# EVALUATING INNOVATIVE STORMWATER TREATMENT TECHNOLOGIES UNDER THE ENVIRONMENTAL TECHNOLOGY VERIFICATION (ETV) PROGRAM

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## Abstract

Assessing, controlling, and treating combined-sewer overflows (CSO), sanitary sewer overflows (SSO), and urban stormwater runoff have become priorities for communities. Improved and cost effective treatment technologies are needed to reduce the adverse impacts that wet weather flows can have on surface water quality.

In October of 1995, the U.S. Environmental Protection Agency (EPA) created a program to facilitate the deployment of such innovative technologies through performance verification and information dissemination. The goal of the Environmental Technology Verification (ETV) Program is to further environmental protection by substantially accelerating the acceptance and use of innovative commercially available treatment technologies. The ETV Program is intended to assist and inform the stakeholders involved in the design, distribution, permitting and purchase of environmental technologies.

Since potential adverse effects on surface water quality from wet weather flow sources has been targeted as a major environmental concern, the Wet-Weather Flow (WWF) Technologies Pilot was created as one of the 12 pilots formed under this ETV Program. Through a cooperative agreement, US EPA and NSF International have partnered to conduct this Pilot. Objective, quality-assured performance data will be made available to all parties in the WWF technology marketplace in the form of a Verification Report and Statement. These will be published on the Web sites, http://www.nsf.org/etv and http://www.epa.gov/etv.

This paper will focus on one of the five areas selected as a high priority within the WWF pilot, stormwater treatment. The stormwater treatment devices or systems being evaluated are designed to intercept and thereby reduce pollutants before they can adversely affect surface water quality. Their function is to serve as an effective Best Management Practice (BMP) to assist end users in complying with meeting NPDES Phase II stormwater compliance permits and other regulatory requirements for protecting surface runoff quality. Based on their operating principles, there are three basic types of BMP devices that are being verified: in-line filtration devices, hydrodynamic separators, and in-drain filtration devices.

An overview of the generic protocol prepared for use as a template for site-specific test plan preparation will be presented. The names of applied vendors, the names and operating principles of their devices, performance measures included in their test plans, and test site locations will be presented. The field-testing organization that developed the test plan and performed the testing for each device will also be identified. In conclusion, the testing process and available data will be discussed.

## PROTOCOL OVERVIEW

As an initial step in the verification process, the process of developing a protocol was embarked upon with the guidance of a six-member technology panel of experts in this field. The chairman of this panel is Roger Bannerman from the Wisconsin DNR. Other members include Michael Bloom from PBS&J, Stan Ciuba from WA Dept. of Ecology, Jeff Dennis from Maine DEP, Tom Maguire from MA DEP, and Rod Frederick from the EPA, Office of Water. The protocol was prepared under contract with Earth Tech, Inc., and peer reviewed by Dale Scherger of Scherger and Associates. This protocol serves as a generic template for preparation of site-specific test plans.

Both the technology panel and Dale's review deemed the protocol to be generally acceptable, with expectations that modifications and improvements would be made as test plans are drafted.

The latest version of the protocol for stormwater source area treatment devices is Draft 4.1, March 2002, and is available on both the NSF International and EPA ETV web sites. This document has evolved from several earlier versions of the original protocol.

The main elements of the protocol are as follows:

- Minimum 15 qualified sampling events required
- Automatic composite sampling (except HC/micro) - Minimum 5 subsamples
- Pollutant list based on vendors claims - Core list by pollutant category:
  - Solids (TSS, TDS, Settleable Solids)
  - Nutrients (P, TKN, Nitrate.Nitrite, Ammonium)
  - Heavy metals (Zn, Pb, Cu, Cd)
  - Petroleum/ Hydrocarbons (TPH, PAH series)
  - Microbiological/Bacteria (Fecal Coliform, E.coli)

Technology panel recommendations that were added in this latest version (Draft 4.1) after a technology panel meeting in November of 2001 include:

- Adding a requirement of suspended sediment concentration as a measure of solids load
- in addition to TSS, including sand/silt split
- Provision of additional guidelines on proper use of automated samplers and sample splitting
- Permitting, but not mandating, analysis of captured sediment/pollutants
- Improving guidance on sampling and lab Quality Assurance

Additional technology panel recommendations still under discussion from November's meeting include:

- Providing guidelines for characterizing trash & debris removal, but not establishing
- removal efficiency quantification procedures
- Adding language about collaborating with other protocol developers, and sharing 3rd
- party credible data generated
- Revisiting some target detection limits and comparing them to other protocols.

