



# **SHARPE-TOPPING**

STRUCTURAL ENGINEERS

## **Drainage Storage Calculations**

**Roughbitchworth Lane**

**Oxspring**

**For**

**Yorkshire Land Ltd**

**Project No. 14088**

**June 2014**

**Tel (01423) 522293**

info@sharpe-topping.com

Windsor House | Cornwall Road  
Harrogate | HG1 2PW

**www.sharpe-topping.com**

|                                                         |                                |                                                                                     |
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| Sharpe Topping Ltd                                      |                                | Page 1                                                                              |
| Windsor House<br>Cornwall Road<br>Harrogate HG1 2PW     |                                |  |
| Date 13/06/2014 17:07<br>File lin100 + 30% climate.srcx | Designed by Paul<br>Checked by |                                                                                     |
| Micro Drainage                                          |                                | Source Control 2014.1.1                                                             |

IH 124 Mean Annual Flood

Input

|                       |        |               |          |
|-----------------------|--------|---------------|----------|
| Return Period (years) | 100    | Soil          | 0.500    |
| Area (ha)             | 50.000 | Urban         | 0.000    |
| SAAR (mm)             | 1133   | Region Number | Region 3 |

Results      l/s

QBAR Rural    485.0  
QBAR Urban    485.0

Q100 years    1008.8

Q1 year        417.1  
Q2 years       457.6  
Q5 years       606.2  
Q10 years      703.2  
Q20 years      796.4  
Q25 years      827.4  
Q30 years      852.5  
Q50 years      918.5  
Q100 years     1008.8  
Q200 years     1144.5  
Q250 years     1188.2  
Q1000 years    1474.3

QBAR FOR 50 Ha = 485 L/SEC.

SITE MEASURES 0.519 Ha,

INTERPOLATED RUN OFF = 5.03 L/SEC.

|                                                     |                                  |                                                                                     |
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| Date June 2014                                      | Designed by PB                   |                                                                                     |
| File lin100 + 30% climate.srcx                      | Checked by                       |                                                                                     |
| Micro Drainage                                      |                                  | Source Control 2014.1.1                                                             |

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 125 minutes.

| Storm<br>Event   | Max<br>Level<br>(m) | Max<br>Depth<br>(m) | Max<br>Infiltration<br>(l/s) | Max<br>Control<br>(l/s) | Max<br>Σ Outflow<br>(l/s) | Max<br>Volume<br>(m³) | Status |
|------------------|---------------------|---------------------|------------------------------|-------------------------|---------------------------|-----------------------|--------|
| 15 min Summer    | 174.150             | 0.400               | 0.0                          | 4.0                     | 4.0                       | 29.6                  | O K    |
| 30 min Summer    | 174.285             | 0.535               | 0.0                          | 4.0                     | 4.0                       | 39.7                  | O K    |
| 60 min Summer    | 174.405             | 0.655               | 0.0                          | 4.1                     | 4.1                       | 48.5                  | O K    |
| 120 min Summer   | 174.468             | 0.718               | 0.0                          | 4.2                     | 4.2                       | 53.2                  | O K    |
| 180 min Summer   | 174.474             | 0.724               | 0.0                          | 4.2                     | 4.2                       | 53.6                  | O K    |
| 240 min Summer   | 174.463             | 0.713               | 0.0                          | 4.2                     | 4.2                       | 52.8                  | O K    |
| 360 min Summer   | 174.430             | 0.680               | 0.0                          | 4.1                     | 4.1                       | 50.4                  | O K    |
| 480 min Summer   | 174.391             | 0.641               | 0.0                          | 4.0                     | 4.0                       | 47.5                  | O K    |
| 600 min Summer   | 174.351             | 0.601               | 0.0                          | 4.0                     | 4.0                       | 44.5                  | O K    |
| 720 min Summer   | 174.310             | 0.560               | 0.0                          | 4.0                     | 4.0                       | 41.5                  | O K    |
| 960 min Summer   | 174.230             | 0.480               | 0.0                          | 4.0                     | 4.0                       | 35.6                  | O K    |
| 1440 min Summer  | 174.077             | 0.327               | 0.0                          | 4.0                     | 4.0                       | 24.2                  | O K    |
| 2160 min Summer  | 173.935             | 0.185               | 0.0                          | 4.0                     | 4.0                       | 13.7                  | O K    |
| 2880 min Summer  | 173.885             | 0.135               | 0.0                          | 3.6                     | 3.6                       | 10.0                  | O K    |
| 4320 min Summer  | 173.851             | 0.101               | 0.0                          | 2.8                     | 2.8                       | 7.4                   | O K    |
| 5760 min Summer  | 173.834             | 0.084               | 0.0                          | 2.2                     | 2.2                       | 6.2                   | O K    |
| 7200 min Summer  | 173.824             | 0.074               | 0.0                          | 1.9                     | 1.9                       | 5.4                   | O K    |
| 8640 min Summer  | 173.816             | 0.066               | 0.0                          | 1.6                     | 1.6                       | 4.9                   | O K    |
| 10080 min Summer | 173.811             | 0.061               | 0.0                          | 1.5                     | 1.5                       | 4.5                   | O K    |
| 15 min Winter    | 174.202             | 0.452               | 0.0                          | 4.0                     | 4.0                       | 33.5                  | O K    |

