# PERCOLATION TEST REPORT & SOAKAWAY SIZING

**BOUD MINERALS**

**PROPOSED STORE BUILDING & YARD,**

**WEST BANK, SUTTON BRIDGE,**

**SPALDING, LINCOLNSHIRE, PE12 9UR**

**PROJECT No: SW23-115**

**DOCUMENT REF: SW23-115-REP-01**




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# 1. INTRODUCTION

Acting upon the instruction of Boud Minerals, we attended site on 20th December 2022, the purpose being to observe the underlying ground conditions and determine the percolation characteristics and infiltration rates of the soil strata.

Percolation tests were undertaken in accordance with the method described within BRE digest 365 (2007 edition)

The opinions and comments expressed within this report are based upon ground conditions encountered in the trial pits excavated at the time of our visit.

This report has been prepared for the named client above and should not be relied upon by any other parties, except for the client's professional advisors, for any use without the express written permission of **SHIELDS WILSON LIMITED**


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# 2. LOCATION & DESCRIPTION OF SITE

## 2.1. Site Location

The site is situated to the West of West Bank Road, Sutton Bridge, where currently lie some buildings and sheds. Appropriate national grid reference TF483218.

A photo of the site location from google maps is contained withing Appendix A.

## 2.2. Site Description

The site currently contains a golf course which contains some buildings & sheds which are to be demolished once construction begins.

The North of the site will be bound by the boundary of Azelis UK Industrial Chemicals.

The Eastern Boundary is boarded by West Bank Road.

The Western boundaries of the will be bound by the Sutton Bridge Golf Club.

The South boundary is bound by an existing store which is owned by the client.

## 2.3. Geological Description

Desktop study of the area has been undertaken using the British Geological Society Maps.

The maps indicate the site to be underlain by tidal flat deposits of clay & silt.

This information is based upon publicly available records. An extract is contained with Appendix B.


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## 3. BOREHOLE EXCAVATIONS

One No. boreholes were dug to test the ground soil conditions. The excavations show a layer of topsoil followed by silt down to 1.8m.

The strata is in-line with the desktop study. Being silty makes ground infiltration a possible method for draining surface water.

Bore Hole logs, a location plan showing both TP01 and SA01 and a photo of the hole can be found in Appendix C.

## 4. PERCOLATION TESTS

One No. percolation test was undertaken on the proposed site.

Logs of the test and subsequent result calculations are contained within Appendix D.

## 5. INFILTRATION TEST RESULTS

Results are summarised and tabulated below.

| Test Pit | Test 1 | Test 2 |
|---|---|---|
| SA01 | $2.42 \times 10^{-5}$ m/s | $1.78 \times 10^{-5}$ m/s |

The results are above average for infiltration in the South Holland area and demonstrate that the underlying geology on the site is suitable for infiltration.

## 6. SOAKAWAY DESIGN

From the infiltration testing results the worst established infiltration rate will be utilised for design purposes, $1.78 \times 10^{-5}$ m/s.

To ensure compliance with current regulations and NPPF guidance the soakaway system has been sized to accommodate a 1 in 100-year storm + 20% climate change.

The system has been sized using Causeway Flow Hydraulic modelling software where a basic model has been analysed to demonstrate the larges drained area (Roof catchment, 2987m²) can be wholly accommodated below ground by the associated soakaway feature.

As recommended within CIRIA SUDS manual for a large drained area, with low flooding consequences, a Factor of Safety of 3.0 has been utilised for design.

The modelling calculation output is within Appendix E.


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## 7. DISCUSSIONS

The ground conditions encountered on site, and percolation test results indicate that the site is suitable for the use of infiltration drainage techniques for disposal of run-off water.

Designs of infiltration features and soakaways are based upon the worst-case calculated infiltration rate of $1.78 \times 10^{-5}$ m/s.

The method of surface water discharge, infiltration on site, is at the top of the SUDs hierarchy to current Building Regulations Approved Document Part H & CIRIA SUDS manual guidance. Findings and calculations contained within this report are therefore considered to demonstrate suitable methods of draining and storing surface water which will be utilised for the proposed development in line with the NPPF & local planning policies.

