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21 May 2020

Peter Sheath Section Manager - Waterways P.O. Box 20 Wyong, NSW 2259 peter.sheath@centralcoast.nsw.gov.au

Dear Peter,

MHL2750 – Tuggerah Lakes catchment February 2020 flood summary and historical comparison

1 Introduction

Manly Hydraulics Laboratory (MHL) is pleased to provide this Tuggerah Lakes February 2020 flood summary and historical comparison to Central Coast Council (CCC). This letter report provides a summary of the February 2020 flood event for rainfall and water level gauges in the Tuggerah Lakes catchment which are owned by CCC, Department of Planning, Industry and Environment - Climate Change and Sustainability Division (DPIE) and WaterNSW. The report includes:

- An event overview summary (Section 2).
- Regional weather conditions (Section 2).
- Station location maps (Section 2).
- Graphical and tabular presentation of flood peaks (Section 3).
- Tabulated daily rainfall totals and maximum recorded intensities (Section 3 and 4).
- Rainfall IFD curves in 2016 Australian Rainfall and Runoff (ARR) format for the Feb 2020 event and comparison with June 2007 flood event. (Section 4).
- Ranking of the top 4 rainfall (intensity over longer durations) and lake level events (max height) that have occurred between 1 Jan 1998 and 31 December 2019 for the stations included in the report (Section 5).
- Rainfall IFD curves in ARR 1987 format (Appendix A).

A comparison between the February 2020 and the June 2007 event has been undertaken to understand the difference in magnitude between these two events. In addition, CCC are responding to an enquiry from the EPA regarding licence breaches associated with the Wyong South Sewage Treatment Plant operation. CCC has requested the ranking of the four highest intensity rainfall events and the four highest flood level for Tuggerah Lake between 1 January 1998 and 31 December 2019. The ranking is focussed on longer duration event recurrence intervals as these have a larger impact on sewage treatment plants and capacity exceedance.

2 Event and monitoring station overview

2.1 Regional weather conditions

Heavy rain in the first half of the February 2020 caused flooding on numerous rivers in eastern New South Wales, with disruptions to road and rail traffic. Rainfall for February was 102% above the long-term average (Figure 2.1). This made it the State's wettest February since 2012 and its wettest month since September 2016.



Figure 2.1 NSW total rainfall February 2020 (Source: Bureau of Meteorology)

Maximum wind speeds of 89km/h were recorded at Norah Head on Sunday 9 February 2020. The low-pressure trough over eastern NSW brought in warm moist air from the Tasman Sea and a second low pressure trough off the coast of NSW reinforced this weather system and provided prolonged heavy rainfall (Figure 2.2).

A state of natural disaster was declared for the Central Coast region on Wednesday 12 February 2020, with widespread flooding and tens of thousands of residents lost power to their homes.



Figure 2.2 Mean sea level pressure map 8 January 2020 (Source: Bureau of Meteorology)

Figure 2.3 is a photograph of Tuggerah Lake at Toukley during dry weather conditions and during the February 2020 flood event.





Figure 2.3 Tuggerah Lake at Toukley photographs

2.2 Monitoring stations

There are 26 monitoring stations selected to be part of this report, including eight (8) water level stations, one (1) sewage pump station and seventeen (17) rainfall stations in the Tuggerah Lakes catchment. Station owners include CCC, DPIE and WaterNSW. Table 2.1 lists the stations presented in this report and Figure 2.3 provides a map of the stations within the catchment.

