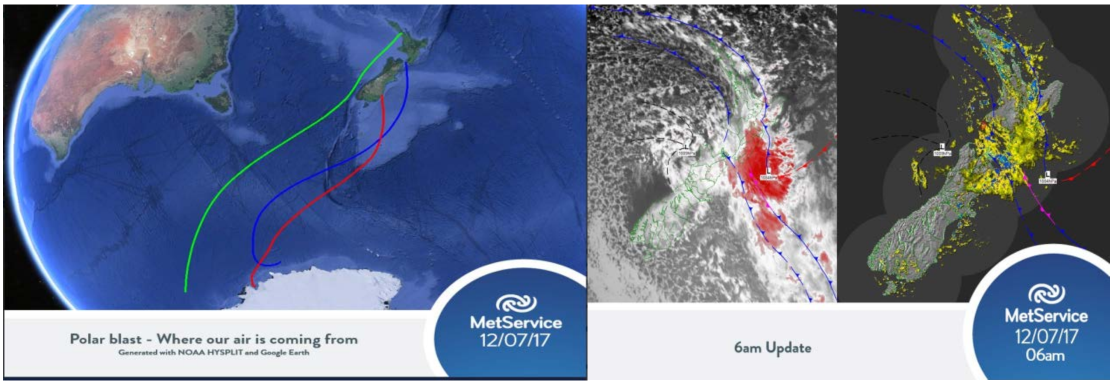
greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Climate and Water Resources Summary for the Wellington Region

Cold Season (May to October) 2017

Release date: 17 November 2017

Contents



These maps from MetService show the air mass trajectories arriving in New Zealand on 12 July 2017, with cloud cover and radar image in the morning indicating a developing low pressure centre in our region. We can see that the air arriving in the Wellington region is coming almost directly from the Antarctic coast. The following day the low caused flooding in the Wairarapa and Wainuiomata, and wind gusts of almost 170km/h in Wellington with trees down and ferry cancellations (see whaitua inset for more details)

In this report you will find:

More information

For more information on monitoring sites and up-to-date data please visit http://www.gw.govt.nz/environmental-science/. Several climate sites are operated by NIWA and/or MetService, and GWRC is grateful for permission to present the data in this report.

Disclaimer

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Report release date: November 2017

The warm season from May to October saw largely average rainfall totals across the region with the exception of the Wairarapa Coast area that received around 70-80% of normal rainfall.

Rainfall (May to October)

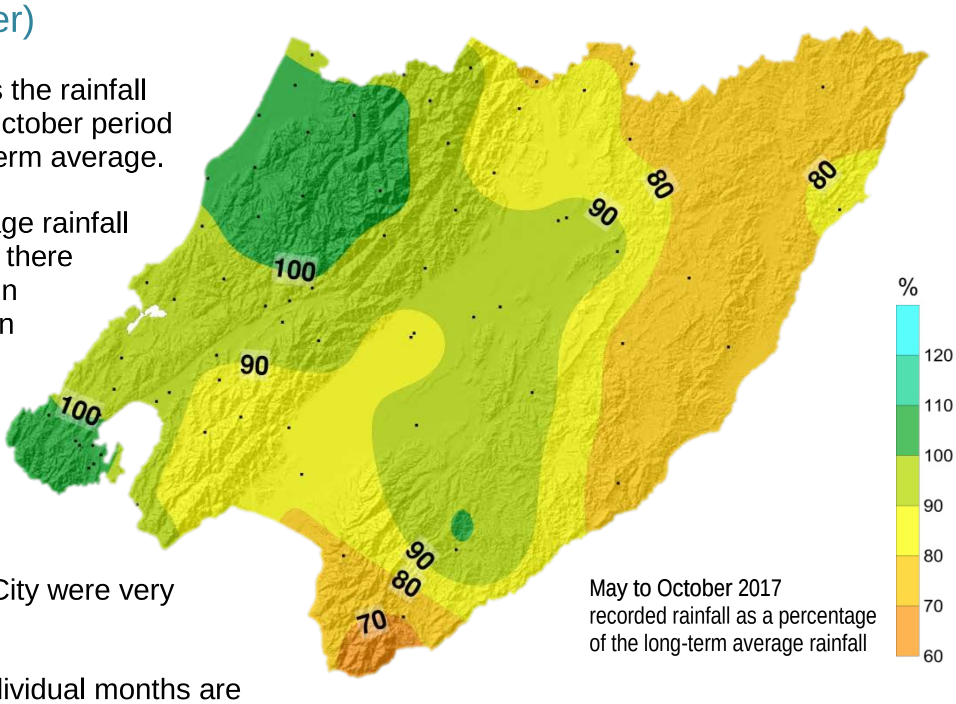
The map to the right presents the rainfall recorded during the May to October period as a percentage of the long term average.

Much of the region had average rainfall over the six month period but there was some striking variations in individual months as can been seen on the following page.

The east coast and hills area of the Wairarapa had around 70-80% of the normal rainfall.

Kapiti Coast and Wellington City were very slightly above average.

Separate rainfall maps for individual months are shown on the following page.



The recorded rainfall shows largely average rainfall was received in the six month period.
(The dots on the map indicate rainfall recording sites)

Another way to consider the weather is to look at the number of days that it rained. If more than 1mm of rain is recorded in a day this is called a 'Rain Day' and if there is more than 25mm this is termed a 'Heavy Rain Day'.

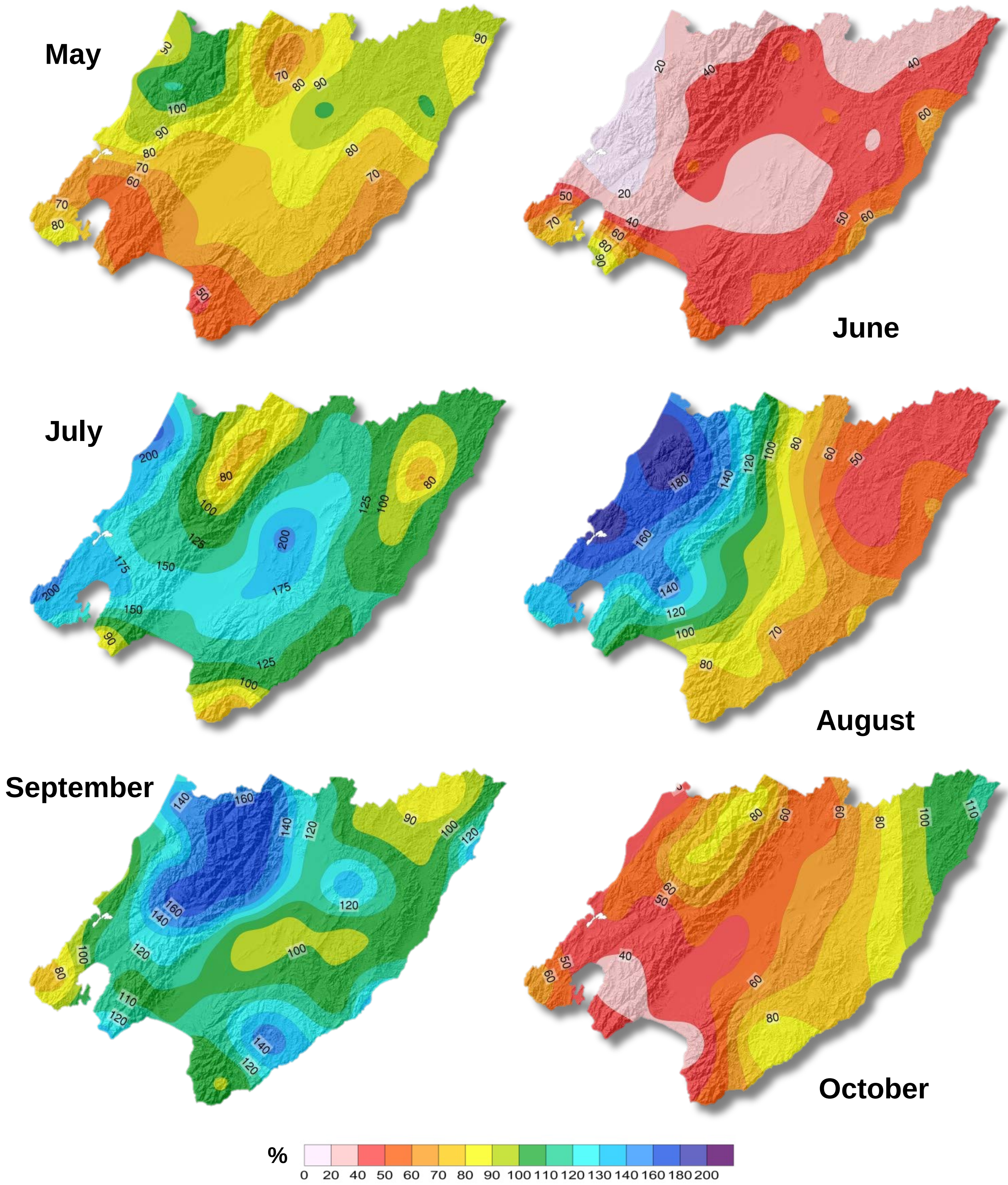
All areas had from around the average amount of Rain Days to 10-15 days more than average. The number of Heavy Rain Days was relatively normal across the region.

Number of Rain Days and Heavy Rain Days during May to October across the region (long-term average in brackets.)

	Kāpiti Coast		Porirua	Hutt Valley & Wellington		Ruamāhanga		Eastern Wairarapa
	Lowland	Hills	Lowland	Lowland	Hills	Lowland	Hills	
Rain Days (>1mm)	70 [70]	117 [103]	71 [66]	76 [69]	105 [95]	60 [44]	124 [114]	83 [74]
Heavy Rain Days(>25mm)	4 [4]	27 [24]	5 [5]	5 [5]	13 [13]	6 [3]	35 [34]	4 [5]

Rainfall by the month

The maps below show the percentage of average rainfall for each month of the May to October 2017 cold season. June stands out as a very dry month across all areas with rainfall totals ranging from 10% to 50% of average – with the exception of the southern tip of Wellington. October was also very dry while June and September were wetter than average over most of the region. August shows the west to east gradient with wet conditions in the west changing to dry conditions in the east.

