

# 1 in 100 + 40% Climate Change Surface Water Drainage Calculations

## Farm Road, Barnsley

**The Investment Room**

**August 2017**

## Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 22 minutes.

| 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 |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 104.524 | 0.274 | 0.0 | 7.1 | 7.1 | 11.7 | O K |
| 30 min Summer | 104.589 | 0.339 | 0.0 | 8.0 | 8.0 | 14.5 | O K |
| 60 min Summer | 104.610 | 0.360 | 0.0 | 8.3 | 8.3 | 15.4 | O K |
| 120 min Summer | 104.585 | 0.335 | 0.0 | 7.9 | 7.9 | 14.3 | O K |
| 180 min Summer | 104.547 | 0.297 | 0.0 | 7.4 | 7.4 | 12.7 | O K |
| 240 min Summer | 104.512 | 0.262 | 0.0 | 6.9 | 6.9 | 11.2 | O K |
| 360 min Summer | 104.459 | 0.209 | 0.0 | 6.1 | 6.1 | 8.9 | O K |
| 480 min Summer | 104.422 | 0.172 | 0.0 | 5.4 | 5.4 | 7.4 | O K |
| 600 min Summer | 104.397 | 0.147 | 0.0 | 4.9 | 4.9 | 6.3 | O K |
| 720 min Summer | 104.377 | 0.127 | 0.0 | 4.4 | 4.4 | 5.5 | O K |
| 960 min Summer | 104.353 | 0.103 | 0.0 | 3.8 | 3.8 | 4.4 | O K |
| 1440 min Summer | 104.333 | 0.083 | 0.0 | 2.9 | 2.9 | 3.5 | O K |
| 2160 min Summer | 104.318 | 0.068 | 0.0 | 2.1 | 2.1 | 2.9 | O K |
| 2880 min Summer | 104.309 | 0.059 | 0.0 | 1.7 | 1.7 | 2.5 | O K |
| 4320 min Summer | 104.298 | 0.048 | 0.0 | 1.2 | 1.2 | 2.1 | O K |
| 5760 min Summer | 104.291 | 0.041 | 0.0 | 1.0 | 1.0 | 1.8 | O K |
| 7200 min Summer | 104.288 | 0.038 | 0.0 | 0.8 | 0.8 | 1.6 | O K |
| 8640 min Summer | 104.285 | 0.035 | 0.0 | 0.7 | 0.7 | 1.5 | O K |
| 10080 min Summer | 104.284 | 0.034 | 0.0 | 0.7 | 0.7 | 1.4 | O K |
| 15 min Winter | 104.558 | 0.308 | 0.0 | 7.6 | 7.6 | 13.2 | O K |
| 30 min Winter | 104.631 | 0.381 | 0.0 | 8.5 | 8.5 | 16.3 | O K |
| 60 min Winter | 104.645 | 0.395 | 0.0 | 8.7 | 8.7 | 16.9 | O K |
| 120 min Winter | 104.596 | 0.346 | 0.0 | 8.1 | 8.1 | 14.8 | O K |
| 180 min Winter | 104.538 | 0.288 | 0.0 | 7.3 | 7.3 | 12.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 125.746 | 0.0 | 17.2 | 23 |
| 30 min Summer | 84.173 | 0.0 | 23.0 | 32 |
| 60 min Summer | 53.779 | 0.0 | 29.4 | 48 |
| 120 min Summer | 33.195 | 0.0 | 36.3 | 80 |
| 180 min Summer | 24.676 | 0.0 | 40.5 | 112 |
| 240 min Summer | 19.858 | 0.0 | 43.5 | 144 |
| 360 min Summer | 14.561 | 0.0 | 47.8 | 204 |
| 480 min Summer | 11.683 | 0.0 | 51.2 | 264 |
| 600 min Summer | 9.841 | 0.0 | 53.9 | 324 |
| 720 min Summer | 8.549 | 0.0 | 56.1 | 382 |
| 960 min Summer | 6.841 | 0.0 | 59.9 | 500 |
| 1440 min Summer | 4.987 | 0.0 | 65.5 | 738 |
| 2160 min Summer | 3.628 | 0.0 | 71.5 | 1104 |
| 2880 min Summer | 2.892 | 0.0 | 76.0 | 1468 |
| 4320 min Summer | 2.096 | 0.0 | 82.6 | 2204 |
| 5760 min Summer | 1.667 | 0.0 | 87.6 | 2896 |
| 7200 min Summer | 1.394 | 0.0 | 91.6 | 3640 |
| 8640 min Summer | 1.205 | 0.0 | 95.0 | 4400 |
| 10080 min Summer | 1.066 | 0.0 | 98.0 | 5112 |
| 15 min Winter | 125.746 | 0.0 | 19.3 | 23 |
| 30 min Winter | 84.173 | 0.0 | 25.8 | 33 |
| 60 min Winter | 53.779 | 0.0 | 33.0 | 50 |
| 120 min Winter | 33.195 | 0.0 | 40.7 | 84 |
| 180 min Winter | 24.676 | 0.0 | 45.4 | 118 |

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## Summary of Results for 100 year Return Period (+40%)

| 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 |
|---|---|---|---|---|---|---|---|
| 240 min Winter | 104.491 | 0.241 | 0.0 | 6.6 | 6.6 | 10.3 | O K |
| 360 min Winter | 104.426 | 0.176 | 0.0 | 5.5 | 5.5 | 7.5 | O K |
| 480 min Winter | 104.387 | 0.137 | 0.0 | 4.6 | 4.6 | 5.8 | O K |
| 600 min Winter | 104.362 | 0.112 | 0.0 | 4.0 | 4.0 | 4.8 | O K |
| 720 min Winter | 104.347 | 0.097 | 0.0 | 3.6 | 3.6 | 4.1 | O K |
| 960 min Winter | 104.333 | 0.083 | 0.0 | 2.9 | 2.9 | 3.6 | O K |
| 1440 min Winter | 104.318 | 0.068 | 0.0 | 2.1 | 2.1 | 2.9 | O K |
| 2160 min Winter | 104.306 | 0.056 | 0.0 | 1.6 | 1.6 | 2.4 | O K |
| 2880 min Winter | 104.298 | 0.048 | 0.0 | 1.2 | 1.2 | 2.1 | O K |
| 4320 min Winter | 104.289 | 0.039 | 0.0 | 0.9 | 0.9 | 1.7 | O K |
| 5760 min Winter | 104.285 | 0.035 | 0.0 | 0.7 | 0.7 | 1.5 | O K |
| 7200 min Winter | 104.283 | 0.033 | 0.0 | 0.6 | 0.6 | 1.4 | O K |
| 8640 min Winter | 104.281 | 0.031 | 0.0 | 0.5 | 0.5 | 1.3 | O K |
| 10080 min Winter | 104.279 | 0.029 | 0.0 | 0.5 | 0.5 | 1.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 240 min Winter | 19.858 | 0.0 | 48.7 | 148 |
| 360 min Winter | 14.561 | 0.0 | 53.6 | 208 |
| 480 min Winter | 11.683 | 0.0 | 57.3 | 268 |
| 600 min Winter | 9.841 | 0.0 | 60.3 | 326 |
| 720 min Winter | 8.549 | 0.0 | 62.9 | 380 |
| 960 min Winter | 6.841 | 0.0 | 67.1 | 498 |
| 1440 min Winter | 4.987 | 0.0 | 73.4 | 744 |
| 2160 min Winter | 3.628 | 0.0 | 80.1 | 1112 |
| 2880 min Winter | 2.892 | 0.0 | 85.1 | 1476 |
| 4320 min Winter | 2.096 | 0.0 | 92.5 | 2196 |
| 5760 min Winter | 1.667 | 0.0 | 98.1 | 2936 |
| 7200 min Winter | 1.394 | 0.0 | 102.6 | 3616 |
| 8640 min Winter | 1.205 | 0.0 | 106.3 | 4376 |
| 10080 min Winter | 1.066 | 0.0 | 109.8 | 5056 |

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## 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) | 19.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.359 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.073

| Time (mins) From: | To: | Area (ha) | Time (mins) From: | To: | Area (ha) | Time (mins) From: | To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 5 | 0.025 | 5 | 10 | 0.024 | 10 | 15 | 0.024 |

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## Model Details

Storage is Online Cover Level (m) 105.985

## Cellular Storage Structure

Invert Level (m) 104.250 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

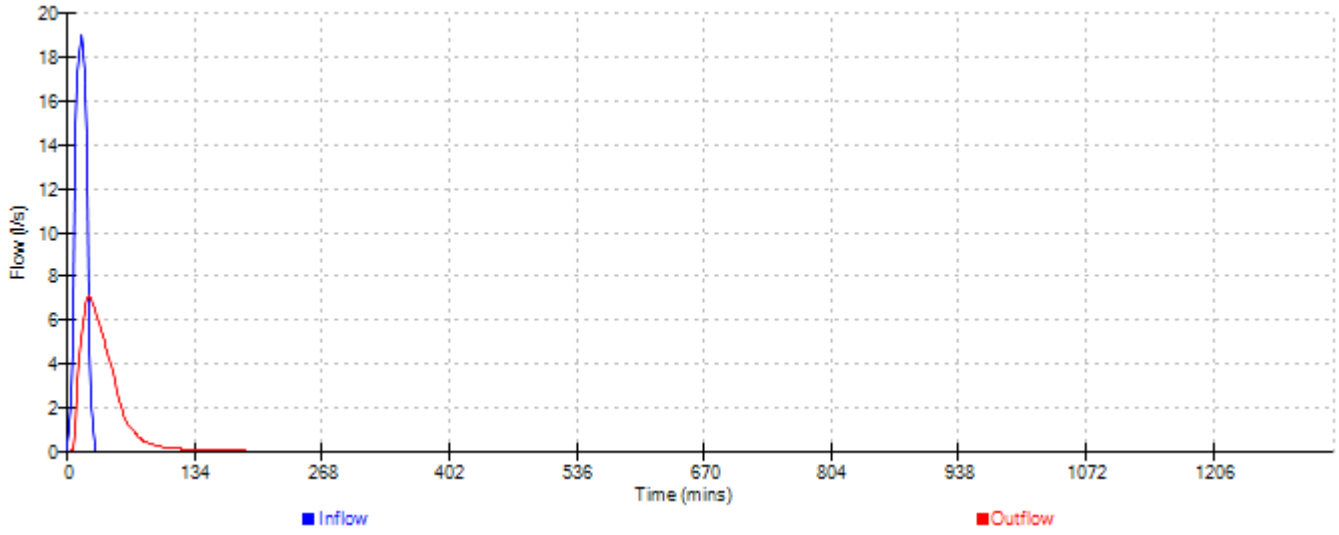
| Depth (m) | Area (m²) | Inf. Area (m²) | Depth (m) | Area (m²) | Inf. Area (m²) | Depth (m) | Area (m²) | Inf. Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 45.0 | 45.0 | 0.400 | 45.0 | 61.4 | 0.401 | 0.0 | 61.4 |

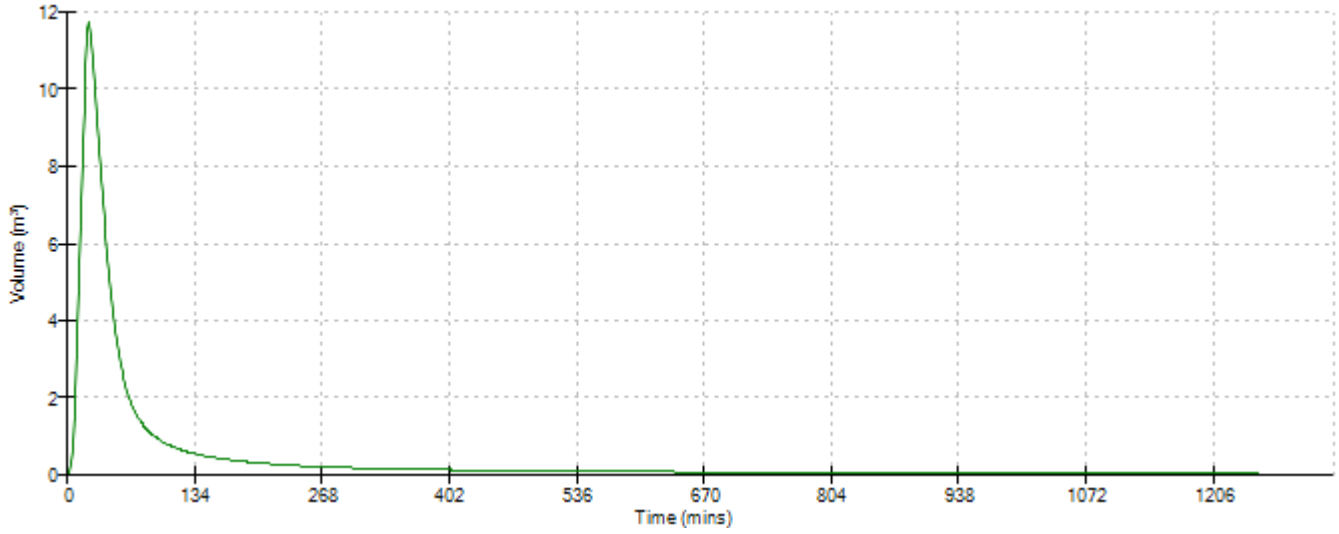
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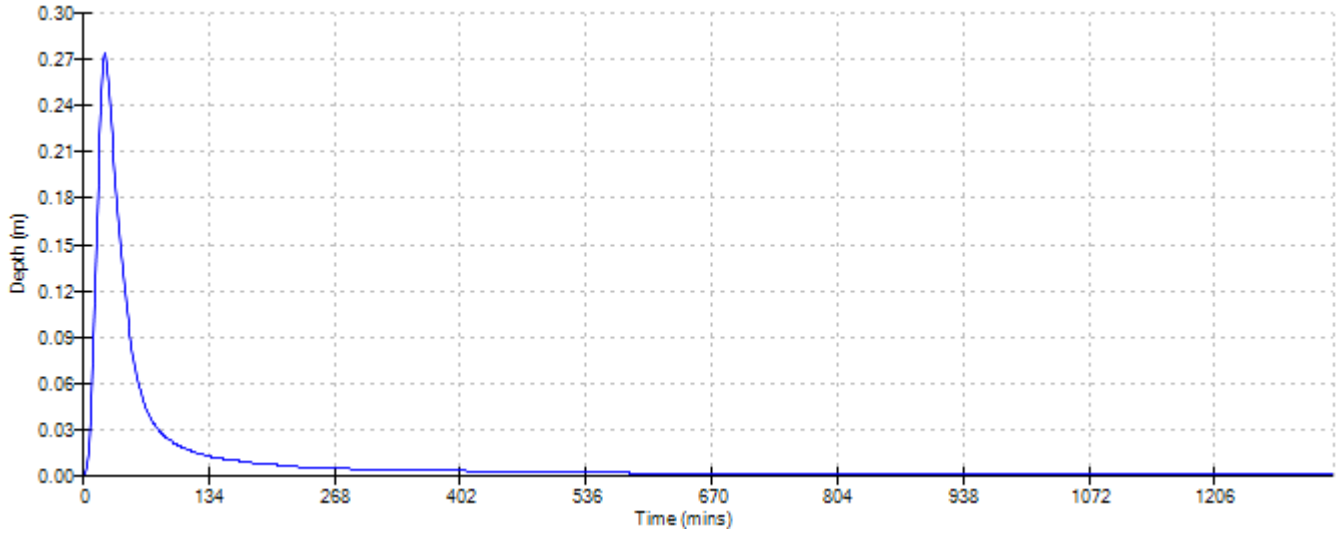
Diameter (m) 0.068 Discharge Coefficient 0.900 Invert Level (m) 104.250