Station name	Station number	Owner	Monitoring parameter
Wyee Basin	561097	DPIE	Rainfall
Wallarah Creek Bridge	211420	DPIE	Water level
Wyong River at Yarramalong	211014	WaterNSW	Water level
Yarramalong	561137	DPIE	Rainfall
Hamlyn Terrace	561133	DPIE	Rainfall
Toukley	211401	DPIE	Water level and rainfall
Wyong Weir Upstream	211417	DPIE	Water level
Wyong River U/S Wyong Bridge	061386	CCC	Water level^
Sterland	567138	DPIE	Rainfall
Mardi Dam	561082	DPIE	Rainfall
Wyong South Sewage Treatment	NA	CCC	Pump station level
Lees Bridge	211425	DPIE	Water level
Kangy Angy	561132	DPIE	Rainfall
Berkeley Vale	561134	DPIE	Rainfall
Long Jetty	211418	DPIE	Water level
Tumbi Umbi	211419	DPIE	Water level
Bateau Bay	561069	DPIE	Rainfall
Strickland	561027	DPIE	Rainfall
Lisarow	561079	DPIE	Rainfall
Narara	561085	DPIE	Rainfall
Mount Elliot	561084	DPIE	Rainfall
Wyoming	561098	DPIE	Rainfall
Wamberal Reservoir	561147	CCC	Rainfall
Erina Heights Paul Oval	561145	CCC	Rainfall
Kincumber	561077	DPIE	Rainfall

Table 2.1 Monitoring station summary

^A rain gauge is located at Wyong River Bridge Upstream station, but data was unable to be delivered by Bureau of Meteorology in time for the publishing of this report.



Figure 2.3 Monitoring station location map (GoogleEarth)

3 February 2020 flood levels and rainfall totals

Table 3.1 summarises the flood peaks recorded at the water level stations during the February 2020 flood event and Figure 3.1 plots the water level stations during the flood event.

Station name	Station number	Owner	Datum	Level (m)
Wallarah Creek Bridge	211420	DPIE	AHD	1.65
Toukley	211401	DPIE	AHD	1.66
Wyong Weir Upstream	211417	DPIE	AHD	5.45
Lees Bridge	211425	DPIE	AHD	2.69
Long Jetty	211418	DPIE	AHD	1.67
Tumbi Umbi	211419	DPIE	AHD	1.88
Wyong River at Yarramalong	211014	WaterNSW	Zero gauge	7.78
			18.95m AHD	
Wyong River U/S Wyong Bridge	061386	CCC	AHD	2.17

Table 3.1 February 2020 water level flood peaks



Figure 3.1 February 2020 flood event water levels (datums as per Table 3.1)

Tables 3.2 presents the daily total rainfall recorded (midnight to midnight). Figures 3.2 to 3.9 plot the water level and daily rainfall for stations within the Tuggerah Lakes catchment included in this report. Figure 3.10 shows the water level recorded at the Wyong South Sewage Treatment Plant (STP).

Date	Wyee Basin	Hamlyn Terrace	Toukley	Yarramalong	Sterland	Mardi Dam	Kangy Angy	Berkeley Vale	Bateau Bay
01/02/2020	0	0	0	0	0	0	0	0	1.5
02/02/2020	11.5	12.5	15.5	16	6.5	5	4	2.5	1
03/02/2020	1	0.5	5.5	0.5	1.5	1.5	1	1	0
04/02/2020	0	0	0	0	0	0	0	0	0
05/02/2020	0	0	0	0	0	0	0	0	23
06/02/2020	23.5	19	*	56	33.5	28	43.5	50	138.5
07/02/2020	125	172	*	151	202.5	204	184	168.5	60
08/02/2020	26	45.5	*	75.5	77	50.5	64.5	71.5	117.5
09/02/2020	124.5	130.5	*	183.5	172.5	130.5	154	52	0.5
10/02/2020	1.5	1	*	0	1	1	1	0	0
11/02/2020	0.5	0	*	0	0.5	0	0.5	0	0
12/02/2020	1	3	0.5	2.5	5	2	1	1	10
13/02/2020	0.5	3.5	7	1.5	5.5	1	2.5	3.5	0
14/02/2020	0	0	0	0	0.5	0.5	0.5	0.5	6.5
15/02/2020	3.5	4	4	6	5.5	3.5	5.5	4	0.5
16/02/2020	0	0	0	0	0.5	0.5	0.5	0.5	3
17/02/2020	8.5	15	7.5	9	14	13.5	11.5	4.5	18.5
18/02/2020	26	21.5	13.5	12.5	11.5	15	12	15	0
19/02/2020	0.5	0.5	0	0	0	0.5	0	0	0
20/02/2020	0	0	0	0	0	0	0	0	29.5
21/02/2020	0	2	3	2	1.5	2	2.5	9	28
22/02/2020	4.5	3.5	1	4	9	20.5	20.5	26.5	0
23/02/2020	0	0	2.5	0	0.5	0	0.5	1.5	0
24/02/2020	1.5	0	0	0	0	0	0	0	0
25/02/2020	0	0	0	0	0	0	0	0	5.5
26/02/2020	0	0	0	0	0	0	0.5	0	0
27/02/2020	0	0	0	0	0	0	0	0	0
28/02/2020	0.5	0	0	0	0	0	0	0	0

