The flooding strategy for the site will aim to protect the existing and the proposed buildings from external flows discharging on the western side of Cooper Street.

The review of the "DRAINS" model indicates that the overland flows emanating from the upstream catchment area are modelled as flowing down Brown Street as opposed to entering the Scottish Hospital site. Detailed site investigations confirm this assumption as flows flowing down Brown Street, due to the grading of the intersection of Brown and Cooper streets, discharge into Cooper Street and then flow down Brown Street again. The investigations indicate that there is no sag at the intersection of these streets but instead a continuous grade towards Brown Street. The detailed survey provided by the Client confirms that Cooper Street continuously grades from East to West towards Brown Street.

For the purpose of the Scottish Hospital development, the upstream catchment runoff will be completely diverted away from the site by providing a physical barrier at the south western boundary of the site off Cooper Street. In order to assess the volume and flows from the upstream catchment, part of the Rushcutters Bay "DRAINS" model was reproduced with the same data used for consistency.

The simulations indicate that the overland flow discharging at the intersection of Brown & Cooper streets from the upstream catchment is approximately 1.25$m^3$/s in a 100-year ARI storm event.

The street drainage system under Brown Street is only a 375mm pipe and is already running at full capacity with a total flow of 498L/s inside the pipe. Increasing the inlet capacity of the system at the intersection will not improve the situation because the constraint is in the outlet pipe size as opposed to the inlet capacity of the system.

The table below summarises the results of the simulations. In the "DRAINS" model, the same labelling of the Rushcutters Bay model is adopted. The overland flow at the intersection is labelled oP23P1 and the pipe under Brown Street is labelled pP23A2A (refer to Rushcutters Bay model).

| ARI (years) | Pipe Flow ($m^3$/s) | Overland Flow ($m^3$/s) | Anticipated Water Depth (m) | Freeboard Required (m) |
|---|---|---|---|---|
| 5 | 0.497 | 0.758 | 0.21 | 0.3 |
| 100 | 0.498 | 1.25 | 0.24 | 0.3 |

The results of the model indicate that the pipe capacity is less than the 5-year ARI. This result is consistent with the findings of the Rushcutters Bay Catchment Flood Study. The detailed results of the "DRAINS" model simulations for the 5-year ARI and the 100-year ARI are included in Appendix 4.

It is proposed to construct a boundary wall on the southern side of The Scottish Hospital to prevent the flows from entering the site. The wall will have a minimum height of 540mm above the existing footpath levels.

## *8.8 Stormwater Management*

### 8.8.1 General

The stormwater management encompasses several aspects of the design. It is divided into the following sections:-

- Site drainage design, including roof water collection and reuse;
- Provision of OSD as required by the relevant authority; and
- Water quality control.

These components have been designed to address the requirements of the relevant authorities.

### 8.8.2 Site Characteristics

The site is currently developed and occupied by the Scottish Hospital and the Presbyterian Aged Care. The heritage building along with the eastern extension is vacant. The building towards the mid western end of the site is currently occupied.

The existing and the proposed site conditions are detailed as follows:-

| Description | Existing | Proposed |
|---|---|---|
| Building Area ($m^2$) | 3160 | 6568 |
| Car Park Area ($m^2$) | 1857 | 460 |
| Total Impervious Area ($m^2$) | 5017 | 7028 |

### 8.8.3 Site Drainage

The roof drainage system will be designed to cater for 20-year ARI storm event in general and 100-year ARI in the event of no overflow can be provided.

The surface drainage system servicing the site will be designed to cater for 20-year ARI storm event with overland flow paths provided around the proposed buildings for storms in excess of the design storm. Five (5) minutes rainfall intensities have been adopted for the calculation of the flows through the system. Refer to the IFD table included in Appendix 1 for rainfall intensity values.

The drainage system will be a combination of minor and major systems capable of conveying the flows to the discharge point. Council advised that On-Site Detention (OSD) will be required for the proposed development.

It is proposed to connect to Council's stormwater infrastructure in Brown Street to retain the existing site discharge point. Specifically, the connection will be made to the 600mm diameter trunk main in Brown Street.

The proposed impervious areas cover approximately 50% of the total site area. An impervious fraction of 0.5 has been adopted. Refer to Appendix 2 for runoff coefficient graph extracted from Council's draft guidelines. The following runoff coefficients are used:-

- $C_{20}$ = 0.79; and
- $C_{100}$ = 0.90.

OSD will be designed using a Time-Area runoff routing model as opposed to Council's pre-determined catchment based values. This is to ensure that the discharge from the site matches the pre-development discharge for all storms up to and including the 100-year ARI storm event. This strategy ensures that the proposed development will not have an adverse impact on Council's infrastructure and the downstream catchment.

The following table outlined the site storage and discharge requirement if Council's catchment based pre-determined values are used:-

| ARI (years) | PSD (L/s/1000$m^2$) | SSR ($m^3$/1000$m^2$) | PSD (L/s) | SSR ($m^3$) |
|---|---|---|---|---|
| 2 | 24 | 5 | 355.2 | 74 |
| 100 | 34 | 29 | 503.2 | 429.2 |

Council Engineer has advised that this method may not be appropriate for the purpose of controlling the runoff from the proposed site and it was agreed that the sizing and the design of the volume versus the discharge is carried out using a more developed method such as the Time-Area runoff routing method.

A "DRAINS" model has been set up for the site to design and size a suitable OSD system. The model uses the site in its natural undeveloped state (100% pervious) as the pre-development condition to determine the maximum permissible site discharge. This approach is considered conservative as the site discharge will be less than the current discharge. However, because Council's infrastructure is under capacity downstream of the site, this method is considered appropriate in this case.

For the proposed site conditions, the values noted in Section 8.8.2 are adopted. A summary of the "DRAINS" model results is tabulated below:-

| ARI (years) | Pre-Developed Flows (L/s) | Post-Developed Flows (L/s) | OSD Volume ($m^3$) | Site Discharge (L/s) |
|---|---|---|---|---|
| 5 | 284 | 423 | 96.7 | 277 |
| 20 | 439 | 593 | 167.2 | 374 |
| 100 | 603 | 752 | 233.4 | 598 |

The results included in the table above indicate that the site discharge is below the pre-developed natural state of the site for minor, intermediate and major storm events. The detailed results of the simulations are included in Appendix 5.

It is proposed to install an OSD tank to be located under the driveway and away from tree root systems. The shape of the tank will be configured as required to have minimal impact on the significant trees on site.

The tank will have a minimum volume of 233.4$m^3$. The discharge from the tank will be configured to have a low level outlet to control the minor storms in the form of a 450mm pipe. A high level outlet will be provided in the shape of a 2m wide spillway weir inside the tank to discharge large storm event flows in conjunction with the piped outlet.