## Stormwater BMP Vendor Applications

The stormwater treatment devices being evaluated under the ETV program are designed to reduce the level of one or more constituents of concern in stormwater drainage from a site. These parameters include sediment or particulates, nutrients, heavy metals, petroleum hydrocarbons, and bacteria. The test plan created for a specific device being verified at a given location contains the manufacturers' removal claims relative to any number of these constituents.

To date, twelve vendors have applied for verification of their devices. These devices can be divided into three categories based on their operating principles: In-line Filtration Devices, Hydrodynamic Separators, and In-drain Filtration Devices.

## *In-line Filtration Systems*

As the name of this category implies, these types of BMP devices employ some type of filtration media as the mechanism for removal of stormwater constituents in an in-line device. There are three vendors who have signed up for verification under this category:

1. Zeta Technology, Inc. (Arkal Filtration System)
2. Stormwater Management Inc. (StormGate, StormFilter, StormScreen, and Catch Basin StormFilter)
3. Aquashield, Inc.(Aqua-Swirl Concentrator and Aqua-Filter)

### Arkal Filtration System

The Arkal Filtration System manufactured by Zeta Technology, Inc. is a pressurized stormwater filtration system that was tested at St. Mary's Hospital in Green Bay, WI. Testing was completed September 17$^{th}$, 2002 after fifteen events were captured.

This system consists of two filtration systems. The first filtration process consists of four "towers" of commercial disk filters, each disk filter containing a set of grooved rings. The size of the grooves determines the particle size that will be removed from the stormwater down to a 25-micron minimum size. Disk size for testing purposes was set up with 50-micron rings. Automatic backwash occurs when the pressure differential across the filter rings exceeds a pre-set level. The redundant system allows for simultaneous filtration with three towers, while the fourth tower is in a backwash mode. This allows for uninterrupted filtration. The backwash water is temporarily stored in a backwash tank and then discharged to a sanitary sewer at the end of the runoff period. The filtered stormwater is sent to a second filtration stage.

This second stage consists of a series of five sealed sand filter tanks that receive the water filtered from the disk filters through a manifold distribution system. The sand filter tanks have an automatic backwash cycle when the pressure differential across the sand filter exceeds a pre-set level. Like the first filtration system, this second system is also redundant. The tanks are sealed to maintain a pressurized flow system. Overflow from the back wash tank discharges back into the holding tank, and at the end of a runoff event, the backwash tank is discharged to a sanitary sewer. The filtered stormwater is discharged to the storm sewer system.

The sand filter is designed to remove 90% of particles greater than a 5-micron size. Because of this specific claim, particle size analysis was performed in addition to suspended solids analysis. Sample locations included the influent and effluent and the by-pass, which occurs during larger runoff events.

Other pollutant constituents were selected in addition to manufacturers' claims. These were selected to give watershed managers information to solve water quality problems in their area. These include but are not limited to all the parameters included in the ETV Stormwater Protocol. Additional parameters include COD and a nutrient series.

The field-testing organizations involved at this site included Earth Tech Inc., U.S. Geological Survey (USGS), and the Wisconsin DNR.

**Stormwater Management, Inc. System**

Stormwater Management, Inc. (SMI, Inc.) has a system being tested under the ETV program in Griffin, Ga. with Integrated Science and Engineering, Inc. as the Field Testing Organization (FTO). This system consists of a StormGate, a StormFilter, and a StormScreen.