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Event: 15 min Summer

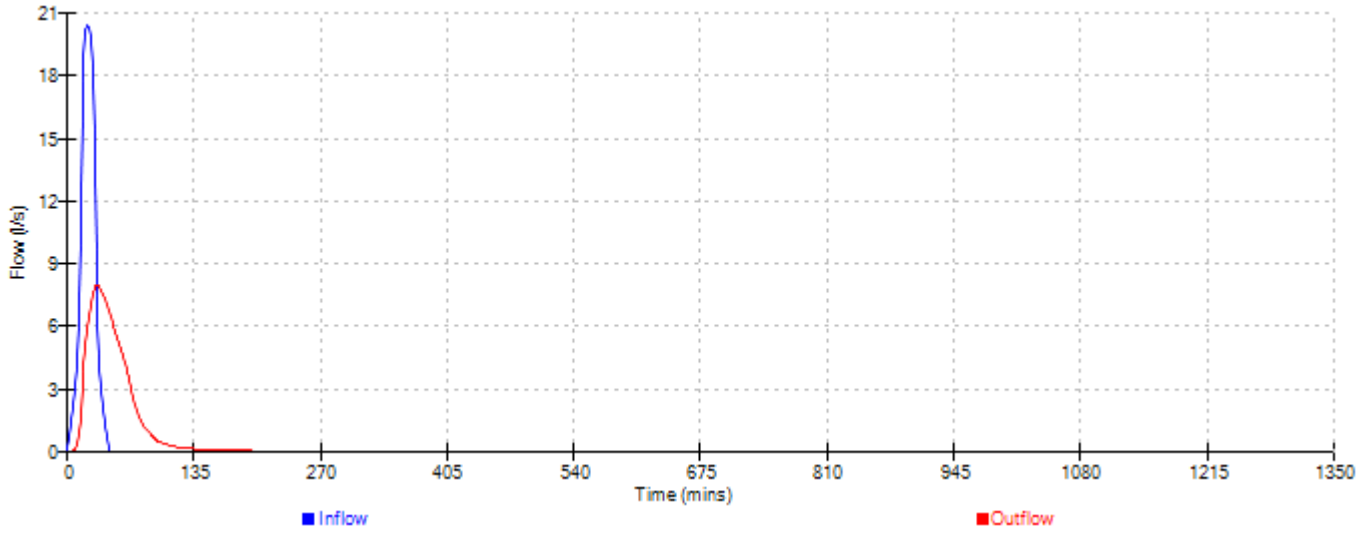


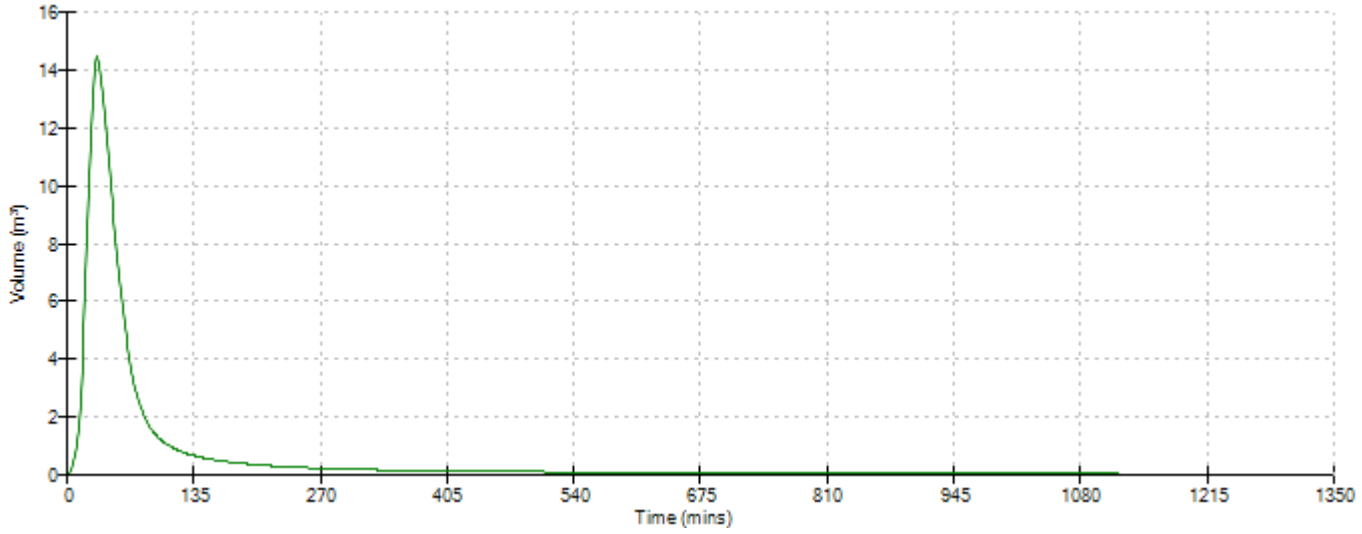



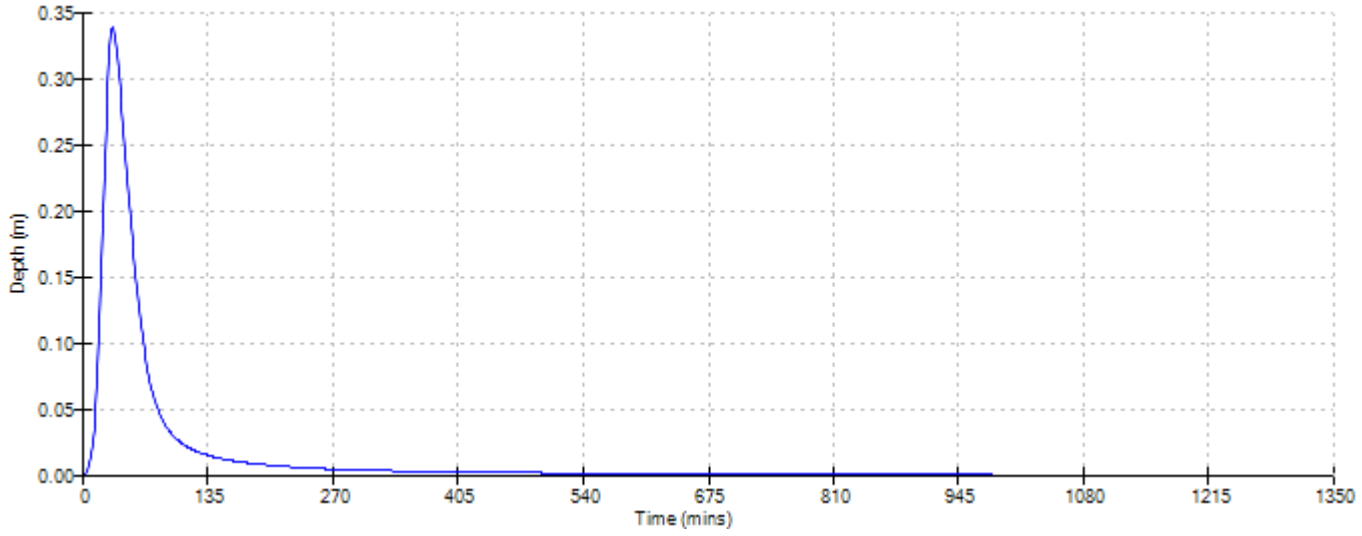




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Event: 30 min Summer

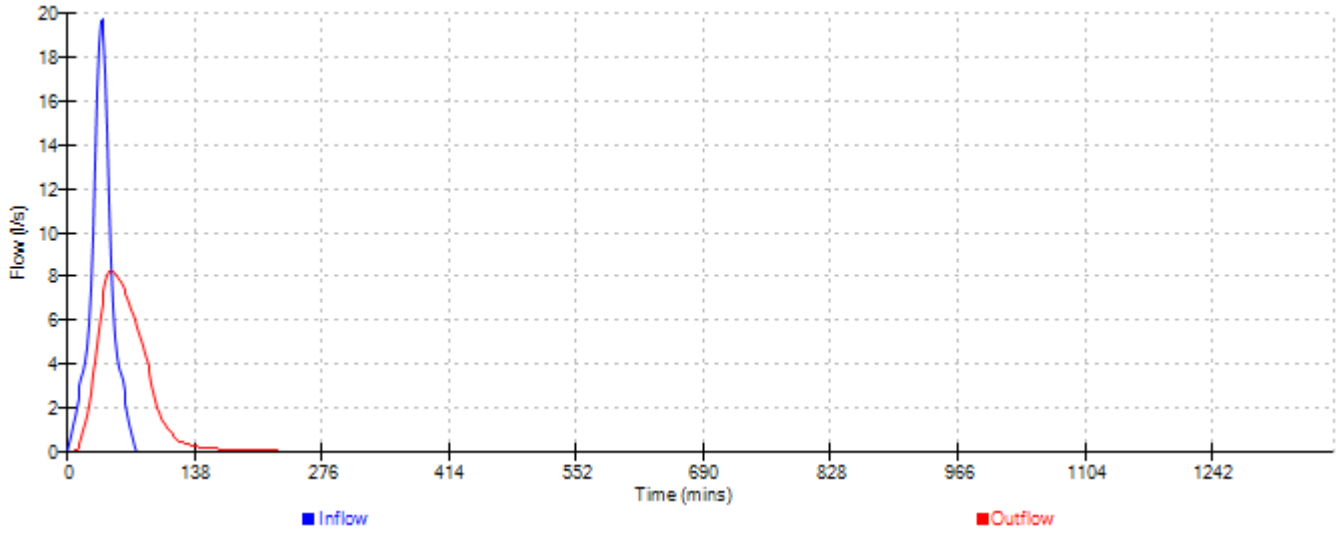


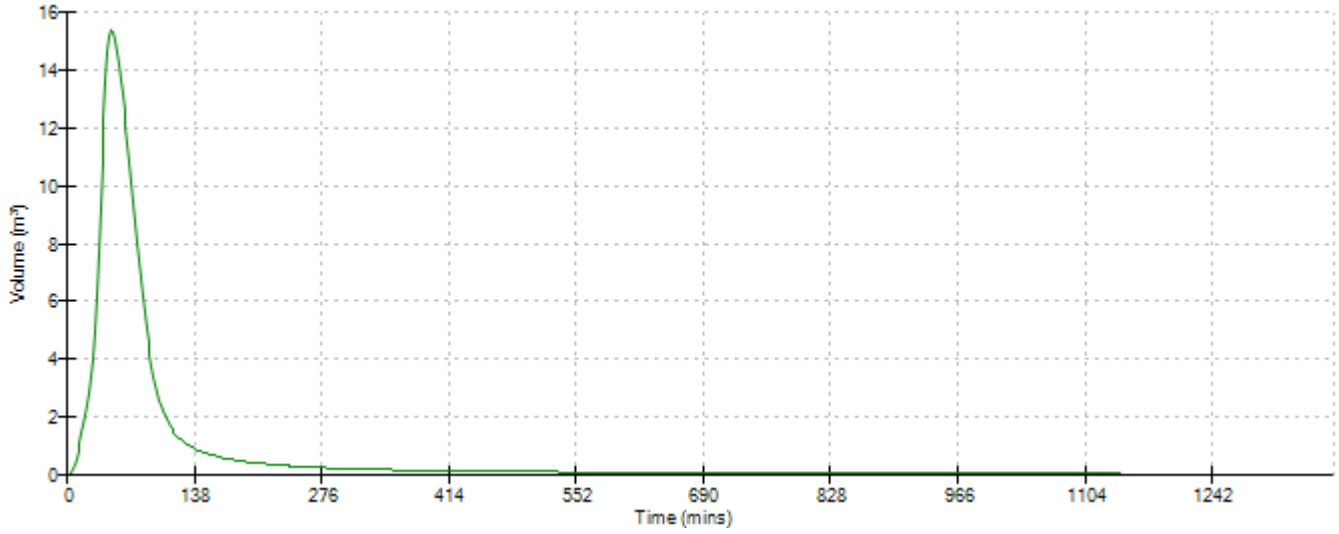



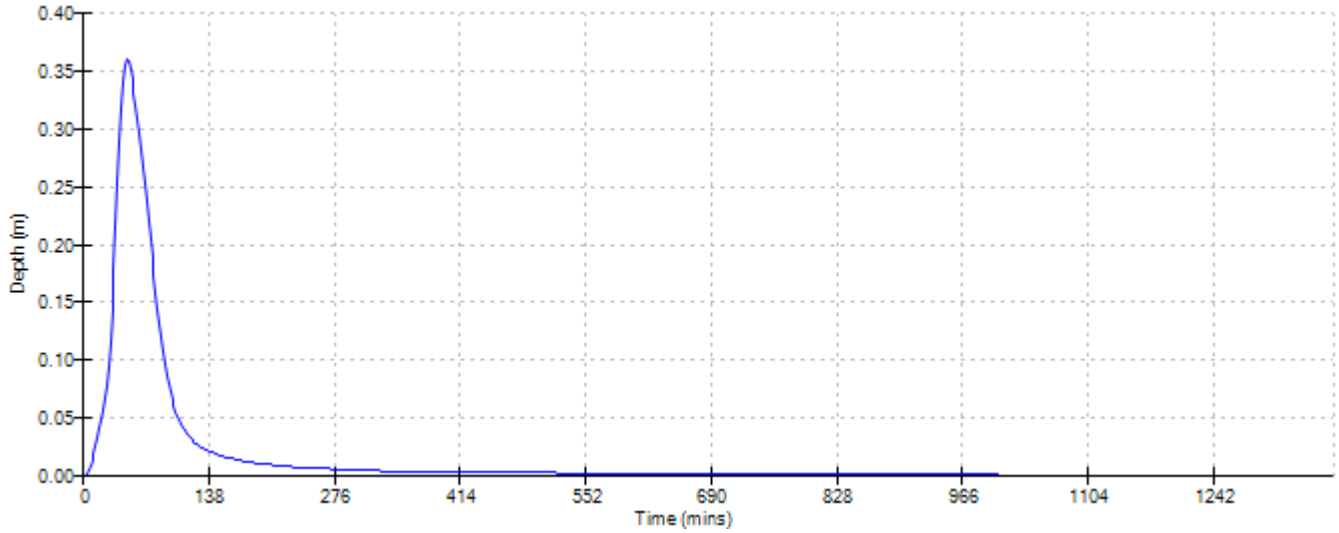




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Event: 60 min Summer

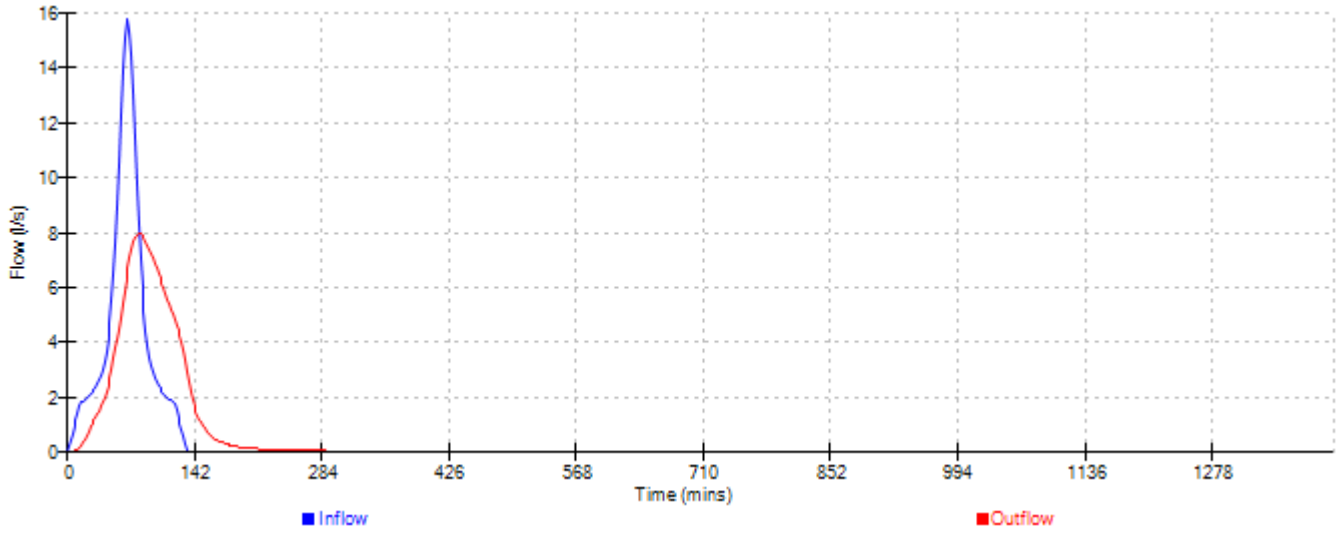


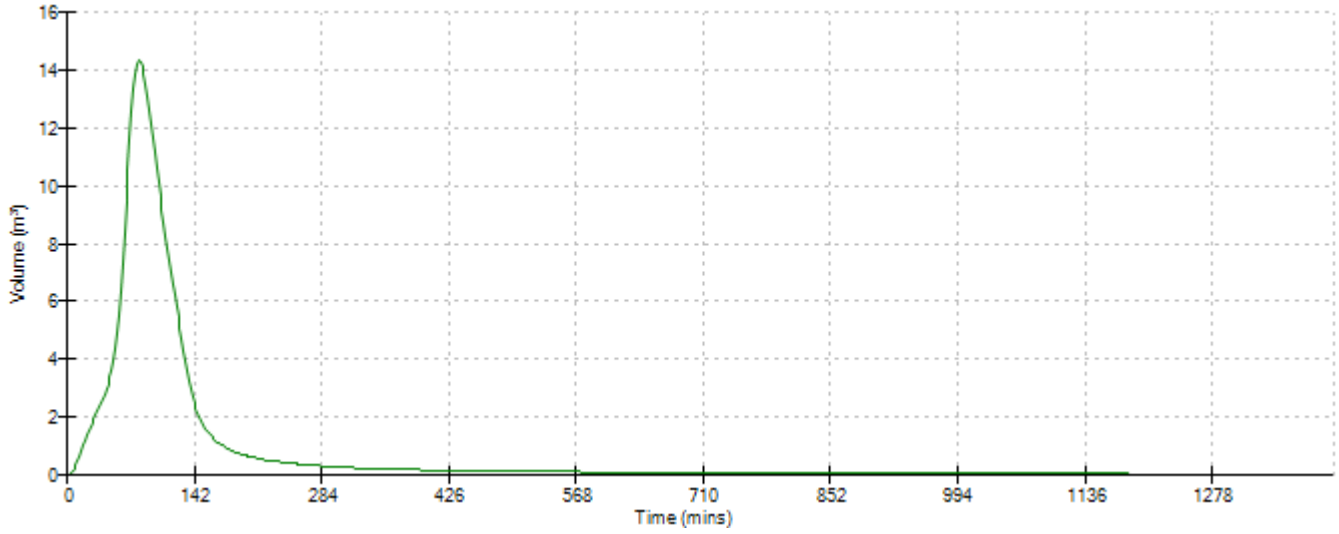



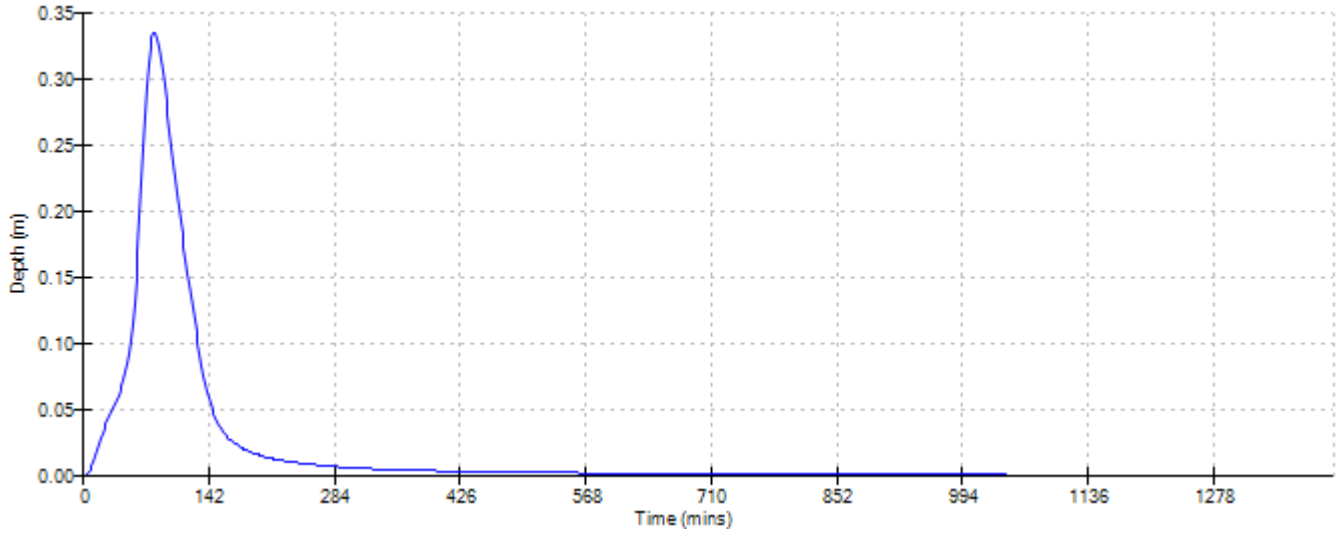




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Event: 120 min Summer

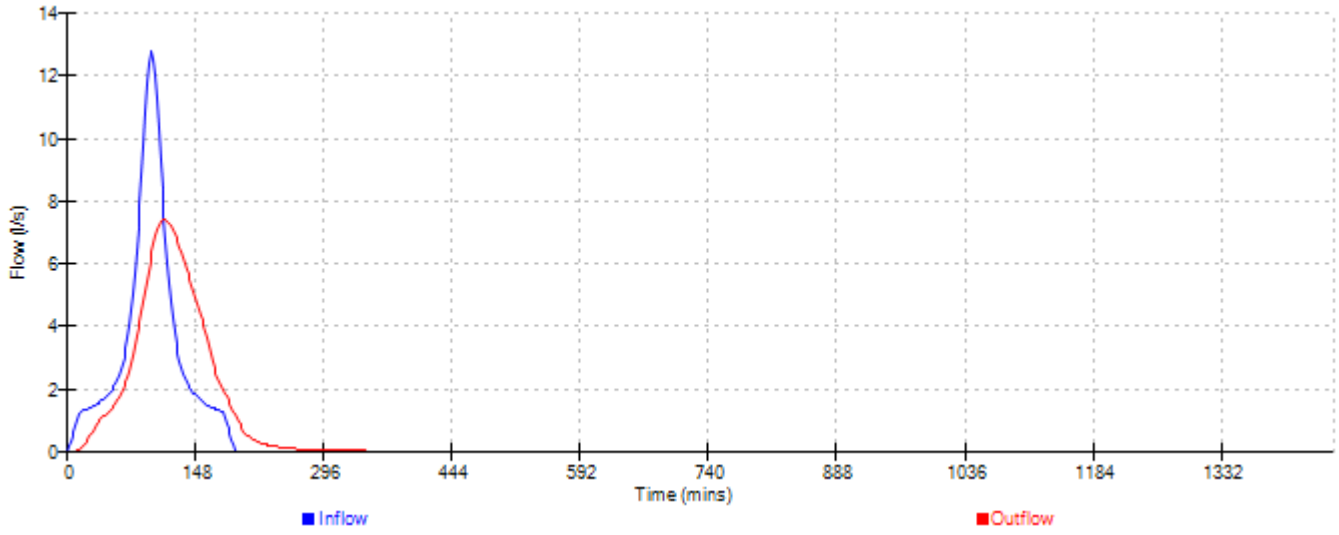


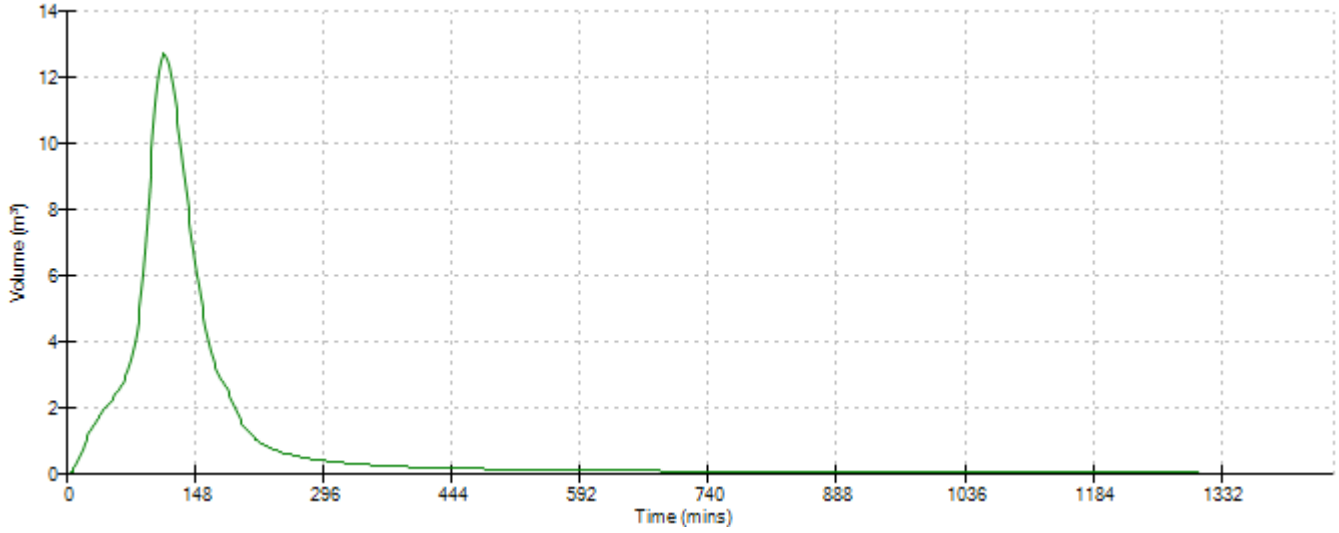



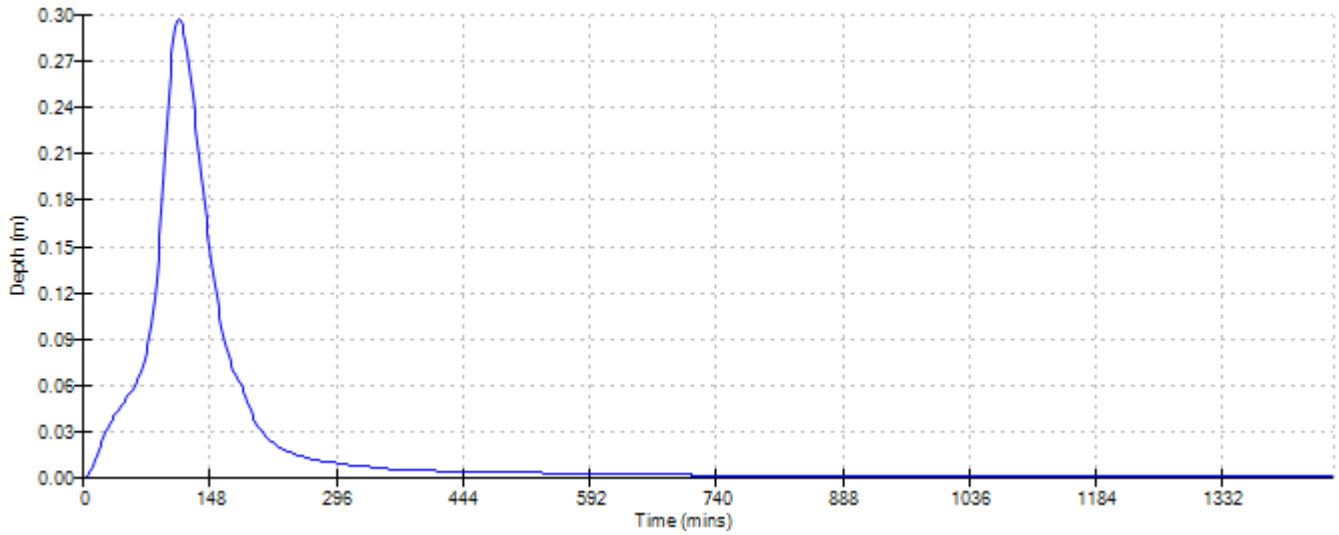




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Event: 180 min Summer

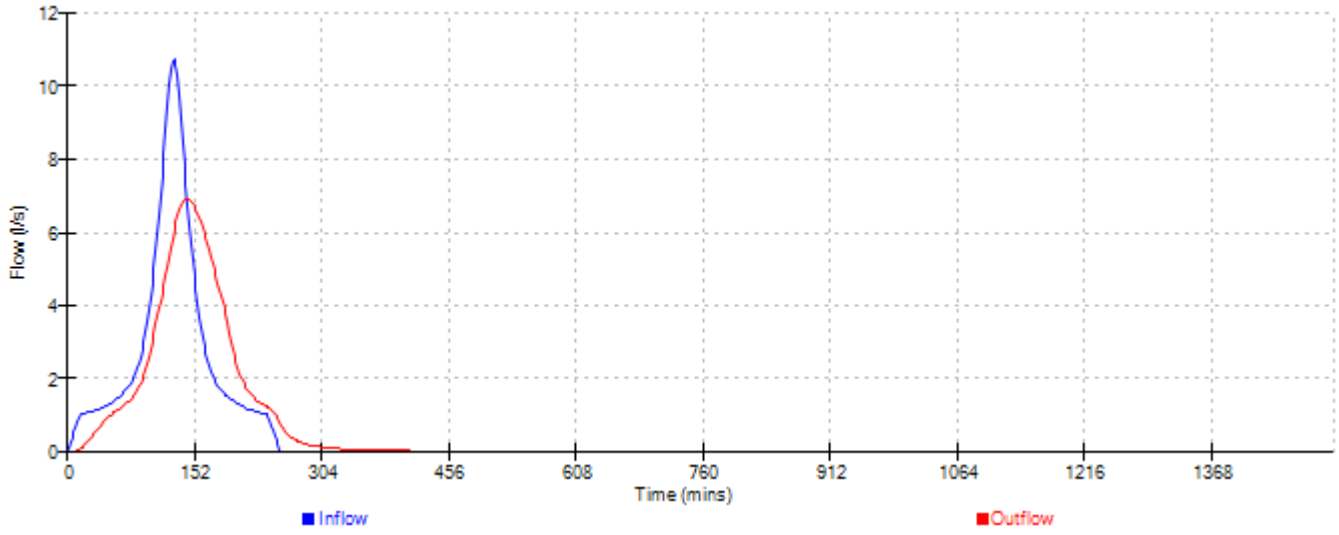


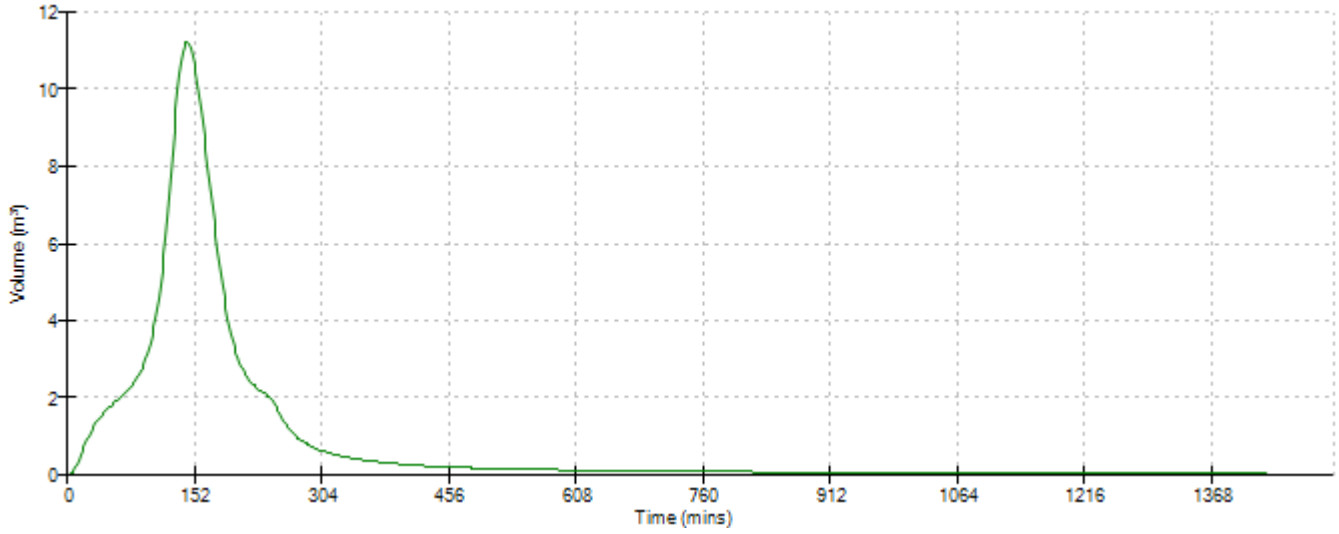



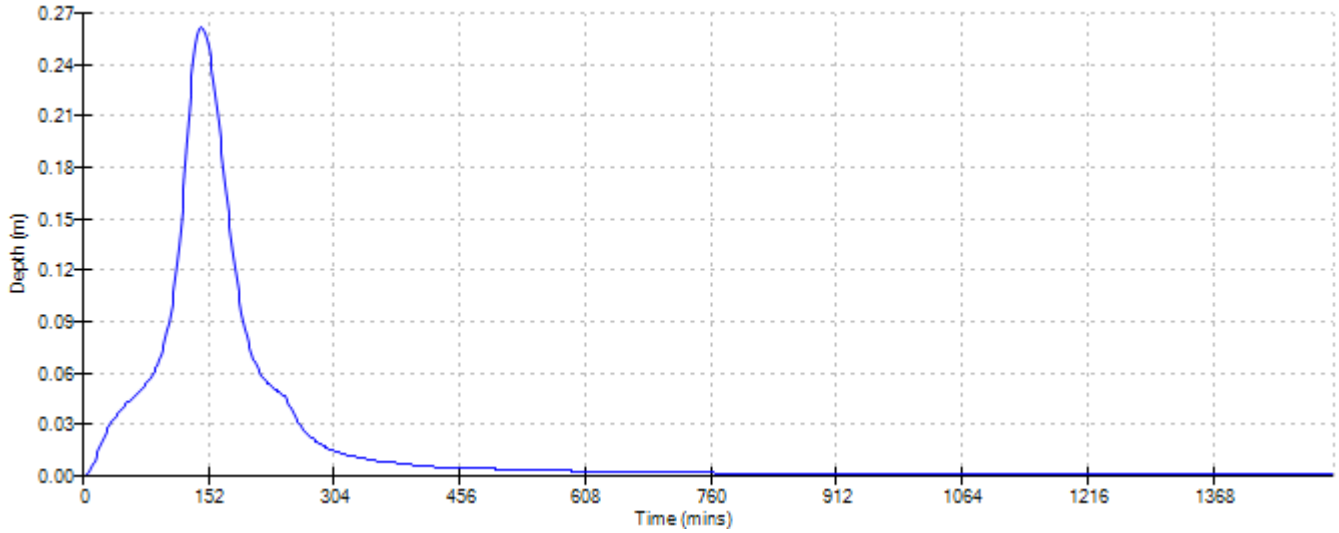




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Event: 240 min Summer