For and on behalf of **SHIELDS WILSON LIMITED**

**Max Barlow, Engineering Technician** **10th March 2023**.

**Checked by A.P.Wilson CEng MIStructE**


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# APPENDIX A


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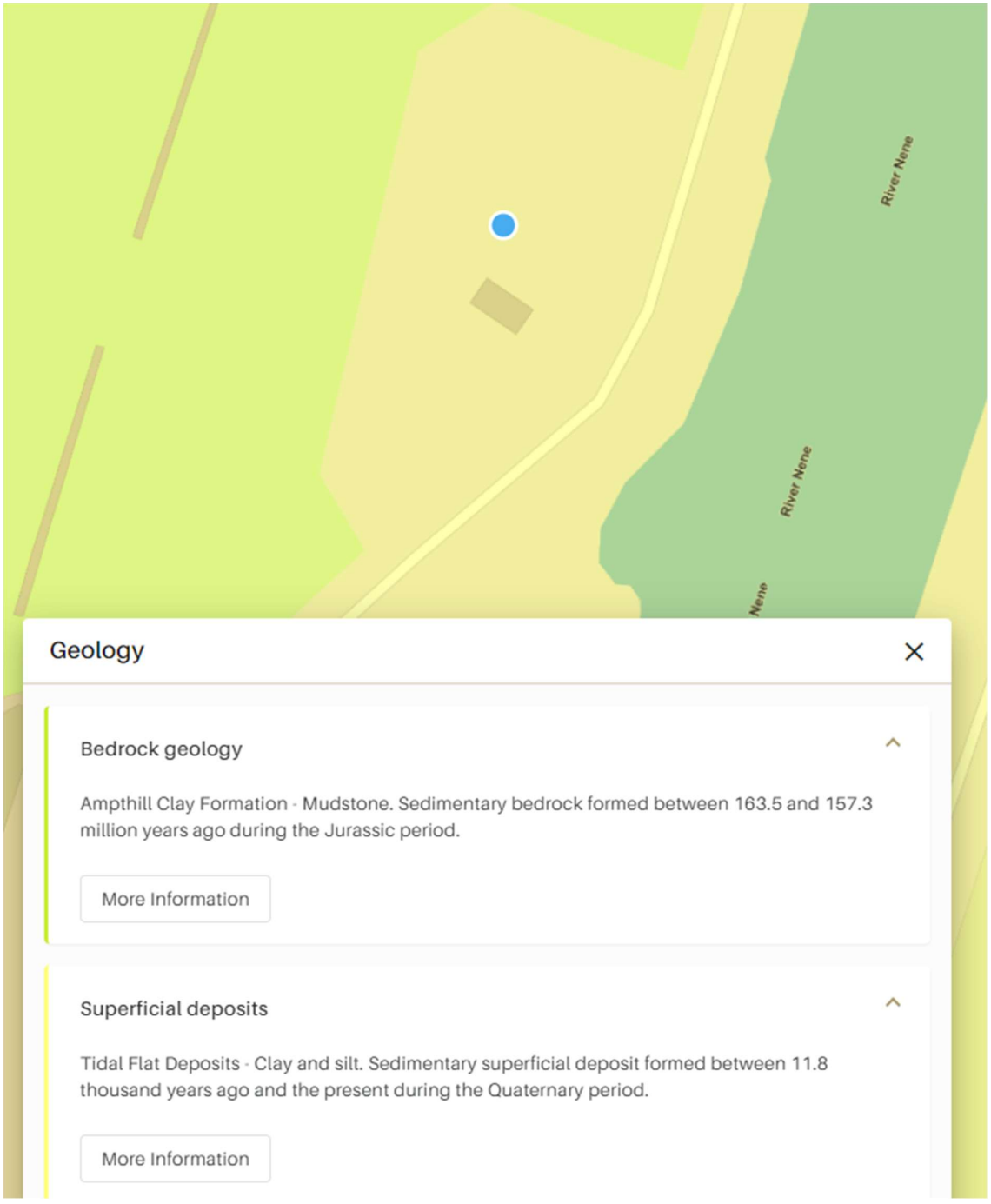




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# APPENDIX B


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Extract British Geological Society Maps – Bedrock Geology & Superficial deposits