The discharge from the site into the Brown Street trunk main will be a 600mm concrete pipe. The location and the depth of this pipe will be coordinated with existing utility infrastructure during detailed design stage. The discharge pipe will pass through a gross pollutant trap prior to connecting into the main (see Section 8.8.5 below).

### 8.8.4 Rainwater Reuse

Rainwater collection and reuse has been investigated within the overall stormwater management strategy. The rainwater reuse is also governed by BASIX requirements.

Rainwater collection and reuse provides water quality and water quantity improvements to the overall integrated stormwater management strategy.

The roof runoff is collected into rainwater tanks for reuse around the site as detailed in the BASIX certificate.

### 8.8.5 Water Quality

To address the water quality requirements of WMC, the site's runoff will be treated prior to discharging into the receiving system. A treatment train approach will be used as follows:-

- Roof runoff collection for reuse within the site. This will allow reduction of water quantity discharge from the site;
- Minimising the use of conventional pipe/pit drainage system by sloping paved areas into landscaped and pervious areas;
- Installation of rain gardens in private and common courtyards to collect runoff from paved surfaces where practical; and
- Installation of a silt/oil arrestor device prior to discharging into the Council's trunk main. The device will capture sediment and hydrocarbons generated from the car park and external flows runoff.

Further water quality improvements such as Water Sensitive Urban Design (WSUD) measures may be used (i.e. grassed swales and/or rain-gardens) subject to space availability and approval of Consulting Arborist.

The extensive tree population covering the undeveloped portions of the site and the heritage listing on some of these trees renders these areas not suitable for WSUD features such as water quality ponds, open drains and bio-retention swales. The excavation of such measures would impact the tree root system, which would not be acceptable.

# APPENDIX 1

## Rainfall Data

IFD Table extracted from Council's Guidelines

# APPENDIX C: Design rainfall intensities

The following design rainfall intensities are to be used throughout the Woollahra Municipal Council LGA.

## Woollahra Municipal Council Design Rainfall Intensities

| Duration | | Average Recurrence Interval | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 in 1 | 1 in 2 | 1 in 5 | 1 in 10 | 1 in 20 | 1 in 50 | 1 in 100 |
| Minutes | Hours | Rainfall Intensities in mm/hour | | | | | | |
| 5 | 0.083 | 104 | 133 | 167 | 187 | 213 | 246 | 271 |
| 6 | 0.100 | 98 | 125 | 157 | 175 | 199 | 231 | 254 |
| 7 | 0.117 | 92 | 118 | 148 | 166 | 189 | 219 | 241 |
| 8 | 0.133 | 88 | 112 | 141 | 158 | 180 | 209 | 231 |
| 9 | 0.150 | 84 | 107 | 135 | 151 | 173 | 201 | 222 |
| 10 | 0.167 | 80 | 102 | 130 | 146 | 166 | 193 | 214 |
| 11 | 0.183 | 77 | 99 | 125 | 140 | 161 | 187 | 207 |
| 12 | 0.200 | 74 | 95 | 121 | 136 | 156 | 181 | 201 |
| 13 | 0.217 | 72 | 92 | 117 | 132 | 151 | 176 | 195 |
| 14 | 0.233 | 69 | 89 | 114 | 128 | 147 | 171 | 190 |
| 15 | 0.250 | 67 | 86 | 111 | 124 | 143 | 167 | 185 |
| 16 | 0.267 | 65 | 84 | 108 | 121 | 139 | 162 | 180 |
| 17 | 0.283 | 64 | 82 | 105 | 118 | 136 | 159 | 176 |
| 18 | 0.300 | 62 | 80 | 102 | 115 | 133 | 155 | 172 |
| 19 | 0.317 | 60 | 78 | 100 | 113 | 130 | 152 | 168 |
| 20 | 0.333 | 59 | 76 | 98 | 110 | 127 | 148 | 165 |
| 21 | 0.350 | 57 | 74 | 95 | 108 | 124 | 145 | 162 |
| 22 | 0.367 | 56 | 72 | 93 | 106 | 122 | 143 | 159 |
| 23 | 0.383 | 55 | 71 | 91 | 104 | 119 | 140 | 156 |
| 24 | 0.400 | 54 | 69 | 90 | 101 | 117 | 137 | 153 |
| 25 | 0.417 | 53 | 68 | 88 | 100 | 115 | 135 | 150 |
| 26 | 0.433 | 52 | 67 | 86 | 98 | 113 | 132 | 147 |
| 27 | 0.450 | 51 | 65 | 85 | 96 | 111 | 130 | 145 |
| 28 | 0.467 | 50 | 64 | 83 | 94 | 109 | 128 | 143 |
| 29 | 0.483 | 49 | 63 | 82 | 93 | 107 | 126 | 140 |
| 30 | 0.500 | 48 | 62 | 80 | 91 | 105 | 124 | 138 |
| 31 | 0.517 | 47 | 61 | 79 | 90 | 104 | 122 | 136 |
| 32 | 0.533 | 46 | 60 | 78 | 88 | 102 | 120 | 134 |
| 33 | 0.550 | 46 | 59 | 77 | 87 | 101 | 118 | 132 |
| 34 | 0.567 | 45 | 58 | 75 | 86 | 99 | 117 | 130 |
| 35 | 0.583 | 44 | 57 | 74 | 84 | 98 | 115 | 128 |
| 36 | 0.600 | 43 | 56 | 73 | 83 | 96 | 113 | 126 |
| 37 | 0.617 | 43 | 55 | 72 | 82 | 95 | 112 | 125 |
| 38 | 0.633 | 42 | 55 | 71 | 81 | 94 | 110 | 123 |
| 39 | 0.650 | 42 | 54 | 70 | 80 | 92 | 109 | 121 |
| 40 | 0.667 | 41 | 53 | 69 | 79 | 91 | 107 | 120 |
| 41 | 0.683 | 40 | 52 | 68 | 78 | 90 | 106 | 118 |

