



Water Sensitive Urban Design Assessment
for
46-54 Ferodale Road & 754 Medowie Road Rezoning
for VC Management Pty Ltd

Report Document Control

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Contents

| | | |
|-----|------------------------------------|----|
| 1. | Introduction..... | 3 |
| 1.1 | Background | 3 |
| 1.2 | Relevant Guidelines | 3 |
| 1.3 | Site Description | 4 |
| 1.4 | Proposed Development..... | 4 |
| 2. | Stormwater Quality | 4 |
| 2.1 | Stormwater Quality Objectives..... | 4 |
| 2.2 | Proposed Treatment Strategy | 5 |
| 2.3 | Catchments | 6 |
| 2.4 | MUSIC Results..... | 11 |
| 3. | Conclusion..... | 13 |

Appendices

Appendix A – MUSICLink Report

1. Introduction

1.1 Background

Northrop Consulting Engineers has been engaged by VC Management (the proponent) to prepare a preliminary water sensitive urban design assessment to support the rezoning of a parcel of land comprising Lots 3-8 DP 243518. The rezoning proposes to change the existing land zoning from RU2 Rural Landscape to R3 Medium Density Residential and a portion of E1 Local Centre to the north-west.

Post-rezoning, the proponent is seeking to lodge a development application for a master-planned residential and commercial area within Lots 3-8, hereafter referred to as the development site. Lots 1 and 2 are currently under separate ownership and do not currently form part of the future development proposal. The subject site is illustrated in Figure 1.

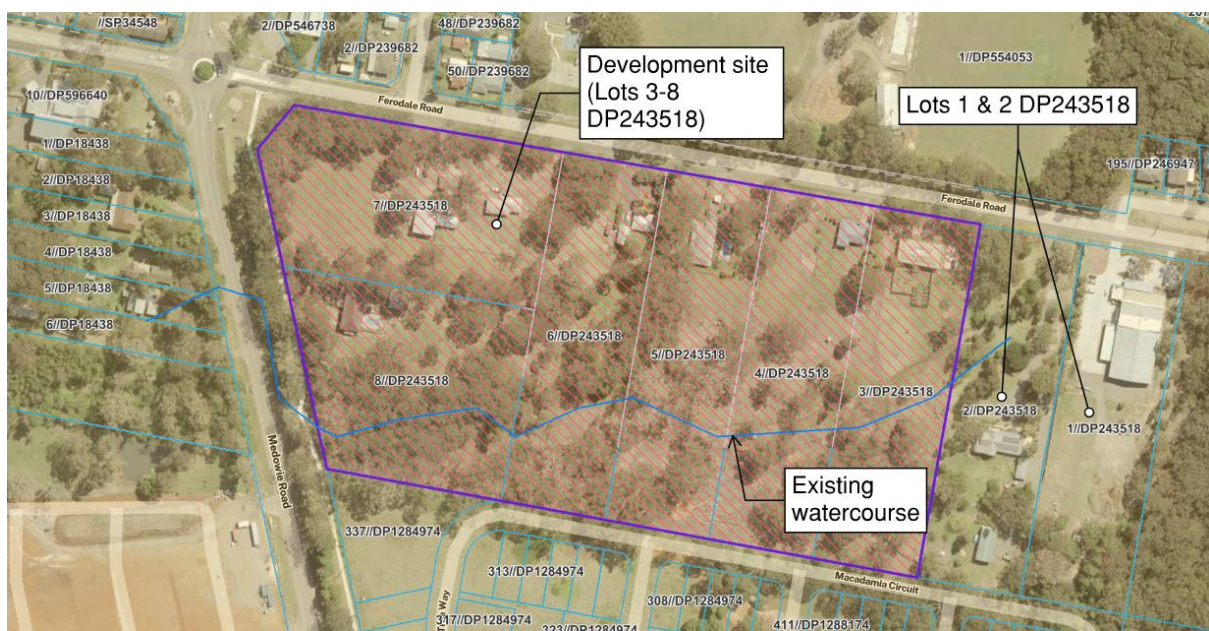


Figure 1 – Subject site (NSW Spatial Viewer).

The area to be rezoned lies within Hunter Water’s Grahamstown drinking water catchment. Hunter Water (HWC) have requested that the proponent demonstrate development sites will have Neutral or Beneficial Effects (NorBE) on water quality. This preliminary assessment is intended to demonstrate that stormwater quality management measures can be provisioned as part of the ultimate development such that both NorBE outcomes and PSC’s stormwater quality objectives can be achieved in an economical manner.

1.2 Relevant Guidelines

This report and associated drawings have been prepared in accordance with the following standards and guidelines:

- Port Stephens Council Development Control Plan (DCP), 2014.
- Port Stephens Council Development Water Sensitive Development Strategy Guidelines, 2011.
- Using MUSIC in Sydney’s Drinking Water Catchments, SCA, 2012.
- New South Wales MUSIC Modelling Guidelines, BMT WBM, 2015.

