

MEMORANDUM



Date: 31 July 2017

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To: Stephanie Clark (PEET)
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From: Jason Harley (Bradlees)

cc: Penny Cooper (RPS)

Revised Biobasin Locations for Stage 1 (West) Flagstone DEV2012/402

1. The design and construction of stormwater infrastructure for Stage 1 Flagstone is required to be implemented generally in accordance with Condition 18 of DEV2012/402. This condition requires the development to proceed in accordance with the following approved documents:

- PDA Guideline No. 13 (Reference 1)
- Flagstone City - Masterplan Flooding Assessment, Doc no. 721743/R1V6, dated 5Sep14 (Reference 2)
- Flagstone City - Stage 1 Stormwater Management Report, Doc. No. 7217/43/R2V5, dated 21Nov15 (Reference 3)

2. Whilst the overall design basis, design assumptions and parameters have not changed, due to the proposed revised layout of Stage 1 West [formerly known as Stage 1K – Stage 1Y], the bio-retention basins have been relocated to suit the new layout and adjustments to revised catchment boundaries.

3. The purpose of this memorandum is to explain the detailed design process and demonstrate that the design outcomes for Stage 1 (West) are generally in accordance with Condition 18.

Stormwater Quantity Management

4. The primary mechanism for the management of stormwater quantity is as follows:

- Frequent Flow Management.
- No worsening for events up to 1% AEP

5. Frequent Flow Management is achieved by limiting the post-developed peak 1 year ARI discharge to pre-developed ARI event discharge through the provision of detention storage co-located with bio-retention basins.

6. The pre-developed 1 year ARI event discharge is detailed as follows:

Table 1 – Original 1 year ARI Discharge (Source: Reference 3)

Original Catchment	Pre-developed 1 year ARI (m3/s)
1A	0.36
1B	0.92
1C	0.56
1D	0.25

7. Figure 1 detailed the original catchment plan and the original bio-retention basins.

8. Figure 2 details the revised catchment plan and bio-retention basins locations

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2012/402

Date: 31/10/17



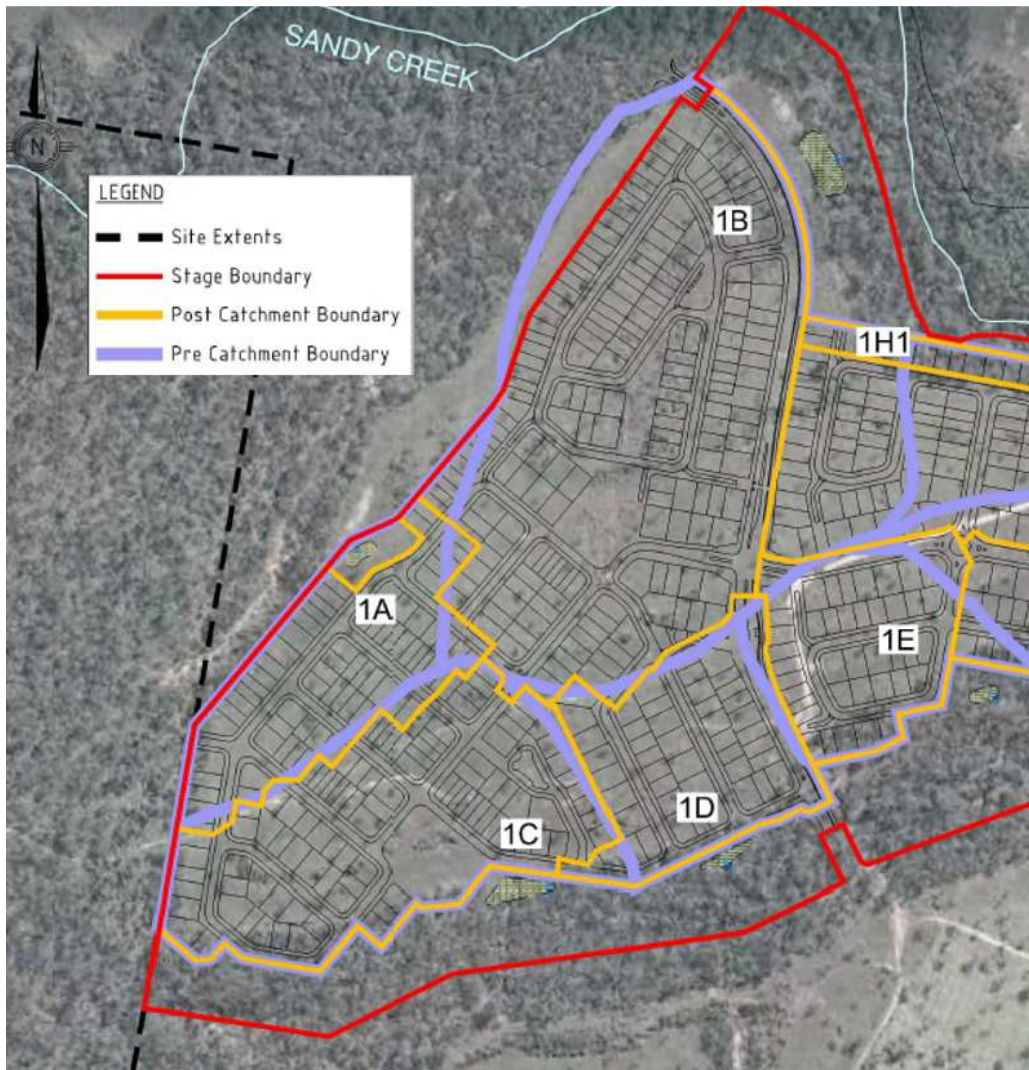


Figure 1 – Original Catchment Plan with Basin locations for Flagstone Stage 1K-1Y (Source: Reference 3)

9. The calculated 1 year ARI detention storage requirements for the original basins are as follows:

Table 2 – Original Basin Storage (Source: Reference 3)

