Complete Storm Events

Australian Rainfall and Runoff
A guide to runoff estimation

Overview

Complete design storm events

Chow, VT; Maidment, DR & Mays, LW (1988) “Applied Hydrology”

Phillips, BC; Lees, SJ, Lynch, SJ (1994) “Embedded design storms – An improved procedure for design flood level estimation”

Rigby, EH and Bannigan, DJ (1996) “The embedded design concept – A critical review”

Rigby, EH and Bannigan, DJ (2003) “Storms, storm bursts and flood estimation – A need for review of the AR&R procedures”

Phillips, BC; Yu, S and de Silva, N. (2005) An Approach to applying Rainfall Areal Reduction Factors in Urban Catchments?

UPRCT, 1994 to date

In the early 1990s when a traditional design storm approach was used to generate design flood hydrographs for an unsteady flood routing model of the Parramatta River and tributary creeks it was noted that 100 yr ARI design flood levels estimated by the model were in the order of 1.0 m lower than previously estimated in the lower reaches of the study area in the vicinity of the Parramatta CBD.

It was eventually concluded that the apparent over-attenuation of the design flood wave was due to the fact that the creeks and channels were being started “dry" and that the available channel storage particularly in the lower reaches was significant in comparison with the volume of the critical 90 minute duration storm.

Consequently a decision was made by the UPRCT to embed the design rainfall burst obtained from AR&R, 1987 into the historical April 1988 storm. This approach gave design flood levels which were more in keeping with historical flood levels and previously estimated design flood levels and confirmed the benefits of this approach.

UPRCT, 1994

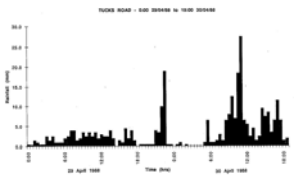


Figure 2a Recorded Rainfall at Tucka Road 00:00 25/04/88 to 18:00 30/4/88

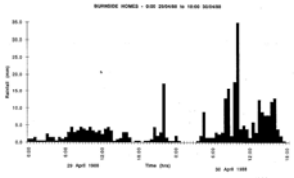
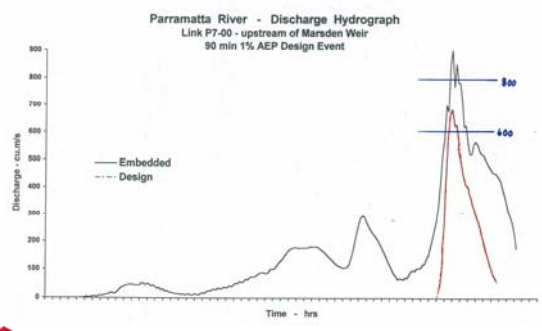
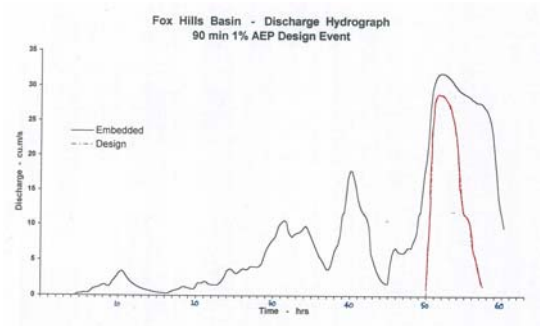


Figure 2b Recorded Rainfall at Burnside Homes 00:00 25/04/88 to 18:00 30/4/88

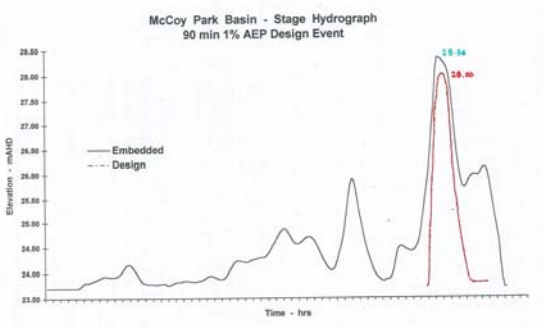
UPRCT, 1994



UPRCT, 1994



UPRCT, 1994



UPRCT, 1994 to date

The adoption of the "embedded" design storm approach raises a number of questions which have potential implications for design flood estimation practices particularly in urban catchments with short duration critical storms including:

(i) is an "embedded" design storm more realistic than a stand-alone (isolated) design storm burst?,
(ii) is channel and floodplain storage leading to under-estimates of design flood levels because creeks and channels are being started "dry" when in reality antecedent rainfall and runoff are partially filling creeks and stream prior to higher rainfall bursts within storms?
(iii) are the required storage volumes for retarding basins being under-estimated because it is also assumed that retarding basins are "dry" at the commencement of design rainfall?

