STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.386	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.015	4-8	0.002

Total Area Contributing (ha) = 0.017

Total Pipe Volume (m³) = 0.281

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	11.800	0.118	100.0	0.005	4.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	17.180	0.292	58.8	0.012	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	1.230	0.190	6.5	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.003	2.500	0.025	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.26	167.100	0.005	0.0	0.0	0.0	0.77	6.0	0.7
1.001	50.00	4.54	166.982	0.017	0.0	0.0	0.0	1.01	7.9	2.3
1.002	50.00	4.55	166.690	0.017	0.0	0.0	0.0	3.06	24.0	2.3
1.003	50.00	4.59	166.500	0.017	0.0	0.0	0.0	1.00	17.8	2.3

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backd (mm)
1	168.100	1.000	Open Manhole	1200	1.000	167.100	100				
2	168.120	1.138	Open Manhole	1200	1.001	166.982	100	1.000	166.982	100	
3	169.000	2.310	Open Manhole	1200	1.002	166.690	100	1.001	166.690	100	
Soakaway	169.000	2.500	Open Manhole	1200	1.003	166.500	150	1.002	166.500	100	
Dummy Pipe	169.000	2.525	Open Manhole	150		OUTFALL		1.003	166.475	150	

No coordinates have been specified, layout information cannot be produced.

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	100	1	168.100	167.100	0.900	Open Manhole	1200
1.001	o	100	2	168.120	166.982	1.038	Open Manhole	1200
1.002	o	100	3	169.000	166.690	2.210	Open Manhole	1200
1.003	o	150	Soakaway	169.000	166.500	2.400	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	11.800	100.0	2	168.120	166.982	1.038	Open Manhole	1200
1.001	17.180	58.8	3	169.000	166.690	2.210	Open Manhole	1200
1.002	1.230	6.5	Soakaway	169.000	166.500	2.400	Open Manhole	1200
1.003	2.500	100.0	Dummy Pipe	169.000	166.475	2.425	Open Manhole	150

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Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	1	100	0.900	1.038	Unclassified	1200	0	0.900	Unclassified
1.001	2	100	1.038	2.210	Unclassified	1200	0	1.038	Unclassified
1.002	3	100	2.210	2.400	Unclassified	1200	0	2.210	Unclassified
1.003	Soakaway	150	2.400	2.425	Unclassified	1200	0	2.400	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003	Dummy Pipe	169.000	166.475	166.500	150	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.386		

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Online Controls for Storm

Pump Manhole: Soakaway, DS/PN: 1.003, Volume (m³): 2.8

Invert Level (m) 166.500

Depth (m)	Flow (l/s)
1.500	0.0000

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Storage Structures for Storm

Cellular Storage Manhole: Soakaway, DS/PN: 1.003

Invert Level (m) 166.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.14000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.14000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	8.0	8.0	0.501	0.0	14.0
0.500	8.0	14.0			

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.356
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

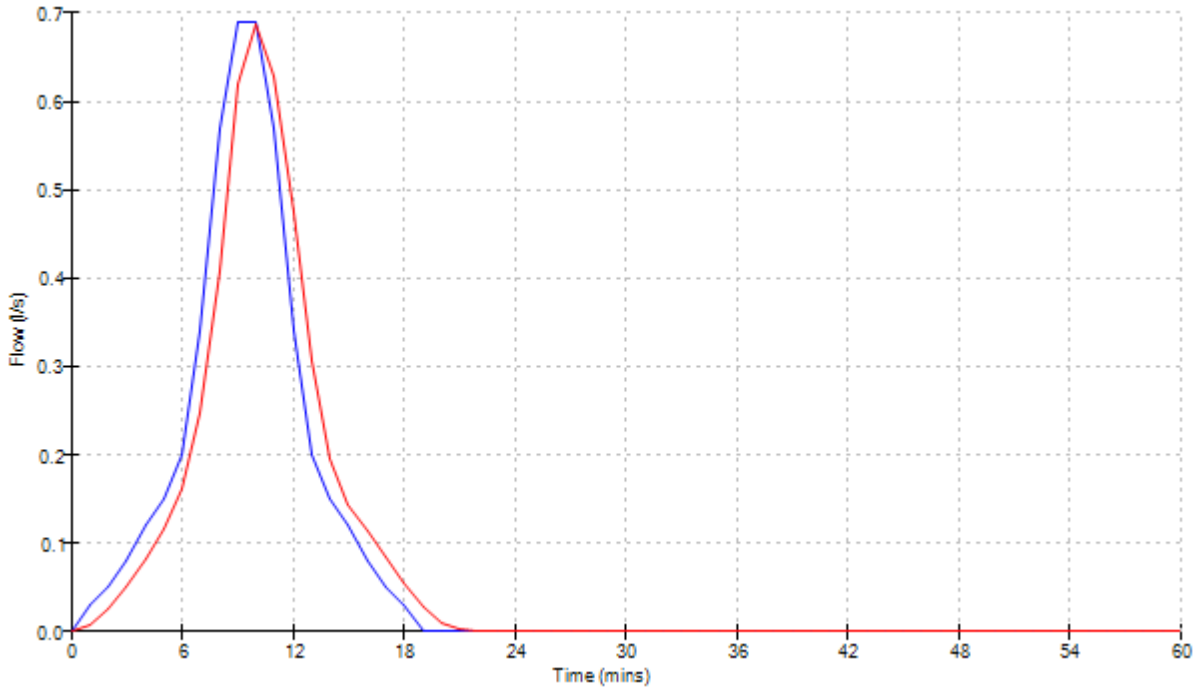
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 10, 30, 100
Climate Change (%)	0, 0, 0, 40

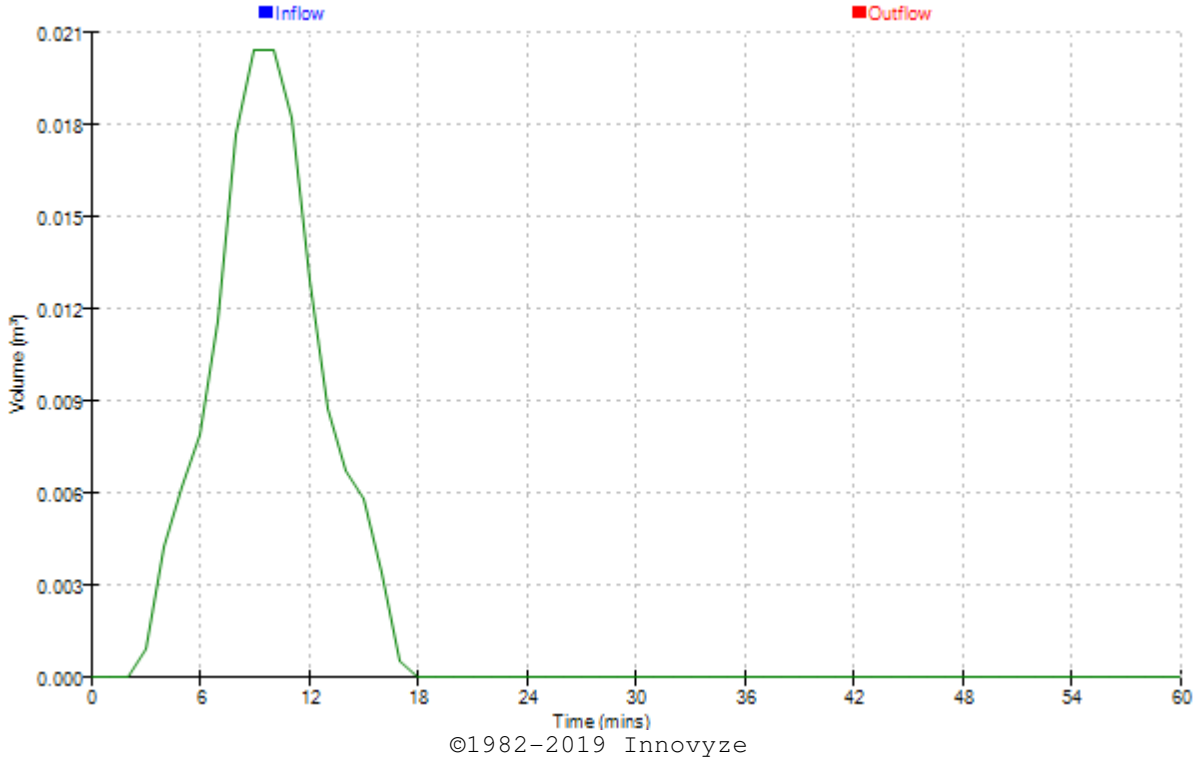
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	15 Summer	1	+0%	100/15 Winter			
1.001	2	15 Winter	1	+0%	100/15 Summer			
1.002	3	15 Winter	1	+0%	10/60 Winter			
1.003	Soakaway	120 Winter	1	+0%	1/120 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	167.123	-0.077	0.000	0.12		0.7	OK	
1.001	2	167.017	-0.065	0.000	0.26		2.0	OK	
1.002	3	166.717	-0.073	0.000	0.16		2.0	OK	
1.003	Soakaway	166.655	0.005	0.000	0.00		0.0	SURCHARGED	

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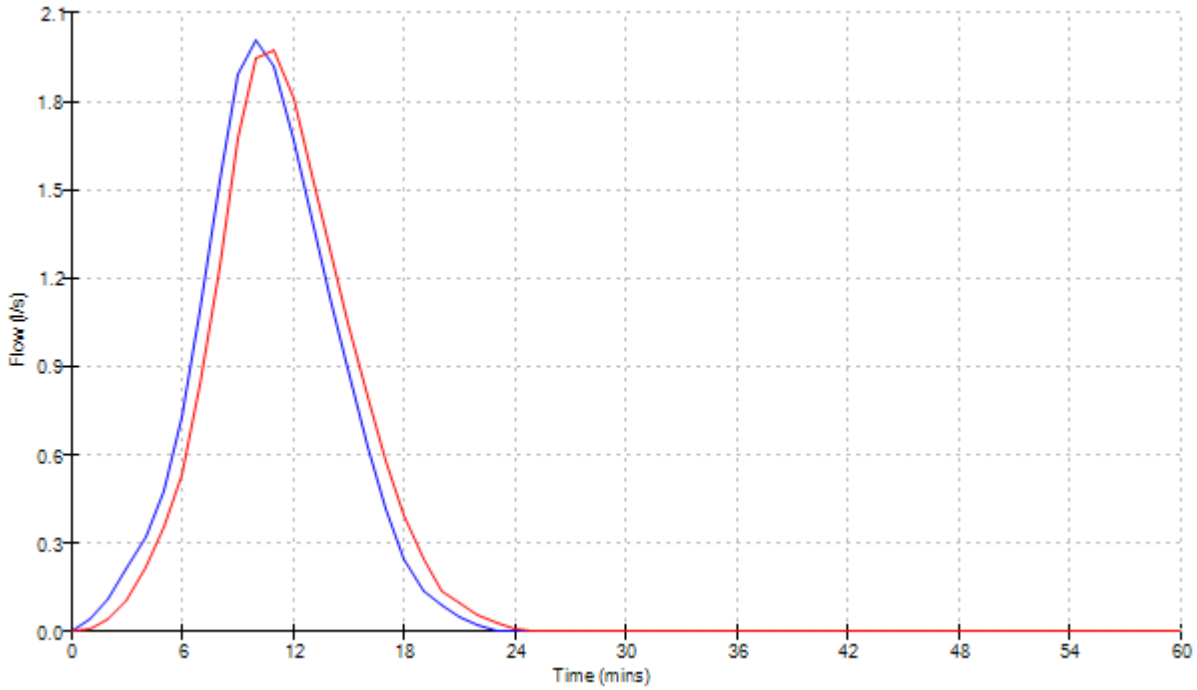
Graphs for Pipe 1.000 US/MH 1 (Storm)
15 minute 1 year Summer I+0%
Status: OK

