FLOOD STUDY

FOR

JAMBEROO ACTION PARK
JAMBEROO RD

JAMBEROO

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& Partners

Consulting Civil-Structural Engineers

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1. INTRODUCTION

GENERAL INFORMATION

Jamberoo Action Park is planning major extensions and Kiama Municipal Council requires a flood study be conducted to determine the effects of the proposed changes on downstream properties.

OBJECTIVES

The objectives of this flood study are:

- Obtain all necessary data to allow the determination of maximum flows for a range of critical design storms on site.
- Determine necessary changes to the site storage network to prevent any adverse effects from the proposed changes.

2. SITE

2.1 DESCRIPTION

The site is located in the Jamberoo foothills south of Albion Park. The site is divided into two catchments labelled Eastern and Western catchments. The eastern catchment takes in most of the park and drains through a large dam known as Jim's dam in the south-east corner of the lot. The Western catchment takes in the neighbouring valley and significant portions fall outside of the parks boundaries. This catchment drains through a gully in the southwest corner of the site. Both catchments link up farther downstream and eventually reach the ocean via the Minnamurra River.

2.2 AVAILABLE DATA

Data available for this flood study includes the 10m contour data provided by the Department of Lands as well as a survey of the park conducted by LandTeam as well as an additional survey conducted by C. Robson and Associates.

3. CATCHMENT

3.1 CATCHMENT DESCRIPTION

The site that is the subject of this study is located on the edge of the catchment of the Minnamurra River that flows into the ocean approximately 7.5 km away.

