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STORMWATER MANAGEMENT STRATEGY

M6801
REZONING DEVELOPMENT PLAN
CLARKES LANE, WANGARATTA
BISLAKE PTY LTD
FEB 2024

Stormwater Quality Management Strategy	
Our Reference	M6801
Client	Bislake Pty Ltd
Project	Rezoning Development Plan
Location	Clarkes Lane, Wangaratta
Report Author	Matthew Sammon/Joel McGennisken
Checked	Kristy Tossol

Revision Table:

Version	Date	Description
1	5TH APRIL 2022	Stormwater Management Strategy
2	10TH OCTOBER 2022	Stormwater Management Strategy
3	26th MAY 2023	Stormwater Management Strategy
4	15th DECEMBER 2023	Stormwater Management Strategy
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Distribution Table:

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1	5TH APRIL 2022	Rural City of Wangaratta
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OBJECTIVE

The objective of this report is to investigate and provide an effective and efficient stormwater management strategy to convey and limit the discharge of the stormwater runoff generated from the proposed development site to the One Mile Creek. This report forms part of the detailed design and analysis carried out by North East Survey Design (NESD) on behalf of Bislake Pty Ltd (Client) to assist with the approval of the Rezoning at Clarkes Lane, Wangaratta.

1. INTRODUCTION

The report will cover the specific site requirements for the stormwater quantity management through the site, covering runoff volumes generated, Permissible Site Discharge (PSD) and the On-Site Detention requirements (OSD).

The proposed development site is located on Clarkes Lane, Wangaratta, refer to Figure 1.1 below for an aerial view of the development site.

Figure 1-1 – Aerial Photo – Subject Site

2. EXISTING SITE CONDITIONS

The site is located approximately 5km's South of the Wangaratta CBD and is surrounded by low density residential zone and public park and recreation zone to the north. The west of the site is also public park and recreation zone with the One Mile River flowing through the zone. The south and part of the east of the site is farming zone. The majority of the site currently slopes towards the west towards One Mile Creek. Cathedral College is located to the north east of the site and this land includes a stormwater basin being located on the west boundary of the college. A stormwater pump will discharge water from the Cathedral College basin at 35L/s based on pump details from previous

development. Stormwater from Cathedral College will be discharged via the proposed Clarkes Lane development drainage system however PSD and OSD will be managed prior to the reaching the Clarkes Lane development system therefore no additional storage will need to be provided. Drainage pipes within the proposed development will be sized to provide capacity for the additional stormwater discharged from the Cathedral College development. The road network throughout this development will connect to existing Milnes Creek Drive development to the North West of the proposed development site.

The development site is low density residential zoning with no existing drainage infrastructure occupying the current site.

3. PROPOSED STORMWATER MANAGEMENT STRATEGY

Elements of WSUD have been utilised to address the current Urban Runoff Management Objectives of CI56-07-04 in order to improve stormwater quality and assist in achieving the objectives of the SEPP – Waters of Victoria and the performance objectives set out in the Urban Stormwater BPEMG. This includes the use of a bioretention basin. This method was identified as the most feasible and effective stormwater treatment and conveyance system currently available. Through review of the existing conditions in conjunction with BPEMG the following stormwater management strategy was derived. Figure 3.1 below shows the Stormwater Management Strategy and catchments to be employed for the site as outlined above.

Figure 3-1 – Stormwater Management Plan

4. STORMWATER RUNOFF ANALYSIS

This runoff analysis was carried out in accordance with the Austroads Guide to Road Design Part 5: Drainage – General and Hydrology Considerations, as per Councils IDM.

From the Austroads Guide Section 6.6 – Rural Hydrology:

4.1 Rational Method

The peak catchment discharge for rural catchments is estimated by the formula:

$$Q_y = k \times C_y \times I_{tc,y} \times A$$

Where:

- Q_y = Flow rate, Q (m^3/s) for an AEP in %.
- K = A conversion factor, k = 0.278 when A is on km^2 and 0.00278 when A is in Ha.
- C_y = Runoff Coefficient, C for an AEP in %.
- $I_{tc,y}$ = Average rainfall intensity, I (mm/h) for design duration of t_c (time of concentration) and AEP in %.
- A = Area of catchment either in Ha, km^2 or m^2.

