APPENDIX A

Filterra System Schematics and Design Assistance Kit

Additional Outfall Configurations for the Filterra® System

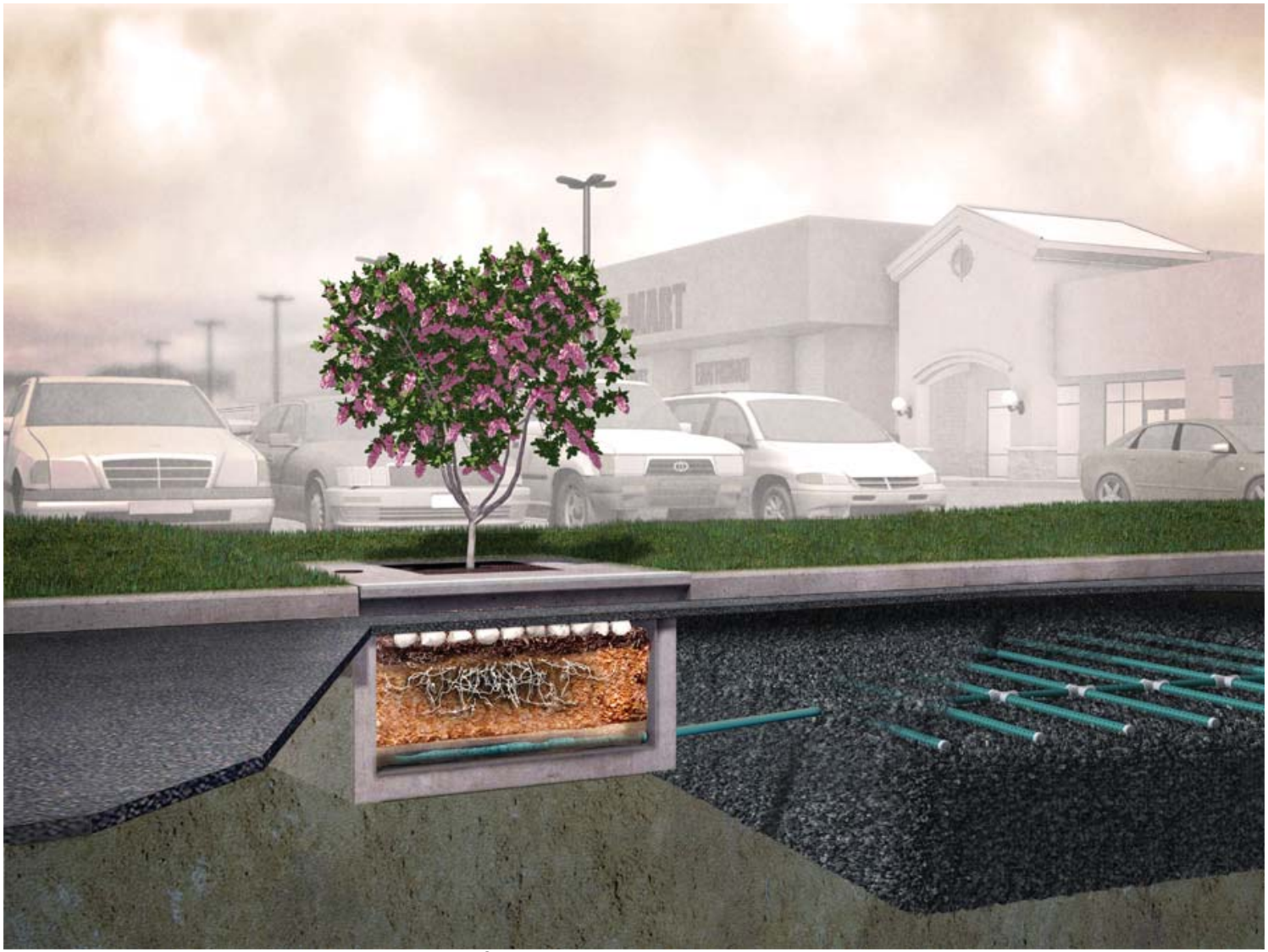

Figure A-1. Filterra® system discharging to a gravel infiltration bed.

Figure A-2. Filterra® system discharging to a rain tank.

Figure A-3. Filterra® system discharging to a Stormtech vault.

WA DOE GULD TAPE/TARP
APPROVED

WESTERN WASHINGTON

Engineering Design Assistance Kit (DAKit) v01a - WA

filterra®
Bioretention Systems
A Growing Idea in Stormwater Filtration

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(866) 349-3458	Sales
(804) 798-8400	Fax
design@filterra.com	E-mail
www.filterra.com	Web

Filterra® Stormwater Bioretention Filtration System

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Introduction and Scope of this Document

At federal, state and local levels, stormwater management is increasingly important. Americast's Filterra® units can help developers comply with NPDES legislation by removing pollutants, using a small efficient natural system that is both cost-effective and reliable.

This document is compiled to assist engineers in the proper design for the best results where Filterra® is used for stormwater quality management. We want your project to be successful and it is important to this success that you follow guidelines contained herein. Please review the essential reading section (p. 6).

The Filterra® Bioretention Filtration System has received General Use Level Designation by the Washington State Department of Ecology for BASIC, ENHANCED AND OIL/GREASE TREATMENT as well as Conditional Use Level Designation for PHOSPHORUS treatment.

It is essential to (as per WA DOE approval conditions):

- Adhere to the Design Guidelines, p.8
- Size the Filterra® unit correctly, using the regional Sizing Table, p.12-13
- Complete the Project Information Form (p.10) and submit with plans to Americast for review before permitting. THIS REVIEW IS MANDATORY as a DOE condition and for warranty to apply and helps ensure that each Filterra® system operates efficiently to maximize performance and minimize maintenance.

Other documents available on request include:

Technical Whitepaper	Scientific paper more fully explaining processes occurring within the system
Filterra Product Performance Data Summary	Data sheet providing the latest facts available
Third Party Data	Data presented by independent parties
Operation & Maintenance Manual	Owner's manual presenting technical and operational details.
Installation Manual	Instruction manual for proper installation.

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Section A

Essential Reading - Filterra Overview

Important!

Please remember to complete and send the Project Information Form (p.10) to Filterra® with plans for evaluation. This review is mandatory as proper placement ensures optimum performance and validates the product warranty.

Toll Free: (866) 349-3458
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design@filterra.com

www.filterra.com

Filterra® Overview
Stormwater Bioretention Filtration System

Save valuable space with small footprint for urban sites

Improve BMP aesthetics with attractive trees or shrubs

Reduce lifetime cost with safer and less expensive maintenance

Remove Pollutants and Comply with NPDES

Filterra® is well-suited for the ultra-urban environment with high removal efficiencies for many pollutants such as petroleum, heavy metals, phosphorus, nitrogen, TSS and bacteria. Filterra® is similar in concept to bioretention in its function and applications, with the major distinction that Filterra® has been optimized for high volume/flow treatment and high pollutant removal. It takes up little space (often only a 4'x4' unit for each mandatory catch basin) and may be used on highly developed sites such as landscaped areas, green space, parking lots and streetscapes. Filterra® is exceedingly adaptable and is the urban solution for Low Impact Development.

Stormwater flows through a specially designed filter media mixture contained in a landscaped concrete container. The filter media captures and immobilizes pollutants; those pollutants are then decomposed, volatilized and incorporated into the biomass of the Filterra® system's micro/macro fauna and flora. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged. Higher flows bypass the Filterra® via a downstream inlet structure, curb cut or other appropriate relief.

Expected Average Pollutant Removal Rates
(Ranges Varying with Particle Size, Pollutant Loading and Site Conditions)

TSS Removal	85%
Phosphorous Removal	60% - 70%
Nitrogen Removal	43%
Total Copper Removal	> 58%
Dissolved Copper Removal	46%
Total Zinc Removal	> 66%
Dissolved Zinc Removal	58%
Oil & Grease	> 93%

Design Guidelines for Using Filterra®

1. Do not place in a sump condition. The Standard Filterra® cannot be used as a stand alone inlet – it will need effective bypass during higher intensity rainfall events.

   Plans MUST show Filterra® Top Curb (TC) and Flow Line (FL) spot elevations and also bypass TC (where applicable) and bypass FL spot elevations.

   The Filterra® TC and FL elevations MUST be higher than the bypass TC and FL elevations for effective bypass. Use Drawing FLP-2 (p.27) as a detail on the project plans.

2. For proper trash collection ensure a minimum 4” and maximum 6” Filterra® throat opening depth and use Drawing CGT-5 (p.28) as a detail on the project plans.

3. Do not direct surface flow to the standard Filterra® in a “head-on” configuration. Refer to Guidelines GU1-A (p.16) and GU2 (p.17) for grading design that encourages flow to enter a Filterra® in a cross linear flow – left-to-right or right to-left in the gutter in front of the throat, as per a wet curb which prevents system damage. During extreme storm events the excess flow should continue past the Filterra® to a bypass inlet or other means of relief. Guideline GU3, Parking Lot Corners, shows common situations (p.18).

4. To calculate which size Filterra® is required, use the Quick Sizing Tables, appropriate to the project’s geographical region and target pollutants and then follow the WWHM instructions on (p.13) to ensure the 91% threshold is met. The maximum contributing drainage area will vary with site conditions and project locations. For further information relating to sizing, please contact Filterra.

5. To ensure correct installation, include the Standard Filterra® Plan Notes (p.29-30) on your Filterra® detail project sheet, as well as detailed drawings FLP-2 and CGT-5 (p.27,28).

6. Positive drainage of each Filterra® unit’s effluent treatment pipe is required to prevent free standing water from accumulating in the system or underdrain. This could occur due to tidal influences or improper connection of Filterra’s effluent pipe to a bypass structure or other outfall.

7. **Send plans and the completed Filterra® Project Information Form** (p.10) to Americast for Filterra® placement review. Plan sheets should include grading, drainage areas, stormwater schedules or profiles, landscape sheets and Filterra® detail sheets. THIS REVIEW IS MANDATORY for warranty to apply and helps ensure that each Filterra® system operates efficiently to maximize performance and minimize maintenance. Our staff also looks for value engineering opportunities.

Methods of sending information for review are as follows:

E-mail: design@filterra.com
AutoCAD or PDF files
Fax: (804) 798-8400
FTP Site: contact Filterra for details

Mail or other:
Filterra Review
11352 Virginia Precast Road
Ashland, VA 23005

Items Considered in Americast's Filterra® Plan Reviews

Following is a summary list of the items Americast considers during plan review. Plan sheets should include grading, drainage areas, stormwater schedules or profiles, landscape sheets and Filterra® details.

Notes

- Filterra® Structure Label or Identification Number
- Planned Filterra® Box Size
- Filterra® Contributing Drainage Area (not the bypass inlet Drainage Area)
- The C Factor for each individual Filterra® drainage area

Checks

- The planned Filterra® box size meets project's regional sizing specification
- Spot elevations (Top Curb & Flow Line) for Filterra® and bypass (TC & FL)
- The Filterra® spot elevations (TC & FL) are higher than bypass spot elevations
- The grading design encourages cross linear flow and not head-on flow
- Filterra® invert elevations are shown (3.5' below TC)
- Filterra® effluent treatment pipe invert elevations are higher than bypass structure or other out fall invert elevations
- The Filterra® outlet drain pipe is sized correctly
- The outlet drain pipe exits perpendicular to the Filterra® wall
- For any conflicting structures such as storm drain pipes below Filterra®
- For most efficient placement of Filterra® units
- Plans include Filterra® details listed below:

  FLP-2: Filterra® Typical Flow Line and Outlet Pipe Relationship

  CGT-5: Filterra® Throat Opening and Gutter or Flume Detail

  Filterra® Standard Plan Notes (2 pages)

Filterra® Project Information Form

PLEASE PRINT AND FAX OR EMAIL THIS FORM

12/09-v01- Western WA

Complete & send to Americast by email, fax or mail.

Address: 11352 Virginia Precast Road
Ashland, VA 23005

Toll Free: **(866) 349-3458**
Fax: (804) 798-8400
Email: design@filterra.com

filterra® Bioretention Systems

Project Information

Project Name/Number:
Regulatory Municipality and State (City, County, etc.):
Target Treatment Rate:
WWHM Gage:
WWHM Precipitation Factor:

Engineering Contact Information
Engineering Firm:
Contact:
Email:

Current Date:
Phone:
Fax:

Filterra® Details (Email, mail or fax plans to Americast - Acceptable formats are AutoCAD or pdf)
Plans sheets should include (1) cover, (2) grading, (3) drainage areas, (4) stormwater schedules or profile, (5) landscaping & (6) Filterra® details.

Filterra Structure #											
Filterra Size (ID ft)	Throat L x W										
Impervious Drainage Area	Acres										
Pervious Drainage Area	Acres										
Percent Filtered											
Filterra Spot Elevation	TC										
	FL										
	INV OUT										
Bypass Spot Elevation	TC										
	FL										
Bypass or Effluent	INV IN										
Modified Structure	Y/N?										
Grate or Top Options	Y/N?										

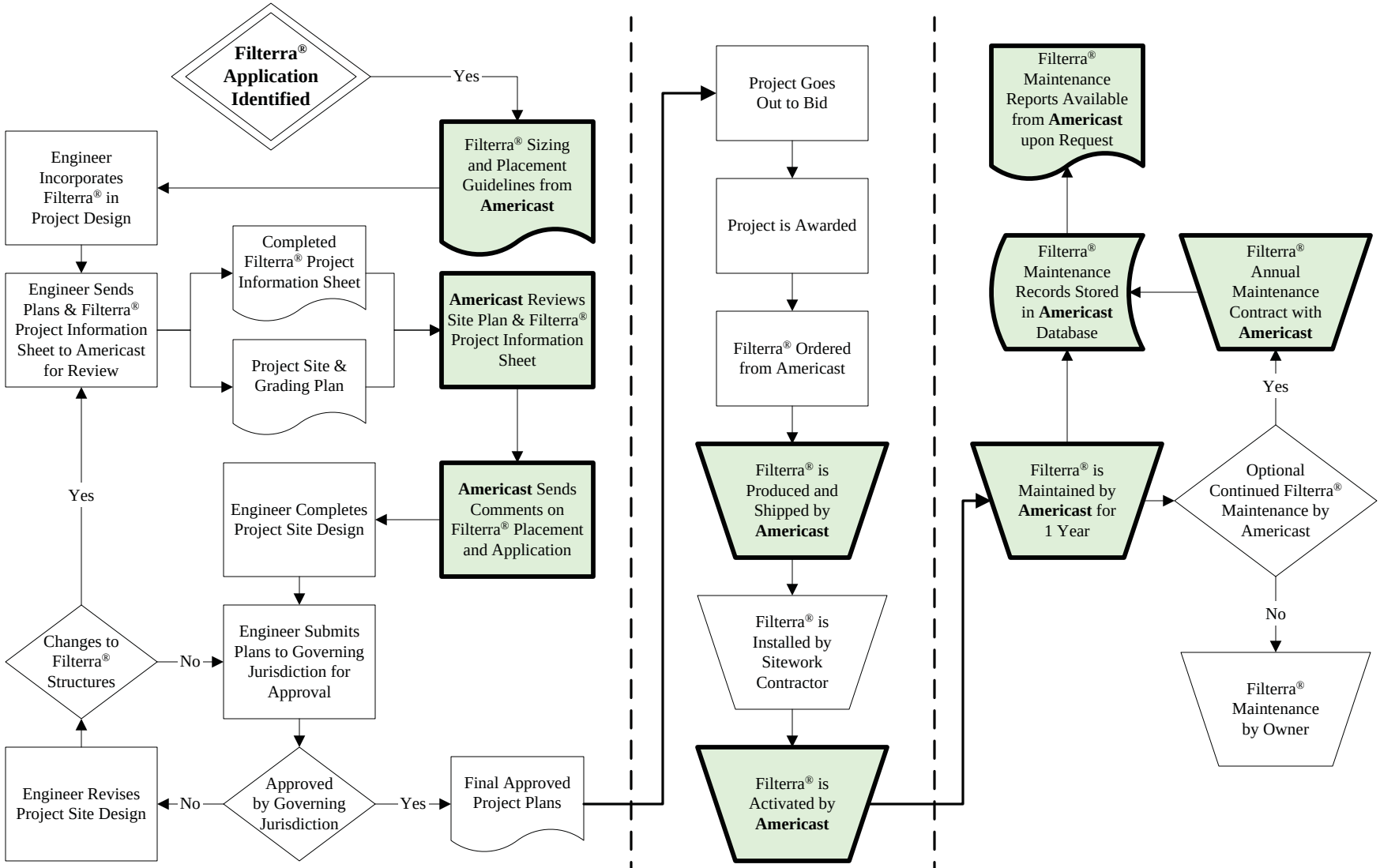
TC = Top Curb , FL = Flow Line

FLP Detail on plans (Y/N) ____

CGT Detail on plans (Y/N) ____

FT Plan Notes shown (Y/N) ____

Filterra® Project Process Flowchart - Design to Maintenance



Bold items indicate services provided by Americast.