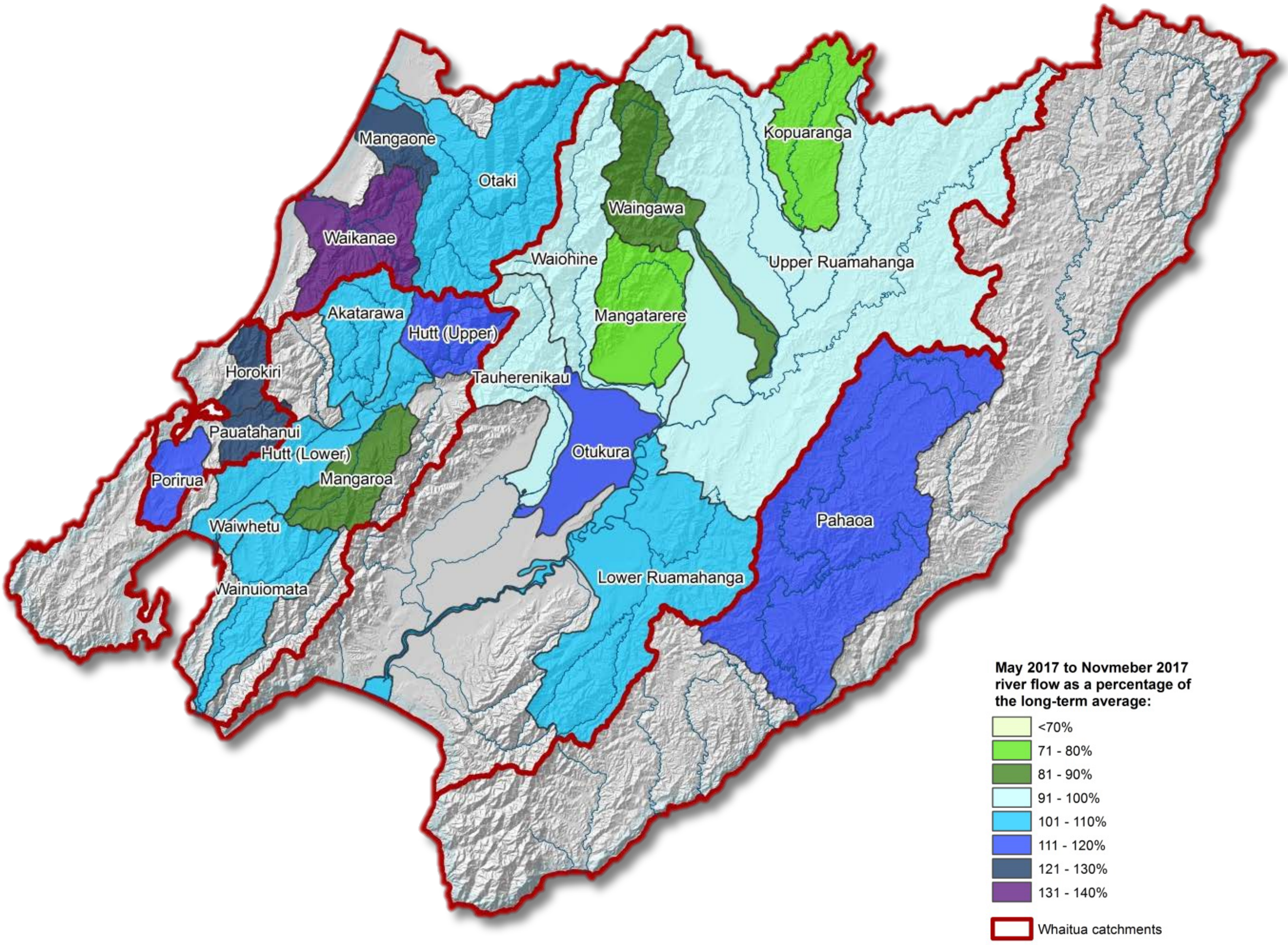


Monthly rainfall as a percentage of the long-term average

River flow

The map below shows the mean recorded river and stream flows, between May and October, for various monitored catchments as a percentage of the long-term average flow for this period.

Most catchments experienced average to above average flows during May to October. The upper Ruamāhanga and contributing catchments were slightly below average.

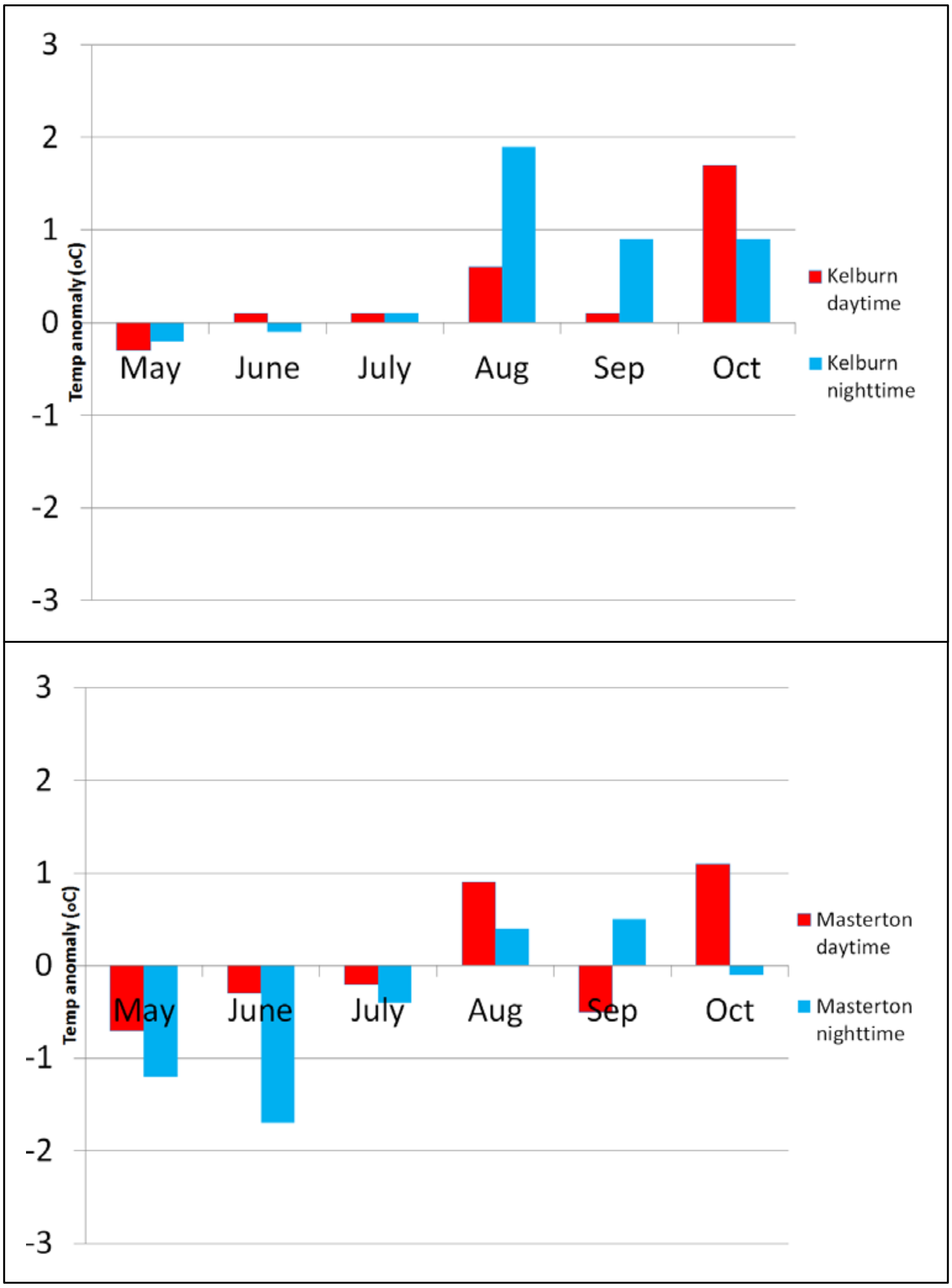


River and stream flows recorded during the May to October period as a percentage of the long-term average

Air temperatures

Air temperature is measured at a number of meteorological monitoring sites across the region. It is useful to look at the anomalies (i.e., departures from normal) in averages of extreme temperature indicators (i.e., daytime maximum and nighttime minimum) across the region to help interpret how dominant and widespread the climate anomalies have been.

The graphs below show the monthly daytime maximum and nighttime minimum temperature anomalies for Kelburn (upper panel) and Masterton (lower panel), in relation to the 1981-2010 climate reference period. The graphs show that most of the period from May to October was marked by a changing pattern shifting from colder than normal in the first half to warmer than normal in the second half. October was the month with the largest departure from average. The average day time maximum temperature in Kelburn for October was the warmest since 1989.



Average daytime and nighttime temperature anomalies for Kelburn (top) and Masterton (bottom) for the cold season period. The temperatures started colder than average during early winter and progressed to warmer than average in the second half of the cold period.

SOURCE: Data from MetService meteorological stations.