***StormGate***

A diversion baffle or hydraulic transistor called "the StormGate" by SMI, Inc. is incorporated into this system. It is designed to divert a certain amount of flow to either the StormFilter or the StormScreen, the other two components of the SMI, Inc. system. Stormwater on the east side of Fifth Street at the test site will flow through a StormGate to divert 10 cfs to the StormScreen device. The StormGate will divert any flows exceeding 10 cfs. The StormGate located on the west side of Fifth Street will divert 0.79 cfs to the StormFilter. Flows exceeding 0.79cfs will be diverted back to the storm drain line.

***StormFilter***

The StormFilter portion of the system is composed of filter cartridges housed in a steel vault at a St. Clair Shores, MI ETV test site. This system uses perlite filter media in the filter cartridges. The filter systems are installed inline with the storm drain lines. The system works by percolating stormwater through the perlite filter media. This filter media is designed to trap particulates and adsorb materials such as suspended solids, petroleum hydrocarbons, and particulate bound removal such as particulate bound phosphorus, nitrogen, and metals.

The typical unit configuration consists of an inlet bay, flow spreader, cartridge bay, an overflow baffle and outlet bay. The outlet bay serves as a grit chamber and provides for flow transition into the cartridge bay. The flow spreader provides for the trapping of floatables, oils and surface scum. Water enters the cartridge bay through the flow spreader and starts to pond. When the water ponds, it infiltrates through the filtration media and into the center tube, and begins to raise the float. Once the ponding submerges the cartridges, the float will pull loose from the lower float seal and generate a siphon effect, which greatly increases the flow potential across the filter media. The siphon effect continues until the water is drawn down to the scrubbing regulator portion of the hood, at which time air bubbles are entrained and the siphon is lost. As the bubbles are entrained across the surface of the cartridge, scouring of the solids deposited on the outer screen of the

filter occurs, which acts as a self-cleaning mechanism. Water will continue to drain gravitationally until the float reseats itself and resets the system.

The anticipated removal efficiencies of the StormFilter are between 50 to 70% of TSS, 40 to 45% of Total Phosphorus, and little to no change in Dissolved Phosphorus. Also anticipated are 30% removal of Total Kjeldhal Nitrogen, 40% removal of Total Zinc, and 20 to 40% removal of Dissolved Zinc and Dissolved Copper. All parameters listed in the Stormwater protocol will be tested for in the influent to the device and the effluent from the device.

***StormScreen***

The StormScreen portion of the system is a device that incorporates screening technology with patented, self-cleaning, siphon-actuated, radial flow cartridges. This system is designed to treat high flow rates through fine screening of the influent, and is intended to target trash and debris and larger suspended solids. The system configuration consists of 20 cartridges which are activated by buoyant forces lifting an internal float and opening the lower float seal that draws polluted influent via a siphon, ensuring a constant operating flow rate as well as even flow distribution over the entire cartridge surface. Polluted stormwater is treated by settling as water enters the vault and by being drawn through the small openings of the StormScreen cartridges.

This system was installed in Griffin, GA in August of 2002 with ISE, Inc. as the FTO.

**Catch Basin StormFilter**

The Catch Basin StormFilter is manufactured by Stormwater Management, Inc. (SMI, Inc.), and is a passive, flow-through stormwater filtration system. It is engineered to replace the standard catch basin, and consists of a concrete or steel vault that houses rechargeable cartridges filled with a variety of filtration media. In the Catch Basin StormFilter, polluted runoff enters the system through a traffic-bearing grate into the primary settling chamber where heavier solids drop to a sump. The runoff water containing the lighter solids and dissolved pollutants is then directed under a baffle into the cartridge chamber where the StormFilter cartridges are housed. The StormFilter works by passing this water through the media-filled cartridges, which are intended to trap particulates and adsorb pollutants such as dissolved metals, nutrients, and hydrocarbons. This catch basin device can be customized to site-specific conditions by using different filter media to remove the desired levels of sediments, soluble phosphorus, nitrates, soluble metals, and oil and grease.

A Catch Basin StormFilter unit designed using CSF® leaf media is being tested under the ETV program. To create this media, Stormwater Management composts leaves into mature stable humus. This humus is then processed into organic granular media created used to remove TSS, oil and grease, and soluble media. CSF (Compost Stormwater Filter), a registered trademark type of media from SMI, Inc., that is a specific gradation of media. It is a level of media retained by a certain sieve size.

