GOULBURN BROKEN
CATCHMENT MANAGEMENT AUTHORITY

2008

Tallarook Flood Investigation

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Goulburn Broken CMA

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1 Introduction

1.1 Background

There is limited knowledge of the way a flood behaves along Dabyminga Creek. Of particular concern is the way in which the flood waters behave in and around the Township of Tallarook. In recent times the demand for development has increased which warrants more precise flood level information.

Dabyminga Creek is situated south of Seymour with a steep catchment area. Intense thunderstorms can cause very rapid rising and violent flowing water. It is unknown to what extent the flood waters may reach, and the severity of flooding from Dabyminga Creek.

The last assessment of flooding at Tallarook was by Kinhill Engineers Pty Ltd, October 1991. The assessment was basic and no modelling has ever been performed.

1.2 Objectives

The objective of this study is to gain a better understanding of the way flood waters behave at Tallarook. Areas that flood in a 100 year ARI flood will be identified which will aid in the assessment of flood risk in Tallarook and increase confidence in decisions regarding development in the area.

2 Hydrologic Analysis

2.1 Calculation of Catchment Area

The area of the Dabyminga Creek catchment was found using two methods:

1. Scale 1:25 000 contour maps and counting the squares

The catchment boundary was drawn using the contour lines on the 1:25 000 scale maps. The limit of the catchment was effectively where the hydraulic study shall commence (the first cross section). Once the boundary outline was developed the area was calculated by counting the number of navigation boxes (one square kilometre) inside the catchment boundary that was determined. The area that was calculated equalled 129 square kilometres.

2. ArcGIS contour lines and polygons

In ArcGIS the 50 metre contour layer was used to outline the catchment boundary using the natural drainage lines. The same limits to the catchment area were applied as the above method. A polygon shape was used to draw the boundary of the catchment and then the area of that polygon was calculated. The area calculated equalled 131 square kilometres.

The ArcGIS calculated catchment area was adopted for the Dabyminga Catchment upstream of the Tallarook Township (at the commencement of the hydraulic model). It was felt that the area was calculated more precisely in ArcGIS than using the first method.

2.2 Best Fit Rural Catchments

In January 1997 an assessment was carried out on the results of hydrology studies for floods. They incorporated hydrology results from RORB models, RAFTS models, and historical events. Results were graphically represented to show an estimated flow (m^3/s) for a given catchment area (km^2).

2.2.1 Methodology

A 'Best-Fit' Line was then developed for Rural Catchments, the equation relating to that line is:

$$\mathbf{Q = 4.67\ Area^{0.763}}$$

Using this formula and the calculated area of the Dabyminga Catchment (131 km^2) the following flow (Q m^3/s) was calculated:

$$\mathbf{Q = 4.67 \times 131^{0.763}}$$

$$\mathbf{Q = 192.66\ m^3/s}$$

2.3 Intensity Frequency Duration (IFD) Analysis

The Intensity-Duration-Frequency (IFD) method for calculating rainfall and runoff is explained in Australian Rainfall and Runoff (AR&R) Volume One. AR&R Volume Two provides the necessary input rainfall for particular areas of Australia and those values are used in order to calculate durations of particular design storms.

2.3.1 Methodology

In order to calculate rainfall for given durations and ARI's, information about the rainfall and geography of the area had to be obtained from AR&R volume 2. The values are shown in the table below.

Table 1 – Information obtained from AR&R Volume 2

Parameter	Value
Region	8
2 year, 1hr intensity	22 mm/hr
2 year, 12hr intensity	3.6 mm/hr
2 year, 72hr intensity	1.18 mm/hr
50 year, 1hr intensity	42.5 mm/hr
50 year, 12 hr intensity	6.8 mm/hr
50 year, 72 hr intensity	2.2 mm/hr
Skewness	0.27
Geographical Factor (6min, 2yr storm)	4.28
Geographical Factor (6min, 50yr storm)	15
Runoff Coefficient (10 year ARI)	0.175

These values were put into a WP software package that uses the method in AR&R to produce an IFD Design Rainfall Table, shown in Appendix A.

The next step was to calculate the time of concentration using the formula from AR&R.

$$t_c = 0.76\ \text{Area}^{0.38}$$

Using this formula and the calculated area of Dabyminga Creek Catchment (131 km²) the following time of concentration (t_c hrs) was calculated:

$$t_c = 0.76 \times 131^{0.38}$$

$$t_c = 4.85\ \text{hrs}$$

As you can see in Appendix A the value of t_c was then put into the table and design rainfall values were interpolated for the duration of 4.85 hours.

The flow Q, which could be expected for a particular Average Recurrence Interval (ARI) was determined using the formula from AR&R.

$$Q = 0.278\ C_y\ I_{tcy}\ A$$

Q = Flow m³/s

$C_y = C_{10}FF_y$ = runoff coefficient for y year ARI

C_{10} = runoff coefficient for 10 year ARI (from AR&R) = 0.175

FF_y =. Frequency Factor for y year ARI (from AR&R)

I_{tcy} = rainfall intensity for a given time (t_c) and y year ARI

t_c = Time of Concentration (hrs) = 4.85 hrs

A = Area of the catchment (km²) = 131 km²

Using the Intensities I_{tcy} that were interpolated from the table in Appendix A, the equation above, and the values shown above the table below shows the calculations of the flow Q at different ARI's.

Table 2 - Discharge - ARI computation

ARI	FF_y	C_y	$I_{tc,y}$	Q_y
2	0.75	0.13125	6.9	32.98105
5	0.9	0.1575	8.8725	50.8912
10	1	0.175	10.1155	64.4676
20	1.1	0.1925	11.792	82.6674
50	1.2	0.21	14.0935	107.784
100	1.3	0.2275	15.9315	131.994

2.4 RORB Analysis

RORB is described as a Network Model in AR&R and is explained in more detail in volume 1 of AR&R.

2.4.1 Methodology

The Dabyminga Catchment upstream of the starting point for the hydraulic model was split up into 18 sub-catchments (A-R). Each of the sub-catchments was defined using natural drainage lines, and ensuring that no sub-catchment was excessively large in comparison with the others.

Once the sub-catchments had been defined each of the sub-catchments were given a representative tributary in order to model the storage time within that sub-catchment. Using representative tributaries to input the hydrograph from a sub-catchment into the main channel is one technique that can be used in setting up the RORB model. The main objective when writing the RORB model is to ensure that the way in which the model is written and developed is consistent. A drawing showing the way the catchment was split up, how the sub-catchments were labelled, and the representative tributaries, is shown in Appendix B.

Once the catchment was split into the sub-catchments the RORB catchment file was created. A copy of the catchment file for Dabyminga Creek is shown in Appendix C. The general Layout of these files is explained in the RORB Version Manual, Chapter 5.

There are two types of 'runs' that can be performed in RORB (DESIGN and FIT). A FIT run enables the user to play around with the k_c and m values in order to fit the modelled hydrograph to known hydrographs within the catchment. Therefore, a FIT run can only be used for gauged catchments. DESIGN runs are used for ungauged catchments, as you cannot fit the model to any known data, and after FIT runs to produce the peak hydrographs for the catchment. A DESIGN run was then undertaken as Dabyminga Creek was an ungauged catchment. The information and parameters to be entered into the program in order to perform a DESIGN run and calculate the output hydrograph is explained in the RORB Version 6 Manual, Chapter 7.

