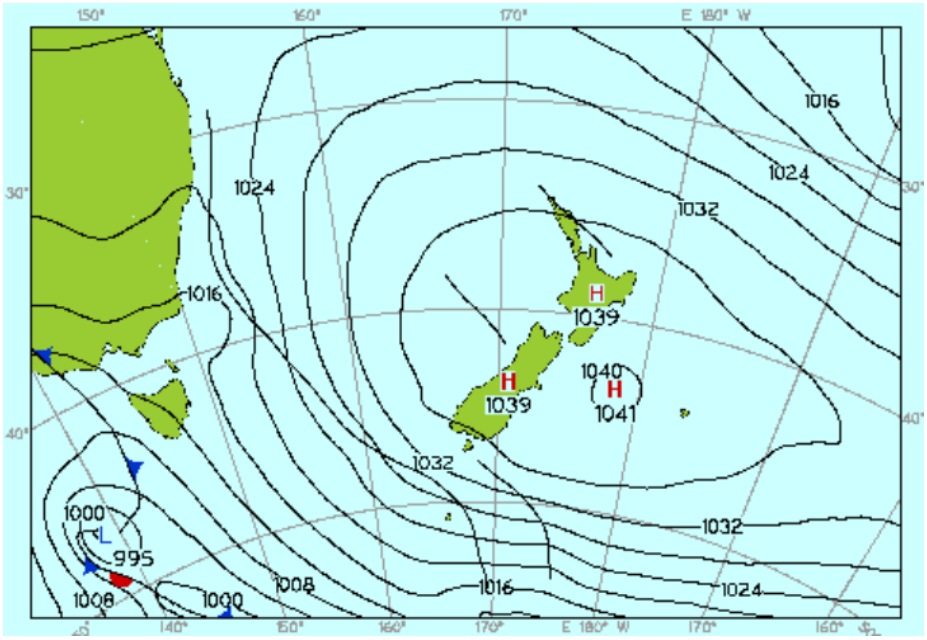
Greater Wellington
Te Pane Matua Taiao

Climate and Water Resources Summary for the Wellington Region

Cold Season (May to October) 2021

Release date: 30 November 2021



Synoptic chart for 2 July 2021 at 12pm, depicting a very large and strong area of high pressure firmly setting over the country. Severe frosts, including the damaging 'black frosts' (invisible ice) were formed along sheltered places in the Wellington Region. In Masterton, the temperature dropped to almost minus six degrees Celsius at the airport 5 July, which was the third lowest on record since 1906. It is important to highlight that this burst of severe frosts occurred during the hottest winter on record, as reported in our winter 2021 report. This makes the contrast even more remarkable, showing the range of increasing extremes while the background average temperatures continue to increase. 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: November 2020

The cold season from May to October 2021 saw average to above average rainfall totals across the region (100 to 130% of normal) over the entire six month period. However, a closer look into the monthly rainfall patterns shows that there was large variation in the rainfall anomaly between months with July and October being very dry compared to normal, and June and August being very wet.

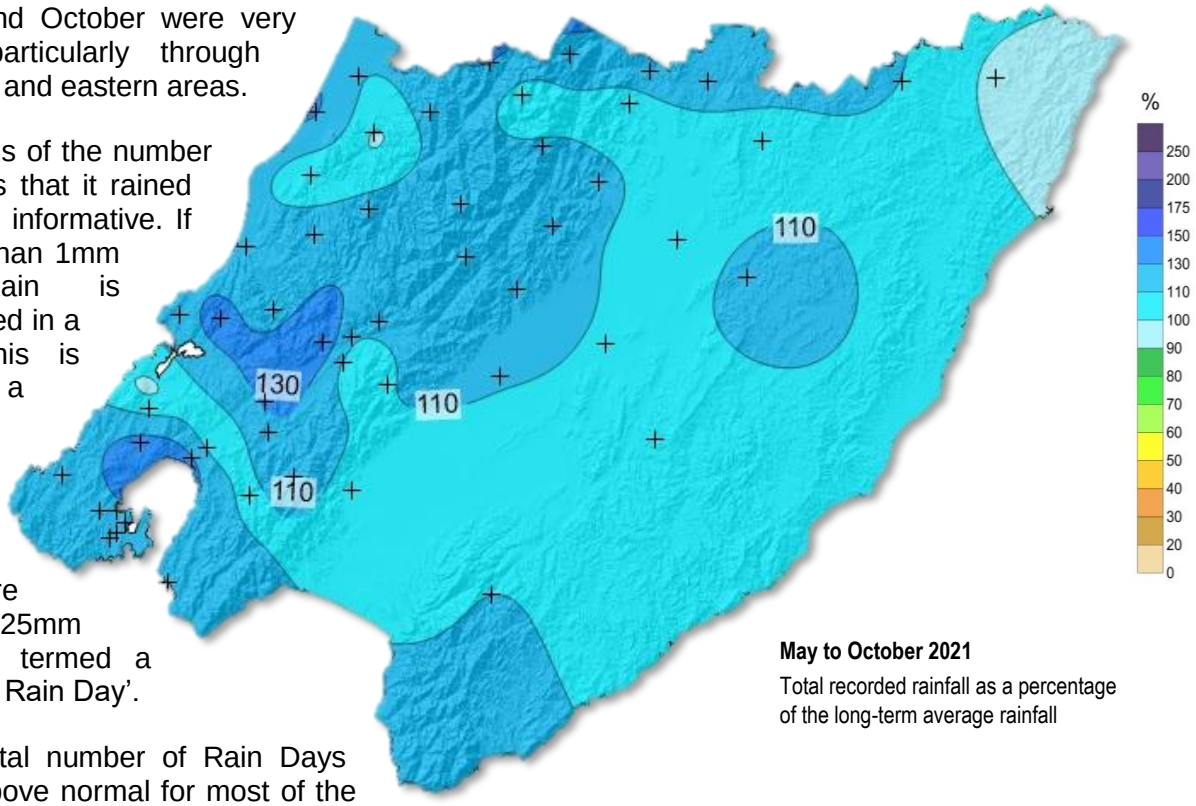
Rainfall (May to October)

The map below shows rainfall recorded during the entire six month period from May to October 2021 as a percentage of the long term average.

The pattern for the six month period is one of largely near average rainfall across the region. The eastern Wairarapa hills received 100 to 110% of normal rainfall totals while the westward Tararua and Remutaka ranges totals were around 100 to 130%.

The close to average six month rainfall anomaly belies the variation seen month to month (see maps on the following page). Two exceptionally wet months, June and August, saw recorded rainfall totals up to 200% of normal. In stark contrast July and October were very dry, particularly through central and eastern areas.

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'.



May to October 2021

Total recorded rainfall as a percentage of the long-term average rainfall

The total number of Rain Days was above normal for most of the region. Also, most areas saw more Heavy Rain Days than normal, reflecting higher-than-average rainfall totals for this period.

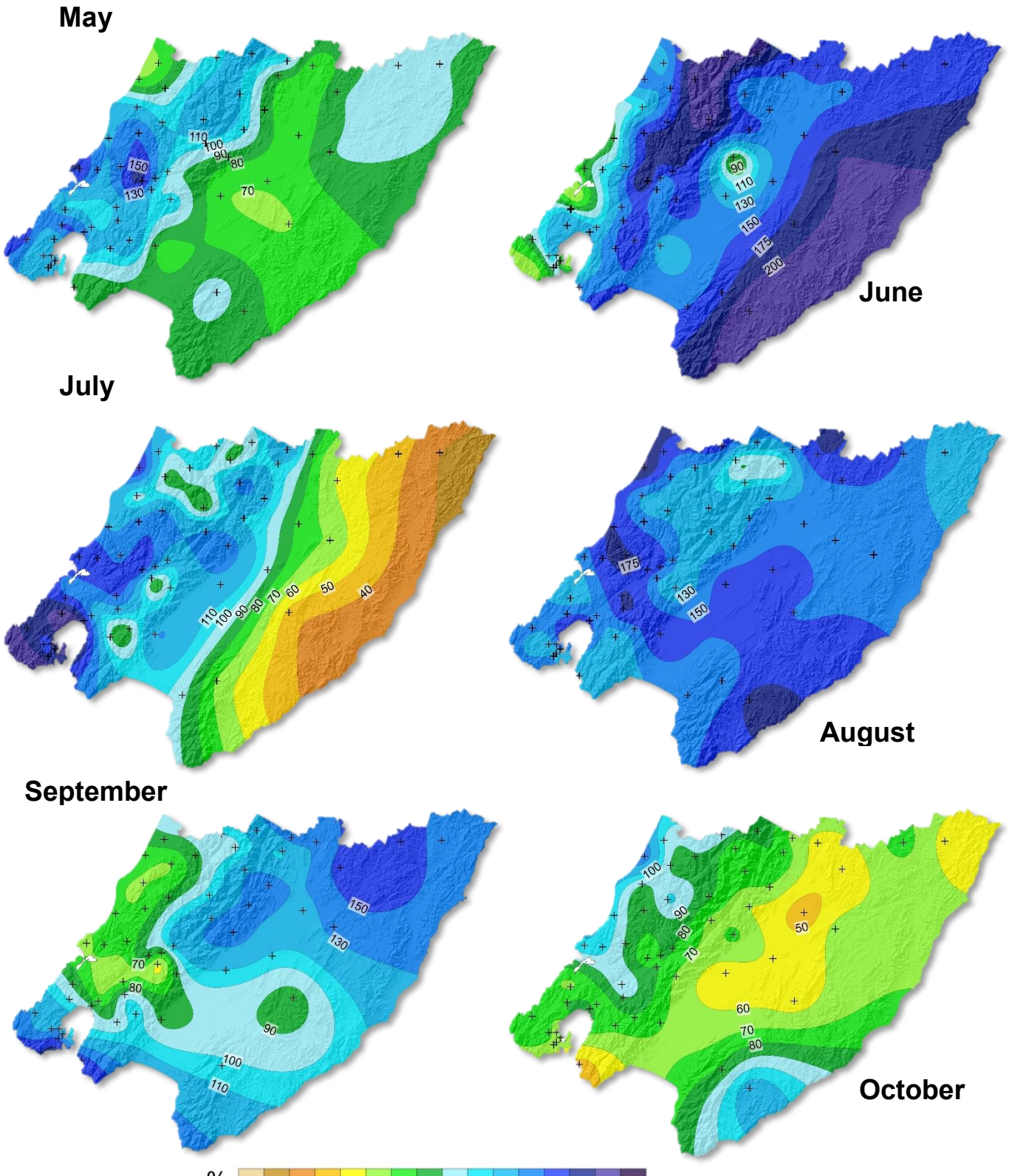
Number of Rain Days and Heavy Rain Days during May to October across the region (long-term average in brackets.)