Table 3.2 Daily rainfall totals (mm)

*Toukley rainfall station lost data during the February 2020 flood event due to excess tips being recorded.

Date	Strickland	Lisarow	Narara	Wyoming	Mount Elliot	Wamberal Reservoir	Erina Heights Paul Oval	Kincumber
01/02/2020	0	0	0	0	0	0	0	0
02/02/2020	6.5	6.5	5.5	5	7	5.5	6	6.5
03/02/2020	1	1	1	1	1	1	1	0.5
04/02/2020	0	0	0	0	0	0	0	0
05/02/2020	0	0	0	0	0	0	0	0
06/02/2020	41.5	44	38.5	31	33	31.5	34.5	21.5
07/02/2020	163	190.5	164.5	166	220	159	186.5	152
08/02/2020	75	65	56	53	64	51.5	55	29
09/02/2020	200	181.5	180	174	151.5	156	171.5	165
10/02/2020	1.5	1	1.5	0.5	2	0.5	2.5	1
11/02/2020	0.5	0	0	0	0	0	0	0
12/02/2020	2.5	2.5	4.5	4.5	4.5	2	3.5	2
13/02/2020	8	9.5	8	4.5	8.5	5.5	4.5	4
14/02/2020	0.5	0	0	0.5	0	0.5	0.5	0
15/02/2020	3.5	4	4.5	5	6	8.5	7	5
16/02/2020	0.5	0	0	0	0	0	0	0.5
17/02/2020	5	4.5	5.5	9.5	4.5	9	12	9
18/02/2020	9.5	9	14.5	13	9	4.5	10	10
19/02/2020	0	0	0.5	0.5	0.5	0	0.5	0
20/02/2020	0	0	0	0	0	0	0	0
21/02/2020	0	3	0	2	0	12.5	3	0
22/02/2020	9.5	11.5	11.5	16.5	16.5	20	21.5	5.5
23/02/2020	0	2	0.5	1	4.5	0.5	3	2
24/02/2020	0	0	0	0	0.5	0	0	0
25/02/2020	0	0	0	0	0	0	0	0
26/02/2020	2.5	3	3.5	3.5	1	2	5	2.5
27/02/2020	0	0	0	0	0	1	0	0
28/02/2020	0	0	0	0	0	0	0	0

Table 3.2 Daily rainfall totals (mm) (cont.)



Figure 3.2 Wallarah Creek Bridge water level and Wyee rainfall station plot

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Figure 3.3 Toukley water level and rainfall station and Hamlyn Terrace rainfall station plot

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Figure 3.4 Long Jetty, Lees Bridge and Tumbi Umbi water level station, and Bateau Bay and Berkeley Vale rainfall station plot



Figure 3.5 Kangy Angy, Lisarow and Strickland rainfall station plot

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Figure 3.6 Narara, Wyoming and Mount Elliot rainfall station plot

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Figure 3.7 Wamberal Rervoir, Erina Heights and Kincumber rainfall station plot



Figure 3.8 Wyong River water level stations and Yarramalong rainfall station plot

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Figure 3.9 Sterland and Mardi Dam rainfall station plot

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Figure 3.10 Wyong South STP effluent pond vs Long Jetty (AHD) water level plot

4 Rainfall intensity-frequency-duration

Rainfall intensities (mm/hr) were calculated for the February 2020 event and plotted against the June 2007 event as shown in Figures 4.1 to 4.17. Rainfall intensity-frequency-duration (IFD) curves were obtained from the Bureau of Meteorology's *Australian Rainfall and Runoff* (2019) datahub webpage. IFD curves for the former *Australian Rainfall and Runoff* (1987) are provided in Appendix A.

