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STORMWATER STRATEGY FOR

PROPOSED SENIORS DEVELOPMENT 'MANNING RISE' ON LOT 343 DP1118417 MARIE AVENUE, TAREE

August 2024
Issue 4

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1 Introduction

This document has been prepared to address stormwater quality and quantity management strategies for a proposed Seniors development on Lot 343 DP1118417, Marie Avenue, Taree. This strategy will conceptually size stormwater water quality measures to comply with Mid-Coast Council's stormwater quality management objectives. Stormwater will be treated by a combination of traditional drainage measures, as well as water sensitive urban design (WSUD) techniques.

The 25.42ha site is located on the Western side of Marie Avenue, Taree. Elevations within the site range from RL.26 to RL.53, with slopes ranging from 3-20%.

The site is predominantly cleared with some sparse vegetation, with an exiting dwelling present in the North-Eastern corner of the site. Three main catchments are prevalent, all draining overland southwards to culvert crossings under Wingham Road, and further on to Munghi Creek, a tributary of the Manning River.

The soils on the site are expected to generally consist of sandy clay, underlain by a highly weathered Siltstone and Sandstone. (*Coffey Geosciences Pty Ltd - TA01489/01-AB, 19th July 2004*).

The development proposes to create a staged Seniors Development consisting of several precincts with independent living units (ILU's).

This strategy is subject to final detailed design in accordance with final conditions of consent.

1.1 Proposed Development

As discussed previously, the proposed development consists of:

- 207 ILU's (primarily "duplex" style)
- Communal Buildings
- Associated Infrastructure
- Internal Roadways
- Bioretention/Detention Basins

The proposed development is shown in Figure 1.

1.2 Stormwater Management Performance Target

The objectives for water quality adopted for this Stormwater Strategy are based on *Greater Taree City Council Development Control Plan, Chapter C3.5 2010* and Mid-Coast Council's *Stormwater Assessment Procedure Policy (July 2021).*

The objective for water quality adopted is:

- Post development loads of Gross Pollutants are to be reduced to 90%, and TSS, TN and TP are to be reduced to less than or equal to pre-developed pollutant loads (i.e. "neutral or beneficial effect on water quality").

Additionally, the objectives for water quantity are:

- Attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 1% AEP rainfall event.

1.3 Proposed Stormwater Management Strategy

This Stormwater Strategy proposes to incorporate a Water Sensitive Urban Design (WSUD) "treatment train" approach, consisting of control measures at source and end-of-line measures to manage the discharge of nutrients and pollutants leaving the site to be reduced to meet the objectives proposed above. These measures will also assist in reducing the post-developed peak flows exiting the site.

All flows captured in the underground stormwater system from the development will enter an end-of-line low flow inlet control (splitter pit), directing the three-month event to the respective water quality bioretention basins at the time of construction. Any flows exceeding the three month event will be piped to a detention basin and/or the respective drainage corridor. If the capacities of the bioretention basins are exceeded, flows will be discharged via a weir or surcharge pit and into the adjacent detention basin/drainage corridor. The basin outlet arrangements will form part of the detailed design for construction certificate.

Water quality during the construction stage will be addressed by a Stormwater Management plan prepared in accordance with NSW Department of Housing "Blue Book" 2004, and form part of the final detailed design drawings.

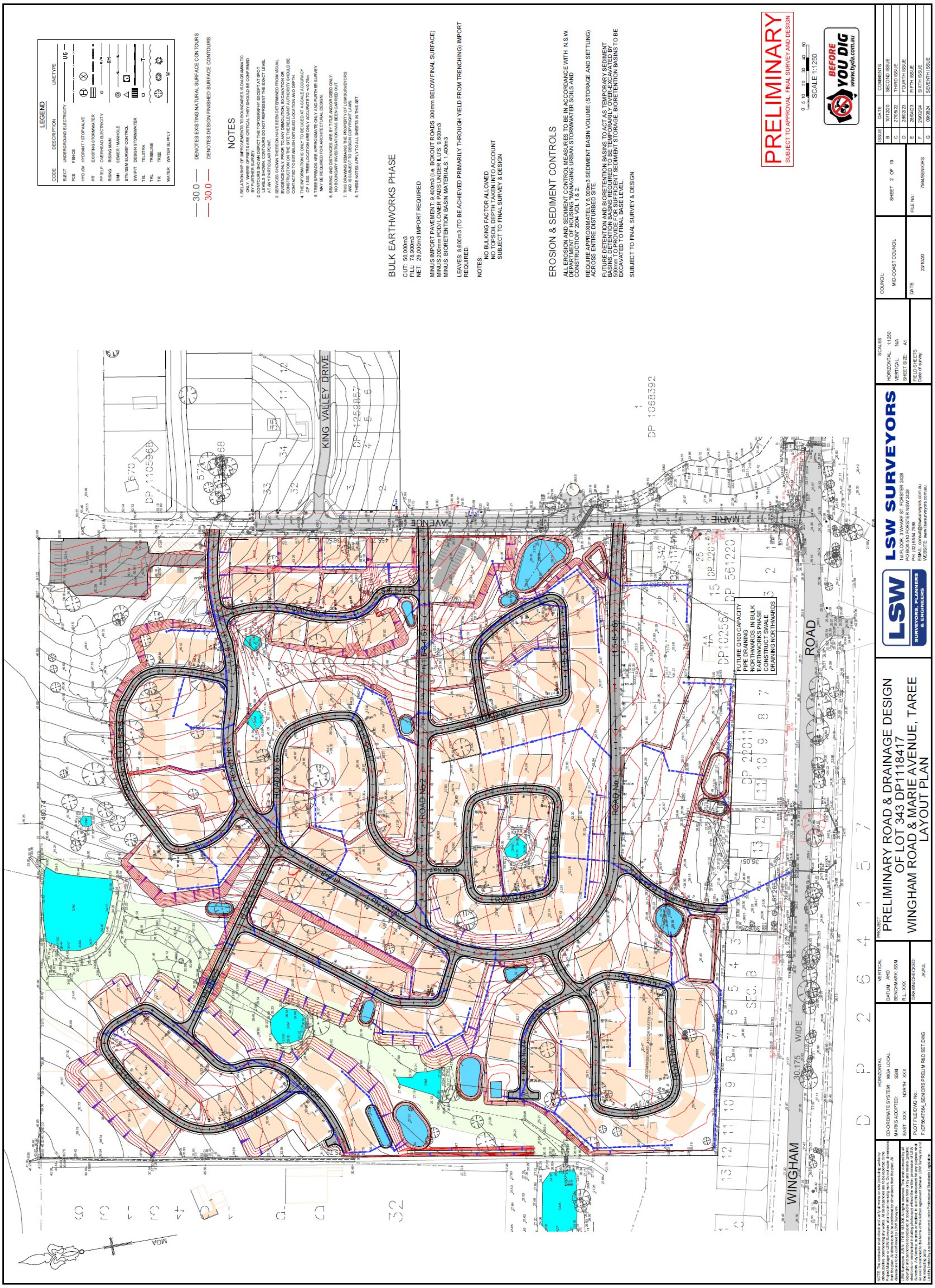


Figure 1 – Proposed Development

2 MUSIC Water Quality Model

MUSIC (Model for Stormwater Improvement Conceptualisation) Version 6.3 was developed by the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC is a conceptual continuous simulation water quality assessment design tool that estimates stormwater pollutant generation from different land uses and routes the stormwater pollutants through a user defined network of stormwater treatment measures ('treatment train') to estimate the performance of a proposed water quality strategy in meeting specified water quality objectives.

As the name suggests, MUSIC is a conceptual tool that simplifies a complex system. MUSIC is based on observed average water quality data, and while all effort has been made to accurately model the proposed scenario, there should be some recognition of the variability in the final performance of the proposed water quality treatment measures to the estimated average results modelled in MUSIC.

To undertake the water quality assessment, a MUSIC model was established for the subject site with two scenarios. The results from the pre development modelling were compared to the post development (with water quality treatment measures) modelling to assess the performance of the proposed stormwater quality controls to meet the water quality objectives stated above.

2.1 Rainfall and Evaporation

In order to establish a MUSIC model, rainfall and evaporation records in the vicinity of Taree were sought.

Bureau of Meteorology records from the nearest Station 060030 (Patanga Close, Taree) were reviewed to determine that the average annual rainfall depth is approximately 1,177mm. *Bureau of Meteorology* records at this station provide complete 6 minute pluviograph data. A 9-year consecutive period of data was required which included both wet and dry years with an average annual rainfall over the period being close to the historic average. Mid-Coast Council have provided a rainfall template to be adopted within the LGA with an average of 1326mm rainfall.

