Aqua-Filter™
Stormwater Filtration System

- Introduction
- System Operation
  - Step 1 - Pretreatment
  - Step 2 - Filtration
  - Aqua-Filter™ Filtration Media
- Installation
  - Buoyancy
  - Traffic Loading
- Retrofit Applications
- Inspection and Maintenance
- Aqua-Filter™ Bypass Orientation
- Aqua-Site Worksheet
- Aqua-Filter™ Sizing Chart
- Aqua-Filter™ Sample Detail Drawing
- Aqua-Filter™ Specifications

Play in Clean water
# Aqua-Filter™ Table of Contents

## AQUA-FILTER™

- Stormwater Filtration Systems 2
- System Operation 2
- Step 1: Pretreatment 4
- Step 2: Filtration 4

## Aqua-Filter™ Filter Media

- Installation 5
- Buoyancy 5
- Traffic Loading 6
- Retrofit Applications 6
- Inspection and Maintenance 6
- Aqua-Filter™ Bypass Orientation 8

## Aqua-Site Worksheets

- Aqua-Filter™ Sizing Chart (English) 13
- Aqua-Filter™ Sizing Chart (Metric) 14
- Aqua-Filter™ Sample Detail Drawings 15
- Aqua-Filter™ Specifications 17

## GENERAL

- SCOPE OF WORK 17
- MATERIALS 17
- PERFORMANCE 18

## AQUA-SWIRL™ CONSTRUCTION

- FILTRATION CHAMBER CONSTRUCTION 19

## INSTALLATION

- A. Excavation and Bedding 20
- B. Backfill Requirements 21
- C. Pipe Couplings 21

## DIVISION OF RESPONSIBILITY

- A. Stormwater /System Manufacturer 21
- B. Contractor 21

## SUBMITTALS

- QUALITY CONTROL INSPECTION 22
  - A. Materials 22
  - B. Inspection 22
  - C. Defects 22

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2733 Kanasita Drive, Suite B • Chattanooga, Tennessee 37343
Phone (888) 344-9044 • Fax (423) 826-2112
www.aquashieldinc.com
The Aqua-Filter™ Stormwater Filtration System is designed for sites that require advanced treatment of runoff stormwater that may discharge into sensitive receiving waters.

Each Aqua-Filter™ system is custom engineered and utilizes a unique approach for pollutant removal. This patented configuration begins with the removal of gross pollutants by the Aqua-Swirl™ Stormwater Treatment System, followed by the removal of fine sediments and waterborne pollutants by the filtration chamber.

The Aqua-Filter™ is not only unique because of its modular design, and HDPE construction, but also because of the ease of installation. The system can be designed for new construction projects or be retrofit for existing storm drainage structures.

The Aqua-Filter™ system is engineered such that the filtration capacity complies with established “water quality treatment” requirements. This means that the system filters the initial movement of fine sediment pollutants that can be particularly harmful.

Performance testing is a normal part of our quality assurance program. Third party testing has demonstrated Total Suspended Solids (TSS) removals of greater than 80% and the effective removal of additional pollutants including hydrocarbons (i.e. light and heavy oils and grease), phosphorus, and various heavy metals (i.e. copper, zinc). See the “Performance and Testing” Section for details.
System Operation

The Aqua-Filter™ Stormwater Filtration System operates under gravitational and hydrodynamic forces with no moving parts or valves, which simplifies the treatment process. The Aqua-Filter™ system also normally operates in an off-line configuration as recommended by the Center for Watershed Protection and most municipalities; fully treating the more frequent 6-month to 1-year design storms (or roughly 90% - 95% of the annual rainfall on a given site). Larger, more intermittent storm events (i.e. 10-year or 25-year) are treated in the Aqua-Swirl™, and the peak over-flow is permitted to partially bypass the filter media internally beneath the filter bed, avoiding the need for external diversion chambers.

The unique Aqua-Filter™ treatment method is illustrated in the drawing shown below and described in the following steps.
Step 1: Pretreatment
Peripheral pre-treatment of stormwater is not necessary when using the Aqua-Filter™ Stormwater Filtration System. In fact, each Aqua-Filter™ is custom engineered to utilize a unique treatment sequence where both the coarse- and fine-grained pollutants are removed.