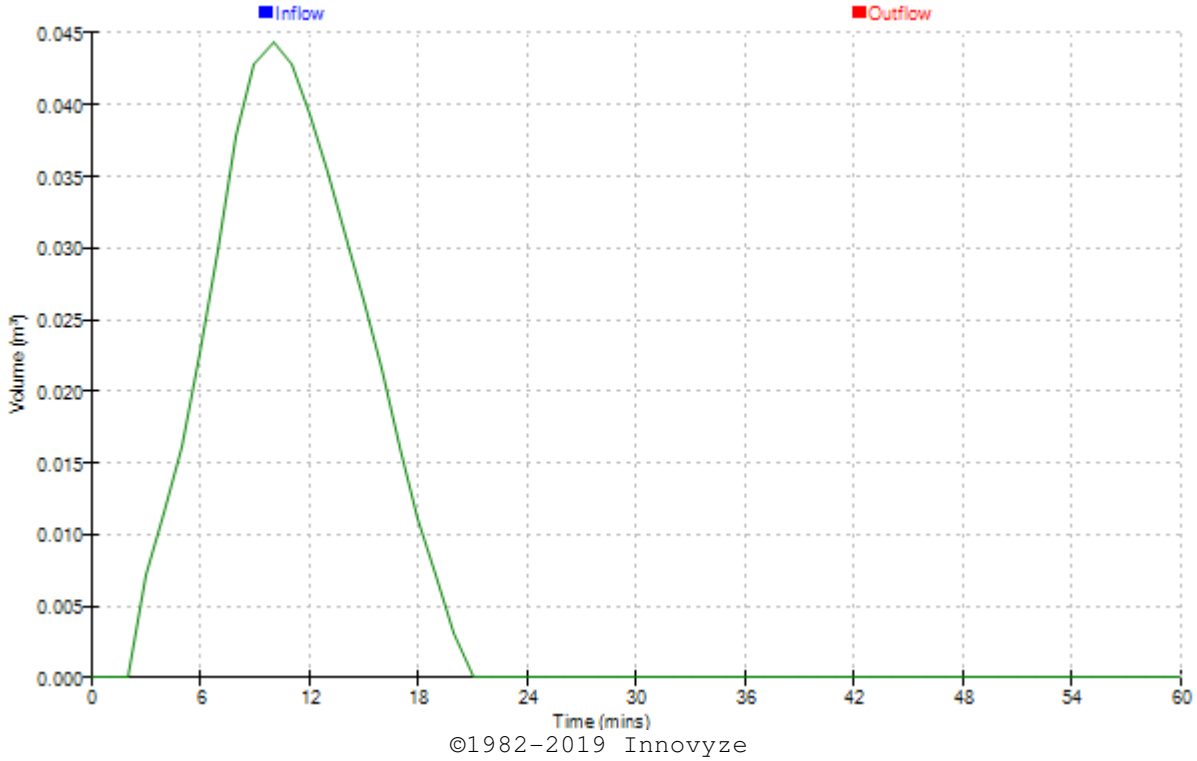




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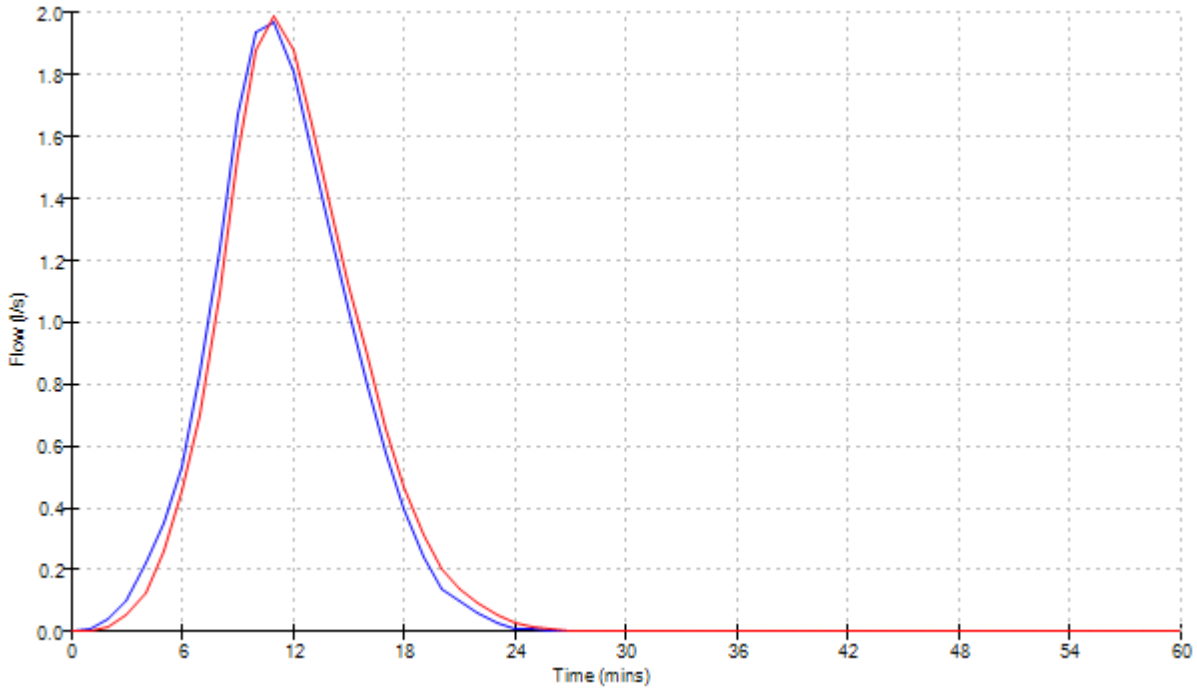
Graphs for Pipe 1.001 US/MH 2 (Storm)
15 minute 1 year Winter I+0%
Status: OK

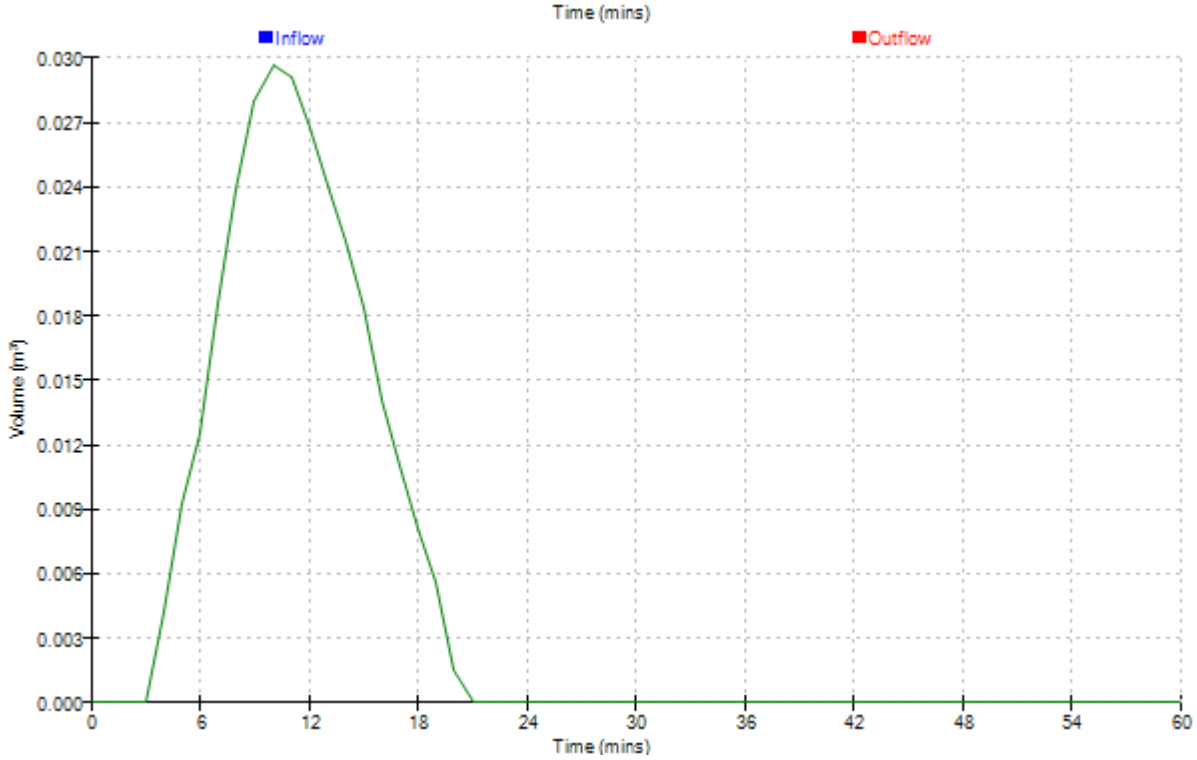




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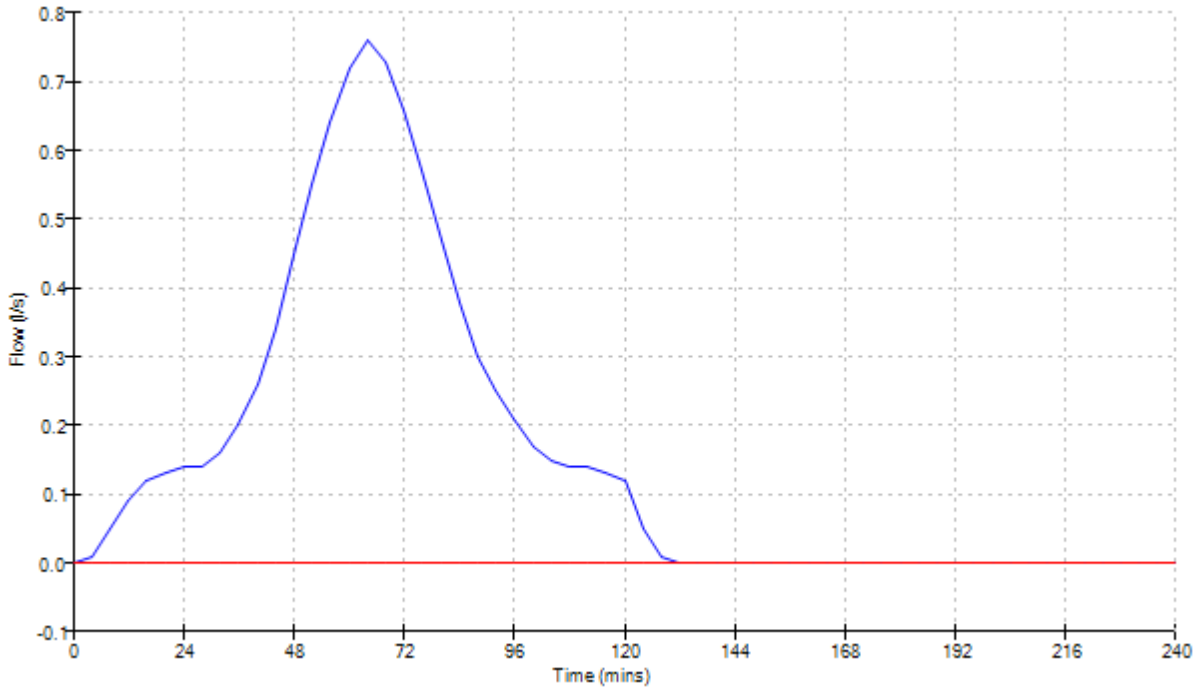
Graphs for Pipe 1.002 US/MH 3 (Storm)
15 minute 1 year Winter I+0%
Status: OK

