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Wandana Heights Water Quality Strategy

Prepared for: Villawood Properties

16 December 2015

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Document Control

Version	Date	Description	Prepared	Reviewed
REV 1	May 2015	Draft Issue	MN	
REV 2	Dec 2015	Final Issue	GJ	MN

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1 Introduction

Biofilta was engaged by Villawood Properties to provide an assessment of water quality treatment works required to meet best practice stormwater targets for the proposed Wandana development, 255 Barrabool Road, Wandana Heights.

This report is to be read in conjunction with the Surface Water Management Strategy (SWMS) dated November 2015 prepared by Water Technology. The SWMS details the hydraulic requirements of drainage infrastructure while this specialist water quality report focusses on the treatment for the site.

The scope of Biofilta's works included the review of opportunities to maximise the reuse of stormwater within the development whilst providing practical treatment measures for challenging topography.

Industry standard water quality modelling software was used to analyse the main catchments at the site and propose treatments which looked at a holistic approach to meeting the required stormwater quality targets.

This report details how each catchment is proposed to be treated taking into account the upstream catchment characteristics, maintenance access, integration with proposed retarding facilities and lowest ongoing cost to Council.

An innovative feature for the water quality and integrated water management is a proposed Biofilta System for the north east catchment to fit the steep terrain while providing the dual benefit of retardation and water quality for the catchment with a minimal footprint.

The Biofilta System will be detailed in later sections of this report, and has been shown to be more cost effective to maintain than an alternative wetland of larger size and presents Council with an example of leading edge water sensitive urban design which requires no proprietary ongoing replacement parts.

Details of how the various treatment facilities have been sized are contained in this report.

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2 Site Description

The subject site is located in Wandana Heights and is bordered by Barrabool Road to the north, Cityview Drive to the east and the Geelong Ring Road to the west.

The development is seeking to provide a logical infill of residential lots with Drewan Park a central open space feature.

The site is essentially the top of a hill and has distinct catchments which runoff will follow and require treatment.

Hydraulic assessment of the various catchments are contained in the Hydraulic report which notes that all site catchments ultimately drain into Highton and the former Kardinia Creek alignment. Hence, water quality improvement to receiving waterways should be considered holistically such that treatment facilities are minimised and the total site outcome is one that meets Best Practice stormwater targets.

A catchment plan showing the general catchments shown below:

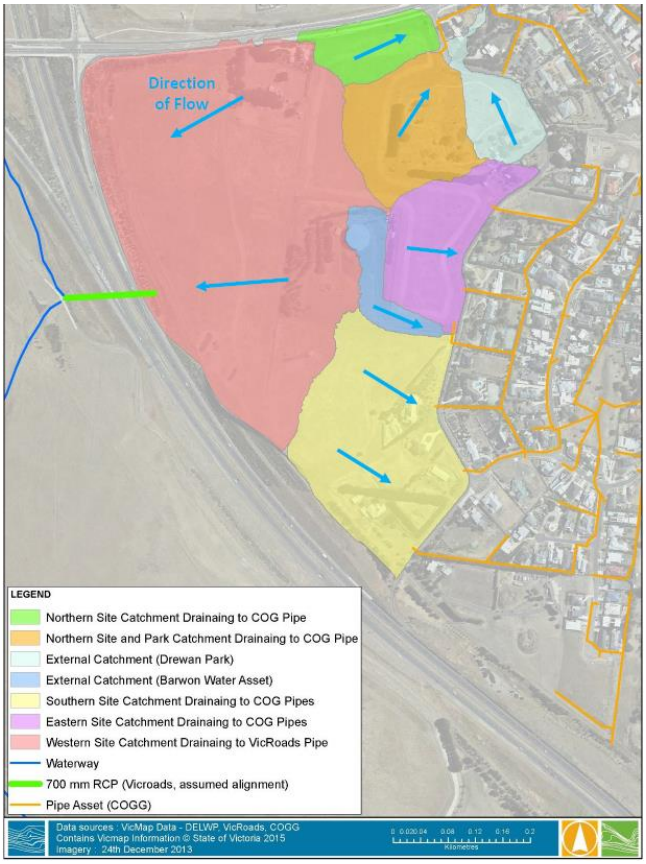

Figure 1: Catchment Plan

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3 Methodology

The objective of the development with respect to stormwater quality is to treat the stormwater as such it can achieve environmental objectives as stated in Urban Stormwater Best Practice Environmental Management Guidelines (BPEMG). BPMEG objectives for stormwater quality improvement are as follows:

- Reduction of Total Suspended Solid (TSS) : 80%
- Reduction of Total Phosphorous (TP) : 45%
- Reduction of Total Nitrogen (TN) : 45%
- Reduction of Gross Pollutants (GP) : 70%

For each catchment, the model for Urban Stormwater Improvement Conceptualisation (MUSIC) V6 has been used to assess the water quality improvement measures for the development.

Treatment measures proposed for each major catchment are sized and their water sensitive urban design (WSUD) performance outcomes presented.

