AMENDMENT TO AGREEMENT FOR MAINTENANCE OF STORM WATER DETENTION SYSTEM

On the 4th day of August, 2005, Rochester Community Schools, whose address is 501 W. University Drive, Rochester, Michigan, 48307, entered into with the City of Rochester Hills, MI, whose address is 1000 Rochester Hills Drive, Rochester Hills, MI 48307 (the "City"), an Agreement for Maintenance of Storm Water Detention System, as recorded by the Oakland County Register of Deeds on February 7, 2007 in Liber 38735, Page 591 (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, Rochester Community Schools has elected to expand the building and parking area for its existing school facility, such that it is now necessary to amend the Agreement to provide for the location of revised storm water detention system needed to accommodate the expansion.

Based on these facts and circumstances, the parties agree to and by this document do hereby amend the existing Agreement so that the previous Exhibit B attached to and included as part of the originally recorded Agreement is hereby superseded and replaced with the revised Exhibit B attached hereto and the original Exhibit B shall be of no further force or effect. In addition, an Exhibit C, consisting of the maintenance plan, is attached hereto and made a part of the Agreement.

IN WITNESS HEREOF, the undersigned have hereunto affixed their signatures on the 23 day of January, 2018.

Rochester Community Schools

John Staran
Approved 2/8/18

By: [signature]
Name Robert Shaner
Its: Superintendent

City of Rochester Hills

By: ______________________
Bryan K. Barnett, Mayor

By: ______________________
Tina Barton, City Clerk

STATE OF MICHIGAN)
)ss.
COUNTY OF OAKLAND)

The foregoing instrument was acknowledged before me this 23 day of January, 2018, Rochester Community Schools of 501 W. University Drive, Rochester, Michigan, 48307, proprietor.

MAUREEN MARIE NAKONEK
NOTARY PUBLIC - STATE OF MICHIGAN
COUNTY OF OAKLAND
My Commission Expires September 17, 2023

Maureen Marie Nakonek
Maureen Marie Nakonek
Notary Public
Oakland County, Michigan
My Commission Expires: 9/17/2023

STATE OF MICHIGAN)
)ss.
COUNTY OF OAKLAND)

The foregoing instrument was acknowledged before me this _________ day of _____________, 2018, by Bryan K. Barnett, Mayor of City of Rochester Hills and Tina Barton, City Clerk of City of Rochester Hills, a Michigan municipal corporation, on behalf of the City of Rochester Hills.

____
Notary Public
____________County, ____________
My Commission Expires: ____________

When recorded, return to:
Tina Barton, City Clerk
City of Rochester Hills
1000 Rochester Hills Drive
Rochester Hills, MI 48309

Drafted by:
James Serbinski
Spalding DeDecker
905 South Blvd East
Rochester Hills, MI 48307

EXHIBIT "A"

LEGAL DESCRIPTIONS

ACE SCHOOL
1440 JOHN R ROAD
ROCHESTER HILLS, MI 48307

FORMER PARCELS: #15-23-400-001 AND #15-23-400-002

ALL PART OF THE NORTHEAST 1/4 OF THE SOUTHEAST 1/4 OF SECTION 23; TOWN 3 NORTH, RANGE 11 EAST, CITY OF ROCHESTER HILLS, OAKLAND COUNTY, MICHIGAN, DESCRIBED AS:

BEGINNING AT A POINT ON THE EAST SECTION LINE, S 05°59'10" W 108.25 FEET FROM THE EAST 1/4 CORNER TO THE POINT OF BEGINNING A: N 86°12'16" W 499.00 FEET; THENCE S 05°24'01" W 160.00 FEET; THENCE S 83°54'22" E 497.00 FEET TO THE SECTION LINE; THENCE N 05°59'10" E 180.00 FEET TO THE POINT OF BEGINNING.

ALSO, INCLUDING:

ALL PART OF THE EAST 1/2 OF SECTION 23, TOWN 3 NORTH, RANGE 11 EAST, CITY OF ROCHESTER HILLS, OAKLAND COUNTY, MICHIGAN, DESCRIBED AS:

BEGINNING AT A POINT ON THE EAST SECTION LINE, S 05°59'10" W 288.25' FROM THE EAST 1/4 CORNER TO THE POINT OF BEGINNING B: S 05°59'10" W 190.00 FEET; THENCE N 84°00'50" W 1328.34 FEET; THENCE N 04°16'40" E 318.76 FEET; THENCE S 86°12'16" E 839.75 FEET; THENCE S 05°24'01" W 160 FEET; THENCE S 83°54'22" E 497.00 FEET TO THE SECTION LINE AND TO THE POINT OF BEGINNING.

15-23-400-012

Mike Taunt
Approved 1/24/18

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SPALDING DEDECKER
Engineers | Surveyors
905 South Blvd. East
Rochester Hills, MI 48307
Phone: (248) 844-5400
Fax: (248) 844-5404
www.sda-eng.com

DRAWN: J.SERBINSKI	DATE: 1-2-18
CHECKED: T.LINDOW	DATE: 1-2-18
MANAGER: T.SOVEL	SCALE:
JOB No. NP16-012	SHEET: 1 OF 1
SECTION 23 TOWN 3 NORTH RANGE 11 EAST	
CITY OF ROCHESTER HILLS OAKLAND COUNTY, MI	

NOTE:
SDA HAS NOT PERFORMED A BOUNDARY SURVEY OF THIS PARCEL AND THE PARCEL DESCRIPTION DOES NOT NECESSARILY REFLECT FIELD–MEASURED VALUES. THE EXHIBIT "A" DESCRIPTION IS WRITTEN BASED UPON THE RECORD DESCRIPTION OF THIS OVERALL PARCEL.

EXHIBIT "B"

GRAPHIC SCALE
0 40 80 160
(IN FEET)
1 inch = 80 ft.

