall for February in the Hutt Valley, Wellington City and Kapiti Coast. Several storm events that occurred during February 2009 are described in Section 4.5.

Autumn 2009 saw a return to settled conditions in March, with below normal rainfall and river flows throughout the region. Rainfall was particularly low in the western Tararua Range and Kapiti Coast. Otaki had its driest March in 20 years, with only 18 mm of rainfall. April had low rainfall in the Wairarapa, but a stormy period at the end of the month meant that western parts of the region had about average rainfall for April. River flows remained below average, due to the dry conditions in March and first half of April, and a medium-level drought was declared for eastern Wairarapa by the Minister of Agriculture.

May 2009 brought rainfall that was welcome in Wairarapa for eliminating the soil moisture deficit. Overall the month was wetter than average in most parts of the region, with about double the long-term average May rainfall occurring in Petone, Lower Hutt, Wainuiomata and southern Wairarapa. River flows were higher than average for May, and a southerly storm resulted in relatively significant flood flows in some rivers (Section 4.6). Easterly and southerly airflows brought more rainfall to eastern Wairarapa in June 2009. However, western parts of the Wellington region experienced well below average rainfall and river flows for June. Kapiti Coast, Wellington City, Porirua and parts of the Tararua Range had less than half the long-term average June rainfall.

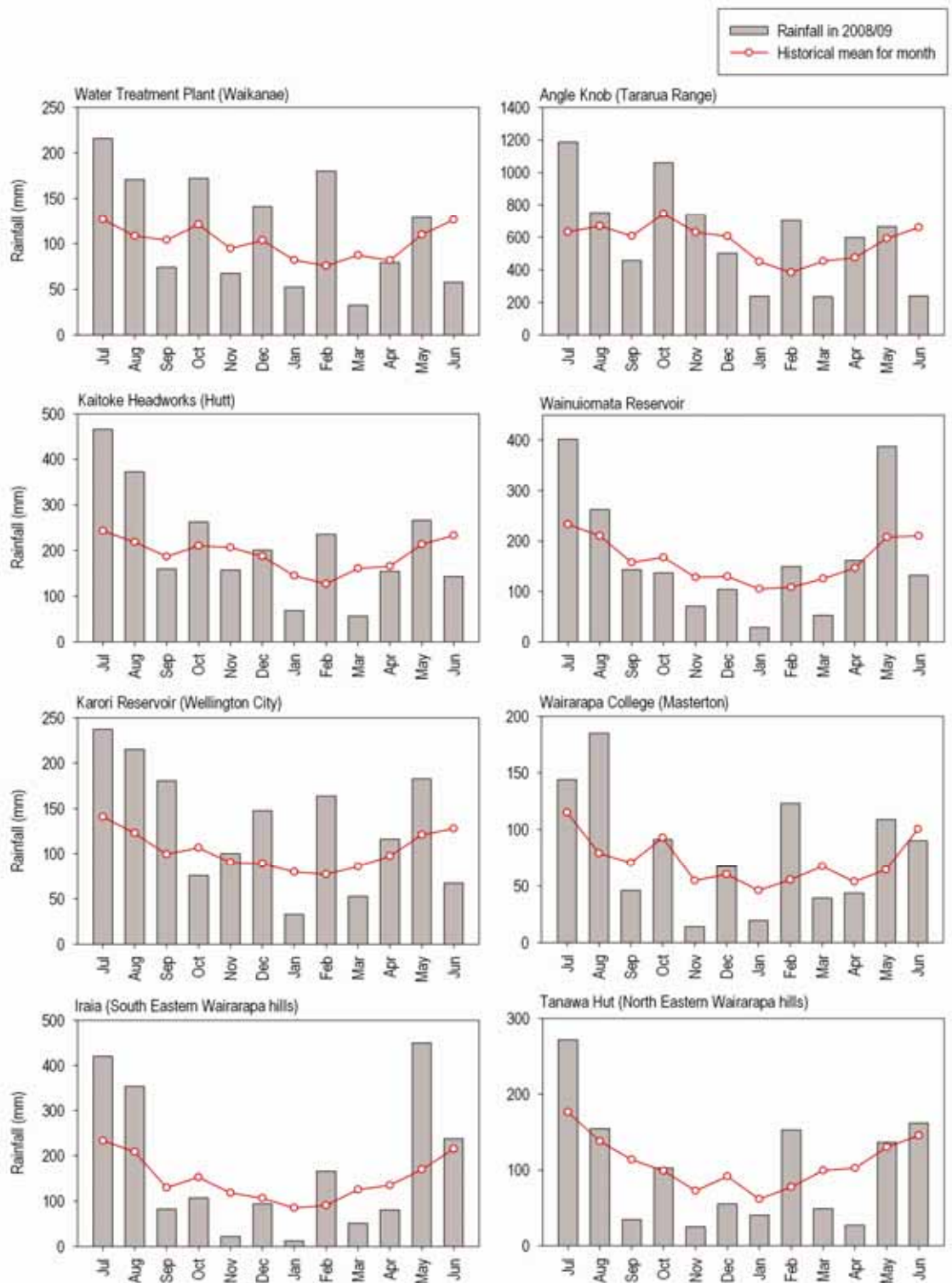


Figure 3.1: Monthly rainfall totals for 2008/09 (grey bars) compared to long-term mean monthly rainfall (red line) at selected rainfall monitoring locations in the Wellington region

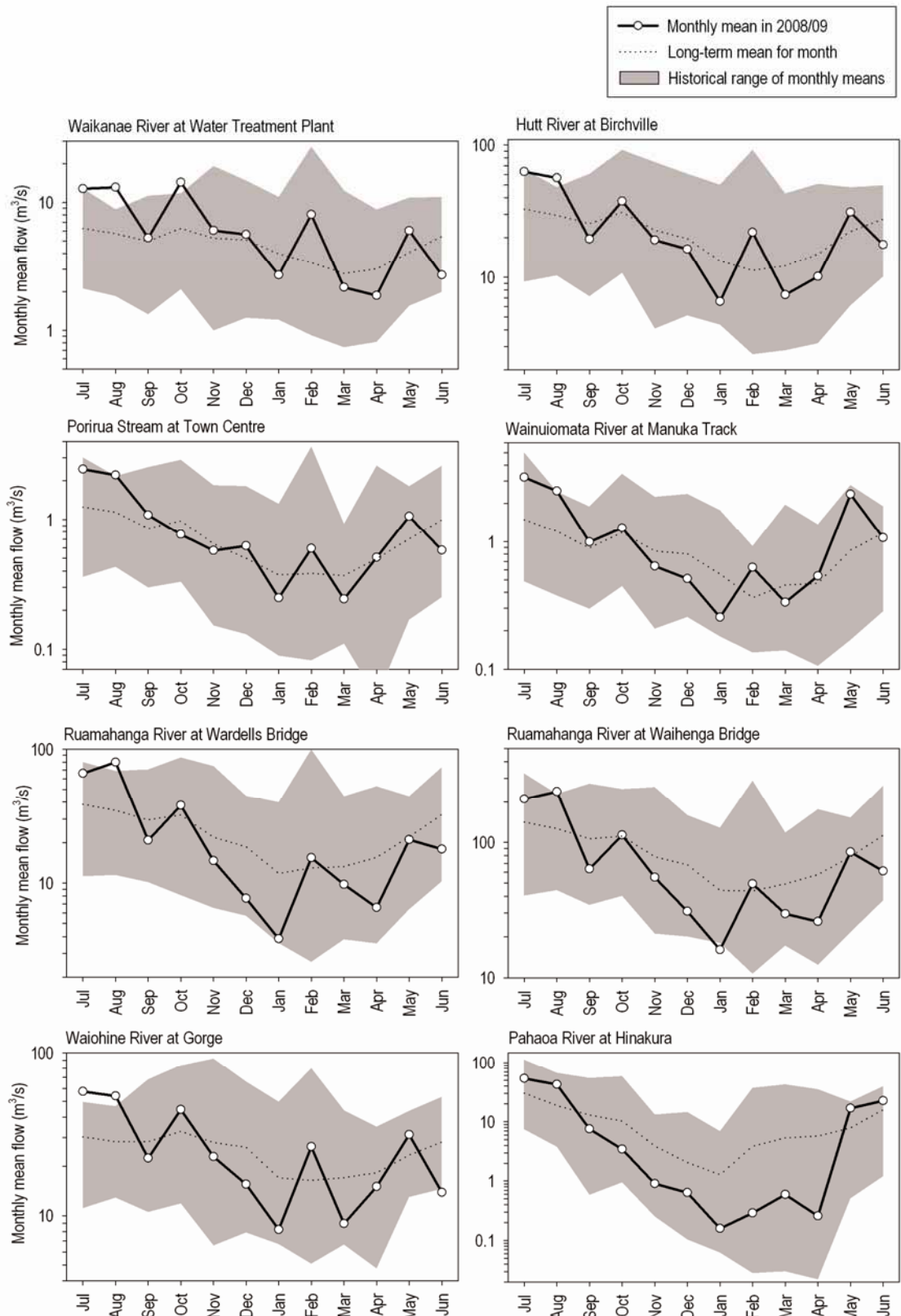


Figure 3.2: Monthly mean river flows for 2008/09 (black line) compared to long-term mean monthly river flows (dotted line) at selected monitoring locations in the Wellington region. Grey shaded area represents the historic range of monthly means. Note the logarithmic scale on y-axes.

### 3.2 Lake Wairarapa and Lake Onoke

The monthly mean water levels in Lake Wairarapa were above the long-term average for July and August 2008 (Figure 3.3). The monthly mean level for August was the highest on record since the Lower Valley Development Scheme came into operation in 1976. The high levels were due to high river flows. The Tauherenikau River, which flows directly into Lake Wairarapa, had well above average monthly flows that were the highest on record for those two months since monitoring began in 1976. High flows in the Ruamahanga River meant that the Barrage gates could not be opened to let water out to lower the level in Lake Wairarapa. There were also two floods during August when the Ruamahanga River contributed water to Lake Wairarapa via the Lower Valley Scheme floodways. Throughout this time, the levels in Lake Onoke were about average. The sea conditions were good with no blockages in the sea spit at the mouth of the Ruamahanga River.

