Print Close Report

# Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

**Calculated by:** Cham Ariyaratne

**Site name:** Denville Hall

**Site location:** HA6 2SB

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

### Site Details

**Latitude:** 51.61047° N

**Longitude:** 0.44005° W

**Reference:** 429300956

**Date:** Nov 16 2022 22:44

**Runoff estimation approach** IH124

### Site characteristics

**Total site area (ha):** 0.874

### Methodology

**$Q_{BAR}$ estimation method:** Calculate from SPR and SAAR

**SPR estimation method:** Calculate from SOIL type

| Soil characteristics | Default | Edited |
|---|---|---|
| SOIL type: | 4 | 4 |
| HOST class: | N/A | N/A |
| SPR/SPRHOST: | 0.47 | 0.47 |

| Hydrological characteristics | Default | Edited |
|---|---|---|
| SAAR (mm): | 669 | 669 |
| Hydrological region: | 6 | 6 |
| Growth curve factor 1 year: | 0.85 | 0.85 |
| Growth curve factor 30 years: | 2.3 | 2.3 |
| Growth curve factor 100 years: | 3.19 | 3.19 |
| Growth curve factor 200 years: | 3.74 | 3.74 |

### Notes

**(1) Is $Q_{BAR}$ < 2.0 l/s/ha?**

When $Q_{BAR}$ is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

**(2) Are flow rates < 5.0 l/s?**

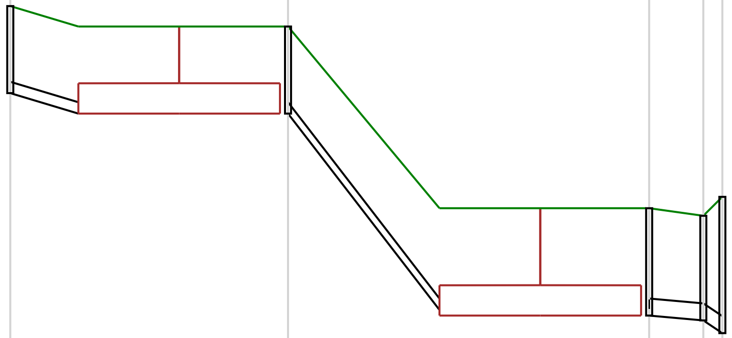
Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

**(3) Is SPR/SPRHOST ≤ 0.3?**

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

| Greenfield runoff rates | Default | Edited |
|---|---|---|
| $Q_{BAR}$ (l/s): | 4 | 4 |
| 1 in 1 year (l/s): | 3.4 | 3.4 |
| 1 in 30 years (l/s): | 9.2 | 9.2 |
| 1 in 100 year (l/s): | 12.77 | 12.77 |
| 1 in 200 years (l/s): | 14.97 | 14.97 |

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.



A4 drawing

Hor Scale 1500
Ver Scale 100

Datum (m) 63.000

| Node Name | SWMH C01 | Car Park Tank 1 | Car P[illegible] A03 | |
|---|---|---|---|---|
| Link Name | 1.000 | 1.001 | 1.00 | 1. |
| Section Type | 150m | 150mm | 225m | 22 |
| Slope (1:X) | 50.0 | 11.6 | 167.9 | 22 |
| Cover Level (m) | 71.270 | 71.000 | 68.600 | 68.500<br>68.750 |
| Invert Level (m) | 70.120<br>69.850 | 69.850<br>67.257 | 67.182<br>67.118 | 66.950<br>67.118 |
| Length (m) | 13.50 | 30.045 | 10.74 | 3. |

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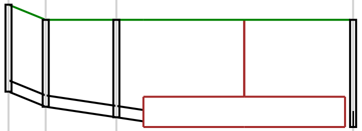
| Node Name | SWBuildingACSWMHPA02Tank 2 |
|---|---|

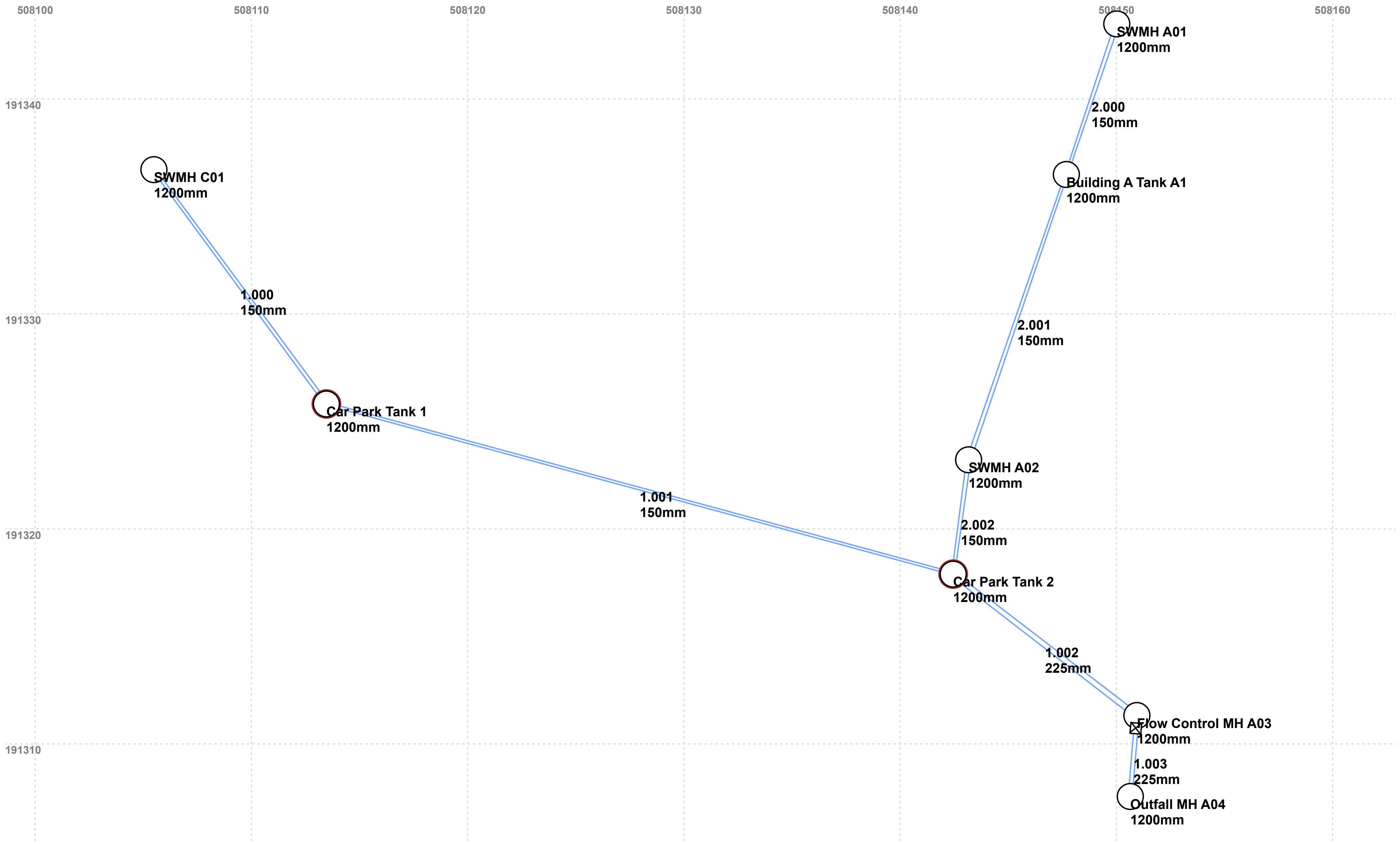


A4 drawing

Hor Scale 1500
Ver Scale 100

Datum (m) 62.000

| | | | | | |
|---|---|---|---|---|---|
| Link Name | 2.0( | 2.001 | | 2.( | |
| Section Type | 150 | 150mr | | 15 | |
| Slope (1:X) | 36.! | 100.9 | | 99 | |
| Cover Level (m) | 68.800 | 68.600 | | 68.600 | 68.600 |
| Invert Level (m) | 67.650<br>67.450 | 67.450 | 67.311 | 67.311<br>67.257 | |
| Length (m) | 7.3! | 14.020 | | 5.3 | |