Discussion in relation to the constructability and ongoing maintenance costs of the WSUD measures are also presented and estimated from first principles and practical experience.

A key methodology for this report is to present to Council, WSUD treatments that contain no proprietary product that requires ongoing lock-in maintenance or product replacement from a single supplier. This includes the Biofilta System proposed for stormwater harvesting at Drewan Park.

All hydraulic retardation facilities proposed by Water Technology are incorporated into the MUSIC model analysis.

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4 NORTH EAST CATCHMENT

4.1 North East Catchment

A Biofilta stormwater treatment system will be installed that integrates with the requirement to provide detention and harvests stormwater from an underground tank. The captured stormwater is then pumped up into a vegetated sand filter located above the tanks and filtered stormwater is then collected in a small reuse tank for the planter sustainability. When the capacity of the small reuse tank is exceeded, the treated water is then released to the drainage system to a standard that meets or exceeds best practice environmental objectives.

The Biofilta System has been successfully installed for similar purposes in a range of locations from Melbourne to Townsville. In general, the treatment system involves a robust treatment train for the removal of pollutants and reuse of filtered stormwater in a compact footprint.

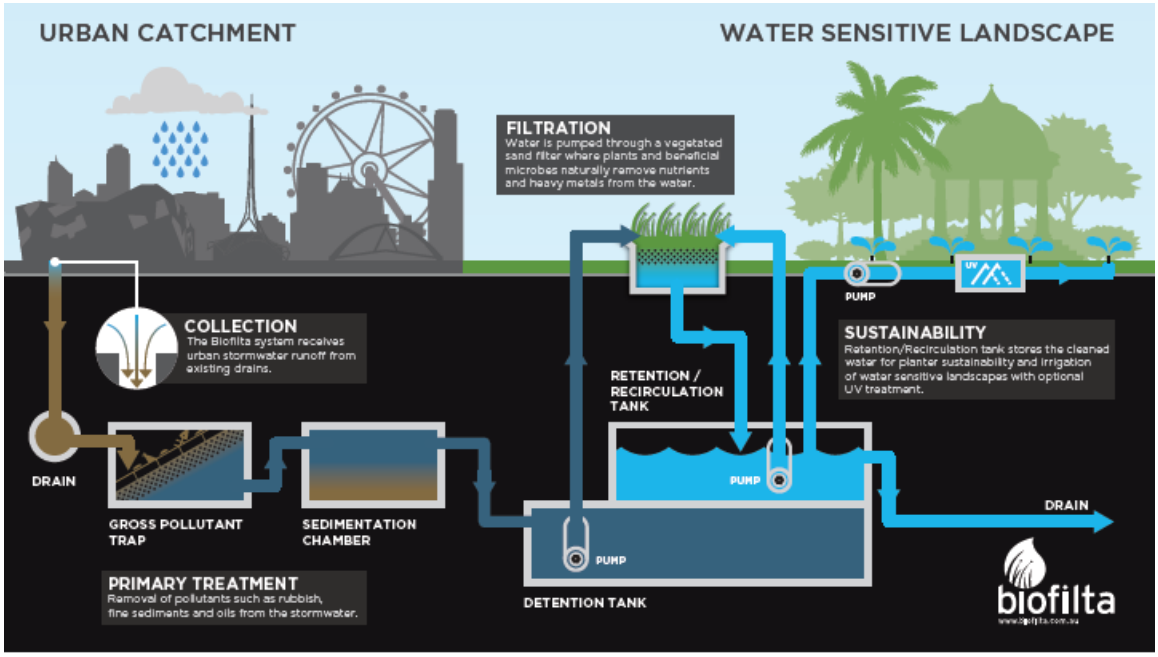

Figure 2: Biofilta General System Schematic

The Biofilta System has the ability to provide fit for purpose irrigation water for local parks and landscapes such as Drewan Park.

Through the design process, it was agreed with Council that Drewan Park would not be irrigated and hence this feature of the Biofilta System has been omitted.

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4.2 CATCHMENT MUSIC MODEL

The north east catchment comprises 3.6ha of proposed urban catchment and the majority of the existing Drewan Park area. Hydraulic results and maximum volumes are taken from the Stormwater Management Report are shown in Figure 3 below:

