AXIOM
CONSULTING
ENGINEERS
6 Webster Street,
Ballarat, Vic. 3350
T03 5331 2688
www.axiomce.com.au

PRELIMINARY STORMWATER STRATEGY

RESIDENTIAL SUBDIVISION
Stonehill Western Precinct, Maddingley

Prepared for

Townsville City Project Pty Ltd

Document Reference

559SS-116-01

Issue	Author	Date	Checked	Date	Authorised	Date
A	Michael Parker	18/07/19	Michael Parker	18/07/19	Chris Coughlan	18/07/19
B	Michael Parker	19/07/19	Michael Parker	19/07/19	Chris Coughlan	19/07/19
C	Michael Parker	10/10/19	Michael Parker	10/10/19	Chris Coughlan	10/10/19
D	Michael Parker	29/11/19	Michael Parker	29/11/19	Chris Coughlan	29/11/19
E	Michael Parker	17/01/20	Michael Parker	17/01/20	Chris Coughlan	17/01/20
F	Michael Parker	31/01/20	Michael Parker	31/01/20	Chris Coughlan	31/01/20

This investigation and report have been authorised by Mr Chris Coughlan, the Director of Axiom Consulting Engineers Pty Ltd.

Chris Coughlan BEng (Civil), MIEAust

ISO 9001 certified
Equal Assurance

TABLE OF CONTENTS

Definitions

AEP	Annual Exceedance Probability
WSUD	Water Sensitive Urban Design
RORB	Runoff and stream flow routing program
MUSIC	Stormwater treatment program

1. INTRODUCTION

This Stormwater Strategy (SS) has been prepared for a proposed staged residential subdivision as part of the Stonehill Estate and includes a separate proposed development known as Queens Brook Estate. The SS will investigate the effects the developments will have on stormwater quantity and discharge.

The broad objectives of the SS are to ensure that there are no adverse impacts on the receiving waterways along with achieving best practice pollutant reductions through Water Sensitive Urban Design (WSUD) and storage of stormwater for onsite detention requirements.

2. SITE & SURROUNDS

The topography of the catchment is undulating with varying slopes up to 1:5. The area north of Werribee Vale Road, which will be utilized for an outfall pipe, is flatter with slopes around 1:150.

The total catchment area from the development sites is 63.6ha and has been split into 9 sub-catchments. The combined catchment area is part of the larger catchment for the Werribee River.

This SS is partially in accordance with the current approved development stormwater strategy, refer Appendix A, sub-catchments 13, 14, 16 & 17, are relevant for this SS as well as locations of proposed Wetlands W3, W4 and W6.

The site is located within Moorabool Shire Council and is zoned as General Residential Zone 1 (GRZ1). A locality plan is sown in Figure 1 below.

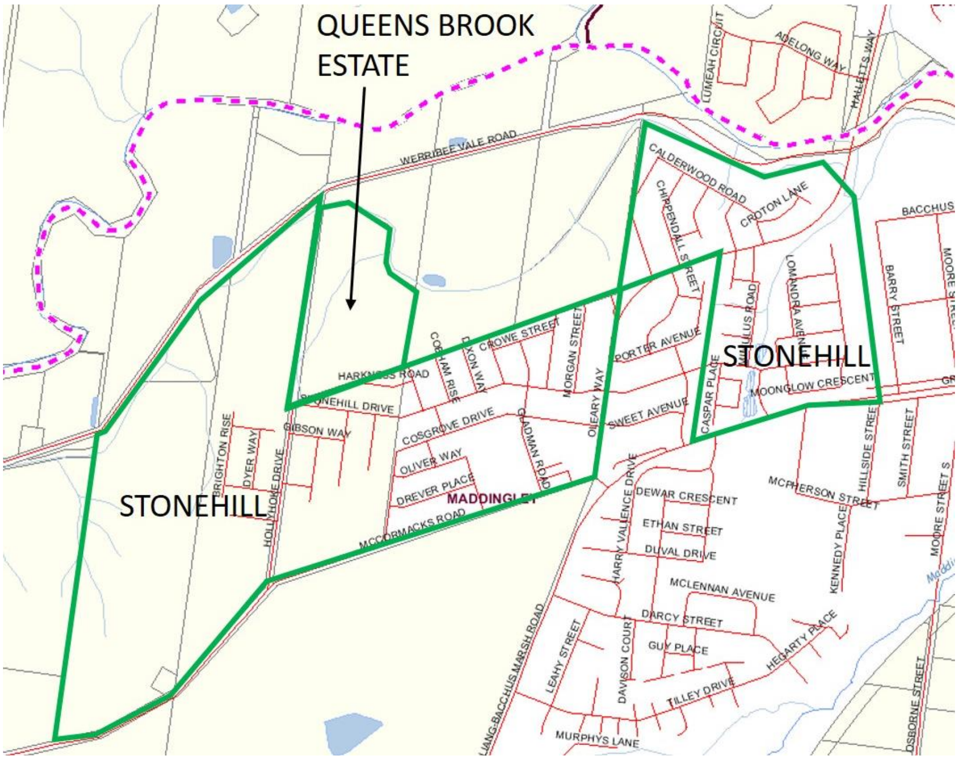


Figure 1 – Locality Plan

3. PROPOSED DEVELOPMENT

The subject site is part of an ongoing development known as Stonehill in Maddingley. The total development is in excess of 1500 lots that have partly been created, currently under construction and to be created in the future. The subject site also includes Queens Brook Estate. Both developments are part of the West Maddingley Development Plan Overlay (DPO3).

4. EXISTING STORMWATER DRAINAGE

An overland flow path exists on the Queens Brook Estate land where W3 and W6 will be located. Another overland flow path exists in the western part of the site where W4 will be located. No formal drainage infrastructure currently exists to Werribee River from each of the overland flow paths and respective catchments.

An existing Southern Rural Water (SRW) channel exists within and surrounding the site, refer to Figure 2 below.

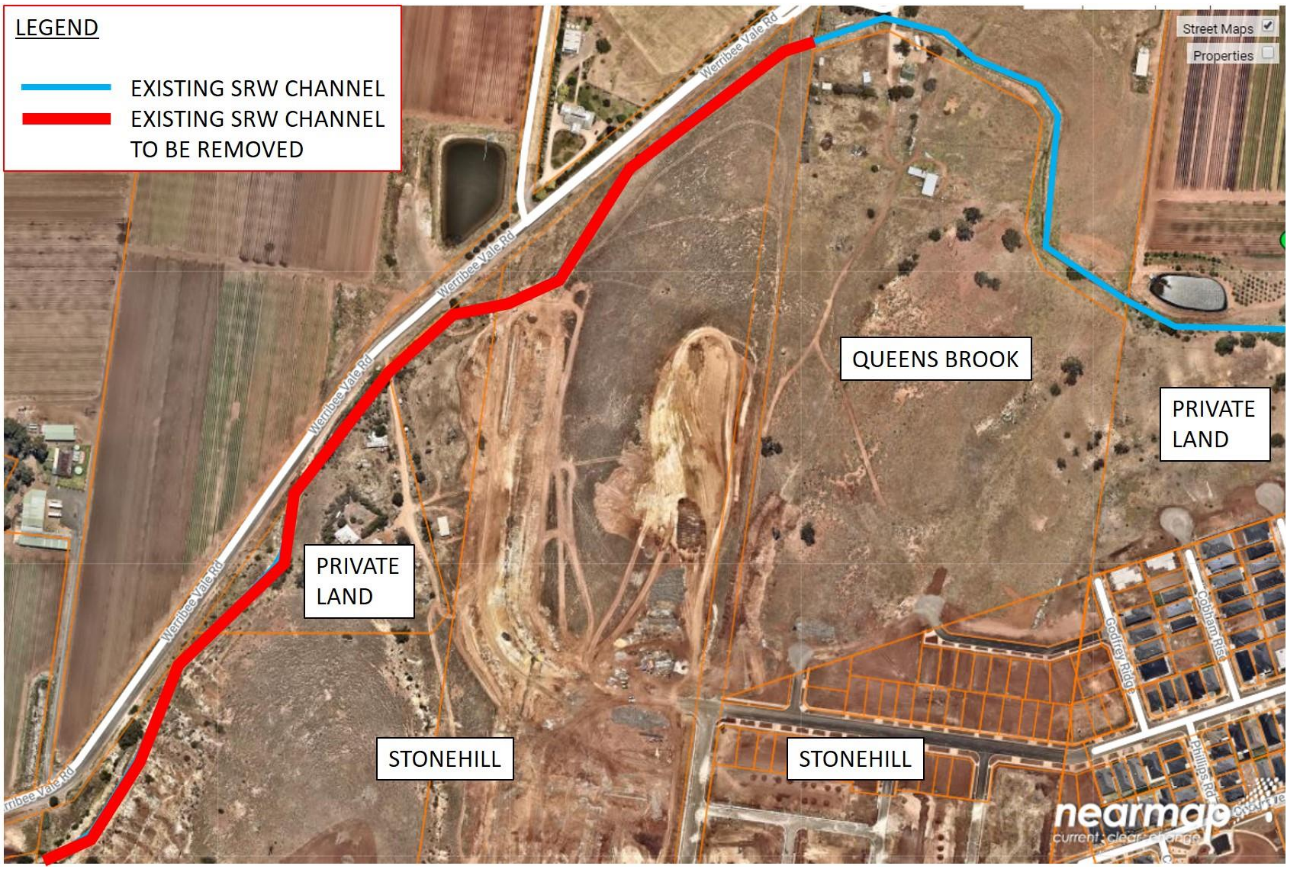


Figure 2 – SRW Channel Layout Plan

Currently, the existing SRW channel collects surface runoff from the escarpments along the southern side of Werribee Vale Road, including in the Stonehill and Queens Brook sites. There are certain sections of the channel that are above ground, usually across major gullies, to allow stormwater to pass under.

