STORMTECH® ISOLATOR ROW

Manufactured Treatment Device Submission
Virginia BMP Clearinghouse
June 30, 2104

PREPARED BY

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Detention • Retention • Water Quality
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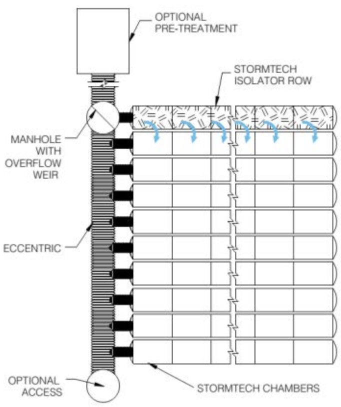
Attachment 1

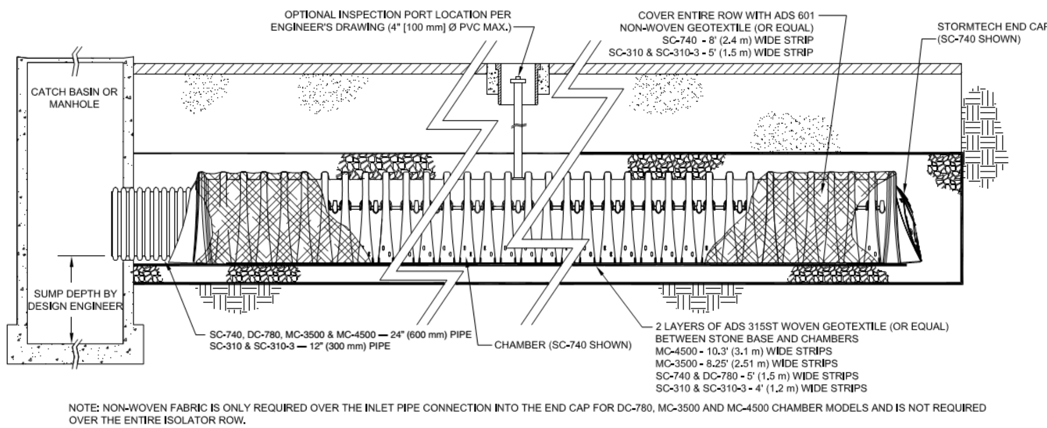
Manufactured Treatment Device (MTD) Registration

1. Manufactured Treatment Device Name: StormTech® Isolator Row™

StormTech Isolator Row with Overflow Spillway
(not to scale)



StormTech Isolator Row (not to scale)



The Isolator Row is a row or rows of StormTech thermoplastic chambers that are wrapped in filter fabric and installed below grade. Stormwater enters the chambers and must pass through the filter fabric media where sediments and other contaminants are filtered out as stormwater exits the Isolator Row through the fabric.

Some of the unique features of the Isolator Row that contribute to its effectiveness and practicality include:

- Vast filtration area – each chamber has large surface area which permits filtration of stormwater through the bottom filter fabric
- Large sediment storage volume
- Entire bottom area accessible for cleaning without obstructions within the row
- A state-of-the-art structural design that meets AASHTO safety factors for both live loads and permanent dead loads

2. Company Name: StormTech (a division of ADS, Inc.)

Mailing Address: 70 Inwood Road, Suite 3
City: Rocky Hill
State: CT Zip: 06067

3. Contact Name (to whom questions should be addressed): Chuck Lacey, Jr. PE

Mailing Address: 12137 Deer Haven Road
City: Marriottsville
State: MD Zip: 21104
Phone number: 301.875.8535
Fax number: n/a
E-mail address: chuck.lacey@ads-pipe.com
Web address: www.stormtech.com

4. Technology

Specific size/capacity of MTD assessed (include units):

The StormTech Isolator row can be sized to meet the needs of the project. Sizing can be either volume based for sites with good infiltrative soils, or the more commonly used practice of rate based sizing using a maximum water quality flow of less than 2.5 gpm/sqft of bottom area using two layers of woven geotextile (315W by ADS).

Range of drainage areas served by MTD (acres):

Site configuration is the only limiting factor as to the drainage area that can be served. In general, StormTech recommends the length of the Isolator Row be limited to less than 175 feet for cleaning/maintenance purposes. Multiple Isolator Rows can be placed side by side to increase the size of the area served.

Include sizing chart or describe sizing criteria:

Volume Based - For sites with good infiltration rates, a volume based approach can be used with a corresponding stage storage curves based on the number of StormTech Isolator Chambers provided. Bare chamber storage volumes listed in table are in cubic feet per chamber:

SC-310	14.7	cf/chamber
SC-740	45.9	cf/chamber
DC-780	46.2	cf/chamber
MC3500	113.0	cf/chamber
MC4500	106.5	cf/chamber

Table 1 - Storage Volume per Chamber

Rate Based - For sites with where a combination of infiltration and detention/retention is used, at rate based approach is typically used. The treatments rates are based on available surface treatment area and factors of safety that were developed from extensive testing. 80% TSS removal and 40% TP removal can be achieved by sizing the Isolator Rows base on these maximum flows per chamber:

Chamber	Specific Flow Rate	Bottom Area	Flow Per Chamber
SC-310	2.5 gpm/sf	17.7 sf	0.10 cfs
RC-310	2.5 gpm/sf	17.7 sf	0.10 cfs
SC-740	2.5 gpm/sf	27.8 sf	0.15 cfs
RC-750	2.5 gpm/sf	27.8 sf	0.15 cfs
DC-780	2.5 gpm/sf	27.8 sf	0.15 cfs
MC-3500	2.5 gpm/sf	43.2 sf	0.24 cfs
MC-4500	2.5 gpm/sf	30.1 sf	0.17 cfs

Table 2 – Treatment Rate per Chamber

Intended application: on-line or offline:

The Isolator Row is an on-line device that is used in conjunction with a structure and associated weir. An upstream manhole provides access to the Isolator Row and typically includes a high flow weir such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row crest the weir and discharge through a manifold to other chambers.

Media used (if applicable):

Two layers of woven geotextile (315W by ADS) is placed between the stone base and chambers.

5. Warranty Information (describe, or provide web address)**:**

Sale of all Stormtech products come a "terms and conditions of sale" which includes a section on limited warranty. This section provides a warranty that the products to delivered are free from defects in materials and workmanship in normal use and service. This warranty is limited to the Buyer and there are no other intended beneficiaries of this warranty.

Further ADS provides a technical service review of all Stormtech projects which can include (at owners discretion) a letter signed by a PE that states the project meets the required sizing criteria and language stating "the proposed use of the product falls within the capacity and capability in which the product was designed to function".

6. Treatment Type

☐ Hydrodynamic Structure
☒ Filtering Structure
☐ Manufactured Bioretention System
Provide Infiltration Rate (in/hr):
☒ Other (describe): Utilizes a combination of woven geotextiles to capture TMDL's and infiltration thru insitu soils

7. Water Quality Treatment Mechanisms (check all that apply)

☒ Sedimentation/settling
☒ Infiltration
☒ Filtration (specify filter media) woven geotextile (315W by ADS)
☐ Adsorption/cation exchange
☐ Chelating/precipitation
☐ Chemical treatment
☐ Biological uptake
☐ Other (describe):

8. **Performance Testing and Certification** (check all that apply):

Performance Claim (include removal efficiencies for treated pollutants, flow criteria, drainage area):

The StormTech Isolator has been tested by numerous agencies. It has been used and installed throughout Virginia with great success. ***Independent*** test data attached includes testing from notable agencies such as: University of New Hampshire, Tennessee Tech and Charlotte-Mecklenburg Storm Water Services. Removal rates from each of these independent tests show removal rates in excess of 80% TSS and 40% TP.

StormTech is requesting the Isolator Row be approved as a stand-alone treatment device providing 80% TSS and 40% TP removal rates. When designing a project, either a volume based method may be used for soils with high infiltration capacities or the more typical rate based method shall be employed to size the system.

Specific size/Capacity of MTD assessed:

StormTech is requesting the Isolator Row be approved as a stand-alone treatment device providing 80% TSS and 40% TP removal rates. When designing a project, either a volume based method may be used for soils with high infiltration capacities or the more typical rate based method shall be employed to size the system.

Has the MTD been "approved" by an established granting agency, e.g. New Jersey Department of Environmental Protection (NJDEP) , Washington State Department of Ecology, etc.

☐ **No**

☒ **Yes**; For each approval, indicate (1) the granting agency, (2) use level if awarded (3) the protocol version under which performance testing occurred (if applicable), and (4) the date of award, and attach award letter.

See attached test reports from University of New Hampshire, Tennessee Tech and Charlotte-Mecklenburg Storm Water Services.

Was an established testing protocol followed?

☐ **No**

☒ **Yes**, (1) Provide name of testing protocol followed, (2) list any protocol deviations:

Provide the information below and provide a performance report (attach report):

See attached test reports from University of New Hampshire, Tennessee Tech and Charlotte-Mecklenburg Storm Water Services

9. MTD History:

How long has this specific model/design been on the market? First installation - 2003

February 23, 2005 - Tennessee Tech University summarized laboratory testing on the Isolator Row in accordance with Maine DEP testing protocol. Tests demonstrated the following:

- 95% TSS overall removal at 8.1 gpm/sqft for US Silica OK-110 (110 micron).
- 80% captured on fabric, 15% captured in stone

October 20, 2006 - Tennessee Tech University summarized laboratory testing on the Isolator Row in accordance with New Jersey Center for Advanced Technologies (NJCAT) testing protocol. Tests demonstrated the following:

- 60% TSS Removal at 3.2 gpm/sqft for Sil-Co-Sil 106 with accumulated fines (D50 = 10 microns)
- 66% TSS Removal at 3.2 gpm/sqft for Sil-Co-Sil 106 (D50 = 22 microns)
- 71% TSS Removal at 3.2 gpm/sqft for Sil-Co-Sil 250 (D50 = 45 microns)
- 88% TSS Removal at 1.7 gpm/sqft for Sil-Co-Sil 250 (D50 = 45 microns)

August, 2007 – NJCAT summarized its third party evaluation of the Tennessee Tech test results and produced the "NJCAT Technology Verification Report StormTech Isolator Row". Their verification is summarized as follows:

- Claim 1: A StormTech® SC-740 IsolatorTM Row, sized at a treatment rate of no more than 2.5 gpm/ft2 of bottom area, using two layers of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 270 mg/L (range of 139 – 361 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of at least 60% for SIL-CO-SIL 106, a manufactured silica product with an average particle size of 22 microns, in laboratory studies using simulated stormwater.
- Claim 2: A StormTech® SC-740 IsolatorTM Row, sized at a treatment rate of no more than 2.5 gpm/ft2 of bottom area, using two layers of woven geotextile fabric under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 318 mg/L (range of 129 – 441 mg/L) has been shown to have a TSS removal efficiency (measured as SSC) of at greater than 84% for SIL-CO_SIL 250, a manufactured silica product with an average particle size of 45 microns, in laboratory studies using simulated stormwater.
- Claim 3: A StormTech® SC-740 IsolatorTM Row, sized at a treatment rate of no more than 6.5 gpm/ft2 of bottom area, using a single layer of woven geotextile under the base of the system and one layer of non-woven fabric wrapped over the top of the system and a mean event influent concentration of 371 mg/L (range of 116 - 614 mg/L) has been shown to have a TSS removal efficiency

(measured as SSC) of 95% for OK-110, a manufactured silica product with an average particle size of 110 microns, in laboratory studies using simulated stormwater.

June 2008 – The University of New Hampshire Stormwater Center released the Final Report on Field Verification Testing of the StormTech Isolator Row Treatment Unit. Testing consisted of determining the water quality performance for multiple stormwater pollutants in accordance with TARP Tier II protocol. Data was recorded for 17 storm events.

- TSS median removal efficiency – 80%
- Petroleum Hydrocarbons median removal efficiency – 90%
- Phosphorus median removal efficiency – 49%

July 2013 – City of Charlotte Stormwater Control Measure (SCM) program monitored the effectiveness of StormTech's Isolator row in treating a 0.41 acre site (Cherry Gardens Senior Apartments) which was comprised of approximately 85% impervious surface. The system was designed to treat the 1-inch water quality volume. The results of the data analysis showed statistically significant reductions in various parameters including Ammonia Nitrogen by 71.5%; TKN by 59.5%; Total Nitrogen by 37.1%; Total Phosphorus by 68.1%; Suspended Sediment Concentration (SSC) by 94%; TSS by 89.6%; Turbidity by 61.9%; and Zinc by 76.1%.

List no more than three locations where the assessed model size(s) has/have been installed in Virginia. If applicable, provide permitting authority. If known, provide latitude & longitude:

Rixlew Lane - Manassas, VA
38°46'17.16"N
77°30'6.07"W

South Run Park – Springfield, VA
38°45'0.69"N
77°16'31.23"W

Cosner Corner – Fredericksburg, VA
38°13'33.64"N
77°30'8.87"W

List no more than three locations where the assessed model size(s) has/have been installed outside of Virginia. If applicable, provide permitting authority. If known, provide latitude & longitude:

Baxter Pharmaceuticals – Covington, GA
33°36'20.51"N
83°41'34.72"W

Cabell's – Christiana, DE
39°40'57.20"N
75°39'11.02"W

Walmart – Denton, MD
38°52'29.37"N
75°49'19.69"W

10. Maintenance:

What is the generic inspection and maintenance plan/procedure? (attach necessary documents):

Per the Isolator Maintenance manual, system should be inspected once each year (preferably in the spring after winter loading of salt/sand). When approximately 3 inches of sediment has accumulated throughout the length of the Isolator Row, system shall be cleaned with a JetVac in accordance with section 2.2 Maintenance.

Is there a maintenance track record/history that can be documented?

☐ No, no track record.

☒ Yes, track record exists; (provide maintenance track record, location, and sizing of three to five MTDs installed in Virginia [preferred] or elsewhere):

Cosner Corner – Fredericksburg, VA
38°13'33.64"N
77°30'8.87"W
Numerous StormTech Isolator systems have been installed at this location since 2005 and include Target, Kohl's and various smaller restaurants. Property owners such as Silver Companies, etal have routinely scheduled maintenance with companies like Clean Harbors, ESI Environmental Services Inc. and Stormwater Maintenance & Consulting to clean these systems. The most recent that ADS is aware of occurred in 2012.

Rockledge Elementary School – Lake Ridge, VA
38°41'2.42"N
77°16'35.94"W
System was installed in summer of 2009. Contractor did not take proper precautions with his E&S and an inspection was performed to get the contractor off of bond the following summer. System was full of sediment and required cleaning one year after installation.

Rixlew Lane - Manassas, VA
38°46'17.16"N
77°30'6.07"W
System was installed summer of 2009. Inspection on June 6, 2014 revealed a slight accumulation of sediment and ADS/StormTech recommended to the owner clean the system within the next 12 months.

11201 Industrial Road – Manassas, VA
38°45'7.22"N
77°32'33.19"W
Project was installed in the Fall of 2011. At the request of the owner, ADS facilitated an inspection of the system in early May of 2014 and system was cleaned on May 9th, 2014.

Recognizing that maintenance is an integral function of the MTD, provide the following: amount of runoff treated, the water quality of the runoff, and what is the expected maintenance frequency for this MTD in Virginia, per year?

Maintenance interval is 3 to 5 years depending on sediment loading into the isolator row. Per the Isolator Maintenance manual, system should be inspected once each year (preferably in the spring after winter loading of salt/sand). When approximately 3 inches of sediment has accumulated throughout the length of the Isolator Row, system shall be cleaned with a JetVac in accordance with section 2.2 Maintenance.

Total life expectancy of MTD when properly operated in Virginia and, if relevant, life expectancy of media:

With proper maintenance, the life expectance of the Isolator Row is 100 years and is based on the life expectancy of a Poly-olefin geomembrane product (see Propex memorandum on longevity).

For media or amendments functioning based on cation exchange or adsorption, how long will the media last before breakthrough (indicator capacity is nearly reached) occurs?

Not Applicable

For media or amendments functioning based on cation exchange or adsorption, how has the longevity of the media or amendments been quantified prior to breakthrough (attach necessary performance data or documents)?

Not Applicable

Is the maintenance procedure and/or are materials/components proprietary?
☐ Yes, proprietary
☒ No, not proprietary

Maintenance complexity (check all that apply):
☐ Confined space training required for maintenance
☐ Liquid pumping and transportation
Specify method:
☒ Solids removal and disposal
Specify method: Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming.

Other noteworthy maintenance parameter (describe): N/A

While ADS/Stormtech is the manufacture of the Isolator row, technical support personnel are available to provide technical support to help owners understanding the simplicity of this system and the need to perform subsequent annual inspection for sediment accumulation. In addition, we put these owners in touch with companies like Clean Harbors, ESI Environmental Services Inc. and Stormwater Maintenance & Consulting to perform cleaning when needed.

11. Comments

Include any additional explanations or comments:

Since 2003 the Isolator Row has been approved on thousands of projects around the world. Listed below are a few examples of these approvals:

- Delaware, DNREC has approved the Isolator Row as a stand-alone treatment device for many years and has endorsed the continued use of the Isolator Row in the recently enacted revised regulations (12/12).
- In Massachusetts the Isolator Row is commonly used to met the State DEP requirement of 80% TSS removal.
- In Maine the DEP approved the Isolator Row based on laboratory testing of 110 micron (US Silica OK-110) particle size
- Based on the New Environmental Technology Evaluation program, the Ontario (Canada) Ministry of the Environment has issued a Certificate of

Technology Assessment for the Isolator Row.

Within the state of Virginia, 129 StormTech systems with Isolators Rows have been installed with several more systems currently in design or under construction. Small engineering firms like Blackwell Engineering and large firms like Bowman Consulting and Kimley-Horn are intimately familiar with and design and performance of the Stormtech Isolator Row. These firms routinely specify the Isolator Row as a cost effectively way to meet and exceed the State's water quality requirements.

12. Certification

Signed by the company president or responsible officer of the organization:

"I certify that all information submitted is to the best of my knowledge and belief true, accurate, and complete."

Signature: Chuck T Lacey Jr.

Name: Chuck T. Lacey, Jr PE

Title: ADS Engineering Product Manager

Date: 06.30.2014

NOTE: All information submitted to the department will be made publically accessible to all interested parties. This MTD registration form will be posted on the Virginia Stormwater BMP Clearinghouse website.

