


Jumbunna Road, Korumburra

Stormwater Management Strategy

September 2017

DOCUMENT CONTROL DATA

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	Synopsis	<i>Stormwater discharge strategy for the proposed residential development located at Jumbunna Road, Korumburra</i>

Reference: 7074

Client: Kufner Textiles (Australia) P/L

Revision Table

Rev	Description	Date	Authorised
A	Draft	06/09/2017	AB

Distribution Table

Date	Revision	Distribution
06/09/2017	A	<i>Council, Beveridge Williams, Client, Drainage Authority</i>

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Glossary of terms

Alphabetical list of terms and abbreviations used in report

AHD	Australian Height Datum A common national surface level datum approximately corresponding to mean sea level.
ARI	Average Recurrence Interval - <i>The average, or expected, value of the periods between exceedances of a given rainfall total accumulated over a given duration.</i>
Authorities	Organisations responsible for supply and management of sewer, water, gas, electricity and telecommunications, roads and transport
BPEMG	Best Practice Environmental Management Guidelines
CMA	West Gippsland Catchment Management Authority
Client	Kufner Textiles (Australia) P/L
Council	South Gippsland Shire Council
IDM	Infrastructure Design Manual
NTWL	Normal Top Water Level
Q ₁₀	Storm water flow generated from 10 year ARI storm event.
Q ₁₀₀	Storm water flow generated from 100 year ARI storm event.
Q _{gap}	Flow difference between Q ₁₀ and Q ₁₀₀ storm event.
RB	Retardation Basin
SB	Sedimentation Basin
SEPP	State Environment Protection Policy
WSUD	Water Sensitive Urban Design

1 INTRODUCTION

Beveridge Williams have been commissioned by Kufner Textiles (Australia) P/L to prepare a preliminary Stormwater Management Strategy (SWMS) for a proposed residential development site located at Jumbunna Road, Korumburra. The total site area is approximately 12.154 ha and it is proposed to develop the land into 103 residential lots.

This SWMS report is intended to provide sufficient evidence that drainage strategy from the proposed development site can meet Stormwater Best Practice Environmental Management Guidelines (BPEMG) and to the satisfaction of South Gippsland Shire Council and other relevant authorities.

1.1 Site Overview

The subject site is located approximately 120km South East of Melbourne and currently vacant land. The site is irregular in shape and can be accessed via Jumbunna Road and Sommers Crescent (see Figure 1).

The site is bounded by a low density residential area in south and Korumburra Secondary College in west. There is an existing dam located on the south west of the site. The property is currently open farm land and utilised for low intensity grazing.

The subject land is situated at the southern edge of the Korumburra township approximately 1.2 km from the town centre via the local road networks and represents a logical progression of the residential development of the Korumburra township.

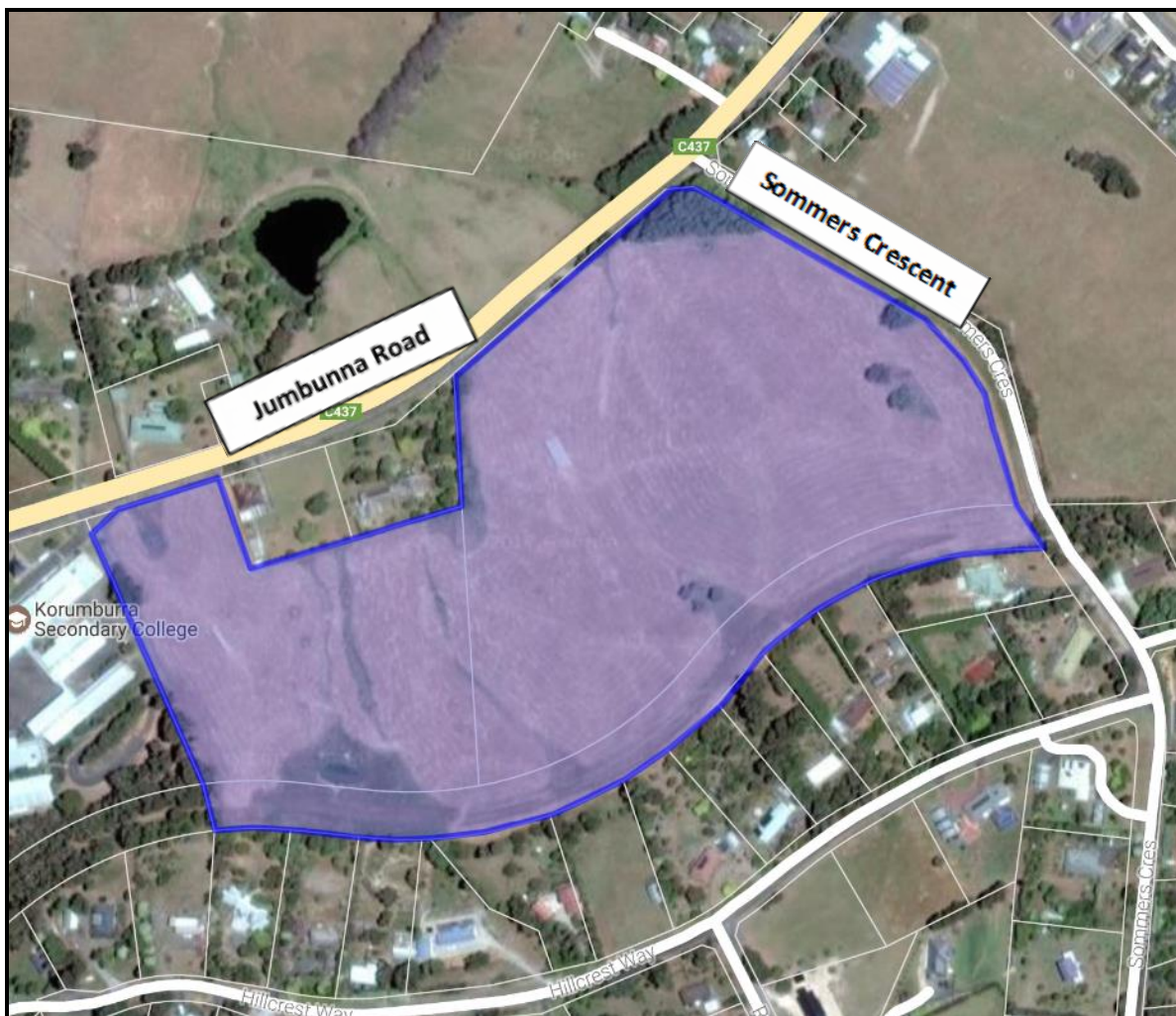


Figure 1: Location Plan (Aerial) (Source: Near Map - Not to Scale)

2 EXISTING CONDITIONS

2.1 Topography

The site is mostly cleared of vegetation. The topography is undulating and generally falls from the south to north.

There are three high points located on the south side of the site. Five low points are recognized located on the opposing north side. The survey conducted by Beveridge Williams is shown in Figure 2 below and Appendix A.

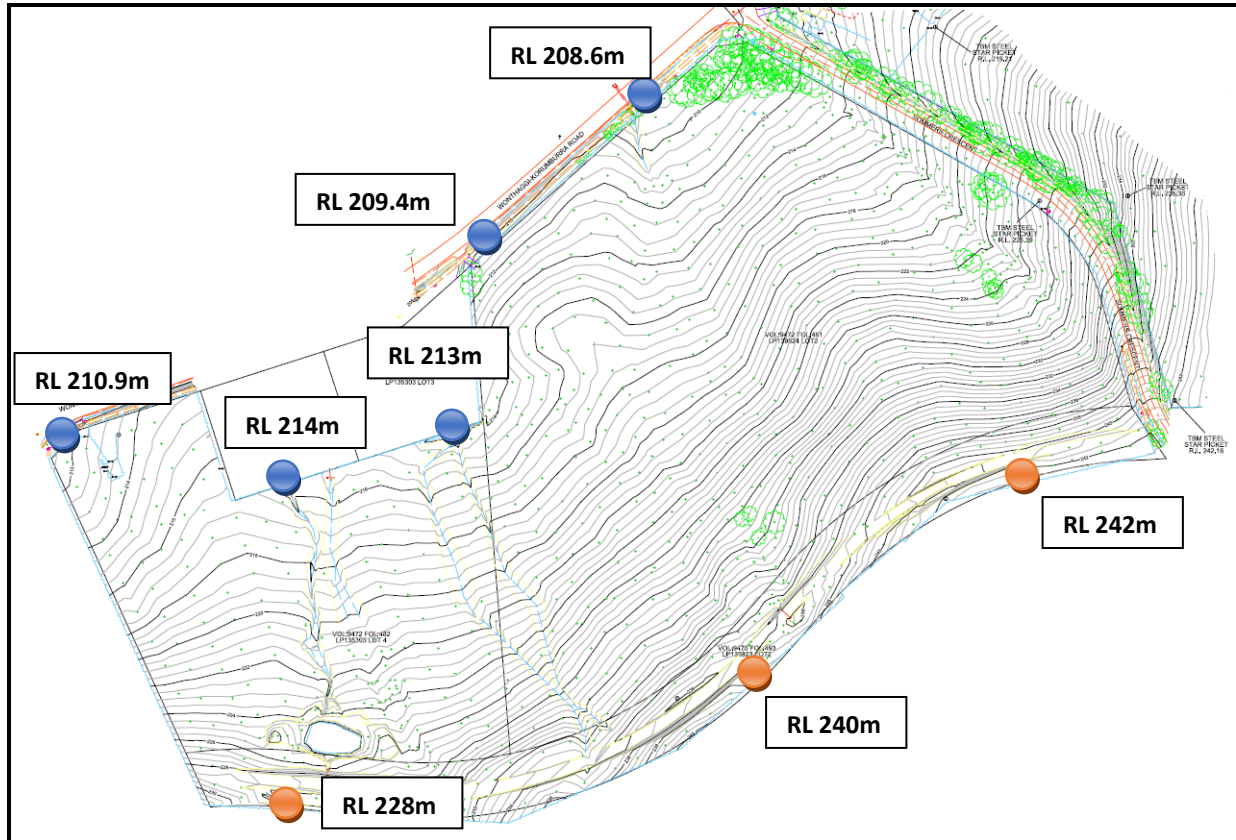


Figure 2: Site Topography Plan (Not to Scale)

2.2 Surface Water and Drainage

The site is relatively steep, with an approximate 1 in 10 grade that is relatively constant throughout the whole site. The site slopes in two directions, from south to north-west and north-east (Refer to Figure 3 below for the Site Analysis Plan).

