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Bureau of Meteorology

Special Climate Statement 44 – extreme rainfall and flooding in coastal Queensland and New South Wales

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1 Introduction

Most of the east coast of Queensland, and the coast of New South Wales from the Illawarra northwards, experienced very heavy rainfall during the period from 22 to 29 January 2013, as a result of the former tropical cyclone *Oswald* tracking southwards along a track just inland from the Queensland coast. This rainfall resulted in severe flooding in many areas within 200 kilometres of the east coast, most notably in the Burnett catchment in Queensland and the Clarence catchment in northern New South Wales, both of which reached record flood peaks.

Oswald formed in the Gulf of Carpentaria on 21 January, and made landfall that night near Kowanyama, on the west coast of the Cape York Peninsula, as a category 1 system. It rapidly weakened after landfall and was downgraded to a tropical low on the morning of 22 January. The low moved near the east coast, being centred off Cooktown on 23 January and then tracked slowly to the south-southeast just inland from the coast. It was centred near Townsville on the 24th, became slow-moving in the St. Lawrence-Rockhampton area on the 25th and 26th, and then resumed a southwards track to be centred near Dalby on the 28th. It then accelerated southwards and moved offshore near Sydney on the 29th before moving out to sea.

Throughout its lifespan, the system brought heavy rainfall, especially in moist easterly to northeasterly flow on its southern flank. The system was also associated with strong winds, with numerous sites experiencing gusts in excess of 100 km/h, and coastal storm surges and high waves, as well as a number of tornadoes, particularly in the Bundaberg area. A storm surge of around 0.5 metres above normal tide levels was observed at several points along the Queensland and New South Wales coast, with 0.59 metres above normal tide levels observed at Tweed Heads, while offshore waves exceeding 12 metres were observed off Coffs Harbour. Significant coastal erosion and some inundation of foreshore areas were experienced.

There are few close precedents in the last 50 years for the track of *Oswald*. While a number of former tropical cyclones have moved far enough south to have significant impacts on New South Wales, most such systems have either originated over the Coral Sea and not approached the Queensland coast until south of the Tropic of Capricorn (e.g. *Zoe* 1974, *Nancy* 1990), or moved south from the Gulf of Carpentaria and tracked through western Queensland (e.g. *Audrey* 1964).

This statement describes notable extreme rainfalls and associated flooding. A detailed account of severe weather associated with the event, such as high winds and tornadoes, will be produced at a later date.

2 Detailed assessment of the event

2.1 Rainfall during the event

The first heavy rains directly associated with the system occurred on 22 January. Merluna, south-east of Weipa, received 202.4 millimetres in the 24 hours to 9 a.m. on the 22nd, with Kowanyama receiving 158.8 millimetres and Weipa 132.8. An easterly flow not directly associated with the core of *Oswald* also brought heavy rain on parts of the east coast, especially around Tully, where Menavale received 292.0 millimetres.

Extreme rainfalls continued in both areas on the 23rd. On the west coast of the Cape York Peninsula, RAAF Scherger received 366.8 millimetres, the heaviest daily rainfall in the region since 1985, while Weipa had 327.8 millimetres, a site record. Heavy rain also continued on the east coast with 280.4 millimetres at Tully.

The focus of extreme rainfalls then moved progressively southwards along, and in the area immediately inland from, the east coast. On the 24th peak rainfalls were between Cardwell and Mackay, including 405 millimetres at Paluma. The next day, the most extreme rainfalls were in the Rockhampton area. A number of sites within 40 kilometres of Rockhampton exceeded 400 millimetres, including 587 millimetres at Upper Dee (near Mount Morgan) and 556.6 millimetres at Pacific Heights, while Rockhampton itself received 349 millimetres.

On the 26th and 27th, the heaviest rainfalls were along and inland from the coast between Gladstone and Bundaberg. Boolaroo Tops, about 60 kilometres south-southwest of Gladstone, had 497 millimetres on the 26th and 468 millimetres on the 27th, for a two-day total of 965 millimetres, whilst other exceptional totals on the 27th, both in the area west of Childers, included 549 millimetres at Mount Rawdon and 480 millimetres at Walla.

The heaviest rain moved south on the 28th and was centred over southeast Queensland and the far northeast of New South Wales. The most extreme daily falls of the event occurred this day, centred on two areas; the Gold Coast hinterland and New South Wales border ranges, and parts of the Scenic Rim area on the southwestern edge of the Brisbane River catchment. Both areas had sites with 24-hour totals in excess of 700 millimetres, with Upper Springbrook, in the Gold Coast hinterland, receiving 744 millimetres and Mount Castle, on the Main Range north of Cunninghams Gap, 709 millimetres. Numerous sites in the Gold Coast hinterland exceeded 400 millimetres. In New South Wales, the highest total was 539 millimetres at Upper Rous River.