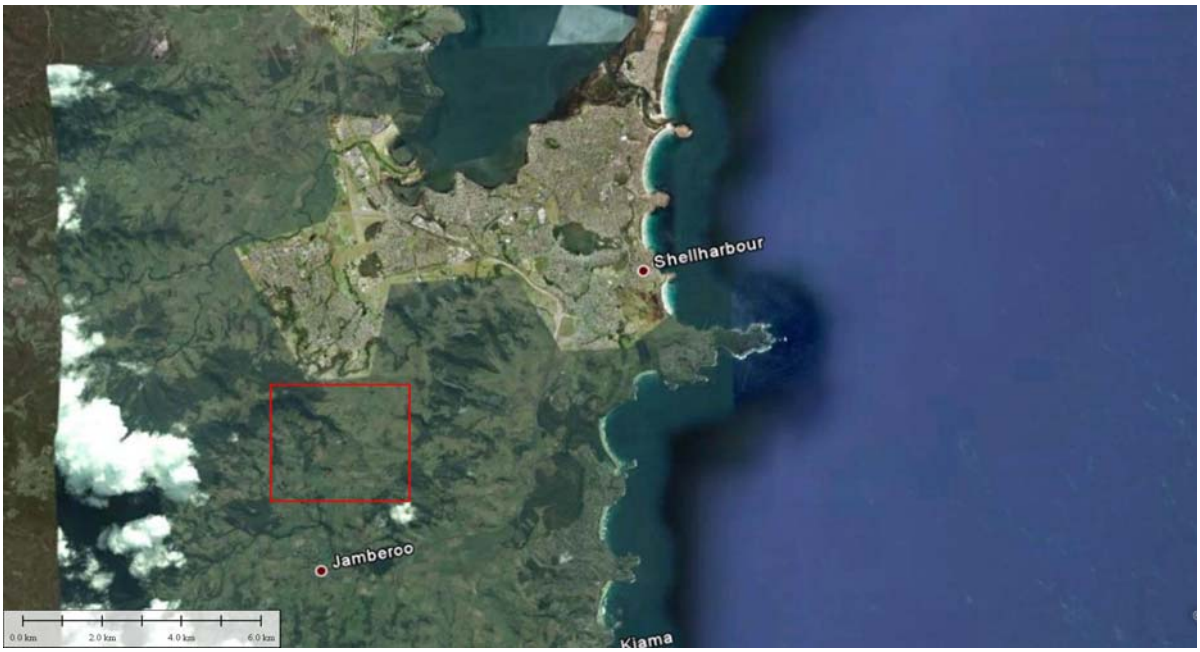

Figure 3.1 Catchment Location

Figure 3.2 Site Location

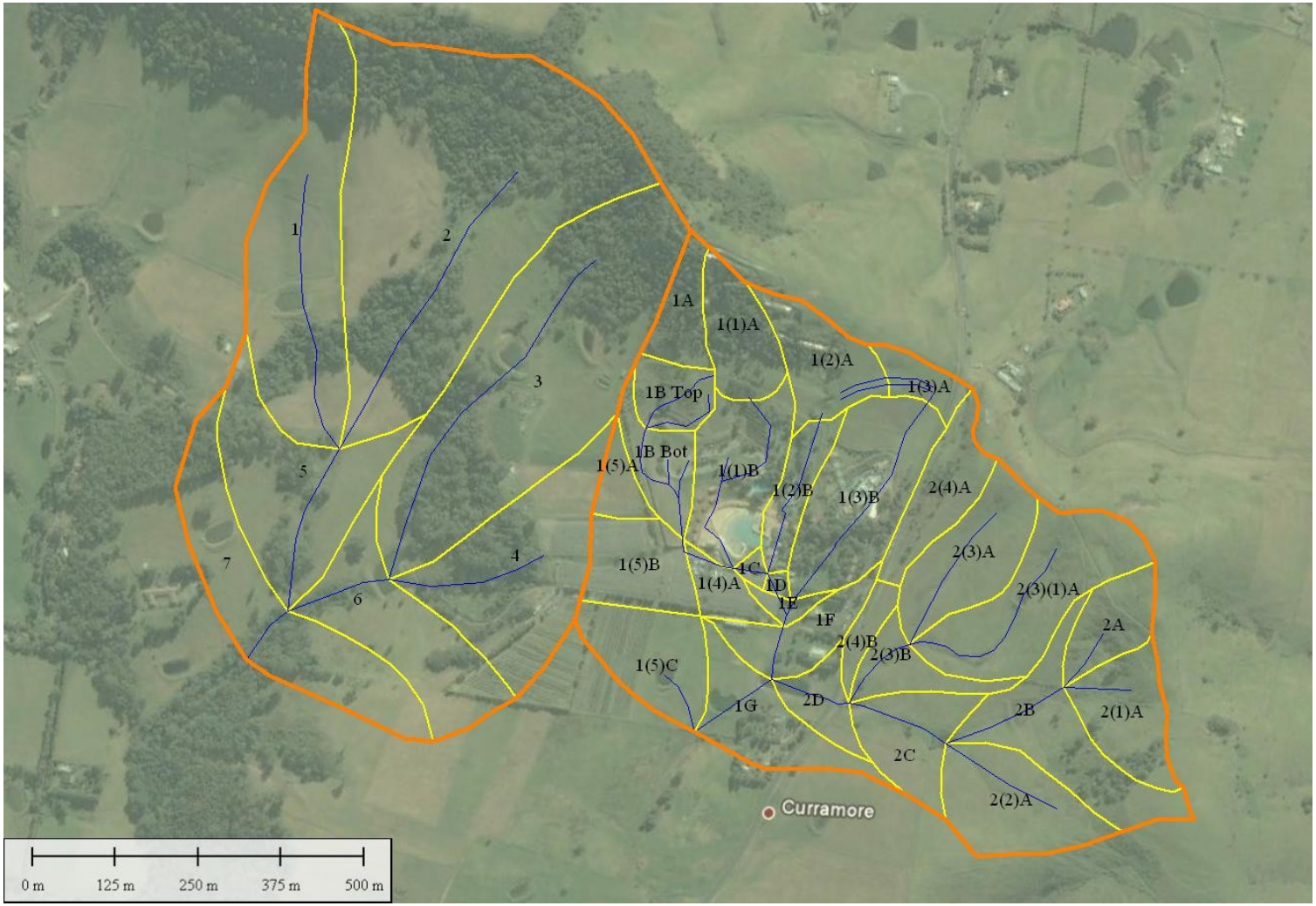

Figure 3.3 Pre Dev Catchment Plan

Table 3.1 Pre Dev Sub-Catchment Areas

Western Catchment SubArea	***Area (Ha)***	***Eastern Catchment SubArea***	***Area (Ha)***
1	***7.155***	***1A***	***1.208***
2	***17.084***	***1BTop***	***1.162***
3	***12.217***	***1BBot***	***1.426***
4	***6.120***	***1(1)A***	***1.877***
5	***5.008***	***1(1)B***	***3.106***
6	***4.159***	***1C***	***0.178***
7	***5.196***	***1(2)A***	***2.156***
		1(2)B	***1.250***
		1D	***0.125***
		1(3)A	***0.802***
		1(3)B	***4.201***
		1E	***0.337***
		1(5)A	***0.695***
		1(5)B	***2.040***
		1(4)A	***0.817***
		1F	***1.667***
		2A	***1.507***
		2(1)A	***2.211***
		2B	***3.491***
		2(2)A	***3.039***
		2C	***2.097***
		2(3)A	***2.824***
		2(3)(1)A	***4.214***
		2(3)B	***1.266***
		2(4)A	***1.955***
		2(4)B	***0.607***
		2D	***1.053***
		1(5)A	***2.512***
		1G	***2.476***