It was concluded that in the case of the Upper Parramatta River catchment that an "embedded" design storm approach provides more realistic design flood levels than the traditional design flood estimation approach

Prospect Creek, 2003-2004

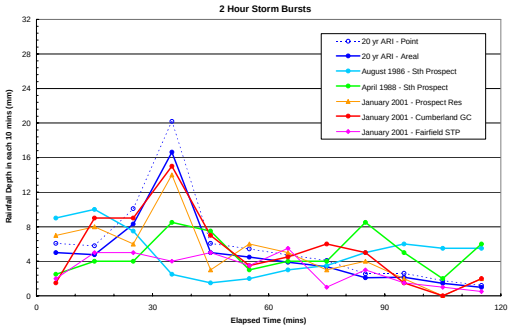
Consideration was given to embedding design storm bursts into the observed 2001 storm based on the approach adopted by the UPRCT in the mid-1990s (Phillips et al, 1994)

This approach was considered because of the calculated similarity of the 2 hour and 9 hour bursts in the 2001 storm to the AR&R design bursts

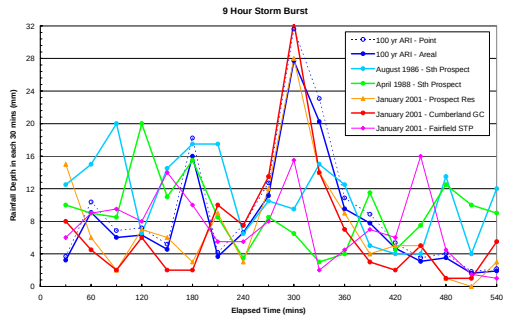
Prospect Creek, 2003-2004

Location of Rainfall Gauges

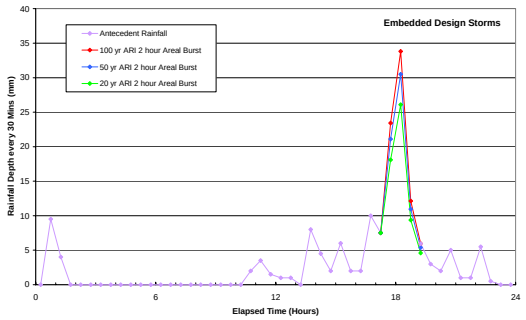
Prospect Creek, 2003-2004



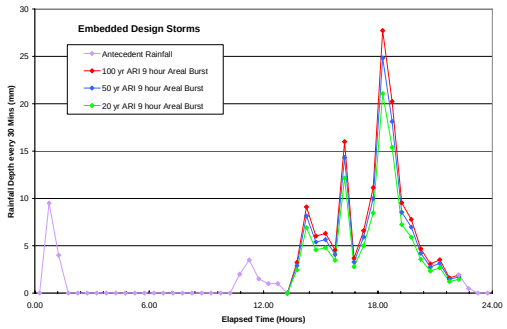
Prospect Creek, 2003-2004



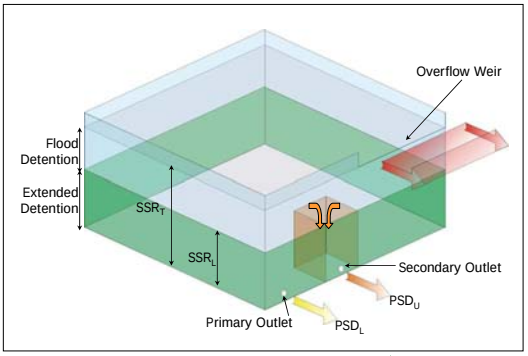
Prospect Creek, 2003-2004



Prospect Creek, 2003-2004



UPRCT, 2002-2005

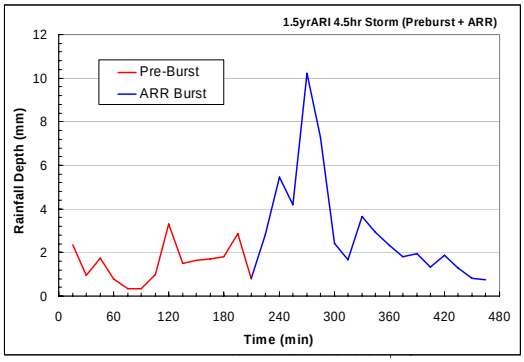


UPRCT, 2002-2005

1 yr -4 yr ARI Events

2 hr Burst	*Depth*	24.7	15.0	**10.3**	1.9	1.5	0.2	0.0	0.0	
	Duration	2.7	10.2	**1.3**	2.0	0.5	0.9	0.0	0.0	
	Intensity	9.2	1.5	**7.9**	1.0	2.9	0.2	*n/a*	*n/a*	
3 hr Burst	*Depth*	196.4	46.3	31.7	**18.4**	7.5	3.8	1.5	0.6	0.3	0.0
	Duration	25.8	5.8	13.3	**2.0**	9.4	10.8	0.5	1.1	0.3	0.0
	Intensity	7.6	8.0	2.4	**9.2**	0.8	0.4	2.9	*0.5*	*1.1*	*n/a*
4.5 hr Burst	*Depth*	123.2	113.0	84.2	58.9	42.0	**23.9**	*3.75*	0.4	0.3	
	Duration	20.7	29.8	37.4	27.0	5.9	**4.0**	*0.5*	1.2	1.8	