The last major day of the event was the 29th, with most of the New South Wales coast, and parts of the northern inland, receiving at least 50 millimetres in the 24 hours to 9 a.m. These falls also extended into the far east of Victoria. Heavier falls were widespread, with totals in the 100–200 millimetres range common in the Sydney region and the Illawarra, as well as scattered locations further north along the coast. There were also continued heavy falls along the Queensland–New South Wales border with

another 377 millimetres at Upper Springbrook. Next day the rain moved out to sea with only light falls (mostly less than 10 millimetres) recorded.

Total rainfall for the 22–29 January period is shown in Figure 1. Almost all of the east coast from the Hunter north to Cape York received at least 200 millimetres, with totals in excess of 400 millimetres common on the Queensland coast from St. Lawrence south to the New South Wales border, as well as between Townsville and Cairns and on the west coast of the Cape York Peninsula. Much higher totals occurred in topographically favoured locations, with eight-day totals of 1496 millimetres at Upper Springbrook and 1426 millimetres at Boolaroo Tops. The highest total in New South Wales was 1046 millimetres at Upper Rous River. The rain was largely confined to areas within 300 kilometres of the coast, with most areas west of an Albury–Dubbo–Mitchell–Hughenden line receiving little or no rain from the event.

The event took place against a background of relatively dry antecedent conditions. Except for localised heavy falls on the Darling Downs and tropical regions north of Townsville, most of the region affected by the event had had less than 50 millimetres in the first three weeks of January, following a dry finish to 2012 in which rainfall for September–December was mostly at least 40 per cent below normal.

2.2 Extreme single and multi-day rainfalls during the event

Table 1 lists the highest daily rainfalls observed during the event. Upper Springbrook's 744 millimetres on 28 January is the highest one-day rainfall in Australia since 772 millimetres fell at Coops Corner, on the Sunshine Coast, in August 2007.

Most of the sites where daily totals in excess of 400 millimetres occurred have relatively short data sets. A number of long-term sites set records, either for any month or for January (Table 2), with the most significant record-breaking taking place on 27 January (Figure 2) in the area inland from the southern Queensland coast, which is a region with limited historical experience of extreme daily rainfalls. Rockhampton (349.0 millimetres on 25 January) and Gladstone (254.4 millimetres on 25 January) both set all-time records for their current sites, and Bundaberg (252.0 millimetres on 27 January) a January record, but in all three cases there have been higher daily rainfalls at former sites in those towns. Gladstone did set records (all sites combined) for its highest 3-day (657.8 millimetres) and 4-day (819.8 millimetres) rainfalls – the latter total exceeded Gladstone's previous record for a whole calendar month, and was more than the site received for the full year in either 2011 or 2012. In total, 26 sites with 80 years or more of data set all-time daily rainfall records, and another 28 set January records (Table 2).

A major feature of the event was the extent of the heavy rain through the coastal and near-coastal catchments, as indicated by catchment rainfall averages (Table 3). Most exceptionally, the catchment average of 206.8 millimetres for the Burnett catchment on 27 January exceeded the previous record (123.6 millimetres) by nearly 70 per cent.

The Burnett catchment also set records by large margins for highest 2-, 3- and 4-day timescales. Catchment records for daily rainfalls were also set for the Mary, Logan–Albert, Kolan and Burrum catchments, and numerous records were set at the 2-, 3- and 4-day timescales.

Over the Brisbane catchment, the highest 1-day rainfall ranked as the sixth-highest since 1900, with the 2-, 3- and 4-day rainfalls ranking second. Catchment total rainfall was slightly above that of the 2011 event for all time periods. In the Bremer sub-catchment the 2013 event ranks second behind 1974 (and ahead of 2011) for all time periods. The only significant record set for a large catchment in New South Wales was for a 3-day period for the Clarence catchment.

Despite the dry first three weeks of the month, the event was of sufficient magnitude for some parts of Queensland to have their wettest January on record, especially in a region extending from Gladstone south to Gayndah (Figure 3).

2.3 Notable flooding arising from the rain event

The heavy rains resulted in major flooding in many catchments along the coasts and adjacent inland of Queensland and far northern New South Wales, as well as in the headwaters of some inland-draining rivers (Figure 4).

The most severely-affected catchments were the Burnett, Burrum and Clarence catchments. All rivers, and various tributaries, reached record levels at numerous locations, including the major centres of Bundaberg and Grafton (Table 4). Conditions were particularly extreme in the upper Burnett catchment, where flood peaks exceeded previous records by several metres at some locations (the largest margin being 5.86 metres at Eidsvold). Most other rivers peaked below their highest levels of 2010–11, although the majority of southeast Queensland rivers reached major flood levels, with the Logan reaching its highest level since 1974 at Waterford Bridge.