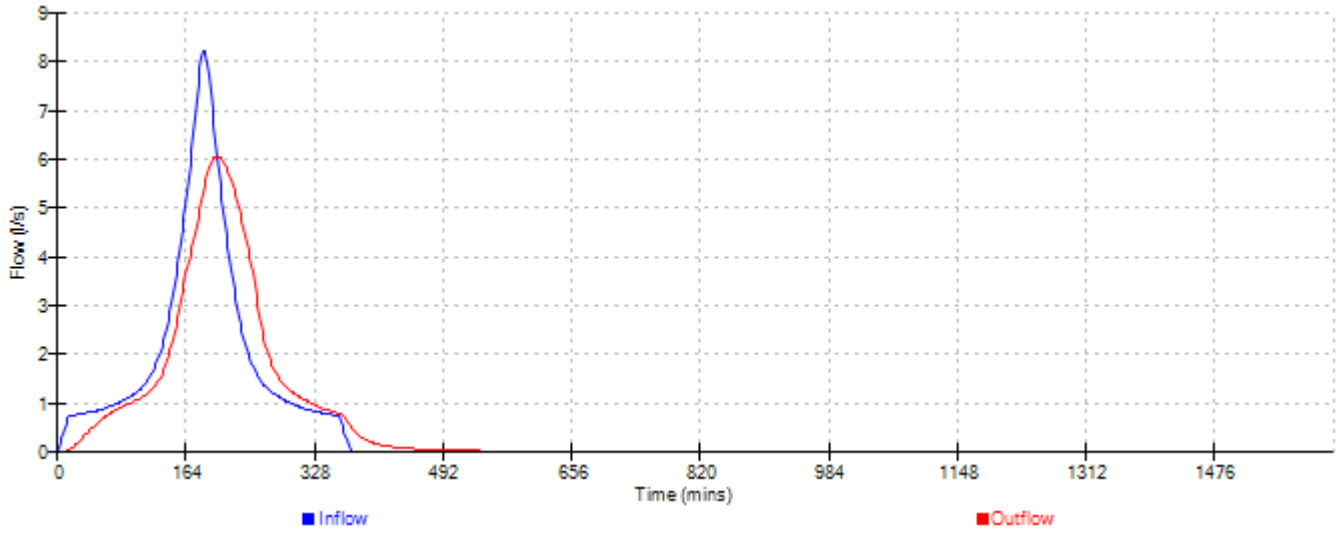


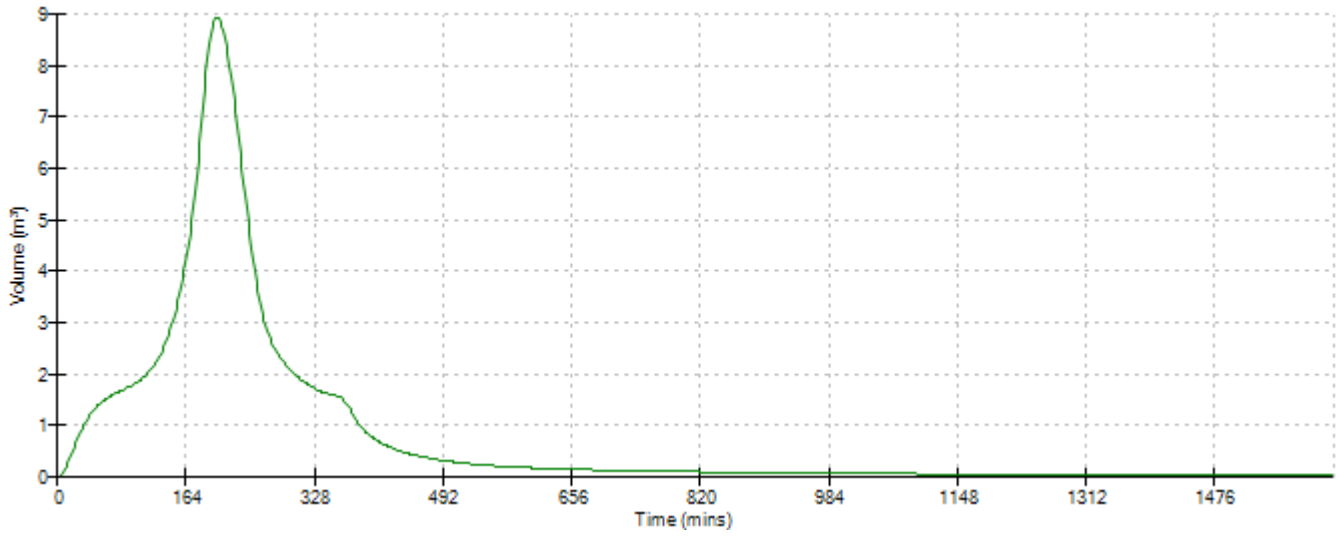



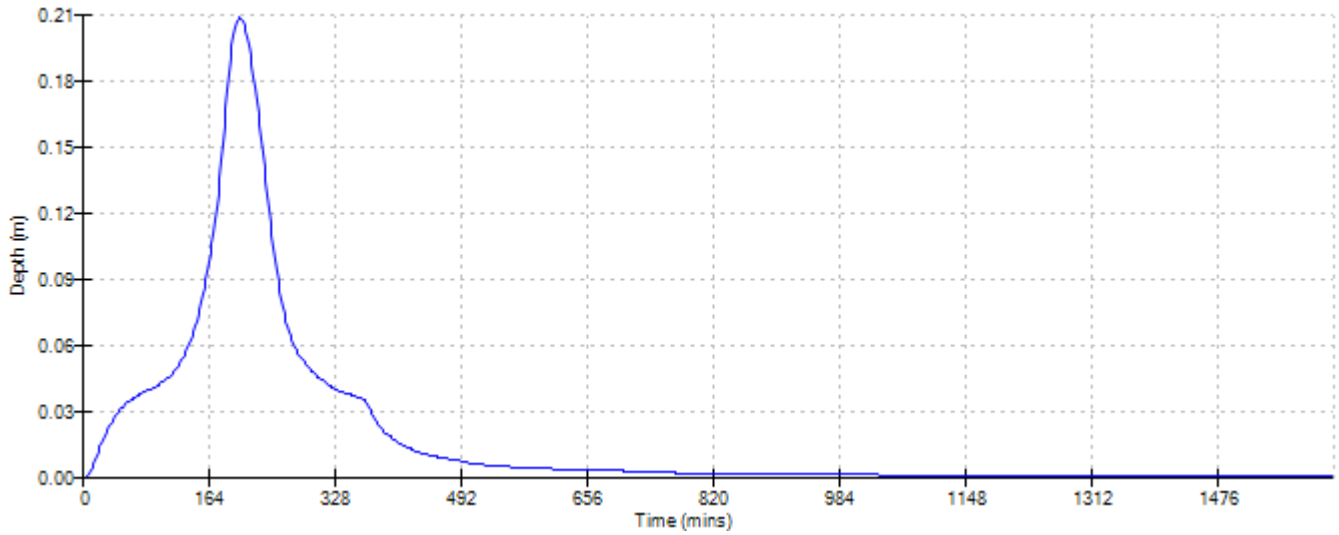




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Event: 360 min Summer

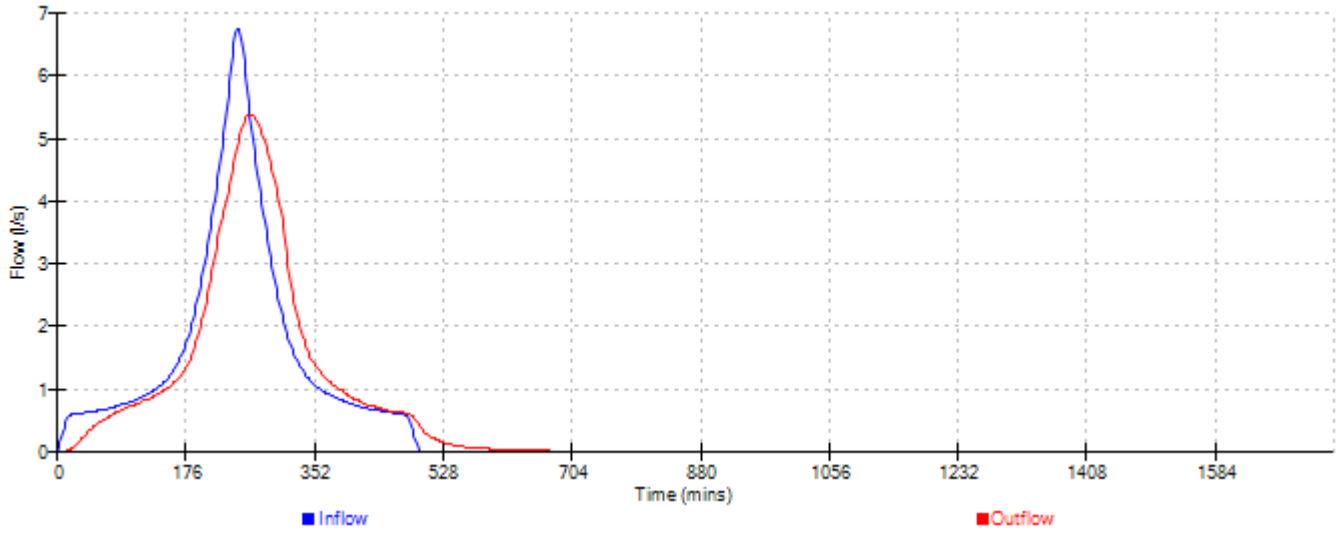


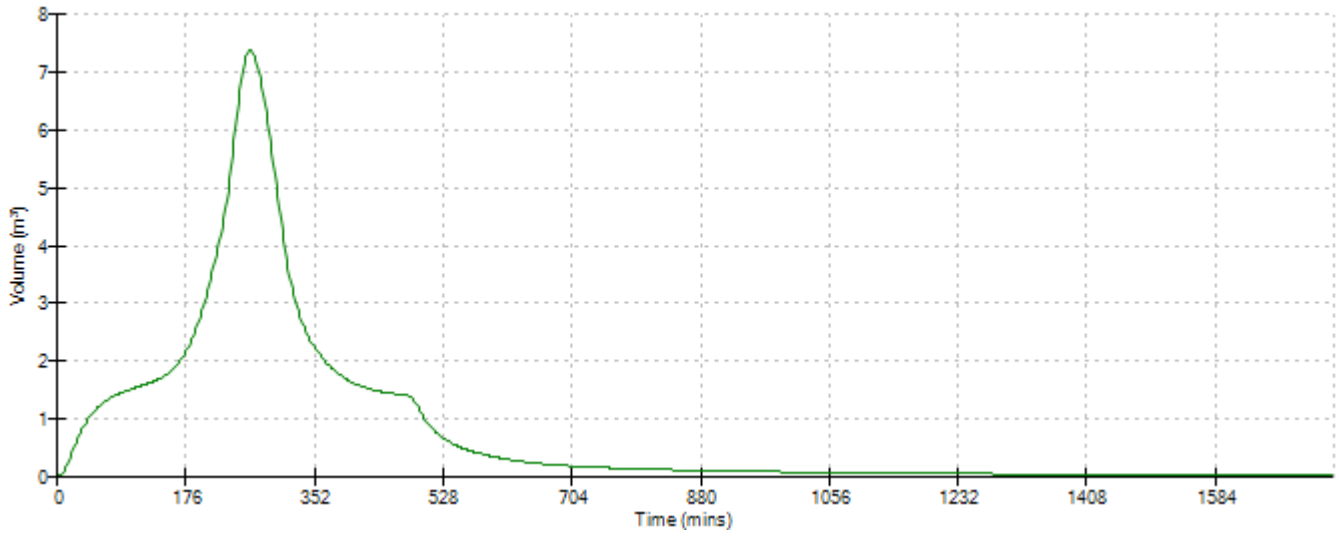



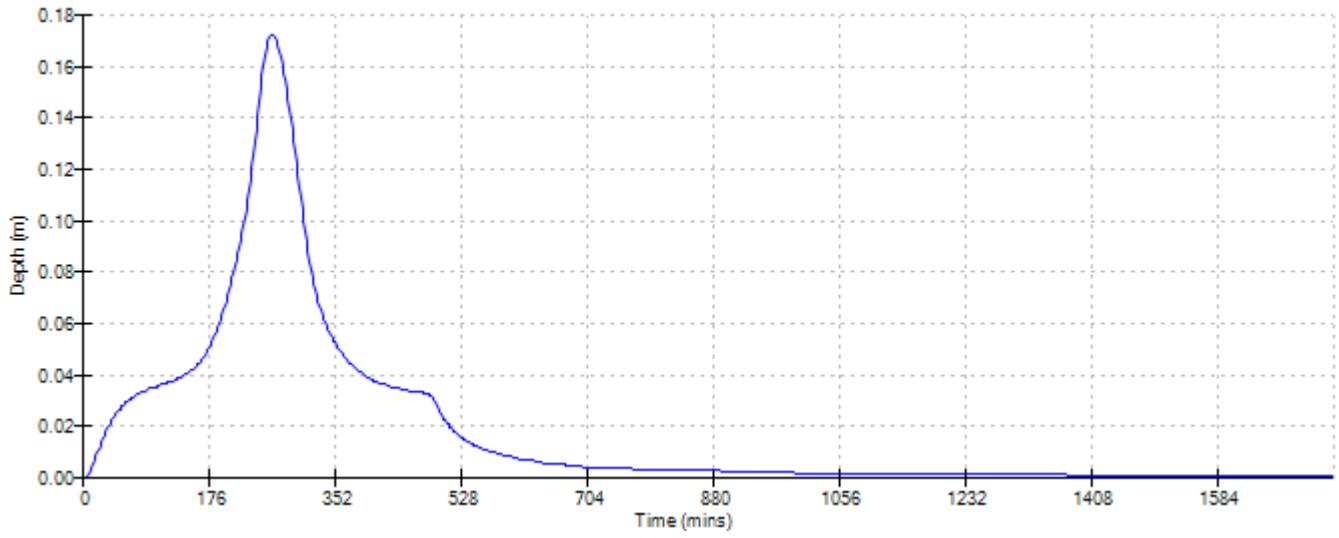




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Event: 480 min Summer

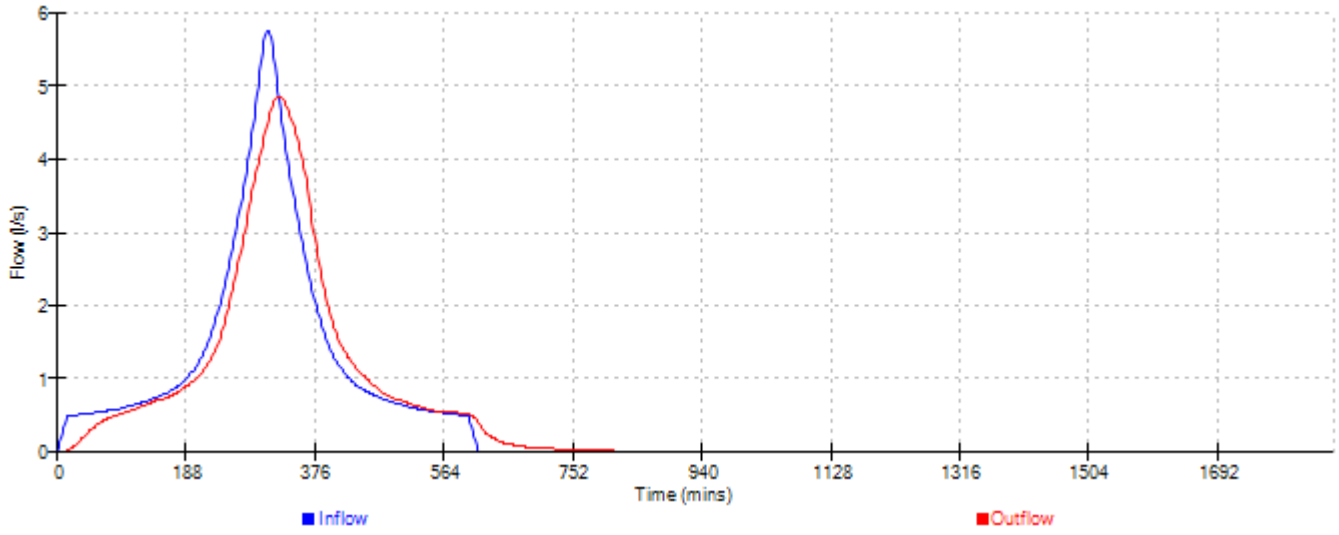


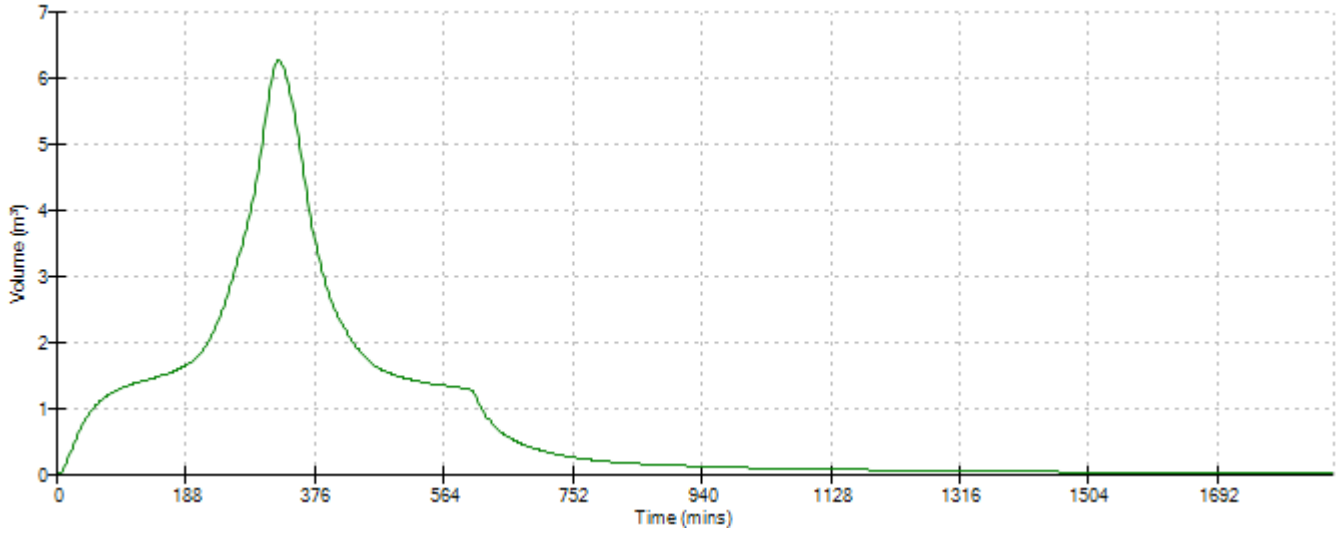



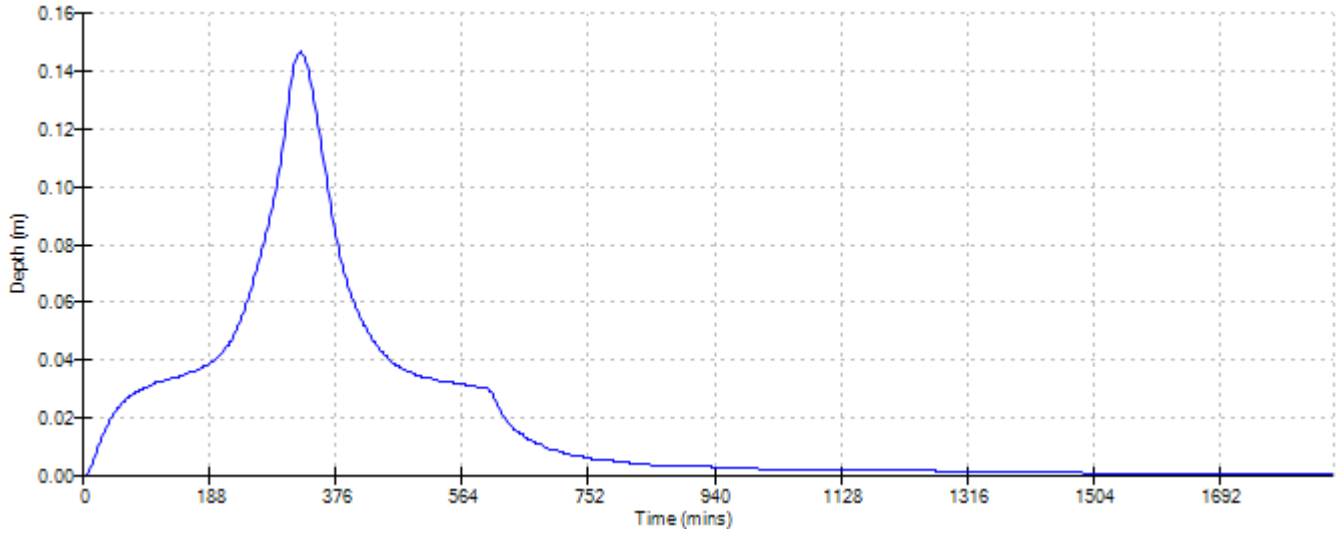




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Event: 600 min Summer

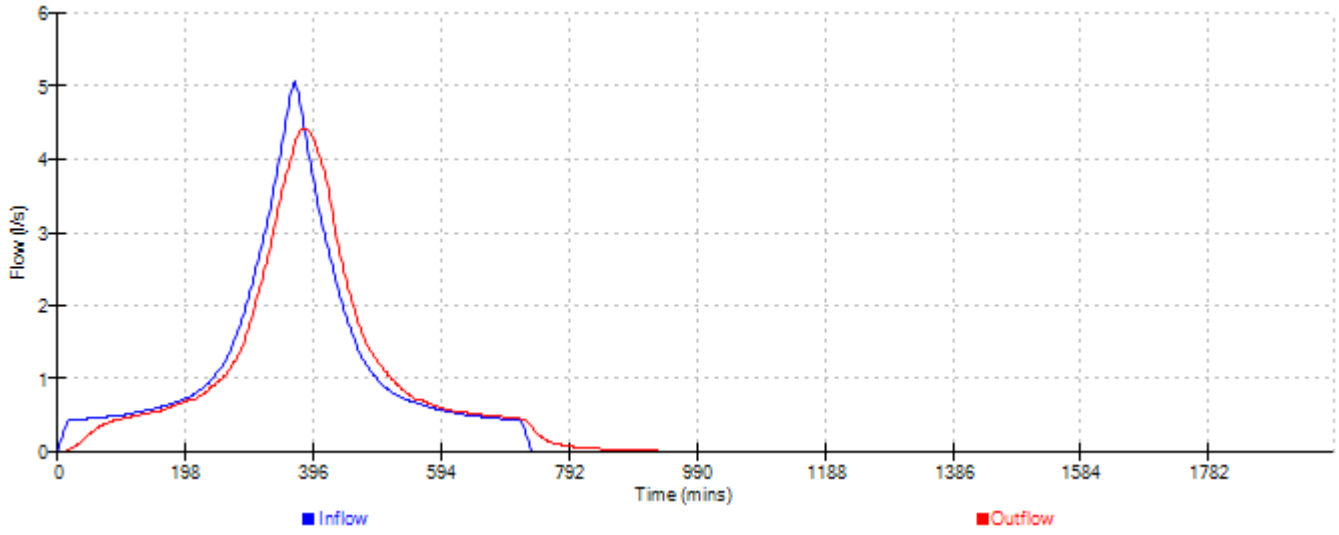


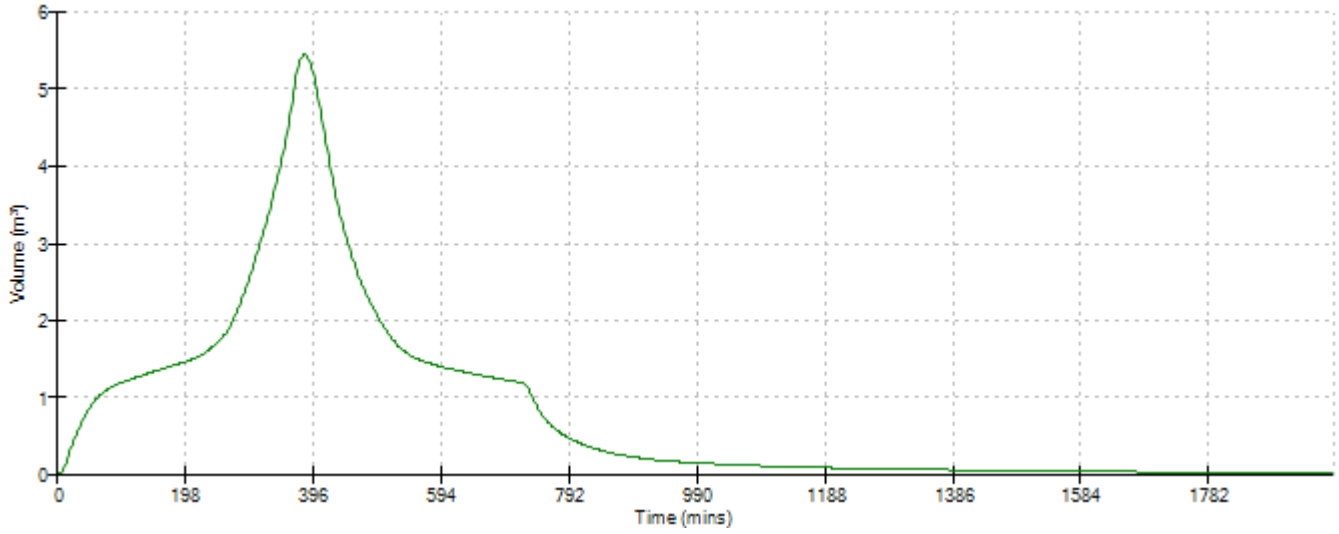



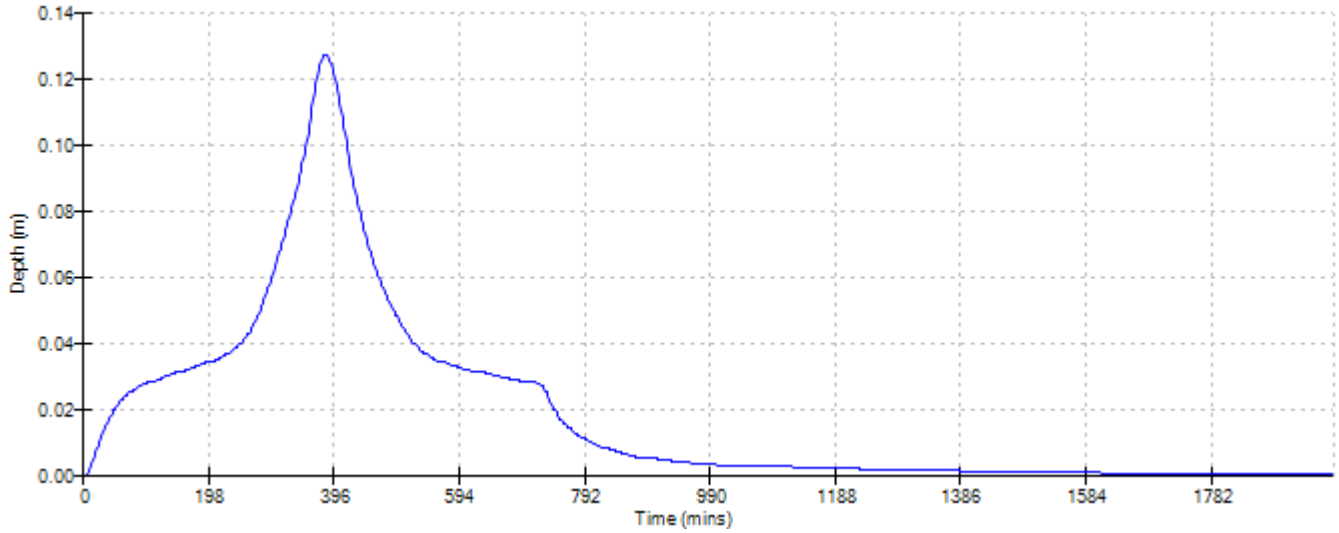




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Event: 720 min Summer

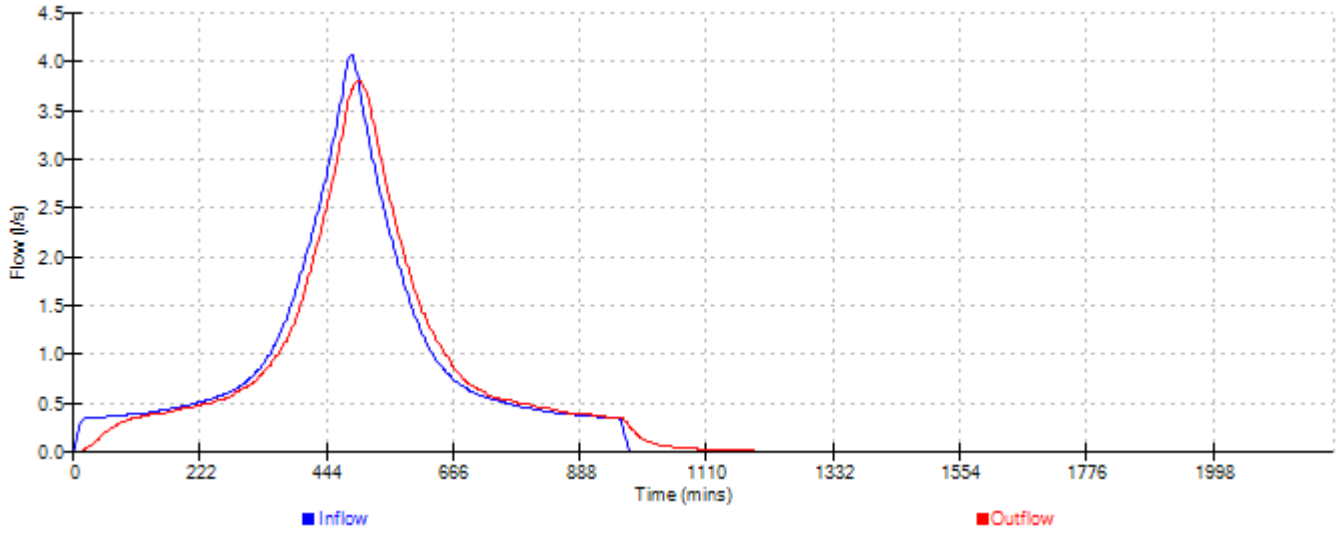


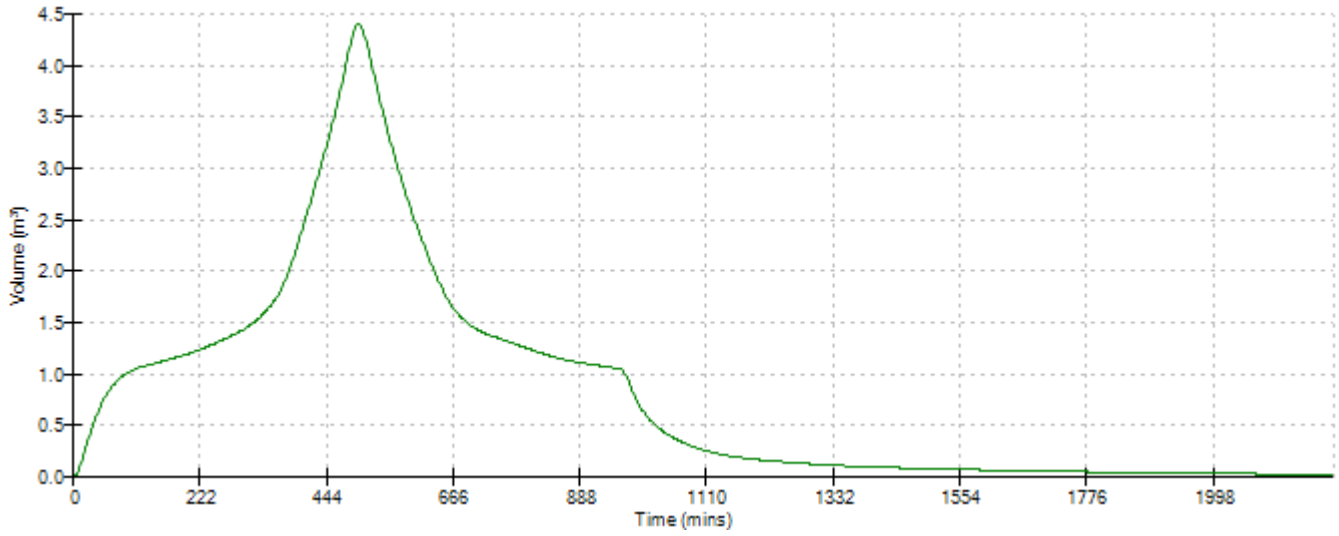



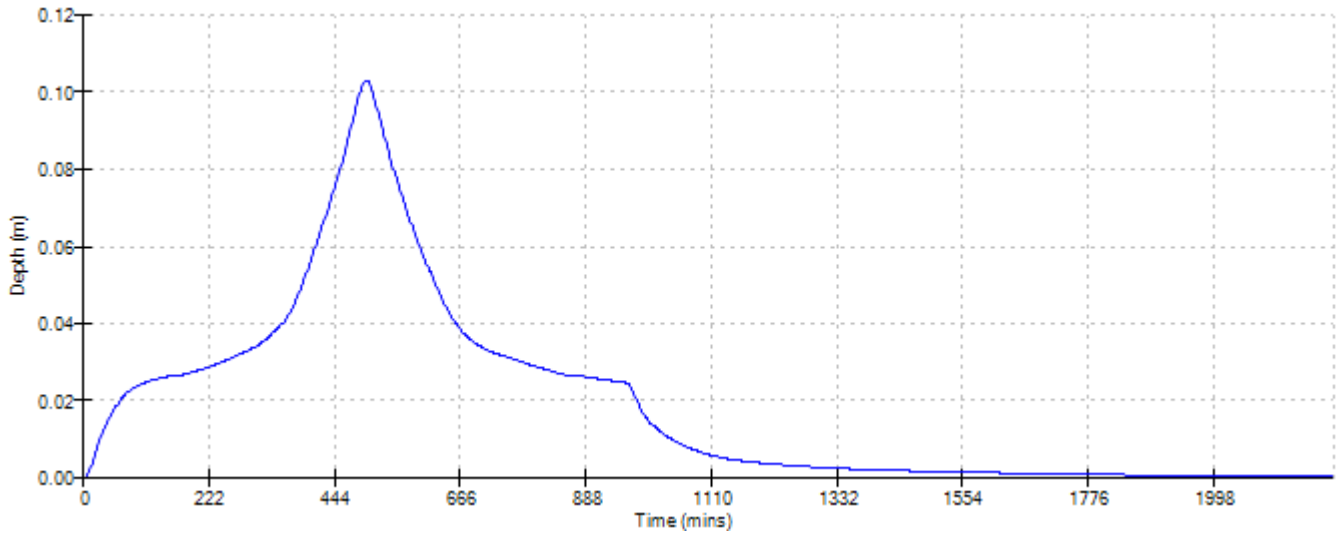




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Event: 960 min Summer

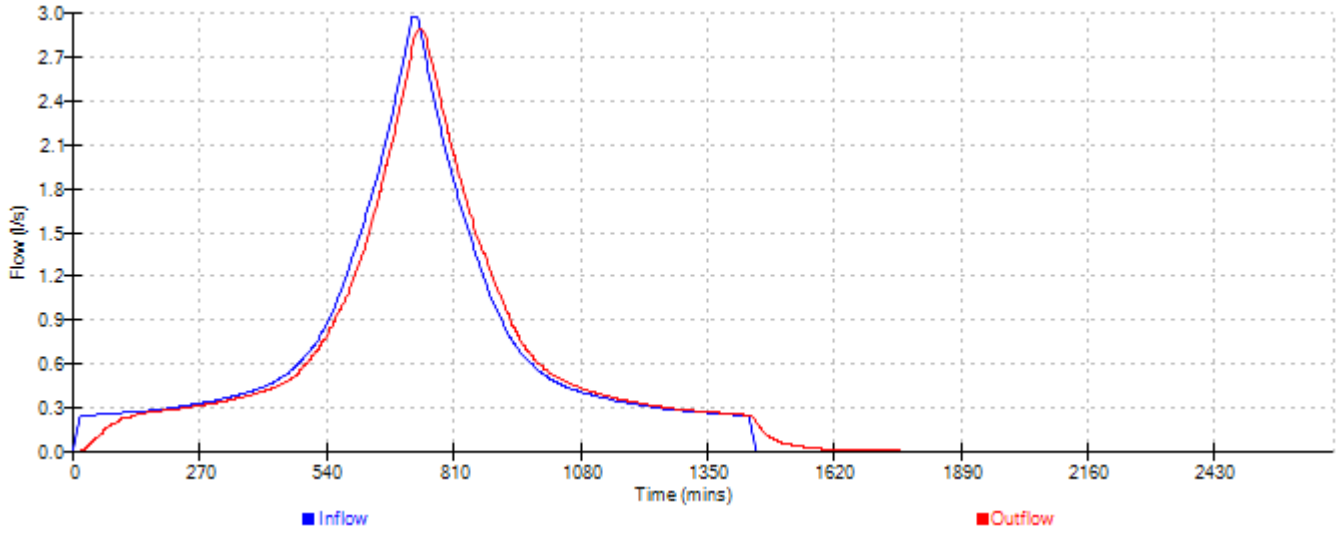


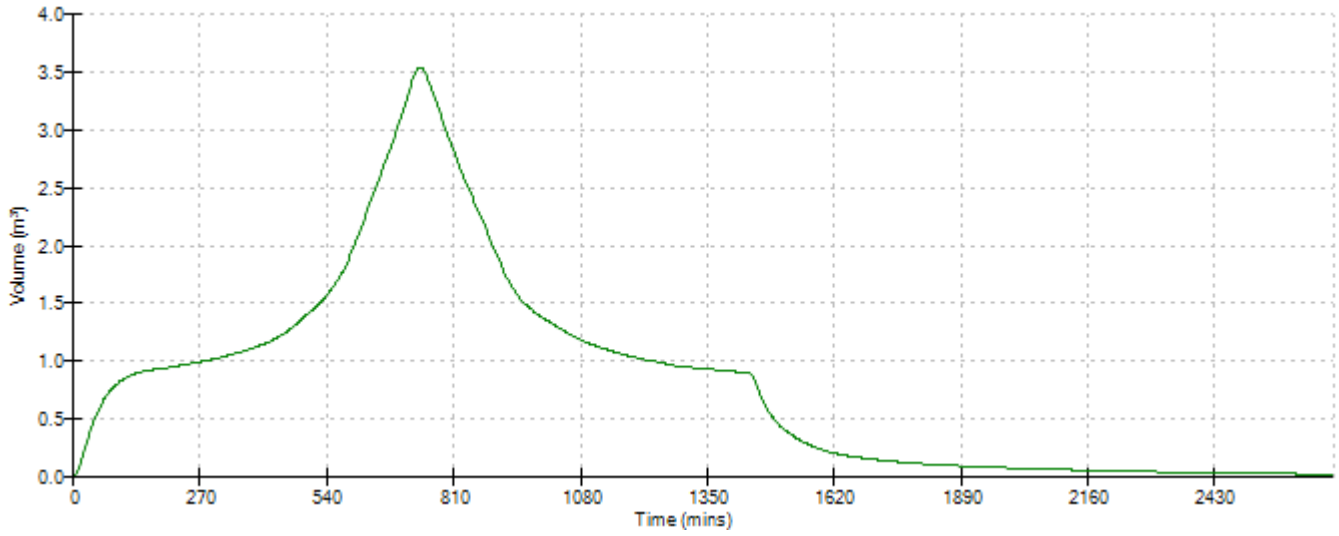