Original Basin	Detention Base Area (m2)
1A	600
1B	2620
1C	1130
1D	675
Total	5025

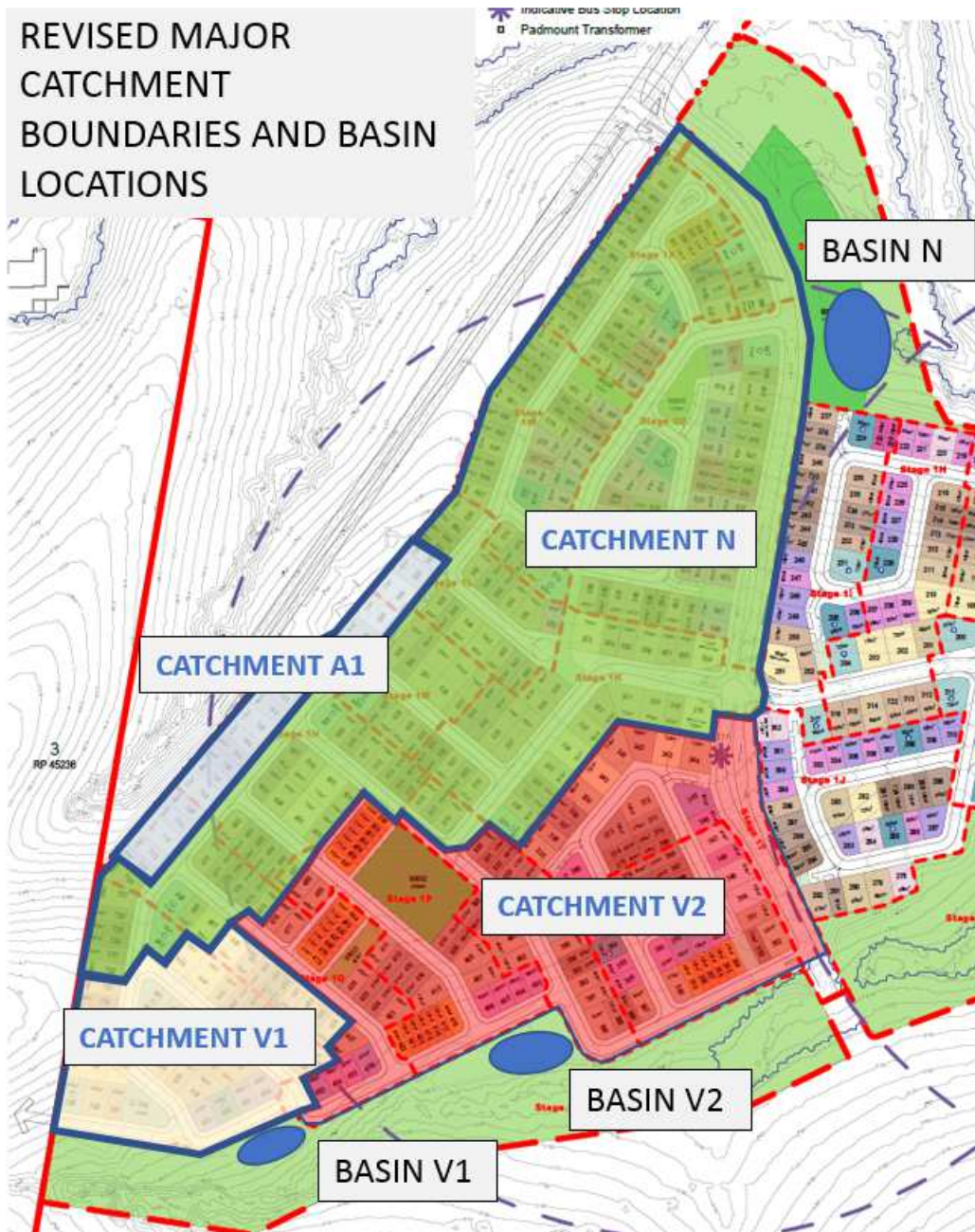


Figure 2 – Revised Catchment Plan and Basin Layout for Flagstone Stage 1 West (Based on RPS Layout July 2017)

10. Detention storage sizing was performed using XP-RAFTS utilising the same catchment parameters as per previous approved documents. The exception to this is Catchment A1, which contains land that sloped to the north-west. Whilst the low flow and roofwater captured in Catchment A1, for the purposes of water quality, is routed to Basin N; the excess runoff generated above Q10 events is discharged to the north-west boundary of Stage 1 (West). This excess peak runoff during a Q100 event is relatively distributed, is less than the overall Q100 pre-developed peak discharge, and is deemed to be acceptable.

11. The calculated 1 year ARI detention storage requirements for the revised basins are as follows:

Table 3 – Revised Basin Storage

Basin	Detention Base Area (m2)
N	3200
V1	506
V2	1322
Total	5028

12. No worsening for events up to 1% AEP was achieved by maintaining the existing development density, as well as limiting creek discharges to pre-developed peak 1 year ARI discharges at similar discharge locations upstream of hydraulic controls.

Stormwater Quality Management

13. The primary mechanism for treating stormwater runoff is the employment of bio-retention basins sized using MUSIC software using the same design parameters and water quality objectives as per the previously approved documents.

14. The original biofiltration area were as follows:

Table 4 – Original bio-filtration areas (Source: Reference 3)

