**AMENDMENT TO AGREEMENT FOR MAINTENANCE OF STORM WATER DETENTION SYSTEM**

On the 10th day of November, 2000, Eitel Dahm Properties, LLC, a Michigan limited liability company, of 45550 Dequindre Road, Shelby Township, MI 48305, entered into with the City of Rochester Hills, MI, whose address is 1000 Rochester Hills Drive, Rochester Hills, MI 48309 (the "City"), an Agreement for Maintenance of Storm Water Detention System, as recorded by the Oakland County Register of Deeds on May 2, 2001 in Liber 22773, Page 492 (the "Agreement"), specifically pertaining to certain property located in the City of Rochester Hills, Oakland, County, Michigan, more particularly described as Exhibit A attached hereto.

Subsequent to the Agreement, Eitel Dahm Properties, LLC, a Michigan limited liability company has elected to expand the parking area for its existing car dealership, known as Audi of Rochester Hills, such that it is now necessary to amend the Agreement to provide for the location of an additional storm water detention system needed to accommodate the additional parking area.

Based on these facts and circumstances, the parties agree to and by this document do hereby amend the existing Agreement with the addition of Exhibit B, showing the storm water system plan, and Exhibit C, consisting of the operation and maintenance manual, attached hereto and made a part of the agreement.

IN WITNESS HEREOF, the undersigned have hereunto affixed their signatures on the 9th day of March, 2017.

**EITEL DAHM PROPERTIES, LLC**
A Michigan Limited Liability Company

By: Eitel Dahm
Eitel Dahm
Its: Member

**CITY OF ROCHESTER HILLS**

By: _____
Bryan Barnett, Mayor

By: _____
Tina Barton, Clerk

STATE OF MICHIGAN )
)
COUNTY OF OAKLAND )

This instrument was acknowledged before me on March 9th, 2017, by Eitel Dahm, Member of Eitel Dahm Properties, LLC, a Michigan Limited Liability Company, on behalf of the said limited liability company.

TAMMY KOZICKI
NOTARY PUBLIC, STATE OF MI
COUNTY OF MACOMB
MY COMMISSION EXPIRES Feb 19, 2023
ACTING IN COUNTY OF Oakland

Tammy Kozicki
Tammy Kozicki, Notary Public
Oakland County, Michigan
My commission expires: 2-19-23

STATE OF MICHIGAN )
)
COUNTY OF OAKLAND )

This instrument was acknowledged before me on _____, 2017, by Bryan Barnett, Mayor, and Tina Barton, Clerk, of the City of Rochester Hills, on behalf of the City.

_____
Notary Public
Oakland County, Michigan
My commission expires:

Drafted By:
David Hanoute
CHMP, INC.
5198 Territorial Road
Grand Blanc, MI 48439

When Recorded Return to:
Clerks Dept.
City of Rochester Hills
1000 Rochester Hills Drive
Rochester Hills, MI 48309

John Staran
Approved 3/13/17

EXHIBIT 'A'

LEGAL DESCRIPTION

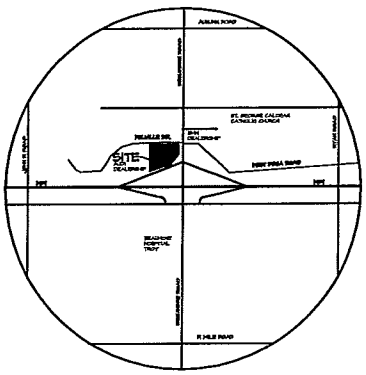
LAND SITUATED IN THE CITY OF ROCHESTER HILLS, OAKLAND COUNTY, MICHIGAN.

PART OF THE SOUTHEAST ¼ OF SECTION 36, TOWN 3 NORTH, RANGE 11 EAST, AVON TOWNSHIP (NOW THE CITY OF ROCHESTER HILLS), OAKLAND COUNTY, MICHIGAN, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS: BEGINNING AT A POINT WHICH IS NORTH 01 DEGREES 59 MINUTES 07 SECONDS WEST 1080.33 FEET ALONG THE EAST LINE OF SECTION 36 AND SOUTH 88 DEGREES 00 MINUTES 53 SECONDS WEST 60.00 FEET AND SOUTH 38 DEGREES 00 MINUTES 53 SECONDS WEST 62.23 FEET FROM THE SOUTHEAST CORNER OF SECTION 36, TOWN 3 NORTH, RANGE 11 EAST, AND ALONG THE NORTHERLY LINE OF M-59, SOUTH 38 DEGREES 00 MINUTES 53 SECONDS WEST 187.38 FEET; THENCE SOUTH 78 DEGREES 00 MINUTES 53 SECONDS WEST, 445.41 FEET; THENCE NORTH 02 DEGREES 25 MINUTES 20 SECONDS WEST 521.27 FEET; THENCE NORTH 87 DEGREES 34 MINUTES 41 SECONDS EAST 563.08 FEET; THENCE SOUTH 01 DEGREES 59 MINUTES 07 SECONDS EAST 304.66 FEET TO THE POINT OF BEGINNING AND CONTAINING 5.94 ACRES.