4.1.1 Average Exceedance Probability (AEP)

From IDM Table 11 the Average Exceedance Probability for Rural Drainage is 10% AEP.

4.2 Definition of Catchment Area

Site areas were taken directly from the existing conditions plan and the Plan of Subdivision. Refer Figure 4.1 above.

Catchment Area - Lots:	12,990 m^2 (12.99 Ha or 0.1299 km^2)
Catchment Area – Unit Development	1.09 m^2 (1.09Ha or 0.0109 km^2)
Catchment Area - Reserves:	74,960 m^2 (7.496 Ha or 0.07496 km^2)
Catchment Area – Road Reserves:	65,680 m^2 (6.568 Ha or 0.06568 km^2)
Total Catchment Area	245,900 m^2 (24.59 Ha or 0.2459 km^2)

4.3 Time of Concentration

From Austroads Table 6.1 for Victoria the time of concentration is calculated from:

$$t_c = 0.76\ A^{0.38}\ (hrs)$$

Where:

A = Catchment area in km^2

Table 4-1 – Total Catchment Time of Concentration Calculation

Catchment Name	Area (ha)	Tc (mins)
Total	24.51	27

4.4 Average Rainfall Intensity

Rainfall Intensity – Frequency – Duration (IFD) data was sourced from the Bureau of Meteorology (BoM), refer to Figure 5.1 below for details.

Based on an Annual Exceedance Probability (AEP) of 10% and 1% the Time of Concentration for:

Table 4-3 – Total Catchment AEP

Catchment Name	Area (ha)	Tc (mins)	Intensity 10% (mm/hr)	Intensity 1% (mm/hr)
Total	24.51	27	52.6	79.9

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	98.9	112	155	184	212	249	277
2 min	83.6	94.6	129	153	176	204	224
3 min	75.7	85.8	117	139	160	185	205
4 min	69.8	79.1	108	128	148	172	191
5 min	64.9	73.6	101	120	138	161	179
6 min	60.7	69.0	94.9	112	129	152	169
10 min	48.8	55.6	76.7	91.0	105	124	138
15 min	39.7	45.3	62.5	74.3	85.8	101	113
20 min	33.8	38.5	53.2	63.2	72.9	86.1	96.2
25 min	29.6	33.7	46.5	55.2	63.7	75.2	83.9
27 min	28.2	32.1	44.3	52.6	60.7	71.6	79.9
30 min	26.4	30.1	41.4	49.2	56.8	66.9	74.7
45 min	20.4	23.1	31.7	37.5	43.3	50.9	56.7
1 hour	16.8	19.0	26.0	30.7	35.4	41.5	46.2
1.5 hour	12.7	14.4	19.5	23.0	26.5	31.0	34.4
2 hour	10.5	11.8	15.9	18.7	21.5	25.1	27.9
3 hour	7.90	8.86	11.9	14.0	16.0	18.7	20.8
4.5 hour	5.97	6.68	8.93	10.5	12.0	14.0	15.6
6 hour	4.90	5.47	7.30	8.55	9.79	11.5	12.8
9 hour	3.70	4.13	5.50	6.45	7.40	8.72	9.77
12 hour	3.03	3.38	4.51	5.30	6.09	7.21	8.10
18 hour	2.27	2.54	3.40	4.01	4.63	5.52	6.23
24 hour	1.84	2.06	2.78	3.29	3.81	4.56	5.17
30 hour	1.56	1.75	2.36	2.81	3.27	3.93	4.46
36 hour	1.36	1.52	2.07	2.47	2.88	3.47	3.94
48 hour	1.09	1.22	1.67	2.00	2.34	2.82	3.22
72 hour	0.785	0.882	1.21	1.46	1.71	2.07	2.37
96 hour	0.619	0.696	0.955	1.15	1.35	1.63	1.87
120 hour	0.514	0.577	0.788	0.944	1.11	1.34	1.53
144 hour	0.442	0.495	0.671	0.799	0.931	1.13	1.29
168 hour	0.389	0.435	0.584	0.691	0.799	0.968	1.11

Figure 4-1 – IFD Table for Wangaratta

4.5 Runoff Coefficient

Predeveloped coefficient of runoff is assumed to be 0.2 based on the existing undeveloped land in which the development will take place.