Surface water from an external catchment (low density residential zone) of approximately 6.0 ha to the south of the site flows in to the site.

A copy of the plan is also attached in Appendix A.

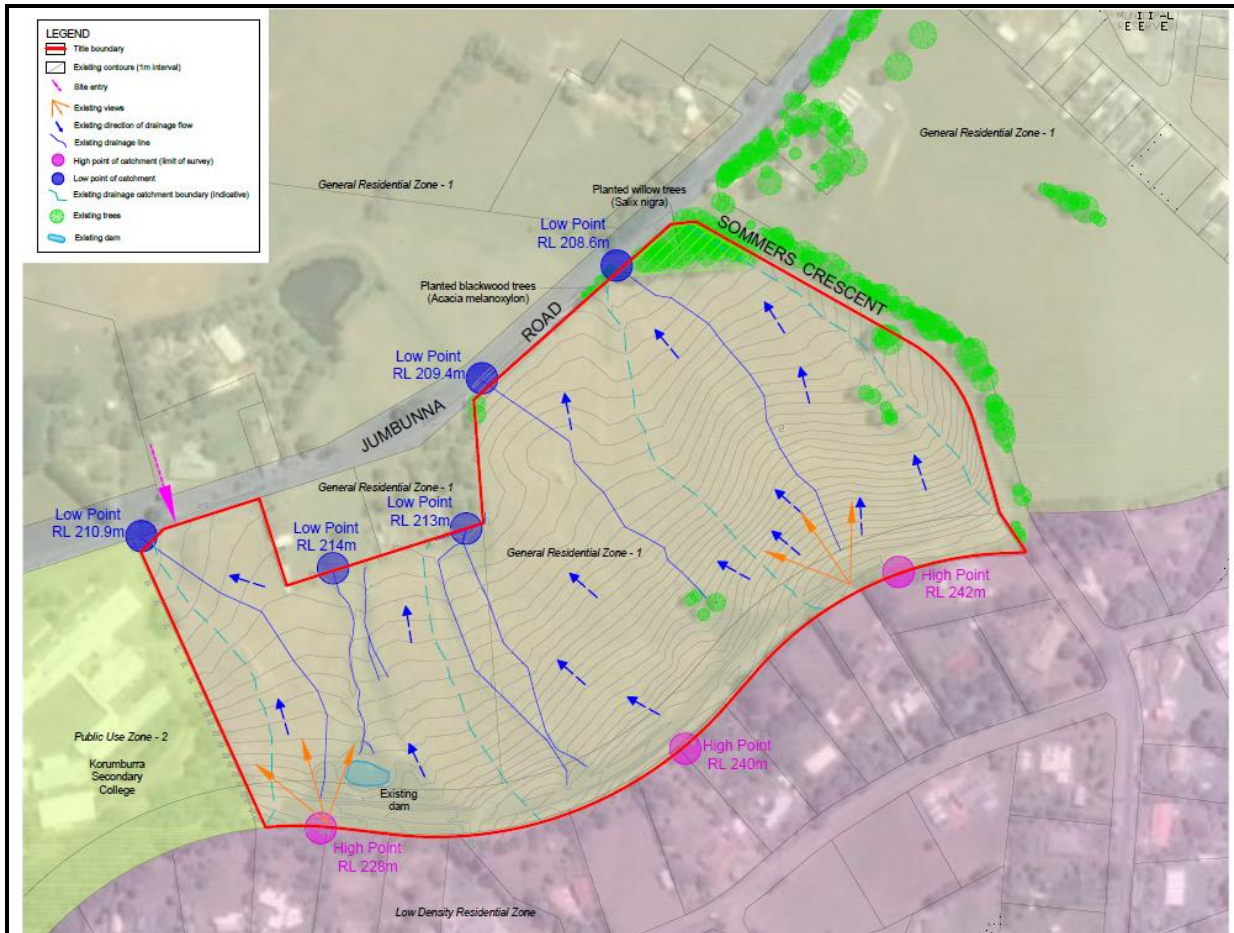


Figure 3: Site Analysis Plan (Not to Scale)

3 DESIGN INTENT

3.1 Proposed Development

The proposal of the subdivision site intends to form 103 residential lots with an average lot size of 763m². The site includes roads (2.287ha) as well as a drainage reserve (0.656ha) and an overland flow path (0.039ha) (Refer to Figure 4 below and Appendix B).

The internal road layout provides a series of roads designed in accordance with their function. The cross sections are of sufficient width to facilitate the provision of on street parking, pedestrian paths, bicycle paths and public transport. The street network ensures safe movement and ease of access both internally and with surrounding uses.



Figure 4: Preliminary Subdivision Plan (Not to Scale)

Details of the indicative subdivision development plan are shown in Table 1 below.

Table 1: Details of Indicative Subdivision Plan of Jumbunna Road, Korumburra

Details	Area
Lots (103)	7.856 ha
Roads (incl. Jumbunna Rd widening)	2.287 ha
Public Open Space	0.718 ha
Drainage reserve	0.656 ha
Overland Flow Path	0.039 ha
Access for Future Development	0.034 ha
Total Site Area	12.154 ha

3.2 Proposed Stormwater Management Strategy

This SWMS has been proposed to follow the existing natural features of the pre-developed site.

For stormwater quantity management, it is proposed to provide a stormwater retardation basin (RB) within an enlarged drainage reserve area on the north-east corner of the site to overdetain the Q_{100} post development flow from the large portion of the site to compensate for a small area of the site that cannot be directed to the drainage reserve.

For stormwater quality management, it is proposed a sedimentation basin along with a bioretention basin in the north-east corner within the RB to provide the stormwater treatment for the majority of development site. For the small portion of the site draining to the north-west, it is proposed a swale to provide required stormwater treatment. In this strategy, rainwater tanks are also proposed within the lots to provide the stormwater treatment for the development site.

Details of both stormwater quantity and quality management are discussed in sections 4 and 5.

4 STORMWATER QUANTITY MANAGEMENT

As part of Victorian SEPP guidelines, stormwater runoff for the 1 in 100 year ARI event will need to be detained from the post development to pre development condition. Details of stormwater quantity management are discussed in the following sections.

4.1 Hydrology

Pre and Post Development Flows (100 year ARI)

The hydrological analysis of the 1 in 100 year ARI flows for the proposed development site was undertaken using RORB modelling to determine the pre-developed flow and design flows for the post developed scenarios. The calculations are included in Appendix C and the results is shown in Table 2 below.

Table 2: RORB Results for the 100 year ARI Peak Pre-and Post-Development Flows

1 in 100 year ARI Peak Flows for Jumbunna Road, Korumburra			Storage Volume Required for the Detention
Pre-Development Flow	Post Development Flow without Detention	Post Development Flow with Detention	
0.97 m ³ /s	3.78 m ³ /s	0.91 m ³ /s	2310 m ³

The above peak flows result indicate that the 1 in 100 year ARI post development peak flows can be detained to the pre-development level by providing a detention storage of 2310 m³.

Gap Flow

Gap flow, which is the difference between the 100 year ARI and 5 year ARI post development flows, was calculated using RORB modelling as above. The calculations are included in Appendix C and the results are shown in Table 3 below.

Table 3: RORB Results for the Gap Flow

100 year ARI Flow	100 year ARI Flow	5 year ARI Flow	Gap Flow
East Side	3.48 m ³ /s	1.03 m ³ /s	2.45 m ³ /s
West Side	0.34 m ³ /s	0.12 m ³ /s	0.22 m ³ /s

4.2 Sub-surface Drainage

The Legal Points of Discharge for the proposed development will be to the existing culverts under Jumbunna Rd, as shown in Figure 5.

The subsurface drainage network from the development site will convey all pipe flows to the culverts, via the proposed water quality treatment facilities and detention basin located on the north-east and north-west corners of the site. The pipe network will be adequately sized to convey the 1 in 5-year ARI storm event flows through the network.

