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STORMWATER QUALITY MANAGEMENT PLAN

AURA PRECINCT 15 WEST

Prepared for **Stockland Development Pty Ltd**

Document information

GENERAL INFORMATION

Author(s)	Matthew Starr
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Prepared by (authors)	Matthew Starr, Daniel Yates
Reviewed by	Jayden Walter
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A	28/09/2023	Matthew Starr
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1 INTRODUCTION

Egis Consulting has been commissioned by Stockland Development Pty Ltd to prepare a Stormwater Quality Management Plan for Precinct 15 West of the Aura development, located within the on the north western side of Bells Creek South at the south western end of the overall Aura development. The proposed precinct is located within the Sunshine Coast Council local government area.

This report has been prepared to demonstrate that the Stormwater Quality Improvement Devices (SQIDs) proposed through the application area will achieve the required Water Quality Objectives (WQOs).

Report Version C was prepared in response to the Request for Further Information2 (RFI2) issued by Economic Development Queensland (EDQ) dated 13 March 2024.

Version D of this report was prepared to address Item 3a of the Further Issues EDQ Letter dated 11 June 2024, which requires the removal of Gross Pollutant Traps (GPT 1, 2 and 12) from the treatment train, or further justification for their inclusion. To address the item the specified GPT's have been removed.

> *The report (Revision E) has been prepared to address changes to the stormwater quality management strategy, which includes removal of GPTs and At-Source WSUD devices for water quality treatment of runoff from the catchments of the future childcare centre, centres, community and multiple residential sites (Lot 8100 to 8103) within the Precinct. These changes are identified as <u>indented italicised text</u> or are noted as updated in table and figure captions.*

1.1 Report Scope

The scope of this report is to:

- Identify the WQOs for the proposed development.
- Provide details of the SQIDs proposed within the Precinct 15 West Stormwater Quality Management Strategy.
- Document the methodology and results of MUSIC modelling undertaken that demonstrates the proposed strategy will achieve the required WQOs.
- Provide management and maintenance details of the construction and operational phases of the proposed SQIDs.

1.2 Previous & Other Documentation

Precinct 15 of the Aura development has been the subject of the following flooding and stormwater management related investigations:

- *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019). Report that identified and defined the stormwater quality management objectives for the overall Aura development.
- *Aura Precinct 15 Stormwater Quality Management Plan – Version 3* (DesignFlow, September 2022). Report documenting the Stormwater Quality Management Plan for Aura Precinct 15. This report is referred to in the PDA Decision Notice.
- *Memorandum – Aura Development Acoustic Bund South* (Egis Consulting, August 2023). Technical Memorandum documenting the hydrologic and hydraulic investigation and analysis of the overland flow path and inlet structure associated with the acoustic bund located adjacent to the Aura Development.

2 SITE DESCRIPTION

2.1 Location

Precinct 15 West is in the western part of Aura. The site is bound by the Bruce Highway to the west, the Precinct 15 East and Lend Lease Community precinct to the east, future CAMCOS corridor to the North and Bells Creek South to the south. The West precinct forms part of the Caloundra South Priority Development Area (Aura). The Master Plan was approved by the (former) Urban Land Development Authority (ULDA reference No. DEV2011/200) now Economic Development Queensland (EDQ).

The location of Precinct 15 West is indicated in **Figure 2-1** below.

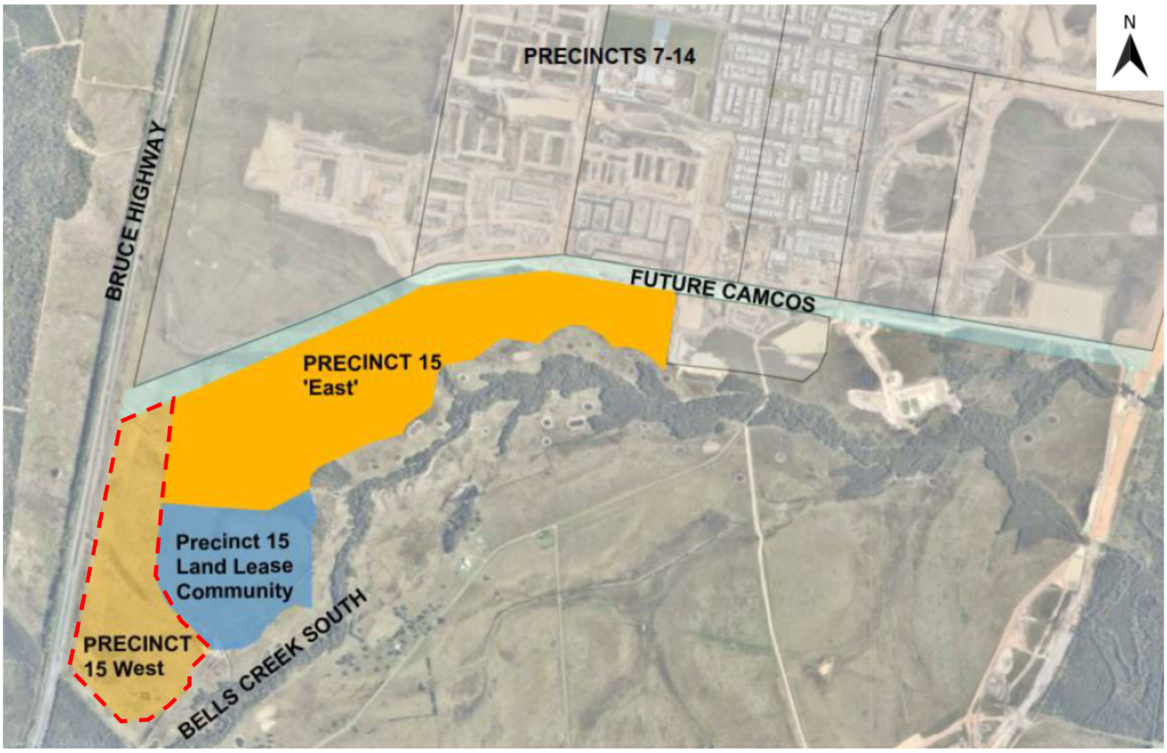


FIGURE 2-1 PRECINCT 15 WEST LOCATION

2.2 Topography & Features

The existing Precinct 15 West site is generally flat with less than 3m of fall across the 600m distance from the northern boundary of the site to the Bells Creek South.

2.3 Discharge Location

The existing and proposed runoff from the Precinct 15 West site discharges to Bells Creek South. It is noted that an overland flow path and inlet structure is proposed to be constructed within the site to convey runoff from external catchments (west of Bruce Highway) under an acoustic bund and through the site. For further details refer to the Egis Consulting *Memorandum – Aura Development Acoustic Bund South* (December 2023).

3 STORMWATER QUALITY MANAGEMENT

It is expected that the proposed development will increase the export of pollutants within stormwater runoff from the subject site. A stormwater management strategy employing suitable Stormwater Quality Improvement Devices (SQIDs) has been proposed to intercept and capture the pollutants so that the potential impacts on waterway downstream are mitigated.

This section discusses:

- The identification of key stormwater pollutants associated with the proposed development.
- The Water Quality Objectives (WQOs) identified for the catchment.
- Proposed measures to mitigate the increase in pollutant export; and
- Modelling of the proposed measures and comparison to the identified WQOs.

In response to the EDQ Further issues letter the stormwater management strategy and modelling has been updated.

3.1 Pollutants of Concern

Typical key pollutants expected to be generated during the operational (post-construction) phase of the planned development are listed as follows, with those presented in capitals being the key pollutants to be targeted for treatment:

- LITTER
- HEAVY METALS (associated with fine sediments)
- SEDIMENT
- Surfactants
- Oxygen demanding substances (possibly present)
- Organochlorines & organophosphates
- NUTRIENTS (N & P)
- Thermal pollution
- Pathogens / Faecal coliforms
- pH altering substances
- Hydrocarbons

Only the key pollutants will be further addressed in this report; however, the treatment train developed will adequately mitigate the other pollutant loads. As heavy metals will predominately be associated with fine sediment, controls proposed to reduce total suspended solids will also adequately reduce loads of heavy metals.

3.2 Water Quality Objectives

As documented within the DesignFlow *Aura Precinct 15 Stormwater Quality Management Plan* (2022) the WQOs for Precinct 15 are based on the catchment and waterway modelling previously undertaken and documented within the DesignFlow & BMT *Aura Development Stormwater Quality Management Plan* (2019). These WQOs consider the High Ecological Value (HEV) of the receiving Pumicestone Passage waterway which has Ramsar wetland status.

The pollutant load reduction WQOs are stated in **Table 3-1** below.

TABLE 3-1 WATER QUALITY OBJECTIVES

POLLUTANT	TOTAL SUSPENDED SOLIDS (TSS)	TOTAL PHOSPHORUS (TP)	TOTAL NITROGEN (TN)	GROSS POLLUTANTS (GP)
Load Reduction	95%	89%	68%	90%

Source: DesignFlow

3.3 Stormwater Quality Management Strategy

The initial stormwater quality management strategy for Precinct 15 West deviated from the current "end of line' treatment strategy applied through Aura. In place of "end of line" devices Precinct 15 West incorporates an area of at-source bioretention systems to meet the prescribed water quality objectives.

In response to the initial EDQ RFI (dated 20 November 2023) the stormwater quality management strategy was updated to include "end of line" bioretention basins to capture and retain pollutant for part of the proposed development. This was documented within Version B.

RFI2 was received from EDQ following the submission of Version B. In response to RFI2 the following changes to the strategy were made:

- The at-source bioretention in Catchments 16, 17, and 24 have been removed. Instead, the runoff from these catchments now drains to the end-of-line bioretention CAT_12_BIO. This addresses Item 1a of RFI2.
- Allowance for treatment of the catchments for the future childcare centre, centres, community and multiple residential sites (Lot 8100 to 8103) have been included in the strategy. As the configuration of development on these lots is unknown at this time and will be subject to their own Development Approval, only preliminary sizing of rainwater tanks have been identified (refer to Table 3-4).

