Environmental Technology Verification Report

of the

Low-Cost Stormwater BMP Study
Abstract

This Technology Verification report describes the nature and scope of an environmental evaluation of catchbasin inserts manufactured by AbTech Industries, AquaSheild, Inc., GeoMarine, Inc., and PacTec, Inc. The information contained in this report represents data that were collected in a laboratory study. The study was limited in scope and therefore the information contained within this report should be combined with other evaluations to understand the total capabilities of the inserts. The data as summarized within this Evaluation Report are being made available and distributed to federal, state, and local governmental regulators and to the stormwater treatment community. The goal of this report is to provide users and purchasers of the inserts with information they need to make more informed decisions about catchbasin inserts and their stormwater discharge.
Acknowledgements

The Civil Engineering Research Foundation (CERF) and the University of Arkansas would like to thank those persons who participated in the preparation, review, and approval of this protocol. Due to their efforts, the overall usefulness of this project has been greatly improved.

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We also express appreciation to those companies that assisted by providing equipment for completion of the research. Those companies include: Instrument and Supply Inc. of Hot Springs, AR, Geotechnical Marine Corp, Key West, FL, AbTech Industries, Scottsdale, AZ, AquaShield, Inc. Chattanooga, TN and PacTec, Inc. Clinton, LA.

Finally, the project would not have been possible without the support of the funding agencies. Funding for this project came from the Mack-Blackwell Transportation Center at the University of Arkansas at Fayetteville, the Arkansas Department of Highways and Transportation (AHTD), and the Federal Highway Administration (FHWA) under the Storm Water Evaluation Component of the FHWA’s Pooled Fund Project (DTFH61-02-X-00010).

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Disclaimer

The information in this document has been funded in part by the Federal Highway Administration (FHWA) under the Storm Water Evaluation Component of the FHWA’s Pooled Fund Project (DTFH61-02-X-00010) with the Civil Engineering Research Foundation’s (CERF) Environmental Technology Evaluation Center (EvTEC). This verification effort has been subjected to CERF’s peer and administrative review. CERF and FHWA make no expressed or implied warranties as to the performance of the inserts evaluated. Mention of corporation names, trade names, or commercial products does not constitute endorsement or recommendation for use of specific products.
Verification Statement

Civil Engineering Research Foundation’s Verification Statement for the Low-Cost Stormwater BMP Study

Technology Type: Stormwater Treatment Technology
Application: Catchbasin Insert Stormwater Treatment
Technology Name: Catchbasin Insert BMPs

Company: AbTech, Industries
Address: 4110 N. Scottsdale Rd. Suite 235
Scottsdale, AZ  85251
Phone: 800-545-8999
URL: http://www.abtechindustries.com/

Company: PacTec, Inc.
Address: PO Box 8069
Clinton, LA  70722
Phone: 800-272-2832
URL: http://www.drainpac.com/

Company: GeoTechnical Marine Corp.
Advanced Aquatic Products International, Inc.
Address: 1107 Key Plaza #201
Key West, FL   33040
Phone: 305-292-3070
URL: http://www.Hydro-Cartridge.com

Company: AquaShield, Inc.
Address: 2733 Kanasita Dr.
Chattanooga, TN   37343
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Program Operation
The CERF Evaluation Program, in partnership with a panel of experts, objectively and systematically documents the performance of commercial-ready technologies. Together, with the full participation of the technology developer, they develop plans, conduct tests, collect and analyze data, and report findings. Verifications are conducted according to a rigorous workplan and established protocols for quality assurance. CERF’s Evaluation Program acts as an objective third-party evaluation service.
Technology Description
The technology treatment processes used in catchbasin inserts include: screening, sedimentation, absorption, and floatation depending on the manufacturer. Trash and debris are removed by screening, sediment is removed by sedimentation, whereas, oils, organic chemicals, and hydrocarbons are removed by floatation and absorption.

Evaluation Description
The primary objective of the evaluation of catchbasin inserts was to perform well-defined laboratory tests to provide performance data on each manufacturer’s equipment. The data is summarized with this Evaluation Report are being made available for distribution to federal, state, local environmental regulators and to the stormwater treatment community. The goal of this report is to provide potential users and purchasers of catchbasin inserts with this information so that they can make informed decision about using catchbasin inserts in their communities.