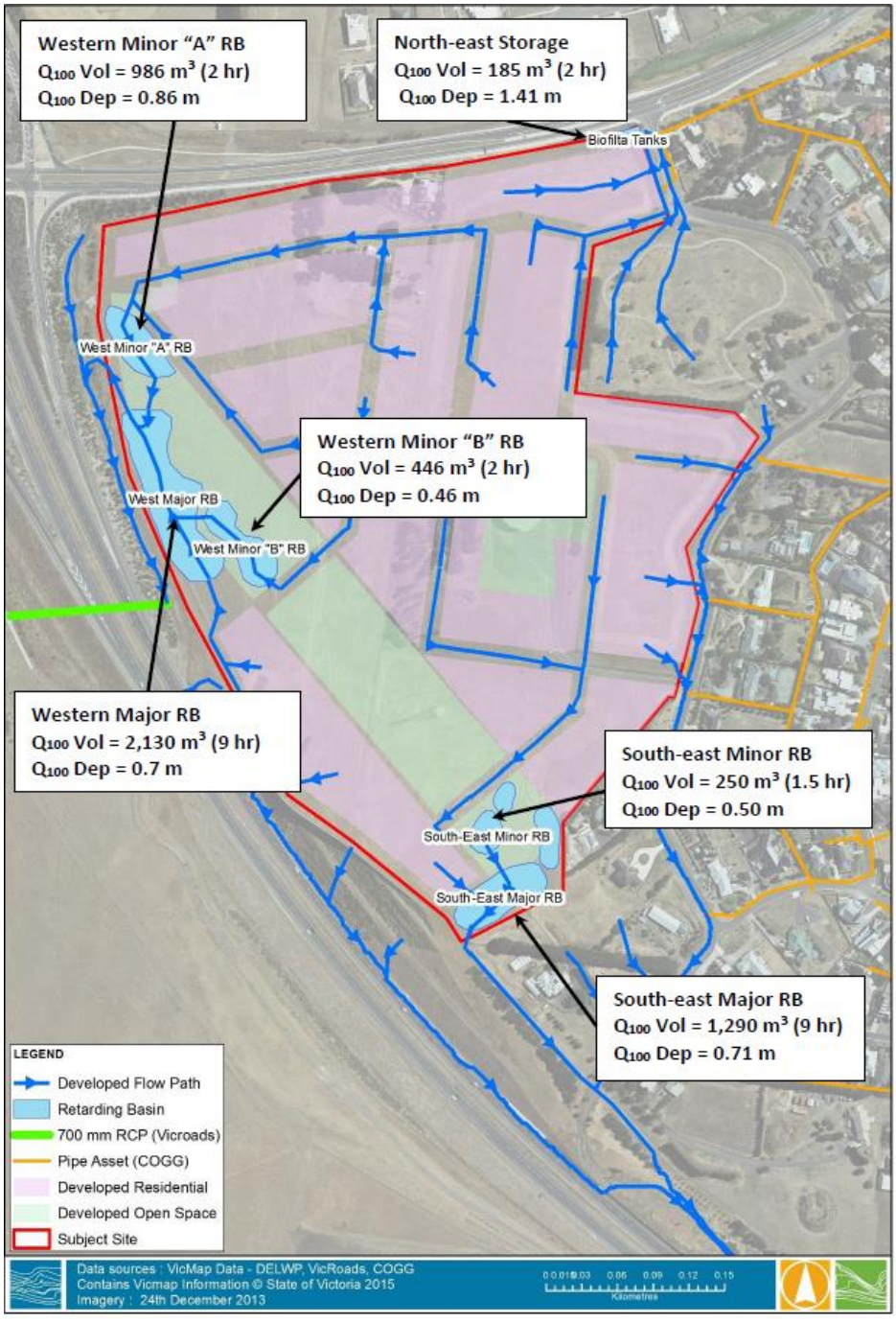

Figure 3: North East Catchment (from WaterTech report Fig 3-9)

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A water quality model was set up to represent each catchment and harvest stormwater from the following sources:

Urban Catchment: 1.8ha with an assumed 70% fraction impervious
Parkland 2.8ha with an assumed 5% fraction impervious

Treatment facilities:

Capture from 20kl underground detention tank and pump to planter at 30 litres per second for filtering and transfer to the above ground holding tank.