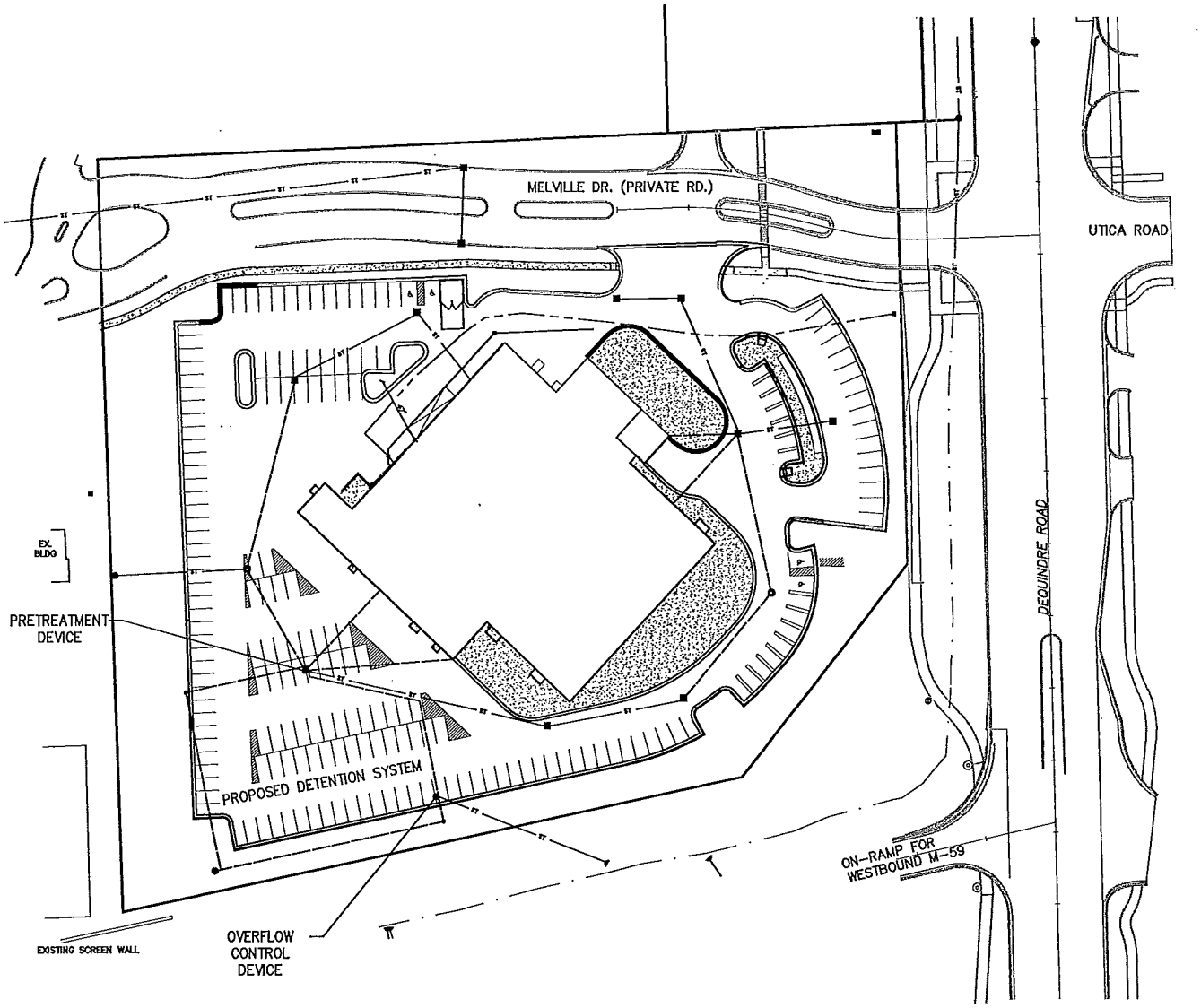
SIDWELL #15-36-426-006

Mike Taunt
Approved 3/13/17

# EXHIBIT B - SITE SKETCH




LOCATION MAP
N.T.S.




| | | |
|---|---|---|
| STORM WATER SYSTEM PLAN<br>AUDI OF ROCHESTER HILLS<br>45441 DEQUINDRE ROAD<br>ROCHESTER HILLS, MI 48309 | SCALE: NOT TO SCALE<br>DATE DRAWN: 2-27-17<br>DATE REVISED: 3-1-17 | FLP<br>5198 TERRITORIAL RD<br>GRAND BLANC, MI 48439<br>(810) 695-5910 |

Mike Taunt
Approved 3/6/17

EXHIBIT 'C'

# OPERATION AND MAINTENANCE MANUAL

## AUDI OF ROCHESTER HILLS
## STORMWATER MAINTENANCE PLAN
## ROCHESTER HILLS, MICHIGAN
## CITY FILE NO. 00-001.3

PROPERTY OWNER:
EITEL DAHM PROPERTIES, LLC
45441 DEQUINDRE ROAD
SHELBY TOWNSHIP, MI 48305
CONTACT: MR. EITEL DAHM

Prepared by:
CHMP, INC.
5198 Territorial Road
Grand Blanc, MI 48439
Phone: (810) 695-5910
Contact: Kevin Cook, P.E.

**OPERATION AND MAINTENANCE MANUAL**

**INTRODUCTION:**

This manual identifies the ownership, operation and maintenance responsibilities for all storm water management systems including the underground detention system, underground storm sewer system, outlet control structure, and pre-treatment device as incorporated into and detailed on the approved Construction Plans as prepared by CHMP, INC. In order to comply with the local best management practices (BMP) and requirements, this manual should serve as a minimum performance standard. This manual should be retained intact and read in its entirety by all parties responsible for the operations and maintenance of the on-site BMP's.

**OWNER:**

Mr. Eitel Dahm, Owner
Eitel Dahm Properties, LLC
45550 Dequindre Road
Shelby Township, MI 48305

**PROPERTY INFORMATION:**

This Operation and Maintenance Manual covers the storm water systems located at the following subject property:

Parcel 15-36-426-006 (45441 DEQUINDRE ROAD)

LAND SITUATED IN THE CITY OF ROCHESTER HILLS, OAKLAND COUNTY, MICHIGAN.

PART OF THE SOUTHEAST ¼ OF SECTION 36, TOWN 3 NORTH, RANGE 11 EAST, AVON TOWNSHIP (NOW THE CITY OF ROCHESTER HILLS), OAKLAND COUNTY, MICHIGAN, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS: BEGINNING AT A POINT WHICH IS NORTH 01 DEGREES 59 MINUTES 07 SECONDS WEST 1080.33 FEET ALONG THE EAST LINE OF SECTION 36 AND SOUTH 88 DEGREES 00 MINUTES 53 SECONDS WEST 60.00 FEET AND SOUTH 38 DEGREES 00 MINUTES 53 SECONDS WEST 62.23 FEET FROM THE SOUTHEAST CORNER OF SECTION 36, TOWN 3 NORTH, RANGE 11 EAST, AND ALONG THE NORTHERLY LINE OF M-59, SOUTH 38 DEGREES 00 MINUTES 53 SECONDS WEST 187.38 FEET; THENCE SOUTH 78 DEGREES 00 MINUTES 53 SECONDS WEST, 445.41 FEET; THENCE NORTH 02 DEGREES 25 MINUTES 20 SECONDS WEST 521.27 FEET; THENCE NORTH 87 DEGREES 34 MINUTES 41 SECONDS EAST 563.08 FEET; THENCE SOUTH 01 DEGREES 59 MINUTES 07 SECONDS EAST 304.66 FEET TO THE POINT OF BEGINNING AND CONTAINING 5.94 ACRES

**STORMWATER MAINTENANCE EXHIBIT:**

Exhibit 'B' of the Storm Water Maintenance Agreement is the Storm Water System Plan which provides a clear presentation of all components of the storm water system. This system is subject to the long-term operation and maintenance responsibilities detailed in this manual. This system includes:

- Storm sewer pipes
- Storm sewer structures (manholes, inlets, catch basins, etc.)
- Underground storm detention (Chambermaxx)
- Outlet control structure
- Pre-Treatment Device (Hydro International Model 6ft FDHC)

**INSPECTIONS;**

The frequency of system inspections outlined in the manual and attached exhibits should be considered the minimum, if no events warrant additional inspections. The frequency of inspections should be fine-tuned over time as system specific conditions are better known and the rate at which certain maintenance operations need to be performed is better understood. Maintenance Inspection Checklists are provided for each of the BMP's in this system. Inspections should be performed by personnel responsible for maintenance and may need to be certified for confined space entry, depending on the component being inspected. Operation of the detention system, outlet control structure, and pre-treatment device may need to be inspected by a practicing civil engineer familiar with their operation.

