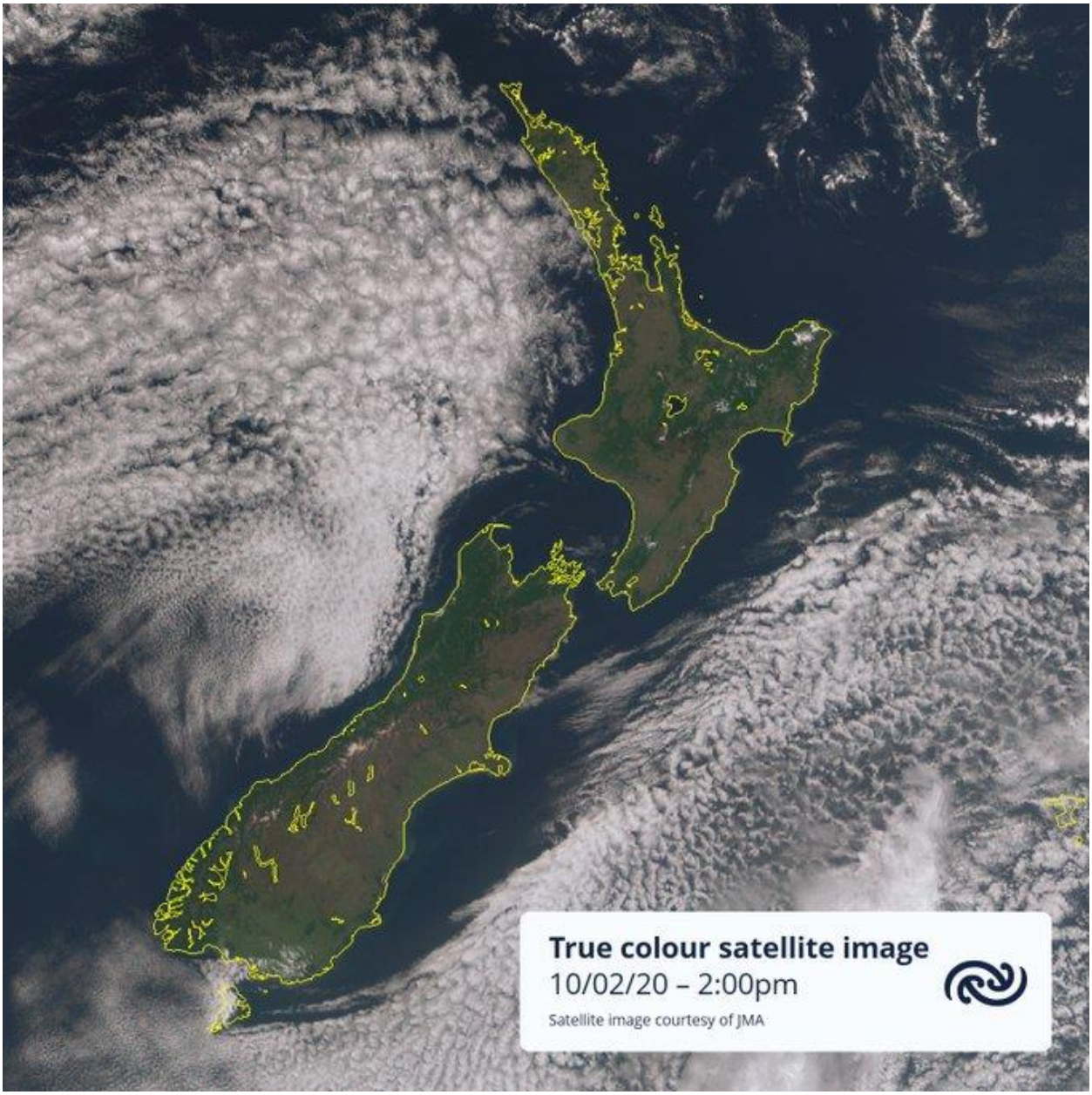
greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Climate and Water Resources Summary for the Wellington Region

Warm Season (November to April) 2019-2020

Release date: 10 June 2020



True colour satellite image showing a very rare occurrence with virtually the entire length of New Zealand simultaneously cloud free, on 10th February 2020. It is very rare to see an image like this and there is no verified record of when a similar condition was last observed. Most of the country experienced very dry conditions during the warm season, with record low rainfall in Auckland, Northland and also in the Wairarapa. Image Credits: MetService.

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

Report release date: June 2020

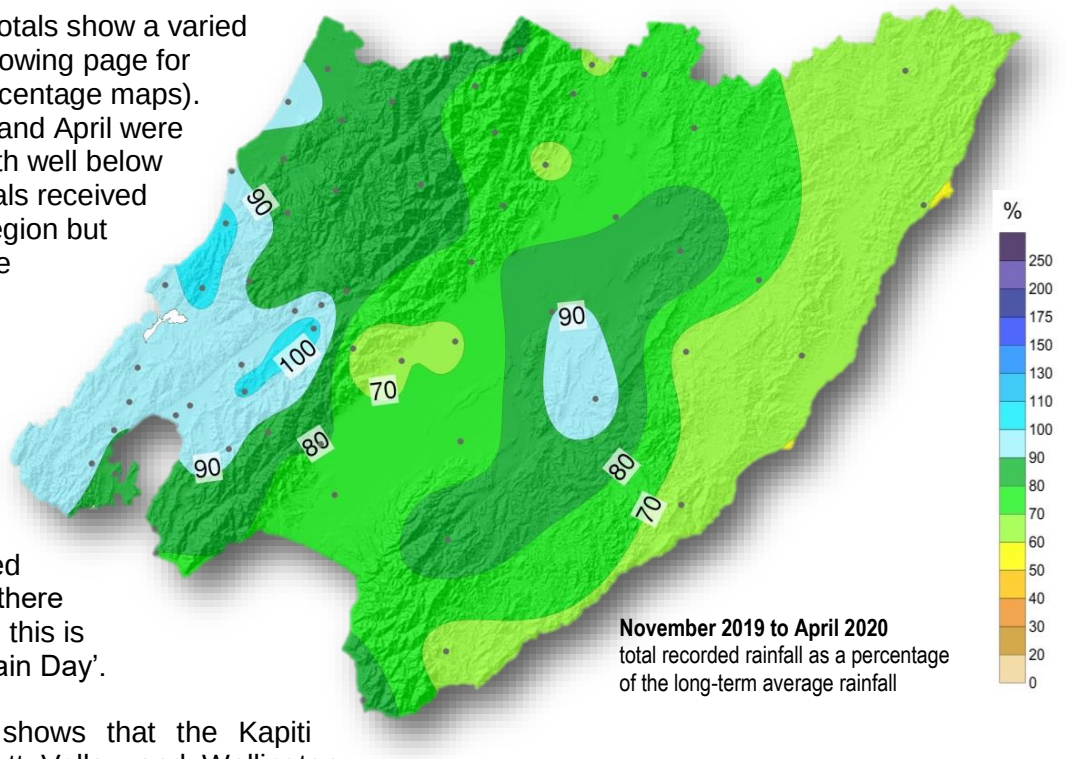
The cold season from November 2019 to April 2020 saw total rain across the region range from around 70 to 100% of average over the entire six month period. However, a look into the rainfall patterns on a monthly basis (see next page) shows that the rainfall anomaly had large variations from month to month.

Rainfall (November to April)

The map below shows rainfall recorded during the entire November 2019 to April 2020 period as a percentage of the long term average.

The pattern for the six month period is that of below average to average rainfall across the region. Places that received average rainfall totals were around the Wellington, Hutt Valley and Porirua areas. Overall drier conditions persisted over the entire Wairarapa area and the Kapiti Coast.

Separate monthly totals show a varied picture (see the following page for monthly rainfall percentage maps). January, February and April were very dry months with well below average rainfall totals received over much of the region but particularly so in the Wairarapa.



November 2019 to April 2020
total recorded rainfall as a percentage of the long-term average rainfall

Analysis of the number of days that it rained can be informative. 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'.

The table below shows that the Kapiti Coast, Porirua, Hutt Valley and Wellington areas had slightly fewer rain days than normal. However, the Ruāmahanga and Eastern Wairarapa had fewer rain days again, with 10 to 15 days fewer than normal.

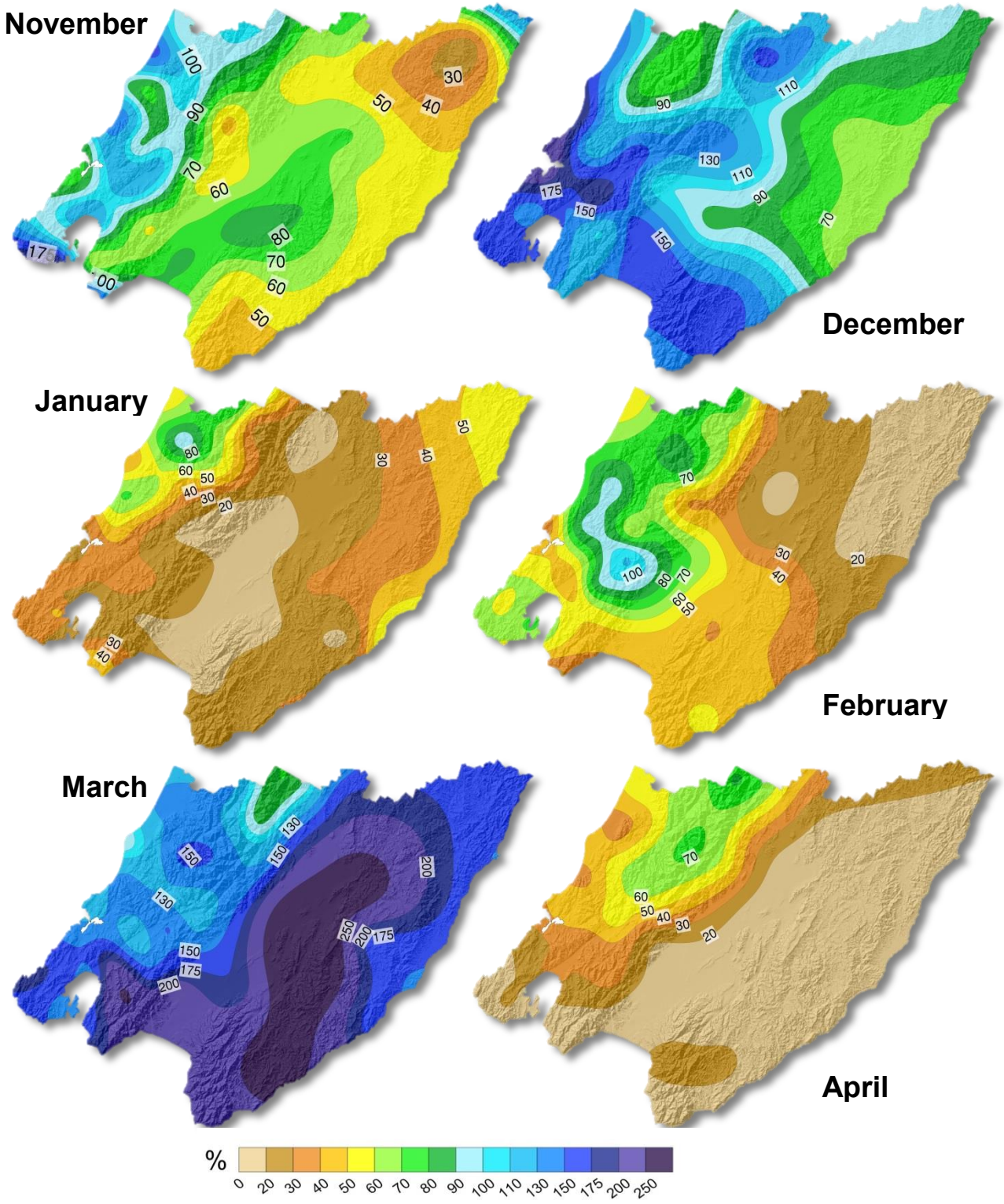
Number of Rain Days and Heavy Rain Days during November to April across the region (long-term average in brackets.)