## Woollahra Municipal Council Design Rainfall Intensities

| Duration | | Average Recurrence Interval | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 in 1 | 1 in 2 | 1 in 5 | 1 in 10 | 1 in 20 | 1 in 50 | 1 in 100 |
| Minutes | Hours | Rainfall Intensities in mm/hour | | | | | | |
| 42 | 0.700 | 40 | 52 | 67 | 77 | 89 | 105 | 117 |
| 43 | 0.717 | 39 | 51 | 67 | 76 | 88 | 103 | 115 |
| 44 | 0.733 | 39 | 50 | 66 | 75 | 87 | 102 | 114 |
| 45 | 0.750 | 38 | 50 | 65 | 74 | 86 | 101 | 113 |
| 46 | 0.767 | 38 | 49 | 64 | 73 | 85 | 100 | 111 |
| 47 | 0.783 | 37 | 48 | 63 | 72 | 84 | 99 | 110 |
| 48 | 0.800 | 37 | 48 | 63 | 71 | 83 | 97 | 109 |
| 49 | 0.817 | 37 | 47 | 62 | 70 | 82 | 96 | 108 |
| 50 | 0.833 | 36 | 47 | 61 | 70 | 81 | 95 | 106 |
| 51 | 0.850 | 36 | 46 | 60 | 69 | 80 | 94 | 105 |
| 52 | 0.867 | 35 | 46 | 60 | 68 | 79 | 93 | 104 |
| 53 | 0.883 | 35 | 45 | 59 | 67 | 78 | 92 | 103 |
| 54 | 0.900 | 35 | 45 | 59 | 67 | 77 | 91 | 102 |
| 55 | 0.917 | 34 | 44 | 58 | 66 | 77 | 90 | 101 |
| 56 | 0.933 | 34 | 44 | 57 | 65 | 76 | 89 | 100 |
| 57 | 0.950 | 33 | 43 | 57 | 65 | 75 | 89 | 99 |
| 58 | 0.967 | 33 | 43 | 56 | 64 | 74 | 88 | 98 |
| 59 | 0.983 | 33 | 42 | 56 | 63 | 74 | 87 | 97 |
| 60 | 1 | 32 | 42 | 55 | 63 | 73 | 86 | 96 |
| 90 | 1.5 | 25 | 33 | 43 | 49 | 57 | 67 | 75 |
| 120 | 2 | 21 | 27 | 36 | 41 | 47 | 56 | 63 |
| 180 | 3 | 16 | 21 | 27 | 31 | 36 | 43 | 48 |
| 240 | 4 | 13 | 17 | 22 | 26 | 30 | 35 | 39 |
| 300 | 5 | 11 | 15 | 19 | 22 | 26 | 30 | 34 |
| 360 | 6 | 10 | 13 | 17 | 19 | 23 | 27 | 30 |
| 720 | 12 | 6 | 8 | 11 | 12 | 14 | 17 | 19 |
| 1440 | 24 | 4 | 5 | 7 | 8 | 9 | 11 | 12 |
| 2880 | 48 | 3 | 3 | 4 | 5 | 6 | 7 | 8 |
| 4320 | 72 | 2 | 3 | 3 | 4 | 4 | 5 | 6 |



| Probable Maximum Precipitation Depth in mm | | | | |
|---|---|---|---|---|
| Duration | | Catchment Area | | |
| Minutes | Hours | 1km$^2$ | 2km$^2$ | 3km$^2$ |
| 15 | 0.25 | 170 | 160 | 160 |
| 30 | 0.5 | 250 | 240 | 230 |
| 60 | 1 | 360 | 350 | 340 |
| 90 | 1.5 | 460 | 450 | 440 |
| 120 | 2 | 540 | 530 | 520 |
| 180 | 3 | 660 | 640 | 630 |
| 360 | 6 | 870 | 850 | 830 |

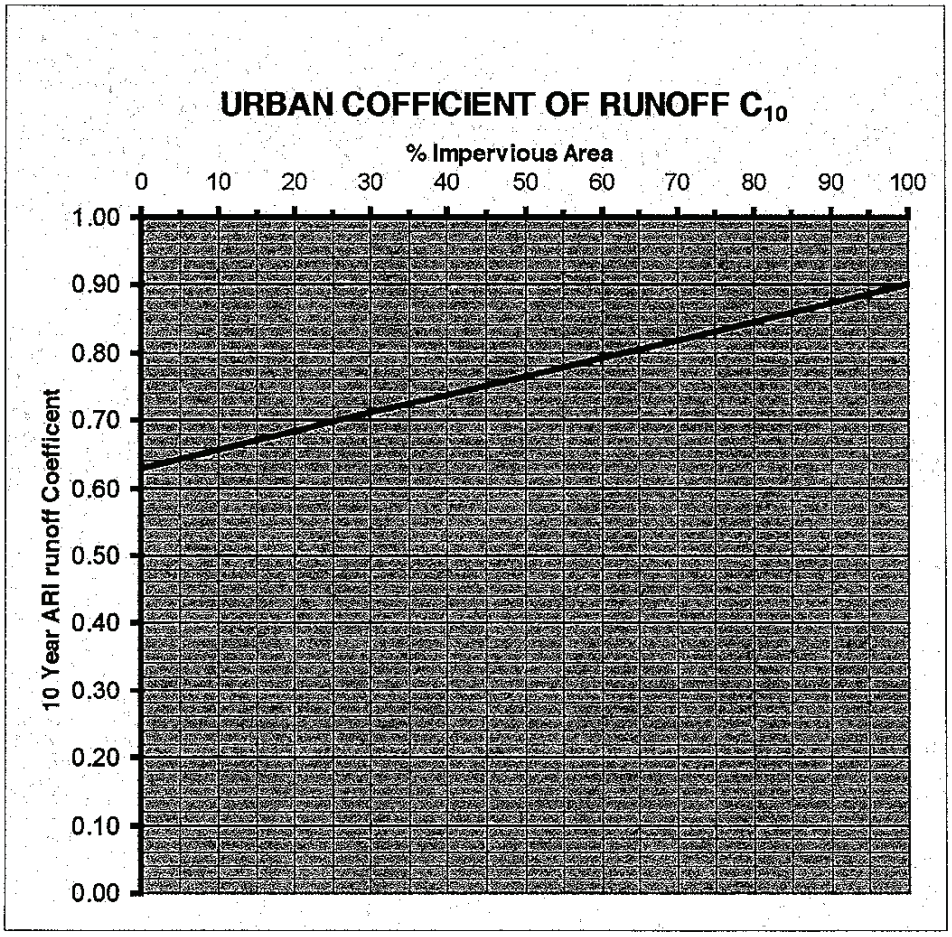
Linear interpolation should be undertaken for durations and catchment sizes not shown.