Experienced consultants were contacted in order to find out the values of the parameters that should be used to calculate the most accurate hydrology. The kc and m values used during the runs for Dabyminga Creek were those that are given in the RORB program (kc = <800mm MAR Formula & m=0.8). Because we had no real data for the catchment these values were not manipulated because there was no proof that by doing so it made the model more accurate. The Areal Reduction Factor used was the Siriwardina & Weinmann formula, and the initial loss value was given to me directly from the consultants who from their experience found to be the most accurate value.

The only parameter that was manipulated was the continuous loss values. These are ranged as follows because that is the recommended value range from the Australian Rainfall and Runoff Manual.

The resulting hydrographs from the RORB Model are in Appendix D and the tabulated results are as follows:

Table 4 – RORB Results

Cont. loss (mm/h)	3.1	3.6	4.1
Initial loss (mm)	**10**	**10**	**10**
Duration	**6h**	**6h**	**6h**
ARI	**100y**	**100y**	**100y**
Rain (mm)	**81.23**	**81.23**	**81.23**
ARF	**0.85**	**0.85**	**0.85**
Q	**208.8**	**194.7**	**181.5**

2.5 Comparison of Techniques

In order to ensure the quality of the Hydrology Results they were critically examined using known information and mathematical techniques.

The IFD analysis result was discarded as it was well below the estimates of the 100 year ARI flows from RORB and the Rural Best Fit Analysis.

It was decided that Boundary Creek catchment would be a suitable catchment to compare the hydrology results against the Dabyminga Creek results. In the Yea Flood Study report created by Water Technology, September 2005, information was provided on catchment area and 100 year ARI peak flow for Boundary Creek.

A comparison was done between the two catchments in order to adopt a starting flow for the hydraulic model. Below is an equation used to compare these catchments.

$$Q_1 = Q_2 \, (A_1/A_2)^{0.7}$$

The results of the comparison are shown in the table below.

Table 5 – Comparison of Flows

Location	Catchment Area (km²)	RORB/URBS peak Flow (m³/s)	Rural Best Fit $Q = 4.67(A)^{0.763}$	Calculated Comparison (using RORB/URBS) $Q_1 = Q_2 \, (A_1/A_2)^{0.7}$
Dabyminga Creek	131	194.7	193	183.8
Boundary Creek	45	87	85	92.2

After assessing the results, it was decided that the initial run in the hydraulic model would have an adopted flow of 195m³/s. The reason for this is that it is around the mid values for losses in the RORB model and it is relatively the same as the rural best fit value. If anything it is on the excessive side looking at the comparison between the two catchments.

3 Hydraulic Analysis

3.1 Survey

To set up the survey an initial visit to the site was made to identify any crucial points of interest within the Creek and the Floodplain. Critical points may be identified as the following:

- Changes in grade along the floodplain;
- Terraces, both high and low;
- Any crossings over the river that my impede flow;
- Normal distance between cross sections along a uniform channel, 150m;

The length of each cross section also needed to be specified for the surveyors. This was done by looking at the floodplain and finding any high terraces of land would not be overtopped by flood waters.

After sketching the cross sections out in the field they needed to be aligned more definitively. The alignment and specification of points within each cross section were given to the surveyors as a map created in ArcGIS, and in the project brief. A copy of the brief is in Appendix E.

3.2 HEC-RAS Model

Hec-Ras is a one dimensional model used to show where flood waters from a particular flow would reach, using on-ground survey information to describe the dimensions of the waterway. Because the model is one dimensional it does have limitations for use and accuracy especially if the floodplain is complicated with numerous flow paths for example.

3.2.1 Methodology

When setting up the Hec-Ras Model the first step was to add the geometry data (cross sections). A straight line was used to represent the reach and then the cross section data from the survey was put into the program. This consisted of the following:

- Cross section survey points (mAHD);
- Running distances between each cross section (m), and;
- Manning's n values.

The survey points of the cross sections were directly taken from the survey data supplied by SKM.

The running distance on the left and the right side of the bank was measured using an ArcGIS map called Dabyminga.mxd. The mid-point between the bank of the river and the outer boundary of each cross section was measured and used for the running distances along the floodplain. This is shown in Appendix F.

The initial manning's n values were 0.035 for the floodplain, and 0.055 for the channel. In order to distinguish this in Hec-Ras the top of bank was identified in each cross section.

The culvert crossings were modelled using cross section 2082 (between 2086 and 2078). In the Bridge/Culvert screen the deck/roadway was the first component of the crossing to define. First you enter the road height at each station along the cross section, which is the height mAHD, entered in the *High Chord* column. The *Low Chord* for a bridge is the bottom of the deck, but when modelling a culvert the entire cross section is filled and the culverts are then cut into the section, therefore a culvert crossing *low chord* is left blank in order to fill the entire cross section from the road height to the invert of the channel. To insert the culverts and effectively cut holes for the water to pass through the cross section, the culvert is then defined in the culvert screen. The size, invert and overt, and the centreline of each culvert is then entered and cut into the section.

Once the river geometry data had been entered it was time to start routing flows through the model. It was decided that a 'Low Flow' Model would be computed first. This meant that we would only include the cross section data up until it reached a high ridge that we thought the water would not breach. If the water breached these sections (glass walled) we would then input the rest of the cross section information. It was found that with the flow of 195m^3/s. The high ridge was not breached and therefore the low flow terrace was the only information that needed to be used.

3.2.2 Sensitivity Analysis

Once the model had been run with the initial flow of 195m^3/s higher and lower flows of were routed through the model to see how it would react. With the larger flow of 210m^3/s the high ridge was breached with the water surface level approximately 50mm above the water surface level of the 195 m^3/s flow. When looking at the breach it was decided that the flow over the high ridge would be minimal and it was best to force the flow through the lower terrace. The flow of 185m^3/s dropped the water surface level by 50mm. Then a flow of 200m^3/s was computed which raised the water surface level about 20mm, and to the top of the high ridge at the culvert.

4 Conclusion

4.1 100 Year ARI Flow

After considering the comparative hydrological analysis and the sensitivity hydraulic analysis, the adopted flow for the 100 year ARI flood was 200m^3/s.

4.2 Flood Inundation Mapping

Using the results from the Hec-Ras model an outline of the 100 year ARI extent was drawn in GIS. All of the survey points from each cross section were loaded into the GIS according to their coordinates. Using the information from Hec-Ras about the water height at each cross section, temporary marks were plotted showing the location at which the water would reach in the 100 year ARI flood. In some cases high islands of land in the floodplain that were shown not to be inundated were also marked to define the flow paths around the islands.

The floodplain was drawn showing the outermost boundary that water would reach. Between each cross section the extent was drawn by looking at where the water was going at the next cross section, and using knowledge of the area and the aerial photography to estimate where the water would go. After drawing the outer boundary it was apparent that there were some high islands within that boundary. The aerial photography showed changes in the colour of the grass at those points and therefore the shape of those islands were interpreted using the points in each cross section and the aerial photography. It was decided that the flow paths shown after mapping out the high islands, where more like shallow sheets of water, and that there was no need to model them separately.

A copy of the flood extent drawn and the cross sections is shown in Appendix G.