Total Western Catchment Area = 56.94 Hectares

Total Eastern Catchment Area = 52.29 Hectares

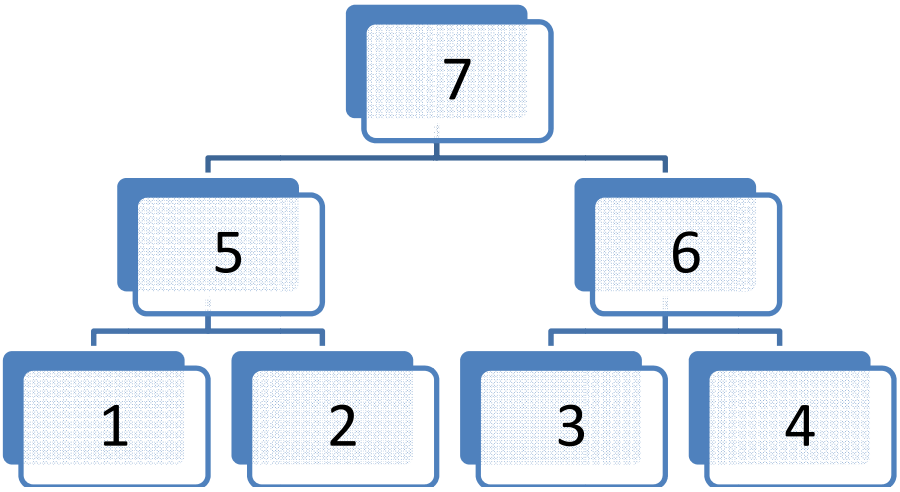

Fig 3.4 Pre Dev Flow paths for western catchment

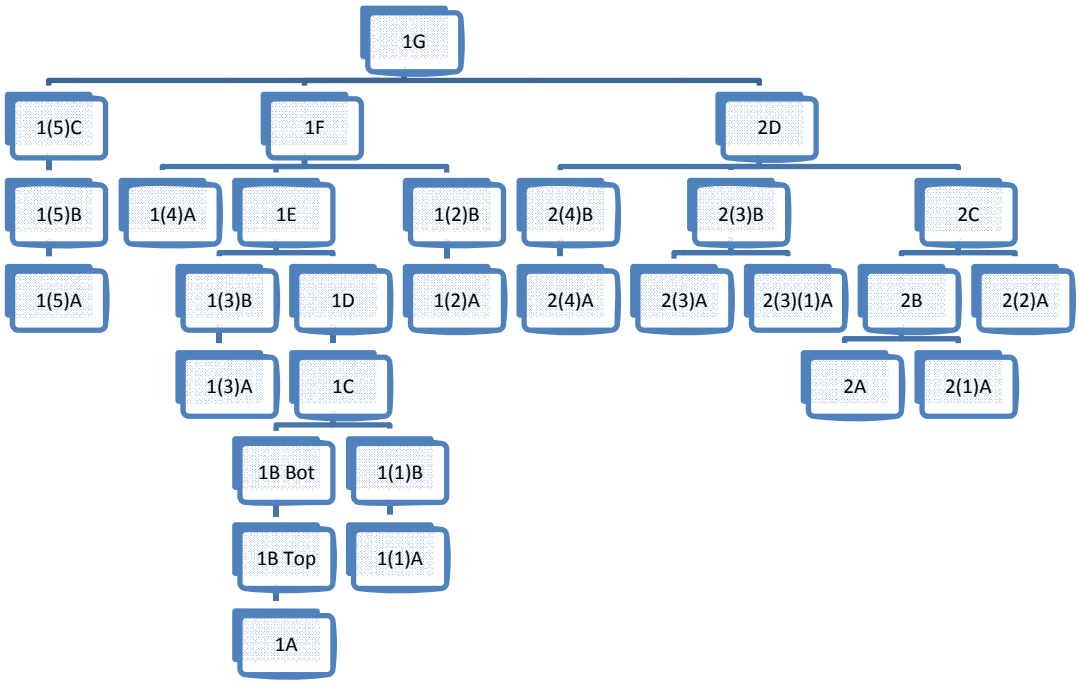

Fig 3.5 Pre Dev Flow paths for Eastern catchment

Fig 3.6 Post Dev Sub-Catchment Areas

Western Catchment	Area (Ha)	Eastern Catchment	Area (Ha)
1	7.16	1A	1.21
2	17.08	1BTop	1.16
3	12.21	1BBot	1.43
4	5.48	1(1)A	1.88
5	5.01	1(1)B	3.11
6	3.95	1C	0.18
7	5.20	1(2)A	2.16
		1(2)B	1.25
		1D	0.12
		1(3)A	0.80
		1(3)B	4.20
		1E	0.34
		1(5)A	0.70
		1(4)A	0.82
		1(5)B	2.04
		1F	1.66
		2A	1.51
		2(1)A	2.21
		2B	3.49
		2(2)A	3.04
		2C	2.10
		2(3)A	2.82
		2(3)(1)A	4.21
		2(3)B	1.27
		2(4)A	1.96
		2(4)B	0.61
		2D	1.05
		1(5)C	3.65
		1G	3.55