Original Catchment	Area (m2)
1A	410
1B	1350
1C	700
1D	400
Total	2860

15. The revised bio-filtration areas for Stage 1 (West) are as follows:

Table 3 – Revised Filtration Area

Basin	Filtration Area (m2)
N	1620
V1	300
V2	870
Total	2790

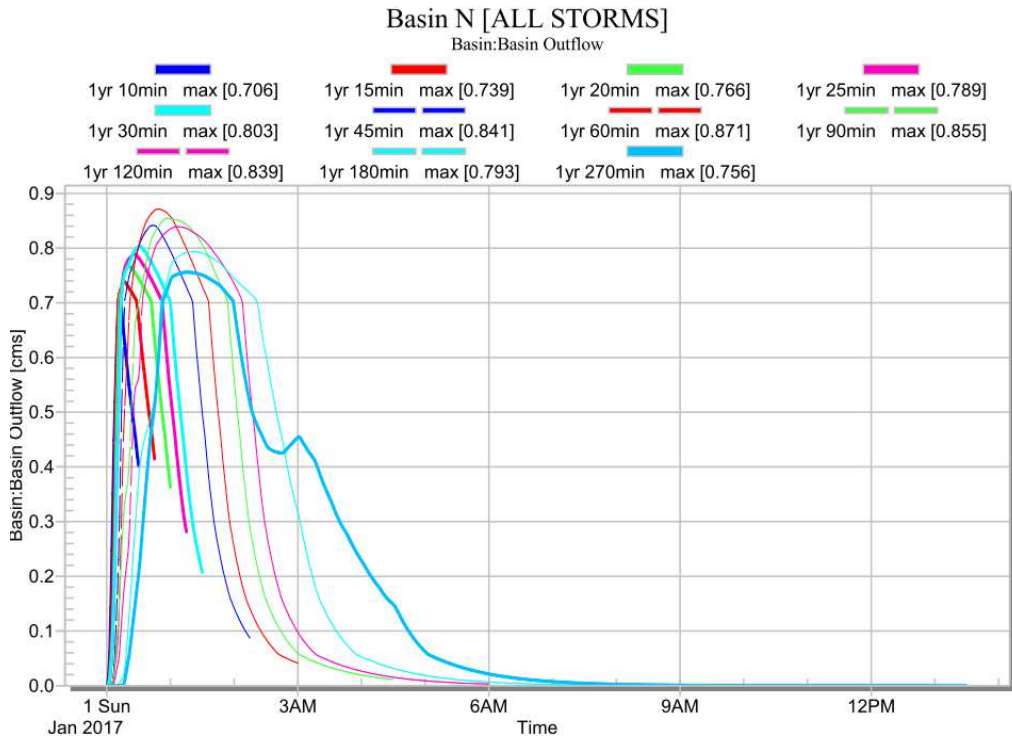
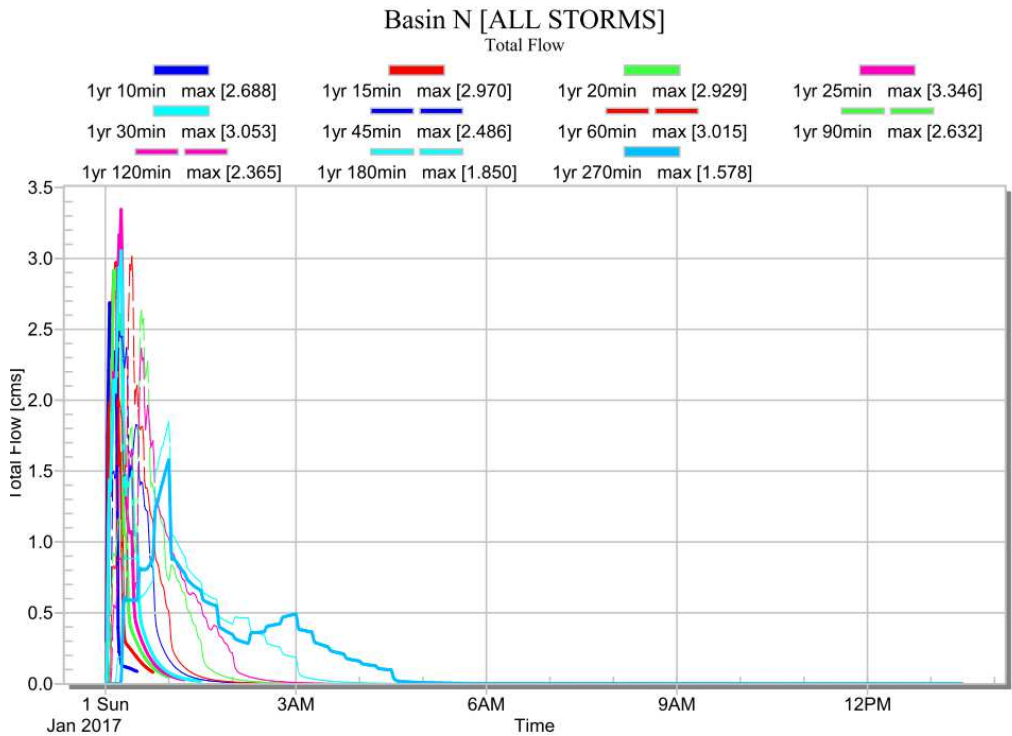
16. Whilst biobasin filtration areas are typically limited to a maximum size of 800 sqm (for maintenance access purposes), the design for Basin N1 incorporates a 300mm high bund within the basin to cater for maintenance vehicle access should future access be required. The bund does not impact the detention storage volume as live detention storage is calculated above the EDD level (+300mm). This bund meets the maintenance performance requirements for the biobasin.