The manufacturer states that there are three primary pollutant removal mechanisms performed by the media:

1. Mechanical filtration to remove sediments and associated total phosphorus
2. Chemical processes to remove soluble metals including lead, copper, and zinc
3. Adsorption processes to remove oil and grease

This Catch Basin StormFilter comprised of four cartridges housed in a steel vault was installed in August at a site in St. Clair Shores, MI. Environmental Consulting and Technology, Inc. (ECT, INC.), the selected FTO, will evaluate this unit.

The performance claims from SMI, Inc. literature indicate that suspended solids removal during testing may reach 95%, depending on particle size distribution and influent concentration. Heavy metals removal rates from 65% to 95% may also be anticipated due to the cation exchange mechanism provided by the humic substances in the CSF leaf media. The high organic content of this CSF media facilitates removal of oil and grease as well as some other organic compounds. The system is optimized for oil and grease removal when loadings are less than 25mg/l. Under these conditions, removal rates may be expected to reach 85%.

### *Aqua-Filter Stormwater System*

The final vendor that has applied for ETV verification of a filtration device is Aquashield, Inc. Their filtration device submitted for verification is known as the "Aqua-Filter Stormwater Filtration System." It is an in-line stormwater filtration system capable of treating large flow rates. Each Aqua-Filter system is custom engineered for the site and utilizes a unique "treatment train" approach which includes a Swirl Concentrator designed for pre-treatment followed by a filtration chamber designed to remove fine sediments, water-borne hydrocarbons, and nutrients such as phosphorus and nitrogen. The Swirl Concentrator portion of the system is a hydrodynamic separator designed to remove TSS (coarse/fine sediment) and free floating oil and debris.

The filtration chamber that follows the Swirl Concentrator in the treatment train contains a cellulose filter media designed for polishing of the stormwater before discharge. There are no moving parts in the system. The manufacturer claims that previous test results indicate a 90-95% removal rate of dissolved petroleum and oils. The patented filter media changes from tan to black when it needs to be removed. High Density Polypropylene is used in lieu of concrete, making the Aqua-Filter System relatively lightweight and chemically resistant.

Field-testing of this unit under the ETV program has not been initiated to date.

## *Hydrodynamic Separators*

A second classification of stormwater treatment devices is generally referred to as "hydrodynamic separators." Basically, a hydrodynamic separator is some type of cylindrical vessel in which a flow stream is introduced tangentially to induce a swirling flow pattern. This causes settleable solids to be accumulated and stored in a manner and a location that will prevent re-suspension of previously captured particulates.

There are five vendors that have applied whose operating principles fit this hydrodynamic separation classification. These include: Baysaver, Inc. with the Baysaver, Practical Best Management (PBM) with the Crystal Stream Oil/Grit Separator, Vortechnics, Inc. with the Vortechs System, CDS Technologies, Inc. with the Continuous Deflection Separator (CDS) device, and Hydro International with the Downstream Defender.

**Baysaver**

The Baysaver Separation System is designed for use as an in-line separation system for the removal of sediments and floatable particles. Separation within the unit occurs as a result of density differences between stormwater and materials being carried by the stormwater. Materials with a specific gravity greater than one are removed as a result of sedimentation, while materials with a specific gravity less than one are removed by floatation. Molecules such as hydrocarbons adsorb to particles that separate out in both the primary and storage manholes. Flow through the BaySaver unit is controlled by the use of a trapezoidal weir that allows the Baysaver Separation System to dictate the volume of water being treated in the storage manhole.

The Baysaver Separation system is comprised of two precast manholes and a High Density Polyethylene Baysaver Separator Unit. The primary manhole is set in-line with the storm drainpipe, and the storage manhole is offset to either side. According to the manufacturer, the two manholes, which must be watertight, provide the retention time and storage capacity necessary to remove the target pollutants from the influent water. The Baysaver Separator Unit is designed to act as a flow control, diverting the influent water to the flow path that will result in the most efficient pollutant removal.