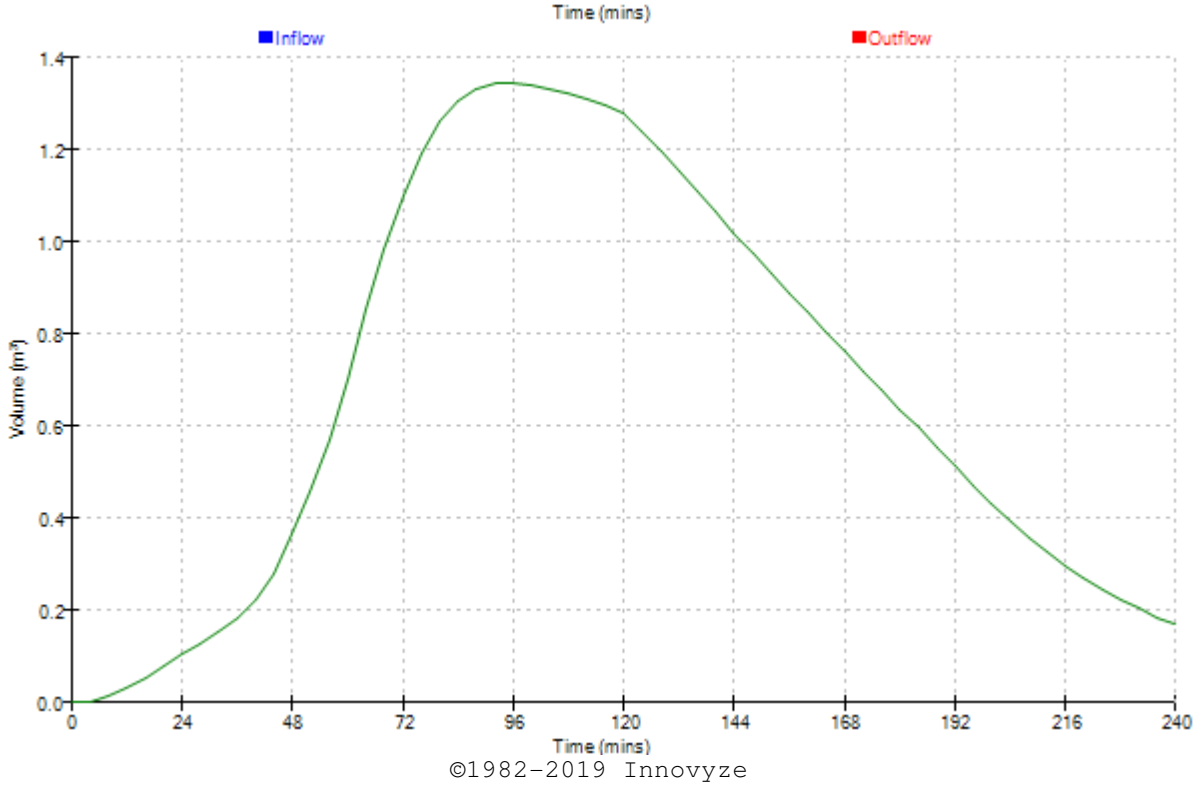




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Graphs for Pipe 1.003 US/MH Soakaway (Storm)
120 minute 1 year Winter I+0%
Status: SURCHARGED





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10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.356
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

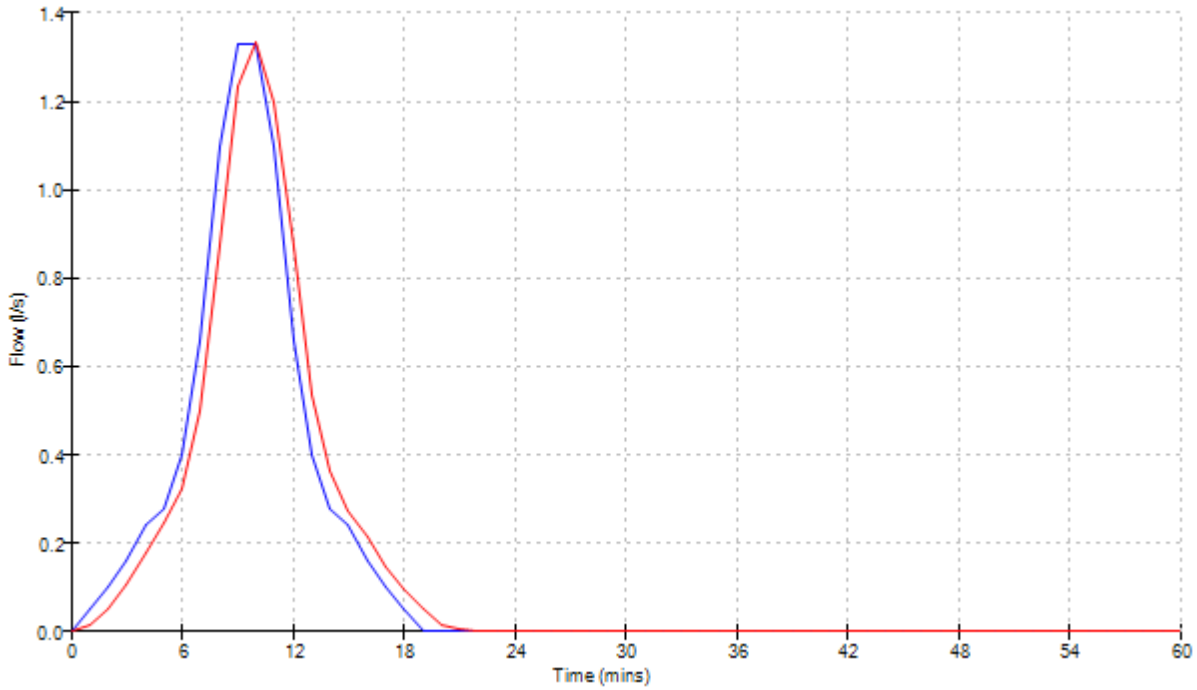
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 10, 30, 100
Climate Change (%)	0, 0, 0, 40

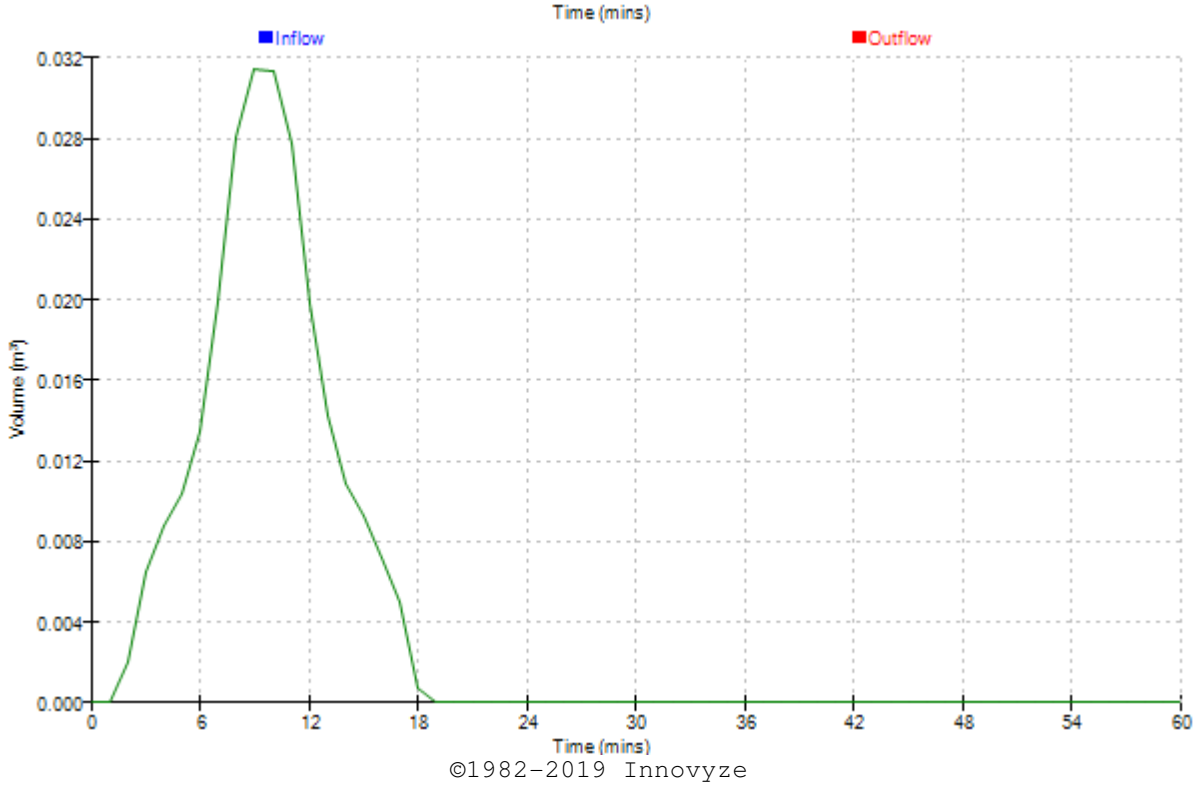
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	15 Summer	10	+0%	100/15 Winter			
1.001	2	15 Winter	10	+0%	100/15 Summer			
1.002	3	120 Winter	10	+0%	10/60 Winter			
1.003	Soakaway	120 Winter	10	+0%	1/120 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	167.133	-0.067	0.000	0.23		1.3	OK	
1.001	2	167.038	-0.044	0.000	0.59		4.5	OK	
1.002	3	166.814	0.024	0.000	0.12		1.4	SURCHARGED	
1.003	Soakaway	166.813	0.163	0.000	0.00		0.0	SURCHARGED	

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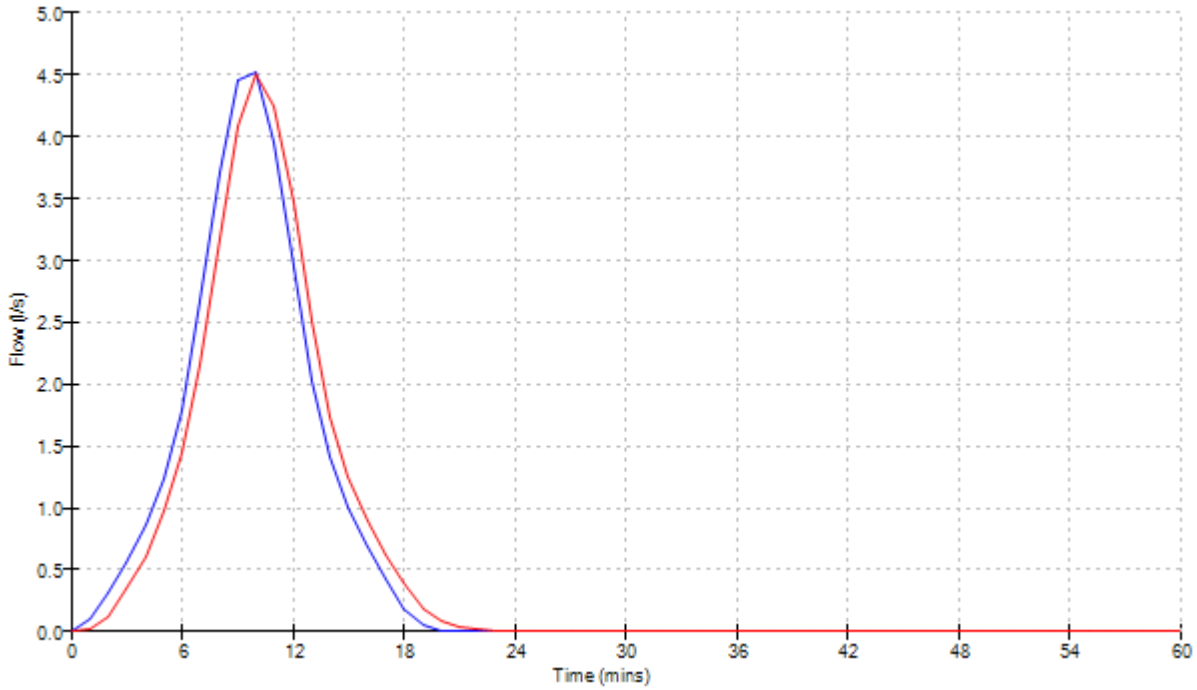
Graphs for Pipe 1.000 US/MH 1 (Storm)
15 minute 10 year Summer I+0%
Status: OK