Records of all routine inspections and any work performed on the system for maintenance, repair or replacement should be maintained by the owner and kept for a minimum of ten (10) years. A copy of all records should be provided to the City of Rochester hills Engineering Division. The records should include this manual, all inspection sheets, approved construction plans and as-built documents, a maintenance log of work performed to the system(s) and contact information for the system inspector, civil engineer, landscape architect, geotechnical engineer and contractor involved with the system.

**STORM WATER SYSTEMS MAINTENANCE:**

Regular inspection and maintenance of BMP's are necessary if these facilities are to consistently perform up to expectations. Stormwater systems are expected to perform quality and quantity control functions as long as the land use they serve exists. Failure to maintain these systems can create the following adverse impacts:

- Increased pollutants to surrounding surface water features
- Potential loss of life or property resulting from catastrophic failure of the facility
- Aesthetic or nuisance conditions, such as mosquitoes or reduced property values due to a degraded facility appearance.

Most of these impacts can be avoided through proper and timely inspection and maintenance. A major concern associated with these impacts is the general public's expectations related to the quality of life provided, in part, by construction of these systems. Inadequate maintenance means the general public may have a false sense of security. The most common cause of stormwater system failure is the lack of adequate and proper operation, inspection, maintenance and management.

Good design and construction can reduce subsequent maintenance needs and costs, but they cannot eliminate the need for maintenance altogether. Maintenance requires a long-term commitment of time, money, personnel and equipment. Monitoring the overall performance of the stormwater management system is a major aspect of any maintenance program.

The maintenance responsibilities for these systems lie with the current property owner and transfer with the property in perpetuity. If maintenance of the system is not performed, the City of Rochester Hills reserves the right to enter the property and perform all necessary work at the property owner's cost. Refer to the *Agreement for Storm Water System Maintenance* for additional details.

**General Maintenance Items:**

Parking Lot Sweeping:
Routine sweeping of all paved surfaces provides a more attractive appearance and removes accumulations of sediment and trash that tend to migrate into stormwater management systems during rainfall events. Parking lot sweeping should be performed quarterly or as necessary to limit sediment and trash build-up.

Grass Mowing and Maintenance:
Mowing requirements at a facility should be designed to the specific site conditions, grass types and seasonal variations in climate. Grassed areas require periodic fertilizing, de-thatching and soil conditioning in order to maintain healthy growth. Provisions will need to be made to reseed and reestablish grass cover in areas damaged by sediment accumulation, stormwater flow, erosion, or other causes. Dead turf will need to be replaced after being discovered. Inspection of the grass areas and other landscaping features should be made annually.

Tash and Debris Removal:
Removal of trash and debris form all areas of the property should be performed monthly. Removal of these items will prevent damage to vegetated areas and eliminate their potential to inhibit the operation of any of the stormwater management systems. Sediment, debris and trash that are removed and collected should be disposed of according to local, State and Federal regulations at suitable disposal and/or recycling centers.

**Stormwater System Management Items:**

The following narratives give an overview of the maintenance requirements of the different components of the stormwater system. The inspection checklists attached to this report offer a more complete listing of what should be inspected, when inspection should occur and the likely frequency of maintenance activities.

Storm Sewer and Structures:
Catch basins, inlets, manholes, outlet control structures, detention pipe and storm sewer pipes should be inspected to check for sediment accumulation and clogging, floatable debris, dead vegetation, etc. The structures and sewers should also be observed during a wet weather event to ensure their proper operation. Accumulated sediment and debris should be removed on an annual basis or as needed based on observed conditions. Structural repairs or maintenance should occur as needed based on observed conditions such as cracks, spalling, joint failure, leakage, misalignment, or settlement of structures. A civil engineer should be retained if problems are thought to exist.

Stormwater Pre-Treatment Devices:
Refer to the attached maintenance manuals from the manufacturer for all inspection and maintenance requirements for the pre-treatment structures.

The following pages include inspection checklists for the various devices and components listed above as well as the manufacturer's manuals for the stormwater pre-treatment structures.

# STORMWATER MANAGEMENT SYSTEM - PERMANENT MAINTENANCE

DATE / TIME OF INSPECTION: _____

INSPECTOR: _____

## STORMWATER MANAGEMENT SYSTEM MANAGEMENT TASKS AND SCHEDULE

POST CONSTRUCTION

| MAINTENANCE ACTIVITIES | SYSTEM COMPONENTS: CATCH BASINS, INLETS, MANHOLES, AND OUTLET CONTROL STRUCTURES | SYSTEM COMPONENTS: STORM SEWER AND DETENTION PIPES | FREQUENCY | COMMENTS |
|---|---|---|---|---|
| **MONITORING / INSPECTION** | | | | |
| INSPECT FOR SEDIMENT ACCUMULATION | X | X | ANNUALLY | |
| INSPECT FOR FLOATABLES, DEAD VEGETATION AND DEBRIS | X | X | ANNUALLY | |
| INSPECT ALL COMPONENTS DURING WET WEATHER AND COMPARE TO AS-BUILT PLANS | X | X | ANNUALLY | |
| INSPECT INSIDE OF STRUCTURES AND PIPES FOR CRACKS, SPOOLING, JOINT FAILURES, SETTLEMENT, SAGGING AND MISALIGNMENT | X | X | ANNUALLY | |
| **PREVENTATIVE ACTIONS** | | | | |
| REMOVE ACCUMULATED SEDIMENT | X | X | ANNUALLY OR AS NEEDED | |
| REMOVE FLOATABLES, DEAD VEGETATION AND DEBRIS | X | X | ANNUALLY OR AS NEEDED | |
| **REMEDIAL ACTIONS** | | | | |
| STRUCTURAL REPAIRS | X | X | AS NEEDED | |
| MAKE ADJUSTMENTS / REPAIRS TO ASSURE PROPER FUNCTIONING | X | X | AS NEEDED | |