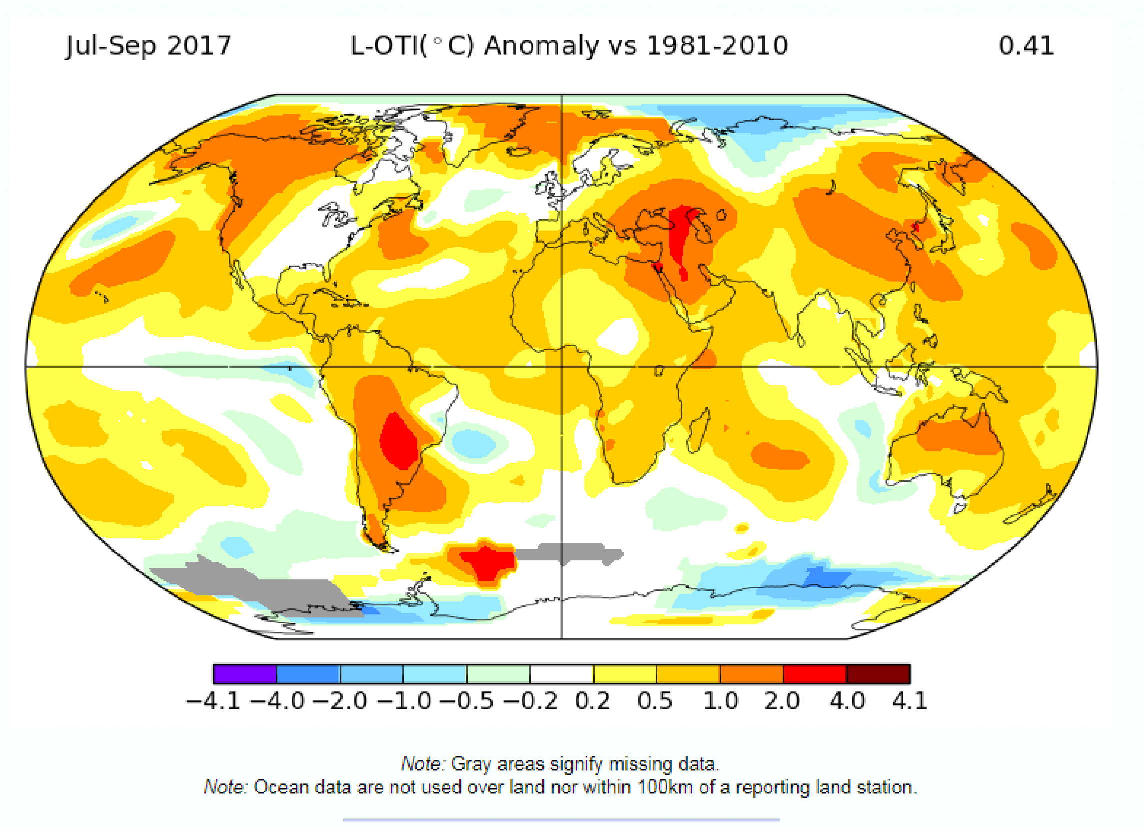
Global climate drivers

Climate variability and climate change

People often ask if the variable weather patterns in our region are a result of climate change. While natural climate variability has always been quite pronounced in our region, weather extremes are expected to get worse as a result of human-induced climate change and "global warming" caused by greenhouse gas emissions (http://www.royalsociety.org.nz/expert-advice/papers/yr2016/climate-change-implications-for-new-zealand/).

Some key observations about climate variability and change in our region during the period May to October 2017:

- The period started with slightly below average temperatures, evolving to much warmer than average towards the second half and with near-record anomalies in October for Wellington;
- The oceanic water temperatures (following page) were warmer than normal around New Zealand during the whole period, and a weak La Niña signature developed in the central Pacific towards the end of the period;
- A large area of anomalous high pressure to the far east of New Zealand helped bring warmer northerly winds over the country, and reduce the westerlies;
- The overall global warming signature had an average global temperature anomaly of about +0.4°C for the period July to September 2017, which is one of the official quarterly measurements provided by NASA.

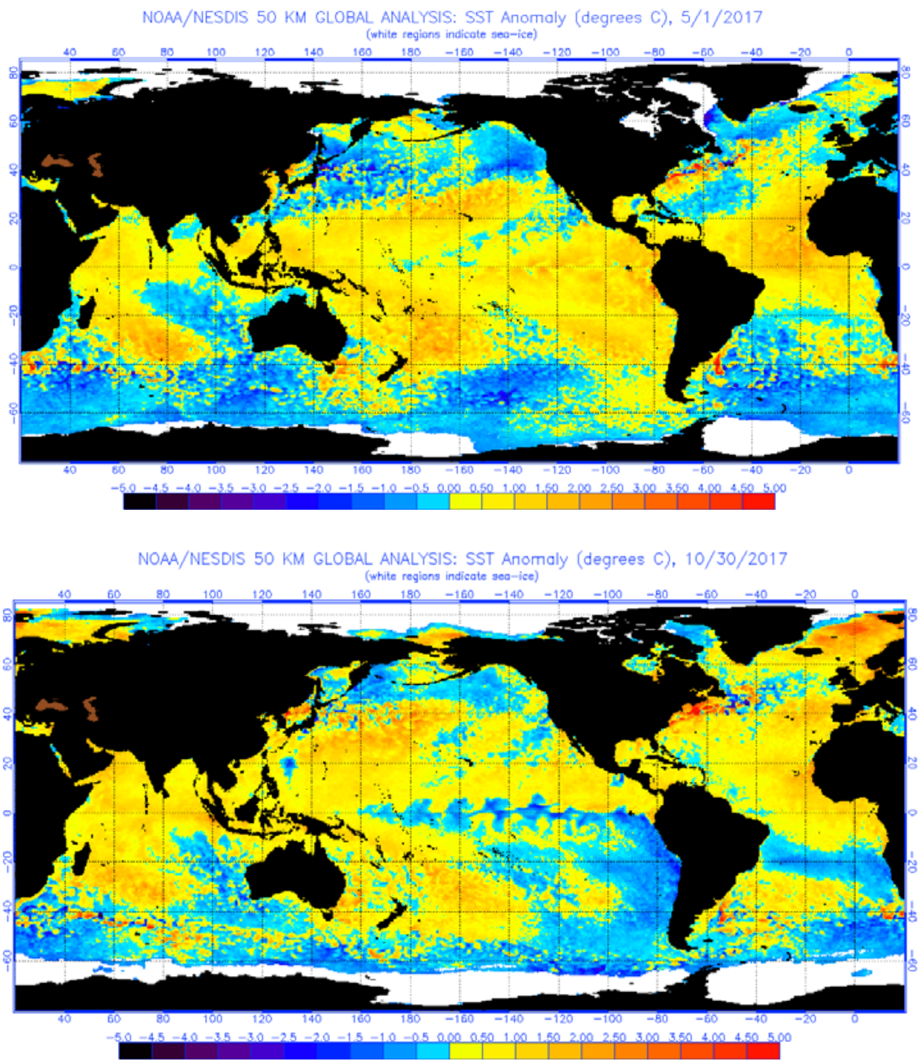


Global temperature anomaly for July-Sep 2017 against the 1981-2010 climate reference period.

Source: NASA

Global climate drivers and extreme weather events

Climate drivers are global mechanisms that can influence the weather in our region. The El Niño/Southern Oscillation[1] (ENSO) phenomenon has evolved into a borderline state between neutral and weak La Niña in the central Pacific Ocean, as seen by comparing the two diagrams below for the beginning (upper diagram) and the end (lower diagram) of the season. The sea ice extent (in white) remains below average for most of the Southern Hemisphere.

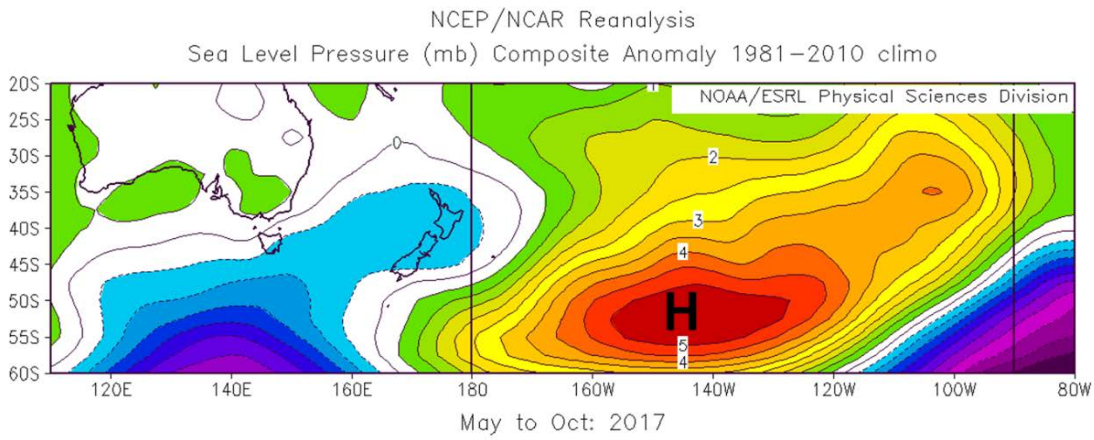


Sea surface temperature anomalies on 1st May 2017 (upper panel) and 30 October 2017(bottom). Warmer than normal waters around NZ prevailed during this time, with weak La Niña conditions developing in the Central Pacific towards the end of the season. Source: NOAA/USA.

While the ENSO phenomenon was only slightly erring towards a weak La Niña, the effects on the climate anomalies towards the second half of the period resembled full La Niña conditions, with weaker westerlies and warmer temperatures in the Wellington region associated with warmer than

[1] https://www.niwa.co.nz/education-+-and-training/schools/students/enln

average waters. A large area of anomalous of high pressure (shown as H on the map below) also helped explain the increase in warm northerly winds and decrease of the westerlies that would normally have been expected during spring, because of the blocking effect of the anticyclonic anomalies.

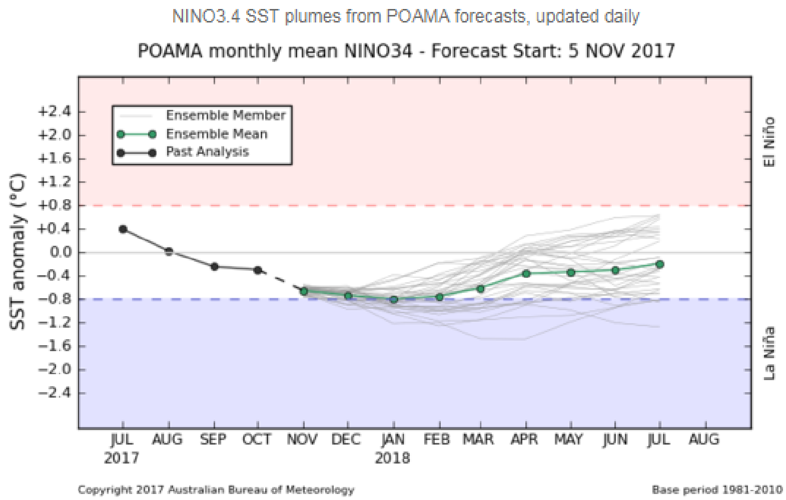


Mean sea level pressure anomaly between May and October 2017.Source: NOAA (USA).The blocking anticyclone shown as H helps explain the increase in northerly winds and the reduction of westerlies during the period.