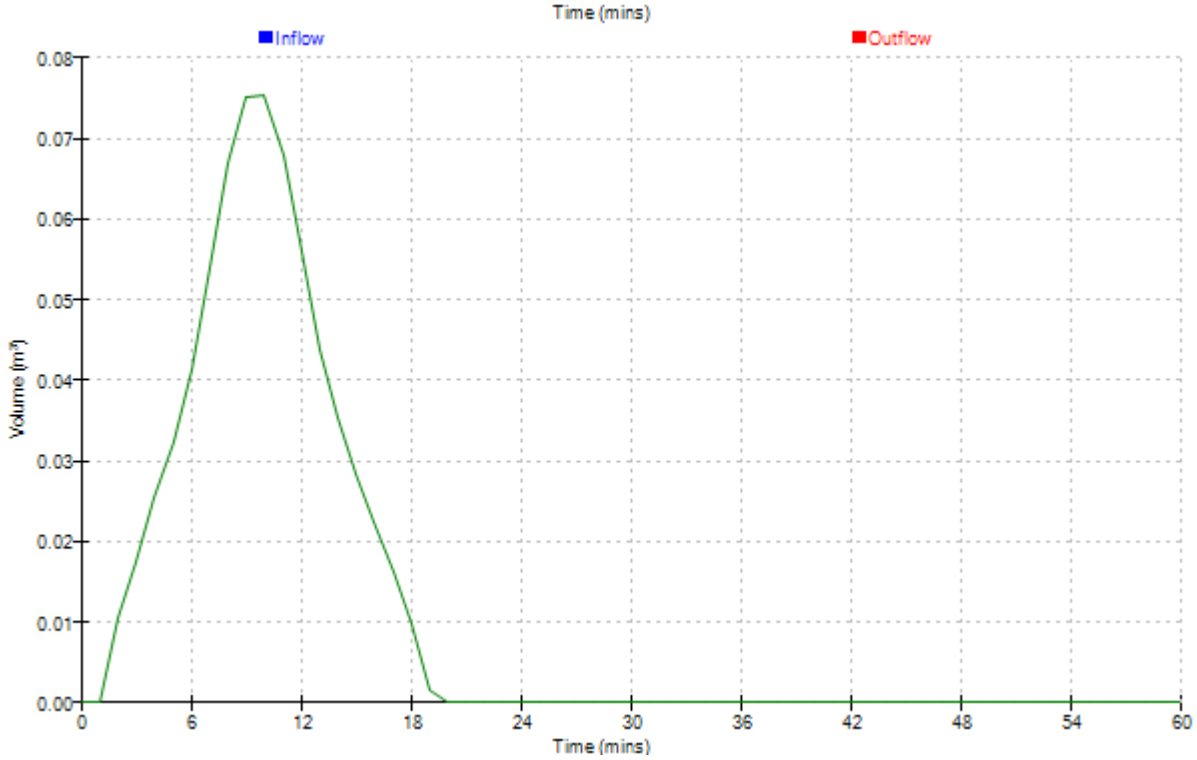




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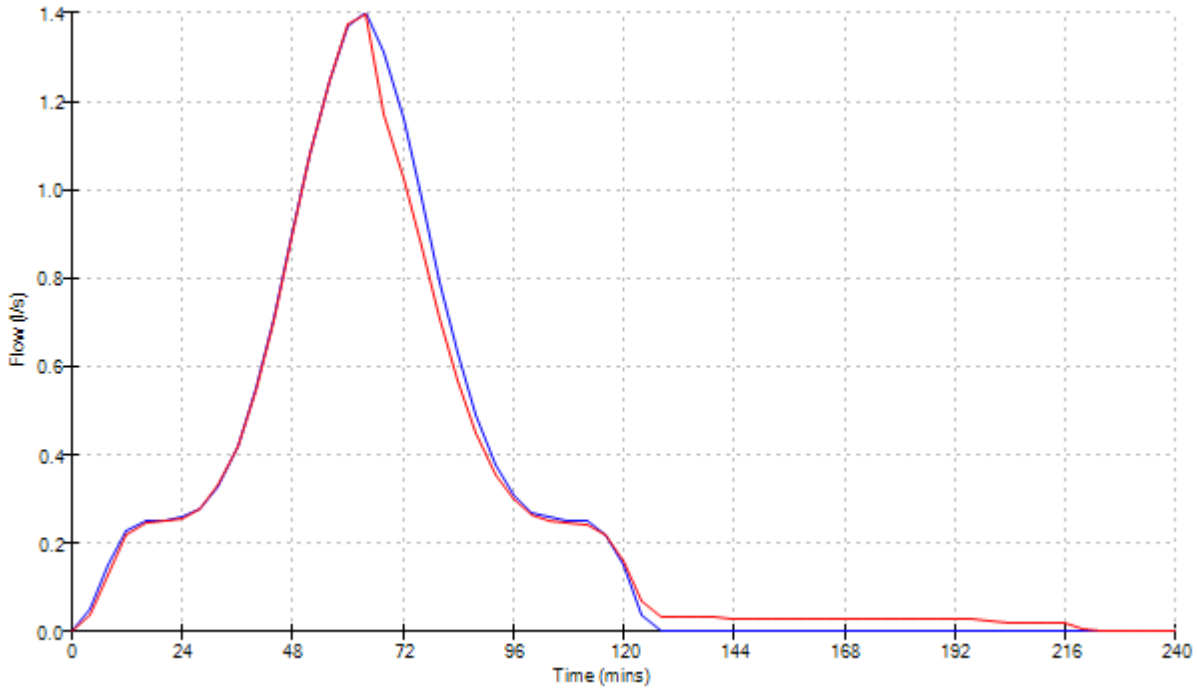
Graphs for Pipe 1.001 US/MH 2 (Storm)
15 minute 10 year Winter I+0%
Status: OK

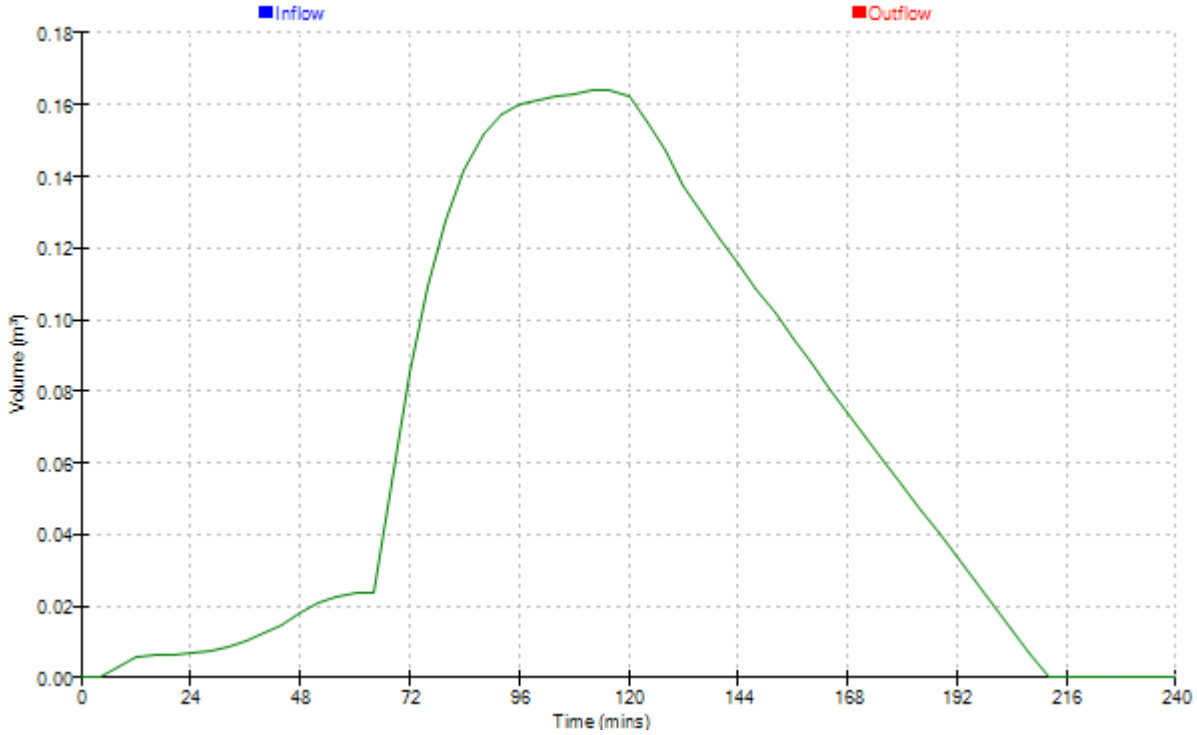




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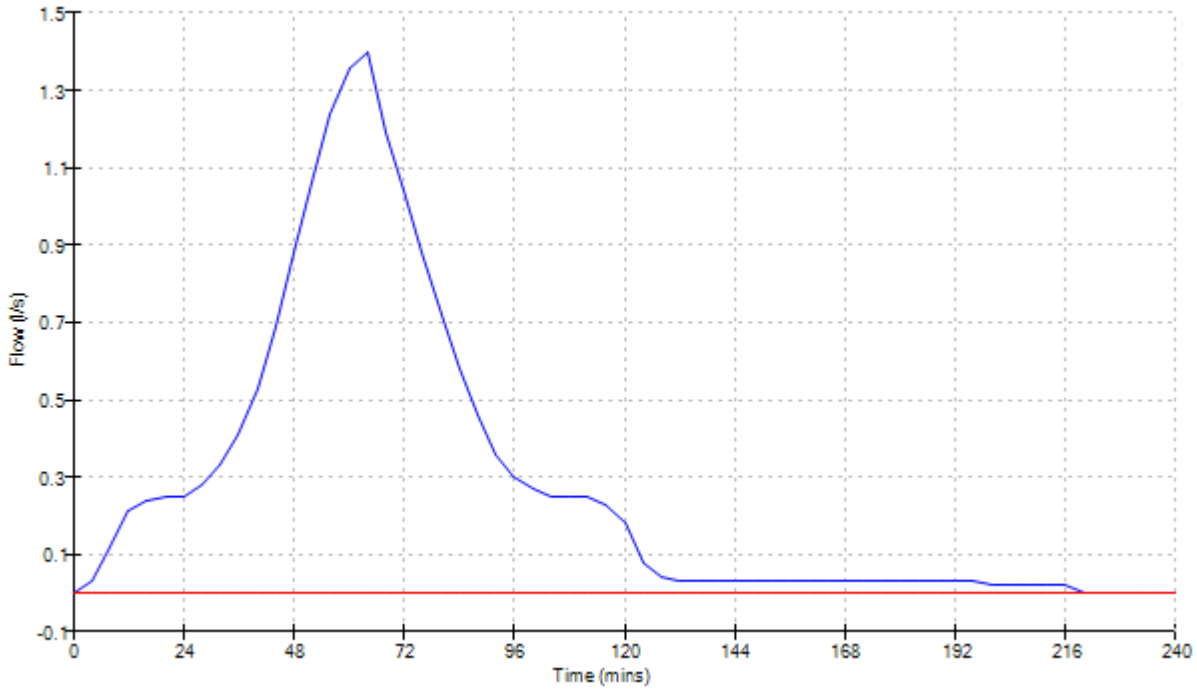
Graphs for Pipe 1.002 US/MH 3 (Storm)
120 minute 10 year Winter I+0%
Status: SURCHARGED

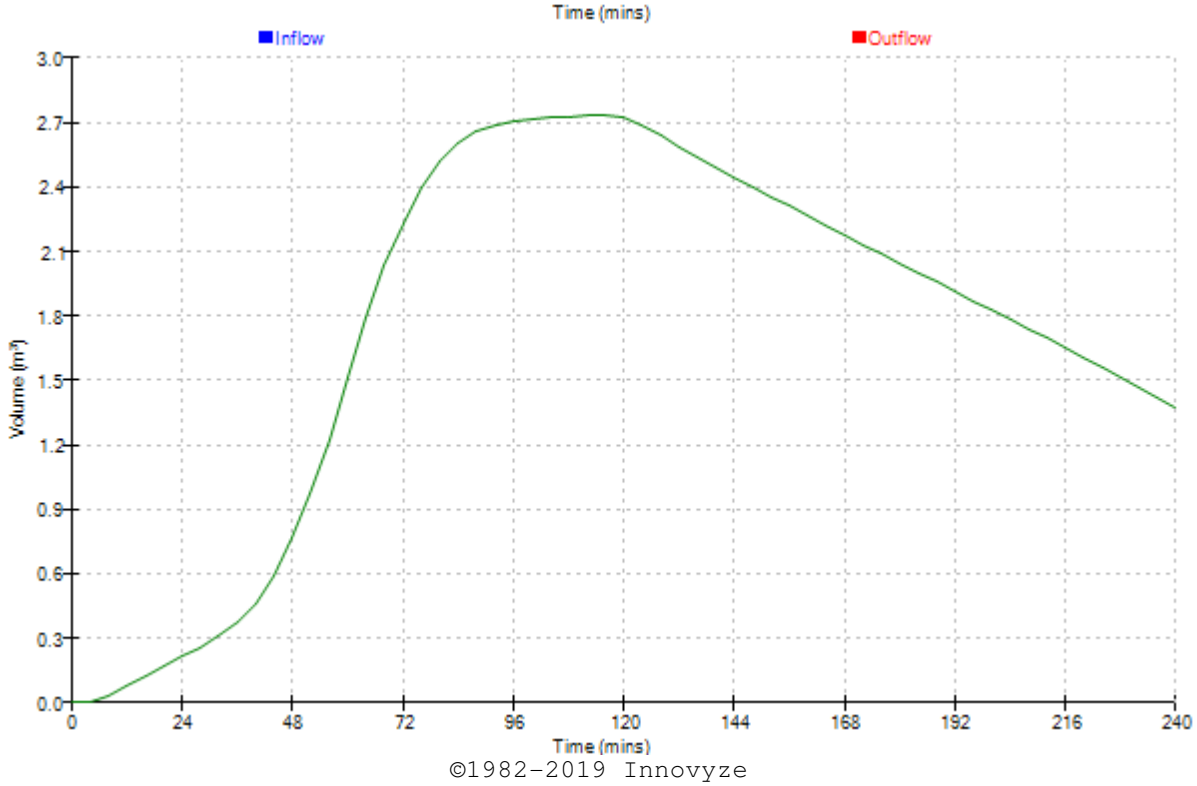




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Graphs for Pipe 1.003 US/MH Soakaway (Storm)
120 minute 10 year Winter I+0%
Status: SURCHARGED





