MOUNT ALEXANDER SHIRE COUNCIL MUSIC GUIDELINES

MUSIC Guidelines
September 2019

MOUNT ALEXANDER SHIRE COUNCIL

This report has been prepared by the office of Spiire

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01 INTRODUCTION

Model for Urban Stormwater Improvement Conceptualisation (MUSIC) by eWater is a modelling software that simulates the quantity and quality of runoff within a catchment. The user can assess and compare various stormwater treatment assets in its performance of nutrient removal. MUSIC is integral in ensuring that receiving water bodies are protected from pollutants produced from the additional runoff of emerging urban developments.

Mount Alexander Shire Council (MASC) requires that stormwater runoff must meet the Urban Stormwater – Best Practice Environmental Management Guidelines (Victoria Stormwater Committee, 1999). The water quality objectives are:

- 80% retention of total suspended solids (TSS);
- 45% retention of total phosphorous (TP);
- 45% retention of total nitrogen (TN); and
- 70% reduction of urban annual litter load.

1.1 PURPOSE OF THIS DOCUMENT

MASC have developed this document to guide designers on input parameters and design considerations for MUSIC specific to MASC. These guidelines aim to:

- Provide consistency in the application process for water sensitive urban design (WSUD) assets in the MASC region;
- Provide advice on using MUSIC in MASC; and
- Provide guidance on parameters in MUSIC specific to MASC stormwater management objectives.

This document is based on the Melbourne Water MUSIC guidelines (2018) and the City of Greater Bendigo MUSIC guidelines (2012) and is adapted for MASC.

At time of this report, the current version of MUSIC is 6.3.

This document presents:

- Model setup: brief overview of the inputs & output of the model;
- Climate data: parameter setup associated with the model template;
- Source nodes: explanation of parameters associated with source nodes; and
- Treatment nodes: guidelines for the input parameters of treatment assets.

1.2 ARR19 TERMINOLOGY

The new ARR19 guidelines introduces new terminology to define storm events and probabilities. A summary of the new terminology is as follows:

- Annual Exceedance Probability (AEP) is used to define design storm events and use a percentage probability. Typically used for events including and rarer than 10% AEP; and
- Exceedances per Year (EY) is used for more frequent events such as 3month recurrence interval (4EY).

Table 1 details a translation of ARR19 and ARR87 terminology.

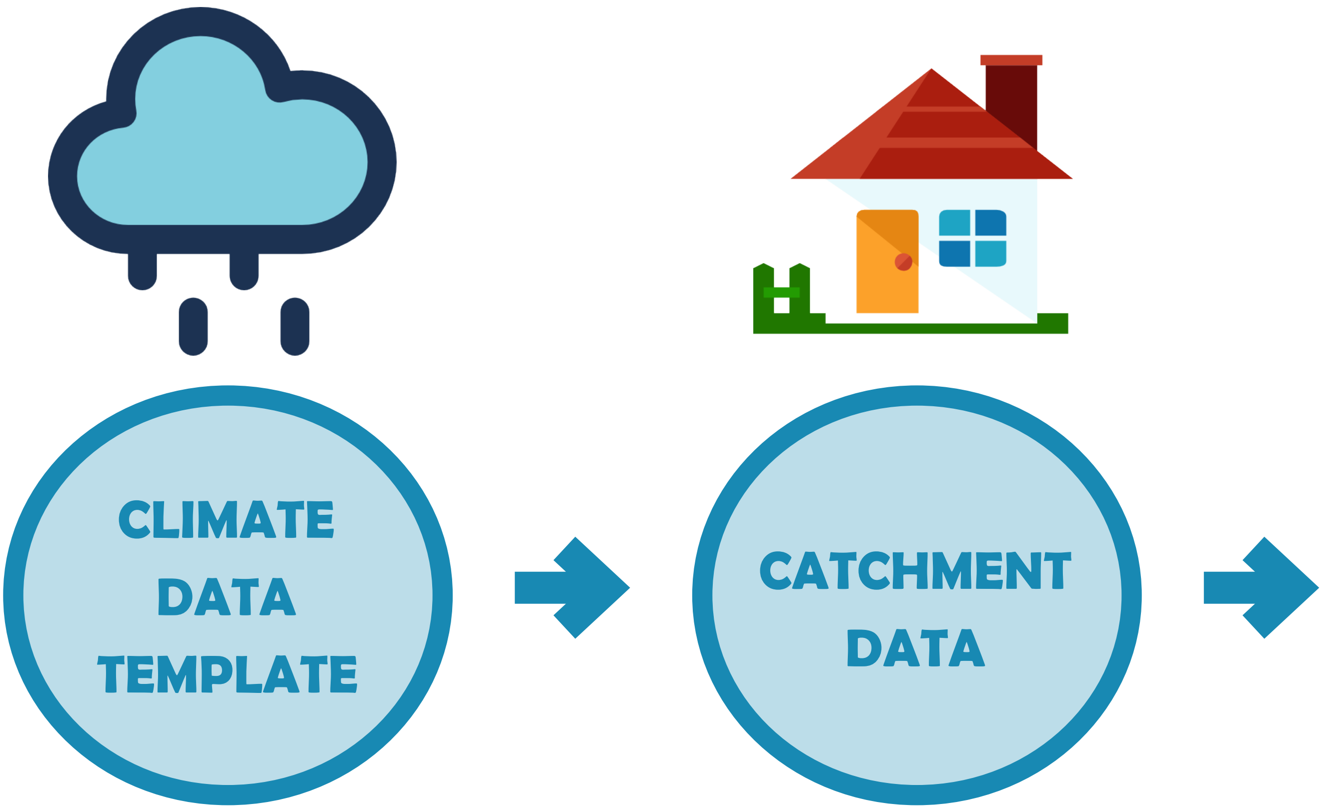
Table 1: ARR87 & ARR19 terminology summary