Seasonal climate outlook update

The ENSO phenomenon is expected to remain borderline between neutral and La Niña for the coming summer season (see below). La Niña is often associated with greater inflow of tropical (moist) air into New Zealand, with increased north-easterly winds and the possibility of wetter events in the east, with warmer than average temperatures prevailing. As the La Niña projection is for a weak event (if confirmed), the influences on the weather patterns would likely be only mild.

The next seasonal climate outlook for summer will be released with our regular seasonal briefing by mid-December



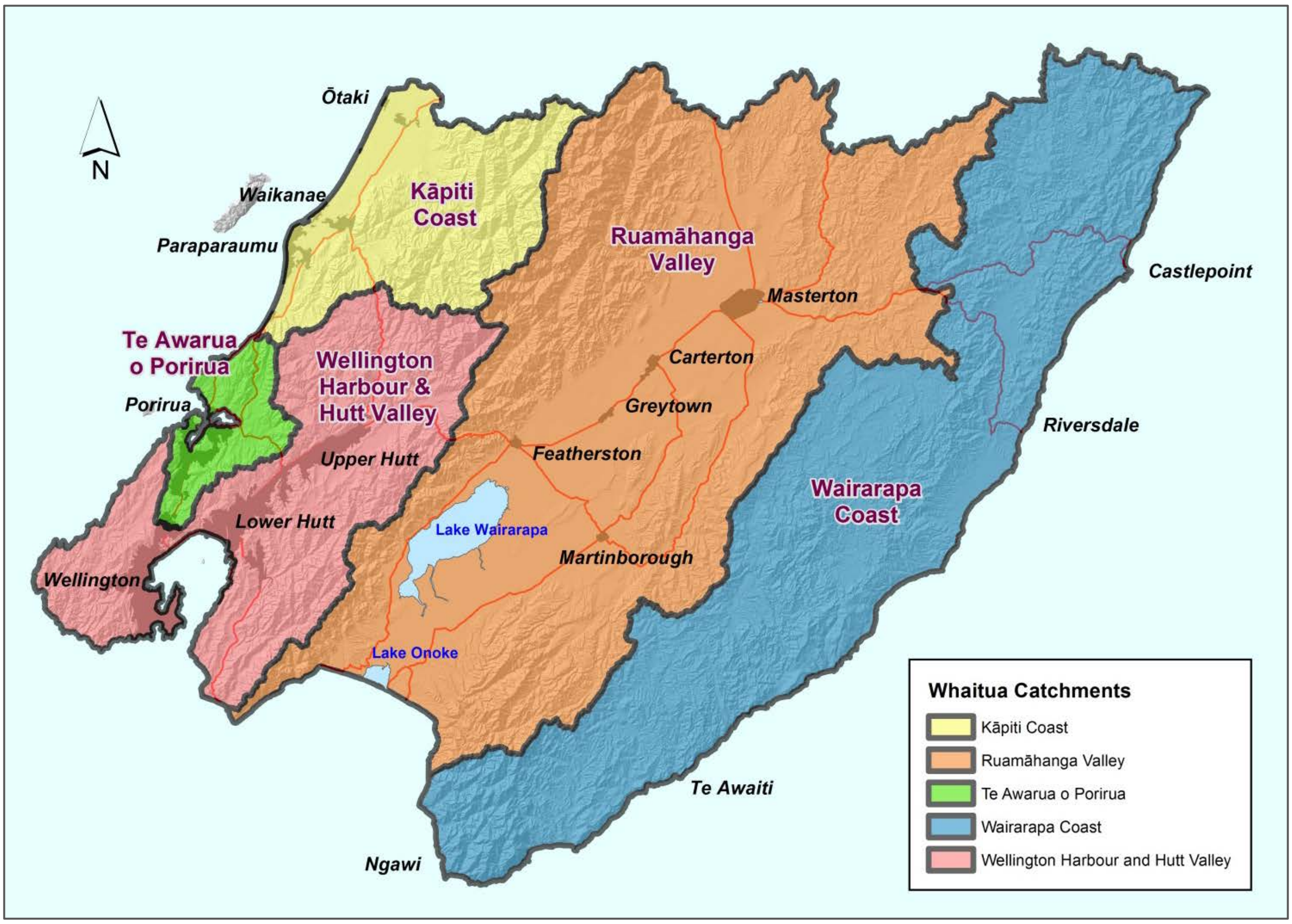
ENSO predictions as of 5 Nov2017, showing borderline conditions between La Niña and neutral phase for the coming summer. Source: BOM (Australia)

What happened in each whaitua catchment?

Climate and water resource summaries are provided in the following sections for each of the five Wellington region whaitua catchment areas (as shown below). The whaitua catchments provide an important sub-regional basis for environmental management in the Wellington region[2], and roughly coincide with the different climate and water resource zones.

Click the following links for May to October 2017 summaries for:

- Wellington Harbour and Hutt Valley
- Te Awarua-o-Porirua
- Kāpiti Coast
- Ruamāhanga Valley
- Wairarapa Coast

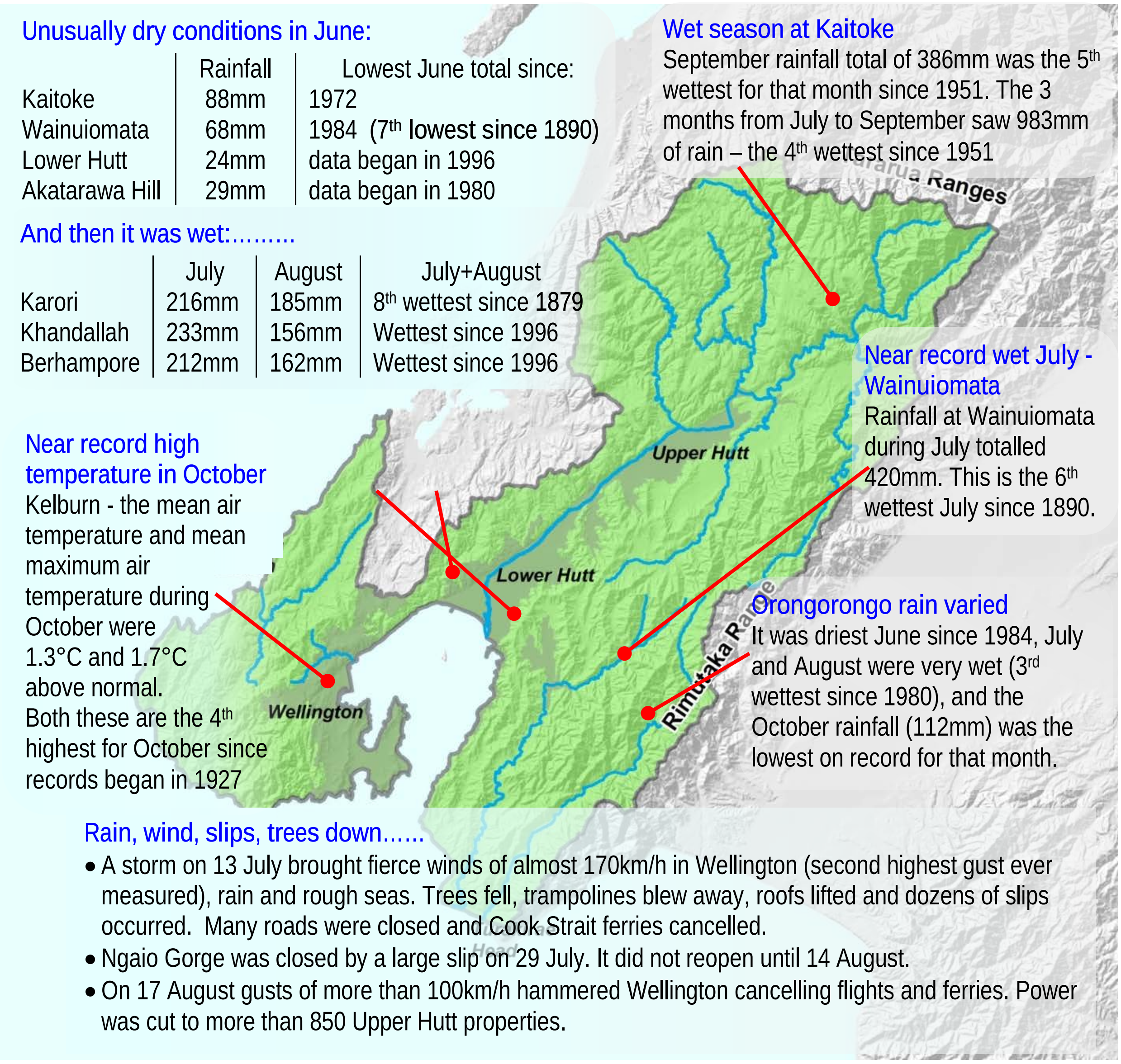


Map of the five whaitua catchment areas in the Wellington region. Each whaitua roughly coincides with a climatic zone, expressing the marked east-to-west contrast that we experience in our region.

2 http://www.gw.govt.nz/whaitua-committees/

Wellington Harbour and Hutt Valley climate summary

- **June was exceptionally dry**
- **Very high rain totals in July and August**
- **Area beset by slips, fallen trees and closed roads**



Unusually dry conditions in June:

	Rainfall	Lowest June total since:
Kaitoke	88mm	1972
Wainuiomata	68mm	1984 (7th lowest since 1890)
Lower Hutt	24mm	data began in 1996
Akatarawa Hill	29mm	data began in 1980

And then it was wet:………

	July	August	July+August
Karori	216mm	185mm	8th wettest since 1879
Khandallah	233mm	156mm	Wettest since 1996
Berhampore	212mm	162mm	Wettest since 1996

Wet season at Kaitoke

September rainfall total of 386mm was the 5th wettest for that month since 1951. The 3 months from July to September saw 983mm of rain – the 4th wettest since 1951

Near record wet July - Wainuiomata

Rainfall at Wainuiomata during July totalled 420mm. This is the 6th wettest July since 1890.