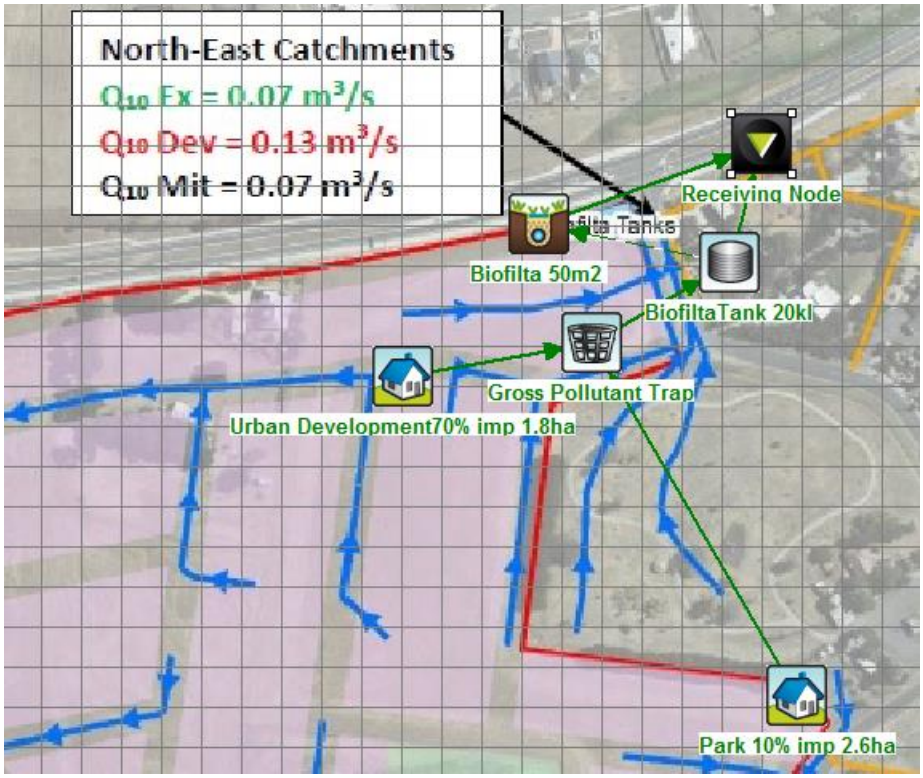

Figure 4: North East Music Model

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4.2.1 Concept Layout of Facilities

It is proposed to locate the collection and detention tanks under the entrance road adjacent to Barrabool Road.

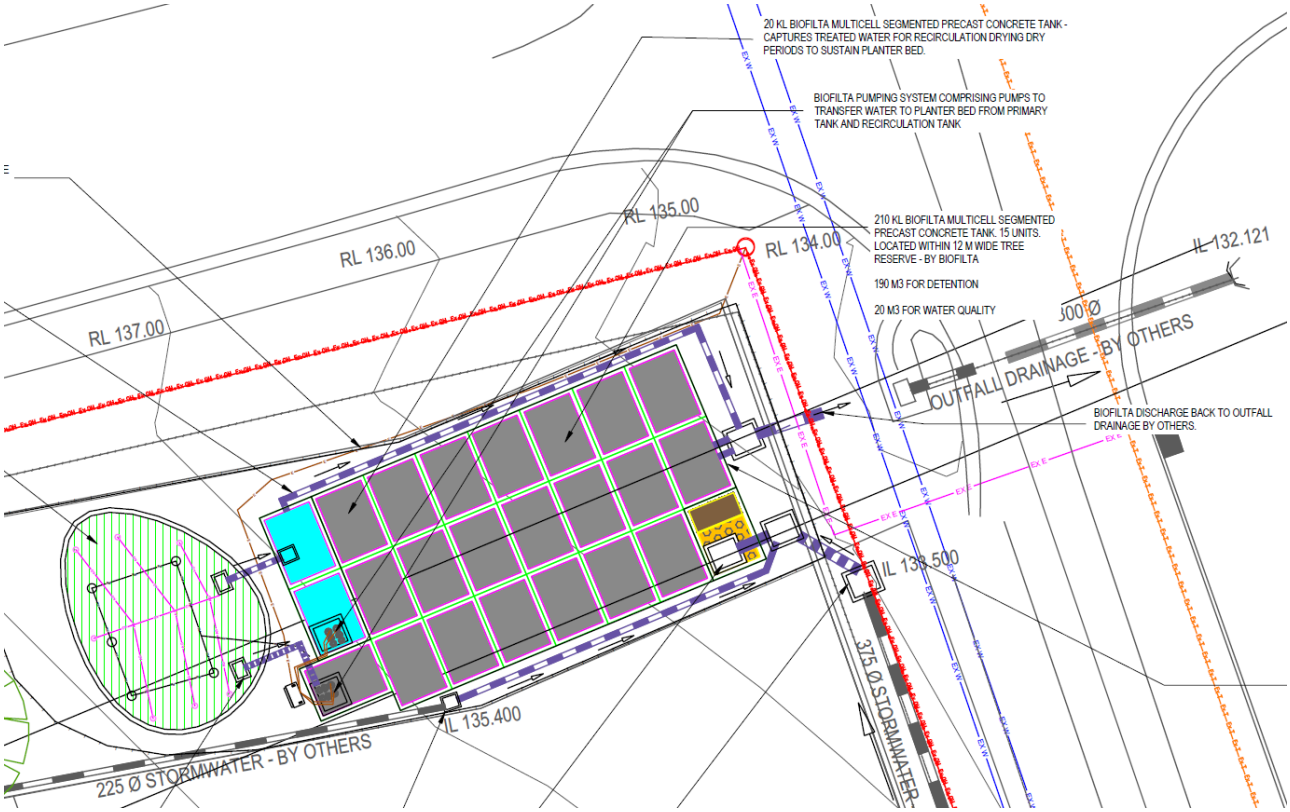

Figure 5: Drewan Park Stormwater Treatment and Reuse location

Figure 6 above shows the concept location of the key facilities which comprise the integrated stormwater project. The tank units shown are modular concrete tanks each with a 10m3 capacity. The tanks are installed as shown in Figure 6 and then have their lids secured and backfill on top. To ensure that the first flush is caught by the transfer system, a local sump will be created in the detention tank for the pump to be located.

Water is pumped from the detention tank to the a 50m2 sand filter using Biofilta's pre-grown plants and blended filter media. Silts, fine sediment, heavy metals and soluble nutrients will be caught in the planter and removed from the stormwater runoff.