Total Western Catchment Area = 56.09 Hectares

Total Eastern Catchment Area = 54.53 Hectares

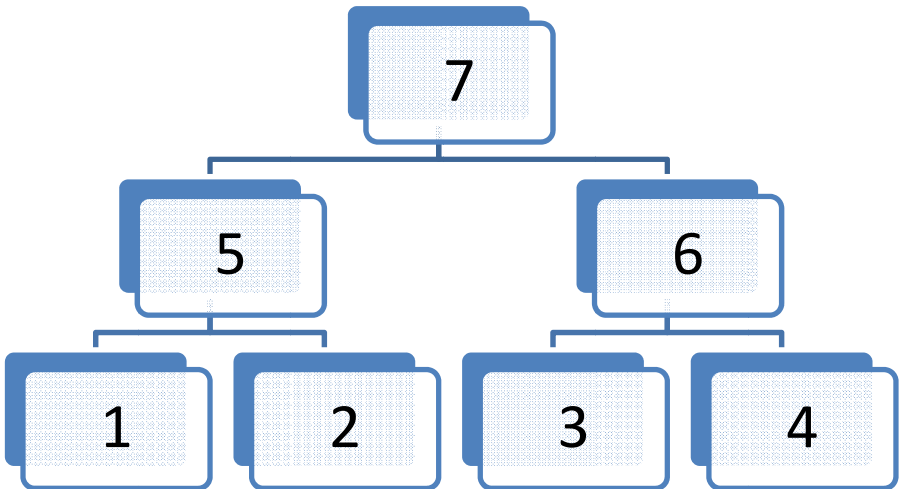

Fig 3.7 Post Dev Flow Paths for Western Catchment

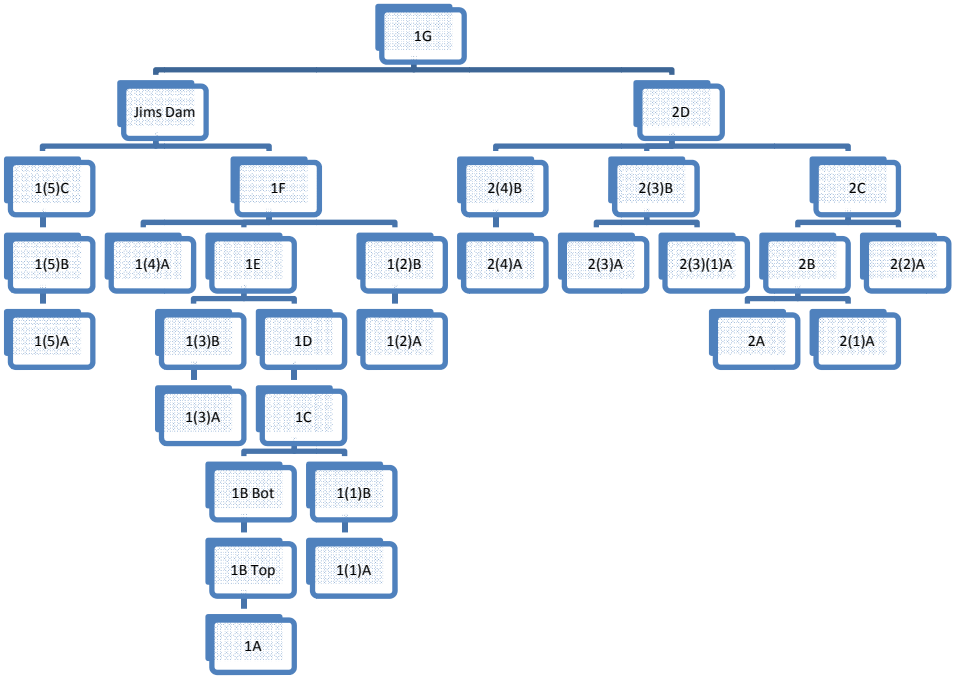

Fig 3.8 Post Dev flow paths for Eastern Catchment

4. HYDROLOGY

4.1 DESIGN FLOOD

The primary flood to be examined in this study is the ARI=100year event, however all standard duration design storms will be generated and analysed.

4.2 CATCHMENT MODELS

Separate models were constructed for each of the two catchments as they are entirely separated. Both models were constructed for existing conditions and then altered to represent the transitioning of significant areas of the park from pervious areas (primarily open grassed space) to impervious (several new car parks as well as a significant amount of hard surfaces being introduced throughout the park).

4.3 CATCHMENT DATA

For the catchment to be analysed design rainfall data is needed. This information comes from Australian Rainfall and Runoff. The data required is; rainfall intensities, skewness, geographical short duration factors and values detailing the location of the site. Figure 4.1 outlines the values used.

Figure 4.1 IFD Data

	Jamberoo
I 2Yr 1 Hr (mm/Hr)	**52.00**
I 2Yr 12 Hr (mm/Hr)	**11.25**
I 2Yr 72 Hr (mm/Hr)	**4.00**
I 50Yr 1 Hr (mm/Hr)	**118.00**
I 50 Yr 12 Hr (mm/Hr)	**27.50**
I 50Yr 72 Hr (mm/Hr)	**9.70**
F2	**4.28**
F50	**15.80**
G	**0**
Zone	**A**
Annual Rain (mm)	**1400**
PMP Co eff	**.65**
Zone	**1**
Elevation (m)	**40**
State	**NSW**
Terrain	**Smooth**

To determine the maximum flow rates using WBNM some parameters needed to be chosen. The values chosen for the parameters were:

- Initial loss = 0mm
- Continual loss = 2.5 mm/hr
- Lag coefficient = 1.6
- Stream lag factor = 1.0

5. CHANGES FROM PRE DEVELOPMENT TO POST DEVELOPMENT

The pre developed sub-catchments have been modified for both the Western and Eastern catchments to produce the post developed analysis. The Western catchment has been reduced in size. This is due to the stormwater from the existing and proposed carparks that are in sub catchment 4 now being directed by drainage pits & pipes to Jim's dam in the Eastern Catchment. The Eastern catchment flow paths have been modified. This is due to the stormwater from the existing and proposed carparks in sub catchments 1(5)A, 1(5)B and 1(5)C now being directed by drainage pits & pipes to Jim's dam. It is important to note that the existing storage volumes have been used for the analysis to produce an accurate result for the increase in outflow from the site at the outlet of both the Western and Eastern catchments due to the modifications to the park. The increase in outflow and the critical duration will then be used to calculate the required increase in dam volume to limit the outflow to pre developed levels.