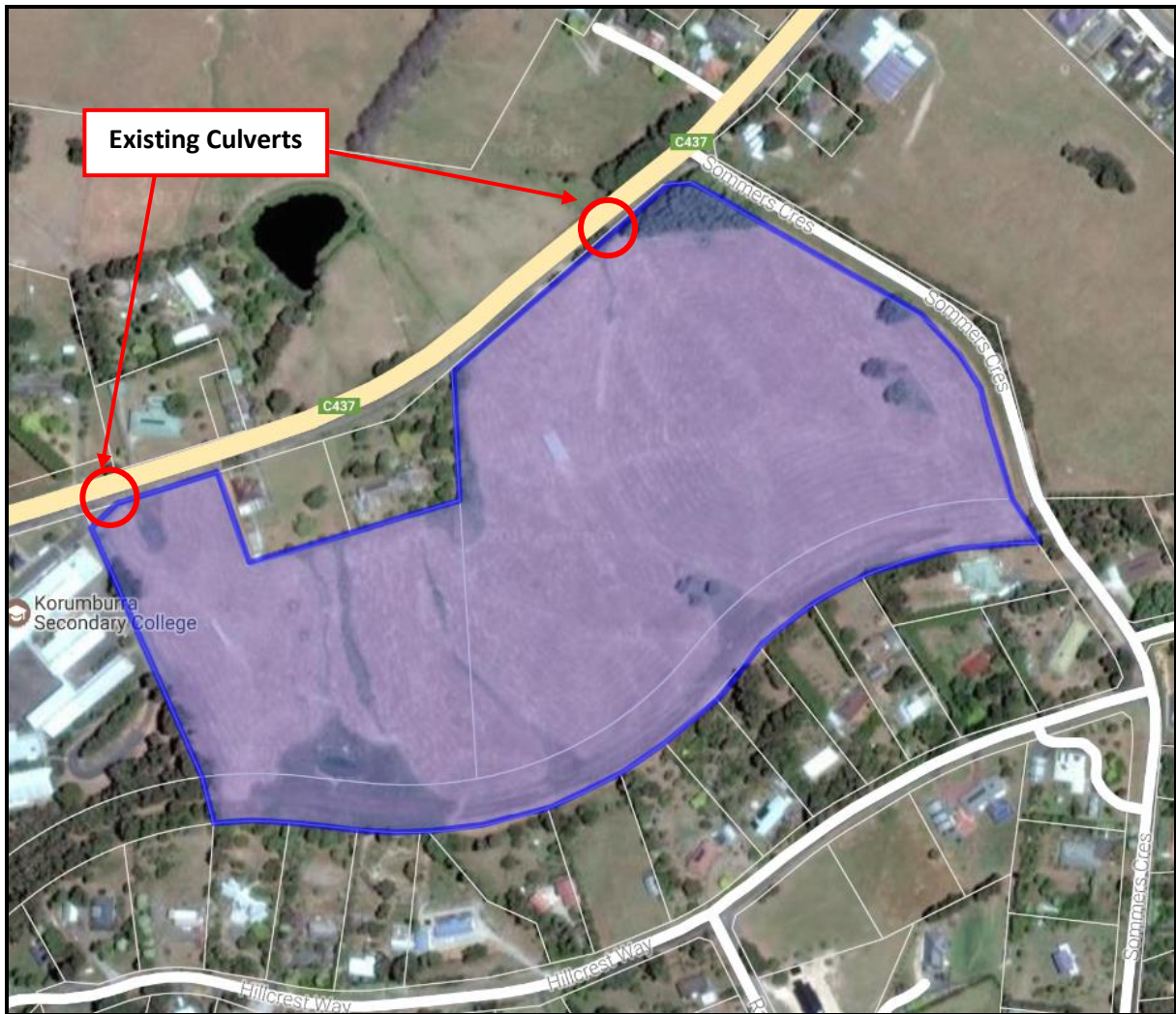


Figure 5: Location of the existing culverts on the north of the site (Not to Scale)

4.3 Subject Site Overland Flow

The majority of the overland flows from the site will be directed via the road network to the proposed RB, which is sized to cater for restricting the Q_{100} post development flow to pre-development level. A small portion of the west side of the site will be discharged to the north-west, but the north-east RB is oversized to compensate (Refer to the Overland Flow Path Plan in Figure 6).

The internal road for the development, will be designed to ensure that the Q_{gap} overland flows through the site are within the safe hydraulic capacity of road floodway.

A PC Convey assessment of the road reserve shows that the Q_{gap} flow can be contained within floodway safety criteria. Typical cross sections are shown in Figures 7 and 8 and the calculation result is included in Appendix D.

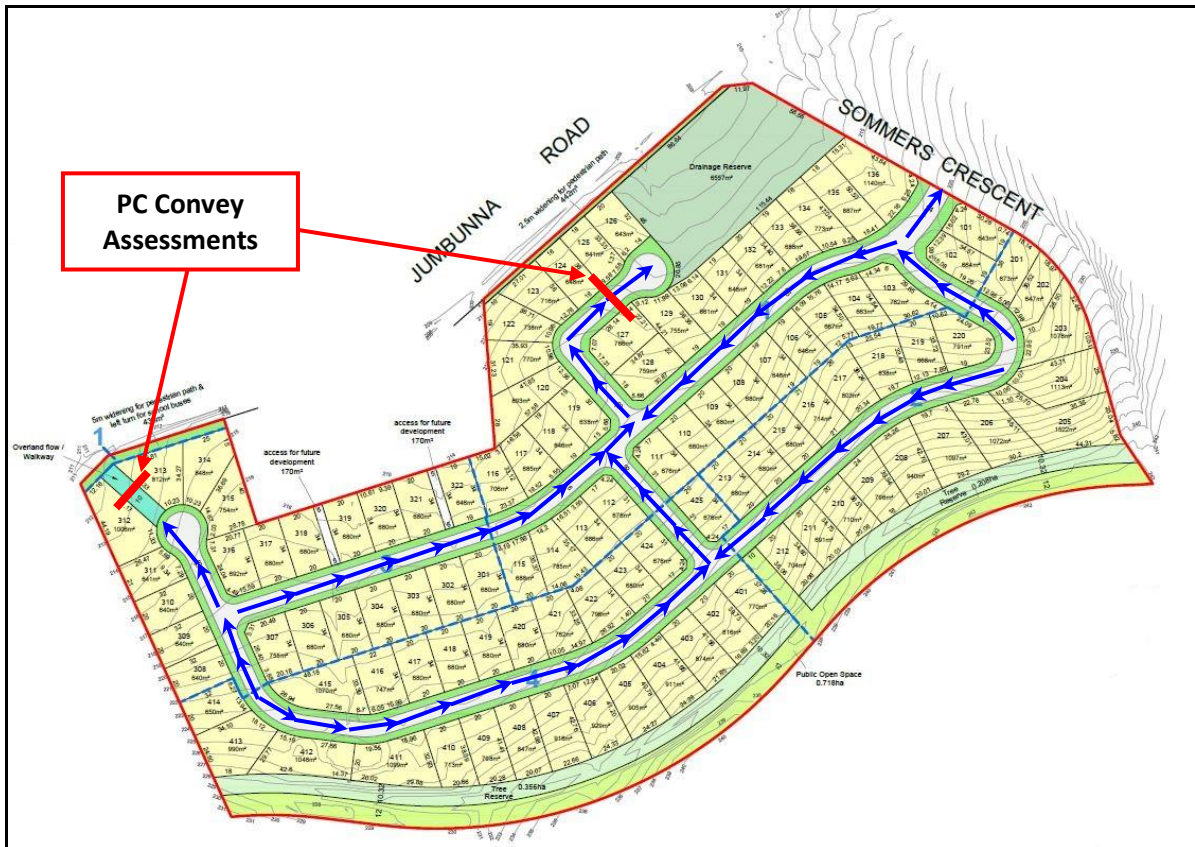


Figure 6: Indicative Overland Flow Path (Not to Scale)