Near record high temperature in October

Kelburn - the mean air temperature and mean maximum air temperature during October were 1.3°C and 1.7°C above normal. Both these are the 4th highest for October since records began in 1927

Orongorongo rain varied

It was driest June since 1984, July and August were very wet (3rd wettest since 1980), and the October rainfall (112mm) was the lowest on record for that month.

Rain, wind, slips, trees down……

- A storm on 13 July brought fierce winds of almost 170km/h in Wellington (second highest gust ever measured), rain and rough seas. Trees fell, trampolines blew away, roofs lifted and dozens of slips occurred. Many roads were closed and Cook Strait ferries cancelled.
- Ngaio Gorge was closed by a large slip on 29 July. It did not reopen until 14 August.
- On 17 August gusts of more than 100km/h hammered Wellington cancelling flights and ferries. Power was cut to more than 850 Upper Hutt properties.

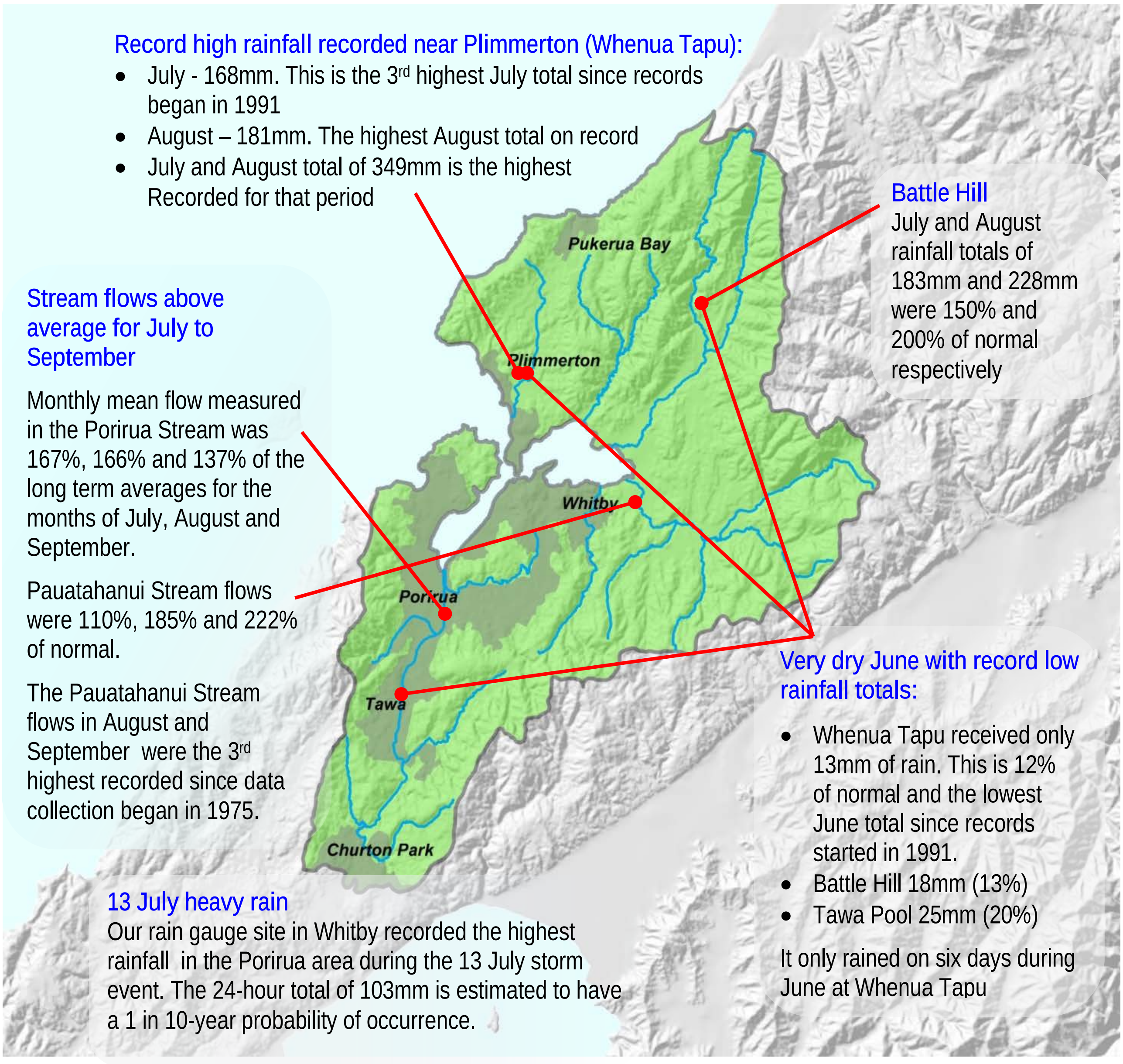
Want to look at the summary tables and graphs?

[Rainfall]

[River flows]

Te Awarua-o-Porirua climate summary

- **Much wetter than average July to September**
- **Record dry June**



Record high rainfall recorded near Plimmerton (Whenua Tapu):

- July - 168mm. This is the 3rd highest July total since records began in 1991
- August – 181mm. The highest August total on record
- July and August total of 349mm is the highest Recorded for that period

Battle Hill

July and August rainfall totals of 183mm and 228mm were 150% and 200% of normal respectively

Stream flows above average for July to September

Monthly mean flow measured in the Porirua Stream was 167%, 166% and 137% of the long term averages for the months of July, August and September.

Pauatahanui Stream flows were 110%, 185% and 222% of normal.

The Pauatahanui Stream flows in August and September were the 3rd highest recorded since data collection began in 1975.

Very dry June with record low rainfall totals:

- Whenua Tapu received only 13mm of rain. This is 12% of normal and the lowest June total since records started in 1991.
- Battle Hill 18mm (13%)
- Tawa Pool 25mm (20%)

It only rained on six days during June at Whenua Tapu

13 July heavy rain

Our rain gauge site in Whitby recorded the highest rainfall in the Porirua area during the 13 July storm event. The 24-hour total of 103mm is estimated to have a 1 in 10-year probability of occurrence.

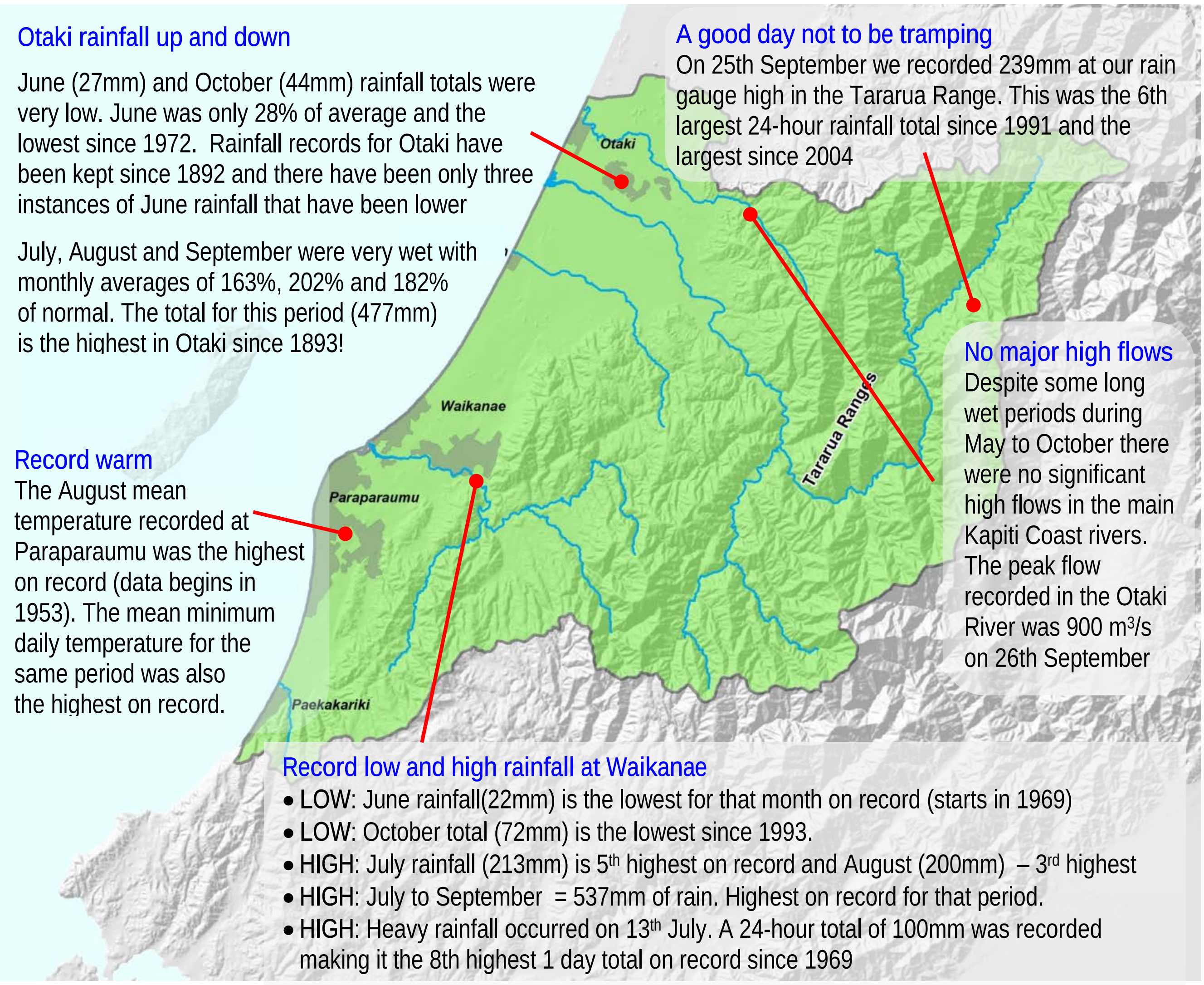
Want to look at the summary tables and graphs?