4.3 Flood Level Contouring

After assessing the results from Hec-Ras and drawing the flood extent and islands, it was now time to draw the flood level contours. The flow profile was used from the Hec-Ras results in order to find out at what running distance a certain water level was reached. A copy is shown in Appendix H. At first the flood level contours were drawn at every 1 metre interval. The running distances were plotted along the river reach using dots and measuring from the invert of each cross section. Using the orientation of the cross sections and knowing that the flood contours must be at right angles to the flow, the contours were drawn. Because of the high islands it was found that there was a need to plot some more contours at smaller intervals to make it easier to define a flood level across the whole extent. From the centre of the town to the north-east a flow path was found and there were no cross sections across it, telling us an accurate flood height. Therefore the flood height at each end of the flow path was known and the flood heights along the path were then estimated to best represent what would be happening in that area. The finished flood inundation map with flood level contours is shown in Appendix I.

5 Appendices

5.1 Appendix A

*** INPUT DATA ECHO ***

8							
2	year,	1	hour	intensity:	22	mm/hr
2	year,	12	hour	intensity:	3.6	mm/hr
2	year,	72	hour	intensity:	1.18	mm/hr
50	year,	1	hour	intensity:	42.5	mm/hr
50	year,	12	hour	intensity:	6.8	mm/hr
50	year,	72	hour	intensity:	2.2	mm/hr

Skewness:2.70E-01

Geographical factor for 6 minute, 2 yr storm: 4.28

Geographical factor for 6 minute, 50 yr storm: 15

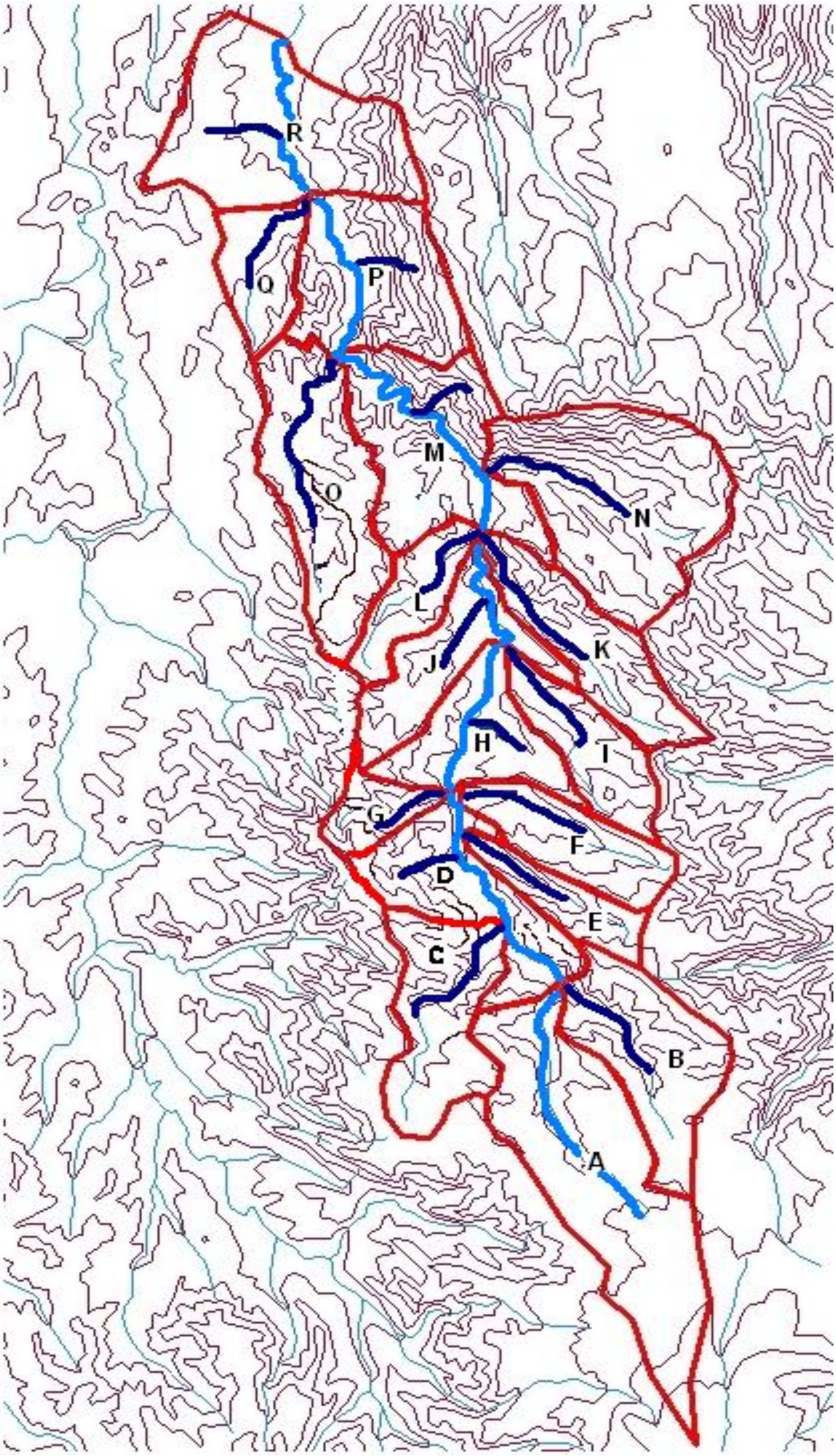
*** OUTPUT IFD TABLE ***

Rainfall Intensity (mm/h) for 8

Duration	Average Storm Recurrence Interval (years)					
	1	2	5	10	20	50	100
6m	51.69	67.86	90.17	104.66	123.93	150.82	172.57
7	48.74	63.95	84.86	98.41	116.45	141.62	161.95
8	46.22	60.61	80.33	93.1	110.1	133.8	152.94
9	44.03	57.72	76.41	88.5	104.6	127.04	145.15
10	42.11	55.18	72.97	84.46	99.78	121.11	138.32
11	40.4	52.92	69.91	80.88	95.5	115.86	132.27
12	38.87	50.89	67.17	77.67	91.67	111.15	126.86
13	37.48	49.06	64.69	74.77	88.22	106.91	121.98
14	36.22	47.39	62.44	72.14	85.08	103.06	117.55
15	35.06	45.86	60.38	69.73	82.21	99.54	113.5
16	34	44.46	58.49	67.52	79.57	96.32	109.79
17	33.02	43.16	56.75	65.48	77.14	93.34	106.37
18	32.1	41.96	55.13	63.59	74.89	90.58	103.21
20	30.46	39.79	52.22	60.19	70.85	85.64	97.52
25	27.16	35.44	46.39	53.38	62.76	75.74	86.17
30	24.65	32.14	41.96	48.23	56.64	68.26	77.59
35	22.66	29.51	38.46	44.16	51.81	62.38	70.85
40	21.03	27.38	35.61	40.85	47.88	57.6	65.37
45	19.67	25.59	33.24	38.09	44.62	53.62	60.83
50	18.52	24.08	31.22	35.76	41.85	50.26	56.98
55	17.52	22.77	29.49	33.74	39.48	47.37	53.68
60	16.65	21.63	27.98	31.99	37.4	44.86	50.81