4.5.1 Post developed weighted coefficient for total catchment area

Assumed coefficients of runoff is based on the IDM Table 10.
Assumed average Lot size to be $600m^2 < 1000m^2$

	Area (Ha)	IDM Coefficient	
Public Reserves	3.942	0.35	1.379
Lots	12.99	0.70	9.093
Unit Sites	1.09	0.90	0.981
Road Reserve	6.568	0.75	4.926
Total	24.59		16.38
			C = 16.38/24.59
		Weighted Coefficient	= 0.67

From Austroads Table 6.1 for Victoria the runoff coefficient is based on the C_{10} value taken from AR&R Vol 2 with adjustment for area:

$C_Y = 1.0 \times 0.1 \times 2.0 = 0.20$

4.6 Permissible Site Discharge (PSD)

PSD for total development site catchment

From Section 4.1 above:

NORTH EAST SURVEY DESIGN

Project: Rezoning
Location: Clarkes Lane Wangaratta
Client: Bislake Pty Ltd
Our Ref.: M6801
Date: 8 February 2022

Peak Flow Rate - Rational Method

Rational Method Equation: $Q = \frac{C \times I \times A}{360}$

Where:
Q = Peak Flowrate for given AEP% (m^3/s)
C = Runoff Coefficient for given AEP
I = Rainfall Intensity at given AEP and t_c (mm/hr)
A = Catchment Area (Ha)
t_c = Time of concentration

Precinct 7 Entire Catchment Area

Average Exceedance Probability	10	%
Coefficient of Runoff	0.20	Weighted
Rainfall Intensity	52.6	mm/hr
Area	24.59	Ha
Time of Concentration	27	mins

Capacity Q:	0.7187	m^3/s
Capacity Q:	718.68	L/s
Capacity Q (25% Reduction):	539.01	L/s

Figure 4-2 – Permissible Site Discharge (PSD) for entire catchment area.

PSD to be reduced by a factor of 25% to account for Boyds formula, the resulting PSD for the development site will be 539L/s.

An additional 35L/s will be added to the PSD because of existing pumped outflow from Cathedral College basin as it is not needed to be controlled or stored but will need to be accommodated in pipe sizing. PSD will then be equal to 574L/s for the overall outlet from the bioretention basin.

4.7 Onsite Detention (OSD) Requirements

The Cathedral College stormwater pump discharging water at 35L/s will be accounted for in inflow and outflow from the basin giving no effect on the OSD storage.

Council's IDM required OSD to be sized to cater for the 1% AEP storm event. Using Boyd's Method the amount of OSD was determined to be 5,705m^3.

NORTH EAST SURVEY DESIGN

Project: Rezoning
Location: Clarkes Lane Wangaratta
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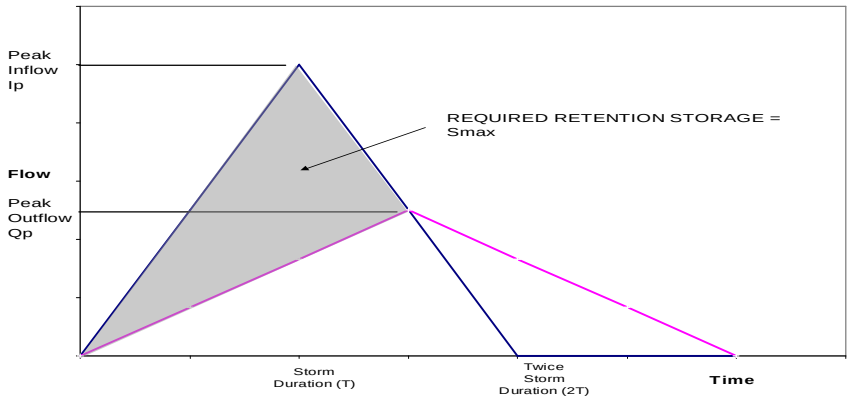
Our Ref.: M6801
Date: 8 February 2022

Flood Storage - Boyd's Formula - Entire Catchment



Boyd's Equation: $$S_{max} = V_1\left(1 - \frac{Q_p}{I_p}\right)$$

Where:
S_{max} = Maximum Volume of Temporary Storage (m^3)
V_1 = Volume of Inflow Flood (m^3)
I_p = Peak discharge of inflow hydrograph (m^3/s)
Q_p = Peak discharge of outflow hydrograph (m^3/s)

