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WATER SENSITIVE DESIGN STRATEGY FOR

PROPOSED SUBDIVISION OF LOT 75 DP1300031 STAGE 5 'SUMMER GREEN' MYALL DRIVE, FORSTER

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Issue 1

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1 INTRODUCTION

This document has been prepared to address stormwater management strategies for a proposed subdivision of part Lot 75 DP1300031, Myall Drive, Forster known as 'Summer Green' Stage 5.

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 strategy will also address stormwater quantity.

The 9.17ha site is located on the southern section of Myall Drive in Forster on the NSW Mid North Coast. The site is bordered by The Southern Parkway to the north, Council public reserve and existing residential land to the east, The Lakes Way to the south and recently developed residential to the west.

The proposed development footprint within the subject site is cleared as part of a bulk earthworks approval. The overall site primarily grades eastwards with slopes of 0.1 to 6% ranging from elevations of 7m to 3.5m AHD northwards towards a low lying part of the site, which eventually drains via a constructed open channel with concrete drain within the downstream The Lakes Estate.

The insitu soils on the site are expected to generally consist of a silty clay topsoil with underlying silty clays and alluvial sandy clays in the lower parts of the site (*Coffey Geotechnics Pty Ltd – 17 October 2007*).

This document follows on from a previous strategy prepared for the site for the purpose of rezoning (*Stormwater Management Strategy, WorleyParsons Services Pty Ltd, 12th November 2008)*, which was in accordance with recommendations from a peer review by *BMT WBM Pty Ltd*, (17th December 2007) and a subsequent Water Sensitive Design Strategy (Lidbury, Summers & Whiteman, 2018) approved for the adjoining residential stages of 'Summer Green'.

1.1 BACKGROUND

1.1.1 Proposed Development

The proposed development is a residential subdivision of part Lot 75 DP1300031. The proposed development consists of:

- 16 Residential Lots + Residue Lot
- Drainage Reserve (water quality bioretention basins and surrounding areas)
- Public Reserve
- Associated Infrastructure
- Roadways

The proposed development is shown in Figure 1.

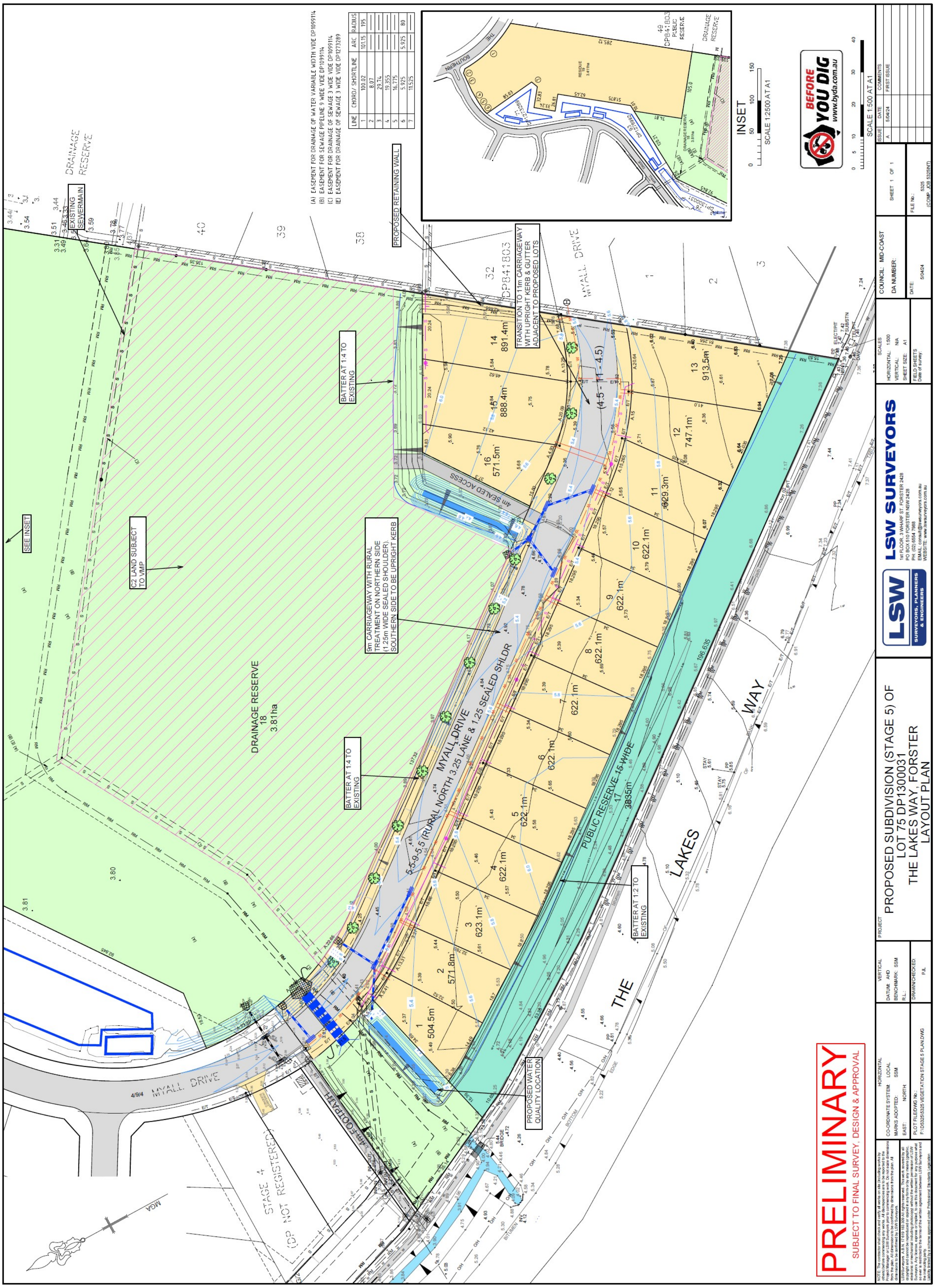


Figure 1 – Proposed Development

1.2 STORMWATER MANAGEMENT PERFORMANCE TARGETS

The objectives for water quality adopted for this Water Sensitive Design Strategy are based on *Great Lakes Council's* DCP Chapter 11 *Water Sensitive Design.* As the development footprint is greater than 2000m^2 and is a "Greenfield" subdivision (less than 10% of existing Lot impervious), the targets are:

- 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 adopted for this Water Sensitive Design Strategy are based on *Great Lakes Council's* DCP Chapter 9.2.5 *Subdivision (Drainage).* The targets 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 Water Sensitive Design 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.

On a typical lot, roof water will be captured by a 5kL Rainwater Tank (100% of roof area, utilising a sealed downpipe system) for the purpose of indoor (plumbed to toilets and laundry) re-use. Any overtopping of this captured roof water will discharge to the inter-allotment or roadside drainage system. For other impervious areas such as patios and paths etc., runoff will discharge to the inter-allotment or roadside drainage system. The captured stormwater for the roadway will drain via kerb and gutter which will convey stormwater to the underground stormwater system.

The captured stormwater for the roadway will drain via kerb and gutter which will convey stormwater to the underground stormwater system. 3 month ARI flows will discharge to the end-of-line bioretention basins. Coarse sediment forebays in the bioretention basins will act as gross pollutant traps and will capture coarse sediment, trash and vegetation matter. Flows greater than the capacity of the basins will bypass and/or overtop via a weir or surcharge pit and into the adjoining drainage reserves. Flows greater than the 3 month ARI will discharge directly into the adjoining drainage reserves.

The external catchments outside the development footprint have been excluded from the water quality modelling as they bypass any treatment measures and are equivalent in both the pre-developed and post-developed scenarios.

The insitu soils on the site are expected to generally consist of a silty clay topsoil with underlying silty clays and alluvial sandy clays in the lower parts of the site (*Coffey Geotechnics Pty Ltd – 17 October 2007*). The report found that groundwater was encountered within 0.2m below the existing surface (prior to filling) at the time of fieldwork. The base of the bioretention basins will be lined and no infiltration has been included in the hydrologic modelling. It is not proposed to utilise infiltration measures as part of the stormwater concept strategy at this time.

2 WATER QUALITY ASSESSMENT

2.1 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 a pre development and post development scenario. 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.

2.2 Rainfall and Evaporation

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

2.2.1 Rainfall

Bureau of Meteorology records from Station 60013 (Forster Tuncurry Marine Rescue) were reviewed to determine that the average annual rainfall depth is approximately 1,217mm. 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 1234mm rainfall.

A 6-minute rainfall time step was considered necessary to model the performance of rainwater tanks more accurately 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 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.

2.3 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%

2.4 Pollutant Concentrations

The pollutant concentrations adopted for existing-state and developed state modelling are shown in Table 3. 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 3 – Pollutant Concentrations

Land use/ Surface Type	Storm flow Concentration Log10 mg/l	Std. Dev. Log10 mg/l	Baseflow Concentration Log10 mg/l	Std. Dev. Log10 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

For the pre-developed model the development footprint was determined as Rural, which is consistent with previous strategies.

For the developed model the proposed site was separated into Roof Areas, Impervious and Pervious areas. Lot impervious areas have been assigned the Urban Residential EMC's.

2.5 Catchment Definition

For the purpose of the water quality modelling, the site was separated into Roof Area, Roads and Driveways (Impervious area) and pervious areas. The pre-developed and post-developed catchments can be seen in Appendix D.

It was assumed that an average lot in the residential lot release would be 60% impervious, consisting of roof area of 300m^2 and impervious of 120m^2.

It should once again be noted that the external catchments that do not enter the water quality basins have been excluded from the water quality modelling as they bypass any treatment measures and are equivalent in both the pre-developed and post-developed scenarios.

Table 4 – MUSIC Pre-Developed Catchment Details

PRE-DEVELOPED Sub-Catchment	Area (ha)	% Imperviousness
1 Existing Pervious Cleared Footprint (Rural)	1.864	0%
2 Existing Upstream Pervious (The Lakes Estate)	0.088	0%
3 Existing Upstream The Lakes Estate (Sealed Roads)	0.062	100%
4 Existing U/S The Lakes Estate Road Reserve Pervious (Urban)	0.043	0%
TOTAL	**2.057**	**3%**

Table 5 – MUSIC Post-Developed Catchment Details

POST-DEVELOPED "A" Sub-Catchment	Area (ha)	% Imperviousness
2 Existing Upstream Pervious (The Lakes Estate)	0.088	0%
3 Existing Upstream The Lakes Estate (Sealed Roads)	0.062	100%
4 Existing U/S The Lakes Estate Road Reserve Pervious (Urban)	0.043	0%
6 EAST Roadway & sealed shoulder (Sealed Roads)	0.113	100%
7 EAST 11 x Roofs (Roofs)	0.330	100%
8 EAST Lot Impervious, Dways, Footpath (Urban)	0.166	100%
9 EAST Remaining Lot Pervious (Urban)	0.308	0%
14 EAST Bioretention Basin (Urban)	0.035	0%
11 EAST Sealed Driveway (Sealed Roads)	0.017	100%
12 EAST Verge Pervious (Urban)	0.103	0%
12 EAST The Lakes Way Road Reserve Pervious (Urban)	0.177	0%
6 WEST Roadway & sealed shoulder (Sealed Roads)	0.038	100%
7 WEST 5 x Roofs (Roofs)	0.150	100%
8 WEST Lot Impervious, Dways, Footpath (Urban)	0.077	100%
9 WEST Remaining Lot Pervious (Urban)	0.085	0%
14 WEST Bioretention Basin (Urban)	0.026	0%
12 WEST Verge Pervious (Urban)	0.051	0%
6 BYPASS Roadway (Sealed Roads)	0.095	100%
17 BYPASS Batter/ Verge Pervious (Urban)	0.093	0%
TOTAL	**2.057**	**51%**

2.6 Modelling Stormwater Management Controls

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

2.6.1 Rainwater Tanks

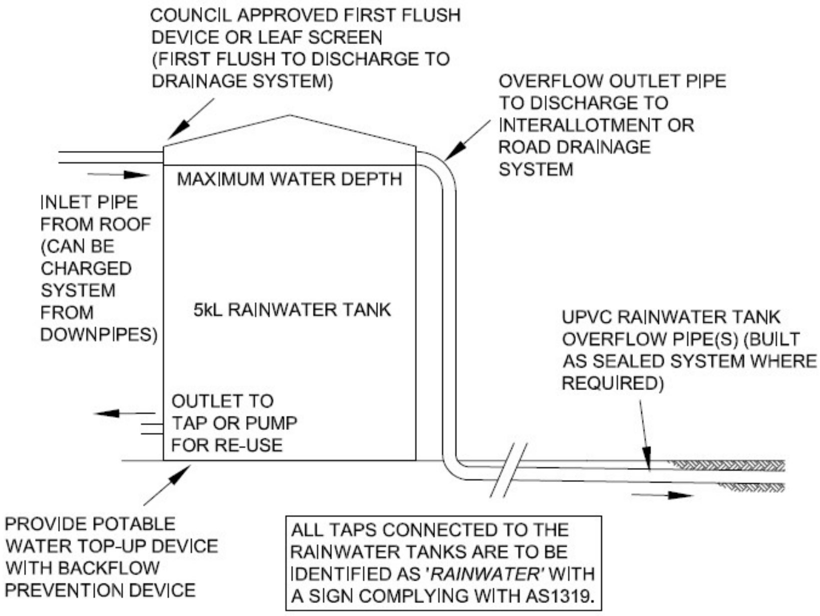
Providing water for an increasing population in Australian climatic conditions is becoming a significant issue, rainwater collection and re-use tanks are considered an important *Best Management Practice* for all developments.