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# APPENDIX C


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| | | | | | |
|---|---|---|---|---|---|
| SHIELDS WILSON e: info@shieldswilson.co.uk t: 01775 729252 STRUCTURAL AND CIVIL ENGINEERING | DATE | MAR' 23. | SCALE @A4 1:2000 | DRAWING NO. SW23-115-SK100 | REV. - |
| | DRAWN | MRB | | | |
| PROJECT: PROPOSED STORE BUILDING & YARD, WEST BANK, SUTTON BRIDGE | TITLE: SOAKAWAY & TRIAL PIT LOCATION PLAN | | | | |
| CLIENT: BOUD MINERALS | STATUS: FOR INFORMATION | | | | |

| REV. | DESCRIPTION | DRN. | APP. | DATE |
|---|---|---|---|---|
| - | PRELIMINARY - FOR APPROVAL | MRB | APW | 22.03.23 |




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| LOGGED BY | JL | JOB NO. | SW23-115 | TP01 |
|---|---|---|---|---|
| DRAWN BY | MRB | DATE OF TESTING | 20/12/22 | |

| | |
|---|---|
| PROJECT: PROPOSED STORE BUILDING & YARD<br>WEST BANK, SUTTON BRIDGE | SITE COORDINATES: TF483218 |
| | GROUND LEVEL: 5.500 APPROX. |
| CLIENT: BOUD MINERALS | EXCAVATION METHOD: HAND AUGER |

| DESCRIPTION | REDUCED LEVEL | LEGEND | (THICK) DEPTH | SAMPLE REF. | TEST REQUIRED | MACKINTOSH PROBE | HAND SHEAR VANE |
|---|---|---|---|---|---|---|---|
| TOP SOIL WITH RUBBLE | | | 0.3m | | | | |
| BROWNEY GREY FIRM CLAY WITH GRAVELY SAND INCLUSIONS | | | (1.5m)<br>1.8m | | | | |

REMARKS: TRIAL PIT TERMINATED @ 1.8m

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# APPENDIX D


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**PROPOSED STORE BUILDING & YARD, WEST BANK, SUTTON BRIDGE**

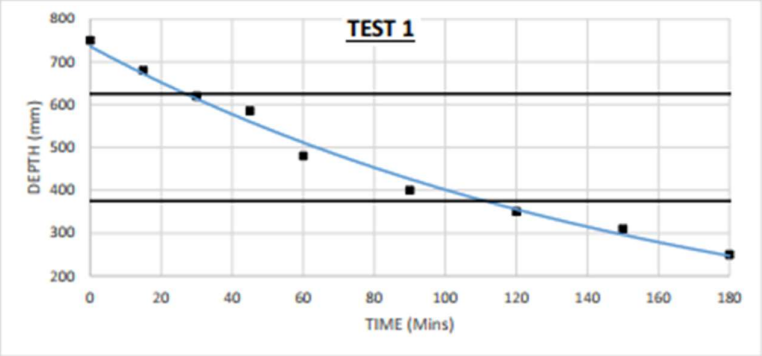
| SA01 | TEST 1 | TEST 2 |
|---|---|---|
| TIME (Mins) | DEPTH mm (d) | DEPTH mm (d) |
| 0 | 750 | 750 |
| 15 | 680 | 740 |
| 30 | 620 | 720 |
| 45 | 585 | 695 |
| 60 | 480 | 670 |
| 90 | 400 | 610 |
| 120 | 350 | 550 |
| 150 | 310 | 505 |
| 180 | 250 | 460 |
| | | |
| | | |