A 6 minute rainfall time step was considered necessary to more accurately model the performance of rainwater tanks and biofiltration devices. It should be noted that this water quality modelling exercise is a comparative assessment (i.e. pre development versus post development with treatment). Therefore the actual rainfall year selected is not significant to the final outcome provided a reasonable correlation to the average rainfall depth is achieved.

Areal potential evapotranspiration values have also been provided in the template to be adopted within the LGA.

2.2 Soil Data and Model Calibration

A rainfall-runoff calibration was undertaken to match the predicted runoff to expected values. The model was calibrated in accordance with the *Guidelines for Water Sensitive Design Strategies - Mid-Coast Council October 2019* for a Soil Hydrologic Group 'D', which broadly corresponds to a clay soil. The adopted parameters are summarised below;

Table 1 – MUSIC Rainfall-Runoff parameters

Impervious Properties	Pervious properties	Groundwater Properties
Rainfall threshold: 1mm (roofs with first flush) and 1.5mm (roads and Impervious areas) Pervious areas 1mm	Soil storage:90 Initial Storage:25 Field Capacity: 65 Infiltration coefficient A: 135 Infiltration coefficient B: 4.0	Initial Depth: 10mm Daily recharge rate: 10% Daily baseflow rate: 10% Daily deep seepage rate: 0%

2.3 Pollutant Concentrations

The pollutant concentrations adopted for existing-state and developed state modelling are shown in Table 2. The event mean concentrations (EMC's) for each of these land uses were derived from *Fletcher et al (2004)* and *Draft NSW MUSIC Modelling Guidelines.*

Table 2 – Pollutant Concentrations

Land use/ Surface Type	Storm flow Concentration Log_{10} mg/l	Std. Dev. Log_{10} mg/l	Baseflow Concentration Log_{10} mg/l	Std. Dev. Log_{10} mg/l
Rural				
Suspended Solids	1.95	0.32	1.15	0.17
Total Phosphorous	-0.66	0.25	-1.22	0.19
Total Nitrogen	0.30	0.19	-0.05	0.12
Roofs				
Suspended Solids	1.30	0.32	-	-
Total Phosphorous	-0.89	0.25	-	-
Total Nitrogen	0.30	0.19	-	-
Urban Residential				
Suspended Solids	2.15	0.32	1.20	0.17
Total Phosphorous	-0.60	0.25	-0.85	0.19
Total Nitrogen	0.30	0.19	0.11	0.12
Sealed Roads				
Suspended Solids	2.43	0.32	1.20	0.17
Total Phosphorous	-0.30	0.25	-0.85	0.19
Total Nitrogen	0.34	0.19	0.11	0.12
Forest				
Suspended Solids	1.60	0.20	0.78	0.13
Total Phosphorous	-1.10	0.22	-1.52	0.13
Total Nitrogen	-0.05	0.24	-0.52	0.13

As the site is currently maintained in a mainly cleared state, the pre-developed model for the subject site was determined as Rural with allowance for small portions of forested area towards the north-eastern corner.

2.4 Catchment Definition

For the purpose of the water quality modelling, the site was separated into Roof Area, Carparking and Hardstand (Impervious area) and pervious areas.

The development site forms the lower reaches of a larger overall catchment draining to Wingham Road. The forested upstream catchment is drained through the development site by a first order riparian corridor. As it is equivalent in both pre and post developed scenarios, it has not been accounted for in water quality modelling.

Table 3 – Contributing Catchment Details

PRE-DEVELOPED Sub-Catchments	Area (m^2)	% Imperviousness
1 Rural Pervious (Rural)	251630	0%
2 Forested (Forest)	1470	0%
3 Existing Roofs West (Roof)	610	100%
4 Existing Roofs East (Roof)	340	100%
5 Existing Hardstand East (Urban)	150	100%
TOTAL	**254,200**	**0.4%**

POST-DEVELOPED Sub-Catchment	Area (m^2)	% Imperviousness
Catchment A		
1 Communal Hardstand (Urban)	2000	100%
2 Urban Pervious (Urban)	3120	0%
3 Forested (Forest)	1470	0%
4 Rural Pervious (Rural)	26430	0%
Catchment A2		
5 Roadway (Sealed Roads)	540	100%
6 Rural Pervious (Rural)	17360	0%
Catchment B		
7 26 x Roofs (Roofs)	9760	100%
8 Roadway (Sealed Roads)	6060	100%
9 Dwelling Curtilage (Urban)	2600	100%
10 Communal Hardstand (Urban)	750	100%
11 Urban Pervious (Urban)	25260	0%
Catchment C		
12 5 x Roofs/ hardstand (Roofs)	4946	100%
13 Roadway (Sealed Roads)	181	100%
14 Communal Hardstand (Urban)	1000	100%
15 Urban Pervious (Urban)	6663	0%
Catchment D		
16 25 x Dwelling Roofs, 2 x Communal (Roofs)	9760	100%
17 Roadway inc. RV Carparking (Sealed Roads)	10548	100%
18 Dwelling Curtilage (Urban)	2700	100%
19 Communal Hardstand (Urban)	1200	100%
20 Urban Pervious (Urban)	28212	0%

Catchment E		
21 8 x Roofs (Roofs)	2964	100%
22 Roadway (Sealed Roads)	3710	100%
23 Dwelling Curtilage (Urban)	800	100%
24 Communal Hardstand (Urban)	650	100%
25 Urban Pervious (Urban)	8766	0%
Catchment F		
26 9 x Roofs (Roofs)	3238	100%
27 Roadway (Sealed Roads)	1888	100%
28 Dwelling Curtilage (Urban)	900	100%
29 Communal Hardstand (Urban)	100	100%
30 Urban Pervious (Urban)	7034	0%
Catchment G		
31 12 x Roofs (Roofs)	4274	100%
32 Roadway (Sealed Roads)	2767	100%
33 Dwelling Curtilage (Urban)	1200	100%
34 Communal Hardstand (Urban)	262	100%
35 Urban Pervious (Urban)	7444	0%
Catchment H (Bypass)		
36 1 x Roof/ hardstand (Roofs)	1080	100%
37 Roadway (Sealed Roads)	254	100%
38 Communal Hardstand (Urban)	365	100%
39 Urban Pervious (Urban)	5154	0%
Catchment I		
40 2 x Roofs/ hardstand (Roofs)	500	100%
41 Roadway (Sealed Roads)	1200	100%
42 Urban Pervious (Urban)	560	0%
Catchment J		
43 17 x Roofs (Roofs)	6216	100%
44 Roadway (Sealed Roads)	2780	100%
45 Dwelling Curtilage (Urban)	1700	100%
46 Urban Pervious (Urban)	11504	0%
Catchment K		
47 14 x Roofs (Roofs)	5036	100%
48 Roadway (Sealed Roads)	2081	100%
49 Dwelling Curtilage (Urban)	1400	100%
50 Communal Hardstand (Urban)	120	100%
51 Urban Pervious (Urban)	7693	0%
TOTAL	**254,200**	**38%**

2.5 Modelling Stormwater Management Controls

The following water quality treatment devices were included in the post-developed state water quality model:

2.5.1 Water Quality Bioretention Basins

Constructed water quality bioretention basins are shallow, extensively vegetated water bodies that use enhanced sedimentation, fine filtration and pollutant uptake processes to remove pollutants from stormwater. These processes are engaged by slowly passing runoff through vegetated areas. Plants filter sediments and pollutants from the water, while bio-films that grow on the plants can absorb nutrients and other associated contaminants.

For this development, it is proposed to construct multiple end-of-line water quality bioretention basins. The basins will also offer benefits to residents by providing aesthetic qualities and habitat for wildlife.