The primary manhole is designed to remove coarse sediments from the influent water and retain them in an eight-foot deep sump. A portion of the influent flow is skimmed from the surface of the primary manhole by the Baysaver Separator Unit and conveyed to the storage manhole. This water enters the off-line storage manhole at an elevation below the water surface and above the floor of the structure, allowing both flotation and sedimentation to occur. The fine sediments and floatables that are entrained in this water remain retained in the manhole.

The Baysaver Separator Unit is designed to limit the flow through the storage manhole by allowing excess water to pass directly from the primary manhole to the outfall. During high intensity storms, the Baysaver Separator Unit Draws water from the center of the primary manhole, approximately four feet below the water surface, and discharges it to the outfall. Simultaneously, it continues to skim the surface water and treat it through the storage manhole. Extremely high flows are conveyed by the separator unit to the bypass, and bypass the storage manhole completely.

The storage manhole is designed to store oils, fine sediments, and floatables off-line; the internal bypass is designed to minimize the risk of resuspension and discharge of contaminants. The system is also designed to minimize the volume of water that must be removed during routine maintenance, resulting in lower disposal fee.

Baysaver, Inc. reported that their Baysaver Separation System will provide a net removal efficiency ranging between 60 to 80% removal of Total Suspended Solids and will also remove a significant portion of free oils that enter the system.

The Baysaver, Inc. System was installed at a site in Griffin, GA in August of 2002, and testing is on-going.

**Crystal Stream Oil/Grit Separator**

Practical Best Management (PBM) of Georgia, Inc manufactures the Crystal Stream Oil/Grit Separator. It is a limited space BMP device that utilizes settlement as the primary constituent removal method; as velocity slows, sediment and grit carried by the stormwater collect in the bottom of the device. It contains a separate oil chamber designed such that motor oils and other fluids that float on water are skimmed and captured in this reservoir for recovery. A trash rack on the top of the device is intended to capture Styrofoam cups and cigarette butts. The unit is purported by PBM, Inc. to capture over 99% of petroleum products and nearly 95% of silt and grit, also entraining many chemicals and heavy metals.

This device was installed and is in the process of being tested at a site in Griffin, GA ISE, Inc. is serving as the FTO.

**Vortechs System**

Vortechnics, Inc manufactures the Vortechs System. It is a design that combines swirl-concentrator and flow –control technologies to ensure effective capture of sediment and oils, and prevent resuspension of trapped pollutants even at flow rates up to 25 cfs.

The Vortechs System consists of a Grit Chamber, an Oil Chamber and Baffle Wall, and Flow Control Chamber. In the grit chamber, a swirling motion created by the tangential inlet directs settleable solids toward the center of the chamber. Sediment is captured in the flow path and settles back into the chamber after a storm event is over. The Oil Chamber has a center baffle that is designed to trap floatables in the oil chamber even during cleanout. In the flow control chamber, the weir and orifice flow controls raise the level and volume in the system as the flow rate increases, and gradually drains the system as the flow rate subsides.

The Vortechs System is being tested at a site in Milwaukee, WI. EarthTech, Inc. in conjunction with the WI DNR and USGS is serving as the FTO.

**Downstream Defender**

HydroInternational manufactures the Downstream Defender. The Downstream Defender is a dynamic separator designed to remove floatables, sediment and free oil from stormwater runoff. Raw liquid is introduced tangentially into the side of the of the cylinder and spirals down the perimeter allowing heavier particles to settle out by gravity and the drag forces on the wall and base of the vessel.

The base of the unit is at a 30 Degree angle. As the flow rotates about the vertical axis, solids are directed at the base of the facility where they are stored in the collection facility. The internal components are designed to direct the main flow away from the perimeter and back up the middle of the vessel as a narrower spiraling column rotating at a slower velocity than the outer downward flow. A dip plate is suspended from the underside of a component support frame. The dip plate locates [better word?] the shear zone and establishes a zone between it and the outer wall for floatables, oil, and grease. According to the manufacturer, the flow that reaches the top of the vessel should be virtually free of solids and is discharged through the outlet pipe. A sump vac procedure is used to remove floatables and solids.