EY	AEP (%)	AEP (1 IN X)	ARI
6	99.78	1.002	0.17
4	98.17	1.02	0.25
3	95.02	1.05	0.33
2	86.47	1.16	0.50
1	63.21	1.58	1.00
0.69	50.00	2	1.44
0.5	39.35	2.54	2.00
0.22	20.00	5	4.48
0.2	18.13	5.52	5.00*
0.11	10.00	10	9.49
0.05	5.00	20	19.5
0.02	2.00	50	49.5
0.01	1.00	100	100
0.005	0.50	200	200

*5 year ARI is generally considered 20% AEP

02
MODEL SETUP

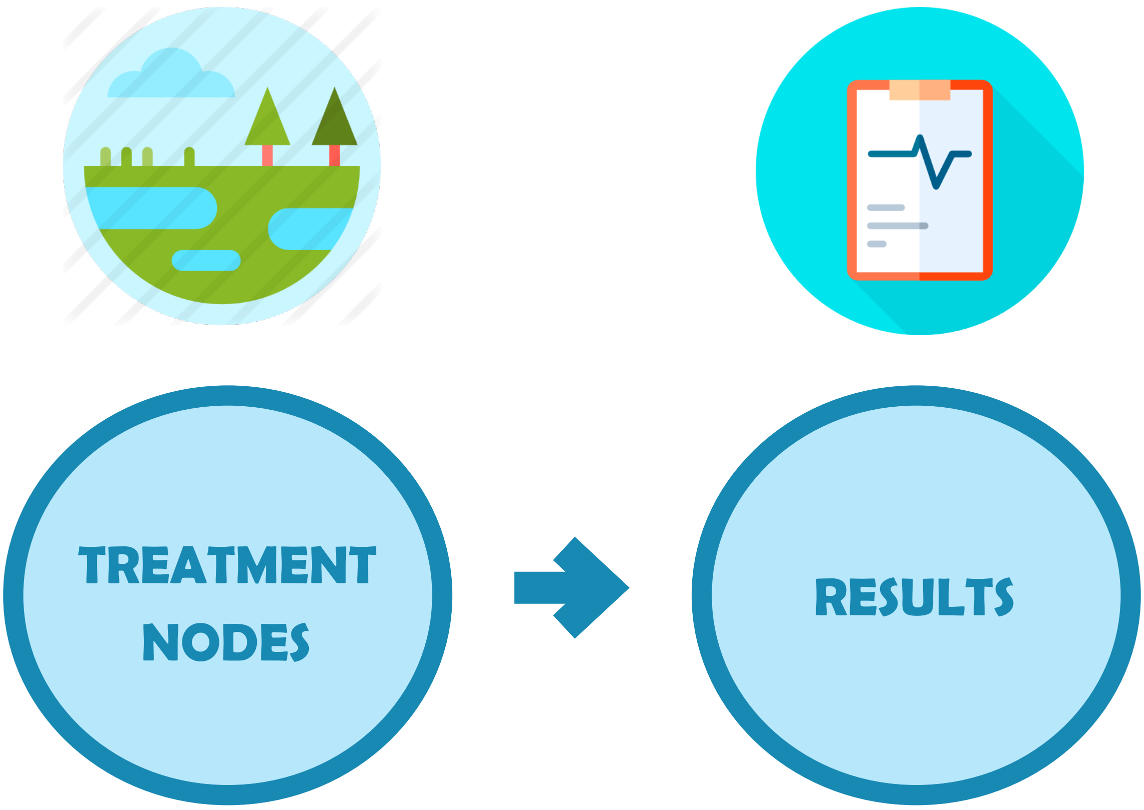
A MUSIC model can generally be broken down into four sections. Below is a breakdown of the modelling process and a summary of each section's inputs or outputs.