[Rainfall]

[River flows]

Kāpiti Coast climate summary

- **Much wetter than average July to September**
- **June was exceptionally dry**
- **Warm than normal**



Otaki rainfall up and down

June (27mm) and October (44mm) rainfall totals were very low. June was only 28% of average and the lowest since 1972. Rainfall records for Otaki have been kept since 1892 and there have been only three instances of June rainfall that have been lower

July, August and September were very wet with monthly averages of 163%, 202% and 182% of normal. The total for this period (477mm) is the highest in Otaki since 1893!

A good day not to be tramping

On 25th September we recorded 239mm at our rain gauge high in the Tararua Range. This was the 6th largest 24-hour rainfall total since 1991 and the largest since 2004

Record warm

The August mean temperature recorded at Paraparaumu was the highest on record (data begins in 1953). The mean minimum daily temperature for the same period was also the highest on record.

No major high flows

Despite some long wet periods during May to October there were no significant high flows in the main Kapiti Coast rivers. The peak flow recorded in the Otaki River was 900 m^3/s on 26th September

Record low and high rainfall at Waikanae

- LOW: June rainfall(22mm) is the lowest for that month on record (starts in 1969)
- LOW: October total (72mm) is the lowest since 1993.
- HIGH: July rainfall (213mm) is 5th highest on record and August (200mm) – 3rd highest
- HIGH: July to September = 537mm of rain. Highest on record for that period.
- HIGH: Heavy rainfall occurred on 13th July. A 24-hour total of 100mm was recorded making it the 8th highest 1 day total on record since 1969

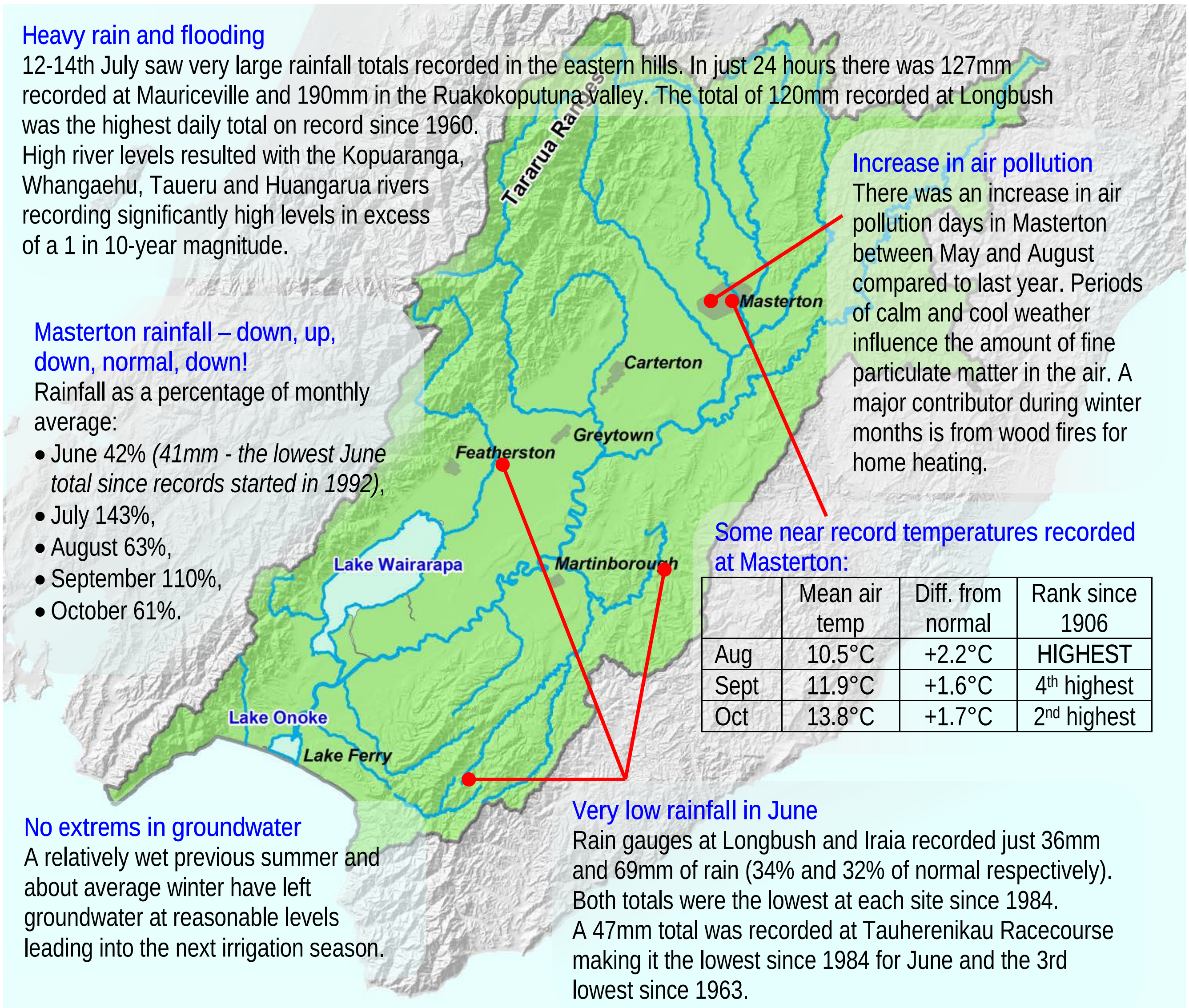
Want to look at the summary tables and graphs?

[Rainfall]

[River flows]

Ruamāhanga Valley climate summary

- **Some months warmer than normal**
- **Flooding in July**



Heavy rain and flooding

12-14th July saw very large rainfall totals recorded in the eastern hills. In just 24 hours there was 127mm recorded at Mauriceville and 190mm in the Ruakokoputuna valley. The total of 120mm recorded at Longbush was the highest daily total on record since 1960.
High river levels resulted with the Kopuaranga, Whangaehu, Taueru and Huangarua rivers recording significantly high levels in excess of a 1 in 10-year magnitude.

Increase in air pollution

There was an increase in air pollution days in Masterton between May and August compared to last year. Periods of calm and cool weather influence the amount of fine particulate matter in the air. A major contributor during winter months is from wood fires for home heating.

Masterton rainfall – down, up, down, normal, down!

Rainfall as a percentage of monthly average:

- June 42% *(41mm - the lowest June total since records started in 1992)*,
- July 143%,
- August 63%,
- September 110%,
- October 61%.

Some near record temperatures recorded at Masterton:

	Mean air temp	Diff. from normal	Rank since 1906
Aug	10.5°C	+2.2°C	HIGHEST
Sept	11.9°C	+1.6°C	4th highest
Oct	13.8°C	+1.7°C	2nd highest

No extrems in groundwater

A relatively wet previous summer and about average winter have left groundwater at reasonable levels leading into the next irrigation season.

Very low rainfall in June

Rain gauges at Longbush and Iraia recorded just 36mm and 69mm of rain (34% and 32% of normal respectively). Both totals were the lowest at each site since 1984.
A 47mm total was recorded at Tauherenikau Racecourse making it the lowest since 1984 for June and the 3rd lowest since 1963.

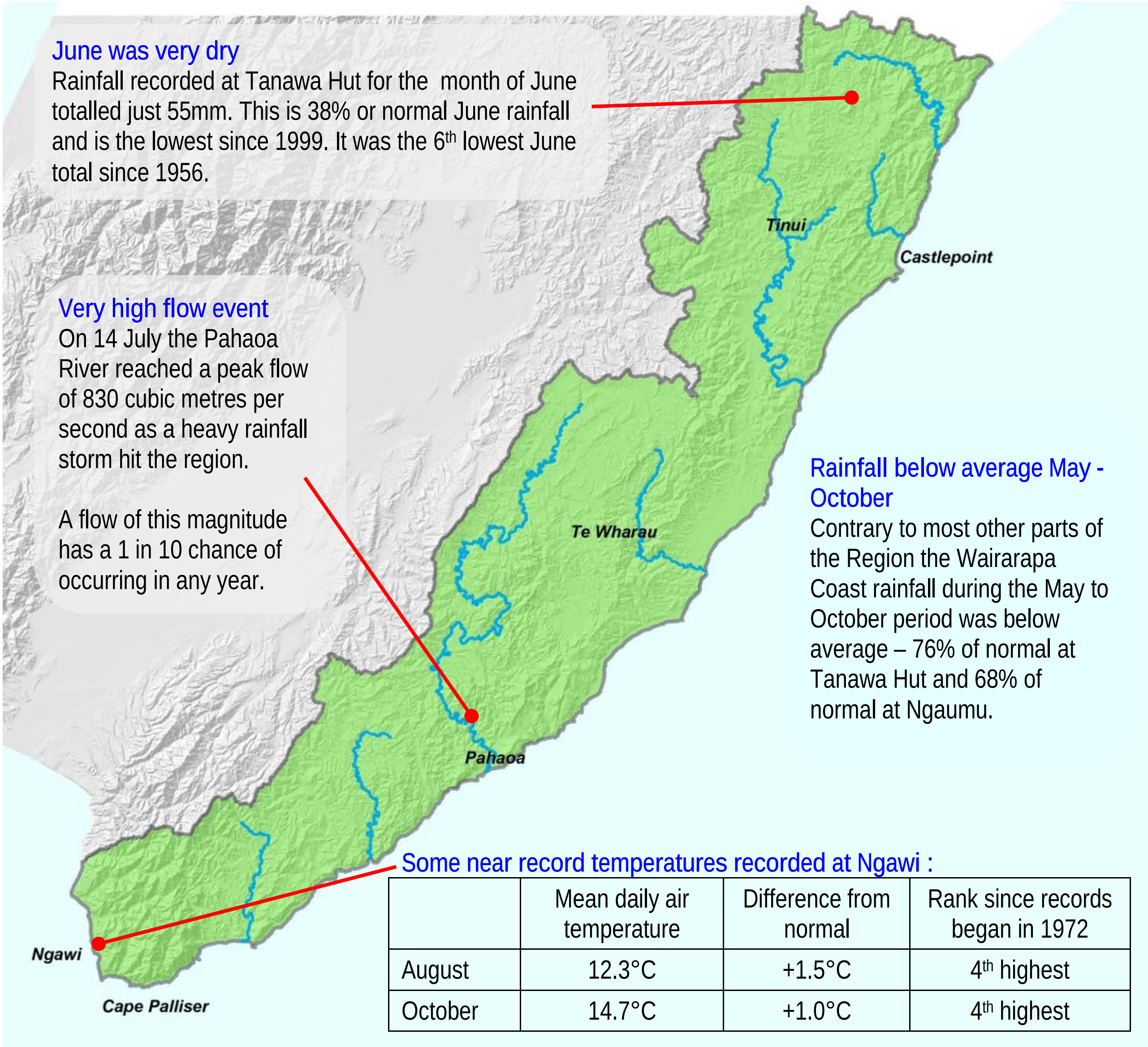
Want to look at the summary tables and graphs?