For MUSIC modelling, the following water quality basin parameters were used:

- 0.30m extended detention depth, 1:3 internal side batters, 1:2 external.
- Effective vegetation planted
- Filter media 400mm thick (Sandy Loam) with 100mm transition layer and 200-300mm drainage layer.
- Filter Media hydraulic conductivity of 100mm/hr
- Filter Media nutrient composition; Total Nitrogen = 400mg/kg and Orthophosphate = 40mg/kg (*Using MUSIC in Sydney's Drinking Water Catchment* , SCA, Dec 2012)
- Subsoil drain which will drain to piped drainage outlet
- Top 100mm ameliorated to provide for plant uptake

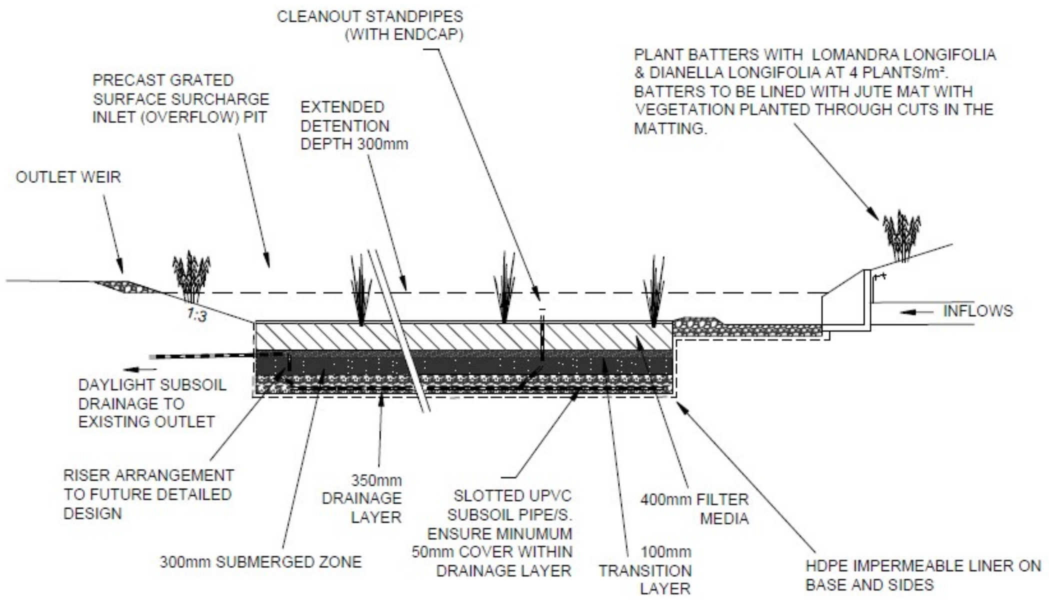
A summary of each basin size is shown in Table 4.

Table 4 – Bioretention Basin Sizing

Bioretention Basin	Filter Area (m^2)
Catchment B	300
Catchment C	150
Catchment D	350
Catchment E	100
Catchment F	100
Catchment G	120
Catchment J	200
Catchment K	120
Total	**1440**

Each basin will have a "splitter pit" arrangement to allow for the approximate 3-month ARI inflows only (however they may be inundated in larger events, but at low velocities). Flows exceeding the approximate 3-month event will be conveyed via pipe or overland flow to a detention basin.

An Operations and Maintenance Manual is to be prepared for the stormwater quality devices proposed for the development. This document will be prepared at the construction certificate stage in accordance with final DA conditions.



TYPICAL BIORETENTION BASIN DETAIL

Not to Scale

Figure 2: Typical Water Quality Bioretention Basin

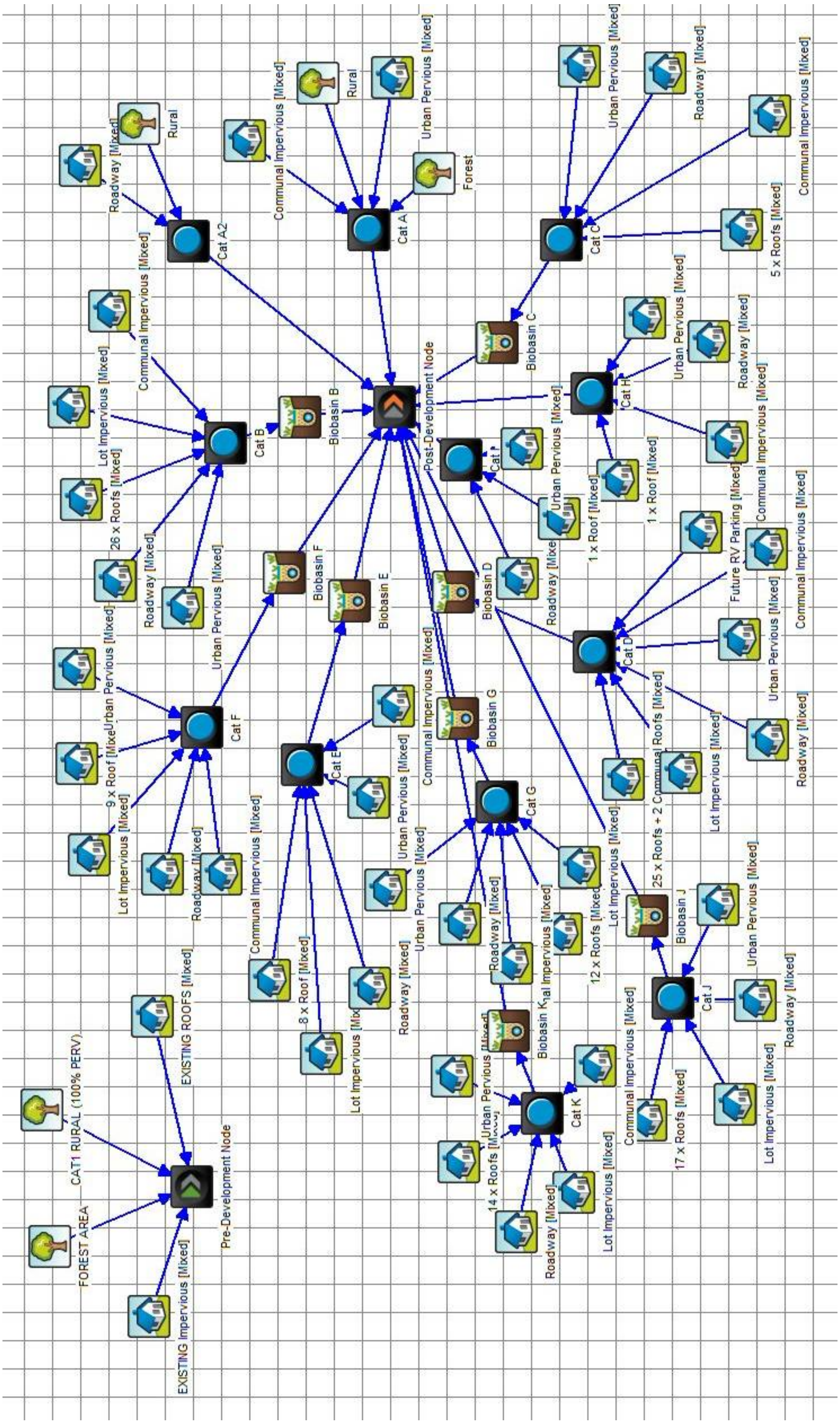


Figure 3: Pre & Post-Developed MUSIC model

2.6 Model Results

Table 5 presents the average annual pollutant export loads at the downstream extent of the contributing catchment under both pre-developed and post developed conditions (with and without treatment).

Table 5 - Annual Average Pollutant Export Loads

Pollutant	Proposed Development Catchment			
	Existing Site Load (kg/yr)	**Developed Site Load (without treatment) (kg/yr)**	**Developed Site Load (with treatment) (kg/yr)**	**% Reduction**
Gross Pollutants	**30.2**	2620	261	**90**
TSS	**12900**	27700	**9350**	66.2
TP	**27.3**	53.1	**26.3**	50.5
TN	**249**	390	**243**	37.6

The results in Table 5 indicate that the proposed Water Sensitive Design Strategy would meet or exceed the water quality objectives for the site, which were:

- Post development loads of Gross Pollutants are to be reduced to 90%, and TSS, TN and TP are to be reduced to less than or equal to pre-developed pollutant loads (i.e. “neutral or beneficial effect on water quality”).

Refer to the Plan of Proposed Development for the locality, size and details of the proposed stormwater treatment measures.

2.7 Construction Stage

Water quality during the construction stage will be addressed by a Stormwater Management plan prepared in accordance with NSW Department of Housing “Blue Book” 2004. Construction methods will be detailed in designs for the construction certificate.

2.8 Maintenance

An Operations and Maintenance Manual is to be prepared for the stormwater quality devices proposed for the development. This document will be prepared at construction certificate stage.

Refer to Appendix C for the locality, size and details of the proposed stormwater treatment measures.

3 Hydrologic Analysis

3.1 Discussion

Hydraulic modelling for this strategy has been undertaken using DRAINS software, incorporating both ILSAX and RAFTS Hydrological models.