On a typical site, roof water will be captured by a 5kL Rainwater Tank (100% of roof area, utilising a sealed downpipe system), for the purpose of indoor (plumbed to toilets and cold-water laundry) re-use. Any overtopping of this captured roof water will discharge to either the inter-allotment or roadside drainage system.

These tanks will require a council approved first flush stormwater filter device, prior to water entering the unit. To ensure the tank will always contain water for indoor re-use, a potable water top-up device with backflow prevention device is to be fitted to the tank. The rainwater tank is to have re-use capabilities in accordance with BASIX requirements. All taps connected to the rainwater tanks are to be identified as *'Rainwater'* with a sign complying with AS1319.
Re-use of the collected stormwater runoff is to be used for non-potable indoor and outdoor purposes only including toilet flushing and cold-water laundry, and outdoor garden irrigation.

For MUSIC modelling, the following parameters were used:

- 5kL tank per dwelling for re-use capturing all roof area (100% capture)
- Mid-Coast Water have provided estimates of typical non-potable water demands for residential dwellings across the LGA over the last 10-years. A constant Internal Re-use of 150L/day/dwelling (re-use for toilet and laundry) and Outdoor Re-use of 98L/day/dwelling were adopted (*Guidelines for Water Sensitive Design Strategies October 2019*)
- The conservative PET – Rain option was chosen for re-use modelling (i.e. outdoor re-use demand is zero when the rainfall exceeds the PET).



TYPICAL RAINWATER TANK DETAIL
Not to Scale

2.6.2 Water Quality Bioretention Basins

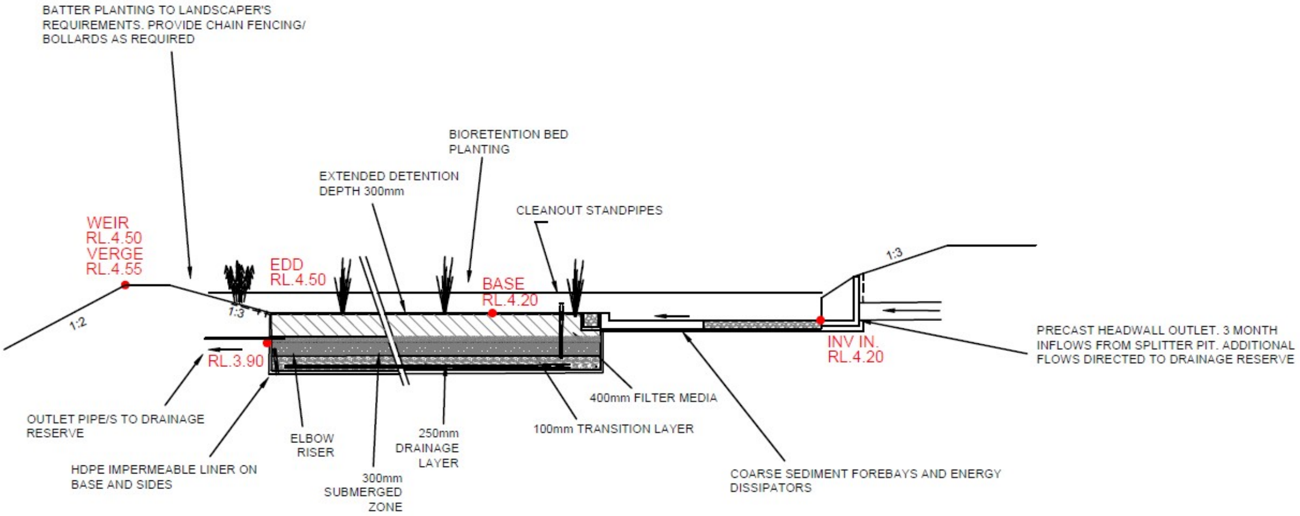
Constructed water quality bioretention basins are shallow, extensively vegetated water bodies that use enhanced sedimentation, fine filtration, and pollutant uptake processes to remove pollutants from stormwater. These processes are engaged by slowly passing runoff through vegetated areas. Plants filter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

For this development, it is proposed to construct an end-of-line water quality bioretention basin to serve the development catchment. 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.
- Effective vegetation planted
- Filter media 300mm thick (Sandy Loam) with 100mm transition layer with underlying 250mm drainage layer and 300mm submerged zone
- Filter Media Total Nitrogen = 400mg/kg and Orthophosphate = 40mg/kg
  (*Using MUSIC in Sydney's Drinking Water Catchment*, SCA, Dec 2012)
- Subsoil drains which will drain to adjacent drainage reserve
- Top 100mm ameliorated to provide for plant uptake
- Energy Dissipator & concrete sediment forebays at pipe outlets

The basins will have a "splitter pit" arrangement to allow for approximately 3-month ARI inflows only (however it 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 the adjacent drainage reserves. The basins will be dedicated to Council as drainage reserve.



TYPICAL BIORETENTION BASIN

Not to Scale

2.6.3 Buffer Strips

Buffer Strips are essentially grassed or otherwise vegetated areas formed to filter sheet flow runoff from an impervious source.

A 1m wide strip of turf running the length of the sealed rural shoulder will be placed on the downslope side to facilitate removal of coarse pollutants. For MUSIC modelling, 100% of the upstream area was buffered.

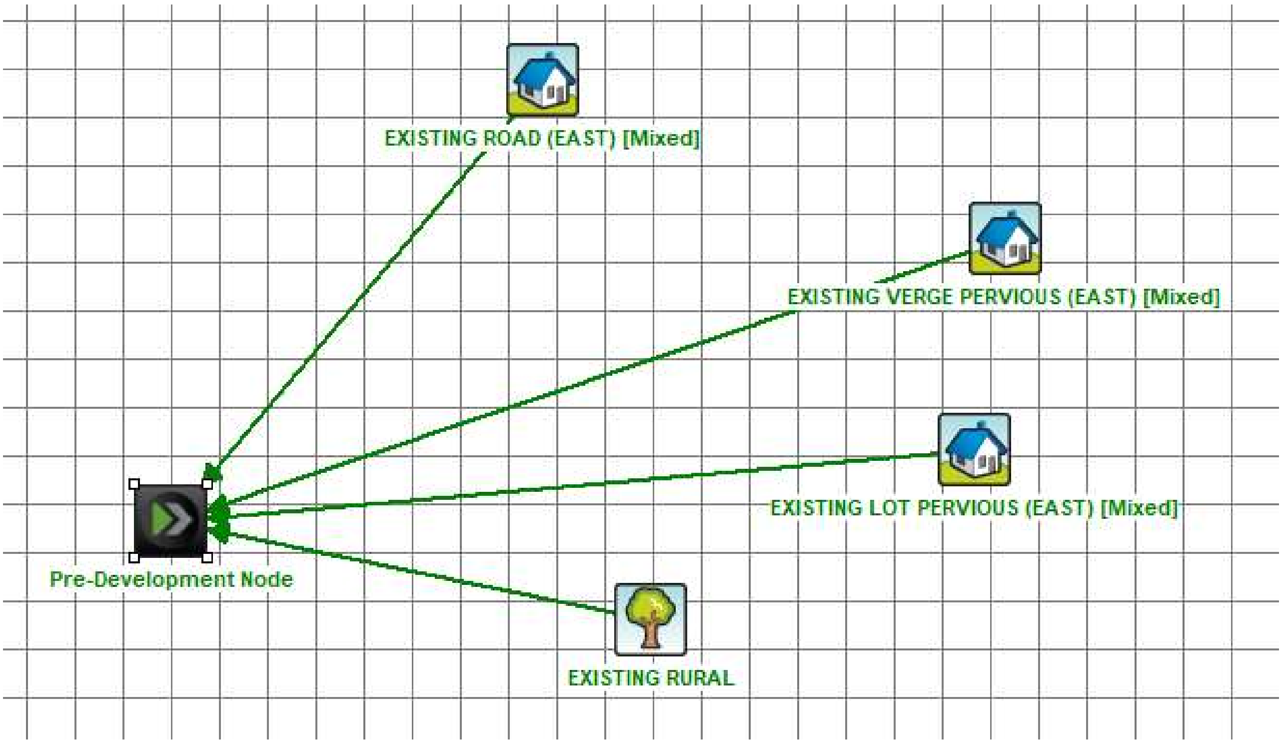


Figure 2: Pre-Developed MUSIC model

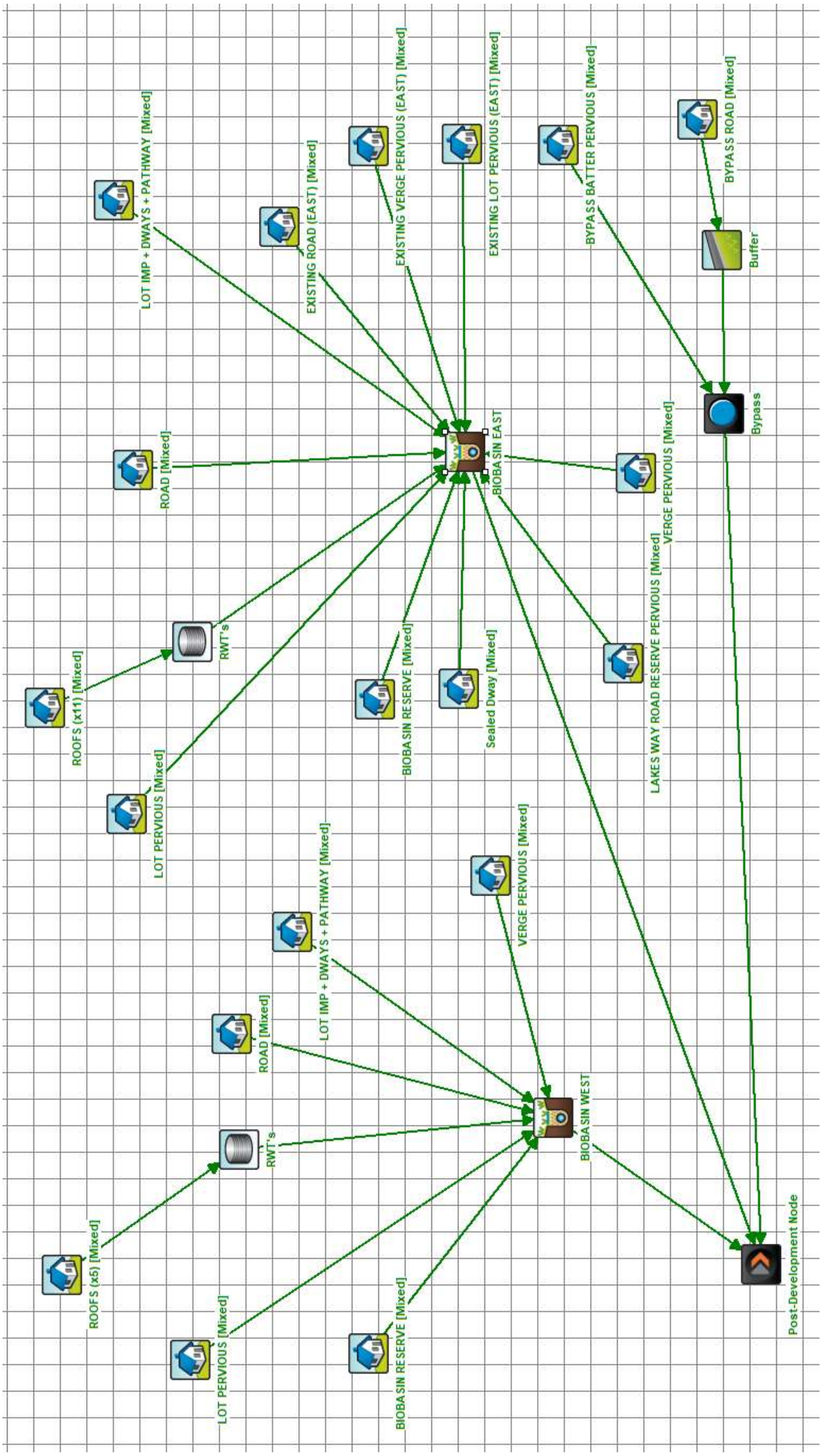


Figure 3: Post-Developed MUSIC model

2.7 Model Results

Table 6 presents the average annual pollutant export loads at the downstream extent of the entire subject site under both pre developed and post developed conditions (with and without treatment).