Due to the development of the Stonehill site, the SRW channel will be decommissioned, shown in Figure 2. The existing channel will be removed and disposed at an appropriate site and backfilled back to either existing surface levels or design levels. The removal activity will also extend through the private land shown in Figure 2 to assist SRW with the decommissioning of its asset.

It is expected the removal of the SRW channel will benefit the stormwater regime in the area. Currently, stormwater from the existing escarpments is collected by the channel (except in the western gully, which passed under the channel). If the channel were to remain, the collected stormwater would overflow and exit the channel in a concentrated manner, which would likely cause erosion and potential flood issues with Werribee Vale Road. With the full removal of the channel, stormwater runoff will flow more naturally and follow the existing overland flow paths and waterways.

5. STORMWATER DISCHARGE

The software program RORB was used to create the hydrological model. RORB is a nonlinear rainfall runoff and streamflow routing model for calculation of flow hydrographs in drainage and stream networks, which are used in the hydraulic model. The overall catchment was broken into sub-catchments and a plan showing these can be found in Appendix B.

The configuration of the RORB model can be seen below in Figure 2.

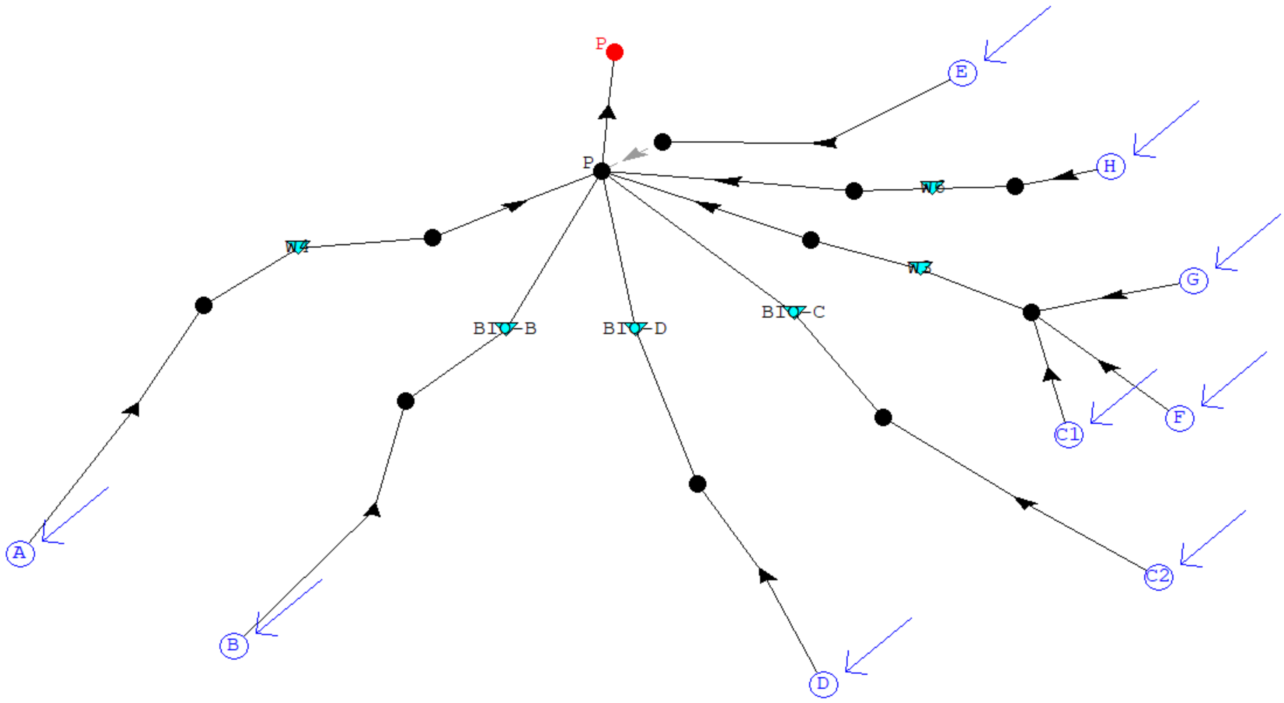


Figure 3 – RORB Model Configuration

RORB Parameters

Runoff coefficient model
Rainfall Intensity Frequency Duration: ARR 2016 IFD
Filtered patterns
Uniform Areal Pattern
Areal Reduction Factor: ARR Data Hub File
Kc = 1.76 (RORB formula)
M = 0.8
Initial Loss = 20mm
Continuing Loss = 1.9
Note: Kc was calibrated using the Design Rainfall Data System (2016) on the Bureau of Meteorology website. Refer to Appendix E for details.

In order to calibrate the RORB model, a pre-development catchment file was created, which represents the current pre-developed scenario (natural reaches and very low fraction impervious) with outputs generated at Werribee River for the 1% AEP event. For comparison, a post-development model was created to assess the likely increase in peak flows and storm duration. Finally, storage nodes were added to the post-development scenario in an attempt to alleviate the increase in flows between the pre and post scenarios. A summary of the RORB model outputs are shown below in Table 1.

Scenario	Peak Storm Duration	Discharge at Werribee River (m^3/s)
Pre-development 1% AEP	1.5 hour	1.74
Post-development 1% AEP no storage	15 minute	12.80
Post-development 1% AEP with storage	30 minute	1.73

Table 1 – RORB Flow Summary

Table 2 below shows the performance of each of the storages, including inflow, outflow and storage volume for the post-development peak discharge storm duration (30 min. as shown above). It should be noted the spillways for W3, W4 and W6 are not engaged at all during the post-development 1% AEP storm event.

Storage	Inflow (m^3/s)	Outflow (m^3/s)	Storage (m^3)
W3	4.496	0.062 (pipe only)	4130
W4	6.973	0.055 (pipe only	6460
W6	1.232	0.126 (pipe only)	1200
Bio-B	0.823	0.555 (pipe and spillway)	269
Bio-C	0.336	0.183 (pipe and spillway)	196
Bio-D	1.016	0.779 (pipe and spillway)	306

Table 2 – RORB Storages Summary

Full results of the post-development storage scenario from RORB can be found in Appendix D.

The storage requirements in Table 2 above can be achieved by creating additional 'air space' above the treatment zones of the proposed wetlands (W3 and W4) and Bioretention Systems (Bio-B, Bio-C and Bio-D).

It should be noted that, while pre-development 1% AEP flows are not reached in the post-development storage 1% AEP scenario, a reduction in peak flows of 68% is achieved. Under the currently approved Stormwater Strategy for Stonehill, with supporting summary report, Melbourne Water were accepting of a 50% reduction in flows between the post-development scenarios with and without storage.

Once stormwater has passed through the various storages, a combined outfall drain (pipe, overland flow path or combination of both) is proposed to extend north along an existing government road reserve, where it will connect to Werribee River via an outlet structure. A single connection to Werribee River is more desirable than the two connections shown in the current SS (as shown in Appendix A). The connection to Werribee River requires Melbourne Water approval, however all abovementioned drainage infrastructure will ultimately be owned and maintained by Council.

6. STORMWATER QUALITY

To address the WSUD requirements for stormwater quality treatment in the post development phase, a MUSC model has been produced. Refer to Appendix C for model layout and results for pollutant reductions.

MUSIC has the ability to simulate rainfall events for catchments and produce outputs from treatment nodes to measure the effectiveness of pollutant reductions at a given discharge point. The discharge point in the model shown in Appendix C is Werribee River.

As stated in *Water Sensitive Urban Design Engineering Procedures – Stormwater* published by CSIRO 2005, the requirements to meet best practice guidelines are as follows:

- 70% reduction in gross pollutants
- 80% reduction in total suspended solids
- 45% reduction in total nitrogen
- 45% reduction in total phosphorous

In order to achieve the above outcomes a series of treatment nodes are proposed, including wetlands, bioretention systems, rainwater tanks and a swale.

As part of Western Water's requirements in relation to Integrated Water Management, rainwater tanks are proposed for each lot in the Stonehill development (excluding Stage 19), which are to be plumbed to the dwelling for reuse in toilet flushing. An allowance for 150L/day has been made for each lot.

A summary of the key elements within the wetlands and bioretention systems is shown below in Table 3.

	W3	W4	W6	BIO-B	BIO-C	BIO-D
Rainwater Tanks						
Storage Volume (kL/lot)	3.5	3.5	3.5	3.5	3.5	3.5
Daily Reuse (kL/lot)	0.15	0.15	0.15	0.15	0.15	0.15
Wetland						
Inlet Zone (m^3)	100	850	100	N/A	N/A	N/A
Surface Area (m^2)	1650	2500	1000	N/A	N/A	N/A
Extended Detention (m)	0.3	0.3	0.3	N/A	N/A	N/A
Permanent Pool Volume(m^3)	400	600	250	N/A	N/A	N/A
Bioretention Basin						
Surface Area (m^2)	N/A	N/A	N/A	300	260	240
Extended Detention (m)	N/A	N/A	N/A	0.3	0.3	0.3

Table 3 – Treatment Node Summary

Wetlands W3, W4 and W6 will consist of an inlet zone (a sedimentation area that removes course particles) and a macrophyte area (a shallow area densely planted with aquatic plants and the main part of the wetland, which removes fine particles and dissolved pollutants). A carefully designed bathymetry ensures the various sections of the wetland perform efficiently.

The bioretention systems remove pollutants using an infiltration process incorporating various layers of sandy loam, sand and course gravel. Treated stormwater is collected in perforated pips below the filter media and transported to a discharge pit.

The swale performs a treatment function as stormwater runoff flows through vegetation in the swale.