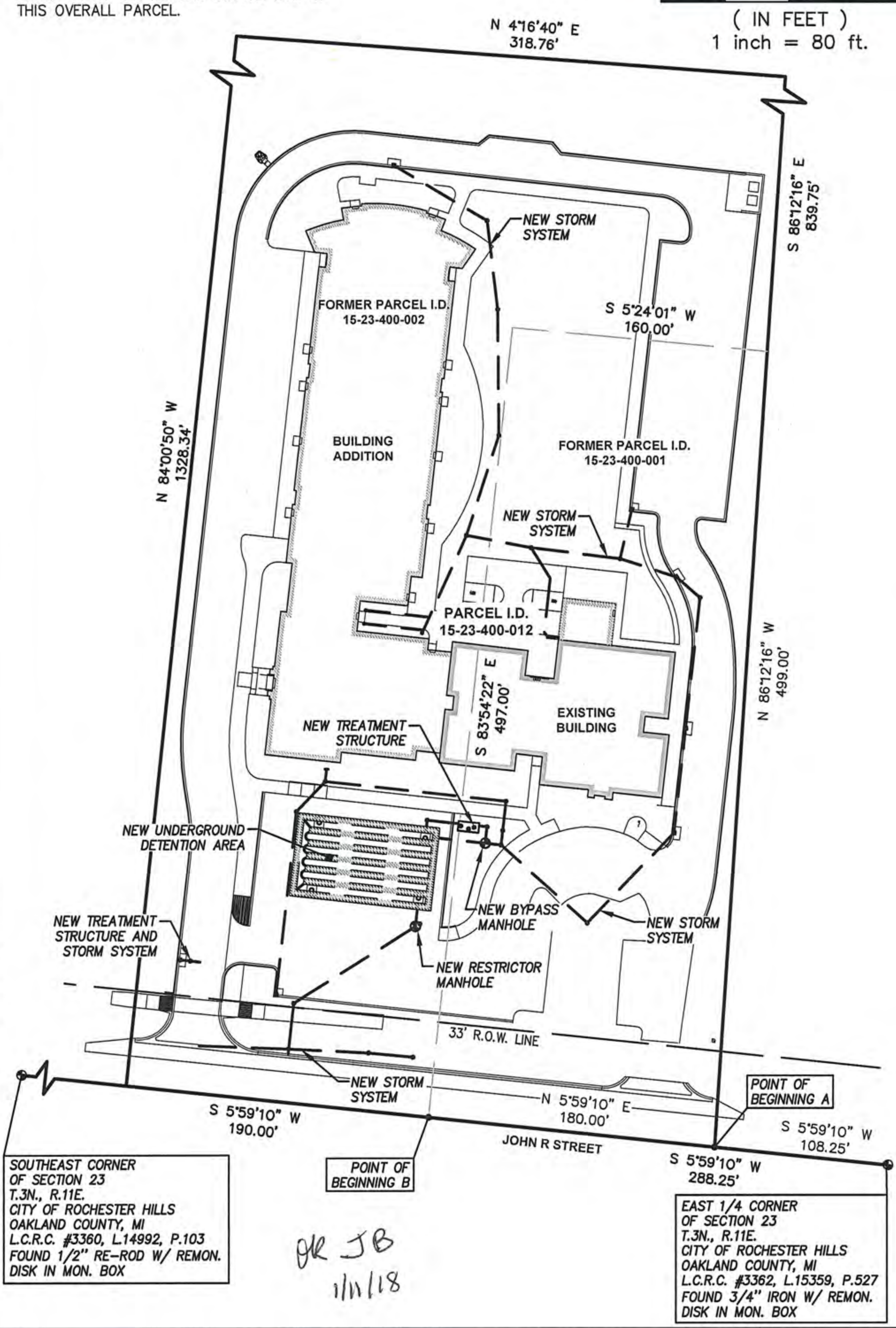

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EXHIBIT "C"

A. PHYSICAL LIMITS OF THE STORM WATER MANAGEMENT SYSTEM

THE STORM WATER MANAGEMENT SYSTEM (SWMS) SUBJECT TO THIS LONG-TERM MAINTENANCE PLAN (LTMP) IS DEPICTED ON EXHIBIT B AND INCLUDES WITHOUT LIMITATION THE STORM SEWERS, MANHOLES, CATCH BASINS, STORM WATER INLETS, CLOSED CONDUITS, UNDERGROUND DETENTION SYSTEMS, FLOW RESTRICTOR STRUCTURE AND OUTLET PIPE THAT CONVEY FLOW FROM THE UNDERGROUND DETENTION SYSTEM TO AN EXISTING STORM MANHOLE THAT OUTLETS TO A CITY STORM SEWER.

FOR PURPOSES OF THIS SWMS, THIS STORM WATER MANAGEMENT SYSTEM AND ALL OF ITS COMPONENTS AS SHOWN ON EXHIBIT B IS REFERRED TO AS THE "SYSTEM".

B. TIME FRAME FOR LONG-TERM MAINTENANCE RESPONSIBILITY

THE PROPRIETOR IS RESPONSIBLE FOR MAINTAINING THE SYSTEM, INCLUDING COMPLYING WITH APPLICABLE REQUIREMENTS OF THE CITY OF ROCHESTER HILLS, UNTIL WAYNE COUNTY RELEASES THE CONSTRUCTION PERMIT. LONG-TERM MAINTENANCE RESPONSIBILITY FOR THE SYSTEM COMMENCES WHEN DEFINED BY THE MAINTENANCE PERMIT ISSUED BY THE COUNTY. LONG-TERM MAINTENANCE CONTINUES IN PERPETUITY.

THE OPERATION OF THE STORM WATER MANAGEMENT SYSTEM, INCLUDING DETENTION BASIN AND PIPES SHALL BE MONITORED TO VERIFY THAT THE SYSTEM IS PERFORMING AS INTENDED AND WILL BE REPAIRED OR MODIFIED AS REQUIRED TO INSURE THAT THE SYSTEM OPERATES AS INTENDED AND AS REQUIRED.