Testing has not begun to date on the Downstream Defender; the test site has yet to be determined.

### CDS Technology

CDS Technology markets the CDS device that is designed to divert the portion of the stormwater containing the majority pollutants (i.e. first flush) into the screen chamber. This water is treated and then returned to the stormwater system. Flows in excess of the CDS treatment flow bypass the screen chamber. Captured solids are permanently retained within the CDS screen and sump. Floating solids are kept in continuous motion on the water surface while heavier materials go into the sump. CDS units use a continuously cleaning screen. The screen is designed to remove neutrally buoyant particles that are captured by typical baffled systems.

A test site for the CDS unit is yet to be determined.

## *In-drain Filtration Systems*

In-drain filtration systems are catch basin inserts designed to remove various pollutants by means of some type of filtration media. There are five different catch-basin inserts that we are verifying in the ETV program. These are the Ultra Urban Filter with Smart Sponge from AbTech Industries, Inc., the Ultra-Drain Guard Oil and Sediment Plus from UltraTech International, Inc., the Hydro-Kleen™ Filtration System from Hydrocompliance Management, Inc., Drain Pac from DrainWorks, Inc., and the Flo-Gard Plus manufactured by Kristar Enterprises, Inc.

### UltraUrban Filter

AbTech Industries, Inc. manufactures this BMP Device. The Ultra Urban Filter with Smart Sponge is an in-drain insert designed to remove sediment, hydrocarbons, and debris from stormwater. The Ultra Urban Filter Series DI2020 is made of high strength corrugated plastic designed to "drop-in" existing stormwater catch basins. It is used in storm drains that experience oil and grease pollution accompanied by sediment and debris.

The filter is designed such that trash and sediment accumulate in the internal basket while oil and grease are captured in the filtration media. According to the manufacturer, oil is bonded with the SmartSponge so that it will not leach back into the environment.

It was installed in August of 2002 at a test site in Griffin, GA and is being evaluated by ISE, Inc. as the FTO.

### Ultra-Drain Guard Oil and Sediment Plus

UltraTech International, Inc. manufactures this "Catch Basin Insert" device. It is designed to capture oil, grease, trash, and sediment from stormwater runoff before it enters the storm drain system. It is installed in a catch basin and is suspended by the grate itself. Stormwater runoff enters the Ultra-Drain Guard Oil and Sediment Plus and is directed toward the pouch by a skirt made of a nom-woven [?] polypropylene, needle-punched, geotextile material. The fabric itself is designed to filter pollutants as the runoff passes over and flows through the material. In addition, each Ultra-Drain Guard Oil and Sediment Plus is equipped with several "filter strips" made of "X-Tex," a unique filter material made of recycled synthetic fibers. The manufacturer claims that this material is extremely effective in the capture and removal of hydrocarbons and other pollutants from stormwater. These filter strips are intended to maximize oil and hydrocarbon removal.

The Ultra-Drain Guard Oil and Sediment Plus are designed with "ByPass Ports" to prevent flooding and ponding from occurring. One unit is said to be capable of filtering out and containing a minimum of forty pounds of oil, sediment, debris, and floatables.

The Ultra-Drain Guard Oil and Sediment Plus was installed in a site in Griffin, GA. in August of 2002. ISE, Inc. is serving as the FTO, and testing is ongoing.

**HydroKleen**

Hydro Compliance Management, Inc., of Ann Arbor, Michigan (Hydro Compliance), manufactures and markets the Hydro-Kleen™ Filtration System. The Hydro-Kleen™ is a stormwater catch basin insert designed to trap hydrocarbons, metals, sediments, and other contaminants contained in stormwater and other surface runoff. The Hydro-Kleen™ contains a multi-chamber system that combines pre-settling sediment removal with dual media filtration. The system is designed to filter hydrocarbons and other contaminants while alleviating concerns with water flow. The Hydro-Kleen™ Filtration System is promoted as a structural BMP to assist end users in complying with meeting NPDES Phase II stormwater compliance permit and other regulatory requirements for protecting surface water runoff quality.