- Timestep
- Rainfall period
- Evapotranspiration

- Source node selection
- Zoning/surface type
- Fraction impervious
- Soil parameters

Model setupIcons made by Freepik, bqlqn & Roundicons from www.flaticno.com



- General guidelines
- Treatment trains
- High flow bypass setup
- Treatment node parameter setup

- Meeting best practice targets
- Treatment train effectiveness

03
CLIMATE DATA

3.1 TIMESTEP

A timestep of 6 minutes is to be used for all models. Dispensation must be sought from Council if not possible as a larger timestep can lead to significant inaccuracy.

3.2 RAINFALL PERIOD

The reference years were selected based on mean annual rainfall (MAR) of Castlemaine. As no 6-min rainfall data is available for Castlemaine, the nearest station with available data was used. The modelling period with a MAR closest to Castlemaine's MAR was selected. Rainfall data for MUSIC is shown in Tables 1 and 2 below.

Table 2: Station Rainfall Data

Rainfall Station	MAR (mm)
Castlemaine	588
Heathcote	572

Rainfall data for MUSIC is shown in Table 3

Table 3: Rainfall Data for MUSIC Modelling

Rainfall Station	Timestep	Modelling Period
088029 - Heathcote	6 min.	1991 - 2000

3.3 EVAPOTRANSPIRATION

The potential evapotranspiration (PET) option in MUSIC is suitable for modelling evapotranspiration. A sensitivity analysis using PET-Rain is recommended as well.

04
SOURCE NODES

4.1 SOURCE NODE SELECTION

Urban nodes should be primarily be used to model existing and proposed urban developments, as well as open spaces. Forest nodes should be used for well-established forested areas and agricultural nodes have higher nutrient concentrations to represent actively farmed areas.

4.2 ZONING/SURFACE TYPE

Nodes can be split into sub-nodes based on the type of surface. For example, node representing a residential development can be split into a roof node and a residential (minus roof) node. This allows for different pollutant concentration data and routing of roofs to rainwater tanks.

4.3 FRACTION IMPERVIOUS

Effective fraction impervious (ratio of impervious area to pervious area) must be used and should be calibrated to streamflow data where possible. For catchments less than 10ha, the next best method is to calibrate to measure of impervious areas connected to the discharge point.

For catchments greater than 10ha, refer to Table 2 for fraction impervious values for different land use types. Deviation from the below must be supported by relevant information or a detailed catchment analysis.