7. CONCLUSION

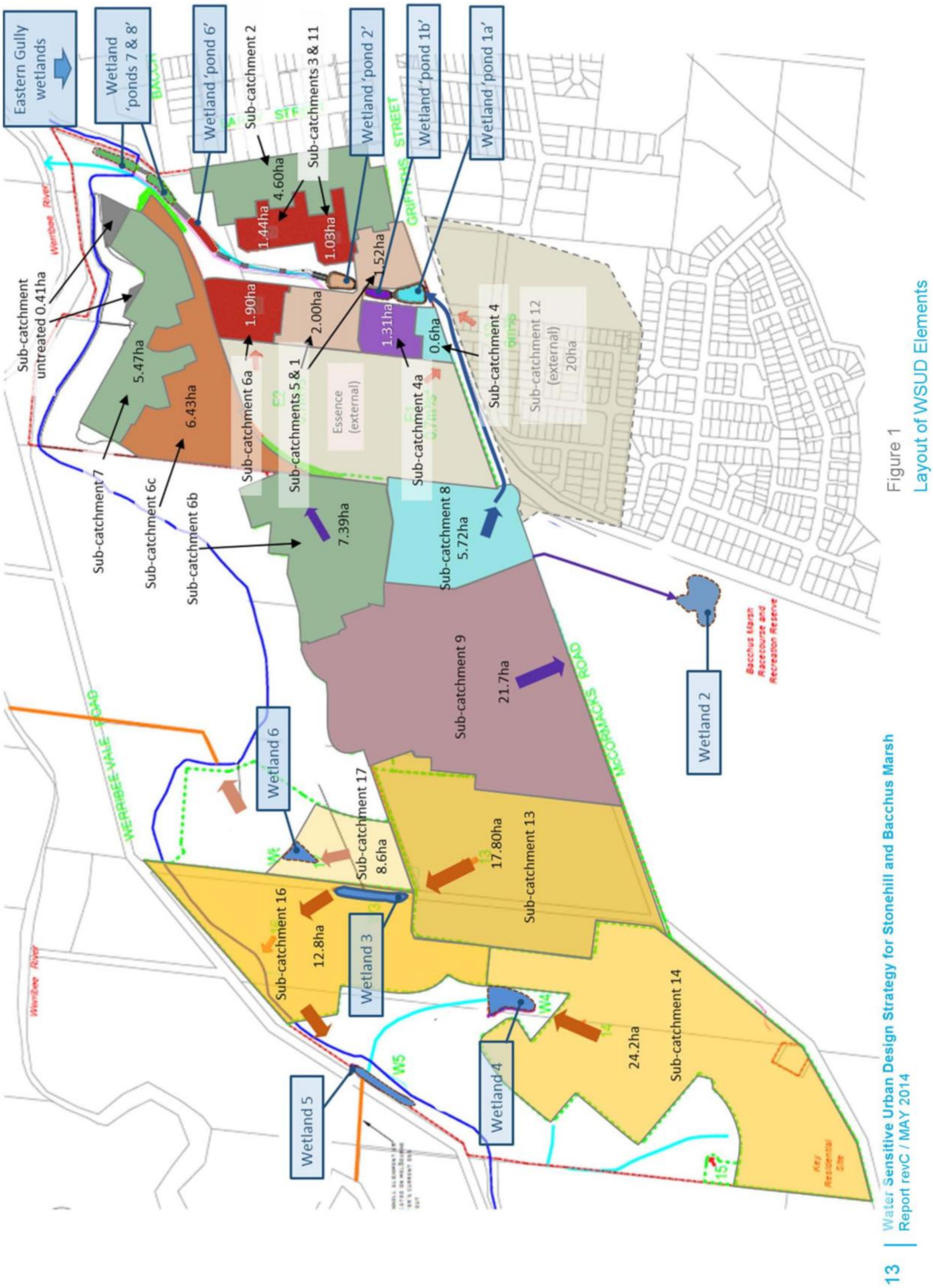
It has been determined that the increase of stormwater runoff due to development in the described catchment area can be significantly decreased back to pre-existing conditions.

The removal of the SRW channel will not affect the natural stormwater runoff in the area. It is noted that the development of the site will direct much of the natural runoff to wetlands and the underground piped network, thus reducing the amount of runoff naturally flowing to Werribee Vale Road.

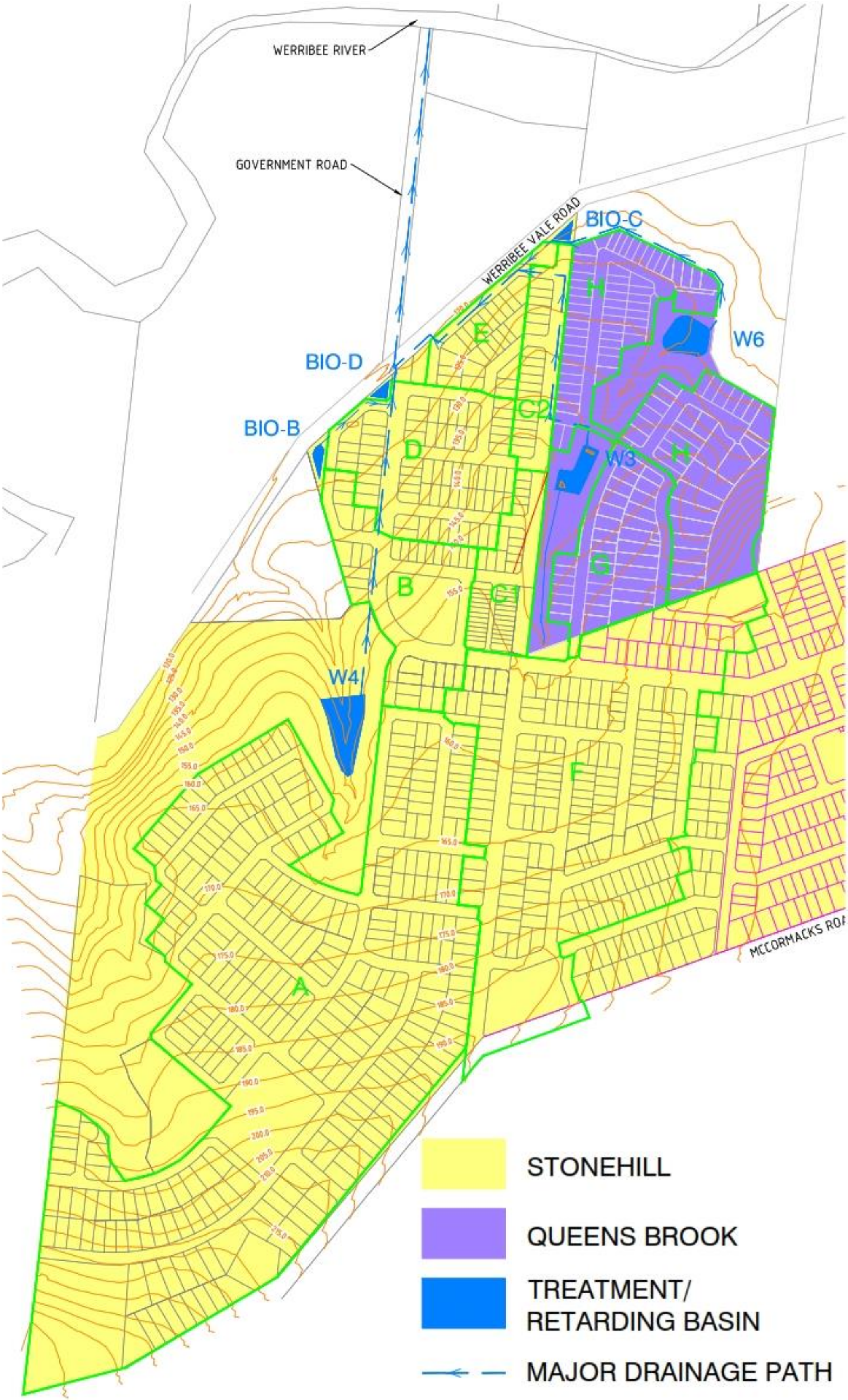
All stormwater from the catchment shall be directed to Werribee River through an existing government road reserve, north of Werribee Vale Road.

Stormwater quality best practice targets can be met using the described treatment nodes.