Table 6 - 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	**16.1**	281	25.8	**90.8**
TSS	**1,230**	2,680	**748**	72.0
TP	**2.69**	4.87	**2.65**	45.6
TN	**20.7**	35.5	**20.4**	42.4

The results in Table 6 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 Water Sensitive Design Plan for the locality, size and details of the proposed stormwater treatment measures.

2.8 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.

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.

3 HYDROLOGIC ANALYSIS

3.1 Overview

Hydraulic modelling for this strategy has been undertaken using DRAINS software with a RAFTS Hydrological model.

This methodology was adopted to match existing ILSAX detailed drainage design previously undertaken for previously constructed stages, but allow for conceptual modelling of the subject catchment. A more detailed ILSAX modelling of the proposed urban catchment will be undertaken at detailed design stage.

3.2 RAFTS Model

The hydrologic modelling in the previous *WorleyParsons* strategy utilised XP-RAFTS runoff routing design and analysis software. Generally the XP-Rafts parameters adopted by *WorleyParsons* (link lags and manning's 'n', Bx = 1) have been utilised for the modelling, however losses updated to ARR2019. The catchments, slopes and impervious percentages however have been revised to reflect the current site layout.

Rainfall inputs were entered using IFD relationships from BOM IFD for the subject site and temporal patterns from ARR2019). These rainfalls have increased since previous strategies.

3.3 ILSAX Model

Hydraulic modelling for the existing urban catchments has been previously undertaken using DRAINS software with an ILSAX Hydrological model. The DRAINS Parameters were modified to provide a realistic hydrological model for the subject site's future detailed modelling. The following parameters were adopted for the DRAINS ILSAX Model:

- Paved (Impervious) Depression Storage – 1mm
- Supplementary Depression Storage – 1mm
- Grassed (Pervious) Depression Storage – 5mm
- Soil Type – 3 (typically slow infiltration rates)
- Antecedent Moisture Condition – 3 (indicates rather wet starting condition for storm event)

Rainfall inputs were entered using IFD relationships from BOM for Forster and temporal patterns from ARR2019. These rainfalls have increased since previous strategies.

3.4 Catchments

The pre-developed and post-developed hydrological catchments can be seen in Appendix D. The pre-developed (XP-RAFTS) catchments are per Appendix B, and a partial catchment draining west has been included in the areas. The post-developed catchments for the subject site are per Section 2.5 above and also Appendix C. The external catchments and catchments are per the *WorleyParsons* strategy and are assumed to drain to the outlet point in all scenarios.

3.5 Pre-Developed Scenario

The pre-developed model includes a detention basin mimicking the natural attenuation in the downstream low lying area. The stage vs storage relationships has been reduced slightly than previously undertaken by *WorleyParsons* due to The Southern Parkway link being constructed in this area. The stage vs discharge to The Lakes Estate open channel has adopted the *WorleyParsons* relationship. Future detailed modelling at Construction Certificate stage will confirm this relationship and any downstream tailwater effect.

This scenario is consistent with previous strategies.

The results are provided in Section 3.7 below.

3.6 Post-Developed Scenarios

Various post-development scenarios have been undertaken to demonstrate the objectives in Section 1.2 can be achieved.

Scenario E models the development of Stage 5 (16 Residential Lots) fully developed with no detention measures. This scenario demonstrates that upon development, no stage detention basin is required (due to it's proximity to the outlet, the peak is best leaving first prior to the larger upstream peak arriving).

Scenario F is similar to the previous *WorleyParsons* post-developed strategy, where the entire residential zoned area is fully developed, however the downstream low lying area is also developed as playing fields, and an end-of-line constriction provided on the outlet to The Lakes Estate. This model has only been provided to model the highest expected tailwater condition for the subject site. The stage vs discharge to The Lakes Estate open channel has adopted the *WorleyParsons* relationship for the constriction. Future detailed modelling at Construction Certificate stage will confirm this relationship and any downstream tailwater effect.

The existing natural surface of the low-lying wetland has been adopted for the pre-developed scenario, and post-developed scenario E (reduced storage with filling into the flood storage below RL 3.92). Scenario F has the playing fields/ Council area proposed filling added to the model (further reduced storage). All models are subject to final detailed design.

The proposed Stage 5 bioretention basins have conservatively not been included in the hydrologic modelling.

The results of all the scenarios are provided in Section 3.7 below.

3.7 Results and Commentary

The results of the pre-developed and post-developed models are shown in Table 9.

Table 9 – Summary of Stormwater Quantity

SCENARIO	20% AEP	20% AEP	1% AEP	1% AEP
	Peak Discharge (m^3/s)	**Peak Flood Level (in basin)** (RL mAHD)	**Peak Discharge** (m^3/s)	**Peak Flood Level (in basin)** (RL mAHD)
Pre-Developed	2.53	3.77	6.62	3.92
Post-Developed SCENARIO E	2.39	3.76	6.14	3.90
Post-Developed SCENARIO F	1.38	3.92	3.87	4.22

As can be seen, the post-developed peak flows are less than the pre-developed peak flows, which satisfies the objectives (Note the previous modelling was undertaken using ARR 2001 rainfalls and achieved better correlation with previous studies. The new ARR2019 parameters have increased peak flows (relative to pre and post-developed)).

Scenario E demonstrates that no specific detention is required for the subject Stage 5. This is due to the Stage 5 being at the downstream end of the catchment, and this peak flow discharging prior to the upper peak arriving.

Scenario F demonstrates that if the playing fields are constructed and an outlet constriction constructed, the peak flows can be substantially reduced. The model has adopted the *WorleyParsons* relationship of stage vs discharge for the proposed constriction to The Lakes Estate open channel. Whilst this scenario has been provided to model the highest expected local tailwater condition for the subject site, if this scenario does eventuate, the constriction could be reduced to reduce the tailwater level.

3.8 Climate Change

The subject site is mapped as a Flood Planning Area within the Great Lakes LEP 2014. The projected Flood Planning Level is the 2100 1% AEP flood level (projected sea level rise) with an additional 500mm freeboard.

Recent modelling of the downstream catchment by *BMT WBM Pty Ltd* (Dunns Creek Catchment Water Management Strategy, August 2015), indicates the 1% AEP flood level within the site is approximately RL 4.30. However this peak results from backwater effects from the overall Wallis Lake catchment and would be expected to occur after the local catchment peak has passed.

The strategy proposes that all proposed dwellings within the site have a minimum freeboard of 0.5m above the local 1% design flood level (without climate change forecasts). The highest level in the proposed Scenario F is RL 4.22 (very conservative given the over constriction), which would require minimum lot levels above this level, and minimum floor levels of RL 4.72.

The lowest minimum lot level within the entire proposed development is RL 5.2, and a minimum floor level of RL 4.8 is recommended, which satisfies any of the above criteria.

4 SUMMARY

4.1.1 Water Quality

A combination of measures discussed above including rainwater tanks and water quality 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 subdivision.

4.1.2 Minor Storm Event

The utilisation of detention in the detention/ bioretention basins in the adjoining development will attenuate captured stormwater runoff. The minor flow (Q_5) criteria is to attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 20% AEP peak rainfall event.

The modelling shows that the total post-developed peak discharges from the 5 year ARI peak storm event for the catchment are less than the pre-developed peak discharges.

4.1.3 Major Storm Event

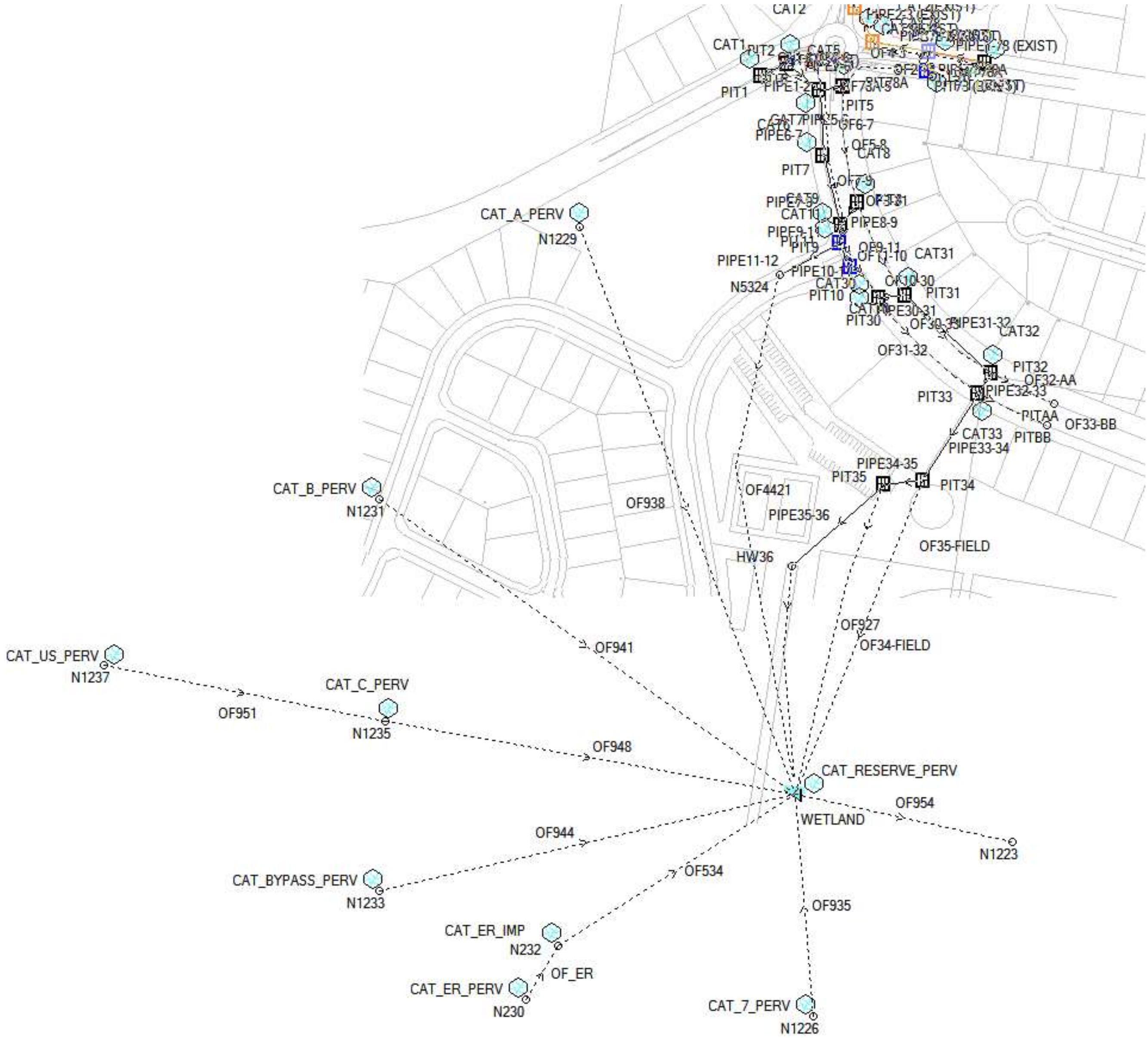
The major flow criteria is to attenuate post-development peak discharges to maintain existing flows for all storm events up to and including the 1% AEP peak rainfall event.

The modelling shows that the total post-developed peak discharges from the 1% AEP peak storm event for the catchment are less than the pre-developed peak discharges.

Refer to the Water Sensitive Design Strategy Plan (Appendix D) for the locality, size and details of the proposed stormwater treatment measures.