The Hydro-Kleen™ Filtration System is a patented multi-media filtration design combined with pre-settling sedimentation containment and overflow by-pass protection for 'hot spot' applications. Each unit is custom manufactured for retrofit or specification to fit a specific catch basin or drain invert size. Units are placed into drains by removing the grate/cover, inserting the unit onto the grate lip, and replacing the cover. Water flow enters the unit and is directed into a pre-settling sedimentation chamber that collects heavy sediments and debris passing through the grate. Water then passes through transition inlets at the top of the sediment chamber into the filtration chamber. The primary media, Sorb-44, is intended to remove hydrocarbons through adsorption. The secondary media is a blend of activated carbon (AC-10) that is intended to remove any remaining hydrocarbons, as well as a variety of other organics, metals, and other contaminants from the runoff. Water then passes through the of the bottom treatment chamber into the catch basin.

Units are designed to trap contaminants contained in the 'first flush' from storm events while allowing overflow protection to eliminate flooding during heavy wet weather events. To accomplish this, the filtration chamber is designed to handle 40 – 50 gpm through the media chamber, effectively handling up to ½ in. of rain per hour in a properly designed drain. Higher flows from high intensity wet weather events are diverted to by-pass outlets that are designed to move whatever flows the drain is designed to handle. This is intended to prevent flooding or ponding on the surface while capturing contaminant loadings from impervious surfaces.

The Hydro-Kleen System is being tested under two different protocols. Laboratory testing is being done under the protocol for in-drain devices developed under the Source Water Protection Pilot in Ann Arbor at NSF International. Field-testing is being conducted at a site in St. Clair Shores, MI under the Stormwater Source Area Treatment Device Protocol.

**DrainPac**

DrainWorks, Inc manufactures DrainPac. It basically consists of three types of parts: a metal support bracket, flexible polymer support structure, and a replaceable bag filter. DrainPac is designed to trap or collect sediment, oil and debris from drain inlets.

A test site and testing organization has yet to be determined.

**Flo-Gard Plus**

Flo-Gard Plus is manufactured by Kristar Enterprises, Inc. It is a catch basin filtration system designed to be effective in the removal of sediment, trash and debris. It features a stainless steel outer basket, a filter liner, and an HDPE adapter ring to allow for use in a wide range of design applications. It also offers a dual bypass feature, an initial "filtering" high flow bypass and an "ultimate" high flow bypass. In both bypass modes, pollutants remain trapped in the system.

This device is not being tested yet, since the site has yet to be determined.

## Summary

This is a snapshot of the Stormwater Technology Area of the ETV Program, as it exists in September of 2002. Twelve vendors have applied for verification with thirteen different devices submitted for verification testing. Testing of the Arkal Filtration System has been recently completed in Green Bay, WI. Testing is on-going for the Vortechs System in Milwaukee, WI under the direction of EarthTech, Inc. as the FTO, and in conjunction with the Wisconsin DNR and US Geological Survey (USGS). Testing is also underway for the Hydro-Kleen Filtration System and the Catch Basin StormFilter from SMI, Inc. in St. Clair Shores, MI with ECT, Inc. as the FTO. In Griffin, GA, with ISE, Inc. as the FTO, verification testing is on-going for the Crystal Stream Oil/Grit Separator from PBM of GA, the StormGate, StormFilter, and StormScreen from the Stormwater Management Inc. (SMI), and the Baysaver Separation System from Baysaver, Inc. Ultra-Urban Filter from AbTech Industries, and the Ultra-Drain Guard Oil and Sediment Plus unit from UltraTech International, Inc. are also being tested in Griffin with ISE, Inc. as the FTO. Five devices that have not begun testing include: the FloGuard Plus from Kristar, Aqua-Filter Stormwater System from Aquashield, the CDS Device from CDS Technologies, the DrainPac from DrainWorks, and the Downstream Defender from HydroInternational, Inc.

As mentioned, our protocol is constantly evolving as test plans are developed and finalized. A current copy of the protocol can be found either on the EPA or NSF ETV web sites, http://www.nsf.org/etv and http://www.epa.gov/etv. Also, verification results in the form of Verification Reports and Statements for the testing that has been completed to date can be found on these web sites.