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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.356
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

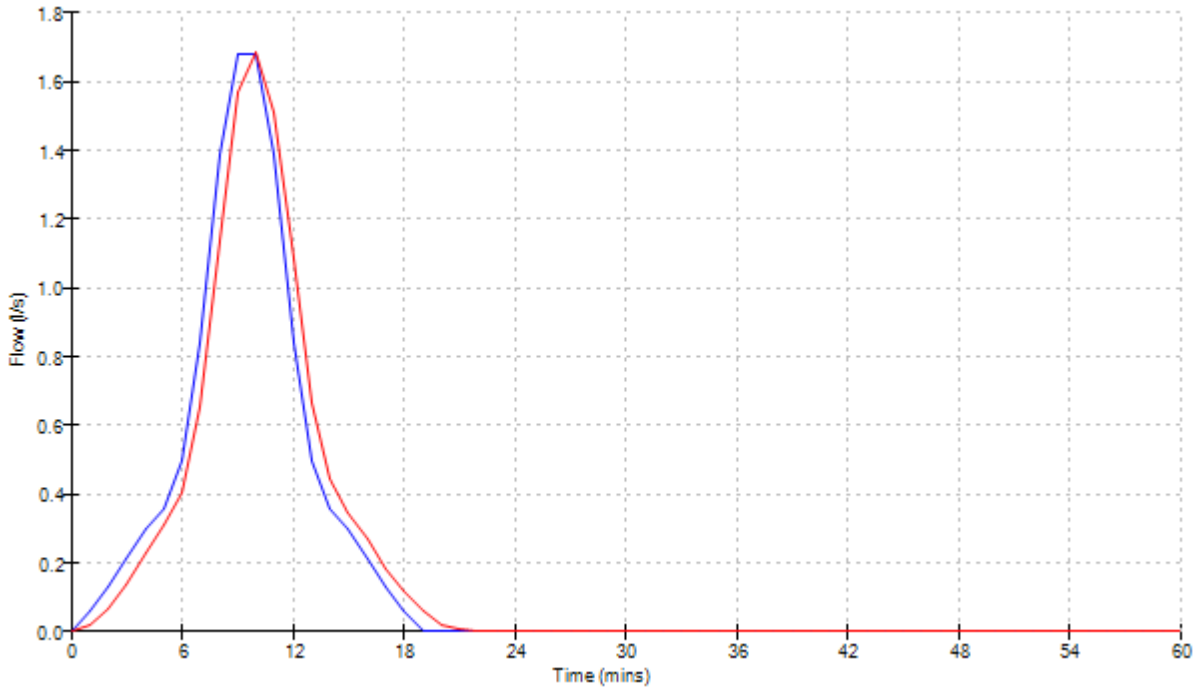
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 10, 30, 100
Climate Change (%)	0, 0, 0, 40

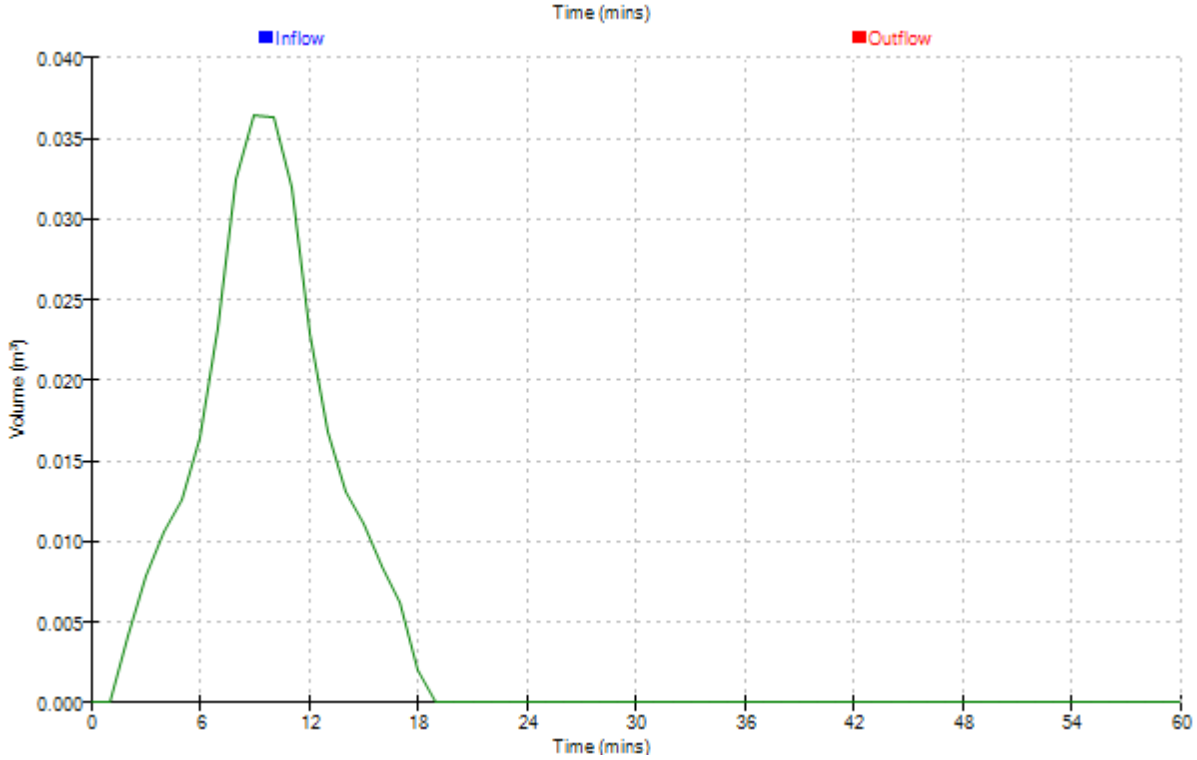
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	15 Summer	30	+0%	100/15 Winter			
1.001	2	15 Winter	30	+0%	100/15 Summer			
1.002	3	180 Winter	30	+0%	10/60 Winter			
1.003	Soakaway	180 Winter	30	+0%	1/120 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	167.137	-0.063	0.000	0.30		1.7	OK	
1.001	2	167.047	-0.035	0.000	0.75		5.7	OK	
1.002	3	166.914	0.124	0.000	0.10		1.3	SURCHARGED	
1.003	Soakaway	166.913	0.263	0.000	0.00		0.0	SURCHARGED	

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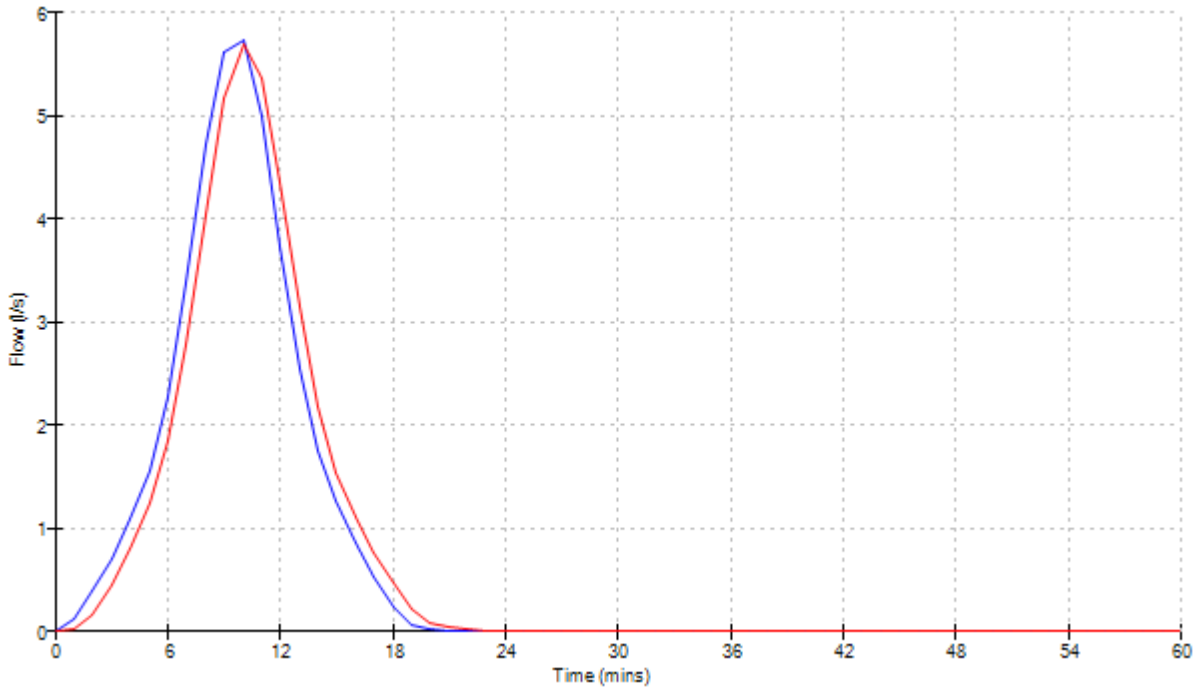
Graphs for Pipe 1.000 US/MH 1 (Storm)
15 minute 30 year Summer I+0%
Status: OK