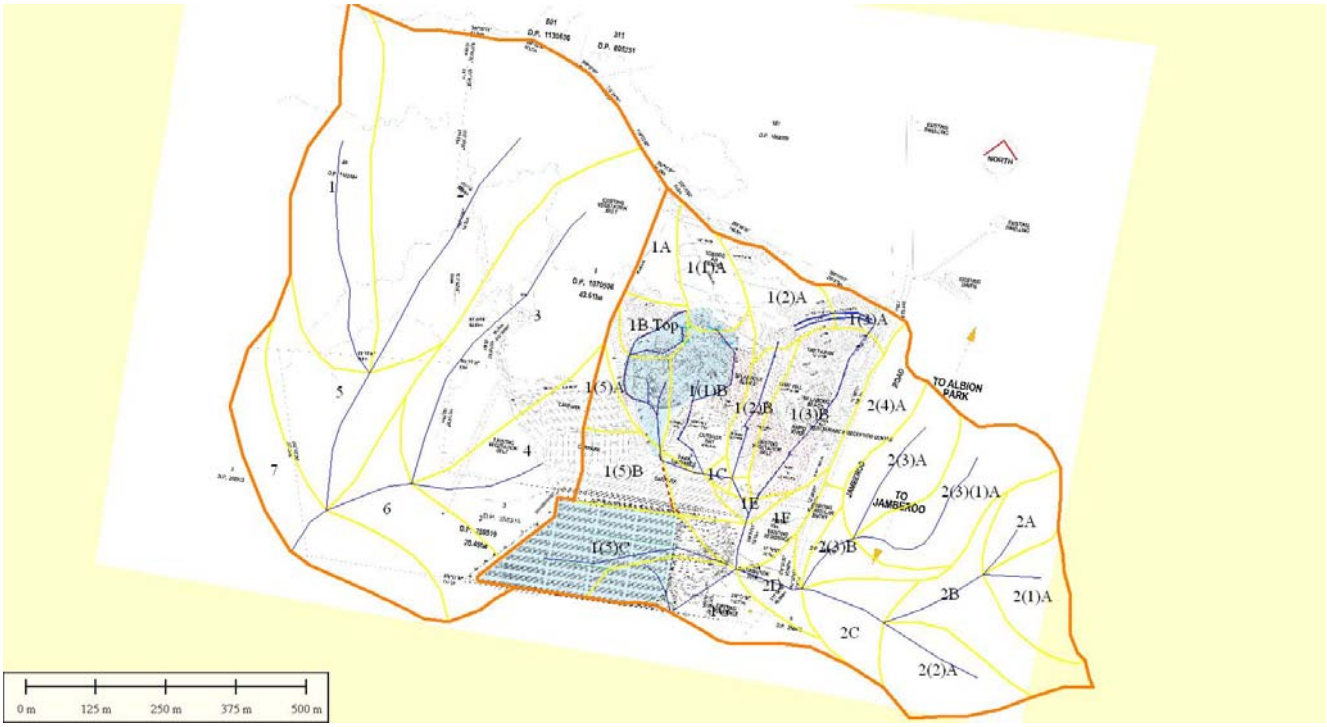

Fig 5.1 Post Dev Catchment Plan

6. WESTERN CATCHMENT HYDROLOGY

WBNM was used to determine flow characteristics for the storms from ARI 20 to PMF at 7 durations ranging from 20 minutes to 6 hours. This entire catchment drains through the dam called bottom dam. The first consideration will be to determine the critical duration for each ARI, followed by an examination of the runoff volumes before and after the proposed site modifications.