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## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FEH-13 | Minimum Velocity (m/s) | 1.00 |
| Return Period (years) | 100 | Connection Type | Level Soffits |
| Additional Flow (%) | 0 | Minimum Backdrop Height (m) | 0.200 |
| CV | 0.750 | Preferred Cover Depth (m) | 1.000 |
| Time of Entry (mins) | 5.00 | Include Intermediate Ground | ✓ |
| Maximum Time of Concentration (mins) | 30.00 | Enforce best practice design rules | ✓ |
| Maximum Rainfall (mm/hr) | 50.0 | | |

## Nodes

| Name | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Easting (m) | Northing (m) | Depth (m) |
|---|---|---|---|---|---|---|---|
| SWMH A01 | 0.048 | 5.00 | 68.800 | 1200 | 508150.017 | 191343.488 | 1.150 |
| Building A Tank A1 | | | 68.600 | 1200 | 508147.686 | 191336.485 | 1.150 |
| SWMH A02 | | | 68.600 | 1200 | 508143.166 | 191323.214 | 1.289 |
| SWMH C01 | 0.057 | 5.00 | 71.270 | 1200 | 508105.491 | 191336.709 | 1.150 |
| Car Park Tank 1 | 0.014 | 5.00 | 71.000 | 1200 | 508113.468 | 191325.811 | 1.150 |
| Car Park Tank 2 | 0.104 | 5.00 | 68.600 | 1200 | 508142.452 | 191317.896 | 1.418 |
| Flow Control MH A03 | | | 68.500 | 1200 | 508150.948 | 191311.321 | 1.382 |
| Outfall MH A04 | | | 68.750 | 1200 | 508150.643 | 191307.554 | 1.800 |

## Links

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.001 | Building A Tank A1 | SWMH A02 | 14.020 | 0.600 | 67.450 | 67.311 | 0.139 | 100.9 | 150 | 5.31 | 50.0 |
| 2.002 | SWMH A02 | Car Park Tank 2 | 5.366 | 0.600 | 67.311 | 67.257 | 0.054 | 99.4 | 150 | 5.40 | 50.0 |
| 1.002 | Car Park Tank 2 | Flow Control MH A03 | 10.743 | 0.600 | 67.182 | 67.118 | 0.064 | 167.9 | 225 | 5.57 | 50.0 |
| 1.003 | Flow Control MH A03 | Outfall MH A04 | 3.779 | 0.600 | 67.118 | 66.950 | 0.168 | 22.5 | 225 | 5.60 | 50.0 |
| 1.000 | SWMH C01 | Car Park Tank 1 | 13.506 | 0.600 | 70.120 | 69.850 | 0.270 | 50.0 | 150 | 5.16 | 50.0 |
| 1.001 | Car Park Tank 1 | Car Park Tank 2 | 30.045 | 0.600 | 69.850 | 67.257 | 2.593 | 11.6 | 150 | 5.33 | 50.0 |
| 2.000 | SWMH A01 | Building A Tank A1 | 7.381 | 0.600 | 67.650 | 67.450 | 0.200 | 36.9 | 150 | 5.07 | 50.0 |

| Name | Vel (m/s) | Cap (l/s) | Flow (l/s) | US Depth (m) | DS Depth (m) | Σ Area (ha) | Σ Add Inflow (l/s) | Pro Depth (mm) | Pro Velocity (m/s) |
|---|---|---|---|---|---|---|---|---|---|
| 2.001 | 1.000 | 17.7 | 6.5 | 1.000 | 1.139 | 0.048 | 0.0 | 63 | 0.925 |
| 2.002 | 1.008 | 17.8 | 6.5 | 1.139 | 1.193 | 0.048 | 0.0 | 62 | 0.928 |
| 1.002 | 1.006 | 40.0 | 30.2 | 1.193 | 1.157 | 0.223 | 0.0 | 146 | 1.103 |
| 1.003 | 2.770 | 110.1 | 30.2 | 1.157 | 1.575 | 0.223 | 0.0 | 80 | 2.374 |
| 1.000 | 1.426 | 25.2 | 7.7 | 1.000 | 1.000 | 0.057 | 0.0 | 57 | 1.258 |
| 1.001 | 2.976 | 52.6 | 9.6 | 1.000 | 1.193 | 0.071 | 0.0 | 43 | 2.266 |
| 2.000 | 1.662 | 29.4 | 6.5 | 1.000 | 1.000 | 0.048 | 0.0 | 48 | 1.337 |

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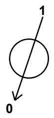
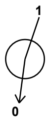
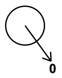
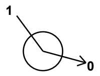
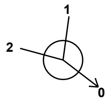
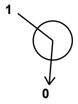
## Pipeline Schedule

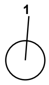
| Link | Length (m) | Slope (1:X) | Dia (mm) | Link Type | US CL (m) | US IL (m) | US Depth (m) | DS CL (m) | DS IL (m) | DS Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.001 | 14.020 | 100.9 | 150 | Circular | 68.600 | 67.450 | 1.000 | 68.600 | 67.311 | 1.139 |
| 2.002 | 5.366 | 99.4 | 150 | Circular | 68.600 | 67.311 | 1.139 | 68.600 | 67.257 | 1.193 |
| 1.002 | 10.743 | 167.9 | 225 | Circular | 68.600 | 67.182 | 1.193 | 68.500 | 67.118 | 1.157 |
| 1.003 | 3.779 | 22.5 | 225 | Circular | 68.500 | 67.118 | 1.157 | 68.750 | 66.950 | 1.575 |
| 1.000 | 13.506 | 50.0 | 150 | Circular | 71.270 | 70.120 | 1.000 | 71.000 | 69.850 | 1.000 |
| 1.001 | 30.045 | 11.6 | 150 | Circular | 71.000 | 69.850 | 1.000 | 68.600 | 67.257 | 1.193 |
| 2.000 | 7.381 | 36.9 | 150 | Circular | 68.800 | 67.650 | 1.000 | 68.600 | 67.450 | 1.000 |

| Link | US Node | Dia (mm) | Node Type | MH Type | DS Node | Dia (mm) | Node Type | MH Type |
|---|---|---|---|---|---|---|---|---|
| 2.001 | Building A Tank A1 | 1200 | Manhole | Adoptable | SWMH A02 | 1200 | Manhole | Adoptable |
| 2.002 | SWMH A02 | 1200 | Manhole | Adoptable | Car Park Tank 2 | 1200 | Manhole | Adoptable |
| 1.002 | Car Park Tank 2 | 1200 | Manhole | Adoptable | Flow Control MH A03 | 1200 | Manhole | Adoptable |
| 1.003 | Flow Control MH A03 | 1200 | Manhole | Adoptable | Outfall MH A04 | 1200 | Manhole | Adoptable |
| 1.000 | SWMH C01 | 1200 | Manhole | Adoptable | Car Park Tank 1 | 1200 | Manhole | Adoptable |
| 1.001 | Car Park Tank 1 | 1200 | Manhole | Adoptable | Car Park Tank 2 | 1200 | Manhole | Adoptable |
| 2.000 | SWMH A01 | 1200 | Manhole | Adoptable | Building A Tank A1 | 1200 | Manhole | Adoptable |