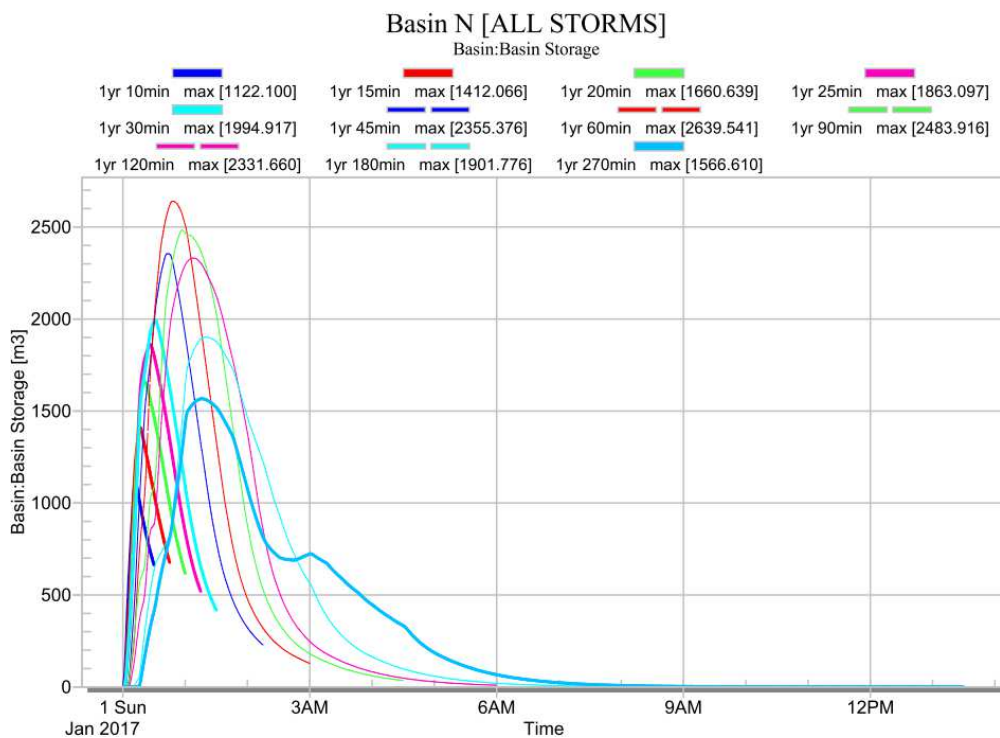
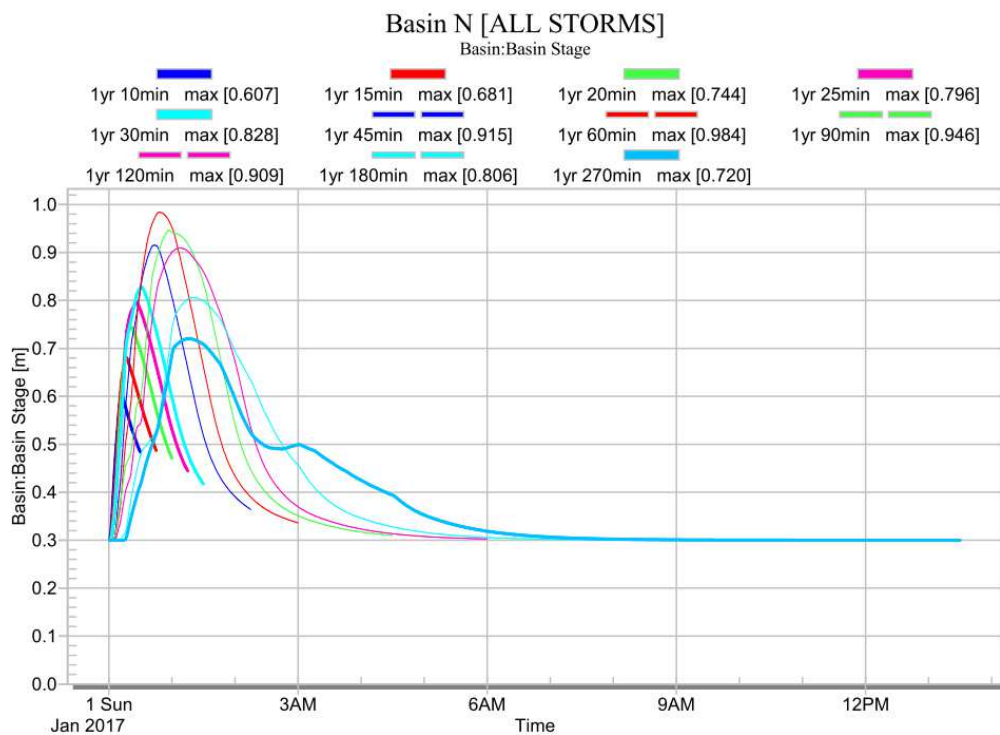
Conclusion

17. This memorandum demonstrates that revised catchment layouts and biobasin designs meet performance requirements outlined in previously approved documents referenced in Condition 18 DEV2012/402

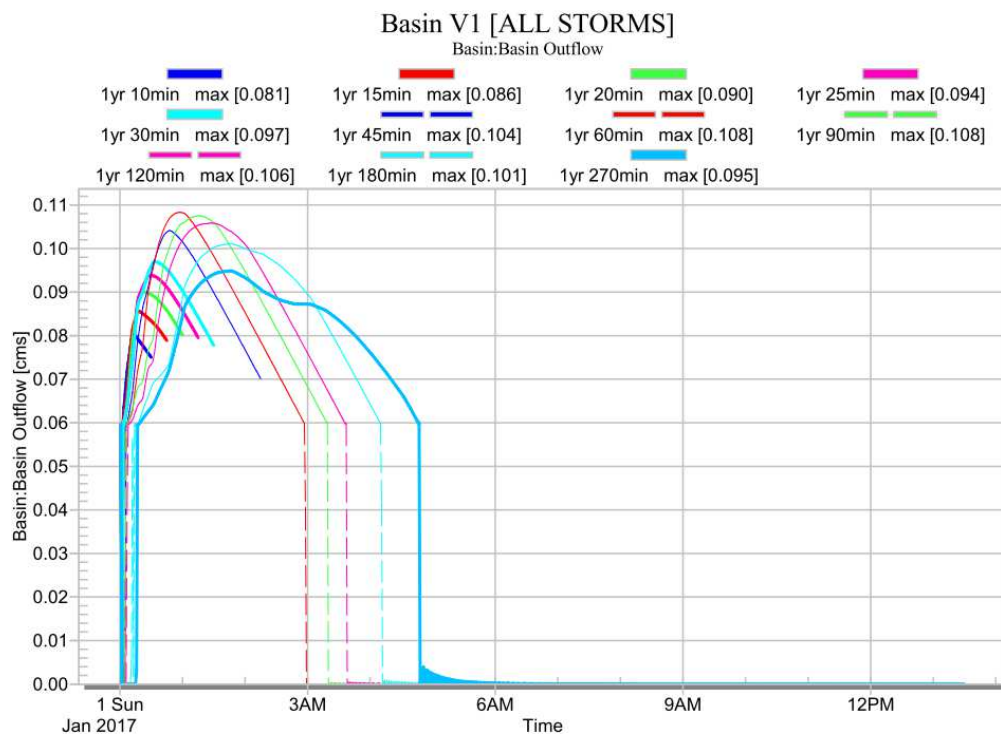
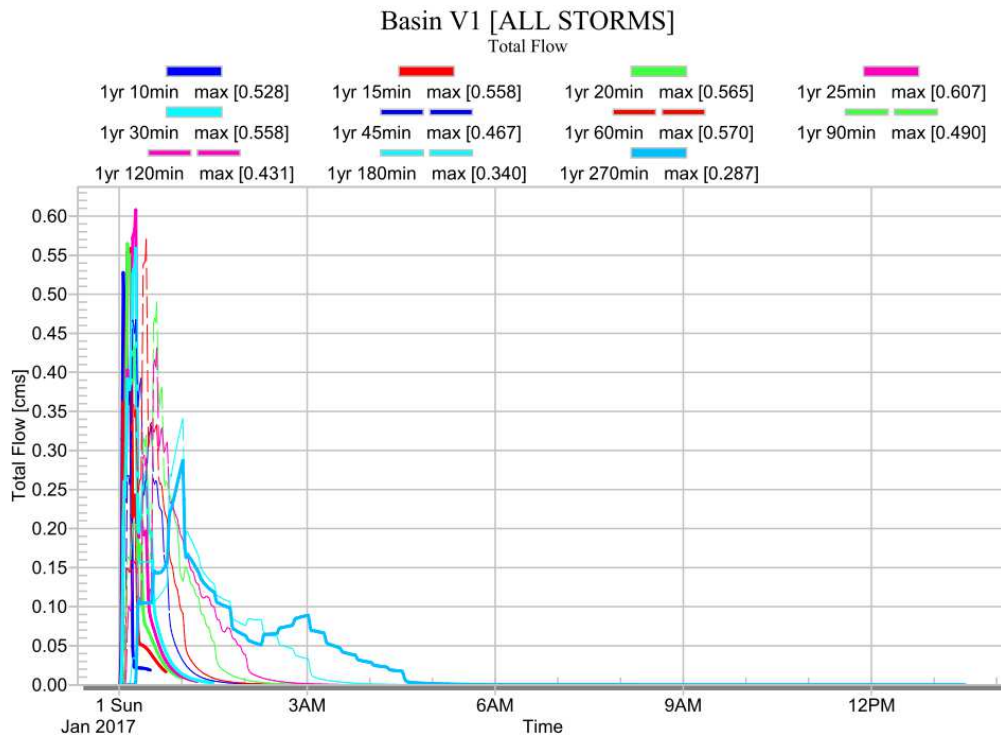
Appendix A - XP-RAFTS Output