## SUMMARY

INSPECTION REMARKS _____

OVERALL CONDITION OF FACILITY: _____

RECOMMENDED ACTIONS NEEDED: _____

DATES ANY MAINTENANCE HAS TO BE COMPLETED BY: _____

| | | |
|---|---|---|
| STORM WATER SYSTEM PLAN<br>AUDI OF ROCHESTER HILLS<br>45441 DEQUINDRE ROAD<br>ROCHESTER HILLS, MI 48309 | SCALE: NON<br>DATE: FEB. 27, 2017 | 5148 TERRITORIAL RD<br>GRAND BLANC, MI 48439<br>(810) 695-5910 |

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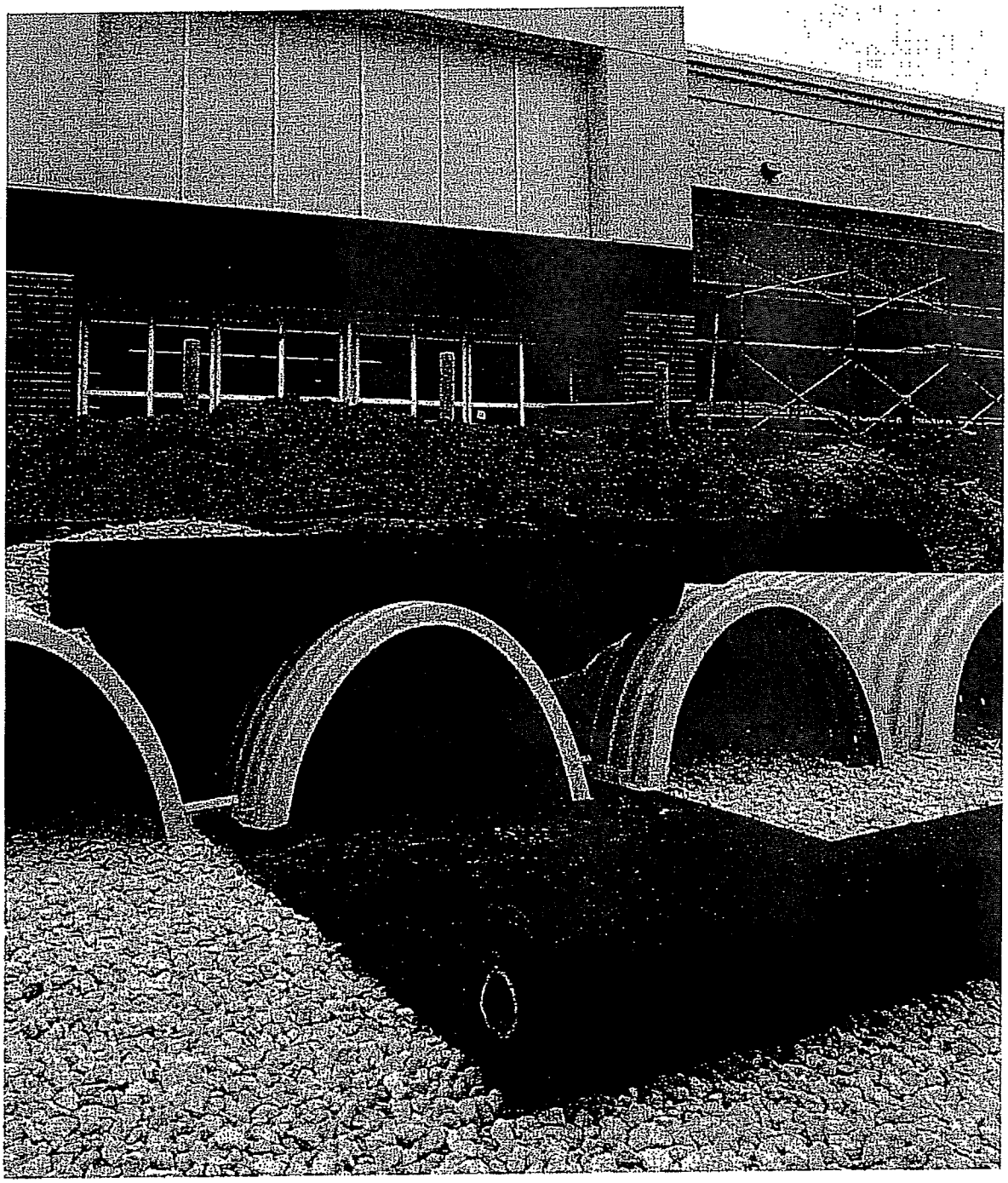
**Save Valuable Land and Protect Water Resources**



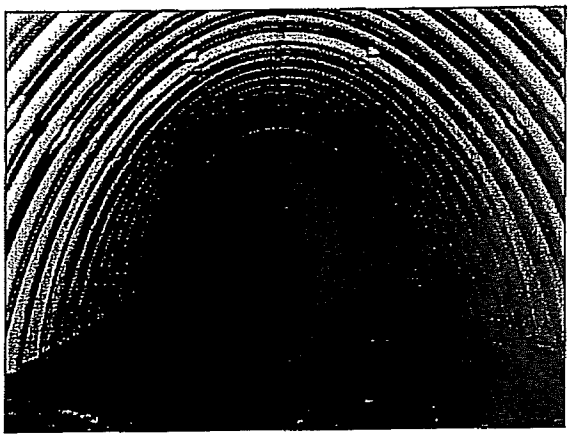
# Isolator® Row O&M Manual

StormTech® Chamber System for Stormwater Management

# 1.0 The Isolator® Row

## 1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.



*Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.*

## 1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

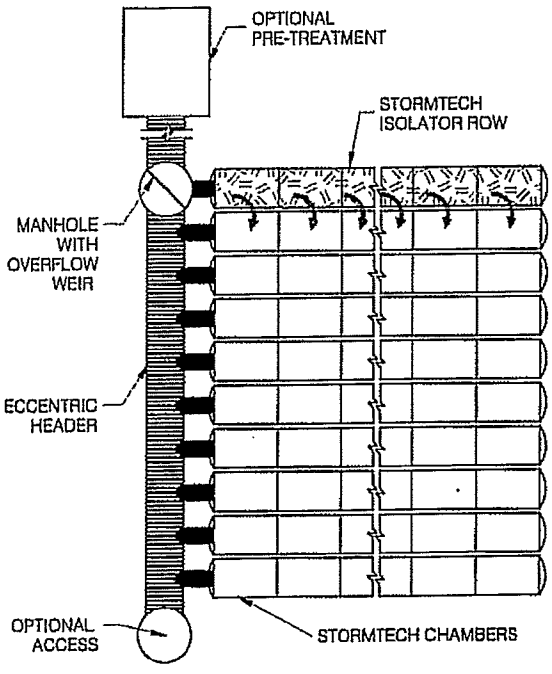
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

*Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.*

**StormTech Isolator Row with Overflow Spillway**
(not to scale)



# 2.0 Isolator Row Inspection/Maintenance

StormTech

## 2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

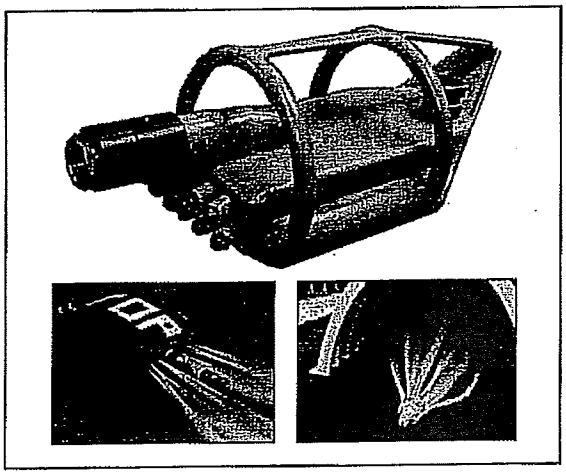
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

## 2.2 MAINTENANCE

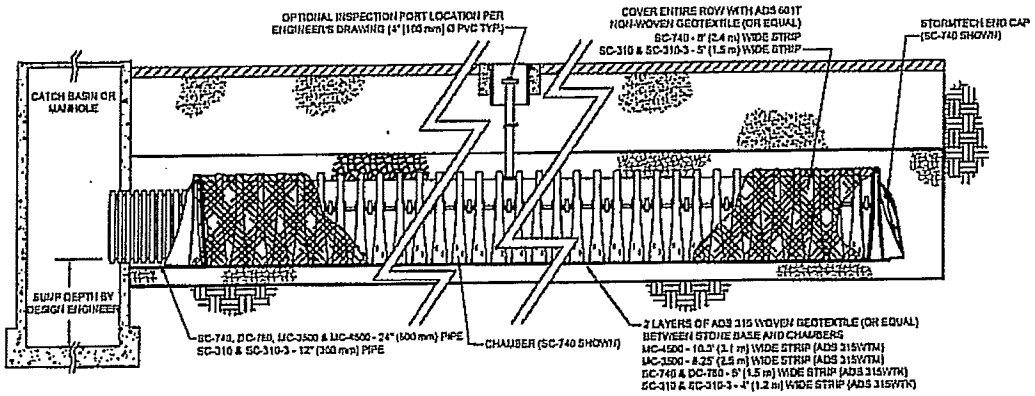
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



*Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)*

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

**StormTech Isolator Row** (not to scale)




**NOTE:** NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

# 3.0 Isolator Row Step By Step Maintenance Procedures

**Step 1)** Inspect Isolator Row for sediment

A) Inspection ports (if present)

i. Remove lid from floor box frame

ii. Remove cap from inspection riser

iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.

iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.

B) All Isolator Rows

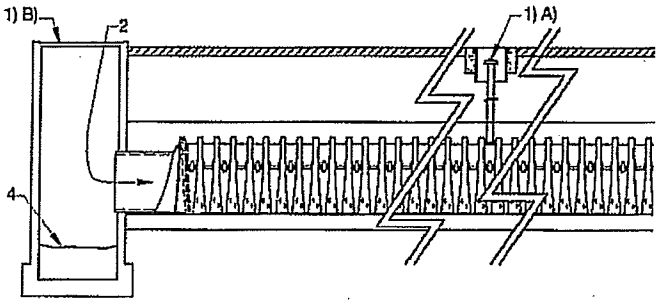
i. Remove cover from manhole at upstream end of Isolator Row

ii. Using a flashlight, inspect down Isolator Row through outlet pipe

1. Mirrors on poles or cameras may be used to avoid a confined space entry
2. Follow OSHA regulations for confined space entry if entering manhole

iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

**StormTech Isolator Row** (not to scale)




**Step 2)** Clean out Isolator Row using the JetVac process

A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable

B) Apply multiple passes of JetVac until backflush water is clean

C) Vacuum manhole sump as required

**Step 3)** Replace all caps, lids and covers, record observations and actions

**Step 4)** Inspect & clean catch basins and manholes upstream of the StormTech system

**Sample Maintenance Log**

| Date | Stadia Rod Readings | | Sediment Depth (1) - (2) | Observations/Actions | Inspector |
|---|---|---|---|---|---|
| | Fixed point to chamber bottom (1) | Fixed point to top of sediment (2) | | | |
| 3/15/01 | 6.3 ft. | none | | New installation. Fixed point is CI frame at grade | djm |
| 9/24/01 | | 6.2 | 0.1 ft. | Some grit felt | sm |
| 6/20/03 | | 5.8 | 0.5 ft. | Mucky feel, debris visible in manhole and in isolator row, maintenance due | rv |
| 7/7/03 | 6.3 ft. | | 0 | System jetted and vacuumed | djm |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70 Inwood Road, Suite 3 | Rocky Hill | Connecticut | 06067