01/04/05

Table 1: WWHM Sizing for **Basic Treatment** - TSS, Oil/Grease and Phosphorous* Treatment
Western Washington Region ONLY - v01a

Available Filterra® Box Sizes (feet)	Approximate Contributing Drainage Area (acres)
4 x 4	0.195
4 x 6 or 6 x 4	0.285
4 x 8 or 8 x 4	0.375
6 x 6	0.430
6 x 8 or 8 x 6	0.575
6 x10 or 10 x 6	0.720
6 x 12 or 12 x 6	0.865

* Conditional Use Level Designation.

Notes:

1. Sizing table intended for planning level use. The design engineer must use the latest version WWHM to calculate the appropriately sized facility.
2. Sizing table meets WA DOE 2005 Stormwater Manual's 91% annual stormwater volume filtered.
3. Sizing table based on WWHM3 parking/flat and the SeaTac rain gauge with a precipitation factor of 1.0. Other precipitation factors, geographic locations and site conditions will affect Filterra sizing.
4. Sand Filter (Filterra) parameters:
   - Filter material depth = 1.8 feet
   - Effective ponding depth = 0.75 feet
   - Zero slope(s) on the filter box
   - Riser height = 0.7 feet
   - Riser diameter = 100 inches
   - Filter Hydraulic Conductivity = 35.46 inches per hour
5. All boxes are a standard 3.5 feet depth (INV to TC).
6. A standard SDR-35 PVC pipe coupling is cast into the wall for easy connection to discharge drain.
7. Dimensions shown are internal. Please add 1' to each external (using 6" walls).
8. Valid for Basic (TSS), Oil/Grease and Total Phosporous Treatment regiments.
9. For sizing in other areas of Washington State please contact Filterra.

Table 2: WWHM Sizing for **Enhanced Treatment** - Dissolved Metals
Western Washington Region ONLY - v01a

Available Filterra® Box Sizes (feet)	Approximate Contributing Drainage Area (acres)
4 x 4	0.140
4 x 6 or 6 x 4	0.210
4 x 8 or 8 x 4	0.275
6 x 6	0.310
6 x 8 or 8 x 6	0.415
6 x10 or 10 x 6	0.520
6 x 12 or 12 x 6	0.630

Notes:

1. Sizing table intended for planning level use. The design engineer must use the latest version WWHM to calculate the appropriately sized facility.
2. Sizing table meets WA DOE 2005 Stormwater Manual's 91% annual stormwater volume filtered.
3. Sizing table based on WWHM3 parking/flat and the SeaTac rain gauge with a precipitation factor of 1.0. Other precipitation factors, geographic locations and site conditions will affect Filterra sizing.
4. Sand Filter (Filterra) parameters:
   - Filter material depth = 1.8 feet
   - Effective ponding depth = 0.75 feet
   - Zero slope(s) on the filter box
   - Riser height = 0.7 feet
   - Riser diameter = 100 inches
   - Filter Hydraulic Conductivity = 24.82 inches per hour
5. All boxes are a standard 3.5 feet depth (INV to TC).
6. A standard SDR-35 PVC pipe coupling is cast into the wall for easy connection to discharge drain.
7. Dimensions shown are internal. Please add 1' to each external (using 6" walls).
8. Valid for Enhanced Treatment regiments (Dissolved Zinc and Copper).
9. For sizing in other areas of Washington State please contact Filterra.

Steps to Sizing A Filterra® Bioretention System

1. Use the Filterra Design Assistance (DAKit)

2. Follow Filterra Guidelines on page 7 and 8 in DAKit

3. Open and run WWHM - In the “Site Information” window, select the appropriate county from the pull down menu in the upper left corner and then click on the project location on the map. Next, click the “General Project Information” button and build your drainage basin (usually <1 acre of impervious) with the “Mitigated” Scenario check box selected. Enter all pervious and impervious areas that direct runoff into the basin.

4. Connect your “basin” to the Sand Filter Element (Filterra)

5. Connect both interflow to the Filterra element.

6. Build Filterra using the Sand Filter module and enter the WWHM imputs as described on the following page.

7. Right click Sand Filter module to ensure the Filterra becomes the POC, Point of Compliance.

8. Ensure both OUTLET 1 and OUTLET 2 check boxes are selected when the POC screen appears.

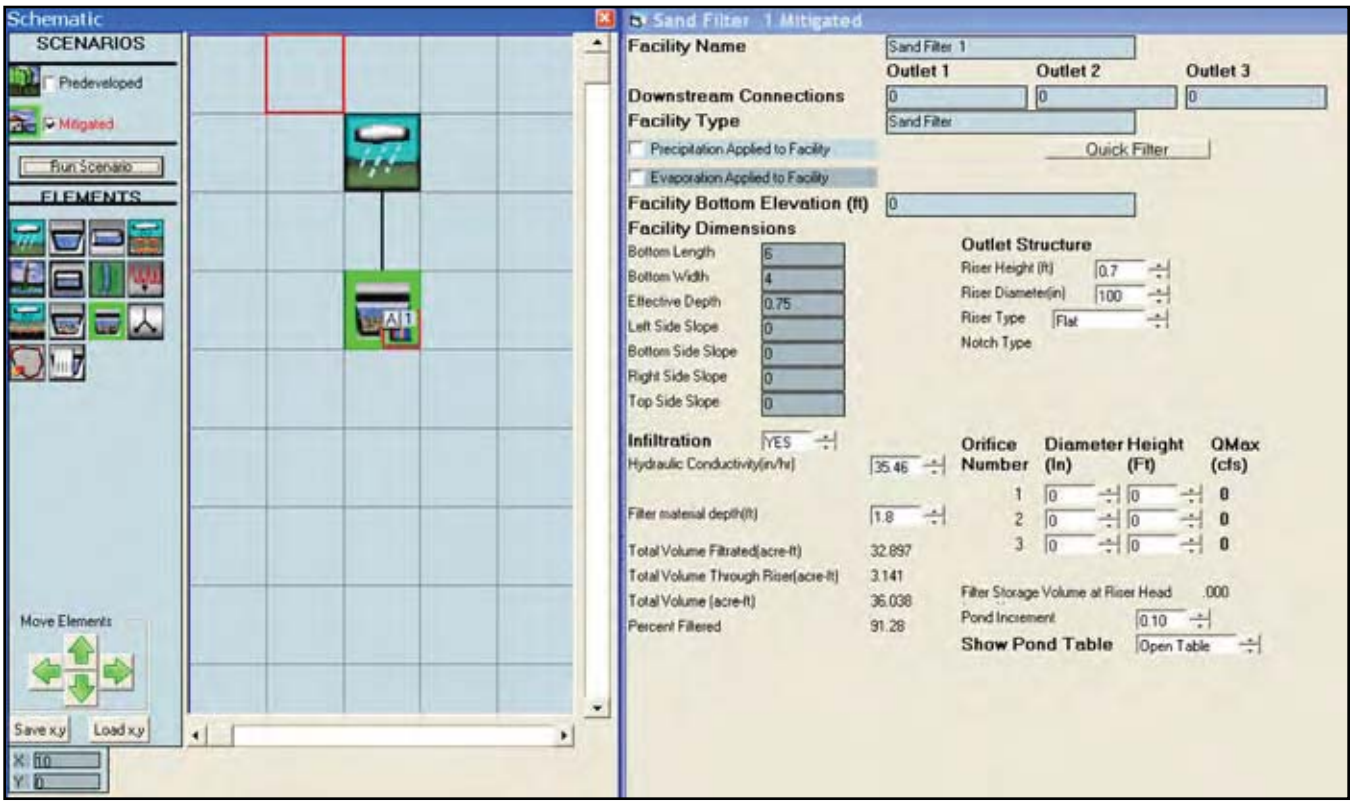
9. Click on the “Run Scenario” button and verify that the Percent Filtered is equal or greater then DOE’s 91% threshold for treated runoff (% of stormwater filtered through the Filterra).

10. Click the “Analysis” button and select the “Water Quality” tab.

11. Select the “701 IN flow to POC 1 Mitigated” dataset and click the “Run Analysis” button.

Send your Project Information Form, grading plan, drainage divides, profiles and cover sheet to **design@filterra.com**.

WWHM - Sand Filter/Filterra Inputs



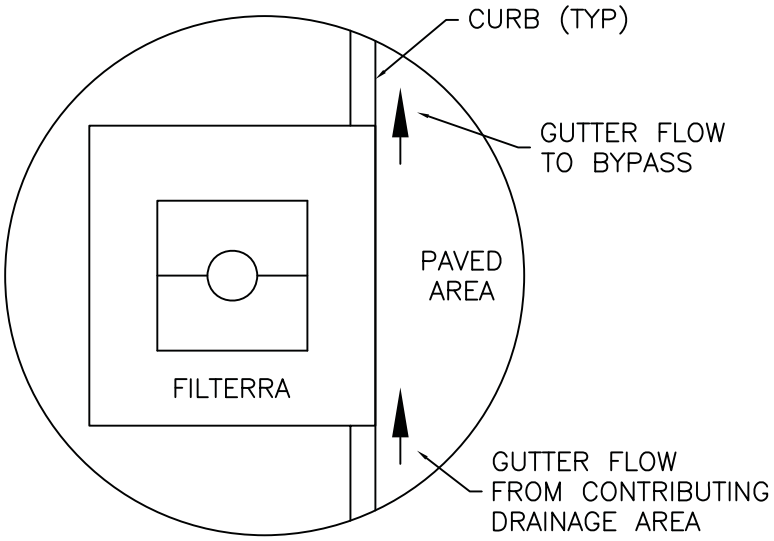
A. BMP Facility

- Bottom Length/Width = Filterra box size (choose from Filterra sizing table)
- Effective Depth (freeboard) = 0.75 feet (9 inches of freeboard)
- There is no slope to a square vault or box
- Hydraulic Conductivity = 35.46 in/hr (Basic) or 24.82 in/hour (Enhanced)
- Filter Material Depth = 1.80 feet

B. Outlet Structure (mimics the bypass CB)

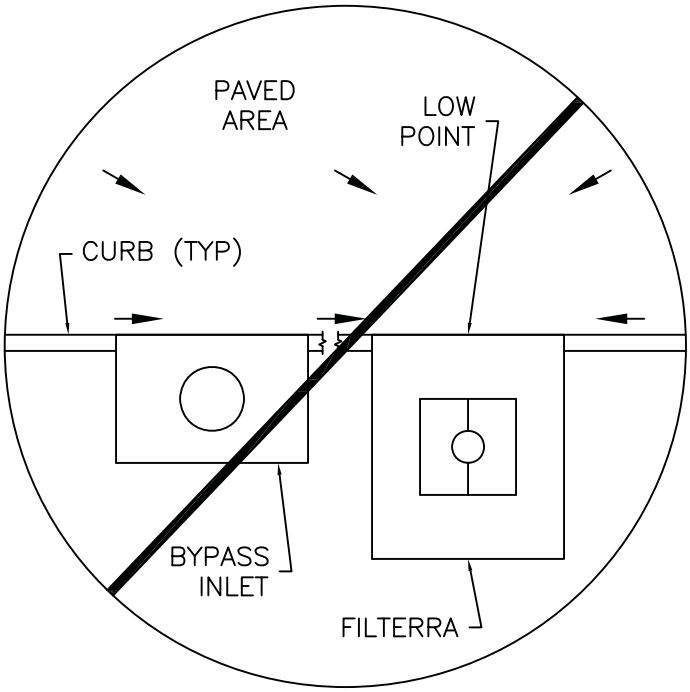
- Riser Height (lower than max. freeboard) = 0.7 feet
- Riser Diameter = 100 inches (no restrictions in flow)

GRADING AND GUTTER FLOW



GUTTER FLOW

GRADING AND CURB AND GUTTER SHOULD BE SUCH THAT GUTTER FLOW APPROACHES THE FILTERRA FROM ONE SIDE OF THE THROAT AND FLOWS AWAY FROM THE FILTERRA ON THE OPPOSITE SIDE DURING EXTREME STORM EVENTS. DESIGN OR INSTALLATION SUCH THAT FLOW APPROACHES FROM BOTH SIDES WILL RESULT IN SITE MAINTENANCE ISSUES AND VOID MANUFACTURER'S MAINTENANCE PROGRAM AND WARRANTY.