B DRAINS (Pre-Developed Modelling) OUTPUT FILES

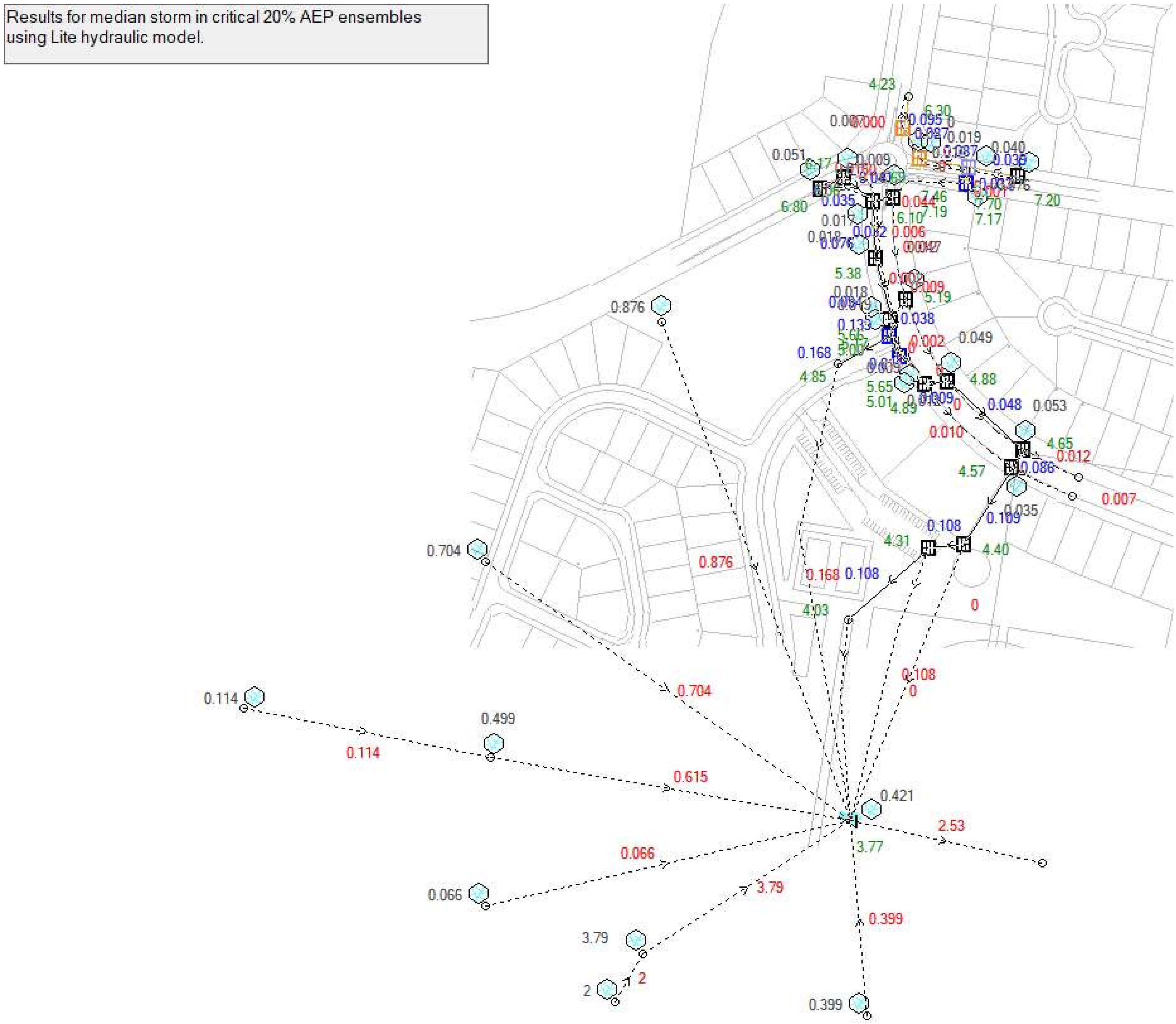
B.1 DRAINS Pre-Developed Model



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		
WETLAND	3.5	0		None						901.848	1392.2	No			433653218		
	3.55	804															
	3.6	1953															
	3.65	3624															
	3.7	5850															
	3.75	8635															
	3.8	11981															
	3.85	15831															
	3.9	20077															
	3.95	24646															
	4	29515															
	4.05	34685															
	4.1	40137															
	4.15	45835															
	4.2	51762															
	4.25	57874															
	4.3	64134															
	4.35	70527															
	4.4	77039															
	4.45	83664															
	4.5	90393															
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
CAT1	PIT1	0.195	54	46	0	0	0	0	5	160	0	3	1	0	0.012	0.21	0
CAT2	PIT2	0.017	100	0	0	5	0	0									
CAT6	PIT6	0.051	70	30	0	5	5	0									
CAT7	PIT7	0.069	32	68	0	0	0	0	37	35	0	2.5	3	0	0.012	0.21	0
CAT9	PIT9	0.052	48	52	0	0	0	0	40	8	0	1.2	3	0	0.012	0.21	0
CAT11	PIT11	0.056	46	54	0	5	5	0									
CAT5	PIT5	0.025	64	36	0	5	5	0									
CAT78A	PIT78A	0.189	56	44	0	0	0	0	130	5	0	1.6	3	0	0.012	0.21	0
CAT78	PIT78(EXIST)	0.058	48	52	0	0	0	0	30	13	0	0.5	3	0	0.012	0.21	0
CAT2(EXIST)	PIT2(EXIST)	0.0001	0	0	0	5	5	0									
CAT3(EXIST)	PIT3(EXIST)	0.029	70	30	0	5	5	0									
CAT8	PIT8	0.142	30	47	23	0	0	0	65	10	6	2	3	3	0.012	0.21	0.012
CAT10	PIT10	0.033	73	27	0	5	5	0									
CAT30	PIT30	0.026	54	46	0	0	0	0	22	7	0	0.5	3	0	0.012	0.21	0
CAT31	PIT31	0.133	30	36	34	0	0	0	60	7	12	0.5	3	3	0.012	0.21	0.012
CAT32	PIT32	0.148	29	47	24	0	0	0	65	7	11	0.5	3	3	0.012	0.21	0.012
CAT33	PIT33	0.1	49	51	0	0	0	0	77	8	0	0.5	3	0	0.012	0.21	0
CAT1 (EXIST)	PIT1(EXIST)	0.205	16	84	0	0	0	0	100	37	0	1	1	0	0.012	0.21	0
Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model									
CAT_ER_PERV	N230	10.31	0	4	0.025	0	1	Forster - RAFTS 29 0.92									
CAT_ER_IMP	N232	7.27	100	4	0.015	0	1	Forster - RAFTS 29 0.92									
CAT_7_PERV	N1226	3.97	0	1	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_A_PERV	N1229	5.052	0	4	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_B_PERV	N1231	3.877	0	4	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_BYPASS_PERV	N1233	0.41	0	1	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_C_PERV	N1235	2.91	0	3	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_US_PERV	N1237	0.59	0	2	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_RESERVE_PERV	WETLAND	7.655	0	0.3	0.04	0	1	Forster - RAFTS 29 0.92									

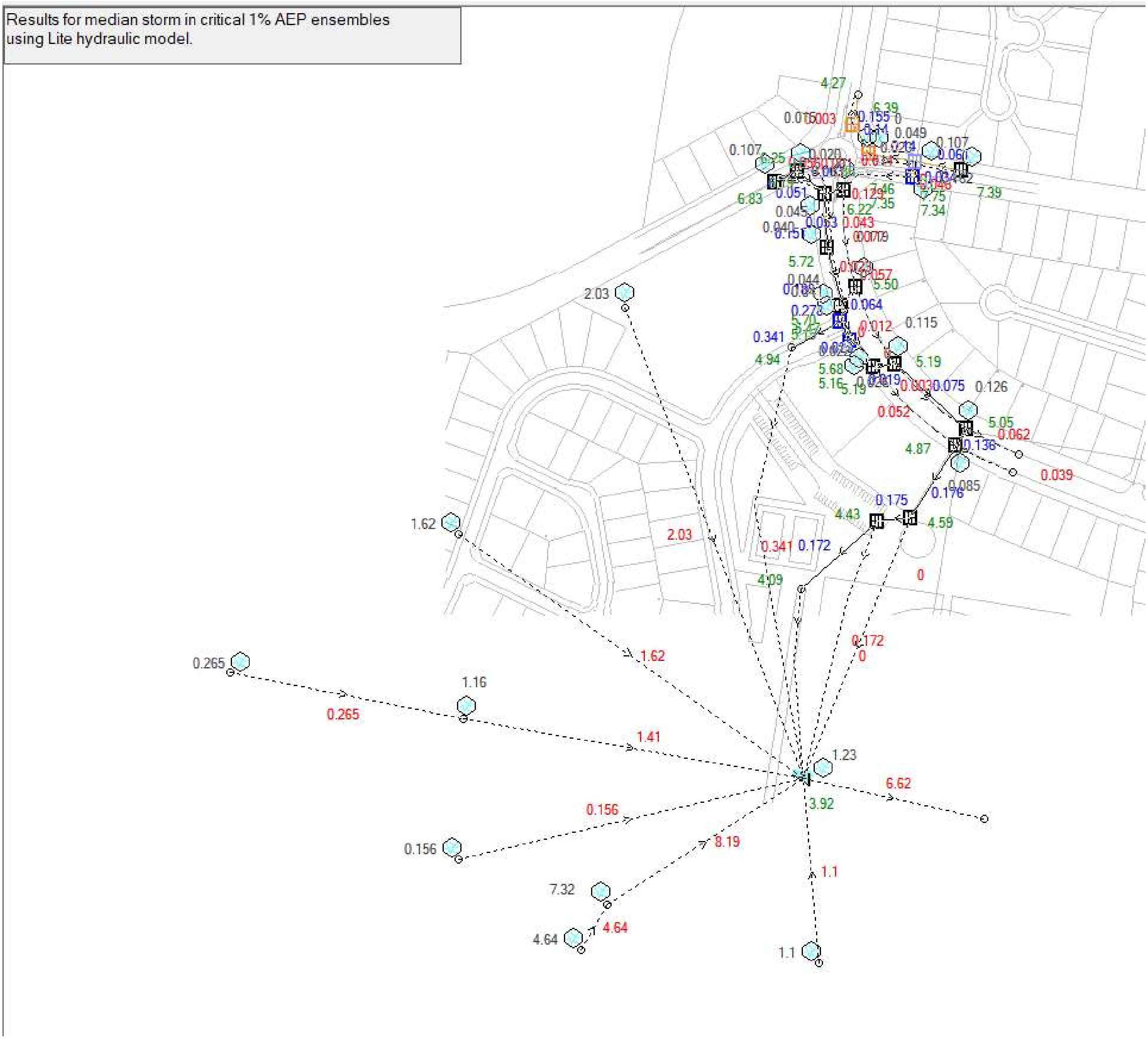
B.2 DRAINS Pre-Developed Model (20% AEP Peak Flows)

DRAINS Worst Case Peak Flows (i.e. worst case storm event for each outlet).