1.3 Site Description

The land to be rezoned is bounded Medowie Rd to the west, Ferodale Road to north, 56 Ferodale Road to the east and an existing residential subdivision to the south (Macadamia Circuit) and has a total area of 7.7 hectares.

A natural watercourse traverses the site from north-east to south-west. Existing site topography grades at 3% to 6% towards the watercourse.

Lots 3-8 currently contain single residential dwellings and ancillary structures, consistent with rural residential land uses. The site has been partially cleared with some scattered vegetation throughout, with denser areas of vegetation centred on the south-eastern portion of the watercourse.

1.4 Proposed Development

The proposed development of Lots 3 to 8 is understood to consist of:

- A commercial area including supermarket, retail spaces, cafés and fast-food offices, public amenities.
- A childcare centre.
- Residential areas on both sides of the watercourse consisting of mixture of detached dwellings and multi-occupancy.
- Associated road, car parking and stormwater management infrastructure.
- Establishment of a dedicated drainage reserve area around the watercourse for preservation of biodiversity including koala trees and natural habitats.

2. Stormwater Quality

2.1 Stormwater Quality Objectives

Two water quality objectives were adopted for this assessment.

- NorBE.
- PSC load-based reduction targets.

NorBE targets were assessed in accordance with Sydney Catchment Authority's guidelines "Using MUSIC in Sydney's Drinking Water Catchments". By design, NorBE targets are variable, depending heavily on the pre-developed condition of the catchment. The following criteria are required to be satisfied to achieve NorBE:

1. Pollutant loading post-development for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN) are to be a minimum of 10% less than pre-developed levels.
2. Pollutant loading post-development for gross pollutants (GP) must be less than or equal than pre-developed levels.
3. Pollutant concentrations for nutrients TP and TN post-development must be equal to or better than pre-developed concentrations over a minimum 5-year modelling period, between the 50th and 98th percentile runoff events.

In addition to NorBE requirements, PSC's DCP specifies load-based water quality targets for all developments larger than 2000 m². The reduction targets vary depending on if the development is located within a sensitive catchment. For the purposes of this assessment and noting the subject site

is located in a drinking water catchment, sensitive targets have been adopted. The required reduction targets are reproduced in Table 1.

Table 1 – PSC minimum load-based treatment criteria for sensitive catchments.

| Pollutant | Reduction Target |
|-----------|--|
| TSS | 85% retention of the annual average load |
| TP | 65% retention of the average annual load |
| TN | 50% retention of the average annual load |
| GP | 90% reduction of the average annual load |

2.2 Proposed Treatment Strategy

For undeveloped sites with low rates of nutrient generation, achieving NorBE targets typically requires substantial area be set aside for tertiary treatment. Noting the subject site is already constrained by flooding, provision of required tertiary treatment area on site is considered uneconomical due to the substantial loss of developable land.

As an alternative, PSC have indicated that provision of water quality treatment for an external catchment may be considered to achieve NorBE targets. This would be subject to adequate treatment measures being provided within the development site to meet Council's load-based targets.

A potential external catchment has been identified as a portion of residential to the north-east of the development site. The piped drainage system for this catchment currently discharges under Ferodale Road onto the subject site via an open channel and culvert. Subject to detailed investigations, it is proposed to provide an end-of-line gross pollutant trap adjacent to Ferodale Road catering to this catchment. The approximate extent of the external treatable catchment area is shown in Figure 2.



Figure 2 – External catchment to be treated.

2.3 Catchments

2.3.1 Pre-developed Scenario

As shown in Figure 2, the pre-developed catchment area comprised the subject site (Lots 3-8), the neighbouring land (Lots 1 & 2) and the upstream external catchment to be treated. The existing fraction impervious for each catchment was estimated based on aerial imagery.

It has assumed that Lots 1 and 2 and the external residential catchment do not have any existing water quality treatment measures currently in place. Pre-developed catchment areas and impervious area assumptions are summarised in Table 2.

Table 2 – Pre-developed MUSIC catchment summary.

| Catchment | Total Area (ha) | MUSIC Zoning/Surface Type | Existing Impervious Fraction |
|--------------------------------|-----------------|---------------------------|------------------------------|
| Lots 3 – 8 (development site) | 7.76 | Rural residential | 5% |
| Lots 1 – 2 (neighbouring land) | 2.45 | Rural residential | 20% |
| External residential catchment | 9.36 | Residential | 60% |
| Total catchment area | 19.57 | | |

2.3.2 Post-developed Scenario

For the development site, a preliminary development masterplan was used to establish end land uses. For the neighbouring land to be rezoned, a blanket residential zoning was assumed, consistent with the proposed zoning.

Within the development site, the following catchment assumptions were adopted:

- For residential zones:
 - 300 sq.m roof area for single dwellings and 200 sq.m for multi-dwellings.
 - Remaining impervious area 50% of the non-roof lot area.
- For commercial lots:
 - Roof area adopted from masterplan
 - Remaining impervious area 80% of the non-roof lot area.
- For both commercial and residential zones:
 - 75% of assumed roof area assumed to be directed to rainwater reuse, with the remainder directly connected to the stormwater system.

