Stormwater Management Study

South Kiama Subdivision
Rezoning
15158 – February 2021

siteplus

planning . engineering . landscape . design . management

STORMWATER MANAGEMENT STUDY

SOUTH KIAMA SUBDIVISION

PREPARED FOR

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PREPARED BY

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EXECUTIVE SUMMARY

On behalf of White Constructions Pty Ltd (WC), Site Plus has prepared a stormwater management study for the proposed rezoning of the land on the western side of the Princes Highway between Saddleback Mountain Road and Weir Street, Kiama

As part of the approval process WC requires an assessment of the proposed site in terms of its capacity to generate stormwater-borne pollutants and stormwater peak flows; and then assess the effectiveness of the proposed measures to mitigate the impacts of both stormwater pollutants and stormwater peak flows.

The site has a total area of 42.4 hectares and will create 407 residential lots. The site is traversed by four well defined creeks dividing the site into three distinct catchments.

The study site is current grazing agricultural land to the south west of Kiama Town Centre and is contained on three sides by Saddleback Mountain Road to the north, The Princes Highway to the west and Weir Street to the South.

This report considers both the stormwater peak flows and stormwater runoff quality of the proposed development. The computer model DRAINS has been used for stormwater runoff and detention storage (OSD) calculations, and the MUSIC (Model for Urban Stormwater Improvement Conceptualisation) model has been used for water quality assessment.

The DRAINS models illustrates that the existing downstream drainage infrastructure passing under the Princes Highway has adequate capacity to safely convey storm for events up to and including what they were designed for (2% AEP). It also illustrates that the proposed development has no adverse effect on peak flow on any of the downstream properties.

The two northern catchments require OSD to be able to ensure there is no increase in peak flow downstream of the Princes Highway culverts in all events up to and including the 1% AEP event.

Modelling has shown that due to the location of the development within the southern catchment (the Munna Munnora Creek catchment) there is no need for OSD within this catchment as the storm peak for the developed area is well advanced of the peak in the hydrograph for the whole catchment at the point of development. This is a result of the development being located near the outlet of a long catchment.

Water Sensitive Urban Design (WSUD) principles have been adopted where considered appropriate. The proposed stormwater drainage concept presents a WSUD strategy for the site incorporating bio-retention basins and gross pollutant traps. The conceptual strategy has been designed and assessed to meet and comply with Kiama Councils WSUD Design Policy 2005 targets. In order to ensure that the highest standard of water quality targets were adhered to, a Neutral or Beneficial Effect (NorBE) assessment has also been undertaken. The WSUD elements will reduce wastewater generation and protect downstream environments.

1. INTRODUCTION

1.1. Preliminary

1.1.1. Siteplus Engagement

White Constructions Pty Ltd (WC) has engaged Site Plus Pty Ltd (Siteplus) to prepare a Stormwater Management Report for the proposed residential subdivision of the property at Lot 1 DP.707300, Lot 5 DP.740252 & Lot 101 DP.1077617 Kiama. Access to the site will be from Saddleback Mountain Road and the extension of Weir Street.

The subject site has an area of 42.4 hectares.

The proposed development is a 407 lot torrens title residential development.

1.1.2. Scope of Work

Siteplus has been engaged by WC to carry out the following services:

- Examine the existing site and determine the peak flows and mean annual pollutant loads leaving the site through the stormwater;
- Study the proposed development and its effects on peak flows and water quality;
- Design appropriate detention and water quality devices to meet the environmental standards set by Kiama Municipal Council, and to achieve the required pollutant removal objectives as set in the Water Sensitive Urban Design Policy;
- Provide sizing of culverts for crossing of water bodies ensuring that safe access is provided for all storm events.
- Provide maintenance guidelines and procedures to ensure the functional longevity of the system; and
- Prepare a Stormwater Management Plan.

1.2. Subject Land

The subject site is located south west of the Kiama Town centre. It abuts the Princes Highway to the east and is situated within the Kiama Municipal Council LGA as shown in Figure 1.

Figure 1 Locality Map
source: www.nearmaps.com

1.3. Existing Site Features

1.3.1. Topography

The subject site falls steeply towards the Princes Highway in the east. Several ridges run through the site dividing the site into three well defined catchments. One being the Munna Munnora Creek and the other two small watercourses discharging at Kendall's Beach.

The Princes Highway forms a large embankment especially at the culvert conveying Munn Munnora Creek of roughly 12.0m

high, this embankment is the main controlling hydraulic structure for stormwater leaving the site.

Much of the land that makes up the proposed development site falls to the east at an average grade of around 15%.

There is a large catchment of approximately 300Ha to the west of the development site. It consists of generally quite steep farming land (approximately 20% grade) with scattered forest in the upper reaches.

Downstream of the site, past the Princes Highway, there is 700-1000m of residentially developed land before the outlet of the watercourses to the ocean at Kendalls and Easts Beaches.

1.3.2. Watercourses

There are four prescribed streams that run through the site. One of these, Munna Munnora Creek is a 3rd Order Stream whilst the others are 1st Order streams. The South most 1st Order watercourse forms a tributary of Munna Munnora Creek. The other 2 watercourses are unnamed water courses, discharging at Kendalls Beach.

In their current state, the channels are generally lightly vegetated. There is an area of significant wetland vegetation along Munna Munnora Creek immediately upstream of the triple culverts beneath the Princes Highway.

2. STUDY OBJECTIVES

The purpose of this study is to determine the impacts of a residential subdivision on stormwater runoff from the site, and to propose measures to mitigate these impacts where required.

2.1. Stormwater Quantity Requirements

The Kiama Municipal Council Drainage Policy requires that post development peak flows do not exceed those for pre-development events up to the 100yr storm event.

The proposed development will involve the construction of impervious surfaces that will generate a greater volume of runoff than the present site.

A catchment wide study has been undertaken upstream of the Princes Highway as it is the major controlling hydraulic structure. OSD will only be proposed where the modelling shows that there is an increase in peak flow leaving the site. The proposed method of OSD will be detention storage devices in the form of above ground basins controlled by the proposed Hydraulic structure. The proposed OSD calculations and results are discussed in detail within Section 3 of this report.

2.2. Onsite Detention System

If the development is to reduce the peak flows leaving the site back to pre-development levels, a single Basin within each major catchment will be proposed if the modelling demonstrates that it is required.

The use of single or multiple outlet structure will be assessed for each catchment depending on suitability.

2.3. Stormwater Pollution Control Targets

The targets outlined below are the objectives and targets consistent with Kiama Council WSUD policy 2005 targets.

The following targets are considered minimum standards for the proposed development:

- 45% retention of baseline load of Total Nitrogen (TN).
- 45% retention of baseline load of Total Phosphorous (TP).
- 80% retention of baseline load of Total Suspended Solids (TSS).
- 70% retention of baseline load of Total Gross Pollutants (GP) or litter.

To ensure the highest water quality target are met for the site, of NorBE assessment will also be undertaken for the site and a sensitivity analysis undertaken.