Catchment Area (A) =	24.5937	ha
Runoff Coefficient (1%) =	0.67	
1% Effective Catchment Area = ∑CA =	16.55	ha
Restricted outflow requirement (PSD) =	0.719	m^3/s
25% Reduction in PSD + Cathedral Outflow=	0.574	m^3/s
Inflow from Cathedral College	0.035	m^3/s

Storage requirement is highest value of S_{max} calculated in the table below
Critical storm duration is the storm duration when S_{max} occurs

Storm Duration (min)	1% AEP Intensity (mm/hr)	I_p (m^3/s)	Q_p (m^3/s)	V_1 (m^3)	S_{max} (m^3)
5	179	8.26	0.574	2479	2307
6	169	7.80	0.574	2809	2603
10	138	6.38	0.574	3827	3483
20	96.2	4.46	0.574	5348	4659
30	74.7	3.47	0.574	6244	5210
60	46.2	2.16	0.574	7771	5705
120	27.9	1.32	0.574	9486	5353
180	20.8	0.99	0.574	10704	4504
360	12.8	0.62	0.574	13465	1066
720	8.1	0.41	0.574	17596	-7201
1440	5.17	0.27	0.574	23556	-26038
2880	3.22	0.18	0.574	31624	-67565

Figure 4-4 – On Site Detention Requirements (OSD)

5. STORMWATER QUALITY MODELLING

In order to address the current Urban Runoff Management Objectives of Clause 56.07-04 for newly created lots only, stormwater quality modelling and design for the proposed development area was carried out in accordance with the current water quality performance objectives set out in the Urban Stormwater BPEMG. The objectives for environmental management of stormwater are presented in Table 5.1 below.

Table 5-1 – Best Practice Environmental Management Guidelines

Pollutant	Current 'Best Practice' Objective
Suspended Solids (SS)	80% reduction of typical urban annual suspended solids load
Total Phosphorus (TP)	45% reduction of typical urban annual total phosphorus load
Total nitrogen (TN)	45% reduction of typical urban annual total nitrogen load
Litter	70% reduction of typical urban annual litter load

In order to determine the reductions in these pollutants are in line with the 'Best Practice' objectives, the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) analysis of the stormwater quality was carried out for the proposed development site.

5.1 MUSIC Model Layout

The following figure, Figure 5.1, below shows the MUSIC model layout used to model the proposed development site.