With regards to the neighbouring land Lot 1 has an approved Development Application (DA) for a future swimming centre. At time of writing there is currently no known development proposed for Lot 2. For the purposes of modelling, it was assumed 50% portion of the total lot area in Lots 1 and 2 would be developed in the future with an assumed impervious fraction of 80%.

Catchment delineations are shown in Figure 3 with parameters summarised in Table 3.



Figure 3 – Post-developed catchments.

Table 3 – Post-developed MUSIC catchment summary.

| Catchment ID | Description | Area (ha) | Zoning/Surface Type | Assumed Impervious Fraction |
|--------------|---|-----------|---------------------|-----------------------------|
| RN1 | Residential North Roof to reuse | 0.79 | Roof | 100% |
| RN2 | Residential North Remainder + Roof Missing Tanks | 0.73 | Residential | 68% |
| RS1 | Residential South Roof to reuse | 0.50 | Roof | 100% |
| RS2 | Residential South Remainder + Roof Missing Tanks, untreated | 0.47 | Residential | 80% |
| RS3 | Residential South Remainder + Roof Missing Tanks, treatable by filter baskets | 0.16 | Residential | 100% |
| C1 | Childcare Roof to reuse | 0.08 | Residential | 80% |
| C2 | Childcare Remainder + Roof Missing Tanks | 0.22 | Roof | 100% |
| C3 | Commercial Precinct Roof to Reuse | 0.40 | Commercial | 90% |

| | | | | |
|------|--|------|------------------|------|
| C4 | Commercial Precinct Remainder + Roof Missing Tanks | 1.53 | Roof | 100% |
| RO1 | Public Roadway | 0.84 | Sealed Road | 70% |
| W1 | Drainage Reserve Lot 3-8 | 2.04 | Revegetated Land | 0% |
| RE1 | Lot 1 and 2 Residential | 2.45 | Residential | 40% |
| OFR1 | Offsite Catchment | 9.36 | Commercial | 60% |

2.3.3 Model Setup

Port Stephens Council (PSC) provides standardised MUSIC modelling parameters including meteorological data and soil conditions via the MUSIC-Link feature. Within this, four rainfall zones can be adopted dependent on location and soil type. For this assessment, Zone B (Meadowie and Raymond Terrace) was adopted with clay type soils.

Where necessary, remaining modelling parameters were adopted from the NSW Music Modelling Guidelines (BMT, 2015). A MUSIC-Link report is included in Appendix A.

2.3.4 Proposed Treatment Measures

Treatment for the development site will be provided via a combination of discrete on-lot treatment, primarily rainwater harvesting tanks and end of line treatment via a GPT and biofiltration basin. Proposed treatment measures are summarised in Table 4.

Table 4 – Pre-developed catchment summary.

| Proposed Measure | Treatment Type | Description |
|---|----------------|--|
| Gross pollutant traps (e.g. Humes HumeGard or equivalent) | Primary | <p>A proprietary gross pollutant trap is proposed to cater for the northern portion of the development site and internal public roadway.</p> <p>In addition, a gross pollutant trap is proposed at the outlet of the external catchment 'OFR1'.</p> <p>GPTs provide primary treatment prior to discharge to secondary and tertiary treatment measures. They are primarily designed to remove litter, debris and coarse sediment from runoff to protect downstream secondary and tertiary treatment measures.</p> |
| Biofiltration Basins | Tertiary | <p>A biofiltration basin with minimum filter area 500 m² has been proposed within the development site, immediately downstream of the proposed GPT.</p> <p>Biofiltration systems are shallow, vegetated water bodies that utilise fine filtration and biological uptake processes to remove pollutants from stormwater.</p> |
| Rainwater Reuse Tanks | Secondary | <p>Rainwater tanks have been provided for individual residential and commercial lots. The following tank sizes were assumed for this investigation:</p> <ul style="list-style-type: none"> Residential lots – 2 kL per dwelling Childcare centre (C1, C2) – 10 kL Commercial precinct (C3, C4) – 20 kL |

It is noted that the above reuse volumes are preliminary estimates and larger volumes may be required at development application stage.

As noted in section 2.3.2, 75% of the assumed roof area was assumed to be directed to the reuse tank.