3. ONSITE DETENTION STORAGE

3.1. Proposed Stormwater Design

The existing contours of the site create a number of natural sub catchments. The proposed drainage design will maintain these natural catchments, conveying stormwater generated by the development towards the existing creeks containing the water quality and quantity devices where required as outlined in this report.

The proposed drainage system will make use of a pit and pipe network to convey minor flows with the excess flow for events beyond above the minor event to be conveyed by the road network. The road network will be suitable as an overflow route in this circumstance due to the relatively short reach length before discharging into the creek system. This will ensure that flood hazard will be kept an acceptable level up to an including the 100 year ARI event.

One aspect of stormwater impact is an increase in the peak flow of stormwater leaving an urbanised site. This will generally controlled by onsite detention basins where this study finds that it may be required.

3.1.1. OSD Basin

OSD will be provided on site at two road crossing within the site making up the two northern sub catchments. Conveying water beneath each crossing will be a culvert that will be sized to attenuate flows in all stormevents up to and including the 1% AEP event whilst still providing 500mm freeboard to the proposed road network.

Storage will be provided by the ponding upstream of the road embankment with a significant increase in the flood level in this site.

The provided OSD will ensure that peak flows leaving the site will be less than or equal to that leaving the site.

The system has been conceptually modelled in the accompanying SitePlus flood study and further details can be provided at the DA Stage.

3.1.2. Drainage Catchments

Preliminary road longitudinal grading's have been carried out as part of the rezoning process.

From this information it became clear that the site falls into four distinct sub-catchments. The attached DRAINS model contains the assumed catchments.

3.2. DRAINS Model

The DRAINS model for this application has been constructed to lump the major catchments of the site and model the effectiveness of the OSD by comparing the pre and post development scenarios. This allows an assessment of the major drainage structure proposed for the site.

DRAINS is a hydrograph based hydrological and hydraulic computer-based model that measures stormwater runoff and allows detention storage facilities to be analysed and designed.

It was assumed within the model that the land proposed for development was allocated a catchment with a fraction impervious of 70% whilst land that was either existing or not proposed to be modified within the development was left with a fraction impervious of 0%.

The design will be designed and analysed within DRAINS utilising the AR&R 87 design procedure. This will be the method to ensure that the basins perform as intended. As a check, AR&R16 procedures will also be run to ensure that a thorough investigation has been undertaken.

3.3. DRAINS Results

During the development of the model it became clear that the southern catchment within the site would not require OSD to ensure that there was no increase in the peak flows leaving the site. If OSD were to be provided there would be a negative impact on the peak discharge from the site. This is due to the location of the subject site close to the outlet of a large, narrow catchment (approximately 287Ha). The peak in the hydrograph produced by the development occurs significantly before that of the peak in the hydrograph of the whole catchment at the highway crossing. The decrease in the peak is due to quick run off times by the proposed impervious surfaces advancing the peak of the subject site further ahead of the whole catchment then it would have in the existing scenario.

The results show in Table 3-1 that the flow of Munna Munnora Creek beneath the Princes Highway through the triple culverts is reduced for all events up to and including the 100 year ARI.

The models did show however that the other two major catchments required OSD in order to reduce peak flows in the developed scenario to equal or less than that of the existing.

In the Northern catchment, draining to the 900mm and 1650mm Culverts, OSD will be in the form of a detention basin with a formed berm across the watercourse and a 1650mm dia RCP as the orifice. An overflow weir will convey flows in excess of the basin capacity controlling flows up to and including the 100 year ARI event.

In the middle catchment, OSD will be provided by the road crossing of the watercourse. A low flow, 1650mm dia RCP will be provided in the invert of the channel with three 1.8x0.9m box culverts to act as the weir. These culverts will also convey stormwater up to and including the PMF event so that the proposed road crossing the creek remains accessible in the case of an emergency.

The proposed measures above have all proven to sufficiently modify the hydrograph so that there is a reduction in the peak flow post development.

Table 3-1 on the next page illustrates the flow rates for both pre and post development scenarios for both the 10yr and 100yr storm events at the critical point mentioned above. Refer to the DRAINS results in Appendix A for further details. The Table shows peak flow reductions from the pre-development peak flows across each sub-catchment.

It is noted that this study has been undertaken to support the rezoning of the site and a more detailed design and analysis would be completed with any further development of the site.

However the above work shows that any future development can be undertaken in accordance with Kiama Municipal Councils Development Standards.

Table 3-1 Pre and Post Development Peak Flows

Sub-Catchment	Peak Flows (m^3/s)			
	10 Year		100 Year	
	Pre	Post	Pre	Post
Munna Munnora Creek	55.6	54.0	104	98.6
Middle Catchment	13.8	12.8	20.8	20.6
900mm Culvert	1.27	0.22	1.98	0.32
1650mm Culvert	6.28	6.07	9.89	8.25

4. STORMWATER QUALITY

4.1. Climate Information

4.1.1. General

MUSIC requires historical rainfall data to determine the pollutant loadings leaving the site. It is best practice to use a sample which consists of higher than average rainfall or wet years. The data used was sourced from the Port Kembla rain gauge from 1970 to 1980. The data was recorded in 5 minute intervals to attain an accurate Metrological template.

4.1.2. Bureau of Meteorology Data

The Historical rainfall data used within the MUSIC model was attained from the Port Kembla Steel works rain gauge and consisted of 5 minute recordings from the year 1970 to 1980 Figure 2 illustrates the recorded historical rainfall during this period.

4.1.3. Evapo-transpiration Data

The evaporation or evapo-transpiration data is a required input for MUSIC. The evaporation data used for the subject model was also attained for the Sydney region. A monthly average was used within the model and is shown through the red line in Figure 2.

4.1.4. Meteorological Template

The meteorological template combines both the evapo-transpiration and historical rainfall data. The meteorological template is shown in Figure 2 for the year of 1970 to 1980.