Rainfall intensity observations during the February 2020 were found to reach magnitudes up to the 1% Annual Exceedance Probability (AEP) (see Figure 4.17). At most stations, rainfall intensity observations during the February 2020 event were typically of rarer AEP for longer durations between 6 hours and 168 hours (7 day) compared with shorter durations.

February 2020 rainfall intensities exceeding those of the June 2007 event are noted at Mardi Dam, Berkeley Vale, Bateau Bay, Lisarow, Strickland, Narara, Mount Elliot, Wyoming, Kincumber, Wamberal Reservoir, Erina Heights Paul Oval and Yarramalong. These are typically observed for longer durations between 6 hour and 168 hour (7day).

It is noted that the Toukley rainfall station lost data during the February 2020 flood event and hence plots notably less than the June 2007 event in Figure 4.3. Hamlyn Terrace and Kangy Angy rainfall stations were installed in 2010 and therefore a comparison with the June 2007 event is not possible.

































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5 Rainfall and water level ranking

The top four recorded lake levels for the period of 1 Jan 1998 – 31 December 2019 is presented in Table 5.1. A comparison of the peak water level during the February 2020 event is also included.

Observed lake levels during the February 2020 event were found to be within 100-300mm of the highest lake level previously recorded since 1998 which occurred in June 2007.

Table 5.1	Tuggerah	Lake highest	water level	ranking (1	Jan 1998	8 – 31 D	ecember
2019)							

Water level station	Rank	Date	Water level (mAHD)	Comparison with Feb 2020 event (mAHD)
	1	10 June 2007	1.68	
Toukley^ 211401	2	15 June 2011	1.09	-
	3	9 May 2001	1.09	1.66
	4	6 June 2016	1.00	
	1	10 June 2007	1.64	
Long Jetty	2	23 April 2015	1.46	
Long Jetty 211418	3	15 June 2011	1.08	1.67
	4	9 May 2001	1.07	

^Toukley water level station experienced significant scour of the bank during the April 2015 flood event causing the gas line to be excavated and damaged, sections of data during this flood event were coded as lost.

The top four recorded rainfall intensities for the period of 1 Jan 1998 – 31 December 2019 are presented in Table 5.2. Table 5.3 provides the rankings for Berkeley Vale and Mardi Dam only, as these sites are nearby to the Wyong South STP. Rainfall intensities are provided for 24, 48, 72, 120- and 168-hour durations. A comparison of the maximum rainfall intensity during the February 2020 event is also included for each of the durations. Single events in the rankings are defined by the maximum rainfall intensity (for the required duration) with timestamps separated by a minimum of 48 hours.

Observations of rainfall intensity for the February 2020 event were found to rank amongst the top four highest previously recorded rainfall intensities since 1998. The February event intensities are noted to be particularly high in comparison to previous events for the 72, 120-and 168-hour durations.

Rainfall intensity rankings for each individual rainfall station are provided in Appendix B.

Table 5.2 Rainfall intensity rankings (1 Jan 1998 – 31 December 2019)

Rank	Rainfall station	Date	Rainfall intensity (mm/h)	Comparison with Feb 2020 event (mm/h)							
	2	4h (1 Day) Duratio	n								
1	Wamberal Reservoir (561147)	20 March 2011	13								
2	Sterland (567138)	8 June 2007	10.2	9.9 mm/h							
3	Yarramalong (561137)	8 June 2007	8.4	(8 Feb 2020 at Mount Elliot 561104)							
4	Bateau Bay (561069)	6 August 1998	7.7	Mount Enlot 501104							
	4	8h (2 Day) Duratio	n								
1	Wamberal Reservoir (561147)	20 March 2011	8.1	7							
2	Sterland (567138)	8 June 2007	7.3	/ mm/n							
3	Yarramalong (561137)	9 June 2007	6.5	(0-9 Feb 2020 at Storland 567161)							
4	Narara (561085)	9 June 2007	6.2	Stenanu 507 101)							
72h (3 Day) Duration											
1	Sterland (567138)	9 June 2007	6.3	6.4 mm/h							
2	Wamberal Reservoir (561147)	21 March 2011	5.7	(7-9 Feb 2020 at							
3	Narara (561085)	9 June 2007 5.7		Sterland 567161)							
4	Strickland (561027)	9 June 2007 5.7									
	12	20h (5 Day) Duratio	on								
1	Sterland (567138)	11 June 2007	3.8	4.1 mm/h							
2	Wamberal Reservoir (561147)	21 March 2011	3.5	(7-11 Feb 2020 at							
3	Narara (561085)	11 June 2007	3.4	Sterland 567161)							
4	Strickland (561027)	11 June 2007	3.4								
	16	68h (7 Day) Duratio	n								
1	Sterland (567138)	13 June 2007	2.7	2.9 mm/h							
2	Wamberal Reservoir (561147)	23 March 2011	2.5	(7-13 Feb 2020 at							
3	Narara (561085)	13 June 2007	2.5	Sterland 567161 &							
				Strickland 561055,							
4	Strickland (561027)	13 June 2007	2.4	3-9 Feb 2020							
				Lisarow 561107)							