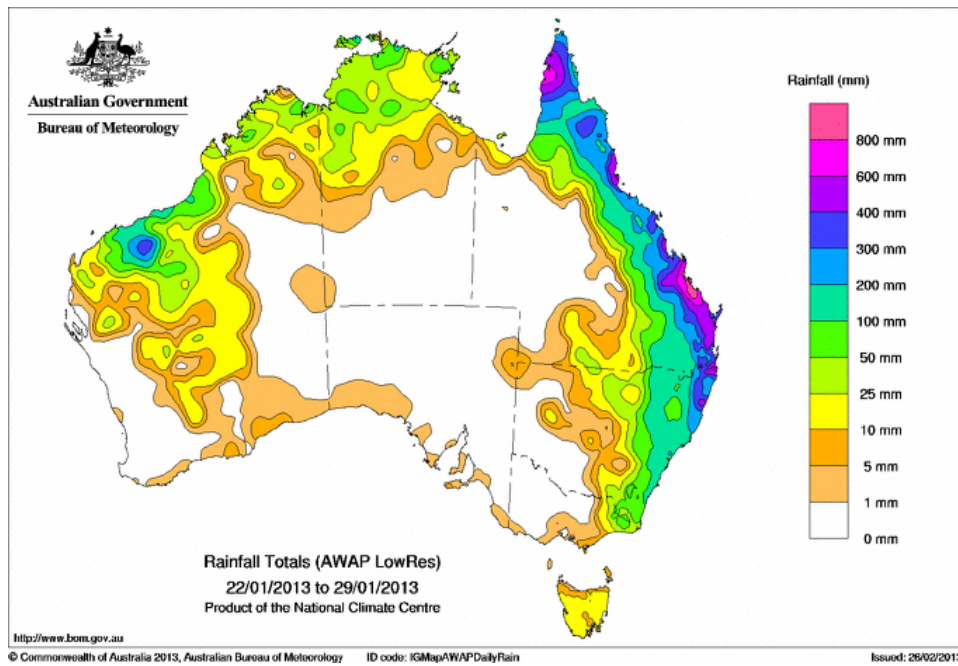


Figure 1. Rainfall for the period 22–29 January 2013.