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Product Catalog

StormTech Subsurface Stormwater Management

Table of Contents

StormTech has thousands of chamber systems in service throughout the world. All StormTech chambers are designed to meet the most stringent industry performance standards for superior structural integrity. The StormTech system is designed primarily to be used under parking lots, roadways and heavy earth loads saving valuable land and protecting water resources for commercial and municipal applications. In our continuing desire to answer designers' challenges, StormTech has expanded the family of products providing engineers, developers, regulators and contractors with additional site specific flexibility.

Advanced Structural Performance for Greater Long-Term Reliability

StormTech developed a state of the art chamber design through:

- Collaboration with world-renowned experts of buried drainage structures to develop and evaluate the structural testing program and product design
- Designing chambers to exceed American Association of State Highway and Transportation Officials (AASHTO) LRFD design specifications for HS-20 live loads and deep burial earth loads
- Subjecting the chambers to rigorous full scale testing, under severe loading conditions to verify the AASHTO safety factors for live load and deep burial applications
- Designed to conform to the product requirements of ASTM F2418 (polypropylene chambers) and design requirements of ASTM F2787 ensuring both the assurance of product quality and safe structural design

Our Chambers Provide...

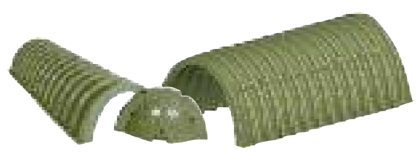
- Large capacity that *fits very tight footprints* providing developers with more useable land for development.
- *A proven attenuation alternative* to cumbersome large diameter metal pipe or snap together plastic crates and unreliable multi-layer systems.
- Provides the *strength* of concrete vaults at a very competitive price.
- The robust *continuous true elliptical arch design* which effectively transfers loads to the surrounding backfill providing the long-term safety factor required by AASHTO. Offers developers a cost-effective underground system that will perform as designed for decades.
- *Designed in accordance with the AASHTO LRFD Bridge Design Specifications* providing engineers with a structural performance standard for live and long-term dead loads.
- *Polypropylene and polyethylene* resins tested using ASTM standards to ensure long and short-term structural properties.
- *Injection molded* for uniform wall thickness and repeatable quality.
- Third party *tested and patented Isolator™ Row* for less frequent maintenance, water quality and long-term performance.
- Incorporates *traditional manifold/header designs* using conventional hydraulic equations that can easily verify flow equalization and scour velocity.
- *Open chamber design* requiring only one chamber model to construct each row assuring ease of construction and no repeating end walls to obstruct access or flow.

StormTech offers a variety of chamber sizes (SC-310, SC-740, DC-780, MC-3500 and MC-4500) so the consulting design engineer can choose the chamber that is best suited for the site conditions and regulatory requirements. StormTech has thousands of chamber systems in service worldwide. We provide plan layout and cost estimate services at no charge for consulting engineers and developers.

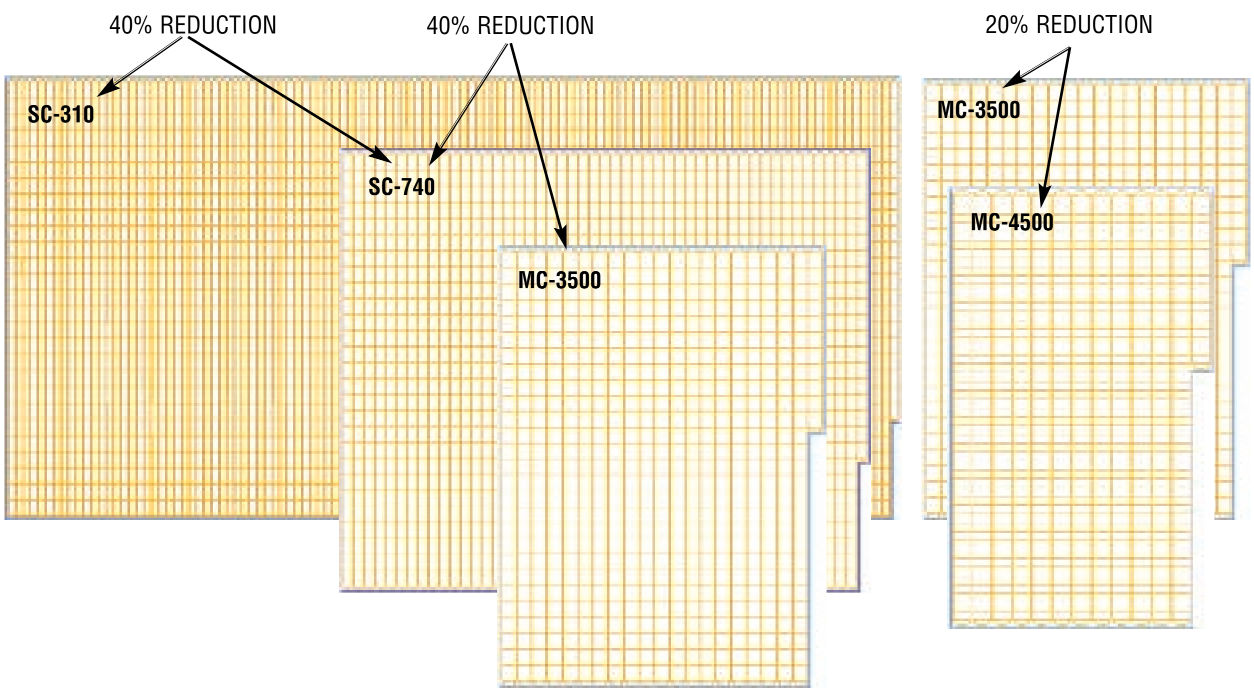
StormTech Subsurface Stormwater Management

PRODUCT SPECIFICATIONS	SC-310	SC-740	DC-780	MC-3500	MC-4500
Height, in. (mm)	16 (406)	30 (762)	30 (762)	45 (1143)	60 (1524)
Width, in. (mm)	34 (864)	51 (1295)	51 (1295)	77 (1956)	100 (2540)
Length, in. (mm)	90.7 (2300)	90.7 (2300)	90.7 (2300)	90 (2286)	52 (1321)
Installed Length, in. (mm)	85.4 (2170)	85.4 (2170)	85.4 (2170)	86.0 (2184)	48.3 (1227)
Bare Chamber Storage, cf (cm)	14.7 (0.42)	45.9 (1.30)	46.2 (1.30)	113.0 (3.20)	106.5 (3.01)
Stone above, in. (mm)	6 (152)	6 (152)	6 (152)	12 (305)	12 (305)
Stone below, in. (mm)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)
Row Spacing, in. (mm)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)
Minimum Installed Storage, cf (cm)	**31.0 (0.88)**	**74.9 (2.12)**	**78.4 (2.22)**	**176.8 (5.01)**	**162.6 (4.60)**
Storage Per Unit Area, cf/sf (cm/sm)	1.31 (0.39)	2.21 (0.67)	2.32 (0.70)	3.57 (1.09)	4.45 (1.35)

***NOTE**: Spec sheets for our RC-310 and RC-750, recycled chambers, are available upon request.*



Example: Footprint Comparison – 100,000 CF Project



StormTech and LEED

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List of LEED Credits that StormTech may contribute towards:

SUSTAINABLE SITES

- **SS Credit 5.1 - Site Development: Protect or Restore Habitat**
  Utilizing StormTech System beneath roadways, surface parking, walkways, etc. may reduce overall site disturbance
- **SS Credit 5.2 - Site Development: Maximize Open Space**
  Utilizing StormTech System can increase overall open space and may reduce overall site disturbance
- **SS Credit 6.1 - Stormwater Design: Quantity Control**
  Design StormTech System per local or LEED stormwater quantity requirements, whichever is more stringent
- **SS Credit 6.2 - Stormwater Design: Quality Control**
  Use of Isolator Row provides sediment removal, and can also promote infiltration and groundwater recharge
- **SS Credit 7.1 - Heat Island Effect: Non-Roof**
  Use of StormTech System may eliminate need for above ground detention ponds, thus reducing thermal impacts of stormwater runoff

Water Efficiency

- **WE Credit 1 - Water Efficient Landscaping**
  Utilize StormTech System to store captured rainwater for landscape irrigation
- **WE Credit 2 - Innovative Wastewater Technologies**
  Utilize StormTech System to store captured rainwater to reduce potable water demand.
- **WE Credit 3 - Water Use Reduction**
  Utilize StormTech System to store captured rainwater and allow reuse for non-potable applications

Materials and Resources

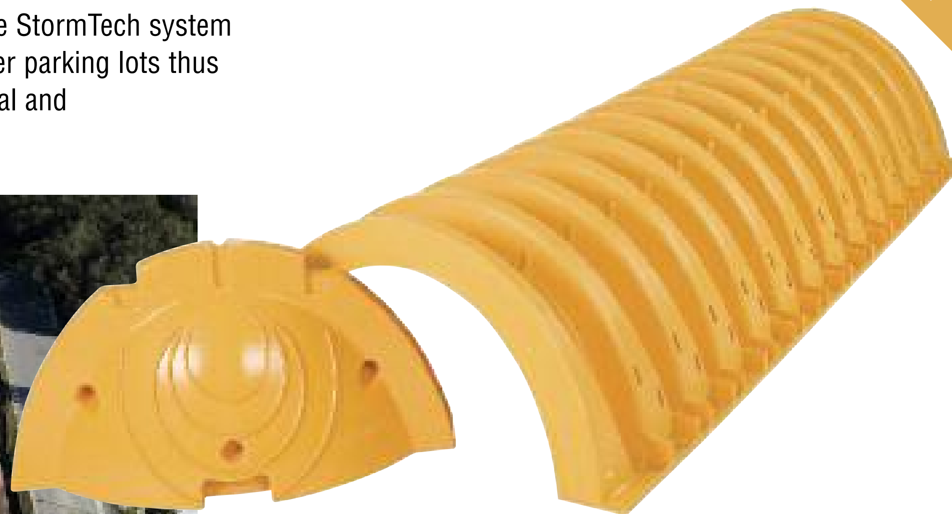
- **MR Credit 4 – Recycled Content**
  Utilize recycled concrete as the backfill material for the StormTech System.
- **MR Credit 5 – Regional Materials**
  Stone backfill material for the StormTech System will apply if extracted within 500 miles of project site.

Innovation & Design

- **ID Credit 1 – Innovation in Design**
  Utilize StormTech System to substantially exceed a performance credit

StormTech SC-310 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.



StormTech SC-310 Chamber (not to scale)

Nominal Chamber Specifications

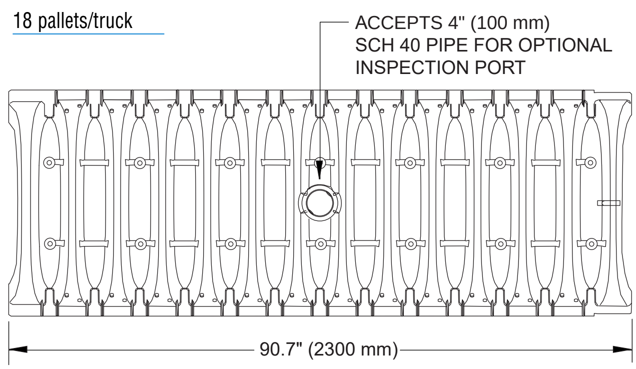
Size (L x W x H)	85.4" x 34.0" x 16.0" (2170 x 864 x 406 mm)
Chamber Storage	14.7 ft³ (0.42 m³)
Min. Installed Storage*	31.0 ft³ (0.88 m³)
Weight	37.0 lbs (16.8 kg)

Shipping

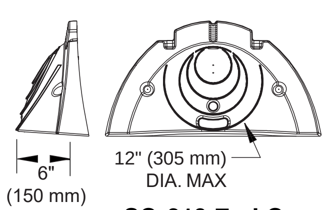
41 chambers/pallet

108 end caps/pallet

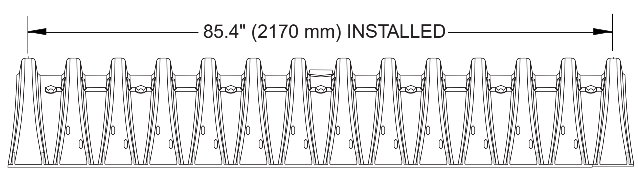
18 pallets/truck

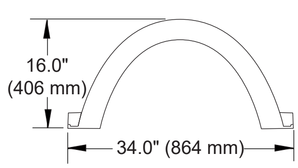


SC-310 Chamber



SC-310 End Cap





StormTech SC-310 Chamber

SC-310 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (152 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft^3 (m^3)	Total System Cumulative Storage ft^3 (m^3)
28 (711)	14.70 (0.416)	31.00 (0.878)
27 (686)	14.70 (0.416)	30.21 (0.855)
26 (680)	Stone 14.70 (0.416)	29.42 (0.833)
25 (610)	Cover 14.70 (0.416)	28.63 (0.811)
24 (609)	14.70 (0.416)	27.84 (0.788)
23 (584)	14.70 (0.416)	27.05 (0.766)
22 (559)	14.70 (0.416)	26.26 (0.748)
21 (533)	14.64 (0.415)	25.43 (0.720)
20 (508)	14.49 (0.410)	24.54 (0.695)
19 (483)	14.22 (0.403)	23.58 (0.668)
18 (457)	13.68 (0.387)	22.47 (0.636)
17 (432)	12.99 (0.368)	21.25 (0.602)
16 (406)	12.17 (0.345)	19.97 (0.566)
15 (381)	11.25 (0.319)	18.62 (0.528)
14 (356)	10.23 (0.290)	17.22 (0.488)
13 (330)	9.15 (0.260)	15.78 (0.447)
12 (305)	7.99 (0.227)	14.29 (0.425)
11 (279)	6.78 (0.192)	12.77 (0.362)
10 (254)	5.51 (0.156)	11.22 (0.318)
9 (229)	4.19 (0.119)	9.64 (0.278)
8 (203)	2.83 (0.081)	8.03 (0.227)
7 (178)	1.43 (0.041)	6.40 (0.181)
6 (152)	0	4.74 (0.134)
5 (127)	0	3.95 (0.112)
4 (102)	0	3.16 (0.090)
3 (76)	Stone Foundation 0	2.37 (0.067)
2 (51)	0	1.58 (0.046)
1 (25)	0	0.79 (0.022)

Note: Add 0.79 cu. ft. (0.022 m^3) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber

	Bare Chamber Storage	Chamber and Stone Stone Foundation Depth in. (mm)		
	ft^3 (m^3)	6 (152)	12 (305)	18 (457)
StormTech SC-310	14.7 (0.4)	31.0 (0.9)	35.7 (1.0)	40.4 (1.1)

Note: Storage volumes are in cubic feet per chamber. Assumes 40% porosity for the stone plus the chamber volume.

Amount of Stone Per Chamber

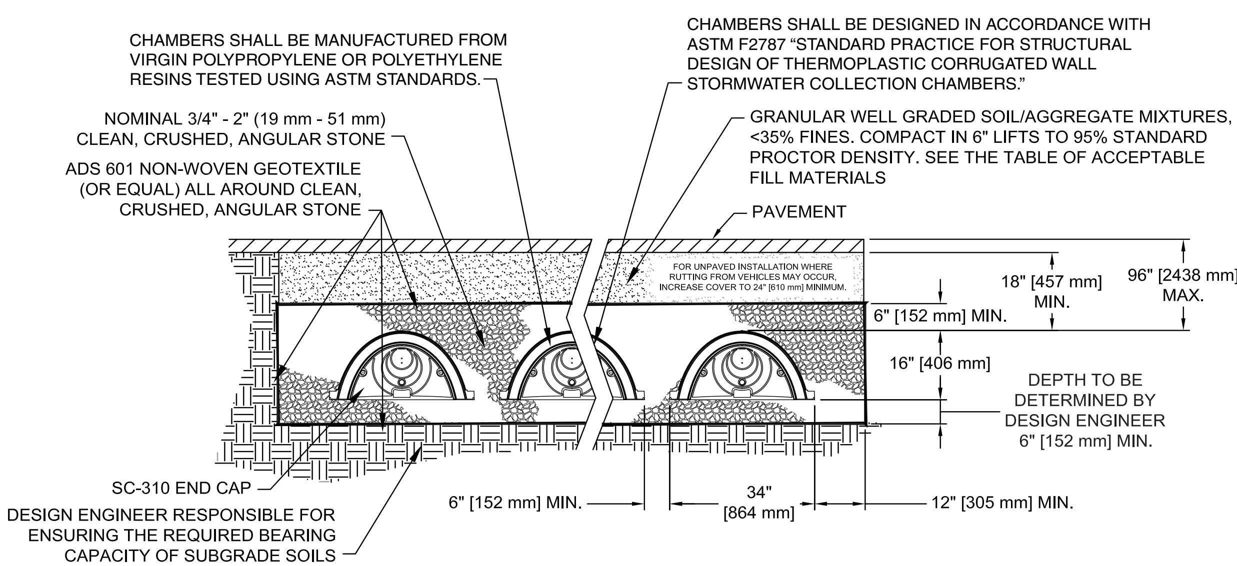
	Stone Foundation Depth		
ENGLISH TONS (yds^3)	**6"**	**12"**	**18"**
StormTech SC-310	2.1 (1.5 yd^3)	2.7 (1.9 yd^3)	3.4 (2.4 yd^3)
METRIC KILOGRAMS (m^3)	**152 mm**	**305 mm**	**457 mm**
StormTech SC-310	1830 (1.1 m^3)	2490 (1.5 m^3)	2990 (1.8 m^3)

Note: Assumes 6" (152 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber

	Stone Foundation Depth		
	6" (152 mm)	12" (305 mm)	18" (457 mm)
StormTech SC-310	2.9 (2.2)	3.4 (2.6)	3.8 (2.9)

Note: Volumes are in cubic yards (cubic meters) per chamber. Assumes 6" (152 mm) of separation between chamber rows and 18" (457 mm) of cover. The volume of excavation will vary as the depth of the cover increases.



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS. WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

StormTech SC-310-3 Chamber

The proven strength and durability of the SC-310-3 Chamber allows for a design option for sites where limited cover, limited space, high water table and escalated aggregate cost are a factor. The SC-310-3 has a minimum cover requirement of 16" (406 mm) to bottom of pavement and reduces the spacing requirement between chambers by 50% to 3" (76 mm). This provides a reduced footprint overall and allows the designer to offer a traffic bearing application yet comply with water table separation regulations.