Availability of Verification Statement and Report
Copies of the public Verification Statement and Verification Report for the Low-Cost Stormwater BMP Study are available from the following:

Civil Engineering Research Foundation
Suite 600
1015 15th Street, NW
Washington, DC 20005
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Acronyms and Abbreviations

ASCE  American Society of Civil Engineers
CERF  Civil Engineering Research Foundation
FHWA  Federal Highway Administration
EvTEC Environmental Technology Evaluation Center
QA/QC Quality Assurance/Quality Check
TPH   Total Petroleum Hydrocarbons
TSS   Total Suspended Solids
UofA  University of Arkansas
USEPA United States Environmental Protection Agency
WAC   Walton Arts Center

cm    centimeter
ft    foot
gpm   gallons per minute
ha    hectare
in    inch
kg    kilogram
lb    pound
m³/s  cubic meter per second
mm    millimeter
mg/L  milligram per liter
Technical Evaluation Panel Key Contacts

Technology: Low Cost Stormwater Best Management Practices

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EvTec assemble the Technical Evaluation Panel Composed of representatives from the user community, academia, and the private sector. The panel oversaw the development and execution of the EvTEC Evaluation Plan and the preparation of this Verification Report. The Technical Evaluation Panel, with the cooperation and assistance of the applicants, identified specific project goals pertaining to the technology
1.0 Introduction

This verification report describes the nature and scope of an environmental evaluation of catchbasin inserts manufactured by four different companies: AbTech Industries, GeoTechnical Marine Corp., AquaShield, Inc., PacTec, Inc. The inserts are manufactured to be retrofitted into existing catchbasins in order to remove sediment, hydrocarbons, metals, nutrients, and debris from stormwater runoff.

The evaluation process and the creation of this report was overseen and coordinated by the Environmental Technology Evaluation Center (EvTEC), a service center of the Civil Engineering Research Foundation (CERF), the research and technology transfer arm of the American Society of Civil Engineers (ASCE). EvTEC is operated through a cooperative agreement with the U.S. Environmental Protection Agency (USEPA). The research was conducted as partial fulfillment of the requirements for a Master’s Degree in Civil Engineering and the thesis, with more indepth analysis, is available at the University of Arkansas (Morgan, 2003).

The inserts were evaluated using a prototype catchbasin and in existing parking lot catchbasins. In the prototype catchbasin, a synthetic stormwater was passed through the inserts and the pollutant removal effectiveness was determined at a high flowrate. Operational requirements of the inserts were monitored for six months in catchbasin located in parking lots in Fayetteville, Arkansas.

The goal of this report is to provide users and purchasers of catchbasin inserts with information needed to make informed decisions about the inserts.

1.1 Technical Background

Stormwater characteristics vary from area to area; but, EPA (2001) listed the target pollutants for treatment with catchbasin inserts as litter and debris, solids (both coarse and suspended), and oil and grease (EPA, 2001). Other pollutants are of concern in stormwater are metals (zinc, copper, lead), nutrients (nitrogen, phosphorus), and pathogens. The pollutant removal mechanisms of catchbasin inserts are: screening, sedimentation, flotation, and absorption. Debris and large particles are removed by screening; smaller particles and sediment along with associated hydrocarbons, metals, nutrients, and pathogens are removed by settling; and hydrocarbons that are not associated with sediment are removed by absorption.

1.2 Project Goals

The goal of this project was to evaluate the pollutant removal efficiency of catchbasin inserts treating a flowrate that would be experienced due to a 30-minute SCS Type II storm with pollutant concentrations that are typical for parking lots. In addition, the inserts were evaluated for operational problems. The pollutants that were of concern were: suspended solids, total petroleum hydrocarbons (TPH) and a representative metal (zinc).
1.3 Summary/Overview of Test Program
The Department of Civil/Environmental Engineering at the University of Arkansas was contracted to evaluate inserts. University of Arkansas personnel conducted pilot scale simulations to determine the pollutant removal effectiveness and field tests to observe the inserts under actual working conditions to determine if there were any unexpected operational, maintenance, safety, nuisance, or other issues associated with the inserts. University of Arkansas personnel collected all samples and recorded all observations. Manufacturers representatives were not present during the evaluations.