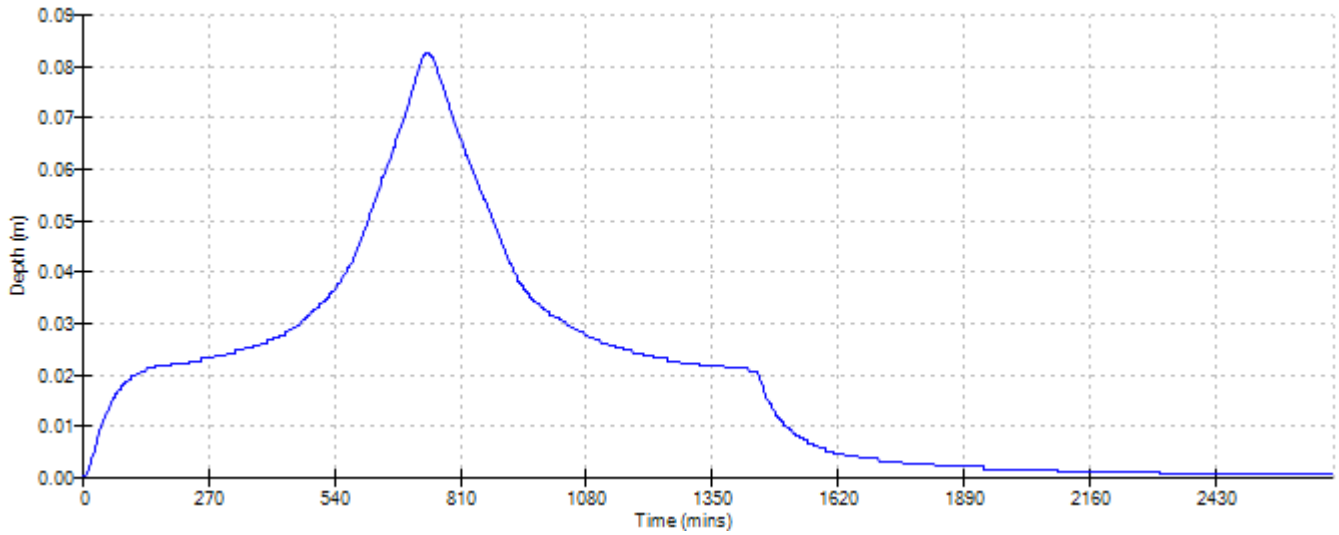




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Event: 1440 min Summer

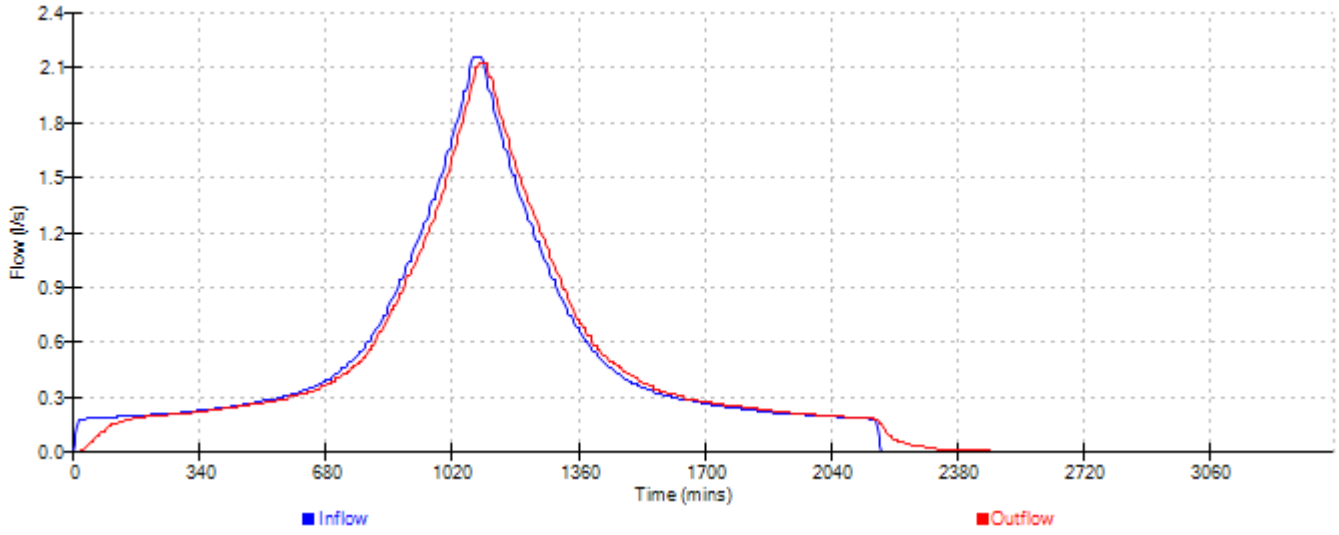


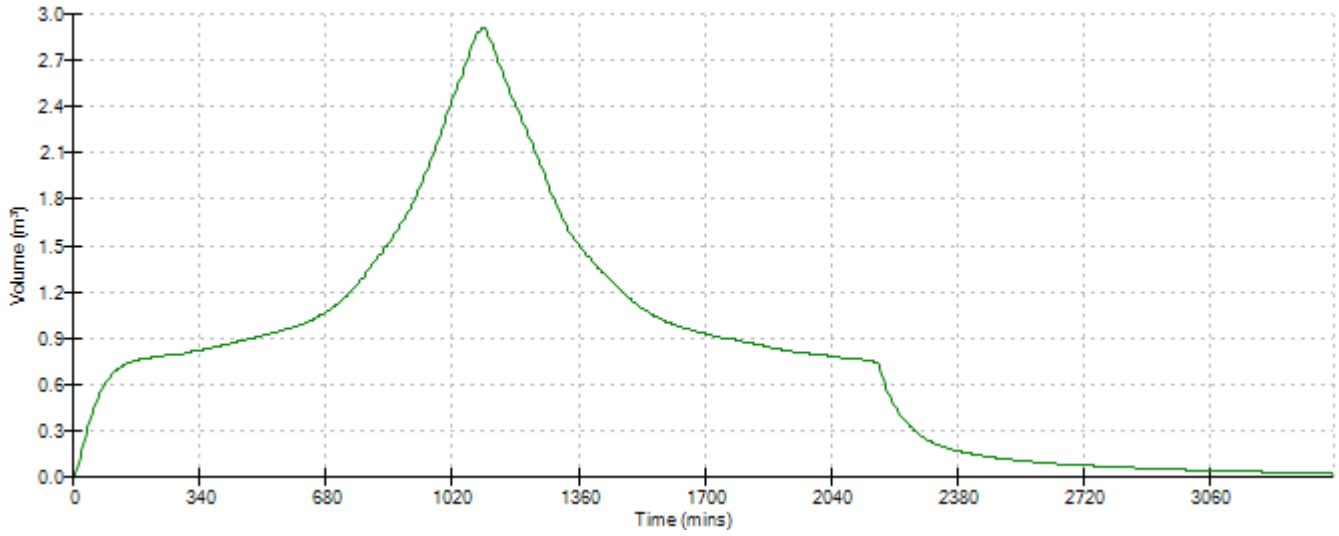



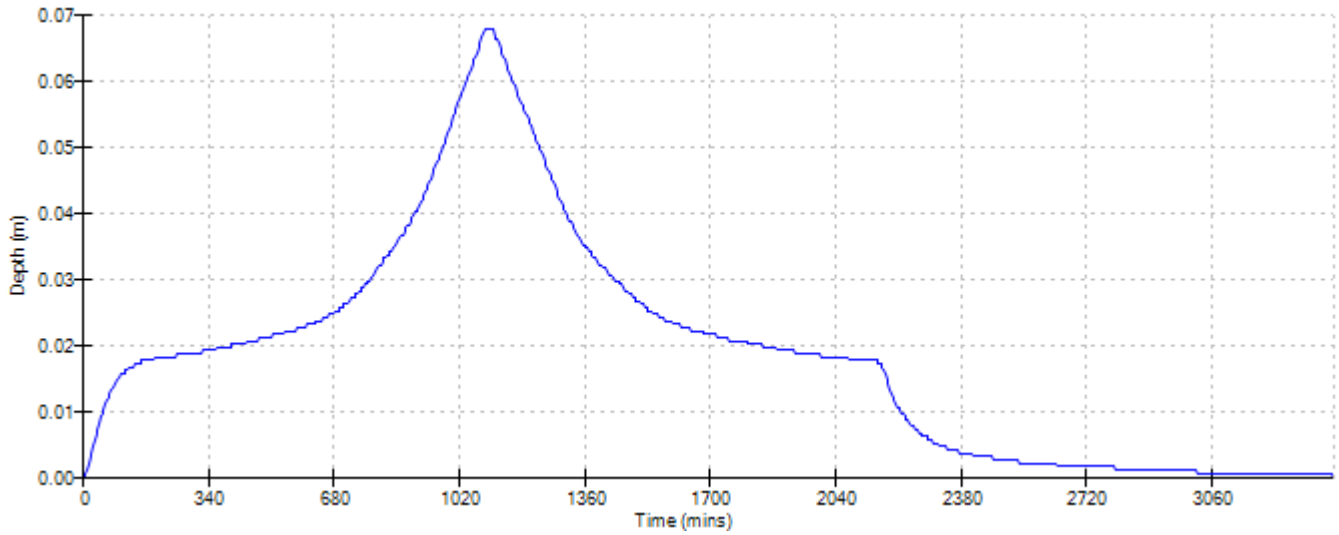




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Event: 2160 min Summer

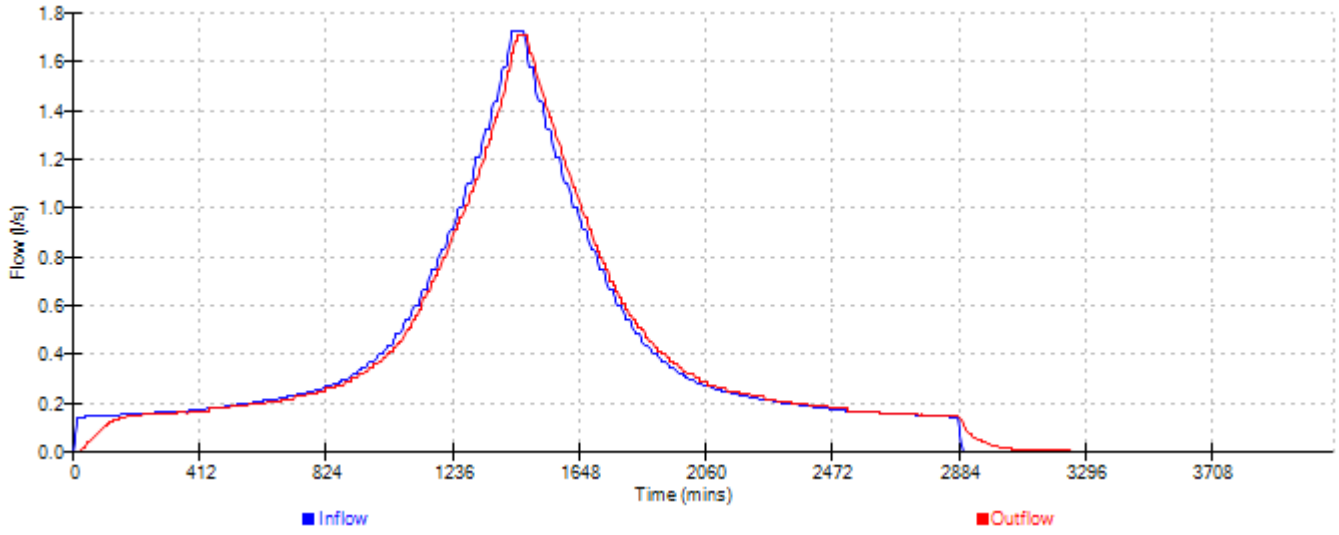


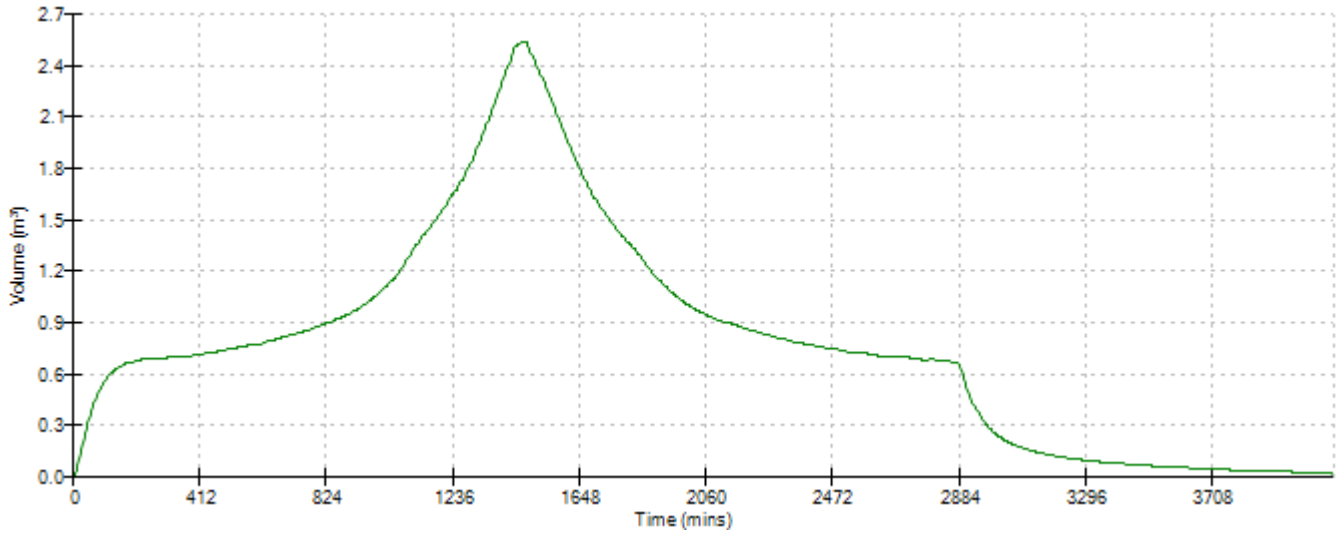



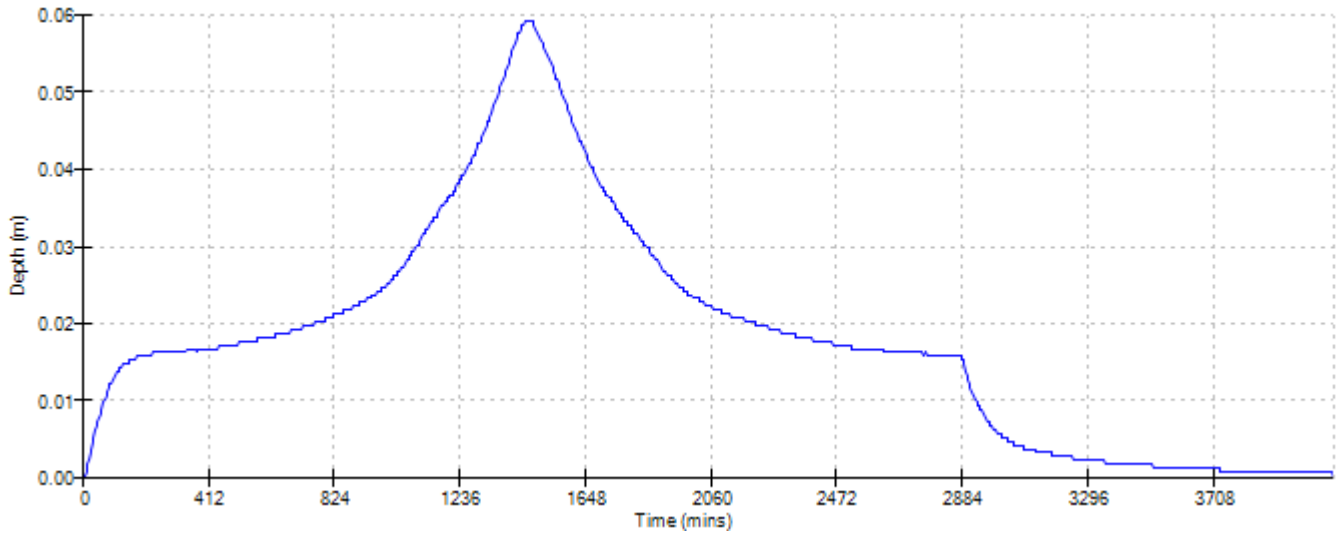




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Event: 2880 min Summer

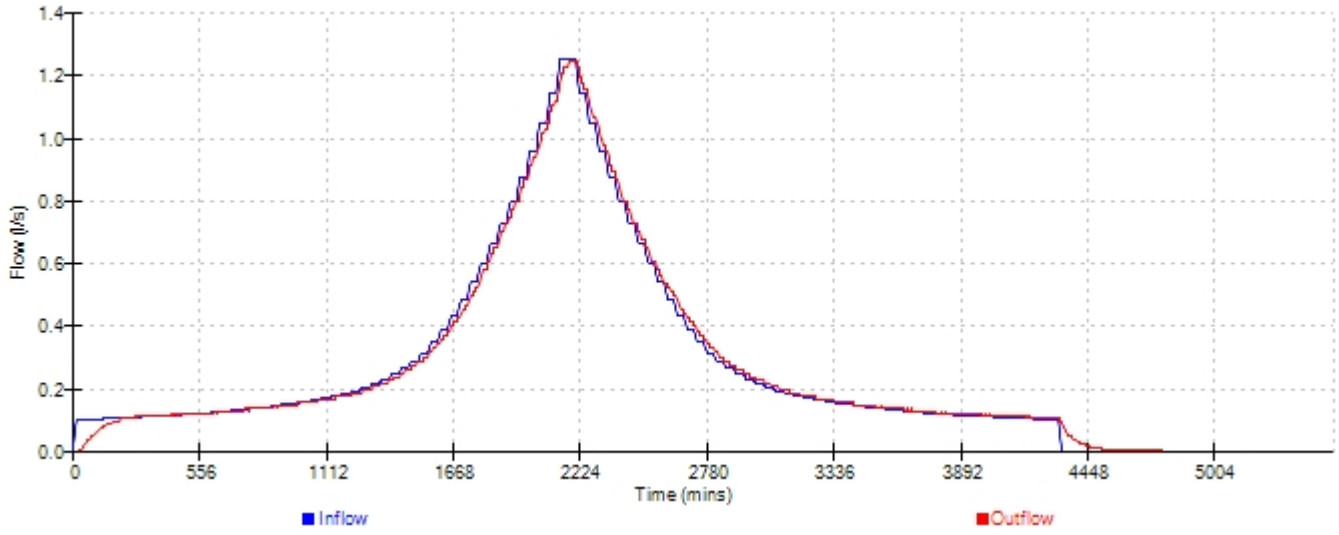


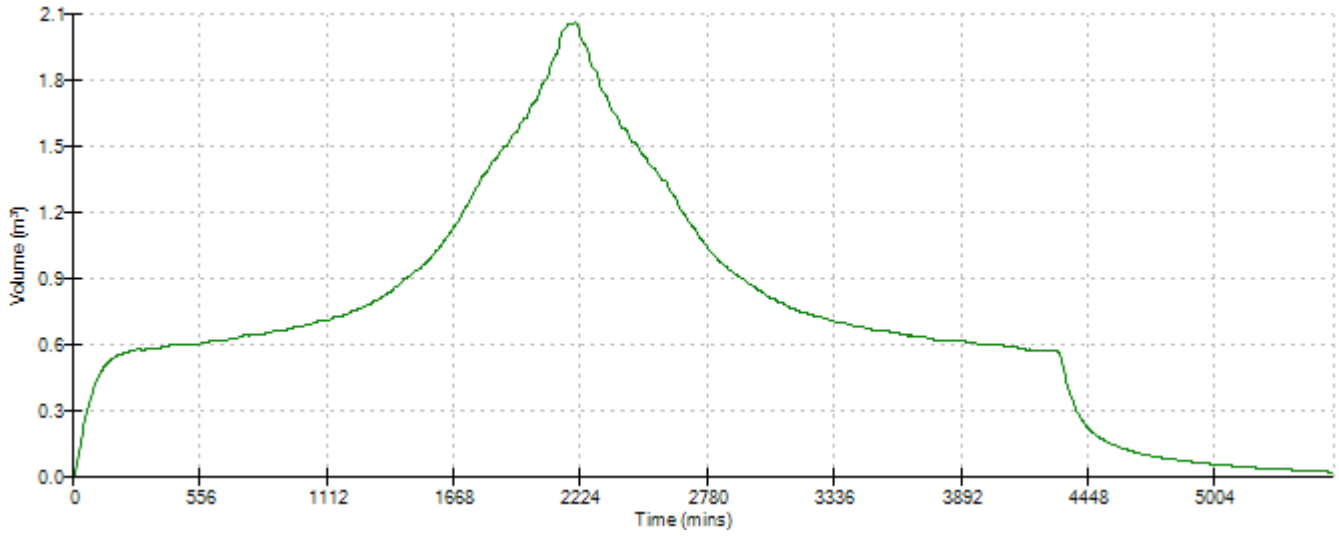



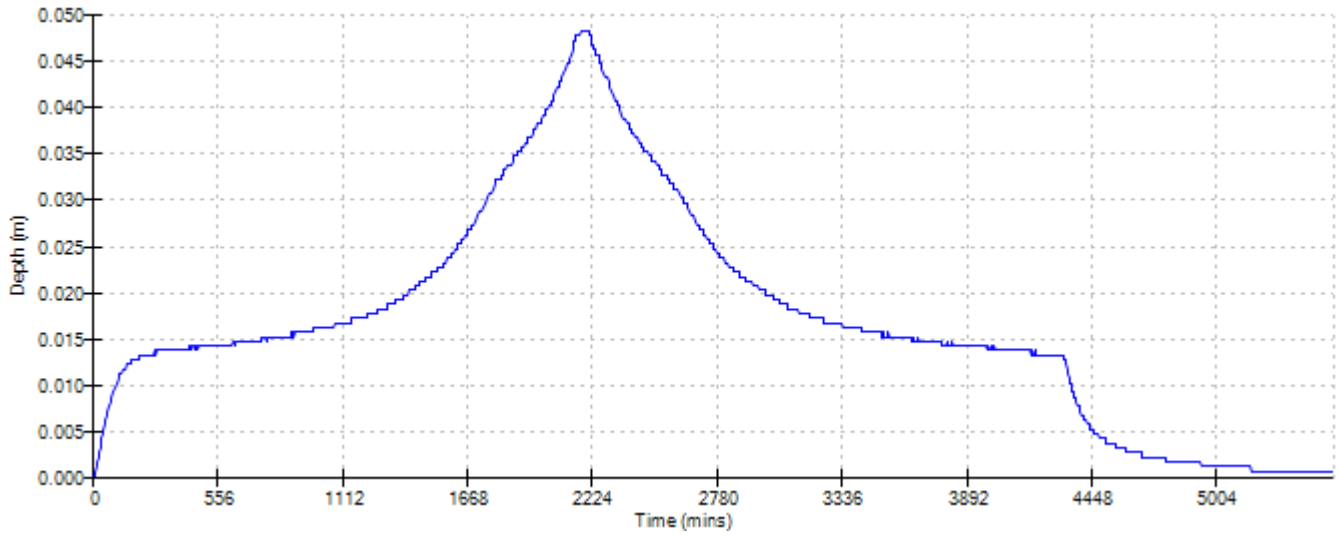




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Event: 4320 min Summer

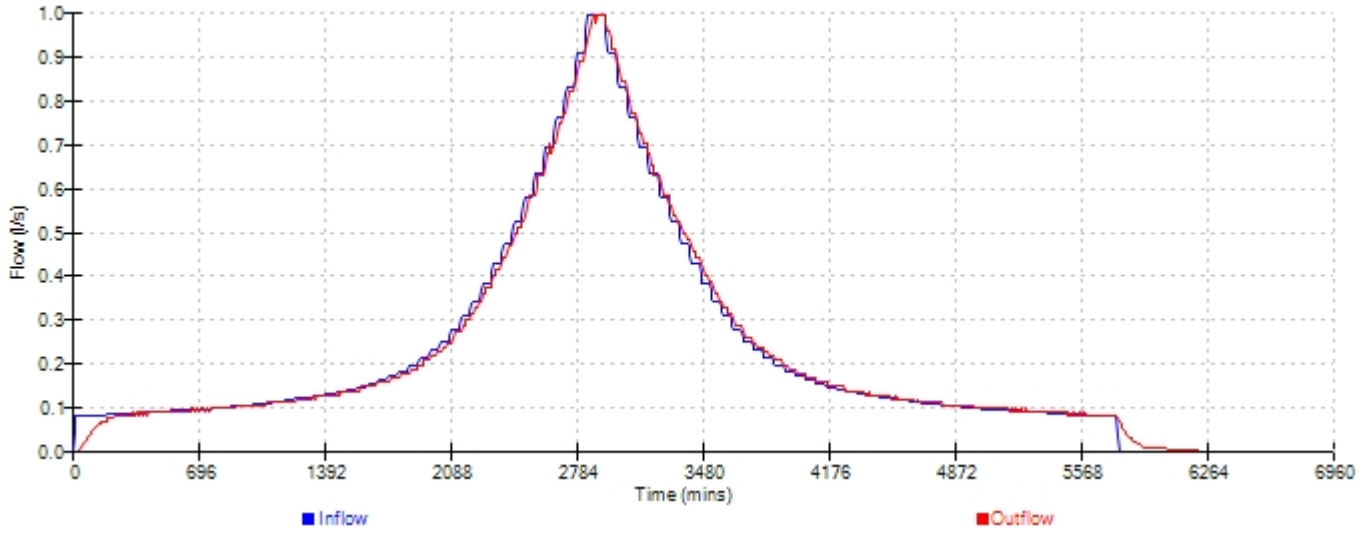


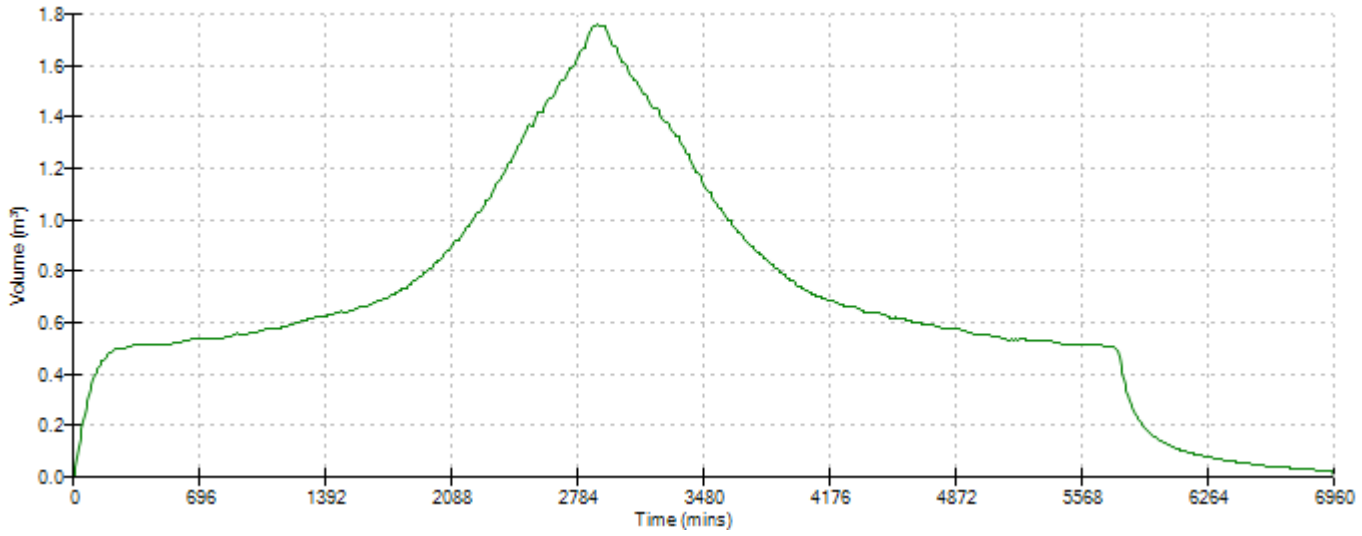



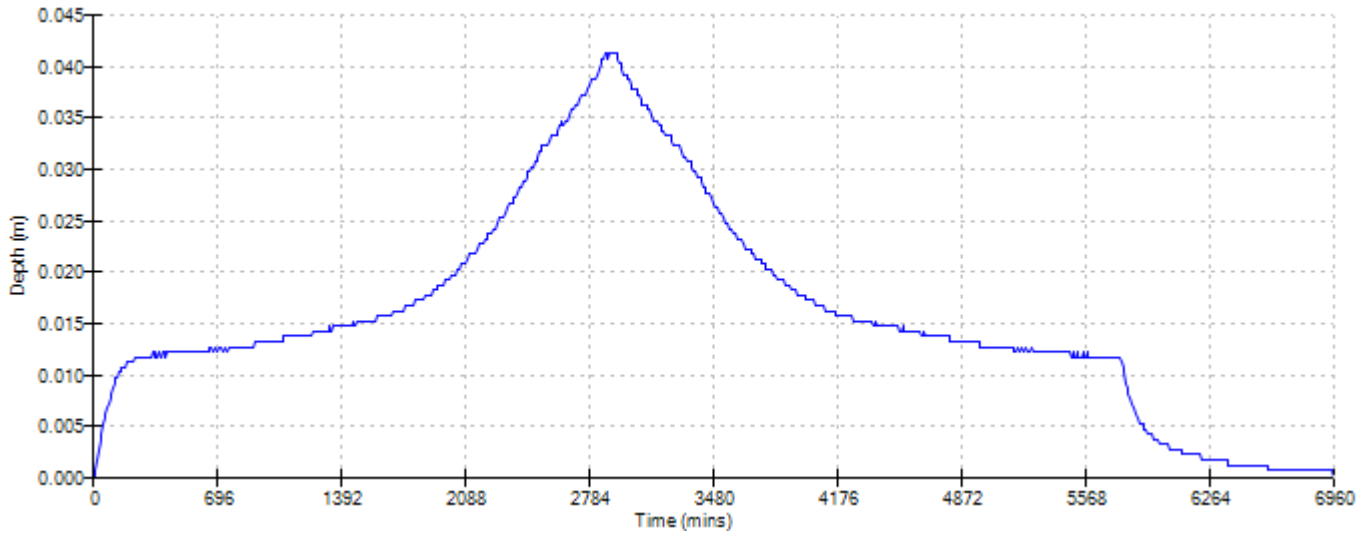




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Event: 5760 min Summer

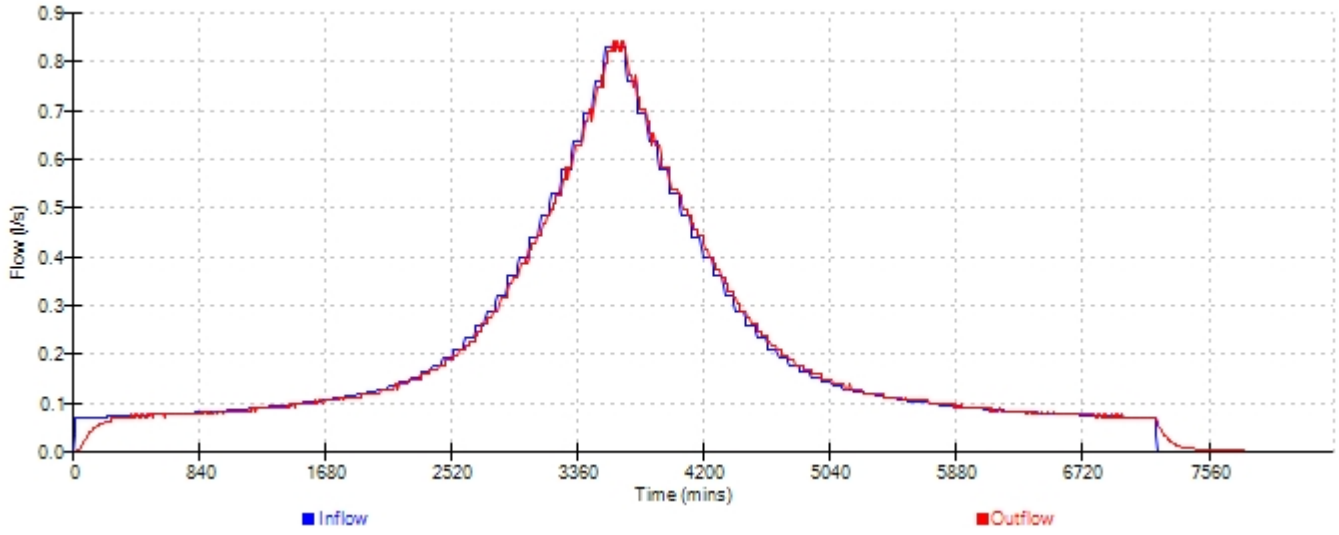


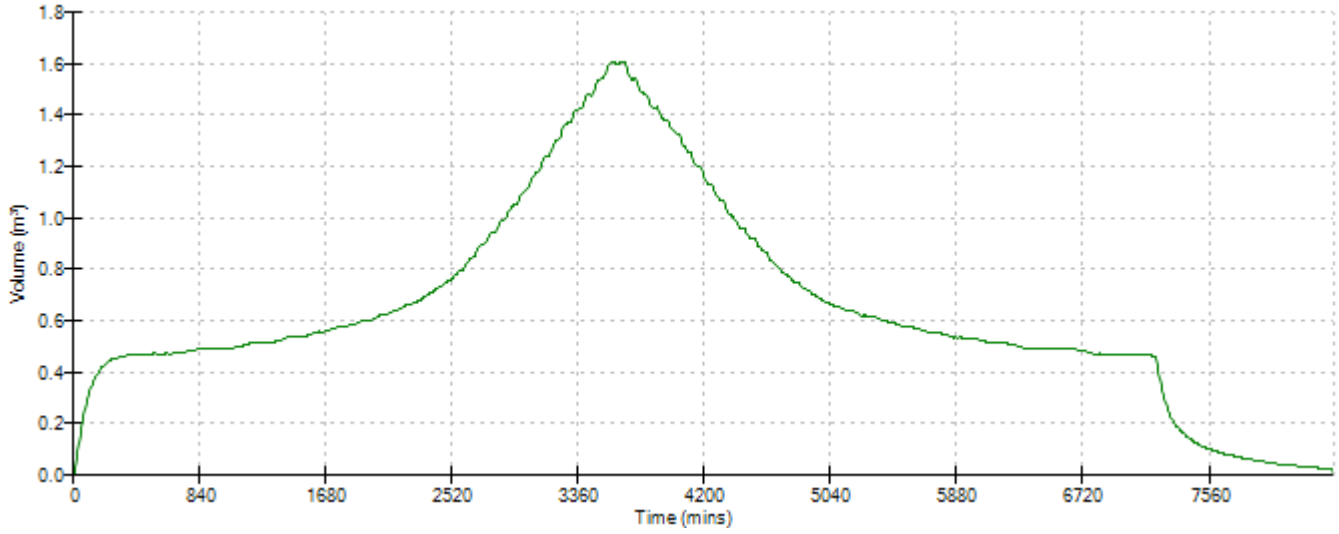



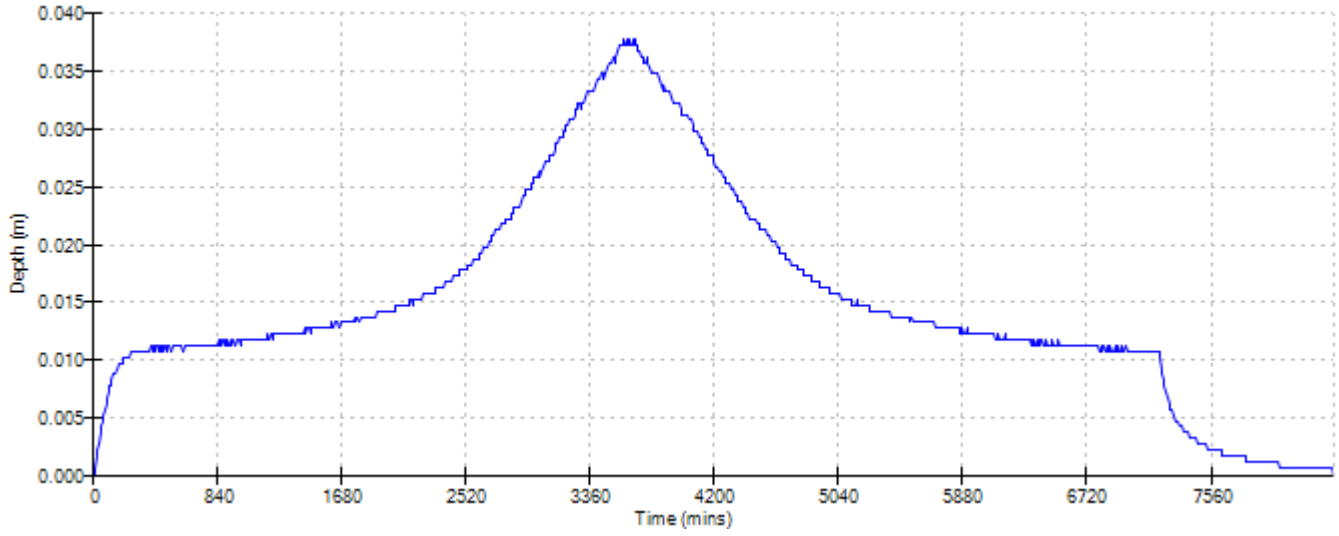