	Intensity	5.9	3.8	2.3	2.2	7.1	**6.0**	7.5	0.3	0.2	
6 hr Burst	*Depth*	83.9	51.2	**13.6**	3.2						
	Duration	35.9	27.8	**6.5**	8.4						
	Intensity	2.3	1.8	**2.1**	0.4						
9 hr Burst	*Depth*	81.7	52.4	34.5	**8.6**	4.6	0.0				
	Duration	32.9	11.8	25.1	**5.4**	1.1	0.0				
	Intensity	2.5	4.4	1.4	**1.6**	4.2	*n/a*				

UPRCT, 2002-2005

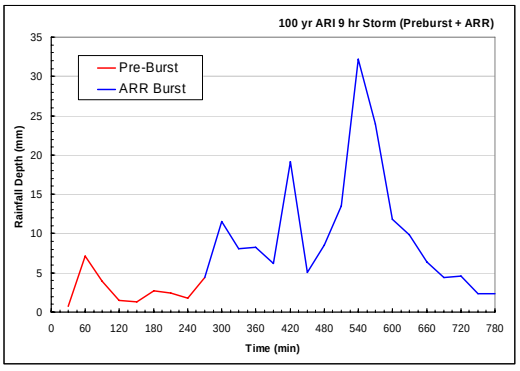


UPRCT, 2002-2005

>10 yr ARI Events

2 hr Burst	*Depth*	165.0	99.7	74.2	**41.2**	2.8	0.0	0.0	
	Duration	22.8	32.1	39.9	**5.7**	2.2	0.0	0.0	
	Intensity	7.2	3.1	1.9	**7.2**	1.3	*n/a*	*n/a*	
3 hr Burst	*Depth*	139.2	99.7	74.2	69.4	**22.0**	2.8	0.3	0.0
	Duration	21.8	31.3	38.9	28.7	**4.1**	2.2	1.8	0.0
	Intensity	6.4	3.2	1.9	2.4	**5.4**	1.3	0.2	*n/a*
4.5 hr Burst	*Depth*	123.2	99.7	58.9	**42.0**	0.4	0.3		
	Duration	20.7	29.8	27.0	**5.9**	1.2	1.8		
	Intensity	5.9	3.3	2.2	**7.1**	0.3	0.2		
6 hr Burst	*Depth*	101.3	100.8	58.7	58.7	**42.0**	3.8	2.8	0.3
	Duration	29.8	19.3	26.8	26.8	**5.9**	10.8	2.2	1.8
	Intensity	3.4	5.2	2.2	2.2	**7.1**	0.4	1.3	0.2
9 hr Burst	*Depth*	101.3	71.9	40.9	23.6	**21.7**	6.8	4.7	0.4
	Duration	28.3	16.2	21.0	5.6	**4.0**	1.7	10.8	1.1
	Intensity	3.6	4.4	1.9	4.2	**5.4**	4.0	0.4	0.3

UPRCT, 2002-2005



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The Wollongong Experience

Rigby, EH and Bannigan, DJ (1996) “The embedded design concept – A critical review”

Rigby, EH and Bannigan, DJ (2003) “Storms, storm bursts and flood estimation – A need for review of the AR&R procedures”