Suspended solids analytical tests were conducted by University of Arkansas researchers. Total petroleum hydrocarbon analytical tests were conducted by an EPA Certified Laboratory, Environmental Services Company, Inc. of Springdale, Arkansas. Zinc analytical tests were conducted by an EPA Certified Laboratory, the USDA Poultry Waste and Water Quality Laboratory on the University of Arkansas campus. The data are presented in Appendix A.

2.0 Methods and Materials
The four inserts were evaluated under field conditions and in pilot scale tests. The field observations were conducted in two parking lots in Fayetteville, Arkansas. The manufacturers provided inserts to hang from the frames of the existing catchbasins in the two parking lots and for pilot scale testing.

2.1 Field Observation
There were two field observation sites, the first site is the Walton Arts Center (WAC) Parking Lot, which provides parking for special events, parking for small businesses (restaurants, bars, and shops), and overflow parking for the University of Arkansas. The second site is the University of Arkansas Physical Plant Vehicle Maintenance Yard (UofA Maintenance Yard), which provides parking for construction equipment and maintenance vehicles.

The WAC Parking Lot is paved with asphaltic concrete, has no significant run-on, and has area drop inlets to direct runoff to the stormwater collection system. The contributing area to each inlet was approximately 0.2 hectares (0.5 acres) with about 90 percent pavement and 10 percent green space. Grate and frames for the drop inlets are Neenah model R-3573 (Neenah Foundry Company, Neenah, WI). The inserts were placed in the lot and observed for four wettest months of the year (mid-March to mid-July).

The UofA Maintenance Yard is paved with asphaltic concrete, has no run-on, and has area drop inlets to direct runoff to the stormwater collection system. The contributing area to each inlet was approximately 0.14 hectares (0.35 acres) with about 60 percent pavement and 40 percent roof top. Grate and frames for the drop inlets are constructed of steel pipe and angles. The inserts were placed in the lot and observed for seven months (mid-March through October).
2.2 Pilot Scale Testing
The purpose of conducting the simulator study was to test the inserts under controlled conditions. So a simulator was constructed that would:

- provide a known volume and flow rate of water,
- provide known pollutant concentrations,
- allow collection of samples from different tests under near identical conditions, thus allowing for comparison between tests, and allow collection of samples in accordance with a set schedule.

The flow rate selected for the testing was 0.013 to 0.014 m$^3$/s (200 to 215 gpm). This flow rate was selected because it would be comparable to the average flow rate for a 30 minute storm on the 0.1 ha (0.25 acre) lot as computed by the SCS method. Ten test runs were made on each of the four inserts.

Pollutant concentrations of 225 mg/l TSS and 31 mg/l TPH were selected as typical for stormwater from parking lots based on studies by Novotny and Olem (1994), the ICBIC (1995), and Woodward-Clyde (1998). City of Fayetteville water was spiked with sediment and diesel fuel to obtain these concentrations. The sediment was minus-30 sieve (0.6 mm) street sweepings from the City of Fayetteville. Other than any zinc associated with the street sweepings, zinc was not added to the synthetic stormwater.

A schematic of the pilot scale set up is shown in Figure 1 and a picture of the pilot scale setup is shown in Figure 2. The simulated catch basin consisted of a wooden frame 122 cm square (48 in) and 122 cm (48 in) high. Into this frame, a 76.2 cm x 71.1 cm (30 in x 28 in) hole was cut representing the catch basin frame. The platform was coated with fiberglass to prevent sorption of oil and grease by the wooden frame.

The water was distributed around the periphery of the catch basin in a 5.08-cm (2-in) manifold with 1.3 cm (0.5 in) orifices at 2.54 cm (1.0 in) centers (see Figure 3). The water ran a short distance over a platform on the simulator, then fell over the edge of the catch basin into the insert. This distribution system allowed the system to simulate weir flow into the insert and also allowed for maximum use of the insert material for treatment of the waste.
Figure 1. Schematic of pilot scale setup.

Figure 2. Side view of pilot scale set up.
2.3 AbTech Industries
The AbTech insert is constructed from high strength corrugated plastic. There are two parts to the AbTech insert, a plastic flange that rested on the catchbasin frame, and the insert that hangs about four inches below the flange (Figure 4). Inside the insert, a plastic mesh covers the sides and bottom. An absorbent material is contained between the wire mesh and the sides or bottom of the insert. After falling through the grate, the water flows directly through the insert and then is discharged from the bottom of the insert. Water ponds in the insert to a point where the available head in the insert is enough to push water through the absorbent material to discharge out the bottom. When flow is higher than the insert could treat, then water bypasses the insert by overflowing between the top of the insert and the plastic flange.