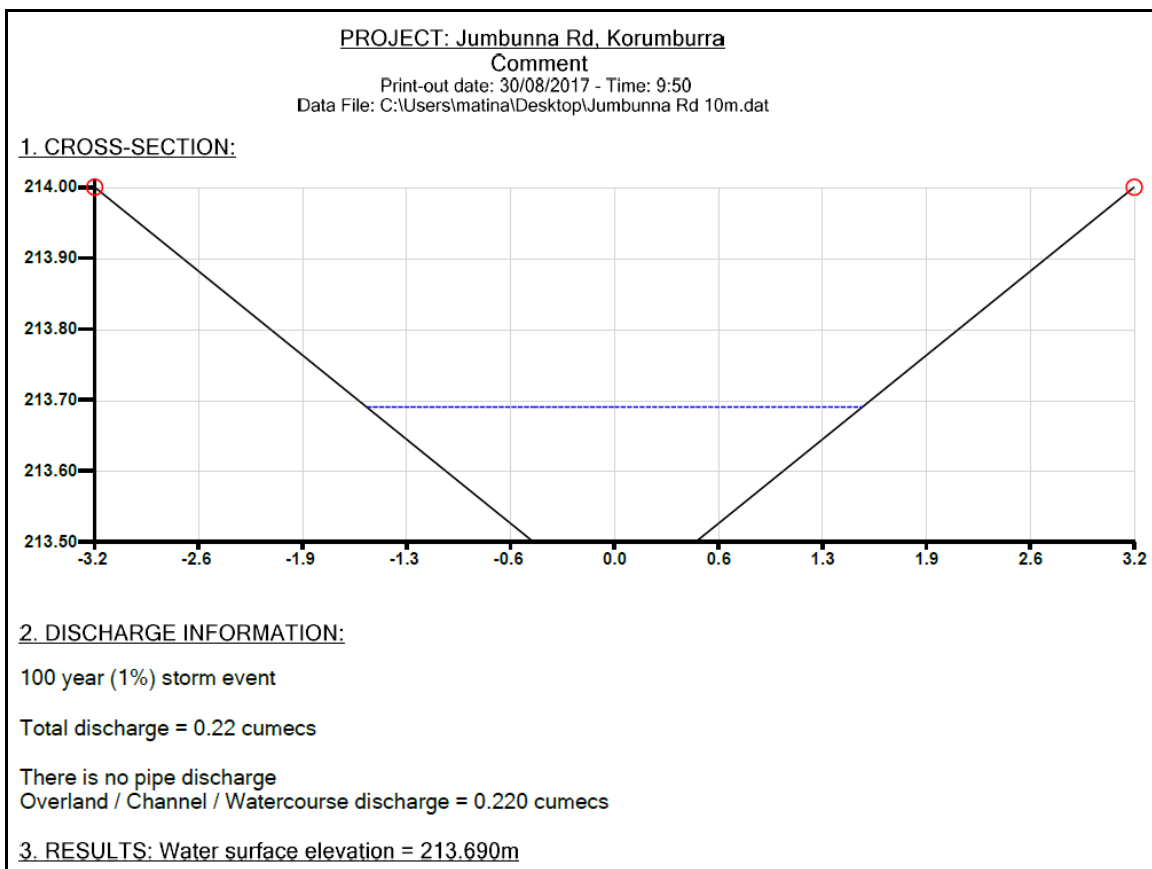


Figure 7: Typical 10m Drainage Reserve Flow Path showing the Q_{gap} Flow (Not to Scale)

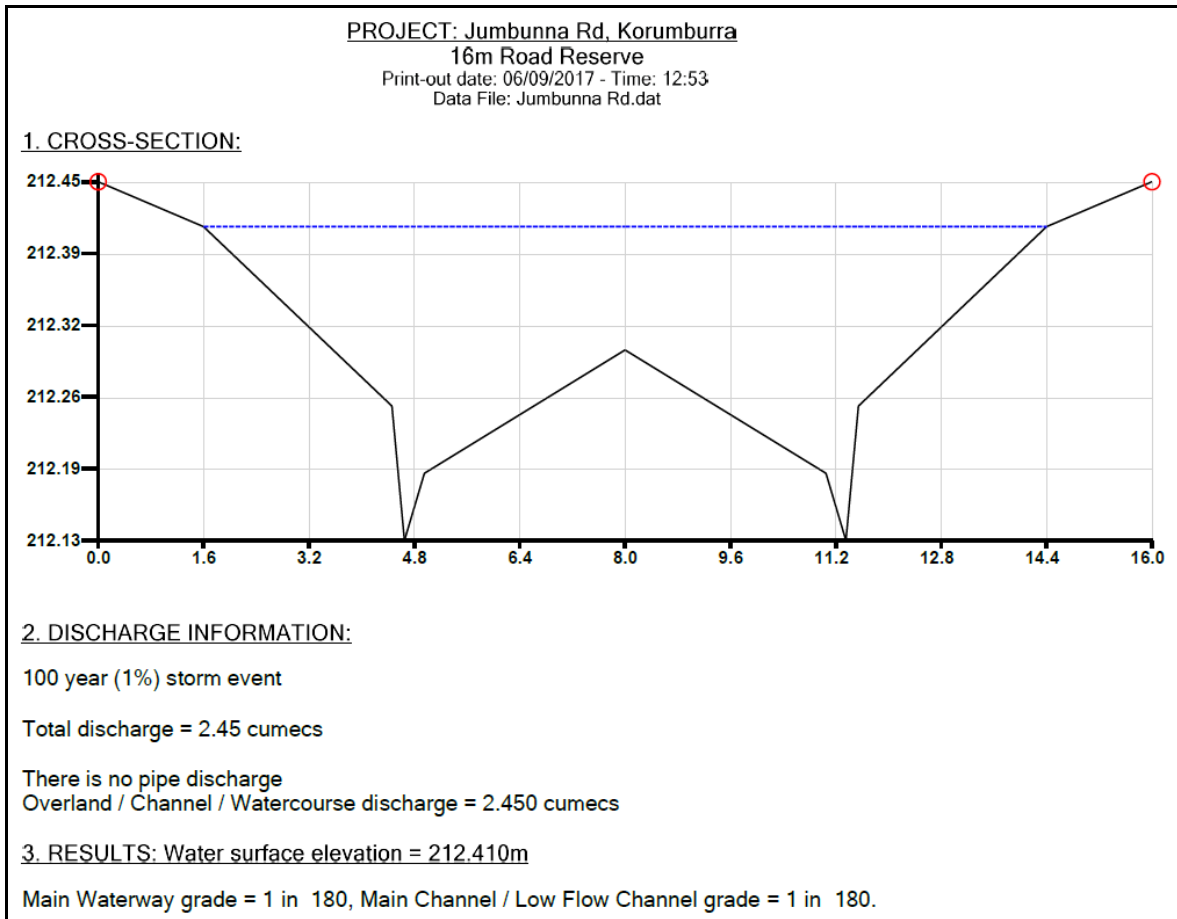


Figure 8: Typical 16m Drainage Reserve Flow Path showing the Q_{gap} Flow (Not to Scale)

4.4 Sizing of the Retarding Basin

It is proposed to provide a retarding basin within the development site to detain the 1 in 100 year ARI post development peak flows to the pre-development level. The size and dimensions of the detention asset are in Table 4 and based on the RORB model outputs shown in Appendix C.

Table 4: Details of the Proposed Retarding Basin

Details of Retarding Basin	
Catchment Area	18.00 ha
• Site	12.15 ha
• external	5.85 ha
Base Level	209.50 m AHD
100 year Level	210.66 m AHD
Top of Batter	211.00 m AHD
Retarding Basin Depth to Top of Batter	1.5 m
Storage Required	2310 m ³
Outlet Controls for RB's	
• Invert Level/Pipe Size	209.50 m AHD/ 2x450 dia
• Crest Elevation/Width for Spillway	210.70 m AHD / 10.0 m

Concept layout of the retarding basin is shown in Figure 11 in Section 5.

5 STORMWATER QUALITY TREATMENT

It is a Victorian Government requirement that quality of stormwater runoff from the proposed development meets the Urban Stormwater Best Practice Environmental Management Guidelines (BPEMG), which are required under Clause 56 of the Victorian Planning Provisions (VPP). The targets are:

- 80% removal of Total Suspended Solids (TSS);
- 45% removal of Total Phosphorus (TP);
- 45% removal of Total Nitrogen (TN); and
- 70% removal of the Total Gross Pollutant Load (Litter).

Stormwater quality modelling was conducted using MUSIC (Model for Urban Stormwater Improvement Conceptualisation) for the proposed development site. The weather station used was obtained from the Narre Warren North weather station from the Melbourne Water rainfall template. This rainfall data was considered as the site is located very close to the designated Mt St Leonard rainfall zone, as shown in dark blue colour in Figure 9.