  In addition to rainwater tanks to capture and treat runoff from roof areas, runoff from these catchments is now proposed to be treated by the end-of-line bioretention basin (CAT_12_BIO).

  As noted above, as the configuration of development on these lots is unknown at this time, it is recommended that future development applications on these lots undertake their own stormwater quality investigations to confirm that the overall Precinct 15 development will maintain achieving the required WQO's.
- The bioretention tree pit in the Catchment 10 has been removed. CAT_GPT_10 remains to treat the stormwater from the Catchment 9, 10 and 11 before draining into the Bells Creek South. This addresses Item 1c of RFI2.
- A sensitivity analysis of different GPT configurations has been conducted to determine the impact of removing Gross Pollutant Traps (GPTs). This analysis assessed the effectiveness of GPTs in pollutant reduction and concluded that GPT devices were not required in the overall stormwater quality management strategy. The undertaking of this sensitivity analysis addressed Item 1d of RFI2 in previous revisions of this report.
- The at-source bioretention pod treating runoff from just the linear park (CAT_37_BIO) has been removed and the runoff of this catchment (CAT_37) will bypass the treatment and drain into the Bells Creek South. This addresses Item 1e of RFI2.
- The at-source bioretention CAT_10_BIO, from CAT_12_BIO to CAT_24_BIO and CAT_37_BIO have been removed. An end-of-line bioretention basin (CAT_12_BIO) is now proposed in their place to meet the Water Quality Objectives. Refer to Figure 3-3 for further details. This addressed Items 1f and 1g of RFI2.

  In addition to the dot point above, the at-source bioretention CAT_03_BIO to CAT08_BIO, CAT_25_BIO, CAT_26_BIO, CAT_28_BIO and CAT_33_BIO have been removed. The end-of-line bioretention basins (CAT_02_BIO and CAT_12_BIO) are now proposed to be larger to meet the Water Quality Objectives.
- To address Item 3a of the EDQ Further Issues Letter the Gross Pollutant Trap (GPT;'s) 1, 2 and 12 have been removed from the strategy. Refer to **Figure 3-3** for the updated layout of the proposed stormwater quality improvement devices.

The strategy has influenced the urban design principles by:

- Limiting street leg lengths.
- Centrally located bioretention within road medians.
- 'Park fronted' terraces out letting directly to treatment devices.

- Consolidated at-source devices within the streetscape using a combination of smart urban design, locally widened road reserves and one-way cross fall roads; and

*To illustrate the proposed treatment strategies **Figure 3-1** (updated) and **Figure 3-2** (updated) are provided below.*

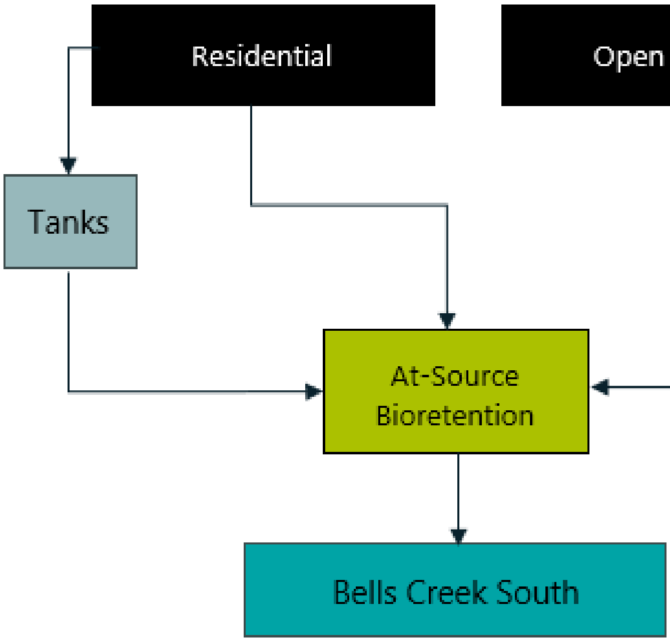


FIGURE 3-1 PRECINCT 15 WEST AT-SOURCE STORMWATER QUALITY MANAGEMENT (UPDATED)

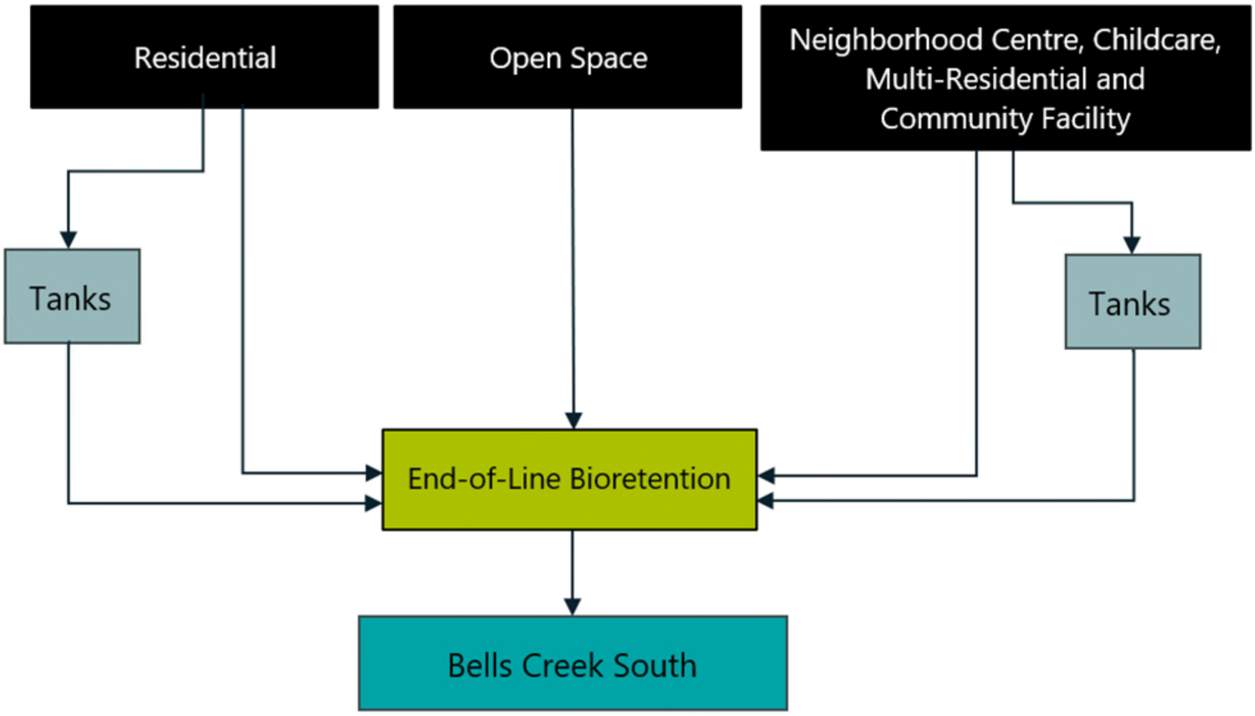


FIGURE 3-2 PRECINCT 15 WEST END-OF-LINE STORMWATER QUALITY MANAGEMENT (UPDATED)

Although the strategy differs from previous strategies across Aura, the same types of stormwater quality improvement devises are proposed to manage stormwater pollutants. **Section 3.4** discusses these devices in detail.

Figure 3-3 below provides an overview of the proposed stormwater quality improvement devices and land use characteristics.

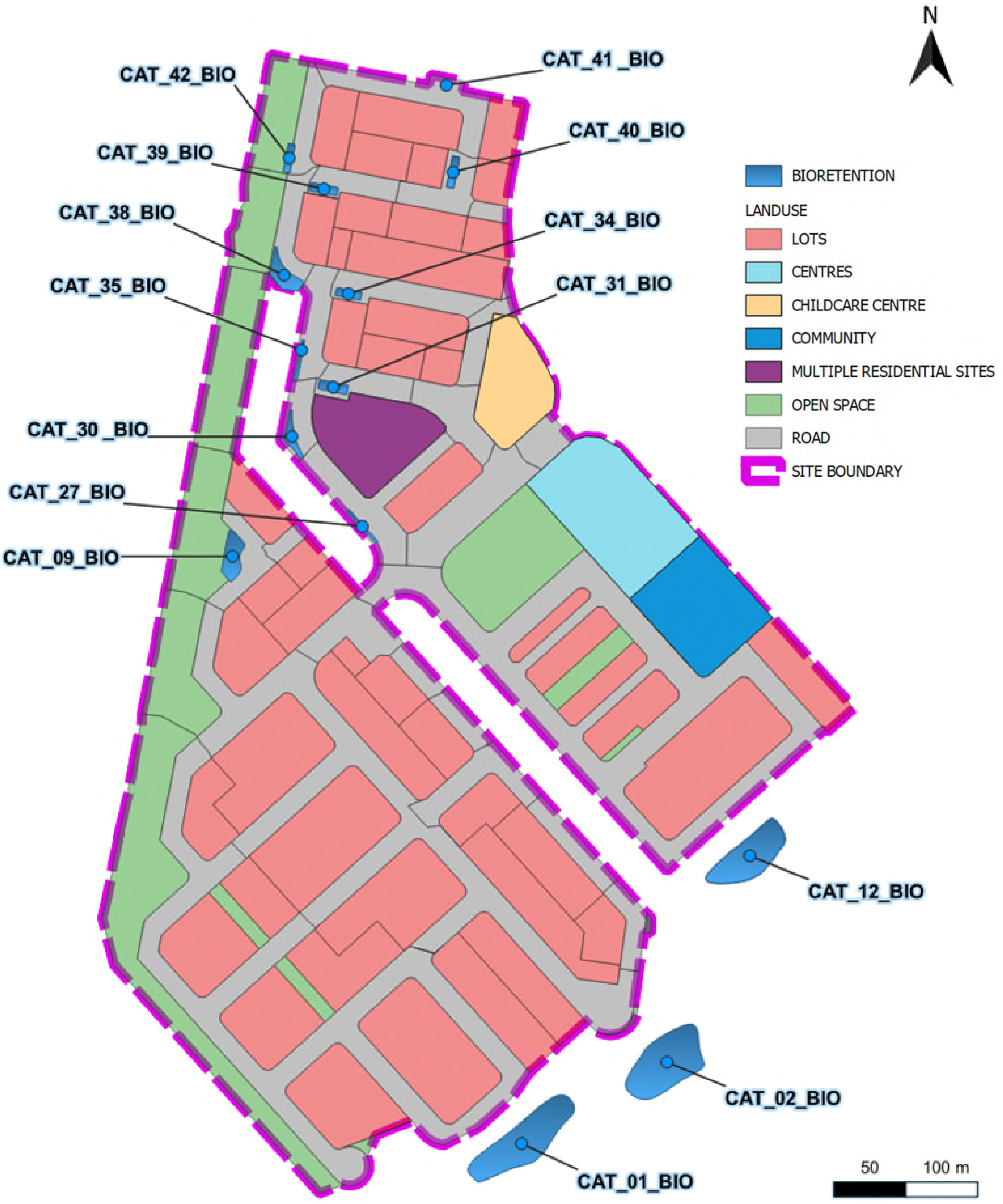


FIGURE 3-3 STORMWATER QUALITY IMPROVEMENT DEVICE LAYOUT (UPDATED)