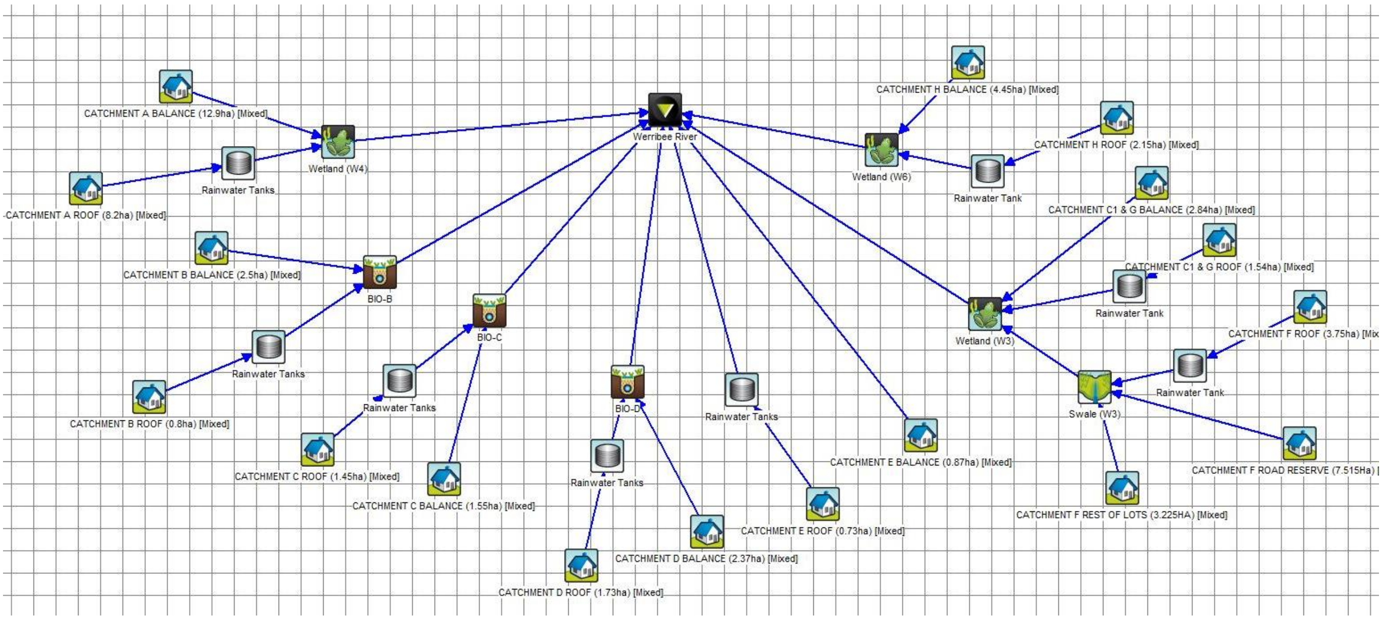
8. APPENDIX A


Eastern Gully wetlands
Wetland 'ponds 7 & 8'
Wetland 'pond 6'
Sub-catchment 2
Sub-catchments 3 & 11
Wetland 'pond 2'
Wetland 'pond 1b'
Wetland 'pond 1a'
Sub-catchment untreated 0.41ha
5.47ha
6.43ha
4.60ha
1.44ha
1.03ha
1.90ha
2.00ha
1.52ha
1.31ha
0.6ha
Sub-catchment 6a
Sub-catchments 5 & 1
Essence (external)
Sub-catchment 4a
Sub-catchment 4
Sub-catchment 12 (external) 20ha
Sub-catchment 7
Sub-catchment 6c
Sub-catchment 6b
7.39ha
Sub-catchment 8
5.72ha
Sub-catchment 9
21.7ha
Wetland 2
Wetland 6
Sub-catchment 17
8.6ha
17.80ha
Sub-catchment 13
Sub-catchment 16
12.8ha
Wetland 3
Sub-catchment 14
24.2ha
Wetland 4
Wetland 5
WERRIBEE VALE ROAD
McCORMACKS ROAD
GRIFFITHS STREET
Figure 1
Layout of WSUD Elements
Water Sensitive Urban Design Strategy for Stonehill and Bacchus Marsh
Report revC / MAY 2014
13

9. APPENDIX B


WERRIBEE RIVER
GOVERNMENT ROAD
WERRIBEE VALE ROAD
BIO-C
BIO-D
BIO-B
W6
W3
W4
MCCORMACKS ROA
STONEHILL
QUEENS BROOK
TREATMENT/
RETARDING BASIN
MAJOR DRAINAGE PATH

10. APPENDIX C



	Sources	Residual Load	% Reduction
Flow (ML/yr)	176	160	9
Total Suspended Solids (kg/yr)	36700	6700	81.7
Total Phosphorus (kg/yr)	73.5	25.6	65.2
Total Nitrogen (kg/yr)	515	283	45.1
Gross Pollutants (kg/yr)	7020	106	98.5

11. APPENDIX D

RORBWin Output File
****

Program version 6.45 (last updated 20th March 2019)
Copyright Monash University and Hydrology and Risk Consulting

Date run: 09 Oct 2019 13:52

Vector file : P:\Project 541 - 560\559 - Stonehill @ Bacchus Marsh\559-116 Western Gully\7. Road & Drainage\RORB\559-116 WESTERN GULLY post Rev B.catg
Storm file : P:\Project 541 - 560\559 - Stonehill @ Bacchus Marsh\559-116 Western Gully\7. Road & Drainage\RORB\Output\559-116 WESTERN GULLY post Rev B_ aep1_du30min.stm
Output information: Flows & all input data

Data checks:
****
Next data to be read & checked:

Catchment name & reach type flag
Control vector & storage data
Code no. 2 16.0
Code no. 12 16.0
Code no. 17 16.0
Code no. 22 16.0
Code no. 26 16.0
Code no. 30 16.0
Code no. 35 7.0 Location read as WERRIBEE VALE ROAD
Code no. 37 7.0 Location read as WERRIBEE RIVER
Sub-area areas
Impervious flag
Fractions impervious
Initial storm data
Rainfall burst times
Pluviograph 1
Sub-area rainfalls

Data check completed

Data:
****

WESTERN GULLY

Time data, in increments from initial time
WESTERN GULLY: 30 min 1% Design Storm No.1 Temporal Pattern
Time increment (hours)= 0.08

	Start	Finish
Rainfall times:	0	6

End of hyeto/hydrographs: 6
Duration of calculations: 200

Pluviograph data (time in incs, rainfall in mm, in
increment following time shown)

1:Temporal pattern (% of depth

Time	1
0	24.06
1	28.49
2	1.57
3	3.47
4	18.19
5	24.22

Total 100.0

DESIGN run control vector

Step	Code	Description
1	1	Add sub-area 'A' inflow & route thru normal storage 1
2	16.0	Route thru existing storage, W4
3	5	Route hydrograph thru normal storage 2
4	3	Store hydrograph from step 3; reset hydrograph to zero
5	1	Add sub-area 'B' inflow & route thru normal storage 3
6	3	Store hydrograph from step 5; reset hydrograph to zero
7	1	Add sub-area 'C' inflow & route thru normal storage 4
8	4	Add h-graph ex step 6 to h-graph ex step 7
9	3	Store hydrograph from step 8; reset hydrograph to zero
10	1	Add sub-area 'D' inflow & route thru normal storage 5
11	4	Add h-graph ex step 9 to h-graph ex step 10
12	16.0	Route thru existing storage, W3
13	5	Route hydrograph thru normal storage 6
14	4	Add h-graph ex step 4 to h-graph ex step 13
15	3	Store hydrograph from step 14; reset hydrograph to zero
16	1	Add sub-area 'E' inflow & route thru normal storage 7
17	16.0	Route thru existing storage, W6
18	5	Route hydrograph thru normal storage 8
19	4	Add h-graph ex step 15 to h-graph ex step 18
20	3	Store hydrograph from step 19; reset hydrograph to zero
21	1	Add sub-area 'F' inflow & route thru normal storage 9
22	16.0	Route thru existing storage, BIO-B
23	4	Add h-graph ex step 20 to h-graph ex step 22
24	3	Store hydrograph from step 23; reset hydrograph to zero
25	1	Add sub-area 'G' inflow & route thru normal storage 10
26	16.0	Route thru existing storage, BIO-C
27	4	Add h-graph ex step 24 to h-graph ex step 26
28	3	Store hydrograph from step 27; reset hydrograph to zero
29	1	Add sub-area 'H' inflow & route thru normal storage 11
30	16.0	Route thru existing storage, BIO-D
31	4	Add h-graph ex step 28 to h-graph ex step 30
32	3	Store hydrograph from step 31; reset hydrograph to zero
33	1	Add sub-area 'I' inflow & route thru normal storage 12
34	4	Add h-graph ex step 32 to h-graph ex step 33
35	7.0	Print hydrograph, WERRIBEE VALE ROAD
36	5	Route hydrograph thru normal storage 13
37	7.0	Print hydrograph, WERRIBEE RIVER
38	0	**********End of control vector**********

Sub-area data

Sub-area	Area km²	Dist. km*	Fraction impervious
A	2.81E-01	1.23E+00	0.60
B	1.41E-01	1.20E+00	0.60
C	2.78E-02	8.58E-01	0.50
D	1.60E-02	8.85E-01	0.60
E	6.63E-02	1.27E+00	0.50
F	3.30E-02	6.53E-01	0.60
G	1.40E-02	7.32E-01	0.60
H	4.10E-02	5.73E-01	0.60
I	1.60E-02	5.62E-01	0.60

Total 6.358E-01

For whole catchment ; Av. Dist., km* = 1.10
For interstation area 1; Av. Dist., km* = 1.10; ISA Factor = 1.000

* or other function of reach properties related to travel time

Normal storage data

Storage no.	Length km*	Rel. delay time	Type	Slope percent
1	0.4	0.018	Lined	7.300
2	0.4	0.018	Lined	7.500
3	0.5	0.020	Lined	5.300
4	0.1	0.005	Lined	10.500

5	0.1	0.007	Lined	4.300
6	0.3	0.015	Lined	7.000
7	0.2	0.048	Lined	0.100
8	0.7	0.158	Lined	0.200
9	0.2	0.011	Lined	10.000
10	0.3	0.014	Lined	8.300
11	0.2	0.007	Lined	14.000
12	0.1	0.006	Lined	5.800
13	0.4	0.030	Lined	2.000

* or other function of reach properties related to travel time

Special storage data

Storage: W4
Initial water level at cease to flow elevation
Spillway data:
Elevation(m)= 153.70 Length(m)= 3.0
Weir coeff. = 2.00
Pipe outlet data:
Entrance loss coeff.= 0.500 Bend loss coeff.= 0.500
Length(m)= 20. Gradient(%)= 2.000 U/S invert el.(m)= 150.40
No. of pipes= 1. Diameter (m)= 0.150
Elevation (m) - Storage (m^3) table

150.40	0.000E+00
150.70	1.162E+03
151.00	1.877E+03
151.30	2.815E+03
151.60	3.753E+03
151.90	4.700E+03
152.20	5.700E+03
152.50	6.700E+03
152.80	7.700E+03
153.10	8.700E+03
153.40	9.700E+03
153.70	1.070E+04
154.00	1.170E+04
155.00	1.400E+04

Storage: W3
Initial water level at cease to flow elevation
Spillway data:
Elevation(m)= 145.20 Length(m)= 4.0
Weir coeff. = 2.00
Pipe outlet data:
Entrance loss coeff.= 0.500 Bend loss coeff.= 0.500
Length(m)= 15. Gradient(%)= 1.000 U/S invert el.(m)= 141.00
No. of pipes= 1. Diameter (m)= 0.150
Elevation (m) - Storage (m^3) table