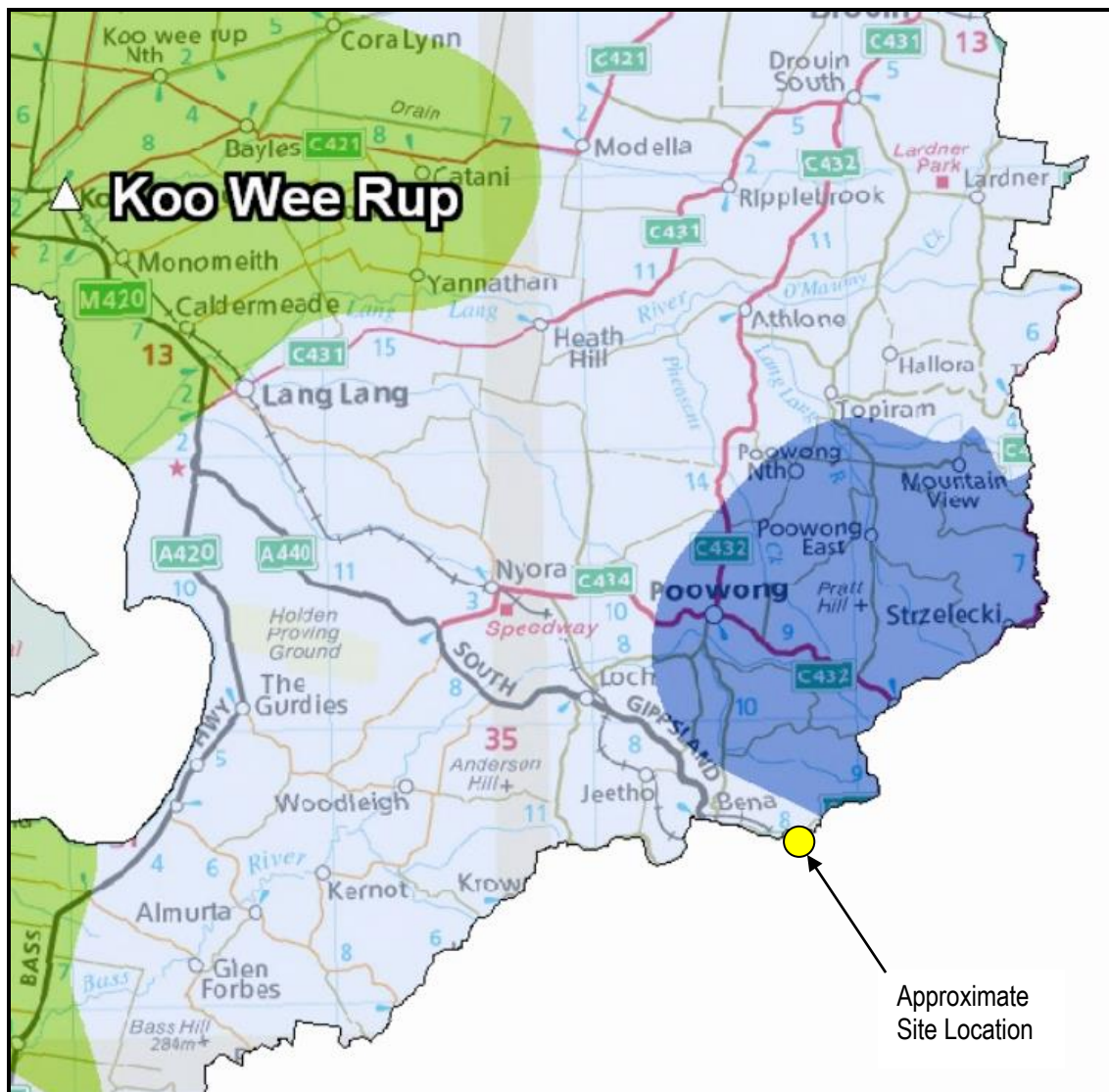


Figure 9: Greater Melbourne Rainfall Distribution (Source: Melbourne Water Music Guidelines – Not to Scale)

The layout of the MUSIC Model is shown in Figure 10 and results of the MUSIC model is shown in Table 5. The proposed stormwater treatment train will be a sedimentation basin and bioretention system, which will be in the base of the detention basin in north-east corner. Stormwater quality treatment for the small area on west side will be carried out via the proposed swale in north-west corner of the site. Rainwater tanks within the residential lots are also proposed in this strategy. The stormwater treatment system will treat the subject site of 12.154 ha.

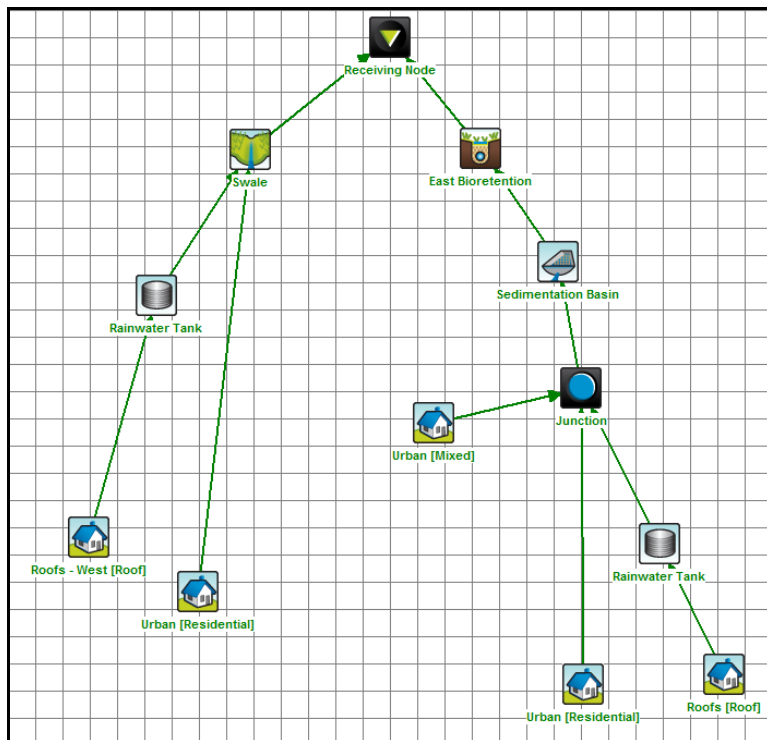


Figure 10: MUSIC Model Layout

Table 5: MUSIC Model Results

Site Treatment	% Removal	BPMSG Target % Removal
Total Suspended Solids (Kg/yr)	86.3	80
Total Phosphorus (Kg/yr)	53.4	45
Total Nitrogen (Kg/yr)	50	45
Gross Pollutants (Kg/yr)	100	70

As shown in Table 5, the results show that the best practice BPMSG target is achieved for all the pollutant types with the proposed treatment assets.

The detailed designs of the proposed stormwater treated have not been completed and will be submitted to South Gippsland Shire Council during the detailed design phase.

The concept layout of the overall stormwater treatment and detentions is shown in Figure 11.

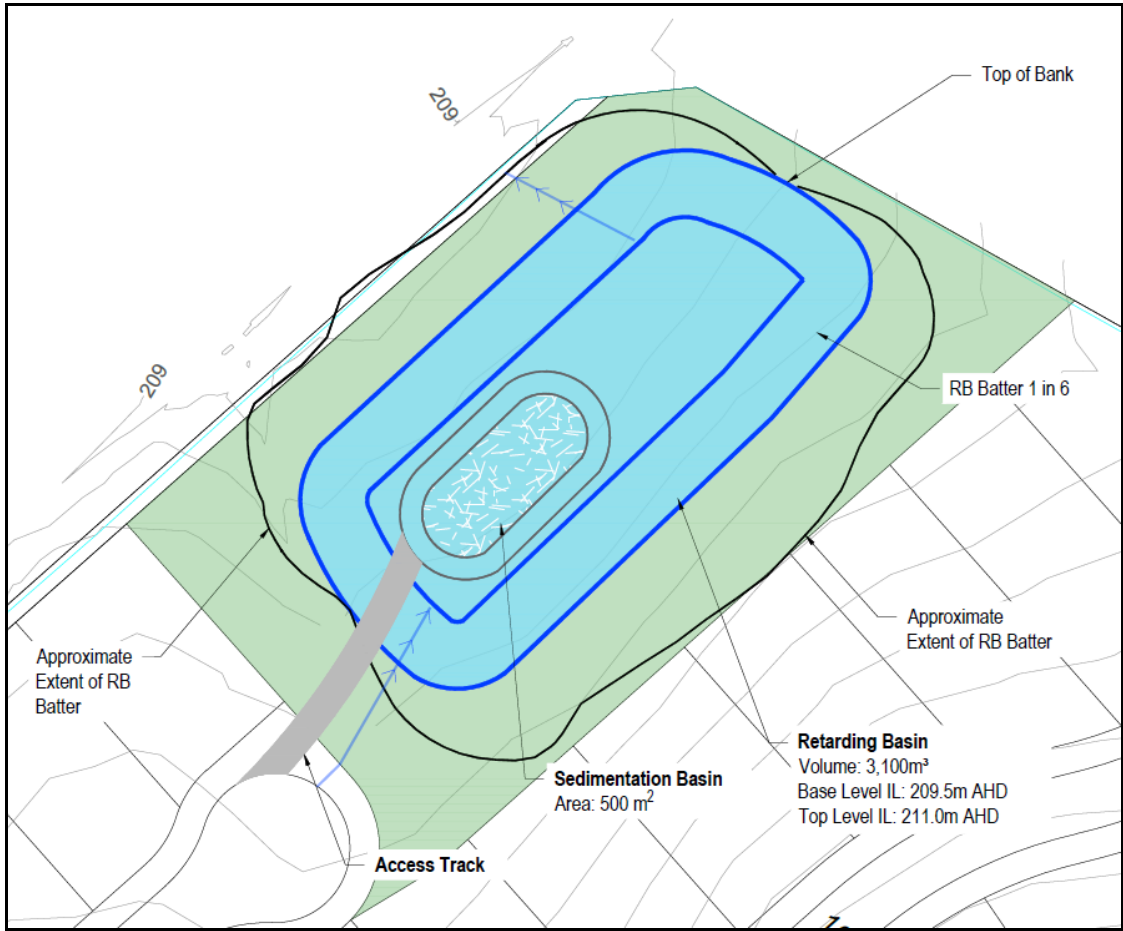


Figure 11: Indicative WSUD Assets Plan (Not to Scale)

6 CONCLUSION

This report has identified an overall stormwater management strategy for the proposed residential development located at Jumbunna Road, Korumburra. This strategy is preliminary only and subject to further changes on the size of the proposed lots and drainage reserve area.