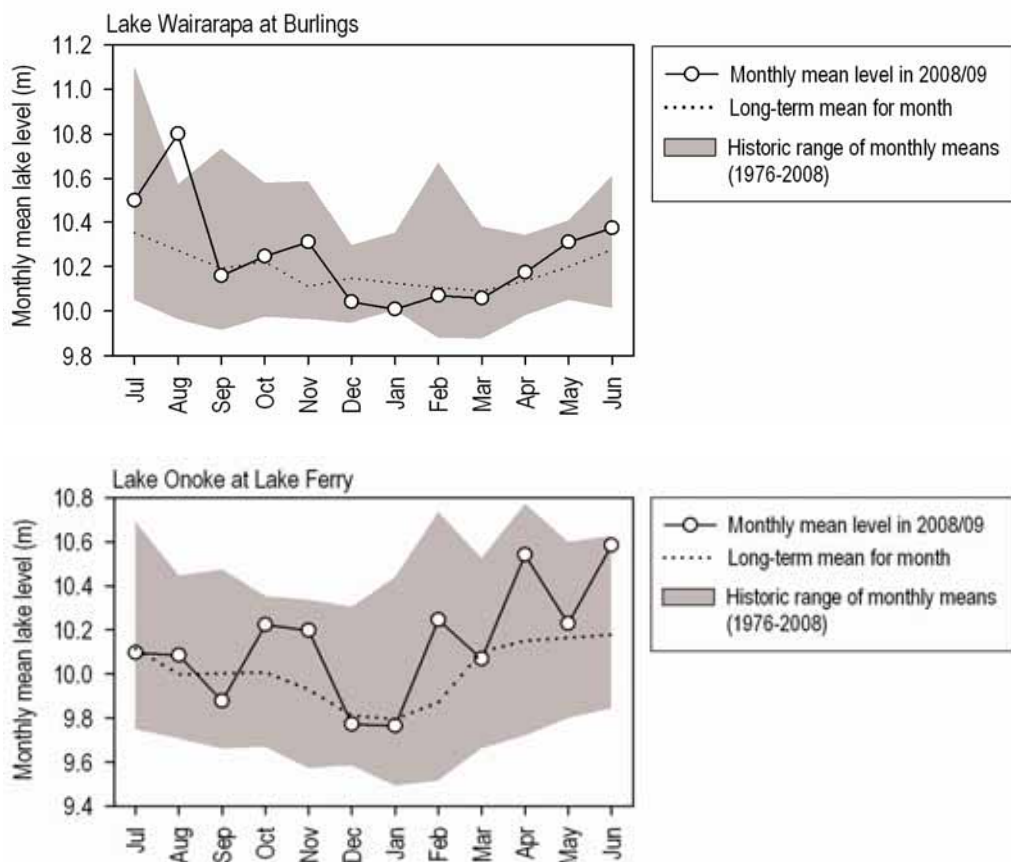


Figure 3.3: Mean monthly levels in Lake Wairarapa (top) and Lake Onoke (bottom) during 2008/09, compared to long-term monthly mean levels (dotted lines)

During September and October 2008 the Barrage gates could be opened for most of the time, allowing Lake Wairarapa levels to drop down to normal. This was despite a flood in the Ruamahanga River in early October (see Section 4) which raised levels in both lakes for a time. Another flood at the end of October, in combination with a blocked Lake Onoke opening, meant that water had to be back-flowed from Lake Onoke into Lake Wairarapa by opening the Barrage gates. An opening to the sea was not possible for at least a week. As a result, the mean levels in both lakes were above normal during November.

During December to early February 2009 the Ruamahanga River's flow was low and the sea spit opening at Lake Onoke was mostly open, resulting in the levels in Lake Onoke dropping back to about average for the time of the year. The Barrage gates were closed throughout most of this time to try and keep the level in Lake Wairarapa up to its target level<sup>2</sup> of 10.15 metres. However, low inflows to the lake, the effects of evaporation, and outflow through the fish pass meant that Lake Wairarapa levels were below average for the time of the year, and remained below the target level.

Through March and April 2009 evaporation losses eased and Lake Wairarapa's level rose slightly to remain about average for these months, aided by high inflows during late February. Lower river flows in April and rougher sea conditions resulted in Lake Onoke being nearly or completely blocked for nearly half the month, giving higher than average levels for the time of the year. In May, increased river flows aided Lake Onoke in staying open, bringing the average level back down again.

During June 2009 increased inflows and rougher sea conditions backed up the lower Ruamahanga River at the Barrage gates, resulting in the levels in both lakes rising above average. A blockage of the spit at Lake Onoke in the last week of June resulted in the backflowing of water into Lake Wairarapa, raising the level in Lake Wairarapa to over 11.3 metres. High seas prevented the Lake Onoke spit being opened and the level in Lake Onoke reached a record high of 12.65 metres on 1 July 2009 (just outside this annual reporting period).

---

<sup>2</sup> A water level management regime for Lake Wairarapa is set out in the Regional Freshwater Plan, consistent with the National Water Conservation (Lake Wairarapa) Order 1989

## **4. Heavy rainfall and floods of 2008/09**

One of the functions of the Greater Wellington hydrometric network is to provide information about floods, both in real-time for flood warning and for reporting and trend analysis. Statistics for the heaviest rainfall events and largest floods during 2008/09 are provided in Tables 4.1 to 4.3 at the end of this section.

Greater Wellington operates a flood warning service for some of the major catchments of the region. Alarms are triggered when rainfall exceeds a certain depth over a certain duration (e.g., 20 mm within 2 hours), or when a certain river level is reached (see Table A3.1, Appendix 3). The river level alarms that were triggered during the year are listed in Table A3.2, Appendix 3. There were more storm events that triggered river level flood warning alarms in 2008/09 (18 events) compared to in 2007/08 (13 events), but less than in the previous year (20 events in 2006/07). Most of the flood warning alarms for 2008/09 were triggered between July and December 2008.

### **4.1 July 2008**

The first notable storm of 2008/09 occurred on 11-12 July 2008. Short but intense rainfall resulted in the most significant flood of 2008/09 in Porirua Stream (with an estimated return period of three years), and triggered river flood warning alarms for the stream as well as various rivers in the Hutt and Ruamahanga catchments.

During the last two days of July two storms occurred in succession, an easterly storm followed by a northwesterly event. The first brought sustained rainfall to Wairarapa, Orongorongo Range, Wainuiomata and parts of the Hutt Valley. Rainfall in northeast Wairarapa was particularly significant over durations of 6 to 12 hours, with an estimated return period of 10 years at Tanawa Hut. The storm resulted in the biggest flood of 2008/09 in the Mangaroa, Wainuiomata, Pahaoa and Tauweru rivers, with estimated return periods of 4 and 5 years respectively for the latter two eastern Wairarapa rivers. The event the following day resulted in the largest flood for 2008/09 in the Waiwhetu Stream. Over the two days, river flood warning alarms were triggered for Otaki River, Hutt River, Wainuiomata River, Waiwhetu Stream, Porirua Stream and Ruamahanga River and many of its tributaries.

### **4.2 August 2008**

A particularly stormy period occurred between 24 and 26 August bringing steady rainfall that mainly affected the Ruamahanga catchment. Rainfall was heavy around northern Wairarapa and Masterton. One of two relatively significant floods for 2008/09 occurred in the Huangarua River on 26 August, with an estimated return period of 3 years. Flood warning alarms were triggered for that river and also for the Tauweru and Ruamahanga rivers.

### **4.3 October 2008**

A typical spring northwesterly storm brought prolonged heavy rainfall to the Tararua Range on 7 October. The rainfall was particularly notable in the eastern Tararua Range and Wairarapa foothills. For example, at Angle Knob (upper

Waingawa catchment) and Phelps (in Waiohine Gorge) the rainfall over the 6 to 12 hour duration had an estimated return period of 12 to 20 years. The 422 mm recorded over 12 hours at Angle Knob was the most rainfall for this duration since records began there in 1982.

The rainfall triggered flood warning alarms for many rivers fed from the Tararua Range, and was the most significant flood of 2008/09 in the Hutt River (2-3 year return period), Ruamahanga River (3-5 year return period), and the Ruamahanga River's western tributaries. This was the largest flood in the Ruamahanga River since July 2006.

#### **4.4 November and December 2008**

Another strong northwesterly flow brought heavy rainfall to the Tararua Range on 1 November, although it was not as prolonged as the storm of 7 October. Nonetheless, it resulted in the largest flood for the year in the Otaki River.

Two storms in late 2008, on 16 and 20 December, caused relatively heavy rainfall particularly around Wellington City and Porirua and also triggered heavy rainfall alarms in the Tararua Range and Hutt Valley. However, no significant river flooding resulted.

#### **4.5 February 2009**

As described in Section 3.1, February was a month of unsettled weather. Three notable storms occurred during the month. The first, on 12 February, brought widespread rainfall to the Wellington region. The rainfall was most significant on the Kapiti Coast and in the Hutt Valley, with an estimated return period of 2-3 years. River flood warning alarms were triggered for several streams and rivers of the western Wellington region. This was the largest flood of 2008/09 in the Waikanae, Pakuratahi, Akatarawa, and Whakatikei rivers. However, the floods were all estimated to have a return period of no more than 2 years.

A second storm, on 20 February, was relatively short but intense, bringing rainfall that was particularly heavy around Lower Hutt, Wainuiomata, Wellington City, and the eastern Tararua Range. For Lower Hutt, it was the most rainfall over 6 hours since a storm in January 2005. River flood warning alarms were triggered again for the major rivers in the west of the region, as well as for the Ruamahanga River.

On the last day of the month, 28 February, a low from the tropics swept down over the country from the north, causing rainfall in many parts of the North Island. In the Wellington region it mainly affected Wairarapa; however, no significant floods resulted.

#### **4.6 May 2009**

A prolonged southerly storm on 23-24 May brought sustained rainfall that particularly affected southern and eastern Wairarapa, Wainuiomata, and Lower Hutt. The Huangarua River had its largest flood since July 2006, with an estimated return period of 4 years.