StormTech SC-310-3 Chamber (not to scale)

Nominal Chamber Specifications

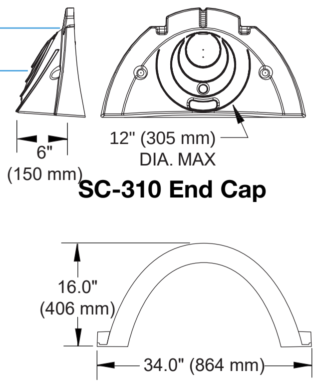
Size (L x W x H)	85.4" x 34.0" x 16.0" (2170 x 864 x 406 mm)
Chamber Storage	14.7 ft³ (0.42 m³)
Min. Installed Storage*	29.3 ft³ (0.83 m³)
Weight	37.0 lbs (16.8 kg)

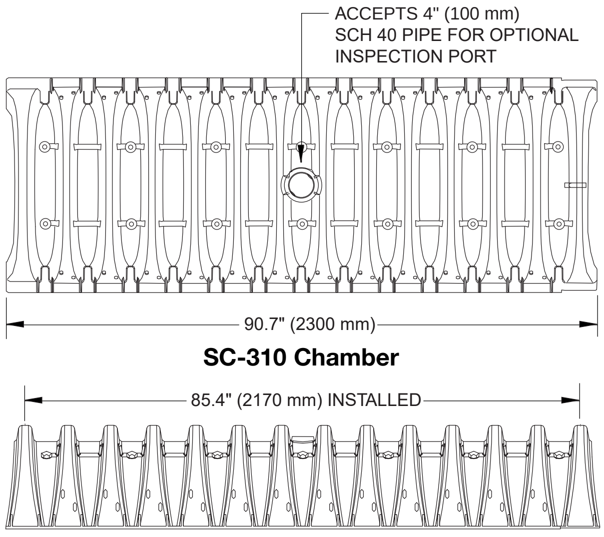
Shipping

41 chambers/pallet

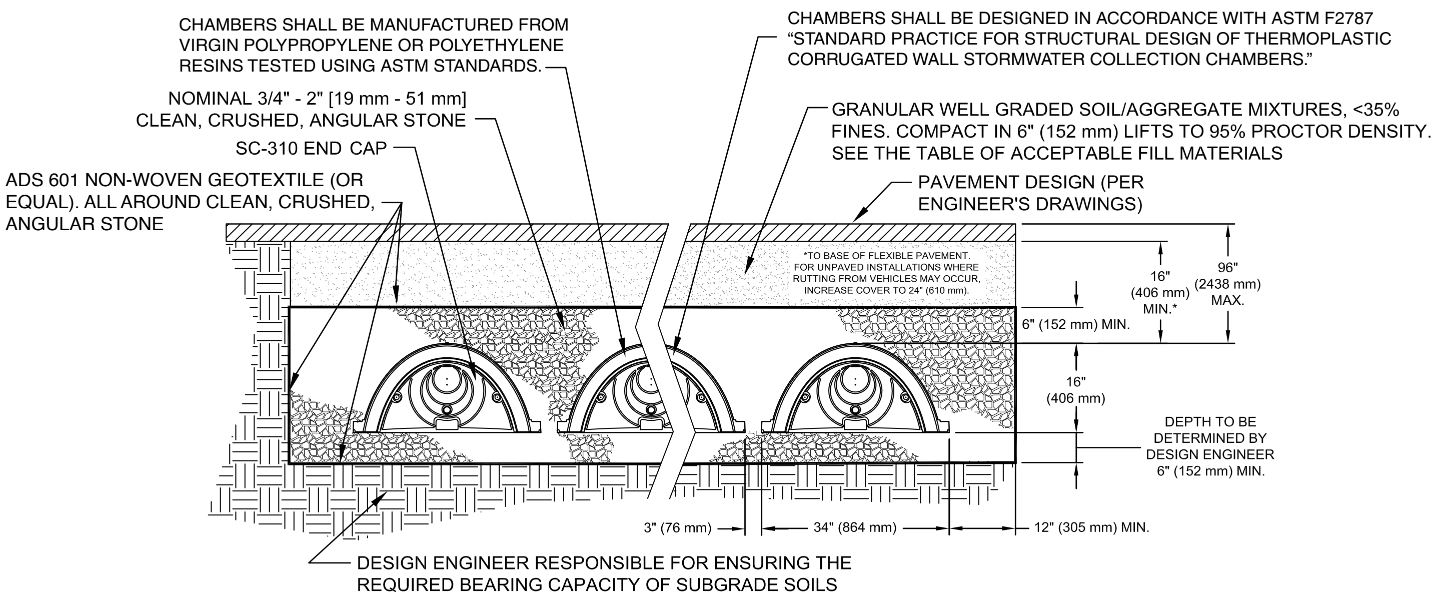
108 end caps/pallet

18 pallets/truck





Typical Cross Section Detail



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

StormTech SC-310-3 Chamber

SC-310-3 Cumulative Storage Volume Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (152 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)		Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
28 (711)	↑	14.7 (0.416)	29.34 (0.831)
27 (686)		14.7 (0.416)	28.60 (0.810)
26 (660)	Stone	14.7 (0.416)	27.87 (0.789)
25 (635)	Cover	14.7 (0.416)	27.14 (0.769)
24 (610)		14.7 (0.416)	26.41 (0.748)
23 (584)	↓	14.7 (0.416)	25.68 (0.727)
22 (559)		14.7 (0.416)	24.95 (0.707)
21 (533)		14.64 (0.415)	24.18 (0.685)
20 (508)		14.49 (0.410)	23.36 (0.661)
19 (483)		14.22 (0.403)	22.47 (0.636)
18 (457)		13.68 (0.387)	21.41 (0.606)
17 (432)		12.99 (0.368)	20.25 (0.573)
16 (406)		12.17 (0.345)	19.03 (0.539)
15 (381)		11.25 (0.319)	17.74 (0.502)
14 (356)		10.23 (0.290)	16.40 (0.464)
13 (330)		9.15 (0.260)	15.01 (0.425)
12 (305)		7.99 (0.226)	13.59 (0.385)
11 (279)		6.78 (0.192)	12.13 (0.343)
10 (254)		5.51 (0.156)	10.63 (0.301)
9 (229)		4.19 (0.119)	9.11 (0.258)
8 (203)		2.83 (0.080)	7.56 (0.214)
7 (178)		1.43 (0.040)	5.98 (0.169)
6 (152)	↑	0	4.39 (0.124)
5 (127)		0	3.66 (0.104)
4 (102)	Stone Foundation	0	2.93 (0.083)
3 (76)		0	2.19 (0.062)
2 (51)		0	1.46 (0.041)
1 (25)	↓	0	0.73 (0.021)

Note: Add 0.73 ft³ (0.021 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume per Chamber ft³ (m³)

	Bare Chamber Storage	Chamber and Stone Volume Stone Foundation Depth in. (mm)		
	ft³ (m³)	6 (152)	12 (305)	18 (457)
SC-310-3	14.7 (0.42)	29.3 (0.83)	33.7 (0.95)	38.1 (1.08)

Note: Assumes 6" (152 mm) of stone above chambers, 3" (76 mm) row spacing and 40% stone porosity.

Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6" (152)	12" (305)	18" (457)
SC-310-3	2.6 (2.0)	3.0 (2.3)	3.4 (2.6)

Note: Assumes 3" (76 mm) of row separation, 6" (152 mm) of stone above the chambers and 16" (406 mm) of cover. The volume of excavation will vary as depth of cover increases.

Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH TONS (yd³)	**6"**	**12"**	**18"**
SC-310-3	1.9 (1.4)	2.5 (1.8)	3.1 (2.2)
METRIC KILOGRAMS (m³)	**152 mm**	**305 mm**	**457 mm**
SC-310-3	1724 (1.0)	2268 (1.3)	2812 (1.7)

Note: Assumes 6" (152 mm) of stone above chambers and 3" (76 mm) row spacing.

Cover	Minimum Required Bearing Resistance for Service Loads ksf (kPa)										
ft (m)	3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
1.5 (0.46)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)
2 (0.61)	6 152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)
2.5 (0.76)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)
3 (0.91)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)
3.5 (1.07)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)
4 (1.22)	6 152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)
4.5 (1.37)	6 152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)
5 (1.52)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)
5.5 (1.68)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)
6 (1.83)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)
6.5 (1.98)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)
7 (2.13)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)
7.5 (2.29)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)
8 (2.44)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)

NOTE: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

StormTech SC-740 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.

StormTech SC-740 Chamber (not to scale)

Nominal Chamber Specifications

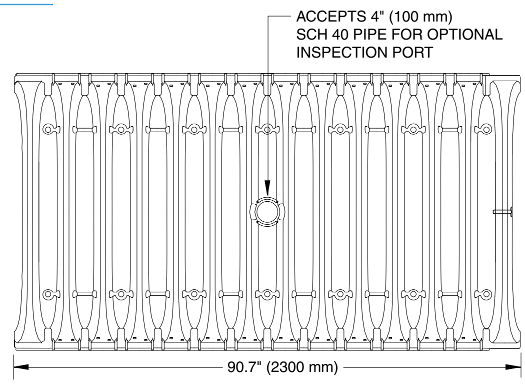
Size (L x W x H)	85.4" x 51.0" x 30.0" (2170 x 1295 x 762 mm)
Chamber Storage	45.9 ft³ (1.30 m³)
Min. Installed Storage*	74.9 ft³ (2.12 m³)
Weight	74.0 lbs (33.6 kg)

Shipping

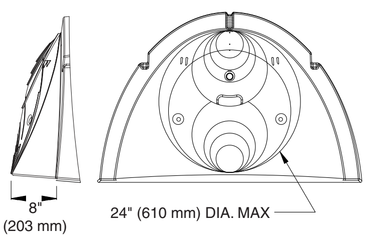
30 chambers/pallet

60 end caps/pallet

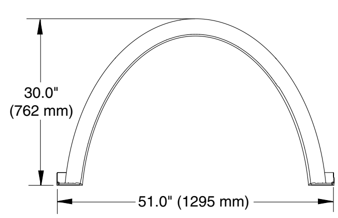
12 pallets/truck

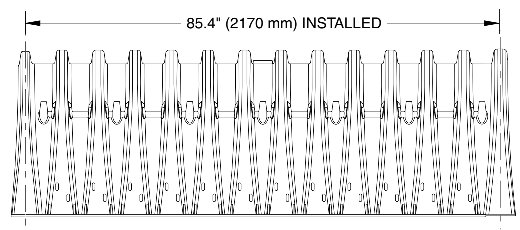


SC-740 Chamber



SC-740 End Cap





StormTech SC-740 Chamber

SC-740 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (152 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage Ft³ (m³)	Total System Cumulative Storage Ft³ (m³)
42 (1067)	↑ 45.90 (1.300)	74.90 (2.121)
41 (1041)	45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone 45.90 (1.300)	72.64 (2.057)
39 (991)	Cover 45.90 (1.300)	71.52 (2.025)
38 (965)	45.90 (1.300)	70.39 (1.993)
37 (948)	↓ 45.90 (1.300)	69.26 (1.961)
36 (914)	45.90 (1.300)	68.14 (1.929)
35 (889)	45.85 (1.298)	66.98 (1.897)
34 (864)	45.69 (1.294)	65.75 (1.862)
33 (838)	45.41 (1.286)	64.46 (1.825)
32 (813)	44.81 (1.269)	62.97 (1.783)
31 (787)	44.01 (1.246)	61.36 (1.737)
30 (762)	43.06 (1.219)	59.66 (1.689)
29 (737)	41.98 (1.189)	57.89 (1.639)
28 (711)	40.80 (1.155)	56.05 (1.587)
27 (686)	39.54 (1.120)	54.17 (1.534)
26 (660)	38.18 (1.081)	52.23 (1.479)
25 (635)	36.74 (1.040)	50.23 (1.422)
24 (610)	35.22 (0.977)	48.19 (1.365)
23 (584)	33.64 (0.953)	46.11 (1.306)
22 (559)	31.99 (0.906)	44.00 (1.246)
21 (533)	30.29 (0.858)	41.85 (1.185)
20 (508)	28.54 (0.808)	39.67 (1.123)
19 (483)	26.74 (0.757)	37.47 (1.061)
18 (457)	24.89 (0.705)	35.23 (0.997)
17 (432)	23.00 (0.651)	32.96 (0.939)
16 (406)	21.06 (0.596)	30.68 (0.869)
15 (381)	19.09 (0.541)	28.36 (0.803)
14 (356)	17.08 (0.484)	26.03 (0.737)
13 (330)	15.04 (0.426)	23.68 (0.670)
12 (305)	12.97 (0.367)	21.31 (0.608)
11 (279)	10.87 (0.309)	18.92 (0.535)
10 (254)	8.74 (0.247)	16.51 (0.468)
9 (229)	6.58 (0.186)	14.09 (0.399)

SC-740 Cumulative Storage Volumes Per Chamber (cont.)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage Ft³ (m³)	Total System Cumulative Storage Ft³ (m³)
8 (203)	4.41 (0.125)	11.66 (0.330)
7 (178)	2.21 (0.063)	9.21 (0.264)
6 (152)	↑ 0	6.76 (0.191)
5 (127)	0	5.63 (0.160)
4 (102)	Stone Foundation 0	4.51 (0.125)
3 (76)	0	3.38 (0.095)
2 (51)	0	2.25 (0.064)
1 (25)	↓ 0	1.13 (0.032)

Note: Add 1.13 cu. ft. (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber

	Bare Chamber Storage	Chamber and Stone Stone Foundation Depth in. (mm)		
	ft³ (m³)	6 (152)	12 (305)	18 (457)
StormTech SC-740	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)

Note: Storage volumes are in cubic feet per chamber. Assumes 40% porosity for the stone plus the chamber volume.

Amount of Stone Per Chamber

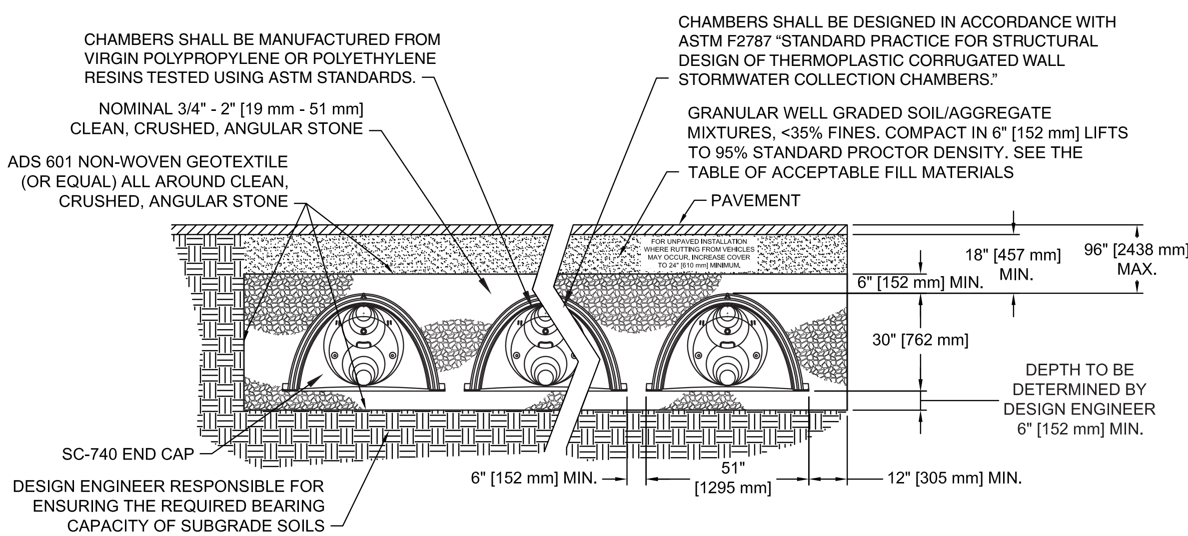
	Stone Foundation Depth		
ENGLISH TONS (yd³)	6"	12"	18"
StormTech SC-740	3.8 (2.8 yd³)	4.6 (3.3 yd³)	5.5 (3.9 yd³)
METRIC KILOGRAMS (m³)	152 mm	305 mm	457 mm
StormTech SC-740	3450 (2.1 m³)	4170 (2.5 m³)	4490 (3.0 m³)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber

	Stone Foundation Depth		
	6" (152 mm)	12" (305 mm)	18" (457 mm)
StormTech SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)

Note: Volumes are in cubic yards (cubic meters) per chamber. Assumes 6" (152 mm) of separation between chamber rows and 18" (457 mm) of cover. Volume of excavation will vary as depth of cover increases.

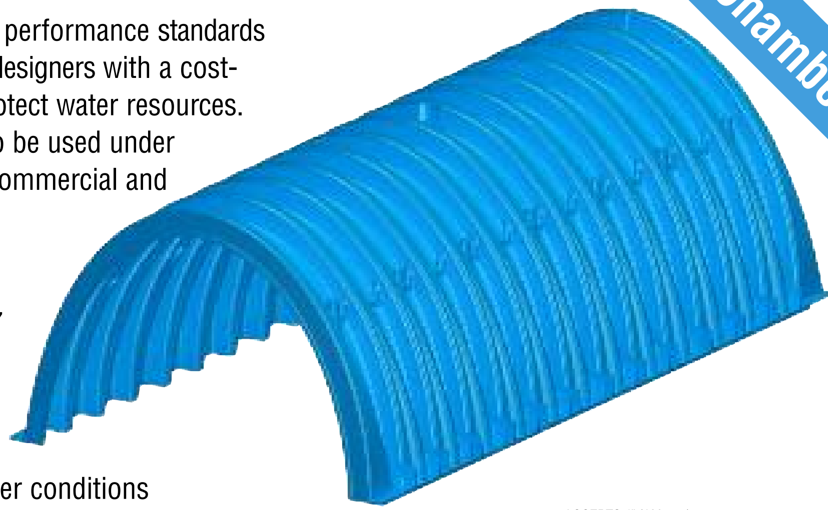


THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS

StormTech DC-780 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.