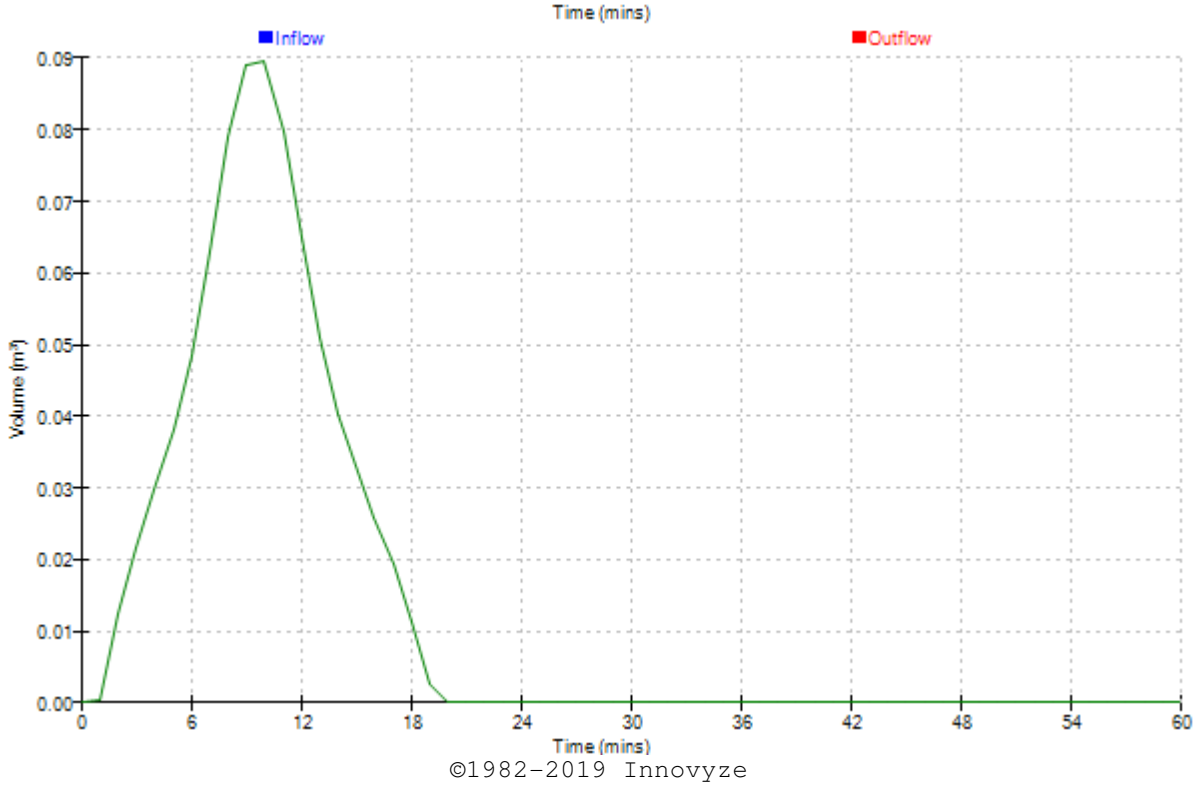




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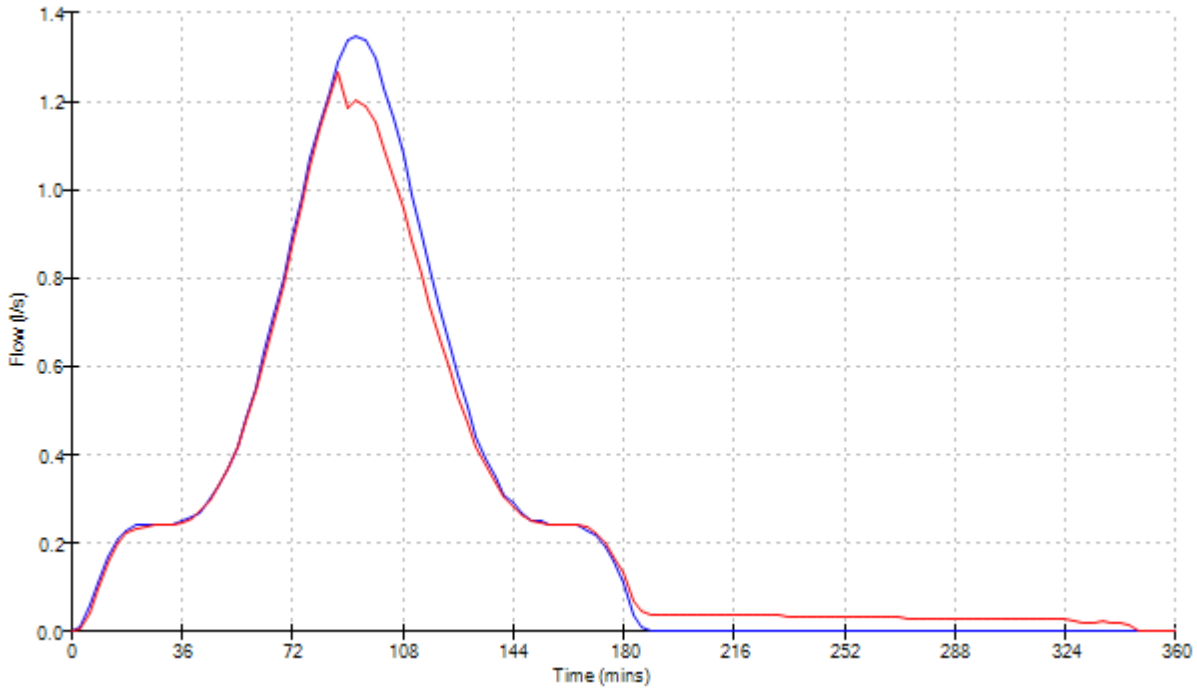
Graphs for Pipe 1.001 US/MH 2 (Storm)
15 minute 30 year Winter I+0%
Status: OK

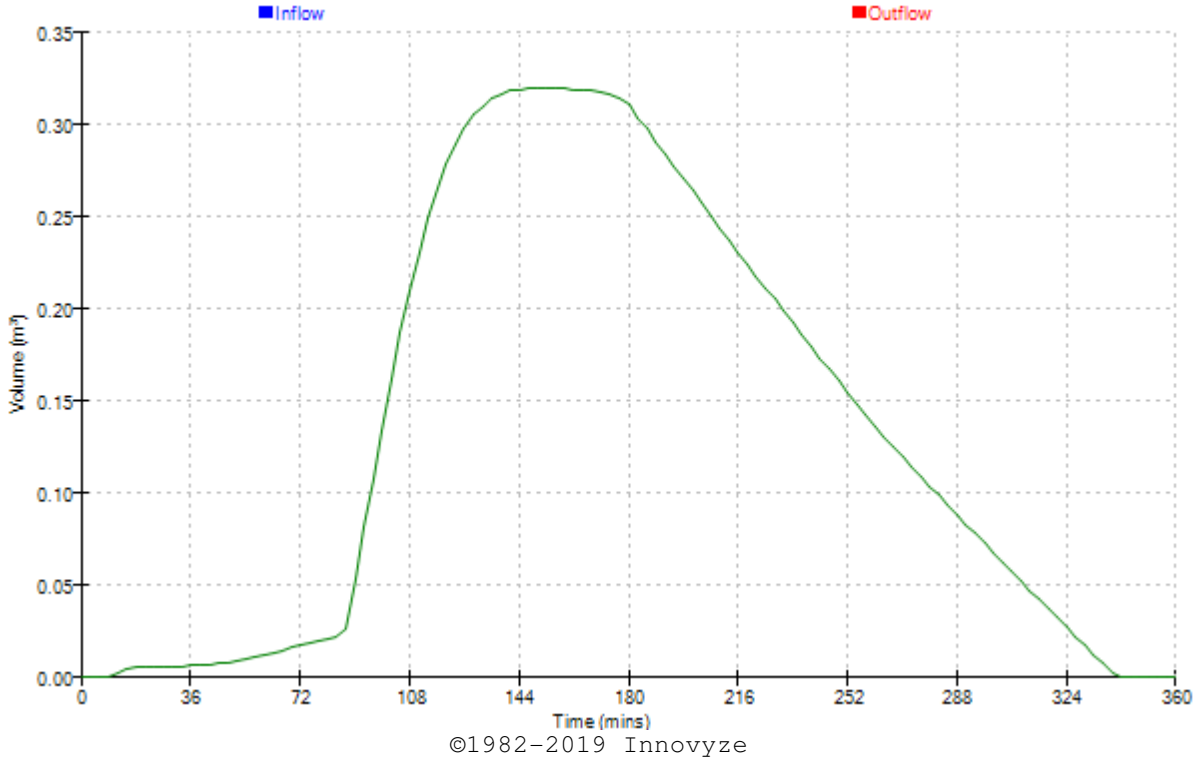




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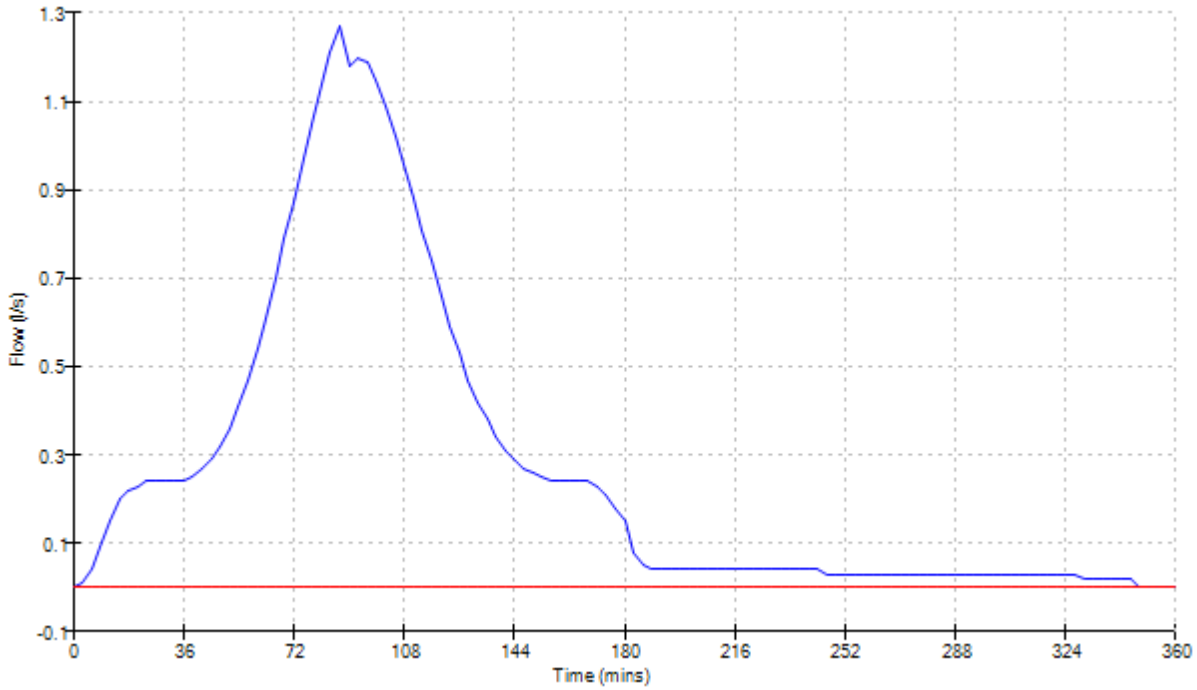
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180 minute 30 year Winter I+0%
Status: SURCHARGED

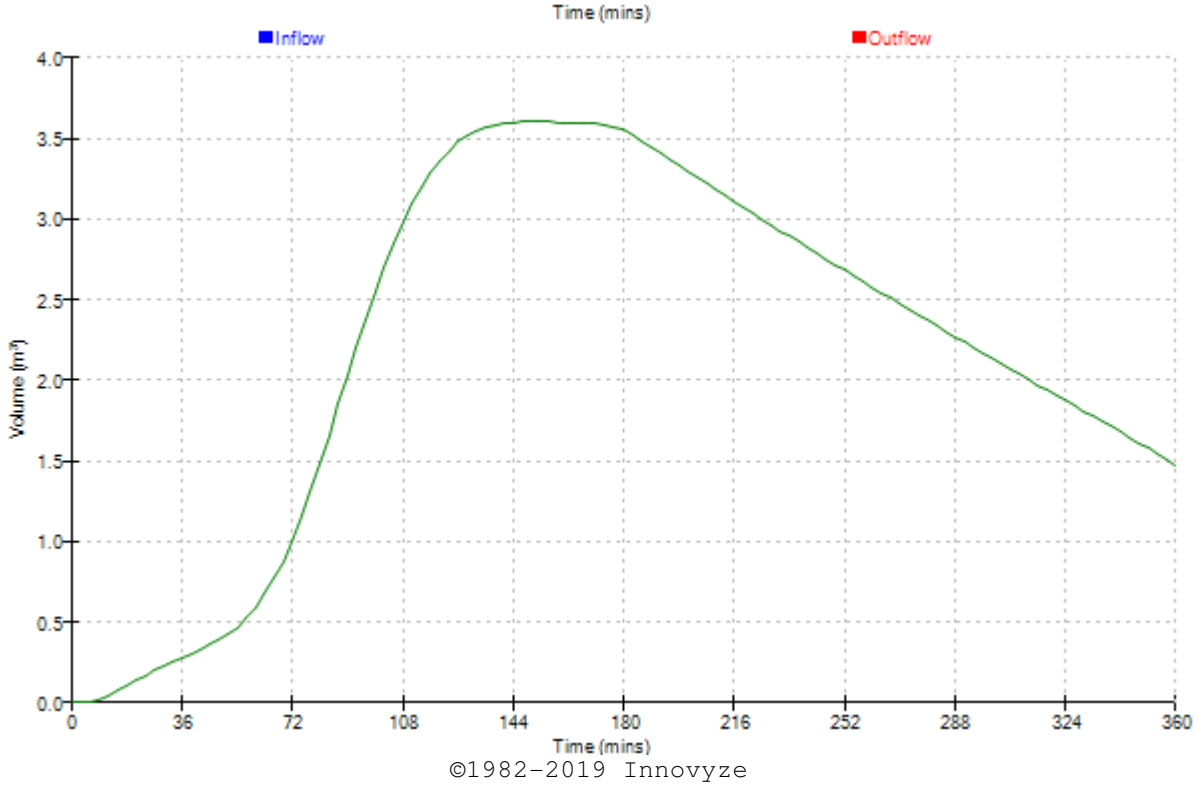




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Graphs for Pipe 1.003 US/MH Soakaway (Storm)
180 minute 30 year Winter I+0%
Status: SURCHARGED