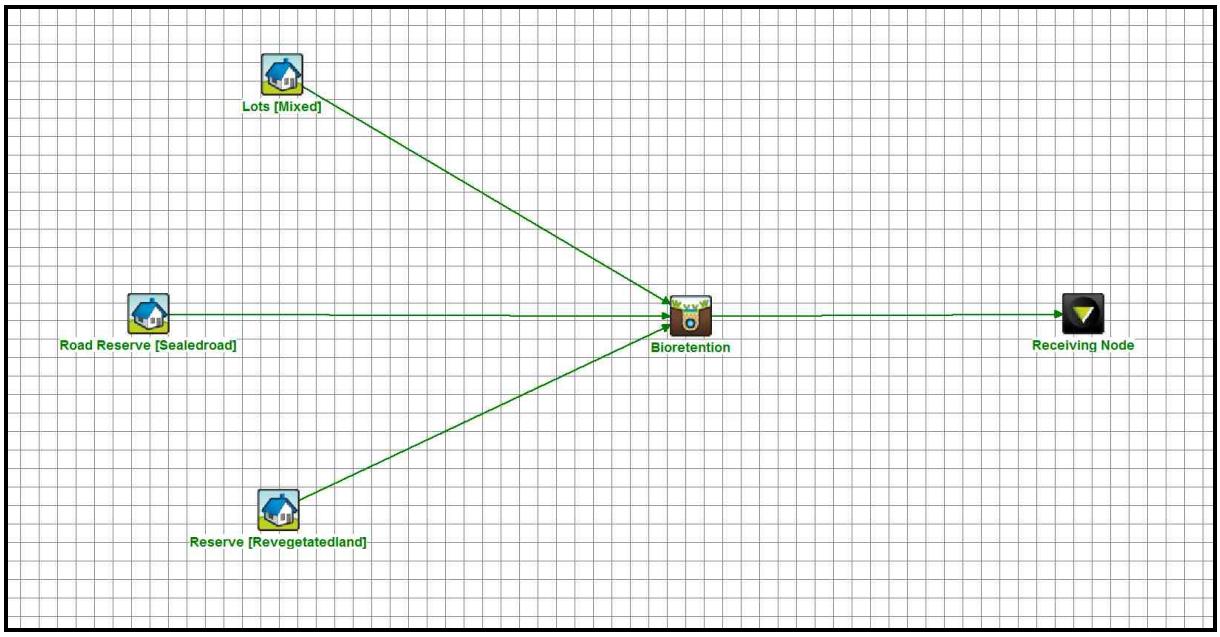


Figure 5-1– MUSIC Model Layout

5.2 MUSIC Model Inputs

5.2.1 Meteorological Data

The Meteorological Template used for the analysis was generated by using the Pluviograph rainfall data from Ovens River (Wangaratta) for the period from 1 January 1974 to 31st December 1983 inclusive using a six (6) minute time step and the monthly Potential Evapo-transpiration (PET) values, both recommended in RCoW's WSUD Guidelines. The rainfall data for Ovens River (Wangaratta) was obtained from the Bureau of Meteorology (BoM) through the MUSIC BoM Rainfall Data Tool.

The mean annual rainfall for the selected period of 1961 to 1967 is 624mm, where the actual observed annual average rainfall is 622mm.
A graphical representation of the meteorological data used is presented in Figure 5.2 below.

The average monthly PET values have been added as recommended in RCOW's WSUD Guidelines Appendix D-1, as follows in Table 5-2:

Table 5-2 – Average Monthly PET Values

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average PET (mm/month)	179	133	112	71	48	35	40	51	73	122	148	151