Table 4: Fraction impervious values (CoGB, 2012)

ZONE	ZONE CODE	BRIEF DESCRIPTION / EXAMPLES	NORMAL RANGE	TYPICAL VALUE
Residential Zones				
Residential 1& 2 zone	R1Z	Large residential (lot size 601m2 – 1000m2)	0.50 - 0.80	0.6
	R2Z	Standard densities (lot size 301m2 – 600m2)	0.70 - 0.80	0.75
		High densities (lot size <300m2)	0.80 - 0.95	0.85
Low Density Residential Zone	LDRZ	Low densities (0.4 Ha min)	0.10 - 0.30	0.20
Mixed Use Zone	MUZ	Mix of residentail, commercial, industrial and hospitals	0.60 - 0.90	0.70
Township Zone	TZ	Small townships with no specific zoning structures	0.40 - 0.70	0.55
Industrial Zones				
Industrial Zone 1	IN1Z	Main zone to be applied in most industrial areas	0.70 - 0.95	0.90
Industrial Zone 2	IN2Z	Large industrial zones away from residential areas	0.70 - 0.95	0.90
Industrial Zone 3	IN3Z	Buffer between Zone 1 and Zone 3	0.70 - 0.95	0.90
		Garden supplies/nurseries	0.30 - 0.60	0.50
		Quarries	0.10 - 0.30	0.20
Business Zones				
Business Zone 1	B1Z	Main zone to be applied in most commercial areas	0.70 - 0.95	0.90
Business Zone 2	B2Z	Offices and associated commercial uses	0.70 - 0.95	0.90
Business Zone 3	B3Z	Offices, manufacturing industries and associated uses	0.70 - 0.95	0.90
Business Zone 4	B4Z	Mix of bulky good retailing and manufacturing industries	0.70 - 0.95	0.90
Business Zone 5	B5Z	Mix of offices and multi-dwelling units	0.70 - 0.95	0.90

4.4 EQUIVALENT RUNOFF COEFFICIENT (C) VALUES

Equivalent runoff coefficient values have been provided based on the IDM to ensure consistencies around water quality modelling and hydrologic modelling. Note these are a guide only.

Table 5: Runoff coefficients (IDM, 2019)

CATCHMENT TYPE	RUNOFF COEFFICIENT
LDRZ - lot areas >2ha	0.30
LDRZ – lot areas >1ha to 2ha	0.30
LDRZ – lot areas >4,000m2 to 1ha	0.35
LDRZ – lot areas >2,000m2 to 4,000m2	0.35
Residential areas – lot areas >1,000m2 to 2,000m2	0.40
Residential areas – lot areas >600m2 to 1,000m2	0.55
Residential areas – lot areas >450m2 to 600m2	0.60
Residential areas – lot areas >300m2 to 450m2	0.65
Residential areas – lot areas <300m2	0.80
Residential areas (medium density, i.e. Units, including potential unit development sites)	0.90
Commercial zones	0.90
Industrial zones	0.90
Residential road reserves	0.75
Landscaped areas	0.25
Public Open Space	0.35
Paved areas	0.95

4.5 SOIL PARAMETERS

When creating source nodes, MUSIC will automatically default the pervious area properties to the Brisbane defaults. The following soil properties are recommended for MASC. These are based on the City of Greater Bendigo properties (2012).

Soil Store Capacity = 30mm

Field Capacity = 20mm

4.6 POLLUTANT CONCENTRATION DATA

Deviation from default values must be due to a significance difference in values and justified with relevant data.

Stochastically generated data must be used.

4.7 USE OF SECONDARY LINKS

Secondary links can be used to direct surface flows and base flows through different routes. This can be modelled by adding a secondary link to a catchment and routing it around the treatment to the receiving node.