Treatment processes used in the AbTech insert are screening, sedimentation, and absorption. The plastic mesh on the inside of the insert provides screening. Between this mesh and the sides, and between the mesh and the bottom of the insert is an absorbent material that provides for oil and grease absorption. The insert used in the test was 63.5 cm (25 in) deep and the water surface area at the top of the insert unit was 2090 cm² (2.25 ft²).
2.4 AquaShield, Inc.
The AquaShield insert is constructed from stainless steel and high-density polyethylene (HDPE). Stainless steel forms the flange used for hanging the insert from the catch basin frame and supports the insert that is hung below the flange (Figure 5). In the insert, there is an upper compartment that provides for settling. A slotted plug divides the upper and lower compartments and provides straining of stormwater as it flows through the insert. The lower compartment contains an absorbent pillow for oil and grease absorption.

Water enters through the catch basin grate and into the top of the insert then flows through the slotted plug, into the upper compartment of the insert. Water ponds in the upper compartment to a point that the available head is enough to push the water through the slotted plug and the absorbent pillow to discharge out the bottom. When the flowrate is higher than the unit could treat, water bypasses the lower compartment by flowing out of ports around the periphery of the insert. A metal collar inside of the upper compartment prevents bypass of water from the entrance directly to the overflow ports. This collar forms a baffle that forces water downward first, then back up to the overflow.

Treatment processes used in the AquaShield insert are straining, sedimentation, and absorption. The slotted plug that separates the upper compartment from the lower compartment provides straining. Settling occurs in the upper compartment. Absorption of oil and grease was accomplished by the absorbent pillow, which is
filled with a patented cellulose material. The AquaShield insert was 46 cm (18.1 in) deep and the surface area at the top of the insert was 1642 cm$^2$ (1.77 ft$^2$)

![Diagram of AquaShield catchbasin insert](image)

Figure 5. AquaShield catchbasin insert.

2.5 DrainPac
The DrainPac insert is constructed of metal frame to which a plastic mesh is suspended. The metal collar can be constructed to set on the catchbasin frame or to be attached to the catchbasin walls. Set inside of the plastic mesh, a bag filter is placed provide both straining and absorption (Figure 6). Water flows into the insert through the catch basin grate and into the top of the insert. Water flows through the bag filter and then is discharged out of the bottom of the insert. Water ponds in the insert to a point where the available head was enough to push the water through the filter bag. When the flowrate was higher than could be forced through the filter bag then water bypasses the insert by flowing out of four overflow tubes.

Treatment processes used in the DrainPac insert are straining, sedimentation, and absorption. The bag filter provides straining and absorption. Settling occurs within the filter bag volume. The DrainPac insert tested was 50.8 cm (20 in) deep and the water surface area at the throat of the insert was 3,123 cm$^2$ (3.36 ft$^2$)
2.6 HydroCartridge

The HydroCartridge insert is a single unit constructed from fiberglass that is hung from the catchbasin frame on flanges molded into the insert (Figure 7). Water flows through the catch basin grate and into the top of the insert. From there, all water was forced to flow to the bottom of the insert, then backed up in annular space on two sides where it discharged from the insert over horizontal weirs on each side of the insert. The discharge over the weirs caused water to stand in the insert at all times; but, the company can provide for the insert to drain between storms.

Treatment processes used in the HydroCartridge insert were sedimentation, flotation, and absorption. Sediment and coarse particles with settling velocities greater than the upward velocity in the annular space will settle out. An absorbent sock suspended in the throat of the insert absorbed oil and grease. HydroCartridge’s absorbent is a patented material labeled “Rubberizer™.” The insert tested was 96.5 cm (38 in) deep and the surface area at the throat of the insert of 3690 cm² (3.98 ft²).

Figure 7. HydroCartridge catchbasin insert.
2.7 Analytical Methods
Analysis for total suspended solids (TSS) was conducted in accordance with Standard Methods 2554 D (APHA, 1998). For total petroleum hydrocarbons (TPH) EPA Method 0418.1 (EPA, 1983b) was used in the analysis. Dissolved zinc samples were analyzed with a SPECTRO Model D ICP Atomic Emission Spectrometer (Kleve, Germany) according to APHA Method 3030E (APHA, 1998).