Filtered water will drain through the planter and drain via gravity into the irrigation tank located next to the detention tank. The irrigation tank has a 20m3 capacity and will be used for irrigation of the planter itself. Any overflow from the minor storm events will discharge back down to the Council drainage system.

The planter will be fully landscaped into the park and will be a feature attraction as per Tract's landscape plan.

4.3 NORTH EAST CATCHMENT WATER QUALITY RESULTS

Results from the treatment train proposed for the North East catchment are outlined below:

MUSIC Model Results Pollutant	Source	Residual	% Reduction	Comparison with Best Practice
Flow	7.94 ML/yr	7.88 ML/yr	0.8	NA
TSS	1320 kg/yr	159 kg/yr	88	Exceeded
TP	2.89 kg/yr	0.655 kg/yr	77.3	Exceeded
TN	22.3 kg/yr	8.18 kg/yr	63.3	Exceeded
Gross Pollutants	275 kg/yr	0 kg/yr	100	Exceeded

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4.4 MAINTENANCE OF THE BIOFILTA SYSTEM

Maintenance of the Biofilta System is relatively straight forward as there are no proprietary elements to the System itself. All components are designed for longevity and standard Council equipment to be used.

In order of treatment train, the key assets and maintenance requirements are outlined below:

ASSET	Activity	Timing	Cost / year
Detention / primary tank	Inspect	12 monthly	
	Clean trash from rack using eduction truck and remove sediments	12 monthly	$2,500
Pump in detention tank	Inspect	12 monthly	Included in detention tank inspection
Planter	Inspect / Weed	6 monthly	$500
	Inspect / Weed + Trim and remove vegetation + Infill plant if necessary	12 monthly	$3,000
	Replace plants and remove top 100mm of media	5 yearly	$2,500/year budget allowance
Reuse tank & pump	Inspect	12	Included in above
Electricity	Cost to run pumps*	1,882kWh @ $0.30kWh to pump approx. 8ML.	$564
		TOTAL COST	$9,064 pa

The above costs are an estimated upper amount and may be less.

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5 WESTERN CATCHMENT

5.1 WESTERN CATCHMENT

The western catchment is the largest on-site catchment totalling 13.5ha and ultimately flows to a drainage system under the Geelong Ring Road. A natural storage exists, however this storage is not counted in the water quality analysis even though it is likely to be providing a high level of sediment removal in its own right.

From the Hydraulic report:

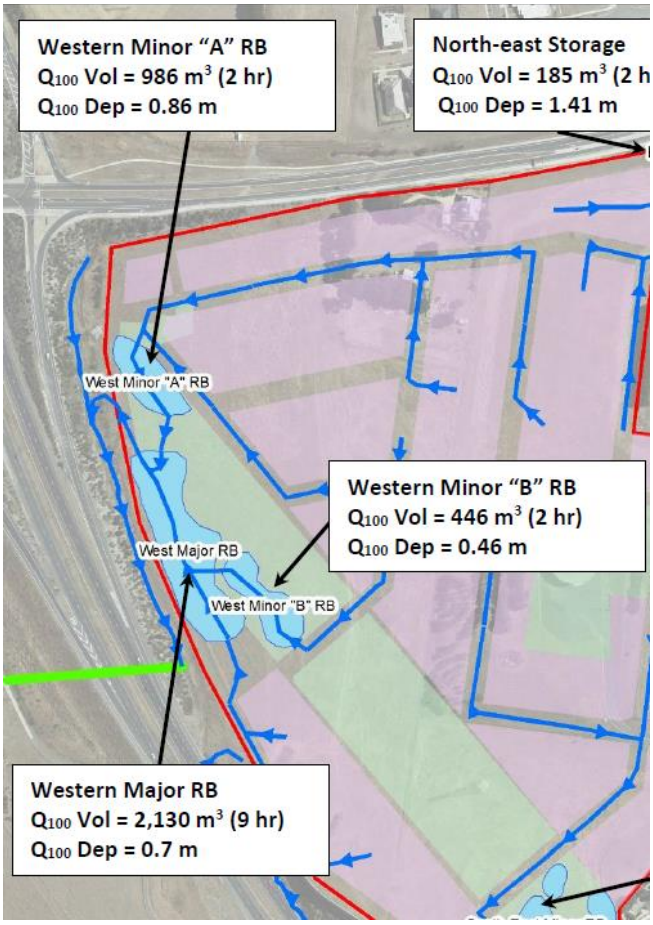

Figure 6: Western Catchment

The northern portion of the western catchment is proposed to be piped to a minor retardation basins (West A) and one major retardation basin. The southern portion of the Western catchment flows to a West B retarding basin before both flowing to a major basin.

West A – 986m3

West B – 446m3

West Major – 2,130

Although the western catchment is large, a high percentage of the catchment is permeable due to the transmission line easement and other undevelopable land for tree reserves.

5.2 WESTERN CATCHMENT MUSIC MODEL

Both detention basins proposed for the western catchment have been modelled in MUSIC as dry basins. The source nodes and model layout follows the catchment delineation from the hydraulic report.