MAINTENANCE OF STORM WATER COLLECTION SYSTEM CONSISTS OF THE FOLLOWING ITEMS, WHICH ARE TO BE DONE AT LEAST TWICE PER YEAR AS FOLLOWS:

1. CLEAN THE COVER OF ALL CATCH BASINS AND INLETS.]

2. CHECK THE DEPTH OF ACCUMULATED SEDIMENT IN EACH STORM STRUCTURE AND REMOVE THE SEDIMENT IF IT IS 12 OR MORE INCHES DEEP.

3. IF WHILE CHECKING THE SEDIMENT IN THE STORM STRUCTURES, IT BECOMES APPARENT THAT THE SEDIMENT HAS ENTERED THE CONNECTING PIPES, THE PIPES SHALL BE JETTED TO REMOVE THE SEDIMENT.

4. IF ANY SETTLING AROUND THE STORM STRUCTURES OR ALONG THE ROUTE OF THE PIPES IS EVIDENT, THE STRUCTURES AND THE PIPES SHALL BE CHECKED FOR OPEN JOINTS AND CRACKS WHICH, IF FOUND, SHALL BE REPAIRED.

MAINTENANCE OF THE DETENTION SYSTEM, OUTLET CONTROL STRUCTURE AND OUTLET PIPES MUST BE PERFORMED AT LEAST TWICE PER YEAR AS FOLLOWS:

1. THE DETENTION SYSTEM IS TO BE INSPECTED AND CLEANED OF ANY ACCUMULATED DEBRIS AND SEDIMENT WHEN SEDIMENT DEPTH REACHES 6".

2. THE DETENTION SYSTEM MUST BE CLEANED IF ITS VOLUME IS REDUCED BY MORE THEN 10% DUE TO THE ACCUMULATION OF SILT AND SEDIMENT.

3. THE OUTLET CONTROL STRUCTURE AND OUTLET PIPES SHALL BE MAINTAINED IN ACCORDANCE WITH MAINTENANCE SCHEDULE FOR THE COLLECTION SYSTEM AS MENTIONED ABOVE.

C. MANNER OF ENSURING MAINTENANCE RESPONSIBILITY

THE PROPRIETOR HAS ASSUMED RESPONSIBILITY FOR LONG-TERM MAINTENANCE OF THE SYSTEM. THE STIPULATION BY WHICH THE PROPRIETOR HAS ASSUMED MAINTENANCE RESPONSIBILITY IS INDICATED IN THE "AGREEMENT FOR STORM SEWER MAINTENANCE". THE CITY OF ROCHESTER HILLS RETAINS THE RIGHT TO ENTER THE PROPERTY AND PERFORM THE NECESSARY MAINTENANCE OF THE SYSTEM IF THE PROPRIETOR FAILS TO PERFORM THE REQUIRED MAINTENANCE ACTIVITIES.

TO ENSURE THAT THE SYSTEM IS MAINTAINED IN PERPETUITY, THE "AGREEMENT FOR STORM SEWER MAINTENANCE" BETWEEN THE CITY OF ROCHESTER HILLS AND THE PROPRIETOR TOGETHER WITH ITS EXHIBIT A (LEGAL DESCRIPTION OF PROPERTY), EXHIBIT B (THE MAP OF THE PHYSICAL LIMITS OF THE STORM WATER MANAGEMENT SYSTEM , AND EXHIBIT C (THIS PLAN FOR LONG TERM MAINTENANCE) WILL BE RECORDED WITH THE OAKLAND COUNTY REGISTER OF DEEDS. UPON RECORDING, A COPY OF THE RECORDED DOCUMENTS WILL BE PROVIDED TO THE CITY OF ROCHESTER HILLS.

D. LONG-TERM MAINTENANCE PLAN AND SCHEDULE

TABLE 1 IDENTIFIES THE MAINTENANCE ACTIVITIES TO BE PERFORMED, ORGANIZED BY CATEGORY (MONITORING/INSPECTIONS, PREVENTATIVE MAINTENANCE, AND REMEDIAL SECTIONS). TABLE 1 ALSO IDENTIFIES SITE-SPECIFIC WORK NEEDED TO ENSURE THAT THE STORM WATER MANAGEMENT SYSTEM FUNCTIONS PROPERLY AS DESIGNED.

E. STORMWATER PRE-TREATMENT DEVICES

1. CONTECT CDS 2015-5-C UNIT
2. CONTECT VORTECHS 3000 UNIT

OK ARS 1-29-18

REFER TO THE ATTACHED MAINTENANCE MANUALS FROM THE MANUFACTURER FOR ALL INSPECTION AND MAINTENANCE REQUIREMENTS FOR THE PRE-TREATMENT STRUCTURES.

SPALDING DEDECKER
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www.sda-eng.com

DRAWN: J.SERBINSKI	DATE: 1-2-18
CHECKED: T.LINDOW	DATE: 1-2-18
MANAGER: T.SOVEL	SCALE:
JOB No. NP16-012	SHEET: 1 OF 2
SECTION 23 TOWN 3 NORTH RANGE 11 EAST	
CITY OF ROCHESTER HILLS OAKLAND COUNTY, MI	

EXHIBIT "C"

TABLE 1

STORM WATER MANAGEMENT SYSTEM LONG-TERM MAINTENANCE SCHEDULE SYSTEM COMPONENT

Maintenance Activities	Underground Detention System	Manufactured Treatment System	Catch Basins, Inlets & Storm Sewers	Inlets to Pretreatment Systems and Detention/retention Systems	Flow Restrictors, Overflow Structures & Outlet Pipes	Rip-rap	Other	Frequency
Monitoring/Inspection								
Inspect for sediment accumulation**/clogging of stone filter	X	X	X	X	X			Annually
Inspect for floatables, dead vegetation and debris	X	X	X	X	X			Annually and after major events
Inspect all components during wet weather and compare to as-built plans	X	X	X	X	X			Annually
Ensure means of access for maintenance remain clear/open	X	X	X	X	X			Annually
Preventative Maintenance								
Remove accumulated sediment	X	X	X		X			As needed*
Remove floatables, dead vegetation and debris	X	X	X	X				As needed
Sweeping of paved surfaces (streets and parking lots)							X	2 times per year
Other - (Recommended By Manufacturer)		X					X	
Remedial Actions								
Repair/stabilize areas of erosion			X	X				As needed
Structural repairs	X	X	X	X	X	X		As needed
Make adjustments/repairs to ensure proper functioning	X	X	X	X	X	X		As needed

* Manufactured treatment system and underground detention systems to be clened according to manufacturer's recommendations: at a minimum, whenever sediment accumulates to a depth of 6-12 inches or if sediment resuspention is observed.