2.8 Sampling Location and Frequency
Influent grab samples were collected at the top of the pilot scale simulator where water entered the insert. Effluent grab samples were collected below the insert and above the effluent collection pan. The heaviest stream of effluent flow was used as the sampling point. Influent samples were taken at 2, 15, 17, and 30 minutes during each test. The results of the influent tests were averaged for a single influent value. Effluent samples were taken at 5, 10, 20, and 25-minute. The results of the effluent samples were also averaged for a single effluent value.

3.0 Evaluation Project Results

3.1 Field Observations
Installation of the inserts was a simple process and involved lifting the grate, cleaning the frame, setting the insert into the frame, and replacing the grate. At the WAC Parking Lot, the grates were heavy enough to require utilization of a backhoe to lift the grate and to replace it after the insert was installed. Therefore, heavy grates would add to the insert maintenance cost because of the need to have a piece of equipment and an operator each time an insert was cleaned. At the UofA Maintenance Yard, the grates were light enough to lift by hand.

The total rainfall in Fayetteville during the period of study was very close to normal rainfall for the period. The measured rainfall by the National Weather Service at the Drake Field, Arkansas weather station for March 1 through Oct. 31, 2003 was 83.3 cm (32.8 in) versus the 30-year average of 85.2 cm (33.5 in) for the same period (NWS, 2003).

Very little material accumulated in the inserts during the observation period. The lack of accumulation of material was likely due to the almost totally impervious nature of the drainage areas. There was essentially no run-on onto the site; therefore, the only sediment available to the inserts was that which fell off of vehicles in the parking lot. It was noted that the water flowing into the catchbasins WAC Parking Lot was clear. Stormwater runoff was not observed at the maintenance yard.

The material captured by the inserts at the Walton Arts Center, ranged from 40 cm$^3$ to 190 cm$^3$ (2.4 in$^3$ to 11.6 in$^3$) per insert (Table 1). Removal of accumulated
sediment, debris, and other material was not required for any of the inserts during the test period. A sieve analysis was not conducted on the material from the HydroCartridge insert because there was not enough material to analyze.

Table 1. Accumulated solids analysis from the WAC Parking Lot inserts.

<table>
<thead>
<tr>
<th>Insert</th>
<th>Sediment Volume, cm³</th>
<th>Sieve Size (mm) % Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4.75</td>
</tr>
<tr>
<td>AquaShield</td>
<td>100</td>
<td>17.6</td>
</tr>
<tr>
<td>AbTech</td>
<td>150</td>
<td>38.9</td>
</tr>
<tr>
<td>HydroCartridge</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>DrainPac</td>
<td>190</td>
<td>8.5</td>
</tr>
</tbody>
</table>

The results from the field test show 67.7% of particles captured were larger than 0.6 mm diameter. Using Stoke’s equation, and an idealized catch basin insert with a throat water surface area of 3000 cm² (1.27 ft²) and a flow rate of 0.013 m³/s (200 gpm) it was calculated that particles larger than 0.3 mm and some fraction of smaller particles should be removed. This calculation compared favorably with the results given above. The turbulence in the working inserts made them less than idealized settling basins; therefore, causing smaller particles to not be captured. The material captured during the five-month testing period at the Walton Arts Center was mostly coarse sediment, leaves, debris, and litter. In the AbTech insert, enough sediment was captured to support the growth of small vegetation. The AquaShield insert collected material below the filter tray in the second compartment.

Maintenance problems encountered in with the inserts included:

- The AquaShield insert filter tray was unseated during most storms and had to be reset by manipulating it with a metal rod through the grate.
- The HydroCartridge insert was quickly filled with sand from equipment washing at the UofA Maintenance Yard and had to be removed because of flooding problems reported by the maintenance staff. The insert was not reinstalled.
- The DrainPac insert unintentionally had a frontend loader bucket load of dirt dumped into it at the UofA Maintenance Yard; but, only partially filled it, so the insert was left in place, but the material captured was not considered representative of stormwater pollutants.
- The AbTech insert at the WAC Parking Lot had a lot of leafy debris from one storm but the debris had washed out a week later after another storm.
Some of these problems should not be construed as related to these particular inserts; because, each installation or incident was not similarly tested on all inserts. These problems did indicate:

- Public works staff should be educated on the water quality issues related to operation of stormwater BMPs.
- The inserts did capture material from accidental spills and therefore indicates that inserts were effective in preventing accidental spills of sediment.
- Debris (leaves, paper, etc.) might dry out between storms and may wash out of inserts during subsequent storms.
- Inserts must be cleaned according to specific site conditions.