# APPENDIX 2

## Runoff Coefficient Graph

Extracted from Council's Guidelines

# Appendix F: Urban coefficient of runoff $C_{10}$




For ARI other than 10 years the $C_{10}$ value is multiplied by frequency factor from the following table. $C_y = F_y \, . \, C_{10}$

Where runoff coefficients calculated from the above equation exceed 1.0 they should be set equal to 1.0. *(Source: Australian Rainfall and Runoff 1987, Chapter 14)*

| ARI (Years) | Frequency factor, $F_y$ |
|---|---|
| 1 | 0.8 |
| 2 | 0.85 |
| 5 | 0.95 |
| 10 | 1.0 |
| 20 | 1.05 |
| 50 | 1.15 |
| 100 | 1.2 |

# APPENDIX 3

## Project Application Drawings

Proposed Site Stormwater Management Plans prepared by Cardno ITC

| Document Title: | Document No: | Revision: |
|---|---|---|
| Legend, Abbreviations & Drawing Schedule | N10926-PA-H00 | A |
| Lower Basement Level - Stormwater Layout | N10926-PA-H01 | A |
| Upper Basement Level - Stormwater Layout | N10926-PA-H02 | A |
| Level 1 - Stormwater Layout | N10926-PA-H03 | A |
| Details | N10926-PA-H04 | A |
| Sediment and Erosion Control Plan | N10926-PA-H05 | A |

# APPENDIX 4

## DRAINS Model Results

Catchment Analysis

## DRAINS MODEL - DATA FOR CATCHMENT ANALYSIS

PIT / NODE DETAILS

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| P23A8 | Sag | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 0.9 m lintel | 5 | 4 | 54.35 | 0.2 | 0 | 0.5 |
| P23A7_1 | OnGrade | NSW Dept. of Housing RM7 Inlet, 3% crossfall, 1% grade | RM7 | | 0.5 | 53.47 | | 0 | 0.2 |
| P23A6_1 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 0.9 m lintel | | 1.3 | 43.16 | | 0 | 0.2 |
| P23A6 | OnGrade | NSW Dept. of Housing RM7 Inlet, 3% crossfall, 1% grade | RM7 | | 2.6 | 41.07 | | 0 | 0.2 |
| P23A5 | OnGrade | NSW Dept. of Housing RM7 Inlet, 3% crossfall, 1% grade | RM7 | | 1.1 | 39.38 | | 0 | 0.2 |
| P23A3A | OnGrade | NSW Dept. of Housing RM7 Inlet, 3% crossfall, 2% grade | RM7 | | 4 | 33.1 | | 0 | 0.2 |
| P23A2A | OnGrade | NSW Dept. of Housing RM7 Inlet, 3% crossfall, 1% grade | RM7 | | 2.1 | 28.8 | | 0 | 0.2 |
| P23A2 | Node | | | | | 21.48 | | 0 | |
| P23A9 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 1.8 m lintel | | 4 | 54.64 | | 0 | 0.2 |
| P23W2 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 1.8 m lintel | | 4 | 39.81 | | 0 | 0.2 |
| P23V3 | Sag | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 1.8 m lintel | 5 | 4 | 40.22 | 0.2 | 0 | 0.5 |
| P23U3 | OnGrade | Manual | kerb inlet all inflows 0.5cums | | 4 | 49.65 | | 0 | 0.2 |
| P23T2 | OnGrade | NSW Dept. of Housing RM7 Inlet, 3% crossfall, 1% grade | RM7 | | 4 | 36.01 | | 0 | 0.2 |
| P23R2 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 1.8 m lintel | | 4 | 29.55 | | 0 | 0.2 |
| P23R1 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 0.9 m lintel | | 3.6 | 29.14 | | 0 | 0.2 |
| P23P1 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 1.8 m lintel | | 4 | 28.97 | | 0 | 0.2 |
| P23N1 | OnGrade | NSW Dept. of Housing RM7 Inlet, 3% crossfall, 1% grade | RM7 | | 0.5 | 28.84 | | 0 | 0.2 |
| P23O1 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 2.4 m lintel | | 4 | 29.02 | | 0 | 0.2 |
| P23Q1 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 0.9 m lintel | | 4 | 31.28 | | 0 | 0.2 |
| P23Y2 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 0.9 m lintel | | 4 | 47.97 | | 0 | 0.2 |
| P23Y1 | OnGrade | Hornsby Council Inlets (KI+grate), 3% crossfall, all grades | Hornsby 1.8 m lintel | | 3.1 | 41.74 | | 0 | 0.2 |
| outflow 1 | Node | | | | | 28.8 | | 0 | |
| outflow 3 | Node | | | | | 15.64 | | 0 | |

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| aP23A8 | P23A8 | 0.0786 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23A6_1 | P23A6_1 | 0.0292 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23A9 | P23A9 | 0.2085 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23W2 | P23W2 | 0.1412 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23V3 | P23V3 | 0.6025 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23U3 | P23U3 | 0.903 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23T2 | P23T2 | 0.0446 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23R2 | P23R2 | 0.0825 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23R1 | P23R1 | 0.0123 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23P1 | P23P1 | 0.0988 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23O1 | P23O1 | 0.8798 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23Q1 | P23Q1 | 0.2501 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23Y2 | P23Y2 | 0.0382 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |
| aP23Y1 | P23Y1 | 0.1195 | 85 | 10 | 5 | 1 | 2 | 2 | 0 | 35 | 35 | 30 | 30 | 30 | 0.015 | 0.035 | 0.035 |

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pP23A8 | P23A8 | P23A7_1 | 20.9449 | 53.6 | 52.67 | 4.44 | Concrete, under roads | 225 | 225 | 0.3 | Existing | 1 | P23A8 |
| pP23A7_1 | P23A7_1 | P23A6_1 | 101.475 | 52.67 | 41.36 | 11.15 | Concrete, under roads | 300 | 300 | 0.3 | Existing | 1 | P23A7_1 |
| pP23A6_1 | P23A6_1 | P23A6 | 19.0796 | 41.36 | 40.07 | 6.76 | Concrete, under roads | 300 | 300 | 0.3 | Existing | 1 | P23A6_1 |
| pP23A6 | P23A6 | P23A5 | 24.6179 | 40.07 | 38.505 | 6.36 | Concrete, under roads | 375 | 375 | 0.3 | Existing | 1 | P23A6 |
| pP23A5 | P23A5 | P23A3A | 57.6092 | 38.505 | 32.2 | 10.94 | Concrete, under roads | 375 | 375 | 0.3 | Existing | 1 | P23A5 |
| pP23A3A | P23A3A | P23A2A | 34.5814 | 32.2 | 28.14 | 11.74 | Concrete, under roads | 375 | 375 | 0.3 | Existing | 1 | P23A3A |
| pP23A2A | P23A2A | P23A2 | 84.6127 | 26.55 | 20.13 | 7.59 | Concrete, under roads | 375 | 375 | 0.3 | Existing | 1 | P23A2A |
| pP23A9 | P23A9 | P23A7_1 | 16.2083 | 53.74 | 52.67 | 6.6 | Concrete, under roads | 225 | 225 | 0.3 | Existing | 1 | P23A9 |
| pP23W2 | P23W2 | P23A5 | 21.5916 | 39.085 | 38.505 | 2.69 | Concrete, under roads | 225 | 225 | 0.3 | Existing | 1 | P23W2 |
| pP23V3 | P23V3 | P23A5 | 15.2209 | 39.495 | 38.54 | 6.27 | Concrete, under roads | 300 | 300 | 0.3 | Existing | 1 | P23V3 |
| pP23U3 | P23U3 | P23A3A | 9.65525 | 48.05 | 32.2 | 164.16 | Concrete, under roads | 300 | 300 | 0.3 | Existing | 1 | P23U3 |
| pP23T2 | P23T2 | P23A3A | 28.3187 | 35.36 | 32.2 | 11.16 | Concrete, under roads | 300 | 300 | 0.3 | Existing | 1 | P23T2 |
| pP23R2 | P23R2 | P23R1 | 3.30801 | 28.75 | 28.59 | 4.84 | Concrete, under roads | 225 | 225 | 0.3 | Existing | 1 | P23R2 |
| pP23R1 | P23R1 | P23A2A | 2.26163 | 28.59 | 28.14 | 19.9 | Concrete, under roads | 225 | 225 | 0.3 | Existing | 1 | P23R1 |
| pP23P1 | P23P1 | P23N1 | 7.52669 | 27.48 | 27.405 | 1 | Concrete, under roads | 375 | 375 | 0.3 | Existing | 1 | P23P1 |
| pP23N1 | P23N1 | P23A2A | 12.1162 | 26.59 | 26.41 | 1.49 | Concrete, under roads | 300 | 300 | 0.3 | Existing | 1 | P23N1 |
| pP23O1 | P23O1 | P23N1 | 6.47583 | 28.22 | 28.11 | 1.7 | Concrete, under roads | 225 | 225 | 0.3 | Existing | 1 | P23O1 |
| pP23Q1 | P23Q1 | P23N1 | 28.0427 | 28.39 | 28.11 | 1 | Concrete, under roads | 375 | 375 | 0.3 | Existing | 1 | P23Q1 |
| pP23Y2 | P23Y2 | P23Y1 | 58.5818 | 43.37 | 40.74 | 4.49 | Concrete, under roads | 300 | 300 | 0.3 | Existing | 1 | P23Y2 |
| pP23Y1 | P23Y1 | P23A6 | 7.65937 | 40.74 | 40.07 | 8.75 | Concrete, under roads | 225 | 225 | 0.3 | Existing | 1 | P23Y1 |