Note the bioretention areas shown in **Figure 3-3** are the filter media area, they do not include batters etc. The integration of SQIDs into the development layout has been coordinated and considered from a bottom-up approach, with water quality driving urban design principals. Through the detailed design process amendments and refinements to SQID areas and catchment will be made as earthworks and final coordination occurs.

3.4 Stormwater Quality Improvement Devices

Table 3-2 below table summarises the proposed stormwater quality improvement devices proposed within Precinct 15 West.

TABLE 3-2 SUMMARY OF STORMWATER TREATMENT DEVICES (UPDATED)

DEVICE	DESCRIPTION
RAINWATER TANKS	To reduce the volume of stormwater runoff requiring treatment, rainwater tanks are proposed for residential land uses. As per Stockland's water conservation policy tanks are to be plumbed for toilet, cold laundry tap, outdoor uses and other non-potable demands. The integration of rainwater tanks is critical to ensure pollutant reductions targets are achieved, **Table 3-3** outlines the rainwater tank requirements for Precinct 15 West. Rainwater tanks will also be provided within the future childcare centre, centres, community and multiple residential sites (Lot 8100 to 8103).
BIORETENTION PODS	At-source bioretention systems (i.e. bioretention pods, bioretention basin) are proposed to capture stormwater runoff from residential, roads and open space land uses. The key constraints for at-source bioretention that need to be considered are: ■ The verge profile. ■ The location of footpaths. ■ The location of other services (crossings, lights, car parking bays, etc); and ■ The extended detention depth (level differences). Within Precinct 15 West where possible roads will incorporate one-way crossfall, this allows a single consolidated bioretention pods. This methodology allows for the footpath to be placed in the high-side verge, alleviating any potential conflicts. Bioretention systems utilise sandy loam soil based media to filter runoff. Sediment particles and suspended solids are trapped within vegetation and on the surface of the filter media while micro-organisms and vegetation remove dissolved nutrients (nitrogen and phosphorus) through biological uptake processes. Subsoil drainage provided below the filter media allows for the treated runoff to discharge from Bioretention systems where it is connected local stormwater drainage systems. The final design of the bioretention systems is to be in accordance with the Water by Design *Bioretention Technical Design Guidelines* (2014).
BIORETENTION BASINS	In response to the EDQ IRR at-source bioretention systems within the southern part of the Precinct (CAT_01 and CAT_02) have been replaced by two end of line bioretention basins, located between the southeastern esplanade road and Bells Creek. In response to the EDQ RFI2, bioretention tree pits were replaced by an additional end-of-line bioretention system, CAT_12_BIO, proposed in catchment CAT_12, located between the southeastern esplanade road and Bells Creek. This CAT_12_BIO aims to treat all the east-south catchment but exclude neighbourhood centre and the community facility area. These neighbourhood centre and the community facility area will have their own local stormwater treatment facility to meet SPP water quality objective during the future development approval stage. The final design of the bioretention systems is to be in accordance with the Water by Design *Bioretention Technical Design Guidelines* (2014).

GPT devices have been removed from the above table as they are no longer adopted in the stormwater quality management strategy.

3.5 Stormwater Quality Improvement Device Design Approach

3.5.1 Rainwater Tanks

Integration of rainwater tanks are critical to Stockland's water conservation and the stormwater quality strategy in Precinct 15 West and ensures pollutant reductions targets are achieved. **Table 3-3** below outlines the rainwater tank requirements for Precinct 15 West, the requirements are consistent with the rainwater tank specifications provided in *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019) and *Aura Precinct 15 Stormwater Quality Management Plan* (DesignFlow, 2022). To ensure compliance with this Stormwater Quality Management Plan these requirements have been written into the Plan of Development.

TABLE 3-3 RAINWATER TANK REQUIREMENTS

LANDUSE	ROOF AREA	TANK SIZE	CONNECTIONS
Residential Detached/attached dwellings (Lot >300m^2)	50% roof area drains to tank	5kL per dwelling	Tanks are to be connected to and supply to the following: ■ Toilets ■ Laundry cold ■ Outdoor taps
Residential Detached/attached dwellings (Lot = 225 – 300m^2)	50% roof area drains to tank	3kL per dwelling	Tanks are to be connected to and supply to the following: ■ Toilets ■ Laundry cold ■ Outdoor taps
Residential Detached/attached dwellings (Lot <225m^2)	No Tanks		
Residential Medium density dwellings	75% roof must connect / drain to tank. If multiple buildings then 50% of total roof area must connect / drain to tank	1KL per dwelling	Tanks are to be connected to and supply to the following: ■ Toilets ■ Laundry cold ■ Outdoor taps
All non-residential Uses including but not limited to: • Commercial • Retail • Industrial • School • Community	50% roof must connect / drain to tank. If multiple buildings then 50% of total roof area must connect / drain to tank	1KL per toilet or urinal or 25KL/ha Minimum 5KL size	Tanks are to be connected to and supply to the following: ■ Toilets ■ Laundry cold ■ Outdoor taps

To address Item 1b of the EDQ RFI2, preliminary sizing of rainwater tanks was undertaken for the future childcare centre, centres, community and multiple residential sites, based on the following:

- A volume of 25KL/ha for the future childcare centre, centres and community sites (Lots 8100, 8102 and 8103).
- For the multiple residential site (Lot 8101) a volume of 1KL per dwelling (with single toilet) and assuming a density of 40 dwellings per hectare.

The preliminary minimum rainwater tank sizes for the future childcare centre, centres, community and multiple residential sites are summarised in ***Table* 3-4** below.

TABLE 3-4 PRELIMINARY MINIMUM RAINWATER TANK SIZE FOR FUTURE DEVELOPMENT

SITE	LOT	LOT AREA (ha)	RAINWATER TANK SIZE (KL)
CHILDCARE CENTRE	8100	0.347	9
MULTIPLE RESIDENTIAL	8101	0.423	11
CENTRES	8102	0.691	18
COMMUNITY	8103	0.497	13

3.5.2 Bioretention Systems

At source bioretention systems (pods and small basins) are integrated into the Precinct 15 West urban layout to capture and treat stormwater flows generated by the development. The systems are to be located in consolidated locations to minimize the number of cells required, systems are generally positioned at side boundaries of lots, within open space or drainage lots. The following criteria are key design requirements:

- Roads are to incorporate one-way cross fall pavement.
- Street leg lengths have been limited to 120m to ensure stormwater flow depths are in accordance with the LGIA design requirements, meaning bioretention systems can be located at the end of streets (no mid-block systems).
- Lots at street ends orientated to front intersecting road, allowing the long side of the lot to provide area of bio within the road reserve, thus avoiding potential conflict with driveways.
- Road typologies that include central medians have been inverted with bioretention systems placed within the central median.

  At-source bioretention treatment has been removed from the entry road into Precinct 15. As such, this is now proposed to be a crowned road and inverted roads are no longer proposed within the Precinct.

- Footpaths are located on the opposite side of the road reserve to bioretention systems.
- Services are to avoid bioretention systems but may pass underneath with appropriate protection as required by the service provider.
- Filter media is a minimum of 1m wide.
- Batters are maximum of 1 in 2.
- Filter media is set 1m minimum from invert of kerb; and
- Extended Detention Depth varies depending on location of systems, constrained roadside systems will have 200mm EDD and unconstrained systems will have 300mm EDD.

Contained within Appendix E of *Engineering Services Report Aura Precinct 15 'West'* (Egis, 2024) typical details of proposed bioretention systems are provided.

3.5.3 Park Requirements

To accommodate the required bioretention basin areas, stormwater quality improvement devices have been included within parks/open space. To ensure the open space remains creditable, criteria specified within the Caloundra South Local Government Infrastructure Agreement must been achieved. These criteria are:

- Max grade 1:4, 1:6 preferred for maintenance requirements.
- Land provided for stormwater treatment facilities for the park are to have a minimal impact on the park's functionality.
- Additional land provision for integrated stormwater treatment facilities for adjoining road areas can be co-located with park treatment facilities also to have no impact on park function.
- Max. 5% of total park area in one location.
- Where possible, stormwater treatment facilities are to be integrated with planting areas and form part of the overall vegetated area.

3.5.4 Frog Buffer Requirements

End of line bioretention basins are proposed to be located within the frog buffer along Bells Creek South. The following criteria is required to be met and is sourced from *Aura Precinct 15 Stormwater Quality Management Plan* (DesignFlow, 2022).