### 3.2 Pilot Scale Tests

Hydraulic capacity testing of the inserts with clean water indicated that DrainPac, HydroCartridge, and AbTech all had initial capacities in excess of 0.015 m$^3$/s (240 gpm). The initial hydraulic capacity of the AquaShield insert was 0.00038 m$^3$/s (6 gpm) without bypassing flow. During pollutant removal efficiency testing, the hydraulic capacity of the DrainPac and AbTech inserts decreased from a capacity greater than 0.015 m$^3$/s (240 gpm) to less than 0.013 m$^3$/s (200 gpm).

Total suspended solids percent removal for the inserts varied significantly as shown in Figure 8, where the box plots show the 25th and 75th percentile value. The whiskers are at the 5th and 95 percentile.

![Box plots showing TSS removal efficiency for different inserts.](image)

Figure 8. TSS removal efficiency.

Regression analysis of TSS removal efficiency as a function of surface area did show a trend of increasing efficiency with increased surface area. For the
available surface area, the AbTech insert performed better than the other inserts; due probably to the fact unlike the other inserts, water flows downward through the AbTech insert and out the bottom.

Another approach to evaluating the effectiveness of the inserts for TSS removal was to look at the trend in removal efficiency with respect to the amount of water filtered. If there was a significant trend, then the slope of that trend would indicate how long the insert could perform before it had to be replaced. During the ten test runs, the TSS removal efficiency of the AquaShield insert decreased from 20 percent to 3 percent, the TSS removal efficiency of the DrainPac insert decreased from 54 percent to 4 percent; whereas, the TSS removal efficiency for the AbTech and HydroCartridge inserts did not change.

The TPH removal efficiency for the inserts was somewhat more consistent than the TSS removal efficiency as shown in Figure 9, where the box plots show the 25th and 75th percentile value. The whiskers are at the 5th and 95 percentile.

![Figure 9. TPH removal efficiency.](image)

After removal of five outliers from the TPH data set, 14 of the 76 tests exhibited negative removal efficiency. This could have been caused from adsorption of diesel onto sediment particles and clumping of these particles. Any one sample could have a higher or lower concentration of these clumps which could be cause the influent concentration to be higher than the average influent concentration and/or the effluent concentration to be lower than the average effluent concentration.
None of the inserts tested exhibited any trend in TPH removal with respect to the volume filtered.

Because the synthetic stormwater was not spiked with zinc, the average concentration of dissolved zinc in the influent samples was only 0.03 mg/l. The results of the zinc tests are presented here (Table 2), but because of the very low concentrations, those results are not considered indicative of the performance of the inserts. None of the inserts exhibited any trends in removal efficiency related to the amount of water filtered. Fourteen of the 80 tests resulted in negative removal efficiencies for dissolved zinc. The most likely causes of negative removal are the same as for the TPH sampling.

<table>
<thead>
<tr>
<th>Insert</th>
<th>Mean Percent Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>AbTech</td>
<td>39.9</td>
</tr>
<tr>
<td>AquaShield</td>
<td>0.0</td>
</tr>
<tr>
<td>DrainPac</td>
<td>-6.4</td>
</tr>
<tr>
<td>HydroCartridge</td>
<td>47.8</td>
</tr>
</tbody>
</table>

The pH of the simulated stormwater was in the range of 6 to 8 and any change in pH between influent and effluent was insignificant.

### 3.3 Laboratory QA/QC Summary

The QA/QC for this project included the following:

- Methodology summary
- Method detection limits
- Chain of custody forms
- Field QC checks by duplicating every 10\textsuperscript{th} sample.
- Laboratory QC checks on every 20\textsuperscript{th} sample
- Conformance/Non-conformance summary.

There were no instances that analytical results were outside method QC acceptance criteria.