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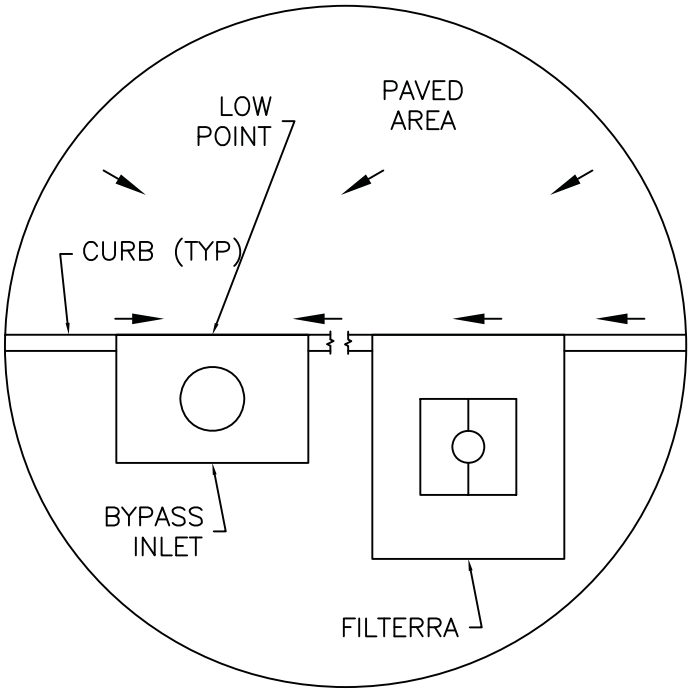

CORRECT

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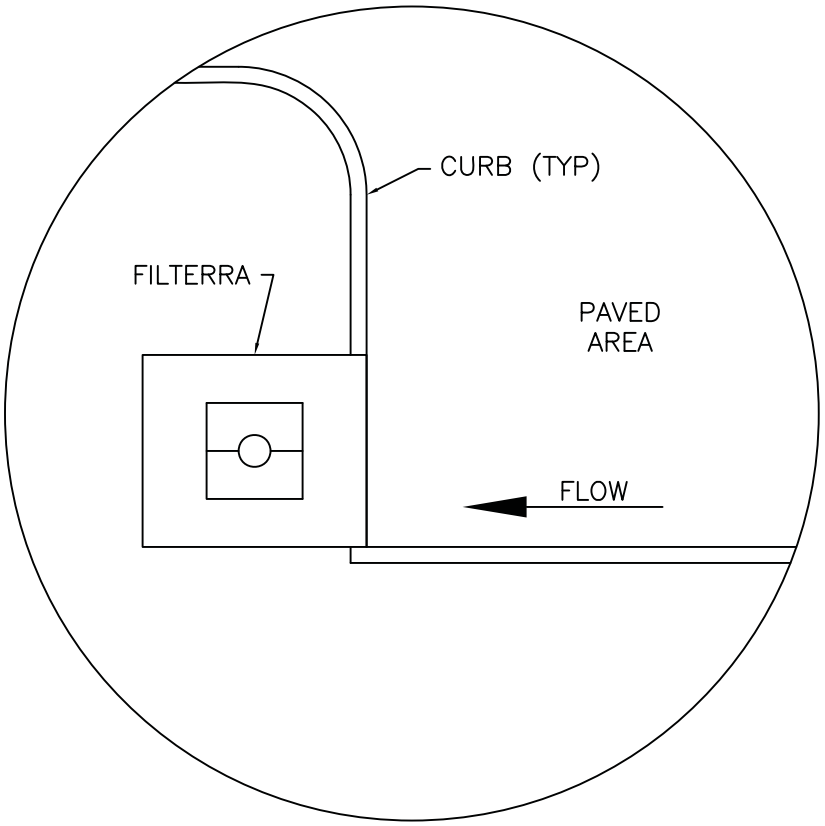
DATE: 03–03–05	DWG: GU1–A

FILTERRA® GUIDELINES
GRADING AND GUTTER FLOW

filterra®

US PAT 6,277,274
AND 6,569,321

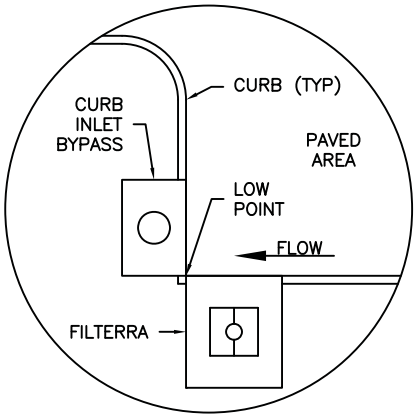
AVOID "HEAD-ON" GUTTER FLOW

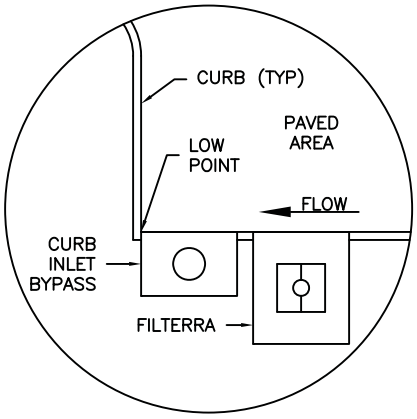


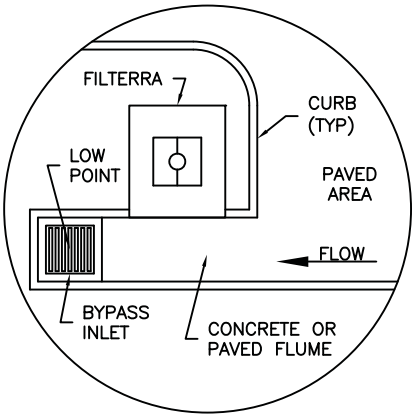
PROBLEM

FLOW FROM THE ADJACENT GUTTER HITS THE FILTERRA "HEAD–ON". THIS CAN CAUSE SYSTEM DAMAGE (MEDIA EROSION OR SUSPENSION). REGARDLESS OF WHETHER BYPASS IS PROVIDED THIS IS A PROBLEM SCENARIO.

GUTTER FLOW SHOULD APPROACH THE FILTERRA PARALLEL TO THE THROAT SO THAT WATER FLOWS IN A LINEAR PATTERN IN FRONT OF THE THROAT. DURING EXTREME STORM EVENTS, EXCESS WATER SHOULD CONTINUE TO FLOW IN FRONT OF THE FILTERRA TO A BYPASS INLET OR OTHER RELIEF.







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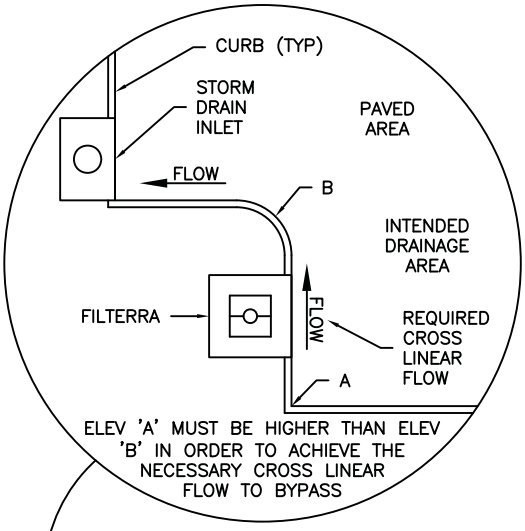
FILTERRA® GUIDELINES
AVOID "HEAD-ON" GUTTTER FLOW

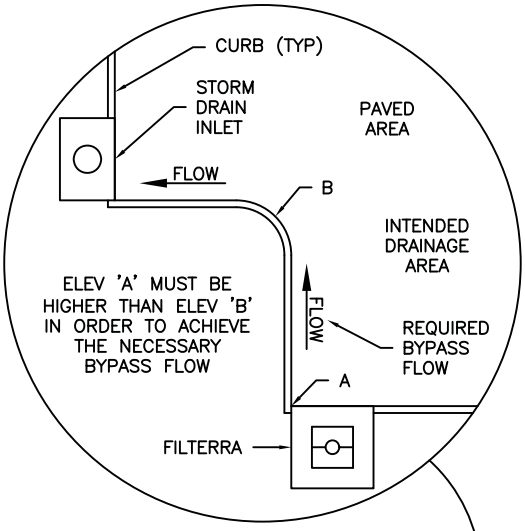
filterra®

US PAT 6,277,274 AND 6,569,321

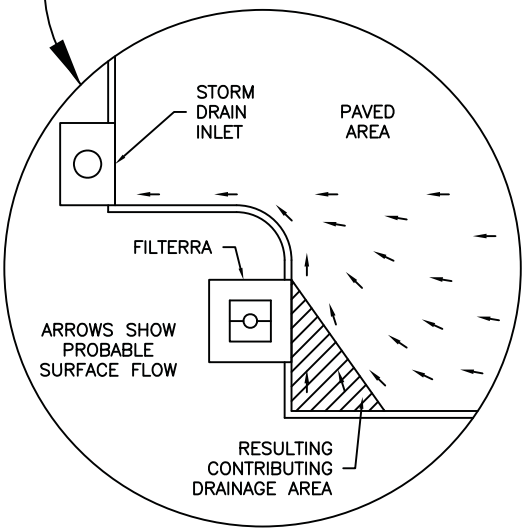
PARKING LOT CORNERS



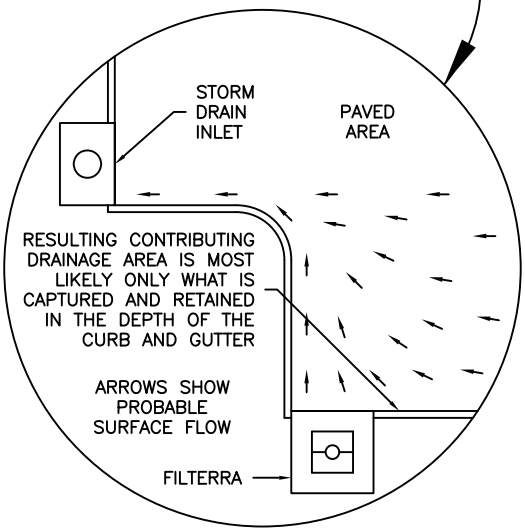
PLACEMENT



PLACEMENT



PROBLEM



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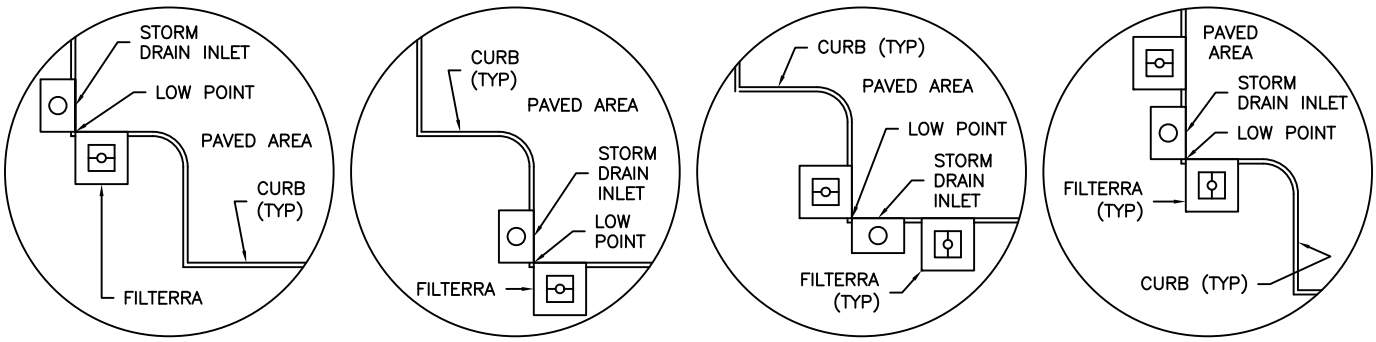

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POSSIBLE PLACEMENT SOLUTIONS

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FILTERRA® GUIDELINES
PARKING LOT CORNERS

filterra®

US PAT 6,277,274 AND 6,569,321

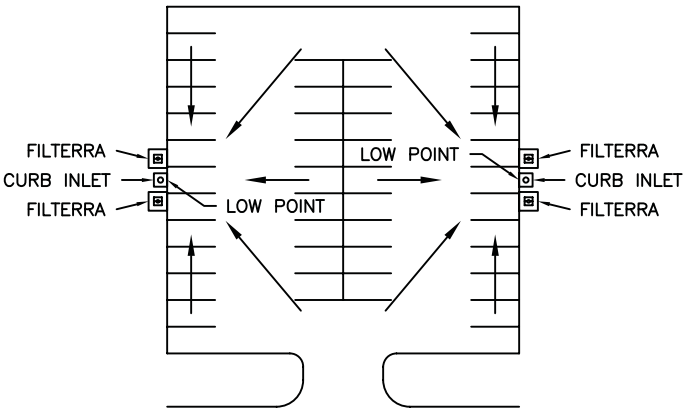
Section B

Filterra® Plans, Placement & Grading

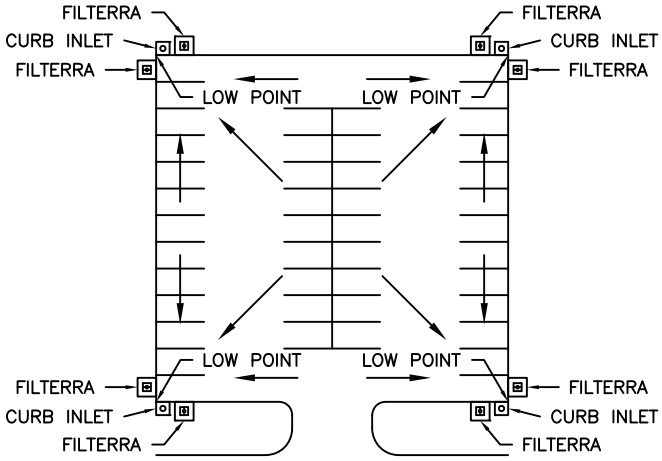
Scenario Ideas to Ensure
Maximum Efficiency &
Minimum Space Used

Toll Free: (866) 349-3458
Fax: (804) 798-8400
design@filterra.com

www.filterra.com

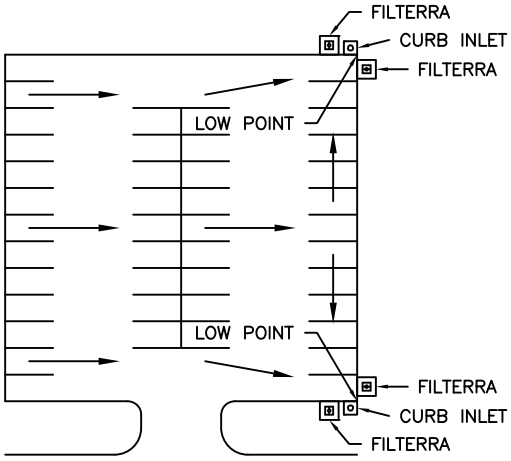


LOW POINTS AT 2 SIDES



LOW POINTS AT 4 CORNERS

ARROWS INDICATE DIRECTION OF SURFACE DRAINAGE FLOW



LOW POINTS AT 2 CORNERS

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DATE: 01–03–05 | DWG: PLG1

FILTERRA® EXAMPLE SCENARIOS

TYPICAL PARKING LOT APPLICATIONS

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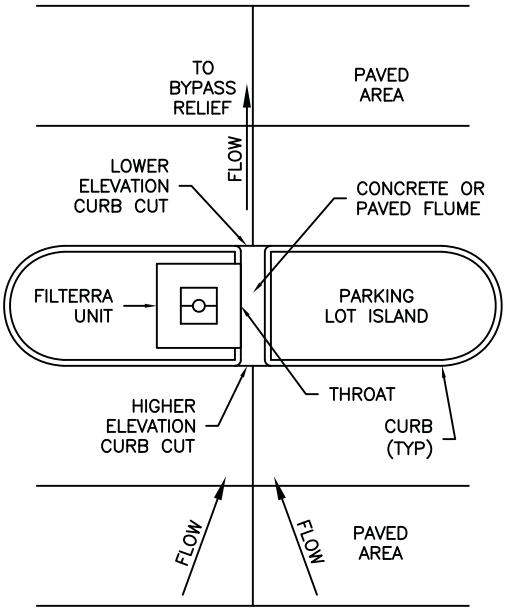
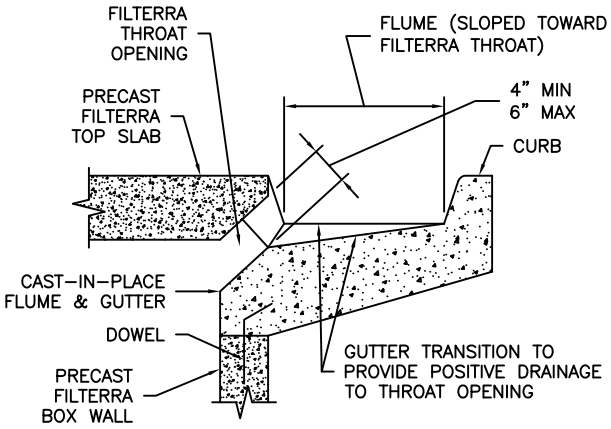
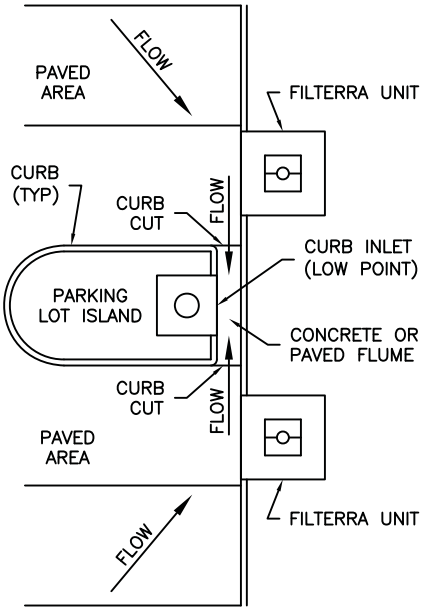
US PAT 6,277,274 AND 6,569,321