## Manhole Schedule

| Node | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections | | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| SWMH A01 | 508150.017 | 191343.488 | 68.800 | 1.150 | 1200 |  | 0 | 2.000 | 67.650 | 150 |
| Building A Tank A1 | 508147.686 | 191336.485 | 68.600 | 1.150 | 1200 |  | 1 | 2.000 | 67.450 | 150 |
| | | | | | | | 0 | 2.001 | 67.450 | 150 |
| SWMH A02 | 508143.166 | 191323.214 | 68.600 | 1.289 | 1200 |  | 1 | 2.001 | 67.311 | 150 |
| | | | | | | | 0 | 2.002 | 67.311 | 150 |
| SWMH C01 | 508105.491 | 191336.709 | 71.270 | 1.150 | 1200 |  | 0 | 1.000 | 70.120 | 150 |
| Car Park Tank 1 | 508113.468 | 191325.811 | 71.000 | 1.150 | 1200 |  | 1 | 1.000 | 69.850 | 150 |
| | | | | | | | 0 | 1.001 | 69.850 | 150 |
| Car Park Tank 2 | 508142.452 | 191317.896 | 68.600 | 1.418 | 1200 |  | 1 | 2.002 | 67.257 | 150 |
| | | | | | | | 2 | 1.001 | 67.257 | 150 |
| | | | | | | | 0 | 1.002 | 67.182 | 225 |
| Flow Control MH A03 | 508150.948 | 191311.321 | 68.500 | 1.382 | 1200 |  | 1 | 1.002 | 67.118 | 225 |
| | | | | | | | 0 | 1.003 | 67.118 | 225 |

## Manhole Schedule

| Node | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|---|---|
| Outfall MH A04 | 508150.643 | 191307.554 | 68.750 | 1.800 | 1200 |  1 | 1.003 | 66.950 | 225 |

## Simulation Settings

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Methodology | FEH-13 | Drain Down Time (mins) | 240 | 30 year (l/s) | 1.0 |
| Summer CV | 0.750 | Additional Storage (m³/ha) | 20.0 | 100 year (l/s) | 1.0 |
| Analysis Speed | Normal | Check Discharge Rate(s) | ✓ | Check Discharge Volume | x |
| Skip Steady State | x | 2 year (l/s) | 1.0 | | |

### Storm Durations

| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |
|---|---|---|---|---|---|---|---|---|---|---|---|

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|
| 2 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 |
| 100 | 20 | 0 | 0 |
| 100 | 40 | 0 | 0 |

## Pre-development Discharge Rate

| | | | |
|---|---|---|---|
| Site Makeup | Greenfield | Growth Factor 30 year | 1.95 |
| Greenfield Method | IH124 | Growth Factor 100 year | 2.48 |
| Positively Drained Area (ha) | | Betterment (%) | 0 |
| SAAR (mm) | | QBar | |
| Soil Index | 1 | Q 1 year (l/s) | |
| SPR | 0.10 | Q 30 year (l/s) | |
| Region | 1 | Q 100 year (l/s) | |
| Growth Factor 1 year | 0.85 | | |

## Node Flow Control MH B02 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | x | Sump Available | ✓ |
| Invert Level (m) | 0.000 | Product Number | CTL-SHE-0049-1000-0800-1000 |
| Design Depth (m) | 0.800 | Min Outlet Diameter (m) | 0.075 |
| Design Flow (l/s) | 1.0 | Min Node Diameter (mm) | 1200 |

## Node Flow Control MH A03 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | x | Sump Available | ✓ |
| Invert Level (m) | 67.118 | Product Number | CTL-SHE-0091-3000-0400-3000 |
| Design Depth (m) | 0.400 | Min Outlet Diameter (m) | 0.150 |
| Design Flow (l/s) | 3.0 | Min Node Diameter (mm) | 1200 |

## Node Building B Tank B1 Depth/Area Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 0.000 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | |

| **Depth (m)** | **Area (m²)** | **Inf Area (m²)** | **Depth (m)** | **Area (m²)** | **Inf Area (m²)** | **Depth (m)** | **Area (m²)** | **Inf Area (m²)** |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 30.0 | 0.0 | 0.800 | 30.0 | 0.0 | 0.801 | 0.0 | 0.0 |

## Node Car Park Tank 1 Depth/Area Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 69.850 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | 0 |

| **Depth (m)** | **Area (m²)** | **Inf Area (m²)** | **Depth (m)** | **Area (m²)** | **Inf Area (m²)** | **Depth (m)** | **Area (m²)** | **Inf Area (m²)** |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 74.9 | 0.0 | 0.400 | 74.9 | 0.0 | 0.401 | 0.0 | 0.0 |

## Node Car Park Tank 2 Depth/Area Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 67.182 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | |

| **Depth (m)** | **Area (m²)** | **Inf Area (m²)** | **Depth (m)** | **Area (m²)** | **Inf Area (m²)** | **Depth (m)** | **Area (m²)** | **Inf Area (m²)** |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 279.7 | 0.0 | 0.400 | 279.7 | 0.0 | 0.401 | 0.0 | 0.0 |