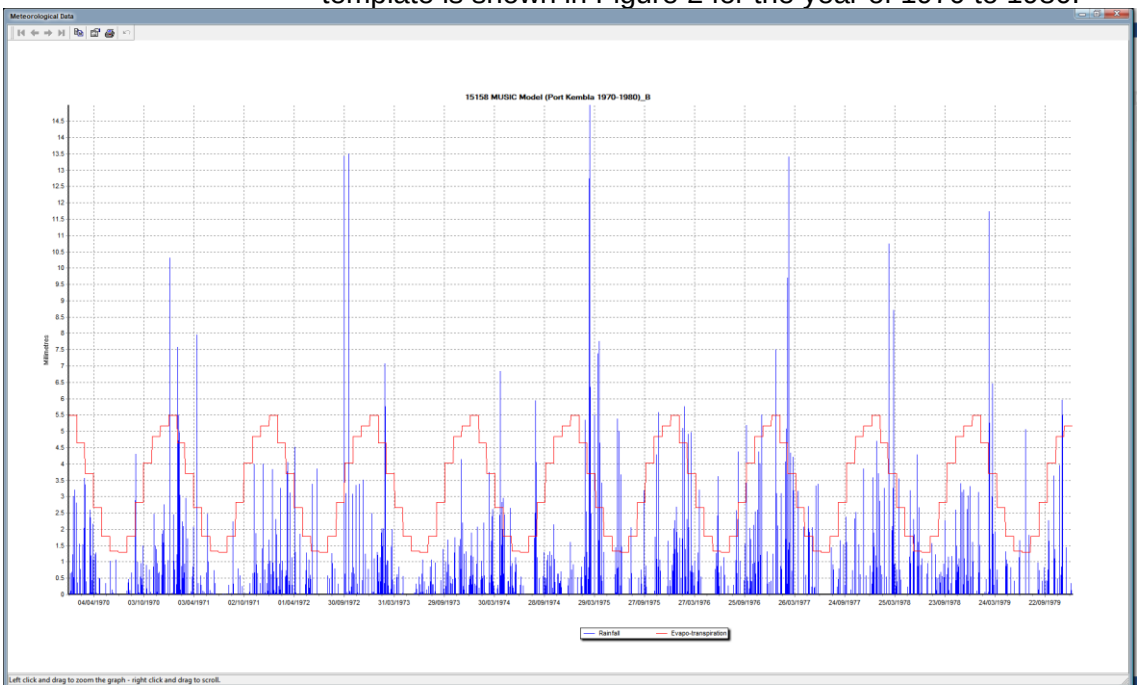


Figure 2 Meteorological Template
source: MUSIC model

4.2. Source Nodes

4.2.1. Proposed Development Sources

The post development scenario was modelled within MUSIC. The roof area of the lots was modelled as 100% impervious draining to a rainwater tank on each lot. All other area not connected to the rainwater tanks including the road reserve was modelled as 70% impervious.

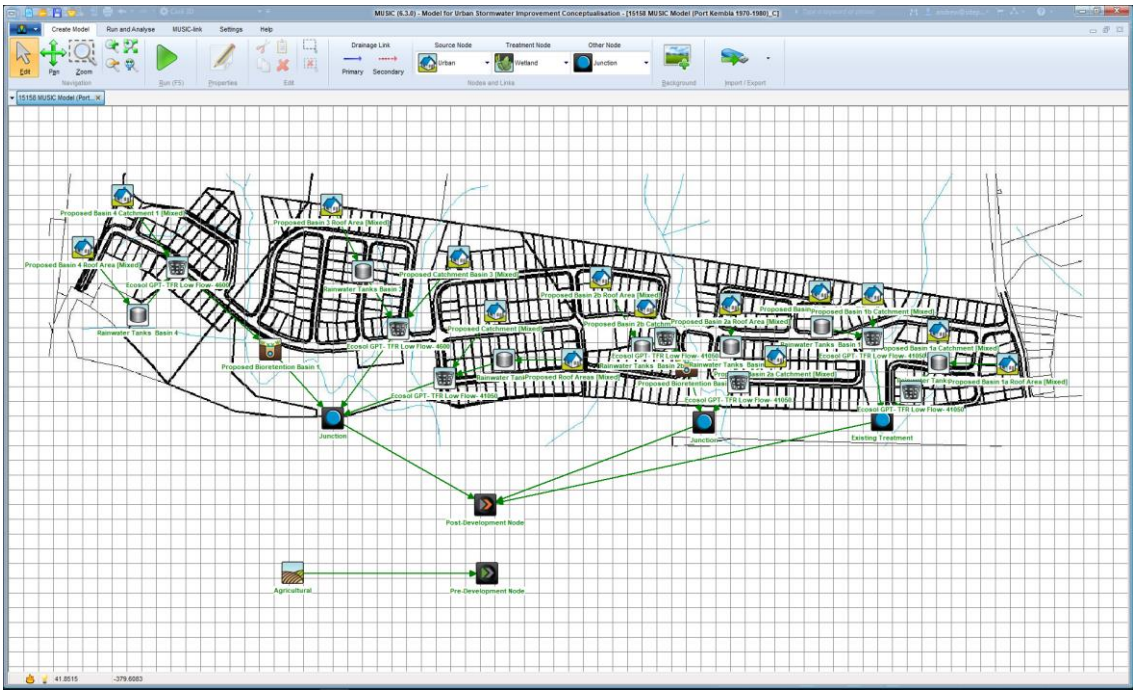


Figure 3 MUSIC Model Schematic Diagram
source: MUSIC model

4.3. Treatment Nodes

4.3.1. Treatment Train Proposed

The treatment train developed for the site consists of a number of treatment measures to remove pollutants whilst conveying the stormwater offsite.

4.3.2. Gross Pollutant Trap

A Gross Pollutant Trap (GPT) has been proposed to treat all stormwater prior to discharge to a watercourse or water quality basin. Seven have been modelled in total. The parameters for the proposed treatment unit are as provided by the manufacturer. These are identical to those previously approved by Kiama Municipal Council at other locations.

- 90% removal of Gross pollutants
- 80% removal of suspended solids
- 45% removal of Phosphorus
- 45% removal of Nitrogen

The proposed GPT's are a propriety system and any replacement shall meet the same targets.

4.3.3. Bio-retention swales

Two bio retention basins have been proposed across the subject site. The basins are an end of line treatment, removing nutrients from the stormwater, ensuring that it meets the requirements outlined by council. They are to be planted out with plants specifically chosen to be effective at nutrient removal.

The following table outlines the area of bio-retention system across the site. The following parameters were the inputs used within the MUSIC model.

Table 4-1 – Bio Retention Basin Areas

Structure	Bio-Retention Filter Media Area (m^2)	Bio-Retention Surface Area (m^2)
Basin 1	180	180
Basin 2	150	150
Total	**330**	**330**

Bio-retention systems filter stormwater using the natural infiltration process. The stormwater enters the swale and infiltrates through the filter media where a number of natural processes occur to remove the nutrients within the stormwater. The surface planting prevents fine sediment clogging the surface of the system, while the plant root mass aids in the nutrient uptake.

The bottom two sand and gravel transition layers direct the treated water into the perforated pipe and then to the downstream pipe network. Figure 4 outlines the proposed design of each bio-retention system within the proposed drainage design.

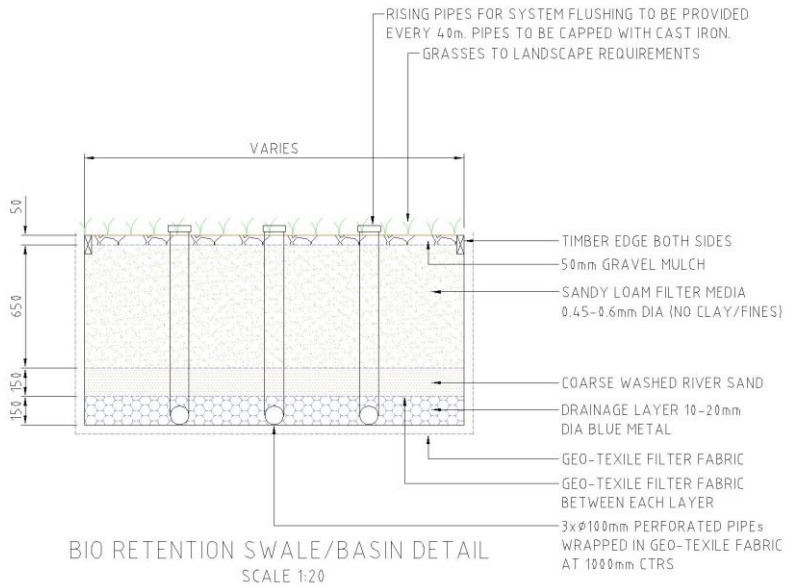


Figure 4. Bio-retention swale details

4.4. Monitoring and Maintenance Procedures

Monitoring and maintenance of water sensitive urban design control is critical to ensure their performance is retained throughout its life cycle. Unmaintained stormwater quality controls can fail leading to an increase of pollutant loads on receiving waters. The following section provides a guide into the monitoring and maintenance of both the gross pollutant traps and bio-retention swale proposed within the development.