**Table 4.1: Maximum short-duration rainfall depths during 2008/09 at selected rainfall monitoring stations in the Wellington region**

Site (Catchment/ area)	1 hour		6 hours		12 hours	
	Depth and Start date	Est. return period (years)	Depth and Start date	Est. return period (years)	Depth and Start date	Est. return period (years)
Water Treatment Plant (Waikanae)	19.5 mm 20 Feb 2009	2	46 mm 20 Feb 2009	2	67 mm 12 Feb 2009	3
QE Park (Paekakariki)*	20 mm 12 Jul 2008	2	46.5 mm 11 Jul 2008	4	55 mm 12 Feb 2009	3
Warwicks (Akatarawa)	22.5 mm 15 May 2009	2	67 mm 12 Feb 2009	2	103 mm 12 Feb 2009	3
Te Marua (Upper Hutt)	18 mm 12 Feb 2009	<2	55 mm 7 Oct 2008 12 Feb 2009	<2	87 mm 7 Oct 2008 12 Feb 2009	<2
TVL (Mangaroa / Whitemans Valley)	16 mm 20 Dec 2008 12 Feb 2009	<2	63 mm 20 Feb 2009	4	72 mm 20 Feb 2009	2
Birch Lane (Lower Hutt)	16.6 mm 20 Feb 2009	<2	64.4 mm 20 Feb 2009	4	74 mm 20 Feb 2009	3
Wainuiomata Reservoir (Wainuiomata)	13 mm 23 May 2009	<2	47.5 mm 20 Feb 2009	2	55.5 mm 20 Feb 2009 10 May 2009	<2
Seton Nossiter Park (Porirua)	17.5 mm 16 Dec 2008	<2	45 mm 20 Feb 2009	2	53 mm 20 Feb 2009	<2
Karori Reservoir (Wellington City)	20.4 mm 16 Dec 2008	2	57.4 mm 20 Feb 2009	4	67 mm 20 Feb 2009	3
McIntosh (W Tararua Range)	30 mm 1 Nov 2008	5	127.5 mm 1 Nov 2008	6	167 mm 7 Oct 2008	3
Angle Knob (E Tararua Range)	51.5 mm 7 Oct 2008	3	251 mm 7 Oct 2008	15	422 mm 7 Oct 2008	20
Phelps (Waiohine, foothills)	19 mm 7 Oct 2008	2	91 mm 7 Oct 2008	20	125 mm 7 Oct 2008	12
Wairarapa College (Masterton)*	14.8 mm 28 Feb 2008	2	34.4 mm 25 Aug 2008	2	43 mm 25 Aug 2008	<2
Alloa (Featherston)	15.6 mm 30 Jul 2008	<2	35.6 mm 30 Jul 2008	2	46.6 mm 30 Jul 2008	<2
Castlehill (Tauweru)	16.5 mm 23 May 2009	3	36 mm 23 May 2009	<2	49.5 mm 30 Jul 2008	<2
Iraia (Huangarua)	13 mm 12 Feb 2009	<2	45 mm 20 Feb 2009	<2	81.5 mm 23 May 2009	2
Tanawa Hut (Whareama)	19.5 mm 30 Jul 2008	2	78 mm 30 Jul 2008	10	108 mm 30 Jul 2008	10

\*Return periods estimated using HIRDS v2.0 (NIWA 2002)

**Table 4.2: Maximum long-duration rainfall depths during 2008/09 at selected rainfall monitoring stations in the Wellington region**

Site (Catchment/ area)	24 hours		48 hours		72 hours	
	Depth and Start date	Est. return period (years)	Depth and Start date	Est. return period (years)	Depth and Start date	Est. return period (years)
Water Treatment Plant (Waikanae)	68 mm 11 Feb 2009	<2	70.5 mm 19 Feb 2009	<2	75.5 mm 9 Feb 2009	<2
QE Park (Paekakariki)*	56.5 mm 11 Feb 2009	<2	57 mm 10 Feb 2009	<2	68.5 mm 9 Feb 2009	<2
Warwicks (Akatarawa)	109.5 mm 11 Feb 2009	<2	110.5 mm 10 Feb 2009	<2	129.5 mm 9 Feb 2009	<2
Te Marua (Upper Hutt)	89.5 mm 6 Oct 2008	<2	91 mm 29 Jul 2008 11 Feb 2009	<2	110.5 mm 29 Jul 2008	<2
TVL (Mangaroa / Whitemans Valley)	75.5 mm 20 Feb 2009	<2	99 mm 23 May 2009	<2	124 mm 22 May 2009	2
Birch Lane (Lower Hutt)	75 mm 20 Feb 2009	<2	81 mm 23 May 2009	<2	90 mm 22 May 2009	<2
Wainuiomata Reservoir (Wainuiomata)	85 mm 24 May 2009	<2	141 mm 23 May 2009	<2	166.5 mm 22 May 2009	<2
Seton Nossiter Park (Porirua)	57 mm 26 Apr 2009	<2	66 mm 27 Apr 2009	<2	102 mm 26 Apr 2009	2
Karori Reservoir (Wellington City)	68.4 mm 20 Feb 2009	<2	83 mm 4 Sep 2008	<2	88.6 mm 3 Sep 2008 26 Apr 2009	<2
McIntosh (W Tararua Range)	189.5 mm 7 Oct 2008	<2	248.5 mm 20 Feb 2009	<2	286 mm 4 Oct 2008	<2
Angle Knob (E Tararua Range)	453 mm 7 Oct 2008	5	501 mm 6 Oct 2008	4	584.5 mm 4 Oct 2008	3
Phelps (Waiohine, foothills)	126.5 mm 6 Oct 2008	3	133 mm 6 Oct 2008	<2	140.5 mm 6 Oct 2008	<2
Wairarapa College (Masterton)*	57 mm 25 Aug 2008	<2	79.4 mm 24 Aug 2008	<2	95.4 mm 24 Aug 2008	<2
Alloa (Featherston)	51.6 mm 30 Jul 2008	<2	59.6 mm 29 Jul 2008	<2	69 mm 24 Aug 2008	<2
Castlehill (Tauweru)	64.5 mm 28 Feb 2009	<2	84 mm 28 Jun 2009	2	104.5 mm 28 Jun 2009	<2
Iraia (Huangarua)	119 mm 23 May 2009	2	183.5 mm 22 May 2009	3	227 mm 22 May 2009	4
Tanawa Hut (Whareama)	120 mm 29 Jul 2008	5	127.5 mm 29 Jul 2008	<2	127.5 mm 28 Jul 2008	<2

\*Return periods estimated using HIRDS v2.0 (NIWA 2002)

**Table 4.3: Maximum river and stream flows during 2008/09 at river flow monitoring sites in the Wellington region<sup>3,4</sup>**

Site	Highest flow in 2008/09 (m <sup>3</sup> /s)	Date of occurrence	Estimated return period (years)
Waitohu S at Water Supply Intake	32	7 Oct 2008	<2
Otaki R at Pukehinau*	886	1 Nov 2008	<2
Mangaone S at Ratanui	9	20 Feb 2009	<2
Waikanae R at Water Treatment Plant	129	12 Feb 2009	<2
Hutt R at Te Marua	419	7 Oct 2008	3
Hutt R at Birchville*	660	7 Oct 2008	2
Hutt R at Taita Gorge	686	7 Oct 2008	<2
Pakuratahi R at Truss Bridge	90	7 Oct 2008	2
	96	12 Feb 2009	3
Mangaroa R at Te Marua	120	30 Jul 2008	<2
Akatarawa R at Cemetery	213	12 Feb 2009	<2
Whakatikei R at Dude Ranch	78	12 Feb 2009	2
Waiwhetu S at Whites Line East	12	31 Jul 2008	2
Wainuiomata R at Manuka Track	24	30 Jul 2008	<2
Wainuiomata R at Leonard Wood Park	42	30 Jul 2008	2
	45	24 May 2009	2
Orongorongo R at Upper Dam Site	25	20 Feb 2009	<2
Taupo S at Flax Swamp	4	12 Jul 2008	2
Horokiri S at Snodgrass	19	12 Feb 2009	n/a
Porirua S at Town Centre	37	12 Jul 2008	3
Ruamahanga R at Mt Bruce	315	7 Oct 2008	2
	318	20 Feb 2009	2
Ruamahanga R at Wardells Bridge	590	7 Oct 2008	5
Ruamahanga R at Gladstone Bridge	975	7 Oct 2008	5
Ruamahanga R at Waihenga Bridge	1205	7 Oct 2008	3
Waipoua R at Mikimiki Bridge	217	7 Oct 2008	3
Waingawa R at Kaituna	298	7 Oct 2008	2-3
Mangatarere S at Gorge	83	7 Oct 2008	4
Waiohine R at Gorge	932	7 Oct 2008	3
Tauherenikau R at Gorge	355	7 Oct 2008	3-4
Kopuaranga R at Palmers	42	8 Oct 2008	<2
Tauweru R at Te Weraiti	303	30 Jul 2008	5
Huangarua R at Hautotara	208	26 Aug 2008	3
	226	23 May 2009	4
Pahaoa R at Hinakura*	641	31 Jul 2008	4

\*Data provided by NIWA but frequency analysis performed by Greater Wellington

#Record not long enough for analysis

<sup>3</sup> For sites where the largest flood was within 10% of the second largest, both floods are listed. This accounts for error in flow measurement

<sup>4</sup> River level stations that are not rated for high flows are omitted from the table

## 5. Low flows and dry spells of 2008/09

The minimum rainfall depths at selected rainfall monitoring stations over 14 and 28 day durations (Table 5.1) give an indication of the driest periods in 2008/09. January and February are usually the months with the lowest rainfall in the Wellington region. However, February 2009 was wetter than average, as described in Section 3.1. As a consequence, the driest periods in 2008/09 tended to occur in January or March/April. In Masterton and eastern Wairarapa, early November through until early December was the driest 28-day period of the year, indicating that an early start to summer occurred in those places.