The MUSIC model for the western catchment is shown in Figure 8 below.

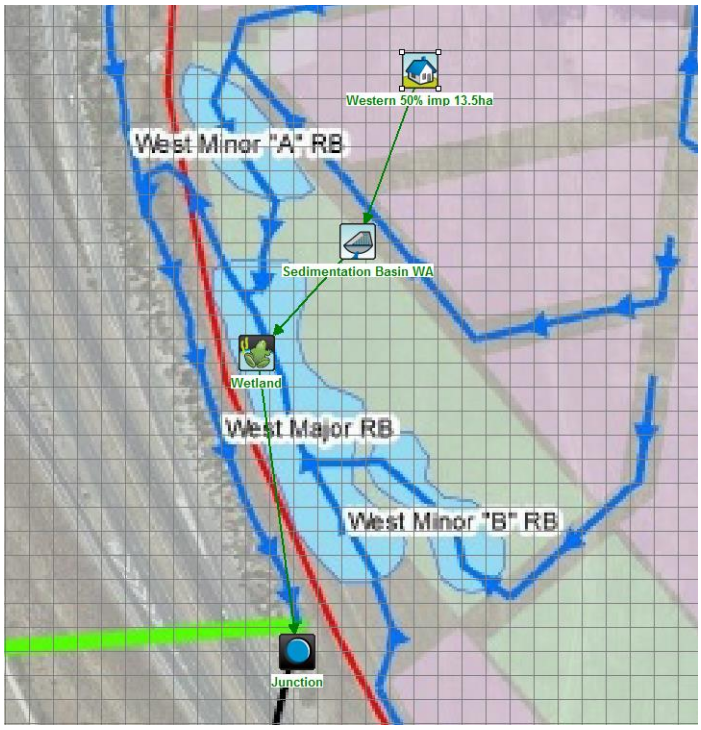

Figure 7: Western Catchment MUSIC layout

Junction nodes are used in this model to provide a point to measure the treatment train effectiveness and compare against best practice targets. Both retarding basins were combined for the purposes of the water quality model.

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These basins are typically grassed and have a pilot channel to ensure that water drains out of the basin and does not turn into a swamp. An inlet and outlet pit with a control orifice plate is installed to retard flows. An example of a dry detention basin is shown below:

Figure 8: Western Catchment Typical Dry Basin

A central wetland will be required in the major retarding basin.

The wetland properties selected for to obtain the required water quality results are:

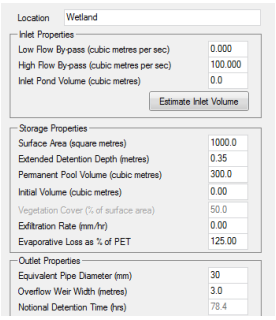

Figure 9: Western Catchment Wetland Properties

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5.3 WESTERN CATCHMENT MUSIC MODEL RESULTS

The output of the MUSIC model for the western catchment is shown below:

	Sources	Residual Load	% Reduction
Flow (ML/yr)	31.2	29	7
Total Suspended Solids (kg/yr)	5530	455	91.8
Total Phosphorus (kg/yr)	12	3.02	74.8
Total Nitrogen (kg/yr)	88.7	48.1	45.8
Gross Pollutants (kg/yr)	1410	0	100

Figure 10: Western Catchment MUSIC results

The results indicate that TSS, TN and TP pollutant removal exceeds best practice standards and that the wetland is sized appropriately.

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6 SOUTH EASTERN CATCHMENT

6.1 SOUTH EASTERN CATCHMENT

The south eastern catchment takes in the existing Barwon Water site and properties adjacent to Cityview Drive.