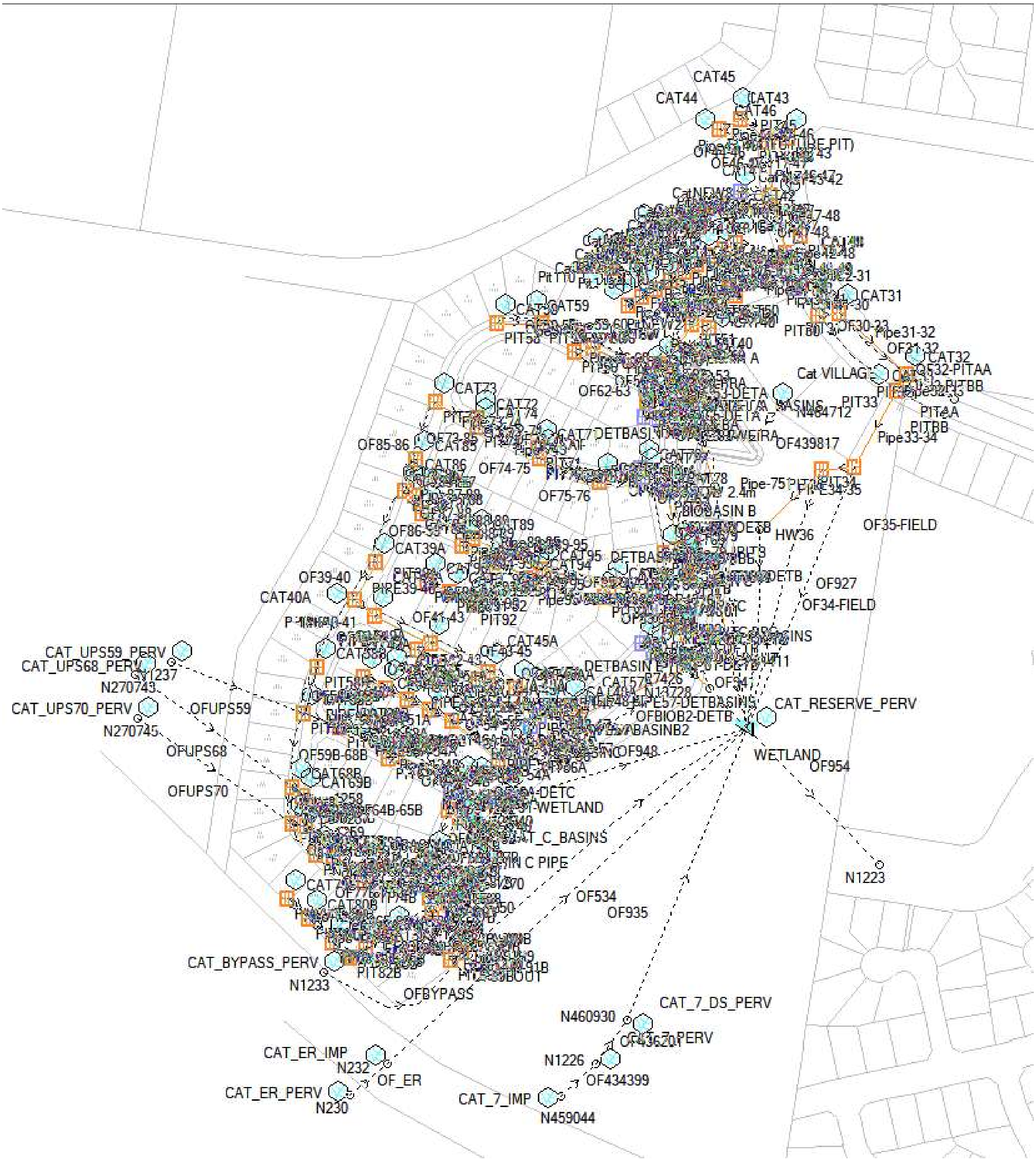
B.3 DRAINS Pre-Developed Model (1% AEP Peak Flows)

DRAINS Worst Case Peak Flows (i.e. worst case storm event for each outlet).
50% Blockage factor (DRAINS new theory) applied to Q100 post-developed model.



C DRAINS (Post-Developed Modelling) OUTPUT FILES

C.1 DRAINS Post-Developed Model SCENARIO E



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 Leng	id		
BIOBASIN B	4.2	0		None						863.672	1514.677	No			4.45E+08		
	4.3	15.1															
	4.4	31.8															
	4.5	50.1															
	4.6	51															
WETLAND	3.5	0		None						900.877	1392.775	No			4.34E+08		
	3.55	804															
	3.6	1942															
	3.65	3649															
	3.7	5834															
	3.75	8471															
	3.8	11563															
	3.85	15090															
	3.9	18874															
	3.95	22846															
	4	26986															
	4.05	31313															
	4.1	35786															
	4.15	40401															
	4.2	45170															
	4.25	50082															
	4.3	55092															
	4.35	60194															
	4.4	65378															
	4.45	70639															
	4.5	75968															
BIOBASIN A	4.5	0		None						853.109	1605.719	No			4.45E+08		
	4.6	15.6															
	4.7	32.9															
	4.8	51.5															
	4.9	70															
BIOBASIN C	4	0		None						861.386	1467.431	No			4.5E+08		
	4.1	13.9															
	4.2	27.6															
	4.3	42.7															
	4.4	43															
DETBASIN B	3.6	0		Culvert	0.5					860.545	1433.276	No			4.37E+08		
	3.61	20															
	4.1	1315															
	4.3	1860															
BIOBASINB2	3.95	0		None						789.724	1392.911	No			4.99E+08		
	4.1	19.3															
	4.2	33.7															
	4.3	52.1															
	4.4	72.6															
	4.5	93.5															
BIOBASIN C2	4.2	0		None						704.427	1278.833	No			5.22E+08		
	4.25	4															
	4.3	8.4															
	4.4	18.1															
	4.5	29															
	4.55	35															
BIOBASIN C1	4.2	0		None						716.282	1331.805	No			5.22E+08		
	4.25	4															
	4.3	8.4															
	4.4	18.1															
	4.5	29															
	4.55	35															
DETBASINB	4	0		Culvert	0.5					875.959	1506.26	No			4.5E+08		
	4.1	57.2															
	4.2	121.5															
	4.3	193															
	4.4	271.3															
	4.5	356.4															
	4.6	447.2															
	4.7	543.3															
	4.8	550															
DETBASIN C	3.8	0		Culvert	0.5					722.4	1313.813	No			4.38E+08		
	3.85	53															
	3.9	111															
	4	239															
	4.1	383															
	4.2	544															
	4.3	720															
	4.4	912															
	4.5	1121															
	4.57	1277															
DETBASIN A	4	0		Culvert	0.5					867.572	1589.674	No			4.34E+08		
	4.1	157.4															
	4.2	326.2															
	4.3	507.8															
	4.4	702.4															
	4.5	910.1															
	4.6	1130.9															
	4.7	1365															
	4.8	1370															

SUB-CATCHMENT DETAILS

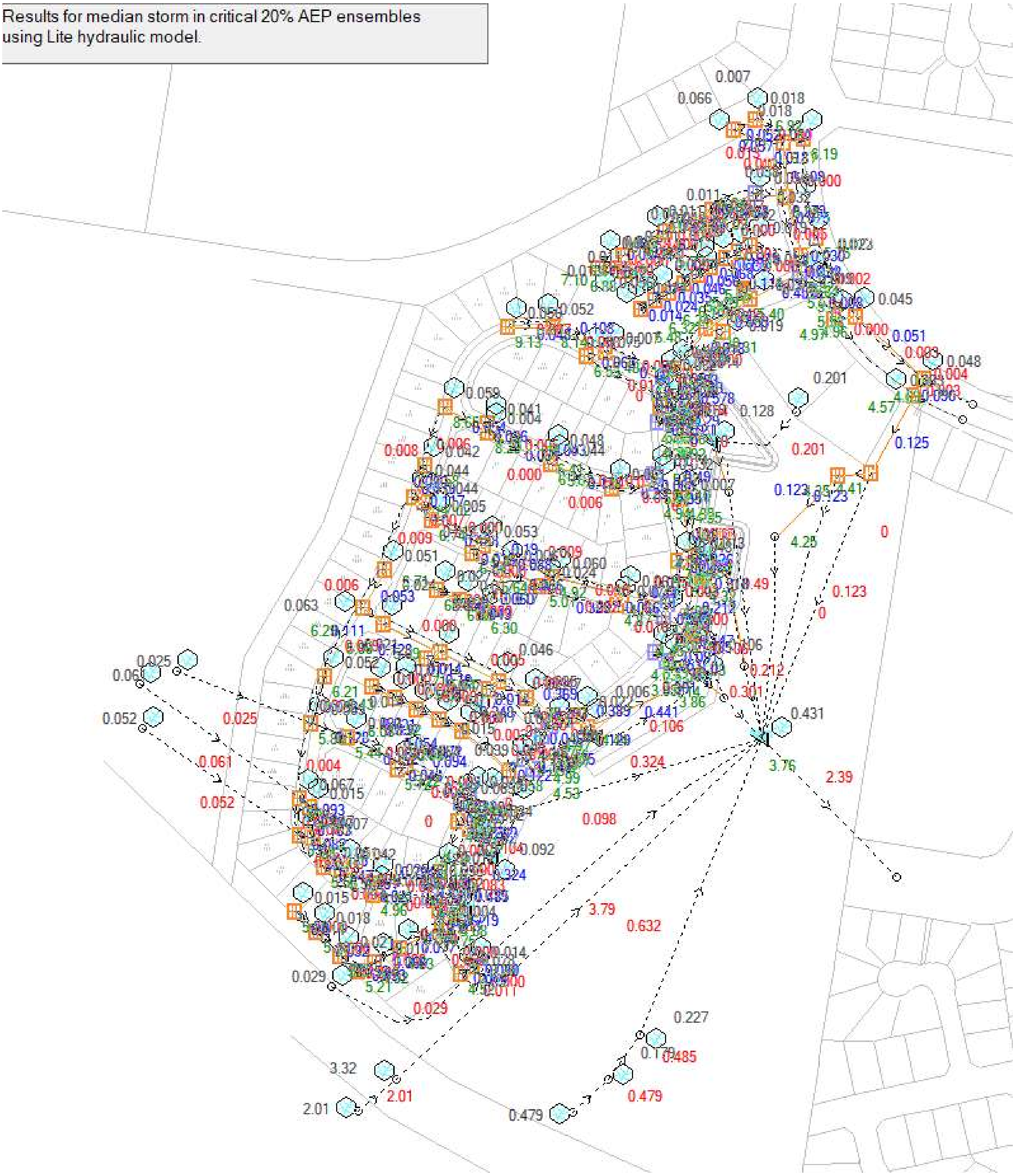
Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp
	Node	Area	Area	Area	Area	Time	Time	Time	Length	Length	Length	Slope(%)	Slope	Slope	Rough	Rough	Rough
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%	%			
CAT70	PIT70	0.218	62	38	0	5	5	6									
CAT77	PIT77 NOW	0.093	57	43	0	5	5	6									
CAT78	PIT78	0.019	84	16	0	5	5	6									
CAT79	PIT79	0.034	83	17	0	5	5	6									
CAT44	PIT44 (FUT	0.195	54	46	0	5	5	0									
CAT45	PIT45	0.017	100	0	0	5	0	0									
CAT46	PIT46	0.051	70	30	0	5	5	0									
CAT47	PIT47	0.112	60	40	0	5	5	0									
CAT48	PIT48	0.068	56	44	0	5	5	0									
CAT49	PIT49	0.048	66	34	0	5	5	0									
CAT50	PIT50	0.087	68	32	0	5	5	0									
CAT51	PIT51	0.125	62	38	0	5	5	0									
CAT52	PIT52	0.154	66	34	0	5	5	0									
CAT53	PIT53	0.037	84	16	0	5	5	0									
CAT42	PIT42	0.097	46	54	0	5	5	0									
CAT41	PIT41	0.031	68	32	0	5	5	0									
CAT40	PIT40	0.049	85	15	0	5	5	0									
CAT58	PIT58	0.164	60	40	0	5	5	0									
CAT59	PIT59	0.152	58	42	0	5	5	0									
CAT60	PIT60	0.021	54	46	0	5	5	0									
CAT61	PIT61	0.177	66	34	0	5	5	0									
CAT62	PIT62	0.159	62	38	0	5	5	0									
CAT63	PIT63	0.001	50	50	0	5	5	0									