Appendix C contains a sample maintenance and inspection checklist for all Gross Pollutant traps (GPT's) and Bio-retention Basins. The checklist should be used by the maintenance authority to ensure that the stormwater treatment devices are retained and function at the desired level.

4.4.1. Gross Pollutant Traps (GPT's)

GPT's should be cleaned every 3 months or after major storm events that exceed 35mm in total as per manufactures standards and specifications. The Ecosol RF100 gross pollutant traps specified can be easily cleaned as the basket unit can be removed from the pit. The following actions should be carried out every 3 month period:

- Remove litter and gross pollutants from basket via either material grab or suction means.
- Remove debris from inlet and outlet to ensure free flow through unit.
- Unblock screen and basket ensure that the basket has not compromised the function of the system.

4.4.2. Bio-retention Basins

Predictive and regular inspections should be carried out on a regular basis for each bio-retention system. The predictive inspection is based on a storm event that enables sediment transport roughly 35mm of rainfall in a single event.

The performance of the bio-retention basin can be based on the following performance indicators:

- Ponding Time, a maximum of 12 hours.
- Even flow distribution across the filter area. No concentrated flow paths should be present.

During the vegetation establishment period a Bio-retention systems should be inspected every 3 months or after a major rainfall event. During the establishment period the following should be monitored:

- Pounding, clogging or blockage of filter media. Untreated water should not be pooling on the surface of the system for extended periods of time.
- Vegetation and density of plants should be at the desired level. No bare patches or sand filter media should be visible on the surface of the system.

- Outlet should be free of debris and free flowing.
- Structures such as pits and weirs should be clear of debris and functioning correctly.
- Any litter should be removed from the filter area.
- Remove all weeds from both the batter slope and filter area. This should be carried out by hand or with targeted herbicide.
- All sedges and native grasses should be maintained or trimmed at an approximately 200mm high to ensure that both fuel load requirements and water treatment is constant.

(Upper Parramatta River Trust, 2004)

After the Bio-retention basin has been established correctly the monitoring and maintenance of the system can be reduced to a 6 monthly interval. During these inspections the following activities should be recorded and documented:

- Maintain free flow through the system.
- Maintain the surface vegetation as vigorous plant growth is important for treatment. This includes scheduled watering in dry periods.
- Prevent undesired growth of weeds and vegetation.
- Removal of debris and sediment.
- Any litter should be removed from the filter area.
- Remove all weeds from both the batter slope and filter area. This should be carried out by hand or with targeted herbicide.
- Remove excess or dead plant material which will increase the nutrient load on the system.

(Upper Parramatta River Trust, 2004)

4.5. Treatment Device Life Cycle Costings

4.5.1. Gross Pollutant Traps

The following costing is based on the standard MUSIC rates for GPT with a volume of 6.0 cubic metres. The GPT devices will have an annual maintenance cost of $2,904 per unit and an initial cost of approximately $64,848 per unit. The GPT device is expected to have a total life cycle of 50yrs.

4.5.2. Bio-retention Swales

The following preliminary costings are based on the standard rates applied by MUSIC with a 25yr renewal period and a total life cycle length of 50yrs.

The initial cost includes complete commissioning of the system, however it does not allow for rock excavation. The cost of each swale is detailed in the table below.

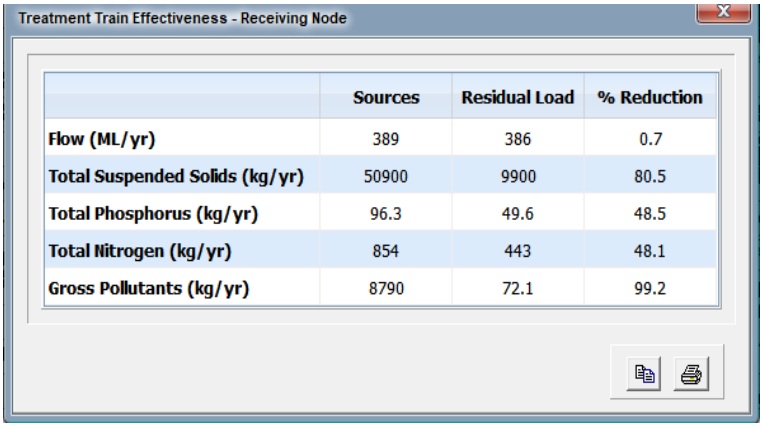
Table 4-2 – Bio-Retention Basin Life Cycle Costing

Structure	Basin Area (m^2)	Life Cycle Cost	Initial Cost	Maintenance Cost (year)
Basin 1	180	$121,417	$25,893	$5,366
Basin 2	150	$111,966	$22,513	$5,045

4.6. Water Quality Results

4.6.1. MUSIC Results

To determine the effectiveness of the treatment train the historical metrological template was simulated through the treatment measures proposed. The table below outlines the annual percentage reduction of pollutants when the proposed water treatment controls have been implemented.



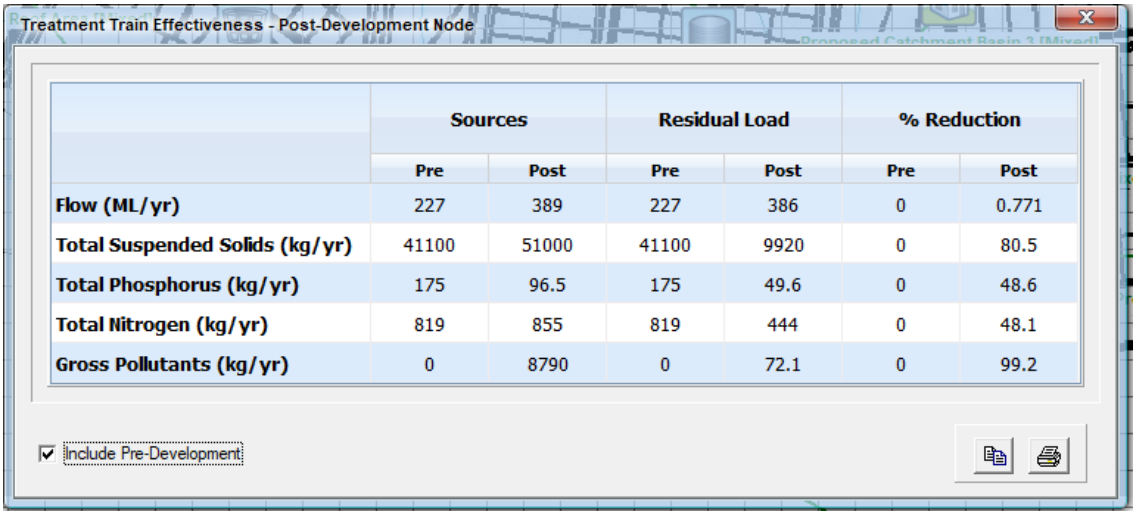
	Sources	Residual Load	% Reduction
Flow (ML/yr)	389	386	0.7
Total Suspended Solids (kg/yr)	50900	9900	80.5
Total Phosphorus (kg/yr)	96.3	49.6	48.5
Total Nitrogen (kg/yr)	854	443	48.1
Gross Pollutants (kg/yr)	8790	72.1	99.2

