## Aqua-Swirl™ Concentrator
### Stormwater Treatment

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Aqua-Swirl™ Concentrator
Stormwater Treatment Systems

The patented Aqua-Swirl™ Concentrator provides a highly effective means for the removal of sediment, floating debris and free-oil. Swirl technology, or vortex separation, is a proven form of treatment utilized in the stormwater industry to accelerate gravitational separation. Independent university laboratory performance evaluations have shown the TSS removal of 91% calculated for a net annual basis. See the “Performance and Testing” Section for details.

Each Aqua-Swirl™ is constructed of High-Density Polyethylene (HDPE), and is therefore modular, lightweight and durable, eliminating the need for heavy lifting equipment during installation. Inspection and maintenance are made easy, with large risers that allow for both examination and cleanout without entering the chamber.

System Operation

As recommended by the Center for Watershed Protection and most municipalities, Aqua-Swirl™ systems typically operate in an off-line configuration providing full treatment of the "first flush" (or approximately 1/3) of the peak design storm diverted to our structure, as shown in the photograph. This allows roughly 90% – 95% of a site’s annual runoff volume to be treated by the Aqua-Swirl™. The larger portion of less frequent storm events are routed past the treatment chamber, thereby reducing turbulence within the system and eliminates the possibility of re-suspension of previously captured pollutants.
The operation begins when stormwater enters the Aqua-Swirl™ by means of its tangential inlet pipe, which induces a circular (or vortex) flow pattern. Because stormwater flow is intermittent by nature, the Aqua-Swirl™ Concentrator retains water between storm events providing both “quiescent and dynamic” settling of inorganic solids. The dynamic settling occurs during each storm event, while the quiescent settling takes place between successive storms. A combination of gravitational and hydrodynamic drag forces encourages the solids to drop out of the flow and migrate to the center of the chamber where velocities are lowest.

Given that a large percentage of settleable solids in stormwater are reported to be small and have low settling velocities, the volume of water retained in the Aqua-Swirl™ Concentrator, providing the quiescent settling, increases its performance. Further, with inorganic particle sizes less than 200 microns, the water velocity needed to promote re-suspension increases due to increasing cohesiveness of finer sediment.

The treated flow exits the Aqua-Swirl™ behind an arced baffle. The top of the baffle is sealed, thereby eliminating any possibility of floatables to escape the system. A vent pipe is extended up the riser to expose the backside of the baffle to atmospheric conditions, preventing a siphon from forming at the bottom of the baffle.
Retrofit Applications

The Aqua-Swirl™ system is designed so that it can easily be used for retrofit applications. With the invert of the inlet and outlet pipe at the same elevation, the Aqua-Swirl™ can easily be inserted into existing drainage system networks. Furthermore, because of the lightweight nature and small footprint of the Aqua-Swirl™, existing infrastructure utilities (i.e., wires, poles, trees) will be unaffected in installation.

Installation

The Aqua-Swirl™ system has been designed and fabricated as a modular unit to facilitate easy installation of the system.

Because AquaShield™'s systems are fabricated from HDPE, the Aqua-Swirl™ is lightweight, and can be installed without the use of heavy lifting equipment. Lifting supports are provided on each unit, to allow easy offloading and installation with a backhoe. Compared to concrete systems, using an Aqua-Swirl™ can significantly reduce installation costs.

In addition, stub-outs for the inlet and outlet are provided. This allows the contractor to simply attach the storm drain pipes to the Aqua-Swirl™ with rubber couplings. Typically, an AquaShield™ representative is present on-site to assist in the installation process.
**Buoyancy**
All Aqua-Swirl™ Concentrator systems are supplied with an octagonal base plate, which extends a minimum of 6” beyond the outside diameter of the swirl chamber. The function of the extension on this base plate is to provide additional surface area to counter any buoyant force exerted on the system. The forces created on the base plate by the weight of the surrounding fill material offsets the buoyant force generated within the system. If needed, concrete can be poured directly onto the base plate to provide additional downward force. AquaShield™ engineering staff can provide buoyancy calculations for your site specific conditions.

**Traffic Loading**
When installed in traffic areas, the system will be designed to withstand H20 loading. In order to accomplish this, a reinforced concrete pad shall be poured in place above the system.

See the “Installation and Fabrication” section for sample concrete pad details and further details on installation and the use of HDPE.
Inspection and cleanout of the Aqua-Swirl™ is simple. The chamber can be inspected and maintained completely from the surface. Free-floating oil and floatable debris can be directly observed and removed through the provided service access.

Cleanout of accumulated sediment will need to be performed when the usable sediment storage volume has been occupied. Sediment depths can easily be determined by lowering a measuring device (i.e. stadia rod) to the top of the sediment pile and to the water’s surface.

A vacuum truck can be used to remove the accumulated sediment and debris. Disposal of the material is typically treated in the same fashion as catch basin cleanouts. AquaShield™ recommends that all materials removed be handled and disposed of in accordance with local and state requirements.