The strategy provides a methodology for the management of stormwater on the subject site which would result in:

- Volume of stormwater detention requirements of 2310 m³ for the development site will be required to detain 1 in 100-year peak post development flow to pre-development level. This volume will be catered by a retarding basin located on the north-east corner of the site;
- Construction of drainage to meet the likely requirements of Council, including 1 in 100 year ARI capacity road reserves and underground drainage for the 1 in 5 year ARI storm event as needed; and
- Stormwater quality treatment system required to meet BPEMG standard will be a sedimentation basin and a bioretention basin located within the stormwater detention basin. The treatment asset for west side will be a swale at the north-west corner of the site. Rainwater tanks in each individual residential lots are also proposed.

The above strategy can be implemented and all West Gippsland CMA and Council's development requirements can be achieved, with no net effect on the downstream properties.

BEVERIDGE WILLIAMS & CO PTY LTD

Prepared by

Reviewed by

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Surface Water Engineer

Aram Manjikian
Senior Surface Water Engineer

Authorised for issue by

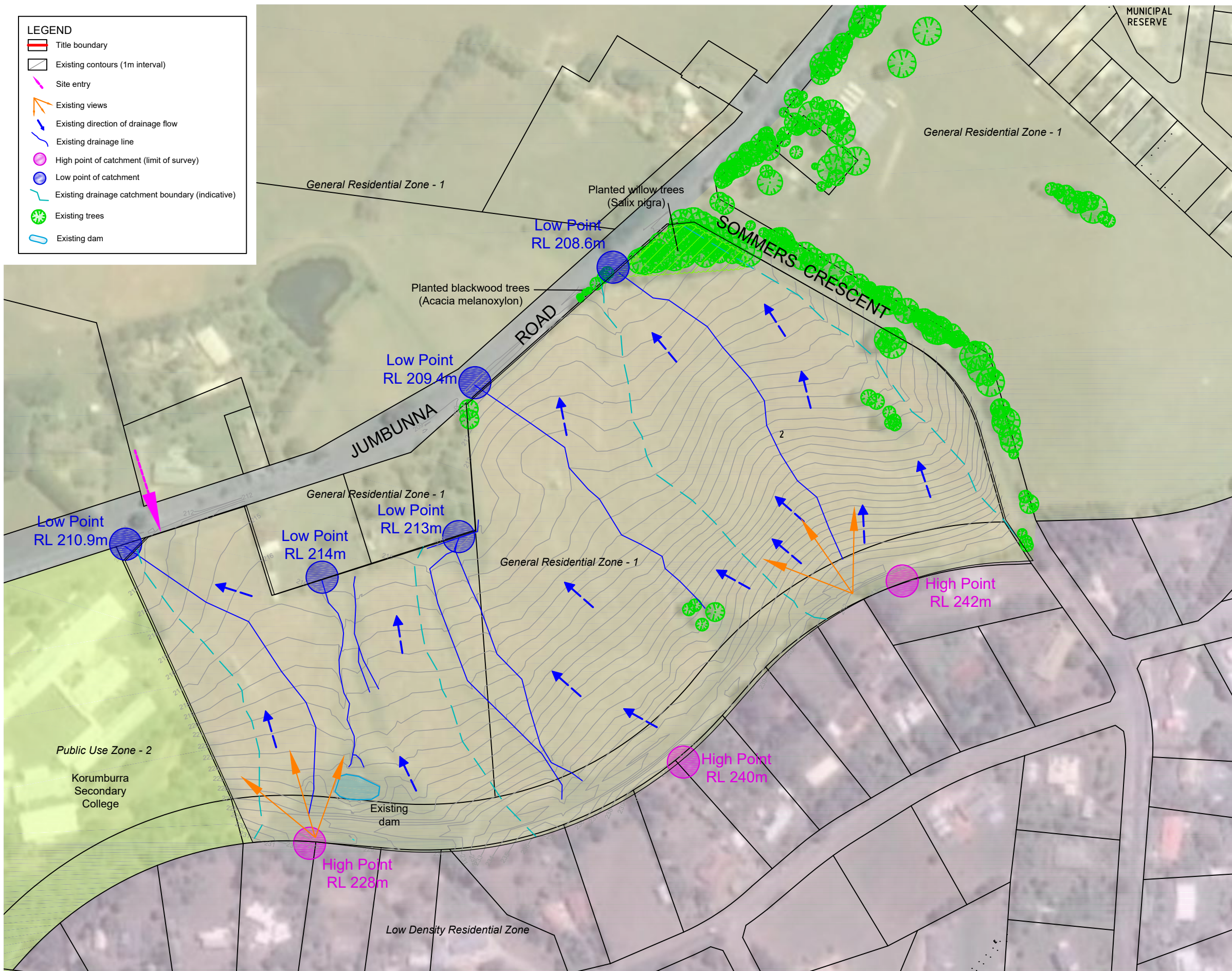
Andrea Bouilly
Project Manager

APPENDIX A
Site Topography and Site Analysis Plans



LEGEND

- Title boundary
- Existing contours (1m interval)
- Site entry
- Existing views
- Existing direction of drainage flow
- Existing drainage line
- High point of catchment (limit of survey)
- Low point of catchment
- Existing drainage catchment boundary (indicative)
- Existing trees
- Existing dam



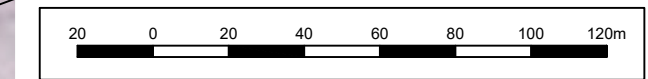
1. View of Willows located on the North-East corner of subject site.



2. Blackwood trees along Jumbunna Road



3. View looking towards Jumbunna road from west boundary



Site Analysis
Jumbunna Road, Korumburra
Kufner Textiles (Australia) P/L

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Date: 19.08.2016		Version No: 01		Job No: L7074		Scale (A1): 1:1000		Scale (A3): 1:2000	
Version	Date	Description	Drafted	Approved	Version	Date	Description	Drafted	Approved
01	19.08.2016	Initial Issue	J.CAHILL	A. BOULLY					

APPENDIX B
Indicative Subdivision Plan



LEGEND

- Title boundary
- Stage boundary
- Stage numbers
- Existing contours (1m interval)
- Lots
- Naturestrip (indicative)
- Road pavement (indicative)
- Public Open Space
- Drainage reserve
- Overland flow path / Walkway
- Tree Reserve

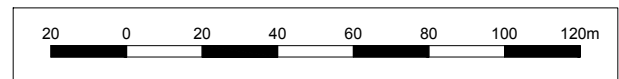


Proposed Order of Staging

TOTAL number of lots	103	Area (ha)
Stage 1	36	4.202
Stage 2	20	2.557
Stage 3	22	2.057
Stage 4	25	3.338

Site Area	12.154ha
* Lots	7.856ha
* Roads (incl. Jumbunna Rd widening)	2.287ha
* Overland Flow Path / Walkway	0.039ha
* Access for future development	0.034ha
Public Open Space	0.718ha
Drainage Reserve	0.656ha
Tree Reserve	0.564ha
Net Developable Area	10.216ha
Lot Yield	103 lots @ 10.1 lots per ha 763m ² average lot size

* Indicates inclusion in NDA



- Notes:**
- This plan is subject to Council approval.
 - All dimensions and areas are subject to survey and final computations.
 - The drainage area is subject to engineering detail design and Council approval.
 - Dimensions of arcs are arc lengths.
 - Further investigation may be required for vegetation retention and removal, site access and egress, and aboriginal and cultural heritage.
 - Road pavement is indicative only and subject to detailed engineering design.
 - All roads are 16m wide access streets unless noted otherwise

Indicative Subdivision & Staging Plan
 Jumbunna Road, Korumburra
 Kufner Textiles (Australia) P/L

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 Melbourne ph : 03 9524 8888
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Version	Date	Description	Drafted	Approved	Version	Date	Description	Drafted	Approved
04	04.07.2017	Design amended							
03	29.06.2017	Design amended							
02	22.07.2016	Staging and lots amended							
01	18.07.2016	Initial Issue							

Date: 04.07.2017
 Version No: **04**
 Job No: L7074
 Scale (A1): 1:1000
 (A3): 1:2000

APPENDIX C
RORB Results and Detention Calculations



Pre development_batch.out

RORBWin Batch Run Summary

Program version 6.15 (last updated 30th March 2010)
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Date run: 24 May 2017 09:42

Catchment file : K:\Jobs Data\7074 Jumbunna Rd
Korumburra_Eng_General\Design\Drainage\Interim\RORB\Pre
Development-Details\Pre development.catg
Rainfall location: Korumburra
Temporal pattern : AR&R87 Volume 2 for zone 1 (filtered)
Spatial pattern : Uniform
Areal Red. Fact. : Based on Siriwardena and Weinmann formulation
Loss factors : Constant with ARI