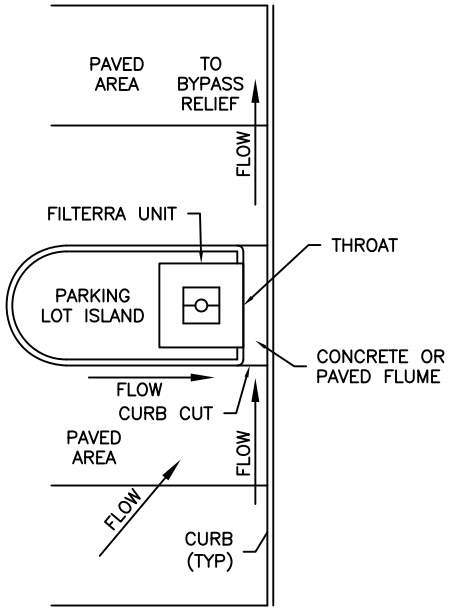
ON–GRADE ISLAND
IN OPEN PARKING LOT



SECTION VIEW OF FILTERRA
THROAT AND FLUME



LOW POINT ISLAND
AT SIDE OF PARKING LOT



ON–GRADE ISLAND
AT SIDE OF PARKING LOT

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FILTERRA® EXAMPLE SCENARIOS

PARKING LOT ISLAND APPLICATIONS

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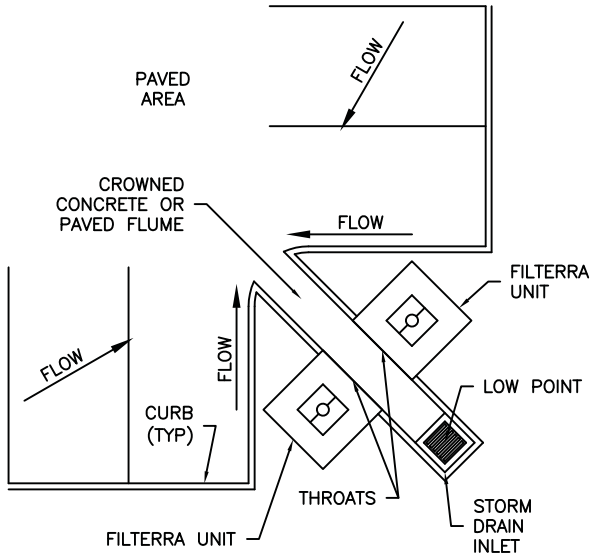
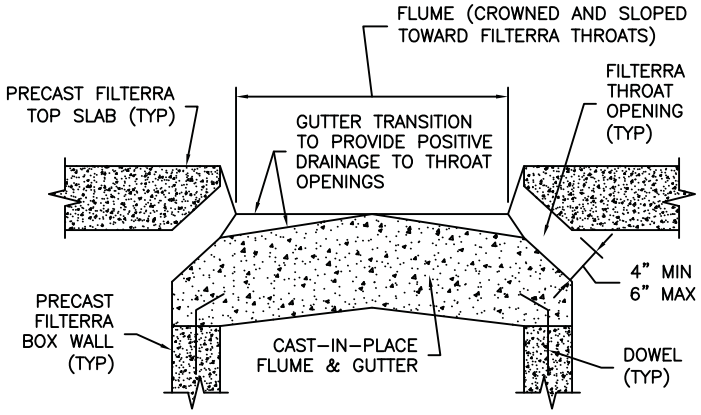
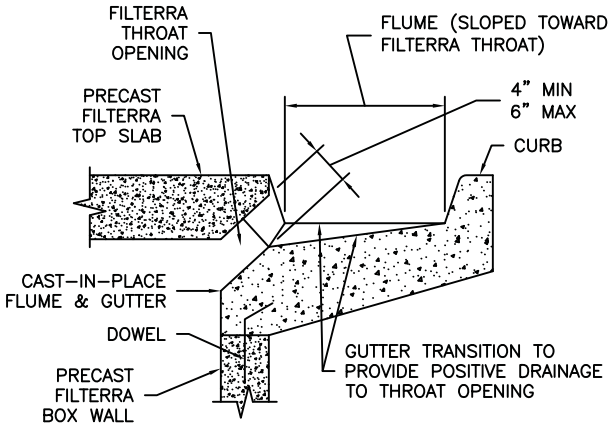


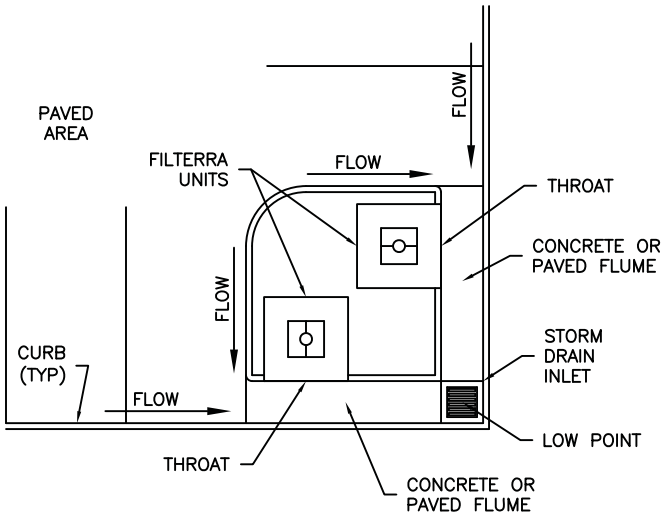
CROWNED FLUME CORNER



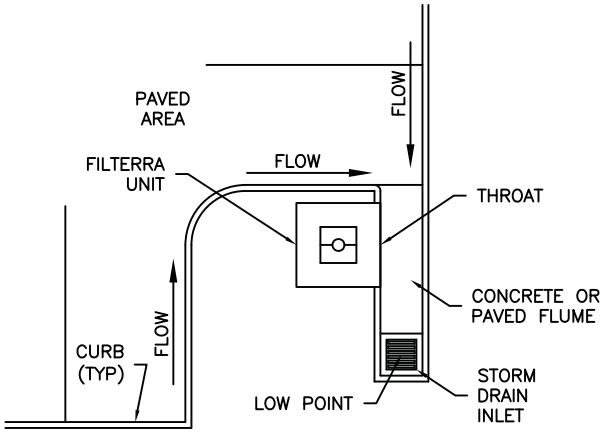
SECTION VIEW OF CROWNED FLUME



SECTION VIEW OF FILTERRA THROAT AND FLUME



TWO FLUME CORNER



ONE FLUME CORNER

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FILTERRA® EXAMPLE SCENARIOS

PARKING LOT CORNER APPLICATIONS

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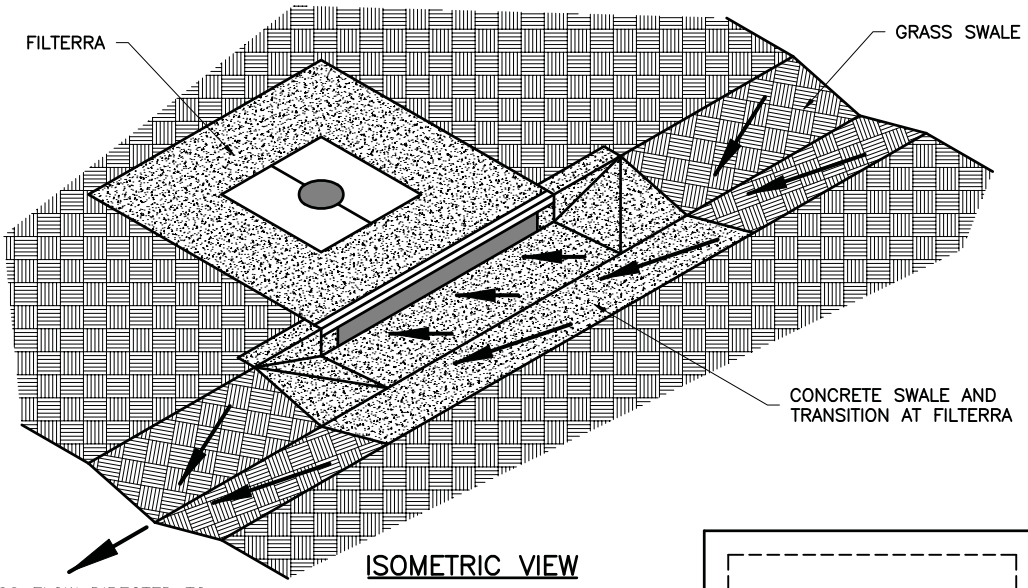
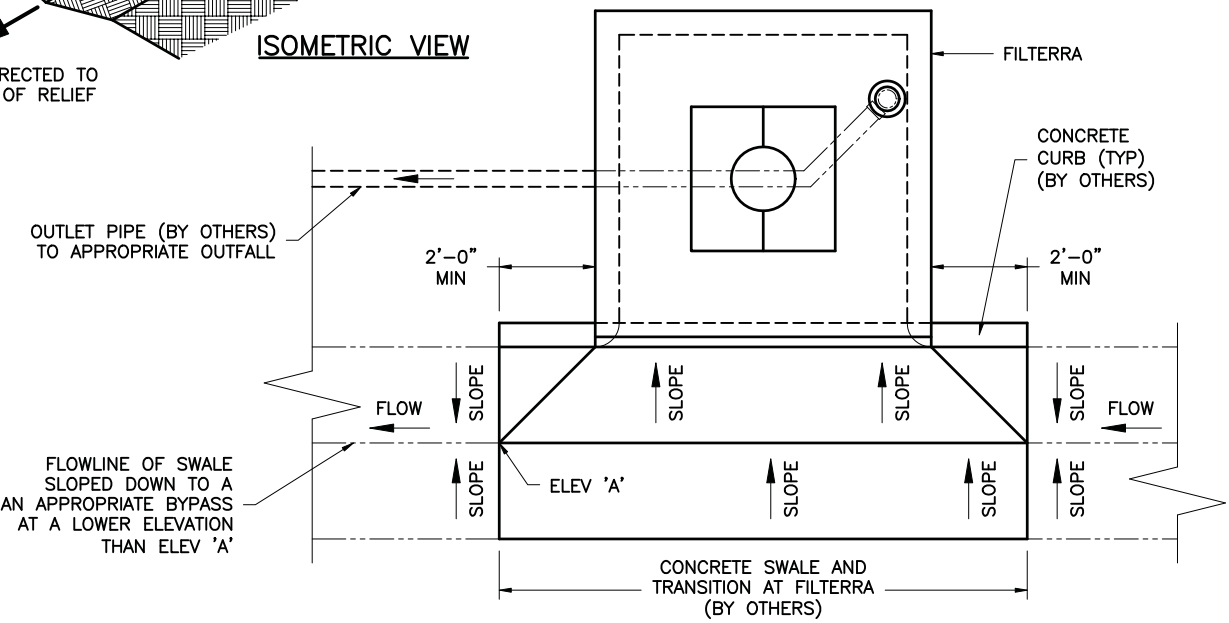
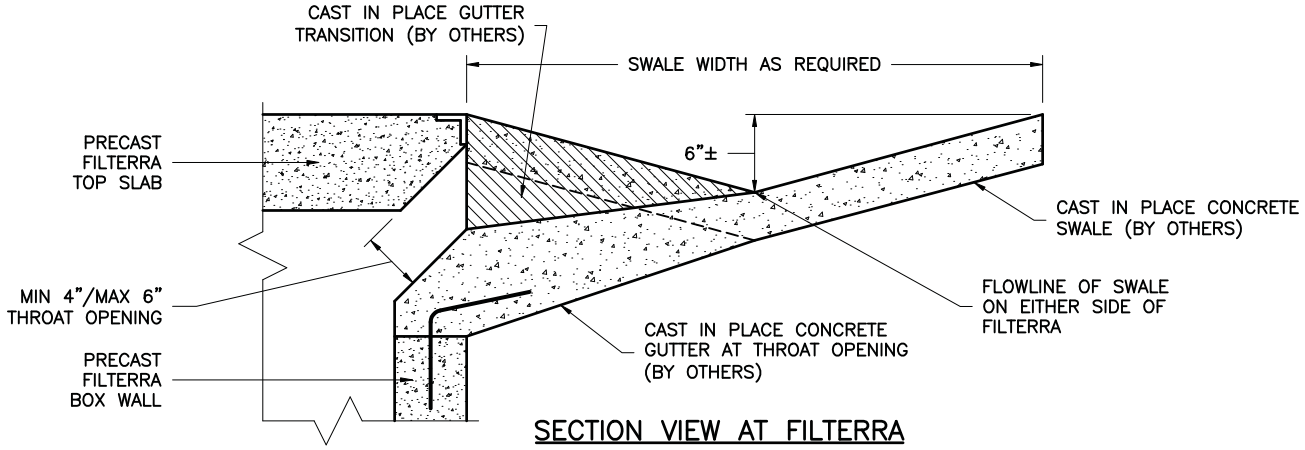


ISOMETRIC VIEW



PLAN VIEW



SECTION VIEW AT FILTERRA

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PRECAST FILTERRA® UNIT TYPICAL SWALE CONFIGURATION

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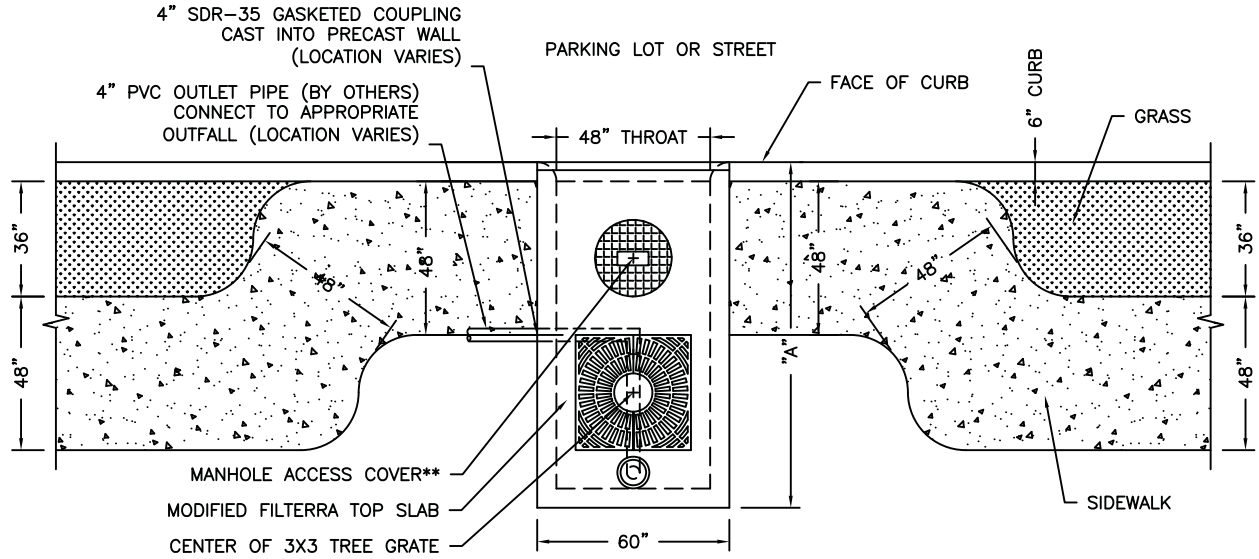


BOX SIZE	DIM. "A"	TREE GRATE	MANHOLE
4x8	9'–0"	3'x3'	YES
6x8	9'–0"	4'x4'*	YES
6x10	11'–0"	(1) 4'x4'	YES
6x12	13'–0"	(1) 4'x4'	YES