**Results for 2 year Critical Storm Duration. Lowest mass balance: 99.93%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH A01 | 10 | 67.698 | 0.048 | 6.3 | 0.0947 | 0.0000 | OK |
| 15 minute summer | Building A Tank A1 | 10 | 67.514 | 0.064 | 6.2 | 0.0719 | 0.0000 | OK |
| 15 minute summer | SWMH A02 | 11 | 67.378 | 0.067 | 6.2 | 0.0753 | 0.0000 | OK |
| 15 minute summer | SWMH C01 | 9 | 70.188 | 0.068 | 7.4 | 0.1439 | 0.0000 | OK |
| 30 minute summer | Car Park Tank 1 | 21 | 69.882 | 0.032 | 8.2 | 2.4264 | 0.0000 | OK |
| 240 minute summer | Car Park Tank 2 | 160 | 67.256 | 0.074 | 9.8 | 21.0104 | 0.0000 | OK |
| 240 minute summer | Flow Control MH A03 | 160 | 67.256 | 0.138 | 3.0 | 0.1562 | 0.0000 | OK |
| 240 minute summer | Outfall MH A04 | 160 | 66.975 | 0.025 | 3.0 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH A01 | 2.000 | Building A Tank A1 | 6.2 | 1.045 | 0.213 | 0.0442 | |
| 15 minute summer | Building A Tank A1 | 2.001 | SWMH A02 | 6.2 | 0.850 | 0.349 | 0.1021 | |
| 15 minute summer | SWMH A02 | 2.002 | Car Park Tank 2 | 6.2 | 0.871 | 0.349 | 0.0383 | |
| 15 minute summer | SWMH C01 | 1.000 | Car Park Tank 1 | 7.5 | 1.740 | 0.296 | 0.0621 | |
| 30 minute summer | Car Park Tank 1 | 1.001 | Car Park Tank 2 | 5.0 | 1.871 | 0.096 | 0.0811 | |
| 240 minute summer | Car Park Tank 2 | 1.002 | Flow Control MH A03 | 3.0 | 0.221 | 0.074 | 0.1986 | |
| 240 minute summer | Flow Control MH A03 | 1.003 | Outfall MH A04 | 3.0 | 1.155 | 0.027 | 0.0097 | 35.9 |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 99.93%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol ($m^3$) | Flood ($m^3$) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH A01 | 10 | 67.746 | 0.096 | 18.0 | 0.1890 | 0.0000 | OK |
| 15 minute summer | Building A Tank A1 | 11 | 67.600 | 0.150 | 17.8 | 0.1693 | 0.0000 | OK |
| 15 minute summer | SWMH A02 | 11 | 67.456 | 0.145 | 17.3 | 0.1639 | 0.0000 | OK |
| 15 minute summer | SWMH C01 | 10 | 70.250 | 0.130 | 21.4 | 0.2754 | 0.0000 | OK |
| 15 minute summer | Car Park Tank 1 | 12 | 69.914 | 0.064 | 26.5 | 4.9136 | 0.0000 | OK |
| 240 minute summer | Car Park Tank 2 | 200 | 67.391 | 0.209 | 22.9 | 58.9972 | 0.0000 | OK |
| 240 minute summer | Flow Control MH A03 | 200 | 67.391 | 0.273 | 3.1 | 0.3083 | 0.0000 | SURCHARGED |
| 15 minute summer | Outfall MH A04 | 71 | 66.976 | 0.026 | 3.0 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol ($m^3$) | Discharge Vol ($m^3$) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH A01 | 2.000 | Building A Tank A1 | 17.8 | 1.242 | 0.606 | 0.1082 | |
| 15 minute summer | Building A Tank A1 | 2.001 | SWMH A02 | 17.3 | 1.031 | 0.979 | 0.2455 | |
| 15 minute summer | SWMH A02 | 2.002 | Car Park Tank 2 | 17.2 | 1.062 | 0.965 | 0.0868 | |
| 15 minute summer | SWMH C01 | 1.000 | Car Park Tank 1 | 21.3 | 1.964 | 0.847 | 0.1483 | |
| 15 minute summer | Car Park Tank 1 | 1.001 | Car Park Tank 2 | 19.2 | 2.701 | 0.365 | 0.2133 | |
| 240 minute summer | Car Park Tank 2 | 1.002 | Flow Control MH A03 | 3.1 | 0.219 | 0.079 | 0.4204 | |
| 240 minute summer | Flow Control MH A03 | 1.003 | Outfall MH A04 | 3.0 | 1.159 | 0.027 | 0.0098 | 71.1 |

**Results for 100 year Critical Storm Duration. Lowest mass balance: 99.93%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH A01 | 11 | 67.902 | 0.252 | 23.5 | 0.4961 | 0.0000 | SURCHARGED |
| 15 minute summer | Building A Tank A1 | 11 | 67.749 | 0.299 | 21.5 | 0.3377 | 0.0000 | SURCHARGED |
| 15 minute summer | SWMH A02 | 12 | 67.505 | 0.194 | 20.9 | 0.2192 | 0.0000 | SURCHARGED |
| 15 minute summer | SWMH C01 | 11 | 70.404 | 0.284 | 27.9 | 0.6033 | 0.0000 | SURCHARGED |
| 15 minute summer | Car Park Tank 1 | 13 | 69.928 | 0.078 | 33.2 | 5.9399 | 0.0000 | OK |
| 240 minute summer | Car Park Tank 2 | 240 | 67.484 | 0.302 | 30.5 | 85.3485 | 0.0000 | SURCHARGED |
| 240 minute summer | Flow Control MH A03 | 240 | 67.484 | 0.366 | 3.2 | 0.4138 | 0.0000 | SURCHARGED |
| 60 minute summer | Outfall MH A04 | 293 | 66.976 | 0.026 | 3.0 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH A01 | 2.000 | Building A Tank A1 | 21.5 | 1.274 | 0.731 | 0.1299 | |
| 15 minute summer | Building A Tank A1 | 2.001 | SWMH A02 | 20.9 | 1.190 | 1.185 | 0.2468 | |
| 15 minute summer | SWMH A02 | 2.002 | Car Park Tank 2 | 21.0 | 1.196 | 1.180 | 0.0912 | |
| 15 minute summer | SWMH C01 | 1.000 | Car Park Tank 1 | 26.7 | 1.954 | 1.062 | 0.1801 | |
| 15 minute summer | Car Park Tank 1 | 1.001 | Car Park Tank 2 | 26.6 | 2.934 | 0.505 | 0.2721 | |
| 240 minute summer | Car Park Tank 2 | 1.002 | Flow Control MH A03 | 3.2 | 0.221 | 0.079 | 0.4273 | |
| 240 minute summer | Flow Control MH A03 | 1.003 | Outfall MH A04 | 3.0 | 1.158 | 0.027 | 0.0098 | 69.9 |

**Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.93%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH A01 | 11 | 68.084 | 0.434 | 28.2 | 0.8538 | 0.0000 | SURCHARGED |
| 15 minute summer | Building A Tank A1 | 12 | 67.887 | 0.437 | 25.1 | 0.4945 | 0.0000 | SURCHARGED |
| 240 minute summer | SWMH A02 | 240 | 67.557 | 0.246 | 8.0 | 0.2778 | 0.0000 | SURCHARGED |
| 15 minute summer | SWMH C01 | 11 | 70.570 | 0.450 | 33.5 | 0.9541 | 0.0000 | SURCHARGED |
| 15 minute summer | Car Park Tank 1 | 13 | 69.938 | 0.088 | 39.3 | 6.6798 | 0.0000 | OK |
| 240 minute summer | Car Park Tank 2 | 240 | 67.557 | 0.375 | 36.6 | 105.7228 | 0.0000 | SURCHARGED |
| 240 minute summer | Flow Control MH A03 | 240 | 67.556 | 0.438 | 3.2 | 0.4954 | 0.0000 | SURCHARGED |
| 240 minute summer | Outfall MH A04 | 240 | 66.976 | 0.026 | 3.0 | 0.0000 | 0.0000 | OK |

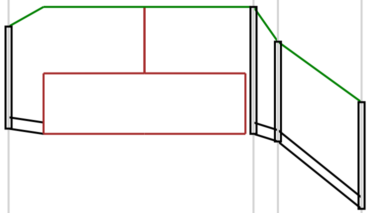
| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH A01 | 2.000 | Building A Tank A1 | 25.1 | 1.426 | 0.855 | 0.1299 | |
| 15 minute summer | Building A Tank A1 | 2.001 | SWMH A02 | 24.4 | 1.388 | 1.382 | 0.2468 | |
| 240 minute summer | SWMH A02 | 2.002 | Car Park Tank 2 | 7.9 | 0.841 | 0.446 | 0.0945 | |
| 15 minute summer | SWMH C01 | 1.000 | Car Park Tank 1 | 31.5 | 2.049 | 1.250 | 0.1910 | |
| 15 minute summer | Car Park Tank 1 | 1.001 | Car Park Tank 2 | 31.9 | 3.058 | 0.607 | 0.3137 | |
| 240 minute summer | Car Park Tank 2 | 1.002 | Flow Control MH A03 | 3.2 | 0.222 | 0.079 | 0.4273 | |
| 240 minute summer | Flow Control MH A03 | 1.003 | Outfall MH A04 | 3.0 | 1.163 | 0.028 | 0.0099 | 72.9 |

## Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.93%

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 240 minute summer | SWMH A01 | 200 | 68.417 | 0.767 | 9.4 | 1.5085 | 0.0000 | SURCHARGED |
| 240 minute summer | Building A Tank A1 | 200 | 68.417 | 0.967 | 9.4 | 1.0936 | 0.0000 | FLOOD RISK |
| 240 minute summer | SWMH A02 | 200 | 68.416 | 1.105 | 9.4 | 1.2501 | 0.0000 | FLOOD RISK |
| 15 minute summer | SWMH C01 | 11 | 70.747 | 0.627 | 39.0 | 1.3312 | 0.0000 | SURCHARGED |
| 15 minute summer | Car Park Tank 1 | 13 | 69.947 | 0.097 | 45.2 | 7.4038 | 0.0000 | OK |
| 240 minute summer | Car Park Tank 2 | 200 | 68.416 | 1.234 | 42.5 | 115.2257 | 0.0000 | FLOOD RISK |
| 240 minute summer | Flow Control MH A03 | 200 | 68.414 | 1.296 | 5.1 | 1.4663 | 0.0000 | FLOOD RISK |
| 240 minute summer | Outfall MH A04 | 204 | 66.983 | 0.033 | 5.1 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 240 minute summer | SWMH A01 | 2.000 | Building A Tank A1 | 9.4 | 1.162 | 0.319 | 0.1299 | |
| 240 minute summer | Building A Tank A1 | 2.001 | SWMH A02 | 9.4 | 0.868 | 0.534 | 0.2468 | |
| 240 minute summer | SWMH A02 | 2.002 | Car Park Tank 2 | 9.0 | 0.841 | 0.506 | 0.0945 | |
| 15 minute summer | SWMH C01 | 1.000 | Car Park Tank 1 | 36.1 | 2.279 | 1.432 | 0.2003 | |
| 15 minute summer | Car Park Tank 1 | 1.001 | Car Park Tank 2 | 37.1 | 3.154 | 0.706 | 0.3535 | |
| 240 minute summer | Car Park Tank 2 | 1.002 | Flow Control MH A03 | 5.1 | 0.222 | 0.129 | 0.4273 | |
| 240 minute summer | Flow Control MH A03 | 1.003 | Outfall MH A04 | 5.1 | 1.341 | 0.046 | 0.0144 | 86.5 |

| Node Name | SWMH B01 | Bu | Flow Control | Tank SWMH B02 B03 |
|---|---|---|---|---|

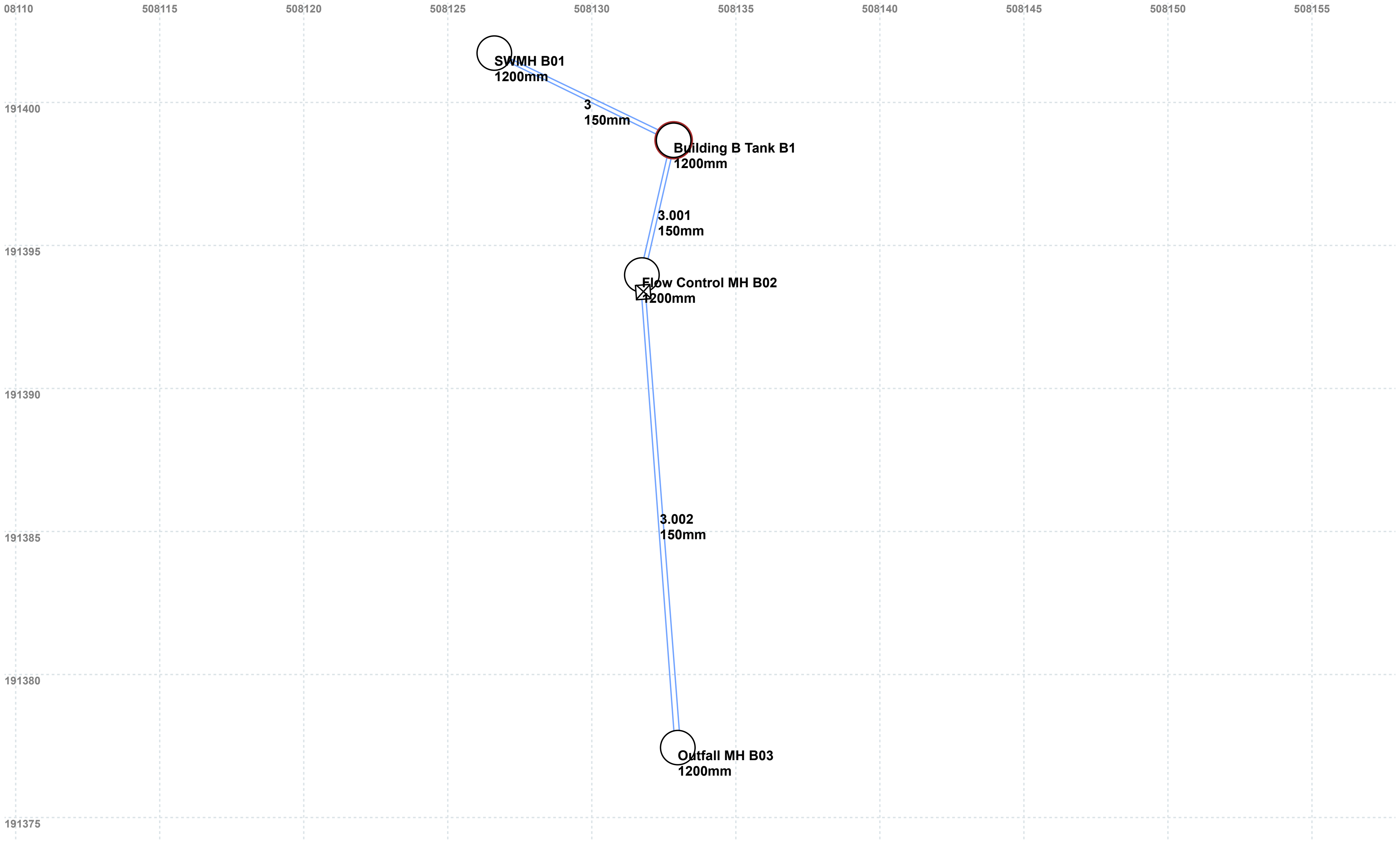


A4 drawing

Hor Scale 1500
Ver Scale 100

Datum (m) 66.000

| | | | | |
|---|---|---|---|---|
| Link Name | 3 | 3.( | 3.002 | |
| Section Type | 15( | 15 | 150mm | |
| Slope (1:X) | 10( | 47 | 18.6 | |
| Cover Level (m) | 73.000 | 73.260 | 72.800 | 72.000 |
| Invert Level (m) | 71.650<br>71.580 | 71.480<br>71.580 | 71.480 | 70.589 |
| Length (m) | 6.9 | 4.{ | 16.570 | |


08110
508115
508120
508125
508130
508135
508140
508145
508150
508155
191400
191395
191390
191385
191380
191375
SWMH B01
1200mm
3
150mm
Building B Tank B1
1200mm
3.001
150mm
Flow Control MH B02
1200mm
3.002
150mm
Outfall MH B03
1200mm

## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FEH-13 | Minimum Velocity (m/s) | 1.00 |
| Return Period (years) | 100 | Connection Type | Level Soffits |
| Additional Flow (%) | 0 | Minimum Backdrop Height (m) | 0.200 |
| CV | 0.750 | Preferred Cover Depth (m) | 1.000 |
| Time of Entry (mins) | 5.00 | Include Intermediate Ground | ✓ |
| Maximum Time of Concentration (mins) | 30.00 | Enforce best practice design rules | ✓ |
| Maximum Rainfall (mm/hr) | 50.0 | | |

## Nodes

| Name | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Easting (m) | Northing (m) | Depth (m) |
|---|---|---|---|---|---|---|---|
| SWMH B01 | 0.046 | 5.00 | 73.000 | 1200 | 508126.616 | 191401.725 | 1.350 |
| Building B Tank B1 | | | 73.260 | 1200 | 508132.841 | 191398.678 | 1.679 |
| Flow Control MH B02 | | | 72.800 | 1200 | 508131.738 | 191393.968 | 1.320 |
| Outfall MH B03 | | | 72.000 | 1200 | 508132.985 | 191377.445 | 1.411 |

## Links

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | SWMH B01 | Building B Tank B1 | 6.931 | 0.600 | 71.650 | 71.581 | 0.069 | 100.4 | 150 | 5.12 | 50.0 |
| 3.001 | Building B Tank B1 | Flow Control MH B02 | 4.837 | 0.600 | 71.581 | 71.480 | 0.101 | 47.9 | 150 | 5.17 | 50.0 |
| 3.002 | Flow Control MH B02 | Outfall MH B03 | 16.570 | 0.600 | 71.480 | 70.589 | 0.891 | 18.6 | 150 | 5.29 | 50.0 |

| Name | Vel (m/s) | Cap (l/s) | Flow (l/s) | US Depth (m) | DS Depth (m) | Σ Area (ha) | Σ Add Inflow (l/s) | Pro Depth (mm) | Pro Velocity (m/s) |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 1.003 | 17.7 | 6.2 | 1.200 | 1.529 | 0.046 | 0.0 | 61 | 0.915 |
| 3.001 | 1.457 | 25.7 | 6.2 | 1.529 | 1.170 | 0.046 | 0.0 | 50 | 1.202 |
| 3.002 | 2.346 | 41.5 | 6.2 | 1.170 | 1.261 | 0.046 | 0.0 | 39 | 1.689 |

## Pipeline Schedule

| Link | Length (m) | Slope (1:X) | Dia (mm) | Link Type | US CL (m) | US IL (m) | US Depth (m) | DS CL (m) | DS IL (m) | DS Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 6.931 | 100.4 | 150 | Circular | 73.000 | 71.650 | 1.200 | 73.260 | 71.581 | 1.529 |
| 3.001 | 4.837 | 47.9 | 150 | Circular | 73.260 | 71.581 | 1.529 | 72.800 | 71.480 | 1.170 |
| 3.002 | 16.570 | 18.6 | 150 | Circular | 72.800 | 71.480 | 1.170 | 72.000 | 70.589 | 1.261 |

| Link | US Node | Dia (mm) | Node Type | MH Type | DS Node | Dia (mm) | Node Type | MH Type |
|---|---|---|---|---|---|---|---|---|
| 3 | SWMH B01 | 1200 | Manhole | Adoptable | Building B Tank B1 | 1200 | Manhole | Adoptable |
| 3.001 | Building B Tank B1 | 1200 | Manhole | Adoptable | Flow Control MH B02 | 1200 | Manhole | Adoptable |
| 3.002 | Flow Control MH B02 | 1200 | Manhole | Adoptable | Outfall MH B03 | 1200 | Manhole | Adoptable |

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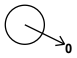
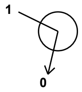
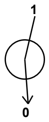
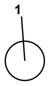
## Manhole Schedule

| Node | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections | | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| SWMH B01 | 508126.616 | 191401.725 | 73.000 | 1.350 | 1200 |  | 0 | 3 | 71.650 | 150 |
| Building B Tank B1 | 508132.841 | 191398.678 | 73.260 | 1.679 | 1200 |  | 1 | 3 | 71.581 | 150 |
| | | | | | | | 0 | 3.001 | 71.581 | 150 |
| Flow Control MH B02 | 508131.738 | 191393.968 | 72.800 | 1.320 | 1200 |  | 1 | 3.001 | 71.480 | 150 |
| | | | | | | | 0 | 3.002 | 71.480 | 150 |
| Outfall MH B03 | 508132.985 | 191377.445 | 72.000 | 1.411 | 1200 |  | 1 | 3.002 | 70.589 | 150 |

## Simulation Settings

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Methodology | FEH-13 | Drain Down Time (mins) | 240 | 30 year (l/s) | 1.0 |
| Summer CV | 0.750 | Additional Storage ($m^3$/ha) | 20.0 | 100 year (l/s) | 1.0 |
| Analysis Speed | Normal | Check Discharge Rate(s) | ✓ | Check Discharge Volume | x |
| Skip Steady State | x | 2 year (l/s) | 1.0 | | |

### Storm Durations

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|
| 2 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 |
| 100 | 20 | 0 | 0 |
| 100 | 40 | 0 | 0 |

## Pre-development Discharge Rate

| | | | |
|---|---|---|---|
| Site Makeup | Greenfield | Growth Factor 30 year | 1.95 |
| Greenfield Method | IH124 | Growth Factor 100 year | 2.48 |
| Positively Drained Area (ha) | | Betterment (%) | 0 |
| SAAR (mm) | | QBar | |
| Soil Index | 1 | Q 1 year (l/s) | |
| SPR | 0.10 | Q 30 year (l/s) | |
| Region | 1 | Q 100 year (l/s) | |
| Growth Factor 1 year | 0.85 | | |

## Node Flow Control MH B02 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 71.480 | Product Number | CTL-SHE-0049-1000-0800-1000 |
| Design Depth (m) | 0.800 | Min Outlet Diameter (m) | 0.075 |
| Design Flow (l/s) | 1.0 | Min Node Diameter (mm) | 1200 |

## Node Building B Tank B1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr) 0.00000
Side Inf Coefficient (m/hr) 0.00000
Safety Factor 2.0
Porosity 1.00
Invert Level (m) 71.581
Time to half empty (mins) 120

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 37.5 | 0.0 | 0.800 | 37.5 | 0.0 | 0.801 | 0.0 | 0.0 |

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## Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol ($m^3$) | Flood ($m^3$) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH B01 | 9 | 71.718 | 0.068 | 6.0 | 0.1230 | 0.0000 | OK |
| 120 minute summer | Building B Tank B1 | 80 | 71.648 | 0.067 | 3.9 | 2.6073 | 0.0000 | OK |
| 180 minute summer | Flow Control MH B02 | 116 | 71.652 | 0.172 | 3.1 | 0.1949 | 0.0000 | SURCHARGED |
| 15 minute summer | Outfall MH B03 | 1 | 70.589 | 0.000 | 0.9 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol ($m^3$) | Discharge Vol ($m^3$) |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | SWMH B01 | 3 | Building B Tank B1 | 6.0 | 1.318 | 0.340 | 0.0347 | |
| 120 minute summer | Building B Tank B1 | 3.001 | Flow Control MH B02 | 2.7 | 0.300 | 0.103 | 0.0612 | |
| 180 minute summer | Flow Control MH B02 | Hydro-Brake® | Outfall MH B03 | 0.9 | | | | 7.3 |