Table 5.3 Berkeley Vale and Mardi Dam rainfall intensity rankings (1 Jan 1998 – 31 December 2019)

Deal		Data	Rainfall	Comparison with Feb 2020 event (mm/h)			
Rank	Rainfall station	Date	(mm/h)	Berkeley Vale (561134)	Mardi Dam (561082)		
		24h (1 Da	y) Duration				
1	Mardi Dam (561082)	8 Jun 2007	6.9				
2	Berkely Vale (561134)	25 Sep 2011	6.5	7.7 mm/h	8.5 mm/h		
3	Berkely Vale (561134)	6 Aug 1998	6.5	(8 Feb 2020)	(7 Feb 2020)		
4	Berkely Vale (561134)	1 Oct 2004	6.2				
		48h (2 Da	y) Duration				
1	Berkely Vale (561134)	9 Jun 2007	5.3				
2	Berkely Vale (561134)	7 Aug 1998	5	5.7 mm/h	5.6 mm/h		
3	Mardi Dam (561082)	28 Jan 2013	4.1	(8 Feb 2020)	(9 Feb 2020)		
4	Mardi Dam (561082)	21 Apr 2015	4				
		72h (3 Da	y) Duration				
1	Berkely Vale (561134)	9 Jun 2007	4.6				
2	Berkely Vale (561134)	8 Aug 1998	3.4	4.7 mm/h	5.4 mm/h		
3	Mardi Dam (561082)	29 Jan 2013	3.3	(9 Feb 2020)	(9 Feb 2020)		
4	Mardi Dam (561082)	22 Apr 2015	3.3				
		120h (5 Da	ay) Duration	1			
1	Berkely Vale (561134)	11 Jun 2007	2.8				
2	Berkely Vale (561134)	5 May 1998	2.1	2.9 mm/h	3.5 mm/h		
3	Berkely Vale (561134)	8 Aug 1998	2.1	(11 Feb 2020)	(11 Feb 2020)		
4	Mardi Dam (561082)	24 Apr 2015	2				

	168h (7 Day) Duration											
1	Berkely Vale (561134)	13 Jun 2007	2									
2	Mardi Dam (561082)	2 Feb 2013	1.8	2.1 mm/h	2.5 mm/h							
3	Mardi Dam (561082)	26 Apr 2015	1.5	(9 Feb 2020)	(13 Feb 2020)							
4	Berkely Vale (561134)	7 May 1998	1.5									

6 Conclusions

This letter report has provided a summary of the February 2020 flood event for rainfall and water level gauges in the Tuggerah Lakes catchment which are owned by CCC, DPIE and WaterNSW.

Rainfall intensities during the February 2020 event were found to reach up to the 1% AEP intensity at Yarramalong. Typically, the rarer AEP for longer durations between 24 hour and 168 hour were the highest intensities when compared with the 2007 flood event. Sterland, Lisarow and Strickland captured the maximum observed rainfall intensities for durations of 72, 120 and 168 hours during the February 2020 event. These intensities are the highest on record since 1998 for the 72, 120 and 168 hour durations.