	Kāpiti Coast		Porirua	Hutt Valley & Wellington		Ruamāhanga		Eastern Wairarapa
	Lowland	Hills	Lowland	Lowland	Hills	Lowland	Hills	
Rain Days (>1mm)	48 [52]	74 [77]	44 [44]	41 [46]	62 [67]	34 [42]	67 [82]	39 [50]
Heavy Rain Days(>25mm)	3 [4]	18 [21]	5 [4]	6 [4]	8 [10]	2 [3]	17 [24]	4 [4]

Rainfall by the month

November, January, February and April rainfall totals were well below average over eastern areas.

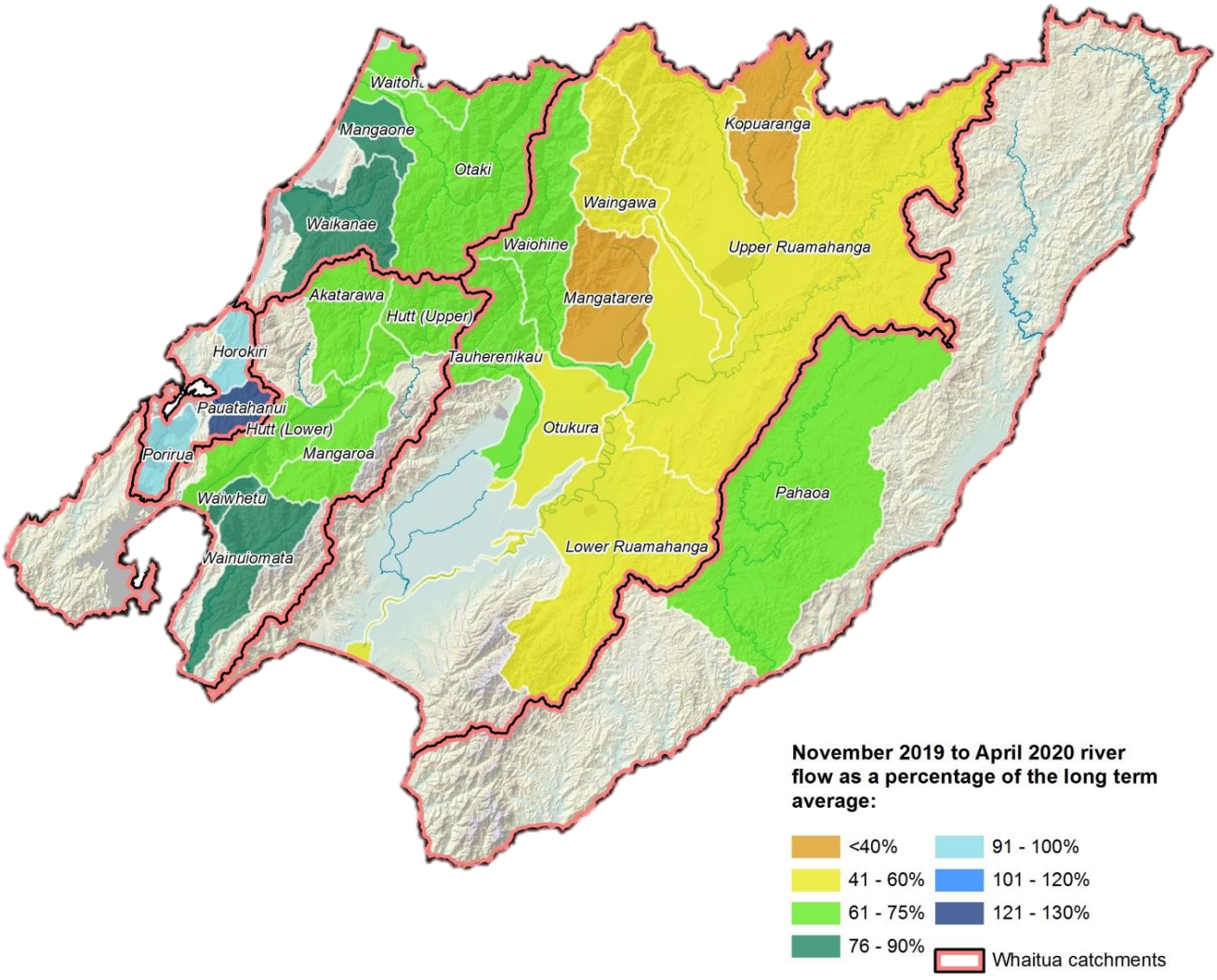
The significance of just a couple of heavy rainfall events is evident in the December and March anomaly maps. Torrential rainfall on 8th December affected parts of the Hutt Valley and Porirua with flooding, while solid rainfall from 27th to 29th March brought significantly large totals to eastern and southern Wairarapa areas.



River flow

The map below shows the average river and stream flow conditions over the November 2019 to April 2020 period, for various monitored catchments, as a percentage of the long-term average flow for the same period.

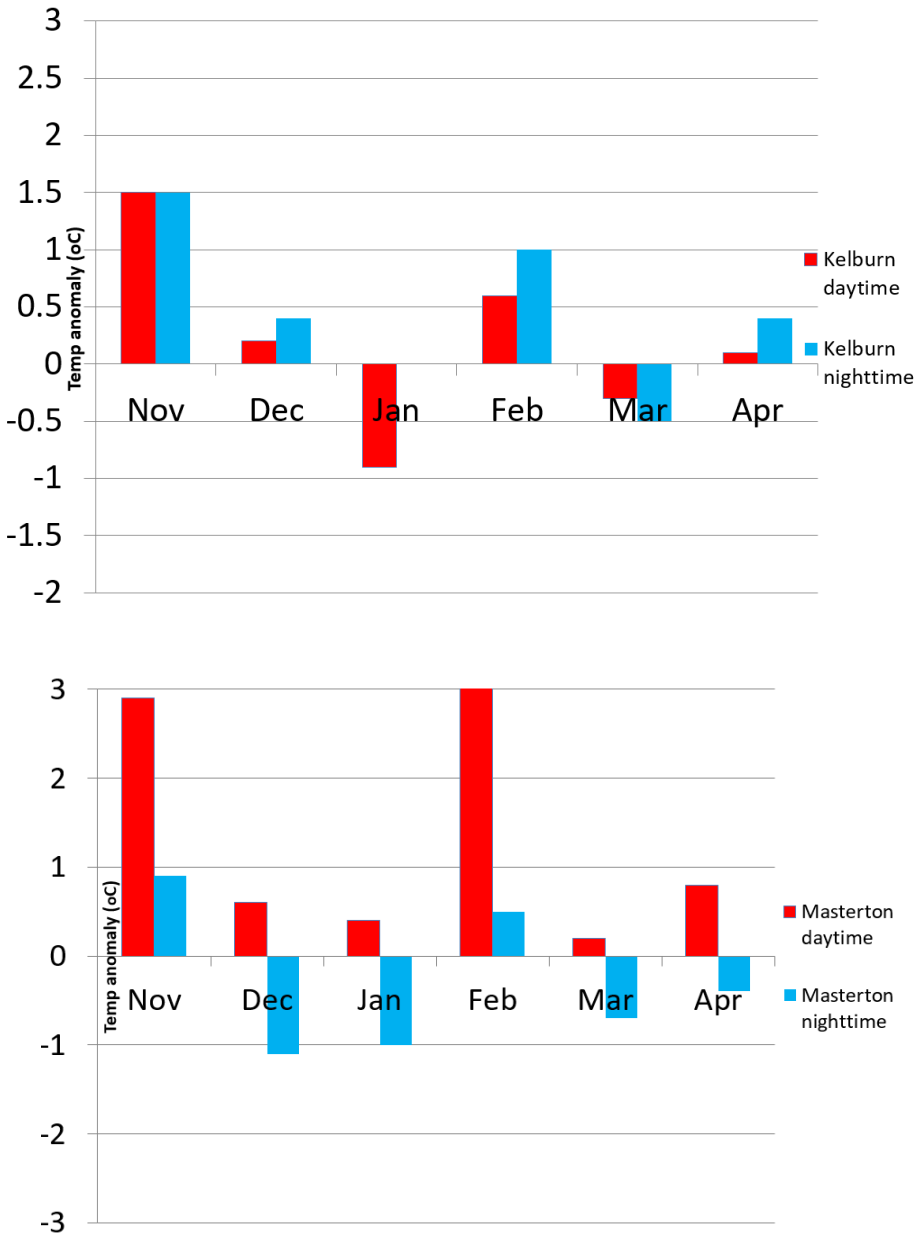
The majority of the region's stream and rivers experienced below average flows during the six month period with the exception of streams in the Porirua area which were relatively higher.



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 average temperatures month by month, in order to understand the climate variability.

The graphs below show the monthly average daytime maximum and average nighttime minimum temperature anomalies (i.e., based on every day of the month) for Kelburn (upper panel) and Masterton (lower panel). We can see that the warm season was mostly warmer than normal, especially in Masterton where the daytime maximum temperature for November was the hottest on record for over 100 years of data (February was the third hottest on record). January and March were relatively cold in Wellington.



Average daytime and nighttime temperature anomalies for Kelburn (top) and Masterton (bottom) for the warm season period. The first half of the period was warmer than average, and the second half was either about average (Wellington) or colder than average (Masterton).
SOURCE: Data from MetService meteorological stations.