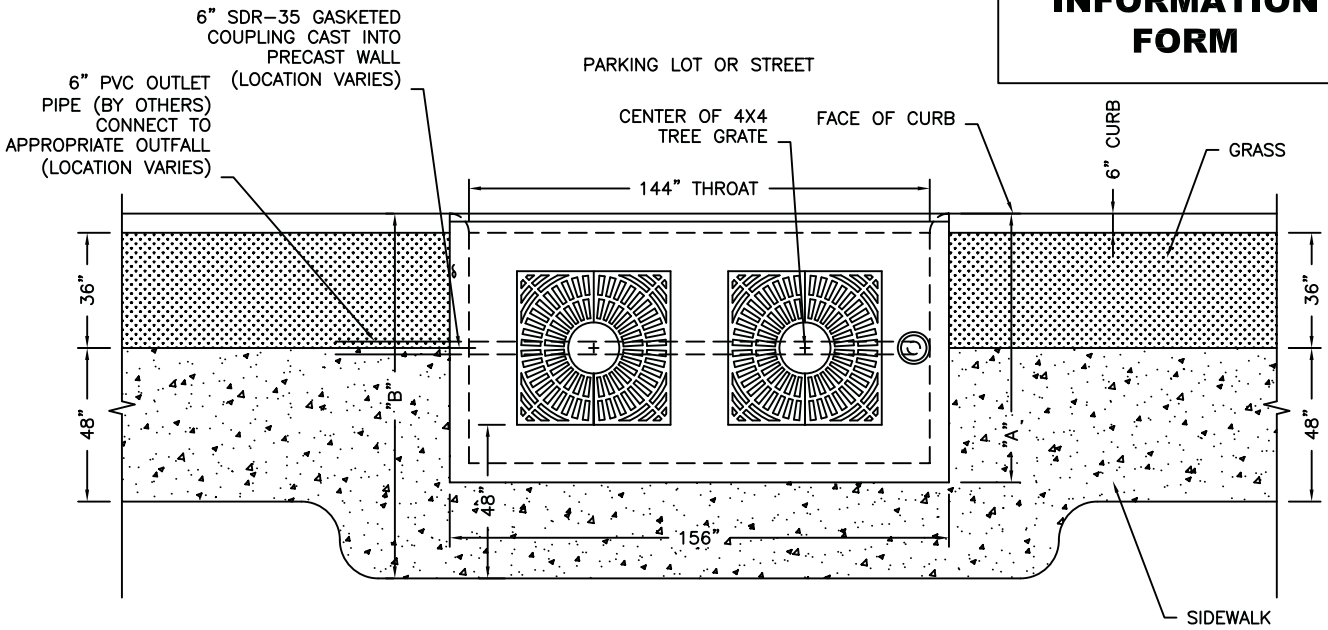
*3'x3' TREE GRATE IS OPTIONAL

**THE MANHOLE COVER IS REQUIRED ON SOME MODIFIED TOP SLABS FOR ACCESS DURING MAINTENANCE VISITS

MODIFIED NARROW LENGTH FILTERRA UNIT

ONLY FOR 4x8 (SHOWN) 6x8 AND 6x10 BOXES

PLEASE NOTE MODIFICATION ON PROJECT INFORMATION FORM



BOX SIZE	DIM. "A"	DIM. "B"	TREE GRATE
8x4	5'–0"	9'–0"	3'x3'
8x6	7'–0"	9'–0"	4'x4'
10x6	7'–0"	11'–0"	4'x4'*
12x6	7'–0"	13'–0"	4'x4'*

*3'x3' TREE GRATE IS OPTIONAL

STANDARD NARROW WIDTH FILTERRA UNIT

SUITABLE FOR ALL STANDARD BOXES

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TYPICAL FILTERRA® SIDEWALK CONFIGURATIONS WESTERN WASHINGTON

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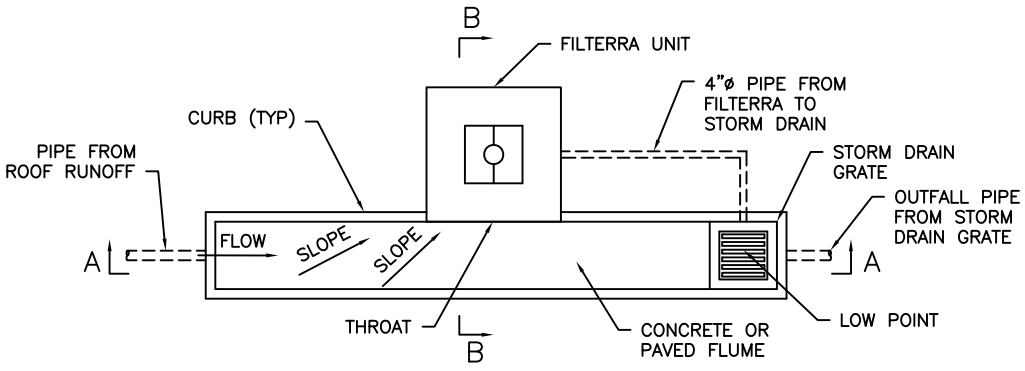
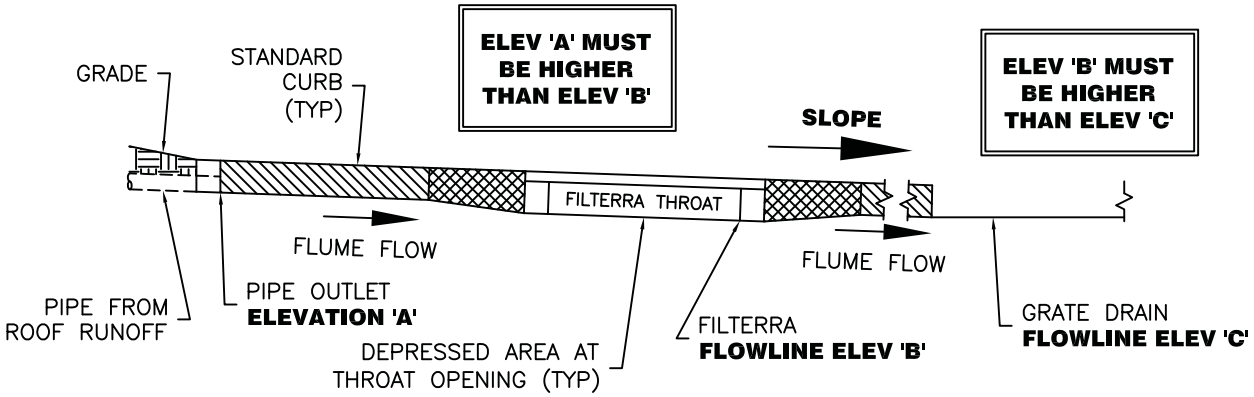
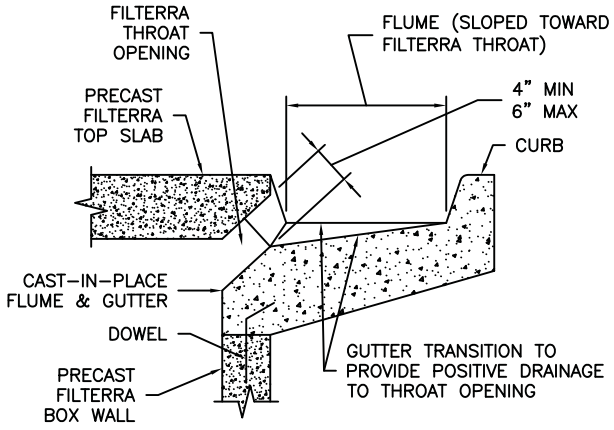
US PAT 6,277,274 AND 6,569,321



FLUME PLAN



FLUME CROSS SECTION A–A



FLUME SECTION B–B

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FILTERRA® EXAMPLE SCENARIOS

ROOF DRAIN FLUME APPLICATION

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Section C

Standard Filterra® Detail Drawings &
Filterra® Plan Notes

For TIF, PDF or CADD versions of these detail drawings, please contact Americast.
Toll Free: (866) 349-3458
E-mail: design@filterra.com

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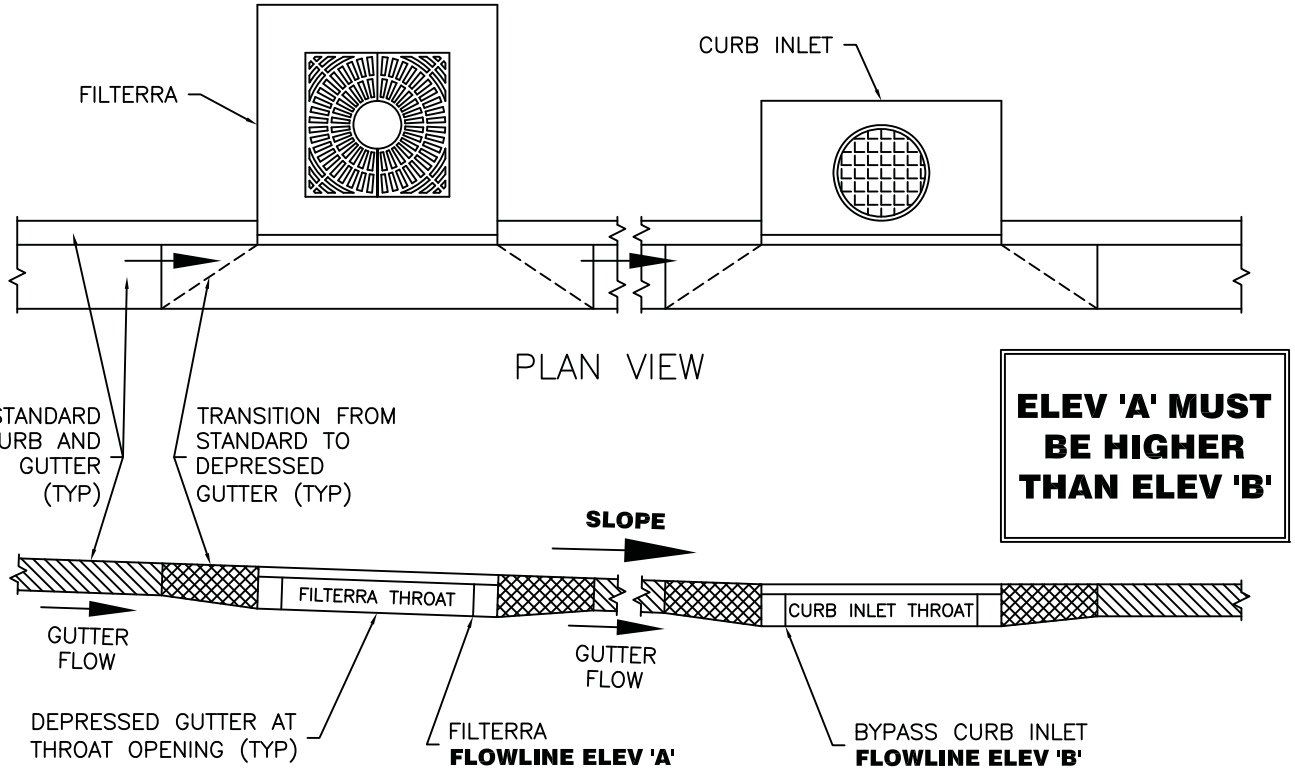
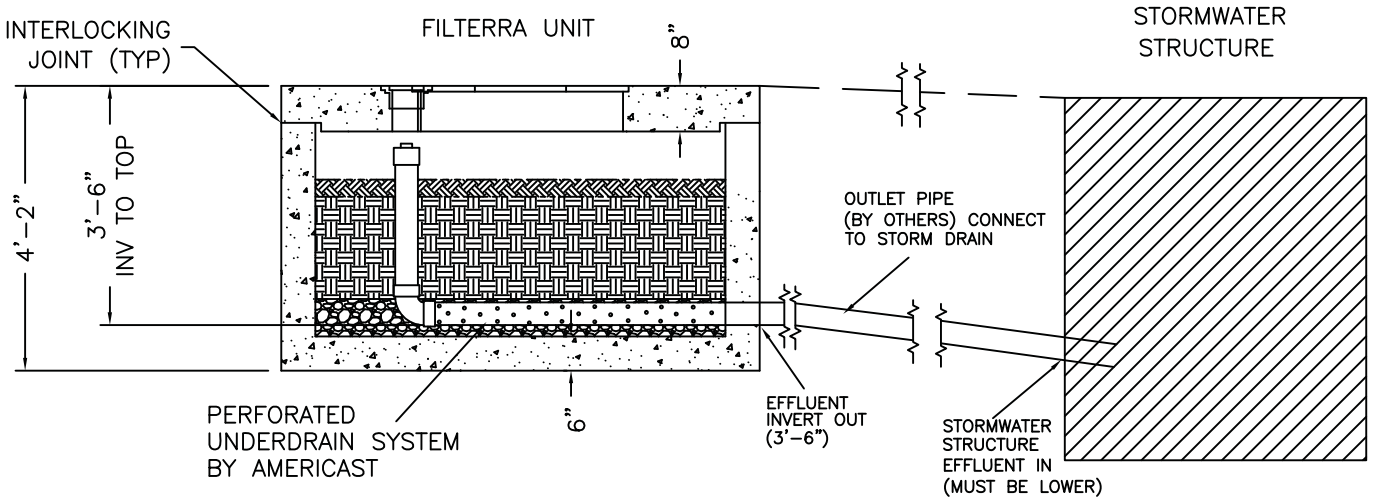
Filterra and Americast reserve the right to alter specifications without notice. Please make certain the Filterra Project Information Form is completed to ensure the verification of the latest specifications for your project.