Assumed rainwater re-use rates for residential dwellings is consistent with the values provided in the NSW MUSIC Modelling Guidelines (BMT, 2015), based on internal reuse for toilet and laundry connections. Reuse within commercial zones was estimated based on estimated number of toilet fixtures and external irrigation rates. Adopted reuse rates are as follows:

- Residential lots – 0.124 kL/day per dwelling
- Childcare centre (C1) – 1 kL/day
- Commercial precinct (C3) – 2 kL/day

| | | |
|--|---------|---|
| Proprietary on-lot gross pollutant capture (e.g. Ocean Protect OceanGuard or equivalent) | Primary | <p>Due to topography of the site, it is expected the southern residential area will not be able to drain to the proposed end of line treatment measures. As such, it has been assumed that the majority of this catchment will discharge directly to the watercourse without additional treatment beyond rainwater tanks.</p> <p>It is understood however a portion of the residential land is to be developed as multi-dwelling complexes. For such sites it is appropriate to assume that full or partial on-lot treatment will be required by PSC. To reflect this, proprietary pit filter inserts were modelled for 25% of the southern catchment, in addition to rainwater reuse tanks.</p> <p>Pit filter inserts capture gross pollutants and fine sediment from runoff, as well as removing small amounts of nutrients and fine sediments attached to larger items captured.</p> |
|--|---------|---|

Treatment measures for Lots 1 and 2 were not modelled in detail. For the purposes of assessing NorBE, it has been assumed that any future commercial development will implement on-lot treatment measures sufficient to achieve PSC's load-based targets as per Table 1. This was represented in MUSIC as a generic treatment node achieving these targets.

Proposed end of line treatment measures are illustrated in Figure 4. The MUSIC model setup is shown in Figure 5.

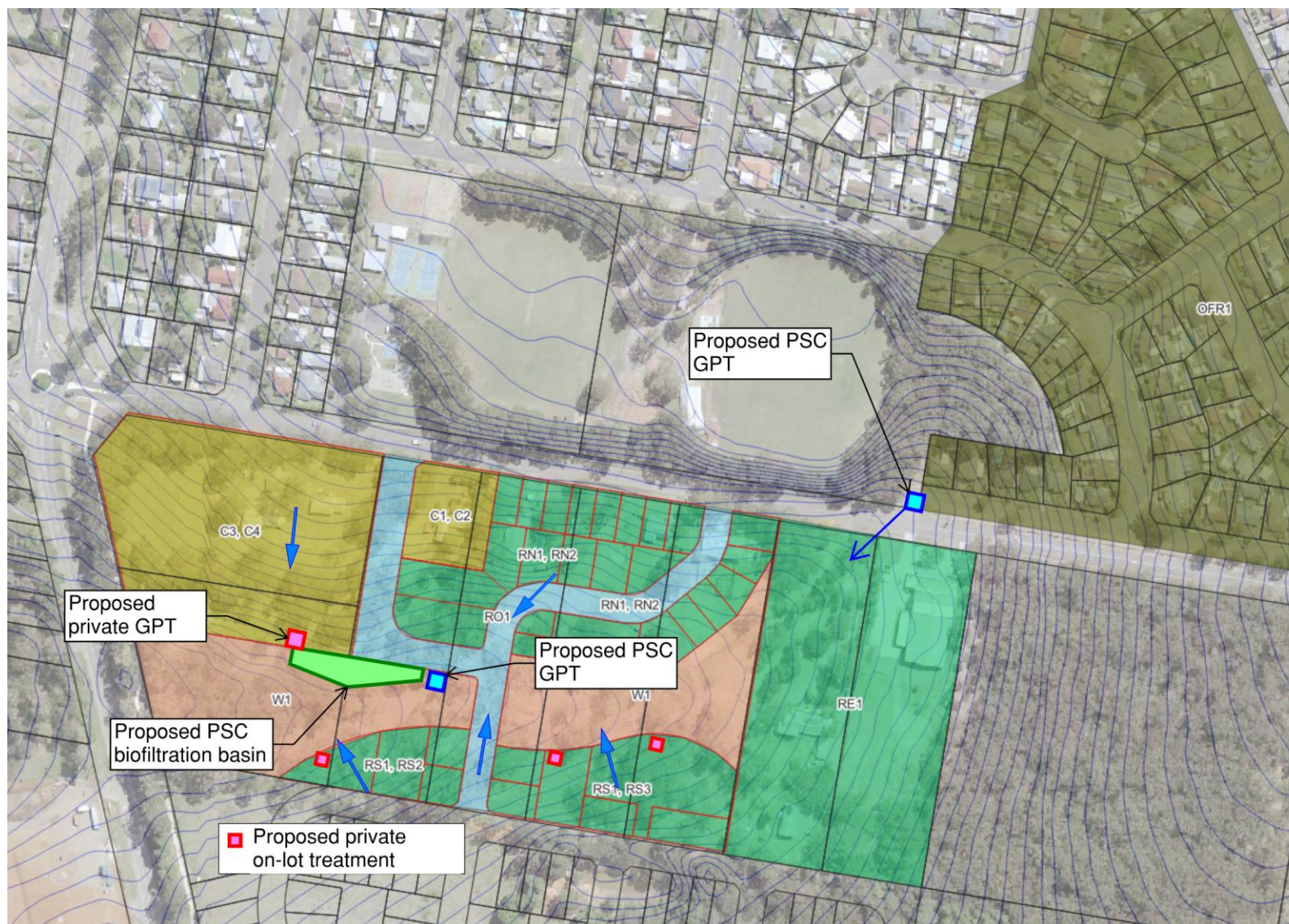


Figure 4 – Proposed treatment devices.