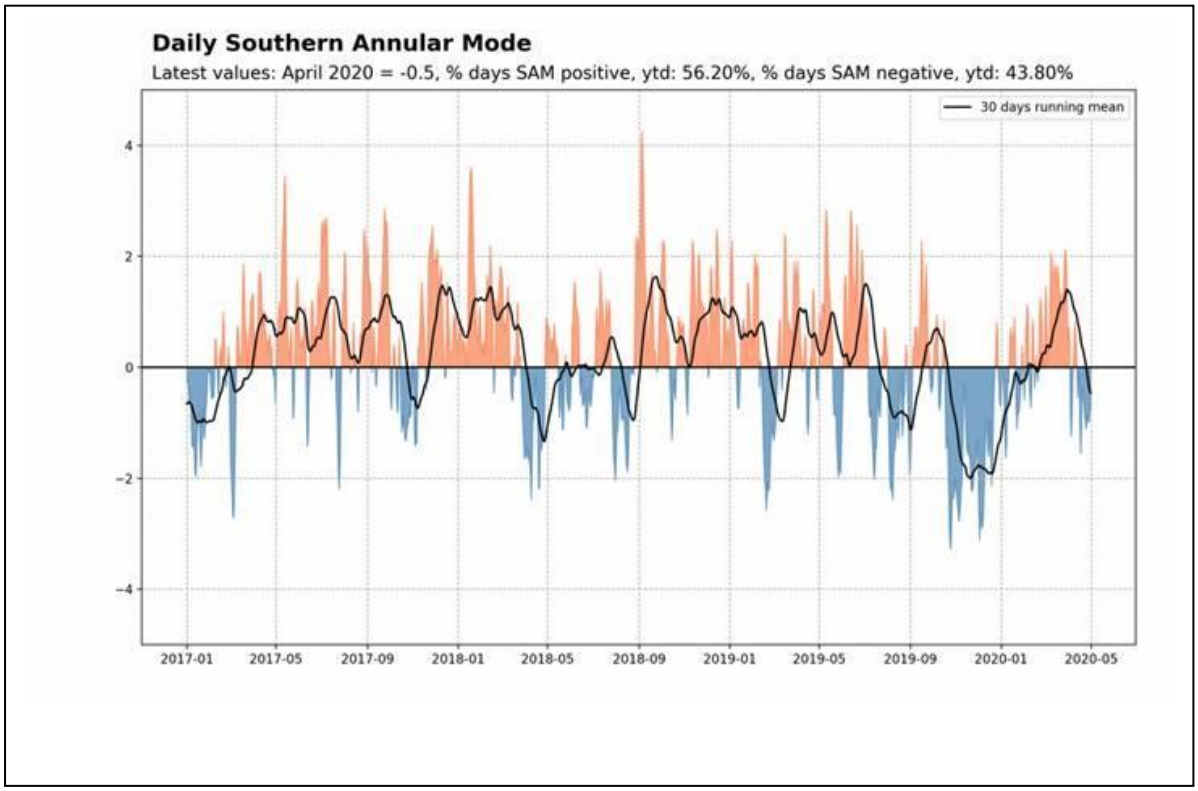
Global climate drivers

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 (https://www.gw.govt.nz/climate-change/).

Some key observations about climate variability and change in our region during the period November 2019 to April 2020 are:

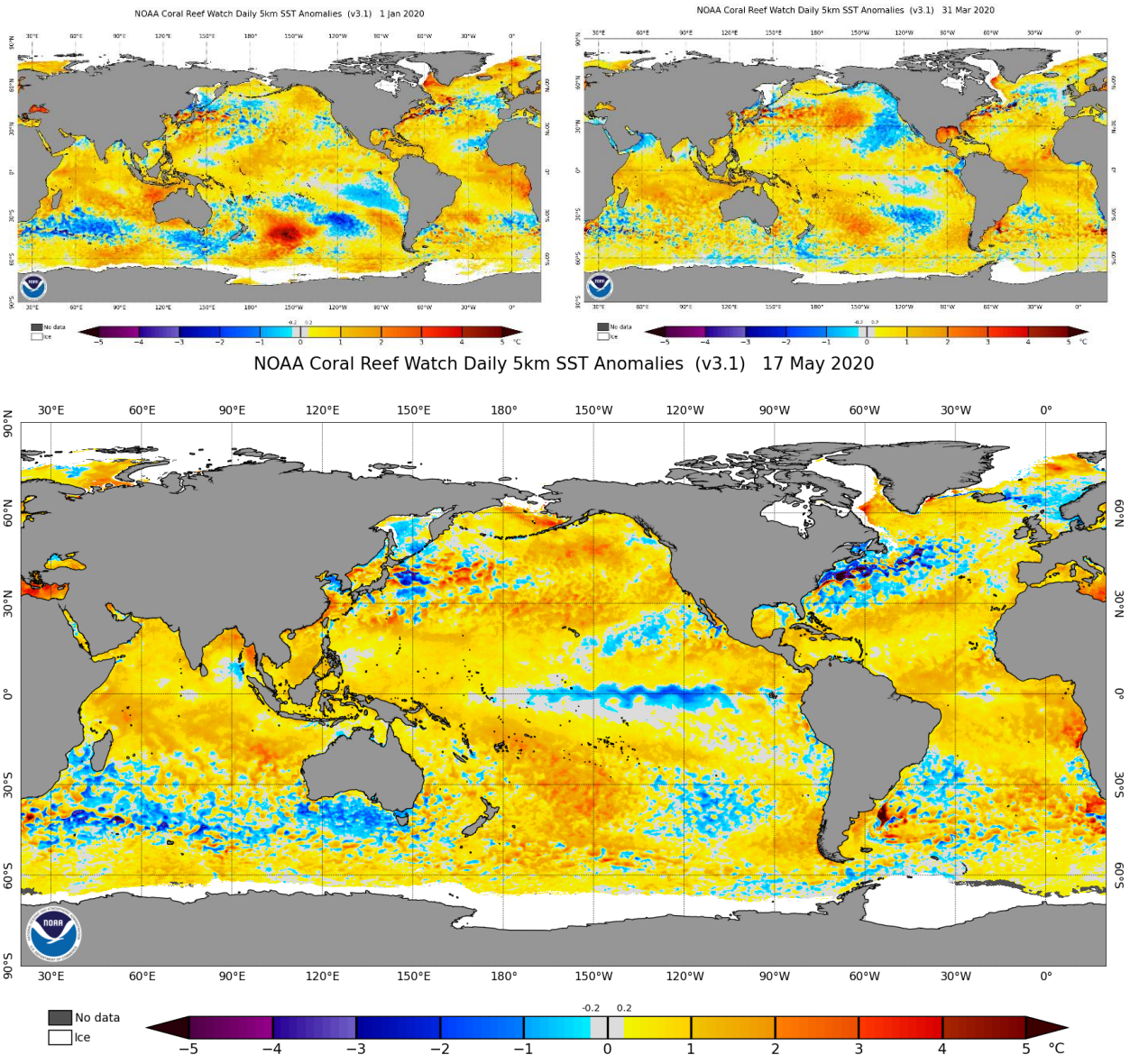
- The six-month period was warmer than normal, especially in the Wairarapa. Masterton broke an all-time record for warm daytime temperatures in November, and was close to breaking it again in February, for over 100 years of data;
- The sea surface temperatures (following page) have been mostly warmer than normal around and east of New Zealand;
- The Southern Annular Mode (below) has been predominantly negative during spring and positive in late summer, when the drought aggravated (graph below);
- Low Pressures southwest of New Zealand and high pressure east of the country helped develop northerly flows, with a strong westerly component persisting as a result of the pressure gradient. A ridge of high pressure projecting towards the North Island helped explain the unusually dry conditions that progressed into summer and autumn.



The Southern annular mode (SAM) has been predominantly positive (red), but it had some marked negative (blue) peaks until the end of 2019.
Source: https://niwa.co.nz/climate/information-and-resources/southern-annular-mode

Global climate drivers and extreme weather events

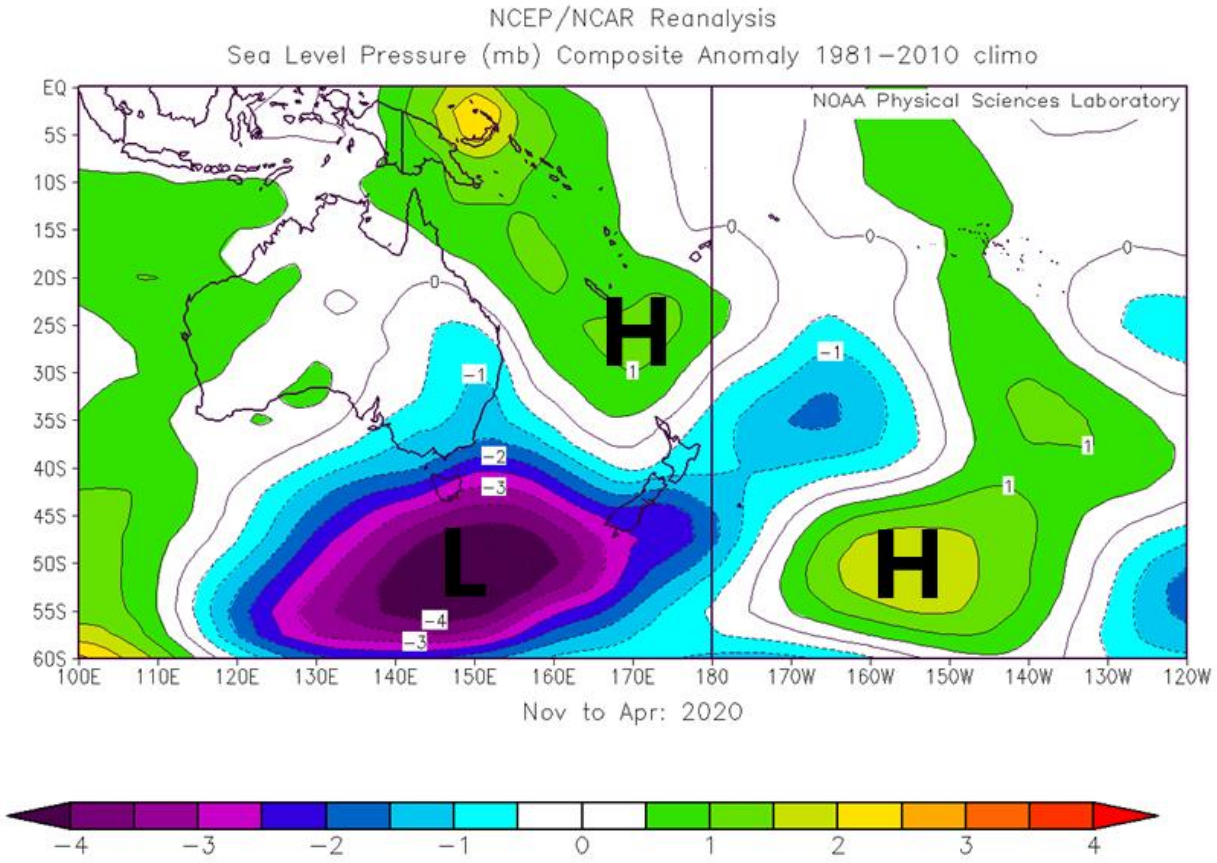
Climate drivers are global mechanisms that can influence the weather in our region. The El Niño/Southern Oscillation[1] (ENSO) phenomenon has been neutral, and is expected to slowly tend towards La Niña over the next few months. The sea surface temperature around New Zealand has been mixed, influenced by a warm water pool to the east and north-east, as well as by cold eddies propagating from the Indian Ocean and south of Australia. The sea ice extent around Antarctica has recovered slightly in comparison to what was observed in 2019, but remains below average as of 17 May (full extension seen in white, bottom panel).