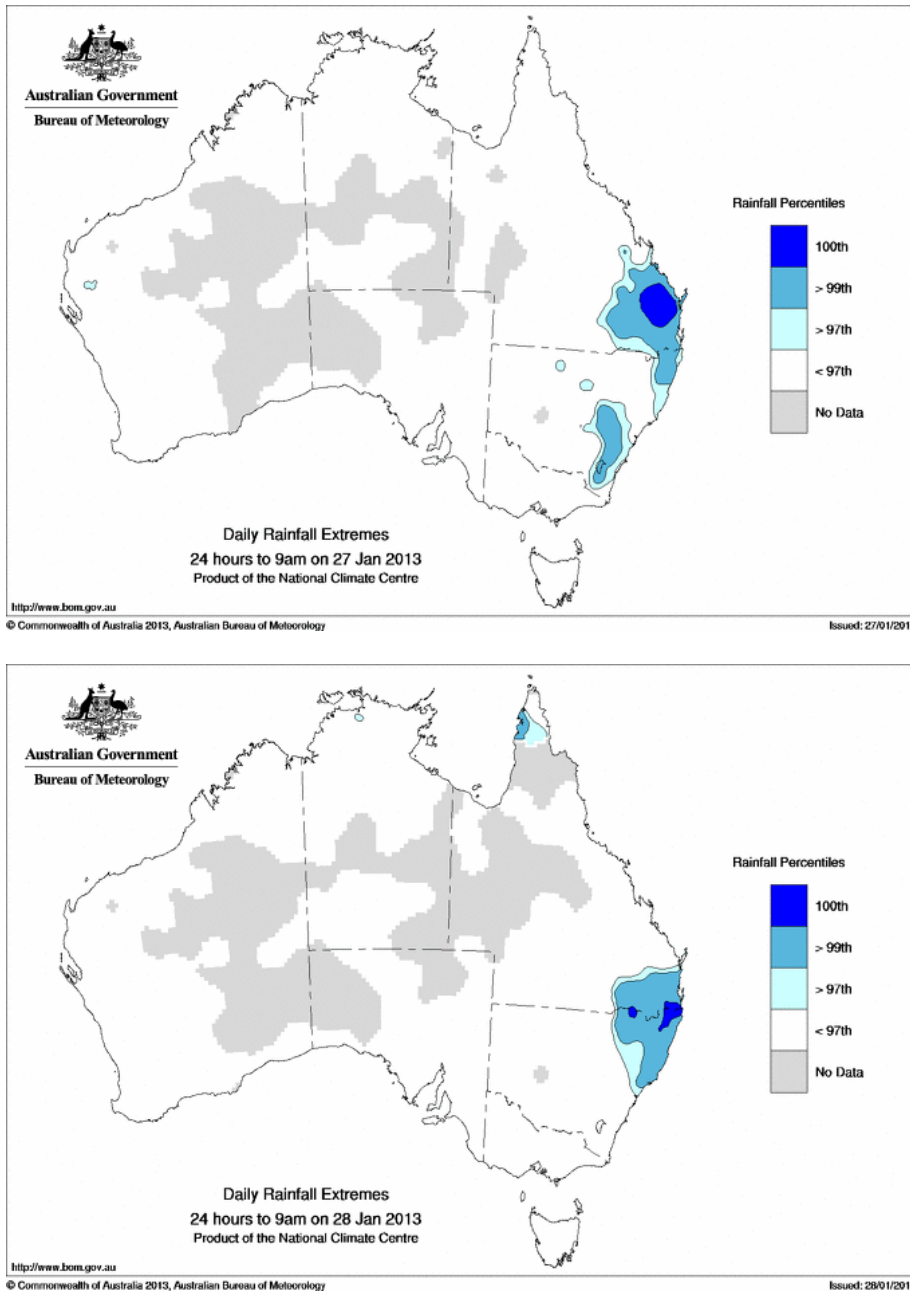


Figure 2. Areas with highest January daily rainfall on record (dark blue) on 27 January (top) and 28 January (bottom). Areas with daily rainfall above the 99th and 97th percentile are also shown.