- 12' Deep Cover applications.
- Designed in accordance with ASTM F 2787 and produced to meet the ASTM F 2418 product standard.
- AASHTO safety factors provided for AASHTO Design Truck (H20) and deep cover conditions



StormTech DC-780 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	85.4" x 51.0" x 30.0" (2169 x 1295 x 762 mm)
Chamber Storage	46.2 ft³ (1.3 m³)
Min. Installed Storage*	78.4 ft³ (2.2 m³)

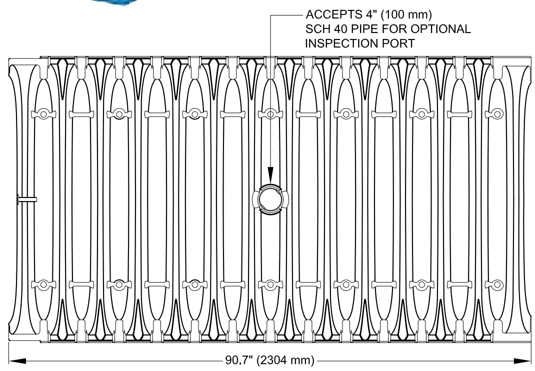
* Assumes 9" (229 mm) stone below, 6" (152 mm) stone above, 6" (152 mm) row spacing and 40% stone porosity.

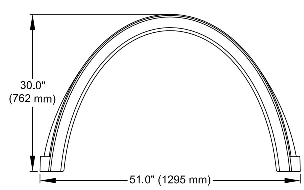
Shipping

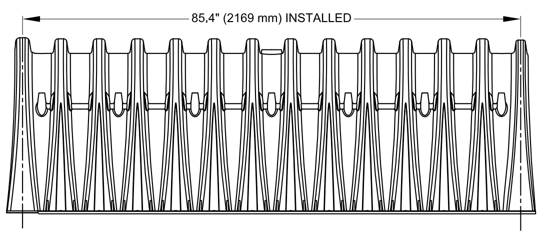
24 chambers/pallet

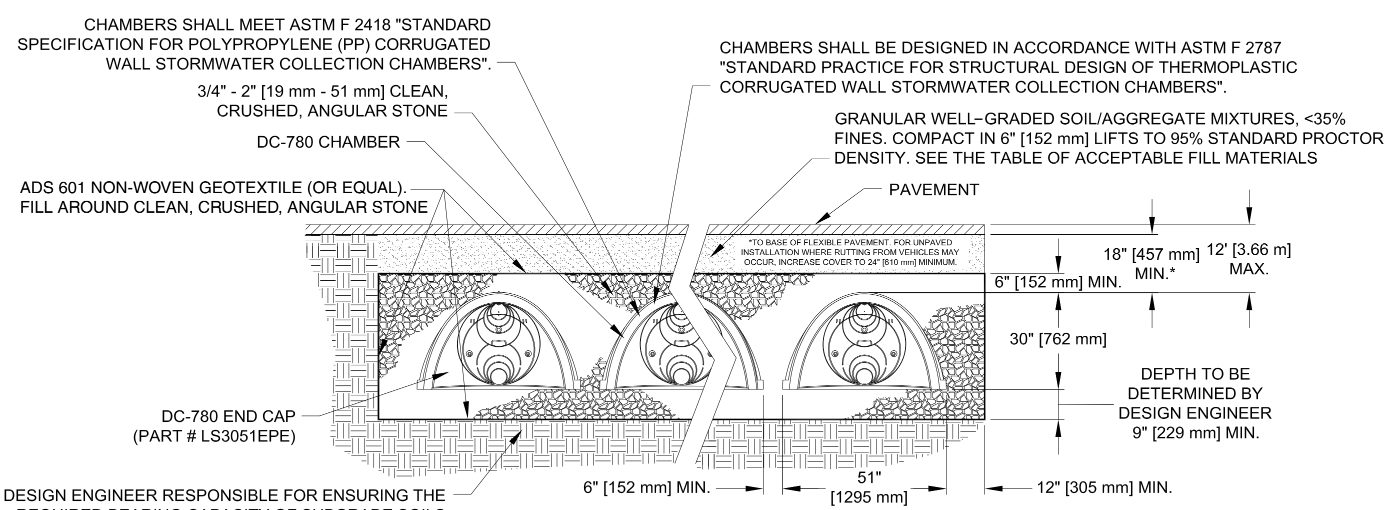
60 end caps/pallet

12 pallets/truck









THIS CROSS SECTION DETAILS THE REQUIREMENTS NECESSARY TO SATISFY THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS USING STORMTECH CHAMBERS

StormTech DC-780 Chamber

DC-780 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 9" (229 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
45 (1143)	↑ 46.27 (1.310)	78.47 (2.222)
44 (1118)	46.27 (1.310)	77.34 (2.190)
43 (1092)	Stone 46.27 (1.310)	76.21 (2.158)
42 (1067)	Cover 46.27 (1.310)	75.09 (2.126)
41 (1041)	46.27 (1.310)	73.96 (2.094)
40 (1016)	↓ 46.27 (1.310)	72.83 (2.062)
39 (991)	46.27 (1.310)	71.71 (2.030)
38 (965)	46.21 (1.309)	70.54 (1.998)
37 (940)	46.04 (1.304)	69.32 (1.963)
36 (914)	45.76 (1.296)	68.02 (1.926)
35 (889)	45.15 (1.278)	66.53 (1.884)
34 (864)	44.34 (1.255)	64.91 (1.838)
33 (838)	43.38 (1.228)	63.21 (1.790)
32 (813)	42.29 (1.198)	61.43 (1.740)
31 (787)	41.11 (1.164)	59.59 (1.688)
30 (762)	39.83 (1.128)	57.70 (1.634)
29 (737)	38.47 (1.089)	55.76 (1.579)
28 (711)	37.01 (1.048)	53.76 (1.522)
27 (686)	35.49 (1.005)	51.72 (1.464)
26 (660)	33.90 (0.960)	49.63 (1.405)
25 (635)	32.24 (0.913)	47.52 (1.346)
24 (610)	30.54 (0.865)	45.36 (1.285)
23 (584)	28.77 (0.815)	43.18 (1.223)
22 (559)	26.96 (0.763)	40.97 (1.160)
21 (533)	25.10 (0.711)	38.72 (1.096)
20 (508)	23.19 (0.657)	36.45 (1.032)
19 (483)	21.25 (0.602)	34.16 (0.967)
18 (457)	19.26 (0.545)	31.84 (0.902)
17 (432)	17.24 (0.488)	29.50 (0.835)
16 (406)	15.19 (0.430)	27.14 (0.769)
15 (381)	13.10 (0.371)	24.76 (0.701)
14 (356)	10.98 (0.311)	22.36 (0.633)
13 (330)	8.83 (0.250)	19.95 (0.565)
12 (305)	6.66 (0.189)	17.52 (0.496)
11 (279)	4.46 (0.126)	15.07 (0.427)

DC-780 Cumulative Storage Volumes Per Chamber (cont.)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
10 (254)	2.24 (0.064)	12.61 (0.357)
9 (229)	↑ 0	10.14 (0.287)
8 (203)	0	9.01 (0.255)
7 (178)	0	7.89 (0.223)
6 (152)	Stone 0	6.76 (0.191)
5 (127)	Foundation 0	5.63 (0.160)
4 (102)	0	4.51 (0.128)
3 (76)	0	3.38 (0.096)
2 (51)	0	2.25 (0.064)
1 (25)	↓ 0	1.13 (0.032)

Note: Add 1.13 cu. ft. (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage	Chamber and Stone Volume- Stone Foundation Depth inches (millimeters)		
	ft³ (m³)	9 (229)	12 (305)	18 (457)
StormTech DC-780	46.2 (1.3)	78.4 (2.2)	81.8 (2.3)	88.6 (2.5)

Note: Assumes 40% porosity for the stone, the bare chamber volume, 6" (152 mm) stone above, and 6" (152 mm) row spacing.

Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH TONS (YD³)	**9"**	**12"**	**18"**
StormTech DC-780	4.2 (3.0 yd³)	4.7 (3.3 yd³)	5.6 (3.9 yd³)
METRIC KILOGRAMS (M³)	**229 mm**	**305 mm**	**457 mm**
StormTech DC-780	3810 (2.3 m³)	4264 (2.5 m³)	5080 (3.0 m³)

Note: Assumes 6" (152 mm) of stone above, and between chambers.

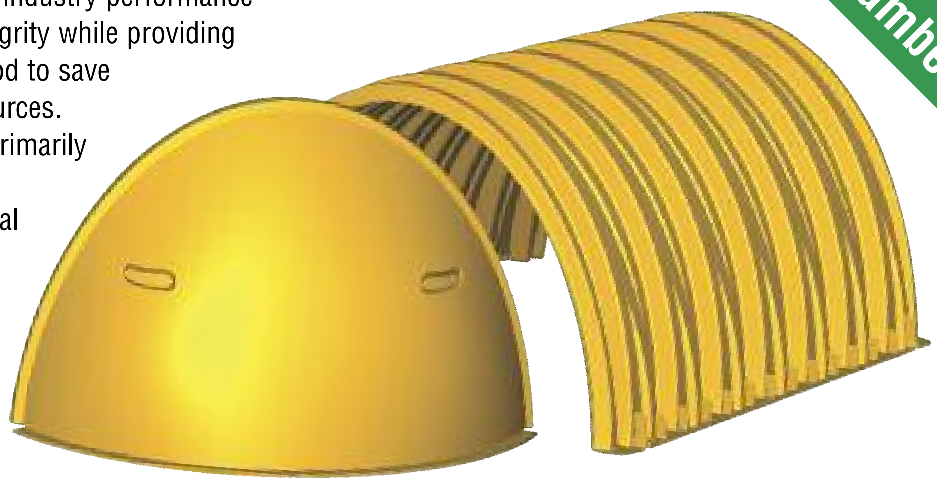
Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	9" (229 mm)	**12" (305 mm)**	**18" (457 mm)**
StormTech DC-780	5.9 (4.5)	6.3 (4.8)	6.9 (5.3)

Note: Assumes 6" (152 mm) of separation between chamber rows and 18" (457 mm) of cover. The volume of excavation will vary as the depth of the cover increases.

StormTech MC-3500 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.



StormTech MC-3500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	90" (2286 mm) x 77" (1956 mm) x 45" (1143 mm)
Chamber Storage	113.0 ft³ (3.20 m³)
Min. Installed Storage*	176.8 ft³ (5.01 m³)
Weight	124 lbs (56.2 kg)

* This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below chambers, 6" (152 mm) of stone between chambers/end caps and 40% stone porosity.

StormTech MC-3500 End Cap (not to scale)

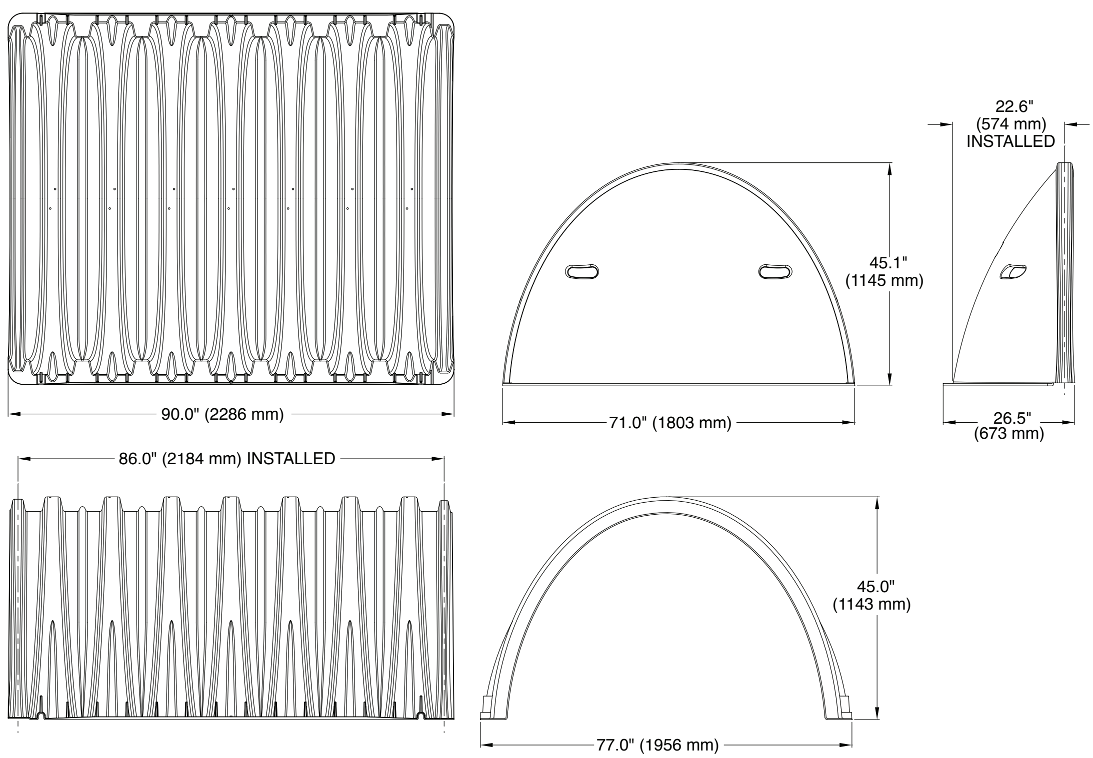
Nominal End Cap Specifications

Size (L x W x H)	26.5" (673 mm) x 71" (1803 mm) x 45.1" (1145 mm)
End Cap Storage	15.6 ft³ (0.44 m³)
Min. Installed Storage*	45.6 ft³ (1.29 m³)
Weight	43 lbs (19.5 kg)

*This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below, 6" (152 mm) of stone perimeter, 6" (152 mm) of stone between chambers/end caps and 40% stone porosity.

Shipping

- 15 chambers/pallet
- 16 end caps/pallet
- 7 pallets/truck



StormTech MC-3500 Chamber

Storage Volume Per Chamber/End Cap ft³ (m³)

	Bare Unit Storage	Chamber/End Cap and Stone Volume — Stone Foundation Depth in. (mm)			
	ft³ (m³)	9 (229)	12 (305)	15 (381)	18 (457)
MC-3500 Chamber	113.0 (3.20)	176.8 (5.01)	181.8 (5.15)	186.8 (5.29)	191.7 (5.43)
MC-3500 End Cap	15.6 (0.44)	45.6 (1.29)	47.3 (1.34)	48.9 (1.39)	50.6 (1.43)

NOTE: Assumes 40% porosity for the stone plus the chamber/end cap volume. End Cap volume assumes 6" (152 mm) stone perimeter.

Amount of Stone Per Chamber

ENGLISH tons (yd³)	Stone Foundation Depth			
	9"	12"	15"	18"
MC-3500	8.4 (5.9 yd³)	9.0 (6.4 yd³)	9.7 (6.8 yd³)	10.3 (7.3 yd³)
End Cap	3.9 (2.8 yd³)	4.2 (2.9 yd³)	4.4 (3.1 yd³)	4.6 (3.2 yd³)
METRIC kg (m³)	229 mm	305 mm	381 mm	457 mm
MC-3500	7620 (4.5 m³)	8164 (4.9 m³)	8800 (5.2 m³)	9344 (5.6 m³)
End Cap	3538 (2.1 m³)	3810 (2.2 m³)	3992 (2.4 m³)	4173 (2.4 m³)

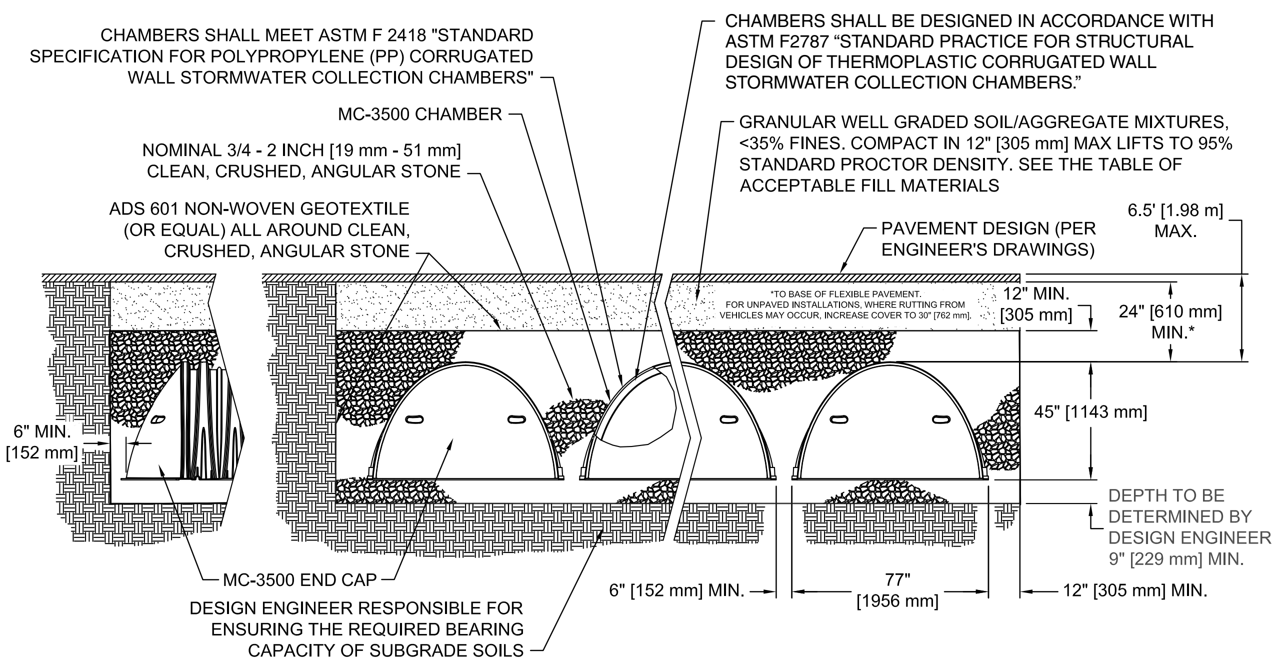
NOTE: Assumes 12" (305 mm) of stone above, and 6" (152 mm) between chambers.

Volume of Excavation Per Chamber/End Cap in yd³ (m³)

	Stone Foundation Depth			
	9" (229 mm)	12" (305 mm)	15" (381 mm)	18" (457 mm)
MC-3500	11.9 (9.1)	12.4 (9.5)	12.9 (9.9)	13.3 (10.2)
End Cap	4.0 (3.1)	4.1 (3.1)	4.3 (3.3)	4.4 (3.4)

NOTE: Assumes 6" (152 mm) of separation between chamber rows and 24" (610 mm) of cover. The volume of excavation will vary as the depth of cover increases.

