

# Technical Note

## TN 6.35 Modeling StormTech® Chambers in Hydraflow Hydrographs

### Introduction

The following steps provide instructions for modeling StormTech chambers as a pond in the Hydraflow Hydrographs modeling software. This document does not address setting up a hydrograph or connecting inlet and outlet devices. This document is for the sole purpose of modeling the chamber stage-storage volume.

StormTech chambers are modeled in Hydraflow Hydrographs using either the “Manual” input option or the “Chambers” input option. The manual input option requires the use of the StormTech Cumulative Storages spreadsheet to calculate the stage storage data. Data points are then copied from the Cumulative Storage spreadsheet into the Manual inputs options menu when creating a pond in Hydraflow Hydrographs. The second option of using the “Chambers” input in Hydraflow is recommended as it makes it easier for the user to modify pond size when designing the outlet controls.

### Data Inputs

Under the Stage/Storage/Discharge setup screen select the “Chambers” option:

- i. Set the parameters for this screen as follows:
- ii. Invert Elev. Dn – Bottom of chamber foot
- iii. Shape – Arch
- iv. Rise, Span, & Barrel Length should follow the values in Table 1

Table 1

Chamber	Rise ft (m)	Span ft (m)	Length ft (m)
SC-160LP	0.87 (0.265)	1.41 (0.430)	7.12 (2.170)
SC-310	1.15 (0.351)	2.30 (0.701)	7.12 (2.170)
SC-740/DC-780	2.05 (0.625)	4.00 (1.219)	7.12 (2.170)
SC-800	2.44 (0.744)	3.71 (1.131)	7.12 (2.170)
MC-3500	3.50 (1.067)	5.60 (1.707)	7.12 (2.170)
MC-4500	4.65 (1.417)	7.24 (2.207)	4.03 (1.228)
MC-7200	4.65 (1.417)	7.46 (2.274)	6.59 (2.009)

*Note: Actual height and width of chambers will overestimate the provided volume. Actual height and width do not account for corrugation height. The values above are based on effective height and widths that simulate the individual chamber volumes.*

- v. No. Barrels – Set to desired chamber count
- vi. Slope – 0.0%
- vii. Headers – “No”
- viii. Stone Encasement – “Yes”
- ix. Bottom Elev. – Set to bottom of stone foundation
- x. Width & Depth (minimum values) should follow the values in Table 2

**Table 2**

Chamber	Width ft (m)	Depth ft (m)
SC-160LP	2.083 (0.635)	2.00 (0.610)
SC-310	3.33 (1.015)	2.33 (0.710)
SC-740/DC-780	4.75 (1.448)	3.50 (1.067)
SC-800	4.75 (1.448)	3.75 (1.143)
MC-3500	7.17 (2.185)	5.50 (1.676)
MC-4500	9.08 (2.768)	6.75 (2.057)
MC-7200	9.08 (2.768)	6.75 (2.057)

- xi. Voids – 40.0%
- a. Modeling the end caps for the MC-3500, MC-4500 and MC-7200 is achieved by increasing the chamber count based on an estimated ratio. One additional chamber or “barrel” shall be added for every four MC-3500 End Caps. Two additional chambers or “barrels” shall be added for every three MC-4500 End Caps. Two additional chambers or “barrels” shall be added for every five MC-7200 End Caps.
  - b. Note this method does not account for stone around the perimeter of the bed or around the manifolds. Perimeter stone can be included in the total volume by adjusting the “Width” value. The method for setting the new width value is as follows:

$$Width = \frac{Area\ of\ Bed}{(Number\ of\ Barrels \times Barrel\ Length)}$$

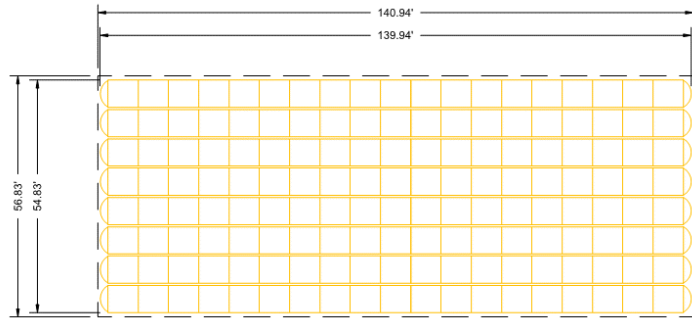
## Examples

The two layouts below contain 152 MC-3500 chambers in 8 rows (16 end caps). As per the guidance above, we will model 156 chambers (the 16 end caps convert to approximately 4 additional chambers). The first set of drawings show the dimensions assuming minimum spacing and offsets for the stone perimeter specified for an MC-3500 chamber. The second set of drawings accounts for the addition of manifolds, an irregular shape, and the inclusion of perimeter stone for an MC-3500 chamber. Both examples have been shown with Imperial units.