75	14.23	18.48	23.89	27.3	31.91	38.25	43.31
90	12.5	16.22	20.95	23.94	27.97	33.51	37.94
2.0h	10.15	13.17	17	19.41	22.66	27.14	30.71
3	7.55	9.79	12.61	14.39	16.79	20.09	22.71
4	6.11	7.92	10.19	11.62	13.56	16.21	18.32
4.85	**5.328**	**6.9**	**8.8725**	**10.1155**	**11.792**	**14.0935**	**15.9315**
5	5.19	6.72	8.64	9.85	11.48	13.72	15.51
6	4.54	5.88	7.55	8.61	10.03	11.98	13.54
8	3.68	4.76	6.11	6.96	8.11	9.68	10.93
10	3.13	4.05	5.19	5.9	6.87	8.2	9.26
12	2.74	3.54	4.54	5.16	6.01	7.17	8.09
14	2.5	3.24	4.15	4.71	5.49	6.54	7.38
16	2.31	2.99	3.83	4.36	5.07	6.05	6.82
18	2.16	2.79	3.58	4.06	4.73	5.64	6.36
20	2.03	2.63	3.36	3.82	4.44	5.29	5.97
22	1.92	2.48	3.17	3.61	4.19	5	5.64
24	1.82	2.36	3.01	3.42	3.98	4.74	5.35
36	1.42	1.84	2.35	2.67	3.1	3.69	4.16
48	1.19	1.53	1.95	2.22	2.58	3.07	3.46
60	1.02	1.32	1.68	1.91	2.22	2.64	2.97
72	0.9	1.16	1.48	1.68	1.95	2.32	2.61

5.2 Appendix B



5.3 Appendix C

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Dabyminga Creek (catchment file)
C -------------------------------------------------------
C
C             Model for Tallarook Flood Investigation
C             Jacinta Herrmann 17/03/2008
C
C             Total Catchment Area = 131 sqkm
C             Ungauged Catchment
C
C -------------------------------------------------------
1,                   All reach types are natural
1,5.51,-99,   Subarea A
3,                   Store
1,2.30,-99,   Subarea B
4
5,1.50,-99,          Route down
3
1,2.80,-99,   Subarea C
4
5,1.32,-99,          Route down
3
1,1.50,-99,   Subarea D
4
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3
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4
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3
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4
3
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3
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4
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3
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4
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3
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4
5,1.22,-99,          Route Down
3
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4
3
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3
1,1.20,-99,   Subarea M
4
3
1,3.00,-99,   Subarea N
4
5,5.15,-99,          Route Down
3
1,3.34,-99,   Subarea O
4
5,2.00,-99,          Route Down
3
```

```
1,1.04,-99,   Subarea P
4
5,2.00,-99,          Route Down
3
1,1.94,-99,   Subarea Q
4
5,1.35,-99,          Route Down
3
1,1.23,-99,   Subarea R
4
5,2.58,-99,          Route to End of Catchment
7
End of Catchment Model
0,                   End of Control Codes
C                    Subareas A-R in sqkm
15.24,7.72,7.23,6.93,2.91,5.02,2.14,5.54,4.62,5.61,6.11,3.39,9.67,13.01,9.62
,8.53,3.66,12.14,-99
C                    Fraction Impervious (for rural areas = 0)
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,-99
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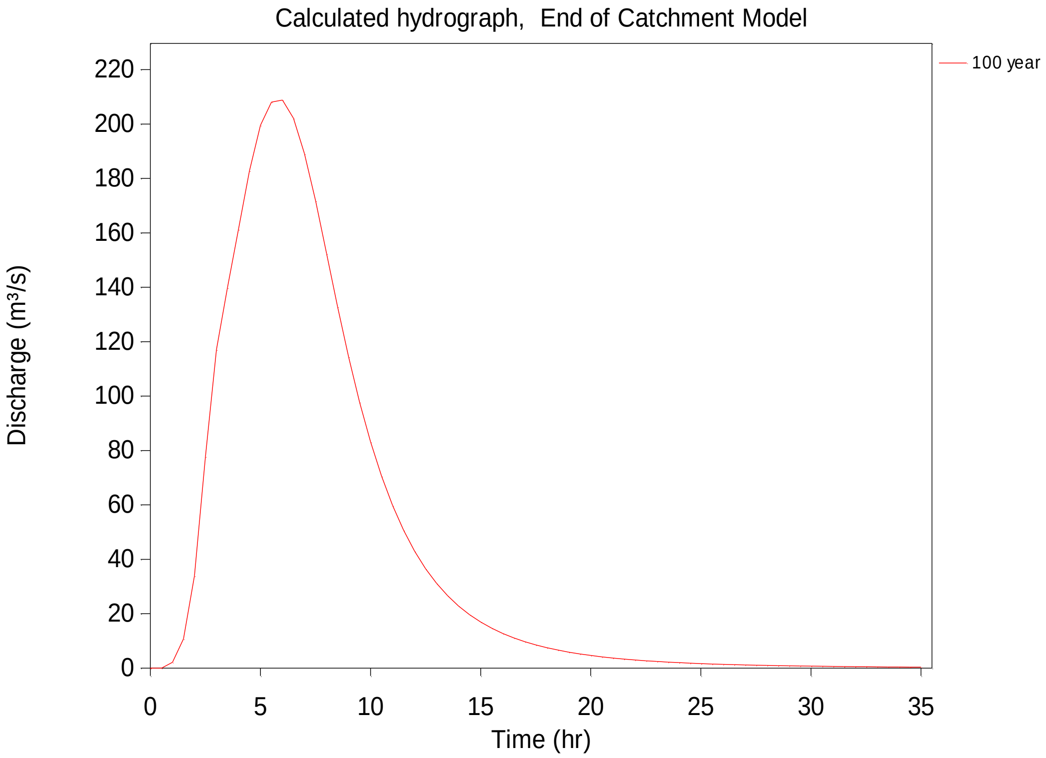
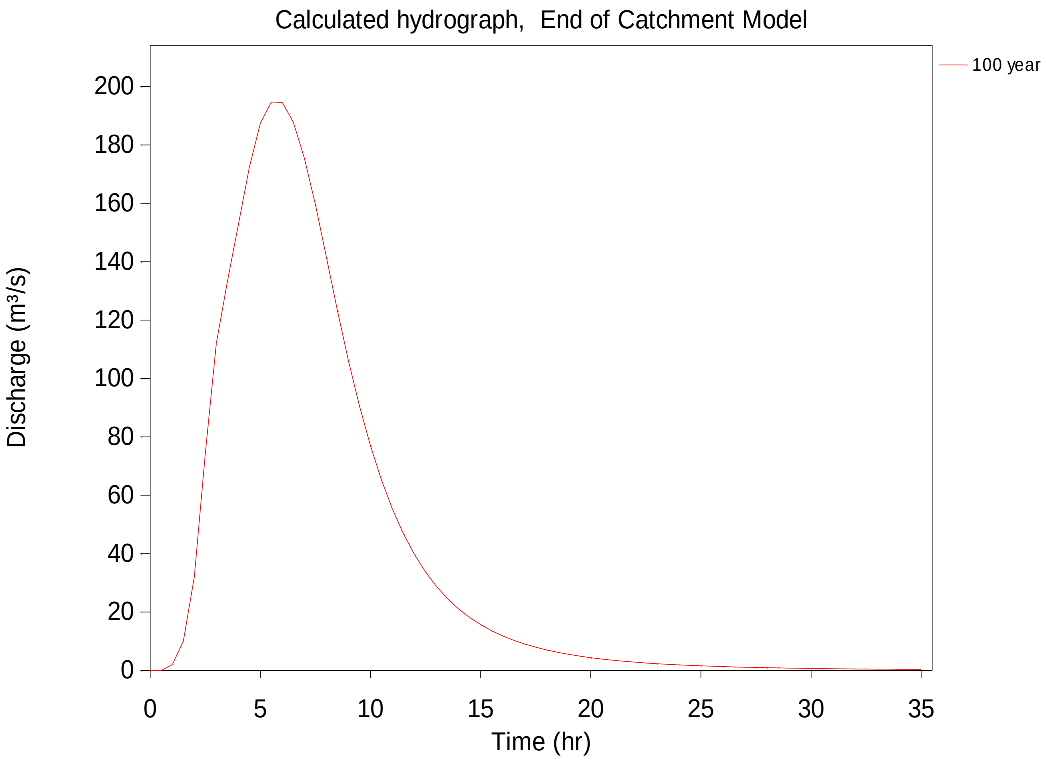
5.4 Appendix D