860.529.8188 | 888.892.2694 | fax 866.328.8401 | www.stormtech.com

**Project:** AUDI ROCHESTER, MI

StormTech
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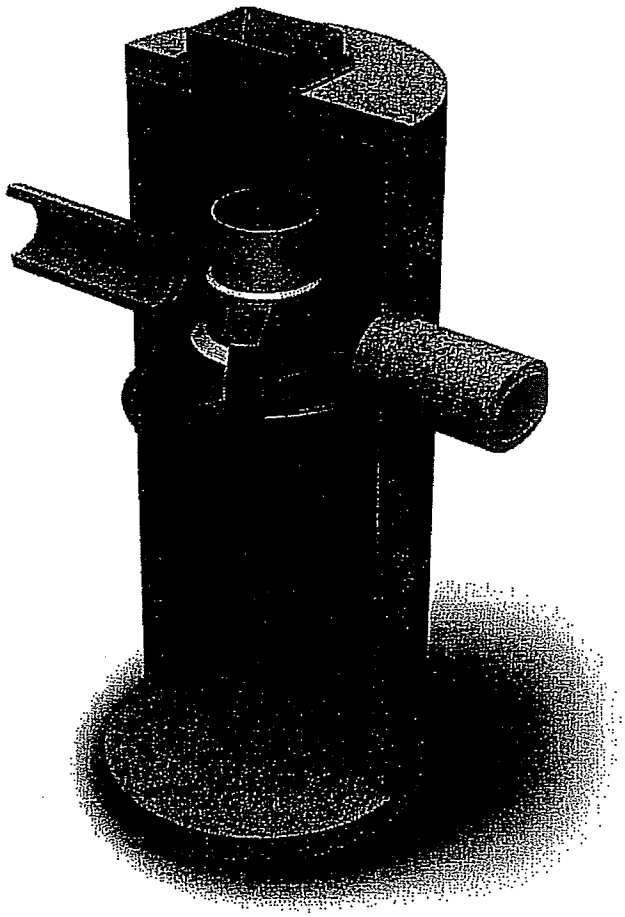
| | | |
|---|---|---|
| Chamber Model - | SC-740 | |
| Units - | Imperial | Click Here for Metric |
| Number of chambers - | 478 | |
| Voids in the stone (porosity) - | 40 | % |
| Base of STONE Elevation - | 690.20 | ft |
| Amount of Stone Above Chambers - | 6 | in |
| Amount of Stone Below Chambers - | 6 | in |
| Area of system - | 18345 | sf |

☑ Include Perimeter Stone in Calculations

Min. Area - 16158 sf min. area

## StormTech SC-740 Cumulative Storage Volumes

| Height of System (inches) | Incremental Single Chamber (cubic feet) | Incremental Total Chamber (cubic feet) | Incremental Stone (cubic feet) | Incremental Ch & St (cubic feet) | Cumulative Chamber (cubic feet) | Elevation (feet) |
|---|---|---|---|---|---|---|
| 42 | 0.00 | 0.00 | 611.50 | 611.50 | 38861.70 | 693.70 |
| 41 | 0.00 | 0.00 | 611.50 | 611.50 | 38250.20 | 693.62 |
| 40 | 0.00 | 0.00 | 611.50 | 611.50 | 37638.70 | 693.53 |
| 39 | 0.00 | 0.00 | 611.50 | 611.50 | 37027.20 | 693.45 |
| 38 | 0.00 | 0.00 | 611.50 | 611.50 | 36415.70 | 693.37 |
| 37 | 0.00 | 0.00 | 611.50 | 611.50 | 35804.20 | 693.28 |
| 36 | 0.05 | 26.29 | 600.98 | 627.27 | 35192.70 | 693.20 |
| 35 | 0.16 | 77.88 | 580.35 | 658.23 | 34565.43 | 693.12 |
| 34 | 0.28 | 134.77 | 557.59 | 692.36 | 33907.20 | 693.03 |
| 33 | 0.60 | 286.69 | 496.02 | 784.72 | 33214.84 | 692.95 |
| 32 | 0.80 | 383.22 | 458.21 | 841.43 | 32430.13 | 692.87 |
| 31 | 0.95 | 454.42 | 429.73 | 884.15 | 31588.69 | 692.78 |
| 30 | 1.07 | 513.62 | 406.05 | 919.67 | 30704.54 | 692.70 |
| 29 | 1.18 | 564.27 | 385.79 | 950.06 | 29784.87 | 692.62 |
| 28 | 1.27 | 604.99 | 369.51 | 974.49 | 28834.81 | 692.53 |
| 27 | 1.36 | 647.70 | 352.42 | 1000.12 | 27860.32 | 692.45 |
| 26 | 1.45 | 695.06 | 333.48 | 1028.54 | 26860.20 | 692.37 |
| 25 | 1.52 | 728.82 | 319.97 | 1048.79 | 25831.66 | 692.28 |
| 24 | 1.58 | 756.35 | 308.96 | 1065.31 | 24782.87 | 692.20 |
| 23 | 1.64 | 785.01 | 297.50 | 1082.51 | 23717.56 | 692.12 |
| 22 | 1.70 | 812.37 | 286.55 | 1098.92 | 22635.05 | 692.03 |
| 21 | 1.75 | 837.90 | 276.34 | 1114.24 | 21536.13 | 691.95 |
| 20 | 1.80 | 861.74 | 266.80 | 1128.55 | 20421.89 | 691.87 |
| 19 | 1.85 | 886.69 | 256.82 | 1143.51 | 19293.35 | 691.78 |
| 18 | 1.89 | 904.90 | 249.54 | 1154.44 | 18149.83 | 691.70 |
| 17 | 1.93 | 924.45 | 241.72 | 1166.17 | 16995.39 | 691.62 |
| 16 | 1.97 | 944.05 | 233.88 | 1177.93 | 15829.22 | 691.53 |
| 15 | 2.01 | 960.74 | 227.20 | 1187.95 | 14651.29 | 691.45 |
| 14 | 2.04 | 977.51 | 220.50 | 1198.00 | 13463.35 | 691.37 |
| 13 | 2.07 | 991.83 | 214.77 | 1206.60 | 12265.34 | 691.28 |
| 12 | 2.10 | 1006.15 | 209.04 | 1215.19 | 11058.74 | 691.20 |
| 11 | 2.13 | 1019.00 | 203.90 | 1222.90 | 9843.56 | 691.12 |
| 10 | 2.15 | 1029.54 | 199.68 | 1229.23 | 8620.66 | 691.03 |
| 9 | 2.18 | 1040.63 | 195.25 | 1235.88 | 7391.43 | 690.95 |
| 8 | 2.20 | 1050.81 | 191.17 | 1241.99 | 6155.55 | 690.87 |
| 7 | 2.21 | 1055.10 | 189.46 | 1244.56 | 4913.56 | 690.78 |
| 6 | 0.00 | 0.00 | 611.50 | 611.50 | 3669.00 | 690.70 |
| 5 | 0.00 | 0.00 | 611.50 | 611.50 | 3057.50 | 690.62 |
| 4 | 0.00 | 0.00 | 611.50 | 611.50 | 2446.00 | 690.53 |
| 3 | 0.00 | 0.00 | 611.50 | 611.50 | 1834.50 | 690.45 |
| 2 | 0.00 | 0.00 | 611.50 | 611.50 | 1223.00 | 690.37 |
| 1 | 0.00 | 0.00 | 611.50 | 611.50 | 611.50 | 690.28 |



# Operation and Maintenance Manual

## First Defense® and First Defense®-HC

Vortex Separator for Stormwater Treatment

Stormwater Solutions

Turning Water Around ...®

# Table of Contents





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# I. First Defense® by Hydro International

## Introduction

The First Defense® is an enhanced vortex separator that combines an effective and economical stormwater treatment chamber with an integral peak flow bypass. It efficiently removes total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® is available in several model configurations (refer to *Section II. Model Sizes & Configurations*, page 4) to accommodate a wide range of pipe sizes, peak flows and depth constraints.