This sequence begins with the Aqua-Swirl™ Stormwater Treatment System designed to target the removal of TSS and free-floating oil and debris. The addition of the Aqua-Swirl™ allows larger debris to settle before filtration and increases filtration effectiveness.

Step 2: Filtration

The filtration chamber in the Aqua-Filter™ is designed to refine and enhance the stormwater quality prior to discharge into sensitive receiving waters. The peak filtration flow rate is based on the calculated “water quality treatment” requirements desired for the site. The Sizing Chart provided later in this Section indicates the peak filtration flow rate for the specific Aqua-Filter™ model.

As the pre-treated water enters the filtration chamber, it is evenly distributed across the filter bed and allowed to permeate through the filter media. The filter media are contained in individual sections, which are layered in a pattern to avoid short-circuiting.

Aqua-Filter™ Filter Media
The natural filter media used for filtration are capable of removing the remaining waterborne pollutants such as oils, grease, fine silts and clays, nutrients (nitrogen, phosphorus), and heavy metals (copper, lead, zinc). The most commonly used media is medium-grained perlite. Other filter media, such as zeolite, granulated activated carbon, leaf compost, and various media blends are available. Performance test reports are provided in the “Performance and Testing” Section of this manual.
Installation

The Aqua-Filter™ Stormwater Filtration System has been designed and fabricated to facilitate easy installation of the system.

Due to the lightweight durable nature of HDPE, typically no special lifting equipment is required to off load the Aqua-Filter™. Lifting supports or cables are provided on each unit, and installation can typically be accomplished with an excavator or track-hoe. Compared to concrete systems, using an Aqua-Filter™ can significantly reduce installation costs.

In addition, stub-outs for the inlet and outlet are provided. AquaShield™ will furnish the coupling between the Aqua-Swirl™ and filter chamber. This requires the contractor to attach the pipes to the Aqua-Filter™ rubber couplings for the system to function properly. Typically, an AquaShield™ representative is present on-site to assist in the installation process.

Buoyancy

All Aqua-Filter™ systems are supplied with anchor feet at each end of the filter chamber. These anchor feet provide additional surface area to counter any buoyant force exerted on the system. If needed, concrete can be poured directly onto the anchors to provide additional surface area for resistive force. The AquaShield™ engineering staff can provide buoyancy calculations for your site-specific conditions.
Traffic Loading
When installed in traffic areas, the Aqua-Filter™ system is designed to withstand H-20 loading. In order to accomplish this, a reinforced concrete pad shall be poured in place above the system. Further details can be found in the "Installation and Fabrication” Section of this manual.

A concrete pad is required in traffic loading areas

Retrofit Applications
The Aqua-Filter™ system is designed so that it can be used for retrofit applications. The filtration system can be installed both above and below grade, and can be used for industrial applications to meet new, more stringent permit requirements.

Inspection and Maintenance
Maintenance of the Aqua-Filter™ Stormwater Filtration System is two-fold. First, inspect the Aqua-Swirl™ and then inspect the filtration chamber.

The first step is to inspect and cleanout the Aqua-Swirl™ pre-treatment chamber. Free-floating oil and floatable debris can be directly observed and removed through the 32-inch service access provided. If cleanout is needed, a vacuum truck can be used to remove the accumulated sediment and debris.

The second step is to inspect and cleanout the Aqua-Filter™ filtration chamber. Inspection of the filtration chamber can be performed from the surface by

Workers use a vacuum truck to clean out an Aqua-Filter™ System
observing the color change of the filter media from its original light color to dark brown. If the filter containers need replacing, entry into the system is required. The spent filter containers are lifted from the chamber as shown below.

Replacement filters are then lowered into the system and set into position. The filters are placed into two-foot by two-foot grates that should be overlapped such that the lower two containers are parallel to the length of the filtration chamber, and the upper two are perpendicular to the length of the chamber. Care must be taken to ensure that the containers are seated into position to promote good contact with the walls on all sides.

Typically, the spent filters do not require any special treatment or handling for disposal. AquaShield™ recommends that all materials removed be handled and disposed of in accordance with local and state requirements.