Table 5.1: Lowest rainfall totals during 2008/09 for 14-day and 28-day durations at selected monitoring locations in the Wellington region

Site Name	14 days		28 days	
	Rainfall minima (mm)	Start date	Rainfall minima (mm)	Start date
Angle Knob (Tararua Range)	6.5	20 Jan 2009	116.5	12 Jan 2009
Waikanae Water Treatment Plant	0	23 Mar 2009 9 Apr 2009	16.5	7 Mar 2009
Kaitoke Headworks (nth Upper Hutt)	0.5	24 Mar 2009	37	9 Mar 2009
Shandon Golf Club (Petone)	0	23 Mar 2009 9 Apr 2009	9.5	23 Mar 2009
Wainuiomata Reservoir	0.5	3 Jan 2009	24.5	29 Dec 2008
Karori Reservoir (Wellington)	0.8	24 Mar 2009	24.4	29 Dec 2008
Phelps (Tararua foothills – Wairarapa)	1.5	10 Apr 2009	24	12 Jan 2009
Wairarapa College (Masterton)	0.2	24 Mar 2009	5.2	7 Nov 2008
Alloa (Featherston)	0	23 Mar 2009	8.4	12 Jan 2009
Tanawa Hut (North-east Wairarapa)	1.5	7 Nov 2008 25 Mar 2009	8.5	31 Mar 2009
Iraia (South-east Wairarapa)	0	20 Jan 2009	7.5	7 Nov 2008

Rivers in the western part of the Wellington region tended to experience their lowest flows for 2008/09 during late January to early February (before the stormy weather of February) or in April 2009 (Table 5.2). In some of the monitored rivers, such as Akatarawa River, the low flows were not significant (i.e., the mean annual low flow was not reached). However, in most rivers of the western part of the region the lowest flows of 2008/09 typically had an estimated return period of 3 to 4 years. The exception was the Otaki River which, in autumn, experienced its fourth lowest flows since monitoring of the river flows began in 1980. This was due to a particularly dry March in Otaki and the western Tararua Range (as mentioned in Section 3.1).

**Table 5.2: Lowest 7-day and 28-day mean river flows during 2008/09 at monitoring stations in the western Wellington region. Mean annual low flow (MALF) is the average of the low flows on record, and generally has a return period of less than two years.**

Site Name	7-day duration			28-day duration		
	Lowest mean flow in 2008/09 (m <sup>3</sup> /s)	Start date	Estimated return period	Lowest mean flow in 2008/09 (m <sup>3</sup> /s)	Start date	Estimated return period
Waitohu S at WSI	0.161	3 Feb 2009	>MALF	0.235	10 Mar 2009	3 years
Otaki R at Pukehinau*	3.742	19 Apr 2009	10 years	6.077	10 Mar 2009	7 years
Mangaone S at Ratanui	0.084	3 Feb 2009	>MALF	0.108	1 Apr 2009	>MALF
Waikanae R at WTP	0.857	19 Apr 2009	4 years	1.145	30 Mar 2009	3 years
Hutt at Birchville*#	3.015	3 Feb 2009	>MALF	4.313	13 Jan 2009	3 years
Hutt R at Taita Gorge#	3.488	3 Feb 2009	3 years	4.953	13 Jan 2009	3 years
Pakuratahi R at Truss Bridge	0.213	3 Feb 2009	3 years	0.269	13 Jan 2009	MALF
Mangaroa R at Te Marua	0.325	29 Jan 2009	3 years	0.441	13 Jan 2009	>MALF
Akatarawa R at Cemetery	1.106	19 Apr 2009	>MALF	1.362	13 Jan 2009	3 years
Whakatikei R at Dude Ranch	0.231	19 Apr 2009	5 years	0.315	29 Mar 2009	4 years
Wainuiomata R at Manuka Track	0.162	2 Feb 2009	3 years	0.209	15 Jan 2009	3 years
Wainuiomata R at LWP#	0.313	28 Jan 2009	>MALF	0.371	29 Mar 2009	>MALF
Orongorongo R at UDS	0.022	28 Jan 2009	5 years	0.040	13 Jan 2009	4 years
Taupo S at Flax Swamp	0.017	2 Feb 2009	>MALF	0.042	11 Nov 2008 11 Mar 2009	>MALF
Horokiri S at Snodgrass	0.076	19 Apr 2009	n/a	0.103	13 Jan 2009	n/a
Porirua S at Town Centre	0.135	19 Apr 2009	3 years	0.164	29 Mar 2009	3 years

\*Data provided by NIWA but frequency analysis performed by Greater Wellington

#Low flow likely to have been significantly affected by upstream abstraction

Rivers in the Wairarapa similarly experienced two phases of low flows in 2008/09, separated by the rainfall and resulting high flows of late February. The most significant low flows occurred in mid January through to early February (Table 5.3), and were generally more severe than in the west of the region. This was a result of particularly low rainfall in November and early summer in the Wairarapa

and eastern Tararua Range. Significant low flows in the Ruamahanga River in January are likely to have been a combined effect of low rainfall, upstream abstraction, and below average groundwater levels that occurred during November to January (McAlister & Tidswell 2009).

Throughout the Wellington region the low river flows were not as severe or prolonged as those of summer and autumn 2007/08 (see Watts & Gordon 2008).

**Table 5.3: Lowest 7-day and 28-day mean river flows during 2008/09 at monitoring stations<sup>5</sup> in the Wairarapa. Mean annual low flow (MALF) is the average of the low flows on record, and generally has a return period of less than two years**

Site Name	7-day duration			28-day duration		
	Lowest mean flow in 2008/09 (m <sup>3</sup> /s)	Start date	Estimated return period	Lowest mean flow in 2008/09 (m <sup>3</sup> /s)	Start date	Estimated return period
Ruamahanga R at Mt Bruce	0.989	3 Feb 2009	8 years	1.669	13 Jan 2009	4 years
Ruamahanga R at Wardells <sup>#</sup>	1.892	3 Feb 2009	9 years	2.646	13 Jan 2009	8 years
Ruamahanga R at Waihenga Bridge <sup>#</sup>	5.553	4 Feb 2009	20 years	9.766	14 Jan 2009	8 years
Waipoua R at Mikimiki <sup>^</sup>	0.195	29 Jan 2009	12 years	0.296	15 Jan 2009	12 years
Waingawa R at Kaituna	1.069	3 Feb 2009	6 years	1.793	13 Jan 2009	5 years
Mangatarere S at Gorge	0.097	29 Jan 2009	6 years	0.145	15 Jan 2009	6 years
Waiohine R at Gorge	3.103	3 Feb 2009	3 years	5.065	10 Mar 2009	4 years
Tauherenikau R at Gorge	1.286	3 Feb 2009	MALF	1.867	15 Jan 2009	3 years
Kopuaranga R at Palmers <sup>#</sup>	0.275	25 Jan 2009	3 years	0.294	15 Jan 2009	4 years
Otukura S at Weir <sup>#</sup>	0.044	3 Feb 2009	3 years	0.068	15 Jan 2009	3 years
Papawai S at U/S Oxi Pond <sup>#</sup>	0.078	21 Jan 2009	n/a	0.101	15 Jan 2009	n/a
Pahaoa R at Hinakura <sup>*</sup>	0.032	3 Feb 2009	4 years	0.063	15 Jan 2009	4 years

<sup>^</sup> Return periods estimated based on a correlation with Atiwhakatu River and should therefore be interpreted with some caution.

<sup>#</sup> Low flow likely to have been significantly affected by upstream abstraction

<sup>\*</sup> Data provided by NIWA

<sup>5</sup> Only the river level sites that are rated for low flows are shown in the table

## 6. Summary

Overall, 2008/09 was an 'average' hydrological year, with no particularly significant drought or flood phases. However, there was some variability within the year with alternating periods of settled and stormy weather. Winter 2008 had high rainfall and river flows, particularly in August. There was an early start to the summer, particularly in the Wairarapa where rainfall was very low in November 2008. However, summer was 'interrupted' by a stormy wet February 2009 before settled, dry conditions returned in March and April 2009.

Although more flood warning alarms were triggered in 2008/09 compared to in the previous year, there were no overly significant floods. Several storms – such as those in February 2009 – resulted in relatively localised heavy rainfall that may have caused surface flooding. A storm on 7 October 2008 that produced heavy rainfall in the Tararua Range caused the largest flood of the year in most of the rivers fed from the range. However, all the floods of 2008/09 at Greater Wellington flow monitoring sites had estimated return periods of five years or less and are not considered significant compared to other floods on record.

The lowest river flows of the year either occurred during January to early February or in April 2009. The most significant low flows of the year occurred in the Ruamahanga River prior to the stormy weather of February. The low flows were exacerbated by the earlier than usual start to summer, and low groundwater levels. Particularly low rainfall on the Kapiti Coast and in the Tararua Range during March led to significant low flows in the Otaki River during April (and similarly, a dry start to autumn in eastern Wairarapa meant that soil moisture deficits persisted until May). However, in all the monitored rivers the low flows were not as prolonged or severe as those that occurred in summer and autumn 2007/08.

## References

McAlister, D.; Tidswell, S. 2009. *Annual groundwater monitoring report for the Wellington region, 2008/09*. Greater Wellington Regional Council, Publication No. GW/EMI-G-09/234.

NIWA 2002. HIRDS v2.0 – High Intensity Rainfall Design System.

Watts, L. 2005. *Hydrological monitoring technical report*. Greater Wellington Regional Council, Publication No. GW/RINV-T-05/88.

Watts, L.; Gordon, M. 2008. *Annual hydrological monitoring report for the Wellington region 2007/08*. Greater Wellington Regional Council, Publication No. GW/EMI-T-08/159.

## **Acknowledgements**

Most of the data presented in this report were collected via Greater Wellington's hydrometric network, which is operated by the Environmental Monitoring Team. Greater Wellington hydrological data are supplemented by data from NIWA, as indicated in the report.