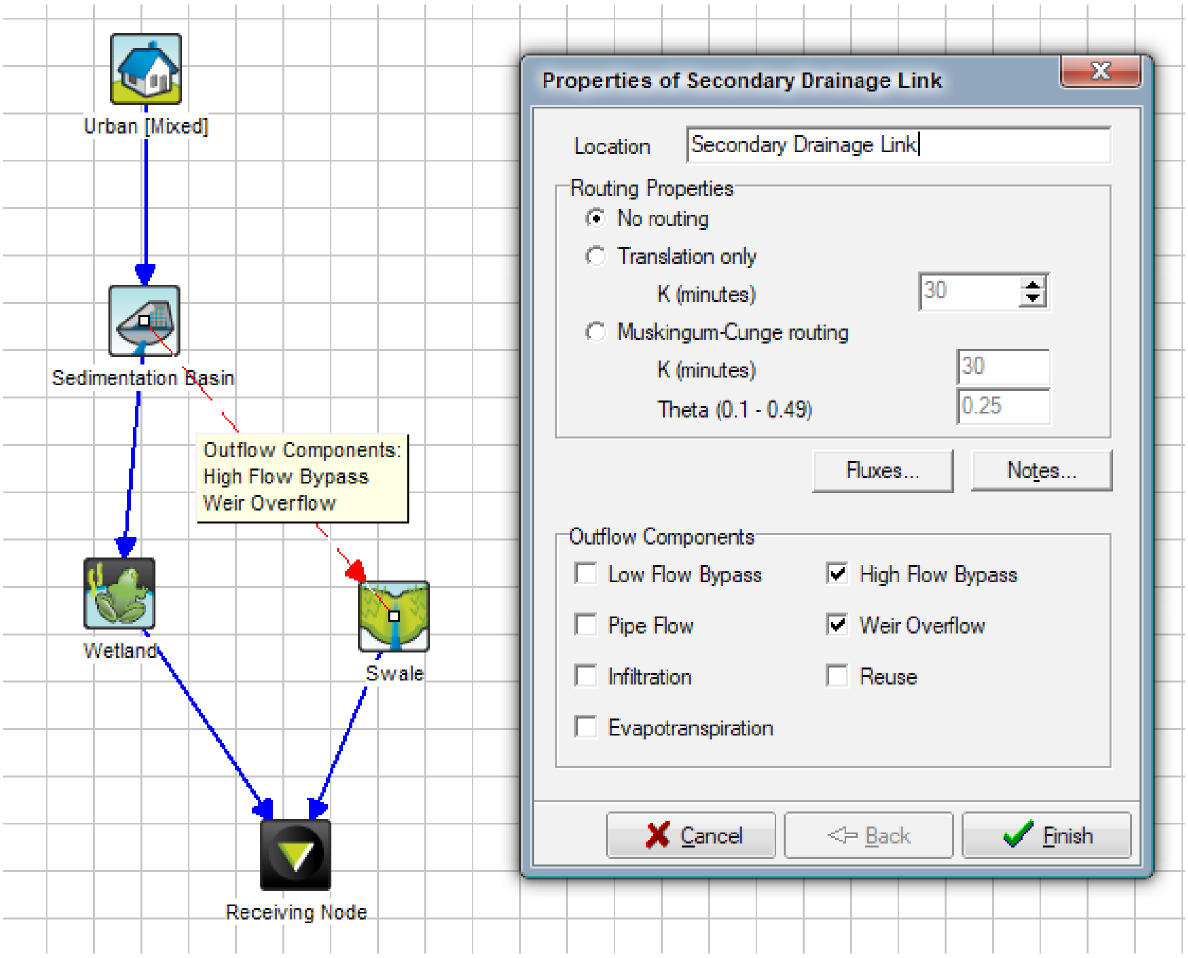


Figure 1: Secondary links overview

05
TREATMENT NODES

5.1 COUNCIL APPROVED WSUD TREATMENT ASSETS

Table 6 below outlines WSUD treatment assets are approved by Council. Council encourages the use of rainwater tanks for rainwater harvesting or retarding basins for stormwater detention/flood management. However, Council does not recognise their use in water quality treatment.

Table 6: Council approved treatment assets

COUNCIL APPROVED	COUNCIL UNAPPROVED
Sediment Pond	Rainwater Tanks
Bioretention Systems/Raingardens	Retarding Basins
Wetlands	
Gross Pollutant Traps	
Swales	
Ponds	
Buffer Strips	

5.2 GENERAL GUIDELINES

5.2.2 TREATMENT TRAINS

Treatment nodes should be linked in the appropriate order with primary treatment nodes being first, followed by secondary and tertiary treatment node.

5.2.3 K, C*, C**

Any changes to the above parameters must be approved by council and supported with published data relevant to the scenario.

5.2.4 CTSR CELLS

CTSR parameter in MUSIC represents the mixing behaviour of treatment nodes. Length to width ratios for shapes is used to estimate the number of CTSR cells. Refer to Figure 2 for guidance in determining the value.

5.2.5 HIGH FLOW BYPASSES

Flows greater than the 63.2% AEP (1EY) must bypass the sediment pond and greater than 98.17% AEP (4EY) must bypass any other treatment system.