An "Inspection and Maintenance Manual" is provided with the Aqua-Filter™ system for more detailed maintenance procedures.
Aqua-Filter™ Bypass Orientation

1ST FLUSH TO AQUA-SWIRL™

DIVERSION STRUCTURE (MANHOLE WITH WEIR WALL)

BY-PASS FLOW

INLET

HIGH FLOW BY-PASS

DIVERSION WEIR WALL

UP-STREAM DIVERSION STRUCTURE

1ST FLUSH TO AQUA- SWIRL™

HIGH FLOW BY-PASS FLOW

DIVERSION OPTION 2

TREATED WATER FROM AQUA-FILTER™

UP-STREAM DIVERSION MANHOLE

CONVERGENCE MANHOLE

1ST FLUSH TO AQUA- SWIRL™

TREATED WATER FROM AQUA-FILTER™

(Elevation View)

(Elevation View)
Aqua-Site Worksheets

Aqua-Site worksheets are provided as an example of the information that AquaShield™ will need to customize an Aqua-Filter™ to a specific work site.

- 1 completed example
- 2 blank worksheets
## Project Information

- **Project Name:** County Recreation Center
- **Location (City, State):** AnyTown, USA
- **Site Use (circle one):** Commercial
- **Site Plan Attached:** Yes
- **Pollutants (TSS, Floatable Debris, oils/grease, TP, etc.):** TSS, Debris, TP, Heavy Metals
- **AutoCAD Version:** 4.0
- **Date Submitted:** 3/12/2004

## Specifier Information

- **Specifier's Name:** Sheri Phillips
- **Design Firm:** Phillips Engineering
- **Address:** 123 Main Street
- **City, State, Zip:** AnyTown, USA
- **Phone:** 423-870-8888
- **Fax:** 423-826-2112
- **E-mail:** sheri@phillipsengr.com

## Specifications

<table>
<thead>
<tr>
<th>Unit Label or Manhole Number</th>
<th>AquaShield™ Model</th>
<th>Design Flow Rate</th>
<th>Inlet/Outlet Pipe</th>
<th>Rim Elevation</th>
<th>Drainage Area Info</th>
<th>Traffic Loads</th>
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<tr>
<td></td>
<td></td>
<td>Water Quality Treatment Flow(1) (cfs - L/s)</td>
<td>Peak Design Flow(2) (cfs - L/s)</td>
<td>Size (ID) (in - mm)</td>
<td>Invert Elevation (ft - m)</td>
<td>Pipe Material Type</td>
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<td>A-1</td>
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<td>5.3</td>
<td>15.9</td>
<td>18</td>
<td>736.2</td>
<td>RCP</td>
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### Special Site Conditions or Requirements:

- Please provide copy of Site Plans showing orientation

### How did you learn about Aqua-Shield™?

- Website

### Specifier's Signature:

- Sheri Phillips

### Date:

- 12-Mar-04

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\(1\) Water Quality Treatment Flow is prescribed by local regulatory agencies to achieve full treatment of specific amount of stormwater.

\(2\) Peak Design Flow refers to maximum calculated flow for an outfall or recurrence interval (10-yr, 25-yr event)
### Project Information

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Design Firm:</th>
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<tr>
<td>Location (City, State):</td>
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</tr>
<tr>
<td>Site Use (circle one): Residential Commercial Industrial Other</td>
<td>Address:</td>
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<tr>
<td>Site Plan Attached: YES NO</td>
<td>City, State, Zip:</td>
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<td>Pollutants (TSS, Floatable Debris, oils/grease, TP, etc.):</td>
<td>Phone:</td>
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### Specifier Information

<table>
<thead>
<tr>
<th>Specifier's Name:</th>
<th>Date:</th>
</tr>
</thead>
</table>

### Special Site Conditions or Requirements:

**Please provide copy of Site Plans showing orientation**

- **How did you learn about Aqua-Shield™?**
- **Traffic Loads**
  - Is the system subject to H-20 loadings? Yes or No

<table>
<thead>
<tr>
<th>Unit Label or Manhole Number</th>
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<th>Inlet/Outlet Pipe</th>
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<th>Drainage Area Info</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Water Quality Treatment Flow</td>
<td>Peak Design Flow</td>
<td>Size (ID)</td>
<td>Inlet Elevation</td>
<td>Outlet Elevation</td>
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<tr>
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<td></td>
<td>(cfs - L/s)</td>
<td>(cfs - L/s)</td>
<td>(in - mm)</td>
<td>(ft - m)</td>
<td>(ft - m)</td>
</tr>
</tbody>
</table>