141.00	0.000E+00
141.30	4.950E+02
141.60	9.910E+02
141.90	1.487E+03
142.20	1.983E+03
142.50	2.479E+03
142.80	2.975E+03
143.10	3.475E+03
143.40	3.975E+03
143.70	4.475E+03
144.00	4.975E+03
144.30	5.475E+03
144.60	5.975E+03
144.90	6.475E+03
145.20	6.975E+03
145.50	7.475E+03
146.00	9.000E+03

Storage: W6
Initial water level at cease to flow elevation
Spillway data:
Elevation(m)= 125.30 Length(m)= 10.0
Weir coeff. = 2.00

Pipe outlet data:
Entrance loss coeff.= 0.000 Bend loss coeff.= 0.000
Length(m)= 20. Gradient(%)= 1.000 U/S invert el.(m)= 124.40
No. of pipes= 1. Diameter (m)= 0.300
Elevation (m) - Storage (m^3) table

124.40	0.000E+00
124.70	7.000E+02
125.00	1.400E+03
125.30	2.100E+03
125.60	2.900E+03
126.50	5.000E+03

Storage: BIO-B
Initial water level at cease to flow elevation
Spillway data:
Elevation(m)= 123.00 Length(m)= 1.5
Weir coeff. = 2.00
Pipe outlet data:
Entrance loss coeff.= 0.500 Bend loss coeff.= 0.500
Length(m)= 20. Gradient(%)= 1.000 U/S invert el.(m)= 122.70
No. of pipes= 1. Diameter (m)= 0.150
Elevation (m) - Storage (m^3) table

122.70	0.000E+00
123.00	1.000E+02
123.30	2.600E+02
124.00	8.000E+02

Storage: BIO-C
Initial water level at cease to flow elevation
Spillway data:
Elevation(m)= 120.00 Length(m)= 1.0
Weir coeff. = 2.00
Pipe outlet data:
Entrance loss coeff.= 0.500 Bend loss coeff.= 0.500
Length(m)= 10. Gradient(%)= 1.000 U/S invert el.(m)= 119.70
No. of pipes= 1. Diameter (m)= 0.150
Elevation (m) - Storage (m^3) table

119.70	0.000E+00
120.00	1.000E+02
120.30	2.600E+02
121.00	5.000E+03

Storage: BIO-D
Initial water level at cease to flow elevation
Spillway data:
Elevation(m)= 121.00 Length(m)= 1.5
Weir coeff. = 2.00
Pipe outlet data:
Entrance loss coeff.= 0.500 Bend loss coeff.= 0.500
Length(m)= 10. Gradient(%)= 1.000 U/S invert el.(m)= 120.70
No. of pipes= 1. Diameter (m)= 0.150
Elevation (m) - Storage (m^3) table

120.70	0.000E+00
121.00	1.000E+02
121.30	2.600E+02
122.00	6.000E+02

Input of parameters:
****

WESTERN GULLY
DESIGN Run
WESTERN GULLY: 30 min 1% Design Storm No.1 Temporal Pattern
Time increment = 0.08 hours

Constant loss model selected

Rainfall, mm, in time inc. following time shown
Time Sub-
Catch Area
Incs ment A B C D E F G H I

0	7.5	7	7	7	7	7	7	7	7	7
1	8.9	9	9	9	9	9	9	9	9	9
2	0.5	0	0	0	0	0	0	0	0	0
3	1.1	1	1	1	1	1	1	1	1	1
4	5.7	6	6	6	6	6	6	6	6	6
5	7.5	8	8	8	8	8	8	8	8	8

Tot. 31.1 31 31 31 31 31 31 31 31 31
Pluvi. ref. no. 1 1 1 1 1 1 1 1 1

Rainfall-excess, mm, in time inc. following time shown

Time Incs	Catch ment	Sub-Area A	B	C	D	E	F	G	H	I
0	0.0	0	0	0	0	0	0	0	0	0
1	8.0	8	8	6	8	6	8	8	8	8
2	0.4	0	0	0	0	0	0	0	0	0
3	1.0	1	1	1	1	1	1	1	1	1
4	5.6	6	6	6	6	6	6	6	6	6
5	7.5	7	7	7	7	7	7	7	7	7

Tot. 22.5 23 23 21 23 21 23 23 23 23

Routing results:
****
WESTERN GULLY
WESTERN GULLY: 30 min 1% Design Storm No.1 Temporal Pattern
DESIGN run no. 1

Parameters: kc = 1.76 m = 0.80

Loss parameters	Initial loss (mm)	Cont. loss (mm/h)
	20.00	1.90

Results of routing through special storage W4
Peak elevation= 152.43 m
Peak outflow = 0.05 m³/s (pipe flow)
Peak storage = 6.46E+03 m³

*** Special storage : W4

	Hydrograph Outflow	Inflow
Peak discharge,m³/s	0.055	6.973
Time to peak,h	0.667	0.500
Volume,m³	2.91E+03	6.54E+03
Time to centroid,h	8.16	0.37
Lag (c.m. to c.m.),h	7.85	0.07
Lag to peak,h	0.362	0.195

Results of routing through special storage W3
Peak elevation= 143.49 m
Peak outflow = 0.06 m³/s (pipe flow)
Peak storage = 4.13E+03 m³

*** Special storage : W3

	Hydrograph Outflow	Inflow
Peak discharge,m³/s	0.062	4.496
Time to peak,h	0.667	0.500
Volume,m³	2.89E+03	4.21E+03
Time to centroid,h	7.73	0.38
Lag (c.m. to c.m.),h	7.42	0.07
Lag to peak,h	0.360	0.193

Results of routing through special storage W6
Peak elevation= 124.91 m
Peak outflow = 0.13 m³/s (pipe flow)
Peak storage = 1.20E+03 m³

```
*** Special storage :   W6

                    Hydrograph
                  Outflow   Inflow
Peak discharge,m³/s     0.126    1.232
Time to peak,h          0.750    0.500
Volume,m³            1.29E+03 1.37E+03
Time to centroid,h       3.65     0.46
Lag (c.m. to c.m.),h     3.33     0.14
Lag to peak,h           0.428    0.178

Results of routing through special storage BIO-B
 Peak elevation=  123.31 m
 Peak outflow =     0.56 m³/s (pipe & spillway flow)
 Peak storage =     2.69E+02 m³

*** Special storage :   BIO-B

                    Hydrograph
                  Outflow   Inflow
Peak discharge,m³/s    0.5550   0.8234
Time to peak,h          0.500    0.500
Volume,m³            7.72E+02 7.73E+02
Time to centroid,h      0.758    0.372
Lag (c.m. to c.m.),h    0.453    0.067
Lag to peak,h           0.195    0.195

Results of routing through special storage BIO-C
 Peak elevation=  120.18 m
 Peak outflow =     0.18 m³/s (pipe & spillway flow)
 Peak storage =     1.96E+02 m³

*** Special storage :   BIO-C

                    Hydrograph
                  Outflow   Inflow
Peak discharge,m³/s    0.1830   0.3356
Time to peak,h          0.583    0.500
Volume,m³            3.22E+02 3.22E+02
Time to centroid,h       1.20     0.38
Lag (c.m. to c.m.),h    0.892    0.078
Lag to peak,h           0.279    0.195

Results of routing through special storage BIO-D
 Peak elevation=  121.39 m
 Peak outflow =     0.78 m³/s (pipe & spillway flow)
 Peak storage =     3.06E+02 m³

*** Special storage :   BIO-D

                    Hydrograph
                  Outflow   Inflow
Peak discharge,m³/s     0.779    1.016
Time to peak,h          0.500    0.500
Volume,m³            9.57E+02 9.66E+02
Time to centroid,h      0.689    0.364
Lag (c.m. to c.m.),h    0.384    0.059
Lag to peak,h           0.195    0.195

*** Calculated hydrograph,  WERRIBEE VALE ROAD

                    Hydrograph
                     Calc.
Peak discharge,m³/s     1.974
Time to peak,h          0.500
Volume,m³            9.49E+03
Time to centroid,h       5.60
Lag (c.m. to c.m.),h     5.29
Lag to peak,h           0.193
```

*** Calculated hydrograph, WERRIBEE RIVER

	Hydrograph Calc.
Peak discharge,m³/s	1.727
Time to peak,h	0.583
Volume,m³	9.46E+03
Time to centroid,h	5.64
Lag (c.m. to c.m.),h	5.33
Lag to peak,h	0.276

Hydrograph summary
****

Site	Description
01	Special storage : W4 - Outflow
02	Special storage : W4 - Inflow
03	Special storage : W3 - Outflow
04	Special storage : W3 - Inflow
05	Special storage : W6 - Outflow
06	Special storage : W6 - Inflow
07	Special storage : BIO-B - Outflow
08	Special storage : BIO-B - Inflow
09	Special storage : BIO-C - Outflow
10	Special storage : BIO-C - Inflow
11	Special storage : BIO-D - Outflow
12	Special storage : BIO-D - Inflow
13	Calculated hydrograph, WERRIBEE VALE ROAD
14	Calculated hydrograph, WERRIBEE RIVER