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 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| oP23A8 | P23A8 | P23Y2 | 0.56 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 9.42 | 0 |
| oP23A6_1 | P23A6_1 | P23Y1 | 0.1 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 11.95 | 0 |
| oP23A9 | P23A9 | P23Y2 | 0.57 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 9.66 | 0 |
| oP23W2 | P23W2 | P23T2 | 0.37 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 8.96 | 0 |
| oP23V3 | P23V3 | P23W2 | 0.1 | | | | Dummy used to model flow across road low points | 0.3 | 0.3 | 0.6 | 4.52 | 0 |
| oP23U3 | P23U3 | P23R2 | 0.24 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 38.02 | 0 |
| oP23T2 | P23T2 | P23A2 | 0.37 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 11.86 | 0 |
| oP23R2 | P23R2 | P23R1 | 0.1 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 12.39 | 0 |
| oP23R1 | P23R1 | P23O1 | 0.47 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 0.53 | 0 |
| oP23P1 | P23P1 | P23A2 | 1.05 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 1 | 0 |
| oP23O1 | P23O1 | P23P1 | 0.2 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 0.51 | 0 |
| OP23Q1 | P23Q1 | outflow 3 | 0.76 | | | | Dummy used to model flow across road low points | 0.3 | 0.3 | 0.6 | 14.39 | 0 |
| oP23Y2 | P23Y2 | P23A6_1 | 0.37 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 10.23 | 0 |
| oP23Y1 | P23Y1 | outflow 1 | 2.48 | | | | 8 m wide road (half section) | 0.3 | 0.3 | 0.6 | 0.61 | 0 |

# DRAINS MODEL - 5-YR ARI RESULTS FOR CATCHMENT ANALYSIS

DRAINS results prepared 23 September, 2010 from Version 2010.08

PIT / NODE DETAILS

| Name | Max HGL | Max Pond HGL | Max Surface Flow Arriving (cu.m/s) | Version 8 Max Pond Volume (cu.m) | Min Freeboard (m) | Overflow (cu.m/s) | Constraint |
|---|---|---|---|---|---|---|---|
| P23A8 | 53.98 | 54.48 | 0.036 | 2.5 | 0.37 | 0 | None |
| P23A7_1 | 53.02 | | 0 | | 0.45 | | None |
| P23A6_1 | 41.86 | | 0.025 | | 1.3 | 0.004 | Inlet Capacity |
| P23A6 | 40.88 | | 0 | | 0.19 | | None |
| P23A5 | 39.48 | | 0 | | -0.1 | | Outlet System |
| P23A3A | 36.33 | | 0 | | -3.23 | | Outlet System |
| P23A2A | 29.04 | | 0 | | -0.24 | | Outlet System |
| P23A2 | 20.39 | | 1.02 | | | | |
| P23A9 | 54.53 | | 0.095 | | 0.11 | 0.029 | Inlet Capacity |
| P23W2 | 39.81 | | 0.215 | | 0 | 0.174 | Outlet System |
| P23V3 | 40.42 | 40.42 | 0.276 | 5 | -0.2 | 0.151 | Outlet System |
| P23U3 | 49.65 | | 0.413 | | 0 | 0.233 | Outlet System |
| P23T2 | 36.01 | | 0.194 | | 0 | 0.266 | Outlet System |
| P23R2 | 29.55 | | 0.27 | | 0 | 0.216 | Outlet System |
| P23R1 | 29.14 | | 0.221 | | 0 | 0.246 | Outlet System |
| P23P1 | 28.97 | | 0.7 | | 0 | 0.758 | Outlet System |
| P23N1 | 29.04 | | 0 | | -0.2 | | Outlet System |
| P23O1 | 29.02 | | 0.648 | | 0 | 0.655 | Outlet System |
| P23Q1 | 29.11 | | 0.114 | | 2.17 | 0.058 | Inlet Capacity |
| P23Y2 | 43.66 | | 0.046 | | 4.31 | 0.012 | Inlet Capacity |
| P23Y1 | 41.67 | | 0.058 | | 0.07 | 0.013 | Inlet Capacity |

SUB-CATCHMENT DETAILS

| Name | Max Flow Q (cu.m/s) | Paved Max Q (cu.m/s) | Grassed Max Q (cu.m/s) | Paved Tc (min) | Grassed Tc (min) | Supp. Tc (min) | Due to Storm |
|---|---|---|---|---|---|---|---|
| aP23A8 | 0.036 | 0.031 | 0.005 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23A6_1 | 0.013 | 0.012 | 0.002 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23A9 | 0.095 | 0.083 | 0.013 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23W2 | 0.065 | 0.056 | 0.009 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23V3 | 0.276 | 0.239 | 0.037 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23U3 | 0.413 | 0.358 | 0.055 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23T2 | 0.02 | 0.018 | 0.003 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23R2 | 0.038 | 0.033 | 0.005 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23R1 | 0.006 | 0.005 | 0.001 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23P1 | 0.045 | 0.039 | 0.006 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23O1 | 0.402 | 0.348 | 0.054 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23Q1 | 0.114 | 0.099 | 0.015 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23Y2 | 0.017 | 0.015 | 0.002 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| aP23Y1 | 0.055 | 0.047 | 0.007 | 1 | 3.89 | 3.89 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |

PIPE DETAILS

| Name | Max Q (cu.m/s) | Max V (m/s) | Max U/S HGL (m) | Max D/S HGL (m) | Due to Storm |
|---|---|---|---|---|---|
| pP23A8 | 0.035 | 2.6 | 53.685 | 53.023 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23A7_1 | 0.102 | 4.8 | 52.772 | 41.855 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23A6_1 | 0.124 | 4.2 | 41.49 | 40.885 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23A6 | 0.203 | 4.6 | 40.228 | 39.478 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23A5 | 0.369 | 6.6 | 38.694 | 36.333 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23A3A | 0.477 | 7.3 | 32.415 | 29.038 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23A2A | 0.497 | 6 | 26.812 | 20.392 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23A9 | 0.067 | 3.6 | 53.847 | 53.023 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23W2 | 0.053 | 1.3 | 39.593 | 39.478 | AR&R 5 year, 1 hour storm, average 55 mm/h, Zone 1 |
| pP23V3 | 0.126 | 3.7 | 39.642 | 39.478 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23U3 | 0.182 | 16.2 | 48.115 | 36.333 | AR&R 5 year, 1 hour storm, average 55 mm/h, Zone 1 |
| pP23T2 | 0.031 | 0.4 | 36.013 | 36.333 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23R2 | 0.054 | 1.4 | 29.174 | 29.14 | AR&R 5 year, 1 hour storm, average 55 mm/h, Zone 1 |
| pP23R1 | 0.039 | 1 | 29.044 | 29.038 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23P1 | 0.072 | 0.7 | 28.972 | 29.036 | AR&R 5 year, 2 hours storm, average 35.1 mm/h, Zone 1 |
| pP23N1 | 0.134 | 1.9 | 29.036 | 29.038 | AR&R 5 year, 2 hours storm, average 35.1 mm/h, Zone 1 |
| pP23O1 | 0.069 | 1.7 | 29.027 | 29.036 | AR&R 5 year, 2 hours storm, average 35.1 mm/h, Zone 1 |
| pP23Q1 | 0.056 | 0.5 | 29.056 | 29.036 | AR&R 5 year, 1 hour storm, average 55 mm/h, Zone 1 |
| pP23Y2 | 0.034 | 2.7 | 43.44 | 41.666 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| pP23Y1 | 0.079 | 2 | 41.037 | 40.885 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |

OVERFLOW ROUTE DETAILS

| Name | Max Q U/S | Max Q D/S | Safe Q | Max D | Max DxV | Max Width | Max V | Due to Storm |
|---|---|---|---|---|---|---|---|---|
| oP23A8 | 0 | 0 | 1.063 | 0 | 0 | 0 | 0 | |
| oP23A6_1 | 0.004 | 0.004 | 0.967 | 0.025 | 0.04 | 0.21 | 1.44 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23A9 | 0.029 | 0.029 | 1.077 | 0.056 | 0.12 | 0.5 | 2.23 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23W2 | 0.174 | 0.174 | 1.094 | 0.098 | 0.26 | 1.92 | 2.69 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23V3 | 0.151 | 0.151 | 13.245 | 0.031 | 0.03 | 10.2 | 0.94 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23U3 | 0.233 | 0.233 | 0.439 | 0.086 | 0.46 | 1.52 | 5.32 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23T2 | 0.266 | 0.266 | 0.964 | 0.107 | 0.35 | 2.2 | 3.26 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23R2 | 0.216 | 0.216 | 0.816 | 0.1 | 0.32 | 1.97 | 3.2 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23R1 | 0.246 | 0.246 | 1.85 | 0.171 | 0.14 | 5.07 | 0.81 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23P1 | 0.758 | 0.758 | 2.134 | 0.209 | 0.3 | 6.4 | 1.44 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23O1 | 0.655 | 0.655 | 1.815 | 0.219 | 0.24 | 6.4 | 1.11 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| OP23Q1 | 0.058 | 0.058 | 10.066 | 0.018 | 0.02 | 5.84 | 1.14 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23Y2 | 0.012 | 0.012 | 1.05 | 0.04 | 0.07 | 0.33 | 1.81 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |
| oP23Y1 | 0.013 | 0.013 | 1.985 | 0.067 | 0.04 | 0.88 | 0.62 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |

# DRAINS MODEL - 100-YR ARI RESULTS FOR CATCHMENT ANALYSIS

DRAINS results prepared 23 September, 2010 from Version 2010.08

PIT / NODE DETAILS

| Name | Max HGL | Max Pond HGL | Max Surface Flow Arriving (cu.m/s) | Version 8 Max Pond Volume (cu.m) | Min Freeboard (m) | Overflow (cu.m/s) | Constraint |
|---|---|---|---|---|---|---|---|
| P23A8 | 54.2 | 54.52 | 0.055 | 3.9 | 0.15 | 0 | None |
| P23A7_1 | 53.04 | | 0 | | 0.43 | | None |
| P23A6_1 | 42.03 | | 0.064 | | 1.13 | 0.021 | Inlet Capacity |
| P23A6 | 41.08 | | 0 | | -0.01 | | Outlet System |
| P23A5 | 39.59 | | 0 | | -0.21 | | Outlet System |
| P23A3A | 36.54 | | 0 | | -3.44 | | Outlet System |
| P23A2A | 29.05 | | 0 | | -0.25 | | Outlet System |
| P23A2 | 20.39 | | 1.733 | | | | |
| P23A9 | 54.64 | | 0.146 | | 0 | 0.073 | Outlet System |
| P23W2 | 39.81 | | 0.397 | | 0 | 0.363 | Outlet System |
| P23V3 | 40.42 | 40.42 | 0.423 | 5 | -0.2 | 0.298 | Outlet System |
| P23U3 | 49.65 | | 0.633 | | 0 | 0.453 | Outlet System |
| P23T2 | 36.01 | | 0.394 | | 0 | 0.486 | Outlet System |
| P23R2 | 29.55 | | 0.511 | | 0 | 0.457 | Outlet System |
| P23R1 | 29.14 | | 0.465 | | 0 | 0.492 | Outlet System |
| P23P1 | 28.97 | | 1.188 | | 0 | 1.251 | Outlet System |
| P23N1 | 29.05 | | 0 | | -0.21 | | Outlet System |
| P23O1 | 29.02 | | 1.108 | | 0 | 1.119 | Outlet System |
| P23Q1 | 29.12 | | 0.175 | | 2.16 | 0.119 | Inlet Capacity |
| P23Y2 | 43.8 | | 0.1 | | 4.17 | 0.044 | Inlet Capacity |
| P23Y1 | 41.74 | | 0.105 | | 0 | 0.088 | Outlet System |