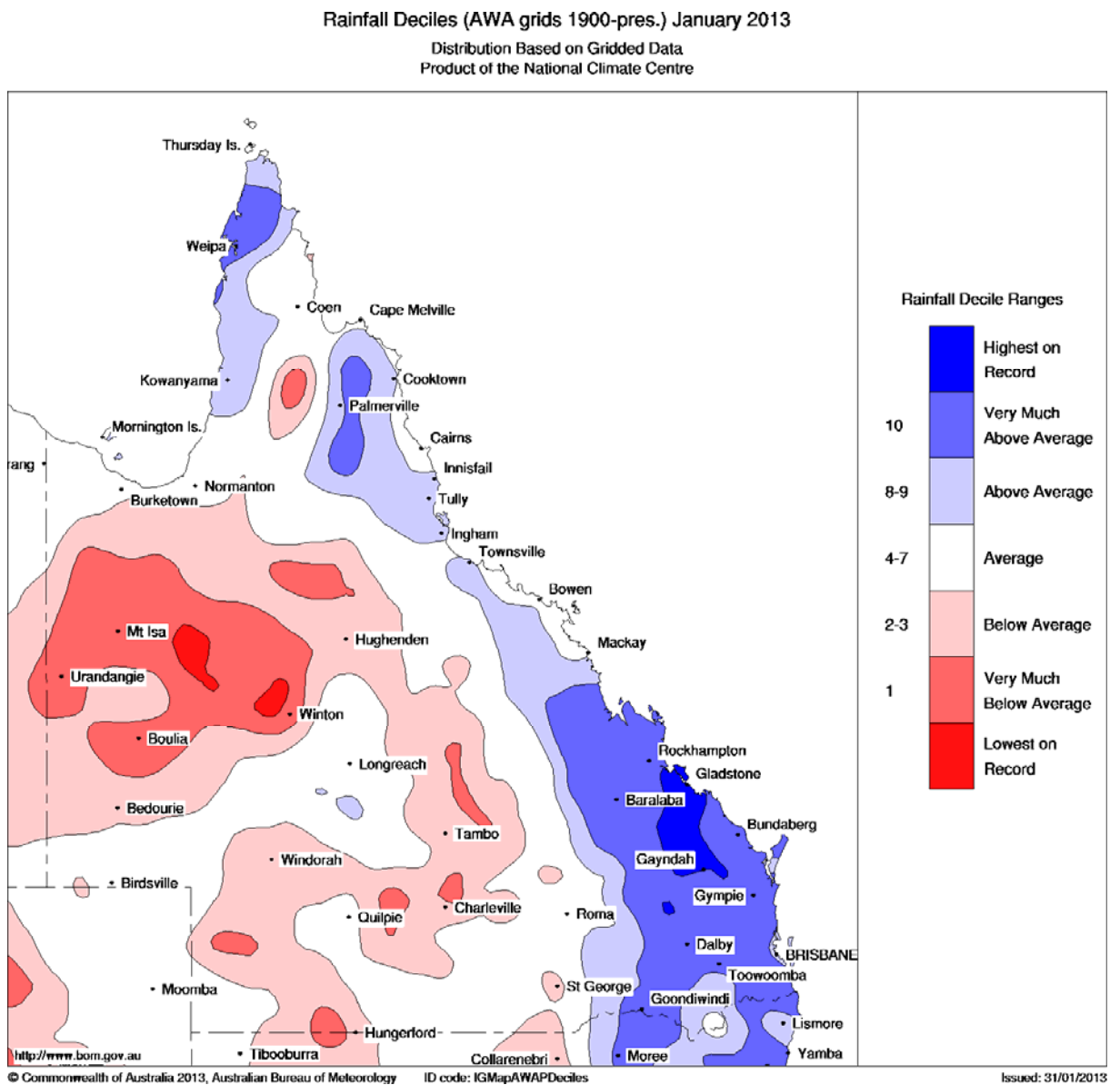


Figure 3. Queensland rainfall for January 2013, showing areas which have had their wettest January on record.

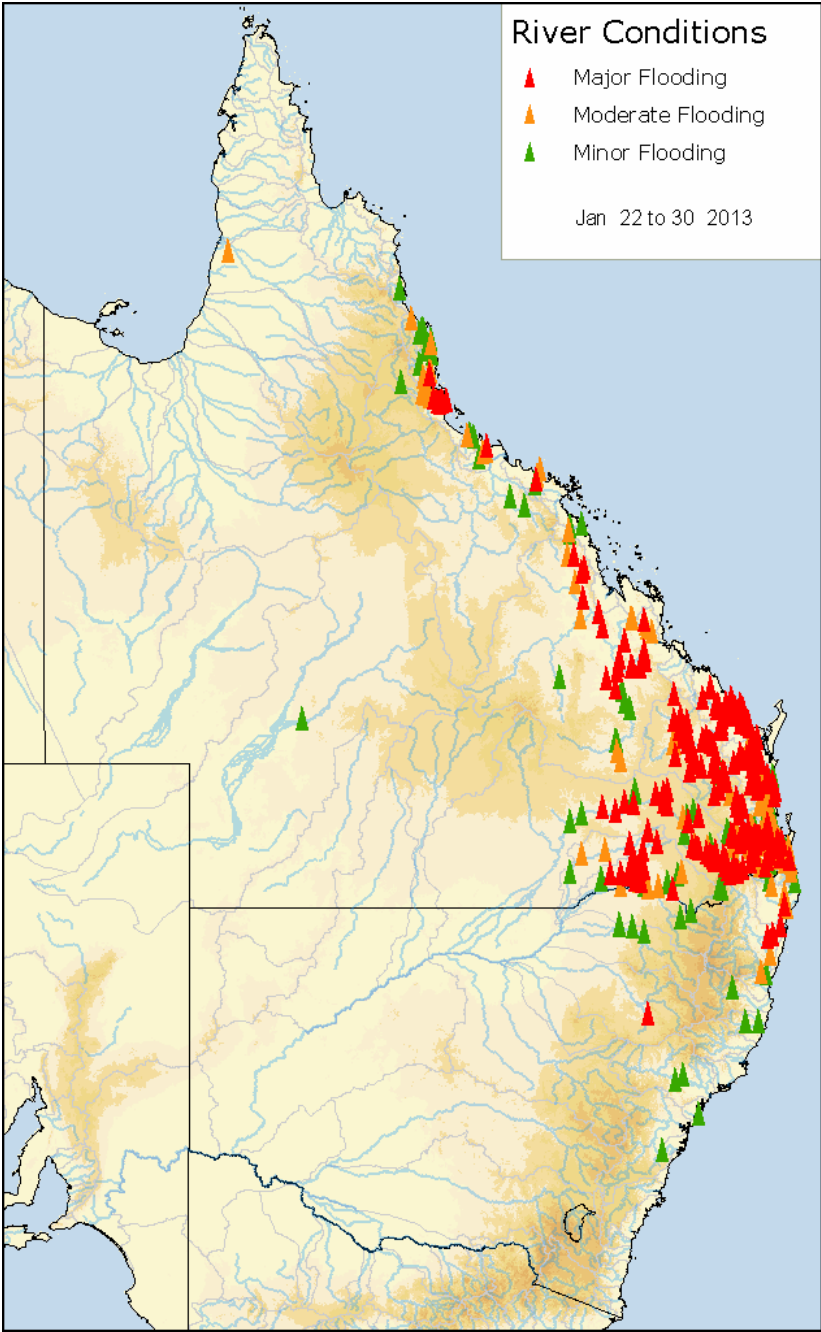


Figure 4. Highest flood classification reached in period 22–30 January 2013.

Table 1. Daily rainfalls in excess of 400 millimetres recorded during the event.