NOTE:
CHEMICALS SHALL NOT BE APPLIED TO BIORETENTION AREA , BUFFER STRIPS AND VEGETATED SWALES OR WATERCOURSES.

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SECTION 23 TOWN 3 NORTH RANGE 11 EAST	
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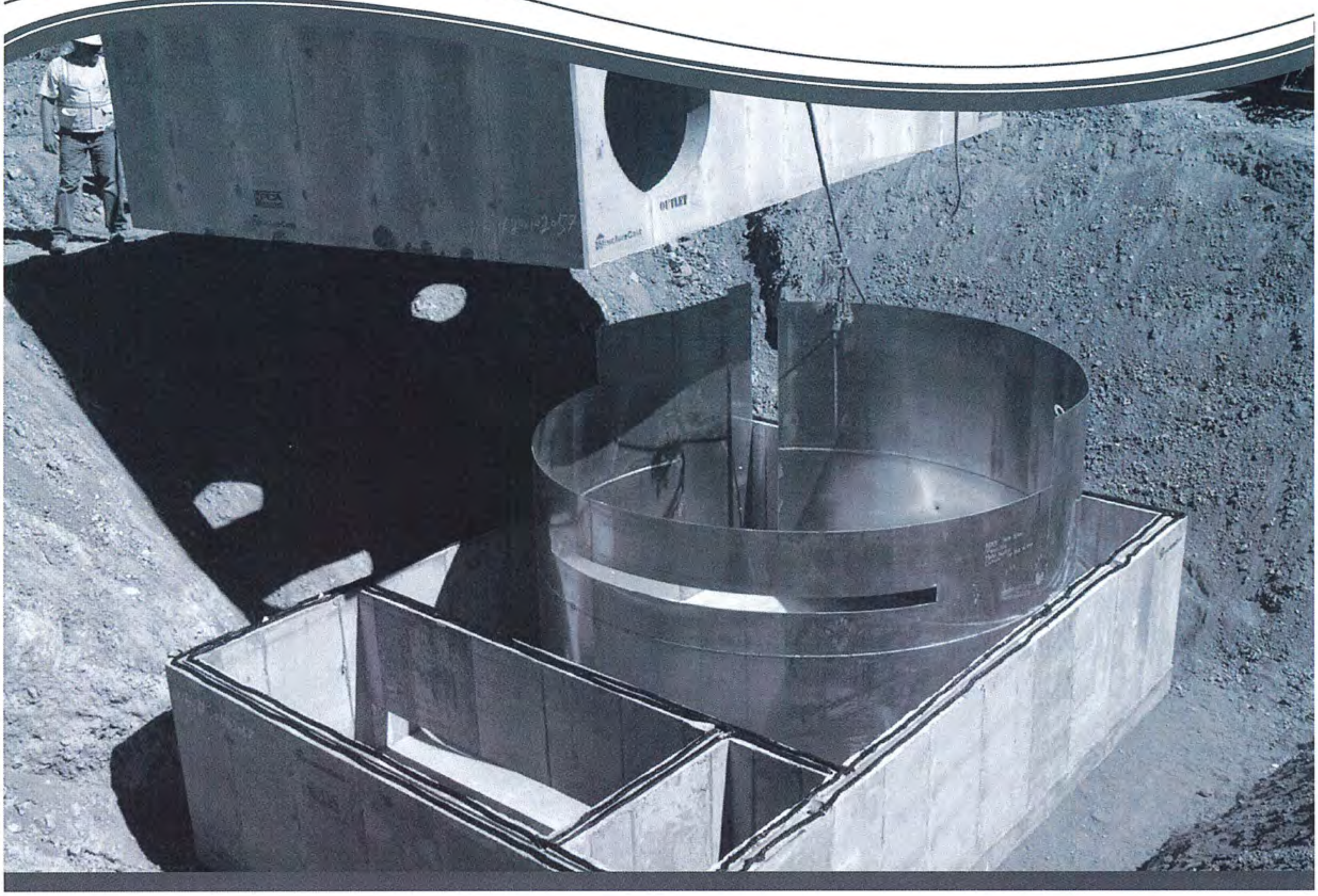
EXHIBIT C

CONTECH®
ENGINEERED SOLUTIONS

Vortechs® Guide
Operation, Design, Performance and Maintenance



Vortechs®

Vortechs®

The Vortechs system is a high-performance hydrodynamic separator that effectively removes finer sediment (e.g. 50-microns (μm), oil, and floating and sinking debris. The swirl concentration operation and flow controls work together to minimize turbulence and provide stable storage of captured pollutants. Precast models can treat peak design flows up to 30-cfs (850-L/s); cast-in-place models handle even greater flows. A typical system is sized to provide a specific removal efficiency of a predefined particle size distribution (PSD).

Operation Overview

Stormwater enters the swirl chamber inducing a gentle swirling flow pattern and enhancing gravitational separation. Sinking pollutants stay in the swirl chamber while floatables are stopped at the baffle wall. Vortechs systems are usually sized to efficiently treat the frequently occurring runoff events and are primarily controlled by the low flow control orifice. This orifice effectively reduces inflow velocity and turbulence by inducing a slight backwater that is appropriate to the site.

During larger storms, the water level rises above the low flow control orifice and begins to flow through the high flow control. Any layer of floating pollutants is elevated above the invert of the Floatables Baffle Wall, preventing release. Swirling action increases in relation to the storm intensity, while sediment pile remains stable. When the storm drain is flowing at peak capacity, the water surface in the system approaches the top of the high flow control. The Vortechs system will be sized large enough so that previously captured pollutants are retained in the system, even during these infrequent events.