SUB-CATCHMENT DETAILS

| Name | Max Flow Q (cu.m/s) | Paved Max Q (cu.m/s) | Grassed Max Q (cu.m/s) | Paved Tc (min) | Grassed Tc (min) | Supp. Tc (min) | Due to Storm |
|---|---|---|---|---|---|---|---|
| aP23A8 | 0.055 | 0.047 | 0.008 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23A6_1 | 0.02 | 0.018 | 0.003 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23A9 | 0.146 | 0.126 | 0.02 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23W2 | 0.099 | 0.085 | 0.014 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23V3 | 0.423 | 0.363 | 0.059 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23U3 | 0.633 | 0.545 | 0.089 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23T2 | 0.031 | 0.027 | 0.004 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23R2 | 0.058 | 0.05 | 0.008 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23R1 | 0.009 | 0.007 | 0.001 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23P1 | 0.069 | 0.06 | 0.01 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23O1 | 0.617 | 0.531 | 0.086 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23Q1 | 0.175 | 0.151 | 0.025 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23Y2 | 0.027 | 0.023 | 0.004 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| aP23Y1 | 0.084 | 0.072 | 0.012 | 1 | 3.53 | 3.53 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |

PIPE DETAILS

| Name | Max Q (cu.m/s) | Max V (m/s) | Max U/S HGL (m) | Max D/S HGL (m) | Due to Storm |
|---|---|---|---|---|---|
| pP23A8 | 0.054 | 2.9 | 53.706 | 53.044 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23A7_1 | 0.127 | 5 | 52.786 | 42.03 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23A6_1 | 0.17 | 4.6 | 41.516 | 41.077 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23A6 | 0.244 | 4.8 | 40.245 | 39.589 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23A5 | 0.402 | 6.8 | 38.703 | 36.536 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23A3A | 0.49 | 7.3 | 32.418 | 29.053 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23A2A | 0.498 | 6 | 26.813 | 20.393 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23A9 | 0.074 | 3.7 | 53.853 | 53.044 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23W2 | 0.053 | 1.3 | 39.666 | 39.589 | AR&R 100 year, 2 hours storm, average 61 mm/h, Zone 1 |
| pP23V3 | 0.127 | 2 | 39.753 | 39.589 | AR&R 100 year, 1 hour storm, average 96 mm/h, Zone 1 |
| pP23U3 | 0.182 | 16.2 | 48.115 | 36.536 | AR&R 100 year, 1 hour storm, average 96 mm/h, Zone 1 |
| pP23T2 | 0.018 | 0.3 | 36.014 | 36.536 | AR&R 100 year, 1 hour storm, average 96 mm/h, Zone 1 |
| pP23R2 | 0.054 | 1.4 | 29.174 | 29.14 | AR&R 100 year, 2 hours storm, average 61 mm/h, Zone 1 |
| pP23R1 | 0.037 | 0.9 | 29.058 | 29.053 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23P1 | 0.073 | 0.7 | 28.972 | 29.047 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23N1 | 0.135 | 1.9 | 29.047 | 29.053 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23O1 | 0.069 | 1.7 | 29.027 | 29.047 | AR&R 100 year, 2 hours storm, average 61 mm/h, Zone 1 |
| pP23Q1 | 0.056 | 0.5 | 29.067 | 29.047 | AR&R 100 year, 1 hour storm, average 96 mm/h, Zone 1 |
| pP23Y2 | 0.056 | 2.9 | 43.464 | 41.74 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| pP23Y1 | 0.083 | 2.1 | 41.204 | 41.077 | AR&R 100 year, 2 hours storm, average 61 mm/h, Zone 1 |

OVERFLOW ROUTE DETAILS

| Name | Max Q U/S | Max Q D/S | Safe Q | Max D | Max DxV | Max Width | Max V | Due to Storm |
|---|---|---|---|---|---|---|---|---|
| oP23A8 | 0 | 0 | 1.063 | 0 | 0 | 0 | 0 | |
| oP23A6_1 | 0.021 | 0.021 | 0.967 | 0.048 | 0.1 | 0.4 | 2.18 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23A9 | 0.073 | 0.073 | 1.077 | 0.075 | 0.19 | 1.13 | 2.59 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23W2 | 0.363 | 0.363 | 1.094 | 0.122 | 0.37 | 2.72 | 3.02 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23V3 | 0.298 | 0.298 | 13.245 | 0.04 | 0.05 | 11.99 | 1.15 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23U3 | 0.453 | 0.453 | 0.439 | 0.105 | 0.61 | 2.15 | 5.76 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23T2 | 0.486 | 0.486 | 0.964 | 0.128 | 0.46 | 2.9 | 3.59 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23R2 | 0.457 | 0.457 | 0.816 | 0.125 | 0.45 | 2.81 | 3.58 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23R1 | 0.492 | 0.492 | 1.85 | 0.203 | 0.2 | 6.4 | 1 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23P1 | 1.251 | 1.251 | 2.134 | 0.239 | 0.42 | 6.4 | 1.74 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23O1 | 1.119 | 1.119 | 1.815 | 0.256 | 0.35 | 6.4 | 1.35 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| OP23Q1 | 0.119 | 0.119 | 10.066 | 0.023 | 0.03 | 7.63 | 1.37 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23Y2 | 0.044 | 0.044 | 1.05 | 0.063 | 0.16 | 0.75 | 2.51 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |
| oP23Y1 | 0.088 | 0.088 | 1.985 | 0.12 | 0.09 | 2.63 | 0.78 | AR&R 100 year, 25 minutes storm, average 146 mm/h, Zone 1 |

# APPENDIX 5

## DRAINS Model Results

On-Site Detention sizing

### DRAINS MODEL - DATA

PIT / NODE DETAILS

| Name | Type | Surface Elev (m) |
|---|---|---|
| OUT-EXG P | Node | 13.47 |
| OUT PROP | Node | 13 |

DETENTION BASIN DETAILS

| Name | Elev | Volume | Init Vol. (cu.m) | Outlet Type | Dia(mm) | Centre RL |
|---|---|---|---|---|---|---|
| OSD 1A | 13.2 | 0 | 0 | Orifice | 450 | 13.5 |
| | 13.5 | 0.243 | | | | |
| | 13.7 | 12.243 | | | | |
| | 14 | 66.2 | | | | |
| | 14.5 | 156.2 | | | | |
| | 14.8 | 210.2 | | | | |
| | 15 | 246.2 | | | | |