Date	Rainfall (mm)	Station number	Station name
24 January	405.0	32064	Paluma
25 January	587.0	539053	Upper Dee TM
	556.6	33077	Pacific Heights
	538.2	39067	Moonmera
	478.0	39242	Broadmeadows
	459.0	39043	Glenlands
	451.0	539054	Besch's Hill TM
	427.0	33008	Byfield
26 January	414.0	39351	Upper Ulam Road
	497.0	539122	Boolaroo Tops TM
27 January	549.0	539094	Mount Rawdon TM
	480.0	39313	Walla TM
	468.0	539122	Boolaroo Tops TM
	422.0	39068	Mount Larcom
	407.0	539021	Fig Tree TM
28 January	744.0	540400	Upper Springbrook Alert
	709.0	540171	Mount Castle Alert
	653.0	40550	Numinbah
	570.0	540581	Springbrook TM
	539.0	558080	Upper Rouse River
	523.0	40937	Benobble Alert
	515.0	40534	Wunburra
	501.0	540573	Stony Creek Road TM
	496.0	540438	Numinbah Valley Alert
	482.0	540437	Numinbah Valley TM
	482.0	41134	Top Plains
	481.0	40930	Laheys Lookout Alert
	480.0	40882	Numinbah Alert
	459.0	540582	Bryn Euryng TM
	451.0	540290	Canungra Army Alert
	447.0	540520	Mount Nebo Alert
	444.0	58036	Chillingham (Limpinwood)
	435.0	540584	Illinbah TM
	435.0	558032	Limpinwood
	430.0	40607	Springbrook Road
	429.5	558049	Huonbrook
	429.0	540054	Little Nerang Dam Alert
	429.0	540612	Little Nerang Dam HW TM
	425.0	41046	The Head
	415.0	40845	Binna Burra Alert
	413.0	540207	Wilson's Peak Alert
	408.0	540519	Upper Tenthill Alert
407.0	40042	Canungra	
407.0	40197	Mount Tamborine	
406.0	40147	Mount Nebo	
406.0	540138	Mount Glorious Alert	
404.0	540169	Thornton Alert	
401.0	40335	Mount Tamborine Alert	

Table 2. Selected long-term stations which have set daily rainfall records for January. All-time records are shown as bold with the previous all-time record shown below the previous January record, where applicable. Where two station numbers are shown combined records have been used.

Station number	Station name	State	Rainfall amount (mm)	Date	Previous record	Years of data
27000	Aurukun	QLD	332.6	23/1	232.4 (11/1/1964)	96
28000	Laura	QLD	172.8	23/1	132.1 (21/1/1907)	110
33008	Byfield	QLD	427.0	25/1	323.9 (11/1/1951)	82
33076	Yaamba	QLD	314.2	25/1	253.5 (22/1/1918)	111
33077	Pacific Heights	QLD	556.6	25/1	509.3 (31/1/1893)	120
35026	Duaringa	QLD	256.8	25/1	154.9 (22/1/1918) 219.2 (20/12/1973)	123
39004	Baralaba	QLD	151.0	25/1	104.5 (9/1/1996)	85
39009	Boona-Choppa	QLD	315.8	27/1	229.6 (28/1/1974) 253.5 (5/2/1931)	85
39019	Callemondah	QLD	346.0	26/1	224.8 (22/1/1956) 330.2 (12/2/1947)	80
39020	Calliope Station	QLD	294.0	25/1	243.4 (31/1/1978)	100
39043	Glenlands	QLD	459.0	25/1	262.4 (23/1/1955)	81
39048	Goovigen	QLD	204.0	25/1	145.0 (31/1/1978)	80
39049	Gracemere	QLD	384.0	25/1	215.1 (22/1/1956)	109
39054	Jambin	QLD	160.0	25/1	152.0 (31/1/1978)	84
39057	Kalpowar	QLD	223.0	26/1	170.2 (13/1/1968)	80
39066/39039	Gayndah	QLD	282.8	27/1	185.4 (20/1/1929)	143
39067	Moonmera	QLD	538.2	25/1	208.3 (23/1/1918) 381.0 (21/2/1929)	107
39068	Mount Larcom	QLD	269.6	25/1	252.2 (31/1/1978)	98
39070	Mount Perry	QLD	345.0	27/1	339.1 (23/1/1890)	122
39073	Mundubbera	QLD	314.9	27/1	178.6 (20/1/1929)	100
39083/39082	Rockhampton	QLD	349.0	25/1	267.5 (29/1/1896)	142
39096	Wateranga	QLD	243.6	27/1	164.1 (16/1/1913)	80
39104/39330	Monto	QLD	185.1	27/1	141.2 (22/1/1956) 152.1 (10/2/1942)	83
40013	Bauple	QLD	258.6	27/1	225.2 (8/1/2011)	104
40020	Blackbutt	QLD	194.8	27/1	149.2 (10/1/2011) 181.0 (9/2/1999)	97
40021	Biggenden	QLD	295.8	27/1	161.0 (9/1/1968) 246.4 (13/7/1954)	113
40042	Canungra	QLD	407.0	28/1	250.0 (27/1/1974) 305.0 (7/2/2010)	93
40060	Cooyar	QLD	180.0	27/1	179.6 (12/1/1910)	107