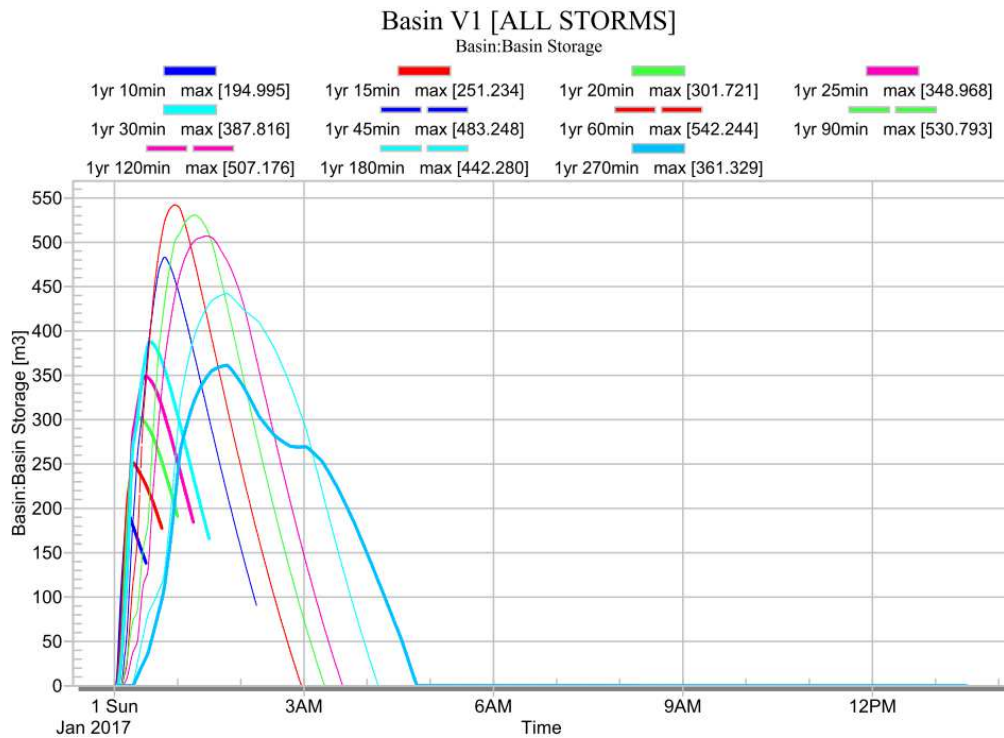
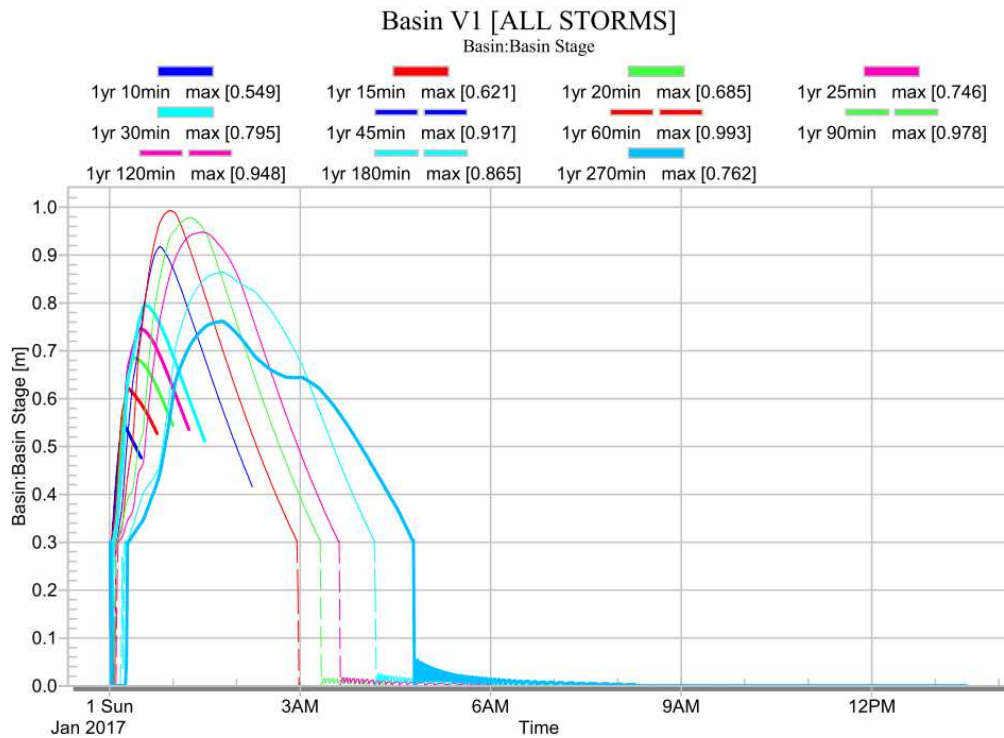
Basin N