CAT64	PIT64	0.126	58	42	0	5	5	0									
CAT65	PIT65	0.05	84	16	0	5	5	0									
CAT56	PIT56	0.213	68	32	0	5	5	0									
CAT73	PIT73	0.174	58	42	0	5	5	0									
CAT74	PIT74	0.012	46	54	0	5	5	6									
CAT75	PIT75	0.131	56	44	0	5	5	6									
CAT76	PIT76	0.18	57	43	0	5	5	6									
CAT72	PIT72	0.118	67	33	0	5	5	0									
CAT71	PIT71	0.141	64	36	0	5	5	6									
CAT69	PIT69	0.141	63	37	0	5	5	6									
CAT90	PIT90	0.08	60	40	0	5	5	6									
CAT91	PIT91	0.05	60	40	0	5	5	6									
CAT92	PIT92	0.05	60	40	0	5	5	6									
CAT93	PIT93	0.019	49	51	0	5	5	6									
CAT94	PIT94	0.071	57	43	0	5	5	6									
CAT95	PIT95	0.175	58	42	0	5	5	6									
CAT96	PIT96	0.179	58	42	0	5	5	6									
CAT97	PIT97	0.139	58	42	0	5	5	6									
CAT98	PIT98	0.108	59	41	0	5	5	6									
CAT85	PIT85	0.122	58	42	0	5	5	6									
CAT86	PIT86	0.128	58	42	0	5	5	6									
CAT87	PIT87	0.126	67	33	0	5	5	6									
CAT88	PIT88	0.015	70	30	0	5	5	6									
CAT89	PIT89	0.155	58	42	0	5	5	6									
CAT84	PIT84	0.039	57	43	0	5	5	6									
CAT83	PIT83	0.227	58	42	0	5	5	6									
CAT100	PIT100	0.158	58	42	0	5	5	6									
CAT101	PIT101	0.103	83	17	0	5	5	6									
CAT_B_BASINS	DETBASIN	0.362	0	100	0	5	5	5									
CAT43	PIT43	0.051	70	30	0	5	5	0									
CAT30	PIT30	0.026	54	46	0	5	5	0									
CAT31	PIT31	0.133	30	36	34	5	5	5									
CAT32	PIT32	0.148	29	47	24	5	5	5									
CAT33	PIT33	0.1	49	51	0	5	5	0									
Cat113	Pit113	0.042	44	56	0	5	5	0									
Cat112	Pit112	0.083	64	36	0	5	5	0									
Cat114	Pit114	0.122	65	35	0	5	5	0									
Cat116	Pit116	0.121	65	35	0	5	5	0									
Cat117	Pit117	0.164	63	37	0	5	5	0									
Cat115	Pit115	0.046	41	59	0	5	5	0									
Cat110	Pit110	0.165	62	38	0	5	5	0									
CAT39A	PIT39A	0.151	58	42	0	5	5	0									
CAT40A	PIT40A	0.185	58	42	0	5	5	0									
CAT41A	PIT41A	0.058	57	43	0	0	0	0	67	4	0	1.3	3	0	0.012	0.021	0
CAT43A	PIT43A	0.163	58	42	0	5	5	0									
CAT45A	PIT45A	0.134	58	42	0	5	5	0									
CAT45AA	PIT45AA	0.137	59	41	0	5	5	0									
CAT47A	PIT47A	0.102	60	40	0	5	5	0									
CAT48A	PIT48A	0.065	59	41	0	5	5	0									
CAT57A	PIT57A	0.015	54	46	0	0	0	0	20	4	0	0.5	3	0	0.012	0.21	0
CAT49A	PIT49A	0.06	60	40	0	5	5	0									
CAT50A	PIT50A	0.05	60	40	0	5	5	0									
CAT51A	PIT51A	0.05	60	40	0	5	5	0									
CAT52A	PIT52A	0.05	60	40	0	5	5	0									
CAT53A	PIT53A	0.05	60	40	0	5	5	0									
CAT54A	PIT54A	0.091	58	42	0	5	5	0									
CAT55A	PIT55A	0.087	58	42	0	5	5	0									
CAT56A	PIT56A	0.08	56	44	0	0	0	0	41	4	0	1	3	0	0.012	0.21	0
CAT42A	PIT42A	0.042	54	46	0	5	5	0									
CAT44A	PIT44A	0.036	51	49	0	0	0	0	45	4	0	0.6	3	0	0.012	0.21	0
CAT46A	PIT46A	0.115	59	41	0	5	5	0									
CAT79B	PIT79B	0.043	60	40	0	5	5	0									
CAT80B	PIT80B	0.053	60	40	0	5	5	0									
CAT81B	PIT81B	0.062	60	40	0	5	5	0									
CAT83B	PIT83B	0.05	60	40	0	5	5	0									
CAT84B	PIT84B	0.024	60	40	0	5	5	0									
CAT85B	PIT85B	0.01	63	37	0	0	0	0	13.5	4	0	0.72	3	0	0.012	0.21	0
CAT87B	PIT87B	0.044	58	42	0	0	0	0	58.2	4	0	0.54	3	0	0.012	0.21	0
CAT68B	PIT68B	0.198	58	42	0	5	5	0									
CAT69B	PIT69B	0.036	38	62	0	0	0	0	37.45	4	0	0.78	3	0	0.012	0.21	0
CAT71B	PIT71B	0.017	52	48	0	0	0	0	20.7	4	0	0.42	3	0	0.012	0.21	0
CAT73B	PIT73B	0.123	59	41	0	5	5	0									
CAT75B	PIT75B	0.073	56	44	0	5	5	0									
CAT77B	PIT77B	0.148	58	42	0	5	5	0									
CAT78B	PIT78B	0.152	59	41	0	5	5	0									
CAT70B	PIT70B	0.137	58	42	0	5	5	0									
CAT72B	PIT72B	0.151	56	44	0	5	5	0									
CAT74B	PIT74B	0.045	33	67	0	0	0	0	40	4	0	2.09	3	0	0.012	0.21	0
CAT76B	PIT76B	0.04	30	70	0	5	5	0									
CAT89B	PIT89B	0.229	62	38	0	5	5	0									
CAT90B	PIT90B	0.034	48	52	0	0	0	0	33.1	4	0	0.51	3	0	0.012	0.21	0
CAT58B	PIT58B	0.152	58	42	0	5	5	0									
CAT59B	PIT59B	0.203	58	42	0	5	5	0									
CAT60B	PIT60B	0.08	43	57	0	0	0	0	83	4	0	1	3	0	0.012	0.21	0
CAT62B	PIT62B	0.188	61	39	0	5	5	0									
CAT63B	PIT63B	0.141	57	43	0	5	5	0									
CAT64B	PIT64B	0.202	64	36	0	5	5	0									
CAT65B	PIT65B	0.009	35	65	0	0	0	0	13.26	4	0	1.14	3	0	0.012	0.21	0
CAT66B	PIT66B	0.005	51	49	0	0	0	0	8.18	4	0	2.08	3	0	0.012	0.21	0
CAT61B	PIT61B	0.153	57	43	0	5	5	0									
CatNEW7	PitNEW7	0.054	70	30	0	5	5	0									
CatNEW8	PitNEW8	0.031	70	30	0	5	5	0									
CatNEW9	PitNEW9	0.031	70	30	0	5	5	0									
CatNEW1	PitNEW1	0.037	70	30	0	5	5	0									
CatNEW2	PitNEW2	0.031	70	30	0	5	5	0									
CatNEW3	PitNEW3	0.031	70	30	0	5	5	0									
CatNEW4	PitNEW4	0.031	70	30	0	5	5	0									
CatNEW5	PitNEW5	0.031	70	30	0	5	5	0									
CatNEW6	PitNEW6	0.031	70	30	0	5	5	0									
Cat VILLAGE	N464712	0.6	50	50	0	5	5	5									
CAT_C_BASINS	DETBASIN	0.317	0	100	0	5	5	5									
CAT_A_BASINS	DETBASIN	0.439	0	100	0	5	5	5									

Name	Pit or Node	Total Area	Impervious Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
CAT_ER_PERV	N230	10.31	0	4	0.025	0	1	Forster - RAFTS 29 0.92
CAT_ER_IMP	N232	7.27	100	4	0.015	0	1	Forster - RAFTS 29 0.92
CAT_7_PERV	N1226	1.008	0	1	0.025	0	1	Forster - RAFTS 29 0.92
CAT_BYPASS_PERV	N1233	0.13	0	1	0.025	0	1	Forster - RAFTS 29 0.92
CAT_UPS59_PERV	N1237	0.1	0	3	0.04	0	1	Forster - RAFTS 29 0.92
CAT_RESERVE_PERV	WETLAND	7.745	0	0.3	0.04	0	1	Forster - RAFTS 29 0.92
CAT_UPS68_PERV	N270743	0.27	0	3	0.04	0	1	Forster - RAFTS 29 0.92
CAT_UPS70_PERV	N270745	0.23	0	3	0.04	0	1	Forster - RAFTS 29 0.92
CAT_7_IMP	N459044	1.049	100	1	0.015	0	1	Forster - RAFTS 29 0.92
CAT_7_DS_PERV	N460930	1.91	0	1	0.04	0	1	Forster - RAFTS 29 0.92

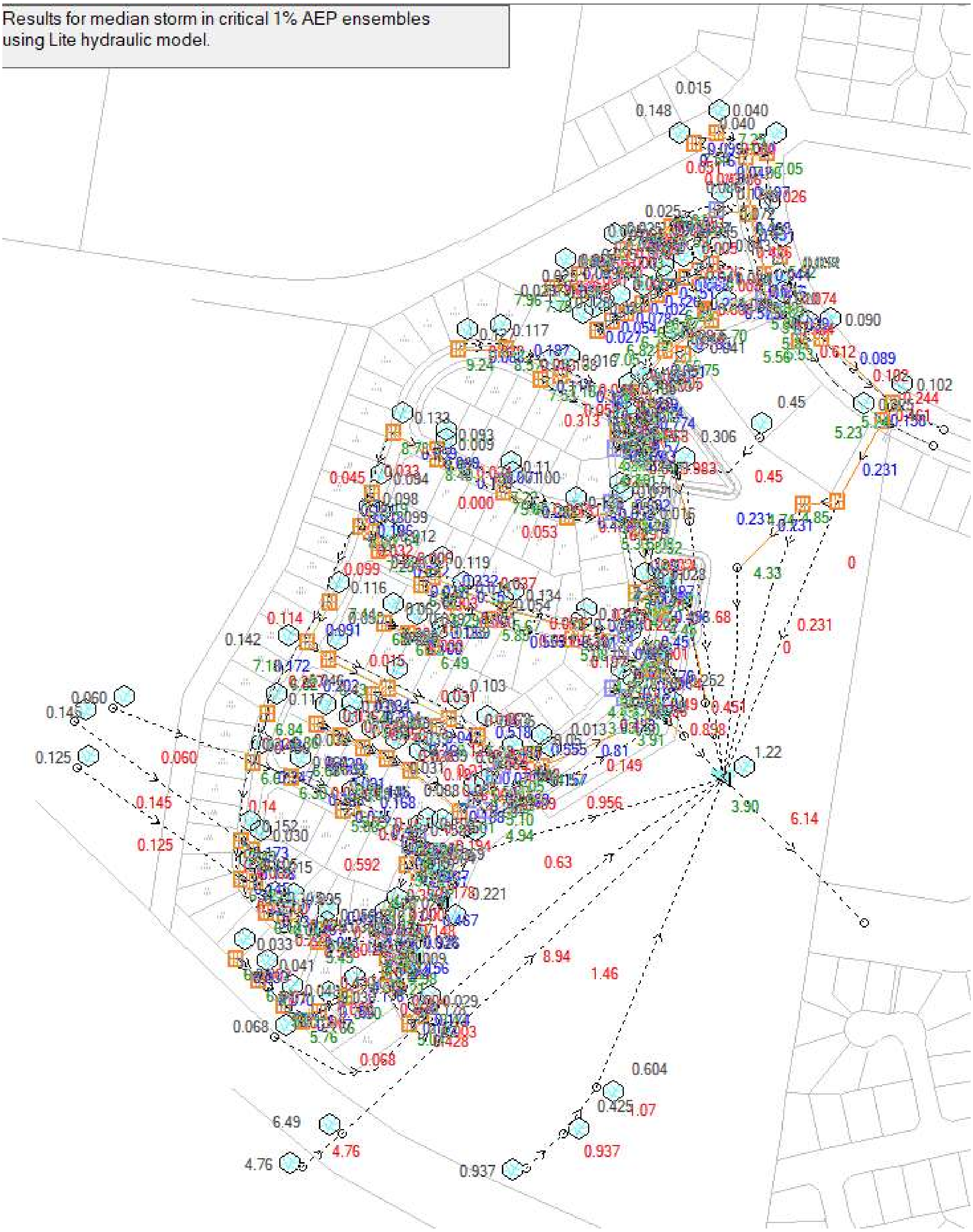
C.2 DRAINS Post-Developed Model SCENARIO E (20% AEP Peak Flows)

DRAINS Worst Case Peak Flows (i.e. worst case storm event for each outlet).