For further details on inspection and cleanout procedures, please see the “Maintenance” section.
### Aqua-Site Worksheet

**Project Information**

- **Project Name:** County Hospital
- **Location (City, State):** Chicago, IL
- **Site Use:** Commercial
- **Site Plan Attached:** Yes
- **Date Submitted:** July 3, 2002

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<tr>
<th>Unit Label or Manhole Number</th>
<th>Aqua Shield™ Model</th>
<th>Design Flow Rate</th>
<th>Peak Design Storm</th>
<th>Invert Elevation</th>
<th>Pipe Material Type</th>
<th>Fill Grade Elevation</th>
<th>Area</th>
<th>Percent Impervious</th>
<th>Estimated Groundwater Elevation</th>
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<td>70</td>
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### Specifier Information

- **Specifier's Signature:** Norma Harris
- **How did you hear about AquaShield™?**
  - website

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2733 Kanasita Drive, Suite A • Chattanooga, Tennessee 37343

Phone (888) 344-9044 • Fax (423) 870-1005

www.aquashieldinc.com
## Aqua-Site Worksheet

### Project Information

- **Project Name:**
- **Location (City, State):**
- **Site Use:** (e.g., Residential, Commercial, Industrial, etc.)
- **Site Plan Attached:**
- **Date Submitted:**

### Specifier Information

- **Specifier's Name:**
- **Design Firm:**
- **Address:**
- **City, State, Zip:**
- **Phone:**
- **Fax:**
- **E-mail:**

### Storm Flow Table

<table>
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<tr>
<th>Unit Label or Manhole Number</th>
<th>AquaShield™ Model</th>
<th>Storm Flow Rate</th>
<th>Inlet Pipe</th>
<th>Outlet Pipe</th>
<th>Rim Elevation</th>
<th>Drainage Area Info</th>
<th>Traffic Loads</th>
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</table>

**Special Site Conditions / Requirements:**

### Please provide copy of Site Plans showing orientation

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**Specifier's Signature:**

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(1) Peak Design Storm Flow refers to the maximum calculated flow for an outfall (10-yr, 25-yr event).

(2) Water Quality Storm Flow is prescribed by local regulatory agencies to achieve full treatment of a specific amount of stormwater and is often about 1/3 of the Peak Design Storm Flow.
# Aqua-Site Worksheet

## Project Information

- **Project Name:**
- **Location (City, State):**
- **Site Use:** (i.e. Residential, Commercial, Industrial, etc.)
- **Site Plan Attached:**
- **Date Submitted:**

## Specifier Information

- **Specifier's Name:**
- **Design Firm:**
- **Address:**
- **City, State, Zip:**
- **Phone:**
- **Fax:**
- **E-mail:**

### Unit Label or Manhole Number

<table>
<thead>
<tr>
<th>AquaShield™ Model</th>
<th>Storm Flow Rate</th>
<th>Inlet Pipe</th>
<th>Outlet Pipe</th>
<th>Rim Elevation</th>
<th>Drainage Area Info</th>
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</table>

### Special Site Conditions / Requirements:

- **Specifier's Signature:**

---

(1) **Peak Design Storm Flow** refers to the maximum calculated flow for an event (10-yr, 25-yr event).

(2) **Water Quality Storm Flow** is prescribed by local regulatory agencies to achieve full treatment of a specific amount of stormwater and is often about 1/3 of the Peak Design Storm Flow.

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Please provide copy of Site Plans showing orientation.
Aqua-Swirl™
Sizing Chart

<table>
<thead>
<tr>
<th>Aqua-Swirl™ Model</th>
<th>Swirl Chamber Diameter (ft)</th>
<th>Peak Design Storm Flow 1 (off-line) (cfs)</th>
<th>Peak Water Quality Flow 2 (on-line) (cfs)</th>
<th>Inlet Pipe Diameter (can vary) (in)</th>
<th>Oil/Debris Storage Capacity (gal)</th>
<th>Sediment Storage Capacity (ft³)</th>
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(1) Peak Design Storm Flow Rate refers to the maximum calculated flow rate for a particular outfall (Q₁₀ year, Q₂₅ year). As recommended by the Center for Watershed Protection and most municipalities, Aqua-Swirl™ systems typically operate in an off-line configuration providing full treatment of the "first flush" (or approximately 1/3) of the peak design storm diverted to our structure. Many regulatory agencies are establishing “water quality treatment flow rates” for their areas based on the initial movement of pollutants into the storm drainage system.

(2) The treatment flow rate of the Aqua-Swirl™ system is engineered to meet or exceed the local water quality treatment criteria. This “water quality treatment flow rate” typically represents about 90% to 95% of the total annual runoff volume.

The design and orientation of the Aqua-Swirl™ Concentrator generally entails some degree of customization. For assistance in design, please contact AquaShield™ directly (888-344-9044) or go to our web site at www.AquaShieldInc.com. CAD details and specifications are available upon request.
Aqua-Swirl™
Specifications

I. GENERAL

This specification shall govern the performance, materials and fabrication of the Stormwater Treatment System.