	ARI (Years)	**5**	**10**	**20**	**50**	**100**	**PMF**
Duration (Min)	**Flows in m^3/sec**						
10		**2.55**	**3.03**	**3.71**	**4.66**	**5.88**	**N.A**
20		**4.60**	**6.14**	**8.15**	**10.80**	**12.88**	**48.84**
30		**7.03**	**8.95**	**11.43**	**14.62**	**17.14**	**56.28**
60		**10.37**	**12.83**	**15.99**	**19.74**	**23.03**	**58.99**
90		**10.57**	**13.12**	**16.40**	**19.98**	**23.37**	**52.92**
120		**11.91**	**14.41**	**17.69**	**21.16**	**24.63**	**48.53**
180		**9.02**	**11.23**	**14.12**	**16.99**	**19.92**	**40.31**
360		**8.61**	**12.68**	**12.68**	**14.75**	**17.05**	**20.86**

Table 6.1 Peak flow data for the pre developed western catchment

From this data it can be seen that the critical duration for all storms apart from the PMF was the two hour burst. The critical PMF burst was one hour.

ARI (Years)	**5**	**10**	**20**	**50**	**100**
Duration (Min)	**120**	**120**	**120**	**120**	**120**
Pre Dev volume (x $10^3 m^3$)	**51.048**	**60.210**	**71.901**	**87.657**	**99.968**
Post Dev volume (x $10^3 m^3$)	**50.364**	**59.391**	**70.904**	**86.419**	**98.505**
Δ Dev (m^3)	**-684**	**-819**	**-997**	**-1238**	**-1463**

Table 6.2 Change in runoff volume due to site changes

7. EASTERN CATCHMENT HYDROLOGY

WBNM was used to determine the flow characteristics for each of the standard duration design storms ranging from 5 years to PMF. Once again the first step in analysis will be to determine the critical duration for each ARI.

	ARI (Years)	5	10	20	50	100	PMF
Duration(Min)	Flows in m^3/sec						
10		6.31	7.35	8.81	10.76	12.29	N.A
20		10.10	11.89	14.31	17.38	19.98	63.66
30		11.15	13.16	15.85	18.82	21.68	65.86
60		13.32	16.03	19.64	23.61	27.39	61.66
90		13.63	16.49	20.29	24.20	28.17	53.85
120		13.91	16.89	20.79	24.78	28.80	48.01
180		11.24	13.65	16.81	19.81	23.03	38.78
360		8.98	10.85	13.17	15.18	17.48	26.20

Table 7.1 Peak flow data for the pre developed Eastern catchment

From the data in table 6.1 it can be seen that the critical duration for all ARIs except for the PMF is the 2 hour burst. The critical duration for the PMF burst is the 30 min. Volumes are for discharge from sub-area 1G.

ARI (Years)	5	10	20	50	100
Duration (Min)	120	120	120	120	120
Pre Dev volume (x $10^3 m^3$)	46.921	55.329	66.047	80.502	91.792
Post Dev volume (x $10^3 m^3$)	49.115	57.881	69.049	84.112	95.878
Δ Dev (m^3)	2194	2552	3002	3610	4086

Table 7.2 Eastern Catchment Flow volume Data

8. CONCLUSION

It can be seen from analysis of the results (Tables 6.2 and 7.2) that changes to the Western catchment storage is not required and changes to the Eastern catchment storage is required to limit the outflow from the site to pre-developed conditions. It was found for the western catchment that due to the altered drainage conditions on the new car park and the subsequent loss of area the volume of runoff actually decreased. Therefore no increase in storage is required for this catchment. The Eastern catchment experienced a net increase in runoff of 4086 $m^{3,}$ however in addition to this another small dam in this catchment is to be filled in and so Jim's dam must be expanded to take this into account as well. The dam to be filled in has an estimated volume of 930 m^3. This brings the total volume increase required in the Eastern Catchment to 5016m^3. This is to be achieved by raising the walls and constructing new weirs for "Jims Dam" at the base of the Eastern catchment. A simplified measure of the required increase to the dam walls obtained by dividing the required volume by the dam's surface area produces a required increase in dam wall height of 1.468m. This estimate is conservative as it assumes that raising the dam walls will not increase the area of the dam. This is clearly not going to be the case and so the actual required height will be somewhat lower. The dam walls are expected to be raised by over a meter and a half and as such will be sufficient to capture the additional runoff generated during a 100 year storm. See the construction drawings for details.

Fig 8.1 Dam Locations

REFERENCE