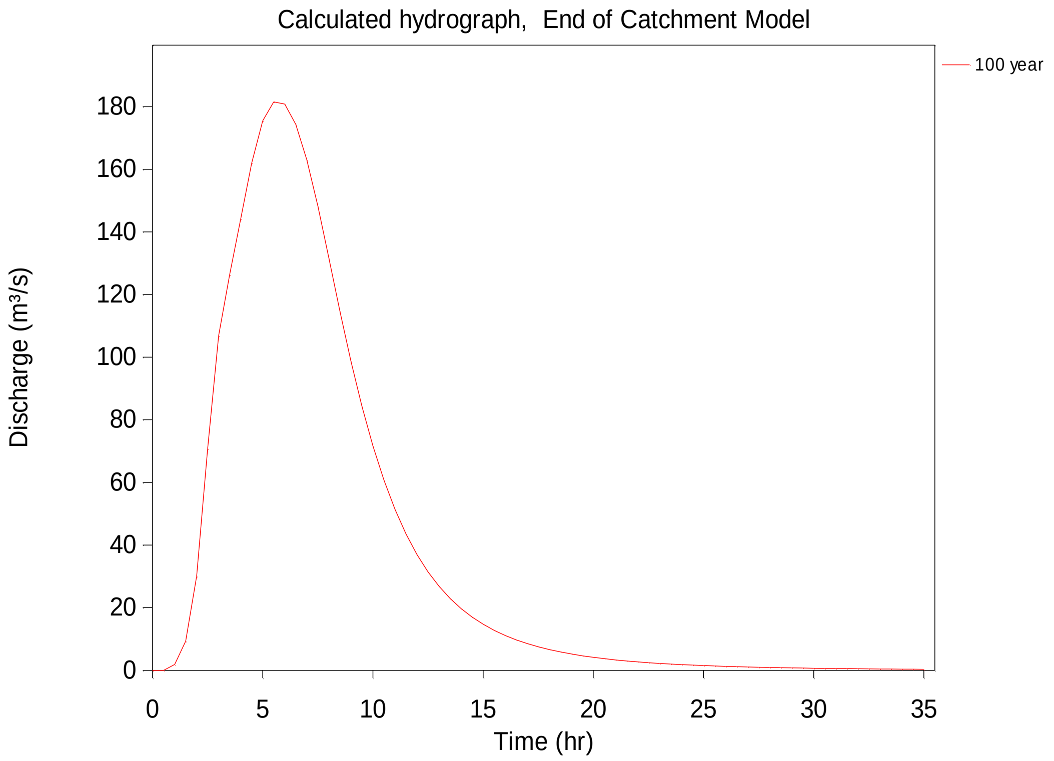
Peak Hydrograh continuous loss 3.1, 6 hour duration storm



Peak Hydrograh continuaous loss 3.6, 6 hour duration storm



Peak Hydrograh continuaous loss 4.1, 6 hour duration storm



5.5 Appendix E

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Survey Brief

Dabyminga Creek

The Goulburn Broken Catchment Management Authority seeks to appoint a consultant with recognised and proven skills in the provision of professional services to undertake a study of the potential extent and impact of flooding for proposed Goulburn River environmental flow regimes.

For further information contact:

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Floodplain and Waterways Engineer
Goulburn Broken Catchment Management Authority
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Facsimile: (03) 58316254

E-mail: jacintah@gbcma.vic.gov.au

February 2008

SURVEY BRIEF

The Goulburn River Environmental Flow Hydraulics Study

February 2008

1. **PROJECT AIM**

To investigate the nature of flooding within Tallarook and its environs, and to determine flood levels.

2. **STUDY AREA**

This study area encompasses the Goulburn River including its floodplain from Lake Eildon to the junction with the River Murray.+

3. **PROJECT FUNDING**

By competitive quotations.

4. **BACKGROUND**

There is limited knowledge of the way a flood behaves along Dabyminga Creek. The catchment is situated south of Seymour, where intense thunderstorms can cause a very rapid rising and violent flowing waterway, due to the steep catchment area. It is unknown to what extent the flood waters may reach, and the severity of flooding from Dabyminga Creek. Of particular concern is the way in which the flood waters behave in and around the Tallarook Township. Recently there has been a demand for new development in the area. With little to no knowledge of how the flood waters behave it is difficult to assess these developments. Therefore there is a need for recent flooding information.

5. **TASK BRIEF**

Term of Reference

Survey will be carried out to achieve a vertical accuracy better than 50 millimetres to Australian Height Datum, and GDA94 Projection. The cross-sections to be surveyed are indicated on Attachment 5. The survey level along the cross section alignment is to be carried out as follows:

1. A level surveyed at every 50 metres within floodplain areas (outside the waterway of Dabyminga Creek).
2. At every change of grade.
3. Within the water include: top of banks, level at every change of grade, and bed invert.
4. Running Distance (RD) for each surveyed level (for each cross section) is to be recorded commencing from the LHS looking downstream.
5. Chainage (CH) for each cross section is to be recorded commencing downstream. Chainage is measured by the distance between the waterway invert of each cross section.
6. Three cross section profiles are to be surveyed at the Hedleys Road crossing and include:
    a. one cross section, 2 metres upstream of the crossing,
    b. one cross section, 2 metres downstream of the crossing,
    c. one cross section, on the crossing itself.

7. Inverts and Overts of the culverts on Hedleys road, including the Dabyminga Creek and the tributary crossing, are to be surveyed at the upstream and downstream sides.

All survey information (cross sections and longitudinal profiles) is to be consolidated in electronic (GIS) and hard copy form, presented clearly on B1 size plans. In addition, for each cross section include an excel spreadsheet providing two columns, the first representing running distance (RD) and the second, the surveyed level (m AHD). Running distance shall commence from left bank looking downstream.

Arrange with Council for prior notification of the survey by newspaper advertisement, and for an introductory letter to be shown to landowners.

Conduct of Survey

Contractor is to carry out the survey in accordance with approved OH&S procedures.

6. CONSULTATION

The GBCMA will arrange for:

- Newspaper advertisement, press release about the project; and
- Preparation of introductory letters for landowners, outlining the aim of the project, to be provided to the surveyors.

7. STUDY PRINCIPAL

Goulburn Broken Catchment Management Authority.

8. PROJECT MANAGEMENT

The Project Manager will be:

Jacinta Hermann
Goulburn Broken Catchment Management Authority
PO Box 1752, Shepparton, Victoria
Phone (03) 5820 1113
Facsimile: (03) 5831 6254
E-mail: jacintah@gbcma.vic.gov.au

The Project Director will be:

Guy Tierney
Goulburn Broken Catchment Management Authority
PO Box 1752, Shepparton, Victoria
Phone (03) 5820 1100
Facsimile: (03) 5831 6254
E-mail: guyt@gbcma.vic.gov.au.