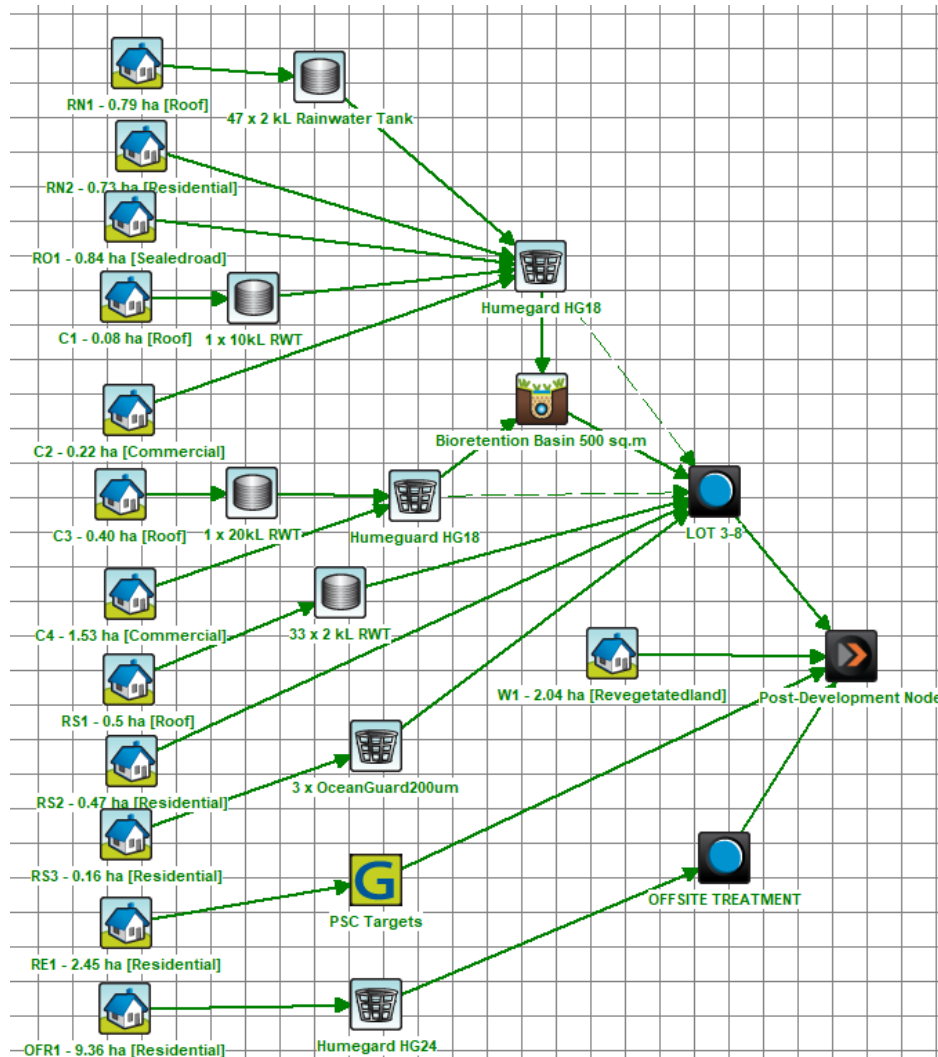


Figure 5 – MUSIC model post-developed schematic.

2.4 MUSIC Results

2.4.1 PSC Reduction Target Criteria (Lots 3-8)

The performance of the proposed treatment measures for Lots 3-8 (the site) is provided in Table 5.

Table 5 – MUSIC results – pollutant load reduction against PSC targets (Lots 3-8 only).

| Pollutant | Source Loading (kg/year) | Residual Loading (kg/year) | Percentage Reduction | Target Reduction |
|------------------------------|--------------------------|----------------------------|----------------------|------------------|
| Total Suspended Solids (TSS) | 7270 | 1110 | 85% | 85% |
| Total Phosphorus (TP) | 13.8 | 4.7 | 66% | 60% |
| Total Nitrogen (TN) | 109 | 49.0 | 55% | 50% |
| Gross Pollutants (GP) | 1320 | 90.7 | 93% | 90% |

The proposed treatment measures are therefore sufficient to achieve pollutant load reductions in accordance with PSC's targets.

2.4.2 NorBE Criteria

For the NorBE assessment, the broader catchment was considered, inclusive of Lots 1 and 2 and the offsite treatment area. Pre and post-development pollutant loading results are provided in Table 6.

Table 6 – MUSIC results – pre- and post-developed comparison.

| Pollutant | Pre-developed Source Loading (kg/year) | Post-developed Residual Loading (kg/year) | Net Reduction |
|------------------------------|--|---|---------------|
| Total Suspended Solids (TSS) | 16200 | 8300 | Yes, >10% |
| Total Phosphorus (TP) | 27.9 | 19.3 | Yes, >10% |
| Total Nitrogen (TN) | 218 | 184 | Yes, >10% |
| Gross Pollutants (GP) | 2360 | 321 | Yes |

The above results demonstrate that the treatment measures proposed under the rezoning proposal result in a net reduction in pollutant loading, satisfying NorBE criteria #1 and #2.