This methodology was adopted to allow for the large rural/ forested catchments to be modelled with RAFTS, but allow for more detailed ILSAX modelling of the proposed urban catchment, and also interaction between the two.

3.2 RAFTS parameters

The predeveloped model was constructed utilising RAFTS catchments representing the large rural/ forested catchments.

It should be noted that hydrological modelling of the subject site (or part there of) has been covered in a number of previous Stormwater Strategies. *Hughes Trueman Consulting Engineers* has modelled the Eastern catchment as part of the existing adjacent Bushland Health development, whilst the Southern catchment has been previously modelled by *Lidbury Summers & Whiteman* (Stormwater Strategy dated November 2006) and *Greater Taree City Council* (Wingham Road Culvert Reconstruction). Values obtained correlate well with published values provided from the above sources (using an ARR87 IFD). Note that the parameters were subject to a sensitivity test, and the peak flows are less determined by the parameters and much more sensitive to the roughness and slope of the RAFTS catchments. The RAFTS peak flow results are considered conservative (lower) given a pre vs post modelling comparison.

Therefore the RAFTS hydrological parameters adopted are as follows.

Table 7 - RAFTS Hydrological Model Parameters

	Pervious Areas	Impervious Areas
Initial Loss (IL)	10 mm	2.0 mm
Continuing Loss (CL)	2.5 mm/hr	0 mm/hr
Manning's n	0.04 (0.08 for upstream)	0.015

3.3 DRAINS ILSAX Parameters

The post-developed DRAINS model contains steady (Lite) ILSAX hydrological models representing the proposed urban catchments.

The following parameters were adopted for the DRAINS ILSAX catchments:

- Paved (Impervious) Depression Storage – 1mm
- Supplementary Depression Storage – 1mm (no supplementary areas modelled)

- Grassed (Pervious) Depression Storage – 5mm
- Soil Type – 3 (high runoff potential, fairly slow infiltration rates)
- Antecedent Moisture Conditions – 3 (indicates rather wet starting condition for storm event)

per Mid-Coast Council's Site Stormwater Drainage Guidelines (July 2022)

The ILSAX flows are higher than the RAFTS flows, which is conservative given the ILSAX only represent post-developed flows, hence the detention required is conservative. Future culvert designs will be modelled using higher peak flows.

3.4 Rainfall Data

Rainfall inputs were entered using IFD relationships from BOM for Taree and temporal patterns/ ensembles and pre-burst rainfall depths from ARR2019 Data Hub.

An Antecedent Moisture Condition of 3 has been adopted, after reviewing previous rainfall records for the area.

3.5 Permeability and Groundwater

As mentioned previously, the soils on the site are expected to generally consist of Sandy Clay, underlain by a highly weathered Siltstone and Sandstone.

The strategy does not propose to utilise infiltration to treat stormwater. The treatment measures are to be lined (subject to insitu permeability) and/or constructed above the existing ground surface so there will be no interaction with groundwater on the site.

3.6 Catchment Definition

The large external catchment to the north currently drains through the site's Western catchment. As the catchment is forested, a Manning's n = 0.08 has been adopted.

The development site itself exhibits three main catchments. An Eastern catchment grades to an existing culvert system (3 x 675Ø RCP's) under Marie Avenue, where flows then travel overland southwards to another culvert system under Wingham Road. The Southern catchment currently drains to existing stormwater infrastructure (pit and pipe) within Wingham Road. The Western catchment travels through the adjacent two land parcels before heading under Wingham Road through 3 x 900Ø RCP culverts. Each of these catchments travel further on to Munghi Creek, a tributary of the Manning River.

The western riparian corridor will be crossed by a set of culverts and all measures within 40m including basins, earthworks and batters will be per the NRAR Guidelines to be detailed in the relevant stage.

Refer to Appendix C for pre and post developed catchment plans.

Table 9 – Contributing Catchment Details

PRE-DEVELOPED Sub-Catchments	Area (m^2)	% Imperviousness
1 Catchment Upstream	213200	0%
2 Catchment West	139400	0.4%
3 Catchment East	60070	0.8%
4 Catchment South	54700	0%
TOTAL	**467,370**	**0.2%**

POST-DEVELOPED Sub-Catchment	Area (m^2)	% Imperviousness
1 Catchment Upstream	213200	0%
2 Catchment A	33020	6%
3 Catchment A2	17900	0%
4 Catchment B	44430	43%
5 Catchment C	12790	48%
6 Catchment D	52420	46%
7 Catchment E	16890	48%
8 Catchment F	13160	47%
9 Catchment G	15920	53%
10 Catchment H	6850	25%
11 Catchment I	2260	75%
12 Catchment J	22200	48%
13 Catchment K	16330	47%
TOTAL	**467,370**	**21% (Dev. Site 38%)**

3.7 Results and Commentary

The results of the pre-developed and post-developed models are shown in Table 10.

Table 10 – Summary of Stormwater Quantity

	Pre-Developed Flows		Post-Developed Flows	
	20% AEP Peak Discharge (m^3/s)	1% AEP Peak Discharge (m^3/s)	20% AEP ARI Peak Discharge (m^3/s)	1% AEP Peak Discharge (m^3/s)
Western Outlet	5.58	11.7	5.13	11.3
Southern Outlet	1.07	2.32	0.93	2.29
Eastern Outlet	1.15	2.52	1.15	2.52

Note the above peak flows are for each outlet of the development. The peak flows produced by DRAINS are the result for the highest upper median value for all durations in the AEP for each catchment (which is the highest of the upper median (critical) peak flow from all of the duration storm ensembles and therefore the most 'representative' storm as per ARR2019)

As can be seen, the peak discharges from the 20% and 1% AEP events (for durations 5mins – 6hours) for each of the catchments has been reduced to less than the pre-developed.

Detention Basins have been provided within the catchments to attenuate post-developed peak flows. Detention storages are as per Table 11 below.

Table 11 – Detention Basin Storages

Detention Basin	Storage (m^3)
Catchment B	800
Catchment C	400
Catchment D	850
Catchment E	400
Catchment H	150
Catchment J	500
Total	**3100**

3.8 Climate Change

As the lowest level on the site is 27m AHD and the site is not mapped in the “Flood Planning Area” in *Greater Taree City Council’s* current flood planning LEP mapping, Council’s draft sea level rise policy does not apply to this site.

4 Summary

4.1 Stormwater Quality Summary

A combination of measures discussed above including end-of-line bioretention basins have been proposed to manage the discharge of nutrients and pollutants leaving the site. The modelling shows that the water quality objective of "neutral or beneficial effect on water quality” can be achieved for the proposed development.

4.2 Stormwater Quantity Summary

The utilisation of detention in the Detention Basins and Bioretention Basins will attenuate captured stormwater runoff. The criteria is to attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 1% AEP rainfall event.

The modelling shows that the total peak discharges from the 20% and 1% AEP events durations for the development has been reduced to less than the pre-developed.