## Appendix 1: Monitoring site details

Table A1.1: Rainfall monitoring sites

Site Name	Catchment/Location	Altitude (m)	Start date	Easting	Northing
Kapakapanui	Otaki (Tararua Range)	1090	06/09/1991	2692100	6028900
McIntosh	Otaki (Tararua Range)	1020	26/09/1991	2704500	6029600
Oriwa	Otaki (Tararua Range)	1050	08/09/1991	2708300	6048100
Taungata	Otaki (Tararua Range)	980	06/09/1991	2700200	6041400
Otaki Depot	Otaki	17	18/07/1984	2691000	6046300
Transmission Lines	Mangaone	140	13/10/1992	2693000	6038900
Shoveler Lagoon	n/a (Te Hapua wetlands)	3	30/03/2009	2685300	6041600
Water Treatment Plant	Waikanae	40	02/08/1969	2684600	6033300
QE Park	Whareroa (Paekakariki)	15	12/09/2001	2676258	6024009
Kaitoke Headworks	Hutt	223	02/01/1991	2693700	6014200
Te Marua	Hutt	150	22/07/1993	2690100	6012400
Centre Ridge	Pakuratahi	510	06/04/1984	2694600	6005900
Tasman Vaccine Ltd	Mangaroa	229	03/05/1968	2679000	5999600
Warwicks	Akatarawa	345	16/06/1980	2684800	6025600
Cemetery	Akatarawa	100	29/03/1988	2686300	6011200
Blue Gum Spur	Whakatikei	335	13/10/1981	2679700	6015600
Birch Lane	Hutt (Lower Hutt)	10	25/04/2001	2671000	5997600
Shandon Golf Club	Hutt (Petone)	4	03/04/2000	2669020	5996170
Orongo Swamp	Orongorongo	420	03/10/1980	2682500	5993700
Wainuiomata Reservoir	Wainuiomata	125	01/01/1890	2676700	5991200
Pencarrow Lakes	Gollans / Pencarrow Lakes	8	22/08/2007	2665946	5979727
Whenua Tapu	Taupo	45	17/04/1991	2667600	6015100
Seton Nossiter Park	Porirua	100	06/07/1992	2662300	5998100
Quartz Hill	Makara	270	03/09/2007	2651936	5993977
Karori Reservoir	Kaiwharawhara	141	02/01/1879	2656100	5988400
Regional Council Centre	n/a (Wellington city)	30	26/07/1996	2658900	5989200
Bannister	Ruamahanga (Tararua Range)	1000	30/09/1974	2718847	6049143
Angle Knob	Waingawa (Tararua Range)	1200	27/12/1974	2715273	6037178
Carkeek	Waiohine (Tararua Range)	1158	30/09/1974	2712181	6043585
Bull Mound	Tauherenikau (Tararua Range)	1000	23/03/1976	2705146	6022522
Mt Bruce	Ruamahanga	300	30/07/1984	2729290	6047000
Mauriceville	Kopuaranga	230	07/05/2008	2736890	6045570
Westons	Waipoua	470	08/11/2007	2726580	6042674
Wairarapa College	Ruamahanga (Masterton)	115	29/05/2002	2732767	6024886
Waingawa	Waingawa	240	09/05/1994	2722560	6032448
Valley Hill	Mangatarere	483	21/04/1997	2716500	6026600
Phelps	Waiohine	125	02/01/1974	2711649	6017328
Waiohine Gorge	Waiohine	140	02/02/2006	2711700	6018300
Parkvale	Parkvale (Carterton)	100	08/01/2008	2723514	6011211

Site Name	Catchment/Location	Altitude (m)	Start date	Easting	Northing
Alloa	Tauherenikau (Featherston)	40	01/03/1963	2709890	6007005
Waiorongomai	Waiorongomai	25	18/05/2009	2690040	5991980
Waihi	Whangaehu	175	10/01/2001	2744120	6037795
Castlehill	Tauweru	240	10/04/1991	2762370	6045690
Te Weraiti	Tauweru	80	09/09/1997	2742125	6019985
Longbush	Southern Whangaehu	255	01/11/2006	2729856	5998567
Iraia	Ruakokoputuna	260	09/04/1969	2708410	5978155
Tanawa Hut	Whareama	280	01/01/1956	2774715	6046105

Table A1.2: River level/flow monitoring sites

Site Name	Start date	Catchment area (km <sup>2</sup> )	Easting	Northing	Comments
Waitohu Stream at Water Supply Intake	17/10/1994	19.2	2696903	6046500	
Mangaone Stream at Ratanui	13/01/1993	9.2	2691891	6039889	
Waikanae River at Water Treatment Plant	03/03/1975	125	2684589	6033100	
Mazengarb Stream at Scaife Drive	03/05/1995	4.5	2679099	6032582	Funded by KCDC
Wharemauku Stream at Coastlands	16/12/1980	7.8	2678860	6030142	Funded by KCDC
Hutt River at Kaitoke Weir	03/02/2004	86.8	2694200	6015000	River level only
Hutt River at Te Marua	05/03/1984	191	2690100	6012400	
Hutt River at Taita Gorge	16/03/1979	556	2676431	6003512	
Hutt River at Estuary Bridge	28/09/1976	623	2669300	5995300	River level only (tidal site)
Pakuratahi River at Truss Bridge	22/05/1978	37.2	2693700	6006900	
Mangaroa River at Te Marua	20/05/1977	102	2688773	6010299	
Akatarawa River at Cemetery	19/02/1979	114	2686308	6011215	
Whakatikei River at Dude Ranch	08/09/1976	46	2680600	6011900	
Mawaihakona 1 Stream at Golf Club	24/08/2006	-	2679500	6005500	Catchment area not defined (spring)
Waiwhetu Stream at Whites Line East	31/05/1978	11.6	2671018	5996214	
Wainuiomata River at Manuka Track	10/06/1982	27.1	2678249	5992347	
Wainuiomata River at Leonard Wood Park	14/04/1977	77.5	2673115	5989539	
Orongorongo River at Upper Dam Site	09/10/1980	7.1	2682500	5992700	
Orongorongo River at Truss Bridge	12/03/1998	31.7	2680182	5987879	
Taupo Stream at Flax Swamp	17/08/1979	8.2	2667093	6012771	Funded by PCC
Horokiri Stream at Snodgrass	15/02/2002	28.8	2671800	6012400	
Porirua Stream at Town Centre	08/09/1965	44.8	2664697	6005684	
Ruamahanga River at Mt Bruce	01/01/1975	76.5	2729300	6047000	
Ruamahanga River at Wardells	10/11/1954	637	2734700	6019200	
Ruamahanga River at Gladstone Bridge	06/06/1992	1315	2730900	6011600	Rated for high flows only

Site Name	Start date	Catchment area (km <sup>2</sup> )	Easting	Northing	Comments
Ruamahanga River at Waihenga Bridge	31/12/1956	2340	2714600	5998400	
Waipoua River at Mikimiki Bridge	05/02/1979	80.5	2730600	6036900	
Te Mara Stream at Kiriwhakapapa	28/11/2008	13.4	2729426	6041124	
Waingawa River at Kaituna	14/05/1976	79	2722700	6032400	
Mangatarere Stream at Gorge	09/02/1999	33.3	2721485	6027140	
Mangatarere Stream at Belvedere Bridge	26/01/2004	55.9	2721063	6018518	Rated for low flows only
Waiohine River at Gorge	27/12/1954	180	2711700	6018300	
Tauherenikau River at Gorge	30/03/1976	112	2708000	6012900	
Kopuaranga River at Palmers	15/03/1985	100	2735300	6039600	
Tauweru River at Te Weraiti	10/12/1969	373	2742100	6020100	Rated for high flows only
Huangarua River at Hautotara	01/01/1968	140	2717300	5987100	Rated for flows stage only
Otukura Stream at Weir	17/12/1997	36.2	2708600	5999500	
Papawai Stream at U/S Oxi Pond	06/12/2005	-	2719168	6008530	Catchment area not defined (spring)
Tilsons Creek at Scott Culvert	03/11/2005	-	2719350	6009560	Catchment area not defined (spring)
Parkvale Stream at Renalls Weir	15/01/2002	-	2723514	6011211	Catchment area not defined
Otaki River at Pukehinau	17/07/1980	306	2695500	6040200	NIWA site partly funded by GW
Hutt River at Kaitoke	21/12/1967	89	2694200	6015000	NIWA site partly funded by GW
Hutt River at Birchville	07/09/1970	427	2685600	6009900	NIWA site partly funded by GW
Pahaoa River at Hinakura	04/09/1986	563	2731700	5986500	NIWA site partly funded by GW

Table A1.3: Lake and wetland level monitoring sites

Site Name	Start date	Easting	Northing
Lake Wairarapa at Burlings	18/09/1953	2691800	5994800
Lake Onoke at Lake Ferry	27/04/1953	2689200	5977000
Lake Wairarapa at Barrage North	01/01/1974	2693400	5985800
Ruamahanga River at Barrage South	01/01/1974	2693400	5985800
Lake Kohangapiripiri	20/08/2007	2665237	5980984
Lake Kohangatara	17/08/2007	2665946	5979727
Te Hapua Wetland at Pateke	7/04/2009	2685782	6041167
Te Hapua Wetland at Shoveler Lagoon	30/03/2009	2685306	6041599
Te Hapua Wetland at Trotter	4/06/2009	2684742	6040867
Te Hapua Wetland at Jill & Joy	3/04/2009	2684362	6041013

## Appendix 2: Monthly hydrological data summary

Table A2.1: Monthly rainfall totals (mm) for July to December 2008 and long-term (LT) mean monthly totals at Greater Wellington rainfall stations