Rainfall

River flows

Wairarapa Coast climate summary

- **Drier than average**
- **Pahaoa River significant high flow in July**



	Mean daily air temperature	Difference from normal	Rank since records began in 1972
August	12.3°C	+1.5°C	4th highest
October	14.7°C	+1.0°C	4th highest

Want to look at the summary tables and graphs?

[Rainfall]

[Soil moisture]

Rainfall statistics

Rainfall was around average for the May to October period at most locations apart from the Wairarapa Coast where around 75% of the normal rainfall was recorded.

June rainfall was very low at all locations except Wellington and Karori. Rain gauges in the Porirua and Kāpiti Coast areas received between 5% and 26% of the normal June rainfall. July, August and September were wet months at many sites.

Whaitua	Location	May %	Jun %	Jul %	Aug %	Sep %	Oct %	May-Oct (mm)	May-Oct (%)
Wellington Harbour & Hutt Valley Click to see cumulative rainfall plots	Kaitoke	64	38	117	143	200	68	1354	102
	Lower Hutt	55	18	201	146	127	35	696	95
	Wainuiomata	45	32	183	101	87	29	981	83
	Karori	73	84	155	150	88	73	766	106
	Wellington	83	95	210	160	101	58	676	120
Te Awarua-o-Porirua Click to see cumulative rainfall plots	Battle Hill	79	13	154	198	105	60	749	96
	Whenua Tapu	90	12	174	194	102	44	591	97
	Tawa	56	20	201	169	108	41	621	90
Kāpiti Coast Click to see cumulative rainfall plots	Otaki	96	26	182	202	163	44	637	116
	Waikanae	121	18	186	190	106	49	765	107
	Paekakariki	74	5	162	142	83	54	632	86
	Tararua (Otaki headwaters)	109	45	72	159	178	84	3042	107
Ruamāhanga Click to see cumulative rainfall plots	Masterton	109	42	143	63	110	61	459	85
	Featherston	73	42	123	97	85	43	476	79
	Longbush	87	34	176	91	109	68	546	98
	Tararua (Waiohine headwaters)	82	33	88	122	166	102	2676	99
Wairarapa Coast Click to see cumulative rainfall plots	Tanawa Hut	88	38	104	45	75	109	598	76
	Ngaumu	68	33	85	37	117	80	432	68

Click the following links to return to climate summaries for:

- Wellington Harbour & Hutt Valley
- Te Awarua-o-Porirua
- Kāpiti Coast
- Ruamāhanga
- Wairarapa Coast

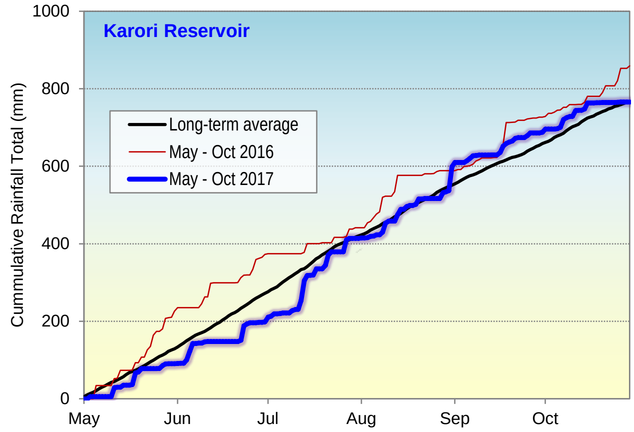
Cumulative rainfall plots

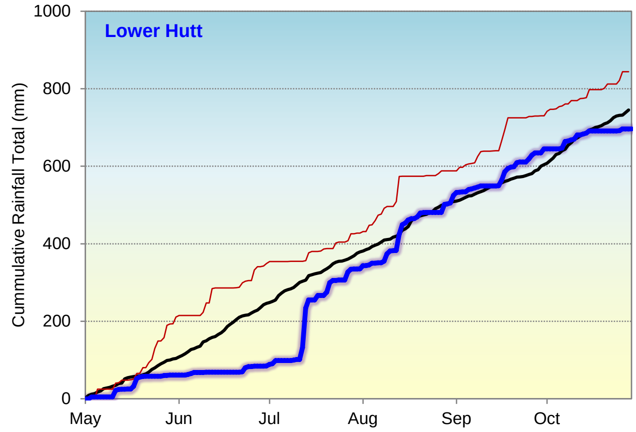
Cumulative rainfall totals for the May to October 2017 period are detailed for various rain gauges sites across the regional whaitua areas as denoted by the blue trace on the following plots. The May to October 2016 period is denoted by the red trace and the black trace represents the long-term average rainfall accumulation.

Wellington and Hutt Valley

The plots highlight that the rainfall accumulation during the May to October period ended up near the average.

The period from the middle of May to early July was very dry in Lower Hutt. The remainder of July was exceptionally wet and the cumulative total quickly rose back to near the average.

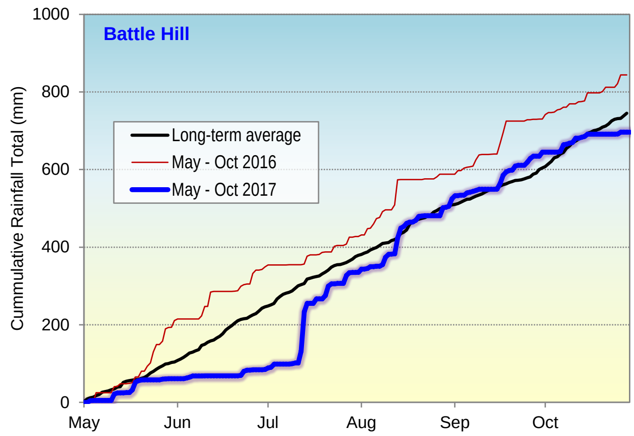


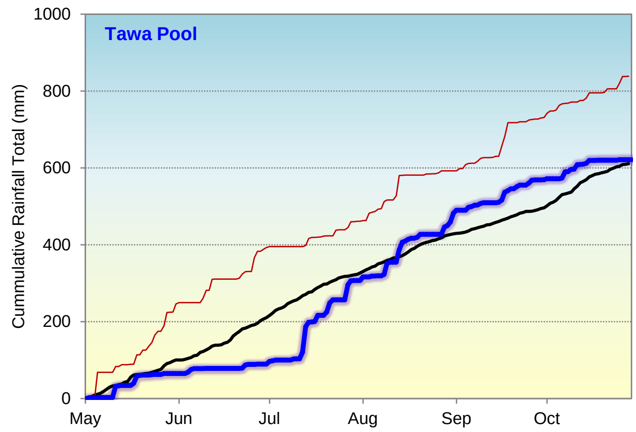


Porirua Harbour

The plots show that the rainfall accumulation trends in the May to October period at the two sites within the Te Awarua-o-Porirua whaitua area were quite similar and both ended the period near the long term average.

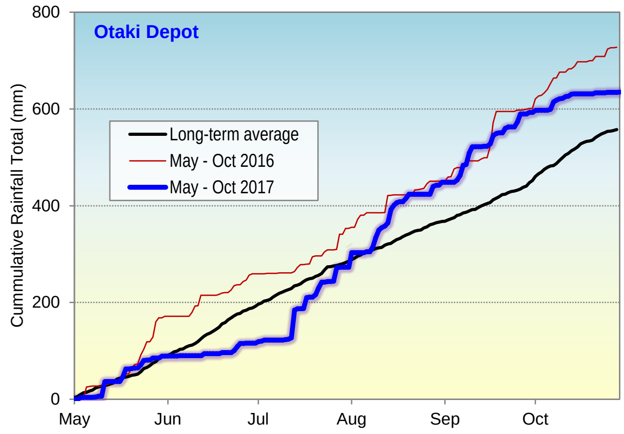
A very dry June and a very wet July are particularly evident.

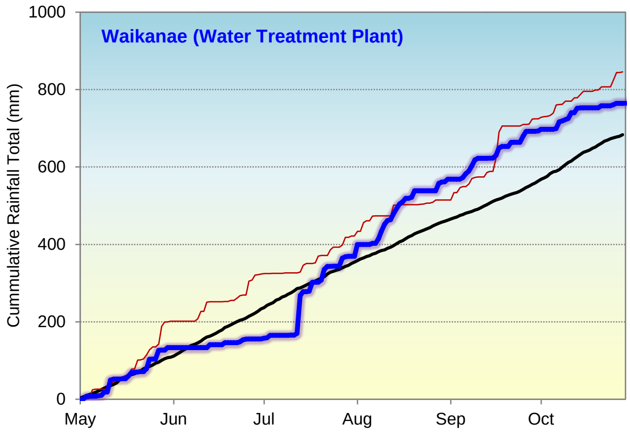




Kāpiti Coast

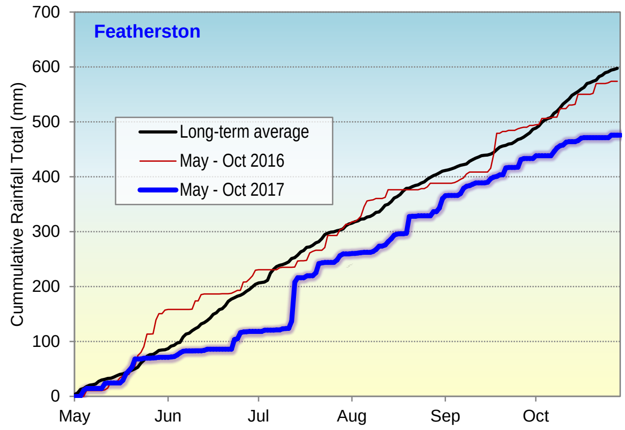
Rainfall recorded at Otaki and Waikanae over the May to October period was slightly above average. The July to October period was very wet.