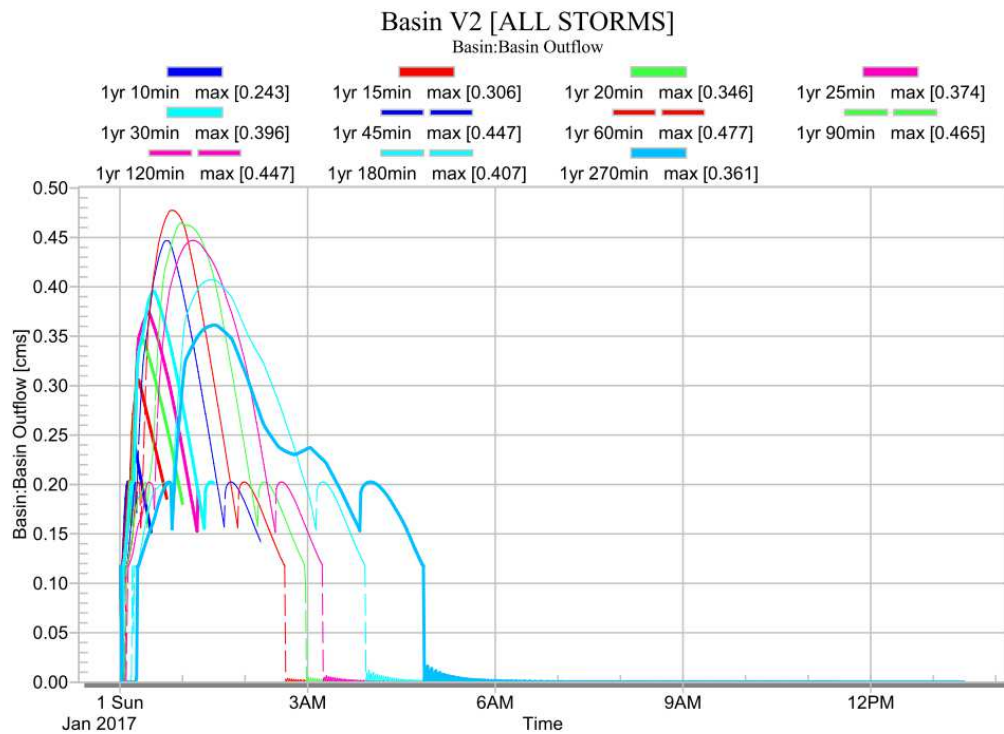
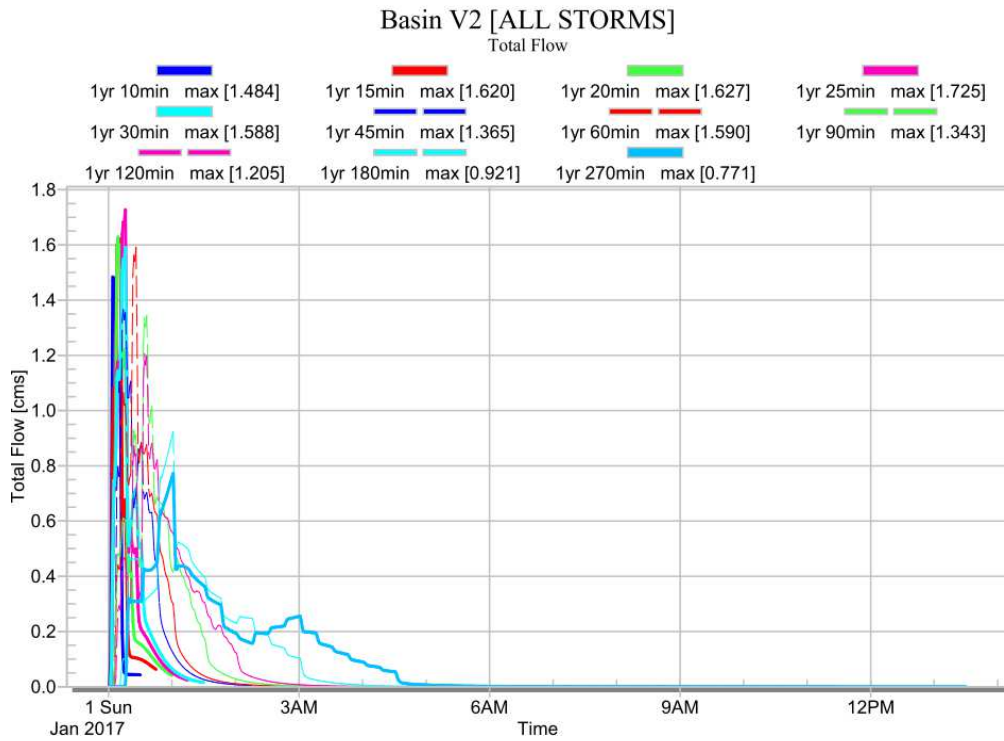