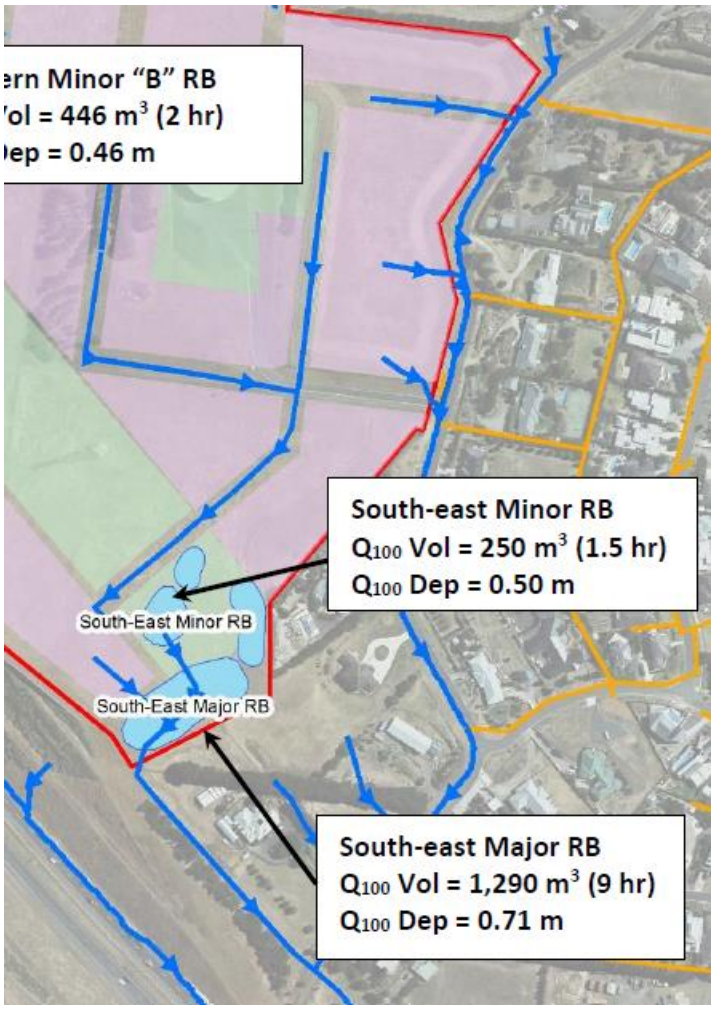

Figure 11: South Eastern Catchment

A detention basin is proposed to retard flows for the steep Barwon Water tank site and adjacent properties and roads to the south.

Existing properties on the western side of Cityview drive currently discharge to roadside pits and stormwater then enters the Council drainage system flowing across Cityview Drive to the east.

Flows greater than the 300mm diameter drain capacity head up and flow overland along Cityview Drive to the south and along Sunderland Drive before discharging into the Transmission and Road reserve.

Figure 12: Sunderland Drive looking us

Overland flows enter the transmission easement:

Figure 13: Sunderland Drive looking downstream

Silts and debris can be seen at the end of the street where natural collection is occurring.

From the end of Sunderland Drive, land falls quickly toward the Geelong Ring Road toward Kardinia Creek.

Figure 14: Sunderland Drive looking downstream

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6.2 SOUTH EASTERN CATCHMENT FACILITIES

It is proposed to construct the 1,320m3 detention basin as per the hydraulic report to retard flows for approximately half of the south east cathment. The outlet from the basin will tend toward the end of Sunderland Drive as shown in 15.

To address the pollutants from development along Cityview drive, it is proposed to install a low flow pipe along Cityview drive which intercepts all minor flows to retarding basin with a combined 1,540m3 capacity and small biobasin within the floor of the basin.

Figure 15: South East WSUD MUSIC

Access to the biobasin is provided from Sunderland Drive and adequate fall exists to command all upstream properties. Low flows from the Cityview Drive catchment will no

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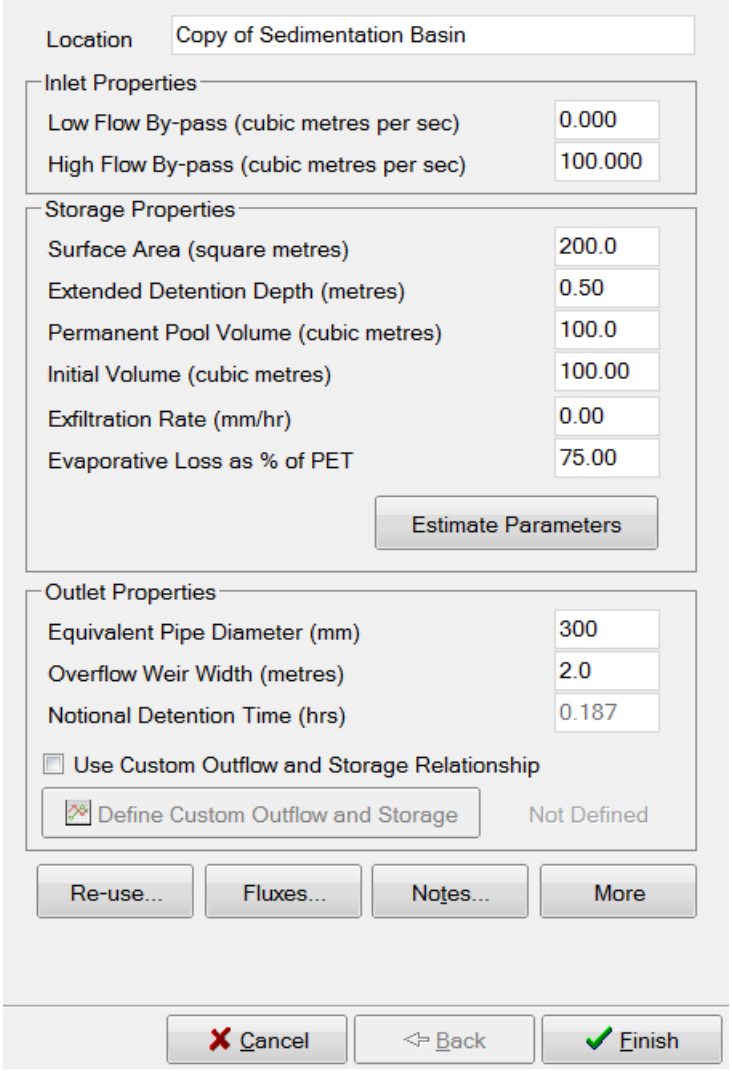
longer enter the Council drainage system and higher flows will continue to travel overland as per the current situation. A similar biobasin would be as shown below:

Figure 16: Typical biobasin constructed by Biofilta

Treatment node data entered into MUSIC:



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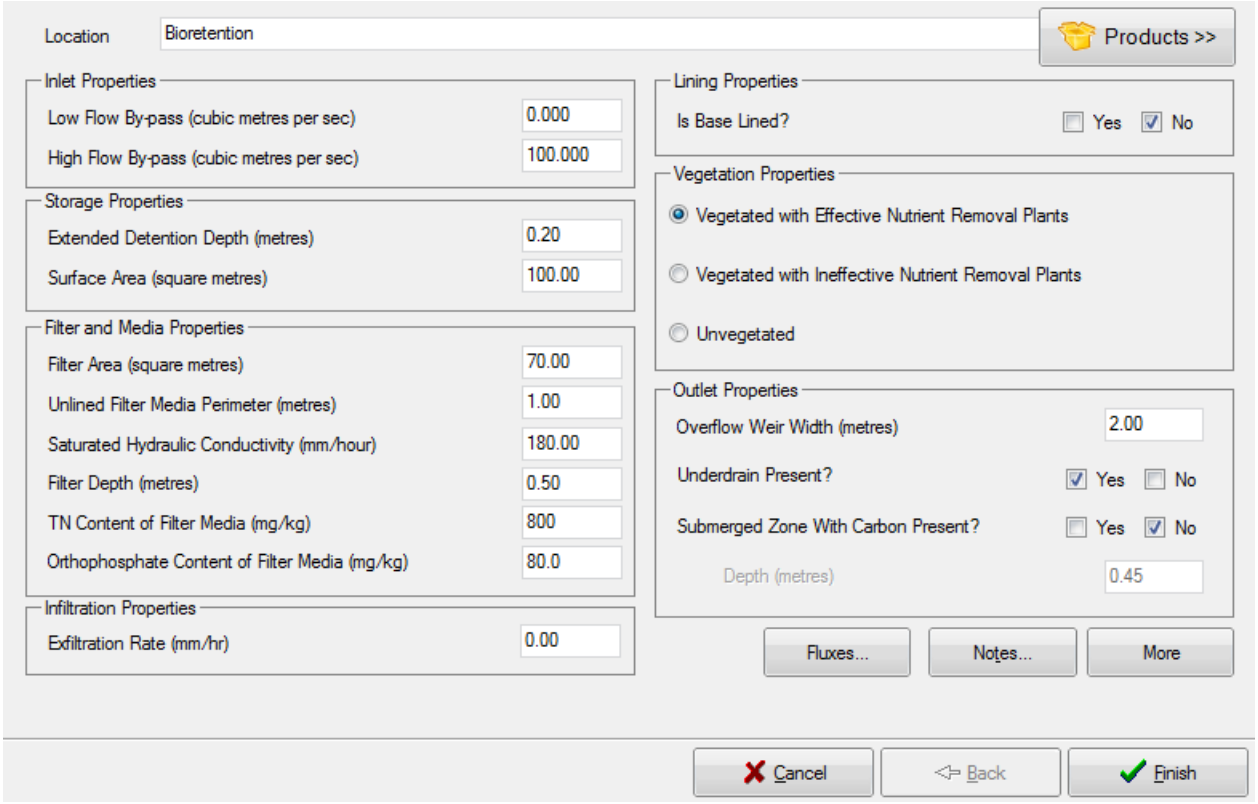

Figure 17: South Eastern Catchment Treatment Nodes

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The MSUC model layout is shown below:

6.3 SOUTH EASTERN MUSIC MODEL RESULTS

Results for the South East catchment with the proposed detention, diversion and treatment facilities are:

	Sources	Residual Load	% Reduction
Flow (ML/yr)	18.6	18.3	1.7
Total Suspended Solids (kg/yr)	3740	505	86.5
Total Phosphorus (kg/yr)	7.59	3.79	50.1
Total Nitrogen (kg/yr)	53.6	29.2	45.6
Gross Pollutants (kg/yr)	838	0	100

Figure 18: South Eastern Catchment MUSIC model results

Best practice requirements are exceeded for the sub catchment.

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7 Conclusion and Recommendations

The overall water quality benefits of this scheme are:

- Exceeding Best Practice stormwater runoff targets for all catchments
- Implements a stormwater treatment system that is simple and uses proven natural processes to treat stormwater.
- Addresses hydraulic issues associated with providing water quality outcomes to steeply sloping properties by collecting and treating on a precinct scale.
- Takes a holistic view of the outcomes for the entire catchment by providing future development with a ready-made precinct biobasin.
- Minimises hydraulic impact on Council's existing drainage network.

The development team recommend that Council accept the water sensitive urban design strategy subject to detailed design being presented to Council's Engineering team.