Figure 5 Treatment Train Effectiveness – Council Requirements

The MUSIC model finds that all the pollutants modelled have achieved the required targets of 80% reduction in Total Suspended Solids, and a 45% reduction of total Nitrogen and Phosphorus as set by Kiama Council at not only the final receiving node but also at each Junction in the model representing the Highway crossings.

The above table illustrates that the Best Practice targets as set by the EPA have been achieved. Therefore the proposed development will not have a negative impact on the receiving water bodies downstream. In reality the development will reduce the total pollutants leaving the site.

A NorBE assessment was also undertaken for the site to ensure that there was no increase in pollutants leaving the site as a result of the development. As is demonstrated in Figure 6 below, the site meets the requirements of a NorBE assessment for all pollutants except for Gross Pollutants where the agricultural node used produces no Gross Pollutants.



	Sources		Residual Load		% Reduction	
	Pre	Post	Pre	Post	Pre	Post
Flow (ML/yr)	227	389	227	386	0	0.771
Total Suspended Solids (kg/yr)	41100	51000	41100	9920	0	80.5
Total Phosphorus (kg/yr)	175	96.5	175	49.6	0	48.6
Total Nitrogen (kg/yr)	819	855	819	444	0	48.1
Gross Pollutants (kg/yr)	0	8790	0	72.1	0	99.2

5. CONCLUSION

A catchment wide drainage study was undertaken to assess the development of the site against Kiama Municipal Council's requirements for water quality and quantity control.

The following conclusion can be made regarding the catchment wide Drainage study and the provision of OSD within the development:

- No OSD will be provided within the Southern Catchment. It was found that providing OSD has the potential to increase the peak flow downstream of the three culverts beneath the Princes Highway. Due to the time of concentration of the whole Munna Munnora Creek catchment.
- Peak flows need to be controlled in the other two major catchments. The proposed measures outlined in this report adequately reduce the peak flow from the site so that is less than the existing scenario.

The development has proposed stormwater treatment measures which effectively remove pollutants in accordance with the Kiama Municipal Council WSUD Design Policy 2005 requirements. The proposed measures remove a full range of pollutants from larger gross pollutants to smaller dissolved pollutants for each sub catchment in the form of either gross pollutant traps or bio-retention basins at each outlet.

6. REFERENCES

BMT WBM Pty Ltd, 2010, *Draft NSW MUSIC modelling Guidelines*, NSW Government, Sydney Metropolitan Catchment Management Authority.

http://www.toolkit.net.au/music

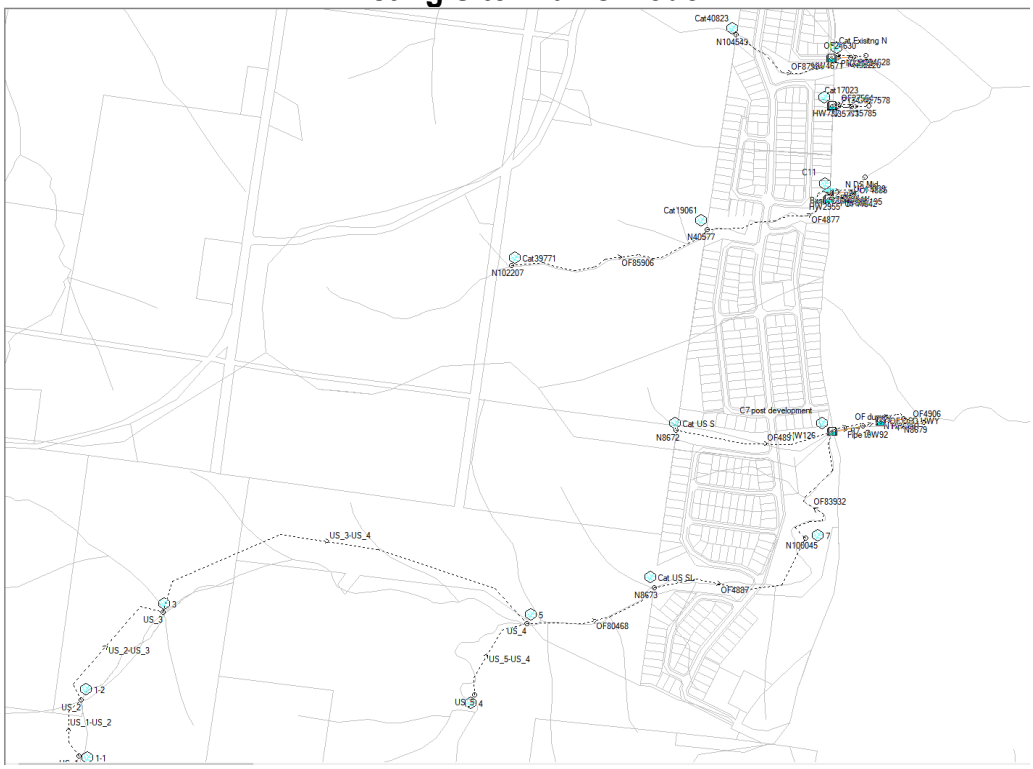
Upper Parramatta River Trust, 2004, *Water Sensitive Urban Design Technical Guidelines for Western Sydney*, Stormwater Trust, Sydney.

Urban Stormwater Best Management Practice Environmental Management Guidelines, Stormwater Committee, CSIRO publishing, 1999.