| Storm<br>Event   | Rain<br>(mm/hr) | Flooded<br>Volume<br>(m³) | Discharge<br>Volume<br>(m³) | Time-Peak<br>(mins) |
|------------------|-----------------|---------------------------|-----------------------------|---------------------|
| 15 min Summer    | 113.993         | 0.0                       | 33.3                        | 24                  |
| 30 min Summer    | 78.041          | 0.0                       | 45.6                        | 37                  |
| 60 min Summer    | 51.031          | 0.0                       | 59.7                        | 64                  |
| 120 min Summer   | 32.151          | 0.0                       | 75.2                        | 108                 |
| 180 min Summer   | 24.110          | 0.0                       | 84.6                        | 140                 |
| 240 min Summer   | 19.515          | 0.0                       | 91.3                        | 174                 |
| 360 min Summer   | 14.501          | 0.0                       | 101.8                       | 244                 |
| 480 min Summer   | 11.724          | 0.0                       | 109.7                       | 312                 |
| 600 min Summer   | 9.932           | 0.0                       | 116.2                       | 382                 |
| 720 min Summer   | 8.668           | 0.0                       | 121.7                       | 448                 |
| 960 min Summer   | 6.984           | 0.0                       | 130.7                       | 580                 |
| 1440 min Summer  | 5.139           | 0.0                       | 144.2                       | 824                 |
| 2160 min Summer  | 3.772           | 0.0                       | 158.8                       | 1148                |
| 2880 min Summer  | 3.023           | 0.0                       | 169.8                       | 1480                |
| 4320 min Summer  | 2.209           | 0.0                       | 186.0                       | 2204                |
| 5760 min Summer  | 1.770           | 0.0                       | 198.8                       | 2936                |
| 7200 min Summer  | 1.491           | 0.0                       | 209.4                       | 3672                |
| 8640 min Summer  | 1.297           | 0.0                       | 218.4                       | 4400                |
| 10080 min Summer | 1.152           | 0.0                       | 226.4                       | 5120                |
| 15 min Winter    | 113.993         | 0.0                       | 37.3                        | 24                  |

|                                                     |                                  |                                                                                     |
|-----------------------------------------------------|----------------------------------|-------------------------------------------------------------------------------------|
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| Windsor House<br>Cornwall Road<br>Harrogate HG1 2PW | Roughbitchworth Lane<br>Oxspring |  |
| Date June 2014                                      | Designed by PB                   |                                                                                     |
| File lin100 + 30% climate.srcx                      | Checked by                       |                                                                                     |
| Micro Drainage                                      |                                  | Source Control 2014.1.1                                                             |

Summary of Results for 100 year Return Period (+30%)

| Storm Event      | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|------------------|---------------|---------------|------------------------|-------------------|---------------------|-----------------|--------|
| 30 min Winter    | 174.356       | 0.606         | 0.0                    | 4.0               | 4.0                 | 44.9            | O K    |
| 60 min Winter    | 174.495       | 0.745         | 0.0                    | 4.3               | 4.3                 | 55.2            | O K    |
| 120 min Winter   | 174.586       | 0.836         | 0.0                    | 4.5               | 4.5                 | 61.1            | O K    |
| 180 min Winter   | 174.593       | 0.843         | 0.0                    | 4.5               | 4.5                 | 61.3            | O K    |
| 240 min Winter   | 174.562       | 0.812         | 0.0                    | 4.5               | 4.5                 | 60.1            | O K    |
| 360 min Winter   | 174.510       | 0.760         | 0.0                    | 4.3               | 4.3                 | 56.3            | O K    |
| 480 min Winter   | 174.449       | 0.699         | 0.0                    | 4.2               | 4.2                 | 51.8            | O K    |
| 600 min Winter   | 174.386       | 0.636         | 0.0                    | 4.0               | 4.0                 | 47.1            | O K    |
| 720 min Winter   | 174.323       | 0.573         | 0.0                    | 4.0               | 4.0                 | 42.5            | O K    |
| 960 min Winter   | 174.196       | 0.446         | 0.0                    | 4.0               | 4.0                 | 33.1            | O K    |
| 1440 min Winter  | 173.968       | 0.218         | 0.0                    | 4.0               | 4.0                 | 16.1            | O K    |
| 2160 min Winter  | 173.875       | 0.125         | 0.0                    | 3.4               | 3.4                 | 9.2             | O K    |
| 2880 min Winter  | 173.850       | 0.100         | 0.0                    | 2.8               | 2.8                 | 7.4             | O K    |
| 4320 min Winter  | 173.828       | 0.078         | 0.0                    | 2.0               | 2.0                 | 5.7             | O K    |
| 5760 min Winter  | 173.816       | 0.066         | 0.0                    | 1.6               | 1.6                 | 4.9             | O K    |
| 7200 min Winter  | 173.808       | 0.058         | 0.0                    | 1.4               | 1.4                 | 4.3             | O K    |
| 8640 min Winter  | 173.803       | 0.053         | 0.0                    | 1.2               | 1.2                 | 3.9             | O K    |
| 10080 min Winter | 173.799       | 0.049         | 0.0                    | 1.1               | 1.1                 | 3.6             | O K    |