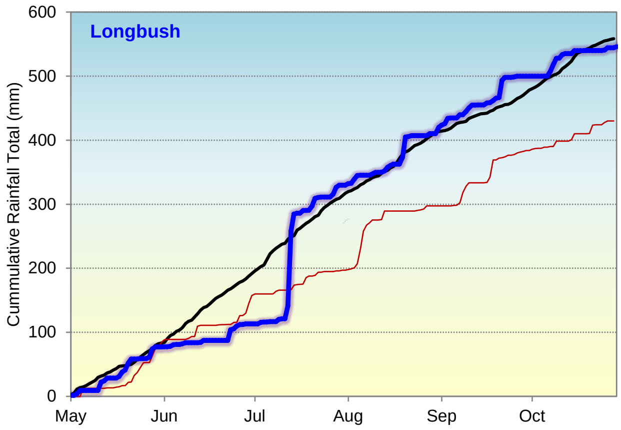




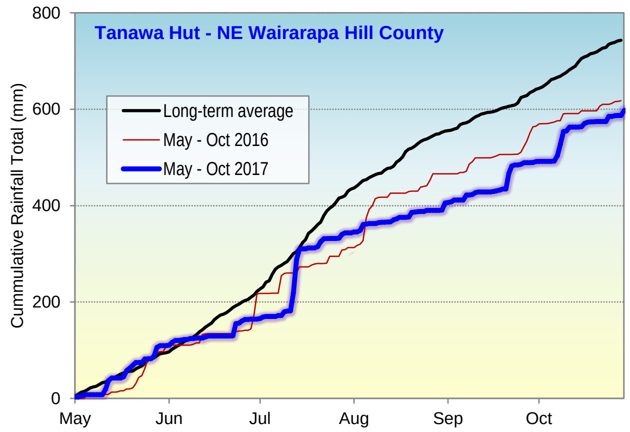
Ruamāhanga

Rainfall near Featherston tracked below average for much of the May to October period ending 129mm below the long term average. Rainfall at Longbush shows a very dry June and a very wet July. Total rainfall was near average but 110mm greater than the previous year.





Wairarapa Coast



The Tanawa Hut rain gauge in the Wairarapa Coast area shows a similar trend to the 2016 year May to October period, finishing 151mm less than the long term average.

River flows - averages

Percentage of average river flow for each month and whole of the May to October 2017 period.

Flows across the region were well above average in a number of areas during July, August and September. Flows during June and October were below average at all sites – June was particularly drier than normal.

		Flow as a percentage of average						
Whaitua	River	May	Jun	Jul	Aug	Sep	Oct	May-Oct
Wellington Harbour & Hutt Valley	Hutt River - Kaitoke	110	49	119	152	210	74	118
	Hutt River - Taita Gorge	101	40	123	151	201	55	110
	Akatarawa River	111	36	101	153	182	54	103
	Mangaroa River	77	33	123	107	134	47	87
	Waiwhetu Stream	88	53	153	148	135	72	110
	Wainuiomata River	87	31	160	133	140	54	102
Te Awarua-o-Porirua	Porirua	92	49	167	174	135	64	117
	Pauatahanui	86	36	114	190	226	91	123
	Horokiri	117	38	148	211	148	79	127
Kāpiti Coast	Otaki	116	35	111	145	181	81	110
	Mangaone	181	52	115	211	179	77	130
	Waikanae	172	46	149	232	199	72	140
Ruamāhanga	Kopuaranga	111	43	122	52	108	46	79
	Waingawa	68	44	84	101	148	77	88
	Waiohine	80	39	89	108	162	68	91
	Mangatarere	68	41	113	64	129	41	75
	Tauherenikau	83	49	104	119	171	57	97
	Otukura	196	87	158	101	108	57	114
	Ruamāhanga	90	43	138	101	155	85	103
Wairarapa Coast	Pahaoa	142	65	174	63	106	74	112

** Analyses have been completed on provisional data which may be subject to change once it is processed and archived*

Click the following links to return to climate summaries for:

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- Te Awarua-o-Porirua
- Kāpiti Coast
- Ruamāhanga
- Wairarapa Coast

River flows – highest

Maximum river and stream flows recorded during the May to October 2017 period. The estimated return period is given for each event.

Whaitua	River	Maximum Flow		
		Flow (m^3/s)	**Date**	**Return Period (years)**
Wellington Harbour & Hutt Valley	Hutt (Kaitoke)	260	26 September	2
	Hutt(Taita Gorge)	618	26 September	<2
	Akatarawa	143	26 September	<2
	Mangaroa	138	13 July	<2
	Waiwhetu	11	13 July	<2
	Wainuiomata	130	13 July	10
Te Awarua-o-Porirua	Porirua	27	13 July	<2
	Pauatahanui	28	13 July	<2
	Horokiri	10	13 July	<2
Kāpiti Coast	Otaki	899	26 September	2
	Mangaone	5	1 August	<2
	Waikanae	134	24 May	<2
Ruamāhanga	Kopuaranga	66	13 July	14
	Waingawa	175	26 September	<2
	Waiohine	593	26 September	<2
	Mangatarere	39	13 July	<2
	Tauherenikau	207	26 September	<2
	Otukura	15	14 July	15
	Ruamahānga (Upper)	449	14 July	<2
	Ruamāhanga (Lower)	1226	14 July	2.5
Wairarapa Coast	Pahaoa	832	14 July	10

** Analyses have been completed on provisional data which may be subject to change once it is processed and archived.*

[1] *Recording sensor damaged during this flood event. This is an estimate of flow only.*

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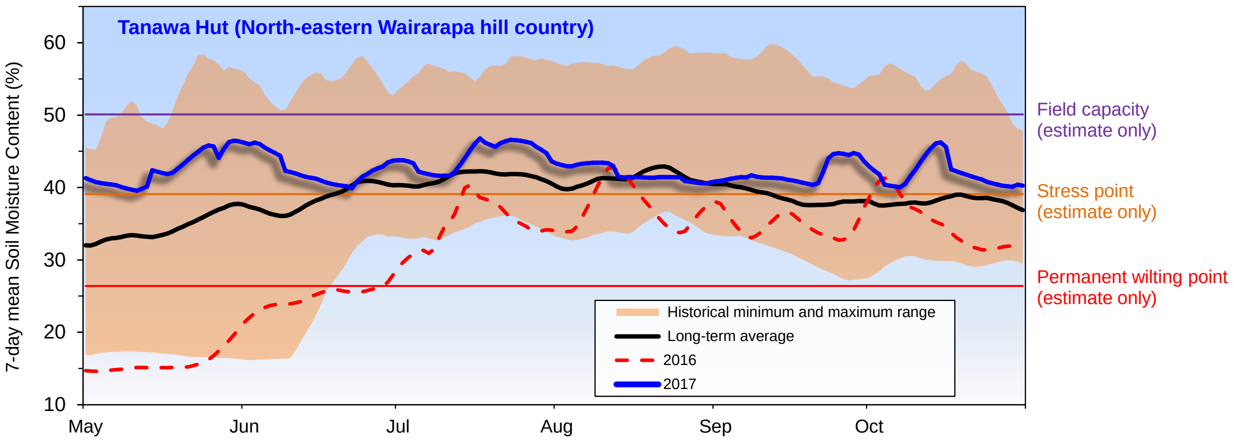
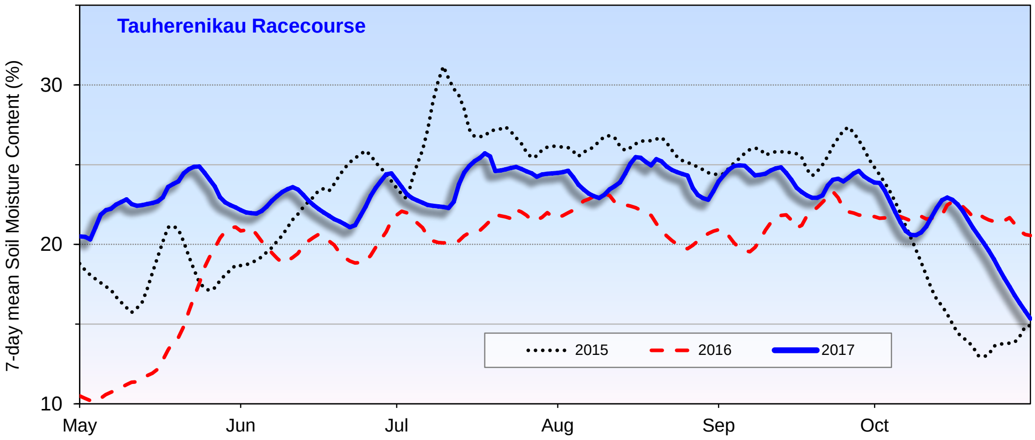
Soil moisture content

Wairarapa Coast

May to October 2017 soil moisture content at monitoring sites at Tanawa Hut in north-east Wairarapa (Wairarapa Coast whaitua) and Tauherenikau racecourse (Ruamāhanga whaitua) are plotted below.

Soil moisture at Tanawa Hutt was slightly above average for most of the period, ending very close to average. Levels at Tauherenikau were about average compared to the last two years, but ended up lower than last year at the end of the period.





Drought monitoring

NIWA maintains a 'drought monitor' and 'drought index' website that provides more information on soil moisture conditions (and other hydrological and climatic information relevant to drought assessment):

https://www.niwa.co.nz/climate/information-and-resources/drought-monitor

Climate Briefings

In addition to the extended warm and cold season reports, the Environmental Science department, GWRC, produces shorter seasonal climate briefings specifically targeting the farming community, with a detailed seasonal outlook always released in the first month of the new season. Those can be accessed from the Climate and Water Resource webpage:

http://www.gw.govt.nz/seasonal-climate-and-water-resource-summaries-2/

The Greater Wellington Regional Council's purpose is to enrich life in the Wellington Region by building resilient, connected and prosperous communities, protecting and enhancing our natural assets, and inspiring pride in what makes us unique

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