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Event: 7200 min Summer

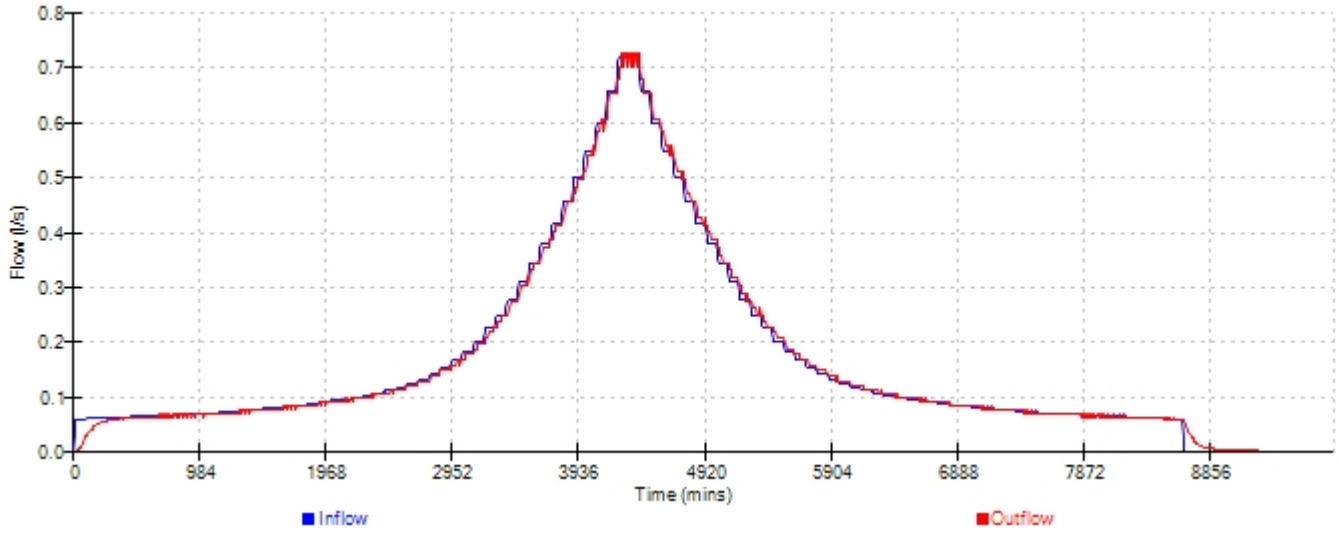


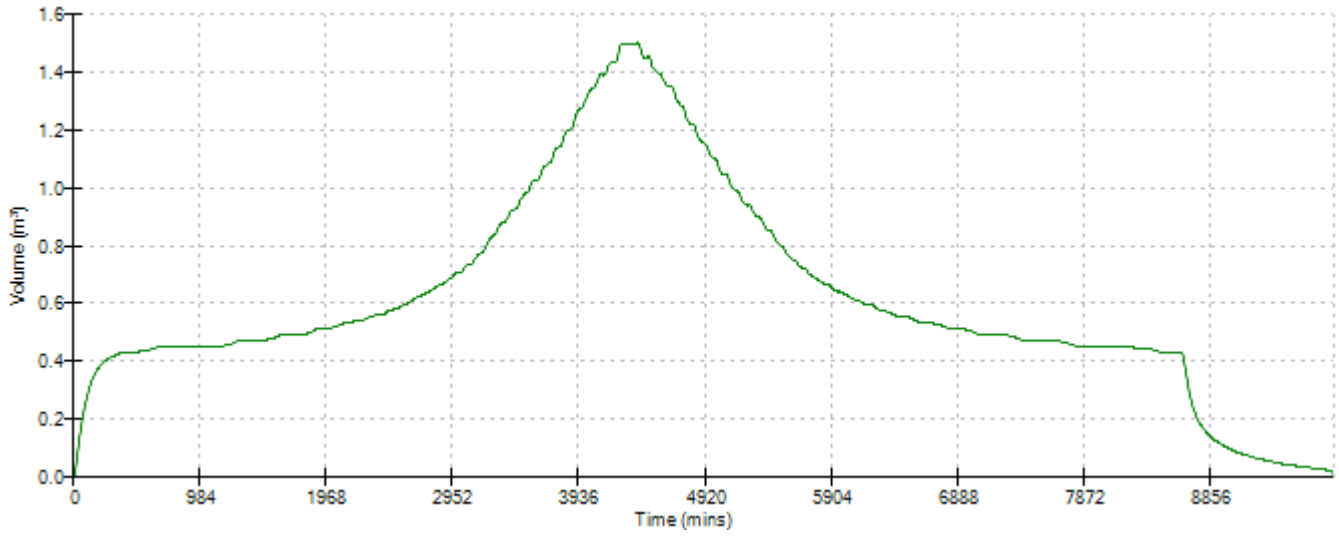



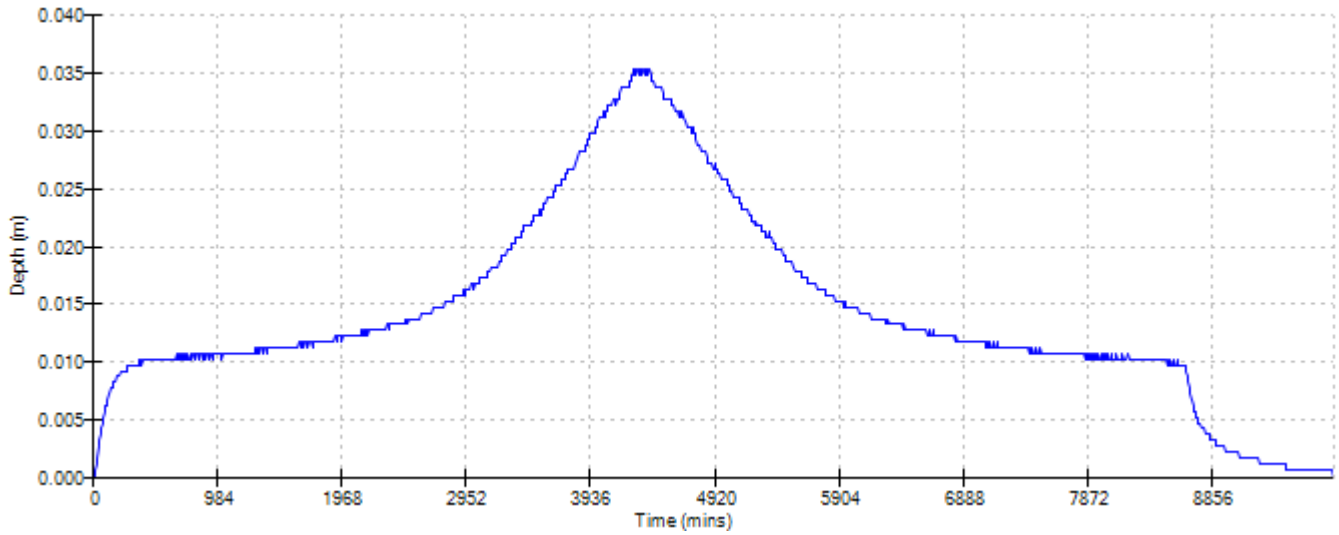




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Event: 8640 min Summer

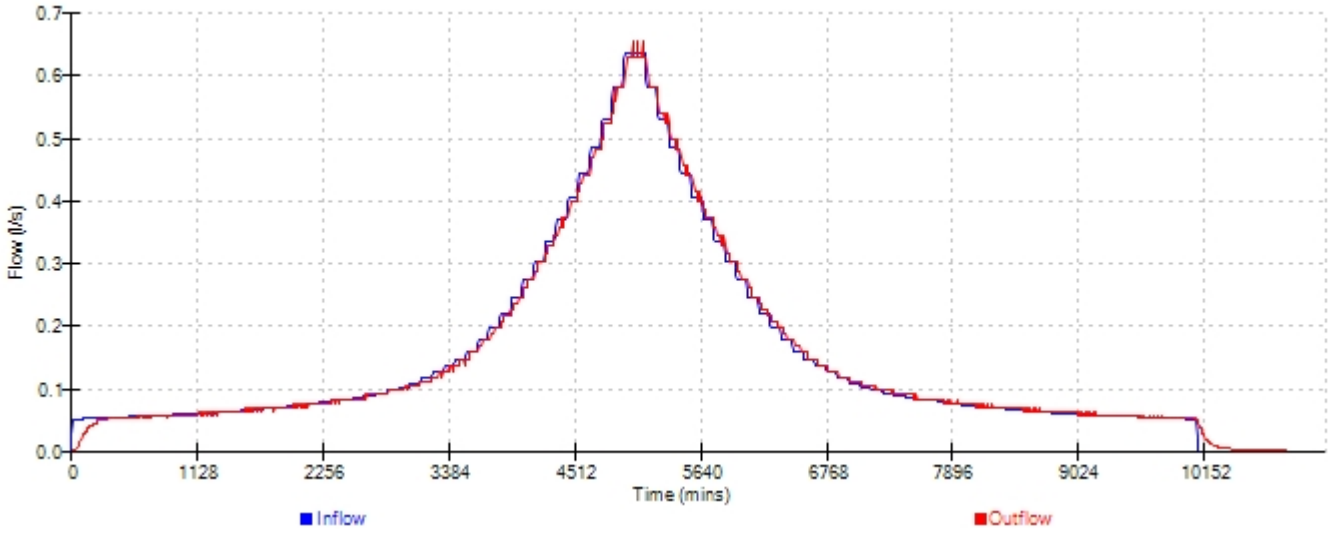


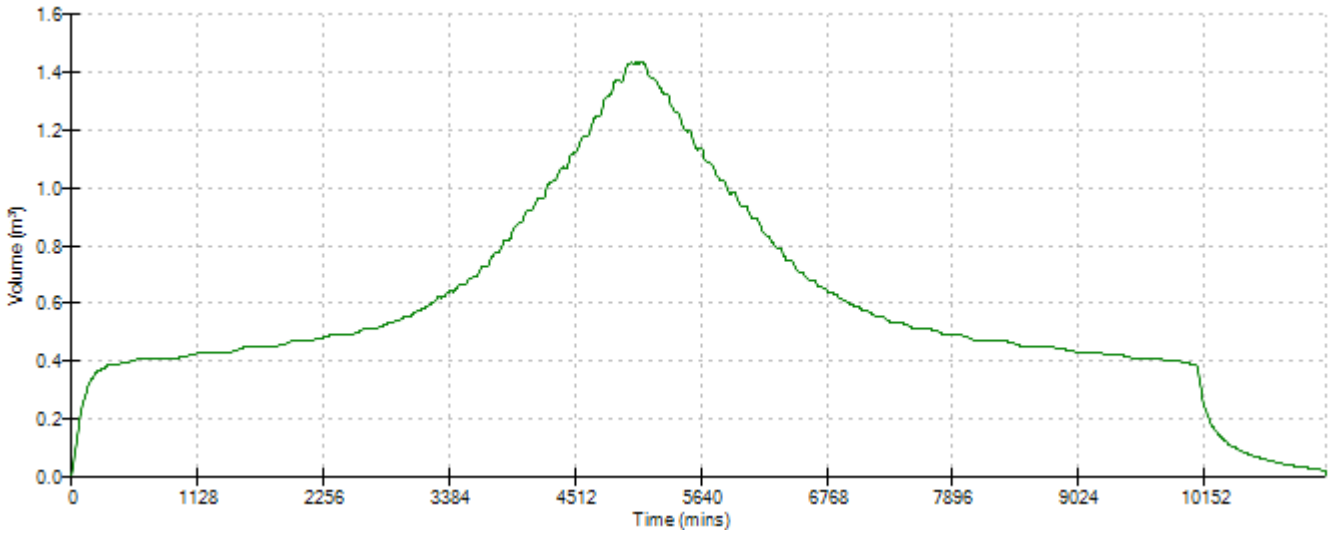



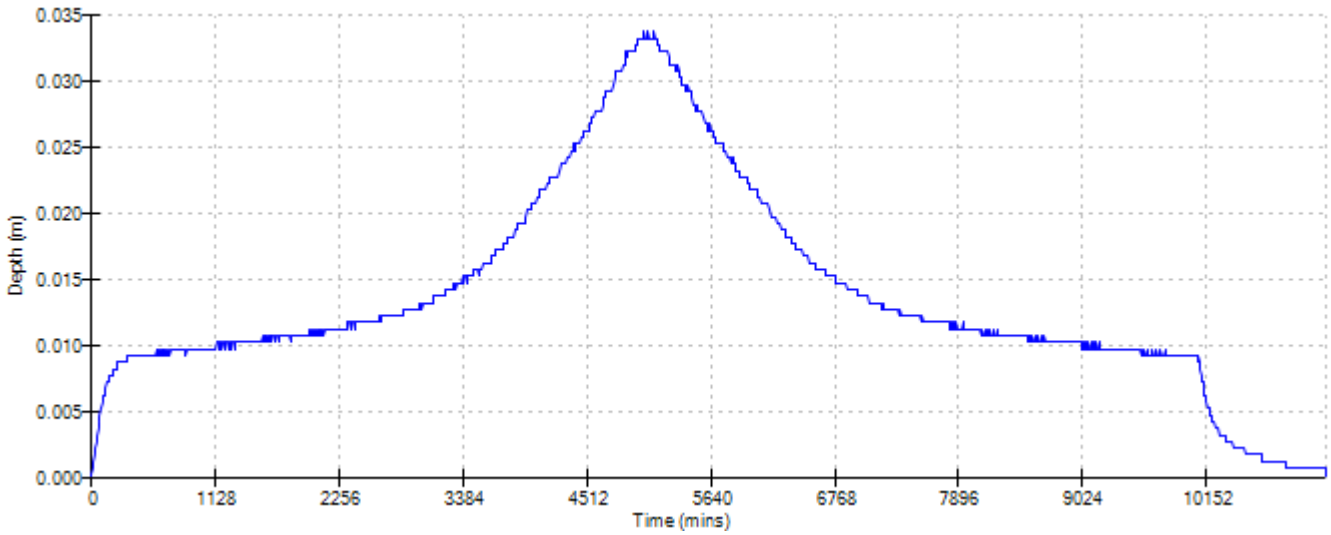




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Event: 10080 min Summer

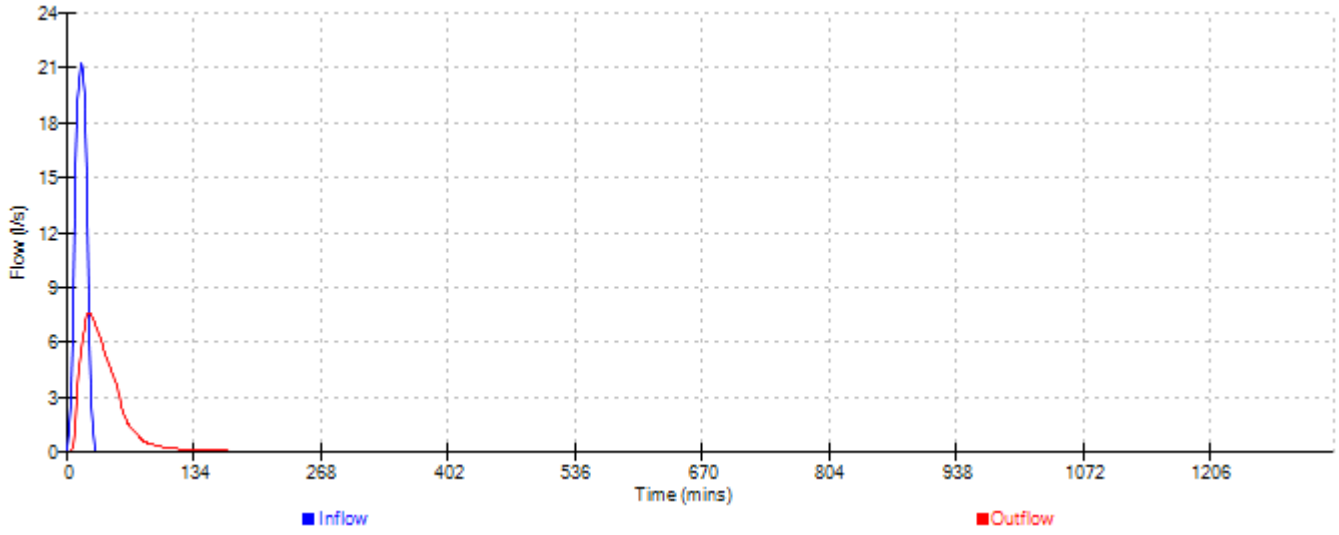


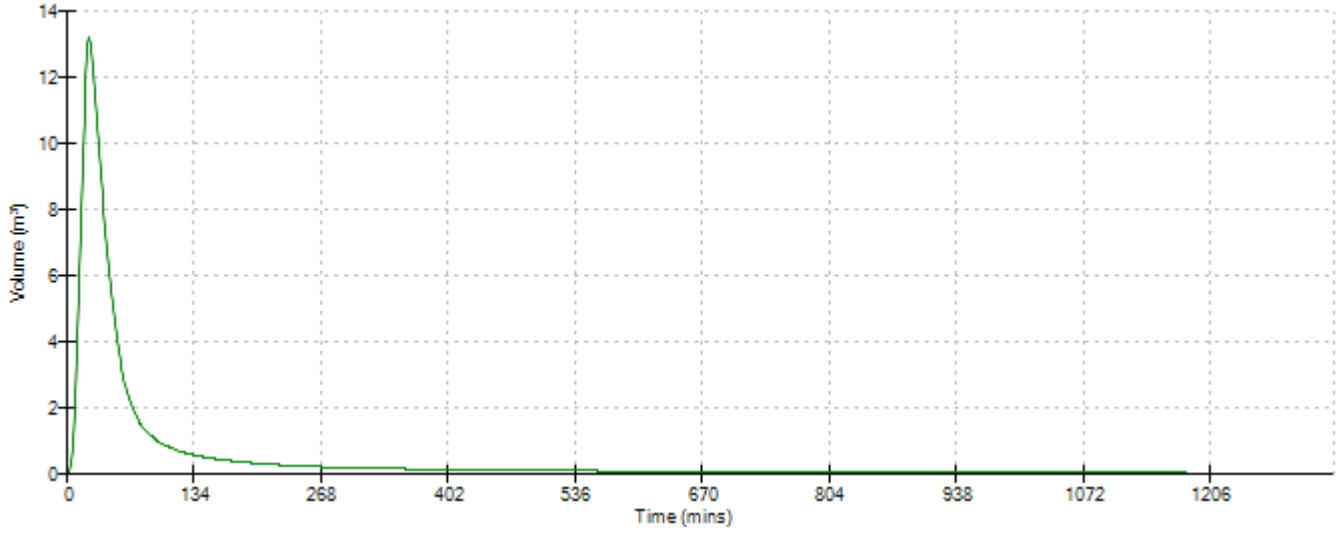



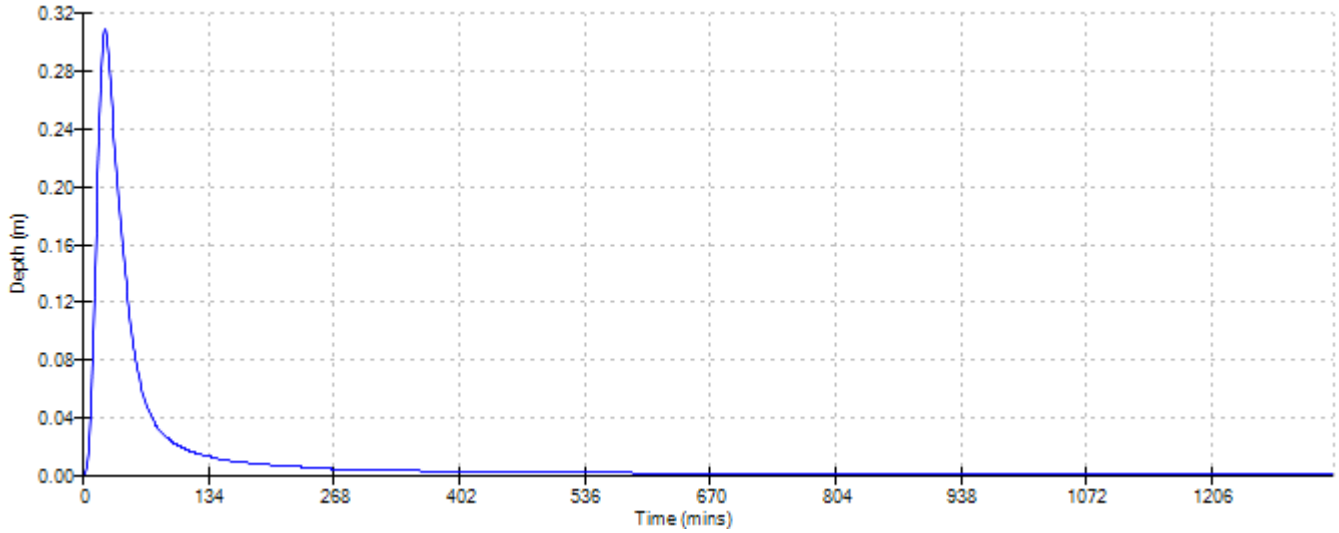




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Event: 15 min Winter

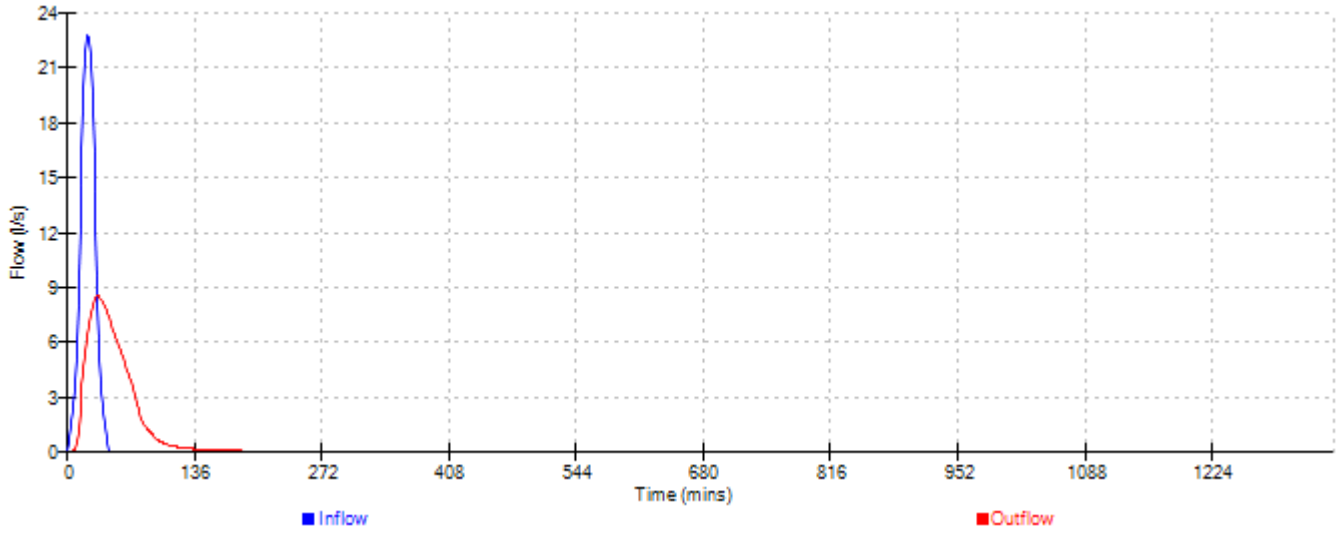


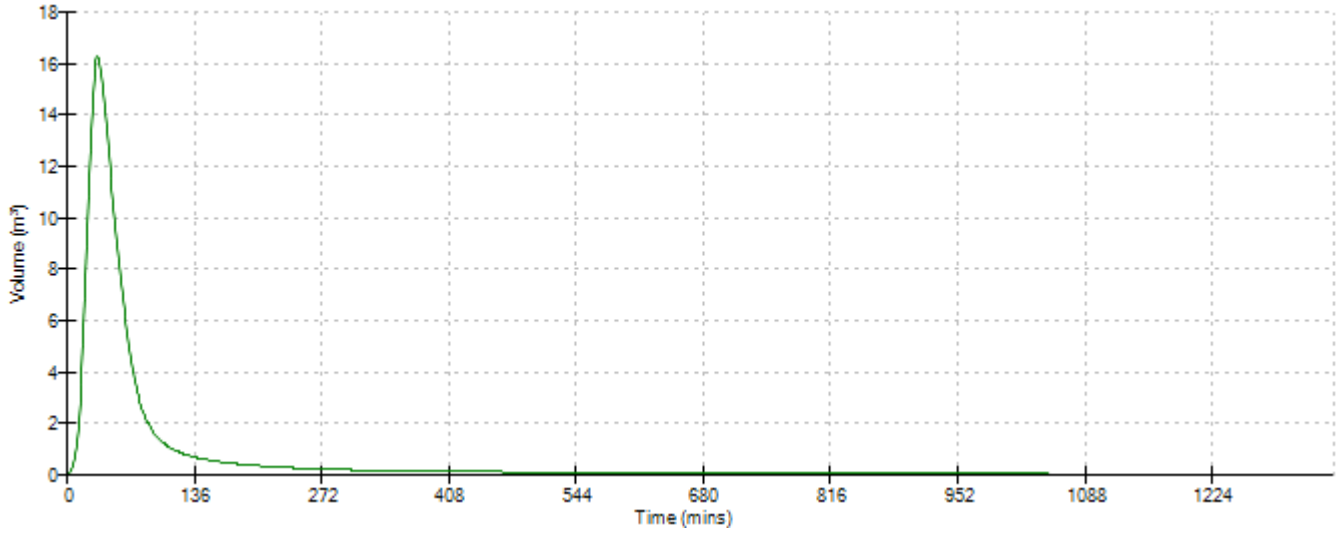



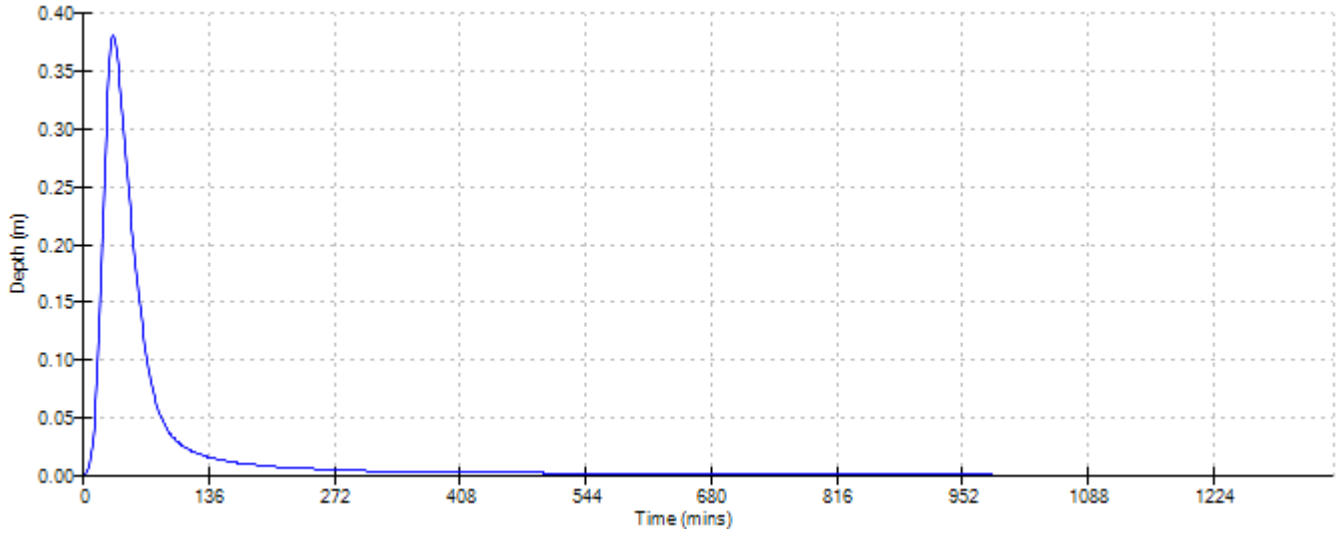




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Event: 30 min Winter

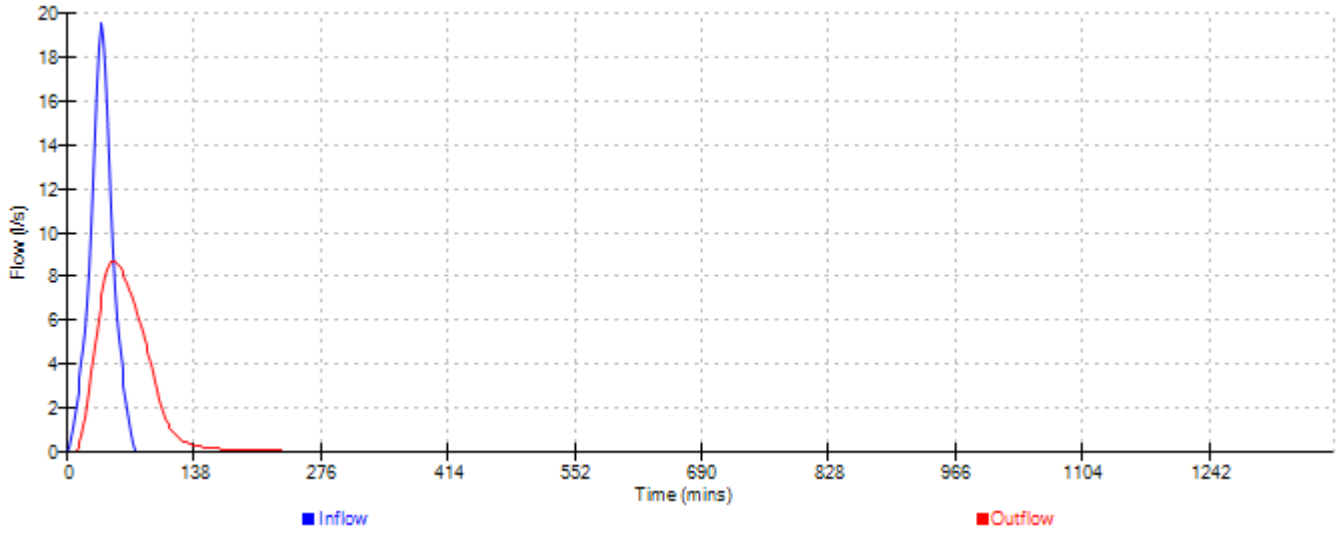


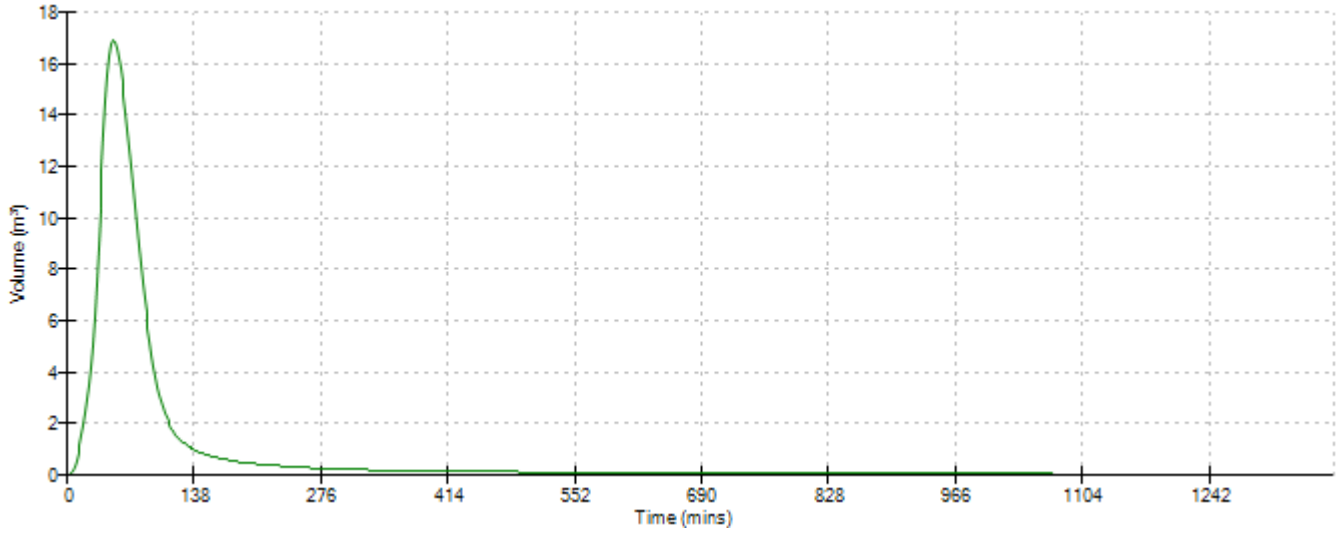



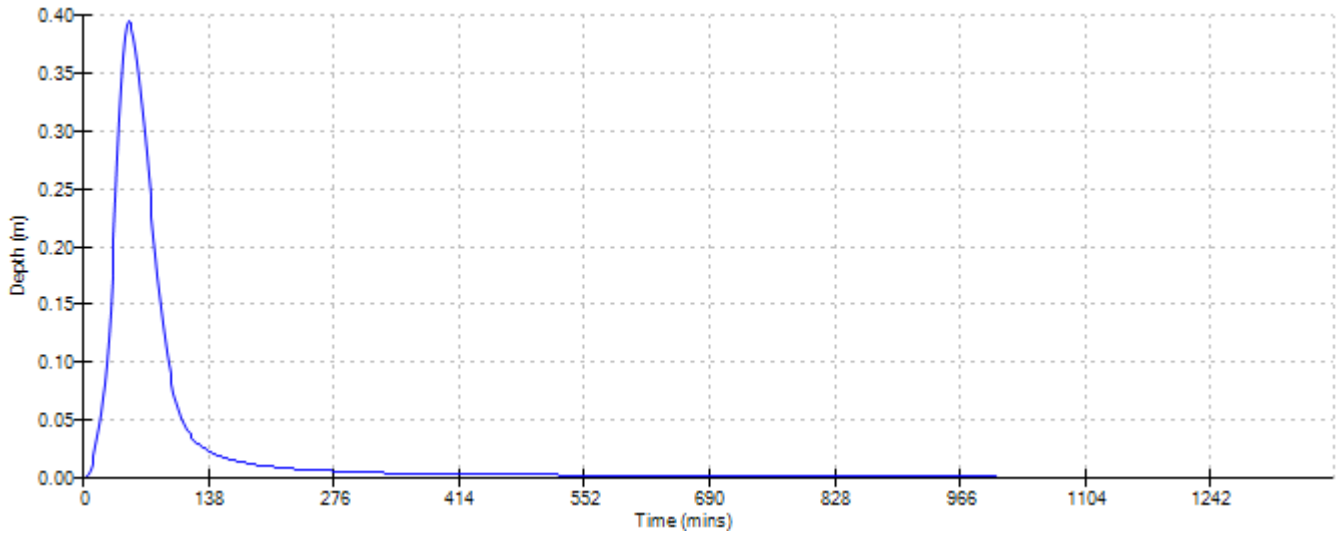




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Event: 60 min Winter

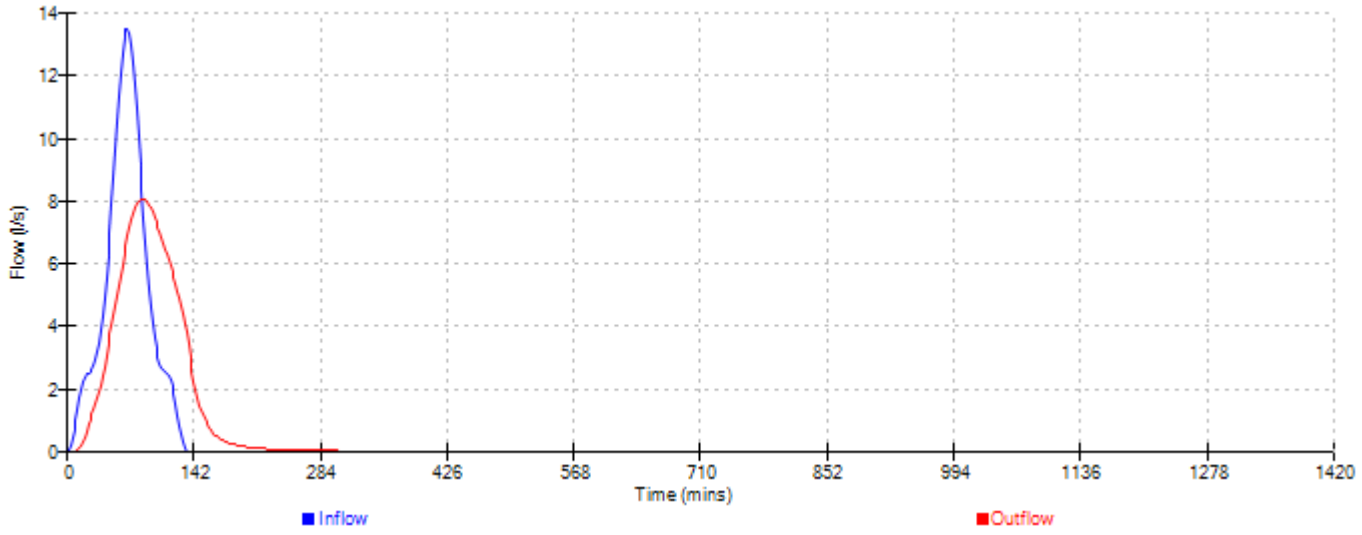