5.2.6 EXFILTRATION

Exfiltration should be set to zero unless supporting geotechnical data is provided and approved by Council.

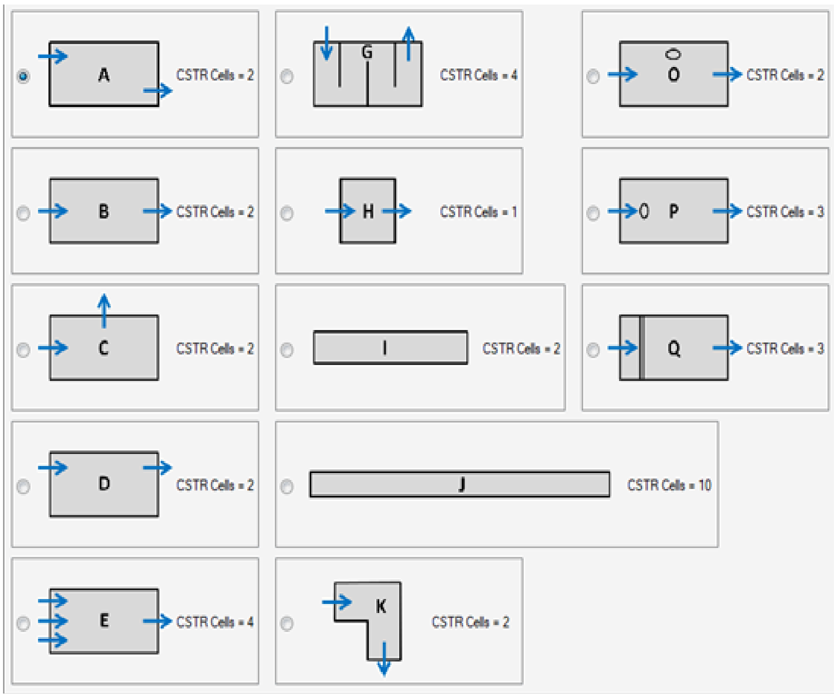


Figure 2: Number of CTSR Cells

5.3 BIORETENTION SYSTEMS/RAINGARDENS

Where the catchment is greater than 5ha, bioretention systems must have a sediment pond upstream. If the catchment is less than 5ha, a vegetated swale, sediment forebay, inlet pond or gross pollutant trap (GPT) is sufficient.

Bioretention systems must have an extended detention depth (EDD) <500mm. However, 300mm is preferred.

5.3.1 FILTER MEDIA

Bioretention systems requires three layers of media: the filter media, transition layer and a drainage layer. The material used for each of these layers must meet specifications outlined in the Adoption Guidelines for Stormwater Biolfiltration Systems (CRC, 2015).

Typical filter media should be in the depth range of 400mm – 600mm and have a hydraulic conductivity in the range of 150mm/hr – 300mm/hr.

TN <1000m/kg and Orthophosphate <80mg/kg to prevent leaching of nutrients from the media.

5.3.2 VEGETATION TYPE

It is recommended that plants that provide effective nutrient be selected for bioretention systems. Adoption Guidelines for Stormwater Biolfiltration Systems (CRC, 2015) recommend plant species that satisfy the general principles for plant selection below:

- Use species capable of survival in sand and low nutrient media, intermittent inundation and prolonged dry periods;
- Use species that are compatible with the local climate and surrounding vegetation;
- Incorporate at least 50% of species with effective characteristics to meet treatment objectives; and
- Select the remaining species to meet additional objectives such as enhanced aesthetics, biodiversity, habitat or shading;

5.3.3 UNDERDRAIN AND SUBMERGED ZONES

Underdrains are required on all bioretention systems. The underdrain pipe should have sufficient capacity to convey the treatment water.

Submerged zones are required on all bioretention systems. A submerged zone depth of 450 – 500mm is recommended.