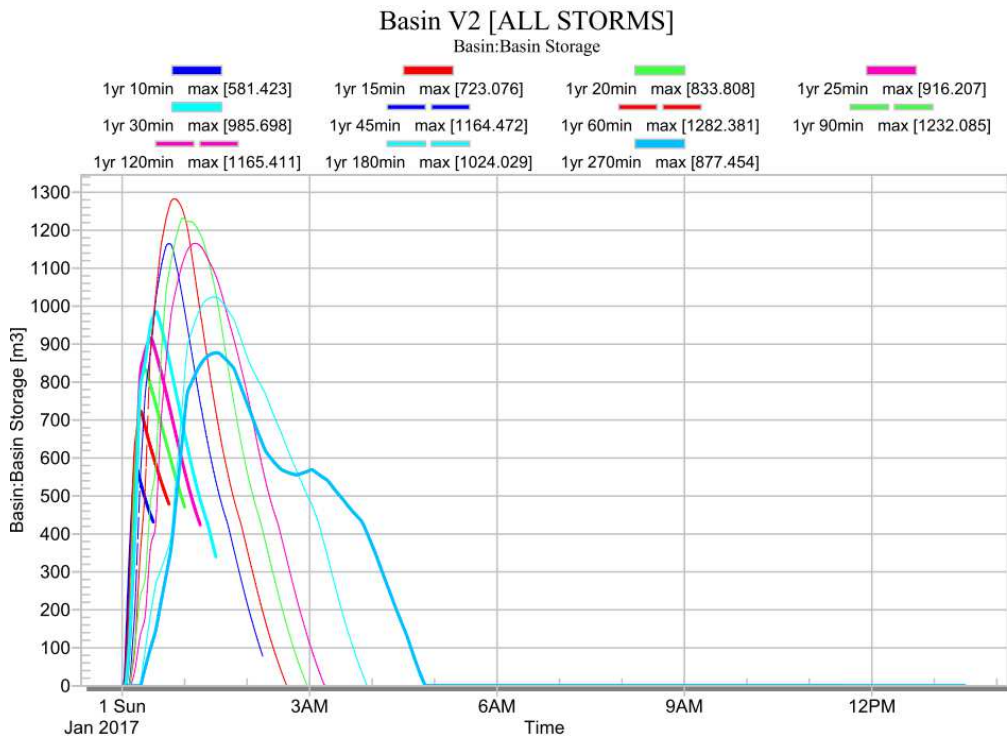
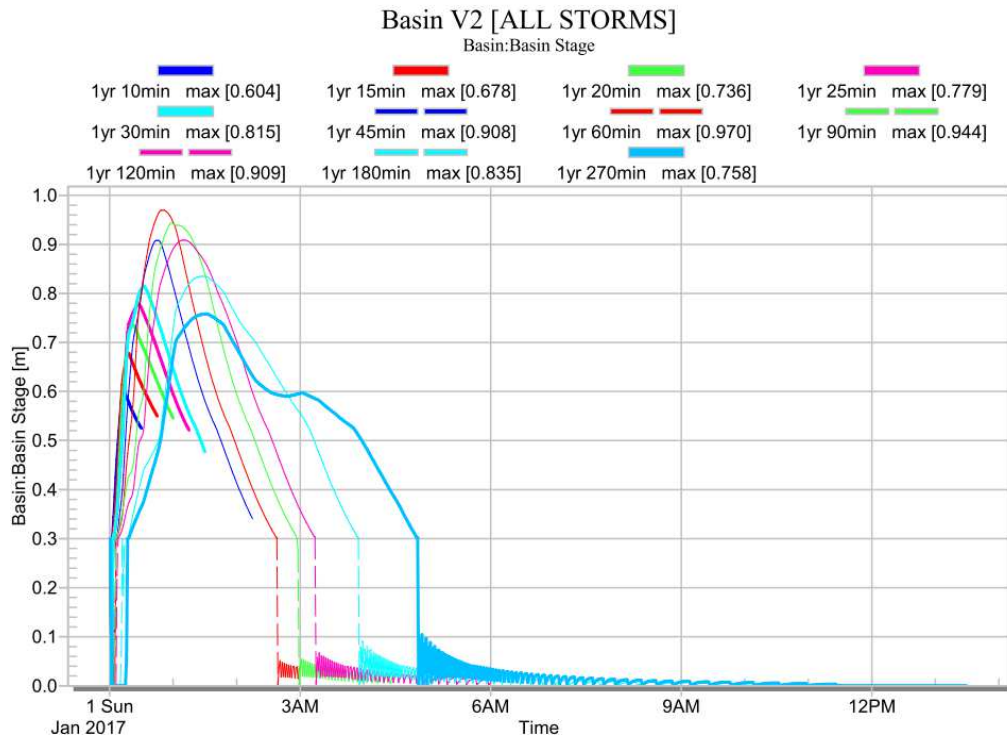
Basin V1





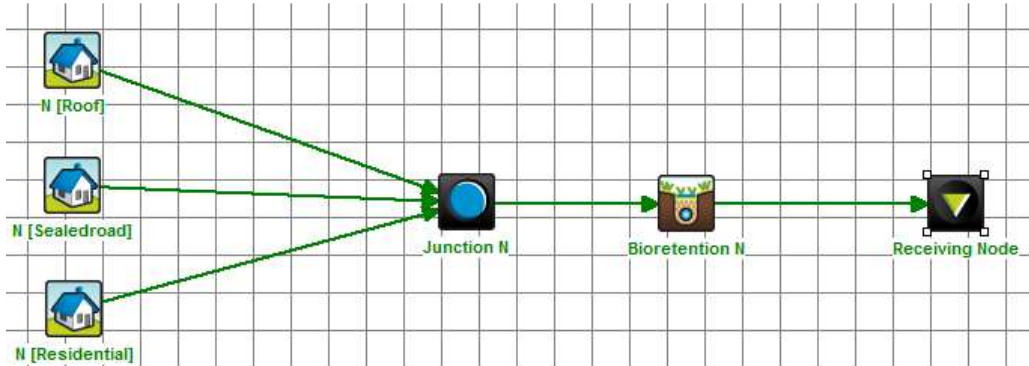
Basin V2





Appendix B - MUSIC Output

Basin N



Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	74.2	70.7	4.7
Total Suspended Solids (kg/yr)	12800	1910	85.1
Total Phosphorus (kg/yr)	26	10.3	60.3
Total Nitrogen (kg/yr)	155	70.8	54.4
Gross Pollutants (kg/yr)	2100	0	100

Properties of Bioretention N

Location: **Bioretention N** [Products >>](#)

Inlet Properties

Low Flow By-pass (cubic metres per sec)

High Flow By-pass (cubic metres per sec)