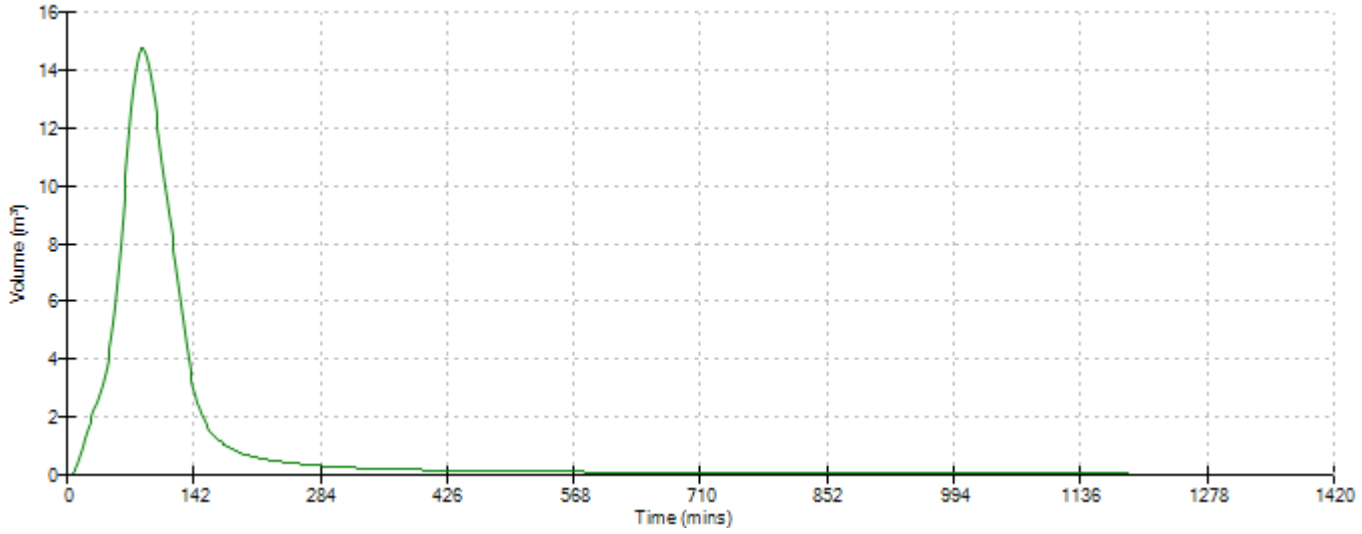



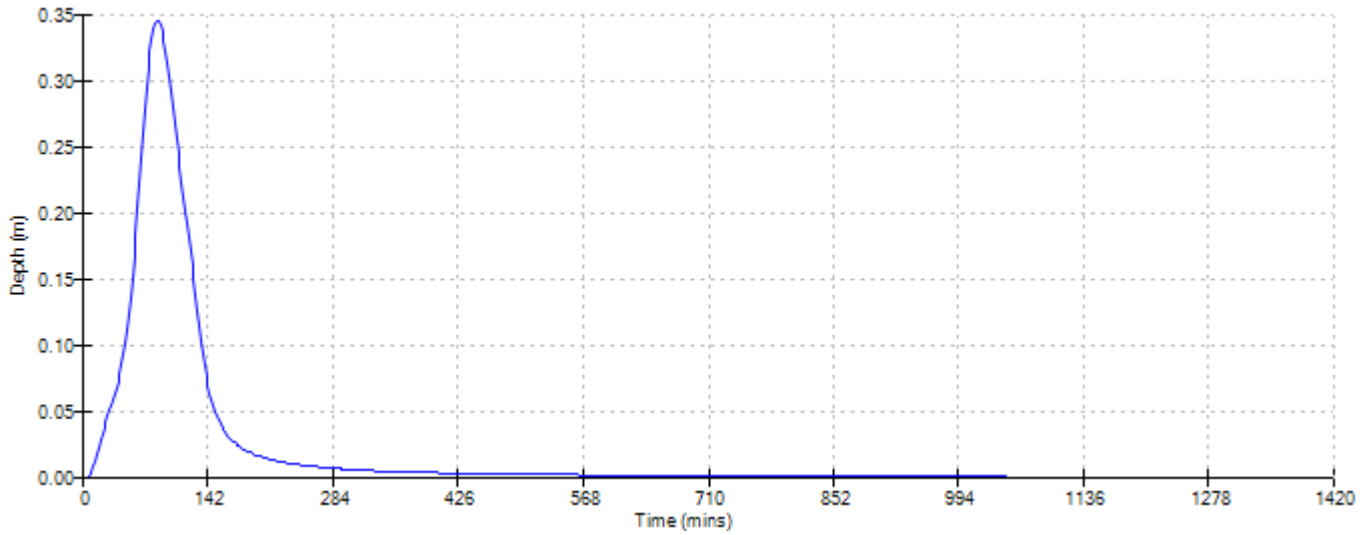




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Event: 120 min Winter

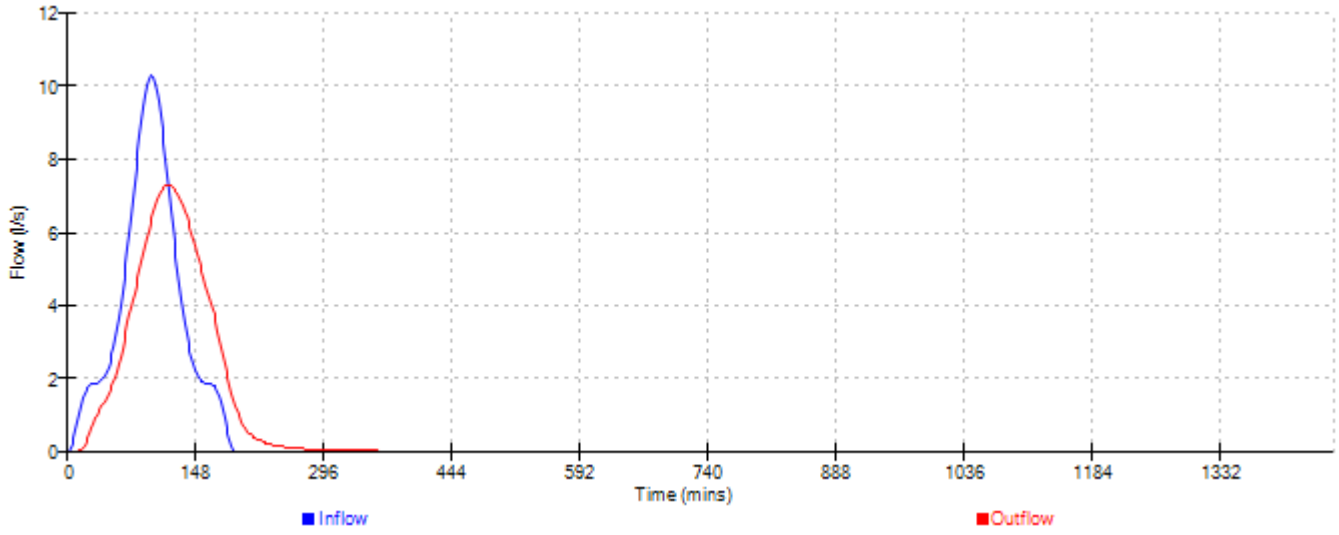


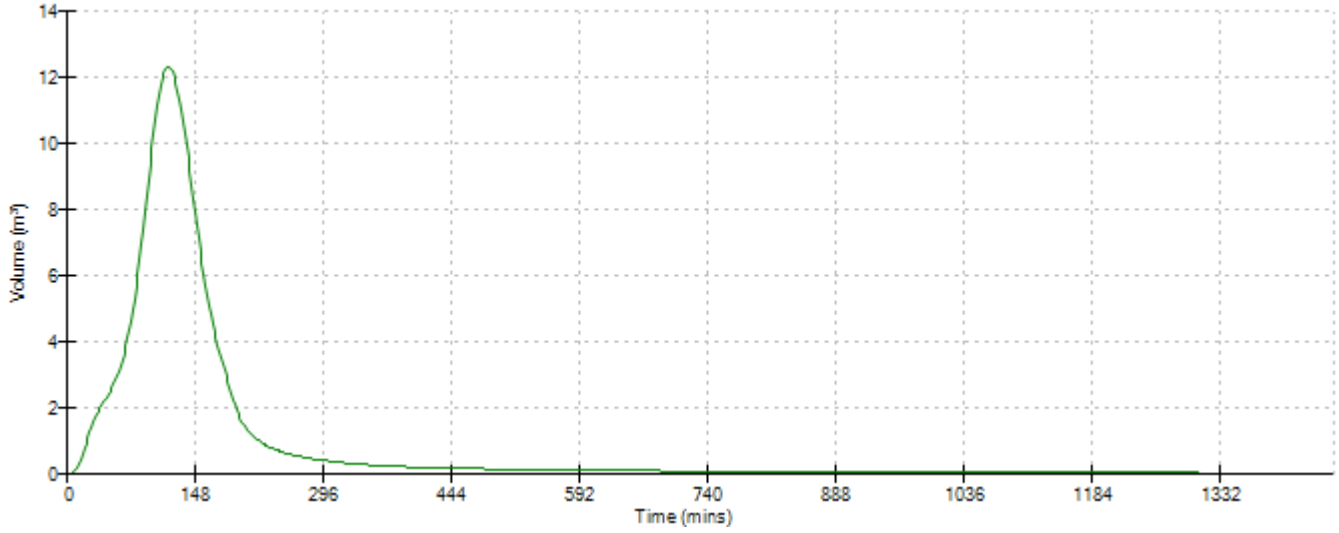



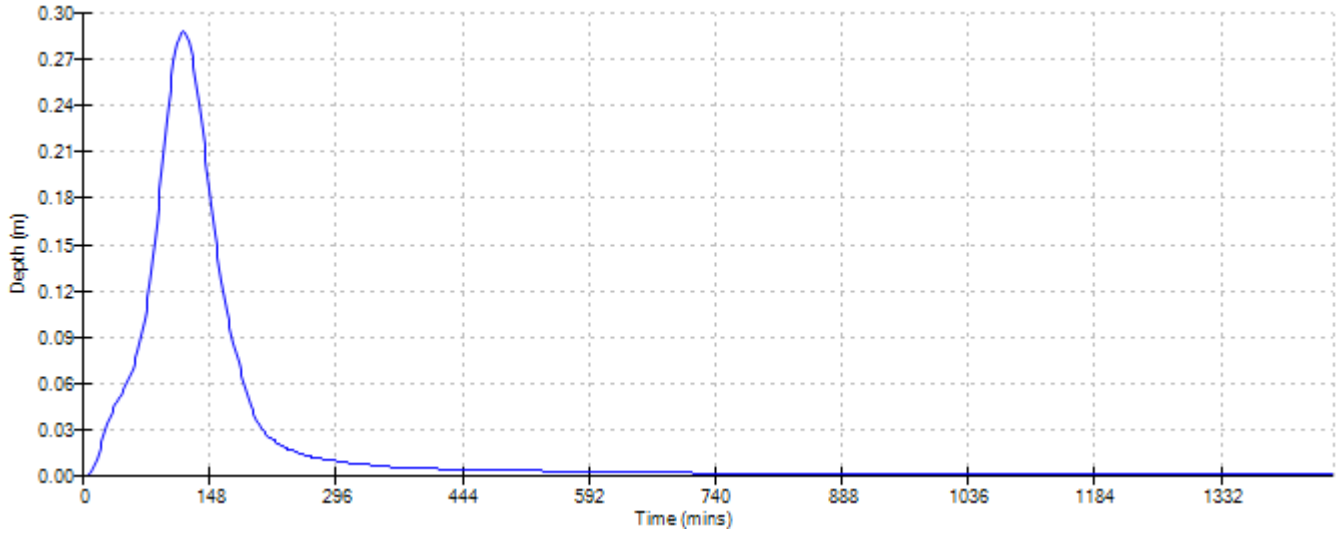




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Event: 180 min Winter

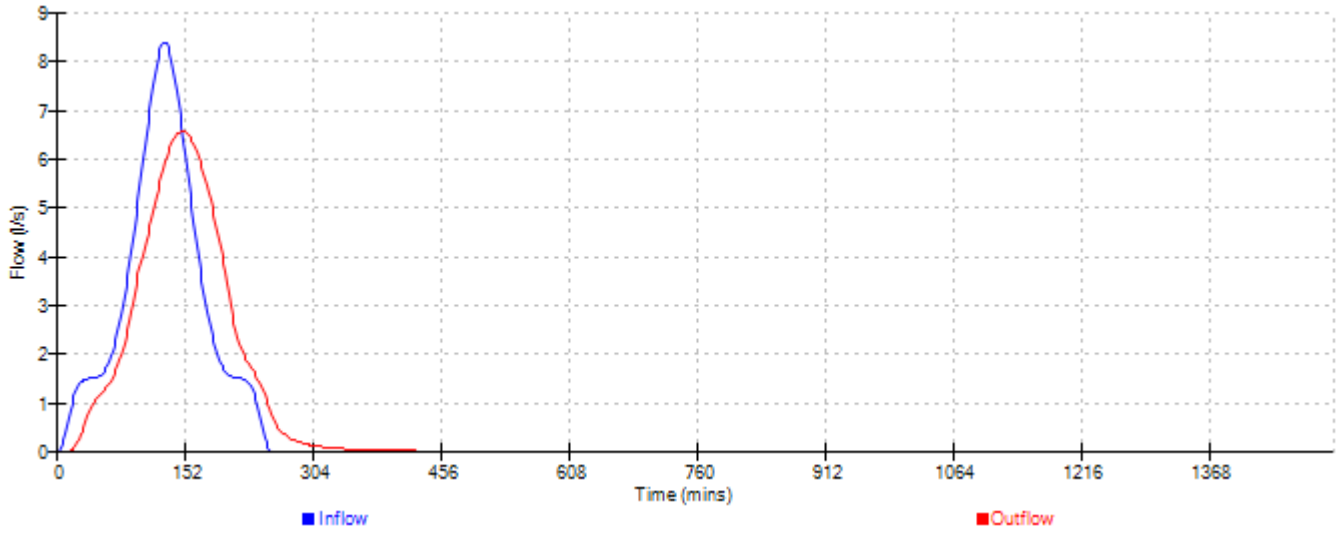


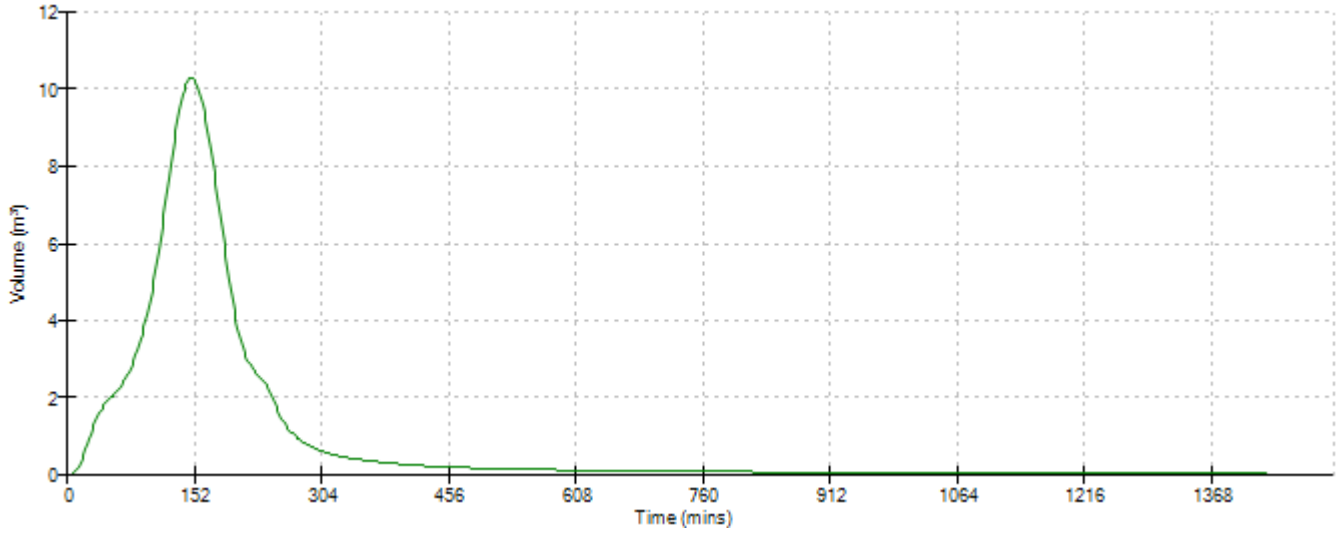



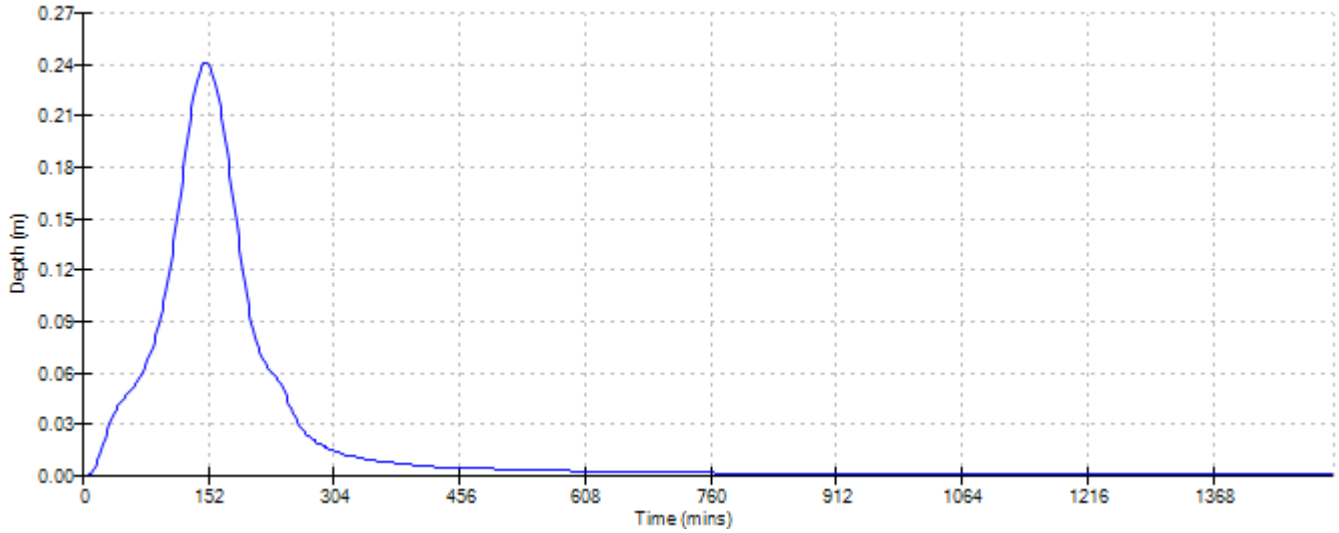




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Event: 240 min Winter

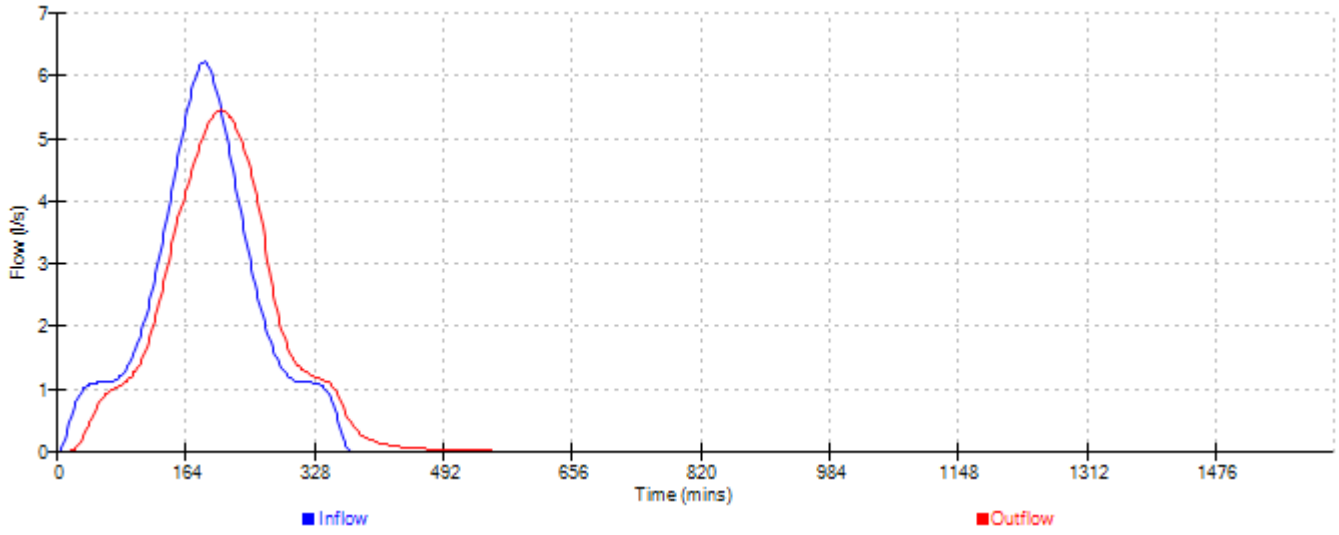


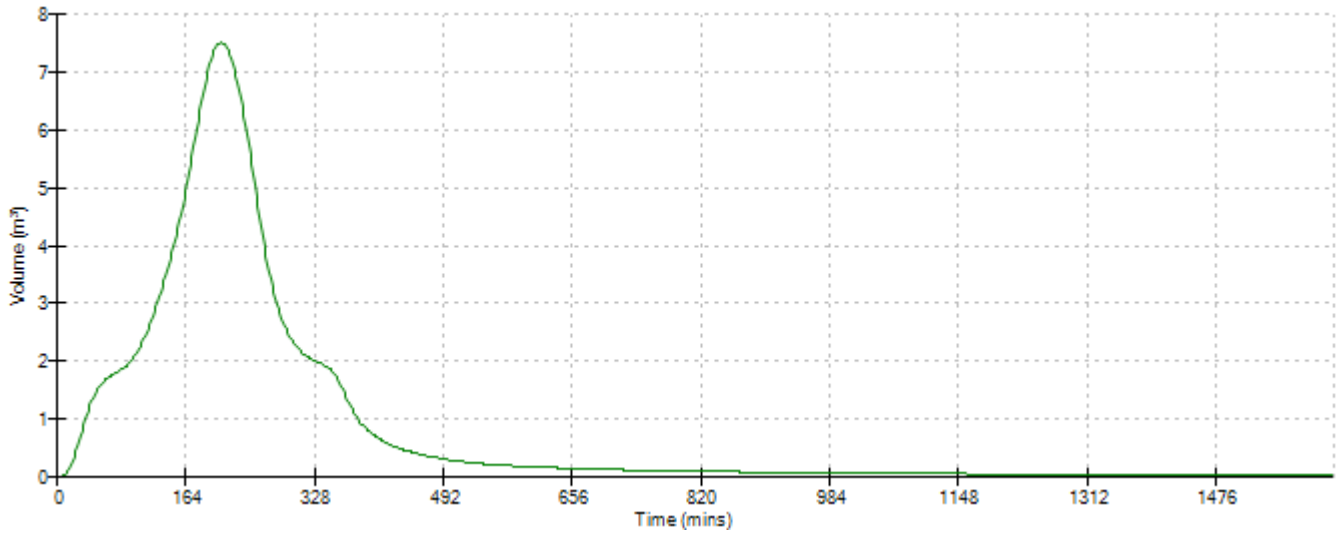



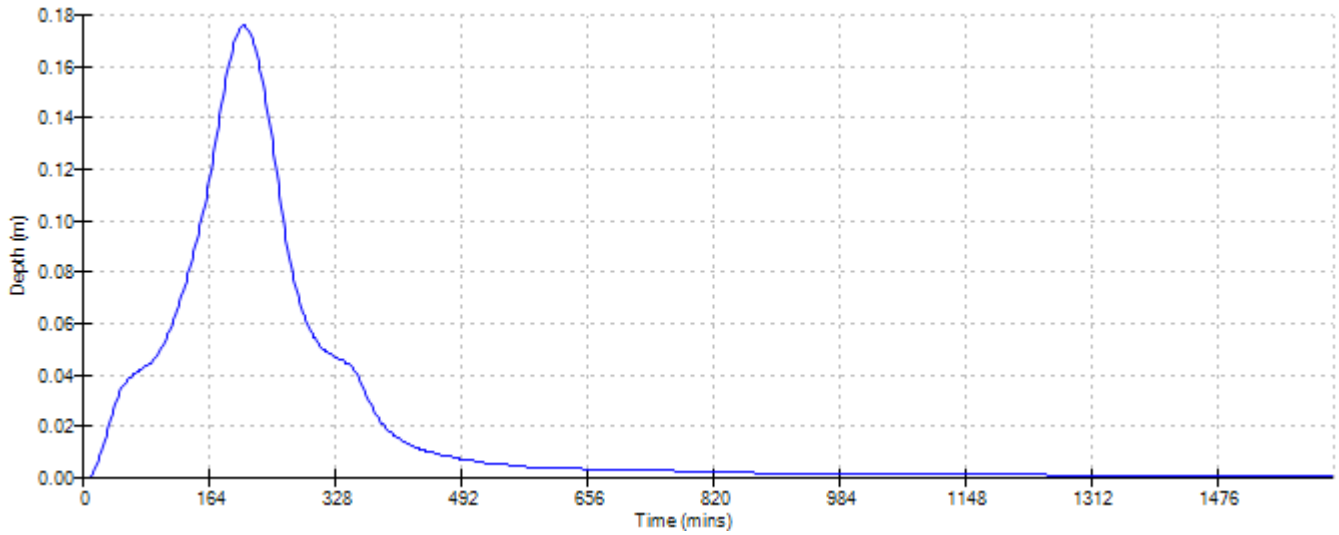




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Event: 360 min Winter

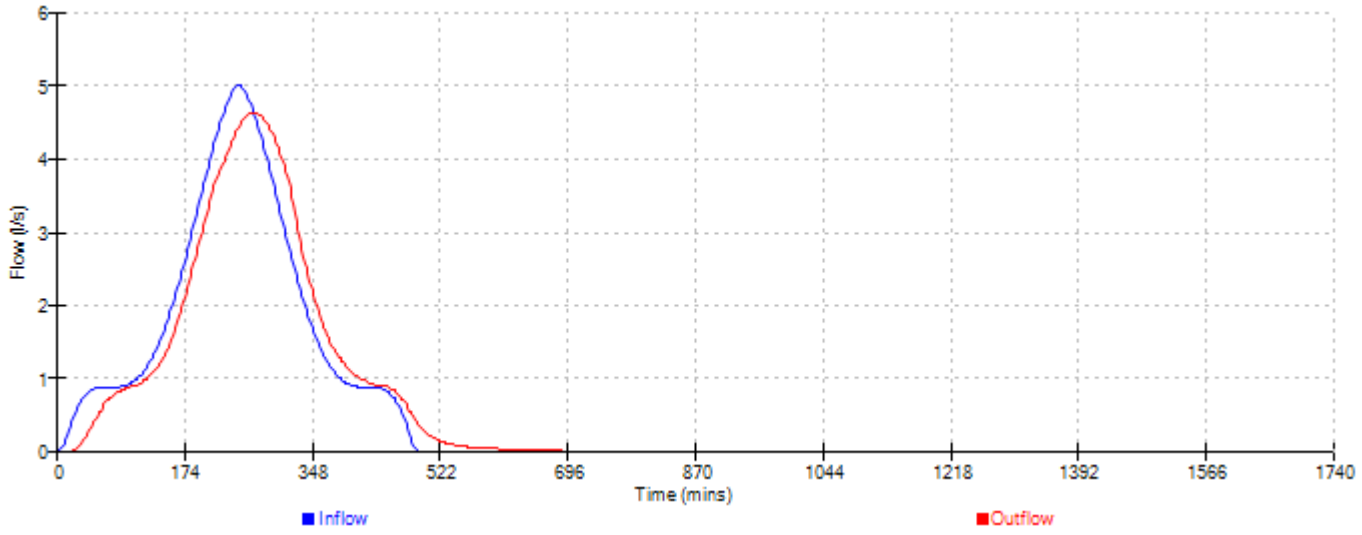


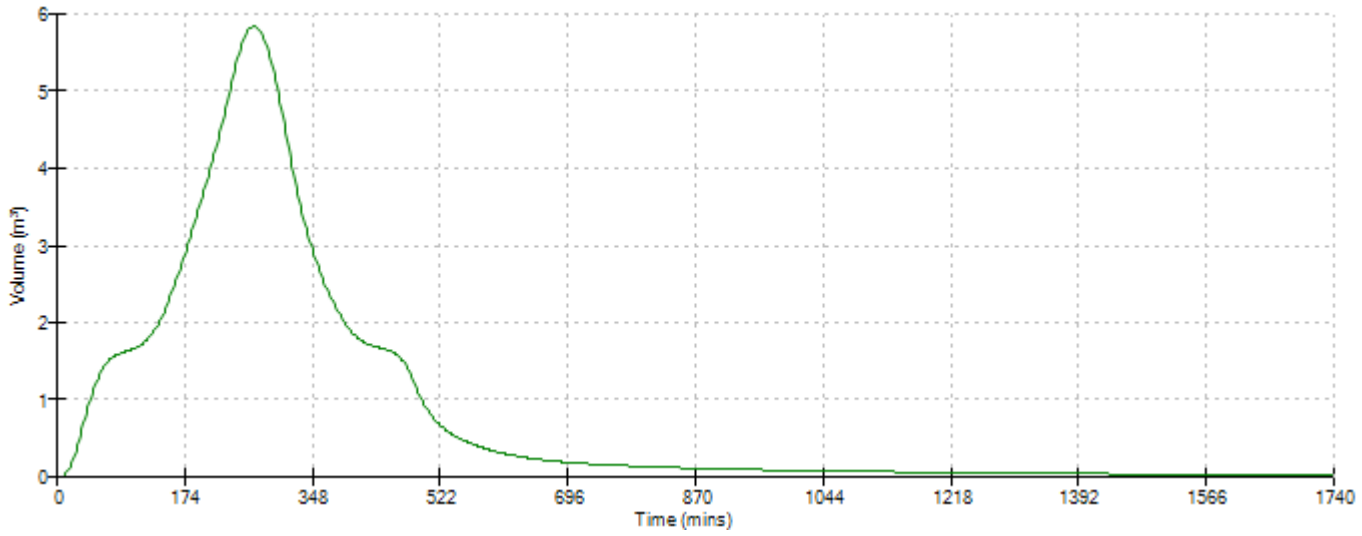



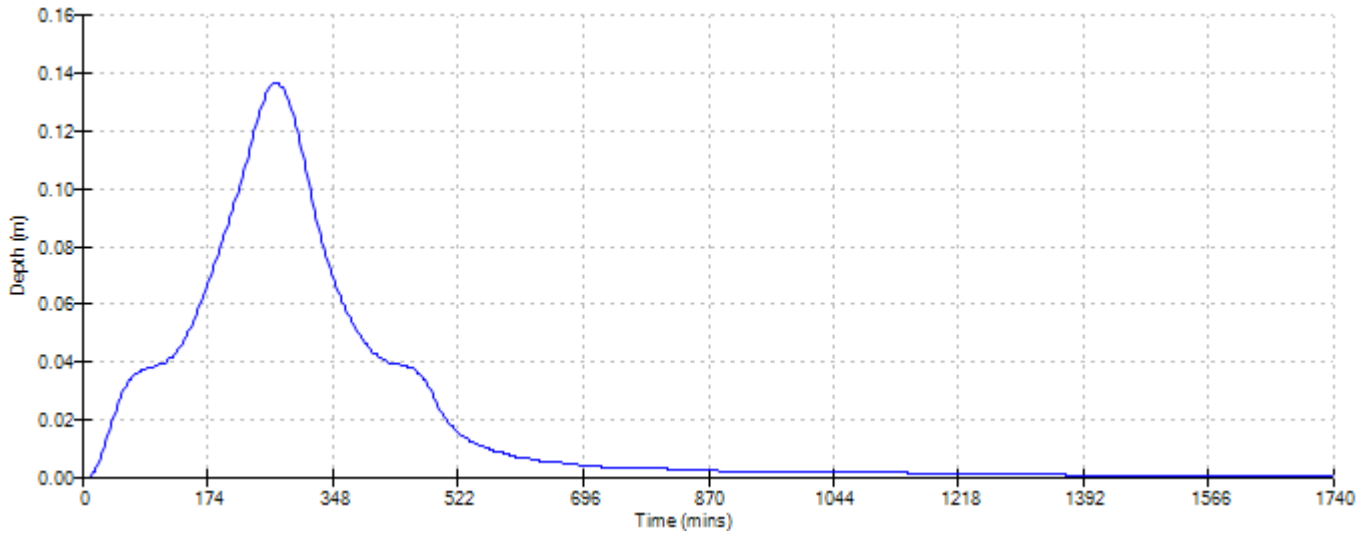




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Event: 480 min Winter

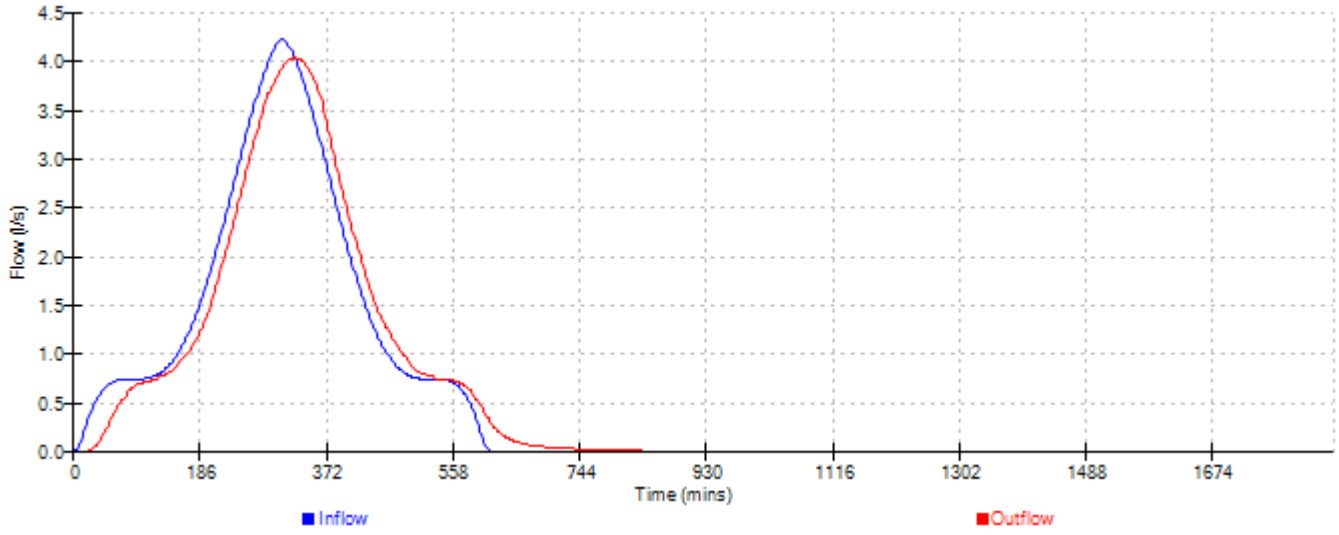


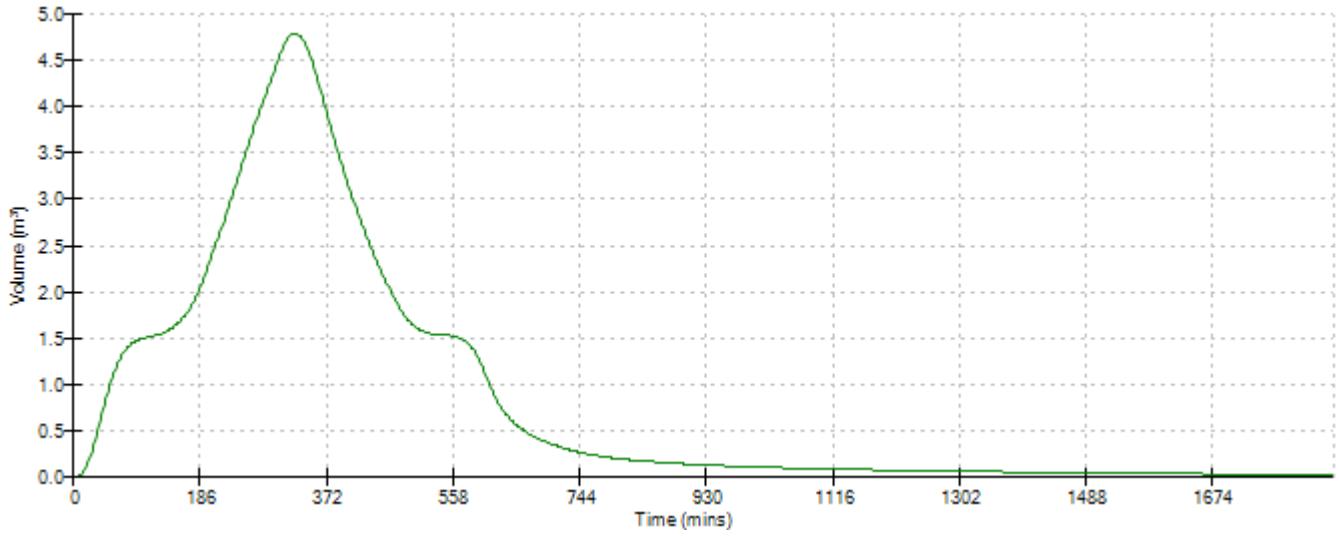



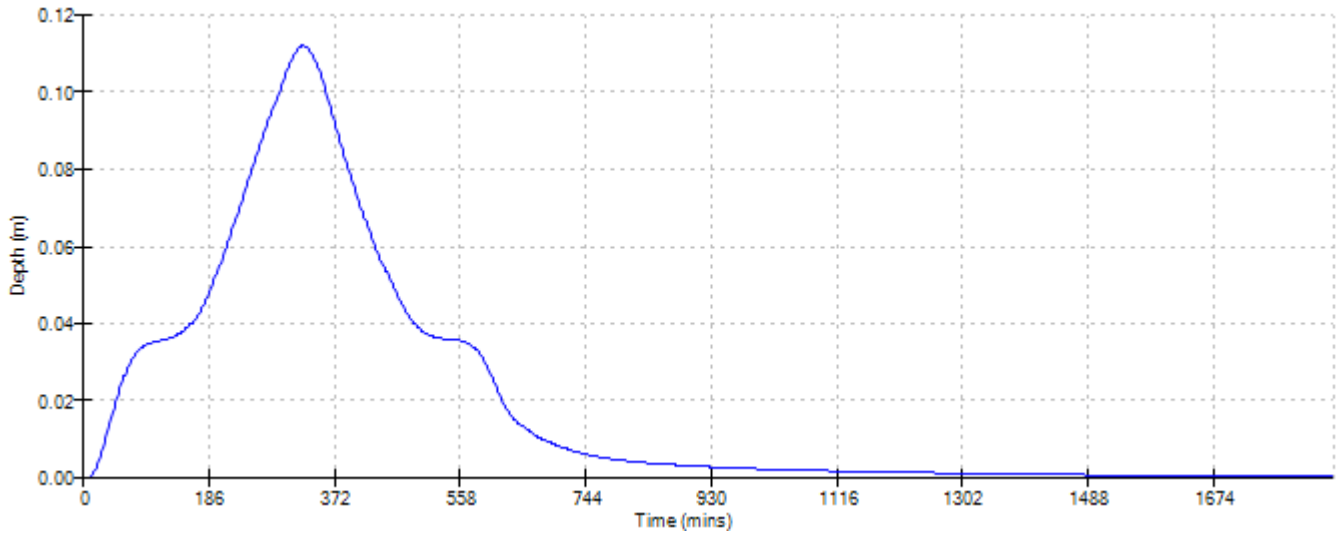