Parameters: kc = 0.36 m = 0.80

Loss parameters Initial loss (mm) Runoff coeff.
10.00 0.60

Peak Description
01 Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001
1	10m	100y	20.40	0.97	0.4612
2	15m	100y	24.57	0.97	0.6373
3	20m	100y	27.70	0.98	0.7293
4	25m	100y	30.22	0.98	0.8111
5	30m	100y	32.30	0.98	0.8669
6	45m	100y	37.03	0.98	0.9417
7	1h	100y	40.48	0.98	0.9747
8	1.5h	100y	48.02	0.99	0.9277
9	2h	100y	54.02	0.99	0.9762
10	3h	100y	63.60	0.99	0.8546
11	4.5h	100y	74.79	1.00	0.9697
12	6h	100y	83.92	1.00	0.9311
13	9h	100y	98.79	1.00	0.8673
14	12h	100y	110.96	1.00	0.7533
15	18h	100y	131.36	1.00	0.4904
16	24h	100y	147.74	1.00	0.6018
17	30h	100y	161.45	1.00	0.4205
18	36h	100y	173.17	1.00	0.4078
19	48h	100y	192.23	1.00	0.4896
20	72h	100y	218.65	1.00	0.3155

Elapsed Run Time (hh:mm:ss) = 00:00:00

Post development_batch.out

RORBWin Batch Run Summary

Program version 6.15 (last updated 30th March 2010)
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Date run: 23 Aug 2017 16:35

Catchment file : K:\Jobs Data\7074 Jumbunna Rd
Korumburra_Eng_General\Design\Drainage\Interim\RORB\Post dev - excluding
reserve-NoRB\Post development.catg
Rainfall location: Korumburra
Temporal pattern : AR&R87 Volume 2 for zone 1 (filtered)
Spatial pattern : Uniform
Areal Red. Fact. : Based on Siriwardena and Weinmann formulation
Loss factors : Constant with ARI

Parameters: kc = 0.95 m = 0.80

Loss parameters Initial loss (mm) Runoff coeff.
10.00 0.60

Peak Description
01 Calculated hydrograph, East
02 Calculated hydrograph, West
03 Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003
1	10m	100y	20.40	1.00	3.0554	0.3034	3.3588
2	15m	100y	24.57	1.00	3.4884	0.3457	3.7831
3	20m	100y	27.70	1.00	3.1195	0.3267	3.4462
4	25m	100y	30.22	1.00	3.1559	0.3133	3.3884
5	30m	100y	32.30	1.00	2.9314	0.2958	3.1479
6	45m	100y	37.03	1.00	2.5924	0.2574	2.8498
7	1h	100y	40.48	1.00	2.6735	0.2282	2.8904
8	1.5h	100y	48.02	1.00	2.5080	0.2280	2.7017
9	2h	100y	54.02	1.00	2.7597	0.2502	3.0099
10	3h	100y	63.60	1.00	1.7551	0.1679	1.9230
11	4.5h	100y	74.79	1.00	1.5979	0.1321	1.7300
12	6h	100y	83.92	1.00	1.1135	0.0961	1.2096
13	9h	100y	98.79	1.00	1.0063	0.0839	1.0897
14	12h	100y	110.96	1.00	1.0317	0.0902	1.1219
15	18h	100y	131.36	1.00	0.6696	0.0597	0.7293
16	24h	100y	147.74	1.00	0.6730	0.0588	0.7318
17	30h	100y	161.45	1.00	0.5373	0.0457	0.5830
18	36h	100y	173.17	1.00	0.4493	0.0392	0.4885
19	48h	100y	192.23	1.00	0.5392	0.0454	0.5846
20	72h	100y	218.65	1.00	0.3884	0.0336	0.4220

Elapsed Run Time (hh:mm:ss) = 00:00:01

RORBWin Batch Run Summary

Program version 6.15 (last updated 30th March 2010)
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Date run: 06 Sep 2017 13:15

Catchment file : K:\Jobs Data\7074 Jumbunna Rd Korumburra_Eng_General\Design\Drainage\Interim\RORB\Post dev - excluding reserve-NoRB\Post development.catg
 Rainfall location: Korumburra
 Temporal pattern : AR&R87 Volume 2 for zone 1 (filtered)
 Spatial pattern : Uniform
 Areal Red. Fact. : Based on Siriwardena and Weinmann formulation
 Loss factors : Constant with ARI

Parameters: kc = 0.95 m = 0.80

Loss parameters Initial loss (mm) Runoff coeff.
 10.00 0.30

Peak Description
 01 Calculated hydrograph, East
 02 Calculated hydrograph, West
 03 Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003
1	10m	5y	10.16	1.00	0.6482	0.1060	0.7314
2	15m	5y	12.51	1.00	0.8622	0.1210	0.9504
3	20m	5y	14.33	1.00	0.8777	0.1150	0.9631
4	25m	5y	15.85	1.00	0.9782	0.1107	1.0857
5	30m	5y	17.13	1.00	0.9328	0.1089	1.0346
6	45m	5y	20.18	1.00	0.8579	0.1149	0.9397
7	1h	5y	22.49	1.00	0.9732	0.1031	1.0751
8	1.5h	5y	26.86	1.00	0.9709	0.1028	1.0625
9	2h	5y	30.37	1.00	1.0312	0.1173	1.1486
10	3h	5y	36.00	1.00	0.5762	0.0723	0.6485
11	4.5h	5y	42.63	1.00	0.7022	0.0657	0.7679
12	6h	5y	48.07	1.00	0.4747	0.0497	0.5244
13	9h	5y	56.98	1.00	0.4449	0.0428	0.4872
14	12h	5y	64.30	1.00	0.4536	0.0458	0.4994
15	18h	5y	76.01	1.00	0.2851	0.0292	0.3143
16	24h	5y	85.40	1.00	0.3045	0.0305	0.3350
17	30h	5y	93.24	1.00	0.2389	0.0232	0.2622
18	36h	5y	99.94	1.00	0.1913	0.0190	0.2103
19	48h	5y	110.81	1.00	0.2340	0.0225	0.2565
20	72h	5y	125.81	1.00	0.1731	0.0173	0.1905

Elapsed Run Time (hh:mm:ss) = 00:00:01

RORBWin Batch Run Summary

Program version 6.15 (last updated 30th March 2010)
 Copyright Monash University and Sinclair Knight Merz

Date run: 31 Aug 2017 09:20

Catchment file : K:\Jobs Data\7074 Jumbunna Rd Korumburra_Eng_General\Design\Drainage\Interim\RORB\Post development - excluding reserve\Post development.catg
 Rainfall location: Korumburra
 Temporal pattern : AR&R87 Volume 2 for zone 1 (filtered)
 Spatial pattern : Uniform
 Areal Red. Fact. : Based on Siriwardena and Weinmann formulation
 Loss factors : Constant with ARI

Parameters: kc = 0.95 m = 0.80

Loss parameters Initial loss (mm) Runoff coeff.
 10.00 0.60

- Peak Description
 01 Calculated hydrograph, East
 02 Special storage : east - Outflow
 03 Special storage : east - Inflow
 04 Calculated hydrograph, West
 05 Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003	Peak0004	Peak0005
1	10m	100y	20.40	1.00	3.0554	0.6103	3.0554	0.3034	0.6553
2	15m	100y	24.57	1.00	3.4884	0.6978	3.4884	0.3457	0.7938
3	20m	100y	27.70	1.00	3.1195	0.7462	3.1195	0.3267	0.8499
4	25m	100y	30.22	1.00	3.1559	0.7726	3.1559	0.3133	0.8582
5	30m	100y	32.30	1.00	2.9314	0.7784	2.9314	0.2958	0.8753
6	45m	100y	37.03	1.00	2.5924	0.8068	2.5924	0.2574	0.8871
7	1h	100y	40.48	1.00	2.6735	0.8204	2.6735	0.2282	0.9044
8	1.5h	100y	48.02	1.00	2.5080	0.8001	2.5080	0.2280	0.9018
9	2h	100y	54.02	1.00	2.7597	0.8183	2.7597	0.2502	0.9151
10	3h	100y	63.60	1.00	1.7551	0.7687	1.7551	0.1679	0.8381
11	4.5h	100y	74.79	1.00	1.5979	0.8116	1.5979	0.1321	0.8869
12	6h	100y	83.92	1.00	1.1135	0.7649	1.1135	0.0961	0.8491
13	9h	100y	98.79	1.00	1.0063	0.7262	1.0063	0.0839	0.8096
14	12h	100y	110.96	1.00	1.0317	0.6950	1.0317	0.0902	0.7442
15	18h	100y	131.36	1.00	0.6696	0.4935	0.6696	0.0597	0.5532
16	24h	100y	147.74	1.00	0.6730	0.5929	0.6730	0.0588	0.6392
17	30h	100y	161.45	1.00	0.5373	0.4570	0.5373	0.0457	0.5027
18	36h	100y	173.17	1.00	0.4493	0.3949	0.4493	0.0392	0.4341
19	48h	100y	192.23	1.00	0.5392	0.4857	0.5392	0.0454	0.5311
20	72h	100y	218.65	1.00	0.3884	0.3494	0.3884	0.0336	0.3830

Elapsed Run Time (hh:mm:ss) = 00:00:01

Routing results:

Jumbunna Road

Jumbunna Road: 1 hour 100 year Design Storm

DESIGN run no. 1

Parameters: kc = 0.95 m = 0.80

Loss parameters Initial loss (mm) Runoff coeff.
 10.00 0.60

*** Calculated hydrograph, East

	Hydrograph
	Calc.
Peak discharge, m ³ /s	2.674
Time to peak, h	0.500
Volume, m ³	4.10E+03
Time to centroid, h	0.580
Lag (c.m. to c.m.), h	0.126
Lag to peak, h	0.0466