### Operation

The First Defense® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The First Defense® has been designed to allow for easy and safe access for inspection, monitoring and clean-out procedures. Neither entry into the unit nor removal of the internal components is necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

### Pollutant Capture and Retention

The internal components of the First Defense® have been designed to optimize pollutant capture. Sediment is captured and retained in the base of the unit, while oil and floatables are stored on the water surface in the inner volume (Fig.1).

The pollutant storage volumes are isolated from the built-in bypass chamber to prevent washout during high-flow storm events. The sump of the First Defense® retains a standing water level between storm events. This ensures a quiescent flow regime at the onset of a storm, preventing resuspension and washout of pollutants captured during previous events.

Accessories such as oil absorbent pads are available for enhanced oil removal and storage. Due to the separation of the oil and floatable storage volume from the outlet, the potential for washout of stored pollutants between clean-outs is minimized.

### Applications

- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line
- Pretreatment for filters, infiltration and storage

### Advantages

- Inlet options include surface grate or multiple inlet pipes
- Integral high capacity bypass conveys large peak flows without the need for "offline" arrangements using separate junction manholes
- Proven to prevent pollutant washout at up to 500% of its treatment flow
- Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
- Delivered to site pre-assembled and ready for installation

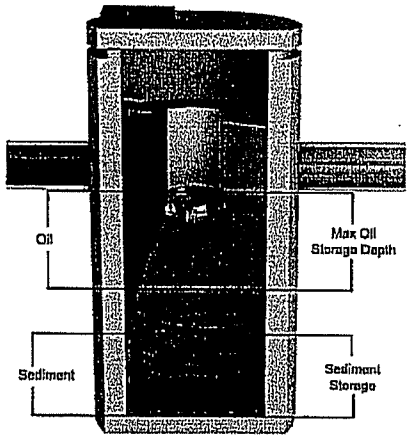


*Fig.1 Pollutant storage volumes in the First Defense®.*

# II. Model Sizes & Configurations

The First Defense® inlet and internal bypass arrangements are available in several model sizes and configurations. The components of the First Defense®-4HC and First Defense®-6HC have modified geometries as to allow greater design flexibility needed to accommodate various site constraints.

All First Defense® models include the internal components that are designed to remove and retain total suspended solids (TSS), gross solids, floatable trash and hydrocarbons (Fig.2a - 2b). First Defense® model parameters and design criteria are shown in Table 1.

## First Defense® Components

1. Built-in Bypass
2. Inlet Pipe
3. Inlet Chute
4. Floatables Draw-off Port
5. Outlet Pipe
6. Floatables Storage
7. Sediment Storage
8. Inlet Grate or Cover

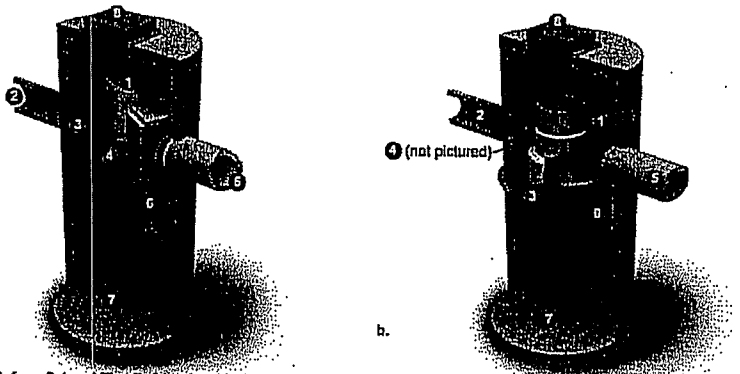


*Fig.2a) First Defense®-4 and First Defense®-6; b) First Defense®-4HC and First Defense®-6HC, with higher capacity dual internal bypass and larger maximum pipe diameter.*

Table 1. First Defense® Pollutant Storage Capacities and Maximum Clean out Depths

| First Defense® Model Number | Diameter (ft / m) | Oil Storage Capacity (gal / L) | Oil Clean Out Depth (in / cm) | Maximum Sediment Storage Capacity[1] Volume (yd³ / m³) | Maximum Sediment Storage Capacity[1] Depth (in / cm) | Recommended Sediment Clean-out Capacity Volume (yd³ / m³) | Recommended Sediment Clean-out Capacity Depth (in / cm) |
|---|---|---|---|---|---|---|---|
| FD-4 | 4 / 1.2 | 160 / 681 | <23.5 / 60 | 1.3 / 1.0 | 33 / 84 | 0.7 / 0.5 | 18 / 46 |
| FD-4HC | | 191 / 723 | <24.4 / 62 | | | | |
| FD-6 | 6 / 1.8 | 420 / 1,590 | <23.5 / 60 | 3.3 / 2.5 | 37.5 / 95 | 1.6 / 1.2 | 18 / 46 |
| FD-6HC | | 496 / 1,878 | <28.2 / 72 | | | | |

NOTE

[1] Sediment storage capacity and clean out depth may vary, as larger sediment storage sump volumes are provided when required.

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# III. Maintenance

## Overview

The First Defense® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the First Defense®. The First Defense® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the First Defense® will no longer be able to store removed sediment and oil. Maximum pollutant storage capacities are provided in Table 1.

The First Defense® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the First Defense®, nor do they require the internal components of the First Defense® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

## Maintenance Equipment Considerations

The internal components of the First Defense®-HC have a centrally located circular shaft through which the sediment storage sump can be accessed with a sump vac hose. The open diameter of this access shaft is 15 inches in diameter (Fig.3). Therefore, the nozzle fitting of any vactor hose used for maintenance should be less than 15 inches in diameter.