For assessment of criteria #3, cumulative frequency plots of nutrient concentrations for total nitrogen and total phosphorous are provided in Figure 6 and Figure 7.

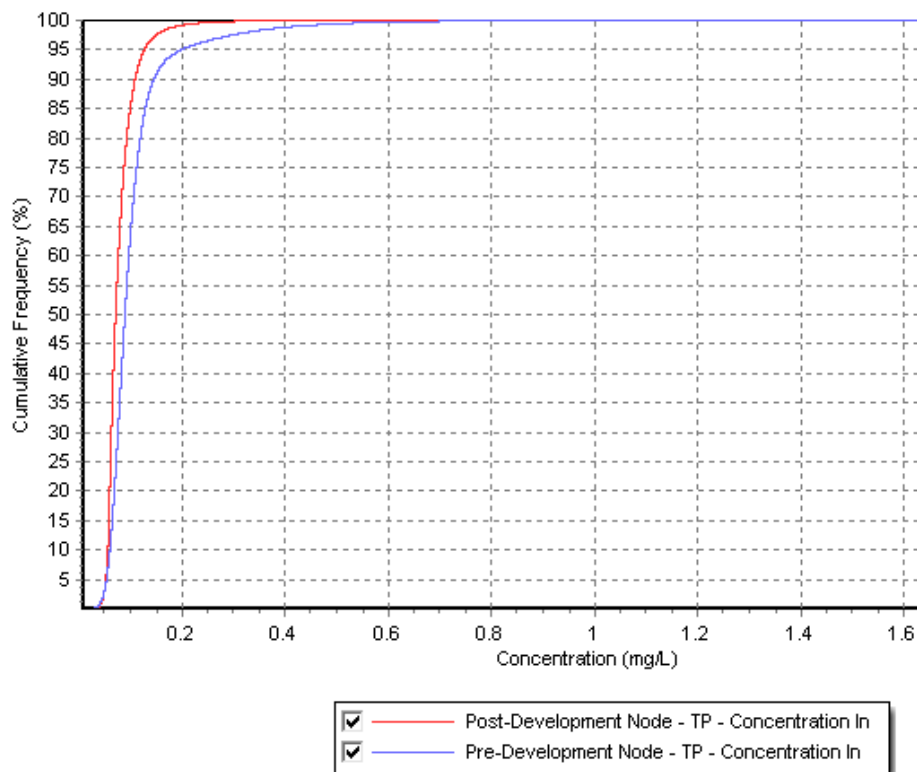


Figure 6 – Total phosphorous (TP) pre and post-developed concentration.

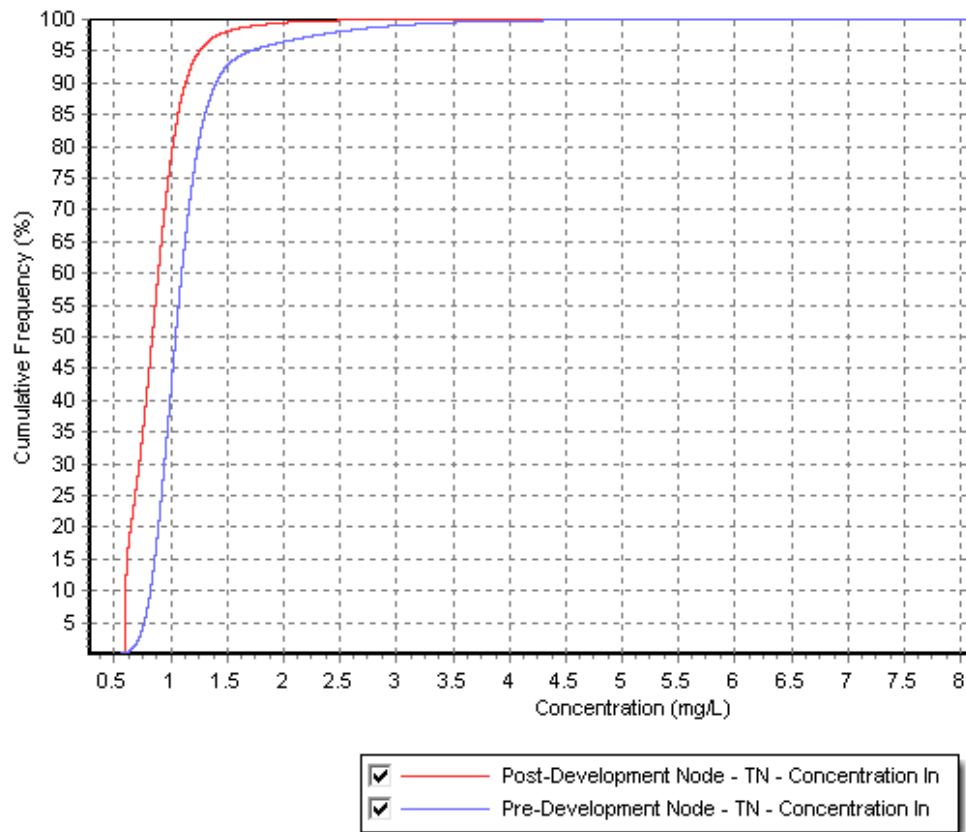


Figure 7 – Total nitrogen (TN) pre and post-developed concentration.