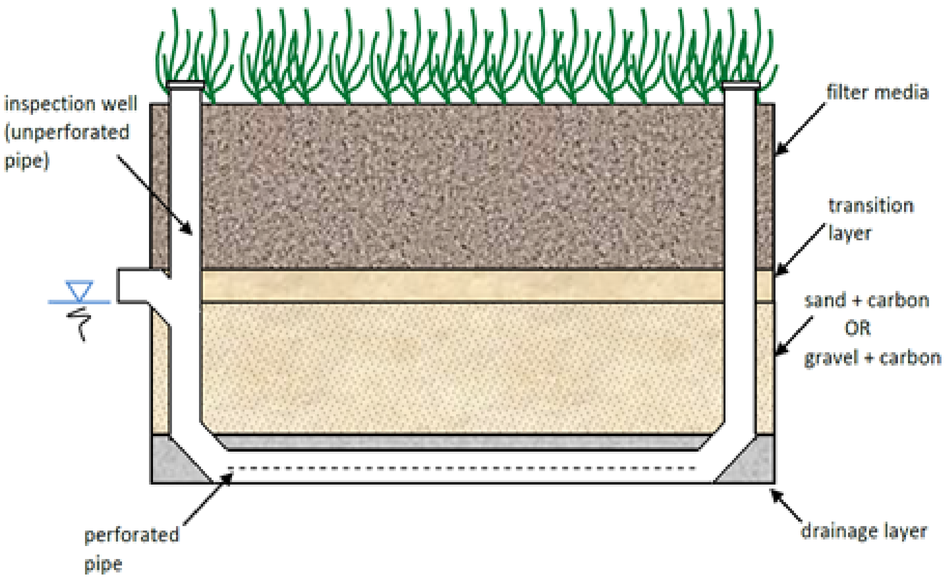


Figure 3: Raingarden long section showing a submerged zone and an underdrain (Monash University, 2009)

5.4 WETLANDS

Wetland design should consider the following:

- Flow distribution:
  - The location of the inlet and outlet of the wetland alongside the wetland geometry should allow for uniform distribution of flow across the water body.
  - Have a length to width ratio of approximately 4:1; and
  - Adhere to velocities of <0.5m/s for 1% AEP (0.01EY) storms and <0.05 for 98.17% (4EY) AEP storms.
- Permanent pool depth:
  - The wetland bathymetry must facilitate establishment of emergent and submerged macrophytes throughout the wetland;
  - A uniform depth across the wetland width minimises the area of fringing vegetation, which negatively influence water treatment by enhancing dead zones;
  - Depths associated with each permanent pool zone should be consistent with Table 7; and

Table 7: Wetland permanent pool depths

PERMANENT POOL ZONES	MINIMUM DEPTH (mm)	MAXIMUM DEPTH (mm)	% OF MACROPHYTE ZONE SURFACE AREA
Shallow Marsh	-	<150	10%
Deep Marsh	150	350	10%
Submerged Marsh	350	700	40%
Open Water	700	1500	40%

  - A minimum 80% of the macrophyte zone at normal water level (NWL) must be ≤350 mm (i.e. shallow and deep marsh);