Water levels in Tuggerah Lakes peaked at 1.67 mAHD during the February 2020 event. Peak lake levels were found to be within 100-300 mm of the highest lake level previously recorded since 1998 which occurred in June 2007.

1987 IFD rainfall plots and rainfall intensity rankings for each station are provided in Appendix A and B.

We trust this report is satisfactory to meet Central Coast Council's requirements. Should you require further information please contact Sarah Dakin on (02) 9949 0242 or by email at <u>sarah-kate.dakin@mhl.nsw.gov.au</u>.

Yours sincerely

Adam Joyner Manager Environmental Data, MHL Manly Hydraulics Laboratory Appendix A: 1987 Rainfall intensity-frequency-duration charts



































Appendix B: Rainfall intensity rankings per rainfall station

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						Dura	ation				
Station	Rank	24 h (1 day)	48 h (2 day)	72 h (3 day)	120 h	(5 day)	168 h	(7 day)
		Intensity (mm/h)	Time								
	1	10.2	8-Jun-07	7.3	8-Jun-07	6.3	9-Jun-07	3.8	11-Jun-07	2.7	13-Jun-07
Sterland	2	6	21-Apr-15	5.1	21-Apr-15	4.3	22-Apr-15	2.6	23-Apr-15	1.9	26-Apr-15
(567138)	3	5.9	5-Jun-16	3.7	6-Jan-16	2.7	31-Aug-19	2	7-Jan-16	1.4	9-Jan-16
	4	5.9	12-Jun-11	3.7	5-Jun-16	2.7	23-Feb-13	1.7	24-Feb-13	1.4	2-Feb-13
	1	6.2	8-Jun-07	5	9-Jun-07	4	9-Jun-07	2.5	9-May-01	1.9	25-Apr-08
Wyee	2	6.1	6-May-01	4.5	21-Apr-15	3.7	8-May-01	2.5	11-Jun-07	1.8	11-May-01
(561097)	3	6	21-Apr-15	4.1	7-May-01	3.2	22-Apr-15	2.2	24-Apr-08	1.8	13-Jun-07
	4	5.7	16-Apr-11	3.5	18-Nov-13	2.7	6-Jan-16	1.9	23-Apr-15	1.4	25-Apr-15
	1	5.5	8-Jun-07	3.7	28-Jan-13	2.9	9-Jun-07	2.1	26-Apr-08	1.6	27-Apr-08
Toukley	2	5.2	28-Jan-13	3.7	8-Jun-07	2.7	25-Apr-08	1.9	9-May-01	1.3	8-May-01
(211401)	3	4.8	5-Jun-16	3.4	7-Aug-98	2.6	8-May-01	1.8	10-Jun-07	1.3	2-Feb-13
	4	4.8	6-Aug-98	3.3	5-Jun-16	2.6	29-Jan-13	1.6	31-Jan-13	1.3	12-Jun-07
	1	6.9	8-Jun-07	4.6	8-Jun-07	3.3	29-Jan-13	2	24-Apr-15	1.8	2-Feb-13
Mardi Dam	2	6	28-Nov-18	4.1	28-Jan-13	3.3	22-Apr-15	2	31-Jan-13	1.5	26-Apr-15
(561082)	3	5.8	30-Aug-19	4	21-Apr-15	3.1	9-Jun-07	1.9	11-Jun-07	1.3	13-Jun-07
	4	5.4	25-Sep-11	3.7	30-Aug-19	2.8	31-Aug-19	1.7	2-Sep-19	1.3	6-Jun-16
	1	6.5	25-Sep-11	5.3	9-Jun-07	4.6	9-Jun-07	2.8	11-Jun-07	2	13-Jun-07
Berkeley	2	6.5	6-Aug-98	5	7-Aug-98	3.4	8-Aug-98	2.1	5-May-98	1.7	2-Feb-13
(561134)	3	6.2	1-Oct-04	3.9	18-Apr-12	3.1	29-Jan-13	2.1	8-Aug-98	1.5	7-May-98
	4	5.8	8-Mar-00	3.8	28-Jan-13	3	22-Apr-15	1.9	16-May-03	1.5	10-Aug-98
	1	7.7	6-Aug-98	5.4	7-Aug-98	3.9	8-Aug-98	2.4	9-Aug-98	1.7	11-Aug-98
Bateau Bay	2	6.3	5-Jun-16	4.3	5-Jun-16	3.4	22-Jul-11	2.2	23-Jul-11	1.6	6-Apr-99
(561069)	3	6.2	20-Mar-11	4.1	21-Jul-11	3.1	9-Jun-07	2.2	4-Apr-99	1.6	22-Jul-11
	4	6.2	25-Sep-11	3.8	20-Mar-11	3.1	22-Apr-15	2	9-Jun-07	1.5	2-Feb-13