Inc	Time	Hyd01	Hyd02	Hyd03	Hyd04	Hyd05	Hyd06	Hyd07	Hyd08	Hyd09	Hyd10	Hyd11	Hyd12	Hyd13	Hyd14
0	0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.08	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.17	0.0150	4.9500	0.0199	3.0306	0.0020	0.4046	0.0196	0.6116	0.0048	0.2136	0.0719	0.8713	0.4388	0.1540
3	0.25	0.0345	3.7585	0.0342	2.3854	0.0070	0.6388	0.2759	0.4238	0.0196	0.2012	0.4178	0.4303	0.9378	0.6308
4	0.33	0.0378	0.0000	0.0388	0.0721	0.0183	0.3042	0.2146	0.0000	0.0375	0.0131	0.2509	0.0000	0.5754	0.7497
5	0.42	0.0408	3.8833	0.0430	2.5177	0.0301	0.5951	0.2548	0.4807	0.0560	0.1700	0.3565	0.6883	1.0117	0.7923
6	0.50	0.0484	6.9725	0.0531	4.4959	0.0620	1.2317	0.5550	0.8234	0.1402	0.3356	0.7794	1.0164	1.9744	1.4969
7	0.58	0.0537	2.2306	0.0604	1.5350	0.1027	0.9171	0.5041	0.2373	0.1830	0.1387	0.5602	0.2139	1.4651	1.7273
8	0.67	0.0549	0.0000	0.0620	0.0000	0.1237	0.2663	0.2248	0.0000	0.1238	0.0000	0.2297	0.0000	0.7295	1.0804
9	0.75	0.0548	0.0000	0.0618	0.0000	0.1260	0.1041	0.0975	0.0000	0.0733	0.0000	0.0987	0.0000	0.4381	0.5964
10	0.83	0.0548	0.0000	0.0617	0.0000	0.1241	0.0479	0.0561	0.0000	0.0502	0.0000	0.0565	0.0000	0.3453	0.4059
11	0.92	0.0547	0.0000	0.0615	0.0000	0.1206	0.0249	0.0323	0.0000	0.0344	0.0000	0.0323	0.0000	0.2925	0.3279
12	1.00	0.0547	0.0000	0.0614	0.0000	0.1162	0.0141	0.0212	0.0000	0.0235	0.0000	0.0211	0.0000	0.2676	0.2859
13	1.08	0.0546	0.0000	0.0613	0.0000	0.1116	0.0085	0.0200	0.0000	0.0206	0.0000	0.0200	0.0000	0.2680	0.2702
14	1.17	0.0546	0.0000	0.0611	0.0000	0.1071	0.0054	0.0190	0.0000	0.0195	0.0000	0.0189	0.0000	0.2683	0.2685
15	1.25	0.0545	0.0000	0.0610	0.0000	0.1026	0.0035	0.0179	0.0000	0.0184	0.0000	0.0179	0.0000	0.2671	0.2678
16	1.33	0.0544	0.0000	0.0608	0.0000	0.0983	0.0024	0.0170	0.0000	0.0175	0.0000	0.0170	0.0000	0.2647	0.2662
17	1.42	0.0544	0.0000	0.0607	0.0000	0.0941	0.0017	0.0161	0.0000	0.0165	0.0000	0.0161	0.0000	0.2614	0.2635
18	1.50	0.0543	0.0000	0.0606	0.0000	0.0901	0.0012	0.0151	0.0000	0.0156	0.0000	0.0151	0.0000	0.2572	0.2599
19	1.58	0.0542	0.0000	0.0604	0.0000	0.0863	0.0009	0.0137	0.0000	0.0144	0.0000	0.0137	0.0000	0.2513	0.2550
20	1.67	0.0542	0.0000	0.0603	0.0000	0.0830	0.0007	0.0125	0.0000	0.0131	0.0000	0.0125	0.0000	0.2453	0.2493
21	1.75	0.0541	0.0000	0.0602	0.0000	0.0798	0.0005	0.0114	0.0000	0.0120	0.0000	0.0114	0.0000	0.2394	0.2434
22	1.83	0.0541	0.0000	0.0600	0.0000	0.0768	0.0004	0.0104	0.0000	0.0109	0.0000	0.0104	0.0000	0.2336	0.2375
23	1.92	0.0540	0.0000	0.0599	0.0000	0.0738	0.0003	0.0095	0.0000	0.0099	0.0000	0.0095	0.0000	0.2280	0.2318
24	2.00	0.0539	0.0000	0.0597	0.0000	0.0710	0.0002	0.0087	0.0000	0.0090	0.0000	0.0087	0.0000	0.2228	0.2264
25	2.08	0.0539	0.0000	0.0596	0.0000	0.0683	0.0002	0.0079	0.0000	0.0082	0.0000	0.0079	0.0000	0.2176	0.2211
26	2.17	0.0538	0.0000	0.0595	0.0000	0.0656	0.0002	0.0072	0.0000	0.0075	0.0000	0.0072	0.0000	0.2126	0.2160
27	2.25	0.0538	0.0000	0.0593	0.0000	0.0631	0.0001	0.0065	0.0000	0.0068	0.0000	0.0065	0.0000	0.2079	0.2112
28	2.33	0.0537	0.0000	0.0592	0.0000	0.0607	0.0001	0.0060	0.0000	0.0062	0.0000	0.0060	0.0000	0.2033	0.2065
29	2.42	0.0536	0.0000	0.0591	0.0000	0.0584	0.0001	0.0054	0.0000	0.0057	0.0000	0.0054	0.0000	0.1990	0.2020
30	2.50	0.0536	0.0000	0.0589	0.0000	0.0562	0.0001	0.0050	0.0000	0.0052	0.0000	0.0050	0.0000	0.1950	0.1978
31	2.58	0.0535	0.0000	0.0588	0.0000	0.0542	0.0001	0.0048	0.0000	0.0049	0.0000	0.0048	0.0000	0.1917	0.1941
32	2.67	0.0535	0.0000	0.0586	0.0000	0.0523	0.0001	0.0046	0.0000	0.0046	0.0000	0.0046	0.0000	0.1886	0.1908
33	2.75	0.0534	0.0000	0.0585	0.0000	0.0504	0.0000	0.0044	0.0000	0.0044	0.0000	0.0044	0.0000	0.1856	0.1877
34	2.83	0.0533	0.0000	0.0584	0.0000	0.0486	0.0000	0.0042	0.0000	0.0042	0.0000	0.0042	0.0000	0.1827	0.1848
35	2.92	0.0533	0.0000	0.0582	0.0000	0.0469	0.0000	0.0040	0.0000	0.0041	0.0000	0.0040	0.0000	0.1799	0.1819
36	3.00	0.0532	0.0000	0.0581	0.0000	0.0453	0.0000	0.0038	0.0000	0.0039	0.0000	0.0038	0.0000	0.1773	0.1792
37	3.08	0.0532	0.0000	0.0579	0.0000	0.0436	0.0000	0.0036	0.0000	0.0037	0.0000	0.0036	0.0000	0.1747	0.1766
38	3.17	0.0531	0.0000	0.0578	0.0000	0.0421	0.0000	0.0035	0.0000	0.0035	0.0000	0.0035	0.0000	0.1722	0.1740
39	3.25	0.0530	0.0000	0.0577	0.0000	0.0406	0.0000	0.0033	0.0000	0.0034	0.0000	0.0033	0.0000	0.1698	0.1715
40	3.33	0.0530	0.0000	0.0575	0.0000	0.0392	0.0000	0.0032	0.0000	0.0032	0.0000	0.0032	0.0000	0.1675	0.1692