Sea surface temperature anomalies on 1st Jan 2020 (left), 31th Mar 2020 (right) and 17th May 2020 (bottom). We can see the equatorial Pacific in a neutral phase in regards to ENSO, with a slight central cooling developing in May. Warmer than normal waters were seen east of New Zealand, especially at the beginning of the year. Source: NOAA/USA.

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

The pressure anomalies over the six month period show two anticyclones (marked as H) and New Zealand in between, dominated by low pressure to the southwest of the country. This pattern contributed to a more frequent north-westerly flow, with variable temperatures on the west coast and warmer temperatures in the Wairarapa. The ridge of high pressure northwest of New Zealand had a marked influence on the North Island, contributing to the severe drought in Northland.



Mean sea level pressure anomaly for Nov to Apr 2019-2020. High pressure anomalies dominated the oceanic areas south-east and north-west of New Zealand, with low pressure anomalies to the south-west. This pattern helped to enhance the westerly flow, creating conditions favouring drought for the north of the North Island.

Source: NOAA (USA).

Another climate driver of interest has been the Indian Ocean Dipole, which has fallen back to normal levels before Christmas, and is now expected to be slightly on the negative side during the winter months. A potentially negative IOD over the coming months may imply a normal or above normal winter rainfall pattern on the west coast, even though the statistical significance is very low.

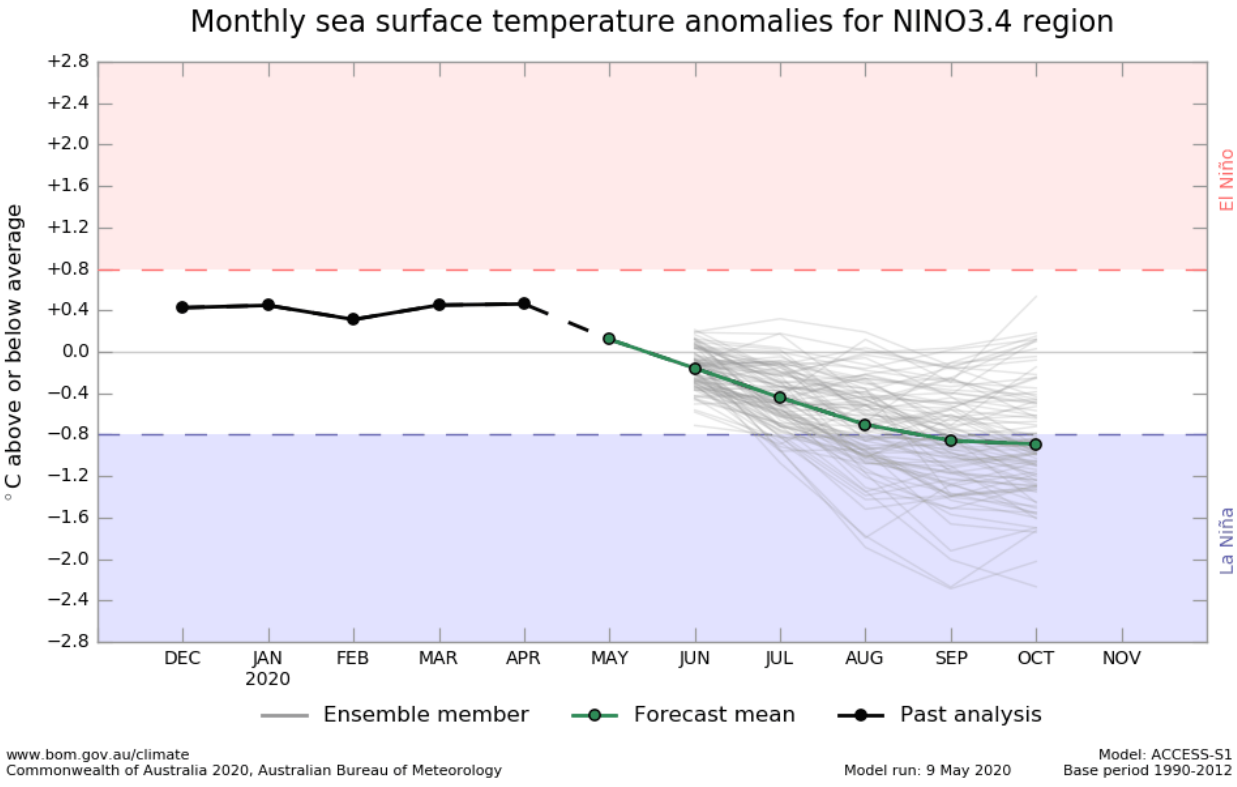
Seasonal climate outlook update

The ENSO phenomenon is expected to remain borderline between neutral and La Niña until spring, while the IOD is expected to be borderline between normal and negative. The waters around New Zealand have been warmer than normal towards the east and northeast of the country. These modes combined tend to suggest higher chances of normal to above normal rainfall on the west coast during winter, with drier conditions over the Wairarapa.

The following points summarise the expected pattern over the next three months:

- ENSO phenomenon likely remaining neutral or borderline La Niña during the winter season;
- Mixed rainfall anomalies, likely wetter on the west coast and drier in the Wairarapa, with high chance of extreme rainfall events (low confidence for rainfall totals);
- Warmer than average Sea Surface Temperature likely east of New Zealand;
- Warmer than average daytime temperatures to persist, especially in the Wairarapa;
- Predominant winds from the northerly quadrant, with occasional strong southerly events and frosts, but unlikely to be too prolonged;
- Westerly flow regime likely to continue for the west coast, but in between long anticyclonic periods dominating the region.

The full climate outlook for winter and early spring will be released with our next seasonal briefing for autumn, to be released by the end of June.



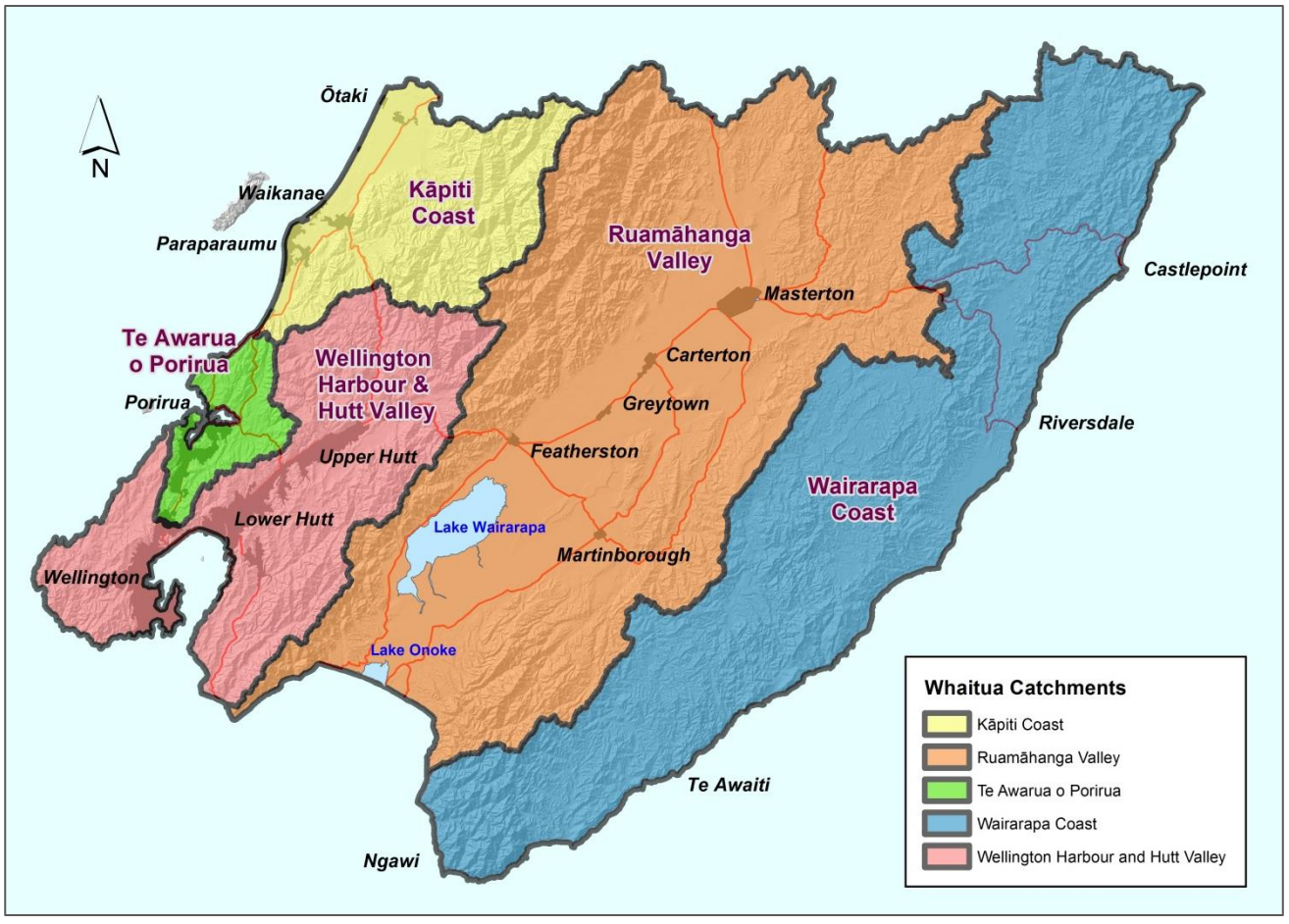
ENSO predictions as of 9 May 2020, showing that the ENSO phenomenon has been neutral, and is expected to tend towards La Niña over the next few months. *Source: BOM (Australia)*