II. SCOPE OF WORK

The Stormwater Filtration System shall be provided by AquaShield™, Inc. 2733 Kanasita Drive, Chattanooga, TN (423-870-8888) and shall adhere to the following material and performance specifications at the specified design flows, and storage capacities.

III. MATERIALS

A. Stormwater Treatment 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 D3350-98a with minimum cell classification values of 345464C. Earlier versions of this specification will not be accepted.

2) PHYSICAL PROPERTIES OF HDPE COMPOUND
   a) Density - the density shall be no less than 0.955 gms/ccm as referenced in ASTM 1505.
   b) Melt Index - the melt index shall be no greater than 9.0 gms/10 minutes when tested in accordance with ASTM 1238- Condition 3.2.3.
   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 3,200 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 2000 hours 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.

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

IV. PERFORMANCE

A. The Stormwater Treatment System shall include a ___-inch inner diameter (ID) circular hydrodynamic flow-through treatment chamber to treat the incoming water. A tangential inlet shall be provided to induce a swirling flow pattern that will cause sedimentary 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 treatment chamber while enhancing the swirling action of the stormwater. The baffle wall shall be curved to no more than 3% variance from the treatment chamber ID radius.

B. The Stormwater Treatment System shall have a sediment storage capacity of ____ cubic feet and be capable of capturing ____ gallons of petroleum hydrocarbons. The Stormwater Treatment System shall have a treatment capacity of _____ cubic feet per second (cfs). The Stormwater Treatment System shall be capable of removing floating trash and debris, floatable oils and 80% of total suspended solids from stormwater entering the treatment chamber.

C. Service access to the Stormwater Treatment System shall be provided via 28-inch outer diameter (OD) access riser(s) over the treatment chamber such that no confined space entry is required to perform routine inspection and maintenance functions.

V. TREATMENT CHAMBER CONSTRUCTION

A. The treatment chamber shall be constructed from high density polyethylene (HDPE) ASTM F 714 cell class 345464 c. For sizes above 60-inch OD, the treatment chamber shall be constructed from profile wall HDPE ASTM F 894 RSC 250 pipe.

B. The bottom thickness of the treatment chamber will be determined in accordance with ASTM D1759. 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 accepted welding practice.

D. The arched baffle wall shall be constructed from HDPE and shall be extrusion welded to the interior of the treatment chamber using accepted welding methods with connections made at 180 degrees of each end. The radius of the baffle shall be no more than 3% larger than the radius of the treatment chamber.

E. HDPE lifting supports shall be provided on the exterior of the Stormwater Treatment System in such a way as to allow the prevention of undue stress to critical components of the Stormwater Treatment System during loading, off-loading and moving operations. The lifting supports shall be constructed as an integral part of the treatment chamber and extrusion welded using accepted welding practices.

F. Top of the treatment chamber shall be built to the requirements of the drawings. Deep burial applications shall require a reinforced HDPE top.

G. Reinforced concrete pads spanning the treatment chamber will be required with traffic rated frames and covers when the Stormwater Treatment System is used in traffic areas. A professional engineer shall approve the design of the concrete pad and the calculations must be included in the submittal.

H. Typical anti-flotation/ buoyancy calculations can be supplied by the manufacturer upon request. In addition, typical drawings of the AquaShield Stormwater Treatment System with concrete anti-flotation structures can also be provided. Anti-flotation structure design and approval are ultimately the responsibility of the specifying engineer. The anti-flotation structure shall be provided by the contractor.

VI. 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 Stormwater Treatment System 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, contains little or no fines) as defined by ASTM D2321, Section 5, Materials, and compacted to
95% proctor density. All required safety precautions for Stormwater Treatment System 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; contains little or no fines) as defined by ASTM D2321, 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 conform to ASTM 1759, Section 4.2, “Design Assumptions”. Backfill shall extend at least 3.5 feet beyond the edge of the Swirl Concentrator for the full height to sub grade and extend laterally into undisturbed soils.

C. **Pipe Couplings** – Pipe couplings to and from the Stormwater Treatment System shall be Fernco® or Mission™ type flexible boot with stainless steel tension bands. A metal sheer guard shall be used to protect the flexible boot.

**VII. DIVISION OF RESPONSIBILITY**

A. **Stormwater Treatment System Manufacturer** - The Manufacturer shall be responsible for delivering the Stormwater Treatment System to the site. The system includes the treatment chamber with debris baffle, inlet and outlet stub-outs, lifting supports, 28-inch OD service access riser(s) to grade with temporary cover, and manhole frame(s) and cover(s).

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 Treatment System, backfilling and furnishing all labor, tools, and materials needed.
VIII. 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.

IX. QUALITY CONTROL INSPECTION

A.Materials - The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the Specifying 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 are damaged beyond repair after delivery will be rejected and, if already installed, shall be repaired to the Specifying 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 Specifying Engineer, after demonstration by the manufacturer that strong and permanent repairs will be made. Repairs shall be carefully inspected by the Specifying Engineer before final acceptance of the components.