# Example 1: Simple Rectangular Shape

## Layout using Standard Chamber Dimensions and Offsets

PROPOSED LAYOUT	
152	STORMTECH MC-3500 CHAMBERS
16	STORMTECH MC-3500 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
40	% STONE VOID
<b>27,793</b>	<b>INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED)</b>
8,010	SYSTEM AREA (ft <sup>2</sup> )
396	SYSTEM PERIMETER (ft)
PROPOSED ELEVATIONS	
999.50	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
993.50	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC)
993.00	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC)
993.00	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT)
993.00	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT)
992.50	TOP OF STONE
991.50	TOP OF MC-3500 CHAMBER
987.75	BOTTOM OF MC-3500 CHAMBER
987.00	BOTTOM OF STONE



## StormTech Stage-Storage Spreadsheet Output

**Project:** Example

Chamber Model - MC-3500

Units - Imperial [Click Here for Metric](#)

Number of Chambers - 152

Number of End Caps - 16

Voids in the stone (porosity) - 40 %


Base of Stone Elevation - 987.00 ft

Amount of Stone Above Chambers - 12 in

Amount of Stone Below Chambers - 9 in

Amount of Stone Between Chambers - 6 in

Area of system - 8010 sf Min. Area - 7795 sf min. area



Include Perimeter Stone in Calculations

StormTech MC-3500 Cumulative Storage Volumes								
Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Single End Cap (cubic feet)	Incremental Chambers (cubic feet)	Incremental End Cap (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch. EC and Stone (cubic feet)	Cumulative System (cubic feet)	Elevation (feet)
66	0.00	0.00	0.00	0.00	267.00	267.00	7792.76	992.50
65	0.00	0.00	0.00	0.00	267.00	267.00	27525.76	992.42
64	0.00	0.00	0.00	0.00	267.00	267.00	27258.76	992.33
63	0.00	0.00	0.00	0.00	267.00	267.00	26991.76	992.25
62	0.00	0.00	0.00	0.00	267.00	267.00	26724.76	992.17

### Hydraflow Inputs (Minimum Installation Requirements)

Item	Input
Storage Type =	UG Chambers
Invert Elev. Dn (ft) =	987.75
Rise (ft) =	3.50
Shape =	Arch
Span (ft) =	5.60
Barrel Length (ft) =	7.17
No. Barrels =	156
Slope (%) =	0.000
Headers =	No
Stone Encasement =	Yes
Bottom Elev. (ft) =	987.00
Width (ft) =	7.17
Depth (ft) =	5.50
Voids (%) =	40.00

### Hydraflow Stage-Storage Results (Minimum Installation Requirements)

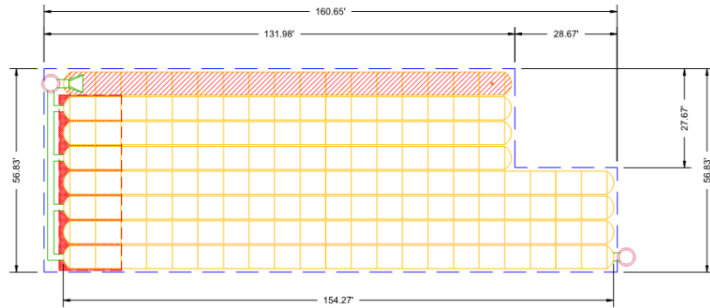
Row	Stage	Elevation	Contour Area	Incremental Storage	Total Storage
	(ft)	(ft)	(sqft)	(cuft)	(cuft)
0	0.00	987.00	n/a	0.000	0.000
1	0.55	987.55	n/a	1,765	1,765
2	1.10	988.10	n/a	3,078	4,843
3	1.65	988.65	n/a	3,797	8,640
4	2.20	989.20	n/a	3,710	12,349
5	2.75	989.75	n/a	3,560	15,910
6	3.30	990.30	n/a	3,331	19,240
7	3.85	990.85	n/a	2,975	22,215
8	4.40	991.40	n/a	2,236	24,451
9	4.95	991.95	n/a	1,765	26,215
10	5.50	992.50	n/a	1,765	27,980

It can be observed that there is a discrepancy between the StormTech Cumulative Storage spreadsheet and the Hydraflow output. However, the Hydraflow outputs produced via this method are usually within 1% of the actual value. In this example, the difference is less than 1.0% of the actual.