	Kāpiti Coast		Porirua	Hutt Valley & Wellington		Ruamāhanga		Eastern Wairarapa	
	Lowland	Hills	Lowland	Lowland	Hills	Lowland	Hills	North	South
Rain Days (>1mm)	76 [76]	108 [103]	72 [66]	74 [69]	94 [95]	68 [67]	112 [114]	76 [70]	72 [82]
Heavy Rain Days(>25mm)	4 [4]	29 [24]	9 [5]	9 [6]	17 [13]	4 [3]	38 [34]	5 [7]	6 [4]

Rainfall by the month

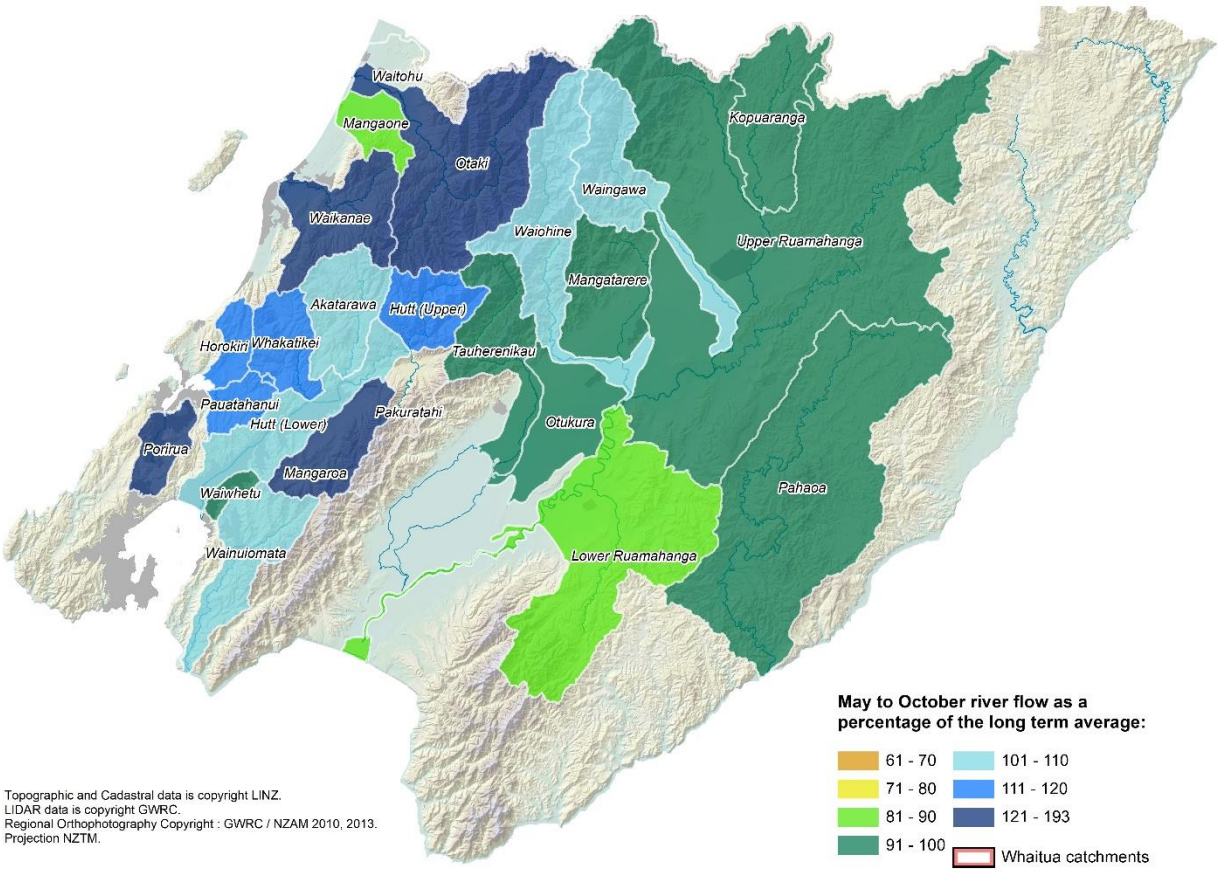
May, July and August rainfall totals were well below average over eastern parts of the region, with other months showing extremes of up to 200% of average rainfall.

The majority of the regional rainfall monitoring stations recorded extreme highs and lows, and ended the six month period with slightly above average rainfall.



River flow

The map below shows mean river and stream flow conditions recorded over the May to October 2021 period, for various monitored catchments, as a percentage of the long-term average flow for the same period.



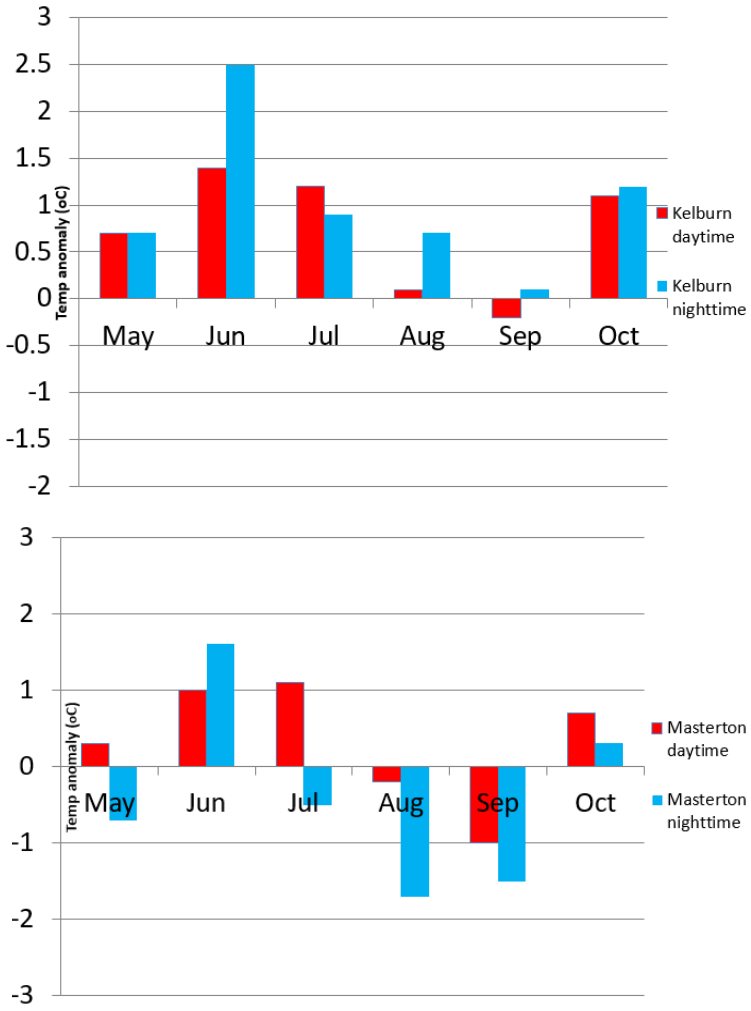
The majority of the region's stream and rivers experienced relatively average flows, with below average to average flows during the six month period apart from catchments draining from the Kāpiti Coast side of the Tararua Range.

Rivers and streams east of the Tararua divide had average flow conditions, whereas those to the west experienced mainly 110-120% above 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 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 cold season was much warmer than normal during the first three months, followed by normal to cooler conditions in August and September (mostly colder in the Wairarapa), and back to warmer than normal temperatures in October. This pattern reflects greater climate variability than normal, considering that winter 2021 was the warmest on record despite severe frosts in the Wairarapa, and unseasonal cold weather in September.



Average daytime and nighttime temperature anomalies for Kelburn (top) and Masterton (bottom) for the cold season period. The first half of the season was the warmest, compared to the climatological averages. Also interesting is that Wellington has been proportionally warmer than the Wairarapa, as a consequence of the easterly flow regime.