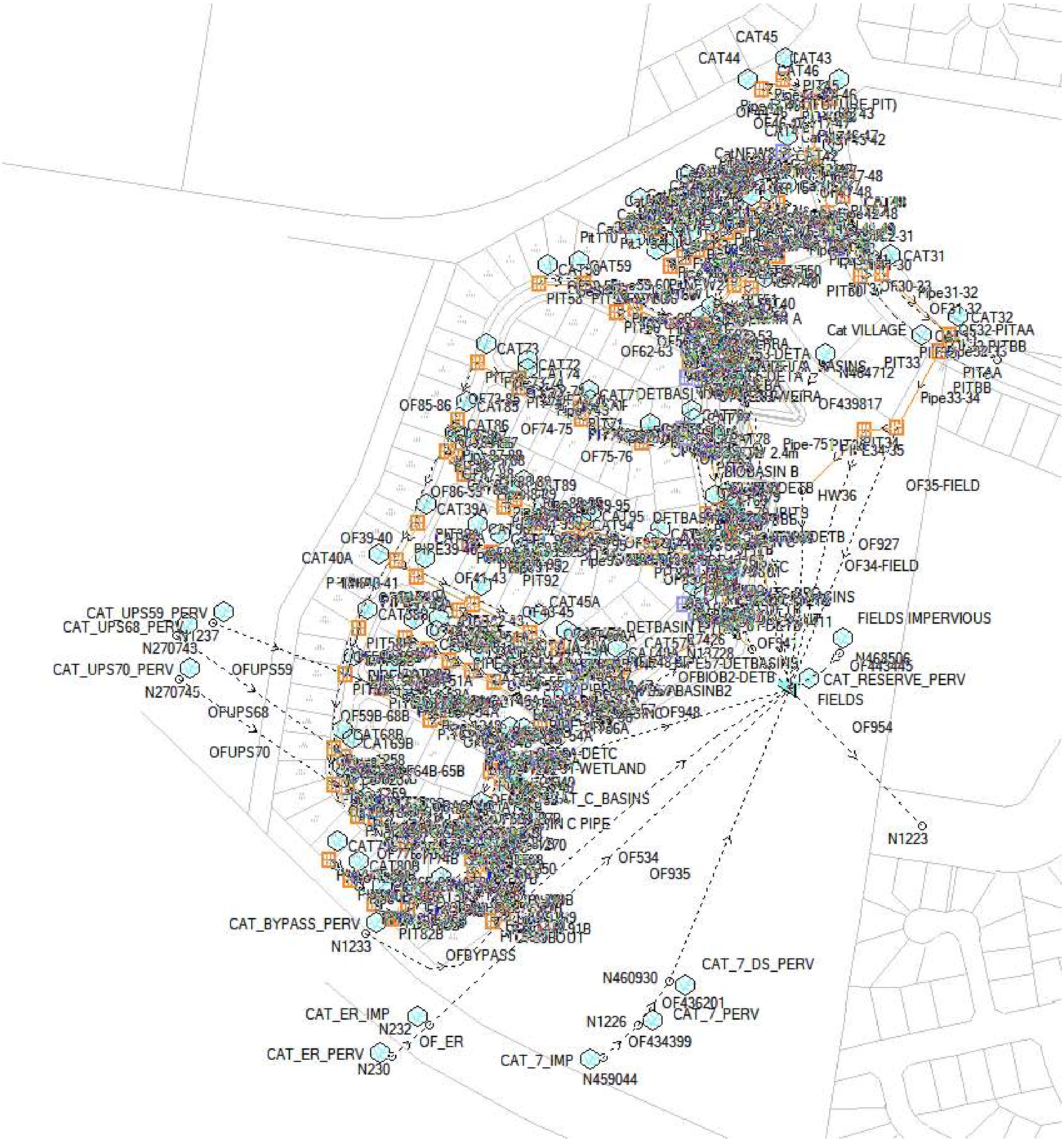


C.3 DRAINS Post-Developed Model SCENARIO E (1% AEP Peak Flows)

DRAINS Worst Case Peak Flows (i.e. worst case storm event for each outlet).
50% Blockage factor (DRAINS new theory) applied to 1% post-developed model.



C.4 DRAINS Post-Developed Model SCENARIO F



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		
BIOBASIN B	4.2	0		None						863.672	1514.677	No			444669020		
	4.3	15.1															
	4.4	31.8															
	4.5	50.1															
	4.6	51															
FIELDS	3.5	0		None						900.877	1392.775	No			433653218		
	3.55	635															
	3.6	1479															
	3.65	2618															
	3.7	4003															
	3.75	5642															
	3.8	7530															
	3.85	9665															
	3.9	11962															
	3.95	14418															
	4	17019															
	4.05	19795															
	4.1	22716															
	4.15	25786															
	4.2	29018															
	4.25	32418															
	4.3	35967															
	4.35	39661															
	4.4	43497															
	4.45	47467															
	4.5	51569															
BIOBASIN A	4.5	0		None						853.109	1605.719	No			444668856		
	4.6	15.6															
	4.7	32.9															
	4.8	51.5															
	4.9	70															
BIOBASIN C	4	0		None						861.386	1467.431	No			450321257		
	4.1	13.9															
	4.2	27.6															
	4.3	42.7															
	4.4	43															
DETBASIN B	3.6	0		Culvert	0.5					860.545	1433.276	No			437390392		
	3.61	20															
	4.1	1315															
	4.3	1860															
BIOBASINB2	3.95	0		None						789.724	1392.911	No			499485365		
	4.1	19.3															
	4.2	33.7															
	4.3	52.1															
	4.4	72.6															
	4.5	93.5															
BIOBASIN C2	4.2	0		None						704.427	1278.833	No			522353267		
	4.25	4															
	4.3	8.4															
	4.4	18.1															
	4.5	29															
	4.55	35															
BIOBASIN C1	4.2	0		None						716.282	1331.805	No			522353262		
	4.25	4															
	4.3	8.4															
	4.4	18.1															
	4.5	29															
	4.55	35															
DETBASINB	4	0		Culvert	0.5					875.959	1506.26	No			449835845		
	4.1	57.2															
	4.2	121.5															
	4.3	193															
	4.4	271.3															
	4.5	356.4															
	4.6	447.2															
	4.7	543.3															
	4.8	550															
DETBASIN C	3.8	0		Culvert	0.5					722.4	1313.813	No			437550961		
	3.85	53															
	3.9	111															
	4	239															
	4.1	383															
	4.2	544															
	4.3	720															
	4.4	912															
	4.5	1121															
	4.57	1277															
DETBASIN A	4	0		Culvert	0.5					867.572	1589.674	No			434358683		
	4.1	157.4															
	4.2	326.2															
	4.3	507.8															
	4.4	702.4															
	4.5	910.1															
	4.6	1130.9															
	4.7	1365															
	4.8	1370															

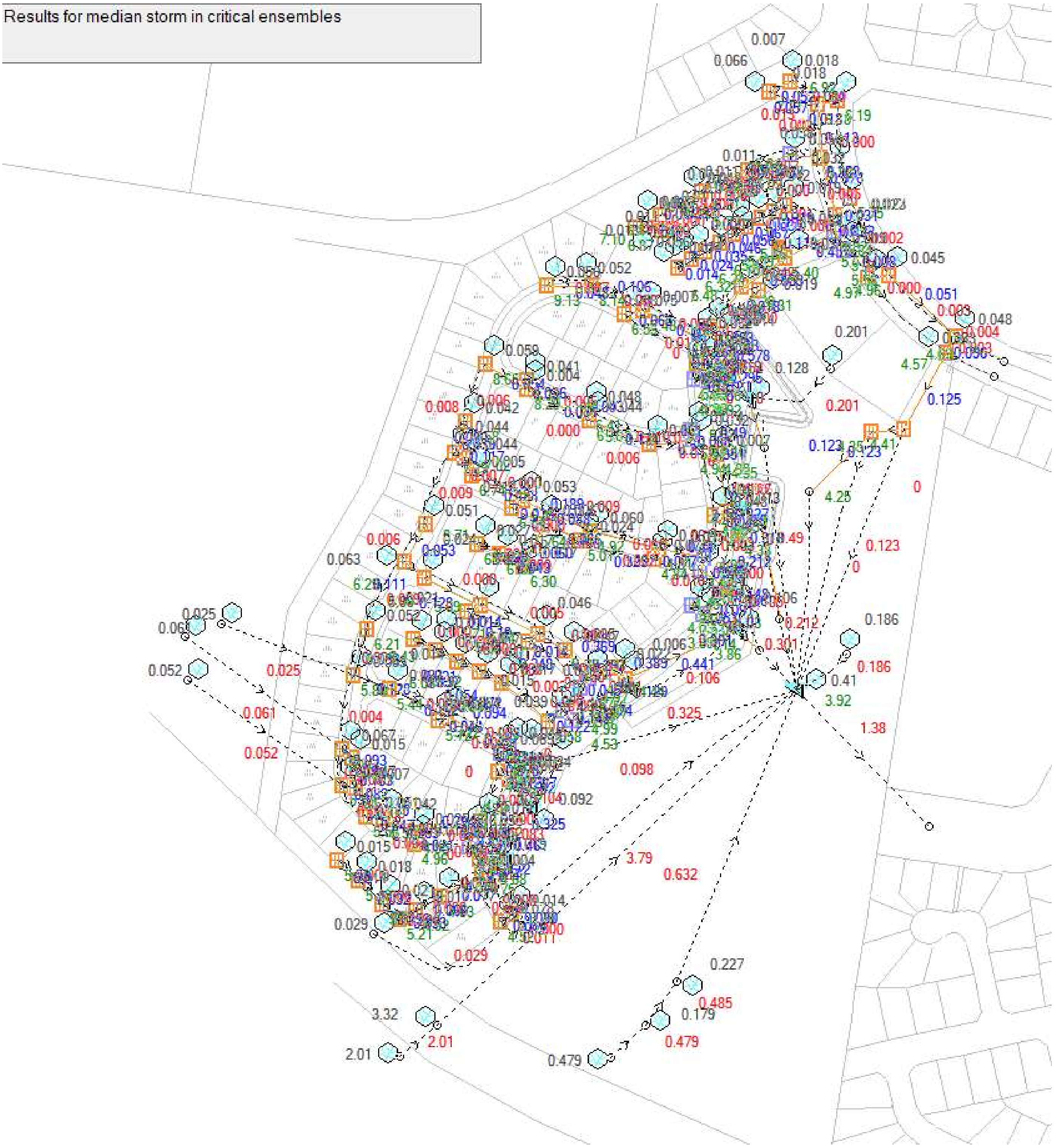
SUB-CATCHMENT DETAILS

Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp
	Node	Area	Area	Area	Area	Time	Time	Time	Length	Length	Length	Slope(%)	Slope	Slope	Rough	Rough	Rough
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%	%			
CAT70	PIT70	0.218	62	38	0	5	5	6									
CAT77	PIT77 NOW 2.4m	0.093	57	43	0	5	5	6									
CAT78	PIT78	0.019	84	16	0	5	5	6									
CAT79	PIT79	0.034	83	17	0	5	5	6									
CAT44	PIT44 (FUTURE PIT)	0.195	54	46	0	5	5	0									
CAT45	PIT45	0.017	100	0	0	5	0	0									
CAT46	PIT46	0.051	70	30	0	5	5	0									
CAT47	PIT47	0.112	60	40	0	5	5	0									
CAT48	PIT48	0.068	56	44	0	5	5	0									
CAT49	PIT49	0.048	66	34	0	5	5	0									
CAT50	PIT50	0.087	68	32	0	5	5	0									
CAT51	PIT51	0.125	62	38	0	5	5	0									
CAT52	PIT52	0.154	66	34	0	5	5	0									
CAT53	PIT53	0.037	84	16	0	5	5	0									
CAT42	PIT42	0.097	46	54	0	5	5	0									
CAT41	PIT41	0.031	68	32	0	5	5	0									
CAT40	PIT40	0.049	85	15	0	5	5	0									
CAT58	PIT58	0.164	60	40	0	5	5	0									
CAT59	PIT59	0.152	58	42	0	5	5	0									
CAT60	PIT60	0.021	54	46	0	5	5	0									
CAT61	PIT61	0.177	66	34	0	5	5	0									
CAT62	PIT62	0.159	62	38	0	5	5	0									
CAT63	PIT63	0.001	50	50	0	5	5	0									
CAT64	PIT64	0.126	58	42	0	5	5	0									
CAT65	PIT65	0.05	84	16	0	5	5	0									
CAT56	PIT56	0.213	68	32	0	5	5	0									
CAT73	PIT73	0.174	58	42	0	5	5	0									
CAT74	PIT74	0.012	46	54	0	5	5	6									
CAT75	PIT75	0.131	56	44	0	5	5	6									
CAT76	PIT76	0.18	57	43	0	5	5	6									
CAT72	PIT72	0.118	67	33	0	5	5	0									
CAT71	PIT71	0.141	64	36	0	5	5	6									
CAT69	PIT69	0.141	63	37	0	5	5	6									
CAT90	PIT90	0.08	60	40	0	5	5	6									
CAT91	PIT91	0.05	60	40	0	5	5	6									
CAT92	PIT92	0.05	60	40	0	5	5	6									
CAT93	PIT93	0.019	49	51	0	5	5	6									
CAT94	PIT94	0.071	57	43	0	5	5	6									
CAT95	PIT95	0.175	58	42	0	5	5	6									
CAT96	PIT96	0.179	58	42	0	5	5	6									
CAT97	PIT97	0.139	58	42	0	5	5	6									
CAT98	PIT98	0.108	59	41	0	5	5	6									
CAT85	PIT85	0.122	58	42	0	5	5	6									
CAT86	PIT86	0.128	58	42	0	5	5	6									
CAT87	PIT87	0.126	67	33	0	5	5	6									
CAT88	PIT88	0.015	70	30	0	5	5	6									
CAT89	PIT89	0.155	58	42	0	5	5	6									
CAT84	PIT84	0.039	57	43	0	5	5	6									
CAT83	PIT83	0.227	58	42	0	5	5	6									
CAT100	PIT100	0.158	58	42	0	5	5	6									
CAT101	PIT101	0.103	83	17	0	5	5	6									
CAT_B_BASINS	DETBASIN B	0.362	0	100	0	5	5	5									
CAT43	PIT43	0.051	70	30	0	5	5	0									
CAT30	PIT30	0.026	54	46	0	5	5	0									
CAT31	PIT31	0.133	30	36	34	5	5	5									
CAT32	PIT32	0.148	29	47	24	5	5	5									
CAT33	PIT33	0.1	49	51	0	5	5	0									
Cat113	Pit113	0.042	44	56	0	5	5	0									
Cat112	Pit112	0.083	64	36	0	5	5	0									
Cat114	Pit114	0.122	65	35	0	5	5	0									
Cat116	Pit116	0.121	65	35	0	5	5	0									
Cat117	Pit117	0.164	63	37	0	5	5	0									
Cat115	Pit115	0.046	41	59	0	5	5	0									
Cat110	Pit110	0.165	62	38	0	5	5	0									
CAT39A	PIT39A	0.151	58	42	0	5	5	0									
CAT40A	PIT40A	0.185	58	42	0	5	5	0									
CAT41A	PIT41A	0.058	57	43	0	0	0	0	67	4	0	1.3	3	0	0.012	0.021	0
CAT43A	PIT43A	0.163	58	42	0	5	5	0									
CAT45A	PIT45A	0.134	58	42	0	5	5	0									
CAT45AA	PIT45AA	0.137	59	41	0	5	5	0									