APPENDIX A

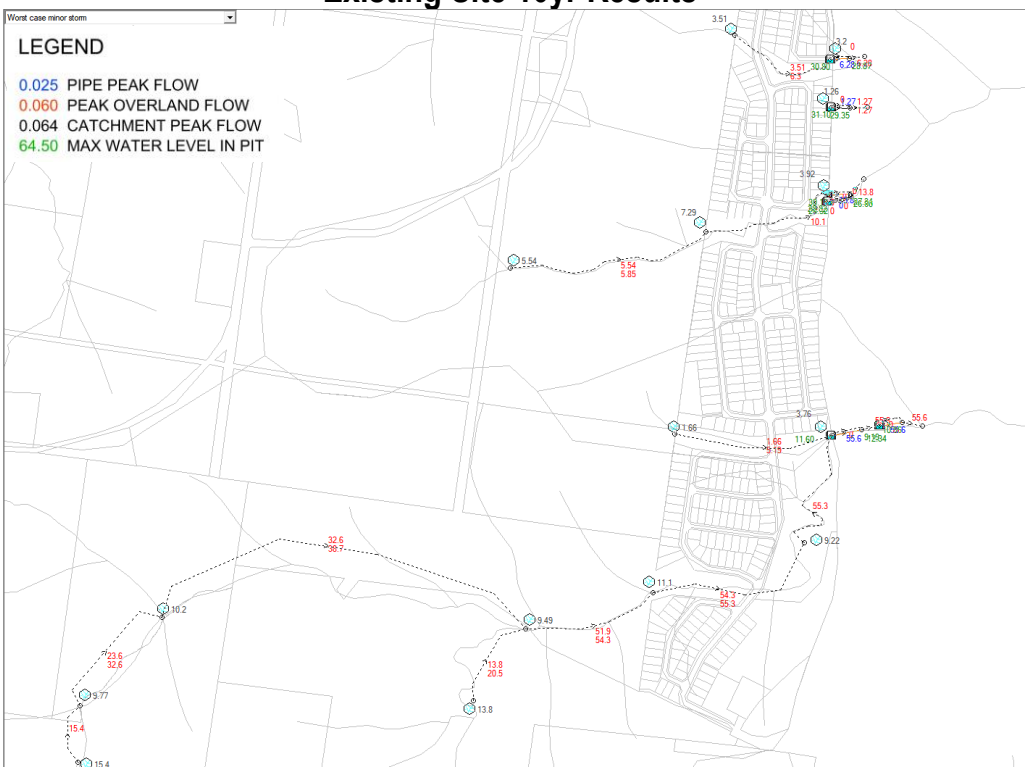
DRAINS Diagrams and Results

Existing Site Drains Model



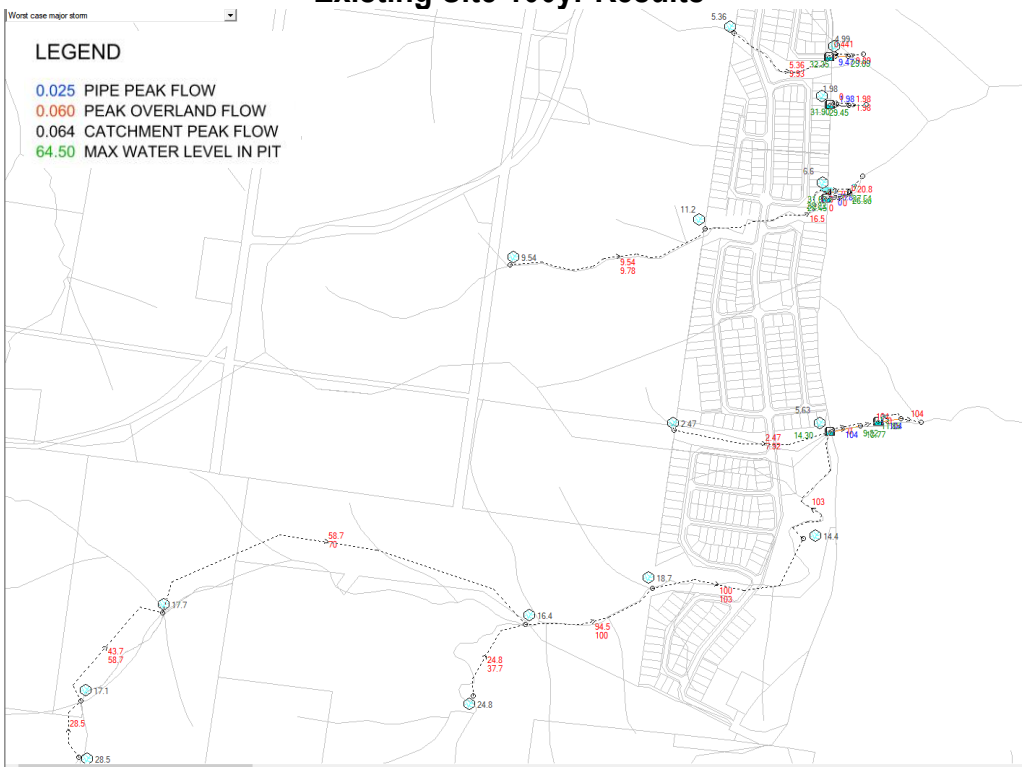
Proposed Site Drains Model

Existing Site 10yr Results