As a storm subsides, treated runoff decants out of the Vortechs system at a controlled rate, restoring the water level to a dry-weather level equal to the invert of the inlet pipe. The low water level facilitates easier inspection and cleaning, and significantly reduces maintenance costs by reducing pump-out volume.

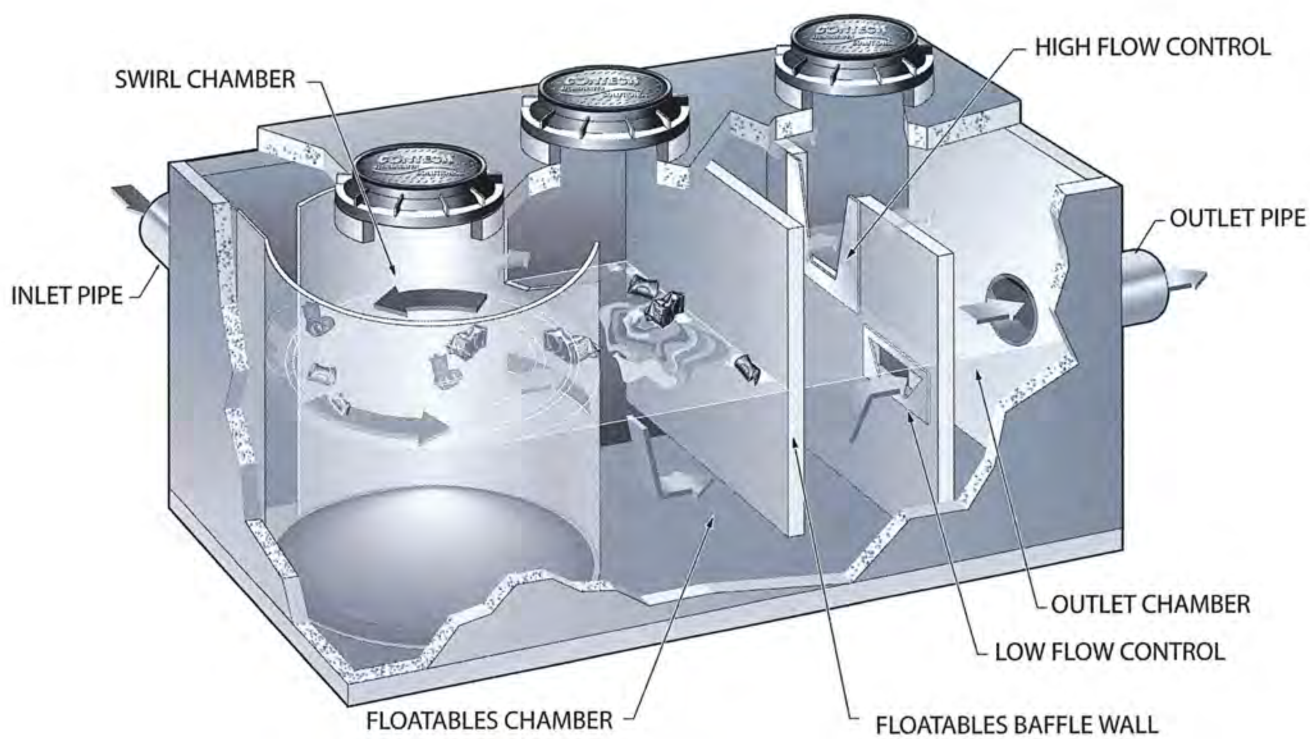
Design Basics

Each Vortechs system is custom designed based on site size, site runoff coefficient, regional precipitation intensity distribution, and anticipated pollutant characteristics. There are two primary methods of sizing a Vortechs system. The first is to determine which model size provides the desired removal efficiency at a given flow for a defined particle size or PSD. The second and more in depth method is the summation of Rational Rainfall Method™ which uses a summation process described below in detail and is used when a specific removal efficiency of the net annual sediment load is required.

Typically Vortechs systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for either 50-μm particles, or a particle gradation found in typical urban runoff (see performance section of this manual for more information).

The Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.



Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes or hourly and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed Vortechs system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Once a system size is established, the internal elements of the system are designed based on information provided by the site engineer. Flow control sizes and shapes, sump depth, oil spill storage capacity, sediment storage volume and inlet and outlet orientation are determined for each system. In addition, bypass weir calculations are made for off-line systems.

Flow Control Calculations

Low Flow Control

The low flow control, or orifice, is typically sized to submerge the inlet pipe when the Vortechs system is operating at 20% of its treatment capacity. The orifice is typically a Cippoletti shaped aperture defined by its flat crest and sides which incline outwardly at a slope of 1 horizontal to 4 vertical.

$$Q_{orfice} = C_d \bullet A \bullet \sqrt{2gh}$$

Where:

$Q_{orifice}$ = flow through orifice, cfs (L/s)

C_d = orifice coefficient of discharge = 0.56 (based on lab tests)

A = orifice flow area, ft^2 (m^2) (calculated by orifice geometry)

h = design head, ft (m) (equal to the inlet pipe diameter)

g = acceleration due to gravity (32.2-ft/s^2 (9.81-m/s^2)

The minimum orifice crest length is 3-in (76-mm) and the minimum orifice height is 4-in (102-mm). If flow must be restricted beyond what can be provided by this size aperture, a Fluidic-Amp™ HydroBrake flow control will be used. The HydroBrake allows the minimum flow constriction to remain at 3-in (76-mm) or greater while further reducing flow due to its unique throttling action.

High Flow Control

The high flow control, or weir, is sized to pass the peak system capacity minus the peak orifice flow when the water surface elevation is at the top of the weir. This flow control is also a Cippoletti type weir.