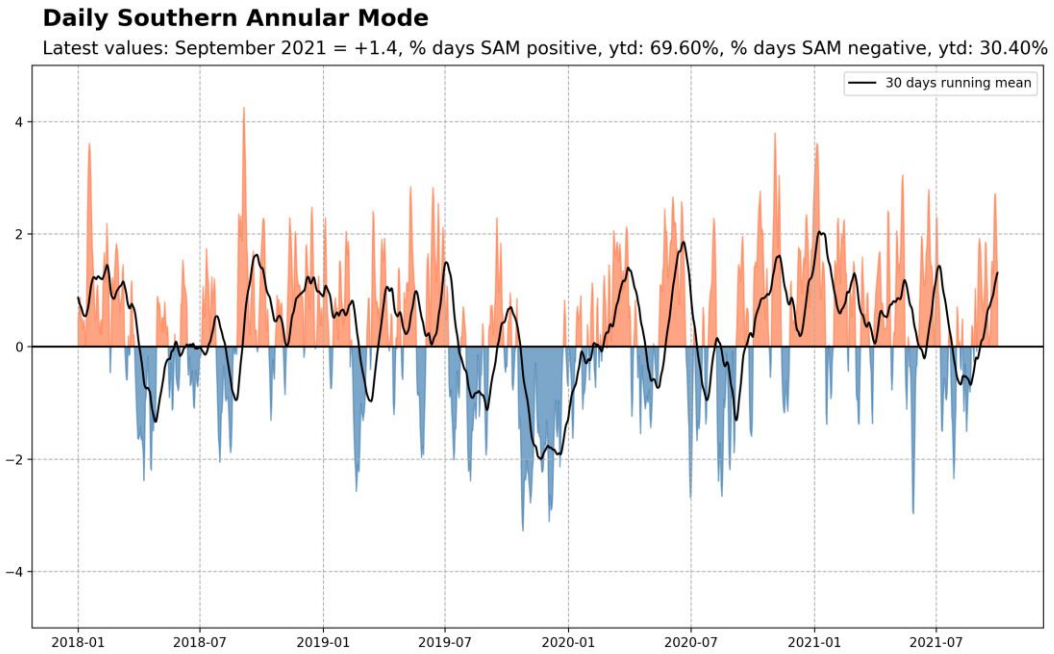
Global climate drivers

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 May to October 2021 are:

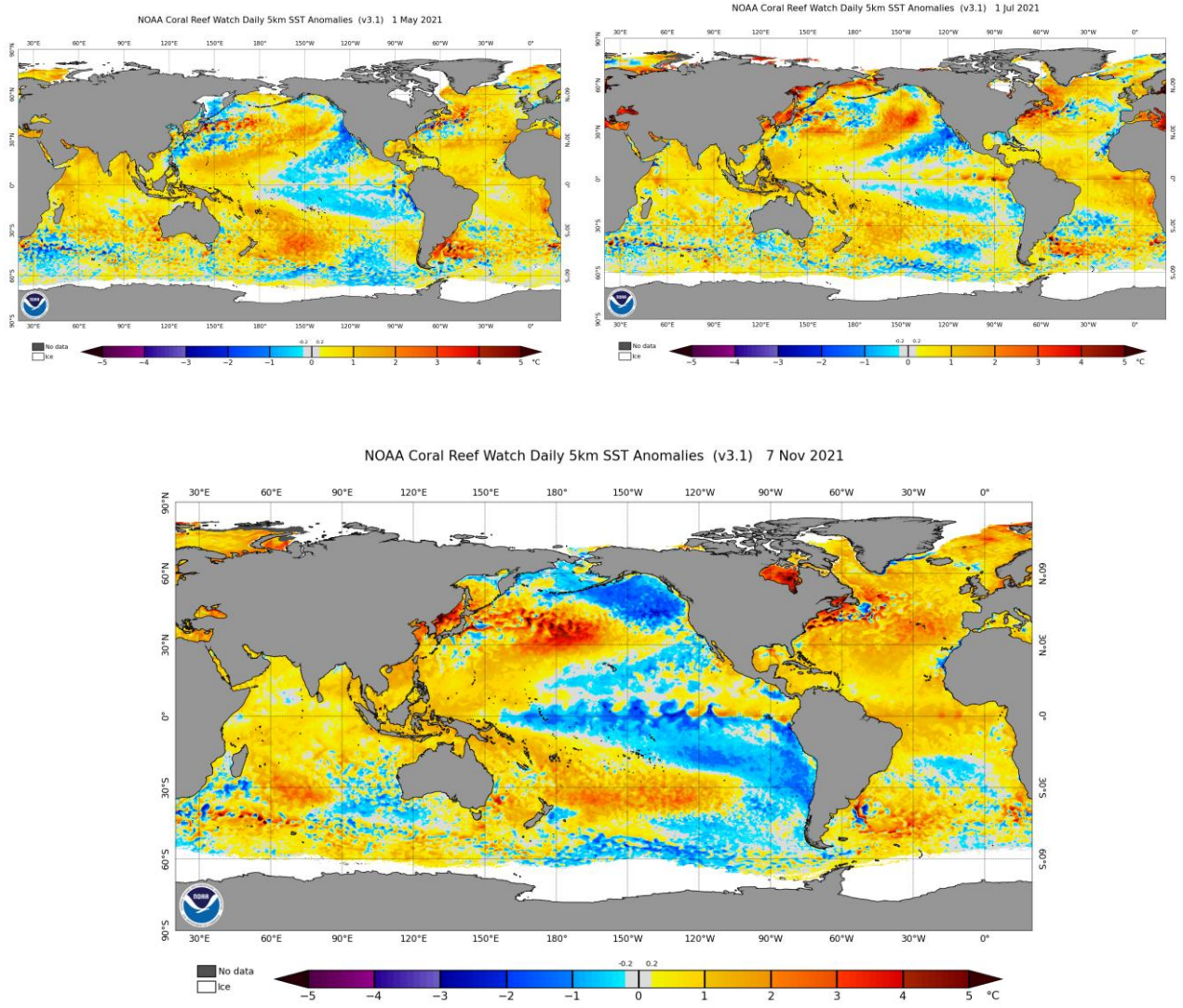
- The six-month period was significantly warmer than normal, more so in Wellington than Masterton, possibly as a result of easterly flow;
- The sea surface temperatures (following page) have warmed considerably around New Zealand into November, as La Niña re-developed in the Equatorial Pacific;
- The Southern Annular Mode (graph below) has been predominantly positive for most of 2021;
- High pressure anomalies dominated the oceanic areas east of New Zealand (page 7), with north-easterly flow and a wet winter overall. A highly alternating flow between easterlies and strong westerly bursts has been observed into spring.



The Southern annular mode (SAM) has been positive for most of this year. Source: https://niwa.co.nz/climate/information-and-resources/southern-annular-mode

Global climate drivers and extreme weather events

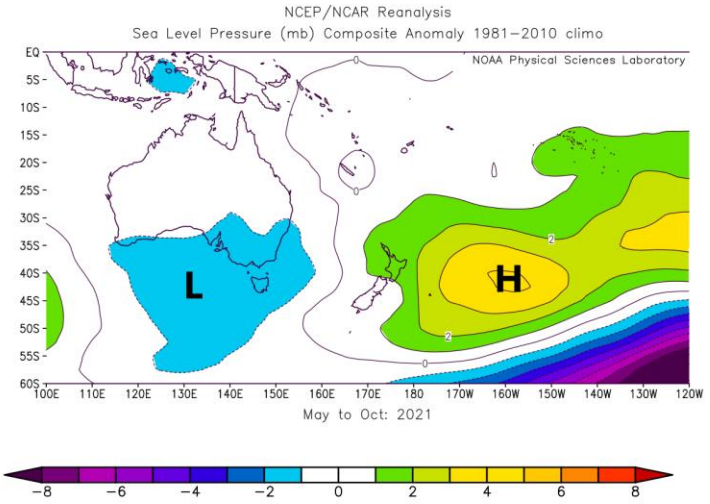
Climate drivers are global mechanisms that can influence the weather in our region. The El Niño/Southern Oscillation[1] (ENSO) phenomenon has now re-shifted towards a negative (La Niña) phase, and is expected to influence the weather patterns over spring and the early summer season. The sea surface temperature around New Zealand has remained mostly warm during the cold season, in response to La Niña. The Indian Ocean Dipole (IOD) has been slightly negative (more favourable to a wet signal in Australia and New Zealand), but is now predicted to become neutral for the remainder of the year. The sea ice extent around Antarctica has been below average, with less coverage than observed last year (full extension seen in white).



Sea surface temperature anomalies on 1 May 2021 (left), 1 July 2021 (right) and 7 November 2021 (bottom). We can see the development of a mature La Niña condition in the Equatorial Pacific (cold blue tongue), with an intensification of the warming around New Zealand apart from a small transient cold blob (bottom image), repeating the conditions observed last year. The sea ice extent (in white) is lower than average, with less sea ice compared to the same time last year. These factors are creating the perfect combination for a hot and humid summer ahead. Source: NOAA/USA.