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FILTERRA® TYPICAL FLOWLINE AND OULET PIPE RELATIONSHIP

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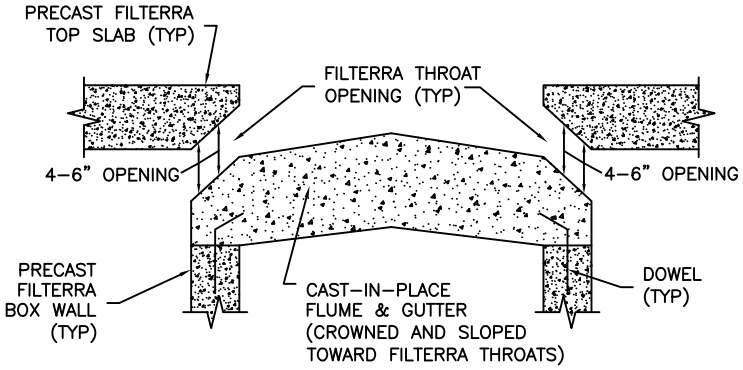
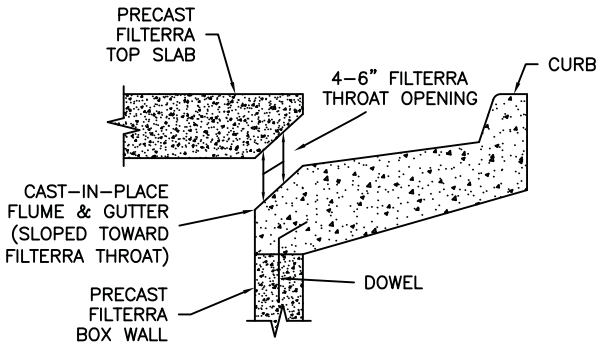
CROWNED FLUME

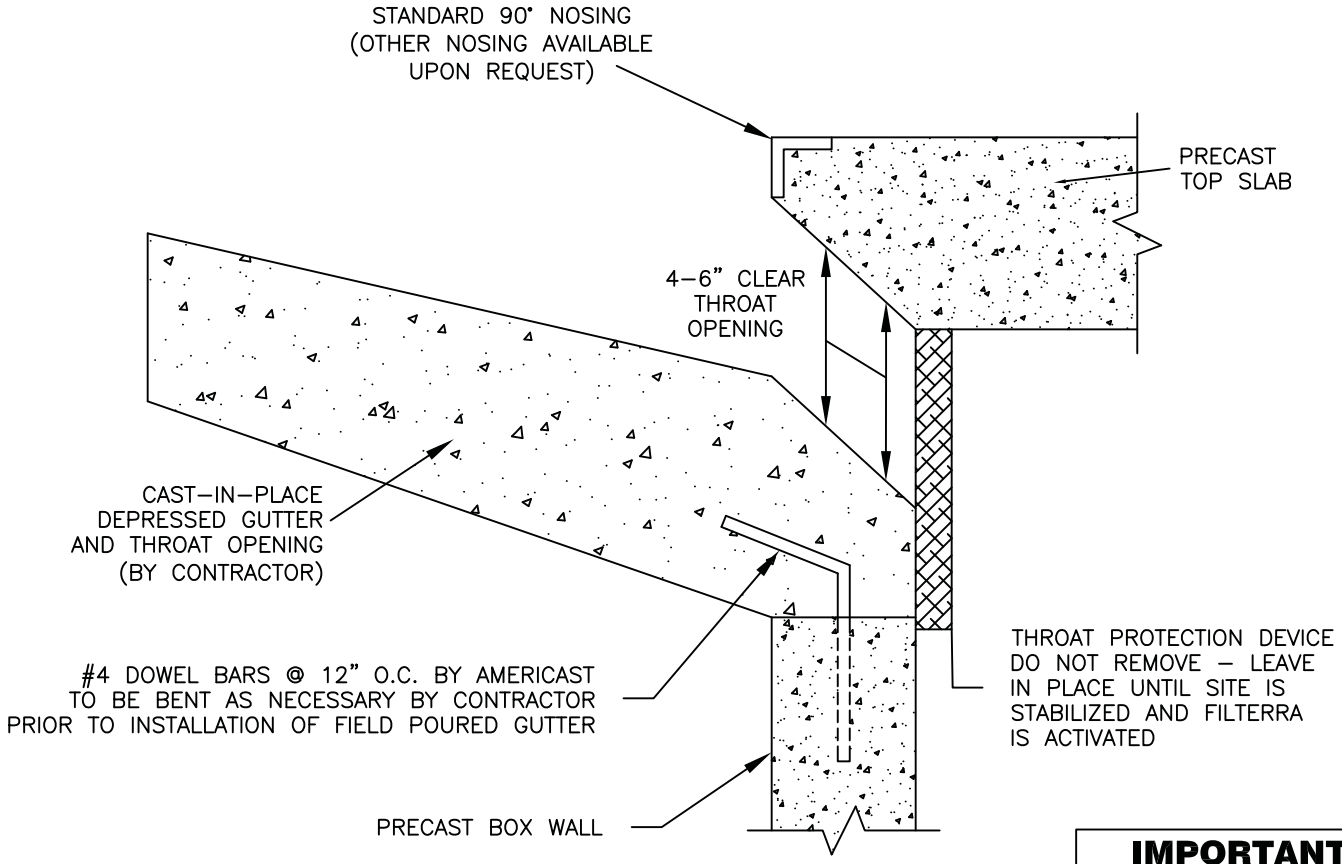


FLUME – SLOPED TOWARDS FILTERRA THROAT



SECTIONS VIEWS OF FILTERRA IN TYPICAL FLUME APPLICATIONS

SEE BELOW FOR DETAILS NOT SHOWN



SECTION VIEW
STANDARD FILTERRA THROAT OPENING

IMPORTANT

FILTERRA FLOWLINE MUST BE AT A HIGHER ELEVATION THAN BYPASS FLOWLINE (DROP INLET OR OTHER)

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FILTERRA® THROAT OPENING AND GUTTER OR FLUME DETAIL

filterra®

US PAT 6,277,274 AND 6,569,321

Filterra® Standard Plan Notes

Construction & Installation

A. Each unit shall be constructed at the locations and elevations according to the sizes shown on the approved drawings. Any modifications to the elevation or location shall be at the direction of and approved by the Engineer.

B. If the Filterra® is stored before installation, the top slab must be placed on the box using the 2x4 wood provided, to prevent any contamination from the site. All internal fittings supplied (if any), must be left in place as per the delivery.

C. The unit shall be placed on a compacted sub-grade with a minimum 6-inch gravel base matching the final grade of the curb line in the area of the unit. The unit is to be placed such that the unit and top slab match the grade of the curb in the area of the unit. Compact undisturbed sub-grade materials to 95% of maximum density at +1- 2% of optimum moisture. Unsuitable material below sub-grade shall be replaced to the site engineer's approval.

D. Outlet connections shall be aligned and sealed to meet the approved drawings with modifications necessary to meet site conditions and local regulations.

E. Once the unit is set, the internal wooden forms and protective mesh cover must be left intact. Remove only the temporary wooden shipping blocks between the box and top slab. The top lid should be sealed onto the box section before backfilling, using a non-shrink grout, butyl rubber or similar waterproof seal. The boards on top of the lid and boards sealed in the unit's throat must **NOT** be removed. The Supplier (Americast or its authorized dealer) will remove these sections at the time of activation. Backfilling should be performed in a careful manner, bringing the appropriate fill material up in 6" lifts on all sides. Precast sections shall be set in a manner that will result in a watertight joint. In all instances, installation of Filterra® unit shall conform to ASTM specification C891 "Standard Practice for Installation of Underground Precast Utility Structures", unless directed otherwise in contract documents.

F. The contractor is responsible for inlet protection/sediment control and cleaning around each Filterra unit.

G. Curb and gutter construction (where present) shall ensure that the flow-line of the Filterra® units is at a greater elevation than the flow-line of the bypass structure or relief (drop inlet, curb cut or similar). Failure to comply with this guideline may cause failure and/or damage to the Filterra® environmental device.

H. Each Filterra® unit must receive adequate irrigation to ensure survival of the living system during periods of drier weather. This may be achieved through a piped system, gutter flow or through the tree grate.

Activation

A. Activation of the Filterra® unit is performed ONLY by the Supplier. Purchaser is responsible for Filterra® inlet protection and subsequent clean out cost. This process cannot commence until the project site is fully stabilized and cleaned (full landscaping, grass cover, final paving and street sweeping completed), negating the chance of construction materials contaminating the Filterra® system. Care shall be taken during construction not to damage the protective throat and top plates.

B. Activation includes installation of plant(s) and mulch layers as necessary.

Included Maintenance

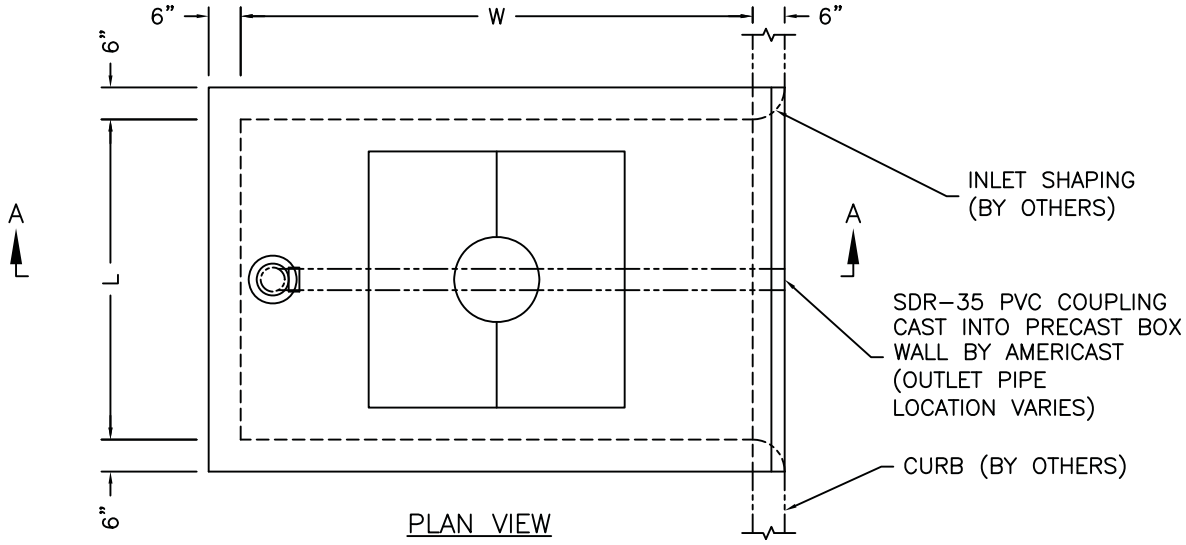
A. Each correctly installed Filterra® unit is to be maintained by the Supplier, or a Supplier approved contractor for a minimum period of 1 year. The cost of this service is to be included in the price of each Filterra® unit. Extended maintenance contracts are available at extra cost upon request.

B. Annual included maintenance consists of a maximum of (2) scheduled visits. The visits are scheduled seasonally; the spring visit aims to clean up after winter loads that may include salts and sands. The fall visit helps the system by removing excessive leaf litter.

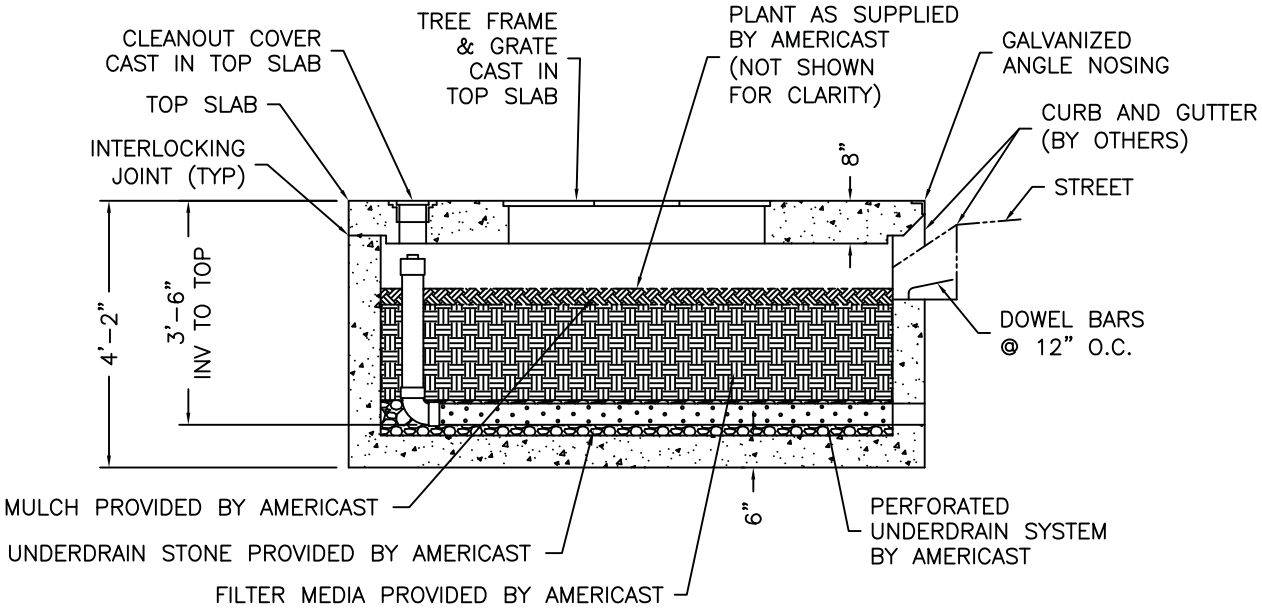
C. Each Included Maintenance visit consists of the following tasks.

1. Filterra® unit inspection
2. Foreign debris, silt, mulch & trash removal
3. Filter media evaluation and recharge as necessary
4. Plant health evaluation and pruning or replacement as necessary
5. Replacement of mulch
6. Disposal of all maintenance refuse items
7. Maintenance records updated and stored (reports available upon request)

D. The beginning and ending date of Supplier's obligation to maintain the installed system shall be determined by the Supplier at the time the system is activated. Owners must promptly notify the Supplier of any damage to the plant(s), which constitute(s) an integral part of the bioretention technology.



PLAN VIEW



SECTION A–A

DESIGNATION	L	W	TREE GRATE QTY & SIZE	OUTLET PIPE
4 x 6	4'–0"	6'–0"	(1) 3x3	4" SDR–35 PVC
4 x 8	4'–0"	8'–0"	(1) 3x3	4" SDR–35 PVC
6 x 8	6'–0"	8'–0"	(1) 4x4	4" SDR–35 PVC
6 x 10	6'–0"	10'–0"	(1) 4x4	6" SDR–35 PVC
6 x 12	6'–0"	12'–0"	(2) 4x4	6" SDR–35 PVC

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PRECAST FILTERRA® UNIT NARROW LENGTH CONFIGURATION WESTERN WASHINGTON

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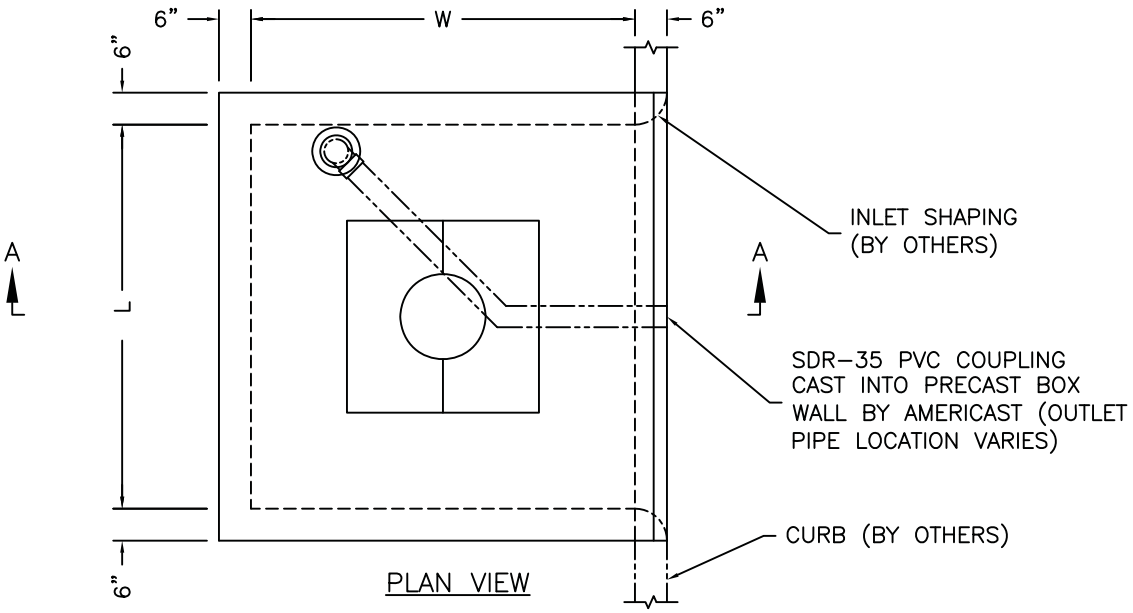
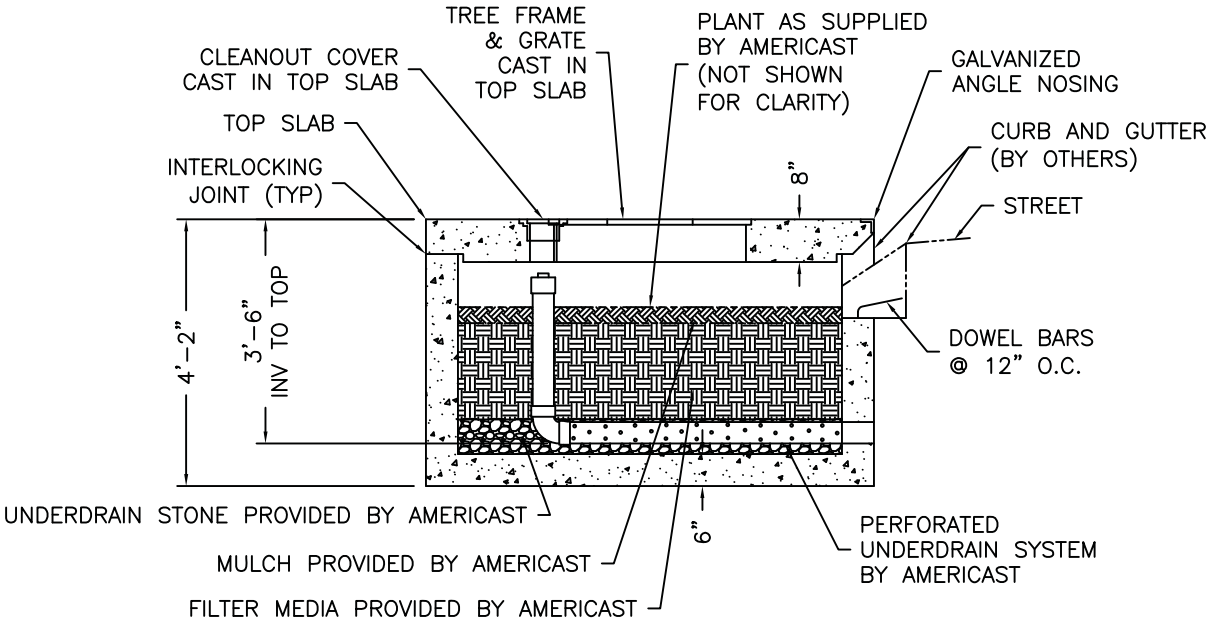