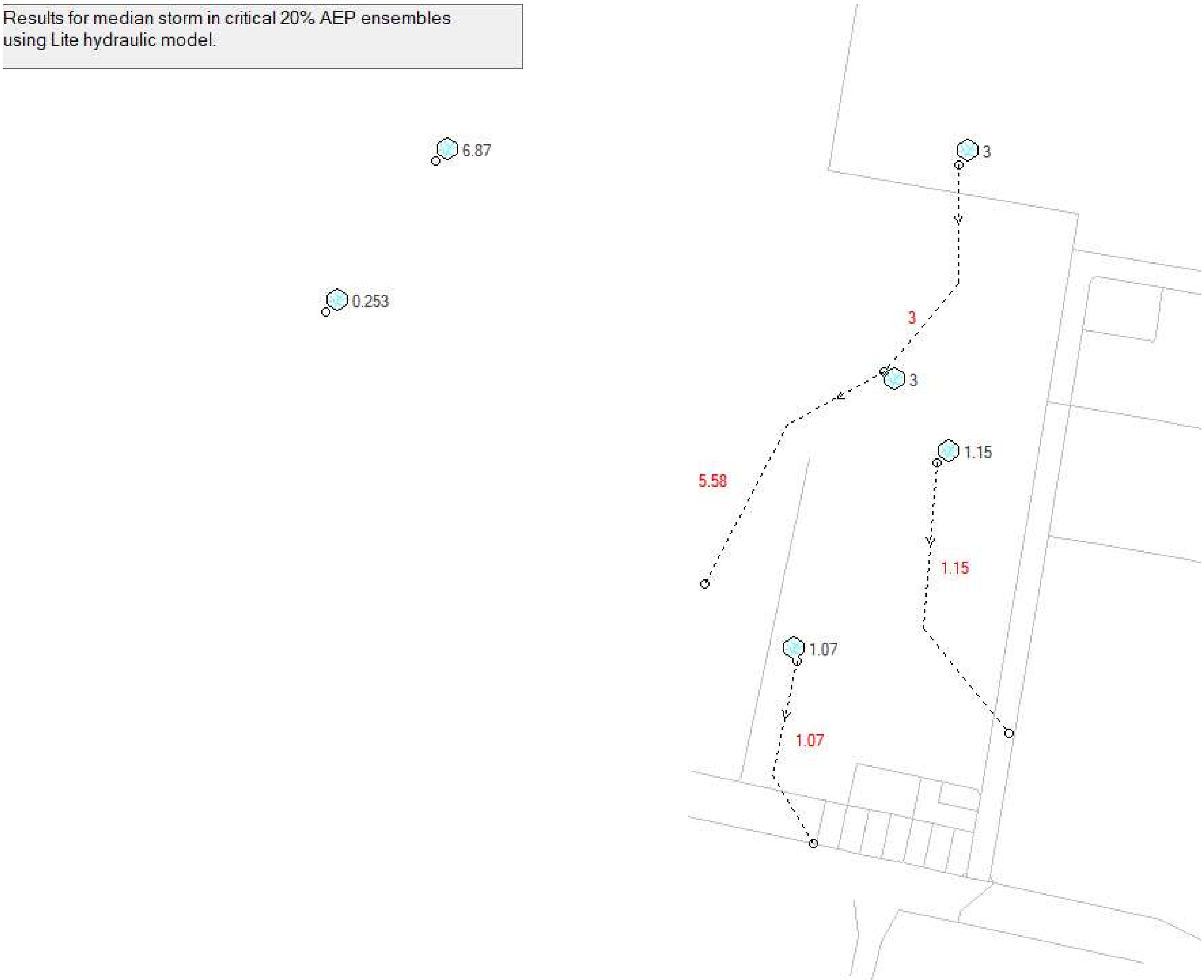
Refer to the Stormwater Strategy Plan (Appendix C) for the locality, size and details of the proposed stormwater treatment measures.

A HYDRAULIC OUTPUT FILES

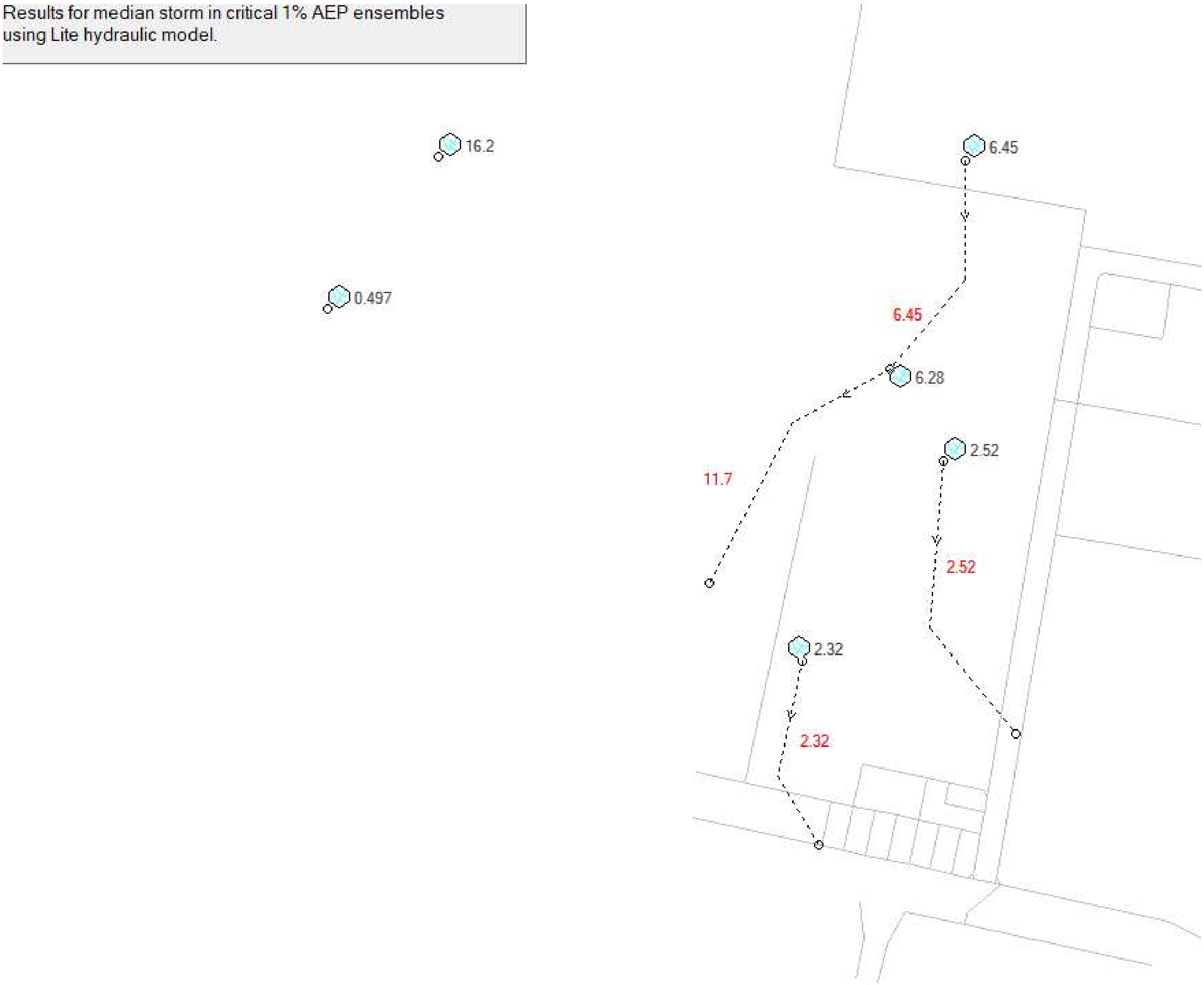
A.1.1 DRAINS Schematic Layout (Pre-developed)

PIT / NODE DETAILS			Version 15																	
Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is	Internal Width (mm)	Inflow is Misaligned	Minor Safe Pond Depth (m)	Major Safe Pond Depth (m)
N3	Node					45		0		445988.459	6473263.61		4		No					
N4	Node					26.75		0		445925.971	6472854.184		5		No					
N6	Node					26		0		445831.352	6473079.891		16		No					
N805	Node					33		0		445912.172	6473011.883		1818		No					
N8031	Node					26.3		0		446096.483	6472949.789		487359		No					
N8255	Node					45		0		445597.76	6473447.527		487823		No					
N9529	Node					45		0		445501.169	6473316.44		490384		No					
N12232	Node							0		446052.328	6473444.57		495809		No					
N803	Node					33		0		446033.404	6473185.352		1791		No					
DETENTION BASIN DETAILS																				
Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id					
SUB-CATCHMENT DETAILS																				
Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model												
CAT WEST	N3	13.94	0	10	0.04	0	1	TAREE RAFTS												
CAT SOUTH	N805	5.47	0	5	0.04	0	1	TAREE RAFTS												
CAT CAL	N8255	64.38	0	10	0.08	0	1	TAREE RAFTS												
1 HA CAL	N9529	1	0	5	0.04	0	1	TAREE RAFTS												
CAT U/S	N12232	21.32	0	10	0.08	0	1	TAREE RAFTS												
CAT EAST	N803	6.031	0	5	0.04	0	1	TAREE RAFTS												
PIPE DETAILS																				
Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	Rl (m)	Chg (m)	RL (m)	etc (m)	
DETAILS of SERVICES CROSSING PIPES																				
Pipe	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	etc etc										
CHANNEL DETAILS																				
Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed							
OVERFLOW ROUTE DETAILS																				
Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %		id	U/S IL	D/S IL	Length (m)			
OF1	N3	N6	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		14						
OF367	N805	N4	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		1823	33	28	50			
OF6809	N12232	N3	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		495810						
OF351	N803	N8031	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0		1802	33	28	50			
PIPE COVER DETAILS																				
Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)																
This model has no pipes with non-return valves																				

A.1.2 DRAINS Pre-Developed Model (20% AEP Peak Flows)



A.1.3 DRAINS Pre-Developed Model (1% AEP Peak Flows)



A.2.1 DRAINS Schematic Layout (Post-developed)