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Event: 600 min Winter

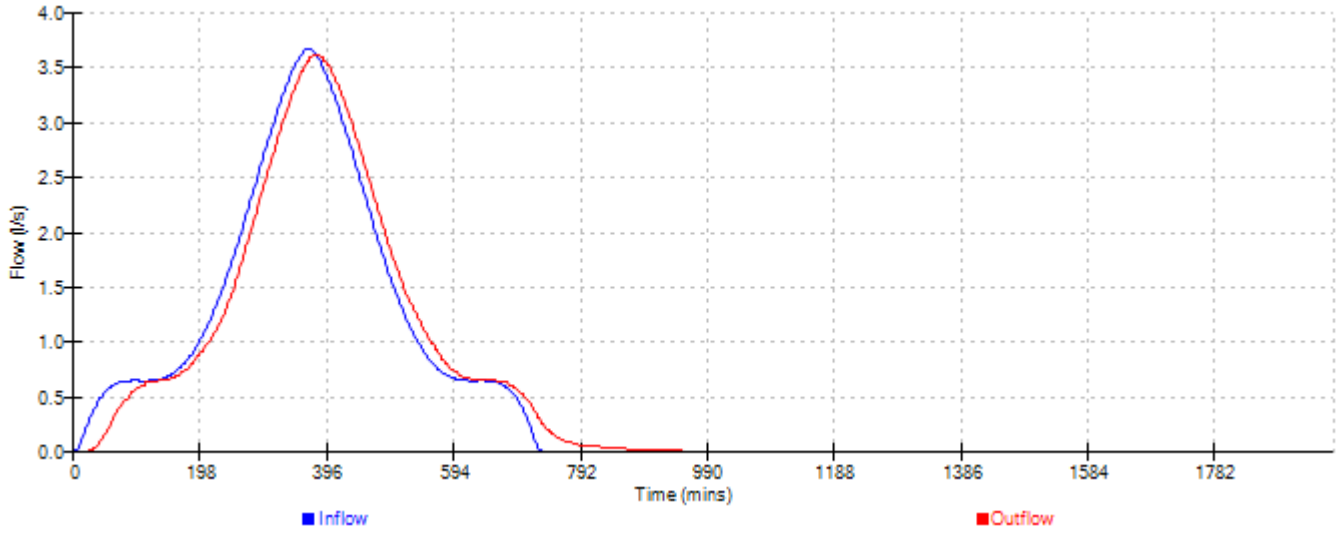


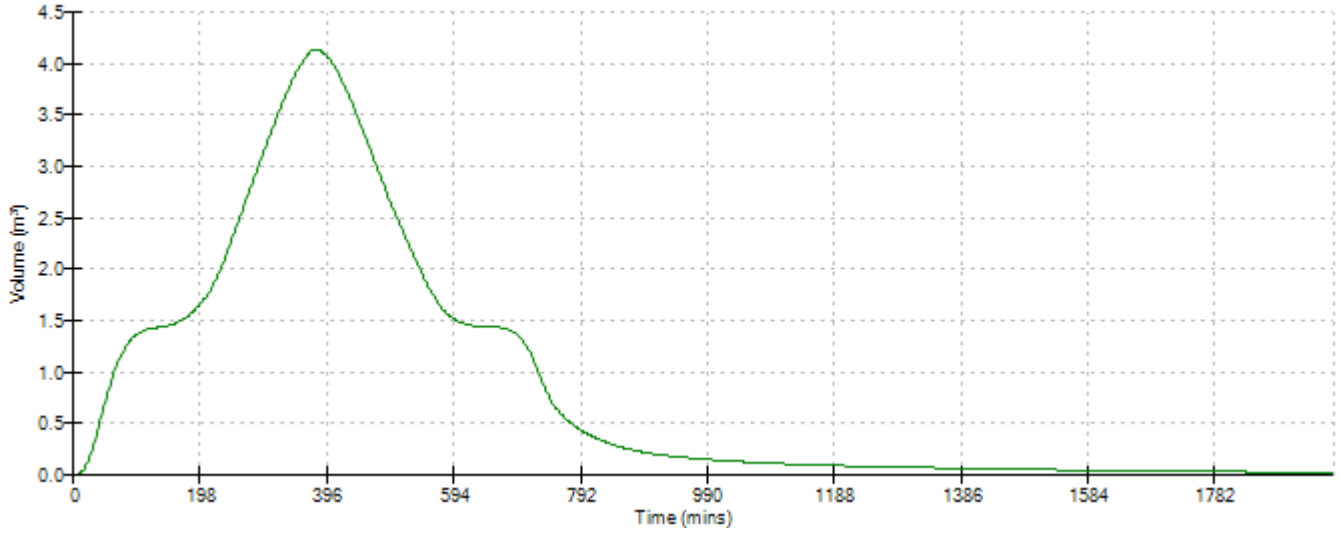



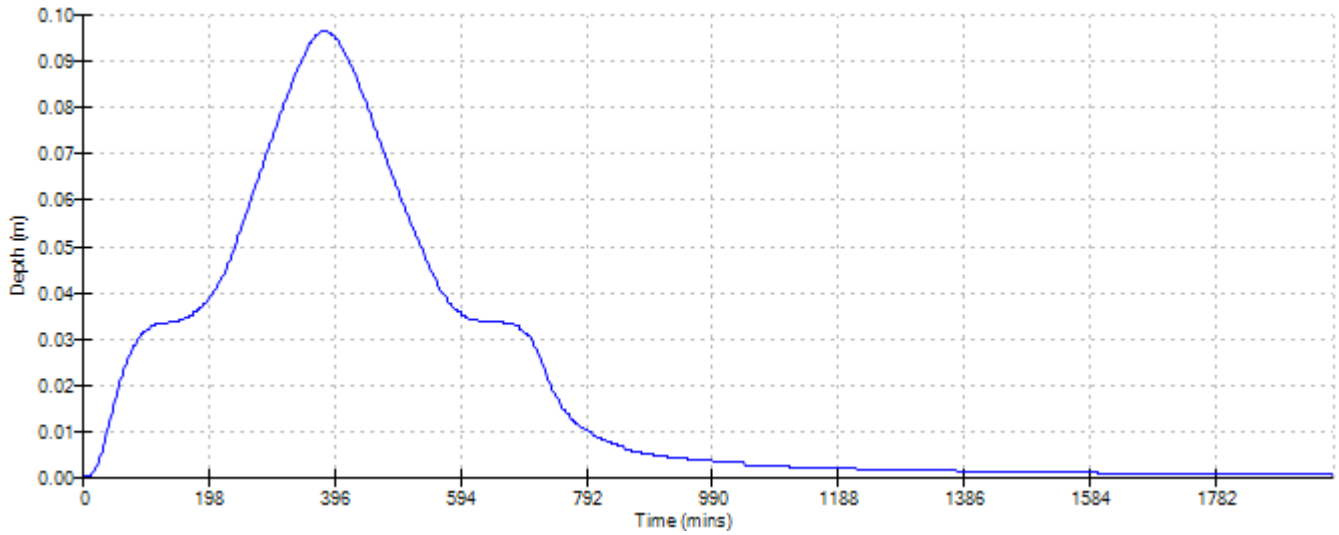




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Event: 720 min Winter

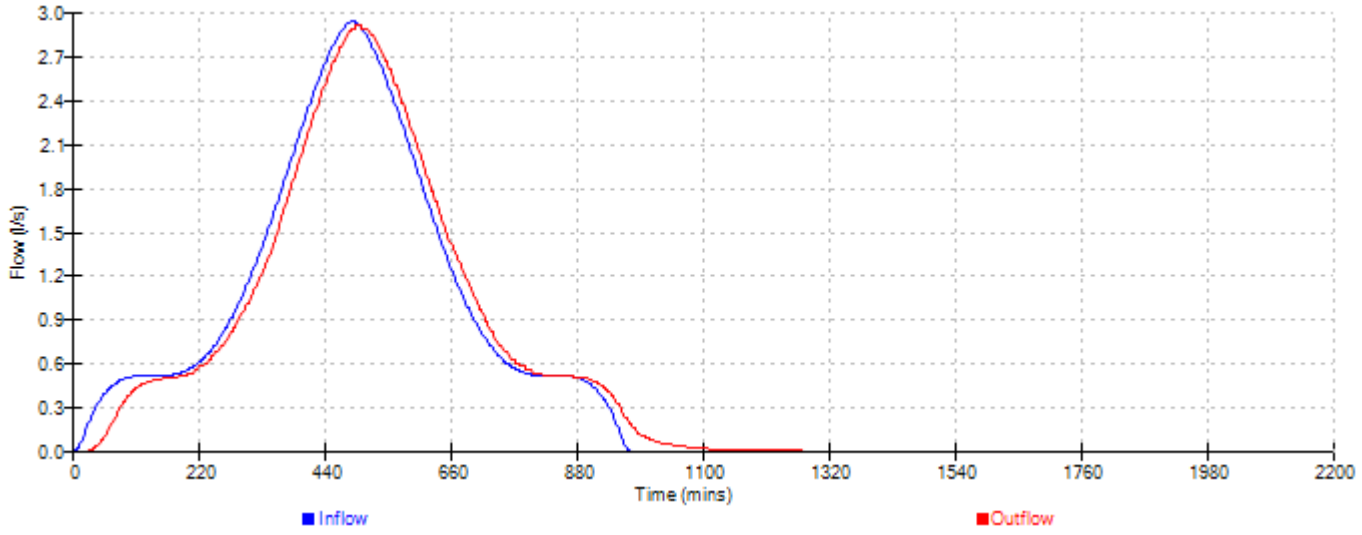


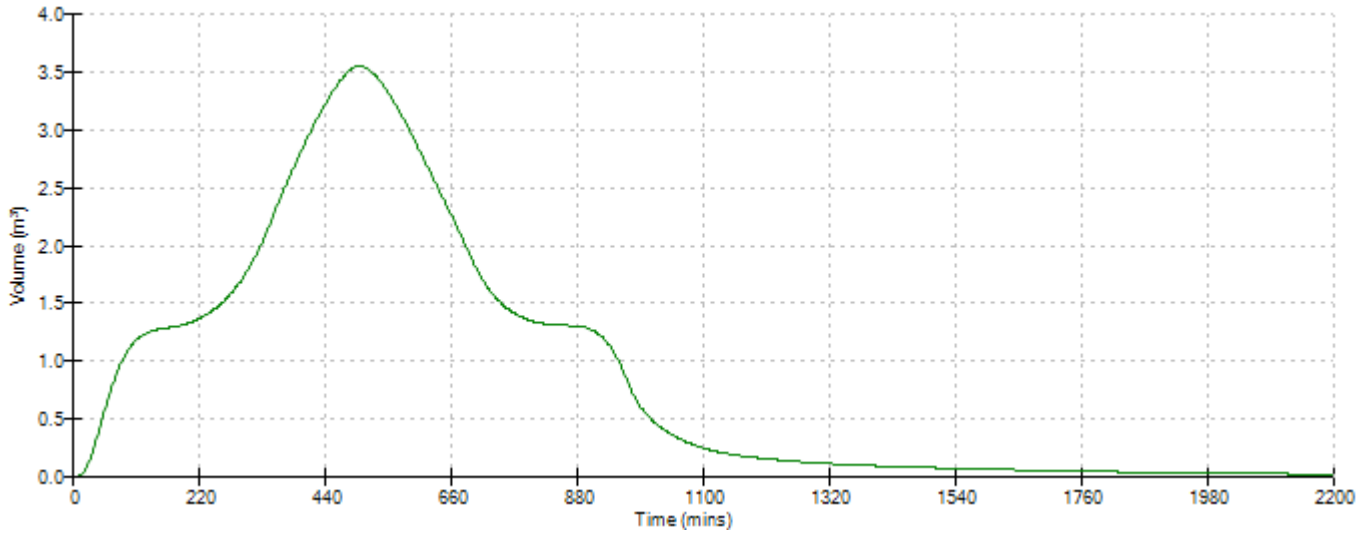



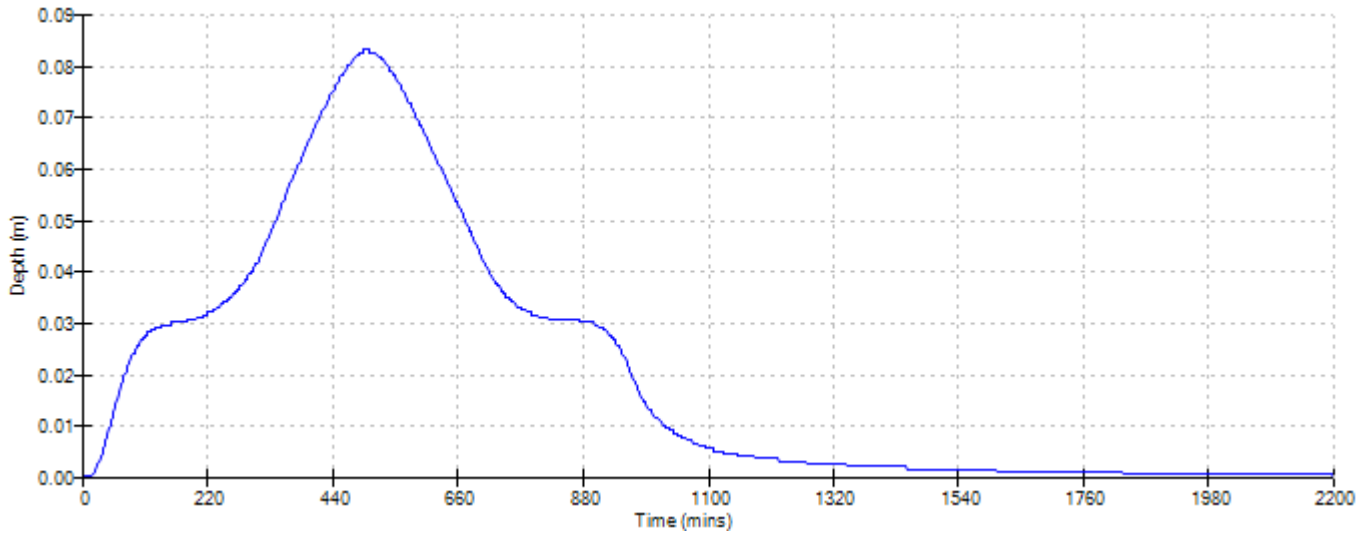




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Event: 960 min Winter

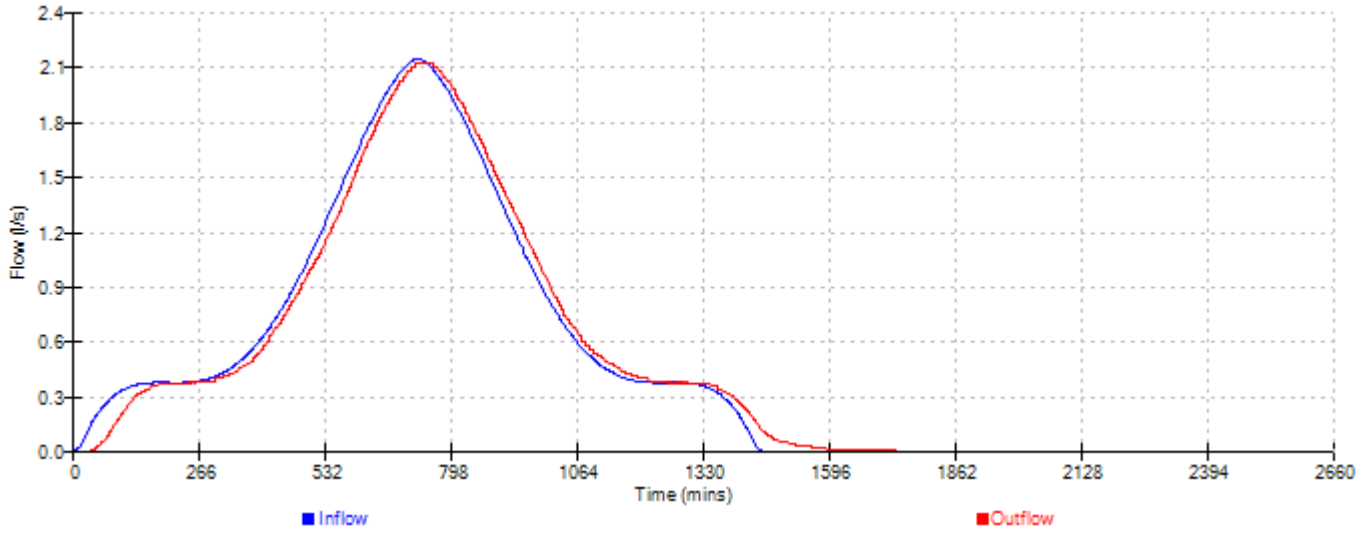


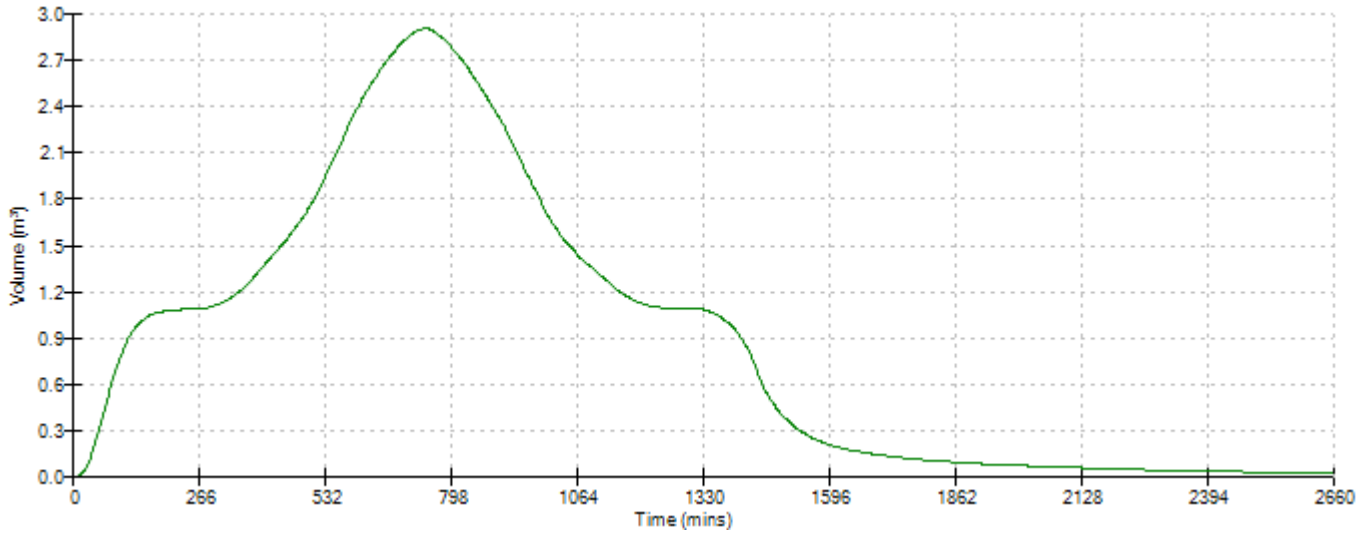



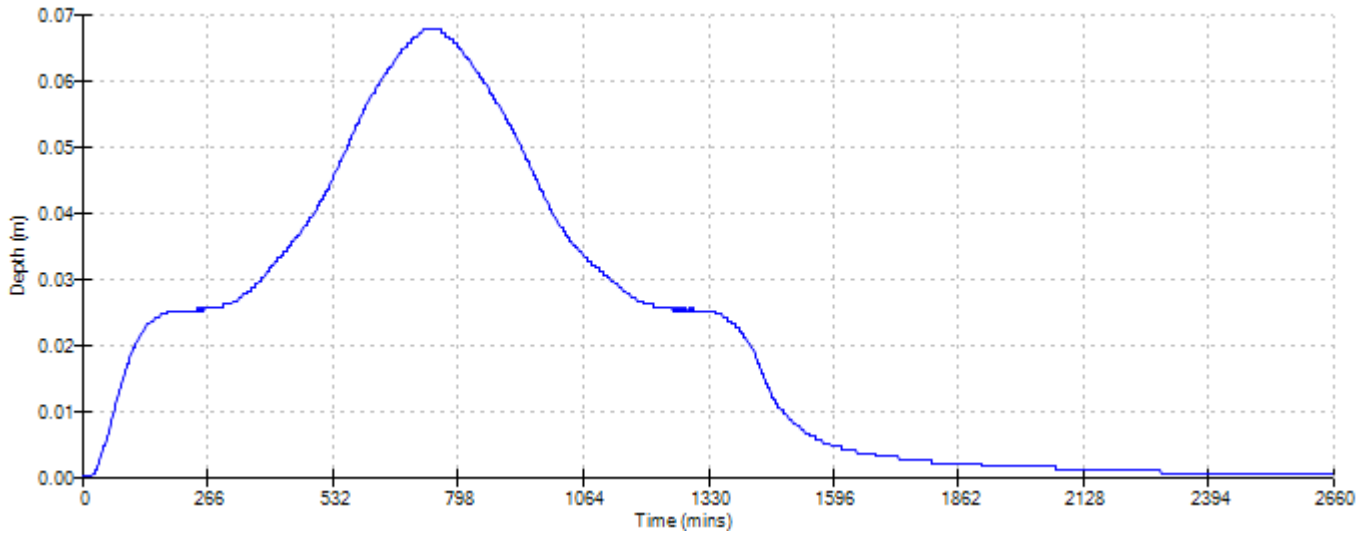




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Event: 1440 min Winter

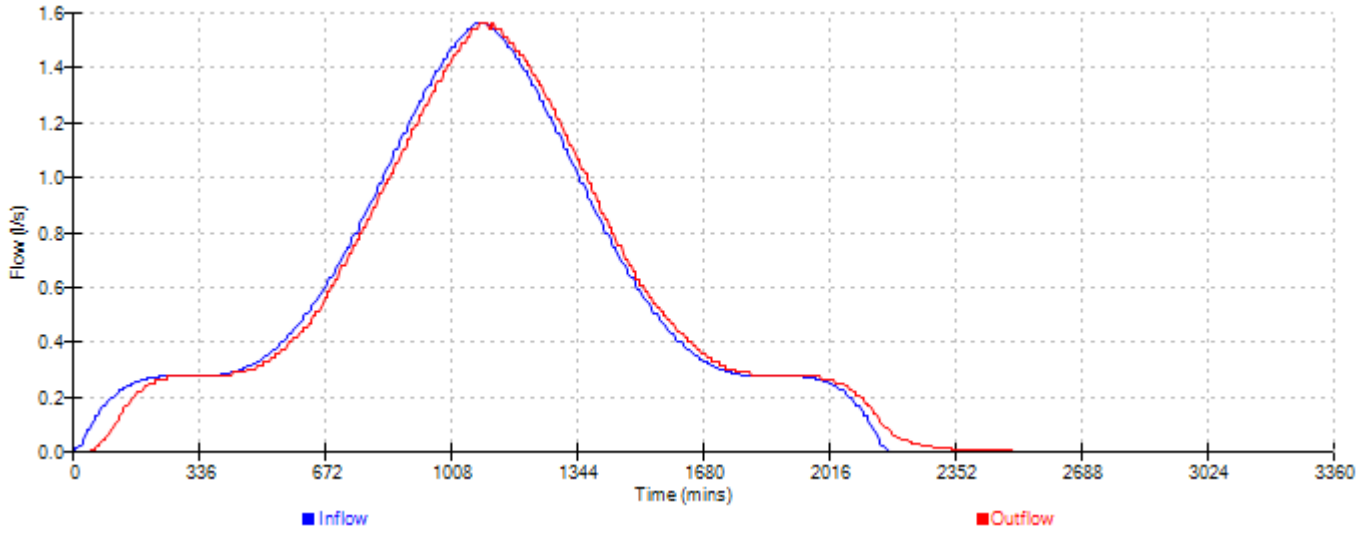


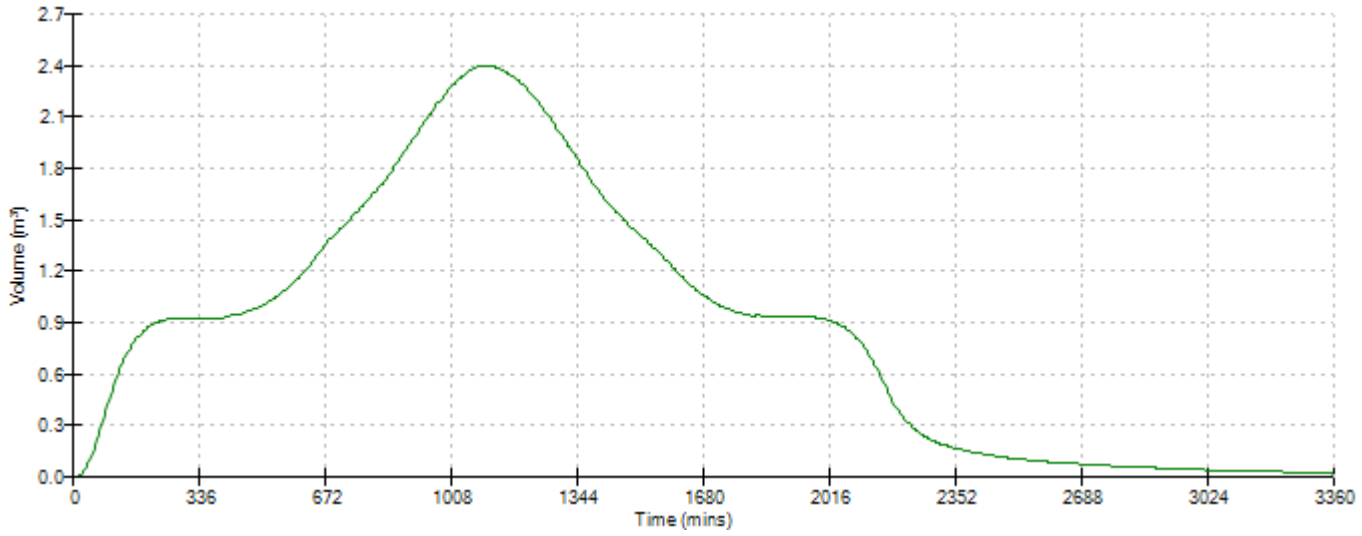



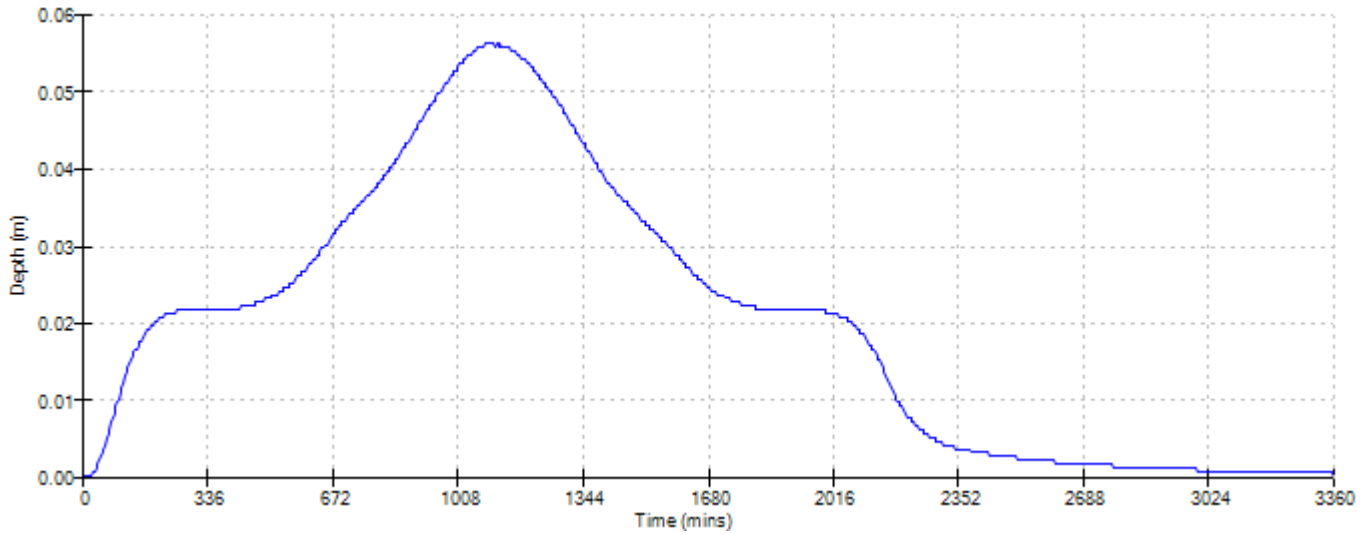




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Event: 2160 min Winter

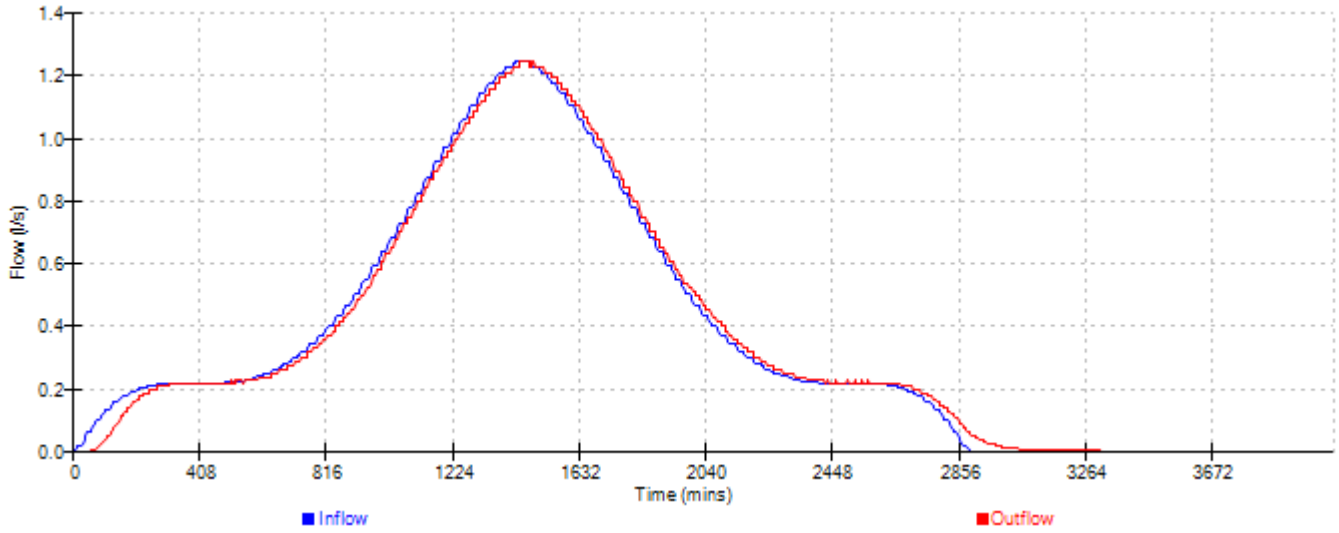


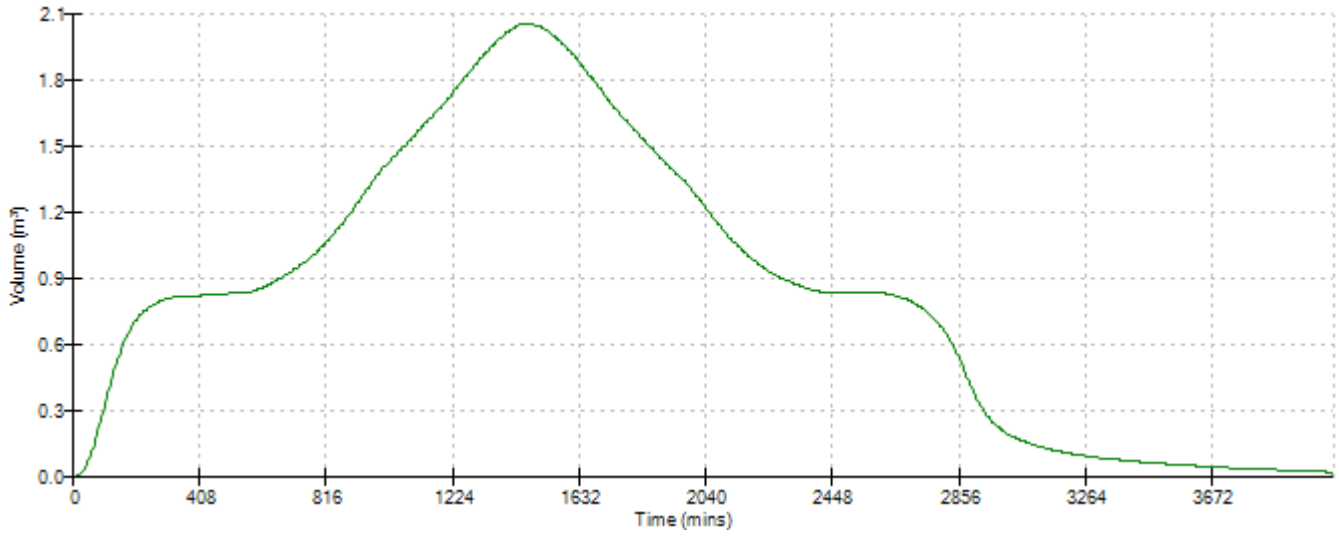



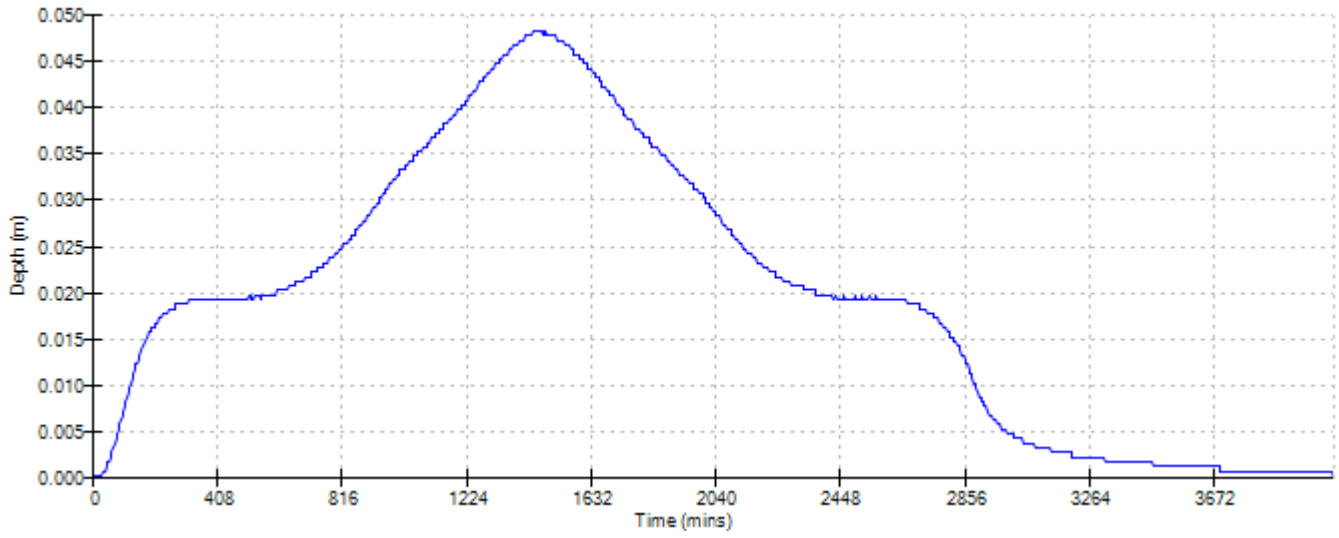




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Event: 2880 min Winter