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:

- 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/

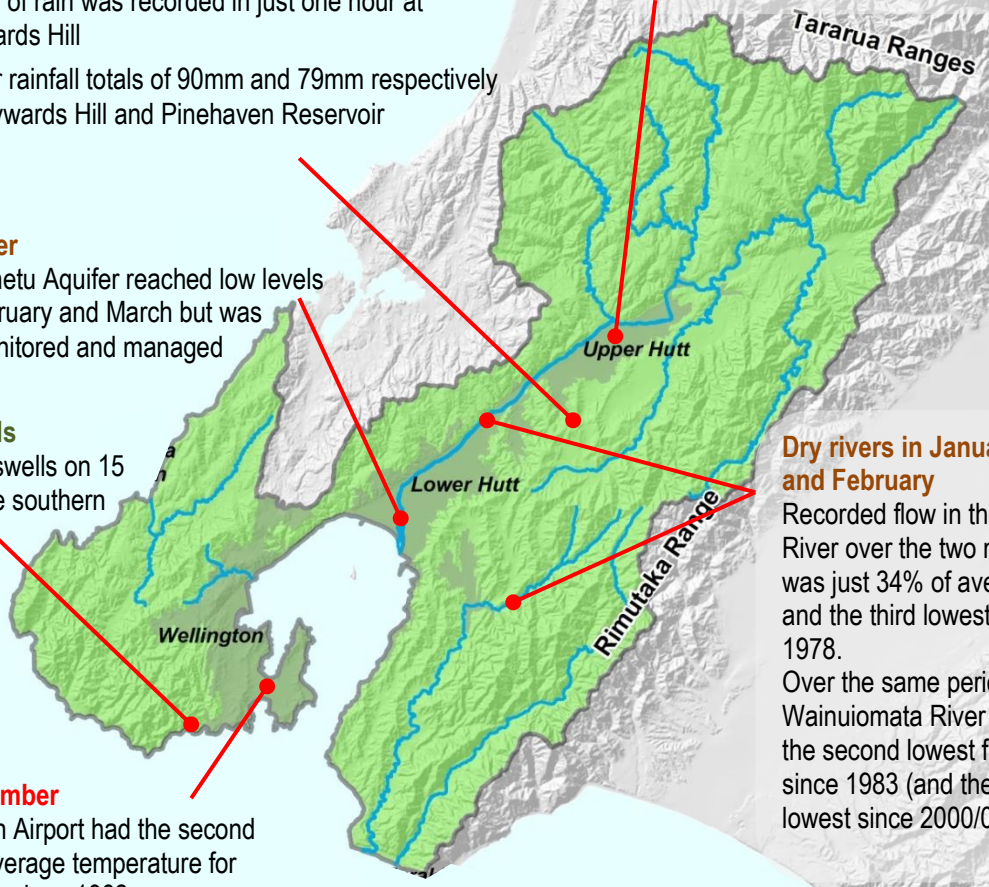
Wellington Harbour and Hutt Valley climate summary

- **Total rainfall was near average, but extremely variable on a month to month basis**
- **Drought affecting the region during late summer followed by a deluge in late March**
- **Temperatures have been average to above**
- **Vigorous westerly flow, making it feel cool**

Torrential rainfall
On 8th December a band of intense rain band brought a deluge to the Hutt valley.

- 42mm of rain was recorded in just one hour at Haywards Hill
- 6 hour rainfall totals of 90mm and 79mm respectively at Haywards Hill and Pinehaven Reservoir

Hot February
Upper Hutt had the third highest average temperature, since 1939



Low aquifer
The Waiwhetu Aquifer reached low levels during February and March but was closely monitored and managed

High swells
5.5 metre swells on 15 April on the southern coast

Dry rivers in January and February
Recorded flow in the Hutt River over the two months was just 34% of average and the third lowest since 1978.
Over the same period the Wainuiomata River had the second lowest flow since 1983 (and the lowest since 2000/01)

Hot November
Wellington Airport had the second highest average temperature for November since 1962.

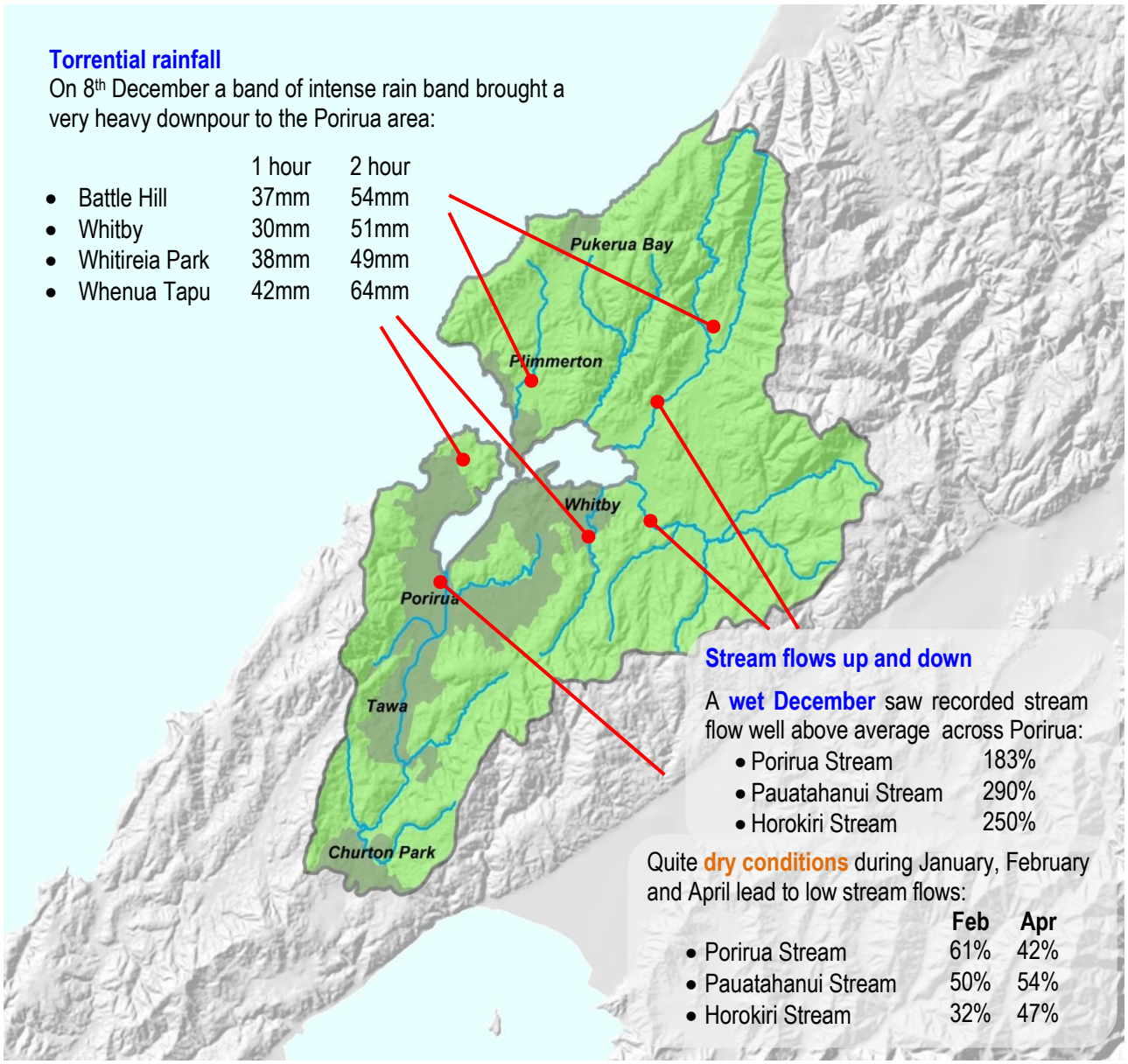
Kelburn had the highest average minimum (nighttime) temperature on record (since 1927), and the second highest on record maximum (daytime) average

Want to look at the summary tables and graphs?

- Rainfall
- River flows

Te Awarua-o-Porirua climate summary

- **Total rainfall was near average, but extremely variable on a month to month basis**
- **Drought affecting the region during late summer followed by a deluge in late March**
- **Temperatures have been average to above**
- **Vigorous westerly flow, making it feel cool**

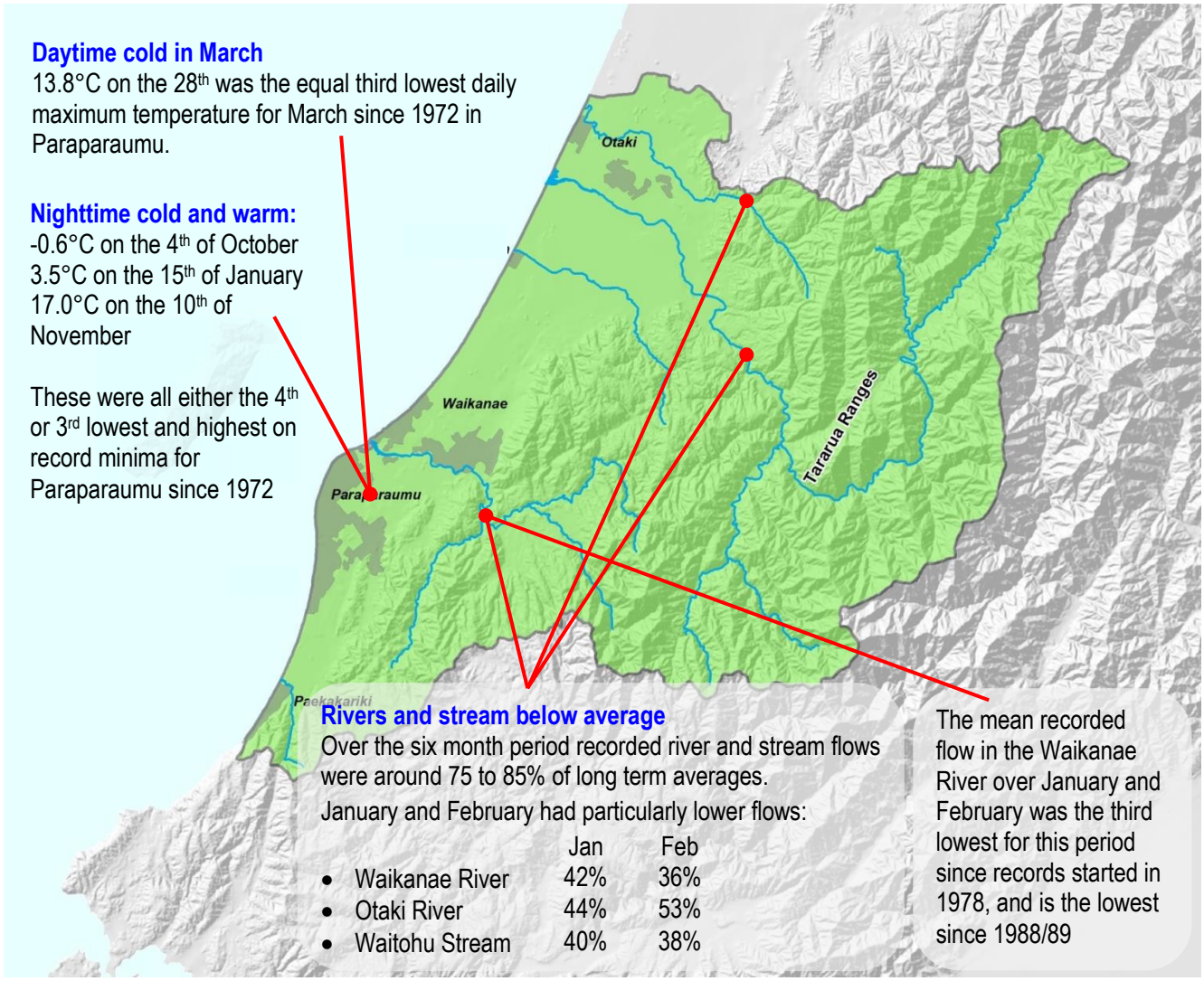


Want to look at the summary tables and graphs?