41	3.42	0.0529	0.0000	0.0574	0.0000	0.0378	0.0000	0.0030	0.0000	0.0031	0.0000	0.0030	0.0000	0.1652	0.1669
42	3.50	0.0529	0.0000	0.0572	0.0000	0.0364	0.0000	0.0029	0.0000	0.0030	0.0000	0.0029	0.0000	0.1631	0.1646
43	3.58	0.0528	0.0000	0.0571	0.0000	0.0351	0.0000	0.0028	0.0000	0.0028	0.0000	0.0028	0.0000	0.1610	0.1625
44	3.67	0.0527	0.0000	0.0570	0.0000	0.0339	0.0000	0.0026	0.0000	0.0027	0.0000	0.0026	0.0000	0.1589	0.1604
45	3.75	0.0527	0.0000	0.0568	0.0000	0.0327	0.0000	0.0025	0.0000	0.0026	0.0000	0.0025	0.0000	0.1570	0.1584
46	3.83	0.0526	0.0000	0.0567	0.0000	0.0315	0.0000	0.0024	0.0000	0.0025	0.0000	0.0024	0.0000	0.1551	0.1565
47	3.92	0.0526	0.0000	0.0565	0.0000	0.0304	0.0000	0.0023	0.0000	0.0024	0.0000	0.0023	0.0000	0.1533	0.1546
48	4.00	0.0525	0.0000	0.0564	0.0000	0.0293	0.0000	0.0022	0.0000	0.0023	0.0000	0.0022	0.0000	0.1515	0.1528
49	4.08	0.0524	0.0000	0.0563	0.0000	0.0283	0.0000	0.0021	0.0000	0.0022	0.0000	0.0021	0.0000	0.1498	0.1511
50	4.17	0.0524	0.0000	0.0561	0.0000	0.0276	0.0000	0.0020	0.0000	0.0021	0.0000	0.0020	0.0000	0.1482	0.1494
51	4.25	0.0523	0.0000	0.0560	0.0000	0.0269	0.0000	0.0019	0.0000	0.0020	0.0000	0.0019	0.0000	0.1466	0.1478
52	4.33	0.0523	0.0000	0.0559	0.0000	0.0261	0.0000	0.0018	0.0000	0.0019	0.0000	0.0018	0.0000	0.1452	0.1463
53	4.42	0.0522	0.0000	0.0557	0.0000	0.0255	0.0000	0.0018	0.0000	0.0018	0.0000	0.0018	0.0000	0.1438	0.1448
54	4.50	0.0522	0.0000	0.0556	0.0000	0.0248	0.0000	0.0017	0.0000	0.0017	0.0000	0.0017	0.0000	0.1424	0.1434
55	4.58	0.0521	0.0000	0.0555	0.0000	0.0241	0.0000	0.0016	0.0000	0.0016	0.0000	0.0016	0.0000	0.1412	0.1421
56	4.67	0.0520	0.0000	0.0553	0.0000	0.0235	0.0000	0.0015	0.0000	0.0016	0.0000	0.0015	0.0000	0.1399	0.1409
57	4.75	0.0520	0.0000	0.0552	0.0000	0.0229	0.0000	0.0015	0.0000	0.0015	0.0000	0.0015	0.0000	0.1388	0.1397
58	4.83	0.0519	0.0000	0.0550	0.0000	0.0223	0.0000	0.0014	0.0000	0.0014	0.0000	0.0014	0.0000	0.1376	0.1385
59	4.92	0.0519	0.0000	0.0549	0.0000	0.0217	0.0000	0.0013	0.0000	0.0014	0.0000	0.0013	0.0000	0.1365	0.1373
60	5.00	0.0518	0.0000	0.0547	0.0000	0.0211	0.0000	0.0013	0.0000	0.0013	0.0000	0.0013	0.0000	0.1354	0.1362
61	5.08	0.0517	0.0000	0.0546	0.0000	0.0205	0.0000	0.0012	0.0000	0.0013	0.0000	0.0012	0.0000	0.1344	0.1352
62	5.17	0.0517	0.0000	0.0545	0.0000	0.0200	0.0000	0.0012	0.0000	0.0012	0.0000	0.0012	0.0000	0.1334	0.1341
63	5.25	0.0516	0.0000	0.0543	0.0000	0.0195	0.0000	0.0011	0.0000	0.0011	0.0000	0.0011	0.0000	0.1324	0.1331
64	5.33	0.0516	0.0000	0.0542	0.0000	0.0190	0.0000	0.0011	0.0000	0.0011	0.0000	0.0011	0.0000	0.1314	0.1322
65	5.42	0.0515	0.0000	0.0540	0.0000	0.0185	0.0000	0.0010	0.0000	0.0010	0.0000	0.0010	0.0000	0.1305	0.1312
66	5.50	0.0515	0.0000	0.0539	0.0000	0.0180	0.0000	0.0010	0.0000	0.0010	0.0000	0.0010	0.0000	0.1296	0.1303
67	5.58	0.0514	0.0000	0.0538	0.0000	0.0175	0.0000	0.0009	0.0000	0.0010	0.0000	0.0009	0.0000	0.1287	0.1294
68	5.67	0.0513	0.0000	0.0536	0.0000	0.0170	0.0000	0.0009	0.0000	0.0009	0.0000	0.0009	0.0000	0.1279	0.1285
69	5.75	0.0513	0.0000	0.0535	0.0000	0.0166	0.0000	0.0009	0.0000	0.0009	0.0000	0.0009	0.0000	0.1270	0.1277
70	5.83	0.0512	0.0000	0.0533	0.0000	0.0161	0.0000	0.0008	0.0000	0.0008	0.0000	0.0008	0.0000	0.1262	0.1268
71	5.92	0.0511	0.0000	0.0532	0.0000	0.0157	0.0000	0.0008	0.0000	0.0008	0.0000	0.0008	0.0000	0.1254	0.1260
72	6.00	0.0511	0.0000	0.0531	0.0000	0.0153	0.0000	0.0007	0.0000	0.0008	0.0000	0.0007	0.0000	0.1246	0.1252
73	6.08	0.0510	0.0000	0.0529	0.0000	0.0149	0.0000	0.0007	0.0000	0.0007	0.0000	0.0007	0.0000	0.1239	0.1245
74	6.17	0.0510	0.0000	0.0528	0.0000	0.0145	0.0000	0.0007	0.0000	0.0007	0.0000	0.0007	0.0000	0.1231	0.1237
75	6.25	0.0509	0.0000	0.0527	0.0000	0.0142	0.0000	0.0006	0.0000	0.0007	0.0000	0.0006	0.0000	0.1224	0.1230
76	6.33	0.0508	0.0000	0.0525	0.0000	0.0138	0.0000	0.0006	0.0000	0.0006	0.0000	0.0006	0.0000	0.1217	0.1222
77	6.42	0.0508	0.0000	0.0524	0.0000	0.0134	0.0000	0.0006	0.0000	0.0006	0.0000	0.0006	0.0000	0.1210	0.1215
78	6.50	0.0507	0.0000	0.0522	0.0000	0.0131	0.0000	0.0006	0.0000	0.0006	0.0000	0.0006	0.0000	0.1203	0.1208
79	6.58	0.0507	0.0000	0.0521	0.0000	0.0127	0.0000	0.0005	0.0000	0.0006	0.0000	0.0005	0.0000	0.1196	0.1202
80	6.67	0.0506	0.0000	0.0520	0.0000	0.0124	0.0000	0.0005	0.0000	0.0005	0.0000	0.0005	0.0000	0.1190	0.1195
81	6.75	0.0505	0.0000	0.0518	0.0000	0.0121	0.0000	0.0005	0.0000	0.0005	0.0000	0.0005	0.0000	0.1184	0.1189
82	6.83	0.0505	0.0000	0.0517	0.0000	0.0117	0.0000	0.0005	0.0000	0.0005	0.0000	0.0005	0.0000	0.1177	0.1182
83	6.92	0.0504	0.0000	0.0515	0.0000	0.0114	0.0000	0.0005	0.0000	0.0005	0.0000	0.0005	0.0000	0.1171	0.1176
84	7.00	0.0504	0.0000	0.0514	0.0000	0.0111	0.0000	0.0004	0.0000	0.0004	0.0000	0.0004	0.0000	0.1165	0.1170
85	7.08	0.0503	0.0000	0.0513	0.0000	0.0108	0.0000	0.0004	0.0000	0.0004	0.0000	0.0004	0.0000	0.1159	0.1163
86	7.17	0.0502	0.0000	0.0511	0.0000	0.0105	0.0000	0.0004	0.0000	0.0004	0.0000	0.0004	0.0000	0.1153	0.1158
87	7.25	0.0502	0.0000	0.0510	0.0000	0.0103	0.0000	0.0004	0.0000	0.0004	0.0000	0.0004	0.0000	0.1147	0.1152
88	7.33	0.0501	0.0000	0.0508	0.0000	0.0100	0.0000	0.0004	0.0000	0.0004	0.0000	0.0004	0.0000	0.1141	0.1146
89	7.42	0.0501	0.0000	0.0507	0.0000	0.0097	0.0000	0.0003	0.0000	0.0004	0.0000	0.0003	0.0000	0.1136	0.1140
90	7.50	0.0500	0.0000	0.0505	0.0000	0.0095	0.0000	0.0003	0.0000	0.0003	0.0000	0.0003	0.0000	0.1130	0.1135
91	7.58	0.0499	0.0000	0.0504	0.0000	0.0092	0.0000	0.0003	0.0000	0.0003	0.0000	0.0003	0.0000	0.1125	0.1129
92	7.67	0.0499	0.0000	0.0503	0.0000	0.0090	0.0000	0.0003	0.0000	0.0003	0.0000	0.0003	0.0000	0.1120	0.1124
93	7.75	0.0498	0.0000	0.0501	0.0000	0.0087	0.0000	0.0003	0.0000	0.0003	0.0000	0.0003	0.0000	0.1115	0.1119
94	7.83	0.0498	0.0000	0.0500	0.0000	0.0085	0.0000	0.0003	0.0000	0.0003	0.0000	0.0003	0.0000	0.1110	0.1114
95	7.92	0.0497	0.0000	0.0498	0.0000	0.0083	0.0000	0.0003	0.0000	0.0003	0.0000	0.0003	0.0000	0.1105	0.1109
96	8.00	0.0496	0.0000	0.0497	0.0000	0.0081	0.0000	0.0003	0.0000	0.0003	0.0000	0.0003	0.0000	0.1100	0.1104
97	8.08	0.0496	0.0000	0.0496	0.0000	0.0078	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1095	0.1099
98	8.17	0.0495	0.0000	0.0494	0.0000	0.0076	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1090	0.1094
99	8.25	0.0495	0.0000	0.0493	0.0000	0.0076	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1086	0.1089
100	8.33	0.0494	0.0000	0.0492	0.0000	0.0075	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1081	0.1085
101	8.42	0.0493	0.0000	0.0490	0.0000	0.0074	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1077	0.1080
102	8.50	0.0493	0.0000	0.0489	0.0000	0.0073	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1073	0.1076
103	8.58	0.0492	0.0000	0.0487	0.0000	0.0073	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1069	0.1072
104	8.67	0.0492	0.0000	0.0486	0.0000	0.0072	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1066	0.1069
105	8.75	0.0491	0.0000	0.0485	0.0000	0.0071	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1062	0.1065
106	8.83	0.0491	0.0000	0.0483	0.0000	0.0071	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1059	0.1062
107	8.92	0.0490	0.0000	0.0482	0.0000	0.0070	0.0000	0.0002	0.0000	0.0002	0.0000	0.0002	0.0000	0.1056	0.1058
108	9.00	0.0489	0.0000	0.0481	0.0000	0.0069	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1052	0.1055
109	9.08	0.0489	0.0000	0.0479	0.0000	0.0069	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1049	0.1052
110	9.17	0.0488	0.0000	0.0478	0.0000	0.0068	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1046	0.1048
111	9.25	0.0488	0.0000	0.0476	0.0000	0.0067	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1043	0.1045
112	9.33	0.0487	0.0000	0.0475	0.0000	0.0067	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1039	0.1042