- No more than 40% of the frog buffer can be used for stormwater management devices, including drainage channels. Stormwater Management Devices must be placed uniformly along the length of the frog buffer to ensure no restriction to the overall connectivity of Wallum Sedgefrog Habitat within the Frog Zone and Frog Buffer.
- Where Stormwater management is located within the Frog Buffer, an average minimum setback of 20m is required between all edges of each stormwater management measure and the frog zone boundary. This set back distance does not apply to stormwater outlet drainage channels.
- The stormwater management measures must be set back 30m from the created Frog Ponds within the Frog Zone and Frog Buffer. Drainage channels and swales from the stormwater management measures to the creek can be closer than 30m.
- The final locations of the stormwater management devices will be determined during detailed design. The location will consider he proposed Wallum Sedgefrog Habitat ponds, foraging habitat and overall habitat connectivity to ensure compliance with Key Performance Criteria 5, listed in Table 6.2a with in the Wallum Sedgefrog Management Plan and Table 8.2a with the Acid Frog Management Plan.

3.5.5 End of Line Concept Designs

The proposed configurations of the end of line bioretention devices were developed with acknowledgement of the surrounding constraints, available area and contributing catchments. Survey of Bells Creek South has been undertaken to determine the standing water and associated bank levels to allow the concept designs to be developed. As illustrated on drawing 3058-DA038 contained within Appendix E of the *Precinct 15 West Engineering Services Report* (Egis, 2023) the end of line bioretention basin filter media level is located ~1.8m above the standing water level is Bells Creek South.

Initial grading of batters, access tracks and bunds have been undertaken to ensure compliance with the requirements outlined in Section 3.5.5 and Section 3.5.6. The final size and location of the end of line systems will be determined through detailed design processes to ensure upstream catchments changes, stormwater network design and any other development constraints are captured.

In response to the EDQ RFI2, an additional end of-line Bioretention Basin CAT_12_BIO was proposed to capture and treat runoff from the east south part of the precinct (CAT_12) including the neighbourhood centre and community facility. This basin will incorporate the following key design attributes:

- Pre-treatment of inflows by a Gross Pollutant Trap.
- Filter Media depth of 500mm to reduce overall basin depth and better enable under-drainage to freely discharge to Bells Creek.
- Batters are maximum of 1 in 4, with provision of vehicular maintenance access into each basin; and
- Extended Detention Depth of 300mm.

4 STORMWATER QUALITY MODELLING

Stormwater quality modelling of the proposed Precinct 15 West development has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Version 6.3.0. MUSIC enables the user to conceptualise the transfer of pollutants through a stormwater drainage system and provides an aid in quantifying the effectiveness of the proposed stormwater quality management strategy. MUSIC only provides quantitative modelling for Total Suspended Solids (TSS), Total Phosphorous (TP), Total Nitrogen (TN) and Gross Pollutants (GP).

4.1 Modelling Methodology

The MUSIC model was setup generally in accordance with the Healthy Land and Water *MUSIC Modelling Guidelines* (2018) and utilising information sourced from the DesignFlow *Aura Precinct 15 Stormwater Quality Management Plan – Version 3* (2022). Subsequent sections discuss the model configuration adopted for the analysis.

The updated layout of the MUSIC model is presented in ***Appendix A*** *(..\SF\P15_West_SWQMP_Nov2024\MUSIC\AuraP15_WQ_Model_update_241217_pref.sqz).*

FIGURE 4-1 MUSIC SOURCE NODE CATCHMENTS & LANDUSE

Meteorological Data

Six minutes pluviographic data was sourced from the Bureau of Meteorology (BOM) for the Caloundra WTP Station (No. 40496).

The 13 year period from 1st January 1997 to 31st December 2009 has been adopted for the rainfall duration as per the *Aura Precinct 15 Stormwater Quality Management Plan* (2022). The mean annual rainfall for this period is 1,348mm. Monthly evapotranspiration data for the 13 year period was sourced from the *MUSIC Modelling Guidelines* (2018) and entered into the MUSIC Model. The annual evapotranspiration value adopted was 1,618mm.

Source Node Configuration

Within the MUSIC model source nodes represent the catchments of the proposed development. Runoff and pollutants (contained within the runoff) are generated by the source nodes.

The split catchment source node approach has been adopted in accordance with Section 3.3.2 of the *MUSIC Modelling Guidelines*, which divides each catchment into different surface types. Roof, Road and Ground source nodes have been utilised. Roof source nodes represent the dwelling roofs, road reserve source nodes represent road and road verge area, while ground nodes represent the ground area of each lot and open space areas (i.e. drainage reserve, acoustic bunded areas).

The MUSIC model catchment delineation and surface types that have been adopted for configuring source nodes are presented on **Figure 4-2** above and in **Table 4-1**.

TABLE 4-1 MUSIC SOURCE NODE AREAS (HA)

CATCHMENT NAME	ROOF TO RWT	ROOF BYPASSING RWT	ROAD	GROUND	OPEN SPACE
CAT_01	0.765	0.853	1.371	0.666	0.995
CAT_02	0.835	0.888	1.247	0.721	0.325
CAT_03	0.042	0.042	0.089	0.036	0.005
CAT_04	0.083	0.083	0.107	0.071	0.000
CAT_05	0.051	0.051	0.170	0.044	0.000
CAT_06	0.049	0.049	0.065	0.042	0.000
CAT_07	0.044	0.044	0.057	0.038	0.000
CAT_08	0.076	0.076	0.172	0.065	0.000
CAT_09	0.080	0.080	0.133	0.068	0.357
CAT_10	0.000	0.000	0.037	0.000	0.000
CAT_11	0.025	0.025	0.000	0.021	0.000
CAT_12	0.290	0.742	1.483	0.298	0.665
CAT_25	0.000	0.175	0.289	0.019	0.000
CAT_26	0.000	0.000	0.086	0.000	0.000
CAT_27	0.000	0.000	0.271	0.000	0.000
CAT_28	0.023	0.023	0.163	0.020	0.000
CAT_30	0.000	0.000	0.101	0.000	0.000
CAT_31	0.039	0.039	0.126	0.034	0.000
CAT_33	0.000	0.000	0.101	0.000	0.000
CAT_34	0.170	0.170	0.183	0.146	0.000
CAT_35	0.052	0.052	0.147	0.045	0.000

CATCHMENT NAME	ROOF TO RWT	ROOF BYPASSING RWT	ROAD	GROUND	OPEN SPACE
CAT_37	0.000	0.000	0.000	0.000	0.369
CAT_38	0.041	0.041	0.126	0.035	0.217
CAT_39	0.075	0.075	0.103	0.064	0.000
CAT_CC	0.087	0.087	0.104	0.069	0.000
CAT_MD	0.074	0.074	0.127	0.148	0.000
CAT_12MD	0.297	0.297	0.356	0.238	0.000
CAT_40	0.096	0.096	0.137	0.083	0.000
CAT_41	0.110	0.110	0.225	0.095	0.000
CAT_42	0.048	0.048	0.102	0.041	0.218
CAT_44	0.027	0.027	0.031	0.023	0.000

The development type of CAT_CC and CAT_12MD is commercial. The development type of CAT_MD is residential 40 dwellings/ha. The surface-type splits for road, roof and ground follow the Table 3.4 of MUSIC Guideline 2018.

The following is noted regarding the source node configuration:

- Area for road and open space nodes have been delineated for each catchment. Area of roofs has been calculated based on the proportion of allotment area as summarised in **Table 4-2** below. Remaining allotment area has been adopted as ground area.

TABLE 4-2 ROOF AREA ASSUMPTIONS

DWELLING TYPE	ROOF AREA
Detached/Attached Dwellings (Lot >300m^2)	70% of Allotment Area
Detached/Attached Dwellings (Lot = 225 - 300 m^2)	70% of Allotment Area
Detached/Attached Dwellings (Lot <225 m^2)	90% of Allotment Area

- Where bioretention systems are proposed within a catchment the source node area has been adjusted to account for the area of the bioretention system.
- Fraction impervious values have been adopted generally in accordance with Table 3.6 of the *MUSIC Modelling Guidelines*.
- Urban residential type rainfall runoff and split catchment pollutant export parameters as per Tables A1.2 and B1.3 of the MUSIC Modelling Guidelines have been adopted.

4.1.1 Drainage Link Configuration

No routing was adopted for drainage links within the MUSIC model. This assumes flows and associated pollutants from all parts of the catchment arrive at the treatment nodes at the same time. This is conservative as it means that MUSIC may overestimate the overflow volumes.

4.1.2 Treatment Node Configuration

Rainwater Tank, Bioretention and Generic treatment nodes have been configured generally in accordance with Section 4.2 of the *MUSIC Modelling Guidelines*. A summary of the configuration, including details of deviations where required, are provided in the following sections.

4.1.2.1 Rainwater Tank & Stormwater Harvesting Nodes

Table 4-3 below summarises the treatment node configuration adopted.

TABLE 4-3 RAINWATER TANK NODE CONFIGURATION

PARAMETER	ADOPTED VALUE	NOTES
High Flow Bypass	100 m^3/s	Default
Low Flow Bypass	0 m^3/s	Default
Volume Below Overflow Pipe	4 kL per detached dwelling allotment > 300m2 2.4 kL per detached dwelling allotment 225 m^2 to 300m^2	5,000 litre tanks with 80% utilisation specified for larger detached dwelling allotments. 3,000 litre tanks with 80% utilisation specified for smaller detached dwelling allotments.
Depth Above Overflow	200 mm	Default
Surface Area	2.5 m^2 per detached dwelling	Surface area based on tank height of 2m.
Overflow Pipe Diameter	90 mm per outlet	Standard uPVC pipe diameter adopted.
Annual Demand	384 mm per square metre	Calculated based on irrigation rate of 538 mm per year with 70% of ground area within lot irrigated on PET minus rain distribution.
Daily Demand	190 L per day per dwelling	Calculated based on detached dwellings having three bedrooms (2.8 EP) with rainwater used for toilet flushing and laundry, adopting half with full water saving fixtures and appliances and remaining adopting standard water saving fixtures and appliances.

Updates were made to the configuration of the Rainwater Tank treatment nodes in response to items raised in the EDQ RFI.