Site	July		August		September		October		November		December	
	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean
Kapakapanui	406	191.8	356.5	190.9	274.5	225.8	357	259	218.5	212.2	261	253.6
McIntosh	792	481.1	631	414.8	405.5	464.8	679	594.7	392	502.2	432	465
Oriwa	732.5	362.3	479	347.6	430	468.3	753	570.9	411.5	504	361	537.5
Taungata	430.5	226.4	331	198.3	236	268	477.5	331.3	224.5	295.6	281	307.5
Otaki Depot	163.5	91.8	149.5	80.1	47	84.4	138.5	94.3	43.5	86.6	143	86.1
Transmission Lines	n/a	143	n/a	122.4	n/a	151	n/a	182.1	n/a	150.3	n/a	171
Shoveler Lagoon	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Water Treatment Plant	215.8	129.2	171	110.1	74	103.3	172	122.3	67.5	93.9	141	104.6
QE Park	234	n/a	152.5	n/a	59	n/a	112.5	n/a	46.5	n/a	134.5	n/a
Kaitoke Headworks	466.5	242.7	372.5	217.4	160	186.7	262.5	210.7	157	206.7	201	187.4
Te Marua	421.5	195.8	269	154.8	126.5	141.6	218	244.4	129	177.1	196.5	144.9
Centre Ridge	403.5	225.2	292	200.5	146	159.3	235.5	213	103.5	183.3	193.5	155.3
Tasman Vaccine Ltd	366	179.6	188	144.9	108.5	121.7	178.5	162.8	89.5	116.5	144	117.3
Warwicks	401.5	189.1	263	188.8	162	188.1	326	263	159	209.2	259.5	222.1
Cemetery	380	151	239	151.7	118.5	138.5	187	209.8	126	141.8	178	145.4
Blue Gum Spur	n/a	179.2	260.5	164.2	139	157.3	207.5	222.2	121	190.5	194	190.9
Birch Lane	267.5	155.5	168.5	153.1	103	78.2	104	148.6	64.5	97.6	106.5	115.5
Shandon Golf Club	250.5	110.5	174.2	97.6	107.8	54.5	79	105.8	55.5	69.6	100.5	80.3
Orongo Swamp	521.5	304.9	331	237.7	185.5	178.2	237.5	276.3	114	219.7	166	202.7
Wainuiomata Res.	401.5	232.2	262.5	209.5	143.5	157.7	136.5	167.6	71	128.5	104	129.6
Pencarrow Lakes	209	n/a	155	n/a	80	n/a	45.5	n/a	42.5	n/a	82	n/a
Whenua Tapu	206	102.3	130.5	89.6	64	90.2	101.5	114.2	42	84.1	126.5	75.3
Seton Nossiter Park	269	138.7	193	111.5	112.5	94.5	78	135.8	86	96.6	131.5	95.6
Quartz Hill	192.5	n/a	177.5	n/a	105	n/a	60.5	n/a	77	n/a	125.5	n/a
Karori Reservoir	237.4	140	215.4	122	180.8	98.8	75.8	106.8	100.2	90.2	147.6	88.6
Regional Council	185.6	110.3	159.8	83.8	114.2	60.1	54.2	99.2	54.4	69.3	92	66.1
Bannister	1043	598.2	<u>803</u>	530.9	<u>520</u>	554.4	1015	602.9	547	521.2	443	533.1
Angle Knob	1186	632.3	752	669.9	457	607.3	1059.5	743.8	738	630.8	502.5	605.5
Carkeek	933	471.8	577.5	470.3	372	447.7	599	486	342.5	388.8	314.5	415.1
Bull Mound	876	487.5	657	446.8	348	399.7	505	478.9	269	401	294	385.1
Mt Bruce	442	238.5	423.5	230.7	107	203.5	336.5	280.2	146	218.8	137.5	187.4
Mauriceville	248.5	n/a	256	n/a	70.5	n/a	199	n/a	55.5	n/a	82.5	n/a
Westons	483.5	n/a	458	n/a	115	n/a	400.5	n/a	165	n/a	142	n/a
Wairarapa College	144	115	185	79	46	70.5	91.2	92.8	14	54.7	67.4	60.1
Waingawa	n/a	229.4	346.5	181.2	n/a	162.1	n/a	247	123	173.3	124	141.2
Valley Hill	566.5	274	564.5	253.5	187.5	242.2	387	399.8	179.5	260.5	149.5	247.3
Phelps	430.5	219.4	323	207.1	120.5	166.1	259	209.1	112	177.9	156.5	154.8
Waiohine Gorge	483	n/a	330.5	n/a	130	n/a	294.5	n/a	113	n/a	166	n/a
Parkvale	138.2	n/a	138.1	n/a	47.5	n/a	82	n/a	9.5	n/a	69.5	n/a

Site	July		August		September		October		November		December	
	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean
Alloa	197	119.9	163	105.1	52	85.2	112.2	100.6	51.6	87.6	97.8	82.9
Waiorongomai	n/a	173.8	n/a	157.8	n/a	129.5	n/a	146.9	n/a	119.7	n/a	117.4
Waihi	184.5	136.1	184	111.9	56	90.4	99.5	129.8	34	70.7	67.5	96.7
Castlehill	219.5	154.5	172	104.3	42.5	86.2	97	99.6	52	93.3	42.5	73.2
Te Weraiti	154.5	109.2	175	83.5	52.5	52	65	86.9	16	56.2	53.5	65.1
Longbush	181	n/a	166	n/a	53	n/a	72.5	n/a	17.5	n/a	66.5	n/a
Iraia	420.5	233.3	353	208.7	82.5	129.6	106.5	152.5	22	118.3	94	106.5
Tanawa Hut	272	174.2	154.5	137.5	34.5	115.1	102.5	98.7	25	73.3	55	92.1

Note: n/a denotes data not available. Numbers underlined indicate that monthly mean rainfall has been estimated from another rainfall station.

**Table A2.2: Monthly rainfall totals (mm) for January to June 2009 and long-term (LT) mean monthly totals at Greater Wellington rainfall stations**

Site	January		February		March		April		May		June	
	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean
Kapakapanui	125	161.8	334.5	154.4	79.5	167.4	170	148.7	223.5	199.4	<u>112.5</u>	230.5
McIntosh	176.5	345.6	562	334.2	162.5	364.8	372	319.4	494	415.6	<u>213</u>	467
Oriwa	163.5	311.8	525.5	304.6	119.5	309	293.5	280.5	328	382.3	<u>152.5</u>	417.7
Taungata	154.5	195.2	354	209.5	58	190.6	186	171.2	232.5	222.9	<u>118</u>	225.4
Otaki Depot	62.5	68.6	161.5	81.2	17.5	61.1	79.5	67.1	79	83	46	106.9
Transmission Lines	n/a	94.5	n/a	107.4	25.5	101.8	112	96.6	162.5	135.3	<u>70</u>	162.6
Shoveler Lagoon	n/a	n/a	n/a	n/a	n/a	n/a	63	n/a	92.5	n/a	47.5	n/a
Water Treatment Plant	52.5	81.2	180	78.6	32.5	85.9	79.5	81.7	129.5	110.4	58	126.3
QE Park	19.5	n/a	135	n/a	16.5	n/a	70	n/a	132	n/a	62	n/a
Kaitoke Headworks	68.5	144.9	235.5	127.1	56.5	160.9	155	165.6	266	213.5	143	232.9
Te Marua	39.5	101.9	233	110.7	40.5	114.6	151	110.6	70	132.8	77	185.4
Centre Ridge	46.5	120.9	255.5	145.6	69.5	151.8	112.5	142	35.5	174	110.5	206.8
Tasman Vaccine Ltd	40.5	92.4	191	81.3	47	96.1	149	103.7	284	147.4	142	174.7
Warwicks	99	163.4	286	131.8	51	164.6	143	133.4	238	173.6	94	211.6
Cemetery	54	118	225.5	101.7	41	119.8	131.5	98.5	231.5	118.2	113	162.7
Blue Gum Spur	45.5	157.5	255.5	103	44	109.4	131.5	120.3	244	144.7	120	179.5
Birch Lane	27.8	85.9	167	106.1	41.8	69	<u>109</u>	72.9	216.5	86.8	72.5	147.8
Shandon Golf Club	23.5	52.4	143	57.9	31	47.7	117.5	55.9	186.5	70.1	57	120.4
Orongo Swamp	45	148.8	254.5	119.4	87	186.1	183	152.2	464	231.5	218	273.5
Wainuiomata Res.	28.5	105.7	149.5	107.9	52.5	126.1	161.5	146.5	387.5	207.6	132	210
Pencarrow Lakes	15	n/a	115	n/a	16	n/a	41	n/a	113.5	n/a	54	n/a
Whenua Tapu	43.5	72	151	85	25	65.6	91	57	116.5	82.5	1.5	105.1
Seton Nossiter Park	25	73.9	141	78.5	n/a	78.1	n/a	86.3	159	101	62.5	131.9
Quartz Hill	23.5	n/a	124	n/a	35	n/a	89.5	n/a	160.5	n/a	51.5	n/a
Karori Reservoir	32.8	80.1	163.8	76.2	52.8	86.1	<u>116</u>	97.4	182.8	120.8	67.2	127.9
Regional Council	21.4	63.9	145.2	58.8	33.2	61.4	74	56.8	116.4	82.3	47.6	99.8
Bannister	155.5	385	777.5	360.8	194	446.8	<u>384</u>	416.9	<u>529</u>	488	<u>261</u>	545.3
Angle Knob	237.5	449.9	704	383.4	233.5	453.2	<u>599</u>	474.7	<u>665.5</u>	592	<u>240</u>	660.3
Carkeek	134.5	290.7	484	270.5	117	332.9	<u>272.5</u>	289.2	<u>374</u>	404.1	<u>181.5</u>	446.6

Site	January		February		March		April		May		June	
	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean
Bull Mound	129	270.4	400.5	262.7	144	329.8	<i>324</i>	305.5	<i>376</i>	402	<i>177.5</i>	443.8
Mt Bruce	63	164.9	306	156.5	37	153.1	102.5	156.2	206	184.4	169.5	243.1
Mauriceville	33.5	n/a	174.5	n/a	24	n/a	46.5	n/a	180.5	n/a	138	n/a
Westons	59	n/a	294	n/a	58.5	n/a	132.5	n/a	214	n/a	148.5	n/a
Wairarapa College	19.2	46	123.2	55.4	39.2	67.4	43.6	53.8	108.8	64.4	90	100.3
Waingawa	52.5	110.2	n/a	120.6	n/a	122.2	95	132.5	193	136.5	158.5	210.4
Valley Hill	63.5	164.6	271.5	158.5	76.5	203.2	<i>140.5</i>	154	<i>294</i>	212.1	<i>207.5</i>	294.9
Phelps	40	112.4	226	121.2	41	149	132.5	144.2	238.5	183	124	212.1
Waiohine Gorge	48	n/a	231.5	n/a	48.5	n/a	152.5	n/a	252	n/a	134.5	n/a
Parkvale	10	n/a	109.5	n/a	31.5	n/a	32.5	n/a	110	n/a	54	n/a
Alloa	15.2	61.6	175	68.7	23	80.7	63.4	79	132.8	96.2	80	111.9
Wairongomai	n/a	98.2	n/a	94.1	n/a	104.5	n/a	115.6	n/a	150.6	90.5	166.1
Waihi	26	55.3	113.5	71	31.5	65	49	73.2	142	72.2	122.5	127.1
Castlehill	29.5	66.6	166.5	66.4	29	72.8	45	83.2	191.5	88.5	168	115.8
Te Weraiti	25.5	53.4	117	44.1	25	53.8	44	53.5	128.5	67.9	99	82.6
Longbush	6	n/a	111.5	n/a	37	n/a	42.5	n/a	162.5	n/a	111	n/a
Iraia	12.5	84.9	166	90.6	51	125.5	80	135.1	<u>450</u>	169.7	238	215.2
Tanawa Hut	40.5	61.8	152.5	75.9	49	100	27	103.7	<u>140</u>	129.8	<i>162</i>	145.3

Notes: n/a denotes data not available. Numbers underlined indicate that monthly mean rainfall has been estimated from another rainfall station. Numbers in italics indicate that data have not yet been quality-checked.