113	9.42	0.0486	0.0000	0.0473	0.0000	0.0066	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1036	0.1039
114	9.50	0.0486	0.0000	0.0472	0.0000	0.0065	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1033	0.1036
115	9.58	0.0485	0.0000	0.0471	0.0000	0.0065	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1030	0.1033
116	9.67	0.0485	0.0000	0.0469	0.0000	0.0064	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1027	0.1030
117	9.75	0.0484	0.0000	0.0468	0.0000	0.0063	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1025	0.1027
118	9.83	0.0484	0.0000	0.0466	0.0000	0.0063	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1022	0.1024
119	9.92	0.0483	0.0000	0.0465	0.0000	0.0062	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1019	0.1021
120	10.00	0.0482	0.0000	0.0463	0.0000	0.0062	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1016	0.1018
121	10.08	0.0482	0.0000	0.0462	0.0000	0.0061	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1013	0.1015
122	10.17	0.0481	0.0000	0.0461	0.0000	0.0060	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1010	0.1013
123	10.25	0.0481	0.0000	0.0459	0.0000	0.0060	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1008	0.1010
124	10.33	0.0480	0.0000	0.0458	0.0000	0.0059	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1005	0.1007
125	10.42	0.0479	0.0000	0.0456	0.0000	0.0059	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.1002	0.1004
126	10.50	0.0479	0.0000	0.0455	0.0000	0.0058	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0999	0.1002
127	10.58	0.0478	0.0000	0.0454	0.0000	0.0057	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0997	0.0999
128	10.67	0.0477	0.0000	0.0452	0.0000	0.0057	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0994	0.0996
129	10.75	0.0477	0.0000	0.0451	0.0000	0.0056	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0991	0.0993
130	10.83	0.0476	0.0000	0.0450	0.0000	0.0056	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0988	0.0991
131	10.92	0.0475	0.0000	0.0448	0.0000	0.0055	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0000	0.0986	0.0988
132	11.00	0.0475	0.0000	0.0447	0.0000	0.0055	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0983	0.0985
133	11.08	0.0474	0.0000	0.0445	0.0000	0.0054	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0980	0.0983
134	11.17	0.0473	0.0000	0.0444	0.0000	0.0054	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0978	0.0980
135	11.25	0.0473	0.0000	0.0443	0.0000	0.0053	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0975	0.0977
136	11.33	0.0472	0.0000	0.0441	0.0000	0.0053	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0973	0.0975
137	11.42	0.0472	0.0000	0.0440	0.0000	0.0052	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0970	0.0972
138	11.50	0.0471	0.0000	0.0439	0.0000	0.0052	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0967	0.0969
139	11.58	0.0470	0.0000	0.0437	0.0000	0.0051	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0965	0.0967
140	11.67	0.0470	0.0000	0.0436	0.0000	0.0051	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0962	0.0964
141	11.75	0.0469	0.0000	0.0434	0.0000	0.0050	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0959	0.0962
142	11.83	0.0468	0.0000	0.0433	0.0000	0.0050	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0957	0.0959
143	11.92	0.0468	0.0000	0.0431	0.0000	0.0049	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0954	0.0956
144	12.00	0.0467	0.0000	0.0430	0.0000	0.0049	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0951	0.0954
145	12.08	0.0466	0.0000	0.0428	0.0000	0.0048	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0949	0.0951
146	12.17	0.0466	0.0000	0.0427	0.0000	0.0048	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0946	0.0948
147	12.25	0.0465	0.0000	0.0426	0.0000	0.0047	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0944	0.0946
148	12.33	0.0465	0.0000	0.0424	0.0000	0.0047	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0941	0.0943
149	12.42	0.0464	0.0000	0.0423	0.0000	0.0046	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0938	0.0941
150	12.50	0.0463	0.0000	0.0421	0.0000	0.0046	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0936	0.0938
151	12.58	0.0463	0.0000	0.0420	0.0000	0.0045	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0933	0.0935
152	12.67	0.0462	0.0000	0.0418	0.0000	0.0045	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0931	0.0933
153	12.75	0.0461	0.0000	0.0417	0.0000	0.0045	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0928	0.0930
154	12.83	0.0461	0.0000	0.0416	0.0000	0.0044	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0926	0.0928
155	12.92	0.0460	0.0000	0.0414	0.0000	0.0044	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0923	0.0925
156	13.00	0.0460	0.0000	0.0413	0.0000	0.0043	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0921	0.0923
157	13.08	0.0459	0.0000	0.0412	0.0000	0.0043	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0918	0.0920
158	13.17	0.0458	0.0000	0.0410	0.0000	0.0042	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0916	0.0918
159	13.25	0.0458	0.0000	0.0409	0.0000	0.0042	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0913	0.0915
160	13.33	0.0457	0.0000	0.0407	0.0000	0.0042	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0911	0.0913
161	13.42	0.0456	0.0000	0.0406	0.0000	0.0041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0908	0.0910
162	13.50	0.0456	0.0000	0.0405	0.0000	0.0041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0906	0.0908
163	13.58	0.0455	0.0000	0.0403	0.0000	0.0040	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0904	0.0906
164	13.67	0.0455	0.0000	0.0402	0.0000	0.0040	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0901	0.0903
165	13.75	0.0454	0.0000	0.0401	0.0000	0.0040	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0899	0.0901
166	13.83	0.0453	0.0000	0.0399	0.0000	0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0896	0.0898
167	13.92	0.0453	0.0000	0.0398	0.0000	0.0039	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0894	0.0896
168	14.00	0.0452	0.0000	0.0397	0.0000	0.0038	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0892	0.0894
169	14.08	0.0451	0.0000	0.0395	0.0000	0.0038	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0889	0.0891
170	14.17	0.0451	0.0000	0.0394	0.0000	0.0038	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0887	0.0889
171	14.25	0.0450	0.0000	0.0393	0.0000	0.0037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0885	0.0886
172	14.33	0.0450	0.0000	0.0391	0.0000	0.0037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0882	0.0884
173	14.42	0.0449	0.0000	0.0390	0.0000	0.0037	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0880	0.0882
174	14.50	0.0448	0.0000	0.0388	0.0000	0.0036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0877	0.0879
175	14.58	0.0448	0.0000	0.0387	0.0000	0.0036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0875	0.0877
176	14.67	0.0447	0.0000	0.0385	0.0000	0.0036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0872	0.0874
177	14.75	0.0447	0.0000	0.0384	0.0000	0.0035	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0870	0.0872
178	14.83	0.0446	0.0000	0.0383	0.0000	0.0035	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0868	0.0870
179	14.92	0.0445	0.0000	0.0381	0.0000	0.0035	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0865	0.0867
180	15.00	0.0445	0.0000	0.0380	0.0000	0.0034	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0863	0.0865
181	15.08	0.0444	0.0000	0.0378	0.0000	0.0034	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0860	0.0862
182	15.17	0.0443	0.0000	0.0377	0.0000	0.0034	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0858	0.0860
183	15.25	0.0443	0.0000	0.0376	0.0000	0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0856	0.0858
184	15.33	0.0442	0.0000	0.0374	0.0000	0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0853	0.0855

185	15.42	0.0441	0.0000	0.0373	0.0000	0.0033	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0851	0.0853
186	15.50	0.0441	0.0000	0.0372	0.0000	0.0032	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0849	0.0851
187	15.58	0.0440	0.0000	0.0370	0.0000	0.0032	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0846	0.0848
188	15.67	0.0439	0.0000	0.0369	0.0000	0.0032	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0844	0.0846
189	15.75	0.0439	0.0000	0.0367	0.0000	0.0031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0841	0.0843
190	15.83	0.0438	0.0000	0.0366	0.0000	0.0031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0839	0.0841
191	15.92	0.0438	0.0000	0.0364	0.0000	0.0031	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0836	0.0838
192	16.00	0.0437	0.0000	0.0363	0.0000	0.0030	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0834	0.0836
193	16.08	0.0436	0.0000	0.0362	0.0000	0.0030	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0832	0.0834
194	16.17	0.0436	0.0000	0.0360	0.0000	0.0030	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0829	0.0831
195	16.25	0.0435	0.0000	0.0359	0.0000	0.0030	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0827	0.0829
196	16.33	0.0434	0.0000	0.0357	0.0000	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0825	0.0827
197	16.42	0.0434	0.0000	0.0356	0.0000	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0822	0.0824
198	16.50	0.0433	0.0000	0.0355	0.0000	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0820	0.0822
199	16.58	0.0432	0.0000	0.0353	0.0000	0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0818	0.0820
200	16.67	0.0432	0.0000	0.0352	0.0000	0.0028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0815	0.0817

12. APPENDIX E

RESULTS FROM ARR RFFE 2015 MODEL

Datetime: 2019-10-08 17:40
Region name: East Coast
Region code: 1
Site name: Catchment1
Latitude at catchment outlet (degree) = -37.683
Longitude at catchment outlet (degree) = 144.402
Latitude at catchment centroid (degree) = -37.689
Longitude at catchment centroid (degree) = 144.401
Distance of the nearest gauged catchment in the database (km) = 14.79
Catchment area (sq km) = 0.636
Design rainfall intensity, 1 in 2 AEP and 6 hr duration (mm/h): 4.110518
Design rainfall intensity, 1 in 50 AEP and 6 hr duration (mm/h): 9.606938
Shape factor of the ungauged catchment: 0.84

ESTIMATED FLOOD QUANTILES:

AEP (%)	Expected quantiles (m^3/s)	5% CL m^3/s	95% CL m^3/s
50	0.310	0.100	0.910
20	0.560	0.200	1.55
10	0.760	0.270	2.16
5	0.990	0.340	2.89
2	1.34	0.440	4.12
1	1.64	0.520	5.26

DATA FOR FITTING MULTI-NORMAL DISTRIBUTION FOR BUILDING CONFIDENCE LIMITS:

1 Mean (loge flow) = -1.269
2 St dev (loge flow) = 0.657
3 Skew (loge flow) = 0.092

Moments and correlations:

No	Most probable	Std dev	Correlation		
1	-1.269	0.660	1.000		
2	0.657	0.229	-0.330	1.000	
3	0.092	0.030	0.170	-0.280	1.000

This is the end of output file.