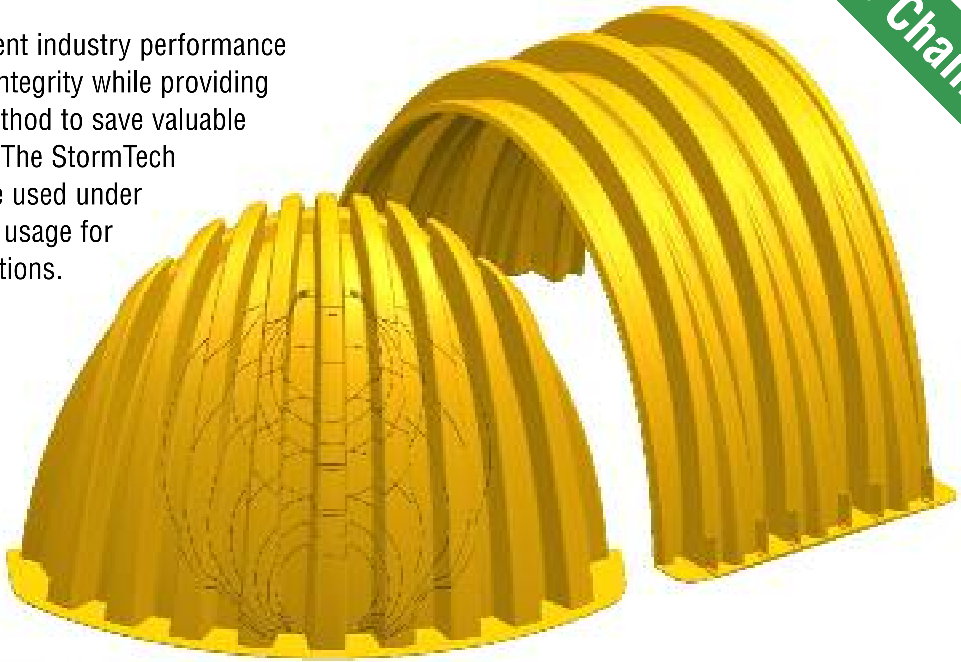
General Cross Section



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

StormTech MC-4500 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.



StormTech MC-4500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	52" (1321 mm) x 100" (2540 mm) x 60" (1524 mm)
Chamber Storage	106.5 ft³ (3.01 m³)
Min. Installed Storage*	162.6 ft³ (4.60 m³)
Nominal Weight	120 lbs (54.4 kg)

* This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below chambers, 9" (229 mm) of stone between chambers/end caps and 40% stone porosity.

StormTech MC-4500 End Cap (not to scale)

Nominal End Cap Specifications

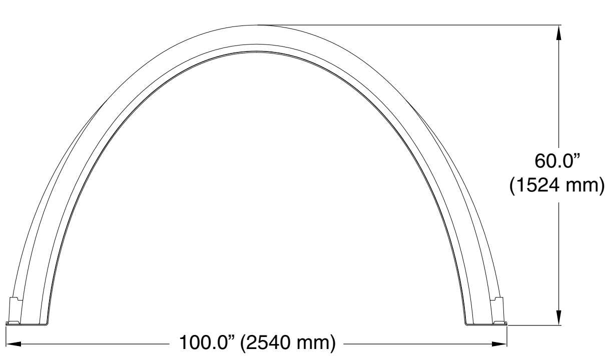
Size (L x W x H)	35.1" (891 mm) x 90.2" (2291 mm) x 59.4" (1509 mm)
End Cap Storage	35.7 ft³ (1.01 m³)
Min. Installed Storage*	108.7 ft³ (3.08 m³)
Nominal Weight	120 lbs (54.4 kg)

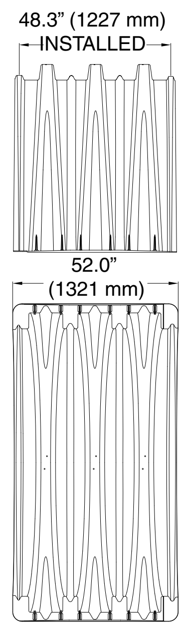
*This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below, 12" (305 mm) of stone perimeter, 9" (229 mm) of stone between chambers/end caps and 40% stone porosity.

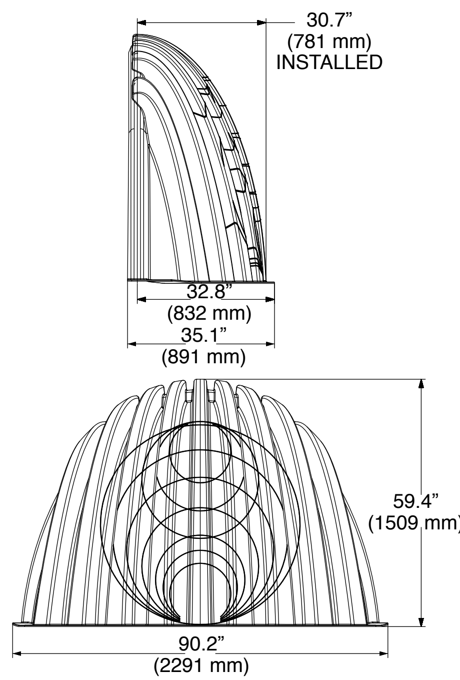
Shipping

8 chambers/pallet

11 pallets/truck







StormTech MC-4500 Chamber

Storage Volume Per Chamber/End Cap ft³ (m³)

	Bare Unit Storage	Chamber/End Cap and Stone Volume — Stone Foundation Depth in. (mm)			
	ft³ (m³)	9 (229)	12 (305)	15 (381)	18 (457)
MC-4500 Chamber	106.5 (3.02)	162.6 (4.60)	166.3 (4.71)	169.9 (4.81)	173.6 (4.91)
MC-4500 End Cap	35.7 (1.01)	108.7 (3.08)	111.9 (3.17)	115.2 (3.26)	118.4 (3.35)

NOTE: Assumes 9” (229 mm) row spacing, 40% stone porosity, 12” (305 mm) stone above and includes the bare chamber/end cap volume. End cap volume assumes 12” (305 mm) stone perimeter.

Amount of Stone Per Chamber

ENGLISH tons (yd³)	Stone Foundation Depth			
	9"	**12"**	**15"**	**18"**
MC-4500	7.4 (5.2)	7.8 (5.5)	8.3 (5.9)	8.8 (6.2)
End Cap	9.6 (6.8)	10.0 (7.1)	10.4 (7.4)	10.9 (7.7)
METRIC kg (m³)	**229 mm**	**305 mm**	**381 mm**	**457 mm**
MC-4500	6681 (4.0)	7117 (4.2)	7552 (4.5)	7987 (4.7)
End Cap	8691 (5.2)	9075 (5.4)	9460 (5.6)	9845 (5.9)

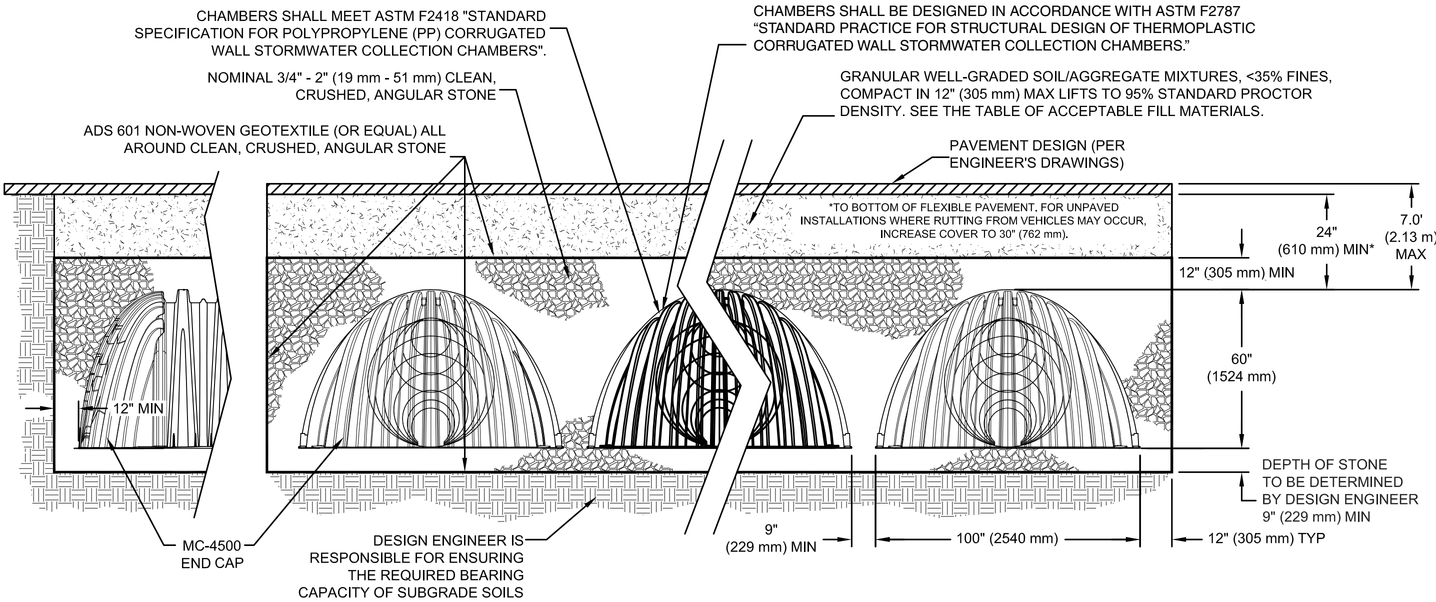
NOTE: Assumes 12" (305 mm) of stone above, 9" (229 mm) row spacing, and 12" (305 mm) of perimeter stone in front of end caps.

Volume of Excavation Per Chamber/End Cap in yd³ (m³)

	Stone Foundation Depth			
	9" (229 mm)	**12" (305 mm)**	**15" (381 mm)**	**18" (457 mm)**
MC-4500	10.5 (8.0)	10.8 (8.3)	11.2 (8.5)	11.5 (8.8)
End Cap	9.3 (7.1)	9.6 (7.3)	9.9 (7.6)	10.2 (7.8)

NOTE: Assumes 9" (229 mm) of separation between chamber rows, 12" (305 mm) of perimeter in front of end caps, and 24" (610 mm) of cover. The volume of excavation will vary as the depth of cover increases.

General Cross Section



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StormTech Isolator™ Row

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patent pending technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

The Isolator Row is a row of StormTech chambers that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as stormwater rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3, and SC-740 models) allow stormwater to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row, protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

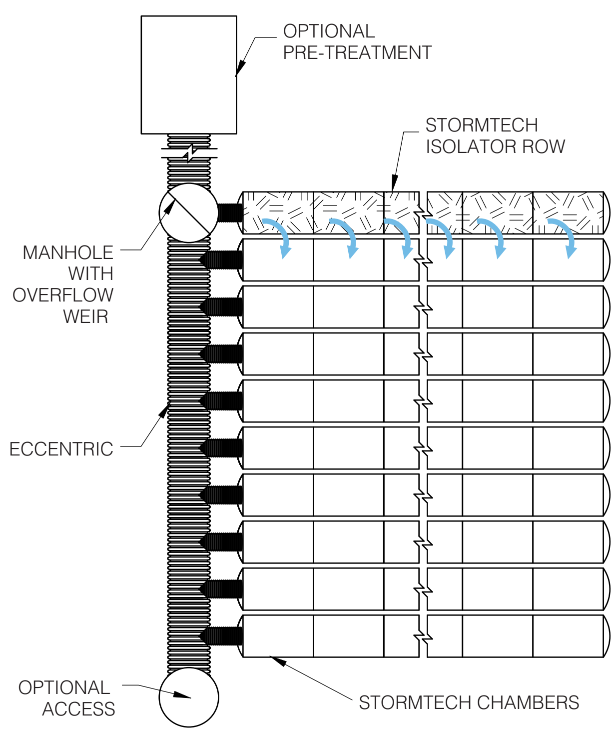
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for stormwater filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row, but typically includes a high flow weir such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row crest the weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating stormwater prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins and oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



StormTech Isolator Row

INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If, upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

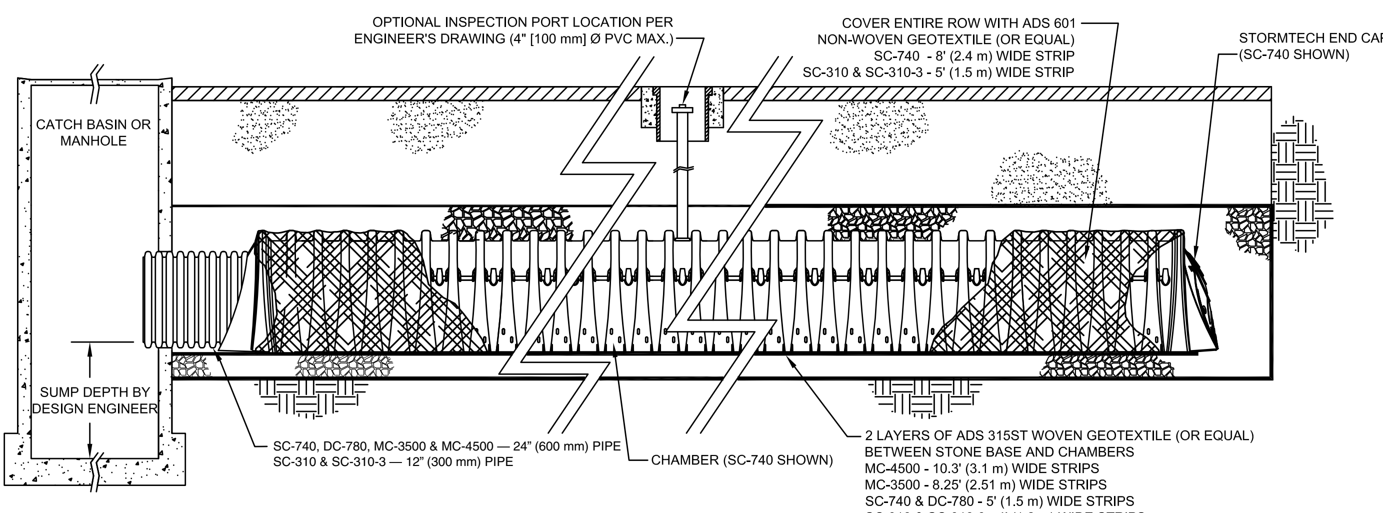
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)



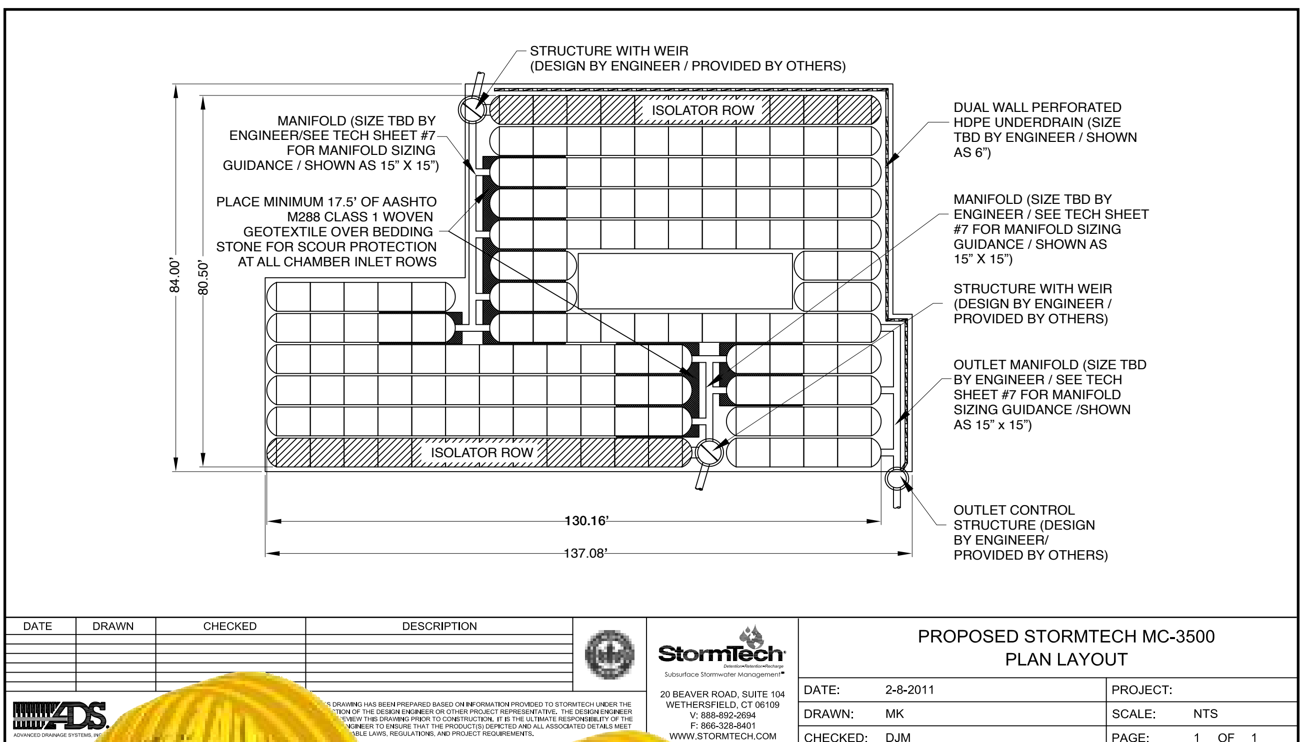
NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

A Family of Products and Services

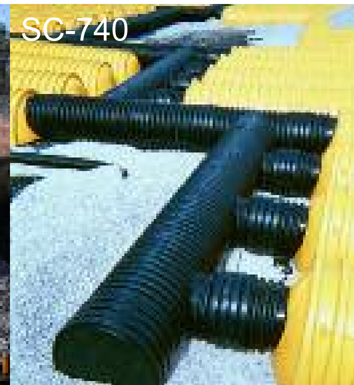
- MC-4500 Chambers and End Caps
- MC-3500 Chambers and End Caps
- SC-310 Chambers and End Caps
- SC-310-3 Chambers and End Caps
- DC-780 Chambers and End Caps
- SC-740 Chambers and End Caps
- SC, DC and MC Fabricated End Caps
- Fabricated Manifold Fittings
- Patented Isolator™ Row for Maintenance and Water Quality
- Chamber Separation Spacers
- In-House System Layout Assistance
- On-Site Educational Seminars
- Worldwide Technical Sales Group
- Centralized Product Applications Department
- Research and Development Team
- Technical Literature, O&M Manuals and Detailed CAD drawings all downloadable via our Web Site

StormTech provides state of the art products and services that meet or exceed industry performance standards and expectations. We offer designers, regulators, owners and contractors the highest quality products and services for stormwater management that "Saves Valuable Land and Protects Water Resources."