**Table A2.3: Monthly mean river flows (m<sup>3</sup>/s) for July to December 2008 and long-term (LT) mean monthly flows at Greater Wellington river monitoring stations**

Site	July		August		September		October		November		December	
	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean
Otaki R at Pukehinau*	53.91	33.07	57.38	33.59	30.22	34.25	58.48	44.81	35.42	34.45	24.17	38.58
Waitohu S at WSI	1.93	0.92	1.90	0.74	0.86	0.85	2.01	1.23	0.99	1.18	0.77	1.04
Mangaone S at Ratanui	0.76	0.39	0.75	0.35	0.32	0.34	0.70	0.60	0.39	0.43	0.32	0.38
Waikanae R at WTP	12.77	6.26	13.12	5.71	5.28	4.96	14.35	6.28	6.05	5.24	5.63	5.10
Mazengarb S at Scaife Drive	0.23	0.18	0.22	0.16	0.19	0.14	0.21	0.17	0.21	0.18	0.19	0.18
Wharemauku S at Coastlands	0.34	n/a	0.31	n/a	0.07	n/a	0.13	n/a	0.06	n/a	0.09	n/a
Hutt R at Kaitoke Weir	n/a – river level only											
Hutt R at Kaitoke*	20.39	10.23	19.64	9.77	8.21	9.09	13.29	10.67	7.81	8.08	5.97	7.42
Hutt R at Birchville*	63.05	32.88	56.55	29.52	19.52	25.51	37.75	31.16	19.19	22.78	16.38	19.69
Hutt R at Te Marua	32.14	15.89	29.53	13.62	11.11	11.61	21.07	18.04	9.22	10.82	7.55	10.10
Hutt R at Taita Gorge	78.27	35.20	68.17	31.77	23.35	25.00	42.52	36.72	n/a	27.61	n/a	24.96
Hutt R at Estuary Bridge	n/a – river level only											
Pakuratahi R at Truss Bridge	5.70	3.22	4.51	2.60	1.60	1.99	3.03	2.74	1.02	2.14	1.64	2.01
Mangaroa R at Te Marua	12.37	5.91	9.28	4.82	2.55	3.58	4.90	4.88	2.06	3.32	1.71	2.79
Akatarawa R at Cemetery	14.31	6.95	13.21	6.80	4.95	5.55	9.89	8.67	6.06	5.88	5.39	4.90
Whakatikei R at Dude Ranch	4.89	1.98	3.84	1.96	1.27	1.61	2.51	2.47	1.41	1.96	1.42	1.72
Mawaihakona S at Golf Club	0.46	n/a	0.54	n/a	0.23	n/a	0.32	n/a	0.31	n/a	0.26	n/a

Site	July		August		September		October		November		December	
	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean
Waiwhetu S at WLE	0.80	0.43	0.66	0.33	0.33	0.33	1.17	0.40	0.21	0.28	0.20	0.24
Wainuiomata R at Manuka Tr	3.22	1.49	2.51	1.21	0.99	0.89	1.28	1.18	0.64	0.84	0.51	0.80
Wainuiomata R at LWP	8.13	4.38	6.93	3.38	2.84	2.68	2.55	2.99	1.22	2.31	0.99	1.87
Orongorongo R at UDS	1.13	0.64	0.77	0.50	0.37	0.35	0.60	0.59	0.24	0.40	0.28	0.37
Orongorongo R at Truss Br	5.67	n/a	4.51	n/a	2.28	n/a	2.69	n/a	1.02	n/a	1.10	n/a
Taupo S at Flax Swamp	0.44	0.14	0.40	0.13	0.13	0.09	0.15	0.11	0.05	0.07	0.09	0.05
Horokiri S at Snodgrass	2.03	0.67	2.20	0.74	0.64	0.48	0.74	0.81	0.28	0.61	0.35	0.31
Porirua S at Town Centre	2.45	1.25	2.21	1.14	1.08	0.85	0.77	0.98	0.57	0.65	0.62	0.50
Ruamahanga R at Mt Bruce	22.69	12.69	22.83	12.24	9.86	12.14	19.74	13.05	9.26	10.76	5.73	10.41
Ruamahanga R at Wardells	65.86	38.51	79.88	34.71	20.78	29.47	37.88	32.12	14.64	21.86	7.70	18.61
Ruamahanga R at Gladstone	n/a – river level only											
Ruamahanga R at Waihenga	210.2	141.4	238.8	126.6	63.62	106.42	113.28	111.25	55.12	78.25	30.92	68.40
Waipoua R at Mikimiki Br	10.72	n/a	11.94	n/a	1.94	n/a	6.89	n/a	2.45	n/a	1.04	n/a
Te Mara S at Kiriwhakapapa	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.21	n/a
Waingawa R at Kaituna	22.06	13.03	20.53	12.75	8.57	12.32	16.14	13.20	8.54	10.80	5.26	10.40
Mangatarere S at Gorge	5.08	2.65	6.29	2.39	1.19	1.60	3.75	2.90	1.49	1.73	0.55	1.54
Mangatarere S at Belvedere	6.59	n/a	8.22	n/a	1.71	n/a	3.77	n/a	1.28	n/a	0.34	n/a
Waiohine R at Gorge	57.46	30.34	53.93	28.33	22.48	28.34	44.48	32.69	22.94	27.98	15.54	26.15
Tauherenikau R at Gorge	23.87	13.08	22.89	11.81	8.65	10.73	14.26	11.83	6.84	8.56	5.68	8.69
Kopuaranga R at Palmers	6.53	4.88	8.96	4.09	1.93	3.29	4.79	3.72	1.24	2.30	0.53	1.47
Tauweru R at Te Weraitii	n/a – river level only											
Huangaaru R at Hautotara	n/a – river level only											
Otukura S at Weir	1.71	0.89	2.38	0.93	0.83	0.66	0.68	0.85	0.39	0.40	0.27	0.38
Papawai S at U/S Oxi Pond	0.63	n/a	0.85	n/a	0.50	n/a	0.49	n/a	0.28	n/a	0.17	n/a
Parkvale S at Renalls Weir	1.95	n/a	3.15	n/a	2.10	n/a	1.52	n/a	0.86	n/a	0.46	n/a
Pahaoa R at Hinakura*	53.94	30.33	42.63	18.79	7.56	12.96	3.44	10.23	0.91	3.88	0.64	2.05

\*Data provided by NIWA. n/a denotes data not available. Data not available for Tilsons Creek at Scott Culvert due to problems maintaining rating curve.

**Table A2.4: Monthly mean river flows (m<sup>3</sup>/s) for January to June 2009 and long-term (LT) mean monthly flows at Greater Wellington river monitoring stations**

Site	January		February		March		April		May		June	
	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean
Otaki R at Pukehinau*	13.44	23.15	33.35	18.21	10.37	19.51	15.60	19.39	31.50	26.91	12.52	33.67
Waitohu S at WSI	0.54	0.66	1.17	0.59	0.36	0.46	0.47	0.45	0.77	0.61	0.32	0.82
Mangaone S at Ratanui	0.25	0.23	0.38	0.27	0.15	0.16	0.14	0.16	0.29	0.21	0.19	0.37
Waikanae R at WTP	2.70	3.97	8.05	3.38	2.16	2.77	1.87	3.02	6.02	4.06	2.70	5.41
Mazengarb S at Scaife Drive	0.17	0.16	0.19	0.15	0.18	0.12	0.19	0.11	0.21	0.13	0.20	0.16
Wharemauku S at Coastlands	0.04	n/a	0.07	n/a	0.04	n/a	0.03	n/a	0.08	n/a	0.05	n/a
Hutt R at Kaitoke Weir	n/a – river level only											
Hutt R at Kaitoke*	2.72	5.17	8.29	4.74	2.91	5.04	4.83	5.84	10.13	8.01	5.26	9.52
Hutt R at Birchville*	6.56	13.29	21.93	11.27	7.37	12.22	10.12	14.99	31.17	22.26	17.73	27.75

Site	January		February		March		April		May		June	
	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean
Hutt R at Te Marua	3.17	5.83	10.33	7.46	3.72	6.55	5.32	7.17	13.92	9.60	8.69	13.26
Hutt R at Taita Gorge	7.52	16.99	23.52	14.43	8.48	14.70	10.98	15.16	33.93	22.02	19.56	29.21
Hutt R at Estuary Bridge	n/a – river level only											
Pakuratahi R at Truss Bridge	0.38	1.22	2.57	1.25	1.01	1.55	1.02	1.38	3.32	2.06	2.14	2.68
Mangaroa R at Te Marua	0.65	1.84	2.42	1.59	0.96	1.34	1.08	2.18	6.26	3.38	4.12	4.65
Akatarawa R at Cemetery	2.28	3.72	6.02	3.46	2.06	3.05	2.60	3.49	7.53	4.91	3.59	6.12
Whakatikei R at Dude Ranch	0.59	1.38	2.02	1.11	0.55	1.01	0.57	1.12	1.95	1.54	0.94	1.91
Mawaihakona S at Golf Club	0.23	n/a	0.47	n/a	0.58	n/a	0.37	n/a	0.72	n/a	0.34	n/a
Waiwhetu S at WLE	0.10	0.20	0.26	0.23	0.09	0.18	0.29	0.18	0.63	0.25	0.31	0.35
Wainuiomata R at Manuka Tr	0.26	0.56	0.63	0.36	0.33	0.46	0.54	0.47	2.37	0.86	1.07	1.17
Wainuiomata R at LWP	0.44	1.36	1.20	1.34	0.59	1.15	1.24	1.35	5.59	2.19	2.46	3.39
Orongorongo R at UDS	0.06	0.24	0.43	0.25	0.13	0.24	0.28	0.26	0.96	0.44	0.38	0.55
Orongorongo R at Truss Br	0.23	n/a	1.83	n/a	0.76	n/a	1.43	n/a	5.71	n/a	2.05	n/a
Taupo S at Flax Swamp	0.05	0.04	0.13	0.05	0.05	0.03	0.09	0.04	0.16	0.07	0.11	0.11
Horokiri S at Snodgrass	0.14	0.46	0.61	0.71	0.17	0.28	0.18	0.17	0.63	0.31	0.42	0.58
Porirua S at Town Centre	0.25	0.37	0.60	0.38	0.24	0.37	0.51	0.50	1.06	0.71	0.58	1.00
Ruamahanga R at Mt Bruce	2.65	7.16	12.58	6.57	4.06	7.47	5.13	7.45	10.98	9.90	5.84	12.01
Ruamahanga R at Wardells	3.85	11.80	15.40	12.92	9.75	13.22	6.57	15.51	21.00	22.00	17.87	32.34
Ruamahanga R at Gladstone	n/a – river level only											
Ruamahanga R at Waihenga	16.10	44.09	49.35	43.70	29.64	49.31	26.02	57.75	84.87	78.25	61.31	112.8
Waipoua R at Mikimiki Br	0.51	n/a	2.36	n/a	1.88	n/a	0.99	n/a	4.50	n/a	3.44	n/a
Te Mara S at Kiriwhakapapa	0.10	n/a	0.50	n/a	0.28	n/a	0.16	n/a	0.69	n/a	0.49	n/a
Waingawa R at Kaituna	2.77	6.78	8.91	6.84	4.16	7.20	5.17	7.77	11.36	9.90	5.78	12.12
Mangatarere S at Gorge	0.24	0.90	1.15	1.06	0.63	1.03	0.50	0.93	2.88	1.66	1.52	2.66
Mangatarere S at Belvedere	0.11	n/a	0.83	n/a	0.67	n/a	0.36	n/a	3.17	n/a	2.29	n/a
Waiohine R at Gorge	8.22	17.02	26.41	16.44	8.94	17.07	15.05	18.28	31.25	23.48	13.88	28.19
Tauherenikau R at Gorge	2.82	5.29	7.58	5.09	3.60	6.00	5.45	6.79	11.96	9.09	7.29	11.91
Kopuaranga R at Palmers	0.34	0.92	0.85	1.56	0.95	1.13	0.40	1.43	3.24	2.39	3.08	4.05
Tauweru R at Te Weraiti	n/a – river level only											
Huanga R at Hautotara	n/a – river level only											
Otukura S at Weir	0.11	0.20	0.15	0.23	0.18	0.22	0.12	0.25	0.62	0.35	0.81	0.50
Tilsons Ck at Scott Culvert	0.19	n/a	0.20	n/a	0.20	n/a	0.16	n/a	0.21	n/a	0.24	n/a
Parkvale S at Renalls Weir	0.15	n/a	0.13	n/a	0.24	n/a	0.17	n/a	0.60	n/a	1.02	n/a
Pahaoa R at Hinakura*	0.16	1.28	0.29	3.85	0.59	5.34	0.26	5.75	16.92	7.87	22.56	15.93