The above graphs demonstrate that post-developed nutrient concentrations between the 50th and 98th frequency percentiles are less than the pre-developed case and as such, NorBE can be achieved at the site.

3. Conclusion

Based on the preliminary water sensitive urban design assessment undertaken, the subject site is recommended for rezoning assessment on the grounds of sufficient opportunities for stormwater quality management. Determination of specific water sensitive urban design measures for the development will be established at the time of development application in consultation with PSC, inclusive of necessary external treatment measures necessary to achieve NorBE outcomes.

Appendix A – MUSICLink Report

MUSIC-*link* Report

| Project Details | | Company Details | |
|---------------------------------|--|-----------------|----------------------------------|
| Project: | | Company: | Northrop |
| Report Export Date: | 22/05/2025 | Contact: | Andrew Killen |
| Catchment Name: | NL240432_Medowie_CD [I] 250522 | Address: | 215 Pacific Highway, Charlestown |
| Catchment Area: | 5.71ha | Phone: | 02 4943 1777 |
| Impervious Area*: | 149.3% | Email: | akillen@northrop.com.au |
| Rainfall Station: | WILLIAMTOWN RAAF - Station 061078 - Zone B | | |
| Modelling Time-step: | 6 Minutes | | |
| Modelling Period: | 1/01/1998 - 31/12/2007 11:54:00 PM | | |
| Mean Annual Rainfall: | 1125mm | | |
| Evapotranspiration: | 1394mm | | |
| MUSIC Version: | 6.4.0 | | |
| MUSIC-link data Version: | 6.40 | | |
| Study Area: | Williamstown | | |
| Scenario: | Sensitive Catchment - Clay soils | | |

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

| Treatment Train Effectiveness | | Treatment Nodes | | Source Nodes | |
|-------------------------------|-----------|----------------------|--------|-------------------|--------|
| Node: LOT 3-8 | Reduction | Node Type | Number | Node Type | Number |
| Flow | 9.61% | Rain Water Tank Node | 4 | Urban Source Node | 16 |
| TSS | 84.9% | Bio Retention Node | 1 | | |
| TP | 65.7% | GPT Node | 4 | | |
| TN | 54.9% | Generic Node | 1 | | |
| GP | 93.1% | | | | |

Comments

N/A

Passing Parameters

| Node Type | Node Name | Parameter | Min | Max | Actual |
|-----------|-----------------------------|-------------------------------|------|------|---------|
| Bio | Bioretention Basin 500 sq.m | Hi-flow bypass rate (cum/sec) | None | None | 100 |
| Bio | Bioretention Basin 500 sq.m | PET Scaling Factor | 2.1 | 2.1 | 2.1 |
| GPT | 3 x OceanGuard200um | Hi-flow bypass rate (cum/sec) | None | 99 | 0.12 |
| GPT | Humegard HG18 | Hi-flow bypass rate (cum/sec) | None | 99 | 0.6 |
| GPT | Humegard HG24 | Hi-flow bypass rate (cum/sec) | None | 99 | 1.05 |
| GPT | Humeguard HG18 | Hi-flow bypass rate (cum/sec) | None | 99 | 0.6 |
| Post | Post-Development Node | % Load Reduction | None | None | 3.5 |
| Post | Post-Development Node | GP % Load Reduction | 90 | None | 91 |
| Pre | Pre-Development Node | % Load Reduction | None | None | 0 |
| Rain | 1 x 10kL RWT | % Reuse Demand Met | None | None | 89.4188 |
| Rain | 1 x 20kL RWT | % Reuse Demand Met | None | None | 92.10 |
| Rain | 33 x 2 kL RWT | % Reuse Demand Met | None | None | 83.40 |
| Rain | 47 x 2 kL Rainwater Tank | % Reuse Demand Met | None | None | 83.9992 |
| Urban | C1 - 0.08 ha | Area Impervious (ha) | None | None | 0.08 |
| Urban | C1 - 0.08 ha | Area Pervious (ha) | None | None | 0 |
| Urban | C1 - 0.08 ha | Total Area (ha) | None | None | 0.08 |
| Urban | C2 - 0.22 ha | Area Impervious (ha) | None | None | 0.182 |
| Urban | C2 - 0.22 ha | Area Pervious (ha) | None | None | 0.037 |
| Urban | C2 - 0.22 ha | Total Area (ha) | None | None | 0.22 |
| Urban | C3 - 0.40 ha | Area Impervious (ha) | None | None | 0.4 |
| Urban | C3 - 0.40 ha | Area Pervious (ha) | None | None | 0 |
| Urban | C3 - 0.40 ha | Total Area (ha) | None | None | 0.4 |
| Urban | C4 - 1.53 ha | Area Impervious (ha) | None | None | 1.295 |
| Urban | C4 - 1.53 ha | Area Pervious (ha) | None | None | 0.234 |
| Urban | C4 - 1.53 ha | Total Area (ha) | None | None | 1.53 |
| Urban | OFR1 - 9.36 ha | Area Impervious (ha) | None | None | 5.597 |
| Urban | OFR1 - 9.36 ha | Area Pervious (ha) | None | None | 3.762 |
| Urban | OFR1 - 9.36 ha | Total Area (ha) | None | None | 9.36 |
| Urban | PRE1 LOT 3-8 | Area Impervious (ha) | None | None | 0.399 |
| Urban | PRE1 LOT 3-8 | Area Pervious (ha) | None | None | 7.360 |
| Urban | PRE1 LOT 3-8 | Total Area (ha) | None | None | 7.76 |
| Urban | PRE2 LOT 1-2 | Area Impervious (ha) | None | None | 0.489 |
| Urban | PRE2 LOT 1-2 | Area Pervious (ha) | None | None | 1.960 |
| Urban | PRE2 LOT 1-2 | Total Area (ha) | None | None | 2.45 |
| Urban | PRE3 OFFSITE CATCHMENT | Area Impervious (ha) | None | None | 5.573 |
| Urban | PRE3 OFFSITE CATCHMENT | Area Pervious (ha) | None | None | 3.786 |
| Urban | PRE3 OFFSITE CATCHMENT | Total Area (ha) | None | None | 9.36 |
| Urban | RE1 - 2.45 ha | Area Impervious (ha) | None | None | 0.984 |
| Urban | RE1 - 2.45 ha | Area Pervious (ha) | None | None | 1.465 |
| Urban | RE1 - 2.45 ha | Total Area (ha) | None | None | 2.45 |