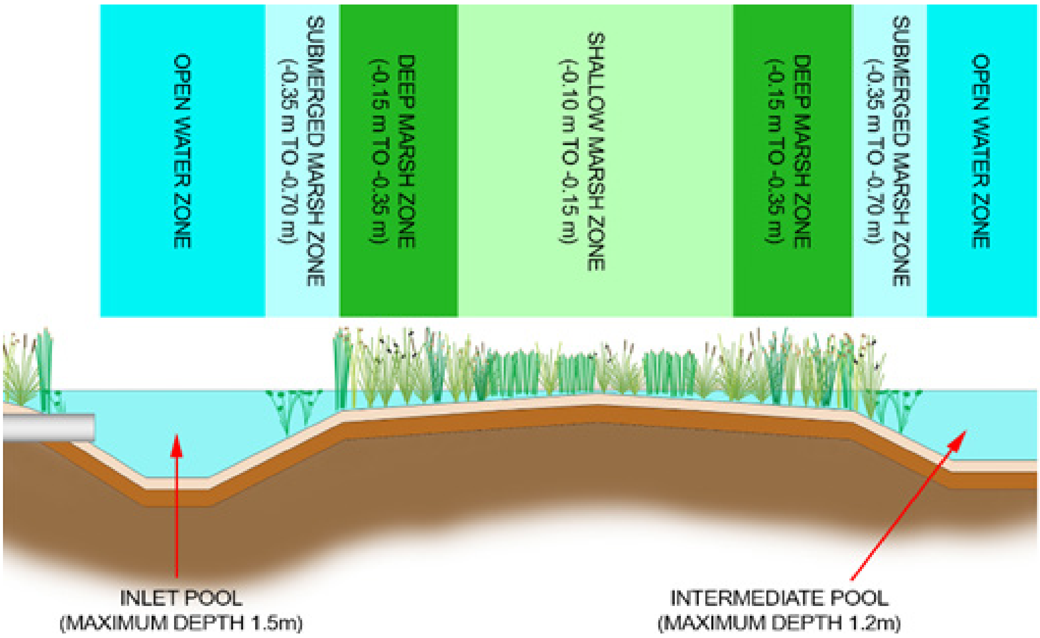


Figure 4: Macrophyte zone planting bands (Melbourne Water, 2018)

- Hydrologic regime
  - The wetland must be designed to provide a 90th percentile residence time (time a particle of water spends in the wetland) of 72 hours;
  - The outlet of the wetland must allow a 72 hour drawdown from EDD to NWL. A custom outflow relationship must be modelled in the treatment node;
  - Calculations and supporting data must be provied to demonstrate the wetland's hydrologic regime; and
  - Wetlands must be designed to enable the permanent pool to be occasionally drawn down;

- Extended detention depth:
  - The EDD must be <500mm (typically 350mm);
- Open water:
  - Inclusion of a limited proportion of open water is supported in the wetland design;
  - Deep zones should be placed at the inlet and outlet to collect heavy sediment particles and reduce blockage probability; and
  - Deep zones in the wetland help to break short-circuits when placed as intermediate pools and provide some degree of treatment via sedimentation, microbial processing in the substrate and via algal oxygenation and nutrient uptake in the water column.
- Vegetation:
  - Macrophyte species planted within the wetland must be suitable for effective nitrogen and phosphorous removal and be approved by MASC's Parks & Gardens team.

5.5 SEDIMENT PONDS

Sediment Ponds must have an EDD between 350mm – 500mm (typically 350mm).

During the concept phase the sediment pond size can be assumed to be 10% of the macrophyte zone area and an average depth of 1.5 metres.

Sediment ponds must be sized to:

- Capture 95% of coarse particles > 125μm diameter for the peak 98.17% AEP storm;
- Have a maximum depth of 1.6m to NWL;
- Provide adequate sediment storage volume to store five years of sediment. Top of sediment accumulation zone must be assumed to be 500mm below NWL; and
- Ensure that velocity through the sediment pond during the peak 1% AEP storm event is < 0.5m/s.

5.6 GROSS POLLUTANT TRAPS/PROPRIETRY PRODUCTS

Gross Pollutant Traps (GPT's) treatment nodes must be supplied by the supplier or supported with reliable studies. Nitrogen and phosphorous reductions from GPT's should be set to zero.

5.7 SWALES

Suggested vegetation heights:

- Grass swale (mowed) height range: 10 – 100mm; and
- Vegetation (not mowed): 100 – 400mm.

Longitudinal grade of 1 – 5% is acceptable. Velocities must not exceed 0.5m/s for storms up to 20% AEP storms and 1.0m/s for 1% AEP storms.

Waterways within the developments cannot be deemed as swales and shall not be included in the treatment train model.

5.8 RAINWATER TANKS

Rainwater tanks are primarily used for hydrology and not treatment. However, the following must be considered when calculating water re-use.

- Only roofs may be connected to rainwater tanks and thus catchment nodes must be split into the appropriate surface types.
- 50% of roof area may be connected to the rainwater tanks. Supporting data must be provided if >50% of roof area is to be connected to rainwater tanks.
- Rainwater may be used for garden irrigation, toilet flushing and laundry cold taps in residential developments.

06 CONCLUSION

The Mount Alexander Shire MUSIC guidelines outline the design elements that need to be considered when assessing WSUD treatment options in MUSIC. This document should be used as a guide only. Values and design considerations outside the provided ranges may be accepted pending discussions with MASC.

07
REFERENCES

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