| Storm Event      | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|------------------|--------------|---------------------|-----------------------|------------------|
| 30 min Winter    | 78.041       | 0.0                 | 51.1                  | 37               |
| 60 min Winter    | 51.031       | 0.0                 | 66.8                  | 64               |
| 120 min Winter   | 32.151       | 0.0                 | 84.2                  | 116              |
| 180 min Winter   | 24.110       | 0.0                 | 94.7                  | 148              |
| 240 min Winter   | 19.515       | 0.0                 | 102.3                 | 186              |
| 360 min Winter   | 14.501       | 0.0                 | 114.0                 | 264              |
| 480 min Winter   | 11.724       | 0.0                 | 122.9                 | 338              |
| 600 min Winter   | 9.932        | 0.0                 | 130.1                 | 412              |
| 720 min Winter   | 8.668        | 0.0                 | 136.3                 | 484              |
| 960 min Winter   | 6.984        | 0.0                 | 146.4                 | 620              |
| 1440 min Winter  | 5.139        | 0.0                 | 161.6                 | 826              |
| 2160 min Winter  | 3.772        | 0.0                 | 177.9                 | 1128             |
| 2880 min Winter  | 3.023        | 0.0                 | 190.1                 | 1476             |
| 4320 min Winter  | 2.209        | 0.0                 | 208.4                 | 2204             |
| 5760 min Winter  | 1.770        | 0.0                 | 222.7                 | 2936             |
| 7200 min Winter  | 1.491        | 0.0                 | 234.5                 | 3672             |
| 8640 min Winter  | 1.297        | 0.0                 | 244.6                 | 4392             |
| 10080 min Winter | 1.152        | 0.0                 | 253.6                 | 5144             |

|                                                     |                                  |                                                                                     |
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| Micro Drainage                                      |                                  | Source Control 2014.1.1                                                             |

#### Rainfall Details

|                       |                   |                       |       |
|-----------------------|-------------------|-----------------------|-------|
| Rainfall Model        | FSR               | Winter Storms         | Yes   |
| Return Period (years) | 100               | Cv (Summer)           | 0.750 |
| Region                | England and Wales | Cv (Winter)           | 0.840 |
| M5-60 (mm)            | 19.400            | Shortest Storm (mins) | 15    |
| Ratio R               | 0.314             | Longest Storm (mins)  | 10080 |
| Summer Storms         | Yes               | Climate Change %      | +30   |

#### Time Area Diagram

Total Area (ha) 0.156

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|-------------|-----------|-------------|-----------|-------------|-----------|
| From:       | To:       | From:       | To:       | From:       | To:       |
| 0           | 4         | 0.052       | 4         | 8           | 0.052     |
|             |           |             |           | 8           | 12        |
|             |           |             |           |             | 0.052     |

|                                                     |                                  |                                                                                     |
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| Date June 2014                                      | Designed by PB                   |                                                                                     |
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| Micro Drainage                                      |                                  | Source Control 2014.1.1                                                             |

#### Model Details

Storage is Online Cover Level (m) 175.000

#### Cellular Storage Structure

Invert Level (m) 173.750 Safety Factor 2.0  
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95  
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m <sup>2</sup> ) | Inf. Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> ) | Inf. Area (m <sup>2</sup> ) |
|-----------|------------------------|-----------------------------|-----------|------------------------|-----------------------------|
| 0.000     | 78.0                   | 78.0                        | 0.900     | 0.0                    | 143.6                       |
| 0.800     | 78.0                   | 143.6                       |           |                        |                             |

#### Hydro-Brake® Outflow Control

Design Head (m) 1.000 Hydro-Brake® Type Md6 SW Only Invert Level (m) 173.750  
Design Flow (l/s) 5.0 Diameter (mm) 93

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100     | 2.8        | 1.200     | 5.4        | 3.000     | 8.5        | 7.000     | 13.1       |
| 0.200     | 4.0        | 1.400     | 5.8        | 3.500     | 9.2        | 7.500     | 13.5       |
| 0.300     | 3.8        | 1.600     | 6.2        | 4.000     | 9.9        | 8.000     | 14.0       |
| 0.400     | 3.7        | 1.800     | 6.6        | 4.500     | 10.5       | 8.500     | 14.4       |
| 0.500     | 3.7        | 2.000     | 7.0        | 5.000     | 11.0       | 9.000     | 14.8       |
| 0.600     | 3.9        | 2.200     | 7.3        | 5.500     | 11.6       | 9.500     | 15.2       |
| 0.800     | 4.4        | 2.400     | 7.6        | 6.000     | 12.1       |           |            |
| 1.000     | 4.9        | 2.600     | 8.0        | 6.500     | 12.6       |           |            |