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

The pressure anomalies over the six month period show an anticyclone to the east of the country (marked as H), and a low to the south of Australia (marked as L). This pattern contributed to the establishment of moist north-easterly flows, expected during La Niñas. The anticyclonic pattern was most pronounced in October and dominated the average, but the month to month variation was high. For example, in September the flow was in fact more El Niño-like, with an anticyclonic flow on the Tasman causing a very strong westerly flow for New Zealand, with some impressive wind gust records in the Wairarapa, and cooler temperatures. In practice, large swings in atmospheric flow have been the keynote of most of the weather patterns this year, following very closely what happened in 2020. However, this year's cold season was wetter than last year's overall. And the warm sea surface temperature (SST) conditions this year seem to be more conducive to a hot summer ahead, compared to last year when a hot summer was predicted but did not eventuate.



Mean sea level pressure anomaly for May to Oct 2021.

High pressure anomalies dominated the oceanic areas east of New Zealand, with an anomalous north-easterly flow bringing warmer temperatures during the cold season, and contributing to moisture transport from the tropics. This led to very significant extreme rainfall events.

Other than ENSO, the Indian Ocean Dipole (IOD) is expected to remain neutral, as noted above, while the Southern Annular Mode (SAM) is expected to remain positive. This suggests that the atmospheric flow over the next few months may be primarily driven by La Niña itself, reinforced by a positive SAM.

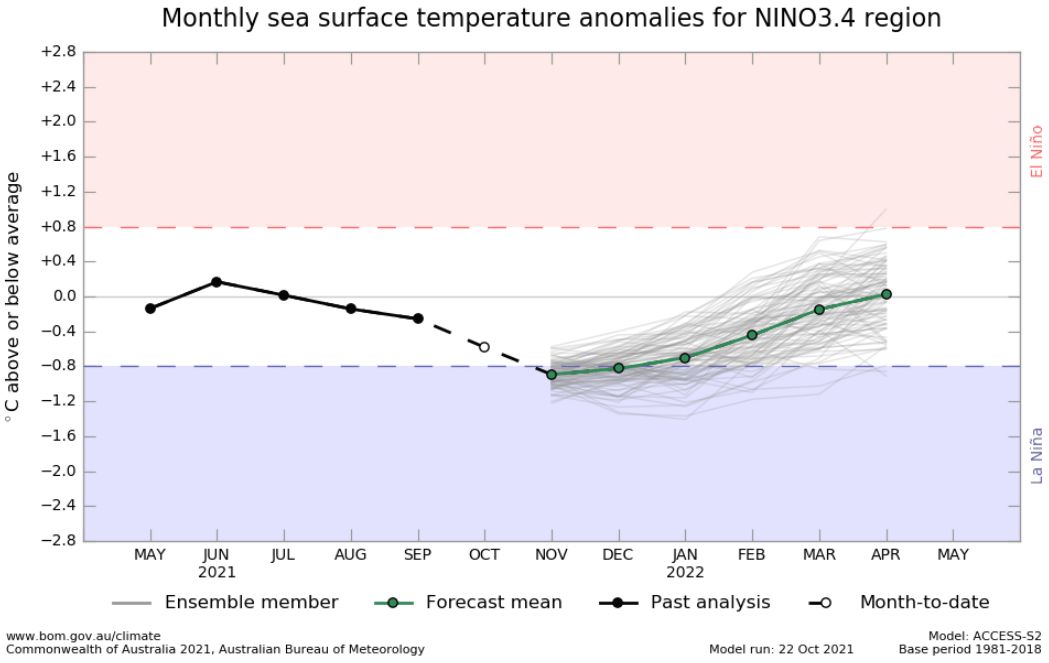
Seasonal climate outlook update

The ENSO phenomenon is expected to remain (borderline) weak La Niña at least until the end of the year, while the Southern Annular Mode is expected to remain mostly positive. The waters around New Zealand have been warmer than normal as expected during La Niñas, with the positive anomalies increasing towards November. La Niña tends to bring increased easterly or north-easterly flows, more humid and hot weather in summer, with thunderstorms inland in the Wairarapa.

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

- La Niña pattern dominating the summer season;
- Mixed rainfall anomalies, possibly drier than average but high chances of heavy easterly rain events and thunderstorms in the Wairarapa (low confidence for seasonal totals);
- Higher than normal risk of the region being affected by an ex Tropical Cyclone, with potential flooding and damaging winds;
- Warmer than average oceanic temperatures;
- Above average temperatures, with large swings between heat waves and cooler weather;
- Predominance of north-easterly flow, but alternating with westerly bursts.

The full climate outlook for summer 2022 will be released with our next seasonal briefing before Christmas.



ENSO predictions as of 22 Oct 2021, showing that the phenomenon is expected to remain borderline between weak La Niña and neutral phase at least until the end of the year. *Source: BOM*

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

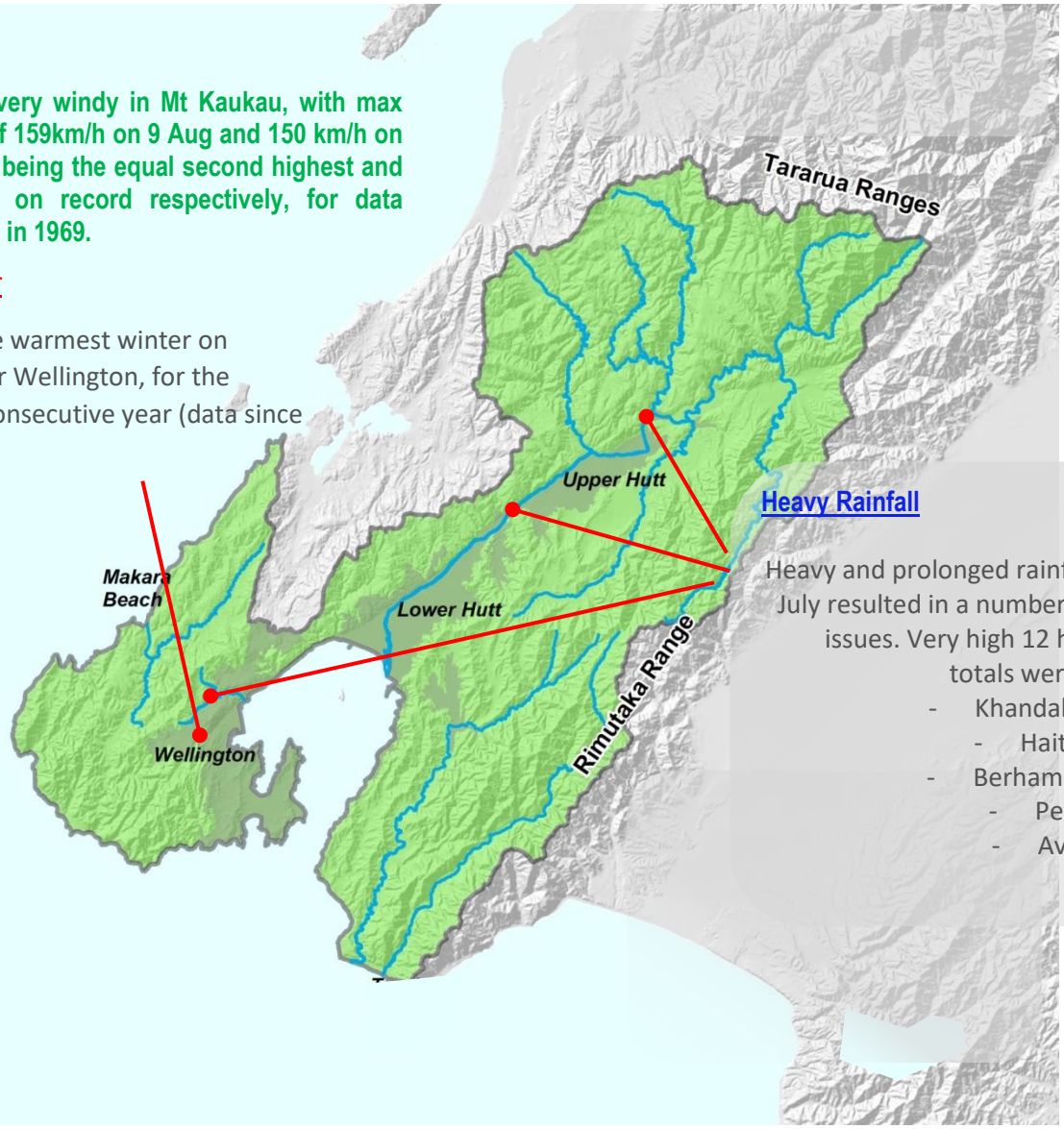
- **Warmer than average**
- **Large swings in flow from westerlies to easterlies**
- **Very wet winter, dry otherwise**

Windy

It was very windy in Mt Kaukau, with max gusts of 159km/h on 9 Aug and 150 km/h on 12 Oct, being the equal second highest and highest on record respectively, for data starting in 1969.

Mild winter

It was the warmest winter on record for Wellington, for the second consecutive year (data since 1927)



Heavy Rainfall

Heavy and prolonged rainfall 16 to 19 July resulted in a number of flooding issues. Very high 12 hour rainfall totals were recorded:

- Khandallah 100mm
- Haitaitai 90mm
- Berhampore 80mm
- Petone 90mm
- Avalon 75mm

Want to look at the summary tables and graphs?