- **(1) Water Quality Treatment Flow** is prescribed by local regulatory agencies to achieve full treatment of specific amount of stormwater.
- **(2) Peak Design Flow** refers to maximum calculated flow for an outfall or recurrence interval (10-yr, 25-yr event).
# Aqua-Site Worksheet

## Project Information

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Designer's Name:</th>
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<tr>
<td>Location (City, State):</td>
<td>Design Firm:</td>
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<tr>
<td>Site Use (circle one): Residential Commercial Industrial Other</td>
<td>Address:</td>
</tr>
<tr>
<td>Site Plan Attached:</td>
<td>City, State, Zip:</td>
</tr>
<tr>
<td>Phone:</td>
<td>Phone:</td>
</tr>
<tr>
<td>Fax:</td>
<td>Fax:</td>
</tr>
<tr>
<td>Date Submitted:</td>
<td>E-mail:</td>
</tr>
</tbody>
</table>

## Special Site Conditions or Requirements:

Please provide copy of Site Plans showing orientation about Aqua-Shield™?

## Specifications

<table>
<thead>
<tr>
<th>Unit Label or Manhole Number</th>
<th>AquaShield™ Model</th>
<th>Design Flow Rate</th>
<th>Inlet/Outlet Pipe</th>
<th>Rim Elevation</th>
<th>Drainage Area Info</th>
<th>Traffic Loads</th>
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</thead>
<tbody>
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<td>Peak Design Flow²</td>
<td>Size (ID)</td>
<td>Inlet Elevation</td>
<td>Outlet Elevation</td>
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<td></td>
<td>(cfs - L/s)</td>
<td>(cfs - L/s)</td>
<td>(in - mm)</td>
<td>(ft - m)</td>
<td>(ft - m)</td>
</tr>
</tbody>
</table>

### Special Site Conditions or Requirements:

#### How did you learn about Aqua-Shield™?

Please provide copy of Site Plans showing orientation about Aqua-Shield™?

(1) Water Quality Treatment Flow is prescribed by local regulatory agencies to achieve full treatment of specific amount of stormwater.

(2) Peak Design Flow refers to maximum calculated flow for an outfall or recurrence interval (10-yr, 25-yr event)

### Specifier’s Information

Specifier's Signature: Date:
Aqua-Filter™ Sample Detail Drawings

Sample Aqua-Filter™ detail drawings are provided as examples of the type of systems that AquaShield™ can offer for a specific work site.
Aqua-Filter Filtration System Model AF-3.2 Off-Line Standard Detail
Aqua-Filter™ Specifications

GENERAL

This specification shall govern the performance, materials, and fabrication of the Aqua-Filter™ Stormwater Filtration Systems.

SCOPE OF WORK

The filtration system shall be provided by AquaShield™, Inc. 2733 Kanasita Drive, Suite B Chattanooga, TN 37343 (888-344-9044) and shall adhere to the following material and performance specifications at the specified design flows, and storage capacities.

MATERIALS

A. The Aqua-Filter™ Stormwater Filtration System shall be made from High-Density Polyethylene (HDPE) resins meeting the following requirements:

1) HDPE Material – The HDPE material supplied under this specification shall be high density, high molecular weight as supplied by manufacturer. The HDPE material shall conform to ASTM D3350-02 with minimum cell classification values of 345464C.

2) PHYSICAL PROPERTIES OF HDPE COMPOUND
   a) Density - the density shall be no less than 0.955 g/cm³ as referenced in ASTM D 1505.
   b) Melt Index - the melt index shall be no greater than 0.15 g/10 minutes when tested in accordance with ASTM D 1238- Condition 190/2.16.
   c) Flex Modulus - flexural modulus shall be 110,000 to less than 160,000 psi as referenced in ASTM D 790.
   d) Tensile Strength at Yield - tensile strength shall be 3,000 to less than 3,500 psi as referenced in ASTM D 638.
e) Slow Crack Growth Resistance shall be greater than 100 hours (PENT Test) as referenced in ASTM F 1473 or greater than 5,000 hours (ESCR) as referenced in ASTM D 1693 (condition C).

f) Hydrostatic Design Basis shall be 1,600 psi at 23 degrees C when tested in accordance with ASTM D 2837.

- Color – black with minimum 2% carbon black.

B. REJECTION - The Aqua-Filter™ Stormwater Filtration System may be rejected for failure to meet any of the requirements of this specification.