- Rainfall
- River flows

Kāpiti Coast climate summary

- **Total rainfall was near average, but extremely variable on a month to month basis**
- **Drought affecting the region during late summer followed by a deluge in late March**
- **Temperatures have been average to above**
- **Vigorous westerly flow, making it feel cool**

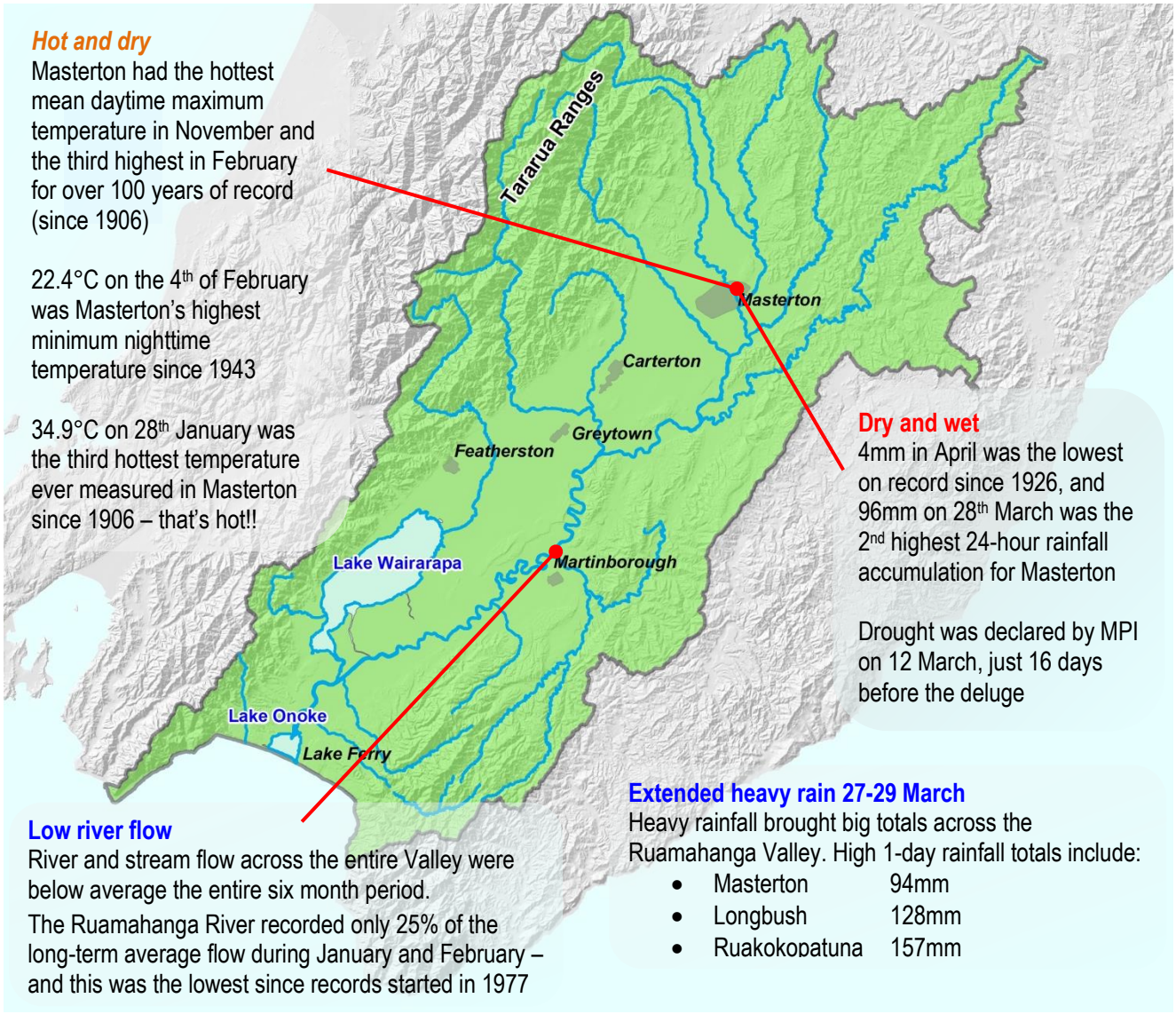


Want to look at the summary tables and graphs?

- Rainfall
- River flows

Ruamāhanga Valley climate summary

- **Below average rainfall**
- **Drought affecting the region followed by a deluge in late March**
- **Temperatures have been well above average**
- **Vigorous westerly flow enhancing the dryness**



Hot and dry

Masterton had the hottest mean daytime maximum temperature in November and the third highest in February for over 100 years of record (since 1906)

22.4°C on the 4th of February was Masterton's highest minimum nighttime temperature since 1943

34.9°C on 28th January was the third hottest temperature ever measured in Masterton since 1906 – that's hot!!

Dry and wet

4mm in April was the lowest on record since 1926, and 96mm on 28th March was the 2nd highest 24-hour rainfall accumulation for Masterton

Drought was declared by MPI on 12 March, just 16 days before the deluge

Low river flow

River and stream flow across the entire Valley were below average the entire six month period.

The Ruamahanga River recorded only 25% of the long-term average flow during January and February – and this was the lowest since records started in 1977

Extended heavy rain 27-29 March

Heavy rainfall brought big totals across the Ruamahanga Valley. High 1-day rainfall totals include:

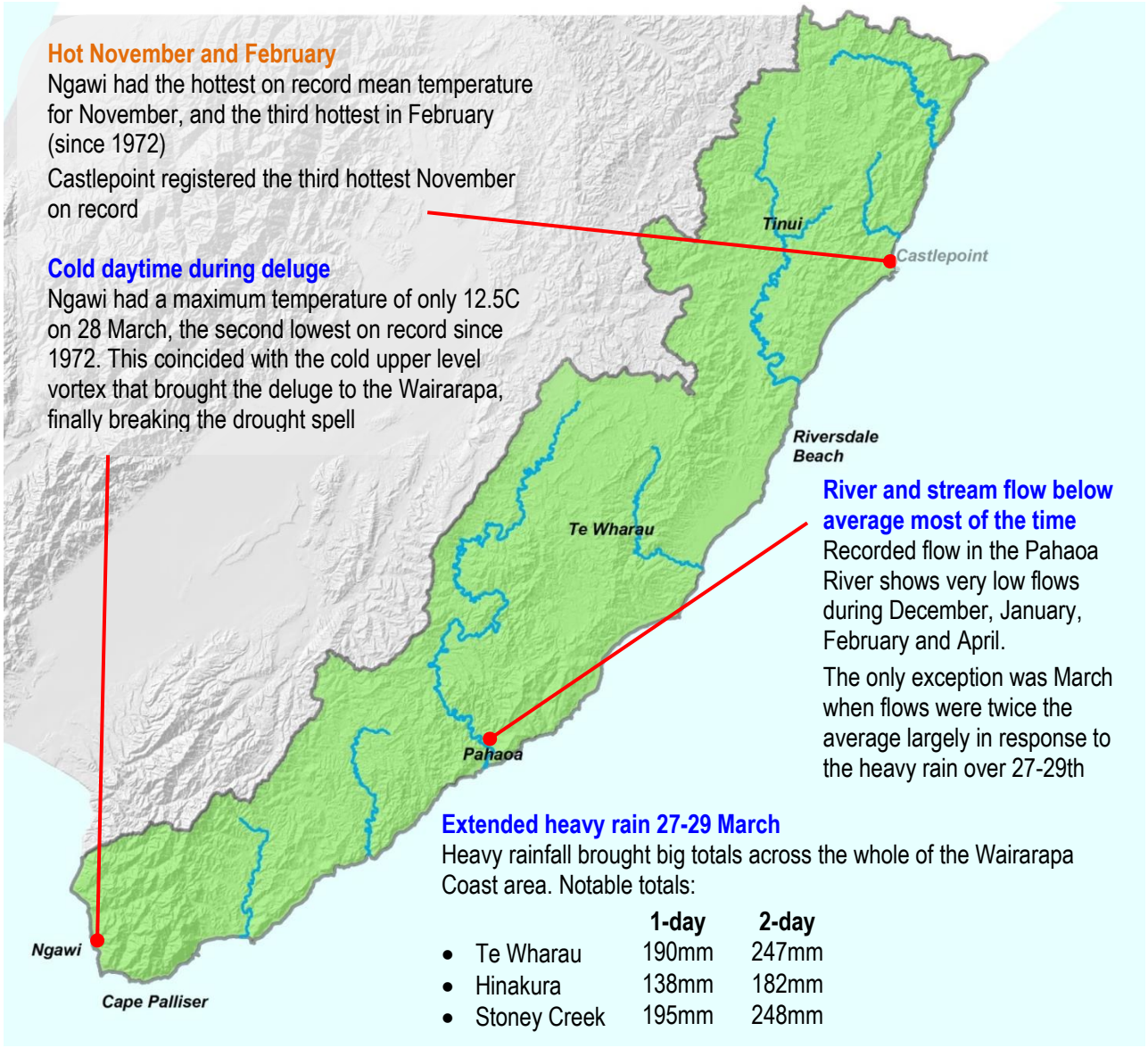
- Masterton 94mm
- Longbush 128mm
- Ruakokopatuna 157mm

Want to look at the summary tables and graphs?