- Rainfall
- River flows

Te Awarua-o-Porirua climate summary

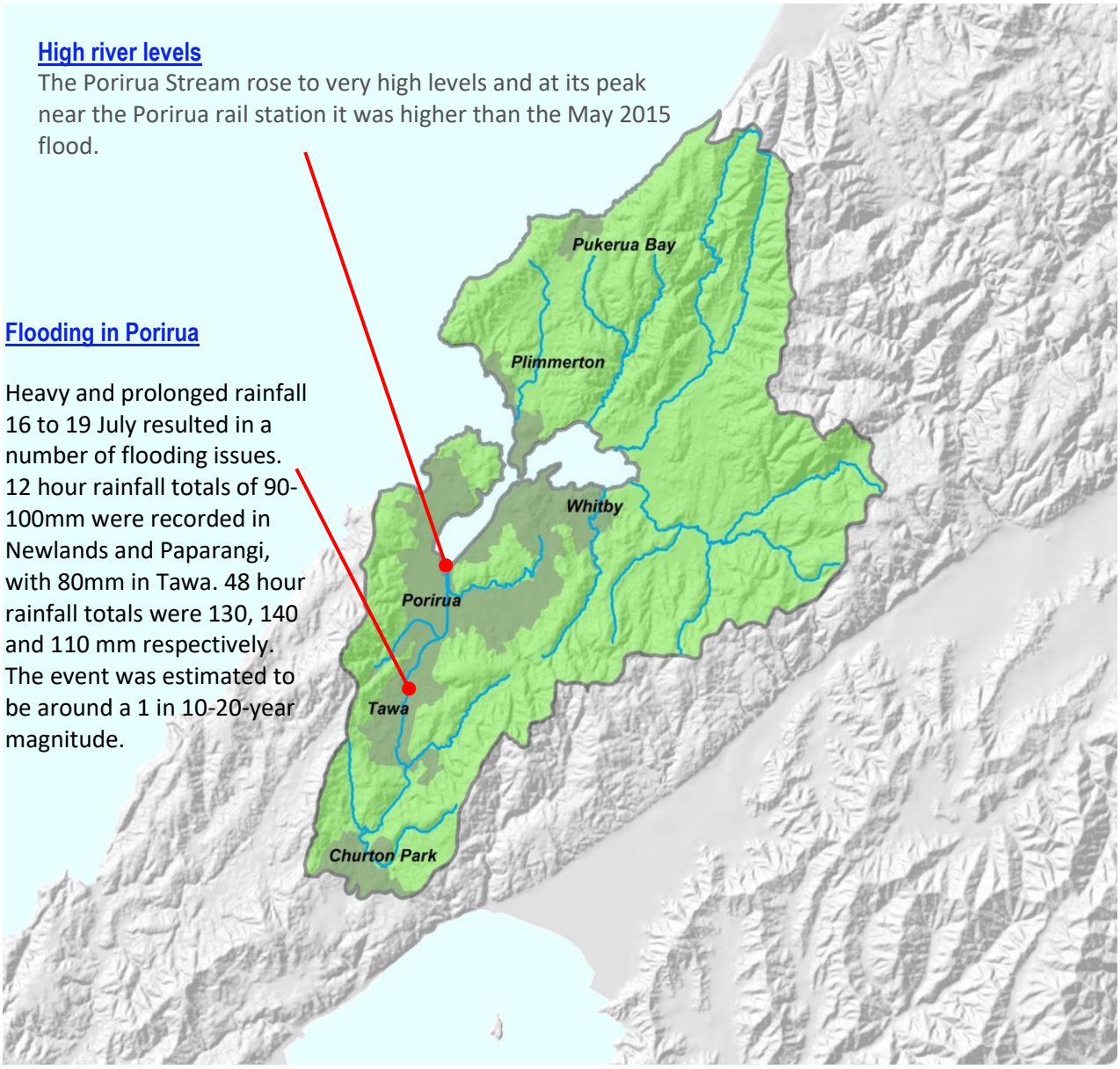
- **Warmer than average**
- **Large swings in flow from westerlies to easterlies**
- **Very wet winter, dry otherwise**

High river levels

The Porirua Stream rose to very high levels and at its peak near the Porirua rail station it was higher than the May 2015 flood.

Flooding in Porirua

Heavy and prolonged rainfall 16 to 19 July resulted in a number of flooding issues. 12 hour rainfall totals of 90-100mm were recorded in Newlands and Paparangi, with 80mm in Tawa. 48 hour rainfall totals were 130, 140 and 110 mm respectively. The event was estimated to be around a 1 in 10-20-year magnitude.

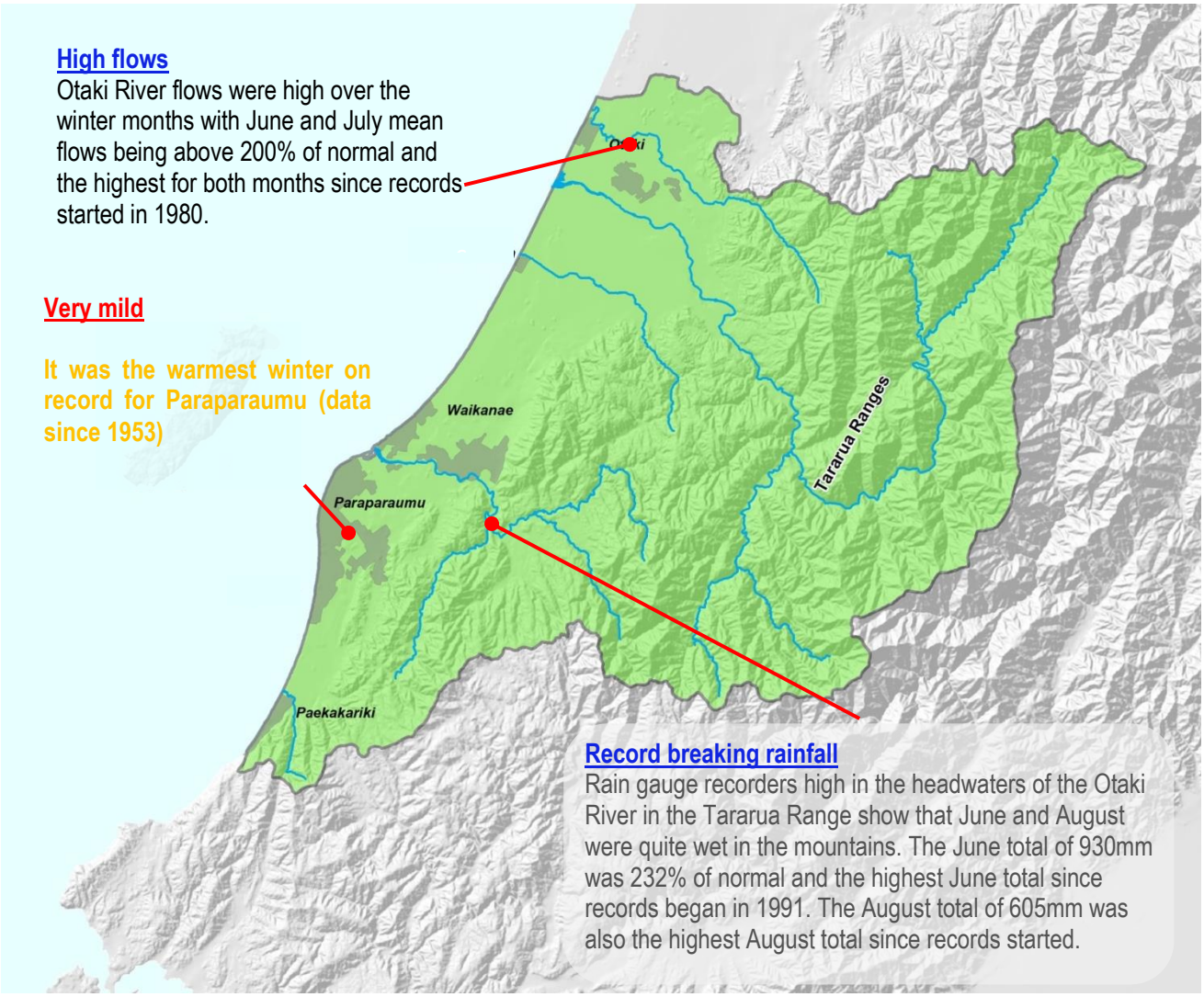


Want to look at the summary tables and graphs?