PERFORMANCE

A. The Aqua-Filter™ Stormwater Filtration System shall include a _______ - foot inner diameter circular Aqua-Swirl™ to pre-treat the incoming water. A tangential inlet shall be provided to induce a swirling flow pattern that will cause settleable solids to accumulate in the bottom center of the chamber in such a way as to prevent re-suspension of captured particles. An arched baffle wall shall be provided in such a way as to prevent floatable liquids and solids from exiting the Aqua-Swirl™.

B. The Aqua-Filter™ Stormwater Filtration System shall include a _______ - foot inner diameter filtration chamber with a filter bed no less than ______ - feet long and ______ -feet in diameter containing ________ -filter containers. A distribution system shall be provided in such a way as to evenly distribute low flows across the filter containers. An overflow bypass shall be provided in such a way as to allow flows larger than the filter bed design capacity to bypass the filter bed and exit the filtration chamber. The filter media shall be manufactured from natural materials as provided by AquaShield™, Inc. and be capable of removing up to 80% total suspended solids, and 95% total petroleum hydrocarbons, and 80% phosphorus, and 90% zinc on a net annual basis.

C. The Aqua-Filter™ Stormwater Filtration System shall have a sediment storage capacity of ____ cubic feet and be capable of capturing ___ gallons of petroleum hydrocarbons. The system shall have a peak hydraulic flow capacity of ____ cubic feet per second (cfs) and a water quality filtration flow rate of ____ cfs.
D. Maintenance access to the treatment system shall be provided via 30-inch (ID) man-way(s) and one (1) 40-inch (ID) man-way with ladder (reduced to 30-inch at grade) such that all maintenance areas are accessible.

AQUA-SWIRL™ CONSTRUCTION

A. The Aqua-Swirl™ Stormwater Treatment System shall be constructed of solid wall high-density polyethylene (HDPE) ASTM F 714 cell class 345464 c. For sizes above 63-inches, the treatment chamber shall be constructed from profile wall HDPE ASTM F 894 RSC 250 or solid wall pipe.

B. The bottom thickness of the Aqua-Swirl™ will be determined in accordance with ASTM D 1759. Calculations must be provided to justify the thickness of the bottom.

C. The inlets and outlets shall be extrusion welded on the inside and outside of the structure using good welding practice.

D. All Aqua-Swirl™ inlet connections larger than 4-inch nominal OD pipe shall be butt fusion welded, electro-fusion welded, or flange connected. For 4-inch OD pipe and smaller threaded transition fittings can be used as well as the acceptable connections listed.

E. Top of the Aqua-Swirl™ shall be built to the requirements of the drawings. If air testing is required, flanged tops or man-ways will be required.

F. Reinforced concrete pads spanning the Aqua-Swirl™ will be required when the Aqua-Filter™ is used in traffic areas. A traffic rated frame and cover will be required. A professional engineer shall approve the design of the concrete pad. Their calculations must be included in the submittal.

G. The manufacturer upon request can supply typical anti-flotation/buoyancy calculations. In addition, typical drawings of the Aqua-Filter™ with concrete anti-flotation structures can also be provided. Anti-flotation structure design and approval are ultimately the responsibility of the specifying engineer. The contractor shall provide the anti-flotation structure.
FILTRATION CHAMBER CONSTRUCTION

A. The filtration chamber of the Aqua-Filter™ shall be constructed from profile wall HDPE ASTM F 894 RSC 250 pipe or solid wall pipe.

B. The inlets and outlets shall be extrusion welded on the inside and outside of the structure using good welding practice.

C. All filtration chamber outlet connections larger than 4-inch nominal OD pipe shall be butt fusion welded, electro-fusion welded, or flange connected. For 4-inch OD pipe and smaller threaded transition fittings can be used as well as the acceptable connections listed.

D. Ends of the filtration chamber shall be built to the requirements of the drawings. If air testing is required, flanged tops or man-ways will be required.

E. Reinforced concrete pads spanning the filtration chamber should be used in traffic loading situations when required by Specifying Engineer. A traffic rated frame and cover will be required for each man-way. A professional engineer shall approve the design of the concrete pad. The Engineer’s calculations must be included in the submittal.

F. Contractor, if required, shall provide anti-floatation and/or anti-settling anchors, with appropriate straps and/or connection devices.