CAT47A	PIT47A	0.102	60	40	0	5	5	0									
CAT48A	PIT48A	0.065	59	41	0	5	5	0									
CAT57A	PIT57A	0.015	54	46	0	0	0	0	20	4	0	0.5	3	0	0.012	0.21	0
CAT49A	PIT49A	0.06	60	40	0	5	5	0									
CAT50A	PIT50A	0.05	60	40	0	5	5	0									
CAT51A	PIT51A	0.05	60	40	0	5	5	0									
CAT52A	PIT52A	0.05	60	40	0	5	5	0									
CAT53A	PIT53A	0.05	60	40	0	5	5	0									
CAT54A	PIT54A	0.091	58	42	0	5	5	0									
CAT55A	PIT55A	0.087	58	42	0	5	5	0									
CAT56A	PIT56A	0.08	56	44	0	0	0	0	41	4	0	1	3	0	0.012	0.21	0
CAT42A	PIT42A	0.042	54	46	0	5	5	0									
CAT44A	PIT44A	0.036	51	49	0	0	0	0	45	4	0	0.6	3	0	0.012	0.21	0
CAT46A	PIT46A	0.115	59	41	0	5	5	0									
CAT79B	PIT79B	0.043	60	40	0	5	5	0									
CAT80B	PIT80B	0.053	60	40	0	5	5	0									
CAT81B	PIT81B	0.062	60	40	0	5	5	0									
CAT83B	PIT83B	0.05	60	40	0	5	5	0									
CAT84B	PIT84B	0.024	60	40	0	5	5	0									
CAT85B	PIT85B	0.01	63	37	0	0	0	0	13.5	4	0	0.72	3	0	0.012	0.21	0
CAT87B	PIT87B	0.044	58	42	0	0	0	0	58.2	4	0	0.54	3	0	0.012	0.21	0
CAT68B	PIT68B	0.198	58	42	0	5	5	0									
CAT69B	PIT69B	0.036	38	62	0	0	0	0	37.45	4	0	0.78	3	0	0.012	0.21	0
CAT71B	PIT71B	0.017	52	48	0	0	0	0	20.7	4	0	0.42	3	0	0.012	0.21	0
CAT73B	PIT73B	0.123	59	41	0	5	5	0									
CAT75B	PIT75B	0.073	56	44	0	5	5	0									
CAT77B	PIT77B	0.148	58	42	0	5	5	0									
CAT78B	PIT78B	0.152	59	41	0	5	5	0									
CAT70B	PIT70B	0.137	58	42	0	5	5	0									
CAT72B	PIT72B	0.151	56	44	0	5	5	0									
CAT74B	PIT74B	0.045	33	67	0	0	0	0	40	4	0	2.09	3	0	0.012	0.21	0
CAT76B	PIT76B	0.04	30	70	0	5	5	0									
CAT89B	PIT89B	0.229	62	38	0	5	5	0									
CAT90B	PIT90B	0.034	48	52	0	0	0	0	33.1	4	0	0.51	3	0	0.012	0.21	0
CAT58B	PIT58B	0.152	58	42	0	5	5	0									
CAT59B	PIT59B	0.203	58	42	0	5	5	0									
CAT60B	PIT60B	0.08	43	57	0	0	0	0	83	4	0	1	3	0	0.012	0.21	0
CAT62B	PIT62B	0.188	61	39	0	5	5	0									
CAT63B	PIT63B	0.141	57	43	0	5	5	0									
CAT64B	PIT64B	0.202	64	36	0	5	5	0									
CAT65B	PIT65B	0.009	35	65	0	0	0	0	13.26	4	0	1.14	3	0	0.012	0.21	0
CAT66B	PIT66B	0.005	51	49	0	0	0	0	8.18	4	0	2.08	3	0	0.012	0.21	0
CAT61B	PIT61B	0.153	57	43	0	5	5	0									
CatNEW7	PitNEW7	0.054	70	30	0	5	5	0									
CatNEW8	PitNEW8	0.031	70	30	0	5	5	0									
CatNEW9	PitNEW9	0.031	70	30	0	5	5	0									
CatNEW1	PitNEW1	0.037	70	30	0	5	5	0									
CatNEW2	PitNEW2	0.031	70	30	0	5	5	0									
CatNEW3	PitNEW3	0.031	70	30	0	5	5	0									
CatNEW4	PitNEW4	0.031	70	30	0	5	5	0									
CatNEW5	PitNEW5	0.031	70	30	0	5	5	0									
CatNEW6	PitNEW6	0.031	70	30	0	5	5	0									
Cat VILLAGE	N464712	0.6	50	50	0	5	5	5									
FIELDS IMPERVIOUS	N468506	0.44	100	0	0	5	5	5									
CAT_C_BASINS	DETBASIN C	0.317	0	100	0	5	5	5									
CAT_A_BASINS	DETBASIN A	0.439	0	100	0	5	5	5									
Name	Pit or	Total	Impervious	Avg	Mannings	Time lag	Rainfall	Hydrological									
	Node	Area	Area	Slope(%)	n	(mins)	Multiplier	Model									
CAT_ER_PERV	N230	10.31	0	4	0.025	0	1	Forster - RAFTS 29 0.92									
CAT_ER_IMP	N232	7.27	100	4	0.015	0	1	Forster - RAFTS 29 0.92									
CAT_7_PERV	N1226	1.008	0	1	0.025	0	1	Forster - RAFTS 29 0.92									
CAT_BYPASS_PERV	N1233	0.13	0	1	0.025	0	1	Forster - RAFTS 29 0.92									
CAT_UPS59_PERV	N1237	0.1	0	3	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_RESERVE_PERV	FIELDS	7.305	0	0.3	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_UPS68_PERV	N270743	0.27	0	3	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_UPS70_PERV	N270745	0.23	0	3	0.04	0	1	Forster - RAFTS 29 0.92									
CAT_7_IMP	N459044	1.049	100	1	0.015	0	1	Forster - RAFTS 29 0.92									
CAT_7_DS_PERV	N460930	1.91	0	1	0.04	0	1	Forster - RAFTS 29 0.92									

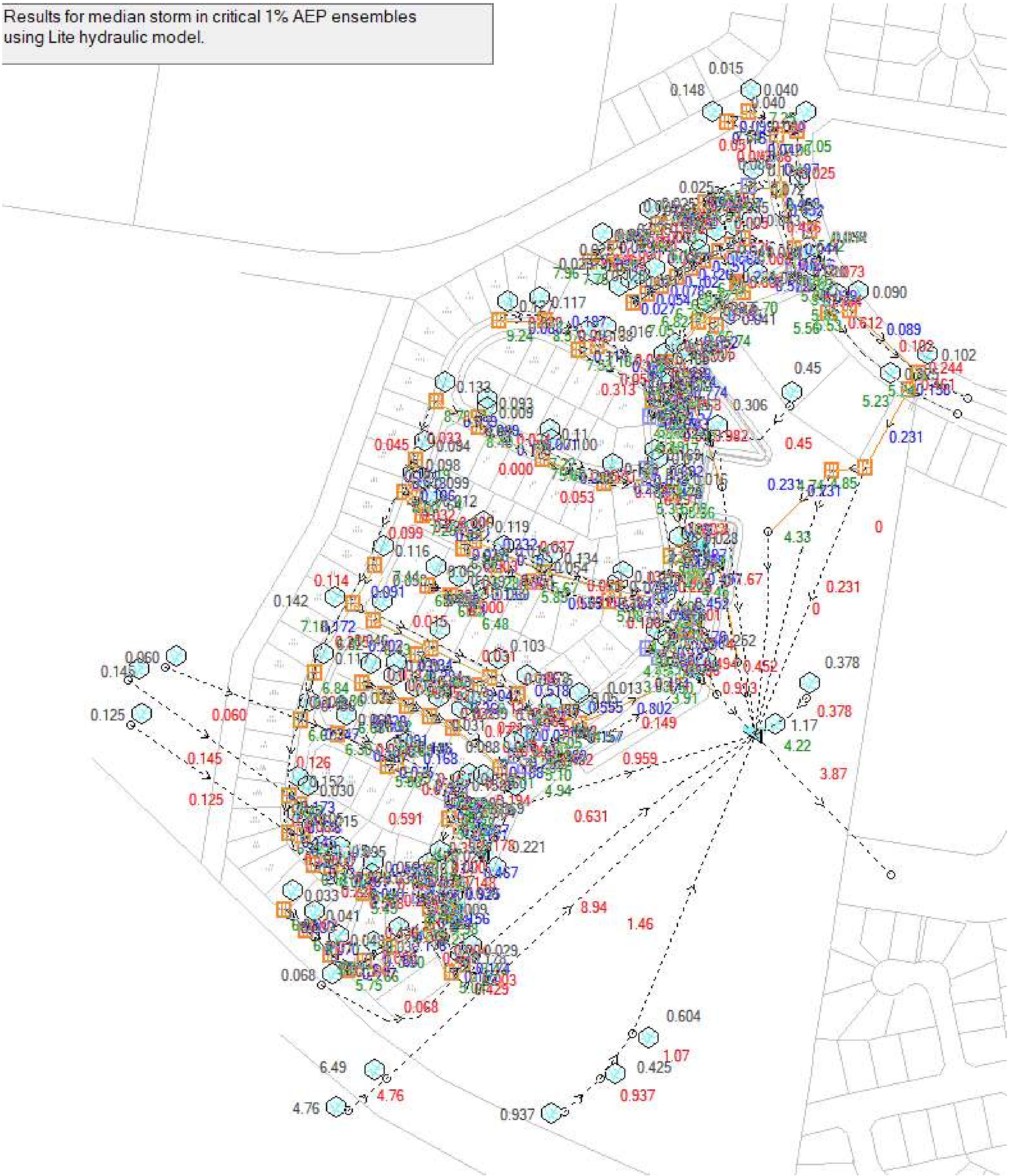
C.5 DRAINS Post-Developed Model SCENARIO F (20% AEP Peak Flows)

DRAINS Worst Case Peak Flows (i.e. worst case storm event for each outlet).



C.6 DRAINS Post-Developed Model SCENARIO F (1% AEP Peak Flows)

DRAINS Worst Case Peak Flows (i.e. worst case storm event for each outlet).
50% Blockage factor (DRAINS new theory) applied to Q100 post-developed model.



D Pre-Developed Catchment Plan

Post-Developed Catchments/ Water Sensitive Design Strategy Plan