						Dura	ation				
Station	Rank	24 h (1 day)	48 h (2 day)	72 h (3 day)	120 h	(5 day)	168 h	(7 day)
		Intensity (mm/h)	Time								
	1	5.9	16-Apr-11	3.9	28-Jan-13	2.9	29-Jan-13	1.8	31-Jan-13	1.7	2-Feb-13
Hamlyn	2	5.4	28-Jan-13	3.8	21-Apr-15	2.8	22-Apr-15	1.7	23-Apr-15	1.3	26-Apr-15
(561133)	3	5.2	25-Sep-11	3.4	28-Jan-15	2.5	31-Aug-19	1.7	11-Jun-17	1.2	2-Feb-15
, , , , , , , , , , , , , , , , , , ,	4	5.1	21-Apr-15	3.2	30-Aug-19	2.5	22-Jul-11	1.6	19-Nov-13	1.2	18-Nov-13
	1	5.9	30-Aug-19	4.3	28-Jan-13	3.5	29-Jan-13	2.1	31-Jan-13	1.9	2-Feb-13
Kangy Angy	2	5.8	20-Mar-11	3.8	18-Apr-12	2.9	22-Apr-15	1.8	24-Apr-15	1.3	26-Apr-15
(561132)	3	5.5	28-Nov-18	3.8	30-Aug-19	2.8	31-Aug-19	1.7	1-Sep-19	1.3	19-Mar-17
	4	5.4	25-Sep-11	3.4	20-Mar-11	2.6	19-Apr-12	1.7	18-Mar-17	1.2	1-Sep-19
	1	5.9	9-Jun-07	5.4	9-Jun-07	5.3	9-Jun-07	3.2	11-Jun-07	2.3	12-Jun-07
Lisarow	2	5.7	5-Jun-16	4.4	28-Jan-13	3.5	29-Jan-13	2.1	31-Jan-13	1.8	2-Feb-13
(561079)	3	5.7	18-Apr-12	3.9	21-Apr-15	3.4	22-Apr-15	2	23-Apr-15	1.5	17-May-03
	4	5.3	14-May-03	3.8	14-May-03	2.9	31-Aug-19	2	17-May-03	1.5	26-Apr-15
	1	6.5	8-Jun-07	6.1	9-Jun-07	5.7	9-Jun-07	3.4	11-Jun-07	2.4	13-Jun-07
Strickland	2	6.2	18-Apr-12	4.1	21-Apr-15	3.7	22-Apr-15	2.3	24-Apr-15	1.7	26-Apr-15
(561027)	3	6.2	5-Jun-16	4	5-Jun-16	2.9	8-Aug-98	2	16-May-03	1.5	17-May-03
	4	5.3	6-Aug-98	4	7-Aug-98	2.9	15-May-03	1.8	5-Feb-02	1.5	6-Feb-02
	1	6.4	8-Jun-07	6.2	9-Jun-07	5.7	9-Jun-07	3.4	11-Jun-07	2.5	13-Jun-07
Narara	2	6.1	5-Jun-16	4.4	21-Apr-15	3.8	22-Apr-15	2.3	23-Apr-15	1.8	2-Feb-13
(561085)	3	6	18-Apr-12	4.3	28-Jan-13	3.4	29-Jan-13	2.1	5-Feb-02	1.7	26-Apr-15
	4	5.8	28-Jan-13	4.2	7-Aug-98	3.1	8-Aug-98	2.1	31-Jan-13	1.7	5-Feb-02
	1	6.5	5-Jun-16	5.2	7-Aug-98	4.5	9-Jun-07	2.7	10-Jun-07	2	12-Jun-07
Mount Elliot	2	6.3	6-Aug-98	4.6	5-Jun-16	4.1	8-Aug-98	2.5	9-Aug-98	1.9	2-Feb-13
(561084)	3	5.9	8-Mar-00	4.4	8-Jun-07	3.6	29-Jan-13	2.2	5-Feb-02	1.8	11-Aug-98
	4	5.6	1-Oct-04	4.3	28-Jan-13	3.4	22-Apr-15	2.2	31-Jan-13	1.8	6-Feb-02