- Rainfall
- River flows

Wairarapa Coast climate summary

- **Below average rainfall**
- **Drought affecting the region followed by a deluge in late March**
- **Temperatures have been well above average**
- **Vigorous westerly flow enhancing the dryness**



Want to look at the summary tables and graphs?

- Rainfall
- Soil moisture

Rainfall statistics

Rainfall was variable over individual six months in the November to April, but ended near average for the Wellington, Hutt Valley, Porirua and Kapiti areas and below average in the Ruāmahanga and Wairarapa Coast areas.

Whaitua	Location	Nov %	Dec %	Jan %	Feb %	Mar %	Apr %	Nov-Apr (mm)	Nov-Apr %
Wellington Harbour & Hutt Valley Click to see cumulative rainfall plots	Kaitoke	88	153	19	72	121	54	964	88
	Lower Hutt	110	152	29	42	202	36	489	94
	Wainuiomata	77	120	21	52	245	25	735	91
	Karori	113	172	39	67	157	21	518	95
	Wellington	133	220	43	49	163	11	469	90
Te Awarua-o-Porirua Click to see cumulative rainfall plots	Battle Hill	128	211	52	74	115	43	553	104
	Whenua Tapu	96	248	33	39	122	44	445	99
	Tawa	104	187	32	68	152	33	411	100
Kāpiti Coast Click to see cumulative rainfall plots	Otaki	102	117	64	63	142	58	457	90
	Waikanae	85	103	57	39	134	40	553	77
	Paekakariki	144	189	68	85	149	42	429	115
	Tararua (Otaki headwaters)	81	84	53	84	142	75	2294	86
Ruamāhanga Click to see cumulative rainfall plots	Masterton	72	97	24	17	240	13	374	80
	Featherston	57	118	19	67	163	30	426	78
	Longbush	78	80	30	48	355	8	373	98
	Tararua (Waiohine headwaters)	96	83	38	65	97	76	1919	78
Wairarapa Coast Click to see cumulative rainfall plots	Tanawa Hut	35	91	52	15	161	20	503	66
	Ngaumu	56	65	32	14	239	9	300	72

Click the following links to return to climate summaries for:

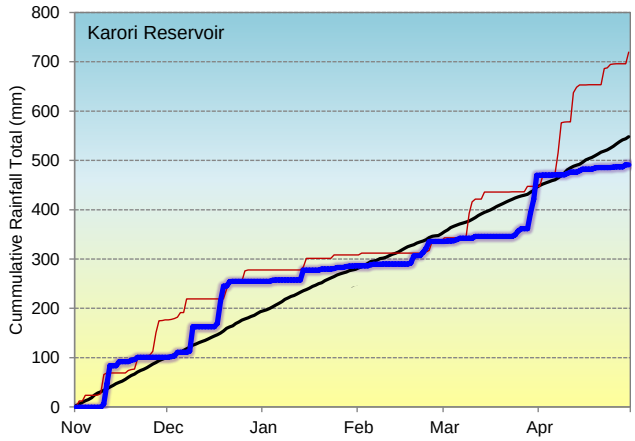
- Wellington Harbour & Hutt Valley
- Te Awarua-o-Porirua
- Kāpiti Coast
- Ruamāhanga
- Wairarapa Coast

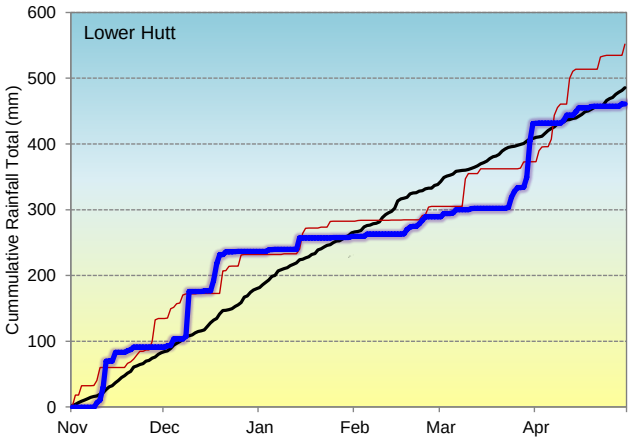
Cumulative rainfall plots

Cumulative rainfall totals for the November to April 2020 period are detailed for various rain gauges sites across the regional whaitua areas, as denoted by the blue trace on the following plots. The November to April 2019 period is denoted by the red trace and the black trace represents the long-term average rainfall accumulation.

Wellington and Hutt Valley

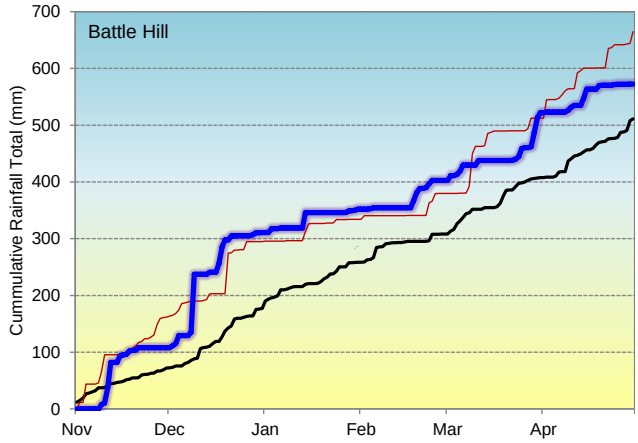
The plots highlight that the rainfall accumulation during the November to April period was about average in Wellington and below average in the Hutt Valley.

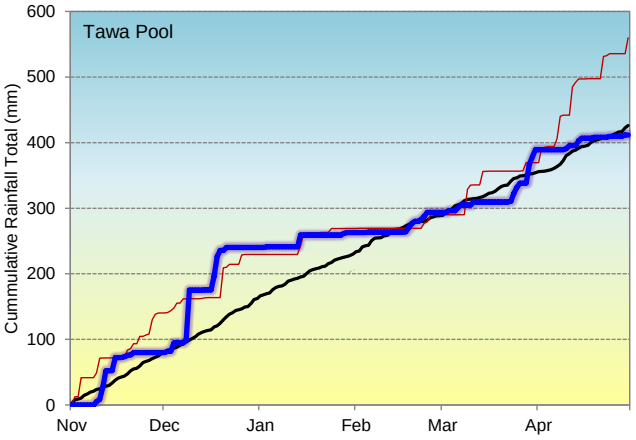




Porirua Harbour

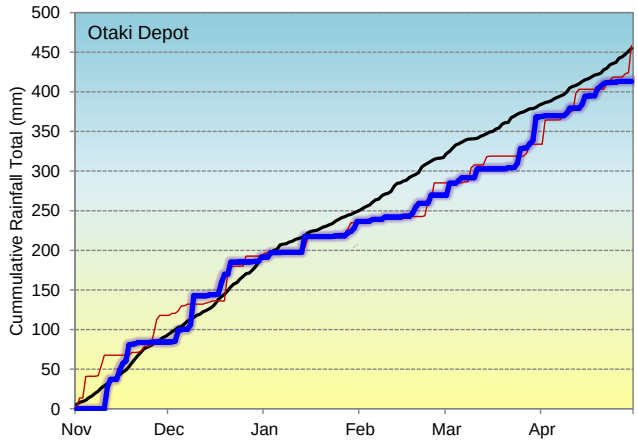
The plots show that the rainfall accumulation evolution over the November to April period at the two sites within the Te Awarua-o-Porirua whaitua area. A large increase during December put the accumulation well above average but drier conditions through January and February brought it back close to normal.

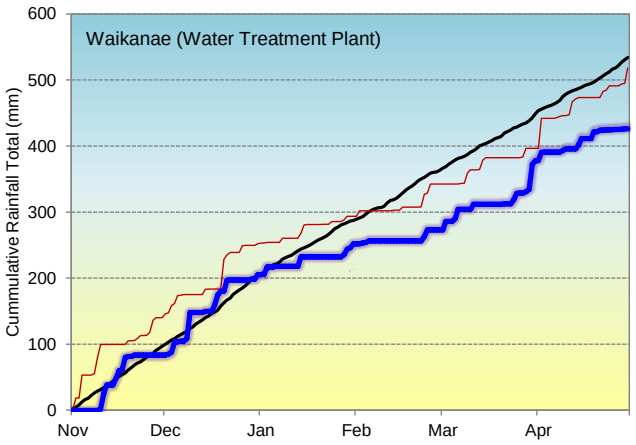




Kāpiti Coast

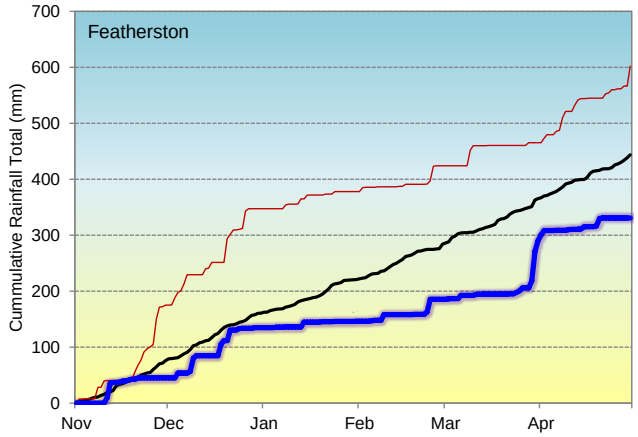
Rainfall recorded at Otaki tracked near to the average throughout the November to April period while Waikanae fell below normal from late January onward.

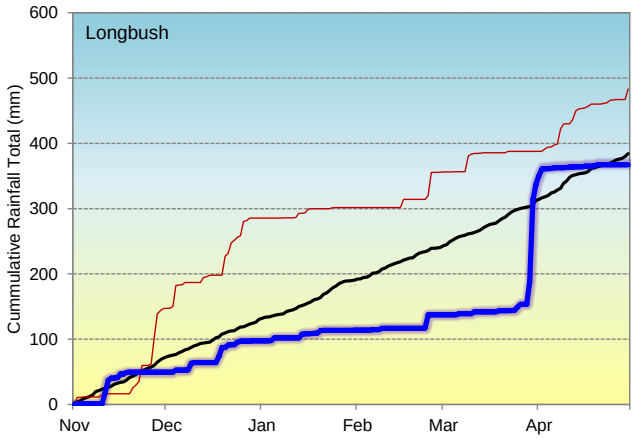




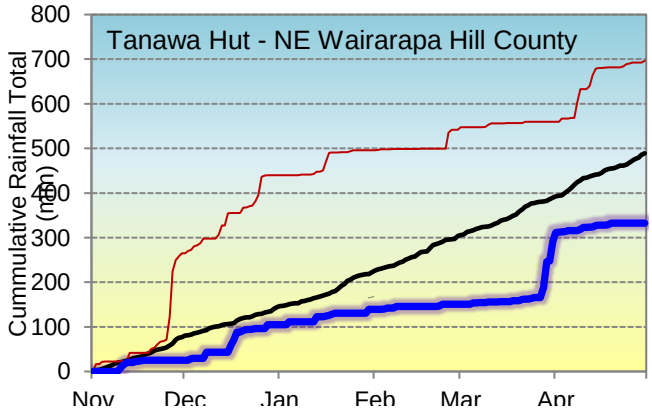
Ruamāhanga

Rainfall accumulation at these two locations shows clearly the effect of the very dry conditions from late December to late March.