9. Terms of Engagement

The terms of engagement will be by Goulburn Broken Catchment Management Authority's letter of acceptance. Copyright of materials produced by vest with government and may be used by contractor free of charge, i.e., the study copyright will be jointly vested in the Goulburn Broken Catchment Management Authority.

This Brief and the Contractor's Proposal will form part of the contract documentation. Contractor should propose a basis for fees under the contract. This could potentially include costs for specific tasks in the project, and schedule of rates for any extra work that may eventuate.

10. Reporting Outcomes

The final report is to include non-technical summaries. Technical matters are to be dealt within the body of the report or subsidiary reports as necessary. All data compiled for the study is to be made available in computer readable form. The report is to include sufficient detail for the work to be replicated.

The consultant shall produce the following:

1. Final report in the following forms:
    a. Stand alone Executive Summary
    b. 3 bound copies in A4 format (Printed on both sides of the page).
2. Plans must be readable and may be required to be separate in larger formats such as B1 size plans. Plan numbers must be obtained from the Goulburn Broken CMA for such plans

11. Project Timetable

The final report is to be completed within 3 weeks of the consultant being notified of acceptance. A draft report is to be available three weeks before the end date.

The following indicative project timetable is proposed:

- Closing date for submissions 12th March 2008
- Consultant appointed 13th March 2008
- Final report 2nd April 2008

12. Form of Response

Proposals will need to clearly demonstrate that the Consultant has the necessary capacity, skills and experience to achieve the project objectives. To establish a consistent basis of comparison, it is mandatory that the Proposal be submitted in the following standard format:

A covering letter referring to the four Attachments and dated and signed by a person authorised to enter into a contract. The letter should identify the key contact person for further information.

Attachment 1 - Executive Summary [This part should be less than two (2) pages. It is to provide a description of the essential elements and virtues of the proposal].

Attachment 2 - Experience in work of this nature, Nominated Resources - names, qualifications and relevant experience of key personal.

Attachment 3 - Detailed costs associated with performance of the tasks; fee structure for appointment, plus itemised costs for support / disbursements (vehicles per km rate as used when directed by the Authority, etc.)

Attachment 4 - Details of Occupational Health and Safety Management Systems should be provided as a separate attachment.

A copy of the contractor’s Professional Indemnity (minimum of $10,000,000) and Public Liability (minimum of $5,000,000) Insurance is to be provided with the proposal.

Proposals should be short and concise, with the minimum of superfluous marketing information.

Proposals that do not conform to the required format may be excluded from the selection process at the Steering Committee’s discretion.

13. Assessment of Proposals

Assessment of proposals will be generally based on the Association of Consulting Engineers of Australia (ACEA) ‘Guidelines on Quality Based Selection of Consulting Engineers’, with weighting established by the subcommittee of the Reference Group.

The evaluation criteria and weighting to be used to assess Proposals are:

- Price 70%

- Relevant experience 15%
- Time performance 15%

Preference will be given to contractor with an approved quality assurance and management program. Proposals shall remain valid for acceptance for two calendar months after the date of submission. The Goulburn Broken Catchment Management Authority reserves the sole right to accept or reject any Proposals, and no correspondence will be entered into regarding the unsuccessful Proposals.
All work undertaken by contractor in the preparation of their Proposals shall be entirely at the consultant's cost. Goulburn Broken CMA shall not be held liable for any costs incurred by contractor in the preparation of Proposals. All contractors that submit proposals will receive notification of the final selection decision.

14. Lodgement of Response

Proposals are to be lodged by email, and clearly marked:

Goulburn Broken Catchment Management Authority
Dabyminga Creek Survey Proposal
Tallarook Flood Investigation

Email proposal MUST be sent to:
Jacinta Herrmann
jacintah@gbcma.vic.gov.au and
Guy Tierney
guyt@gbcma.vic.gov.au

Along with the Proposal a covering letter shall be provided, certifying the accuracy of all information supplied, providing the name of the authorised contact, and signed by a senior officer of the organisation.
In lodging a Proposal the organisation is deemed to have accepted the terms and conditions of the Consultancy Brief. All responses shall become the property of the Goulburn Broken Catchment Management Authority.

15. Closing Date

The closing time for the lodgement of responses is **4:00 pm on Wednesday 12th March 2008.**
Late responses will not be considered.

16. Confidentiality

The Goulburn Broken Catchment Management Authority undertakes to treat all information received in Proposals as strictly confidential and commercial-in-confidence. The information will only be made available to the sub-committee of the Steering Committee. On completion of the selection process, only one copy of the information will be maintained on a secure file and all other copies will be destroyed. The intellectual property contained in Proposals remains the property of the consultant that lodged the submission.

17. Further Information

The point of contact for further information of a technical or explanatory nature should be the Project Manager.

18. Date of Brief

The date of this Consultancy Brief is Wednesday 5th March 2008.

Attachment 1 - Executive Summary

[This part should be less than two (2) pages. It is to provide a description of the essential elements and virtues of the proposal].

Appreciation of the Study Requirements
Project Manager
Structure of the Study Team
Methodology for conduct of the study (Link to Tasks in Attachment 3).
Related Experience of the Nominated Study Team

Attachment 2 - Experience in work of this nature

Nominated Resources - names, qualifications and relevant experience of key personal.

Study Team Structure			
Team Member	**Qualifications**	**Specialist Skill Area**	**Related Projects**

Attachment 3 – Project Costs and Tasks

Detailed costs associated with performance of the tasks; fee structure for appointment, plus itemised costs for support / disbursements (vehicles per km rate as used when directed by the Authority, etc.)

Task	Purpose / output	Activities	Timing	Resources	Cost

Attachment 4 - Details of Occupational Health and Safety Management Questionnaire

Copies of policies, procedures extracts from log books, samples of reports and samples of completed checklists should be included to demonstrate that your organisation has an appropriate Health and Safety Management System in place. Any procedure manuals, etc. will be returned on request. The Consultant should address each of the six items in the first Table and not where not applicable for both tables.

It is incumbent on the Contractor to provide sufficient information to satisfy our Management that you have an effective Health and Safety Management System in place.

REVIEW OF POTENTIAL CONTRACTOR’S OH&S MANAGEMENT SYSTEM

The contractor / consultant should be asked to show evidence that systems exist in order to verify their status.