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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.356
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

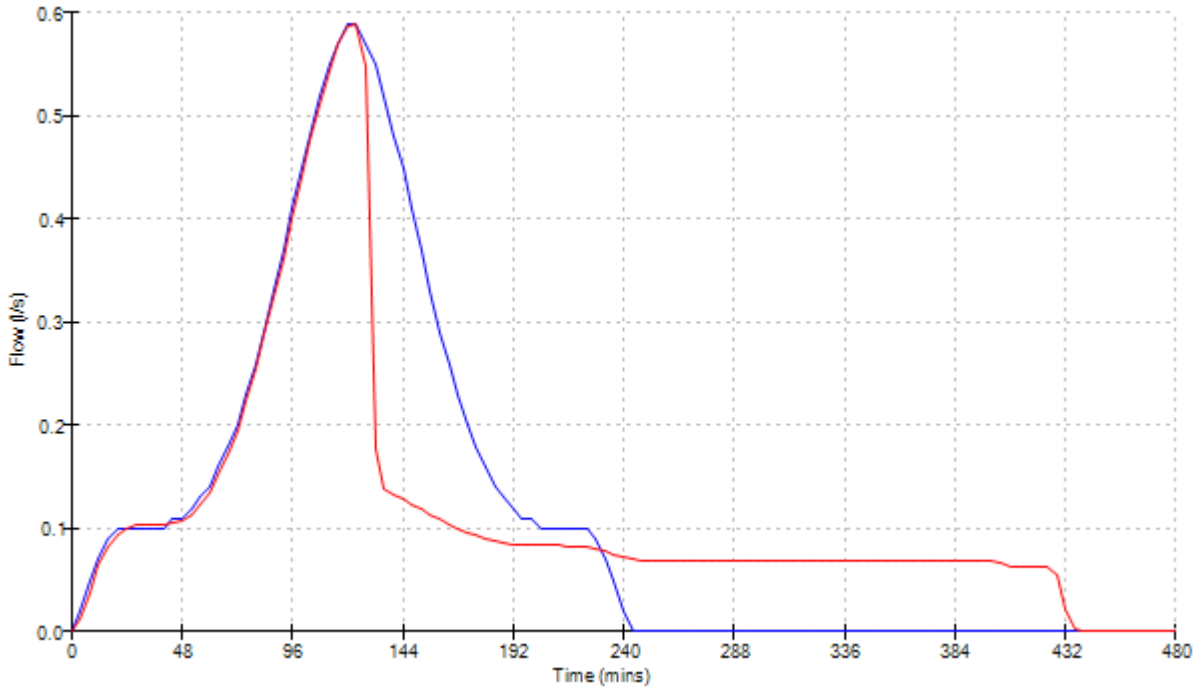
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 10, 30, 100
Climate Change (%)	0, 0, 0, 40

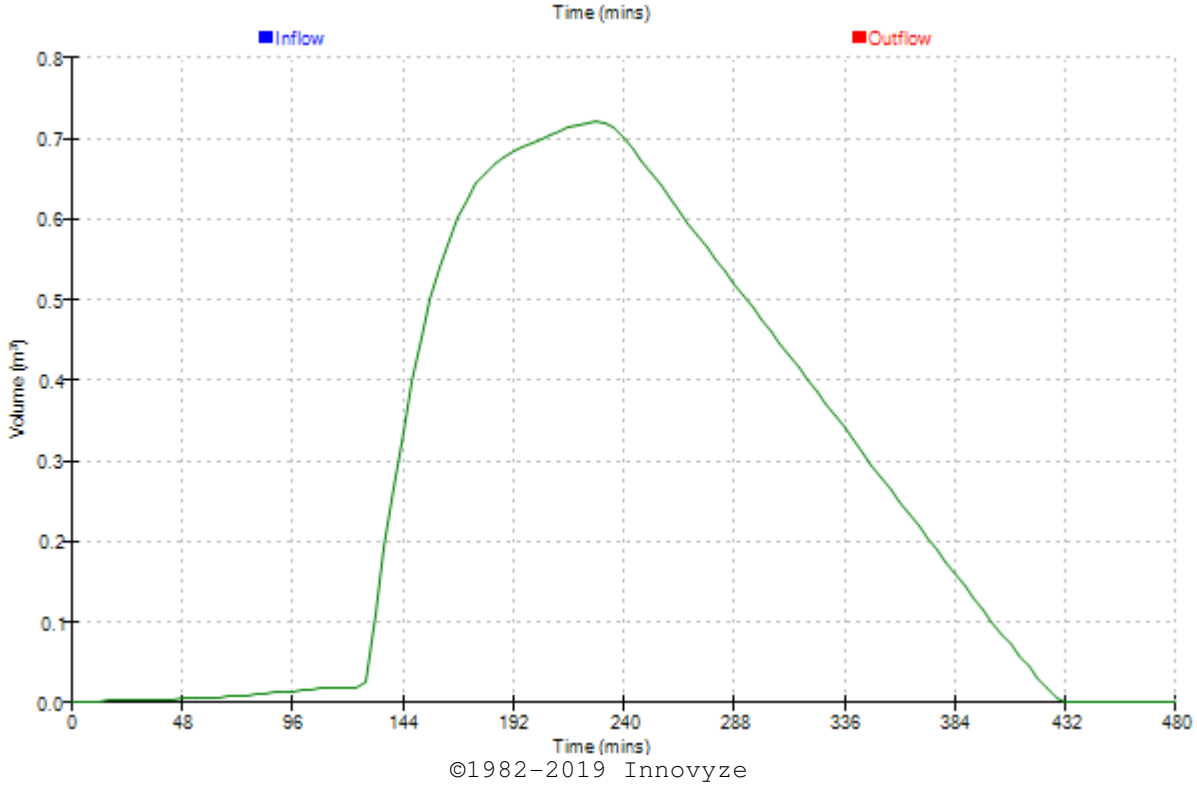
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	240 Winter	100	+40%	100/15 Winter			
1.001	2	240 Winter	100	+40%	100/15 Summer			
1.002	3	240 Winter	100	+40%	10/60 Winter			
1.003	Soakaway	240 Winter	100	+40%	1/120 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	167.743	0.543	0.000	0.10		0.6	SURCHARGED	
1.001	2	167.742	0.660	0.000	0.26		2.0	SURCHARGED	
1.002	3	167.739	0.949	0.000	0.14		1.7	SURCHARGED	
1.003	Soakaway	167.739	1.089	0.000	0.00		0.0	SURCHARGED	

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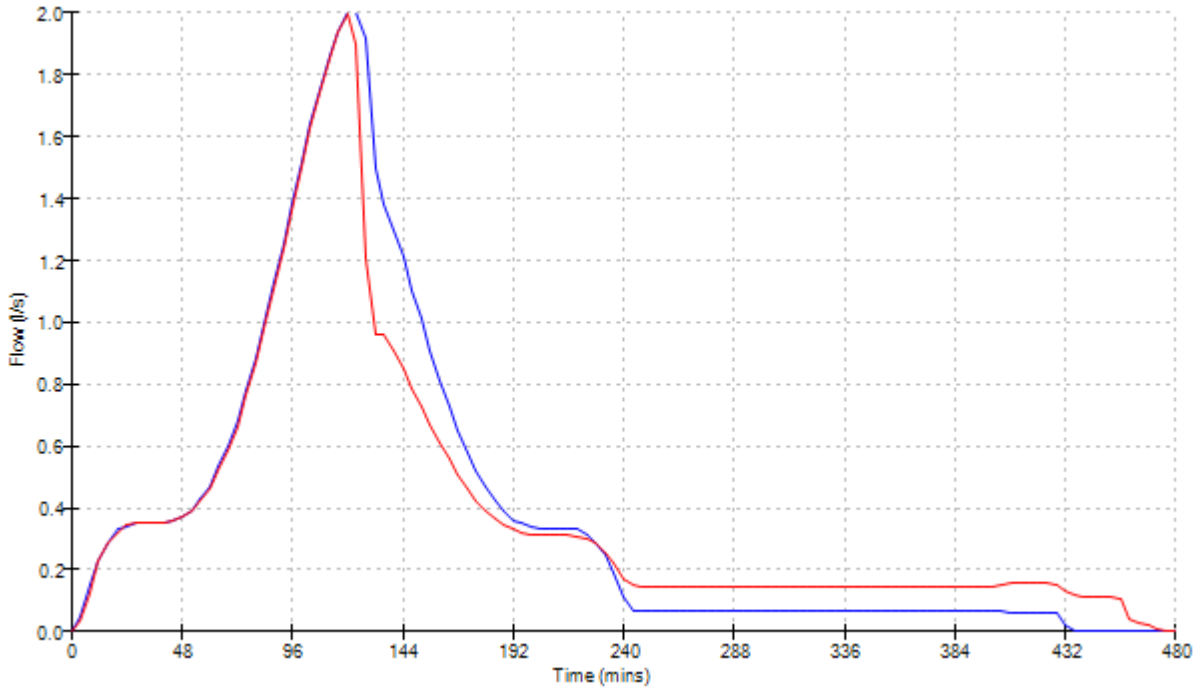
Graphs for Pipe 1.000 US/MH 1 (Storm)
240 minute 100 year Winter I+40%
Status: SURCHARGED