Only certain parameters are reported when they pass validation

| Node Type | Node Name | Parameter | Min | Max | Actual |
|-----------|---------------|----------------------|------|------|--------|
| Urban | RN1 - 0.79 ha | Area Impervious (ha) | None | None | 0.79 |
| Urban | RN1 - 0.79 ha | Area Pervious (ha) | None | None | 0 |
| Urban | RN1 - 0.79 ha | Total Area (ha) | None | None | 0.79 |
| Urban | RN2 - 0.73 ha | Area Impervious (ha) | None | None | 0.497 |
| Urban | RN2 - 0.73 ha | Area Pervious (ha) | None | None | 0.232 |
| Urban | RN2 - 0.73 ha | Total Area (ha) | None | None | 0.73 |
| Urban | RO1 - 0.84 ha | Area Impervious (ha) | None | None | 0.587 |
| Urban | RO1 - 0.84 ha | Area Pervious (ha) | None | None | 0.252 |
| Urban | RO1 - 0.84 ha | Total Area (ha) | None | None | 0.84 |
| Urban | RS1 - 0.5 ha | Area Impervious (ha) | None | None | 0.5 |
| Urban | RS1 - 0.5 ha | Area Pervious (ha) | None | None | 0 |
| Urban | RS1 - 0.5 ha | Total Area (ha) | None | None | 0.5 |
| Urban | RS2 - 0.47 ha | Area Impervious (ha) | None | None | 0.269 |
| Urban | RS2 - 0.47 ha | Area Pervious (ha) | None | None | 0.195 |
| Urban | RS2 - 0.47 ha | Total Area (ha) | None | None | 0.465 |
| Urban | RS3 - 0.16 ha | Area Impervious (ha) | None | None | 0.089 |
| Urban | RS3 - 0.16 ha | Area Pervious (ha) | None | None | 0.065 |
| Urban | RS3 - 0.16 ha | Total Area (ha) | None | None | 0.155 |
| Urban | W1 - 2.04 ha | Area Impervious (ha) | None | None | 0 |
| Urban | W1 - 2.04 ha | Area Pervious (ha) | None | None | 2.037 |
| Urban | W1 - 2.04 ha | Total Area (ha) | None | None | 2.037 |

Only certain parameters are reported when they pass validation

Failing Parameters

| Node Type | Node Name | Parameter | Min | Max | Actual |
|-----------|-----------------------|----------------------|-----|------|--------|
| Post | Post-Development Node | TN % Load Reduction | 45 | None | 37.4 |
| Post | Post-Development Node | TP % Load Reduction | 60 | None | 49.6 |
| Post | Post-Development Node | TSS % Load Reduction | 90 | None | 62.5 |
| Pre | Pre-Development Node | GP % Load Reduction | 90 | None | 0 |
| Pre | Pre-Development Node | TN % Load Reduction | 45 | None | 0 |
| Pre | Pre-Development Node | TP % Load Reduction | 60 | None | 0 |
| Pre | Pre-Development Node | TSS % Load Reduction | 90 | None | 0 |

Only certain parameters are reported when they pass validation