The weir flow control is sized by solving for the crest length and head in the following equation:

$$Q_{weir} = C_d \bullet L \bullet (h)^{3/2}$$

Where:

Q_{weir} = flow through weir, cfs (L/s)

C_d = Cippoletti weir coefficient = 3.37 (based on lab testing)

h = available head, ft (m) (height of weir)

L = design weir crest length, ft (m)

Bypass Calculations

In most all cases, pollutant removal goals can be met without treating peak flow rates and it is most feasible to use a smaller Vortechs system configured with an external bypass. In such cases, a bypass design is recommended by Contech Engineered Solutions for each off-line system. To calculate the bypass capacity, first subtract the system's treatment capacity from the peak conveyance capacity of the collection system (minimum of 10-year recurrence interval). The result is the flow rate that must be bypassed to avoid surcharging the Vortechs system. Then use the following arrangement of the Francis formula to calculate the depth of flow over the bypass weir.

$$H = (Q_{bypass} / (C_d \bullet L))^{2/3}$$

Where:

H = depth of flow over bypass weir crest, ft (m)

Q_{bypass} = required bypass flow, cfs (L/s)

C_d = discharge coefficient = 3.3 for rectangular weir

L = length of bypass weir crest, ft

The bypass weir crest elevation is then calculated to be the elevation at the top of the Cippoletti weir minus the depth of flow.

Hydraulic Capacity

In the event that the peak design flow from the site is exceeded, it is important that the Vortechs system is not a constriction to runoff leaving the site. Therefore, each system is designed with enough hydraulic capacity to pass the 100-year flow rate. It is important to note that at operating rates above 100-gpm/ft^2 (68-Lps/m^2) of the swirl chamber area (peak treatment capacity), captured pollutants may be lost.

When the system is operating at peak hydraulic capacity, water will be flowing through the gap over the top of the flow control wall as well as the orifice and the weir.

Performance

Full Scale Laboratory Test Results

Laboratory testing was conducted on a full scale Vortechs model 2000. The 150-µm curve demonstrates the results of tests using particles that passed through a 60-mesh sieve and were retained on a 100-mesh sieve. The 50-µm curve is based on tests of particles passing through a 200-mesh sieve and retained on a 400-mesh sieve (38-µm). A gradation with an average particle size (d50) of 80-µm, containing particles ranging from 38–500-µm in diameter was used to represent typical stormwater solids. (Table 1)

Particle Size Distribution (µm)	Percentage of Sample Make-Up
<63	42%
63 - 75	4%
75 - 100	9%
100 - 150	7%
150 - 250	11%
>250	27%

Table 1: Particle gradation of typical urban runoff used for efficiency curve

As shown, the Vortechs system maintains positive total suspended solids (TSS), defined by the tested gradations, removal efficiencies over the full range of operating rates. This allows the system to effectively treat all runoff from large, infrequent design storms, as well as runoff from more frequent low-intensity storms.

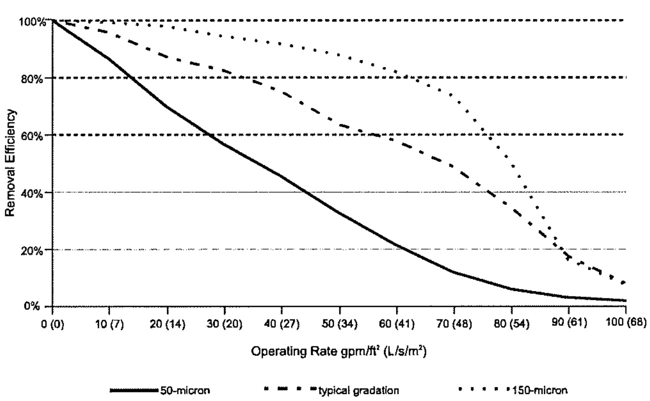


Figure 1: Vortechs model 2000 Removal Efficiencies

Typical Vortechs systems are designed to treat peak flows from 1.6-cfs (45-L/s) up to 30-cfs (850-L/s) online without the need for bypass. However, external bypasses can be configured to convey peak flows around the system if treatment capacity is exceeded. The system can also be configured to direct low flows from the last chamber of the system to polishing treatment when more stringent water quality standards are imposed. In all configurations, high removal efficiencies are achieved during the lower intensity storms, which constitute the majority of annual rainfall volume.

Full report available at www.conteches.com/vortechs.

Laboratory Testing

Full reports available at www.conteches.com/vortechs

Technical Bulletin 1: Removal Efficiencies for Selected Particle Gradations

Technical Bulletin 2: Particle Distribution of Sediments and the Effect on Heavy Metal Removal

Technical Bulletin 3: Sizing for Net Annual Sediment Removal

Technical Bulletin 3a: Determining Bypass Weir Elevation for Off-Line Systems

Technical Bulletin 4: Modeling Long Term Load Reduction: The Rational Rainfall Method

Technical Bulletin 5: Oil Removal Efficiency

Field Monitoring

Following are brief summaries of the field tests completed to date.

Full reports available at www.conteches.com/vortechs

DeLorme Mapping Company

Yarmouth, ME

Contech Engineered Solutions

Prior to this premier field test of the Vortechs system, Contech developed an extensive body of laboratory data to document total suspended solids (TSS) removal efficiency. Contech performed this field study in order to compare the performance predicted using laboratory data to the performance of a correctly sized system in the field.

The study site was the headquarters of DeLorme Mapping in Yarmouth, Maine. The building, driveway, parking lot and ancillary facilities were constructed in 1996. A Vortechs model 11000 was installed to treat runoff from the 300-space, 4-acre (1.62-ha) parking lot.

Testing Period	May 1999 to Dec 1999
# of Storms Sampled	20
Mean Influent Concentration	328-mg/L
Mean Effluent Concentration	60-mg/L
Removal Efficiency	82%

The main purpose of the DeLorme study was to verify that the sizing methodology developed from our full-scale laboratory testing was valid and an accurate means of predicting field performance. The results of the study confirmed our sizing methodology.

Village Marine Drainage

Lake George, NY

New York State Department of Environmental Conservation, Division of Water

The New York State DEC used funds obtained in a Section 319 grant to initiate a study of the effectiveness of the Vortechs system to remove sediment and other pollutants transported by stormwater to Lake George, Lake George Village, New York. "Since the 1970s, when there was a rapid increase in the rate and concentration of development along the southwestern shores of Lake George, we have been concerned about the impact of stormwater discharges into the lake," said Tracy West, co-author of the study.