Contract Name: ____

Contract Description: ____

Contract Manager: ______________________ Date ____________________

Contractor: ____

Indicate in the following manner:

✓ Acceptable X Not Acceptable *N/A* Not Applicable

1. OHS Policy and Management	
Company Health and Safety Policy The policy provided by the potential contractor should: be signed by the CEO or equivalent outline clear statement of objectives show commitment to improve performance be relevant to company operations be reviewed on a regular basis	
Certified OHS Management System Certification demonstrates that the potential contractor meets minimum standards, verified by an independent party. These may include: SafetyMAP (three levels of certification) NSCA 5 Star System International Safety Rating System Or other system. Certificates should be available for perusal if they have had an audit by an auditing firm.	
OHS Management System or Plan The company OHS Manual or Plan should include as a minimum: Occupational health and safety policy Management health and safety responsibilities General occupational health and safety procedures Safe work procedures relevant to the company operations Public safety procedures Induction and training procedures Issue resolution and OHS consultation mechanisms	

Health and Safety Responsibilities Health and safety responsibilities in the company should be documented and may comprise: OHS responsibility statements part of employee’s job description part of formal and informal performance appraisal Managers and supervisors should be formally held accountable for health and safety performance of their employees.	
2. Safe Work Practices and Procedures	
Safe Work Procedures The potential contractor should be able to demonstrate safe work procedures which: are relevant to company operations contain a description of the tasks and associated hazards outline control measures & methods to minimise health and safety risks make reference to any relevant Legislation, Codes of Practice or Australian Standards	
Safe Work Permits Where relevant, the potential contractor should be able to demonstrate safe work permits for the following types of work: Work in Confined Spaces / Trenches (Confined Space Entry Permits) Hot Work (Hot Work Permit) Lockout/Tagout permits (plant, electrical systems)	
Incident Reporting and Investigation Potential contractors should be able to provide evidence of the following: incident report and investigation form incident investigation procedure evidence of completed investigation forms	
Plant Safety The potential contractor should have mechanisms in place for the identification of hazards, assessment of risks and the implementation of control measures associated with plant. This may include: documented risk assessments for relevant plant or risk assessment procedure copy of plant operator licences, permits register of plant requiring registration list of persons responsible for undertaking plant risk assessments plant maintenance and inspection forms pre-start daily safety inspection forms for plant plant fault reporting system and forms	

Hazardous Substances Potential contractor should provide evidence demonstrating safe handling and storage of hazardous substances: manifest or register of chemicals used by the company Material Safety Data Sheets for chemicals used safe handling procedures, including personal protective equipment relevant training documentation	
Manual Handling The potential contractor should be able to demonstrate evidence of: documented risk assessments for manual handling hazards systems used to control manual handling risks (eg: lifting aids, work procedures)	
3. Health and Safety Training	
The potential contractor should be able to demonstrate evidence of: records of training and competencies of employees (licences, permits, certificates) records of 'on the job' training tool box meetings conducted induction training program	
4. Health and Safety Workplace Inspection	
Regular Inspections The potential contractor should provide evidence of: workplace inspection schedules completed inspection reports types of inspections undertaken	
Standard Inspection Checklists View copies of the types of inspection checklists used by the potential contractor.	
Hazard Reporting from. The potential contractor should provide evidence which may include: documented hazard reporting procedure and forms completed hazard reports	

5. Health and Safety Consultation	
Health and Safety Committee Evidence may include records which show: structure of committee meeting schedule minutes of meetings	
Employee Consultation Potential contractor should provide evidence of: list of employee health and safety representatives documented procedures for consultation and dissemination of information employee involvement in inspections, accident investigations	
6. OHS Performance Monitoring	
Safety Performance Statistics Evidence may include: reports on company health and safety injury trend data performance targets established (eg: lost time injuries, person days lost)	
Health and Safety Performance Information Evidence of information provided to employees: records of who receives reports types of reports produced	
Conviction of Health and Safety Offence If conviction reported, determine: nature and circumstances of incident corrective actions undertaken	

Comments

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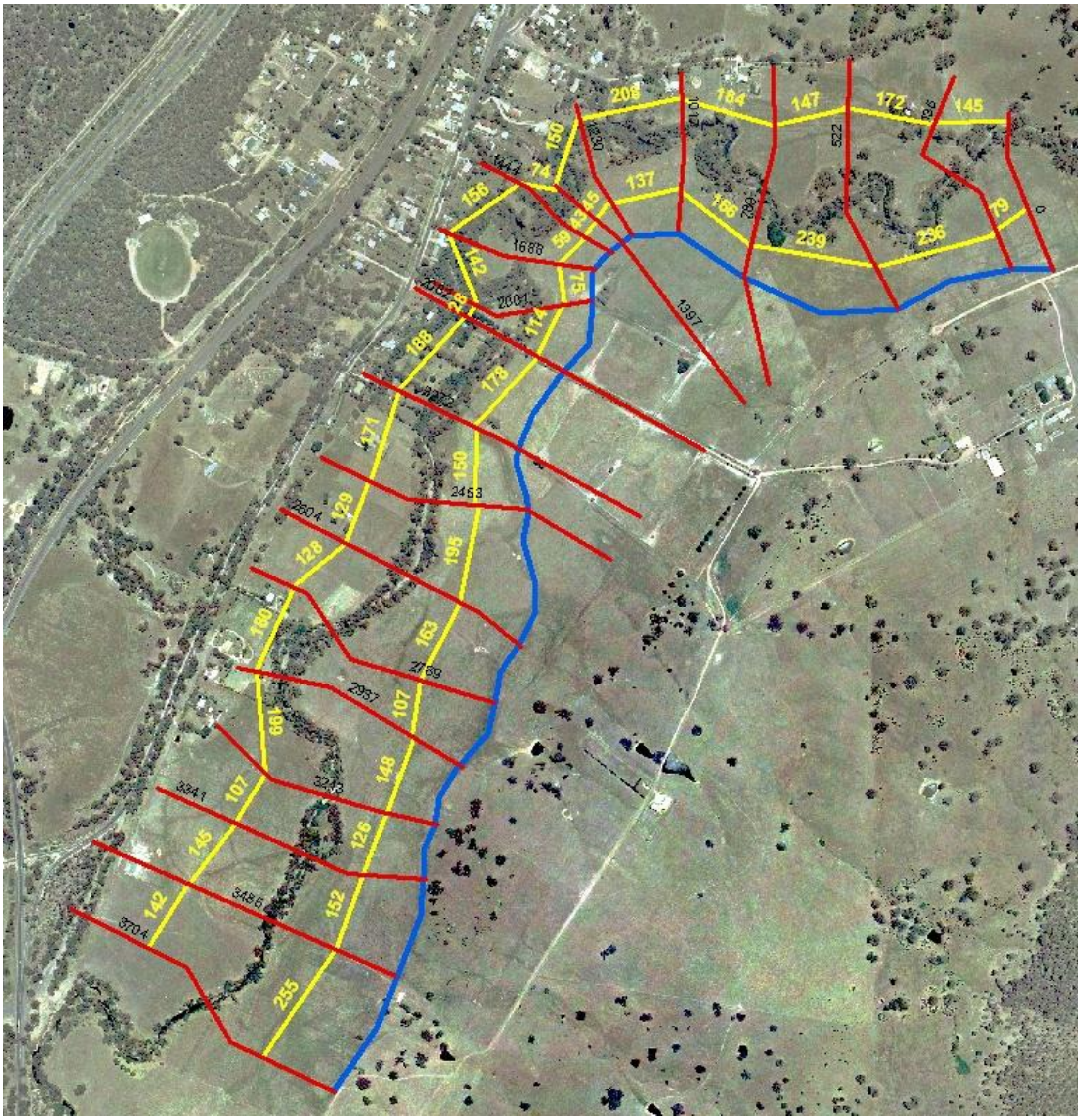
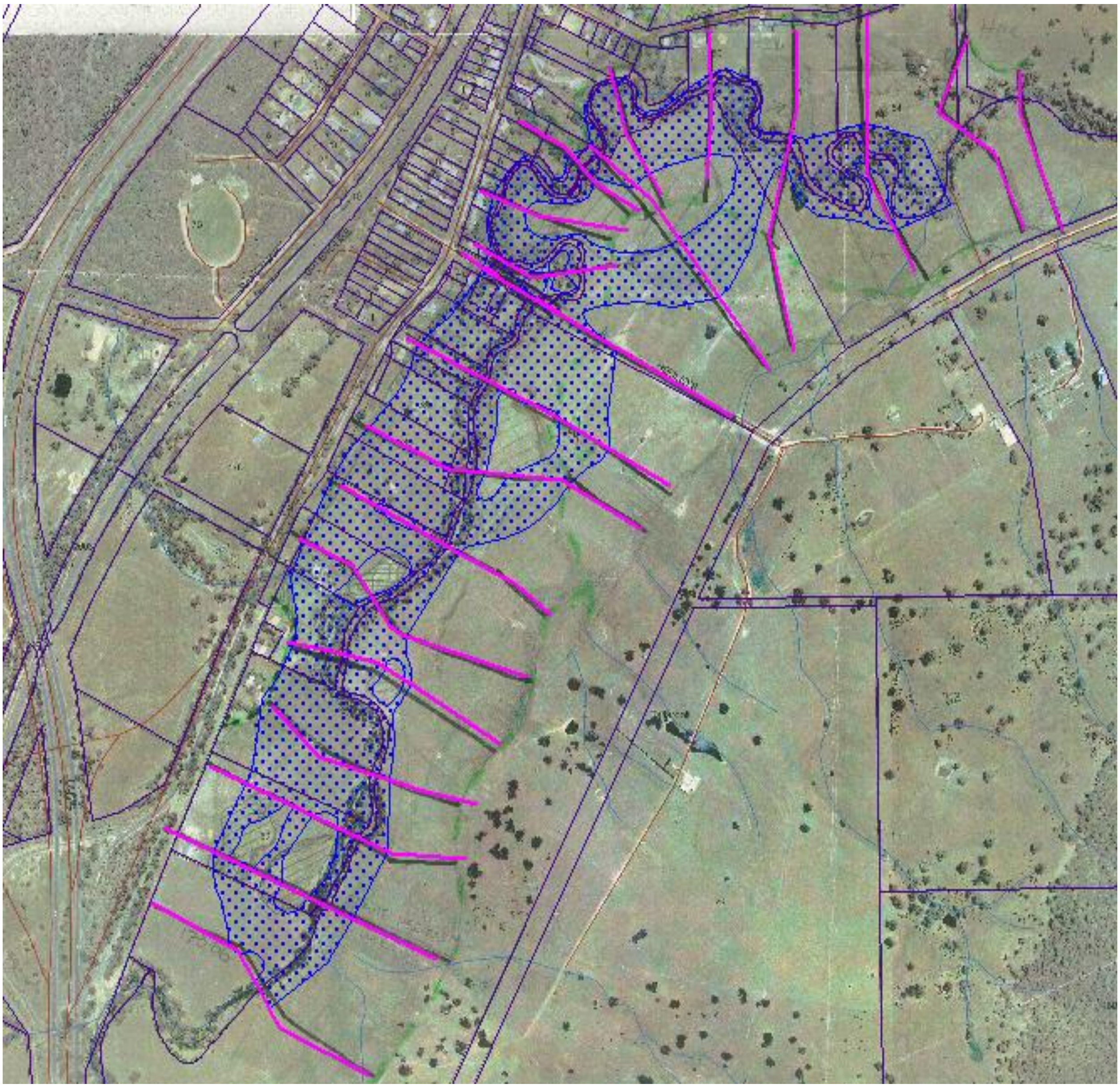
Attachment 5 - Details of Cross Section Location