PIT / NODE DETAILS — Version 15

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is	Internal Width (mm)	Inflow is Misaligned	Minor Safe Pond Depth (m)	Major Safe Pond Depth (m)
N1	Node					45		0		445736.883	6473402.59		4		No					
N803	Node					33		0		446026.637	6473148.2		1791		No					
N805	Node					33		0		445881.094	6472948.851		1818		No					
N8255	Node					45		0		445597.76	6473447.527		487823		No					
N9529	Node					45		0		445505.111	6473316.44		490384		No					
N2	Node					45		0		445966.176	6473319.124		491370		No					
N3	Node					45		0		445809.797	6473233.567		491383		No					
N5	Node					45		0		445702.85	6473059.125		491387		No					
N10051	Node					27.25		0		445650.565	6473182.708		491421		No					
N8031	Node					29.25		0		446096.483	6472949.789		487359		No					
N4	Node					27		0		445787.647	6472903.506		5		No					
N10067	Node							0		445891.551	6473187.461		491534		No					
N10699	Node					26.5		0		445605.41	6473117.114		492960		No					
HW1	Headwall				0.5	33.4		0		445801.571	6473334.585		494518							
N11366	Node					29.6		0		445788.368	6473320.392		494519		No					
N11367	Node							0		445830.235	6473511.628		494526		No					
N11368	Node							0		445830.711	6473400.404		494528		No					
N11379	Node							0		445763.919	6473014.046		494599		No					
N11381	Node							0		445802.477	6472850.46		494610		No					
N140880	Node					27		0		445864.044	6472907.932		812854		No					
N11384	Node							0		445798.389	6472796.274		494619		No					
N11385	Node							0		446024.64	6472948.851		494621		No					
N79519	Node					26.2		0		445719.909	6473133.763		660928		No					
N19404	Node							0		446135.009	6472916.625		513244		No					
N217861	Node					29.25		0		446073.647	6472967.347		1003769		No					

DETENTION BASIN DETAILS

Name	Elev	Volume	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
DetBasinJ	27	0		Culvert	0.5					445647.238	6473220.733	No			491399
	27.1	22.8													
	27.8	437.3													
	28	572.9													
BioBasinG	33	0		None						445880.619	6473282.525	No			491400
	33.3	45													
BioBasinF	28	0		None						445663.874	6473089.07	No			491401
	28.3	30													
DetBasinD	28.4	0		Culvert	0.5					446071.222	6473018.723	No			491402
	28.5	5.7													
	28.6	44.1													
	28.7	121.7													
	28.8	218.6													
	28.9	318.4													
	29	420.8													
	29.1	525.8													
	29.2	633.3													
	29.3	743.5													
	29.4	856.2													
DetBasinB	27.57	0		Culvert	0.5					445762.423	6472950.436	No			491403
	27.6	0.6													
	27.7	34.3													
	27.8	119.9													
	27.9	213.8													
	28	310.3													
	28.1	409.5													
	28.2	511.4													
	28.3	615.9													
	28.4	723.2													
	28.5	833.2													
	28.57	911.9													
BioBasinK	28.5	0		None						445751.332	6473214.079	No			491404
	28.8	45													
DetBasinC	27.1	0		Culvert	0.5					445875.39	6472919.382	No			494613
	27.2	36.3													
	27.3	74.2													
	27.4	113.6													
	27.5	154.7													
	27.6	197.4													
	27.7	241.8													
	27.8	287.9													
	27.9	335.8													
	28	385.3													
	28.1	436.7													
DetBasinE	26.25	0		Culvert	0.5					445755.135	6473115.213	No			494636
	26.3	0.8													
	27.3	462.2													
BioBasinD3	30	0		None						446054.348	6473043.123	No			726430
	30.3	31.8													
BioBasinC	28.75	0		None						445760.481	6472972.252	No			942127
	29.05	110													
	29.1	115													
DetBasinH	28.5	0		Culvert	0.5					446054.575	6472972.711	No			1003379
	28.6	12.6													
	28.7	26.2													
	28.8	40.8													
	28.9	56.5													
	29	73.4													
	29.1	91.3													
	29.2	110.4													
	29.3	130.6													
	29.4	152.1													
	29.5	174.7													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor	Rainfall Multiplier
CAT J	N1	2.22	48	52	0	5	5	0										0				1
CAT D	N803	5.242	46	54	0	5	5	0										0				1
CAT C	N805	1.279	48	52	0	5	5	0										0				1
1HA ILSAX	N9529	1	0	100	0	0	5	0										0				1
CAT G	N2	1.592	53	47	0	5	5	0										0				1
CAT K	N3	1.633	47	53	0	5	5	0										0				1
CAT F	N5	1.316	47	53	0	5	5	0										0				1
CAT I	N4	0.226	75	25	0	5	5	0										0				1
CAT E	N10067	1.689	48	52	0	5	5	0										0				1
CAT A	N11368	3.302	6	94	0	5	5	0										0				1
CAT B	N11379	4.443	43	57	0	5	5	0										0				1
CAT H	N11385	0.685	25	75	0	5	5	0										0				1

Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
1 HA RAFTS	N8255	1	0	5	0.04	0	1	TAREE RAFTS
CAT A2	N10051	1.79	3	10	0.04	0	1	TAREE RAFTS
CAT UPSTREAM	N11367	21.32	0	10	0.08	0	1	TAREE RAFTS

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	RI (m)	Chg (m)	RL (m)	etc (m)
OutBasinJ	DetBasinJ	N10051	10	27	26.95	0.5	Concrete, under roads	375	375	0.6	NewFixed	1	DetBasinJ	0					
OutBasinD	DetBasinD	N8031	10	28.4	28.35	0.5	Concrete, under roads	525	525	0.6	NewFixed	3	DetBasinD	0					
OutBasinB	DetBasinB	N4	10	27.57	27.52	0.5	Concrete, under roads	525	525	0.6	NewFixed	2	DetBasinB	0					
Culvert	HW1	N11366	12	29.72	29.6	1	Concrete, under roads	600	600	0.6	NewFixed	4	HW1	0					
OutbBasinC	DetBasinC	N140880	10	27.1	27.05	0.5	Concrete, under roads	375	375	0.6	NewFixed	1	DetBasinC	0					
OutBasinE	DetBasinE	N79519	10	26.25	26.2	0.5	Concrete, under roads	375	375	0.6	NewFixed	2	DetBasinE	0					
P33371	DetBasinH	N217861	10	28.5	28.45	0.5	Concrete, under roads	225	225	0.6	NewFixed	1	DetBasinH	0					

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	Chg (m)	Bottom Elev (m)	Height of Service (m)	etc