						Dura	ation				
Station	Rank	24 h (1 day)	48 h (2 day)	72 h (3 day)	120 h	(5 day)	168 h (7 day)	
		Intensity (mm/h)	Time								
	1	6.2	5-Jun-16	5.2	21-Apr-15	4.3	22-Apr-15	2.6	23-Apr-15	1.9	26-Apr-15
Wyoming	2	5.9	28-Jan-13	4.4	28-Jan-13	4.1	9-Jun-07	2.5	11-Jun-07	1.8	13-Jun-07
(561098)	3	5.6	21-Apr-15	4	9-Jun-07	3.6	29-Jan-13	2.2	31-Jan-13	1.7	2-Feb-13
	4	5	9-Jun-07	4	5-Jun-16	2.7	5-Jun-16	1.9	16-May-03	1.4	6-Feb-02
	1	6.8	5-Jun-16	5.1	7-Aug-98	4.4	9-Jun-07	2.7	9-Jun-07	2	11-Jun-07
Kincumber	2	6.8	7-Jun-07	4.7	5-Jun-16	3.7	8-Aug-98	2.3	18-Mar-17	1.8	19-Mar-17
(561077)	3	6.4	6-Aug-98	4.5	21-Apr-15	3.5	22-Apr-15	2.3	9-Aug-98	1.7	2-Feb-13
	4	5.4	19-Jan-15	4.5	8-Jun-07	3.5	22-Jul-11	2.2	23-Jul-11	1.6	22-Jul-11
	1	13	20-Mar-11	8.1	20-Mar-11	5.7	21-Mar-11	3.5	21-Mar-11	2.5	23-Mar-11
Wamberal	2	6.8	5-Jun-16	4.6	5-Jun-16	3.3	9-Jun-07	2	11-Jun-07	1.6	2-Feb-13
(561147)	3	6.5	16-Apr-11	3.5	28-Jan-13	3.1	5-Jun-16	1.9	7-Jun-16	1.5	6-Jun-16
, , , , , , , , , , , , , , , , , , ,	4	5	25-Sep-11	3.3	17-Apr-11	3	29-Jan-13	1.8	31-Jan-13	1.5	11-Jun-07
Frina	1	4.9	4-Apr-15	4.3	21-Apr-15	3.9	9-Jun-07	2.4	10-Jun-07	1.7	11-Jun-07
Heights Paul	2	4.9	7-Jun-07	4	28-Jan-13	3.7	22-Apr-15	2.2	23-Apr-15	1.6	26-Apr-15
Oval	3	4.8	30-Aug-19	3.7	8-Jun-07	3.4	29-Jan-13	2	31-Jan-13	1.4	2-Feb-13
(561145)	4	4.7	21-Apr-15	3.3	30-Aug-19	2.6	31-Aug-19	1.7	19-Nov-13	1.3	18-Nov-13
	1	8.4	8-Jun-07	6.5	9-Jun-07	5.1	9-Jun-07	3.1	11-Jun-07	2.2	13-Jun-07
Yarramalong	2	5.8	30-Aug-19	4.2	21-Apr-15	3.5	22-Apr-15	2.1	23-Apr-15	1.7	2-Feb-13
(561137)	3	5.5	28-Jan-13	4	28-Jan-13	3.1	29-Jan-13	1.9	31-Jan-13	1.5	24-Apr-15
	4	5.1	29-Mar-02	3.5	23-Feb-13	2.7	23-Feb-13	1.7	31-Mar-02	1.2	1-Apr-02

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