# Example 2: Inclusion of Manifolds, Irregular Shapes, and Perimeter Stone

## Layout Including Additional Perimeter Stone for Manifolds


PROPOSED LAYOUT	
152	STORMTECH MC-3500 CHAMBERS
16	STORMTECH MC-3500 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
40	% STONE VOID
28,512	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED)
8,337	SYSTEM AREA (sf)
435	SYSTEM PERIMETER (ft)
PROPOSED ELEVATIONS	
999.50	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
993.50	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC)
993.00	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC)
993.00	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT)
993.00	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT)
992.50	TOP OF STONE
991.50	TOP OF MC-3500 CHAMBER
989.42	18" TOP MANIFOLD INVERT
987.92	24" ISOLATOR ROW PLUS CONNECTION INVERT
987.92	24" BOTTOM CONNECTION INVERT
987.75	BOTTOM OF MC-3500 CHAMBER
987.00	BOTTOM OF STONE



## StormTech Stage-Storage Spreadsheet Output (Including Manifold & Perimeter Stone)

**Project:** Example

Chamber Model -	MC-3500
Units -	Imperial <a href="#">Click Here for Metric</a>
Number of Chambers -	152
Number of End Caps -	16
Voids in the stone (porosity) -	40 %
Base of Stone Elevation -	987.00 ft
Amount of Stone Above Chambers -	12 in
Amount of Stone Below Chambers -	9 in
Amount of Stone Between Chambers -	6 in
Area of system -	8337 sf



Include Perimeter Stone in Calculations

Min. Area - 7795 sf min. area

StormTech MC-3500 Cumulative Storage Volumes								
Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Single End Cap (cubic feet)	Incremental Chambers (cubic feet)	Incremental End Cap (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch, EC and Stone (cubic feet)	Cumulative System (cubic feet)	Elevation (feet)
66	0.00	0.00	0.00	0.00	277.90	277.90	28512.16	992.50
65	0.00	0.00	0.00	0.00	277.90	277.90	28234.26	992.42
64	0.00	0.00	0.00	0.00	277.90	277.90	27956.36	992.33
63	0.00	0.00	0.00	0.00	277.90	277.90	27678.46	992.25
62	0.00	0.00	0.00	0.00	277.90	277.90	27400.56	992.17

### Calculating "Width"

$$Width = \frac{Area\ of\ Bed}{(Number\ of\ Barrels \times Barrel\ Length)} = \frac{8,337\ sf}{(156\ Barrels \times 7.17\ ft)} \approx 7.45\ ft$$

### Hydraflow Inputs (Manifolds & Perimeter Included)

Item	Input
Storage Type =	UG Chambers
Invert Elev. Dn (ft) =	987.75
Rise (ft) =	3.50
Shape =	Arch
Span (ft) =	5.60
Barrel Length (ft) =	7.17
No. Barrels =	156
Slope (%) =	0.000
Headers =	No
Stone Encasement =	Yes
Bottom Elev. (ft) =	987.00
Width (ft) =	7.45
Depth (ft) =	5.50
Voids (%) =	40.00

Note: 16 end caps convert to approximately 4 additional barrels for a total of 156

### Hydraflow Stage-Storage Results (Manifolds & Perimeter Included)

Row	Stage	Elevation	Contour Area	Incremental Storage	Total Storage
	(ft)	(ft)	(sqft)	(cuft)	(cuft)
0	0.00	987.00	n/a	0.000	0.000
1	0.55	987.55	n/a	1,834	1,834
2	1.10	988.10	n/a	3,147	4,981
3	1.65	988.65	n/a	3,866	8,846
4	2.20	989.20	n/a	3,778	12,625
5	2.75	989.75	n/a	3,629	16,254
6	3.30	990.30	n/a	3,400	19,654
7	3.85	990.85	n/a	3,043	22,697
8	4.40	991.40	n/a	2,305	25,002
9	4.95	991.95	n/a	1,834	26,836
10	5.50	992.50	n/a	1,834	28,669

With added complexity, the addition of manifold offsets, and inclusion of perimeter stone the Hydraflow outputs can have a higher percent deviation than that shown in Example 1. For this example, the percent difference is approximately 1.0%.