### 4.0 Summary

The pollutant removal efficiency of four commercially available catch basin inserts was tested for TSS, TPH, and dissolved zinc. The inserts tested included AbTech Industries Ultra Urban Filter, AquaShield Incorporated’s AquaShield insert, PacTec Incorporated’s DrainPac, and Geotechnical Marine Corporation’s...
HydroCartridge. Field observations and pilot scale tests were conducted. Pilot scale tests were conducted at flow rates of 0.013 to 0.014 m$^3$/s (200 to 215 gpm) and concentrations of 225 mg/l for TSS and 31 mg/l for TPH.

4.1 Maintenance and Cost
Two general operational problems of catchbasin inserts were discovered during the testing: 1) the potential for plugging if the inserts are overloaded with sediment, and 2) the potential for debris to dry between storms and flush out in a subsequent storm. Little can be done affordably to solve the second problem; but, the first problem could be solved by appropriate training and maintenance.

Maintenance of inserts is fairly simple provided the inlet grate can be lifted by manpower and power equipment is available for vacuuming the accumulated sediment and debris from the insert. A city or other entity considering catch basin inserts as a component of its stormwater management system should consider the maintenance requirements as well as the initial costs.

Education of citizens and city employees regarding illegal dumping of pollutants into storm drains would decrease maintenance requirements and help avoid plugging and the subsequent flooding that may follow. In addition, a regular schedule of inspection and cleaning could result in more effective removal of debris.

Two operational problems that were particular to the current design of two inserts were discovered during testing: 1) due to an large accidental spill of sediment, the HydrCartridge insert plugged and caused localized flooding, and 2) the slotted center plug of the AquaShield insert could become dislodged and flip if the catchbasin becomes flooded or surcharged.

The quoted cost as of January 2003, without shipping, of each of the four inserts are shown in Table 3.

Table 3. Quoted cost of inserts.

<table>
<thead>
<tr>
<th>Insert</th>
<th>Quoted Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AbTech Ultra</td>
<td>$590</td>
</tr>
<tr>
<td>AquaShield™</td>
<td>$1,200</td>
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4.2 Pollutant Removal
Under the controlled pilot test conditions, the inserts were able to achieve average total suspended solids and total petroleum hydrocarbon removal as shown in Table 4.

Table 4. Average pollutant removal percentages.

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4.3 Summary
For the pollutants (gradation and concentration) and the relatively high flowrates tested in this evaluation, the pollutant removal efficiencies determined in this study were moderate to low and were lower than determined in some previous evaluations (ICBIC, 1995; Woodward-Clyde, 1998; EPA, 1999; CEPA, 2000; Creech Engineers, 2001). Maintenance problems were encountered with some of the inserts and some of the observation locations, which could cause flooding, release of captured debris, decrease in pollutant capture, and mosquito breeding. In addition, due to this work and other findings, some of the manufacturers have made modification in their inserts to improve operation and pollutant removal capabilities. Selection of inserts should take into account many factors; such as, flowrate, pollutants, pollutant concentration, sediment gradation, maintenance requirement, and the current design of the inserts.
REFERENCES


## Appendices

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- Appendix 2: AquaShield Data ......................................................21
- Appendix 3: DrainPac Data ..........................................................23
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Appendix 1: AbTech Data

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**Numbering scheme for samples**
- **I** = influent sample
- **E** = effluent sample

**XXYY = XXth. test run, YYth. minute after start of run.** For instance, **E 1210** is an effluent sample taken from the **12th.** test run, 10 minutes after initiation of the sampling run.
## Appendix 2: AquaShield Data

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<th>TPH (mg/l)</th>
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Numbering scheme for samples
I = influent sample
E = effluent sample

XXYY = XXth. test run, YYth. minute after start of run. For instance, E 1210 is an effluent sample taken from the 12th. test run, 10 minutes after initiation of the sampling run.
Appendix 3: DrainPac Data

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Numbering scheme for samples
I = influent sample
E = effluent sample

XXYY = XXth. test run, YYth. minute after start of run. For instance, E 1210 is an effluent sample taken from the 12th. test run, 10 minutes after initiation of the sampling run.
Appendix 4: HydroCartridge Data

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<th>Zinc (mg/l)</th>
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Numbering scheme for samples
I = influent sample
E = effluent sample

XXYY = XXth. test run, YYth. minute after start of run. For instance, E 1210 is an effluent sample taken from the 12th. test run, 10 minutes after initiation of the sampling run.