Storage Properties

Extended Detention Depth (metres)

Surface Area (square metres)

Filter and Media Properties

Filter Area (square metres)

Unlined Filter Media Perimeter (metres)

Saturated Hydraulic Conductivity (mm/hour)

Filter Depth (metres)

TN Content of Filter Media (mg/kg)

Orthophosphate Content of Filter Media (mg/kg)

Infiltration Properties

Exfiltration Rate (mm/hr)

Lining Properties

Is Base Lined? ☐ Yes ☒ No

Vegetation Properties

☒ Vegetated with Effective Nutrient Removal Plants

☐ Vegetated with Ineffective Nutrient Removal Plants

☐ Unvegetated

Outlet Properties

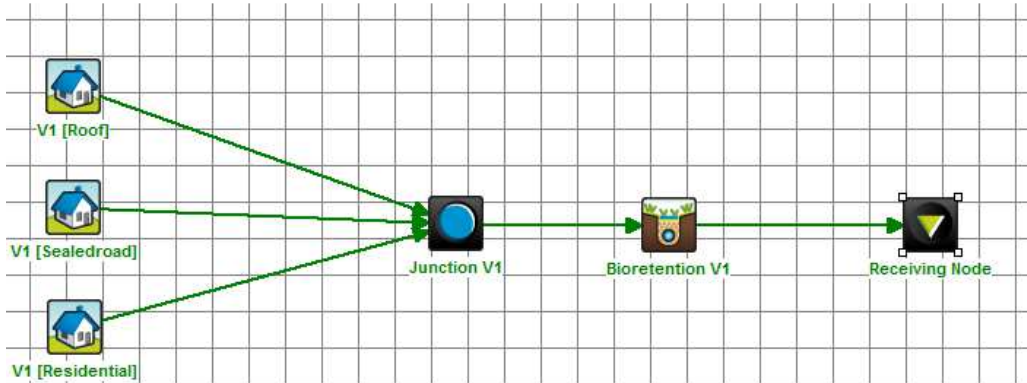
Overflow Weir Width (metres)

Underdrain Present? ☒ Yes ☐ No

Submerged Zone With Carbon Present? ☐ Yes ☒ No

Depth (metres)

Basin V1



Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	13.3	12.7	4.9
Total Suspended Solids (kg/yr)	2300	346	85
Total Phosphorus (kg/yr)	4.63	1.84	60.2
Total Nitrogen (kg/yr)	27.7	12.6	54.5
Gross Pollutants (kg/yr)	377	0.0247	100

Properties of Bioretention V1

Location: [Products >>](#)

Inlet Properties

Low Flow By-pass (cubic metres per sec)

High Flow By-pass (cubic metres per sec)

Storage Properties

Extended Detention Depth (metres)

Surface Area (square metres)

Filter and Media Properties

Filter Area (square metres)

Unlined Filter Media Perimeter (metres)

Saturated Hydraulic Conductivity (mm/hour)

Filter Depth (metres)

TN Content of Filter Media (mg/kg)

Orthophosphate Content of Filter Media (mg/kg)

Infiltration Properties

Exfiltration Rate (mm/hr)

Lining Properties

Is Base Lined? ☐ Yes ☒ No

Vegetation Properties

☒ Vegetated with Effective Nutrient Removal Plants

☐ Vegetated with Ineffective Nutrient Removal Plants

☐ Unvegetated

Outlet Properties

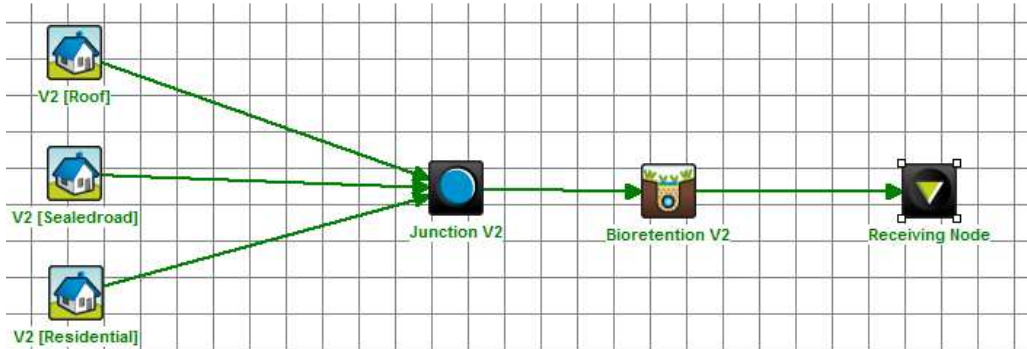
Overflow Weir Width (metres)

Underdrain Present? ☒ Yes ☐ No

Submerged Zone With Carbon Present? ☐ Yes ☒ No

Depth (metres)

Basin V2



Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	39.2	37.3	4.8
Total Suspended Solids (kg/yr)	6690	993	85.2
Total Phosphorus (kg/yr)	13.8	5.52	60
Total Nitrogen (kg/yr)	80.9	36.5	54.8
Gross Pollutants (kg/yr)	1110	11.8	98.9

Properties of Bioretention V2

Location: Bioretention V2 [Products >>](#)

Inlet Properties

Low Flow By-pass (cubic metres per sec)

High Flow By-pass (cubic metres per sec)

Storage Properties

Extended Detention Depth (metres)

Surface Area (square metres)

Filter and Media Properties

Filter Area (square metres)

Unlined Filter Media Perimeter (metres)

Saturated Hydraulic Conductivity (mm/hour)

Filter Depth (metres)

TN Content of Filter Media (mg/kg)

Orthophosphate Content of Filter Media (mg/kg)

Infiltration Properties

Exfiltration Rate (mm/hr)

Lining Properties

Is Base Lined? ☐ Yes ☒ No

Vegetation Properties

☒ Vegetated with Effective Nutrient Removal Plants

☐ Vegetated with Ineffective Nutrient Removal Plants

☐ Unvegetated

Outlet Properties

Overflow Weir Width (metres)

Underdrain Present? ☒ Yes ☐ No

Submerged Zone With Carbon Present? ☐ Yes ☒ No

Depth (metres)

[Fluxes...](#) [Notes...](#) [More](#)