Please refer to attached ArcGIS Shape Files to GBCMA's email. Below is a screen grab showing crossing locations:

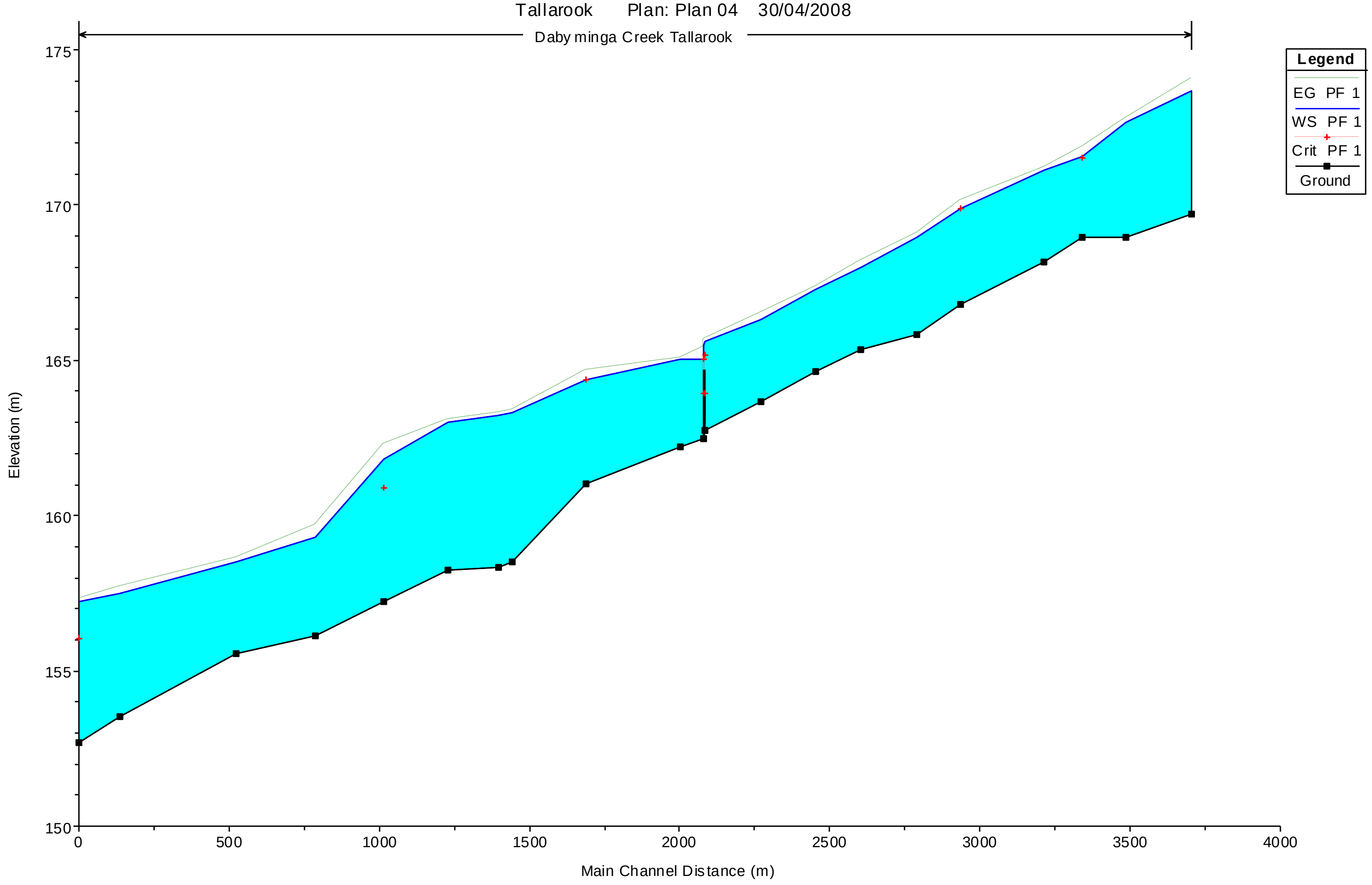
5.6 Appendix F



5.7 Appendix G



5.8 Appendix H



5.9 Appendix I