- Rainfall
- River flows

Kāpiti Coast climate summary

- **Warmer than average**
- **Large swings in flow from westerlies to easterlies**
- **Very wet winter, dry otherwise**

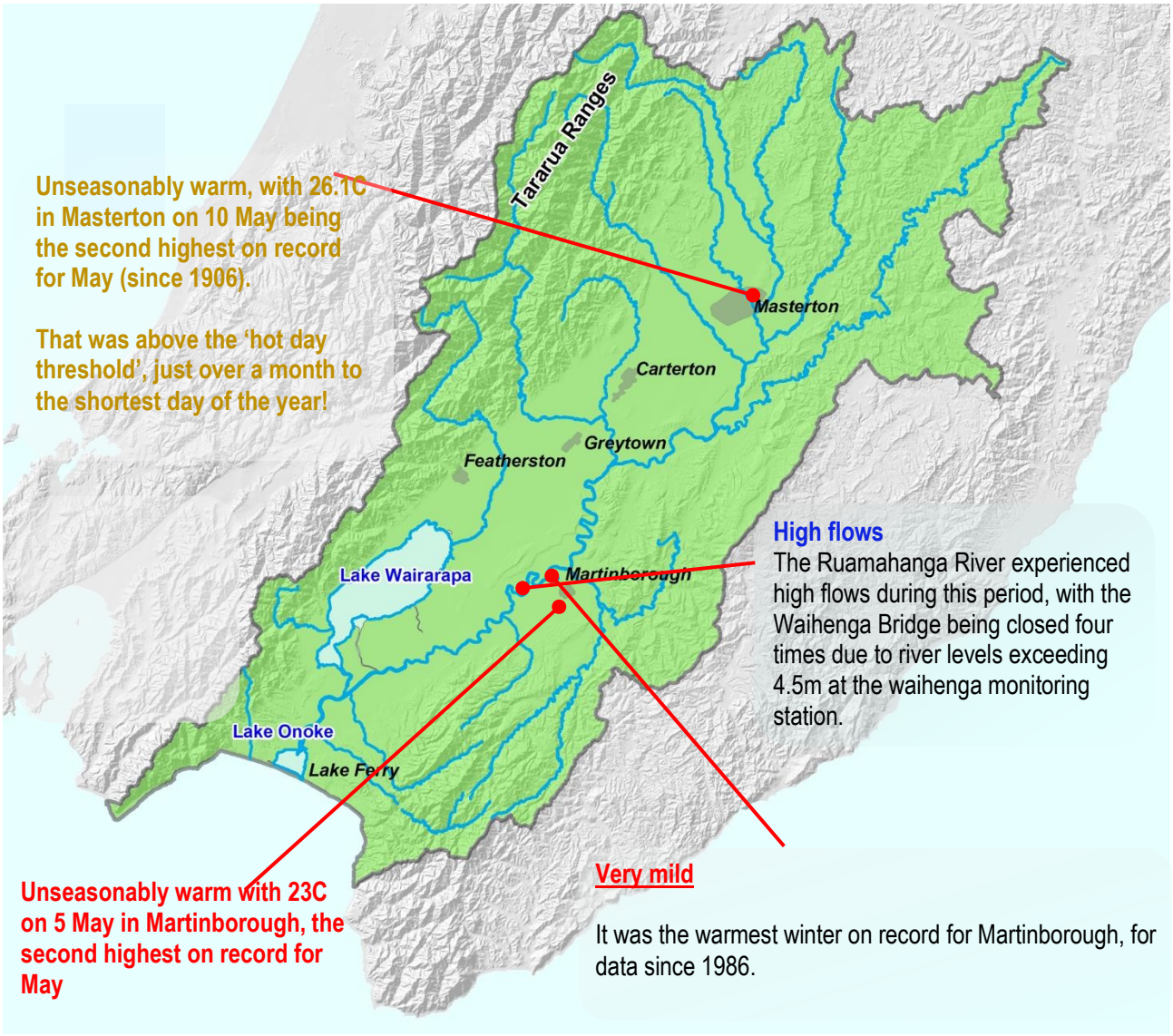


Want to look at the summary tables and graphs?

- Rainfall
- River flows

Ruamāhanga Valley climate summary

- **Warmer than average**
- **Wet winter, easterly flow**

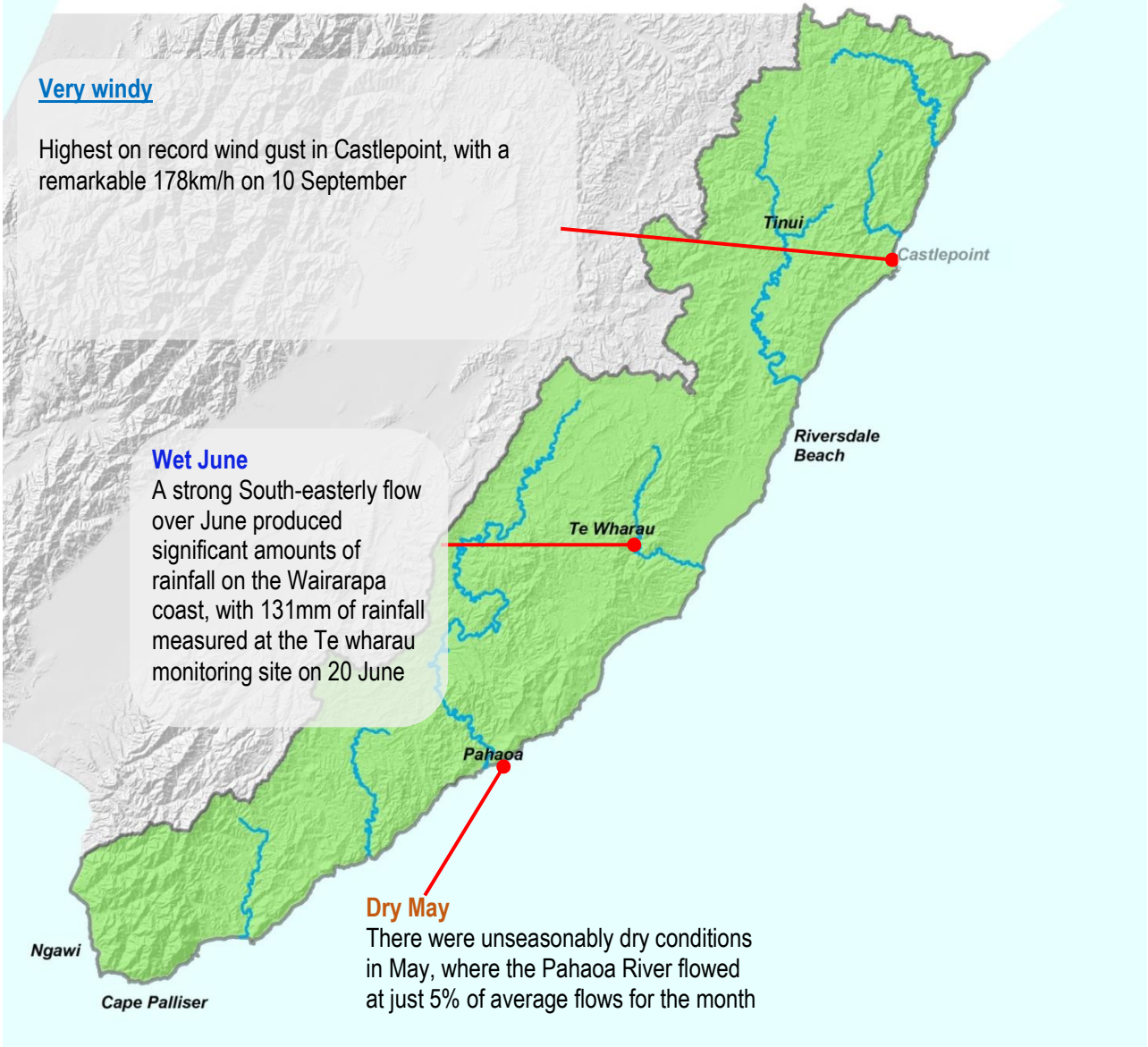


Want to look at the summary tables and graphs?

- Rainfall
- River flows

Wairarapa Coast climate summary

- **Warmer than average**
- **Wet winter, easterly flow**



Want to look at the summary tables and graphs?

- Rainfall
- Soil moisture

Rainfall statistics

Rainfall was quite variable over individual months in the May to October period, but ended above average for the total period in a number of areas.

Whaitua	Location	May %	Jun %	Jul %	Aug %	Sep %	Oct %	May-Oct (mm)	May-Oct %
Wellington Harbour & Hutt Valley Click to see cumulative rainfall plots	Kaitoke	102	166	119	137	109	80	1575	120
	Lower Hutt	117	122	141	134	76	76	482	112
	Wainuiomata	115	148	91	122	98	75	678	110
	Karori	112	98	161	115	118	72	881	114
	Wellington	107	89	156	133	100	80	735	112
Te Awarua-o-Porirua Click to see cumulative rainfall plots	Battle Hill	129	94	161	161	69	118	892	121
	Whenua Tapu	173	79	159	132	68	106	723	119
	Tawa	121	94	176	130	86	79	741	115
Kāpiti Coast Click to see cumulative rainfall plots	Otaki	70	122	115	164	85	100	628	110
	Waikanae	115	111	98	133	64	82	710	100
	Paekakariki	128	89	130	174	72	103	764	117
	Tararua (Otaki headwaters)	109	219	98	155	96	104	3408	128
Ruamāhanga Click to see cumulative rainfall plots	Masterton	75	151	79	143	123	45	534	104
	Featherston	66	119	124	156	100	60	598	105
	Longbush	70	184	48	150	150	86	563	102
	Tararua (Waiohine headwaters)	99	164	31	116	141	57	2849	106
Wairarapa Coast Click to see cumulative rainfall plots	Tanawa Hut	91	164	31	116	141	57	775	99
	Ngaumu	120	179	49	168	126	71	518	125

Click the following links to return to climate summaries for:

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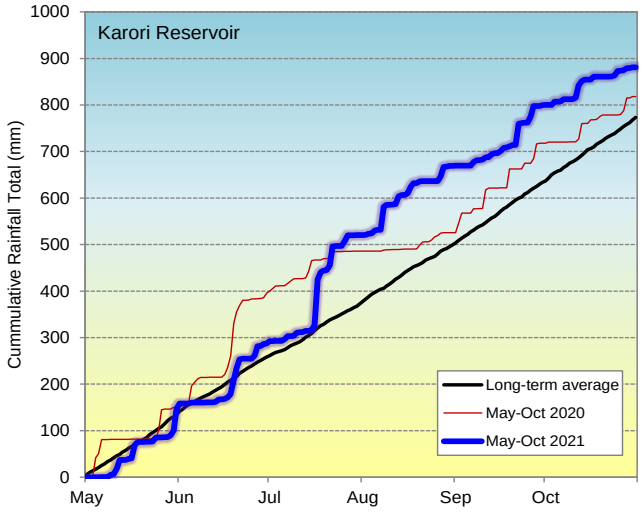
- Kāpiti Coast
- Ruamāhanga
- Wairarapa Coast

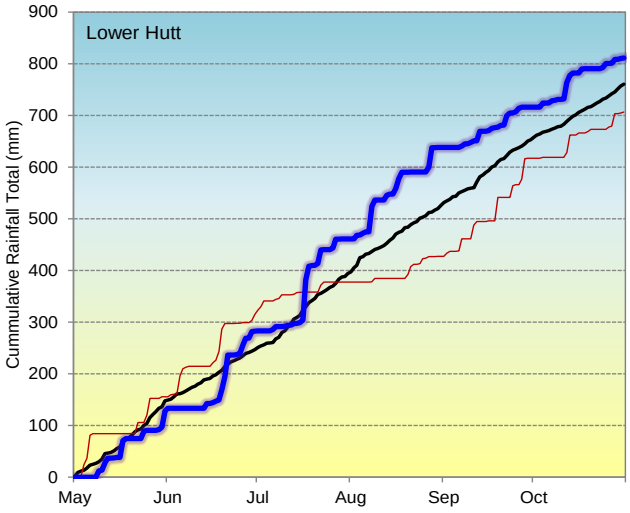
Cumulative rainfall plots

Cumulative rainfall totals for the May to October 2021 period are shown for various rain gauges sites across the regional whaitua areas, as denoted by the blue trace on the following plots. The May to October for the previous year (2020) is denoted by the red trace and the black trace represents the long-term average rainfall accumulation.

Wellington and Hutt Valley

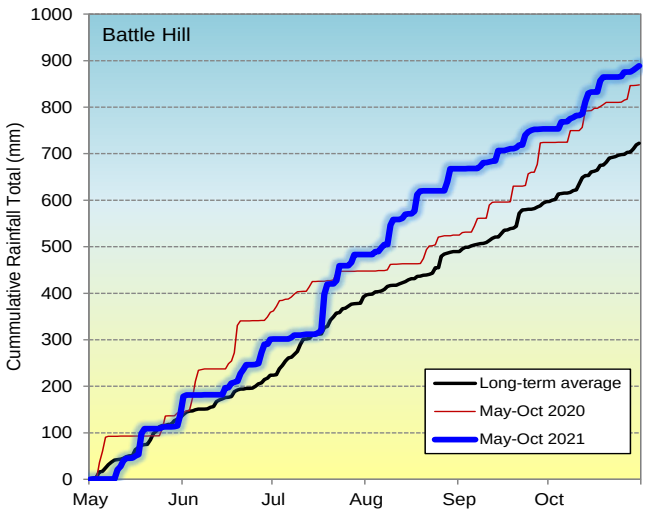
The plots highlight that the rainfall accumulation ended above the six month average but was punctuated by a very wet June, July and August.

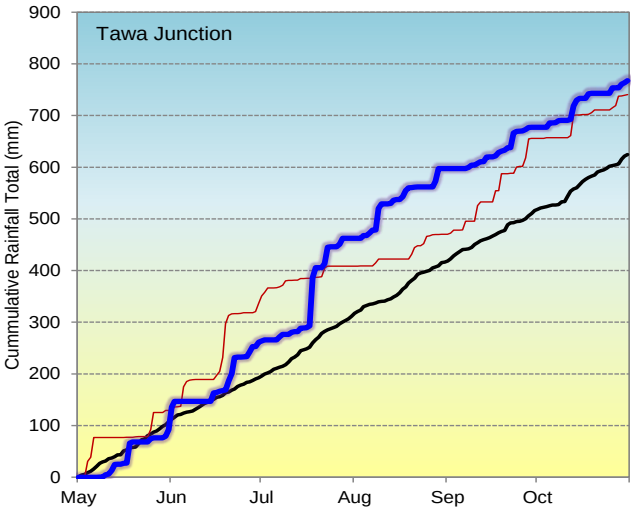




Porirua Harbour

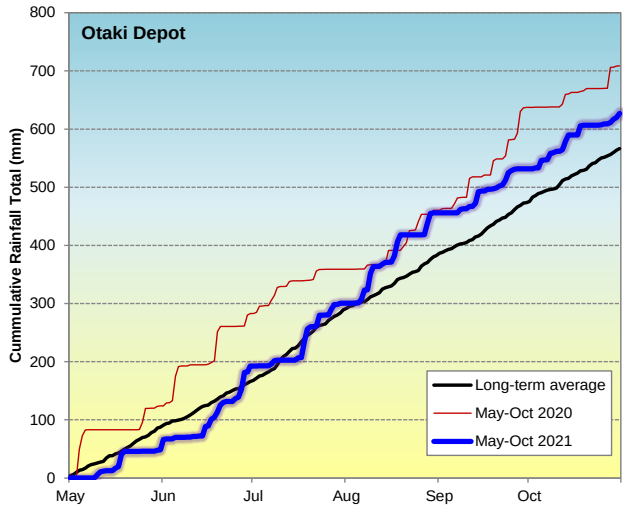
The plots shows the rainfall accumulation over the May to October period at two sites within the Te Awarua-o-Porirua whaitua area. Wet conditions in May and July contributed to the six month accumulation ending above normal.

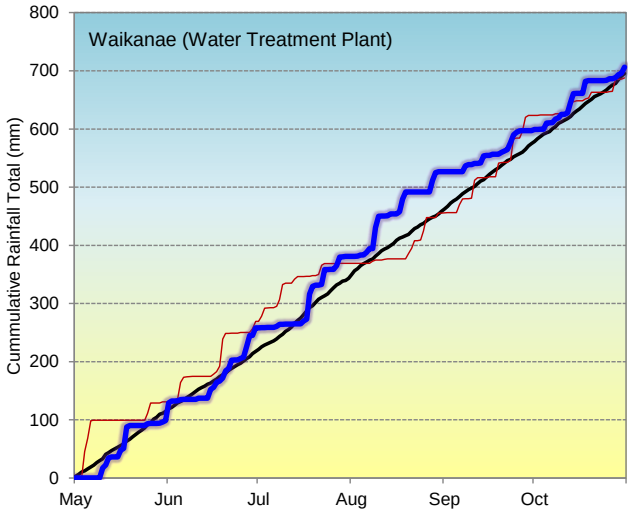




Kāpiti Coast

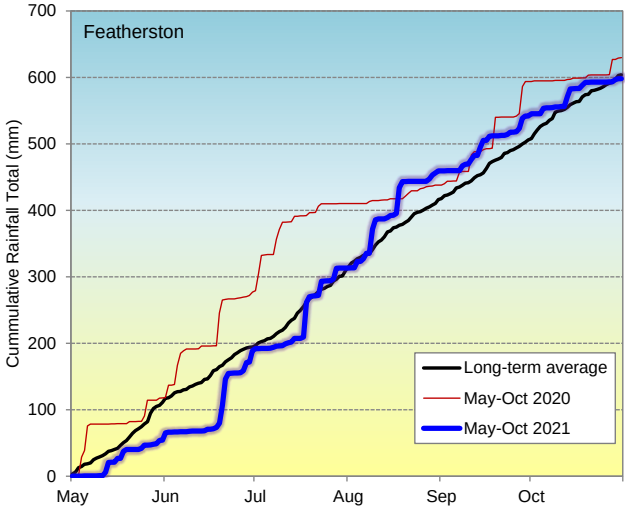
Rainfall recorded at Otaki tracked below average throughout the entire May to June period while Waikanae was closer to normal.