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed

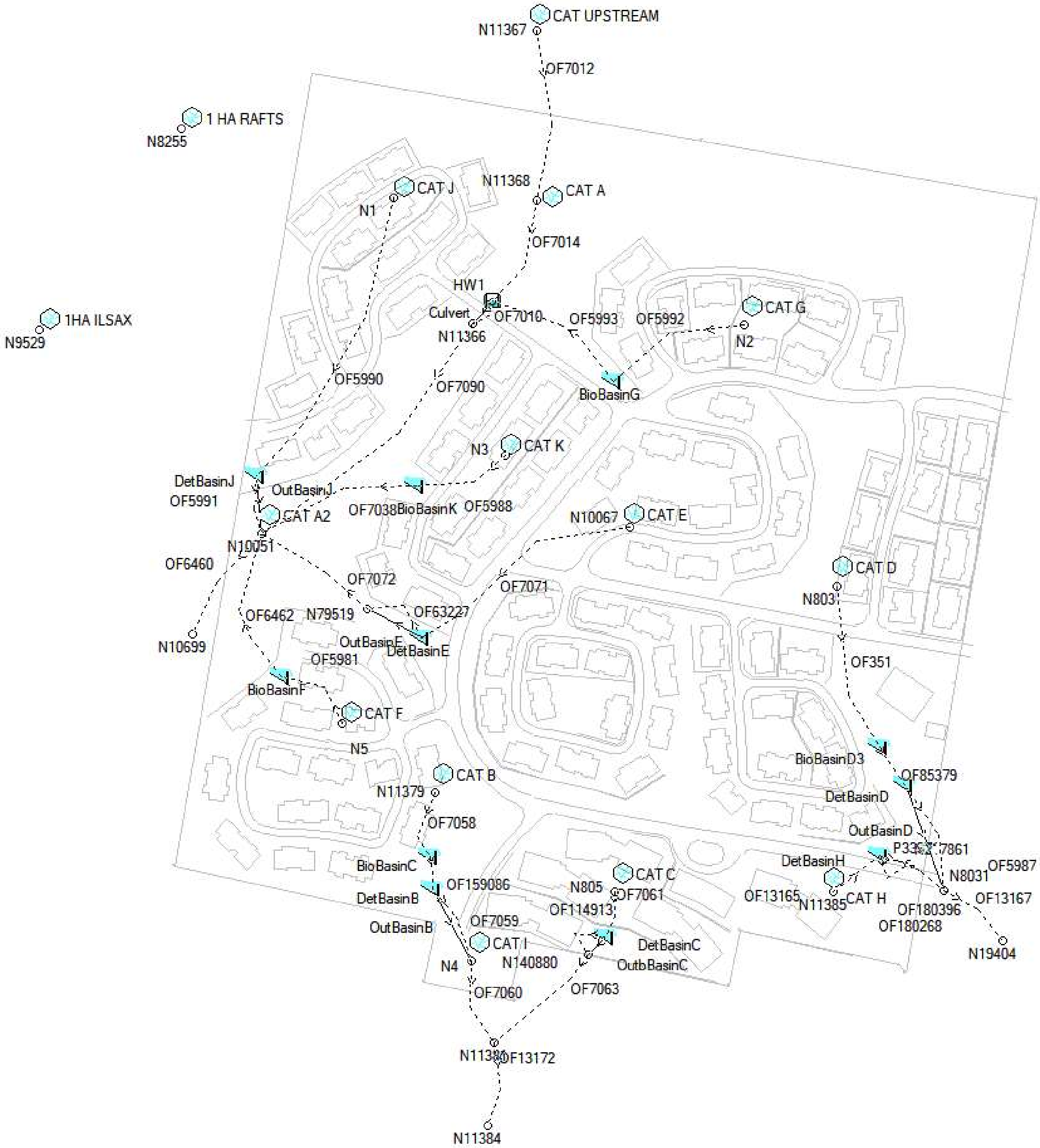
OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storms (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	U/S IL	D/S IL	Length (m)
OF5990	N1	DetBasinJ	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	491422			5
OF351	N803	BioBasinD3	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	1802			5
OF7061	N805	DetBasinC	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494614			5
OF5992	N2	BioBasinG	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	491427			5
OF5988	N3	BioBasinK	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	491418			5
OF5981	N5	BioBasinF	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	491408			5
OF5991	DetBasinJ	N10051	0.1	27.8	5	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	491424			5
OF6460	N10051	N10699	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	492963			5
OF5993	BioBasinG	HW1	0.1	33.3	3	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	491428			5
OF6462	BioBasinF	N10051	0.1	28.3	3	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	492965			5
OF5987	DetBasinD	N8031	0.1	29.05	2.5	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	491416			5
OF13167	N8031	N19404	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	513245			5
OF7059	DetBasinB	N4	0.1	28.25	3	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494608			5
OF7060	N4	N11381	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494609			5
OF7038	BioBasinK	N10051	0.1	28.8	3	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494573			5
OF7071	N10067	DetBasinE	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494641			5
OF7010	HW1	N11366	0.1	33.4	50	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494520			12
OF7090	N11366	N10051	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494725			5
OF7012	N11367	N11368	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494527			5
OF7014	N11368	HW1	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494533			5
OF7058	N11379	BioBasinC	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494603			5
OF13172	N11381	N11384	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	513252			5
OF114913	DetBasinC	N140880	0.1	27.65	0.6	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	812986			5
OF7063	N140880	N11381	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494618			5
OF13165	N11385	DetBasinH	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	513242			5
OF63227	DetBasinE	N79519	0.1	27	5	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	661052			5
OF7072	N79519	N10051	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	494642			5
OF85379	BioBasinD3	DetBasinD	0.1	30.3	3	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	726554			5
OF159086	BioBasinC	DetBasinB	0.1	29.05	3	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	942251			5
OF180268	DetBasinH	N217861	0.1	29.2	0.6	1.7	Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	1003627			5
OF180396	N217861	N8031	0.1				Dummy used to model flow across road low points	0.2	0.05	0.6	1	0	1003892			5

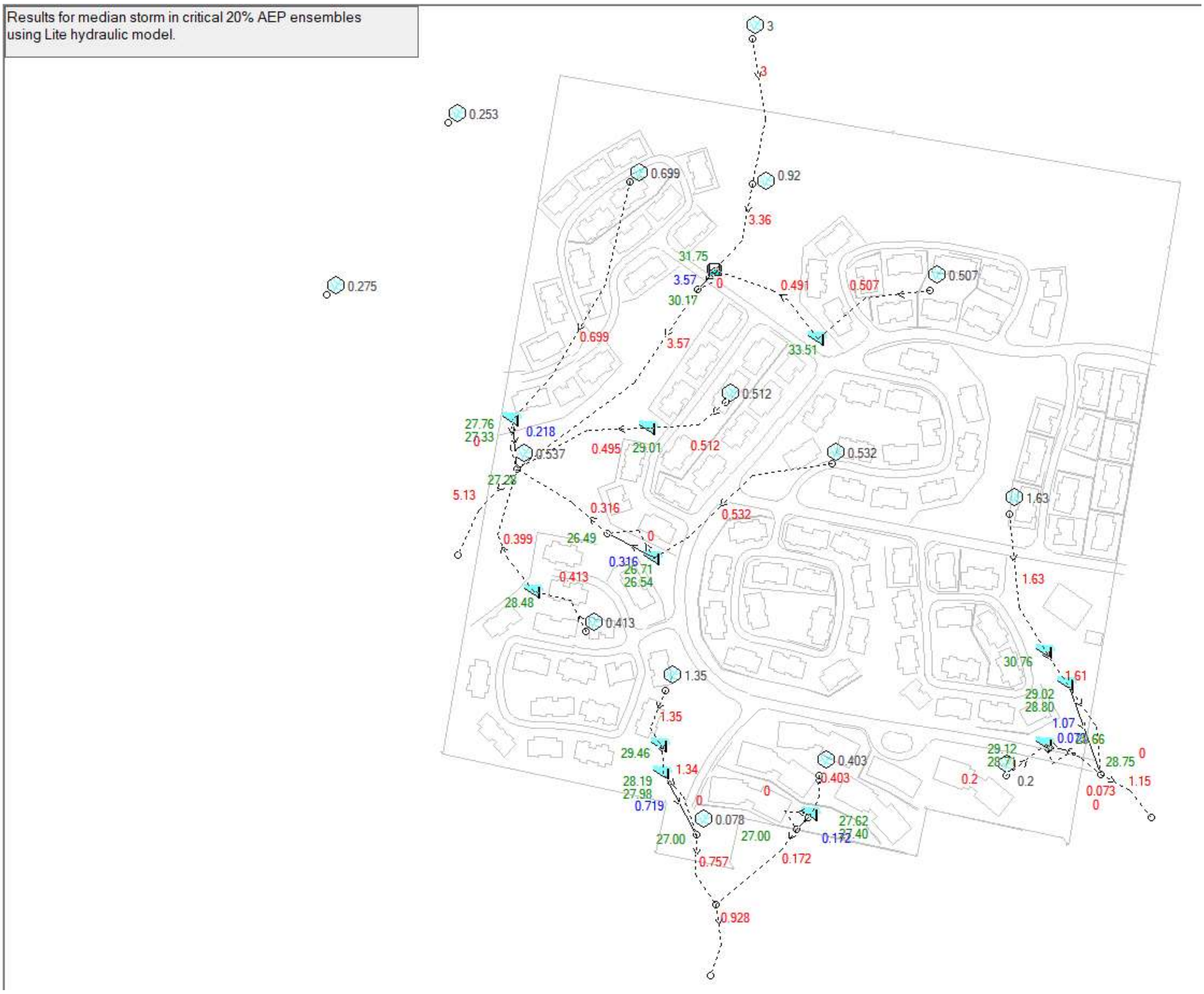
PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cover (m)	Cover (m)	
OutBasinJ	Concrete, under roads	375	0.7	-0.41	Unsafe
OutBasinD	Concrete, under roads	525	0.7	-0.57	Unsafe
OutBasinB	Concrete, under roads	525	0.7	-1.09	Unsafe
Culvert	Concrete, under roads	600	0.7	-0.65	Unsafe
OutbBasinC	Concrete, under roads	375	0.7	-0.46	Unsafe
OutBasinE	Concrete, under roads	375	0.7	-0.41	Unsafe
P33371	Concrete, under roads	225	0.7	-0.26	Unsafe