With regards to the changes please note:

- **Table 4-3** specifies how the rainwater tank treatment nodes have been configured in MUSIC, not the actual configuration of the treatment device. A condition can be included in the approval to state that rainwater tanks are to be installed with a suitable first flush device.
- Item 16(f) of EDQ RFI states that "*individual rainwater tanks for standard residential lots must incorporate a conservative factor to ensure the MUSIC model is modelled conservatively*" and "*at the end-of-life of the rainwater tank or water pump, some property owners may elect not to replace their rainwater tanks or pumps*". Therefore, the configuration of Rainwater Tank node volume has been updated to assume only 80% of residential lots have functioning rainwater tank, by reducing the size of each tank node volume by 20%.
- Annual irrigation demand has adopted 70% of ground area in accordance with the MUSIC modelling Guidelines (2018). Irrigation distribution has also been updated to account for no irrigation when rainfall occurs (i.e. PET minus rain now adopted).
- The depth above overflow value of 200mm has been adopted in accordance with the MUSIC Modelling Guidelines.
- Given the potential for property owners to not replace rainwater tanks or pumps (as stated in Item 16(f) of the EDQ RFI1) the potential for property owners to replace full water saving appliances and fixtures (when broken) with standard (less water conserving) appliances and fixtures would also be expected. Furthermore, the likelihood (and frequency) of water efficient appliances and fixtures being replaced by standard options would also be higher (say 50%). Therefore, the daily demand value has been updated to account for the potential for 50% of full water saving fixtures and appliances being replaced by standard appliances and fixtures over time.

4.1.2.2 Bioretention Nodes

The breakdown of bioretention filter area and the coverage (i.e. filter area as a percentage of the catchment area treated) along with extended detention depth, is summarised in **Table 4-4** below.

TABLE 4-4 STORMWATER CATCHMENT AND BIORETENTION SYSTEM AREAS (*UPDATED*)

BIORETENTION DEVICE ID	CATCHMENT AREA (m^2)	BIORETENTION AREA (m^2)	COVERAGE (%)	EXTENDED DETENTION DEPTH (mm)
CAT_01_BIO	46,494	1,906	4.1%	300
CAT_02_BIO	56,651	2,324	4.1%	300
CAT_09_BIO	7,175	359	5.0%	200
CAT_12_BIO	63,348	2,229	3.5%	300
CAT_27_BIO	2,705	60	2.2%	200
CAT_30_BIO	1,013	145	14.3%	200
CAT_31_BIO	2,379	135	5.7%	200
CAT_34_BIO	6,691	101	1.5%	200
CAT_35_BIO	2,959	57	1.9%	200
CAT_38_BIO	4,609	301	6.5%	200
CAT_39_BIO	3,177	108	3.4%	200
CAT_40_BIO	5,200	110	2.7%	200
CAT_41_BIO	5,400	174	2.7%	200
CAT_42_BIO	4,583	95	2.1%	200
	Average Coverage		**4.3%**	

The at-source bioretention CAT_03_BIO to CAT08_BIO, CAT_25_BIO, CAT_26_BIO, CAT_28_BIO and CAT_33_BIO have been removed. The end-of-line bioretention basins (CAT_02_BIO and CAT_12_BIO) are now proposed to be larger to meet the Water Quality Objectives, as indicated in ***Table 4-4*** *above.*

Other bioretention node configuration properties are presented below in **Table 4-5**.

TABLE 4-5 BIORETENTION NODE CONFIGURATION

PARAMETER	ADOPTED VALUE	NOTES
High Flow Bypass	100 m^3/s	Default
Low Flow Bypass	0 m^3/s	Default
Extended Detention Depth	Variable	Refer to
Surface Area	Variable	Based on average of filter area and area at top of extended detention depth, assuming batters of 1 in 4 from filter surface to extended detention depth.
Filter Area	Variable	Refer to
Unlined Filter Media	0.1	Assumes filter is lined
Saturated Hydraulic Conductivity	200 mm/hr	As per MUSIC Modelling Guidelines
Filter Depth	500 mm	As per MUSIC Modelling Guidelines
TN Content of Filter Media	400 mg/kg	As per MUSIC Modelling Guidelines
Orthophosphate Content of Filter Media	30 mg/kg	As per MUSIC Modelling Guidelines
Exfiltration Rate	0 mm/hr	Assumes no exfiltration
Based Lined	Yes	Assumes no exfiltration
Vegetation Properties	Vegetated with Effective Nutrient Removal Plants	
Overflow Weir Width	Variable	Based on filter area divided by 10 as per MUSIC Modelling Guidelines

4.2 Modelling Results

The results of the MUSIC model are summarised in **Table 4-7** below.

TABLE 4-6 MUSIC MODELLING RESULTS (*UPDATED*)

Pollutant	WQO (Load Reduction)	Source Load (kg/year)	Residual Load (kg/year)	Pollutant Reduction
Total Suspended Solids	95%	34,800	1,780	94.9%
Total Phosphorus	89%	71.0	6.63	90.7%
Total Nitrogen	68%	432	125	71.2%
Gross Pollutants	90%	4,520	28.2	99.4%

MUSIC model file AuraP15_WQ_Model_update_241217_pref.sqz | filepath \\egis.racine.local\bu_batiment\CAL\05_Projects\BNE\21\000307.11 - Aura Precinct15 DA\6_Model\SF\P15_West_SWQMP_Nov2024\MUSIC\.

The results confirm that the proposed stormwater quality management strategy achieves a reduction in pollutant export to meet the required WQOs.

> *It is understood that, based on review of the model results by Design Flow, the TSS Pollutant Reduction of 94.8% is appropriate for compliance.*

5 CONSTRUCTION, OPERATIONAL MANAGEMENT & MAINTENANCE OF SQIDS

The following details management and maintenance requirements for the construction and operation phases of the SQIDs proposed.

5.1 Construction & Establishment Phases

Construction of the development and the following building works has the potential to mobilise large quantities of litter and sediment in runoff. Therefore a staged construction and establishment method for SQIDs is recommended.

5.1.1 Bioretention Systems

Construction of the development and the building works has the potential to mobilise large quantities of sediment in runoff. For Bioretention Systems to perform as designed there is a need to protect filter media and pod vegetation during this phase of the development. Therefore, a staged construction and establishment method for construction of the Bioretention System will be followed.

It is proposed to follow an installation procedure for each Bioretention System generally in accordance with *Option 1 of the Staged Construction and Establishment Methodology* as outlined in *Table 3.6* and *Section 3.8.1* of the *Water by Design Construction and Establishment Guidelines* (2011). A summary of this methodology is presented below.

1. Civil Works (Functional Installation) – Initially the Bioretention System will be used for erosion and sediment control. Once most of the civil construction works are complete, earthworks and shaping to create the layout and functional elements of the Bioretention Systems will be undertaken. The installation of functional elements (e.g. inlets, outlets structures, subsoil drainage, transition layers and filter media) shall be undertaken as per the methodology detailed in *Section 3.9.1* in the *Water by Design Construction and Establishment Guidelines* (2011). Prior to the commencement of the Building Phase, sediment fences will be erected around the perimeter of the Bioretention System to avoid the entry of sediment. Laying a temporary filter cloth (or 25mm thick layer of coarse sand and 25mm of topsoil) over the Bioretention System shall protect the Bioretention Systems during both the Civil Works and the Building Phase.
2. Building Phase (Building Construction) – During this phase the Bioretention Systems shall continue to operate. Sediment fences shall remain around the perimeter of the Bioretention System (both around the filter media and the top of batter) to restrict sediment inflow. Clear indications of the restriction of traffic to the Bioretention systems shall also be displayed.
3. Landscape Establishment (Operational Establishment) – when the Building Phase is 80% complete, the temporary protective measures and accumulated sediments within the Bioretention System will be removed. The Bioretention System shall be planted with vegetation and landscaping as proposed. Sufficient watering and removal of weeds following planting shall be undertaken in accordance with *Section 3.9.3* of the *Water by Design Construction and Establishment Guidelines* (2011).

5.2 Operational Phase

5.2.1 Rainwater Tanks

The inspection and maintenance of Rainwater Tanks are to be undertaken by each separate property owner in accordance with relevant manufacturers guidelines. Sunshine Coast Council provide guidance for plumbing approval, installation and use of rainwater tanks.

Visit *https://www.sunshinecoast.qld.gov.au/development/building/rainwater-tanks* for further information.

5.2.2 Bioretention Systems

The following sections outline the proposed procedures and methodology for the Operational Phase management as well as the maintenance of the Bioretention Systems proposed as part of the development.

The following methodology will be followed through the operational phases of the Bioretention Systems. The information provided in this section will be incorporated into the detailed design. General requirements, health and safety and yearly reviews for the Bioretention Systems are also provided.

No monitoring of water quality is proposed. The level of operational management and the maintenance proposed is considered best practice and if followed will ensure SQIDs will operate to their design intent.

5.2.2.1 Inspection Requirements

During Operational Phase, regular inspections of the Bioretention Systems are required to ensure vegetation establishes and the properties of the filter media remain effective.

Checklists have been developed for the Bioretention Systems. The condition and maintenance carried out will be recorded on the checklist at the time the inspection and/or maintenance is undertaken. A copy of the checklist is presented in **Appendix B**.

Maintenance personnel should also be encouraged to report and document changes in vegetation type within the Bioretention Systems. Photographic documentation and mapping of vegetation types are to be recorded annually to determine changes in vegetation over time. Photographs of each device are to be taken at the same location annually.

Through these procedures a reliable maintenance database can be developed and used to determine if the maintenance undertaken is ensuring the SQID is functioning as intended.

Except for periods of extended wet weather, mosquitoes are unlikely to be an issue - as surface water within the Bioretention Systems is not expected to remain for more than two days.

5.2.2.2 Weed Removal

Maintenance personnel will need to identify species of both terrestrial and semi-aquatic weeds common to the area. As the Bioretention Systems are "dry" SQIDs, aquatic weed infestation is unlikely. When weeds have been identified they are to be removed by hand immediately or eradication methods scheduled before the infestation becomes larger and more difficult to control. It should be noted that herbicides should not be used in the removal of invasive weeds as this has negative impacts on downstream water quality.