Results of routing through special storage east

Peak elevation= 210.66 m
Peak outflow = 0.82 m³/s (pipe flow)
Peak storage = 2.31E+03 m³

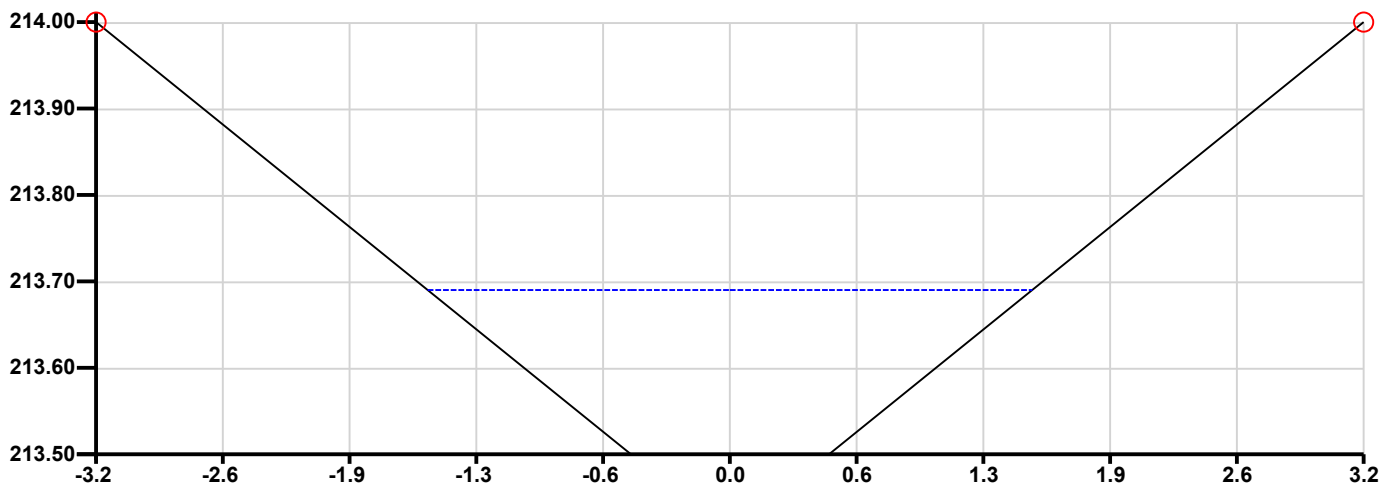
*** Special storage : east

	Hydrograph	
	Outflow	Inflow
Peak discharge, m ³ /s	0.820	2.674
Time to peak, h	0.833	0.500
Volume, m ³	4.05E+03	4.10E+03
Time to centroid, h	1.28	0.58
Lag (c.m. to c.m.), h	0.831	0.126
Lag to peak, h	0.380	0.047

APPENDIX D
PC Convey Results



1. CROSS-SECTION:



2. DISCHARGE INFORMATION:

100 year (1%) storm event

Total discharge = 0.22 cumecs

There is no pipe discharge

Overland / Channel / Watercourse discharge = 0.220 cumecs

3. RESULTS: Water surface elevation = 213.690m

Main Waterway grade = 1 in 150, Main Channel / Low Flow Channel grade = 1 in 150.

	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK	TOTAL CROSS-SECTION
Discharge (cumecs):	0.00	0.22	0.00	0.22
D(Max) = Max. Depth (m):	0.00	0.19	0.00	0.19
D(Ave) = Ave. Depth (m):	0.00	0.13	0.00	0.13
V = Ave. Velocity (m/s):	0.00	0.58	0.00	0.58
D(Max) x V (cumecs/m):	0.00	0.11	0.00	0.11
D(Ave) x V (cumecs/m):	0.00	0.07	0.00	0.07
Froude Number:	0.00	0.52	0.00	0.52
Area (m ²):	0.00	0.38	0.00	0.38
Wetted Perimeter (m):	0.00	3.09	0.00	3.09
Flow Width (m):	0.00	3.05	0.00	3.05
Hydraulic Radius (m):	0.00	0.12	0.00	0.12
Composite Manning's n:	0.000	0.035	0.000	0.035
Split Flow?	-	-	-	No

4. CROSS-SECTION DATA:

SEGMENT NO.	LEFT HAND POINT		RIGHT HAND POINT		MANNING'S N
	CHAINAGE (m)	R.L. (m)	CHAINAGE (m)	R.L. (m)	
1	-3.200	214.000	-0.500	213.500	0.035
2	-0.500	213.500	0.000	213.500	0.035
3	0.000	213.500	0.500	213.500	0.035
4	0.500	213.500	3.200	214.000	0.035

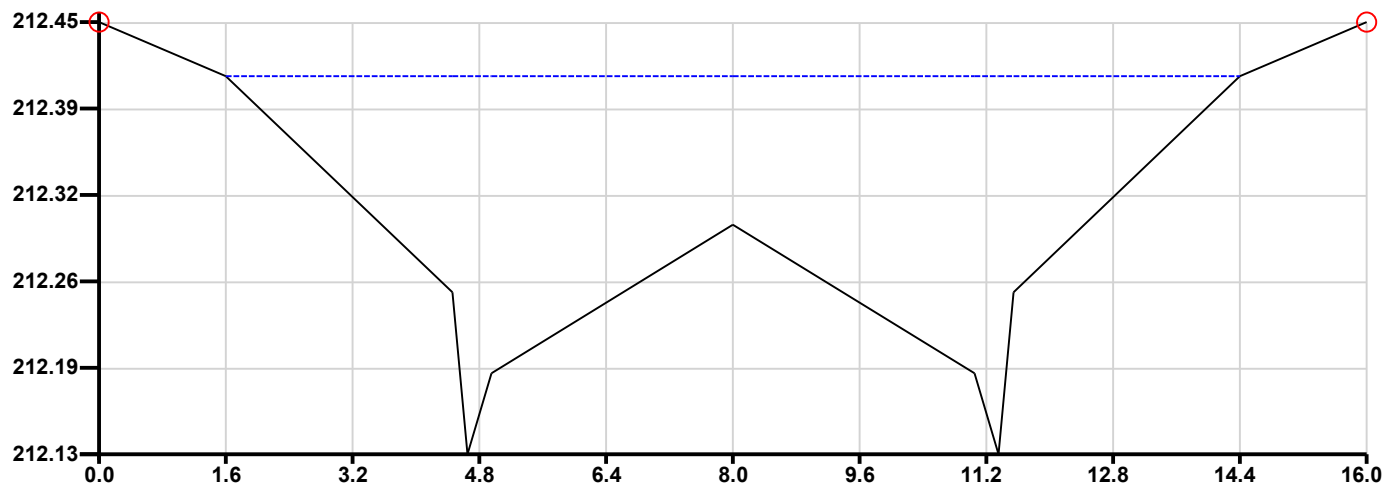
PROJECT: Jumbunna Rd, Korumburra

16m Road Reserve

Print-out date: 06/09/2017 - Time: 12:53

Data File: Jumbunna Rd.dat

1. CROSS-SECTION:



2. DISCHARGE INFORMATION:

100 year (1%) storm event

Total discharge = 2.45 cumecs

There is no pipe discharge

Overland / Channel / Watercourse discharge = 2.450 cumecs

3. RESULTS: Water surface elevation = 212.410m

Main Waterway grade = 1 in 180, Main Channel / Low Flow Channel grade = 1 in 180.

	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK	TOTAL CROSS-SECTION
Discharge (cumecs):	0.00	2.52	0.00	2.52
D(Max) = Max. Depth (m):	0.00	0.28	0.00	0.28
D(Ave) = Ave. Depth (m):	0.00	0.13	0.00	0.13
V = Ave. Velocity (m/s):	0.00	1.48	0.00	1.48
D(Max) x V (cumecs/m):	0.00	0.42	0.00	0.42
D(Ave) x V (cumecs/m):	0.00	0.20	0.00	0.20
Froude Number:	0.00	1.30	0.00	1.30
Area (m^2):	0.00	1.70	0.00	1.70
Wetted Perimeter (m):	0.00	12.89	0.00	12.89
Flow Width (m):	0.00	12.80	0.00	12.80
Hydraulic Radius (m):	0.00	0.13	0.00	0.13
Composite Manning's n:	0.000	0.013	0.000	0.013
Split Flow?	-	-	-	No

4. CROSS-SECTION DATA:

SEGMENT NO.	LEFT HAND POINT		RIGHT HAND POINT		MANNING'S N
	CHAINAGE (m)	R.L. (m)	CHAINAGE (m)	R.L. (m)	
1	0.000	212.450	1.600	212.410	0.035
2	1.600	212.410	4.460	212.250	0.013
3	4.460	212.250	4.650	212.130	0.013
4	4.650	212.130	4.950	212.190	0.013
5	4.950	212.190	8.000	212.300	0.013
6	8.000	212.300	11.050	212.190	0.013
7	11.050	212.190	11.350	212.130	0.013
8	11.350	212.130	11.540	212.250	0.013
9	11.540	212.250	14.400	212.410	0.013
10	14.400	212.410	16.000	212.450	0.035