PLAN VIEW



SECTION A–A

DESIGNATION	L	W	TREE GRATE QTY & SIZE	OUTLET PIPE
4 x 4	4'–0"	4'–0"	(1) 3x3	4" SDR–35 PVC
6 x 6	6'–0"	6'–0"	(1) 3x3	4" SDR–35 PVC

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PRECAST FILTERRA® UNIT STANDARD CONFIGURATION WESTERN WASHINGTON

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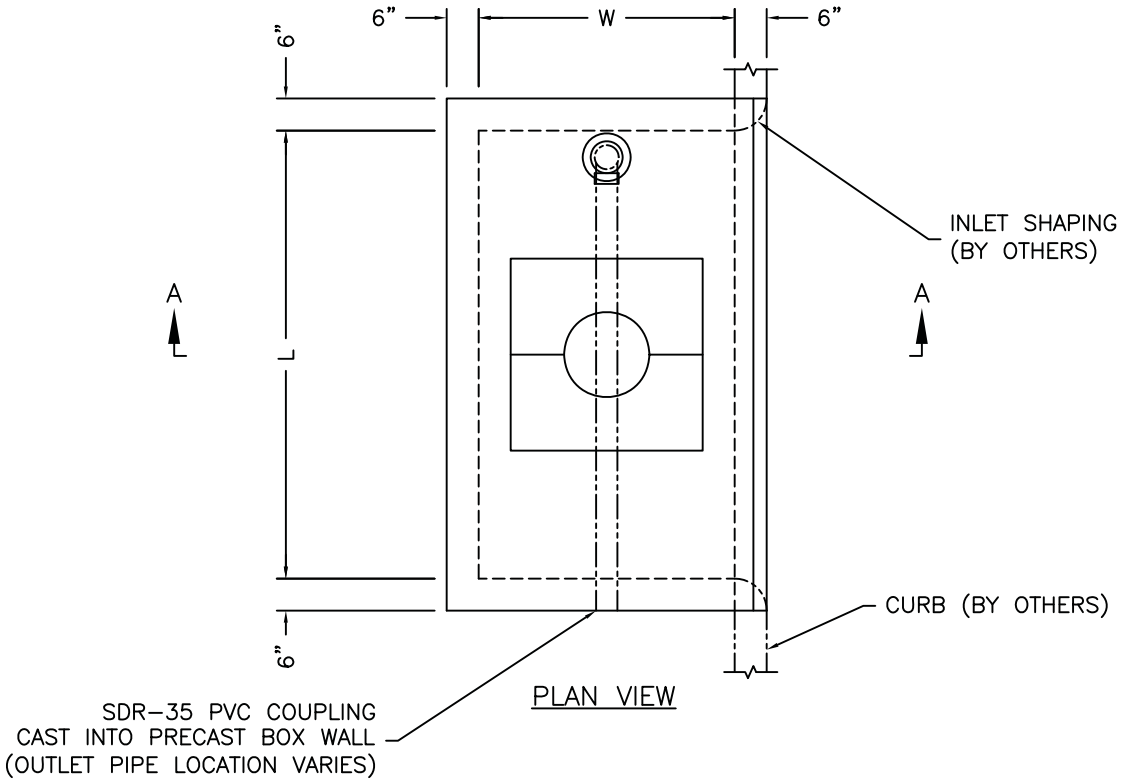
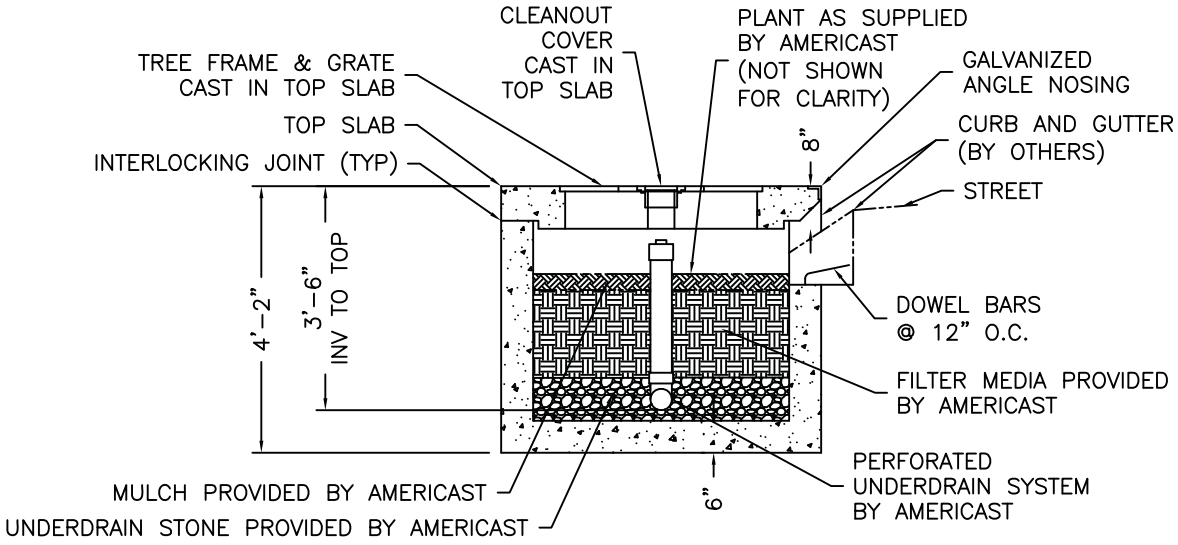


PLAN VIEW



SECTION A–A

DESIGNATION	L	W	TREE GRATE QTY & SIZE	OUTLET PIPE
6 x 4	6'–0"	4'–0"	(1) 3x3	4" SDR–35 PVC
8 x 4	8'–0"	4'–0"	(1) 3x3	4" SDR–35 PVC
8 x 6	8'–0"	6'–0"	(1) 4x4	4" SDR–35 PVC
10 x 6	10'–0"	6'–0"	(1) 4x4	6" SDR–35 PVC
12 x 6	12'–0"	6'–0"	(2) 4x4	6" SDR–35 PVC

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PRECAST FILTERRA® UNIT NARROW WIDTH CONFIGURATION WESTERN WASHINGTON

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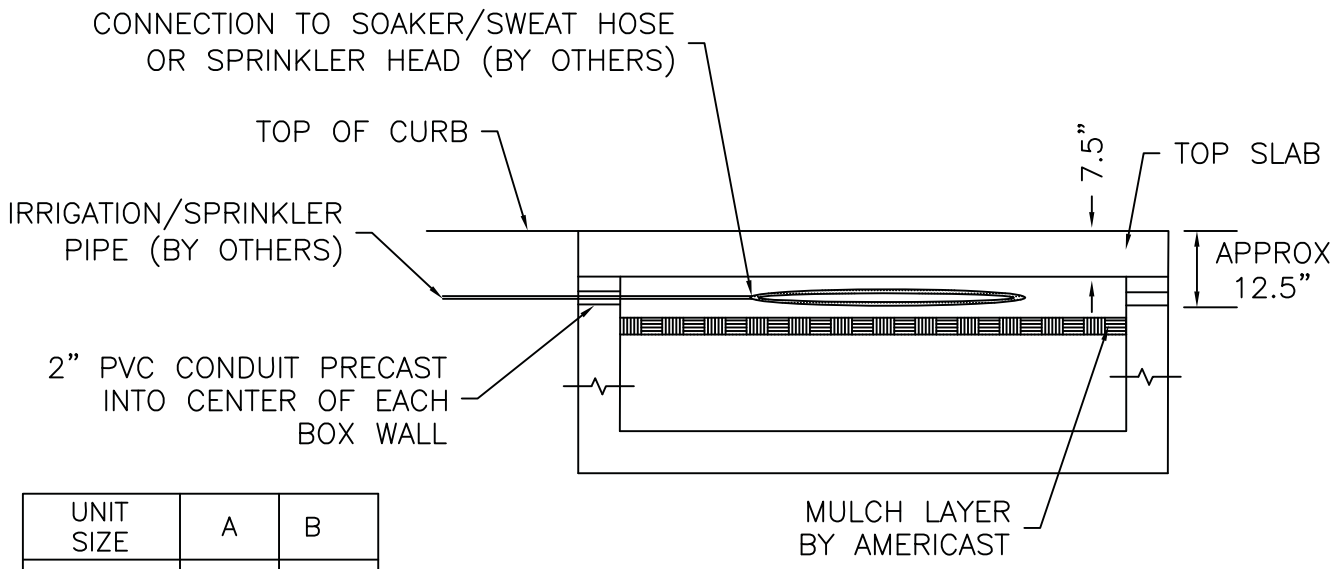
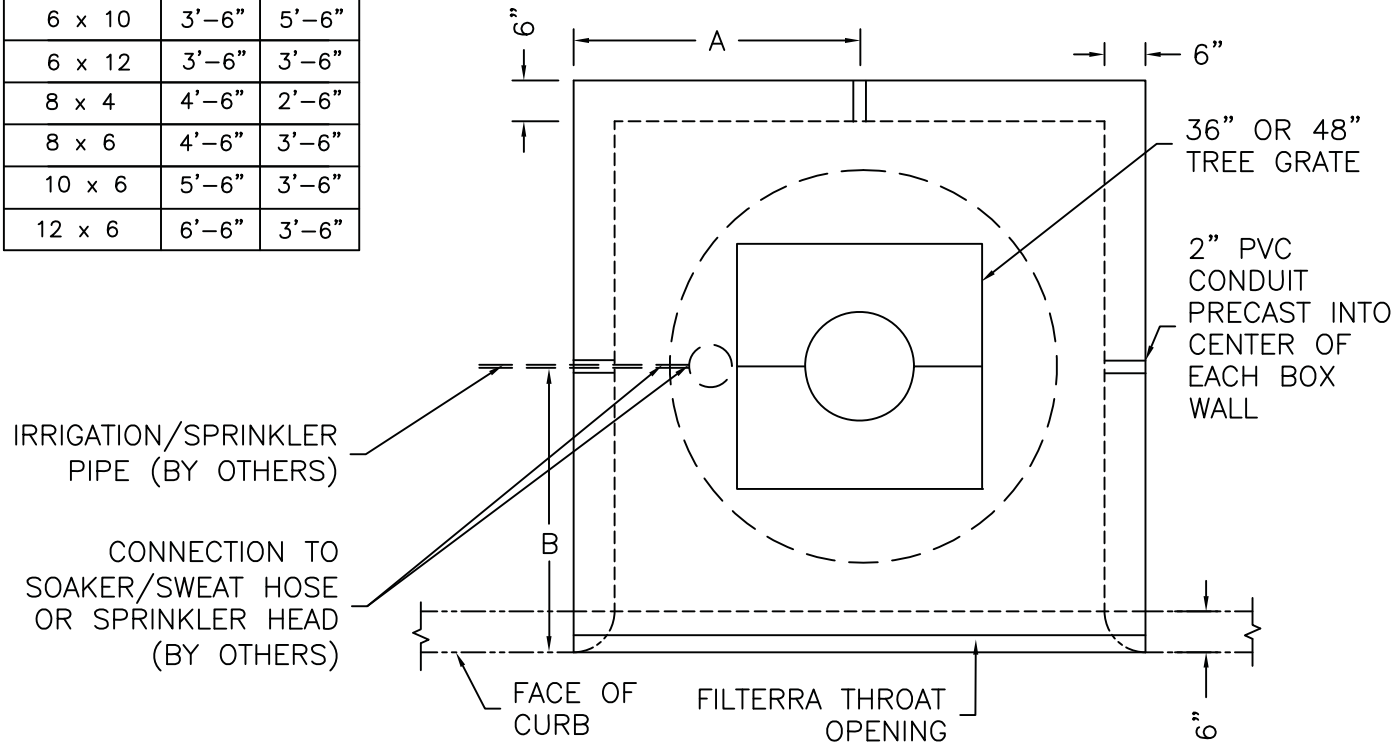


ELEVATION VIEW

UNIT SIZE	A	B
4 x 4	2'–6"	2'–6"
4 x 6	2'–6"	3'–6"
4 x 8	2'–6"	4'–6"
6 x 6	3'–6"	3'–6"
6 x 8	3'–6"	4'–6"
6 x 10	3'–6"	5'–6"
6 x 12	3'–6"	3'–6"
8 x 4	4'–6"	2'–6"
8 x 6	4'–6"	3'–6"
10 x 6	5'–6"	3'–6"
12 x 6	6'–6"	3'–6"



PLAN VIEW

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FILTERRA® IRRIGATION PLANNING LAYOUT WESTERN WASHINGTON

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Section D

Filterra® Technical Section

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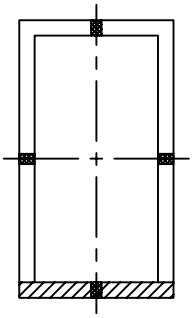
www.filterra.com



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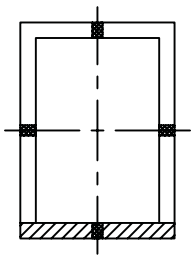

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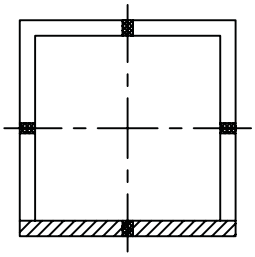

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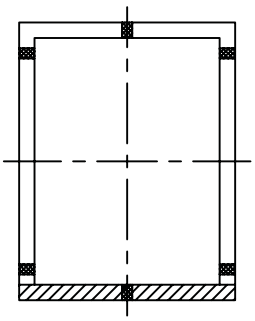

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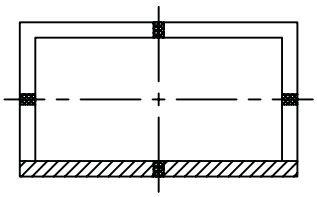

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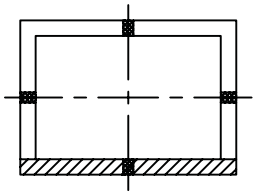