**INFILTRATION TEST - HOLE SA01**

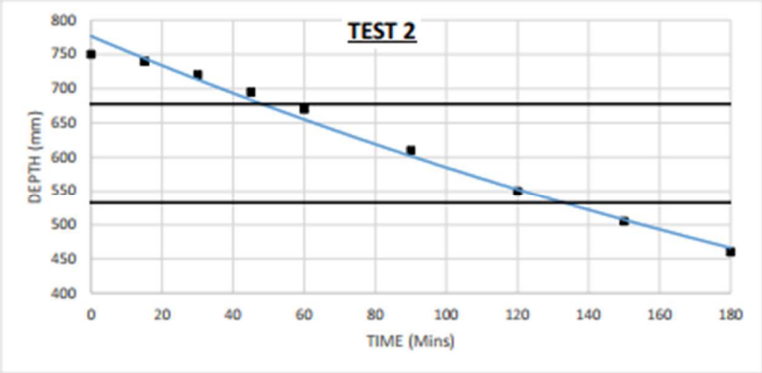
**PROJECT NO.** 23-115

**SITE VISIT:** 20/12/2022

| TRIAL PIT DIMENSIONS (m) | |
|---|---|
| A [L] | 1.60 |
| B [W] | 0.70 |
| C [D] | 1.00 |




| SOIL INFILTRATION RATE, f |
|---|
| TEST 1 |
| 2.41859E-05 m/s |
| 0.087069189 m/h |




| SOIL INFILTRATION RATE, f |
|---|
| TEST 2 |
| 1.78193E-05 m/s |
| 0.064149577 m/h |


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# APPENDIX E


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## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Maximum Time of Concentration (mins) | 30.00 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 50.0 |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 |
| FSR Region | England and Wales | Connection Type | Level Soffits |
| M5-60 (mm) | 20.000 | Minimum Backdrop Height (m) | 0.200 |
| Ratio-R | 0.400 | Preferred Cover Depth (m) | 1.200 |
| CV | 0.750 | Include Intermediate Ground | ✓ |
| Time of Entry (mins) | 5.00 | Enforce best practice design rules | ✓ |

## Nodes

| Name | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Depth (m) |
|---|---|---|---|---|---|
| Top | 0.000 | 5.00 | 5.400 | 1 | 0.975 |
| Soakaway | 0.300 | | 5.400 | 1 | 1.075 |

## 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | Top | Soakaway | 10.000 | 0.600 | 4.425 | 4.325 | 0.100 | 100.0 | 150 | 5.17 | 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) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 1.005 | 17.8 | 0.0 | 0.825 | 0.925 | 0.000 | 0.0 | 0 | 0.000 |

## 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 10.000 | 100.0 | 150 | Circular | 5.400 | 4.425 | 0.825 | 5.400 | 4.325 | 0.925 |

| Link | US Node | Dia (mm) | Node Type | MH Type | DS Node | Dia (mm) | Node Type | MH Type |
|---|---|---|---|---|---|---|---|---|
| 1.000 | Top | 1 | Manhole | Adoptable | Soakaway | 1 | Manhole | Adoptable |

## Manhole Schedule

| Node | CL (m) | Depth (m) | Dia (mm) | Connections | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|
| Top | 5.400 | 0.975 | 1 | ○ | | | |
| | | | | 0 | 1.000 | 4.425 | 150 |
| Soakaway | 5.400 | 1.075 | 1 | 1 | 1.000 | 4.325 | 150 |
| | | | | ○ | | | |

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**Simulation Settings**

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Analysis Speed | Normal |
| FSR Region | England and Wales | Skip Steady State | x |
| M5-60 (mm) | 20.000 | Drain Down Time (mins) | 240 |
| Ratio-R | 0.400 | Additional Storage (m³/ha) | 20.0 |
| Summer CV | 0.750 | Check Discharge Rate(s) | x |
| Winter CV | 0.840 | Check Discharge Volume | x |

**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 %) |
|---|---|---|---|
| 30 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 |
| 100 | 20 | 0 | 0 |

**Node Soakaway Soakaway Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.06410 | Invert Level (m) | 4.325 | Depth (m) | 0.420 |
| Side Inf Coefficient (m/hr) | 0.06410 | Time to half empty (mins) | 448 | Inf Depth (m) | |
| Safety Factor | 3.0 | Pit Width (m) | 2.000 | Number Required | 9 |
| Porosity | 0.94 | Pit Length (m) | 15.000 | | |

**Node Soakaway Soakaway Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.06410 | Invert Level (m) | 4.325 | Depth (m) | 0.420 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) | 177 | Inf Depth (m) | |
| Safety Factor | 3.0 | Pit Width (m) | 2.000 | Number Required | 9 |
| Porosity | 0.30 | Pit Length (m) | 15.000 | | |