Notes: \*Data provided by NIWA. n/a denotes data not available. Data not available for Tilsons Creek at Scott Culvert due to problems maintaining rating curve.

**Table A2.5: Monthly mean lake levels (m) for July to December 2008 and long-term (LT) mean levels at Greater Wellington lake level monitoring stations**

Site	July		August		September		October		November		December	
	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean	2008	LT mean
Lake Onoke at Lake Ferry	10.096	10.114	10.084	9.998	9.877	10.001	10.223	10.007	10.197	9.929	9.772	9.811
Lake Wairarapa at Burlings	10.500	10.351	10.800	10.271	10.158	10.191	10.246	10.221	10.310	10.113	10.040	10.147
Lake Wairarapa at Barrage North	10.424	10.285	10.650	10.208	10.057	10.156	10.269	10.176	10.283	10.104	10.105	10.177
Ruamahanga River at Barrage South	10.534	10.381	10.739	10.295	10.052	10.222	10.339	10.209	10.315	10.071	9.794	9.945
Lake Kohangapiripiri	1.796	n/a	1.611	n/a	1.475	n/a	1.365	n/a	1.303	n/a	1.28	n/a
Lake Kohangatera	0.321	n/a	0.305	n/a	0.214	n/a	0.199	n/a	0.357	n/a	0.478	n/a
Te Hapua Wetland at Pateke	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Te Hapua Wetland at Shoveler Lagoon	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Te Hapua Wetland at Trotter	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Te Hapua Wetland at Jill & Joy	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Note: n/a denotes data not available.

**Table A2.6: Monthly mean lake levels (m) for January to June 2009 and long-term (LT) mean levels at Greater Wellington lake level monitoring stations**

Site	January		February		March		April		May		June	
	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean	2009	LT mean
Lake Onoke at Lake Ferry	9.764	9.795	10.245	9.871	10.068	10.100	<u>10.540</u>	10.150	10.228	10.164	10.583	10.177
Lake Wairarapa at Burlings	10.007	10.124	10.069	10.104	10.056	10.089	10.173	10.134	10.305	10.199	10.371	10.275
Lake Wairarapa at Barrage North	10.050	10.139	10.077	10.099	10.041	10.085	10.207	10.119	10.246	10.192	10.356	10.250
Ruamahanga River at Barrage South	9.773	9.918	10.287	9.982	10.111	10.176	10.499	10.275	10.378	10.319	10.653	10.394
Lake Kohangapiripiri	1.192	n/a	1.187	n/a	1.238	n/a	1.182	n/a	1.414	n/a	1.421	n/a
Lake Kohangatera	0.053	n/a	0.236	n/a	n/a	n/a	0.537	n/a	0.548	n/a	0.475	n/a
Te Hapua Wetland at Pateke	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5.045	n/a	5.061	n/a
Te Hapua Wetland at Shoveler Lagoon	n/a	n/a	n/a	n/a	n/a	n/a	2.798	n/a	2.968	n/a	3.008	n/a
Te Hapua Wetland at Trotter	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Te Hapua Wetland at Jill & Joy	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.004	n/a	3.021	n/a

Notes: n/a denotes data not available. Numbers underlined indicate that monthly mean lake level has been estimated, due to some missing record.

### Appendix 3: River flood warning alarm levels and occurrences

Table A3.1: Greater Wellington river flood warning alarm levels

Site	Flood warning alarm level (mm)	Comments
Waitohu at Water Supply Intake	900	
Otaki at Pukehinau	4500	
Mangaone at Ratanui	1700	
Waikanae at Water Treatment Plant	3200	
Hutt at Te Marua	3800	
Hutt at Birchville	3500	
Hutt at Taita Gorge	28000	
Mangaroa at Te Marua	2500	
Akatarawa at Cemetery	2000	
Waiwhetu at Whites Line East	1300	Initial alarm level
Wainuiomata at Manuka Track	2000	
Wainuiomata at Leonard Wood Park	1500	
Porirua at Town Centre	900	
Ruamahanga at Mt Bruce	4000	
Ruamahanga at Wardells Bridge	3000	Initial alarm level
Ruamahanga at Gladstone Bridge	2000	
Ruamahanga at Waihenga Bridge	3350	Initial alarm level
Waipoua at Mikimiki Bridge	1800	Initial alarm level
Waingawa at Kaituna	2800	Initial alarm level
Mangatarere at Gorge	1800	
Waiohine at Gorge	2500	Initial alarm level
Tauweru at Te Weraiti	9000	
Huangerua at Hautotara	3400	

Table A3.2: River level flood warning alarms triggered during 2008/09

Event date	Alarm levels triggered	
12 July 2008	Hutt River at Birchville Akatarawa River at Cemetery Porirua Stream at Town Centre Waipoua River at Mikimiki	Waiohine River at Gorge Ruamahanga River at Wardells Ruamahanga River at Gladstone Ruamahanga River at Waihenga
23 July 2008	Ruamahanga River at Waihenga	
27 July 2008	Ruamahanga River at Waihenga	
30-31 July 2008	Otaki River at Pukehinau Hutt River at Te Marua Hutt River at Birchville Mangaroa River at Te Marua Waiwhetu Stream at WLE Porirua Stream at Town Centre Wainuiomata River at Manuka Track	Waipoua River at Mikimiki Mangatarere Stream at Gorge Waiohine River at Gorge Tauweru River at Te Weraiti Huangarua River at Hautotara Ruamahanga River at Wardells Ruamahanga River at Gladstone Ruamahanga River at Waihenga
3 August 2008	Porirua Stream at Town Centre	Ruamahanga River at Waihenga
15 August 2008	Waikanae River at WTP Akatarawa River at Cemetery	Hutt River at Birchville
25-26 August 2008	Tauweru River at Te Weraiti Huangarua River at Hautotara	Ruamahanga River at Gladstone Ruamahanga River at Waihenga
5 October 2008	Otaki River at Pukehinau	Ruamahanga River at Gladstone Ruamahanga River at Waihenga
7 October 2008	Otaki River at Pukehinau Waitohu Stream at WSI Waikanae River at WTP Hutt River at Te Marua Hutt River at Birchville Mangaroa River at Te Marua	Waipoua River at Mikimiki Waingawa River at Kaituna Mangatarere Stream at Gorge Waiohine River at Gorge Ruamahanga River at Wardells Ruamahanga River at Gladstone Ruamahanga River at Waihenga
23 October 2008	Ruamahanga River at Waihenga	
1-2 November 2008	Otaki River at Pukehinau Waikanae River at WTP Hutt River at Te Marua Hutt River at Birchville Akatarawa River at Cemetery	Waiohine River at Gorge Ruamahanga River at Wardells Ruamahanga River at Gladstone Ruamahanga River at Waihenga
16 December 2008	Porirua Stream at Town Centre	
21 December 2008	Porirua Stream at Town Centre	

Event date	Alarm levels triggered	
12 February 2009	Otaki River at Pukehinau Waitohu Stream at WSI Waikanae River at WTP Porirua Stream at Town Centre	Hutt River at Te Marua Hutt River at Birchville Akatarawa River at Cemetery
20-21 February 2009	Otaki River at Pukehinau Waitohu Stream at WSI Waikanae River at WTP Mangaone Stream at Ratanui Porirua Stream at Town Centre Waiwhetu Stream at WLE	Hutt River at Birchville Waiohine River at Gorge Ruamahanga River at Wardells Ruamahanga River at Gladstone Ruamahanga River at Waihenga
28 February 2009	Ruamahanga River at Wardells	
29 April 2009	Porirua Stream at Town Centre	Waiwhetu Stream at WLE
23 May 2009	Huangarua River at Hautotara	

Water, air, earth and energy – elements in Greater Wellington's logo that combine to create and sustain life. Greater Wellington promotes **Quality for Life** by ensuring our environment is protected while meeting the economic, cultural and social needs of the community

**For more information, contact Greater Wellington:**

Wellington office  
PO Box 11646  
Manners Street  
Wellington 6142  
T 04 384 5708  
F 04 385 6960

Masterton office  
PO Box 41  
Masterton 5840  
T 06 378 2484  
F 06 378 2146

Photo Credit  
The Hutt River during  
autumn 2009

GW/EMI-G-09/233  
November 2009

[www.gw.govt.nz](http://www.gw.govt.nz)