5.2.2.3 Replanting

Replanting of vegetation is to be carried out to replace dead or damaged vegetation, vegetation that has been removed by scour or erosion, or vegetation that is being re-planted following tilling or the replacement of filter media. Removed vegetation should be replaced by plants of similar size and species, or as indicated on the appropriate Landscaping Plans.

5.2.2.4 Filter Inspection & Replacement

Fine sediment and silt may accumulate within the filter media of the Bioretention Systems over time. Removal of sediment and silt trapped within the filter media is expected to be the costliest maintenance requirement for Bioretention Systems.

It is recommended that a visual inspection of the infiltration properties be undertaken at least three times per year with more frequent inspections no greater than three months apart between October and May. This is to determine whether built-up fine sediment and silt has reached a point where the filter media has become clogged.

The infiltration properties of the filter media within the Bioretention Systems needs to be checked after a period of significant rainfall event, which is defined as a 24 hour period with rainfall greater than 100mm, or a shorter period with an average rainfall intensity greater than 50mm/hr. This is an ideal period to assess the infiltration properties as water should not pond for an extended period. Therefore inspections should occur 24 to 72 hours after an appropriate rainfall event.

In the event that isolated boggy patches occur within the Bioretention Systems then the subsoil drainage pipes could be blocked. If this is not the case and no other blockages have been observed, then surface of the media is to be tilled (raked and aerated) to a depth of 100 to 150mm. This will require temporarily removing and storing the surface vegetation prior to tilling the surface. Should the infiltration properties be improved then the removed vegetation and coarse aggregate layer can be replanted. Should tilling prove unsuccessful or if an infiltration check indicates filter media to be clogged, then the top portion of the filter media is to be replaced as follows:

1. Removal of surface vegetation and coarse aggregate layer and store for re-establishment.
2. Remove the top 150mm of filter media and dispose of in an approved manner.
3. Till the remaining filter media to a further depth of 300mm.
4. Place a new layer of appropriate filter media as per the specification (refer to **Appendix C**), free from organic matter, clay and silt; and
5. Replant the removed vegetation.

If blockages occur frequently, a filter media with a higher saturated hydraulic conductivity should be considered. Reassessing the species and planting density of vegetation is also an option. Unless changes to the filter media specification are made through a review of the SQID performance, the filter media to be used for the Bioretention Systems is to be a Sandy Loam as per the FAWB *Guidelines for Filter Media in Biofiltration Systems* (*Version 3.01*, 2009) presented in **Appendix C**.

5.2.2.5 Subsoil Drainage Inspection & Cleanout

The build-up of fine sediment and silt within the subsoil drainage pipes is unlikely as it will be trapped by the filter media. However, the subsoil drainage is to be checked annually for blockages that may be caused by foreign matter entering through cleanout inspection openings or by small fauna. This can be done by either:

- Observing the condition of the subsoil drain through the cleanout and inspection openings located towards the downstream end of a subsoil drainage pipe.
- Observing the amount of sediment and silt flushed into the downstream field inlet when water is pumped into the upstream end of the subsoil drainage line (through a cleanout and inspection opening).

If a considerable amount of sediment and silt is observed or carried into the downstream inlet, then each subsoil drainage line must be flushed out with high pressure water.

Water is to be pumped into each subsoil drainage pipe through the upstream cleanout inspection opening until all sediment has been ejected from the pipe. To collect the water and ejected sediment within the downstream pit a temporary barrier is to be placed over the downstream pipe opening (such as sand bags) and a pump used to draw the water, sediment and silt out of the pit and irrigated onto areas of open space away from each basin. This will ensure the sediment and silt does not enter the downstream waterway.

If frequent issues occur with the subsoil drainage system, CCTV checking could be undertaken to identify any damage subsoil drainage.

5.2.2.6 Monitoring

Visual monitoring of bioretention systems is proposed as part of the inspection and maintenance requirements for the Systems. Visual inspections will occur at least three times per year with more frequent inspections to occur no more than three months apart between October and May. Inspection should be made not less than 24 hours and not more than 72 hours after the cessation of rainfall if the total rainfall on any day exceeds 100mm.

5.3 General Requirements

5.3.1 Yearly Review of Maintenance Management Plan

Each year a review is to be carried out to determine if the programmed inspection and maintenance (including checklists) is ensuring SQIDs are functioning as intended. The review should include an assessment of the maintenance database to determine whether the programmed inspections and maintenance is effective. Information on the database should be assessed to determine whether any noticeable changes are evident in vegetation, presence of fauna and operational efficiency of any structures or features of the device. This will further provide indicators as to whether sufficient information is being recorded for management purposes.

5.3.2 Maintenance Personnel Safety (OH&S)

The *Workplace Safety Regulation* 2011 requires that all reasonably practicable steps be taken to protect an employee's health in a workplace. Organisations involved in the inspection and maintenance of the SQIDs should therefore:

- Have a documented occupational health and safety policy in place.
- Ensure all staff and maintenance personnel are aware of and abide by the policy; and
- The policy provides a mechanism for review and improvement.

As part of the policy personnel involved in the maintenance of the SQIDs are to have sufficient resources (such as personnel protective equipment, training etc.) to carry out the task in a safe manner.

5.3.3 Public Safety

The safety of the public in the area of the SQID being maintained also needs to be ensured. Notices to inform the staff and public accessing the site regarding the SQID maintenance needs to be circulated prior to the scheduled date. Temporary signage and safety barriers need to be erected around maintenance work areas prior to the works commencing and are not to be removed until all works have finished.

6 CONCLUSION

Egis Consulting has prepared this Stormwater Quality Management Plan for Precinct 15 West of the Aura development to support the proposed Development Application for Reconfiguration of a Lot over the western portion of the subject site known as Aura Precinct 15 'West'.

Version C was prepared in response to the Request for Further Information 2 (RFI2) issued by Economic Development Queensland (EDQ) dated 13 March 2024.

This report (Version D) has been prepared to address Item 3a of the Further Issues EDQ Letter dated 11 June 2024, which requires the removal of Gross Pollutant Traps (GPT 1, 2 and 12) from the treatment train, or further justification for their inclusion. To address the item GPT's 1, 2 and 12 have been removed.

> *The report (Revision E) has been prepared to address changes to the stormwater quality management strategy, which includes removal of GPTs and At-Source WSUD devices for water quality treatment of runoff from the catchments of the future childcare centre, centres, community and multiple residential sites (Lot 8100 to 8103) within the Precinct.*

This report has therefore:

- Identified the pollutants of concern and pollutant load reduction Water Quality Objectives to be achieved.
- Proposed an updated stormwater quality management strategy utilising the following stormwater quality improvement devices:
  - Allotment scale Rainwater Harvesting and reuse.
  - Bioretention systems, being bioretention pods and basins.

  Preliminary sizing of rainwater tanks have been identified for the future childcare centre, centres, community and multiple residential sites (Lot 8100 to 8103).

  > *As the configuration of development on future childcare centre, centres, community and multiple residential sites is unknown at this time, it is recommended that future development applications on these lots undertake their own stormwater quality investigations to confirm that the overall Precinct 15 development will maintain achieving the required WQO's.*
- As discussed in Version B, litter baskets and stormwater harvesting have been removed from the strategy.
- Presented MUSIC modelling methodology and results, now including the future childcare centre, centres, community and multiple residential sites (Lot 8100 to 8103), demonstrating the proposed strategy will achieve a reduction in pollutant export to achieve the identified water quality objectives.
- Incorporated removal of GPT's 1, 2, and 12 from the MUSIC model, the results of which do not significantly impact the pollutant reductions (i.e. Water Quality Objectives are still achieved).
- Identified the operational management and maintenance requirements for SQIDs during both construction and operational phases of the development.
- The previous Version D of this report has addressed Item 3a of the EDQ Further Issues Letter. This revision continues to address this item.

7 RECOMMENDATIONS

Egis recommends that the stormwater quality management plan proposed within this report is approved and adopted for detailed design phase of the development.

8 REFERENCES

DesignFlow & BMT (2019), *Aura Development Stormwater Quality Management Plan*.

DesignFlow (2022), *Aura Precinct 15 Stormwater Quality Management Plan – Version 3*.

Egis Consulting (2023), *Memorandum – Aura Development Acoustic Bund South*.

Egis Consulting (2023), *Engineering Services Report Aura Precinct 15 'West'*.