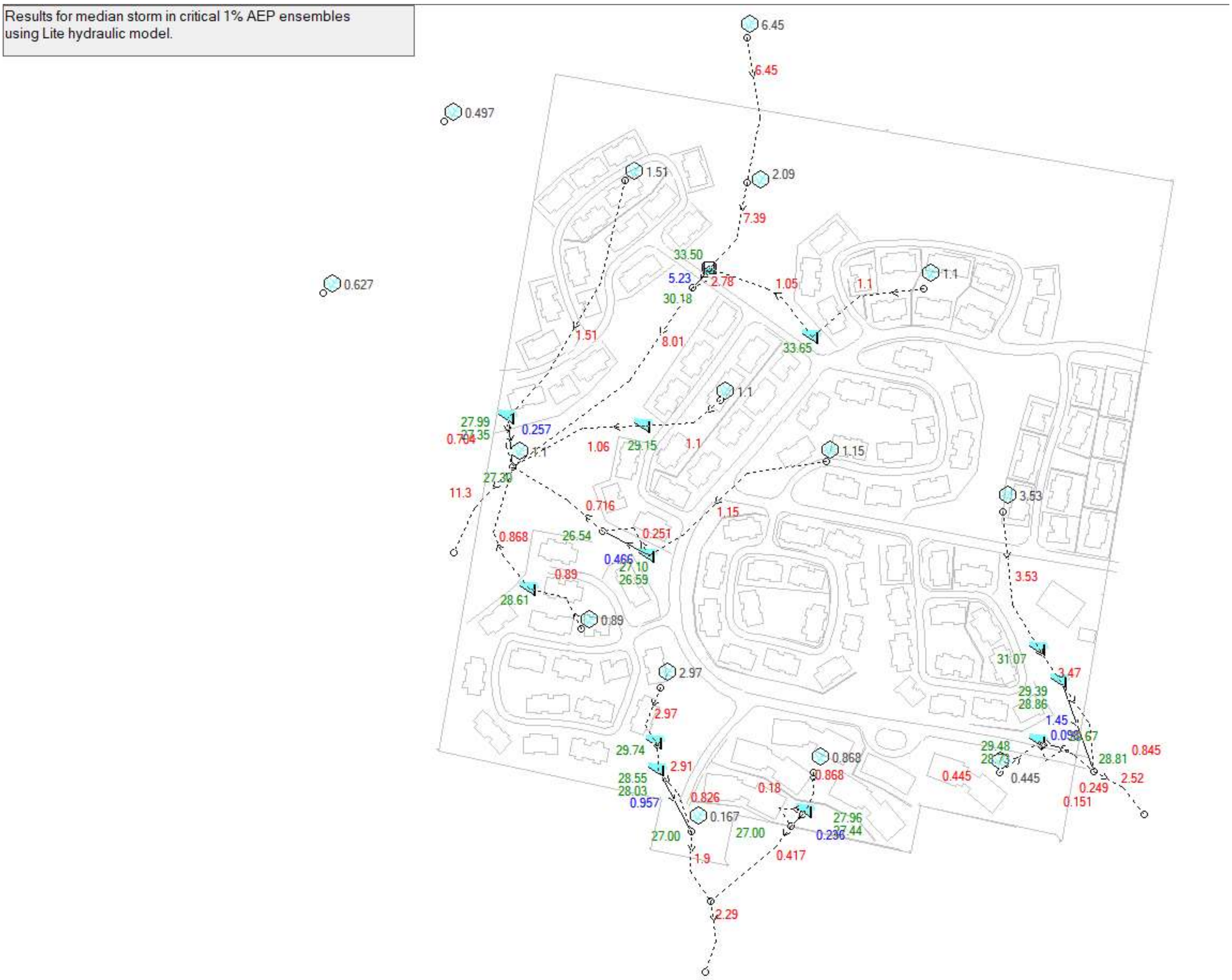
This model has no pipes with non-return valves


CAT UPSTREAM
N11367
OF7012
1 HA RAFTS
N8255
CAT J
N1
N11368
CAT A
OF7014
HW1
Culvert
OF7010
N11366
OF5993
OF5992
CAT G
N2
1HA ILSAX
N9529
OF5990
OF7090
BioBasinG
N3
CAT K
DetBasinJ
OF5991
OutBasinJ
OF7038
BioBasinK
OF5988
CAT A2
N10067
CAT E
N10051
OF6460
OF7072
OF7071
CAT D
N803
OF6462
N79519
OF63227
N10699
OutBasinE
DetBasinE
OF5981
OF351
BioBasinF
CAT F
N5
BioBasinD3
CAT B
N11379
OF85379
DetBasinD
OF7058
OutBasinD
BioBasinC
DetBasinH
OF5987
N8031
CAT C
OF159086
N805
OF7061
OF13165
N11385
CAT H
OF13167
DetBasinB
OF114913
OF180396
OF180268
OutBasinB
OF7059
CAT I
DetBasinC
N19404
N140880
OutbBasinC
N4
OF7060
OF7063
OF13172
N11384

A.2.2 DRAINS Post-Developed Model Schematic Layout (20% AEP Peak Flows)



A.2.3 DRAINS Post-Developed Model Schematic Layout (1% AEP Peak Flows)



B Pre-Developed Catchment Plan

C Post Developed Catchment Plan & Stormwater Strategy Measures

NOTE: The contractor shall check and verify all works on site (including works by others) before commencing any works. All discrepancies are to be reported to the Project Manager or LSW Surveyors prior to commencing work. Do not scale dimensions from the plan. All dimensions to be confirmed by dimensions from the plan. All dimensions to be confirmed by LSW Surveyors.

HORIZONTAL
CO-ORDINATE SYSTEM: MGA 56 (GDA94)
MARKS ADOPTED: PM 79459
EAST: 446141.986 NORTH: 6473301.522

PLOT FILE/DWG No.:
F:\D7564\7564 SENIORS\PRELIM R&D SET.dwg

VERTICAL
DATUM: AHD
BENCHMARK: PM 79459
R.L.: 50.48

DRAWN/CHECKED:
MG

PROJECT

PRELIMINARY ROAD & DRAINAGE DESIGN OF LOT 343 DP1118417 WINGHAM ROAD & MARIE AVENUE, TAREE PRE-DEVELOPED CATCHMENT PLAN

LSW
SURVEYORS, PLANNERS & ENGINEERS
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PO BOX 510 FORSTER NSW 2428
PH: (02) 6554 7988
EMAIL: consult@lswsurveyors.com.au
WEBSITE: www.lswsurveyors.com.au

SCALES
HORIZONTAL: 1:2000
VERTICAL: N/A
SHEET SIZE: A1

FIELD SHEETS
Date of survey: 15/04/20

COUNCIL:
MID-COAST COUNCIL

DATE:
16/09/20

SHEET 1 OF 1

FILE No.:
7564_SENIORS

ISSUE	DATE	COMMENTS
A	30/10/20	FIRST ISSUE
B	28/04/23	2ND ISSUE

NOTE: The contractor shall check and verify all works on site (including works by others) before commencing any works. All discrepancies are to be reported to the Project Manager or LSW Surveyors prior to commencing work. Do not scale dimensions from the plan. All dimensions to be confirmed by dimensions from the plan. All dimensions to be confirmed by LSW Surveyors.

HORIZONTAL	
CO-ORDINATE SYSTEM:	MGA 56 (GDA94)
MARKS ADOPTED:	PM 79459
EAST: 446141.986	NORTH: 6473301.522
PLOT FILE/DWG No.:	F:\D7564\7564 SENIORS\PRELIM R&D SET.dwg

VERTICAL	
DATUM:	AHD
BENCHMARK:	PM 79459
R.L.:	50.48
DRAWN/CHECKED:	PJL

PROJECT

PRELIMINARY ROAD & DRAINAGE DESIGN OF LOT 343 DP1118417 WINGHAM ROAD & MARIE AVENUE, TAREE POST-DEVELOPED CATCHMENT PLAN

LSW SURVEYORS, PLANNERS & ENGINEERS
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SCALES	
HORIZONTAL:	1:1250
VERTICAL:	N/A
SHEET SIZE:	A1
FIELD SHEETS Date of survey:	15/04/20

COUNCIL: MID-COAST COUNCIL

DATE: 16/09/20

SHEET 1 OF 1

FILE No.: 7564_SENIORS

ISSUE	DATE	COMMENTS
A	30/10/20	FIRST ISSUE
B	28/04/23	2ND ISSUE
C	29/02/24	3RD ISSUE
D	09/08/24	4TH ISSUE