40093	Gympie	QLD	239.2	27/1	176.0 (10/1/1898)	125
40096	Helidon	QLD	156.4	28/1	127.0 (27/1/1974)	118
40113	Kumbia	QLD	203.0	27/1	113.4 (23/1/1996) 146.1 (28/12/1921)	93
40126	Maryborough	QLD	258.8	27/1	250.7 (31/1/1893)	125
40135	Moogerah Dam	QLD	293.0	28/1	217.7 (24/1/1947) 243.4 (8/2/1991)	88
40151	Mungar Junction	QLD	231.0	27/1	201.0 (10/1/1996)	118
40198	Tarome	QLD	297.6	28/1	247.0 (27/1/1974)	99
40199	Tarong	QLD	177.0	27/1	139.7 (20/1/1929)	90
40200	Theebine	QLD	360.0	27/1	283.2 (8/1/2011)	106
40255	Wooroolin	QLD	210.0	27/1	142.5 (20/1/1929)	95
40400	Moorang	QLD	321.0	28/1	243.0 (27/1/1974)	84
40550	Numinbah	QLD	653.0	28/1	525.3 (24/1/1947)	84
40922/40112	Kingaroy	QLD	234.0	27/1	129.4 (4/1/1996) 169.0 (8/2/1981)	108
41108	Beau Maison	QLD	154.2	20/1	124.5 (21/1/1956) 136.1 (5/11/1938)	94
55046	Pine Ridge	NSW	131.0	29/1	106.0 (23/1/1991) 114.8 (24/2/1955)	81
55047	Valais	NSW	127.0	29/1	126.2 (30/1/1984)	130
55062	Werris Creek	NSW	109.4	29/1	104.2 (8/1/1974)	121
56023	Old Koreelah	NSW	205.0	28/1	143.0 (5/1/2008) 176.8 (19/2/1961)	100
57024	Woodenbong	NSW	215.2	28/1	136.7 (20/1/1938)	80
57103	Kookabookra	NSW	102.4	28/1	97.8 (13/1/1968)	82
60013	Forster-Tuncurry	NSW	181.0	28/1	142.7 (13/1/1911)	115
61082	Wyee	NSW	171.8	29/1	148.6 (15/1/1948)	113
61100	Broke	NSW	85.0	29/1	83.0 (17/1/1988)	94
84002	Bonang	VIC	117.0	29/1	77.2 (8/1/1934)	121
84014	Dellicknora	VIC	136.0	29/1	127.0 (28/1/1920)	96

Table 3. Highest catchment-averaged rainfalls during the event. Values shown in bold are the highest on record for that catchment/period. Catchments marked (*) are sub-catchments of the Brisbane River system.

Catchment	Number of days	Highest rainfall (mm)	Period ending	Record in 1900-2012 period (mm)
Boyne	1	280.79	26/1	361.65 (12/2/1947)
	2	508.07	26/1	414.48 (11-12/2/1947)
	3	731.86	27/1	463.20 (11-13/2/1947)
	4	804.72	27/1	473.56 (11-14/2/1947)
Bremer*	1	197.91	28/1	215.36 (27/1/1974)
	2	278.62	28/1	371.57 (26-27/1/1974)
	3	311.35	28/1	427.79 (25-27/1/1974)
	4	329.03	29/1	469.19 (25-28/1/1974)
Brisbane	1	133.86	28/1	170.69 (27/1/1974)
	2	263.15	28/1	279.24 (26-27/1/1974)
	3	302.02	28/1	348.51 (25-27/1/1974)
	4	316.17	28/1	397.44 (25-28/1/1974)
Burnett	1	206.82	27/1	123.61 (20/1/1929)
	2	255.07	27/1	175.60 (20-21/1/1929)
	3	304.63	27/1	190.43 (19-21/1/1929)
	4	326.72	28/1	212.33 (11-14/7/1954)
Burrum	1	263.71	27/1	255.45 (21/2/1992)
	2	348.48	27/1	419.11 (16-17/1/1913)
	3	430.88	27/1	498.89 (15-17/1/1913)
	4	442.52	27/1	517.99 (14-17/1/1913)
Clarence	1	145.44	28/1	186.60 (21/2/1954)
	2	213.72	28/1	229.72 (9-10/3/2001)
	3	278.37	29/1	266.51 (9-11/3/2001)
	4	290.62	29/1	296.47 (10-13/3/1974)
Fitzroy	1	93.16	25/1	97.44 (17/2/1959)
	2	142.64	26/1	165.97 (22-23/1/1918)
	3	171.68	26/1	203.49 (20-22/4/1928)
	4	199.35	27/1	217.06 (19-22/4/1928)
Kolan	1	280.21	27/1	251.38 (16/1/1913)
	2	448.77	27/1	412.43 (16-17/1/1913)
	3	578.22	27/1	512.08 (15-17/1/1913)
	4	614.72	27/1	565.12 (15-18/1/1913)
Lockyer*	1	139.29	28/1	155.15 (27/1/1974)
	2	236.95	28/1	247.39 (26-27/1/1974)
	3	276.49	28/1	294.33 (26-28/1/1974)
	4	296.37	29/1	337.73 (25-28/1/1974)
Logan-Albert	1	208.84	28/1	184.58 (26/1/1974)
	2	272.63	28/1	352.76 (26-27/1/1974)
	3	309.31	29/1	420.49 (25-27/1/1974)
	4	333.67	29/1	451.33 (25-28/1/1974)