**Results for 30 year Critical Storm Duration.  Lowest mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 120 minute summer | SWMH B01 | 104 | 71.813 | 0.163 | 7.6 | 0.2960 | 0.0000 | SURCHARGED |
| 120 minute summer | Building B Tank B1 | 100 | 71.813 | 0.232 | 7.5 | 8.9655 | 0.0000 | SURCHARGED |
| 120 minute summer | Flow Control MH B02 | 100 | 71.813 | 0.333 | 2.4 | 0.3765 | 0.0000 | SURCHARGED |
| 15 minute summer | Outfall MH B03 | 1 | 70.589 | 0.000 | 0.9 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 120 minute summer | SWMH B01 | 3 | Building B Tank B1 | 7.5 | 0.813 | 0.425 | 0.1220 | |
| 120 minute summer | Building B Tank B1 | 3.001 | Flow Control MH B02 | 2.4 | 0.375 | 0.093 | 0.0852 | |
| 120 minute summer | Flow Control MH B02 | Hydro-Brake® | Outfall MH B03 | 0.9 | | | | 15.0 |

**Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute summer | SWMH B01 | 168 | 71.931 | 0.281 | 7.6 | 0.5089 | 0.0000 | SURCHARGED |
| 180 minute summer | Building B Tank B1 | 168 | 71.931 | 0.350 | 7.3 | 13.5077 | 0.0000 | SURCHARGED |
| 180 minute summer | Flow Control MH B02 | 168 | 71.931 | 0.451 | 3.3 | 0.5095 | 0.0000 | SURCHARGED |
| 15 minute summer | Outfall MH B03 | 1 | 70.589 | 0.000 | 0.9 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 180 minute summer | SWMH B01 | 3 | Building B Tank B1 | 7.3 | 0.780 | 0.411 | 0.1220 | |
| 180 minute summer | Building B Tank B1 | 3.001 | Flow Control MH B02 | 3.3 | 0.373 | 0.129 | 0.0852 | |
| 180 minute summer | Flow Control MH B02 | Hydro-Brake® | Outfall MH B03 | 0.9 | | | | 20.6 |

**Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute summer | SWMH B01 | 176 | 72.027 | 0.377 | 9.1 | 0.6824 | 0.0000 | SURCHARGED |
| 180 minute summer | Building B Tank B1 | 180 | 72.026 | 0.445 | 8.7 | 17.2049 | 0.0000 | SURCHARGED |
| 180 minute summer | Flow Control MH B02 | 180 | 72.026 | 0.546 | 3.1 | 0.6177 | 0.0000 | SURCHARGED |
| 15 minute summer | Outfall MH B03 | 1 | 70.589 | 0.000 | 0.9 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 180 minute summer | SWMH B01 | 3 | Building B Tank B1 | 8.7 | 0.821 | 0.493 | 0.1220 | |
| 180 minute summer | Building B Tank B1 | 3.001 | Flow Control MH B02 | 3.1 | 0.383 | 0.119 | 0.0852 | |
| 180 minute summer | Flow Control MH B02 | Hydro-Brake® | Outfall MH B03 | 0.9 | | | | 20.4 |

**Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute summer | SWMH B01 | 180 | 72.125 | 0.475 | 10.6 | 0.8609 | 0.0000 | SURCHARGED |
| 180 minute summer | Building B Tank B1 | 180 | 72.125 | 0.544 | 10.2 | 21.0083 | 0.0000 | SURCHARGED |
| 180 minute summer | Flow Control MH B02 | 180 | 72.125 | 0.645 | 3.0 | 0.7291 | 0.0000 | SURCHARGED |
| 15 minute summer | Outfall MH B03 | 1 | 70.589 | 0.000 | 0.9 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 180 minute summer | SWMH B01 | 3 | Building B Tank B1 | 10.2 | 0.825 | 0.574 | 0.1220 | |
| 180 minute summer | Building B Tank B1 | 3.001 | Flow Control MH B02 | 3.0 | 0.355 | 0.116 | 0.0852 | |
| 180 minute summer | Flow Control MH B02 | Hydro-Brake® | Outfall MH B03 | 0.9 | | | | 20.7 |

## 1. Project & Site Details

| | |
|---|---|
| Project / Site Name (including sub-catchment / stage / phase where appropriate) | Denville Hall |
| Address & post code | 62 Duck's Hill Rd, London, Northwood HA6 2SB |
| OS Grid ref. (Easting, Northing) | E 508107<br>N 191341 |
| LPA reference (if applicable) | |
| Brief description of proposed work | demolition of no. 48 and no. 60 Ducks Hill Road, a derelict garage and wooden storage unit and the erection of 12 assisted-living units (Class C2) in two separate buildings (Buildings A and B) and proposed ancillary communal space, including café and |
| Total site Area | 8729 m$^2$ |
| Total existing impervious area | 2124 m$^2$ |
| Total proposed impervious area | 3079 m$^2$ |
| Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)? | |
| Existing drainage connection type and location | To surface water sewer |
| Designer Name | C Ariyaratne |
| Designer Position | Director |
| Designer Company | Chathom Limited |

## 2. Proposed Discharge Arrangements

### 2a. Infiltration Feasibility

| | |
|---|---|
| Superficial geology classification | None recorded |
| Bedrock geology classification | Lambeth Group - Clay, Silt and Sand |
| Site infiltration rate | m/s |
| Depth to groundwater level | m below ground level |
| Is infiltration feasible? | No |

### 2b. Drainage Hierarchy

| | *Feasible (Y/N)* | *Proposed (Y/N)* |
|---|---|---|
| 1 store rainwater for later use | N | N |
| 2 use infiltration techniques, such as porous surfaces in non-clay areas | N | N |
| 3 attenuate rainwater in ponds or open water features for gradual release | N | N |
| 4 attenuate rainwater by storing in tanks or sealed water features for gradual release | Y | Y |
| 5 discharge rainwater direct to a watercourse | N | N |
| 6 discharge rainwater to a surface water sewer/drain | Y | Y |
| 7 discharge rainwater to the combined sewer. | N | N |

### 2c. Proposed Discharge Details

| | |
|---|---|
| Proposed discharge location | Surface water sewer located onsite |
| Has the owner/regulator of the discharge location been consulted? | Yes |

## 3. Drainage Strategy

### 3a. Discharge Rates & Required Storage

| | *Greenfield (GF) runoff rate (l/s)* | *Existing discharge rate (l/s)* | *Required storage for GF rate ($m^3$)* | *Proposed discharge rate (l/s)* |
|---|---|---|---|---|
| *Qbar* | 4 | | | |
| *1 in 1* | 3.4 | 36.5 | | 4 |
| *1 in 30* | 9.2 | 91.2 | | 4 |
| *1 in 100* | 12.77 | 134.9 | | 4 |
| *1 in 100 + CC* | | | | 4 |
| *Climate change allowance used* | | 40% | | |

| | |
|---|---|
| 3b. Principal Method of Flow Control | Vortex flow control x 2 |