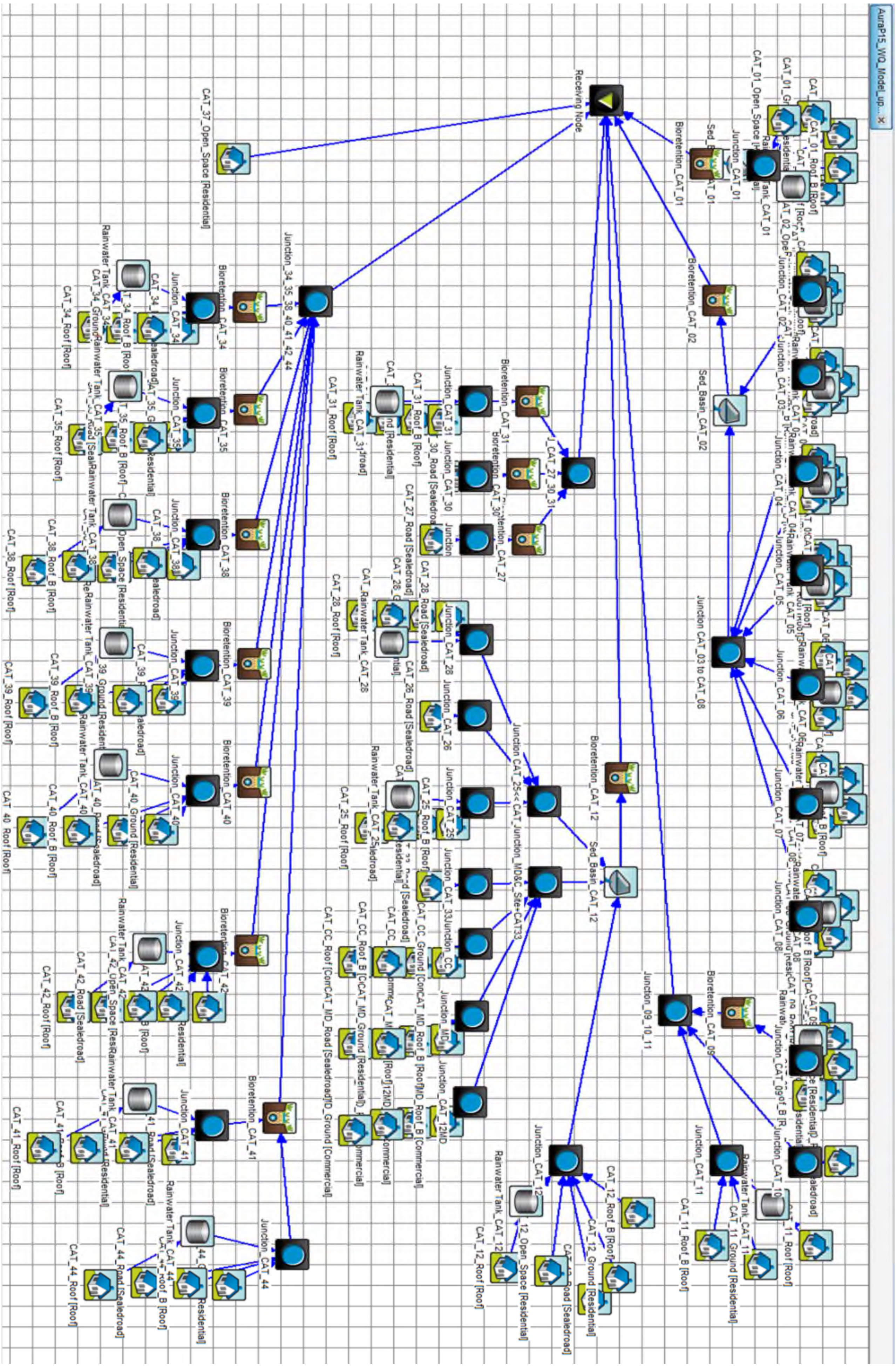
Queensland Department of Infrastructure, Local Government and Planning (2017), *State Planning Policy*.

Healthy Land and Water (2018), *MUSIC Modelling Guidelines*.

Water by Design (2011), *Construction and Establishment Guidelines*.

FAWB (2009), *Guidelines for Filter Media in Biofiltration Systems (Version 3.01)*.

APPENDIX A:
MUSIC MODEL CONFIGURATION


AuraP15_WQ_Model_up...
Receiving Node
Bioretention_CAT_01
Bioretention_CAT_02
Sed_Basin_CAT_02
Junction CAT_03 to CAT_08
Junction_09_10_11
Bioretention_CAT_09
Bioretention_CAT_12
Sed_Basin_CAT_12
Junction_34_35_38_40_41_42_44
CAT_37_Open_Space [Residential]
Bioretention_CAT_34
Bioretention_CAT_35
Bioretention_CAT_38
Bioretention_CAT_39
Bioretention_CAT_40
Bioretention_CAT_41
Junction_CAT_44

APPENDIX B: CHECKLIST

Bioretention Basin Inspection & Maintenance Requirements

Treatment Device / Property	Inspection	Inspection Frequency	Maintenance
Bioretention Basin			
Litter & Weeds	Visually check for litter, weeds and debris within the Bioretention Basin.	Quarterly for first year then every six months after establishment. Also after significant storm events.*	Remove litter, weeds and debris from the basin and dispose of at approved waste disposal facility.
Inlet and Outlet	Visually check for blockages within the upstream and downstream inlet pits. Check for locked weep holes within the upstream pit.		Remove any blockages or debris within inlet pits or blockages to weep holes.
Sedimentation	Visually check surface of Bioretention Basin for accumulation of sediment.		If sediment build-up is observed, remove accumulated sediment where it is smothering vegetation.
Scour, Erosion and Vehicle Damage	Visually check Bioretention Basin surface for scouring and areas of erosion or vehicle damage.		Repair damage to Bioretention Basin surface and filter media if exposed. Undertake replanting if necessary and maintain watering of area until vegetation has established.
Vegetation	Visually check for any planted vegetation that has died.	Quarterly for first year then every six months after establishment.	Remove dead vegetation and replace with stock of equivalent size and species as detailed in plant schedule. Maintain watering until new vegetation has established.
Filter Media	Check surface of Bioretention Basin for any isolated "boggy" areas.	Every six months.	Increase infiltration rate by tilling the surface of the filter media.
	Visually check and determine time of ponding within basin after a storm event.*	During wetter periods.	If duration of ponding exceeds 48 hours, trial tilling of the surface of the filter media. If no improvement occurs then dispose and replace the top 100 to 150mm layer of filter media (below is the detailed procedure): i. Remove vegetation and store for replanting. ii. Remove top 150mm of filter media and dispose of in an approved manner. iii. Till the remaining filter media to a further depth of 300mm. iv. Place a new layer of appropriate filter media; v. Replant removed vegetation
Subsoil Drainage	Check subsoil drainage for blockages. This is subject to earlier stages of inspection. To discover blockage, flush subsoil drain from the upstream inspection opening. If there is no evidence of a blockage, no further action is required.	Subject to earlier stage of inspection.	If blockage is discovered remove by flushing out the subsoil drainage pipe. Below is an outline of the procedure i. Set up a pump and an appropriate collection device (i.e. a sandbag) at the downstream pipe. ii. Draw outflow through pipe, not allowing any sediment/silt to enter the downstream stormwater drainage system. iii. Collect and dispose flushed material appropriately.

* Significant Rain Event defined as a 24 hour period with rainfall greater than 200mm, or shorter period with an average rainfall intensity greater than 20mm/hour.

BIORETENTION BASIN INSPECTION & MAINTENANCE CHECKLIST

SQID:	
Location:	
Date:	
Time:	
Inspector:	
Weather Conditions	

	Condition Acceptable			
Maintenance Item	**Yes**	**No**	**N/A**	**Comments**
1. Basin Surface				
Clear of sediment build-up				
Check for erosion, scour, vehicle & other damage				
Check for dead or damaged vegetation				
2. Filter Media				
Check for erosion, scour, vehicle & other damage				
Check for isolated boggy patches				
3. Subsoil Drainage				
Visually check subsoil drainage through cleanout inspection openings for build-up of sediment				
Check for blockages to subsoil drainage using other methods (eg. CCTV or flush-out)				

Additional Comments

Actions to be taken

APPENDIX C:
BIORETENTION SPECIFICATION

GUIDELINES FOR FILTER MEDIA IN BIOFILTRATION SYSTEMS (Version 3.01) June 2009

The following guidelines for filter media in biofiltration systems have been prepared on behalf of the Facility for Advancing Water Biofiltration (FAWB) to assist in the development of biofiltration systems, including the planning, design, construction and operation of those systems.

NOTE: This is a revision of the previous FAWB guideline specifications (published in 2006 (Version 1.01), 2008 (Version 2.01)). It attempts to provide a simpler and more robust guideline for both soil-based and engineered filter media. FAWB acknowledges the contribution of EDAW Inc., Melbourne Water Corporation, Dr Nicholas Somes (Ecodynamics), Alan Hoban (South East Queensland Healthy Waterways Partnership), Shaun Leinster (DesignFlow) and STORM Consulting to the preparation of the revised guidelines.

1 GENERAL DESCRIPTION

The biofiltration filter media guidelines require three layers of media: the filter media itself (400-600 mm deep or as specified in the engineering design), a transition layer (100 mm deep), and a drainage layer (50 mm minimum cover over underdrainage pipe). The biofiltration system will operate so that water will infiltrate into the filter media and move vertically down through the profile.

The filter media is required to support a range of vegetation types (from groundcovers to trees) that are adapted to freely draining soils with occasional wetting. The material should be based on **natural or amended natural soils** or it can be **entirely engineered**; in either case, it can be of siliceous or calcareous origin. In general, the media should have an appropriately high permeability under compaction and should be free of rubbish, deleterious material, toxicants, declared plants and local weeds (as listed in local guidelines/Acts), and should not be hydrophobic. The filter media should contain some organic matter for increased water holding capacity but be low in nutrient content. In the case of natural or amended natural soils, the media should be a **loamy sand**.

Maintaining an adequate infiltration capacity is crucial in ensuring the long-term treatment efficiency of the system. The ability of a biofiltration system to detain and infiltrate incoming stormwater is a function of the filter surface area, extended detention (ponding) depth, and the hydraulic conductivity of the filter media (Figure 1). Most importantly, design of a biofiltration system should optimize the combination of these three design elements.

For a biofiltration system in a temperate climate with an extended detention depth of 100 – 300 mm and whose surface area is approximately 2% of the connected impervious area of the contributing catchment, the prescribed hydraulic conductivity will generally be between 100 – 300 mm/hr in order to meet best practice targets (Figure 2). This configuration supports plant growth without requiring too much land space. In warm, humid (sub- and dry- tropical) regions the hydraulic conductivity may need to be higher in order to achieve the required treatment performance using the same land space (i.e., ensuring that the proportion of water treated through the media meets requirements).

Where one of these design elements falls outside the recommended range, the infiltration capacity can still be maintained by offsetting another of the design elements. For example, a filter media with a lower hydraulic conductivity may be used, but the surface area or the extended detention depth would need to be increased in order to maintain the treatment capacity. Similarly, if the available land were the limiting design element, the system could still treat the same size storm if a filter media with a higher hydraulic conductivity were installed. Where a hydraulic conductivity greater than 300 mm/hr is prescribed, potential issues such as higher watering requirements during the establishment should be considered. Biofiltration systems with a hydraulic conductivity greater than 600 mm/hr are unlikely to support plant growth due to poor water retention, and may also result in leaching of pollutants. However plant survival might be possible if the outlet pipe were raised to create a permanently submerged zone.