INSTALLATION

A. Excavation and Bedding
The trench and trench bottom shall be constructed in accordance with ASTM D 2321, Section 6, Trench Excavation, and Section 7, Installation. The HDPE Aqua-Filter™ shall be installed on a stable base consisting of 12-inches of Class I stone materials (angular, crushed stone or rock, crushed gravel; large void content, containing little or no fines) as defined by ASTM D 2321, Section 5, Materials, and compacted to 95% proctor density. Additional bedding shall be tamped uniformly under the lower portion of the filtration chamber up to the spring-line to provide adequate support. All required safety precautions for the Aqua-Filter™ installation are the responsibility of the Contractor.
B. Backfill Requirements
Backfill materials shall be Class I or II stone materials, (well graded gravels, gravelly sands; containing little or no fines) as defined by ASTM D 2321, Section 5, Materials and compacted to 90% proctor density. Class I materials are preferred. Backfill and bedding materials shall be free of debris. Backfilling shall be done to conform to ASTM F 1759, Section 4.2, “Design Assumptions”. Backfill shall extend at least 3.5 feet beyond the edge of the Aqua-Filter™ and for the full height to sub-grade and extend laterally to undisturbed soils.

C. Pipe Couplings
Couplings to and from the Stormwater Treatment System shall be Fernco®, Mission™ or equal type flexible boot with stainless steel tension bands. A metal sheer guard should be used when available.

DIVISION OF RESPONSIBILITY

A. Stormwater /System Manufacturer
The Manufacturer shall be responsible for delivering the Aqua-Filter™ to the site. The system includes the Aqua-Swirl™ with all internal components and service access riser to surface, the filtration chamber with all internal components, service access risers to surface, filter media, pipe coupling between the Aqua-Swirl™ and filtration chamber, and manhole frames and covers.

B. Contractor
The Contractor shall be responsible for preparing the site for the system installation including, but not limited to, temporary shoring, excavation, cutting and removing pipe, new pipe, bedding, and compaction. The Contractor shall be responsible for furnishing the means to lift the system components off the delivery trucks. The Contractor shall be responsible for providing any concrete anti-floatation/anti-creep restraints, anchors, collars, etc. with any straps or connection devices required. The Contractor shall be responsible for field cutting, if necessary, HDPE service access risers to grade. The Contractor shall be responsible for sealing the pipe connections to the Stormwater Filtration System, backfilling and furnishing all labor, tools, and materials needed.
SUBMITTALS

The Contractor shall be provided with dimensional drawings and, when specified, utilize these drawings as the basis for preparation of shop drawings showing details for construction and reinforcing. Shop drawings shall be annotated to indicate all materials to be used and all applicable standards for materials, required tests of materials and design assumptions for structural analysis. Shop drawings shall be prepared at a scale of not less than ¼ inch per foot. Three (3) hard copies of said shop drawings shall be submitted to the Specifying Engineer for review and approval.

QUALITY CONTROL INSPECTION

A. Materials
The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the Engineer. Such inspection may be made at the place of manufacture, or on the work site after delivery, or at both places. The sections shall be subject to rejection at any time if material conditions fail to meet any of the specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. All sections, which have been damaged beyond repair during delivery, will be rejected and, if already installed, shall be repaired to the Engineer's acceptance level, if permitted, or removed and replaced, entirely at the Contractor's expense.

B. Inspection
All sections shall be inspected for general appearance, dimensions, soundness, etc.

C. Defects
Structural defects may be repaired, subject to the acceptance of the Engineer, after demonstration by the manufacturer that strong and permanent repairs will be made. The Specifying Engineer before final acceptance shall carefully inspect repairs.
Aqua-Guardian™
Catch Basin Insert

- Introduction
- System Operation
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- Installation
- Inspection and Maintenance
- Aqua-Guardian™ Worksheets
- Aqua-Guardian™ Sizing Chart
- Aqua-Guardian™ Sample Detail Drawing

Keeping streets clean
Aqua-Guardian™ Table of Contents

AQUA-GUARDIAN™ ........................................................................................................2

Catch Basin Insert ........................................................................................................2
  System Operation ........................................................................................................2
  Retrofit Applications ..................................................................................................3
  Installation ................................................................................................................4
  Inspection and Maintenance .......................................................................................4

Aqua-Guardian™  Worksheet .....................................................................................6

Aqua-Guardian™ Sizing Chart (English) .................................................................10
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Aqua-Guardian™  Sample Detail Drawings ............................................................12