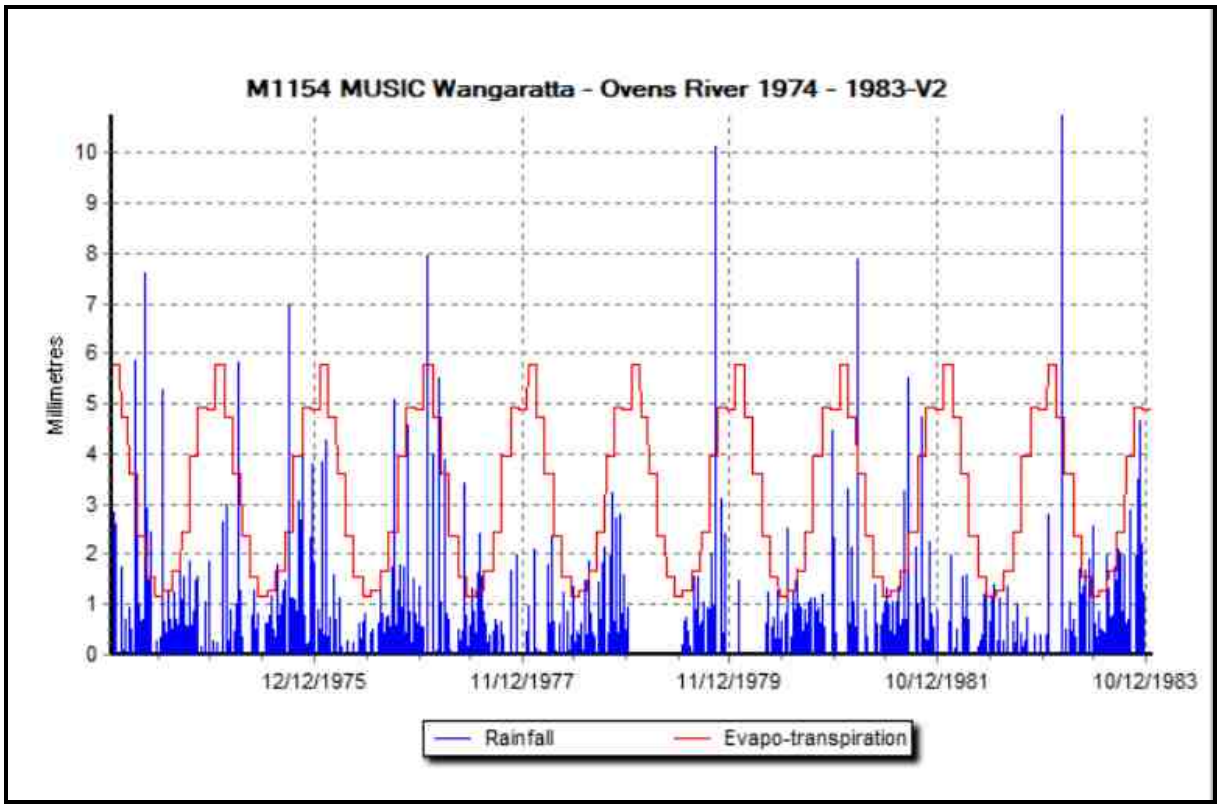


Figure 5-2 – Meteorological Data Template – Wangaratta 1st Jan 1974 to 31st Dec 1983

5.2.2 Stormwater Catchment Modelling (Source Nodes)

As part of the modelling of the stormwater quality discharged from the proposed development site a Catchment Plan was prepared. Figure 5.1 above shows the Catchments used in the MUSIC analysis.

As can be seen from the Catchment Plan above the site has been broken down into sub-catchments. These sub-catchments were further broken down into areas applicable to MUSIC, Source Nodes. The percent impervious for each of the MUSIC Source Nodes was based on coefficients of runoff based on values from Council's IDM.

Table 5.2 below summarises the percent impervious used for each of the MUSIC Source Nodes and Table 5.3 summarises the sub-catchment areas for each of the MUSIC Source Nodes used in the MUSIC modelling.

Table 5-3 – MUSIC Source Node Percent Impervious Summary

Source Node	Impervious (%)
Reserves	30
Lots	70
Road Reserve	75

Table 5-4 – Sub-Catchment Summary

Source Node	Area (Ha)
Reserves	2.78
Lots Ground	14.80
Road Reserve	7.00

5.2.3 Stormwater Treatment Modelling (Treatment Nodes)

From the Stormwater Management Strategy developed and outlined above in Section 4, the following WSUD treatment nodes have been utilised in the modelling:

- Bioretention Basin

Table 5.4 below summarise the WSUD elements utilised in the MUSIC modelling.

Table 5-4 – WSUD Input Summary – Bio retention Basin

	Bio retention
Low Flow Bypass (m^3/s)	0.000
High Flow Bypass (m^3/s)	100.000
Extended Detention Depth (m)	1.00
Surface Area (m^2)	3,000.00
Filter Area (m^2)	9.00
Unlined Filter Media Perimeter (m)	12.00
Saturated Hydraulic Conductivity (mm/hr)	180.00
Filter Depth (m)	0.60
TN Content of Filter Media (mg/kg)	800
Orthophosphate Content of Filter Media (mg/kg)	55.0
Exfiltration Rate (mm/hr)	0.0
Is Base Lined	Yes
Vegetated with Effective Nutrient Removal Plants	Yes
Overflow Weir Width (m)	2.00
Underdrain Present ?	Yes
Submerged Zone With Carbon Present ?	No
Submerged Zone Depth (m)	0.45

Based on the figures above, the stormwater water quality performance objectives for environmental management of stormwater as defined in Urban Stormwater BPEMG can be achieved for the development site.

5.2.4 MUSIC Model Output

Using the above MUSIC model and inputs the pollutant reductions presented in Table 6.5 were obtained at the Outlet Node.

Table 5-5 – Treatment Train Effectiveness Summary (% Reduction)

	Receiving Node
Flow (ML/yr)	0.8
Total Suspended Solids (kg/yr)	90.0
Total Phosphorus (kg/yr)	67.9
Total Nitrogen (kg/yr)	46
Gross Pollutants (kg/yr)	100.0

Based on the figures above, the stormwater water quality performance objectives for environmental management of stormwater as defined in Urban Stormwater BPEMG can be achieved for the development site.

6. MATERIALS SPECIFICATIONS – BIORETENTION AREA

Reference is to be made to the Facility for Advancing Water Biofiltration (FAWB) Guidelines for Filter Media in Biofiltration Systems at the time of construction to ensure the materials specified here re relevant.

It is the intent that the stormwater from the development site will infiltrate through the various media layers and into the slotted pipe located at the bottom of the profile. The slotted pipe will discharge the treated stormwater into the underground piped drainage system.