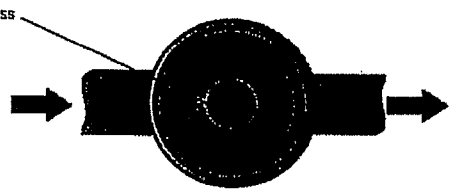


*Fig.3 The central opening to the sump of the First Defense®-HC is 15 inches in diameter.*

## Determining Your Maintenance Schedule

The frequency of clean out is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge-Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil / flotables removal, for a 6-ft First Defense® typically takes less than 30 minutes and removes a combined water/oil volume of about 705 gallons.

*Inspection Procedures*

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.
2. Remove the grate or lid to the manhole.
3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. Fig.4 shows the standing water level that should be observed.
4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the components and water surface.
5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel.
6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.
7. Securely replace the grate or lid.
8. Take down safety equipment.
9. Notify Hydro International of any irregularities noted during inspection.

## Floatables and Sediment Clean Out

Floatables clean out is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.5).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose and skimmer pole to be lowered to the base of the sump.

*Scheduling*

- Floatables and sump clean out are typically conducted once a year during any season.
- Floatables and sump clean out should occur as soon as possible following a spill in the contributing drainage area.

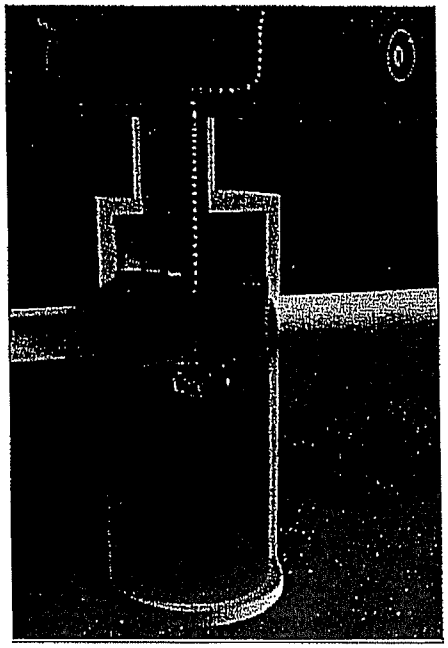

*Fig.4 Floatables are removed with a vactor hose (First Defense model FD-4, shown).*

*Recommended Equipment*

- Safety Equipment (traffic cones, etc)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net (if only floatables are being removed)
- Sediment probe (such as a Sludge Judge®)
- Vactor truck (flexible hose recommended)
- First Defense® Maintenance Log

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*Floatables and sediment Clean Out Procedures*

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.
2. Remove the grate or lid to the manhole.
3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.
4. Remove oil and floatables stored on the surface of the water with the vactor hose (Fig.5) or with the skimmer or net (not pictured).
5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (page 9).
6. Once all floatables have been removed, drop the vactor hose to the base of the sump. Vactor out the sediment and gross debris off the sump floor (Fig.5).
7. Retract the vactor hose from the vessel.
8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components, blockages, or irregularly high or low water levels.
9. Securely replace the grate or lid.

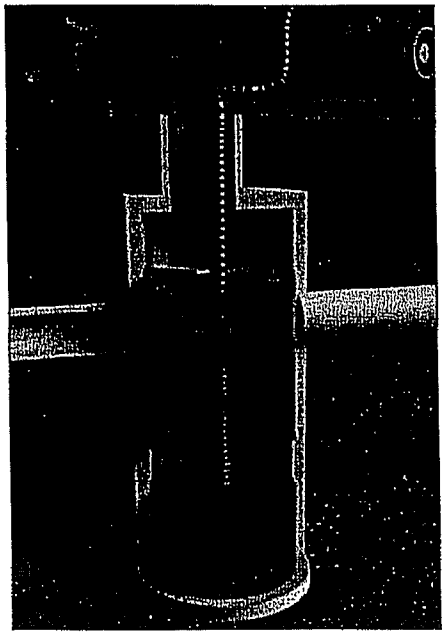

*Fig.5 Sediment is removed with a vactor hose (First Defense model FD-4, shown).*

## Maintenance at a Glance

| Activity | Frequency |
|---|---|
| Inspection | - Regularly during first year of installation<br>- Every 6 months after the first year of installation |
| Oil and Floatables Removal | - Once per year, with sediment removal<br>- Following a spill in the drainage area |
| Sediment Removal | - Once per year or as needed<br>- Following a spill in the drainage area |
| NOTE: For most clean outs the entire volume of liquid does not need to be removed from the manhole. Only remove the first few inches of oils and floatables from the water surface to reduce the total volume of liquid removed during a clean out. | |

Hydro International

## First Defense® Installation Log

| | |
|---|---|
| HYDRO INTERNATIONAL REFERENCE NUMBER: | |
| SITE NAME: | |
| SITE LOCATION: | |
| OWNER: | CONTRACTOR: |
| CONTACT NAME: | CONTACT NAME: |
| COMPANY NAME: | COMPANY NAME: |
| ADDRESS: | ADDRESS: |
| TELEPHONE: | TELEPHONE: |
| FAX: | FAX: |

**INSTALLATION DATE:** / /

**MODEL SIZE (CIRCLE ONE):** FD-4 FD-4HC FD-5 FD-6HC

**INLET (CIRCLE ALL THAT APPLY):** GRATED INLET (CATCH BASIN) INLET PIPE (FLOW THROUGH)

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## First Defense® Inspection and Maintenance Log

| Date | Initials | Depth of Floatables and Oils | Sediment Depth Measured | Volume of Sediment Removed | Site Activity and Comments |
|---|---|---|---|---|---|
| | | | | | |
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Notes

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Stormwater Solutions

Hydro International

Turning Water Around...®

Date: 10/25/16
Project Name: Audi Rochester Hills
Hydro Reference No. 15-12273

**Statement of Sizing**

Hydro International's First Defense High Capacity® can be sized based on a treatment flow rate. Each unit has a treatment flow rate as shown in Table 1 based on NJDEP/NJCAT test data.

In this case the treatment flow rate of 2.35 cfs and a 10-yr flow rate of 5.1 cfs were provided by the Project Engineer.

**Table 1**

| Model | NJCAT Treatment Flow Rate (cfs) | Approximate Hydraulic Capacity (cfs) |
|---|---|---|
| 4ft FDHC | 1.5 | 18 |
| 6ft FDHC | 3.38 | 32 |
| 8ft FDHC | 6.00 | 50 |

Based on the provided treatment flow rate and peak flow rate, the 6ft FDHC is the recommended unit to use on this site. The unit can be installed on line if the pipe diameter does not exceed 48".

Installation, operation and maintenance and other documents can be obtained from www.hydro-int.com

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