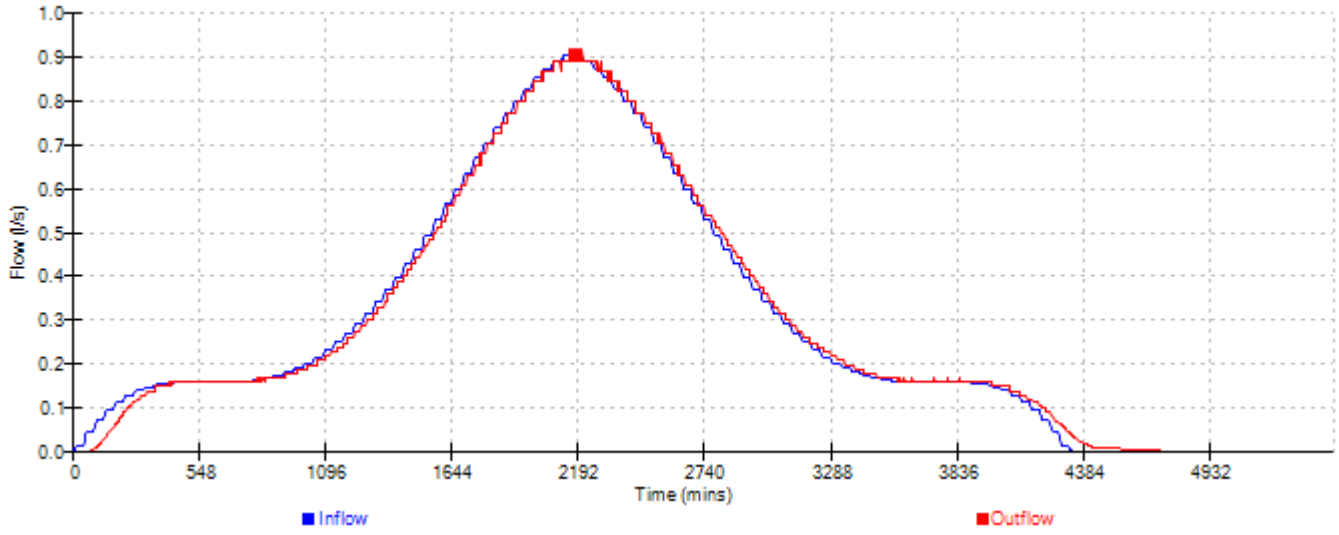


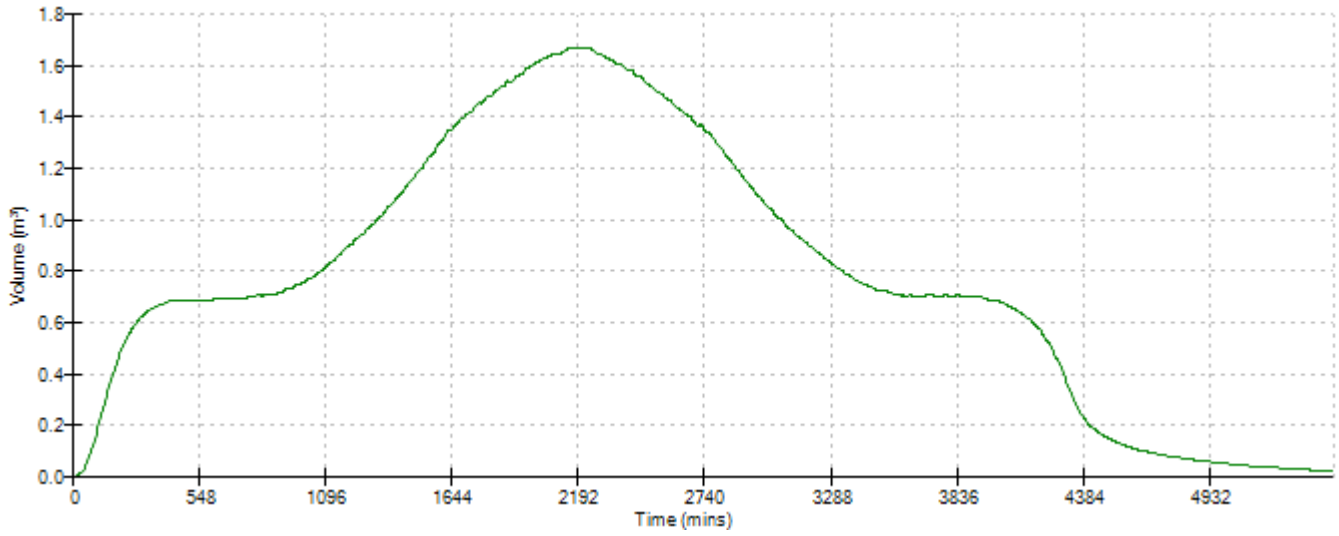



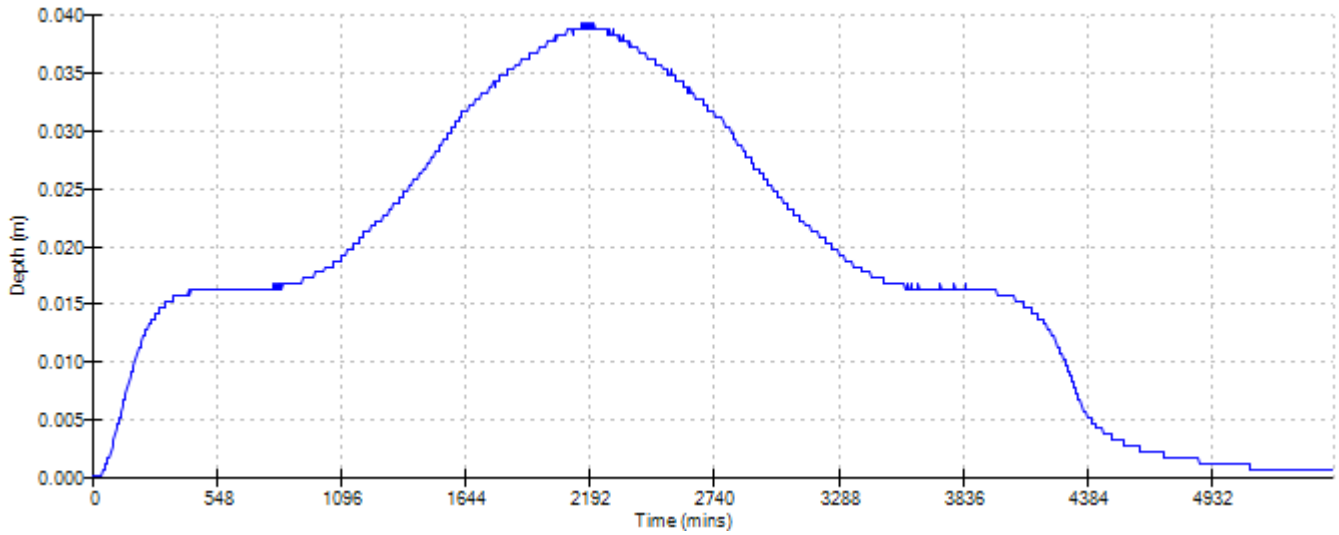




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Event: 4320 min Winter

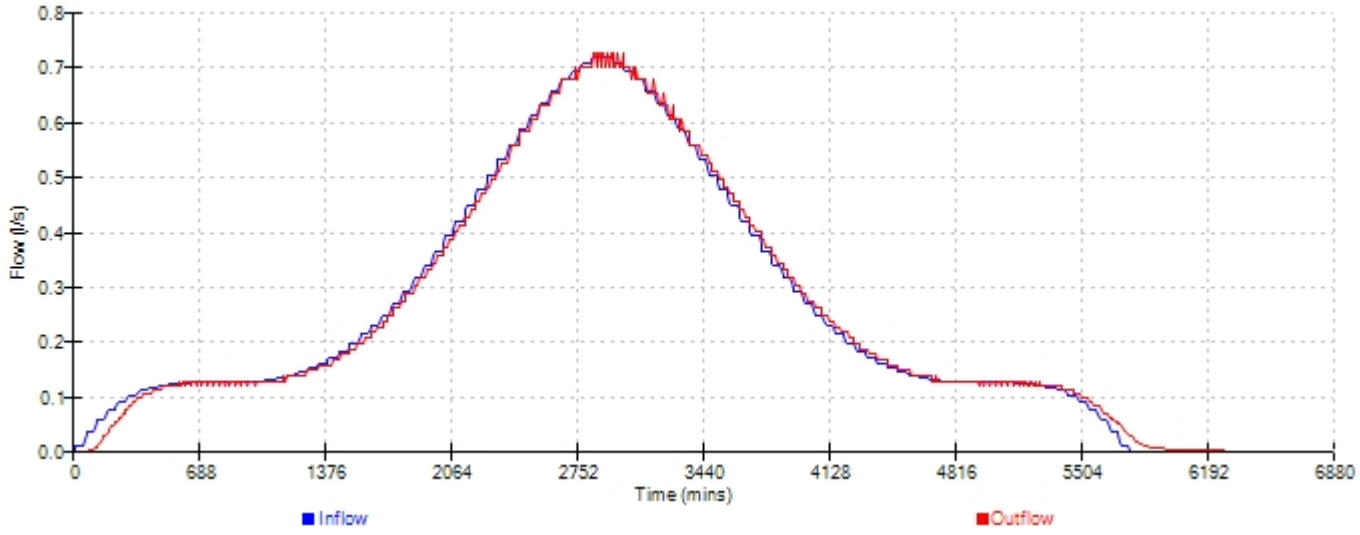


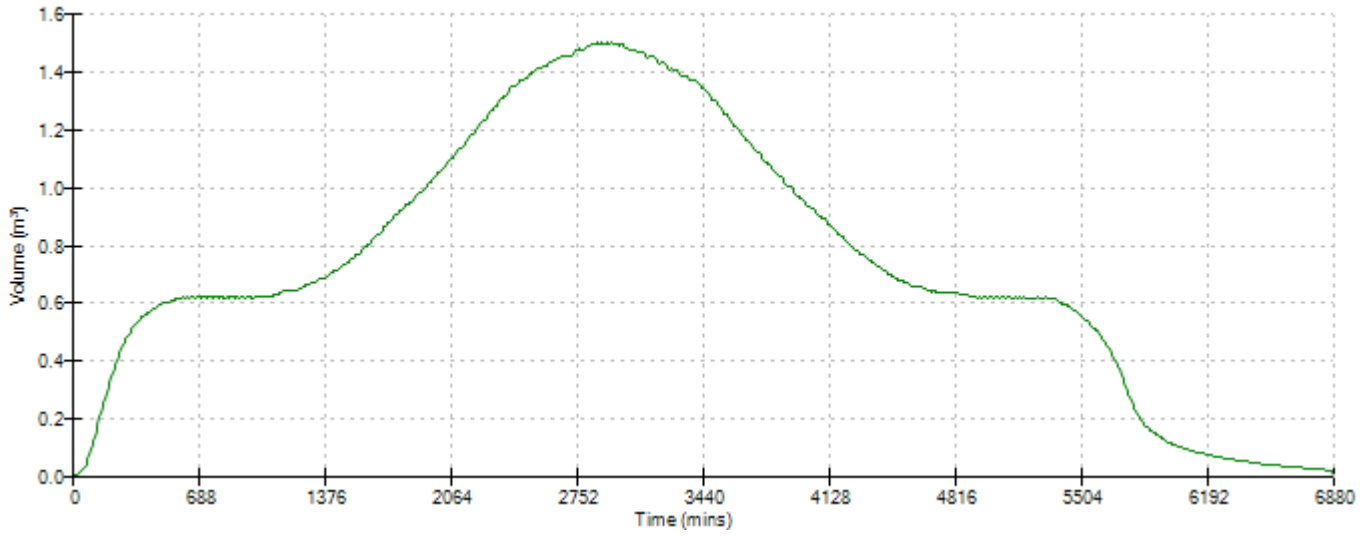



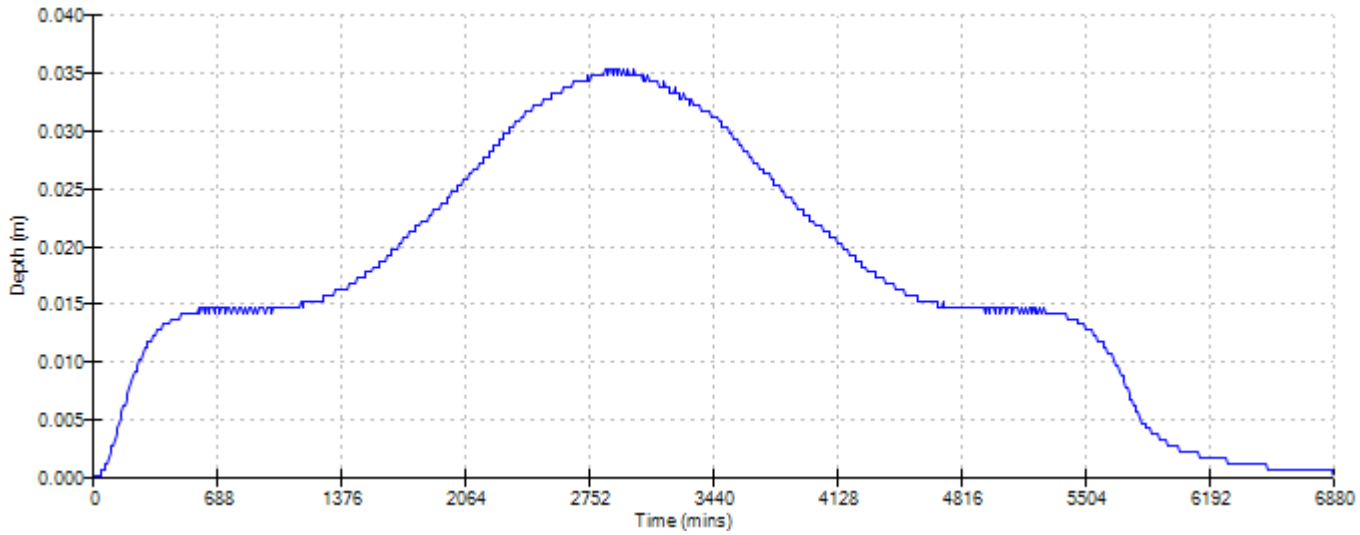




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Event: 5760 min Winter

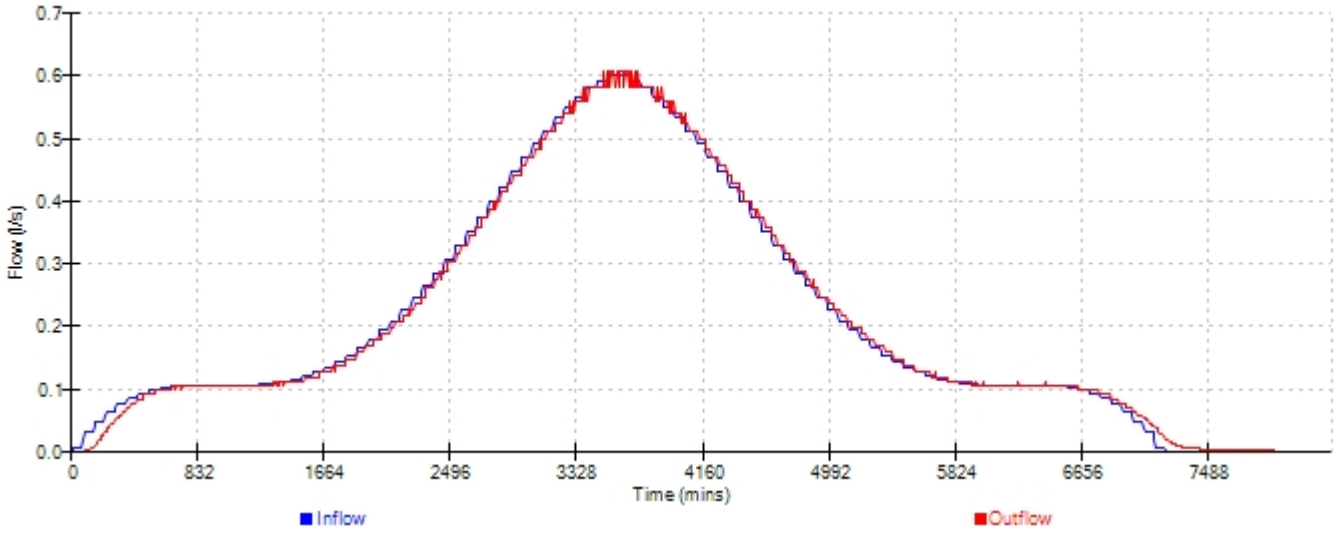


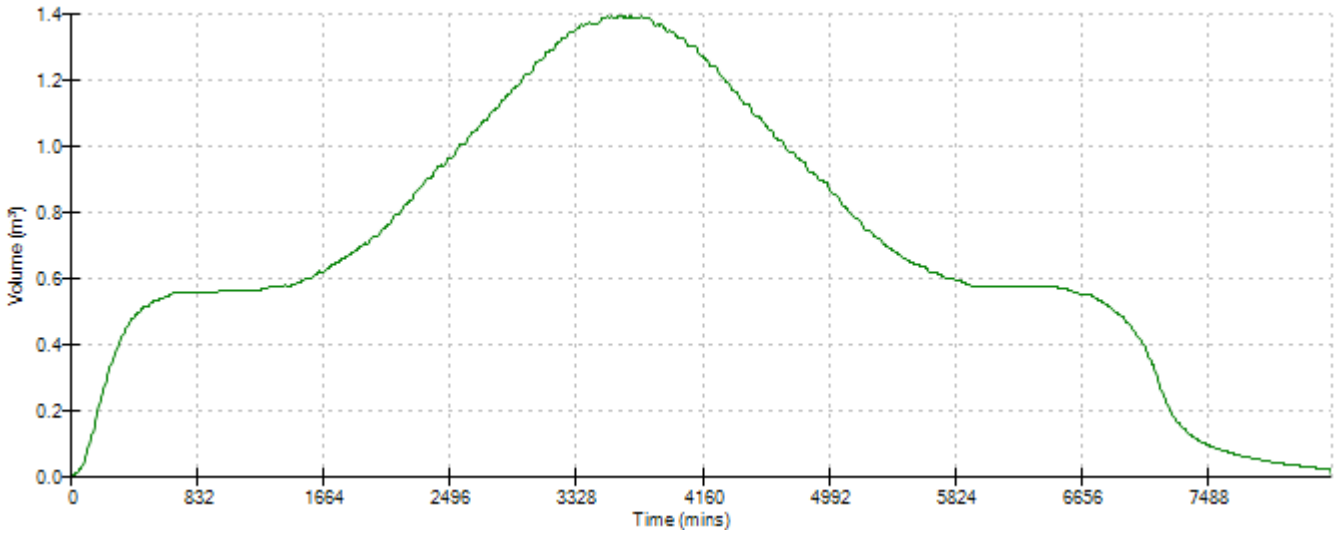



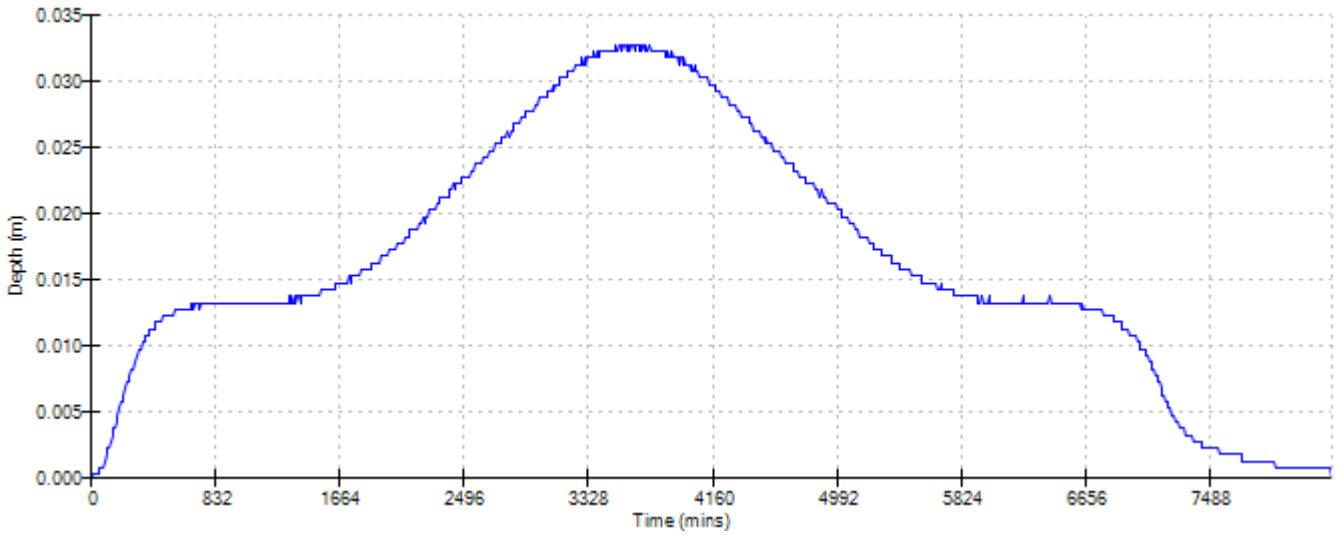




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Event: 7200 min Winter

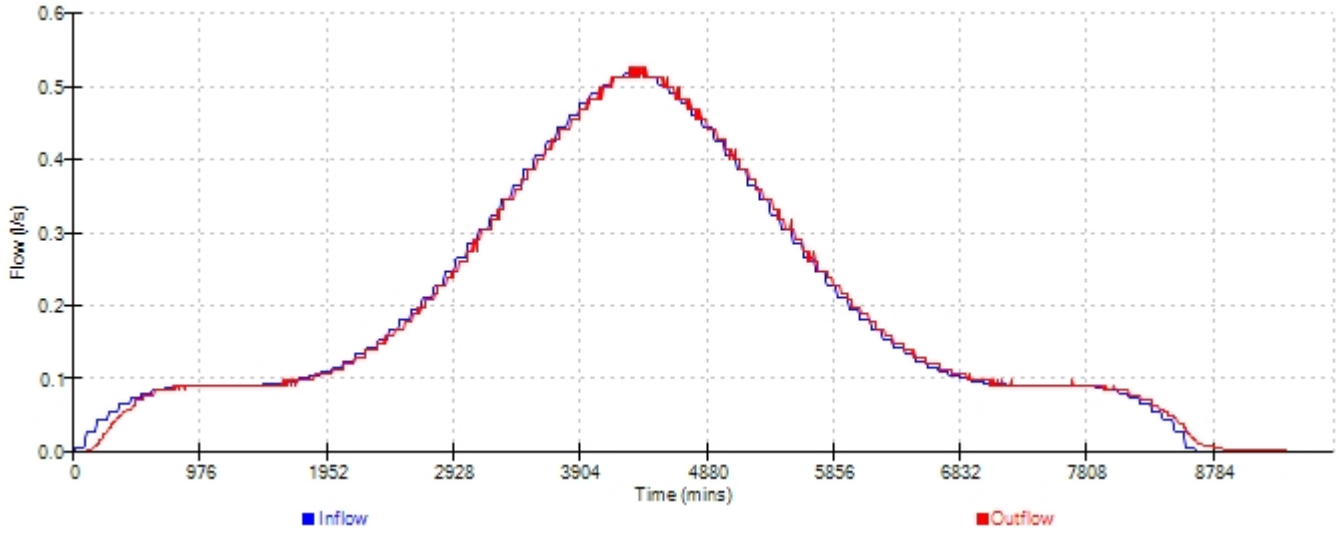


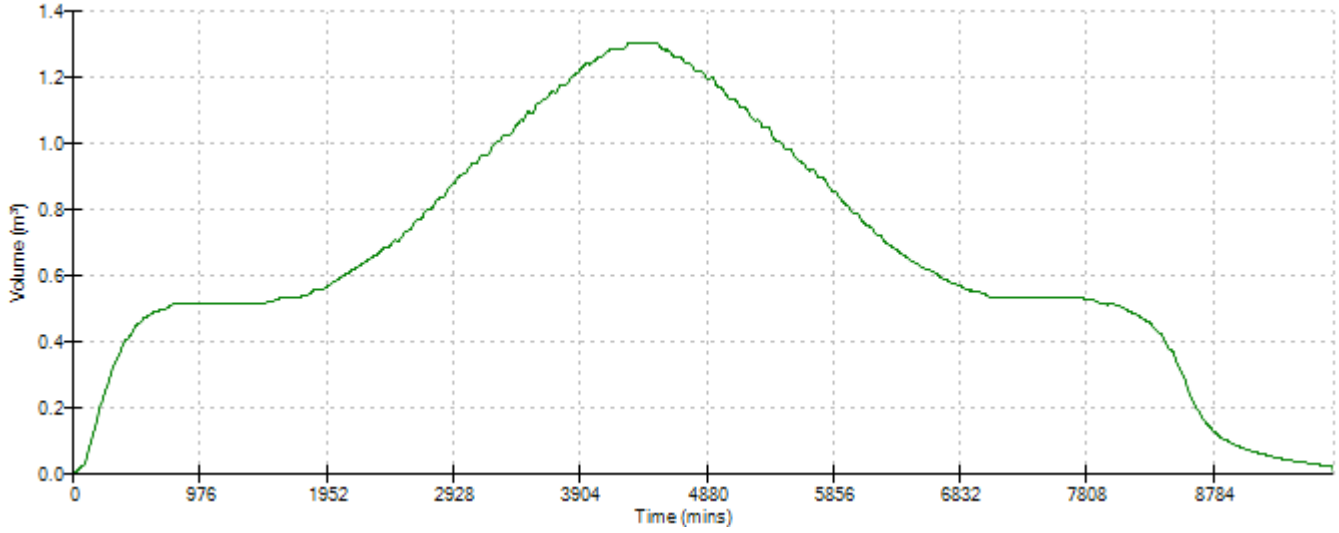



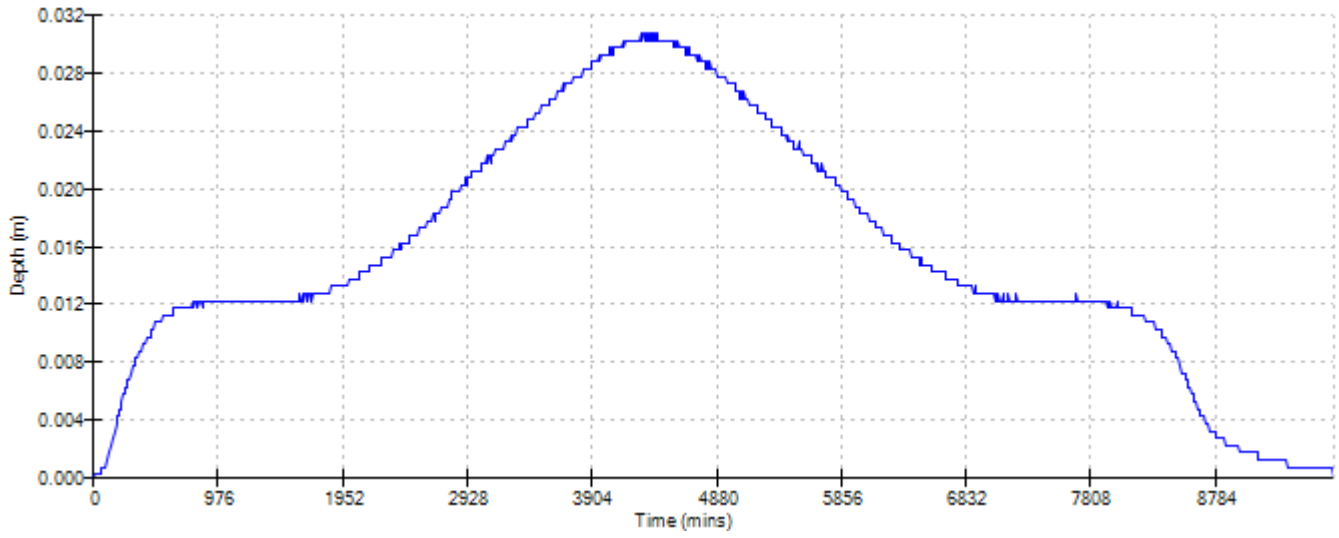




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Event: 8640 min Winter

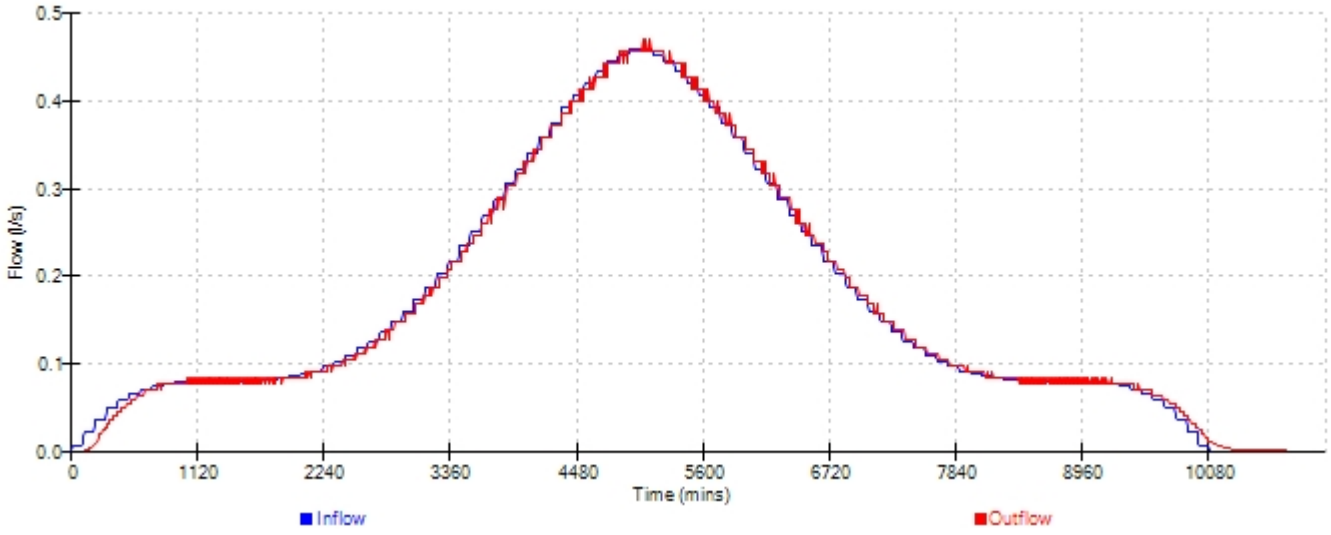


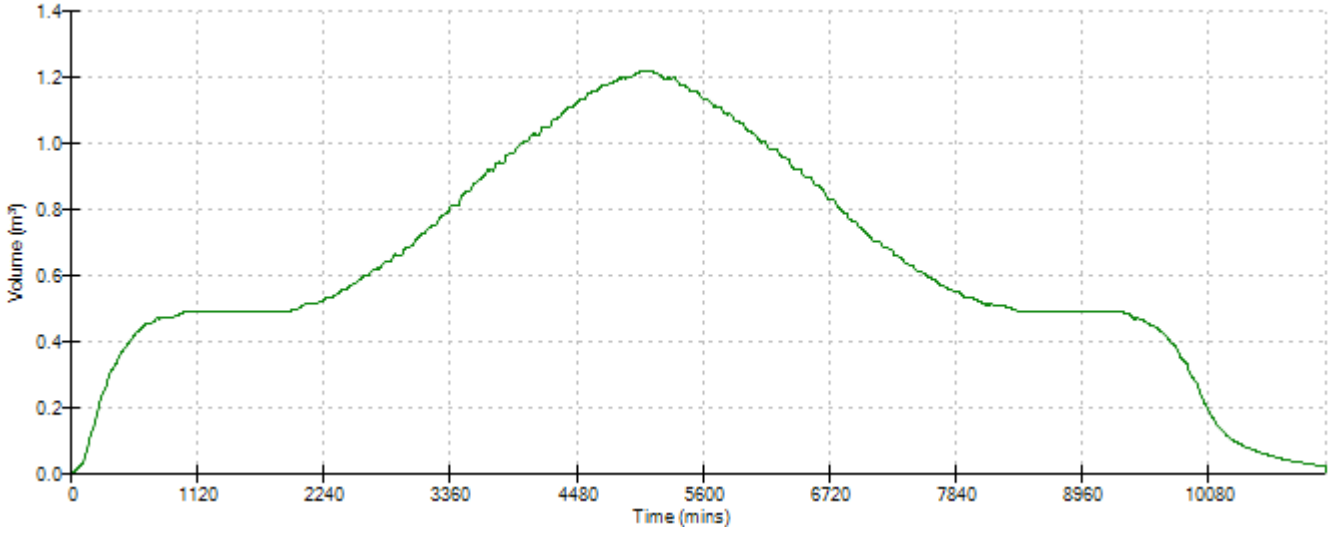



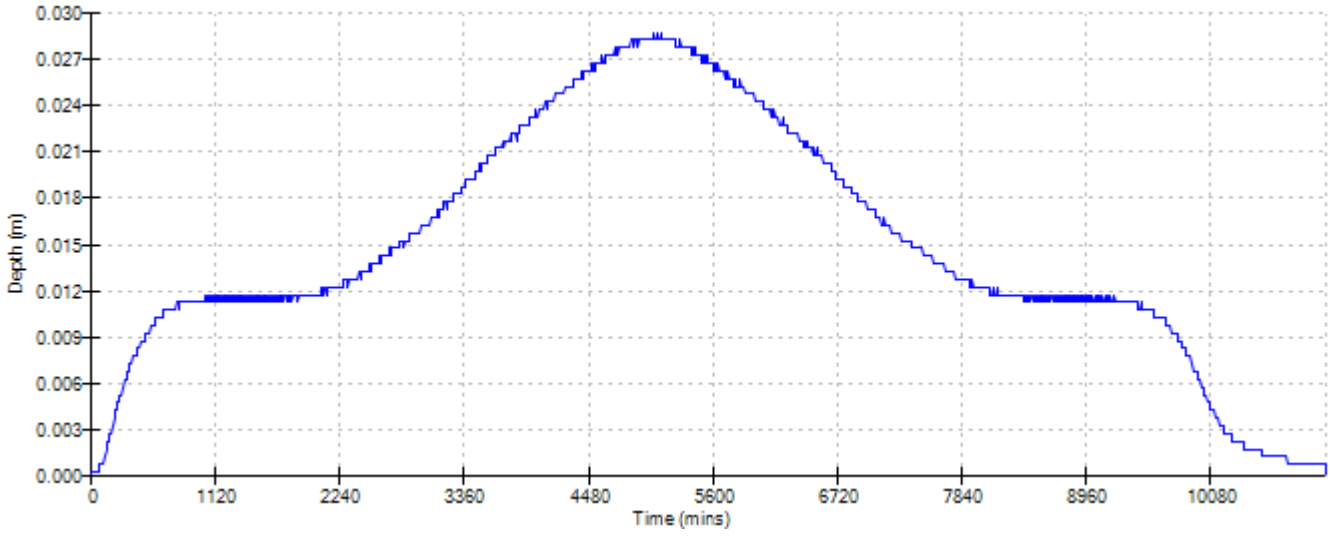




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Event: 10080 min Winter




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