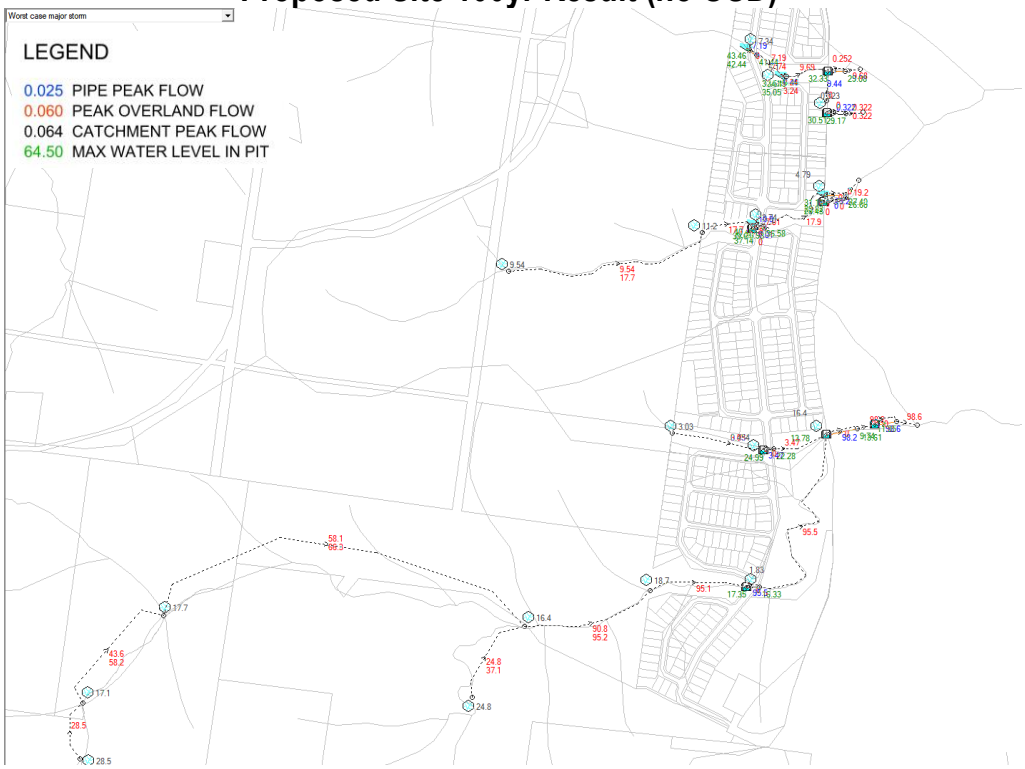


Proposed Site 10yr Results

Existing Site 100yr Results

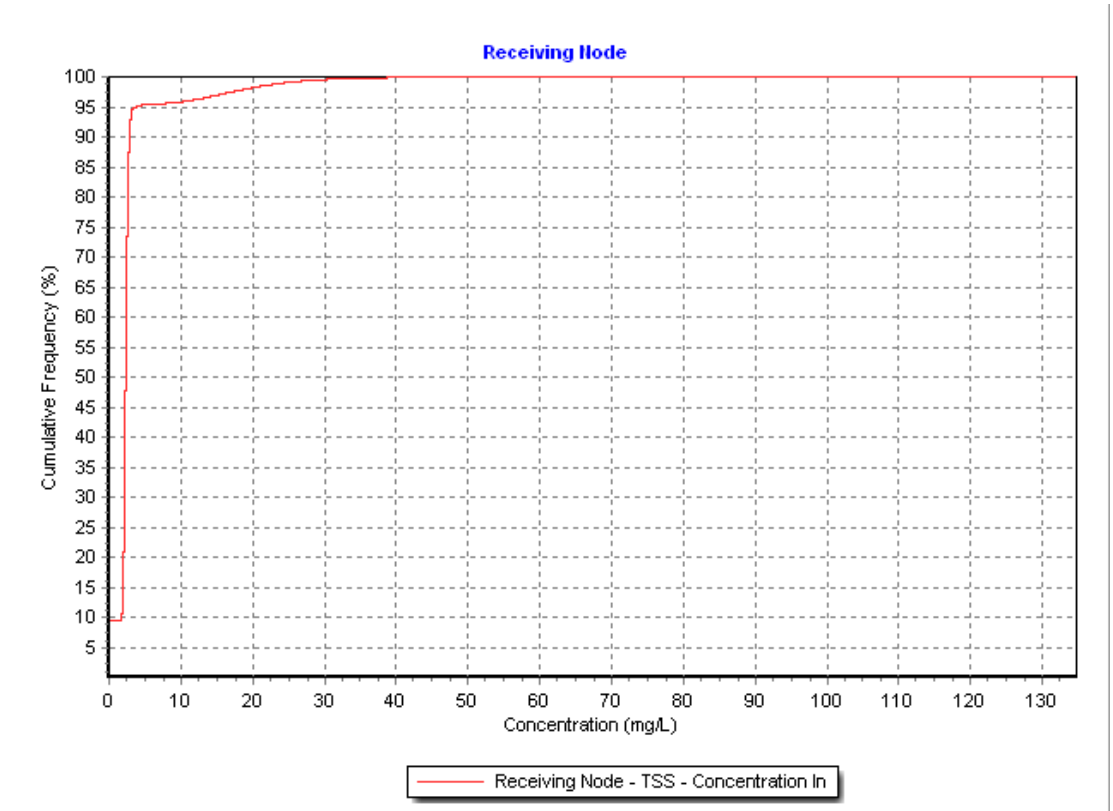


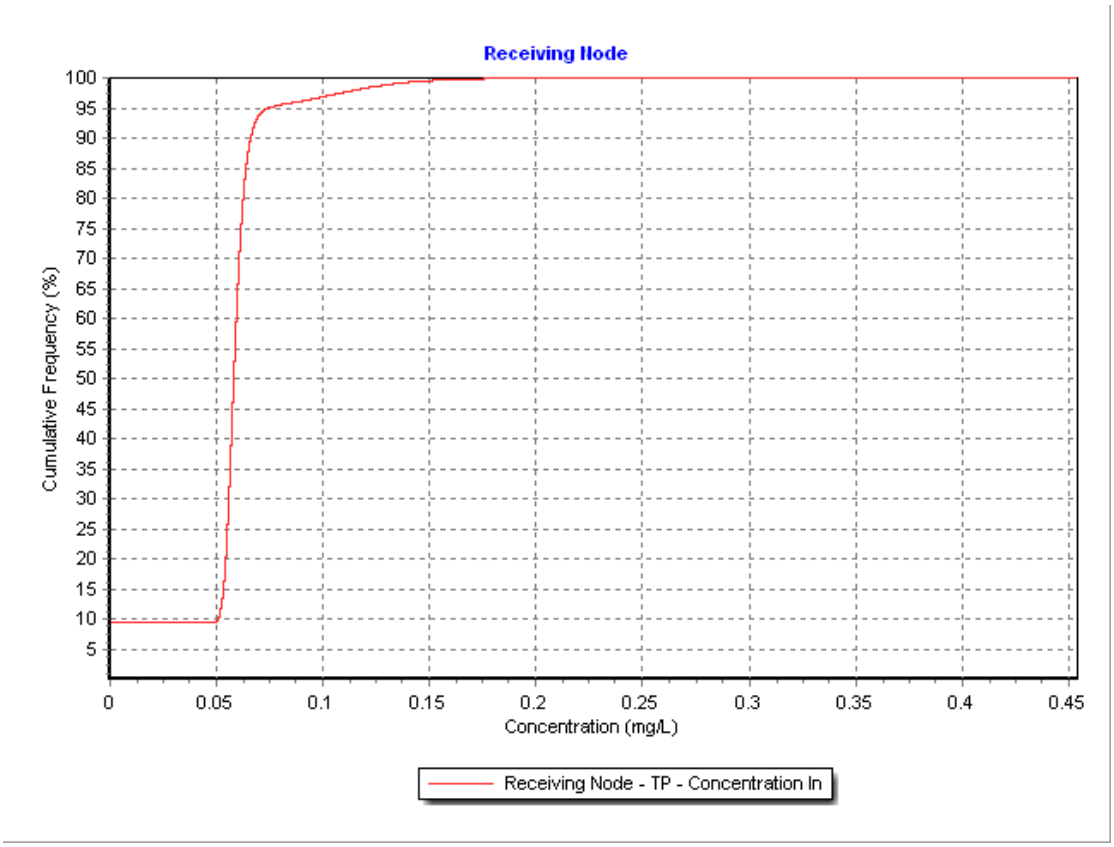
Proposed Site 100yr Result (no OSD)