Materials are to be placed and lightly compacted so as to avoid future subsidence and shall be in general accordance with the following geotechnical requirements:

6.1 Filter Material *(350mm Depth)*

Filter Material is to have a saturated hydraulic conductivity of approximately 180mm/hr and is to be free of rubbish and deleterious material.

A filter material consisting of the following composition is likely to provide the required saturated hydraulic conductivity:

- Silt & Clay: < 3% Particle Size: <0.05mm
- Very Fine Sand: 5 – 30% Particle Size: 0.05 – 0.15mm
- Fine Sand: 10 – 30% Particle Size: 0.15 – 0.25mm
- Medium to Coarse Sand: 40 – 60% Particle Size: 0.25 – 1.0mm
- Coarse Sand: 7 – 10% Particle Size: 1.0 – 2.0mm
- Fine Gravel: < 3% Particle Size: 2.0 – 3.4mm

The filter media should be well graded i.e., it should have all particle size ranges present from the 0.075mm to the 4.75mm sieve (as defined by AS1289.3.6.1 – 1995).
The filter media must be tested for the following:

- Total Nitrogen (TN) Content: < 1000mg/kg (Target – 800mg/kg)
- Organic Matter Content: > 3% (w/w) (Target – < 5%)
- Orthophosphate Content: < 80mg/kg (Target – < 55mg/kg)
- pH: as specified for 'natural soils and soil blends' 5.5 – 7.5.
- Electrical Conductivity (EC): as specified for 'natural soils and soil blends' 1.2dS/m.

Filter materials are to be tested to ensure that the above properties are present and assessed by a horticulturist to ensure that they are capable of supporting a healthy vegetation community.

Source: FAWB Guidelines for Filter Media in Biofiltration Systems June 2009.

6.2 Transition Layer *(100mm Depth)*

Transition Layer is to be a sand / coarse sand material with a typical particle size distribution of percent passing through various sieve sizes of:

- 1.4mm 100% passing.
- 1.0mm 80% passing.
- 0.7mm 44% passing.
- 0.5mm 8.4% passing.

6.3 Drainage Layer *(150mm Depth)*

Drainage Layer is to be coarse sand or fine gravel material with a typical particle size distribution of 2 – 5mm. Material is to be washed and clean.

7. VEGETATION SPECIFICATIONS – BIORETENTION AREA

It is preferred to leave the landscaping to experts, Landscape Architects, to recommend specific species and planting arrangements to ensure the correct and most appropriate species are nominated and in keeping with the overall aesthetics of the development. As a preliminary recommendation the typical suitable species is presented in Table 8.1 below.

Table 7-1 – Plant Species for Bioretention Areas

Scientific Name	Common Name	Height	Planting Density (plants / m^2)
Epacris impessa	Common Heath	0.5 – 1.5	2 – 4
Carex appressa	Tall Sedge	0.5 – 1.2	4 – 8
Fionia nodosa	Knobby Club-rush	0.5 – 1.5	6 – 8
Juncus amabilis	-	0.2 – 1.2	8 – 10
Juncus flavidus	Yellow Rush	0.4 – 1.2	8 – 10
Lepidosperma laterale	Variable Sword-sedge	0.5 – 1.0	6

8. DESIGN PARAMETERS (ASSUMPTIONS AND EXCLUSIONS)

As part of the stormwater quality analysis the following assumptions and exclusions were made:

8.1 Meteorological Template

The Meteorological Template used for the analysis was generated by using the Pluviograph rainfall data from Ovens River (Wangaratta) for the period from 1st January 1974 to 31st December 1983 inclusive using a six (6) minute time step and the Potential Evapo-transpiration (PET) values provided by RCoW's WSUD Guidelines.

8.2 Exfiltration Rate

An Exfiltration Rate of 0.00mm/hr in line with the Melbourne Water MUSIC Guidelines.

9. CONCLUSION

This report has identified an effective Stormwater Management Strategy for the proposed development. Through the use of a bioretention basin, which incorporate WSUD, the stormwater generated from the proposed development site can be conveyed to the nominated point of discharge.
In achieving these stormwater water runoff requirements, the Planning Permit Conditions related to stormwater drainage can be satisfied.