**Other (defaults)**

| | | | | | |
|---|---|---|---|---|---|
| Entry Loss (manhole) | 0.250 | Entry Loss (junction) | 0.000 | Apply Recommended Losses | x |
| Exit Loss (manhole) | 0.250 | Exit Loss (junction) | 0.000 | Flood Risk (m) | 0.300 |

**Approval Settings**

| | | | |
|---|---|---|---|
| Node Size | ✓ | Minimum Full Bore Velocity (m/s) | |
| Node Losses | ✓ | Maximum Full Bore Velocity (m/s) | 3.000 |
| Link Size | ✓ | Proportional Velocity | ✓ |
| Minimum Diameter (mm) | 150 | Return Period (years) | |
| Link Length | ✓ | Minimum Proportional Velocity (m/s) | 0.750 |
| Maximum Length (m) | 100.000 | Maximum Proportional Velocity (m/s) | 3.000 |
| Coordinates | ✓ | Surcharged Depth | ✓ |
| Accuracy (m) | 1.000 | Return Period (years) | |
| Crossings | ✓ | Maximum Surcharged Depth (m) | 0.100 |
| Cover Depth | ✓ | Flooding | ✓ |
| Minimum Cover Depth (m) | | Return Period (years) | 30 |
| Maximum Cover Depth (m) | 3.000 | Time to Half Empty | x |
| Backdrops | ✓ | Discharge Rates | ✓ |
| Minimum Backdrop Height (m) | | Discharge Volume | ✓ |
| Maximum Backdrop Height (m) | 1.500 | 100 year 360 minute (m³) | |
| Full Bore Velocity | ✓ | | |

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|---|---|---|---|

**Rainfall**

| Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) | Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) |
|---|---|---|---|---|---|
| 30 year 15 minute summer | 268.706 | 76.035 | 100 year 360 minute summer | 40.484 | 10.418 |
| 30 year 15 minute winter | 188.566 | 76.035 | 100 year 360 minute winter | 26.315 | 10.418 |
| 30 year 30 minute summer | 174.929 | 49.499 | 100 year 480 minute summer | 31.414 | 8.302 |
| 30 year 30 minute winter | 122.757 | 49.499 | 100 year 480 minute winter | 20.871 | 8.302 |
| 30 year 60 minute summer | 116.589 | 30.811 | 100 year 600 minute summer | 25.431 | 6.956 |
| 30 year 60 minute winter | 77.459 | 30.811 | 100 year 600 minute winter | 17.376 | 6.956 |
| 30 year 120 minute summer | 70.438 | 18.615 | 100 year 720 minute summer | 22.452 | 6.017 |
| 30 year 120 minute winter | 46.797 | 18.615 | 100 year 720 minute winter | 15.089 | 6.017 |
| 30 year 180 minute summer | 53.298 | 13.715 | 100 year 960 minute summer | 18.166 | 4.784 |
| 30 year 180 minute winter | 34.645 | 13.715 | 100 year 960 minute winter | 12.033 | 4.784 |
| 30 year 240 minute summer | 41.604 | 10.995 | 100 year 1440 minute summer | 12.896 | 3.456 |
| 30 year 240 minute winter | 27.641 | 10.995 | 100 year 1440 minute winter | 8.667 | 3.456 |
| 30 year 360 minute summer | 31.221 | 8.034 | 100 year +20% CC 15 minute summer | 418.486 | 118.417 |
| 30 year 360 minute winter | 20.295 | 8.034 | 100 year +20% CC 15 minute winter | 293.674 | 118.417 |
| 30 year 480 minute summer | 24.324 | 6.428 | 100 year +20% CC 30 minute summer | 274.758 | 77.747 |
| 30 year 480 minute winter | 16.160 | 6.428 | 100 year +20% CC 30 minute winter | 192.813 | 77.747 |
| 30 year 600 minute summer | 19.756 | 5.404 | 100 year +20% CC 60 minute summer | 183.946 | 48.611 |
| 30 year 600 minute winter | 13.498 | 5.404 | 100 year +20% CC 60 minute winter | 122.209 | 48.611 |
| 30 year 720 minute summer | 17.490 | 4.687 | 100 year +20% CC 120 minute summer | 111.074 | 29.354 |
| 30 year 720 minute winter | 11.754 | 4.687 | 100 year +20% CC 120 minute winter | 73.795 | 29.354 |
| 30 year 960 minute summer | 14.215 | 3.743 | 100 year +20% CC 180 minute summer | 83.767 | 21.556 |
| 30 year 960 minute winter | 9.416 | 3.743 | 100 year +20% CC 180 minute winter | 54.451 | 21.556 |
| 30 year 1440 minute summer | 10.161 | 2.723 | 100 year +20% CC 240 minute summer | 65.123 | 17.210 |
| 30 year 1440 minute winter | 6.829 | 2.723 | 100 year +20% CC 240 minute winter | 43.266 | 17.210 |
| 100 year 15 minute summer | 348.738 | 98.681 | 100 year +20% CC 360 minute summer | 48.580 | 12.501 |
| 100 year 15 minute winter | 244.728 | 98.681 | 100 year +20% CC 360 minute winter | 31.578 | 12.501 |
| 100 year 30 minute summer | 228.965 | 64.789 | 100 year +20% CC 480 minute summer | 37.697 | 9.962 |
| 100 year 30 minute winter | 160.677 | 64.789 | 100 year +20% CC 480 minute winter | 25.045 | 9.962 |
| 100 year 60 minute summer | 153.288 | 40.510 | 100 year +20% CC 600 minute summer | 30.518 | 8.347 |
| 100 year 60 minute winter | 101.841 | 40.510 | 100 year +20% CC 600 minute winter | 20.851 | 8.347 |
| 100 year 120 minute summer | 92.562 | 24.461 | 100 year +20% CC 720 minute summer | 26.943 | 7.221 |
| 100 year 120 minute winter | 61.496 | 24.461 | 100 year +20% CC 720 minute winter | 18.107 | 7.221 |
| 100 year 180 minute summer | 69.806 | 17.964 | 100 year +20% CC 960 minute summer | 21.799 | 5.740 |
| 100 year 180 minute winter | 45.376 | 17.964 | 100 year +20% CC 960 minute winter | 14.440 | 5.740 |
| 100 year 240 minute summer | 54.269 | 14.342 | 100 year +20% CC 1440 minute summer | 15.476 | 4.148 |
| 100 year 240 minute winter | 36.055 | 14.342 | 100 year +20% CC 1440 minute winter | 10.401 | 4.148 |