Please contact one of our inside Technical Service professionals or Stormwater Product Managers (SPMs) to discuss your particular application. A wide variety of technical support material is available from our website at **www.stormtech.com.** For any questions, please call StormTech at **888-892-2694**.



Example of a Typical Chamber Layout



StormTech

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StormTech®

Detention • Retention • Water Quality

A division of ADS

Isolator® Row O&M Manual

StormTech® Chamber System for Stormwater Management

U.S. GREEN BUILDING COUNCIL MEMBER

1.0 The Isolator® Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

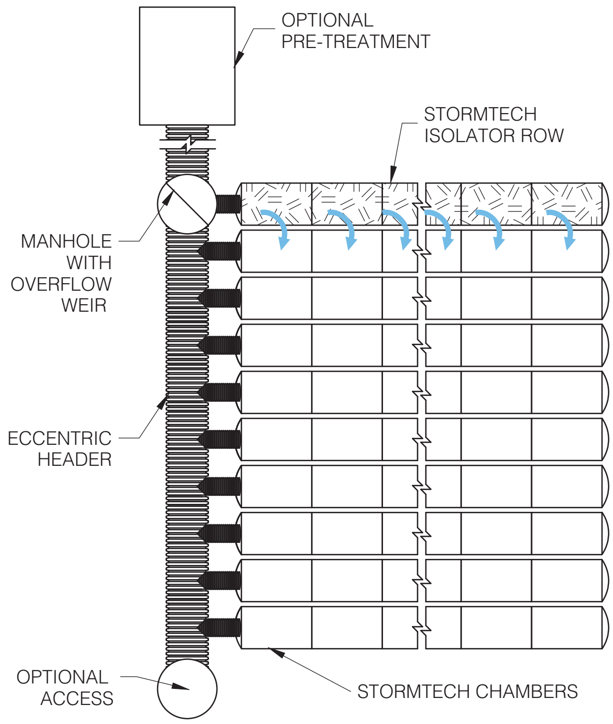
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

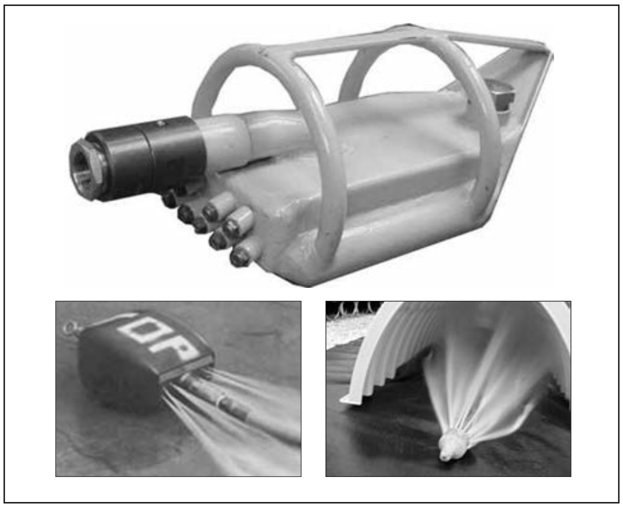
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

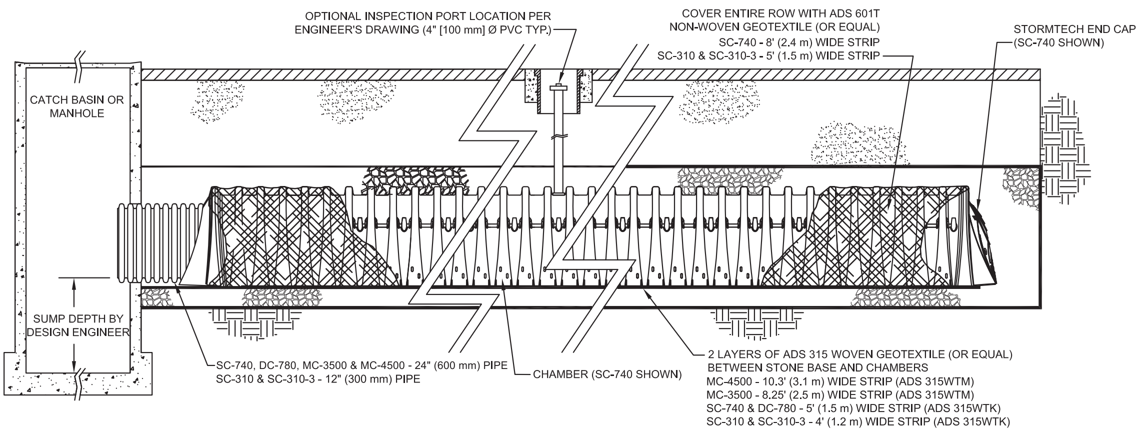
The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)



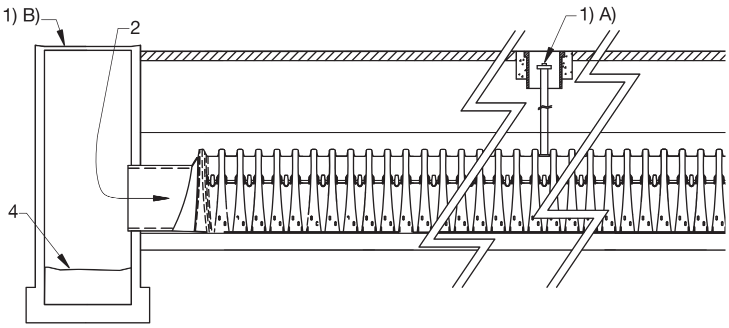
NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

3.0 Isolator Row Step By Step Maintenance Procedures

Step 1) Inspect Isolator Row for sediment

- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process

- A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

StormTech®
Detention • Retention • Water Quality

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GEOSYNTHETICS CROSS REFERENCE CARD

ADS Geosynthetics	Propex®	TenCate Mirafi®	Skaps	Thrace LINQ®	Contech®	TNS/Crown	Hanes TerraTex	Carthage Mills	Terrafix®	Texel	US Fabrics	Layfield Plastics	WinFab Willacoochee
NONWOVENS													
Civil													
0311	311	135N	GT131	120EX	C-31NW	R031	N03	FX-30HS		7604	US80		
0351	351	140NL	GT135	125EX	C-35NW,C-38NW	R035	N04	FX-35HS	200R	7605	US90	LP3.5	
0401	401	140NC	GT140	130EX	C-40NW,C-46NW	R040	SD	FX-40HS	270R	7607	US105	LP4	
0451	451	140N	GT142	140EX	C-45NW	R042	N04.5	FX-45HS		7609	US120	LP4.5	
0501	501	150N	GT150	150EX	C-50NW		N05, S04	FX-50HS	300R				
0601	601	160N	GT160	150EX	C-60NW	R060	N06	FX-60HS	360R	7611	US160	LP6	
0701	701	170N	GT170	160EX	C-65NW,C-70NW	R070	N07	FX-70HS	400R	7612	US180	LP7	
0801	801	180N	GT180	180EX	C-80NW,C-86NW	R080	N08	FX-80HS	420R	7616	US205	LP8	
1001	1001	1000N	GT110		C-100NW	R100	N10	FX-100HS	600R	7618	US160NW	LP10	
1101	1101	1100N		250EX	C-110NW		N11						
1201	1201	1120N	GT112	275EX	C-120NW	R120	N12	FX-120HS	800R	918	US180NW	LP12	
1601	1601	1160N	GT116	350EX	C-160NW	R160	N16	FX-160HS	1200R	580g	US205NW	LP16	
Environmental													
651	651	S600	GE160			E060	N06E	FX-65HS					
861	861	S800	GE180			E080	N08E	FX-86HS					
1071	1071	S1000	GE110			E100	N10E						
1291	1291	S1200	GE112			E120	N12E						
1701	1701	S1600,S1700	GE116		C-170NW	E160	N16E	FX-160HS					
Paving Fabric													
4597	4597		GC150										
4598	4598	Mirapave 500	GC140		C-46NW	C040	OL-I	FX-42A/O					
4599	4599	Mirapave 400	GC130		C-38NW	C039	OL	FX-38A/O					
WOVENS													
Stabilization													
135W	135ST	500XL	W100					FX-44			US150		135W
200W	200ST	500X	W200, W180		C-200,C-180			FX-55	24-15		US200		200W
250W	250ST	550X	W250		C250			FX-60	200W				250W
270W	270ST		W270		C-300								270W
315W	315ST	600X	W300/W315					FX-66	400W		US315		315W
Filtration/Monofilaments													
													2119
104F	104F	FW700			C70/06			Carthage 6%			US670		2199
106F													2198
111F	111F	FW402						Carthage 15%			US1040		2197
117F	117F	FW401						Carthage 30%			US3040		
Reinforcement													
	2X2							FX-200MF					
02X2HF	2X2HF	HP270											2X2HF
03X3HF	3X3	HP370											3X3HF
04X4TK	4X4	HP565						FX-350MF					4x4
04X4HF	4X4HF	HP570			C-400			FX-400MF					4x4HF
	4X6							FX-400MF,600MF					

This table is for comparison purposes only. The Performance Equivalents were determined from data published in the Geotechnical Fabrics Report (GFR), Specifiers' Guide. These Geotextile products are the closest Performance Equivalents and do not necessarily match properties in every case. This Table should in no way be used as a guide by itself. All Performance Equivalents should be determined by the Engineer of record.

FINAL REPORT ON FIELD VERIFICATION TESTING OF THE STORMTECH ISOLATOR™ ROW TREATMENT UNIT

Submitted to

StormTech LLC

June 2008

University of New Hampshire Stormwater Center (UNHSC)
Gregg Hall ● 35 Colovos Road ● Durham, New Hampshire 03824-3534 ● http://www.unh.edu/erg/cstev/

FINAL REPORT ON FIELD VERIFICATION TESTING OF THE STORMTECH ISOLATOR™ ROW TREATMENT UNIT BY THE UNIVERSITY OF NEW HAMPSHIRE STORMWATER CENTER

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FINAL REPORT ON FIELD VERIFICATION TESTING OF THE STORMTECH ISOLATOR™ ROW TREATMENT UNIT
MAY 2008

1.0 INTRODUCTION

Under an agreement from StormTech, LLC, field verification testing of a StormTech Isolator™ Row stormwater treatment unit was conducted at the University of New Hampshire Stormwater Center, Durham NH. Testing consisted of determining the water quality performance for the following parameters:

- Total Suspended Sediment (TSS)
- Total Petroleum Hydrocarbons-Diesel Range (TPH-D)
- Nitrogen as Nitrate (DIN)
- Total Zinc (TZn)
- Total Phosphorus (TP)

Efficiency tests were conducted under normalized conditions at various ambient rainfall intensities, flow rates, and pollutant concentrations; all important variables reflective of natural field performance conditions. This report reflects analyses performed from December 2006 through March 2008. This included monitoring of 17 rainfall runoff events in total. Monitored storm flow does not include system bypass.

The StormTech Isolator™ Row treatment unit is one of 10 devices that are configured and tested in parallel, with a single influent source providing uniform loading to all devices. All treatment strategies were uniformly sized to target a rainfall-runoff depth equivalent to 90% of the annual volume of rainfall. Under the parallel and uniformly sized configuration, a normalized performance evaluation is possible because different treatment strategies of the same scale receive runoff from events of the same duration, intensity, peak flow, volume, antecedent dry period, and watershed loading.

Primary funding for the Center program has been provided by the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) and the National Oceanic and Atmospheric Administration (NOAA).The UNH Stormwater Center is housed within the Environmental Research Group (ERG) at the University of New Hampshire (UNH) in Durham, New Hampshire.

2.0 TEST FACILITY DESCRIPTION

The UNH Stormwater Center studies stormwater-related water quality and quantity issues. The Stormwater Center's field facility is designed to evaluate and verify the performance of stormwater management devices and technologies in a parallel, event normalized setting. Ten different management systems are currently undergoing side-by-side comparison testing under strictly monitored natural conditions (figure 1).

The site was designed to function as numerous, uniformly sized, isolated, parallel treatment systems. Rainfall-runoff is evenly divided at the head of the facility in a distribution box, designed with the floor slightly higher than the outlet invert elevations to allow for scour across the floor and into the pipe network. Effluent from all systems is piped into a central sampling gallery, where system sampling and flow monitoring conveniently occurs. The parallel configuration normalizes the treatment processes for event and watershed-loading variations.

The Center is located on the perimeter of a 9 acre commuter parking lot at the University of New Hampshire in Durham. The parking lot is standard dense mix asphalt that was installed in 1996, and is used to near capacity throughout the academic year. The sub-catchment area is large enough to generate substantial runoff, which is gravity fed to the parallel treatment processes. The lot is curbed and entirely impervious. Activity is a combination of passenger vehicles and routine bus traffic. The runoff time of concentration for the lot is 22 minutes, with slopes ranging from 1.5-2.5%. The area is subject to frequent plowing, salting, and sanding during the winter months. Literature reviews indicate that contaminant concentrations are above or equal to national norms for parking lot runoff. The climatology of the area is characterized as a coastal, cool temperate forest. Average annual precipitation is 48 inches uniformly distributed throughout the year, with average monthly precipitation of 4.02 in +/- 0.5. The mean annual temperature is 48°F, with the average low in January at 15.8°F, and the average high in July at 82°F.

2.1 System Configuration and Sizing

The tested system configuration was for a single StormTech Isolator™ Row. System layout and drawings are attached as Appendix 1. System configuration typically includes a StormTech Isolator™ Row in series with StormTech chambers used either for retention, detention, or infiltration. Isolator™ bypass can be caused by non-design flows or decreased filtration capacity from sediment accumulation. Monitored storm flow does not include system bypass. The 30" nyloplast structure at the end of the system indicated in the drawings was not installed.

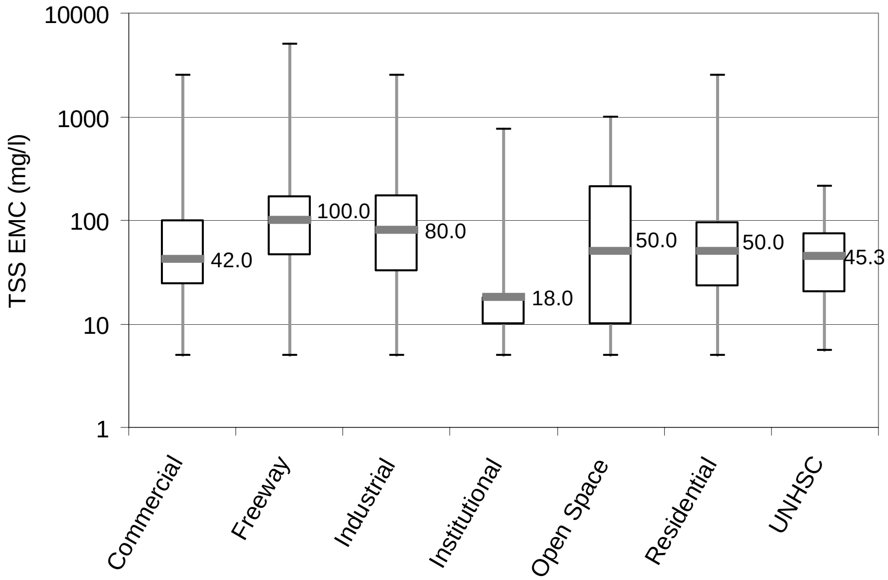
The Isolator™ Row system was designed for a 1 cubic foot per second treatment flow, or the equivalent of rainfall runoff from 1 acre of impervious surface. This is a 5 chamber system of the StormTech SC-740 chambers (51" x 30" x 85.4"). Storage per chamber is 45.9 ft^3 or a total storage of 229.5 ft^3. The bottom of the chambers were double-lined with ADS 9750 woven geotextile. The tops and sides of the chambers were single lined with ADS 6600 woven geotextile. See appendix 1 for drawings. The type and placement of the liner is critical. The junctions of non- and woven geotextile were double folded over-top and backfilled with ¾" stone to create a seal. The excavation was lined with a 30 mil HDPE liner not indicated on the drawings.

The system was installed in late September 2006. System monitoring began in December to allow for system flushing and start-up to prevent influences that may be construction associated.

2.2 Reference TSS Information

Comparisons of the TSS concentrations for varied land uses are presented in Figure 1. Urban highways pollutant concentrations tend to be twice the mean measured concentrations for parking lots and residential uses. The UNH facility data is within the national norm for parking lots.

Figure 1: Total Suspended Solids (TSS) for varied land uses and at the UNH Stormwater Center (mg/L); (Source: National Stormwater Quality Database, 2005[1])



3.0 INSTRUMENTATION AND MEASURING TECHNIQUES

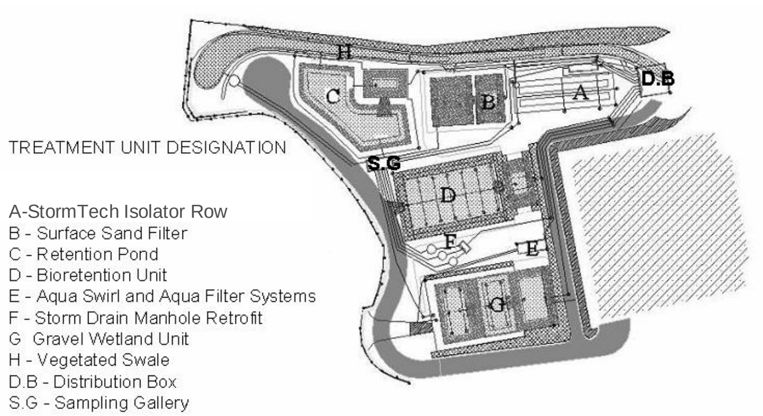
3.1 Flow

Influent and effluent flow levels were measured using Teledyne Isco 6712 Automated samplers accompanied by Teledyne Isco 730 Bubbler Flow Modules in combination with Thelmar compound weirs.

3.2 Other Measurements

Temperature, pH, Specific Conductivity, and Dissolved Oxygen, are collected by a YSI 600XL sonde. These parameters are monitored real-time the treatment unit, but are outside the scope of work identified under this contract.

Figure 2: Site Plan: Plan view of the University of New Hampshire field research facility



[1] Pitt, R. E., Maestre, A., and Center for Watershed Protection. (2005) "The National Stormwater Quality Database (NSQD, version 1.1)." USEPA Office of Water, Washington, D.C.

3.3 Water Quality Analysis

Samples were processed and analyzed by an EPA certified laboratory using the standard methodologies outlined in Table 1.