SUB-CATCHMENT DETAILS

| Name | Pit or Node | Total Area (ha) | Paved Area % | Grass Area % | Supp Area % | Paved Time (min) | Grass Time (min) | Paved Length (m) | Grass Length (m) | Paved Slope(%) % | Grass Slope % | Paved Rough | Grass Rough |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CAT EXG 100P | OUT-EXG P | 1.48 | 0 | 100 | 0 | 0 | 10 | 0 | 63 | 0 | 4 | 0 | 0.15 |
| CAT-PROP2 | OSD 1A | 1.48 | 47.5 | 52.5 | 0 | 0 | 10 | 145 | 63 | 2 | 4 | 0.014 | 0.15 |

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWLEVEL OUT PIPE 2 | OSD 1A | OUT PROP | 10 | 13.5 | 13.4 | 1 | Concrete, not under roads | 600 | 600 | 0.3 | NewFixed | 1 | OSD 1A |

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 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HIGH LEVEL OUT 2 | OSD 1A | OUT PROP | 1 | 14.8 | 2 | 1.6 | Dummy | 0.2 | 0.05 | 0.6 | 1 | 0 |

### DRAINS MODEL - RESULT FOR 5-YEAR ARI

SUB-CATCHMENT DETAILS

| Name | Max Flow Q (cu.m/s) | Paved Max Q (cu.m/s) | Grassed Max Q (cu.m/s) | Paved Tc (min) | Grassed Tc (min) | Due to Storm |
|---|---|---|---|---|---|---|
| CAT EXG 100P | 0.284 | 0 | 0.284 | 0 | 24.12 | AR&R 5 year, 1 hour storm, average 55 mm/h, Zone 1 |
| CAT-PROP2 | 0.423 | 0.315 | 0.121 | 5.78 | 21.81 | AR&R 5 year, 25 minutes storm, average 86 mm/h, Zone 1 |

PIPE DETAILS

| Name | Max Q (cu.m/s) | Max V (m/s) | Max U/S HGL (m) | Max D/S HGL (m) | Due to Storm |
|---|---|---|---|---|---|
| LOWLEVEL OUT PIPE 2 | 0.277 | 2.4 | 13.755 | 13.655 | AR&R 5 year, 1.5 hours storm, average 42.4 mm/h, Zone 1 |

OVERFLOW ROUTE DETAILS

| Name | Max Q U/S | Max Q D/S | Safe Q | Max D | Max DxV | Max Width | Max V | Due to Storm |
|---|---|---|---|---|---|---|---|---|
| HIGH LEVEL OUT 2 | 0 | 0 | 0.256 | 0 | 0 | 0 | 0 | |

DETENTION BASIN DETAILS

| Name | Max WL | MaxVol | Max Q Total | Max Q Low Level | Max Q High Level |
|---|---|---|---|---|---|
| OSD 1A | 14.17 | 97.1 | 0.277 | 0.277 | 0 |

## DRAINS MODEL - RESULT FOR 20-YEAR ARI

SUB-CATCHMENT DETAILS

| Name | Max Flow Q (cu.m/s) | Paved Max Q (cu.m/s) | Grassed Max Q (cu.m/s) | Paved Tc (min) | Grassed Tc (min) | Due to Storm |
|---|---|---|---|---|---|---|
| CAT EXG 100P | 0.439 | 0 | 0.439 | 0 | 22.61 | AR&R 20 year, 1 hour storm, average 73 mm/h, Zone 1 |
| CAT-PROP2 | 0.593 | 0.422 | 0.197 | 5.2 | 20.62 | AR&R 20 year, 25 minutes storm, average 112 mm/h, Zone 1 |

PIPE DETAILS

| Name | Max Q (cu.m/s) | Max V (m/s) | Max U/S HGL (m) | Max D/S HGL (m) | Due to Storm |
|---|---|---|---|---|---|
| LOWLEVEL OUT PIPE 2 | 0.374 | 2.6 | 13.801 | 13.701 | AR&R 20 year, 1 hour storm, average 73 mm/h, Zone 1 |

OVERFLOW ROUTE DETAILS

| Name | Max Q U/S | Max Q D/S | Safe Q | Max D | Max DxV | Max Width | Max V | Due to Storm |
|---|---|---|---|---|---|---|---|---|
| HIGH LEVEL OUT 2 | 0 | 0 | 0.256 | 0 | 0 | 0 | 0 | |

DETENTION BASIN DETAILS

| Name | Max WL | MaxVol | Max Q Total | Max Q Low Level | Max Q High Level |
|---|---|---|---|---|---|
| OSD 1A | 14.56 | 167.2 | 0.374 | 0.374 | 0 |

## DRAINS MODEL - RESULT FOR 100-YEAR ARI

SUB-CATCHMENT DETAILS

| Name | Max Flow Q (cu.m/s) | Paved Max Q (cu.m/s) | Grassed Max Q (cu.m/s) | Paved Tc (min) | Grassed Tc (min) | Due to Storm |
|---|---|---|---|---|---|---|
| CAT EXG 100P | 0.603 | 0 | 0.603 | 0 | 21.3 | AR&R 100 year, 1 hour storm, average 96 mm/h, Zone 1 |
| CAT-PROP2 | 0.752 | 0.461 | 0.302 | 6.14 | 22.54 | AR&R 100 year, 1.5 hours storm, average 74 mm/h, Zone 1 |

PIPE DETAILS

| Name | Max Q (cu.m/s) | Max V (m/s) | Max U/S HGL (m) | Max D/S HGL (m) | Due to Storm |
|---|---|---|---|---|---|
| LOWLEVEL OUT PIPE | 0.45 | 2.8 | 13.832 | 13.732 | AR&R 100 year, 1.5 hours storm, average 74 mm/h, Zone 1 |

OVERFLOW ROUTE DETAILS

| Name | Max Q U/S | Max Q D/S | Safe Q | Max D | Max DxV | Max Width | Max V | Due to Storm |
|---|---|---|---|---|---|---|---|---|
| HIGH LEVEL OUT 2 | 0.148 | 0.148 | 7.665 | 0.04 | 0.02 | 11.99 | 0.57 | AR&R 100 year, 1.5 hours storm, average 74 mm/h, Zone 1 |

DETENTION BASIN DETAILS

| Name | Max WL | MaxVol | Max Q Total | Max Q Low Level | Max Q High Level |
|---|---|---|---|---|---|
| OSD 1A | 14.93 | 233.4 | 0.598 | 0.45 | 0.148 |

# 9 ENERGY EFFICIENCY

The building services will incorporate energy efficiency initiatives as listed below.

These building services energy efficiency initiatives for the project will mainly relate to:

- Maximisation of Daylighting;
- Energy Efficient Lighting;
- Lighting Control;
- Energy Monitoring and Reporting;
- Mechanical Systems (Heating, Ventilation and Air Conditioning);
- Natural Ventilation;
- Water Efficiency; and
- Stormwater Management and Reuse.

These initiatives will be further developed in the design stage of the project.