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**Results for 30 year Critical Storm Duration. Lowest mass balance: 99.91%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute winter | Top | 172 | 4.545 | 0.120 | 0.1 | 0.0000 | 0.0000 | OK |
| 180 minute winter | Soakaway | 172 | 4.545 | 0.220 | 23.9 | 75.0142 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) |
|---|---|---|---|---|---|---|---|
| 180 minute winter | Top | 1.000 | Soakaway | -0.1 | -0.014 | -0.006 | 0.1638 |
| 180 minute winter | Soakaway | Infiltration | | 2.0 | | | |
| 180 minute winter | Soakaway | Infiltration | | 1.6 | | | |

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**Results for 100 year Critical Storm Duration. Lowest mass balance: 99.91%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute winter | Top | 176 | 4.633 | 0.208 | 0.1 | 0.0000 | 0.0000 | SURCHARGED |
| 180 minute winter | Soakaway | 176 | 4.633 | 0.308 | 31.3 | 104.6998 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) |
|---|---|---|---|---|---|---|---|
| 180 minute winter | Top | 1.000 | Soakaway | -0.1 | -0.016 | -0.008 | 0.1760 |
| 180 minute winter | Soakaway | Infiltration | | 2.2 | | | |
| 180 minute winter | Soakaway | Infiltration | | 1.6 | | | |

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**Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.91%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 240 minute winter | Top | 232 | 4.707 | 0.282 | 0.1 | 0.0000 | 0.0000 | SURCHARGED |
| 240 minute winter | Soakaway | 232 | 4.707 | 0.382 | 30.3 | 130.1589 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) |
|---|---|---|---|---|---|---|---|
| 240 minute winter | Top | 1.000 | Soakaway | -0.1 | -0.013 | -0.007 | 0.1760 |
| 240 minute winter | Soakaway | Infiltration | | 2.3 | | | |
| 240 minute winter | Soakaway | Infiltration | | 1.6 | | | |

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