Wairarapa Coast



The Tanawa Hut rain gauge in the Wairarapa Coast area showed a similar rainfall accumulation trend to the Longbush gauge (above), but finished the period with a well below average total.

River flows - averages

The average river flows over the entire November to April period were below average across much of the region. Flows in the Ruāmahanga Valley were as low as 30 to 60% of normal over the 6 month period. January and February saw very low flow conditions everywhere.

		Flow as a percentage of average						
Whaitua	**River**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**Nov-Apr**
Wellington Harbour & Hutt Valley	Hutt River - Kaitoke	88	101	31	37	112	59	74
	Hutt River - Taita Gorge	84	102	35	34	90	47	69
	Akatarawa River	95	101	38	47	84	62	75
	Mangaroa River	82	112	28	27	96	28	66
	Waiwhetu Stream	105	162	49	30	94	39	82
	Wainuiomata River	82	115	41	37	144	58	81
Te Awarua-o-Porirua	Porirua	96	187	71	60	115	50	99
	Pauatahanui	131	299	75	50	97	54	129
	Horokiri	96	244	71	34	66	45	95
Kāpiti Coast	Waitohu	126	60	41	48	97	64	78
	Otaki	103	59	45	64	117	87	78
	Mangaone	84	59	90	79	154	132	89
	Waikanae	122	105	39	36	89	63	80
Ruamāhanga	Kopuaranga	42	47	28	16	59	34	37
	Waingawa	78	70	24	31	50	63	56
	Waiohine	82	70	29	37	80	69	64
	Mangatarere	44	60	19	11	57	39	40
	Tauherenikau	75	81	21	26	104	71	66
	Otukura	71	55	21	5	61	104	57
	Ruamāhanga	74	65	25	25	61	60	55
Wairarapa Coast	Pahaoa	32	13	4	1	225	62	79

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- Wairarapa Coast

River flows – lowest

Minimum river and stream flows recorded during the November to April 2020 period.

Whaitua	River	Minimum Flow		
		Flow (m^3/s)	Date	Comment
Wellington Harbour & Hutt Valley	Hutt (Kaitoke)	0.895	15-Mar	*4th lowest on record (from 1968)*
	Hutt (Taita Gorge)	3.13	10-Feb	
	Akatarawa	1.092	8-Feb	*102% of average low flow*
	Mangaroa	0.351	17-Mar	
	Wainuiomata	0.143	10-Mar	
Te Awarua-o-Porirua	Porirua	0.137	14-Mar	
	Pauatahanui	0.114	14-Mar	
	Horokiri	0.089	16-Mar	
Kāpiti Coast	Waitohu	0.106	22-Apr	
	Otaki	5.477	10-Feb	*107% of average low flow*
	Mangaone	0.207	3-Nov	*29% of average low flow*
	Waikanae	1.084	15-Mar	
Ruamāhanga	Kopuaranga	0.228	26-Feb	*Approx. a 1 in 5-year low flow*
	Waingawa	0.91	13-Mar	
	Waiohine	2.68	10-Feb	
	Mangatarere	0.063	14-Mar	*38% of average low flow*
	Tauherenikau	0.619	27-Jan	*47% of average low flow*
	Otukura	0.004	13-Feb	*6% of average low flow*
	Ruamāhanga (Upper)	1.699	14-Mar	*Approx.. a 1 in 10-year low flow*
	Ruamāhanga (Lower)	5.169	14-Mar	*Approx.. a 1 in 20-year low flow*
Wairarapa Coast	Pahaoa	0.006	10-Mar	*Approx.. a 1 in 15-year low flow*

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

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River flows – highest

Maximum river and stream flows recorded during the November to April 2020. 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)	201	20 December	1
	Hutt(Taita Gorge)	465	8 December	1
	Akatarawa	164	8 December	1
	Mangaroa	62	8 December	1
	Waiwhetu	12	8 December	2
	Wainuiomata	31	8 December	2
Te Awarua-o-Porirua	Porirua	29	8 December	1
	Pauatahanui	78	8 December	20
	Horokiri	19	8 December	1
Kāpiti Coast	Otaki	524	20 December	1
	Mangaone	5	15 November	1
	Waikanae	80	8 December	1
Ruamāhanga	Kopuaranga	6	29 March	1
	Waingawa	251	20 December	1
	Waiohine	714	20 December	1
	Mangatarere	29	20 December	1
	Tauherenikau	238	20 December	1
	Otukura	2	28 March	1
	Ruamāhanga (Upper)	371	20 December	1
	Ruamāhanga (Lower)	647	20 December	1
Wairarapa Coast	Pahaoa	384	29 March	1

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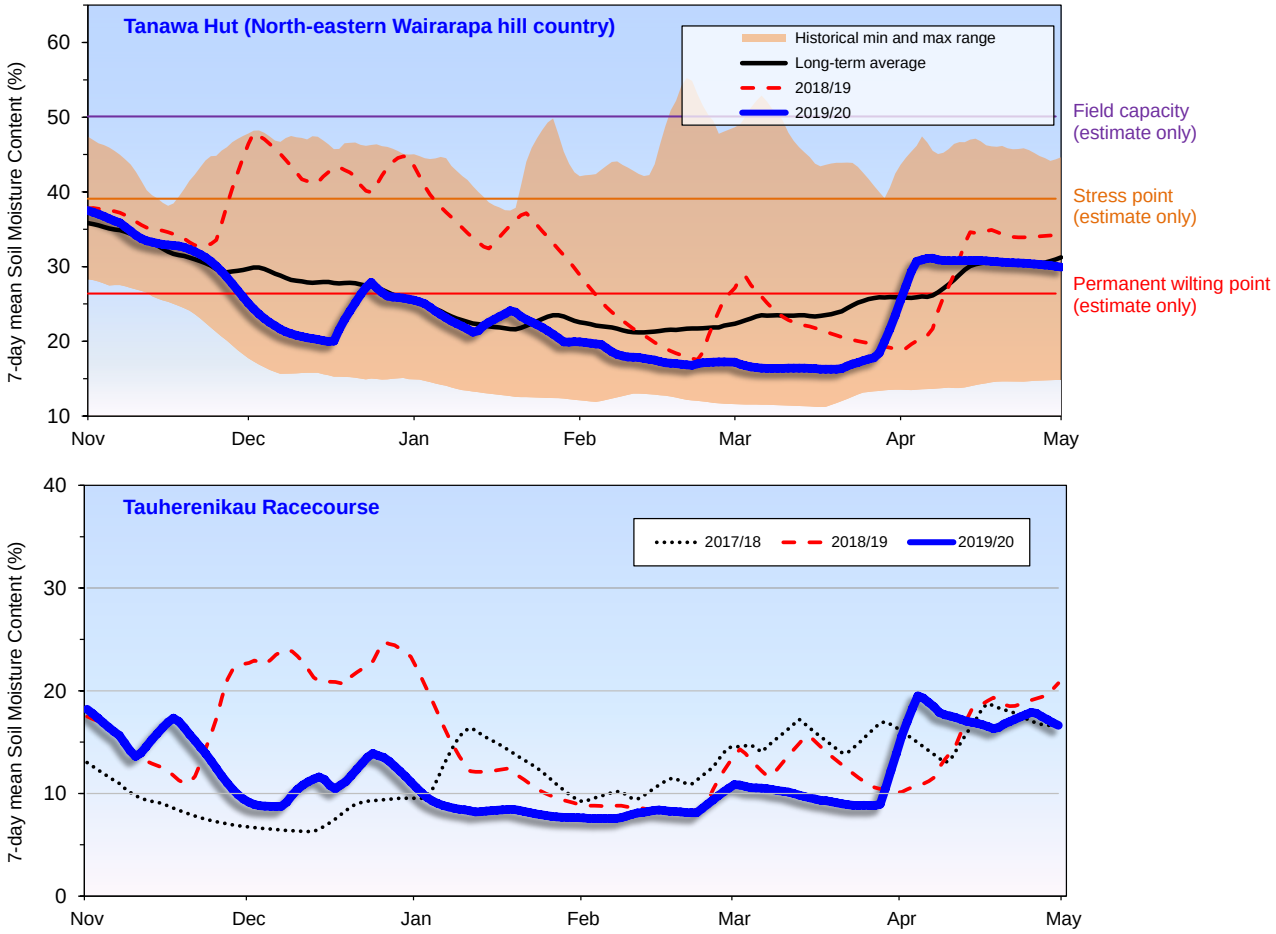
Soil moisture content

Wairarapa Coast

November 2019 to April 2020 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 started to dip below average in late November before recovering only to fall well below normal through February and March.



Drought monitoring

GWRC maintains a drought check webpage with regional anomaly maps and links to live data across the region:

http://www.gwrc.govt.nz/drought-check/

Climate Briefings

Additionally to the extended water resources reports, the Environmental Science department, GWRC, also produces seasonal updates specifically targeting the farming community. Those can be accessed from the main Climate and Water Resource webpage:

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

Environmental data

GWRC maintains a comprehensive online environmental data server providing real time data across the region for several climatic and hydrological variables

http://graphs.gw.govt.nz

Interactive Climate Change Mapping

The Environmental Science department at GWRC has produced one of the first comprehensive climate change mapping tools publicly available in New Zealand. The online mapping tool is fully interactive and easy to understand, allowing users to plot over twenty different variables, projected over every available IPCC scenario for both mid and late century

https://mapping1.gw.govt.nz/gw/ClimateChange/

Sea level Rise Mapper (New)

The Environmental Science department at GWRC is also making available a comprehensive sea level rise (SLR) mapper for the whole region. The tool allows users to have a view of sea level rise impacts, for values between zero and 5m SLR, including the effects of storm surge for selected heights. We encourage community and stakeholders to use this tool as a first screening of likely impacts that the region will be dealing with, as sea levels continue to rise.

https://mapping1.gw.govt.nz/GW/SLR/

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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