### 3c. Proposed SuDS Measures

| | *Catchment area ($m^2$)* | *Plan area ($m^3$)* | *Storage vol. ($m^3$)* |
|---|---|---|---|
| Rainwater harvesting | 0 | | 0 |
| Infiltration systems | 0 | | 0 |
| Green roofs | 0 | 0 | 0 |
| Blue roofs | 0 | 0 | 0 |
| Filter strips | 530 | 0 | 0 |
| Filter drains | 0 | 0 | 0 |
| Bioretention / tree pits | 0 | 0 | 0 |
| Pervious pavements | 0 | 0 | 0 |
| Swales | 0 | 0 | 0 |
| Basins/ponds | 0 | 0 | 0 |
| Attenuation tanks | 3549 | | 147 |
| **Total** | **4079** | **0** | **147** |

## 4. Supporting Information

| 4a. Discharge & Drainage Strategy | *Page/section of drainage report* |
|---|---|
| Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results | 2.5 |
| Drainage hierarchy (2b) | 3.6 |
| Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location | 3.7, appendix A |
| Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations | 3.7, appendix C |
| Proposed SuDS measures & specifications (3b) | 3.6, 3.7, appendix C |

| 4b. Other Supporting Details | *Page/section of drainage report* |
|---|---|
| Detailed Development Layout | Appendix B |
| Detailed drainage design drawings, including exceedance flow routes | 3.6, 3.7, appendix C |
| Detailed landscaping plans | Appendix B |
| Maintenance strategy | Appendix D |
| Demonstration of how the proposed SuDS measures improve: | 4 |
| a) water quality of the runoff? | |
| b) biodiversity? | |
| c) amenity? | |

# Appendix D – SuDS Maintenance Plan

As the maintenance of the communal SuDS features will be carried out via a Management Company, the form of agreement should include the required maintenance listed below. Should the maintenance be transferred at a later date to a public body, then the model agreement SuDS MA1 should be used, details of which can be found in the CIRIA guidance C625.

The following section describes the required maintenance for each feature in turn. The SuDS maintenance requirements listed below should be reviewed after the first 5 years, with a view to agreeing a new regime for the ongoing maintenance.

Notwithstanding the routine inspections and maintenance requirements, after severe storm events all features shall be inspected to clear debris and repair damaged structures or features. Records of the maintenance carried out shall be prepared by the Management Company.

## Green Roofs

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Regular inspections | Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability | Annually and after severe storms |
| | Inspect soil substrate for evidence of erosion channels and identify any sediment sources | Annually and after severe storms |
| | Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system | Annually and after severe storms |
| | Inspect underside of roof for evidence of leakage | Annually and after severe storms |
| Regular maintenance | Remove debris and litter to prevent clogging of inlet drains and interference with plant growth | Six monthly and annually or as required |
| | During establishment (i.e. year one), replace dead plants as required | Monthly (but usually responsibility of manufacturer) |
| | Post establishment, replace dead plants as required (where > 5 % of coverage) | Annually (in autumn) |

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| | Remove fallen leaves and debris from deciduous plant foliage | Six monthly or as required |
| | Remove nuisance and invasive vegetation, including weeds | Six monthly or as required |
| | Mow grasses, prune shrubs and manage other planting as required- clippings should be removed and not allowed to accumulate | Six monthly or as required |
| Remedial actions | If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled | As required |
| | If drain inlet has settled, cracked or moved, investigate and repair as appropriate | As required |

Swales

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Regular maintenance | Remove litter and debris | Monthly, or as required |
| | Cut grass- to retain grass height within specified design range | Monthly (during growing season), or as required |
| | Manage other vegetation and remove nuisance plants | Monthly at start, then as required |
| | Inspect inlets, outlets and overflows for blockages, and clear if required | Monthly |
| | Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours | Monthly or when required |
| | Inspect vegetation coverage | Monthly for 6 months, quarterly for 2 years, then half yearly |
| | Inspection inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies | Half yearly |

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Occasional maintenance | Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required | As required or if bare soil is exposed over 10 % or more of the swale treatment area |
| Remedial actions | Repair erosion or other damage by re-turfing or reseeding | As required |
| | Relevel uneven surfaces and reinstate design level | As required |
| | Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of soil surface | As required |
| | Remove build up of sediment on upstream gravel trench, flow spreader or at top of filter strip | As required |
| | Remove and dispose of oils or petrol residues using safe standard practices | As required |

Bioretention Systems

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Regular inspections | Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary | Quarterly |
| | Check operation of underdrains by inspection of flows are rain | Annually |
| | Assess plants for disease infection, poor growth, invasive species etc and replace as necessary | Quarterly |
| | Inspect inlets and outlets for blockage | Quarterly |
| Regular maintenance | Remove litter and surface debris and weeds | Quarterly |
| | Replace any plants, to maintain planting density | As required |
| | Remove sediment, litter and debris build up from around inlets or from forebays | Quarterly to biannually |

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Occasional maintenance | Infill any holes or scour in the filter medium, improve erosion protection if required | As required |
| | Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch | As required |
| Remedial actions | Remove and replace filter medium and vegetation above | As required but likely to be > 20 years |

Filter Drains

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Regular maintenance | Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices | Monthly or as required |
| | Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage | Monthly |
| | Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies | Six monthly |
| | Remove sediment from pre-treatment devices | Six monthly or as required |
| Occasional maintenance | Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g. NJUG, 2007 or BS 398:2010 | As required |
| | At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium | Five yearly or as required |
| | Clear, perforated pipework of blockages | As required |

Storage Tanks

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Regular maintenance | Inspect and identify any areas that are not operating correctly. If required, take remedial action | Monthly for 3 months, the annually |
| | Remove debris from the catchment surface (where it may cause risks to performance) | Monthly |
| | For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary | Annually |
| | Remove sediment from pre-treatment structures and/or internal forebays | Annually, or as required |
| Remedial actions | Repair/rehabilitate inlets, outlet, overflows and vents | As required |
| Monitoring | Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed | Annually |
| | Survey inside of tank for sediment build-up and remove if necessary | Every 5 years or as required |

Permeable Paving

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| Regular maintenance | Brushing and vacuuming (standard cosmetic sweep over whole surface) | Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment |
| Occasional maintenance | Stabilise and mow contributing and adjacent areas | As required |

| Maintenance schedule | Required action | Typical frequency |
|---|---|---|
| | Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying | As required – once per year on less frequently used pavements |
| Remedial Actions | Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving | As required |
| | Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material | As required |
| | Rehabilitation of surface and upper substructure by remedial sweeping | Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging) |
| Monitoring | Initial inspection | Monthly for three months after installation |
| | Inspect for evidence of poor operation and/or weed growth – if required, take remedial action | Three monthly 48 h after large storms in first six months |
| | Inspect silt accumulation rates and establish appropriate brushing frequencies | Annually |
| | Monitor inspection chambers | Annually |

Other Drainage items

| Product Type | Period | Responsibility | Maintenance Methods |
|---|---|---|---|
| Standard Manholes/ Inspection Chambers | As necessary | Owner/ Maintenance Company | Remove and clean any soil and vegetation that covers the manhole cover to prevent blockage of the drainage system at the manhole.<br>Renew/replace any damaged/missing bolts and damaged/missing manhole covers |
| Drainage pipes | Six monthly intervals | Owner/ Maintenance Company | Inspect underground drainage pipes to ensure that the distribution pipework arrangement is operational and free from blockages. If required, take remedial action |
| Flow control | Annually | Maintenance Company for communal areas | Renew any missing/broken items<br>Cleaning out<br>Check outlet spigot |