Testing Period	Feb 2000 to Dec 2000
# of Storms Sampled	13
Mean Influent Concentration	801-mg/L
Mean Effluent Concentration	105-mg/L
Removal Efficiency	88%

The study concluded that the Village and Town of Lake George should consider installing additional Vortechs systems in areas where sedimentation and erosion have been identified as non-point source pollution problems.

Harding Township Rest Area
Harding Township, NJ
RTP Environmental Associates

This third party evaluation was performed under a U.S. Environmental Protection Agency grant, administered by the New Jersey Department of Environmental Protection. A. Roger Greenway, principal of RTP Environmental Associates, Inc., conducted the study in conjunction with Thonet Associates, which assisted with data analysis and helped develop best management practices (BMP) recommendations.

The Vortechs model 4000 was sized to handle a 100-year storm from the 3 acre (1.21 ha) paved parking area at the Harding Rest Stop, located off the northbound lane of I-287 in Harding Township, New Jersey.

Testing Period	May 1999 to Nov 2000
# of Storms Sampled	5
Mean Influent Concentration (TSS)	493-mg/L
Mean Effluent Concentration (TSS)	35-mg/L
Removal Efficiency (TSS)	93%
Mean Influent Concentration (TPH)	16-mg/L
Mean Effluent Concentration (TPH)	5-mg/L
Removal Efficienty (TPH)	67%

The study concluded that truck rest stops and similar parking areas would benefit from installing stormwater treatment systems to mitigate the water quality impacts associated with stormwater runoff from these sites.

Timothy Edwards Middle School
South Windsor, CT
UCONN Department of Civil & Environmental Engineering

This study of the Vortechs system was published as a thesis by Susan Mary Board, as part of the requirements for a Master of Science degree from the University of Connecticut. Her objective was to determine how well the Vortechs system retained pollutants from parking lot runoff, including total suspended solids (TSS), nutrients, metals, and petroleum hydrocarbons.

A Vortechs model 5000 was installed in 1998 to treat runoff from the 82-space parking lot of Timothy Edwards Middle School. The entire watershed was approximately 2 acres (0.81 ha), and was 80% impervious.

Testing Period	Jul 2000 to Apr 2001
# of Storms Sampled	weekly composite samples taken
Mean Influent Concentration	324-mg/L
Mean Effluent Concentration	73-mg/L
Removal Efficiency	77%

Additionally, the Vortechs system was particularly effective in removing zinc (85%), lead (46%), copper (56%), phosphorus (67%) and nitrate (54%).

The study concluded that the Vortechs system significantly reduced effluent concentrations of many pollutants in stormwater runoff.

Maintenance

The Vortechs system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit, e.g., unstable soils or heavy winter sanding will cause the swirl chamber to fill more quickly but regular sweeping will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. Inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations. It is useful and often required as part of a permit to keep a record of each inspection. A simple inspection and maintenance log form for doing so is provided on the following page, and is also available on conteches.com.

The Vortechs system should be cleaned when inspection reveals that the sediment depth has accumulated to within 12 to 18 inches (300 to 450 mm) of the dry-weather water surface elevation. This determination can be made by taking two measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.

Cleaning

Cleaning of the Vortechs system should be done during dry weather conditions when no flow is entering the system. Clean-out of the Vortechs system with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. If such a truck is not available, a "clamshell" grab may be used, but it is difficult to remove all accumulated pollutants using a "clamshell".

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads to solidify the oil since these pads are usually much easier to remove from the unit individually and less expensive to dispose of than the oil/water emulsion that may be created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants.

Cleaning of a Vortechs system is typically done by inserting a vacuum hose into the swirl chamber and evacuating this chamber of water and pollutants. As water is evacuated, the water level outside of the swirl chamber will drop to a level roughly equal to the crest of the lower aperture of the swirl chamber.

Floating pollutants will decant into the swirl chamber as the water level is drawn down. This allows most floating material to be withdrawn from the same access point above the swirl chamber. Floating material that does not decant into the swirl chamber during draw down should be skimmed from the baffle chamber. Sediment may accumulate outside the swirl chamber. If this is the case, it may be necessary to pump out other chambers. It is advisable to check for sediment accumulation in all chambers during inspection and maintenance.

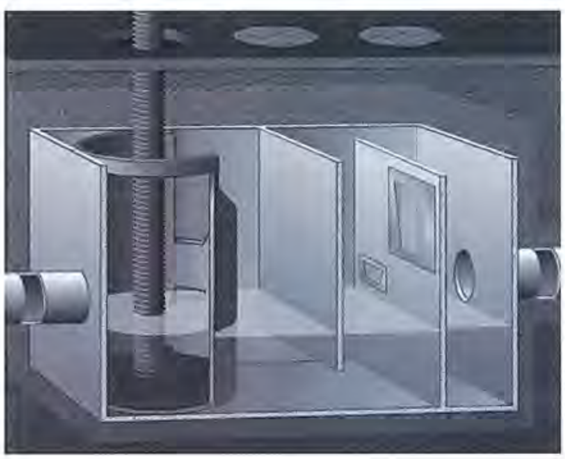
These maintenance recommendations apply to all Vortechs systems with the following exceptions:

1. It is strongly recommended that when cleaning systems larger than the Model 16000 the baffle chamber be drawn down to depth of three feet prior to beginning clean-out of the swirl chamber. Drawing down this chamber prior to the swirl chamber reduces adverse structural forces pushing upstream on the swirl chamber once that chamber is empty.
2. Entry into a Vortechs system is generally not required as cleaning can be done from the ground surface. However, if manned entry into a system is required the entire system should be evacuated of water prior to entry regardless of the system size.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed.

Disposal of all material removed from the Vortechs system should be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

Contech has created a network of Certified Maintenance Providers (CCMP's) to provide maintenance on Vortechs systems. To find a CCMP in your area please visit www.conteches.com/maintenance.