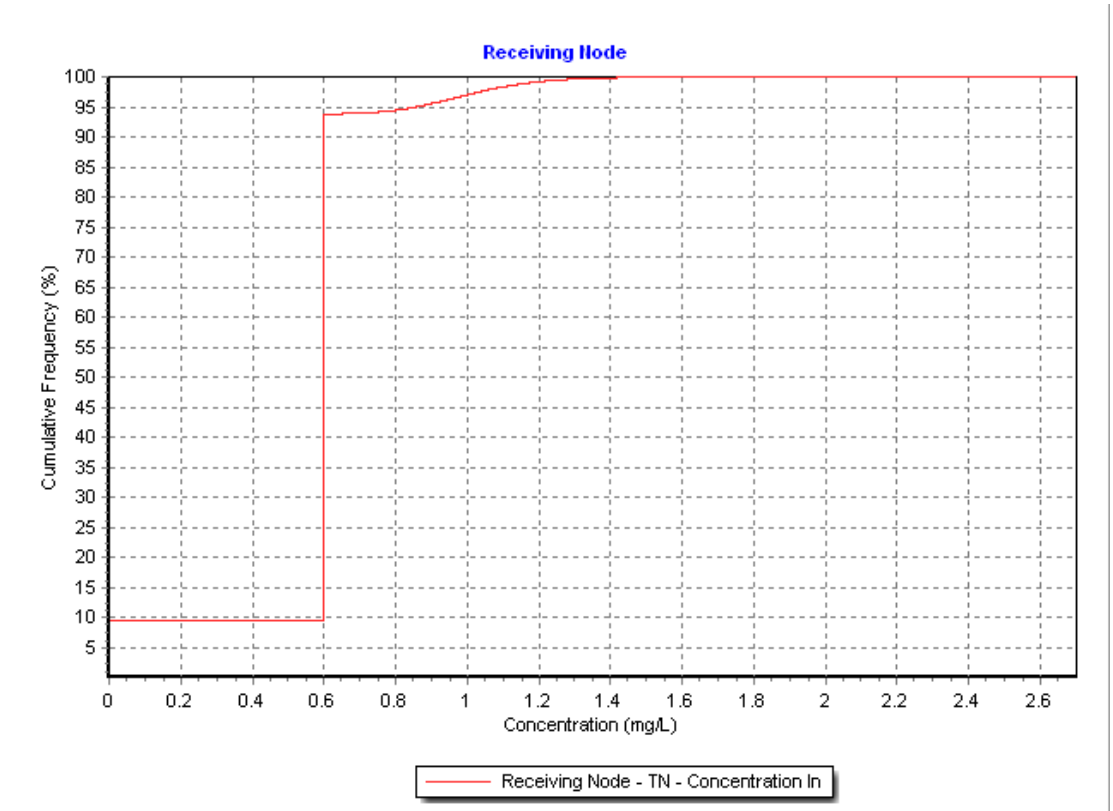


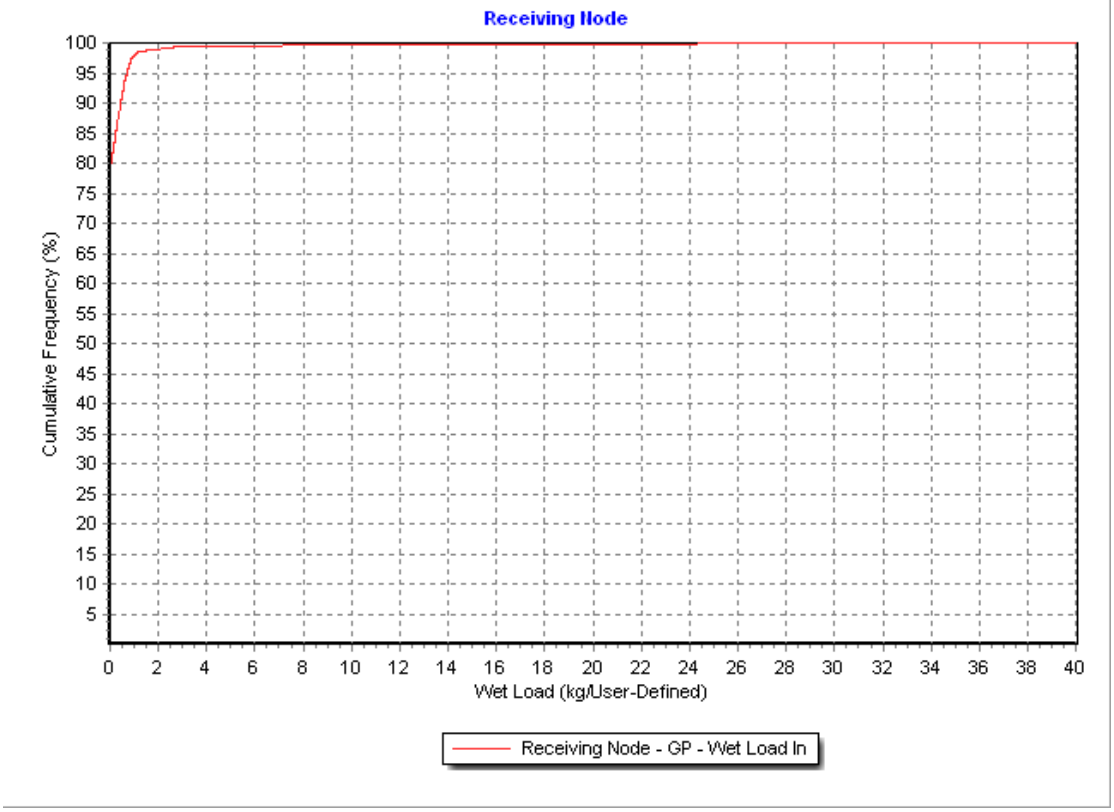
APPENDIX B

MUSIC Outputs


Receiving Node
Cumulative Frequency (%)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Concentration (mg/L)
Receiving Node - TSS - Concentration In


Receiving Node
Cumulative Frequency (%)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
Concentration (mg/L)
Receiving Node - TP - Concentration In


Receiving Node
Cumulative Frequency (%)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
Concentration (mg/L)
Receiving Node - TN - Concentration In


Receiving Node
Cumulative Frequency (%)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Wet Load (kg/User-Defined)
Receiving Node - GP - Wet Load In

APPENDIX C

Maintenance Procedure Checklist

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Bio-retention Basin Inspection and Maintenance Checklist

Location: **Date:**

Maintenance Officer:

Signature:

Item Inspected	Checked		Maintenance Needed		Inspection Frequency
	Y	N	Y	N	
DEBRIS CLEANOUT					6 monthly
Surface clear of debris					
Inlet area clear of debris					
Overflow area clear of debris					
TRENCH SURFACE VEGETATION					6 monthly
Vegetation condition					
Vegetation maintenance					
Weed infestation					
Evidence of erosion					
Surface grass to be cut at 50mm blade					1 monthly
DEWATERING					6 monthly
Trench surface dewatering between storms					
Top soil layer require replacing					
Entire planting surface require replacing					
OUTLET CHANNEL & PIT					Yearly
Pit Condition					
Evidence of concrete failing					
Evidence of erosion downstream					

Source: Water Sensitive Urban Design Technical Guidelines for Western Sydney

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Gross Pollutant Trap Inspection and Maintenance Checklist

Location: **Date:**

Maintenance Officer:

Signature:

Item Inspected	Checked		Maintenance Needed		Inspection Frequency
	Y	N	Y	N	
DEBRIS CLEANOUT					3 monthly
Surface clear of debris					
Inlet pipe clear of debris					
Clear sump of debris					
Clear sump of sediment					
INTERNAL FUNCTION					6 monthly
Basket and screens compromised					
Signs of rust or deterioration					
Pipes connections sealed and functioning					
DEWATERING					6 monthly
Correct drop through pit					
High amounts of pooling water					
PIT CONDITION					Yearly
Pit Condition					
Evidence of concrete failing					
Evidence of seepage					

Source: Water Sensitive Urban Design Technical Guidelines for Western Sydney