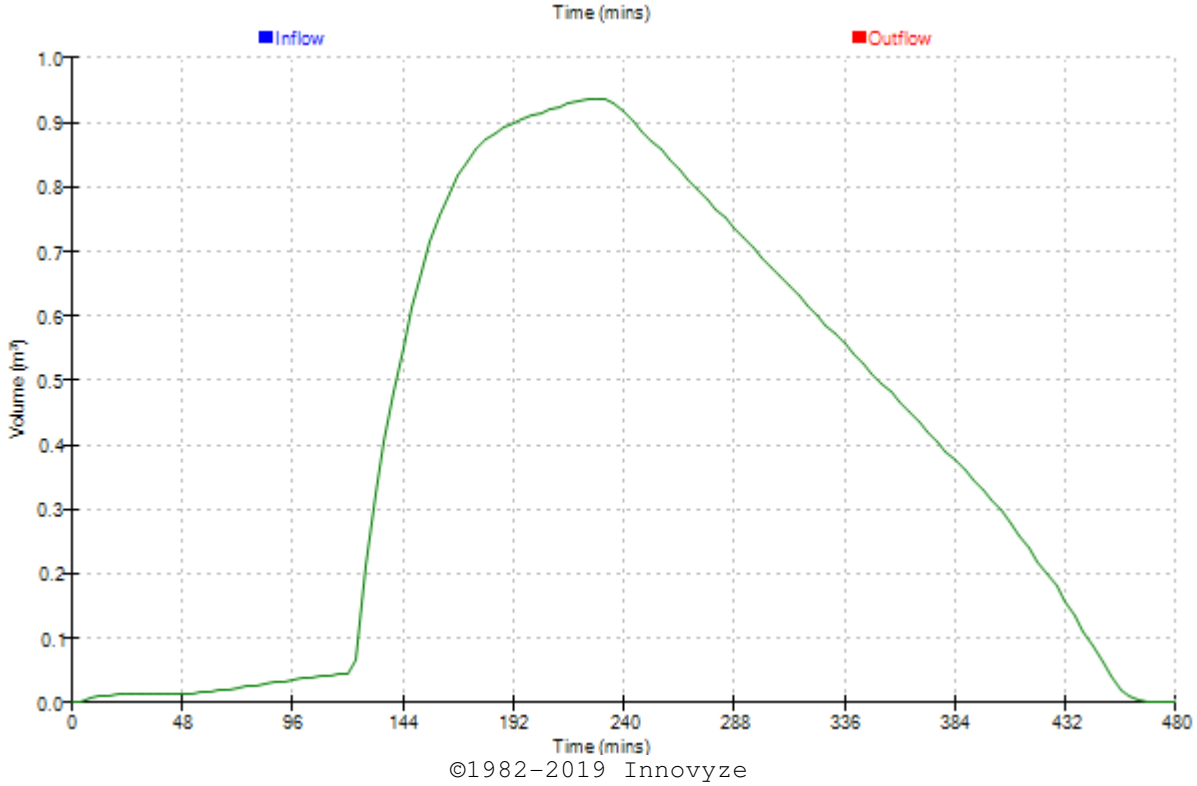




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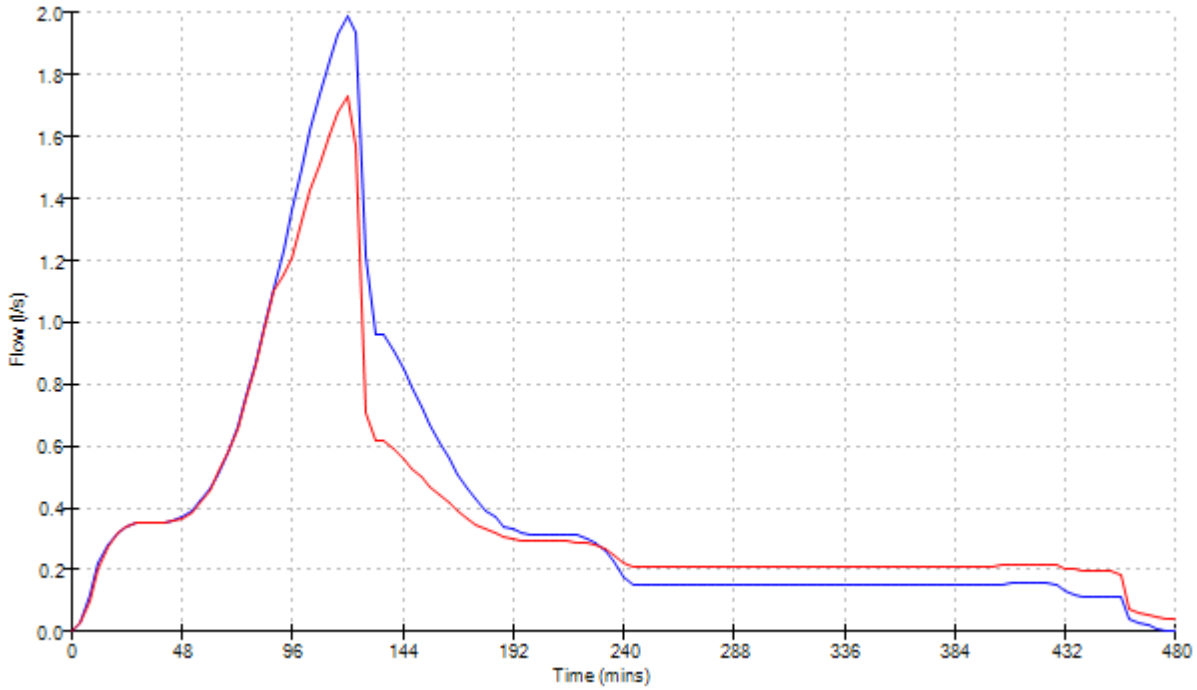
Graphs for Pipe 1.001 US/MH 2 (Storm)
240 minute 100 year Winter I+40%
Status: SURCHARGED

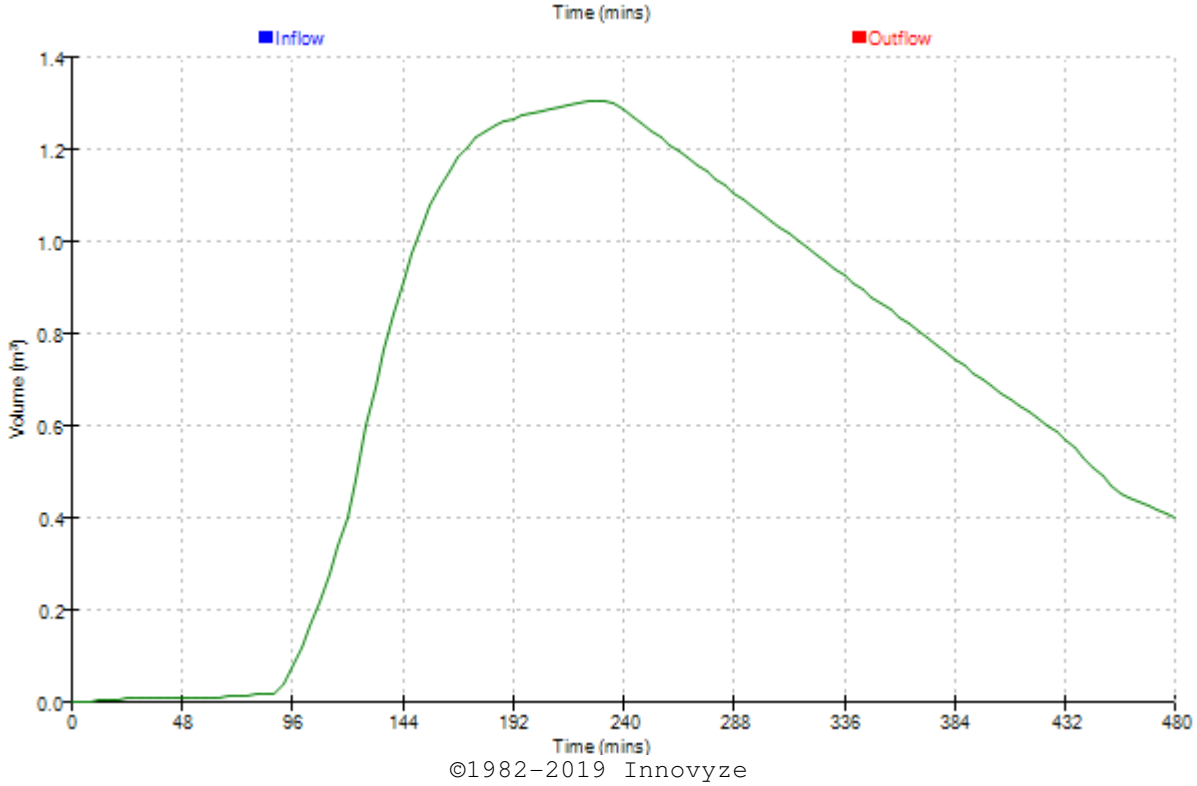




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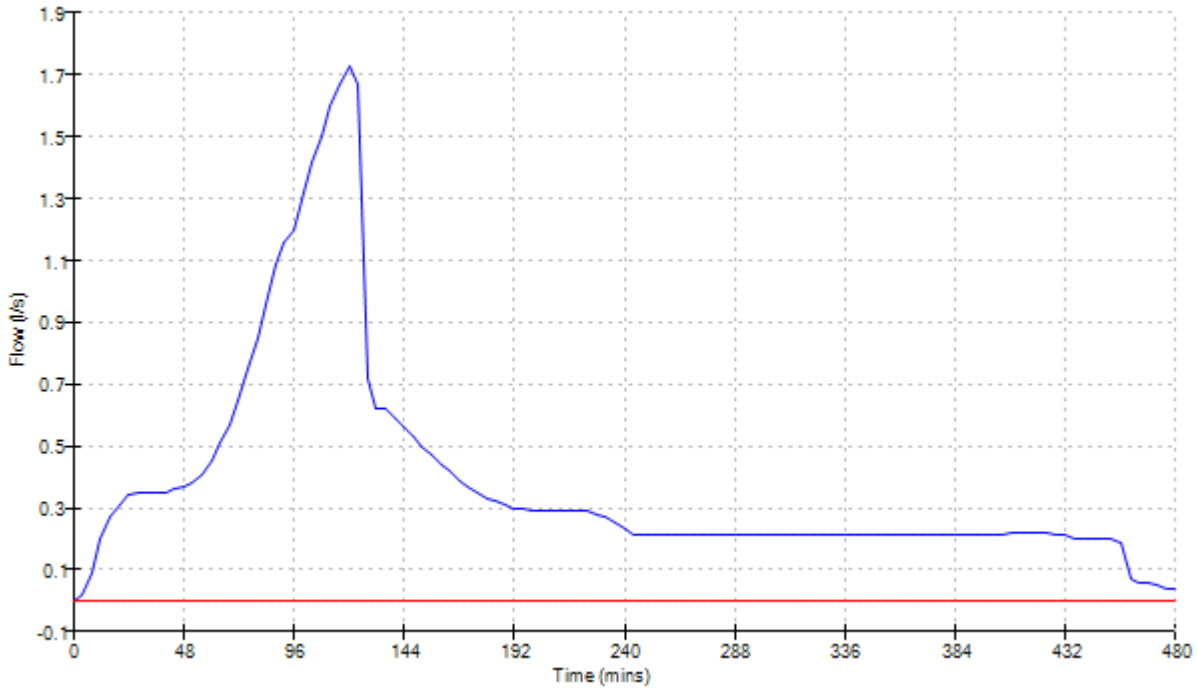
Graphs for Pipe 1.002 US/MH 3 (Storm)
240 minute 100 year Winter I+40%
Status: SURCHARGED

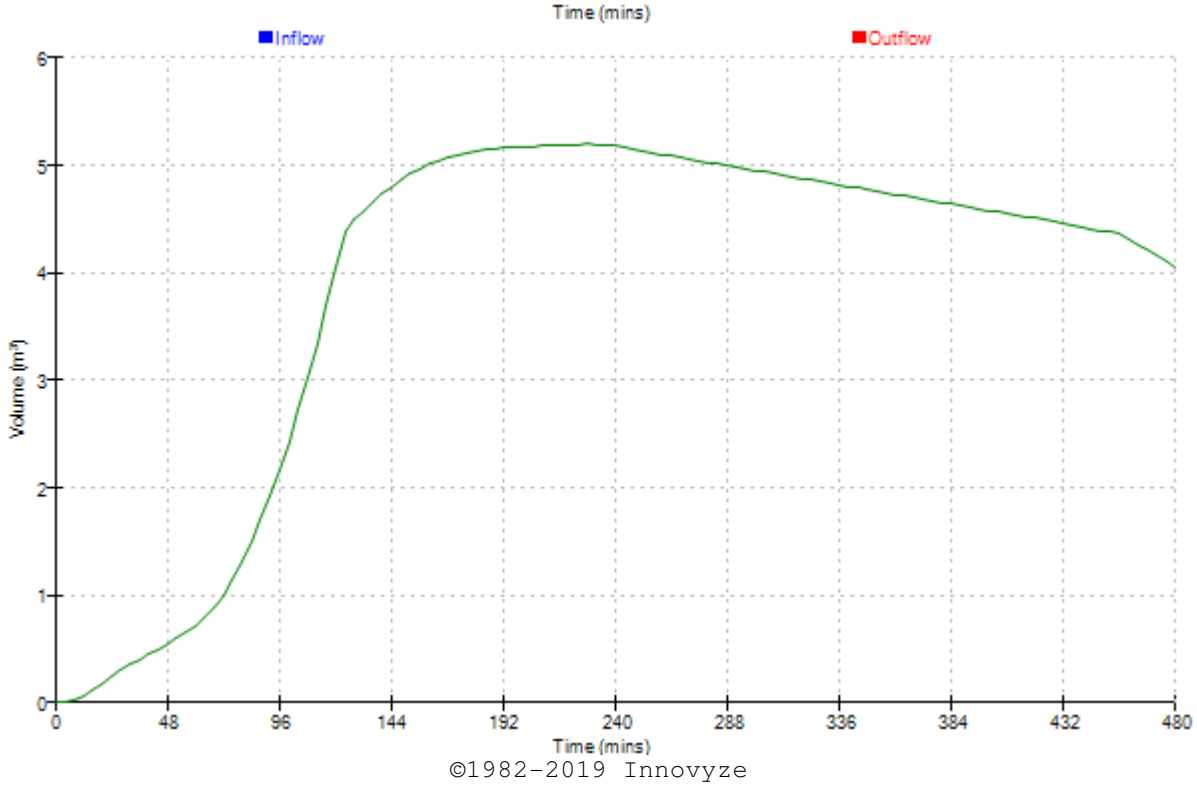




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Graphs for Pipe 1.003 US/MH Soakaway (Storm)
240 minute 100 year Winter I+40%
Status: SURCHARGED





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