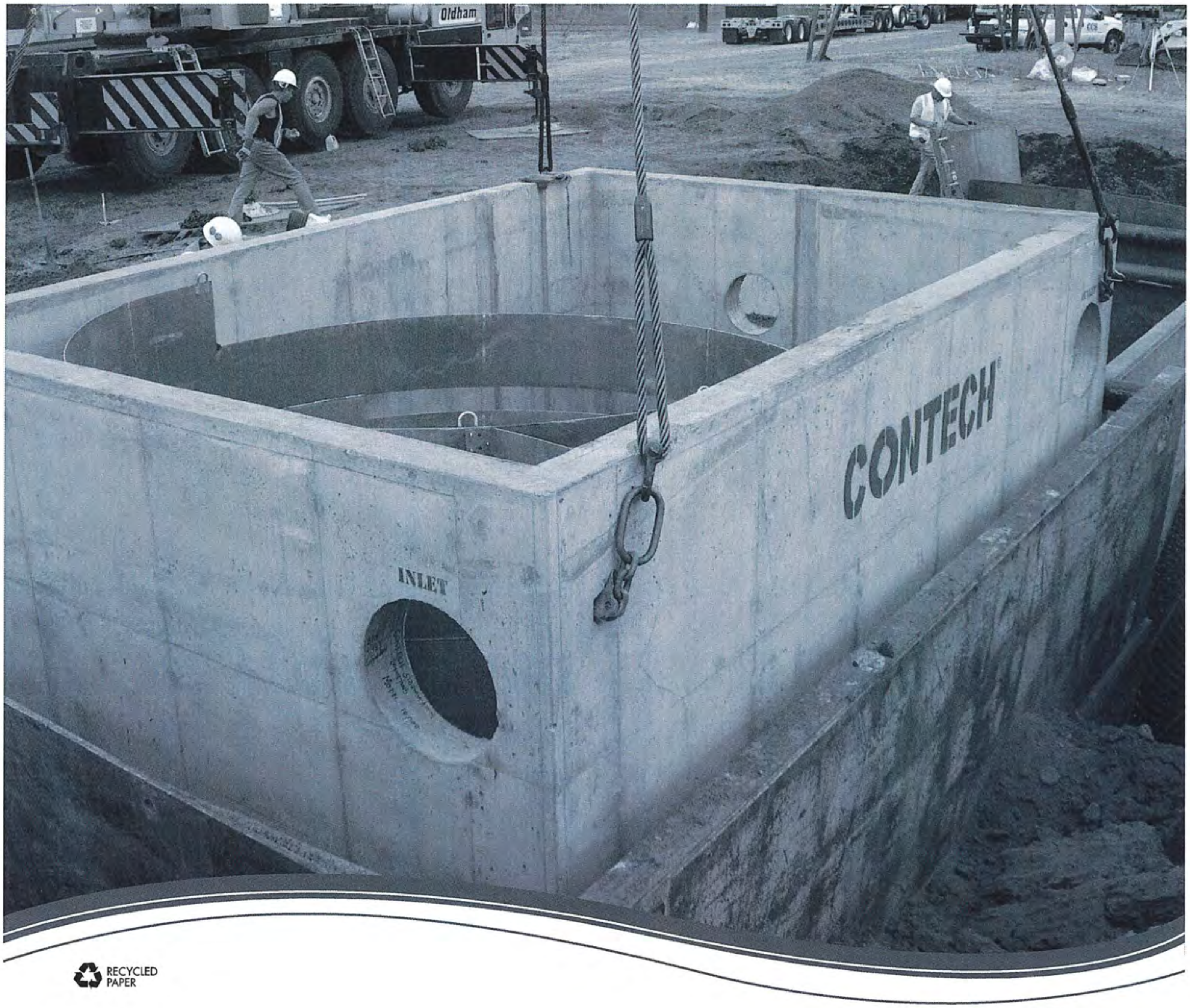


Vortechs Inspection & Maintenance Log

Vortech Model: ____________________ **Location:** ______________________________

Date	Water depth to sediment	Floatable layer thickness	Describe maintenance performed	Maintenance personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than eighteen inches the system should be cleaned out. Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.



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vx_manual 04/17 PDF Revision

CONTECH®
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CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

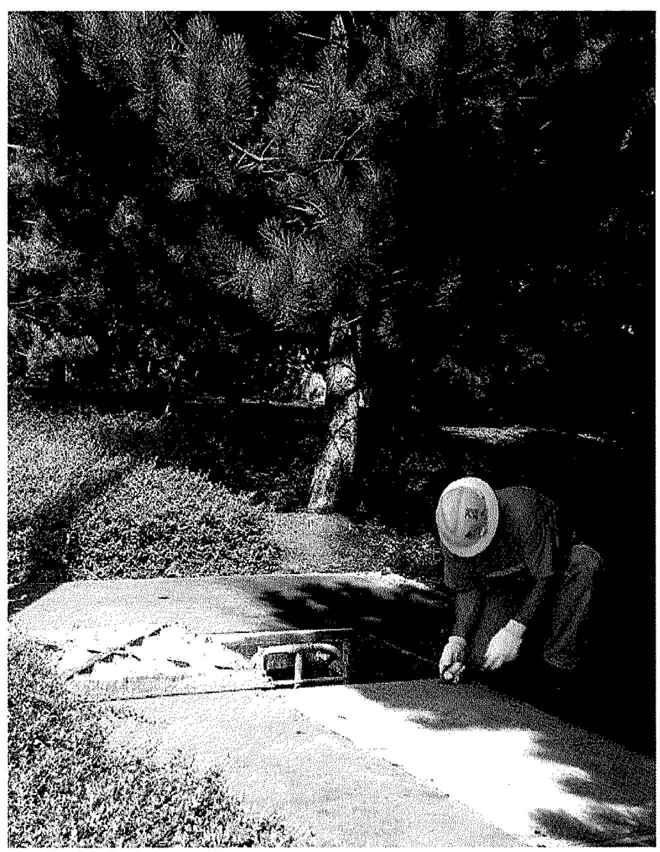
The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.



CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.