Table 1: Laboratory analytical methods and detection limits for each analyte.

Analyte	Analytical Method	Sample Detection Limit (mg/L)	Method Detection Limit (mg/L)[a]
Nitrate/Nitrite in water	EPA 300.0A	0.1	0.008
Total Suspended Solids	EPA 160.2	10	0.4
Total Phosphorus	EPA 300.0A	0.01	0.008
Zinc in water	EPA 6010b	0.01	0.001-0.05
Total Petroleum Hydrocarbons –Diesel Range	EPA 8015B	0.4	0.1-3.0 ug/L

[a]Method detection limit is different than sample detection limit which will be less and is based on sample volume available for analyses.

4.0 TEST PROCEDURES

4.1 Rainfall Collection and Measurement.

A rainfall collection system consisting of a 6"diameter 2 foot high anodized aluminum housing, funnel, debris screen, and tipping bucket mechanism is installed at a controlled site within the research complex. Specified components are the ISCO Model 674 Tipping Bucket Rain Sensor with Rain Gauge. The precipitation event data is stored in the ISCO 6712 and the accumulated rainfall is retrieved through FlowLink 4.21 via a desktop computer located on-site.

4.2 Field Sampling Procedures.

Discrete samples are taken for influent and effluent waters by automated samplers. Automatic samples are programmed to take samples at uniform time intervals that are determined prior to each independent rain event. Generally at least 10 samples will be taken for each rain event; five discrete samples are taken within the time of concentration and the remaining samples (up to 19 more, 24 in total) taken over the remainder of the hydrograph. Influent time of concentration is approximately 22 minutes. Effluent time of concentrations vary for each device depending on conveyance lengths and treatment strategies. All samples are stored in thermostatically controlled conditions at 39°F.

One Liter disposable LDPE sample bags are used to assure clean, non-contaminated sample containers. Prior to a sampling event, each bag is labeled with a unique, water proof, adhesive bar code that corresponds with a field identification number containing information relating to the stormwater treatment unit, the sample number (1-24) and the date of sampling. Records are kept that correlate sample number with sample time, date, flow, and other real time water quality parameters. Detailed written and electronic records are kept identifying the technician who loaded each sampler, the date, time, and unique bar code and field identification numbers. This begins the chain-of-custody record that accompanies each sample to track handling and transportation of each sample throughout the sampling process.

Analyses substantially comply with the Technology Acceptance and Reciprocity Partnership (TARP), and the Technology Acceptance Protocol – Ecology (TAPE) guidelines. We operate under a detailed Quality Assurance Project Plan (QAPP) which is available on request.

4.3 Characterization of Influent Solids

Large 7000 liter first flush samples were taken for 11 storms through out the year to measure total solids (TS) for which a concurrent storm volume was monitored by auto-sampler. Large volume samples enable the capture of the entire sediment load (total solids) for the first flush and respective sampling period. PSDs are determined using wet sieving and hydrometer (ASTM Standard D 422 – 63). Total solids PSDs are not to be compared with samples with PSD's obtained by auto-sampler and which are determined by laser diffraction. Method consistency is needed for PSD to be comparable.

A serial decantation process is used to reduce the volume over a period of 96 hours. The TS sample is allowed to settle for 48 hours. Half of the volume is then decanted transferred into a settling tank. After an additional 48 hours, a second decanting occurs, which allows for the sediments to be recovered, wash sieved, and weighed to develop the mass of total solids and influent particle size distribution (PSD).

5.0 DATA EVALUATION

Data analyses include a range of approaches. Analyses include:

- evaluation of storm characteristics
- construction of pollutographs
- event mean concentrations
- normalized performance efficiencies

Pollutographs are based on time versus concentration for influent and effluent from discrete sample monitoring. Pollutographs can be used to assess the efficacy of the sampling programs by determining whether the bulk of the mass-load wash-off was monitored. This is determined by the observation of diminishing concentrations over time.

Event mean concentrations (EMC's) are a parameter used to represent the flow-proportional average concentration of a given parameter during a storm event. It is defined as the total constituent mass divided by the total runoff volume. When combined with flow measurement data, the EMC can be used to estimate the pollutant loading from a given storm.

$$EMC = \frac{\sum_{i}^{n} V_i C_i}{V_{total}} \quad \text{where } n \text{ is the number of samples}$$

$$\text{Performance efficiency for individual storms} = 100 \times \frac{EMC_{influent} - EMC_{effluent}}{EMC_{influent}}$$

$$\text{Method 1:} \qquad \text{Removal Efficiency (RE)} = \frac{\text{Sum of all Storm Efficiencies}}{\text{Number of Storms}}$$

Method 2: Efficiency Ratio (ER)=

$$ER = \frac{\text{Average EMC}_{influent} - \text{Average EMC}_{effluent}}{\text{Average EMC}_{influent}}$$

Pollutant loadings adjusted for event mean concentrations, are compared for each pollutant parameter using simple statistics. The data provides a basis to evaluate the primary study question; i.e., to discern whether stormwater treatment unit BMP's have served to produce observable (and perhaps statistically significant) improvement in quality and reduction in volume of stormwater runoff.

6.0 RESULTS

Table 2 displays rainfall event characteristics for the 17 monitored storm events. Storms ranged in size from low intensity to high intensity, small volume to large volume. Every attempt was made to sample rainfall events across the range of seasons and while there is variation there are predominantly more winter storms in the data set. With subsurface filtration systems like the StormTech Isolator™ Row seasonal fluctuations do not have significant effects on system performance. It should be noted that a number of events were not included in final calculations due to quality assurance procedures followed by UNHSC. These entries are left blank. A common reason for disqualification is EMC's calculated below detection limit.

Table 2: Rainfall-Runoff event characteristics for 17 storm events

Rainfall Event	Peak Intensity (in/hr)	Storm Duration (min)	Total Depth (in)	Peak Flow (gpm)	Volume (gal)	Season
12/23/2006	0.36	1020	1.21	225	80300	Winter
1/6/2007	0.36	760	0.50	346	43404	Winter
3/2/2007	0.48	535	1.02	200	52718	Winter
3/11/2007	0.12	430	0.28	85	23324	Winter
4/12/2007	0.12	590	0.37	115	30421	Spring
4/27/2007	0.24	450	0.54	146	31004	Spring
5/11/2007	0.60	125	0.26	488	13150	Spring
7/4/2007	0.48	235	0.45	260	23979	Summer
9/9/2007	1.32	345	0.48	923	27626	Summer
12/24/2007	1.08	305	0.33	499	22196	Winter
12/29/2007	0.36	655	0.42	114	32563	Winter
1/11/2008	0.72	690	0.68	233	47832	Winter
1/18/2008	0.48	250	0.59	47	2215	Winter
2/1/2008	0.11	645	1.23	187	21859	Winter
2/13/2008	0.40	411	2.74	39	6542	Winter
3/7/2008	0.24	365	0.34	139	27391	Winter
3/8/2008	0.60	500	1.21	288	70938	Winter

6.1 Event Mean Concentrations and Removal Efficiencies

Performance statistics and EMC values are presented for each storm for the 5 contaminants across 17 monitored storm events in tables 3-7 below. A variety of performance characterizations are made. In general use of removal efficiencies can be complicated, however in this setting such measures are appropriate as all systems tested receive the same stormwater from the same watershed. In addition to median and average removal efficiencies (Res), and efficiency ratios (ERs) are also displayed. Advantages and disadvantages of each measure are discussed in further detail in the summary and conclusion section of this report. In addition influent and effluent EMC probabilities are presented in figure 2 as box and whisker box plots for the range of storms monitored and the range of contaminants measured. Effluent probability plots are useful in discerning overall performance trends and in comparing UNHSC results to other datasets that may exist for the treatment technology.

Table 3: Total Suspended Solids Event Mean Concentrations and Removal Efficiencies for 17 storm events at influent and effluent points of the StormTech Isolator™ Row Unit (A3)

Date	Analyte Process	Units	TSS Influent	Effluent
12/23/2006	RE	%		
	EMC	mg/l		
1/6/2007	RE	%		13%
	EMC	mg/l	18.096	15.815
3/2/2007	RE	%		64%
	EMC	mg/l	128.683	46.086
3/11/2007	RE	%		62%
	EMC	mg/l	65.661	24.883
4/12/2006	RE	%		85%
	EMC	mg/l	36.234	5.482
4/27/2007	RE	%		3%
	EMC	mg/l	15.555	15.123
5/11/2007	RE	%		81%
	EMC	mg/l	123.364	23.482
7/4/2007	RE	%		90%
	EMC	mg/l	48.402	4.602
9/9/2007	RE	%		38%
	EMC	mg/l	32.032	19.981
12/24/2007	RE	%		62%
	EMC	mg/l	120.000	46.000
12/29/2007	RE	%		100%
	EMC	mg/l	16.000	0.000
1/11/2008	RE	%		85%
	EMC	mg/l	94.000	14.000
1/18/2008	RE	%		86%
	EMC	mg/l	130.000	18.000
2/1/2008	RE	%		100%
	EMC	mg/l	21.000	0.000
2/13/2008	RE	%		86%
	EMC	mg/l	22.000	3.000
3/7/2008	RE	%		14%
	EMC	mg/l	14.000	12.000
3/8/2008	RE	%		79%
	EMC	mg/l	48.000	10.000
Process			**TSS**	
Ave RE			**66%**	
Median RE			**80%**	
ER			**72%**	

Table 4: Total Petroleum Hydrocarbons-Diesel Range Event Mean Concentrations and Removal Efficiencies for 17 storm events at influent and effluent points of the StormTech Isolator™ Row Unit (A3)

Date	Analyte Process	Units	TPH-D Influent	Effluent
12/23/2006	RE	%		100%
	EMC	ug/l	378.692	0.000
1/6/2007	RE	%		52%
	EMC	ug/l	1094.223	520.344
3/2/2007	RE	%		65%
	EMC	ug/l	2239.940	783.313
3/11/2007	RE	%		71%
	EMC	ug/l	1647.889	472.401
4/12/2006	RE	%		33%
	EMC	ug/l	631.229	421.917
4/27/2007	RE	%		90%
	EMC	ug/l	455.725	45.428
5/11/2007	RE	%		59%
	EMC	ug/l	969.972	401.795
7/4/2007	RE	%		53%
	EMC	ug/l	926.978	435.902
9/9/2007	RE	%		100%
	EMC	ug/l	261.366	0.000
12/24/2007	RE	%		62%
	EMC	ug/l	890.000	340.000
12/29/2007	RE	%		
	EMC	ug/l		
1/11/2008	RE	%		100%
	EMC	ug/l	750.000	0.000
1/18/2008	RE	%		91%
	EMC	ug/l	3200.000	300.000
2/1/2008	RE	%		
	EMC	ug/l	400.000	
2/13/2008	RE	%		100%
	EMC	ug/l	870.000	0.000
3/7/2008	RE	%		100%
	EMC	ug/l	850.000	0.000
3/8/2008	RE	%		100%
	EMC	ug/l	490.000	0.000
Process			**TPH-D**	
Ave RE			**78%**	
Median RE			**90%**	
ER			**75%**	

Table 5: Dissolved Inorganic Nitrogen Event Mean Concentrations and Removal Efficiencies for 17 storm events at influent and effluent points of the StormTech Isolator ™ Row Unit (A3)

Date	Analyte Process	Units	DIN Influent	Effluent
12/23/2006	RE	%		-26%
	EMC	mg/l	0.259	0.326
1/6/2007	RE	%		64%
	EMC	mg/l	0.383	0.138
3/2/2007	RE	%		-28%
	EMC	mg/l	0.193	0.247
3/11/2007	RE	%		-8%
	EMC	mg/l	0.429	0.464
4/12/2006	RE	%		-421%
	EMC	mg/l	0.050	0.259
4/27/2007	RE	%		-117%
	EMC	mg/l	0.111	0.240
5/11/2007	RE	%		-77%
	EMC	mg/l	0.258	0.456
7/4/2007	RE	%		
	EMC	mg/l		
9/9/2007	RE	%		-221%
	EMC	mg/l	0.189	0.605
12/24/2007	RE	%		
	EMC	mg/l		
12/29/2007	RE	%		-40%
	EMC	mg/l	0.500	0.700
1/11/2008	RE	%		-150%
	EMC	mg/l	0.200	0.500
1/18/2008	RE	%		
	EMC	mg/l		
2/1/2008	RE	%		
	EMC	mg/l		
2/13/2008	RE	%		-100%
	EMC	mg/l	0.200	0.400
3/7/2008	RE	%		
	EMC	mg/l		
3/8/2008	RE	%		-150%
	EMC	mg/l	0.200	0.500
Process			**DIN**	
Ave RE			**-106%**	
Median RE			**-88%**	
ER			**63%**	

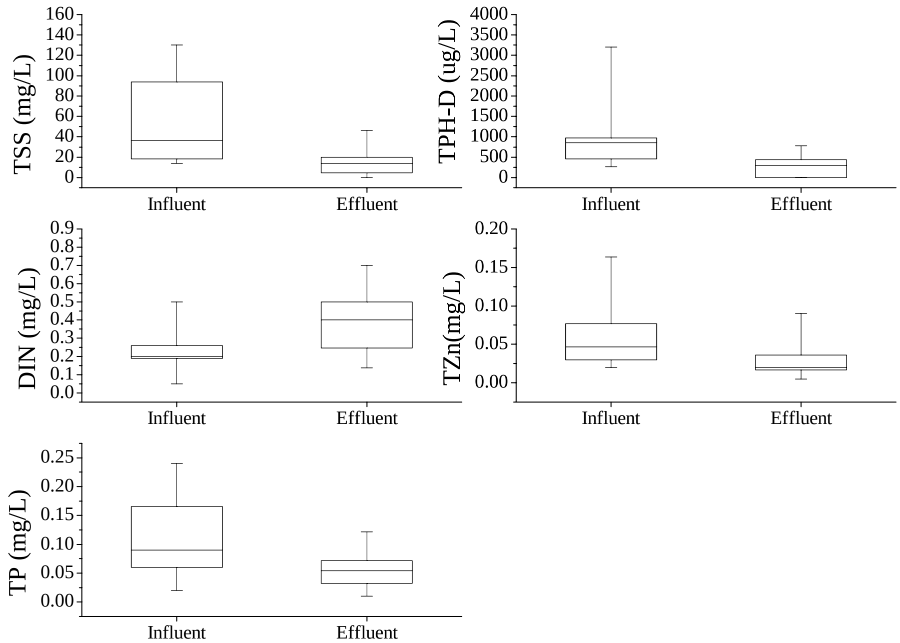
Table 6: Total Zinc Event Mean Concentrations and Removal Efficiencies for 17 storm events at influent and effluent points of the StormTech Isolator ™ Row Unit (A3)

Date	Analyte Process	Units	TZn Influent	Effluent
12/23/2006	RE	%		
	EMC	mg/l		
1/6/2007	RE	%		37%
	EMC	mg/l	0.027	0.017
3/2/2007	RE	%		57%
	EMC	mg/l	0.163	0.071
3/11/2007	RE	%		53%
	EMC	mg/l	0.077	0.036
4/12/2006	RE	%		53%
	EMC	mg/l	0.046	0.022
4/27/2007	RE	%		76%
	EMC	mg/l	0.021	0.005
5/11/2007	RE	%		58%
	EMC	mg/l	0.087	0.036
7/4/2007	RE	%		63%
	EMC	mg/l	0.046	0.017
9/9/2007	RE	%		37%
	EMC	mg/l	0.049	0.030
12/24/2007	RE	%		40%
	EMC	mg/l	0.150	0.090
12/29/2007	RE	%		33%
	EMC	mg/l	0.030	0.020
1/11/2008	RE	%		83%
	EMC	mg/l	0.060	0.010
1/18/2008	RE	%		56%
	EMC	mg/l	0.090	0.040
2/1/2008	RE	%		50%
	EMC	mg/l	0.040	0.020
2/13/2008	RE	%		50%
	EMC	mg/l	0.040	0.020
3/7/2008	RE	%		0%
	EMC	mg/l	0.020	0.020
3/8/2008	RE	%		60%
	EMC	mg/l	0.050	0.020
Process			**TZn**	
Ave RE			**50%**	
Median RE			**53%**	
ER			**52%**	

Table 7: Total Phosphorus Event Mean Concentrations and Removal Efficiencies for 17 storm events at influent and effluent points of the StormTech Isolator™ Row Unit (A3)

Date	Analyte Process	Units	TP Influent	Effluent
12/23/2006	RE	%		1%
	EMC	mg/l	0.033	0.033
1/6/2007	RE	%		19%
	EMC	mg/l	0.081	0.065
3/2/2007	RE	%		49%
	EMC	mg/l	0.240	0.121
3/11/2007	RE	%		42%
	EMC	mg/l	0.175	0.102
4/12/2006	RE	%		22%
	EMC	mg/l	0.069	0.054
4/27/2007	RE	%		22%
	EMC	mg/l	0.051	0.039
5/11/2007	RE	%		64%
	EMC	mg/l	0.198	0.072
7/4/2007	RE	%		54%
	EMC	mg/l	0.165	0.076
9/9/2007	RE	%		2%
	EMC	mg/l	0.096	0.094
12/24/2007	RE	%		59%
	EMC	mg/l	0.170	0.070
12/29/2007	RE	%		50%
	EMC	mg/l	0.040	0.020
1/11/2008	RE	%		67%
	EMC	mg/l	0.120	0.040
1/18/2008	RE	%		67%
	EMC	mg/l	0.120	0.040
2/1/2008	RE	%		50%
	EMC	mg/l	0.060	0.030
2/13/2008	RE	%		25%
	EMC	mg/l	0.080	0.060
3/7/2008	RE	%		-50%
	EMC	mg/l	0.020	0.030
3/8/2008	RE	%		89%
	EMC	mg/l	0.090	0.010
Process			**TP**	
Ave RE			**37%**	
Median RE			**49%**	
ER			**47%**	

Figure 3: Effluent EMC box and whisker plot comparisons for the range of contaminants. Box reflects the 25th and 75th percentile, the line reflects the median and the whiskers reflect minimum and maximum.



6.2 Particle Size Distributions (PSD)

Particle size information for 3 influent events determined by autosampler and laser diffraction are presented in Figures 3 - 4. Two distinct methods where employed to assess influent PSD, a total solids method and an autosampler method. The total solids method refers to actual sediments existing in a full volume sample of influent first flush. Autosampler PSD is reflective of the particle size range pulled by a sampler using a 3/8th ID sampling line and a peristaltic pump. Total solids PSDs were quantified using wet sieving and hydrometer (ASTM Standard D 422 – 63). The two methods are not directly comparable. The autosampler method represents the industry standard and that referred to in the TARP protocol. The total solids method represents actual PSD for the contributing watershed.