Mary	1	250.67	27/1	229.55 (28/3/1955)
	2	317.65	28/1	348.65 (27-28/3/1955)
	3	384.69	27/1	362.95 (26-28/3/1955)
	4	451.67	28/1	388.72 (8-11/1/1968)
Richmond	1	140.50	28/1	235.24 (21/2/1954)
	2	199.60	28/1	338.29 (20-21/2/1954)
	3	256.08	29/1	374.85 (10-12/3/1974)
	4	269.53	29/1	437.90 (10-13/3/1974)
Tweed	1	276.52	28/1	325.05 (6/2/1931)
	2	416.57	29/1	441.05 (5-6/2/1931)
	3	502.90	29/1	566.41 (4-6/2/1931)
	4	539.46	29/1	625.43 (4-7/2/1931)

Table 4. Record flood heights reached during the event at sites with 40 years or more of data.

River	Location	Peak flood height (m)	Date	Previous record (m)
Clarence	Grafton	8.09	29/1	7.89 (Mar 1890)
Clarence	Ulmarra	6.08	29/1	6.08 (Mar 1890)
Burnett	Abercorn TM	11.15	27/1	8.5 (Jan 1996)
Burnett	Yarrol	12.45	26/1	10.98 (Mar 1992)
Burnett	Ceratodus	19.93	27/1	15.8 (1893)
Burnett	Wuruma Dam	3.74	27/1	3.38 (Dec 2010)
Burnett	Eidsvold	22.06	27/1	16.20 (Dec 2010)
Burnett	Mt. Lawless	17.98	28/1	17.18 (Feb 1942)
Burnett	Walla	23.25	28/1	23.11 (Jan 1890)
Burnett	Woongarra	17.55	29/1	17.03 (Jan 1890)
Burnett	Bundaberg	9.53	29/1	9.04 (Jan 1890)
Boyne	Proston	12.42	27/1	9.56 (Jan 2011)
Boyne	Gayndah Flume	17.48	28/1	16.34 (Dec 2010)
Baffle	Mimdale	22.33	27/1	20.12 (Feb 1971)
Boonara Creek	Ettiewyn	11.39	27/1	10.33 (Jan 2011)
Lockyer Creek	Mulgowie	9.27	28/1	9.14 (Jan 1976)
Bremer	Kalbar	11.00	28/1	10.95 (Feb 1991)
Burrum	Bruce Highway	14.29	27/1	13.84 (Jan 1996)
Burrum	Burrum Highway	13.60	27/1	12.17 (Mar 1992)
Barambah Ck	Ban Ban	14.00	27/1	10.15 (Feb 1971)
Kolan	Springfield	14.35	26/1	12.27 (Mar 1992)
Kolan	Gin Gin Creek	16.00	27/1	12.66 (Mar 1992)
Don	Goovigen	11.03	27/1	10.82 (Feb 1978)
Don	Rannes	14.05	26/1	12.60 (Dec 1973)
Condamine	Emu Vale	8.89	28/1	7.59 (May 1996)
Weir	Ballymena	11.22	30/1	11.14 (Dec 2010)

Notes and contacts

Values in this statement are current as of 24 April 2013, and subject to the Bureau's normal quality control processes. Rainfall data from telemetry gauges (those with ALERT, AL (Alert) or TM (Telemetered) in their names) may be from non-Bureau owned stations and includes real-time operational data from automated systems and has not been checked.

The data set from which area averages and other spatial analyses are drawn commences in 1900.

The following climatologists may be contacted for further information about this event:

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Dr Aaron Coutts-Smith (02) 9296 1525 (NSW)

Dr Jeff Sabburg (07) 3239 8660 (Queensland)