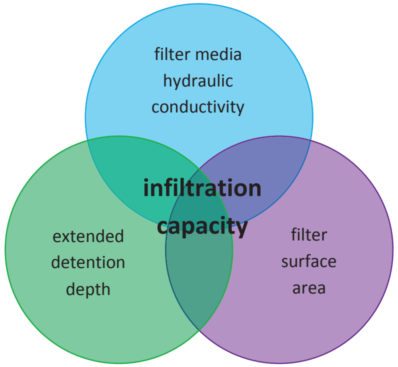


Figure 1. Design elements that influence infiltration capacity.

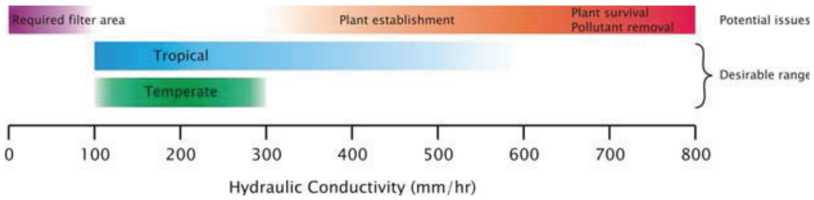


Figure 2. Recommended filter media hydraulic conductivity range and potential issues

The infiltration capacity of the biofiltration system will initially decline during the establishment phase as the filter media settles and compacts, but this will level out and then start to increase as the plant community establishes itself and the rooting depth increases (see Appendix A). In order to ensure that the system functions adequately at its eventual (minimum) hydraulic conductivity, a safety co-efficient of 2 should be used: i.e., **designs should be modelled using half the prescribed hydraulic conductivity**. If a system does not perform adequately with this hydraulic conductivity, then the area and/or ponding depth should be increased. It may also be desirable to report sensitivity to infiltration rate, rather than simply having expected rate. This is important when assessing compliance of constructed systems as systems should ideally meet best practice across a range of infiltration rates.

2 TESTING REQUIREMENTS

2.1 Determination of Hydraulic Conductivity

The hydraulic conductivity of potential filter media should be measured using the ASTM F1815-06 method. This test method uses a compaction method that best represents field conditions and so provides a more realistic assessment of hydraulic conductivity than other test methods.

Note: if a hydraulic conductivity lower than 100 mm/hr is prescribed, the level of compaction associated with this test method may be too severe and so underestimate the actual hydraulic conductivity of the filter media under field conditions. However, FAWB considers this to be an appropriately conservative test, and recommends its use even for low conductivity media.

2.2 Particle Size Distribution

Particle size distribution (PSD) is of secondary importance compared with hydraulic conductivity. A material whose PSD falls within the following recommended range does not preclude the need for hydraulic conductivity testing i.e., it does not guarantee that the material will have a suitable hydraulic conductivity. However, the following composition range (percentage w/w) provides a useful guide for selecting an appropriate material:

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

Clay and silt are important for water retention and sorption of dissolved pollutants, however they substantially reduce the hydraulic conductivity of the filter media. This size fraction also influences the structural stability of the material (through migration of particles to block small pores and/or slump). It is essential that the total clay and silt mix is **less than 3% (w/w)** to reduce the likelihood of structural collapse of such soils.

The filter media should be well-graded i.e., it should have all particle size ranges present from the 0.075 mm to the 4.75 mm sieve (as defined by AS1289.3.6.1 - 1995). There should be no gap in the particle size grading, and the composition should not be dominated by a small particle size range. This is important for preventing structural collapse due to particle migration.

2.3 Soil-Based Filter Media: Properties

The following specifications are based on results of extensive treatment performance testing conducted by FAWB as well as recommendations made by AS4419 – 2003 (Soils for Landscaping and Garden Use). Filter media must be tested for the following; media that do not meet these specifications should be rejected or amended:

i. Total Nitrogen (TN) Content – <1000 mg/kg.

ii. Orthophosphate (PO_4^{3-}) Content – <80 mg/kg. Soils with total phosphorus concentrations >100 mg/kg should be tested for potential leaching. Where plants with moderate phosphorus sensitivity are to be used, total phosphorus concentrations should be <20 mg/kg.

iii. Organic Matter Content – at least 3% (w/w). An organic content lower than 3% is likely to have too low a water holding capacity to support healthy plant growth. In order to comply with both this and the TN and PO_4^{3-} content requirements, a low nutrient organic matter will be required.

iv. pH – as specified for 'natural soils and soil blends' 5.5 – 7.5 (pH 1:5 in water).

v. Electrical Conductivity (EC) – as specified for 'natural soils and soil blends' <1.2 dS/m.

Optional testing:

vi. Dispersibility – this should be carried out where it is suspected that the soil may be susceptible to structural collapse. If in doubt, then this testing should be undertaken.

Potential filter media should generally be assessed by a horticulturalist to ensure that they are capable of supporting a healthy vegetation community. This assessment should take into consideration delivery of nutrients to the system by stormwater. Any component or soil found to contain high levels of salt (as determined by EC measurements), high levels of clay or silt particles (exceeding the particle size limits set above), or any other extremes which may be considered retardant to plant growth should be rejected.

3 ENGINEERED FILTER MEDIA

Where there is not a locally available soil-based material that complies with the properties outlined in Sections 2.1 - 2.3, it is possible to construct an appropriate filter medium. A washed, well-graded sand with an appropriate hydraulic conductivity should be used as the filter medium. Suitable materials include those used for the construction of turf profiles (e.g. golf greens); these materials are processed by washing to remove clay and silt fractions. In large quantities (>20 m^3), they can be obtained directly from sand suppliers, while smaller quantities can be purchased from local garden yards. The **top 100 mm of the filter medium** should then be ameliorated with appropriate organic matter, fertiliser and trace elements (Table 1). This amelioration is required to aid plant establishment and is designed to last four weeks; the rationale being that, beyond this point, the plants receive adequate nutrients via incoming stormwater.

Table 1. Recipe for ameliorating the top 100 mm of sand filter media

Constituent	Quantity (kg/100 m^2 filter area)
Granulated poultry manure fines	50
Superphosphate	2
Magnesium sulphate	3
Potassium sulphate	2
Trace Element Mix	1
Fertilizer NPK (16.4.14)	4
Lime	20

Laboratory testing has shown that biofilters that contain an engineered filter medium will achieve essentially the same hydraulic and treatment performance as those containing a soil-based filter medium (Bratieres *et al.*, 2009). However, it is recommended that a submerged zone be included in biofiltration systems that utilise such a free draining filter medium to provide a water source for vegetation between rainfall events.

4 TRANSITION LAYER

The transition layer prevents filter media from washing into the drainage layer. Transition layer material shall be a clean, well-graded sand material containing <2% fines. To avoid migration of the filter media into the transition layer, the particle size distribution of the sand should be assessed to ensure it meets 'bridging criteria', that is, the smallest 15% of the sand particles bridge with the largest 15% of the filter media particles (Water by Design, 2009; VicRoads, 2004):

D_{15} (transition layer) ≤ 5 x D_{85} (filter media)

where: D_{15} (transition layer) is the 15^{th} percentile particle size in the transition layer material (i.e., 15% of the sand is smaller than D_{15} mm), and
D_{85} (filter media) is the 85^{th} percentile particle size in the filter media.

A dual-transition layer, where a fine sand overlays a medium-coarse sand, is also possible. While it is acknowledged that this can increase the complexity of the construction process, testing indicates that a dual-transition layer produces consistently lower levels of turbidity and concentrations of suspended solids in treated outflows than a single transition layer. Therefore, it is recommended that this design be specified for stormwater harvesting applications (to enable effective post-treatment disinfection) and where minimising the risk of washout during the establishment period is of particular importance.

The transition layer can be omitted from a biofiltration system provided the filter media and drainage layer meet the following criteria as defined by the Victorian Roads *Drainage of Subsurface Water from Roads - Technical Bulletin No 32* (VicRoads, 2004):

D_{15} (drainage layer) ≤ 5 x D_{85} (filter media)

D_{15} (drainage layer) = 5 to 20 x D_{15} (filter media)

D_{50} (drainage layer < 25 x D_{50} (filter media)

D_{60} (drainage layer) < 20 x D_{10} (drainage layer)

These comparisons are best made by plotting the particle size distributions for the filter media and gravel on the same soil grading graphs and extracting the relevant diameters (Water by Design, 2009).

5 DRAINAGE LAYER

The drainage layer collects treated water at the bottom of the system and converys it to the underdrain pipes. Drainage layer material is to be clean, fine gravel, such as a 2 – 5 mm washed screenings. Bridging criteria should be applied to avoid migration of the transition layer into the drainage layer (Water by Design, 2009; VicRoads, 2004):

D_{15} (drainage layer) ≤ 5 x D_{85} (transition layer)

where: D_{15} (drainage layer) is the 15^{th} percentile particle size in the drainage layer material (i.e., 15% of the gravel is smaller than D_{15} mm), and
D_{85} (transition layer) is the 85^{th} percentile particle size in the transition layer material.

Note: The perforations in the underdrain pipes should be small enough that the drainage layer cannot fall into the pipes. A useful guide is to check to that the D_{85} (drainage layer) is greater than the pipe perforation diameter.

Geotextile fabrics are **not recommended** for use in biofiltration systems due to the risk of clogging. An open-weave shade cloth can be placed between the transition layer and the drainage layer to help reduce the downward migration of smaller particles if required, however this should only be adopted where there is insufficient depth for transition and drainage layers.

6 INSTALLATION

It is recommended that filter media be lightly compacted during installation to prevent migration of fine particles. In small systems, a single pass with a vibrating plate should be used to compact the filter media, while in large systems, a single pass with roller machinery (e.g. a drum lawn roller) should be performed. Under no circumstance should heavy compaction or multiple-passes be made. Filter media should be installed in two lifts unless the depth is less than 500 mm.

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