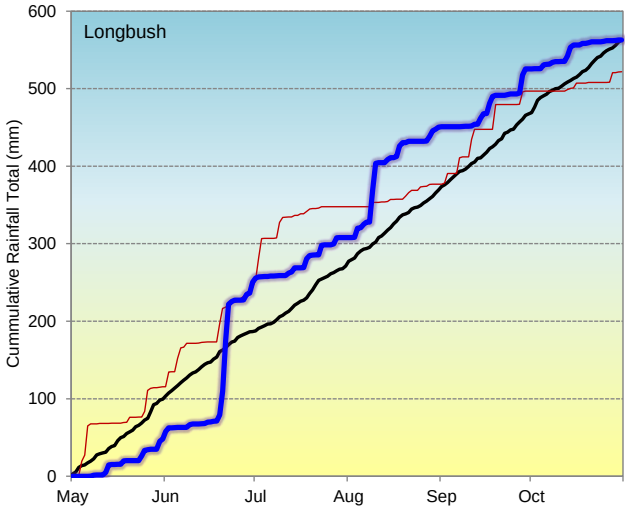




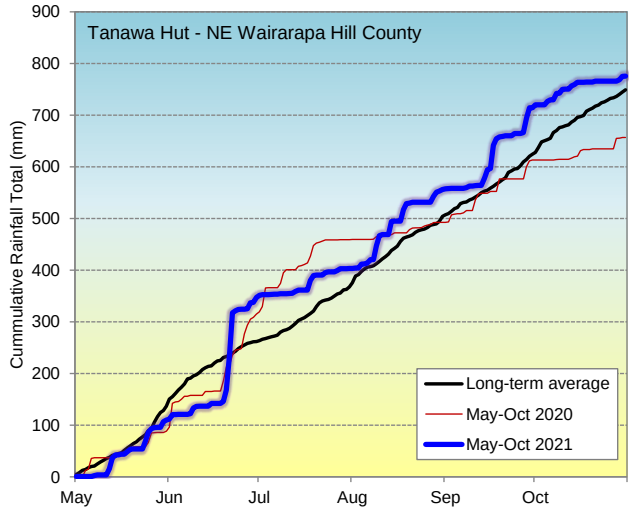
Ruamāhanga

Rainfall accumulation at these two locations clearly shows the dry May and wet June, August and September conditions.





Wairarapa Coast



The Tanawa Hut rain gauge in the Wairarapa Coast area shows a steep increase due to very wet conditions during June before flattening off thanks to a dry July

River flows – averages

River flows over the entire May to October period ranged from 74 to 226 percent of average.

		Flow as a percentage of average						
Whaitua	**River**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**May-Oct**
Wellington Harbour & Hutt Valley	Hutt River - Kaitoke	107	180	138	115	90	64	115
	Hutt River - Taita Gorge	82	170	123	123	65	54	104
	Akatarawa River	87	153	129	129	73	57	104
	Mangaroa River	42	180	144	184	113	99	133
	Waiwhetu Stream	66	104	115	148	75	72	98
	Wainuiomata River	59	181	111	131	81	72	109
Te Awarua-o-Porirua	Porirua	84	119	205	129	85	68	121
	Pauatahanui	72	130	201	232	124	142	160
	Horokiri	84	106	159	150	71	83	113
Kāpiti Coast	Waitohu	118	358	242	288	219	160	226
	Otaki	122	242	212	184	148	107	167
	Mangaone	60	103	81	87	67	50	74
	Waikanae	111	184	166	152	79	63	125
Ruamāhanga	Kopuaranga	30	130	83	124	137	54	97
	Waingawa	87	150	118	97	113	66	105
	Waiohine	98	185	108	99	104	60	108
	Mangatarere	54	148	109	94	110	39	94
	Tauherenikau	76	137	119	101	96	60	100
	Otukura	41	71	81	146	92	73	92
	Ruamāhanga	58	127	88	98	98	58	89
Wairarapa Coast	Pahaoa	5	212	28	105	110	103	93

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River flows – lowest

Minimum river and stream flows recorded during the May to October 2020 period.

Whaitua	River	Minimum Flow		
		Flow (m^3/s)	Date	Comment
Wellington Harbour & Hutt Valley	Hutt (Kaitoke)	1.084	9- May	
	Hutt (Taita Gorge)	2.731	9- May	
	Akatarawa	0.879	9- May	
	Mangaroa	0.075	9- May	
	Wainuiomata	0.151	9- May	
Te Awarua-o-Porirua	Porirua	0.167	8- May	
	Pauatahanui	0.110	8- May	
	Horokiri	0.087	6- May	
Kāpiti Coast	Waitohu	0.382	6- May	
	Otaki	4.350	14- June	
	Mangaone	0.127	21-May	
	Waikanae	0.959	9- May	
Ruamāhanga	Kopuaranga	0.278	3- May	
	Waingawa	1.292	9- May	
	Waiohine	3.337	9- May	
	Mangatarere	0.143	7- May	
	Tauherenikau	1.078	9- May	
	Otukura	0.123	10- May	
	Ruamāhanga (Upper)	2.679	9- May	
	Ruamāhanga (Lower)	9.255	9- May	
Wairarapa Coast	Pahaoa	0.123	6- May	

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

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

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)	97	27- June	
	Hutt(Taita Gorge)	284	18- July	1
	Akatarawa	56	28- June	1
	Mangaroa	67	22- June	1
	Waiwhetu	5	18- July	
	Wainuiomata	17	22- June	1
Te Awarua-o-Porirua	Porirua	26	18- July	1
	Pauatahanui	16	18- July	
	Horokiri	7	18- July	
Kāpiti Coast	Waitohu	21	28- June	1
	Otaki	476	28- June	1
	Mangaone	2	28- June	1
	Waikanae	68	28- June	1
Ruamāhanga	Kopuaranga	27	19- July	1
	Waingawa	104	19- July	1
	Waiohine	270	27- June	1
	Mangatarere	24	19- July	1
	Tauherenikau	105	18- July	1
	Otukura	7	10- Aug	1
	Ruamāhanga (Upper)	278	19- July	1
	Ruamāhanga (Lower)	705	19- July	1
Wairarapa Coast	Pahaoa	493	22- June	1

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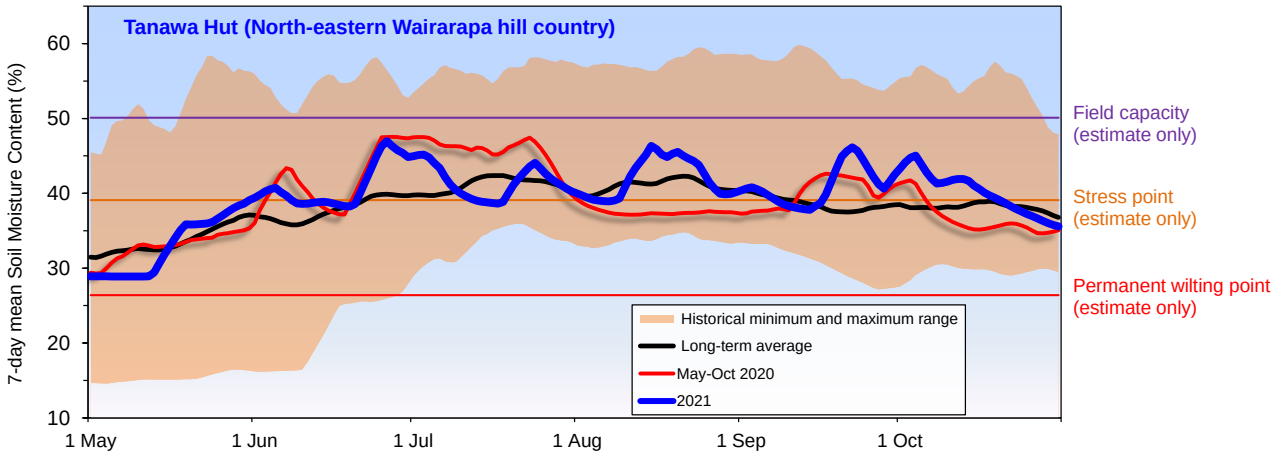
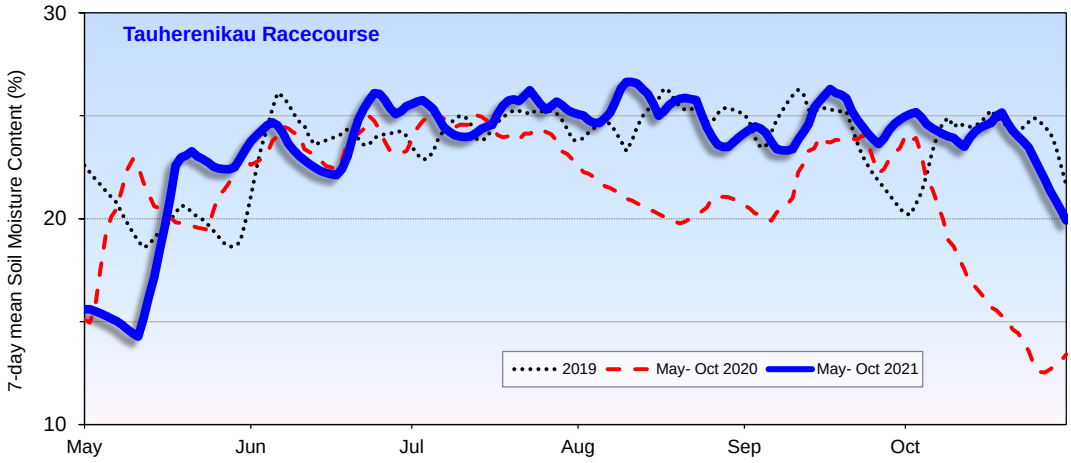
Soil moisture content

Wairarapa Coast

May to October 2021 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 Hut has tracked near to above average over the period whereas at Tauherenikau Racecourse there were two periods of well below average soil moisture in response to very low rainfall conditions during May.





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/

Seasonal climate hub (reports available from 2015 onwards)

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

https://www.gwrc.govt.nz/environment/environmental-data-hub/climate-monitoring/

Environmental data (real time)

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

Climate Change impacts (New Wairarapa video and report)

https://www.gwrc.govt.nz/environment/climate-change/impacts-on-our-region/

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

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/

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