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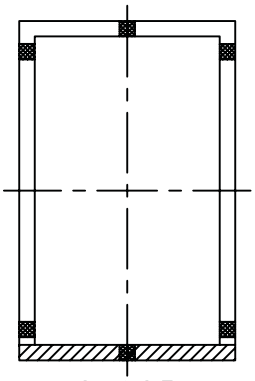

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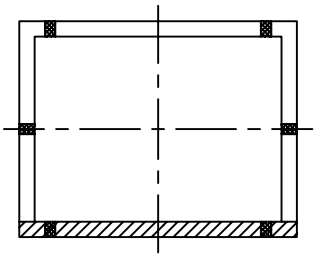

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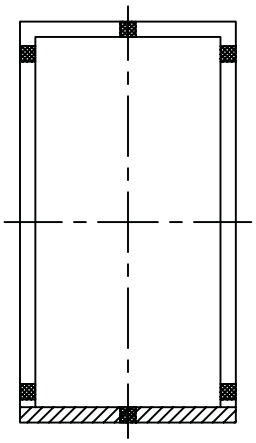

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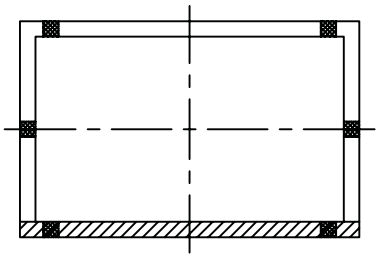

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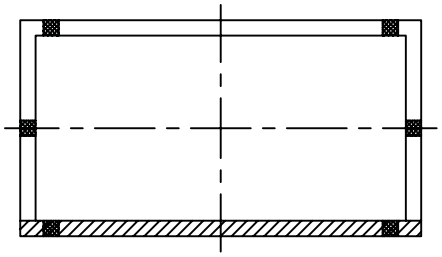
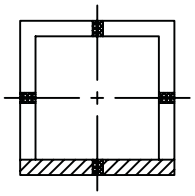


12x6B



4x4B

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DATE: 12-09-09 | DWG: WWA FTOPC-3

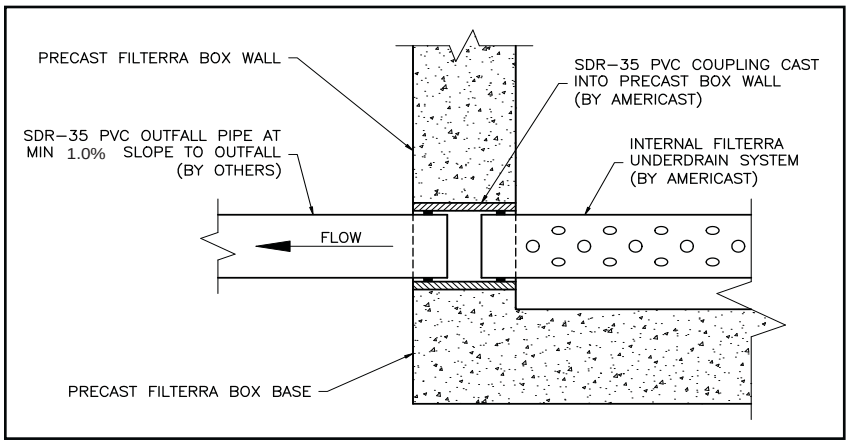
FILTERRA® PVC OUTLET PIPE COUPLING LOCATIONS WESTERN WASHINGTON

filterra®

US PAT 6,277,274 AND 6,569,321

Filterra® Piping Technical Details

Filterra® is supplied with an internal underdrain system that exits a wall in a perpendicular direction. Most efficient drainage is accomplished when the drain exits on the lower side of the Filterra®, i.e. nearest the overflow bypass. This is more important when using the larger sized Filterra® Systems.



Drawing DP1: Section View through Filterra Precast Box Wall at Outfall Pipe Connection

All units are supplied with the drainage pipe coupling precast into the wall, at a depth of 3.50 feet (INV to TC). Drawing DP1 is a detail of the coupling. The coupling used is SDR-35 PVC.

Typically, a minimum slope of 1.0% is adequate to accommodate the flow of treated water from the Filterra®, but each site may present unique conditions based on routing of the outfall pipe (elbows). The pipe must not be a restricting point for the successful operation of Filterra®. All connecting pipes must accommodate freefall flow. Table 3 lists WA DOE approved treatment sizing flow rates of the various size Filterra® units. A safety factor of at least two should be used to size piping from the Filterra based on these conservative approved treatment flow rates.

Table 3: Filterra WA DOE Approved Treatment Flow Rates for WA Sizing & Pipe Details

Important Note: Actual flow rate may be more than double rates below.

Filterra® Size (feet)	Expected Flow Rate (cubic feet/second)	Connecting Drainage Pipe
4x4	0.019	4” SDR-35 PVC
4 x 6 or 6 x 4	0.028	4” SDR-35 PVC
4 x 8 or 8 x 4	0.037	4” SDR-35 PVC
6 x 6	0.042	4” SDR-35 PVC
6 x 8 or 8 x 6	0.056	4” SDR-35 PVC
6 x 10 or 10 x 6	0.069	6” SDR-35 PVC
6 x 12 or 12 x 6	0.083	6” SDR-35 PVC

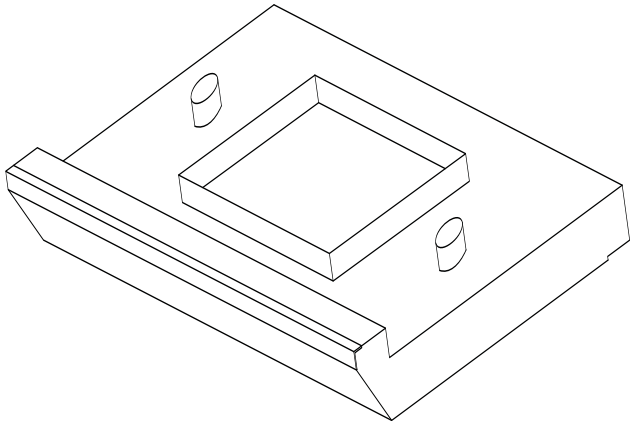
Filterra® Modified Options: Recessed Tops

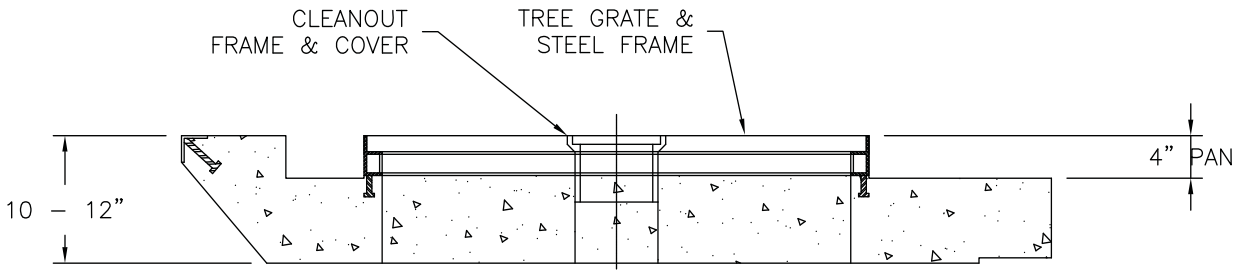
Modified recessed top with mulch

Filterra® modified recessed tops allow a seamless integration using pavers, mulch or sod.

NOTE: Modified recessed tops increase the depth of the Filterra® invert out.

Modified recessed top prior to shipping





Filterra® Modified Options: Ornamental Grates

Modified colored grates are plastic coated to reduce corrosion. All grates are available in 36” and 48”. Some modified grates may not be ADA compliant. For additional options please call (866) 349-3458.

FT Radial
Color Choices: ■ Black ■ Green

FT New Orleans
Color Choices: ■ Black ■ Green

UA Standard Flat

UA Title-24

UA OT Title- 24

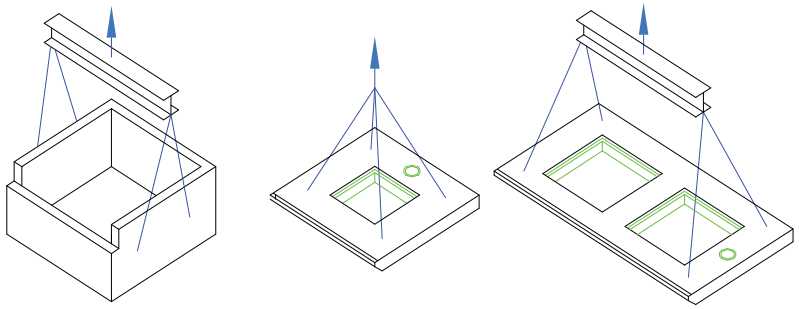
UA Chinook

Americast Filterra Weights and Lifting Details

Western Washington

				Top Only			Box + Media			*Spreader Bar	
				Pounds	Tons		Pounds	Tons		Min	Max
4'-0" Throat		4x4		1,482	0.74		7,570	3.78		4.67 ft	7.17 ft
		4x6		2,618	1.31		11,613	5.81		4.83 ft	7.33 ft
		4x8		3,829	1.91		15,996	8.00		5.00 ft	7.50 ft
6'-0" Throat		6x4		2,385	1.19		11,483	5.74		5.33 ft	7.33 ft
		6x6		**3,758**	**1.88**		**14,186**	**7.09**		**6.67 ft**	**8.67 ft**
		6x8		4,589	2.29		19,014	9.51		6.67 ft	8.67 ft
		6x10		6,242	3.12		24,801	12.40		6.83 ft	8.83 ft
		6x12		6,825	3.41		30,847	15.42		7.00 ft	9.00 ft
8'-0" Throat		8x4		3,787	1.89		15,686	7.84		5.50 ft	7.50 ft
		8x6		4,568	2.28		18,911	9.46		7.17 ft	9.17 ft
10'-0" Throat		10x6		6,199	3.10		24,446	12.22		7.33 ft	9.33 ft
12'-0" Throat		12x6		6,762	3.38		30,382	15.19		7.50 ft	9.50 ft

*** BOX AND TOP MUST BE LIFTED SEPARATELY**



* A 7.50 ft spreader bar is suitable for all sizes shown.

12/23/2009

Filterra® Plant Selections

The Filterra® Stormwater Bioretention Filtration System harnesses the power of nature to capture, immobilize and cycle pollutants to treat stormwater runoff. Trees, grasses and shrubs do more than make it attractive; they also enhance pollutant removal.

Above ground, the system's shrubs, grasses or trees add beauty and value to the urban landscape. Underground, nature's complex physical, chemical and biological processes are hard at work removing a wide range of non-point source pollutants from treated stormwater. Pollutants are decomposed, volatilized and incorporated into the biomass of Filterra's micro/macro fauna and flora.

A wide range of plants are suitable for use in bioretention systems, and a list is available indicating those suitable for use with Filterra. The selection varies by location according to climate.

Additional photos are available at www.filterra.com. Some of the most popular selections to date are shown below:

Filterra® with Heavenly Bamboo

Filterra® with Galaxy Magnolia

Filterra® with Western Redbud

Filterra® with Purple Leaf Plum

Common Filterra® Placements

Typical Filterra placement at a fast food chain.

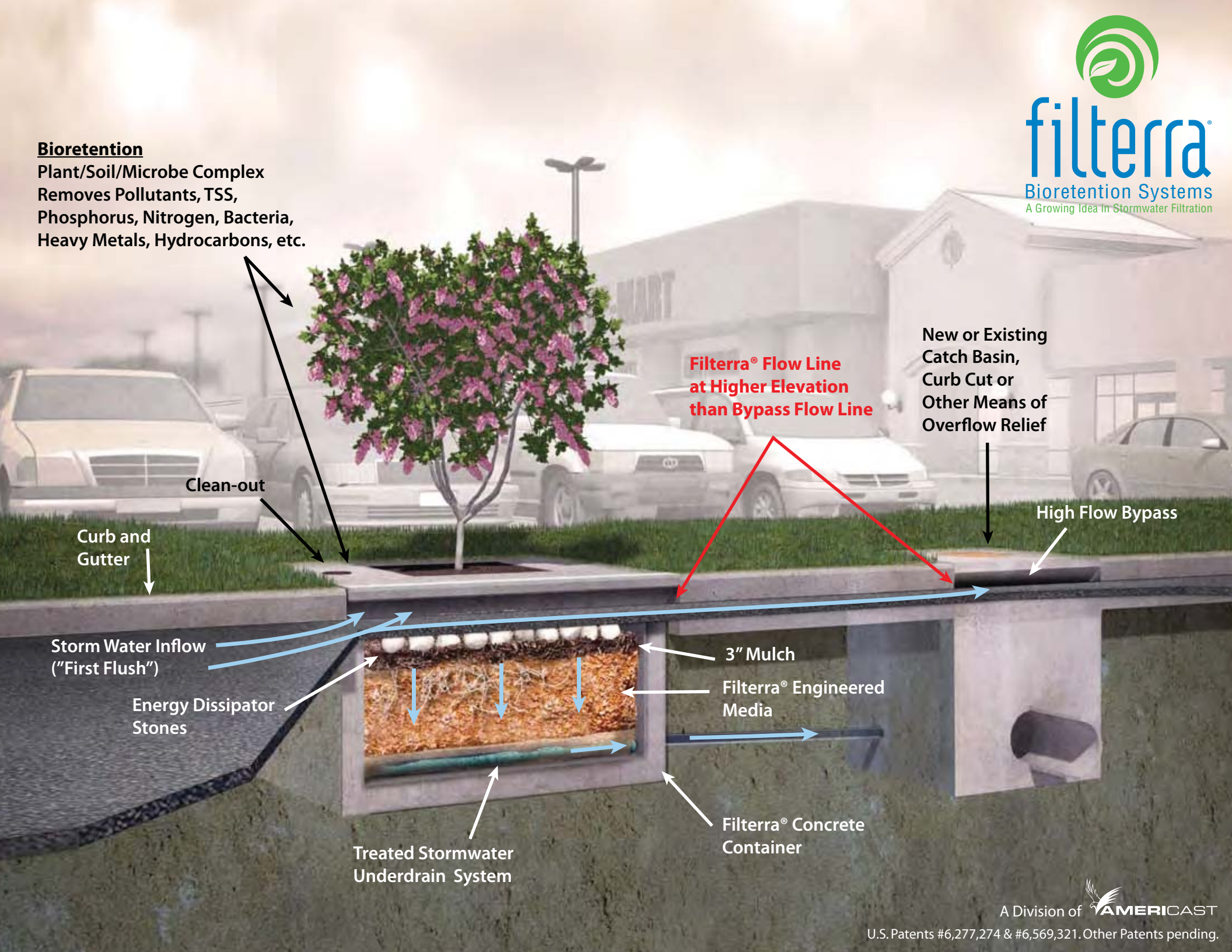
Even the largest Filterra unit blends in with landscaping.

Ideal for stormwater treatment where space is tight.

High flows bypass Filterra into a grass swale.

Filterra used with a flumed bypass in a commercial parking lot.

Providing aesthetics and treatment in a residential area.


Bioretention
Plant/Soil/Microbe Complex
Removes Pollutants, TSS,
Phosphorus, Nitrogen, Bacteria,
Heavy Metals, Hydrocarbons, etc.
filterra
Bioretention Systems
A Growing Idea in Stormwater Filtration
Filterra® Flow Line
at Higher Elevation
than Bypass Flow Line
New or Existing
Catch Basin,
Curb Cut or
Other Means of
Overflow Relief
Clean-out
Curb and
Gutter
High Flow Bypass
Storm Water Inflow
("First Flush")
Energy Dissipator
Stones
3" Mulch
Filterra® Engineered
Media
Treated Stormwater
Underdrain System
Filterra® Concrete
Container
A Division of AMERICAST
U.S. Patents #6,277,274 & #6,569,321. Other Patents pending.