Figure 4: Influent particle size distributions by autosampler and laser diffraction for 3 storms in 2007

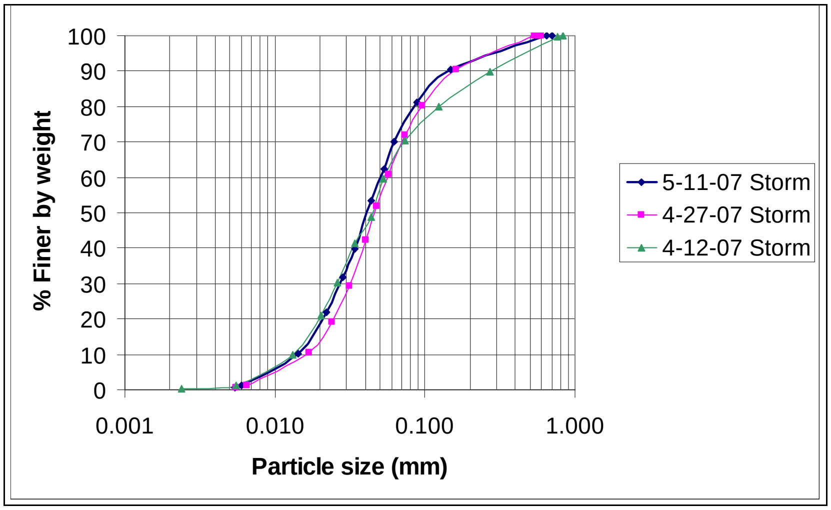
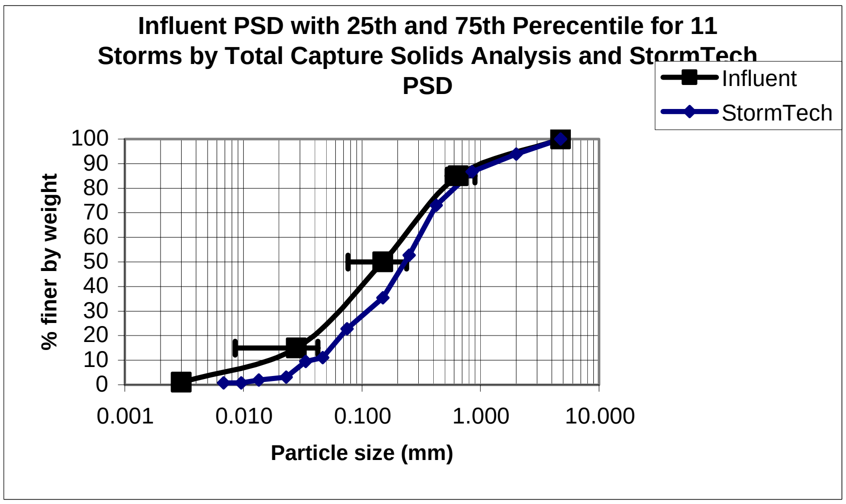


Figure 5: Particle size distributions by wet-sieving and hydrometer analyses for influent (n= 11 storms, 25th and 75th percentile) and in-system sediments for the StormTech Isolator^{TM} Row



Particle size ranges represented by the auto sampler are the same sampling method representative of the TSS sediment characterization used to report water quality performance.

Table 8: Particle Size Summary for Parking Lot Runoff 2006-2008

Particle	Influent Total Capture (mm)	Influent Autosampler (mm)
d15	0.028	0.015
d50	0.150	0.038
d85	0.650	0.103

7.0 SUMMARY AND CONCLUSIONS

The range of statistical analyses presented reveal a range of performance trends. Efficiency Ratio (ER) analysis was performed on the final dataset for both treatment devices. For many stormwater treatment system datasets ER is a stable estimation of overall treatment performance as it minimizes the impact of low concentration values, or relatively clean storms with low influent EMC concentrations. Where Removal Efficiencies (RE) reflect treatment unit performance on a storm by storm basis, ERs weight all storms equally and reflect overall influent and effluent averages across the entire data set. REs are presented as an average of aggregate storms and as a median value. In general median RE values are more reliable in highly variable, non-normally distributed datasets such as those experienced in stormwater treatment unit performance studies. A review of REs on a per event basis, ERs for the entire period of monitoring, and EMCs per event and probabilistically over the entire period of monitoring will reveal the measured performance variations attributable to season, flow, concentration, and other factors.

Overall the StormTech Isolator™ Row does well at removing nearly all contaminants assessed with the exception of dissolved inorganic nitrogen. Non-vegetated filtration systems such as the Isolator™ Row would not be expected to remove nitrogen. Vegetative uptake of nitrogen is the primary removal mechanism for filtration systems. This system achieves a median removal efficiency of 80% for TSS which meets most recommended regulatory levels for water quality treatment for sediments. The Isolator™ Row system does marginally better (90% RE) for TPH and demonstrates good removal for TP (49% RE).

Of interest is the StormTech Isolator™ Row's performance improvements over the study period. System performance increased substantially in the initial few months indicating a filter ripening. This demonstrates substantial improvements in filtration effectiveness with the development of a filter cake from accumulated sediment over time. As is typical of every filtration system, improvements in filtration effectiveness will continue and need to be balanced with decreases in hydraulic capacity. Significant decreases in hydraulic capacity will result in increased frequency of bypass. System maintenance will be an important component of long-term performance to insure limited bypass and maximum treatment.

7.2 Future Research Recommendations

The StormTech Isolator^{TM} Row demonstrates advanced ability to meet current federal guidelines for stormwater management for all contaminants assessed with the exception of nitrogen. Data suggests enhanced removal efficiencies over time. Naturally a stasis point will be reached where treatment efficiencies enhanced by the accumulation of organic matter on the filter are offset by reduced filtration capacity of the Isolator^{TM} Row coupled with increase incidence of bypass. To date, this analysis can not be completed. Future research on such matters could greatly inform suggested maintenance recommendations and guidelines.

APPENDIX 1: SYSTEM DRAWINGS

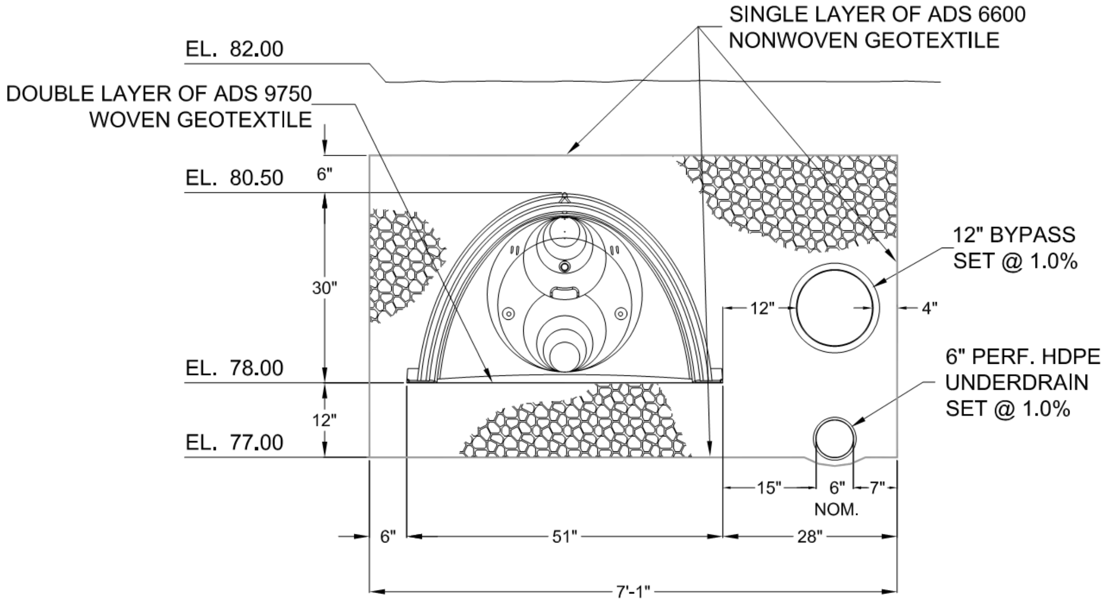


Figure 6: Section A-A for Isolator™ Row[a]

[a]The single layer of ADS nonwoven geotextile was installed along the outside of the chamber (except bottom) not on the perimeter of the stone as indicated.

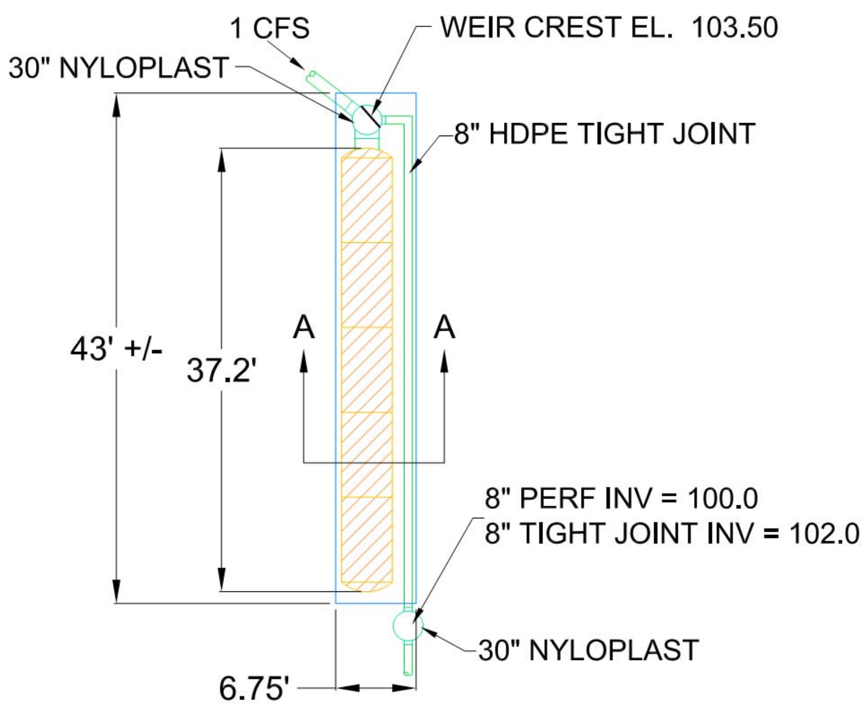


Figure 7: Plan View A-A for Isolator™ Row[a]

[a]30"nyloplast was not installed, and bypass not combined

APPENDIX 2: ISOLATOR^{TM} ROW OPERATIONS AND MAINTENANCE PLAN

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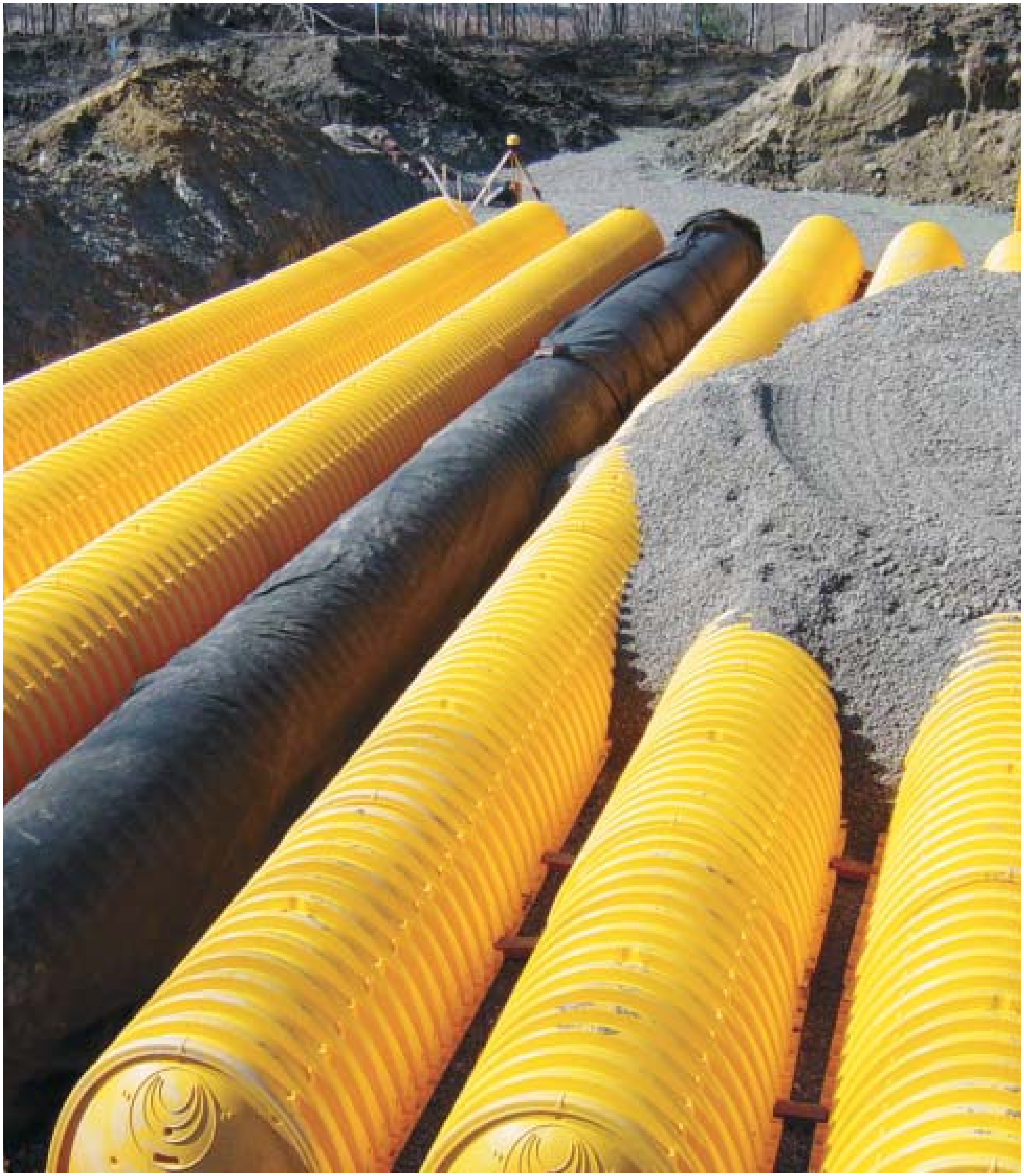


Isolator™ Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator™ Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patent pending technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR™ ROW

The Isolator Row is a row of StormTech chambers, either SC-740 or SC-310 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

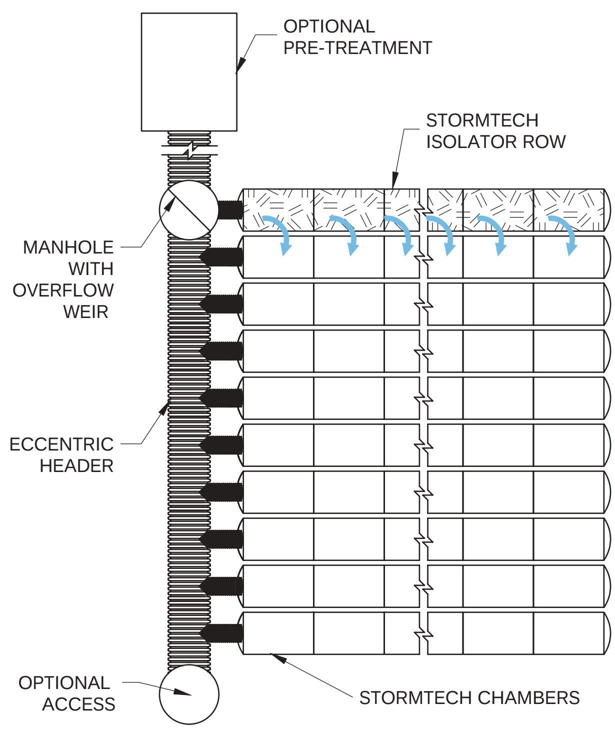
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

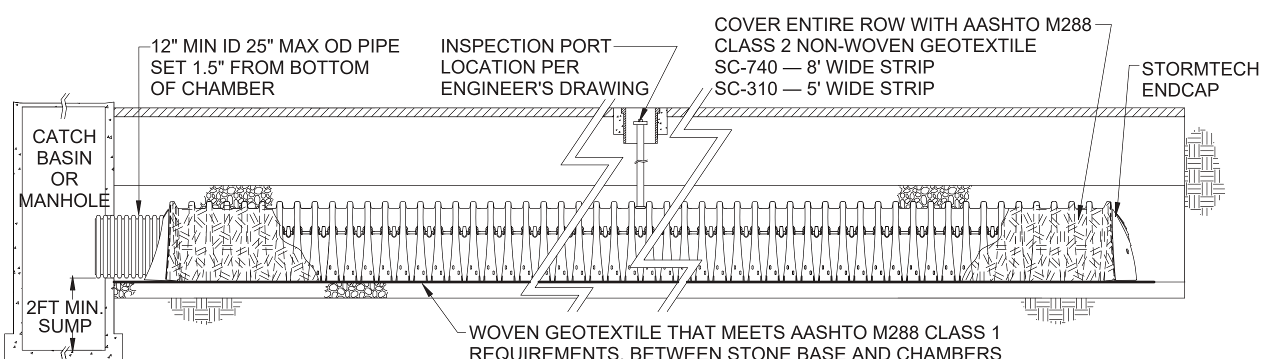
2.2 MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

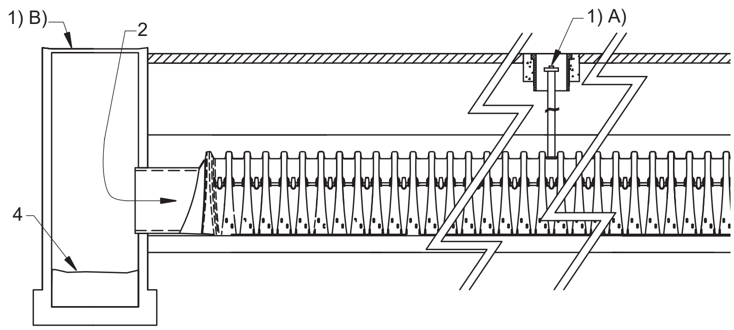
StormTech Isolator Row (not to scale)



3.0 Isolator Row Step By Step Maintenance Procedures

Step 1) Inspect Isolator Row for sediment
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process
- A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

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