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SCS ENGINEERS

October 18, 2004

DC Office of Zoning
441 4th Street, N.W.
Suite 210
Washington DC 20001
Attn: Mr. Alberto Bastida

RE: Case No. 03-28 Fort Totten Solid Waste Transfer Facility PUD Application – **Addendum 2**

Dear Mr. Bastida,

Please find enclosed twenty (20) copies of the Addendum 2 to the PUD Application for the Fort Totten Solid Waste Transfer Facility (Case No. 03-28) on behalf of the District of Columbia Public Works Solid Waste Administration. This document addresses the stormwater treatment proposed for the site.

Please do not hesitate to contact me if you have questions regarding the information contained within this Addendum.

Sincerely,

Dana L. Murray, P.E.
Project Manager
SCS ENGINEERS

Enclosures

cc: Thomas Henderson, Administrator Solid Waste Administration

ZONING COMMISSION
District of Columbia
CASE NO. 03-28
EXHIBIT NO. 20

ZONING COMMISSION
District of Columbia
CASE NO.03-28
EXHIBIT NO.20

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SCS ENGINEERS

October 12, 2004

DC Office of Zoning
441 4th Street, N.W.
Washington DC 20001
Attn: Mr. Alberto Bastida

RE: Case No. 03-28 Fort Totten Solid Waste Transfer Facility PUD Application – **Addendum 2**

Dear Mr. Bastida,

SCS Engineers is pleased to submit twenty (20) copies of the Addendum 2 to the PUD Application for the Fort Totten Solid Waste Transfer Facility (Case No. 03-28) on behalf of the District of Columbia Public Works Solid Waste Administration. This document addresses the stormwater treatment proposed for the site.

Please do not hesitate to contact me if you have questions regarding the information contained within this Addendum.

Sincerely,

Dana L. Murray, P.E.
Project Manager
SCS ENGINEERS

Enclosures

cc: Thomas Henderson, Administrator Solid Waste Administration

SCS ENGINEERS

Addendum 2

APPLICATION FOR CONSOLIDATED APPROVAL OF A PLANNED UNIT DEVELOPMENT

Fort Totten
Solid Waste Transfer Facility
4900 Bates Road, N.E.

Prepared for:

Office of the Zoning Commission
441 4th Street, N.W.
Suite 210 South
Washington, D.C. 20001

Case No. 03-28

October 2004

ZONING COMMISSION
District of Columbia
Case 03-28
Exhibit 20

STORMWATER TREATMENT

The purpose of this addendum is to provide information on the permanent stormwater treatment systems that will be installed at the Fort Totten Solid Waste Transfer Facility. As shown in Exhibits A-1 through A-3, new stormwater treatment systems based on peak treatment capacity will be installed in three locations on the site. The purpose of these treatment systems is to remove contaminated sediment, floating oil, and debris from the stormwater surface runoff. Also included in Exhibit B of this addendum are technical bulletins from an approved pre-manufactured treatment system.

EXHIBIT A-1
SITE YARD DRAINAGE AND PIPING PLAN

EXHIBIT A-2
STORMWATER AND SANITARY PIPE PROFILES

EXHIBIT A-3
STORMWATER TREATMENT SYSTEM DETAILS

DRAWN BY: BJD DATE: 10-12-04 FILE NAME: M:\2200070.05\JULY2004SUB\ADDENDUM 2\C-5

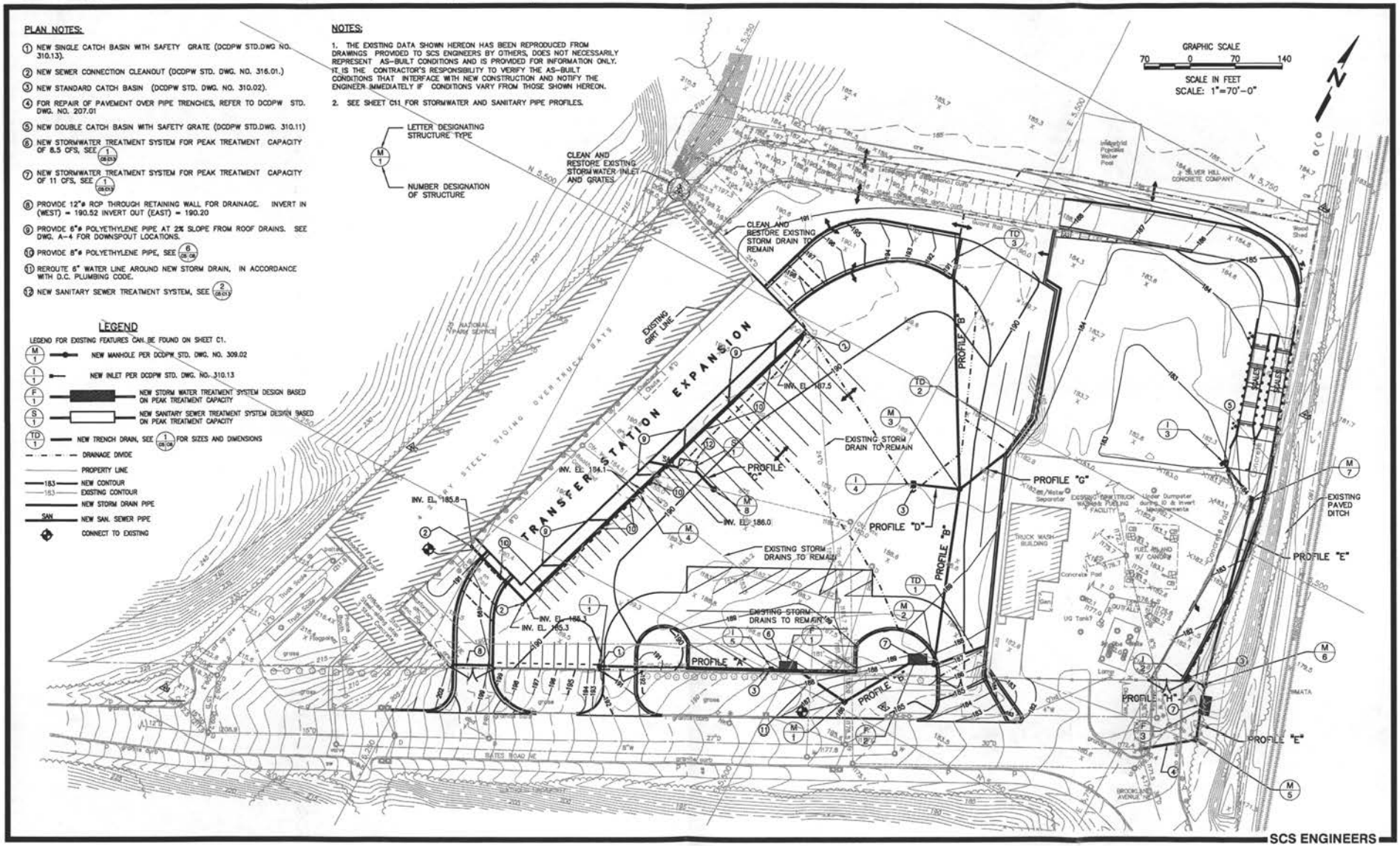
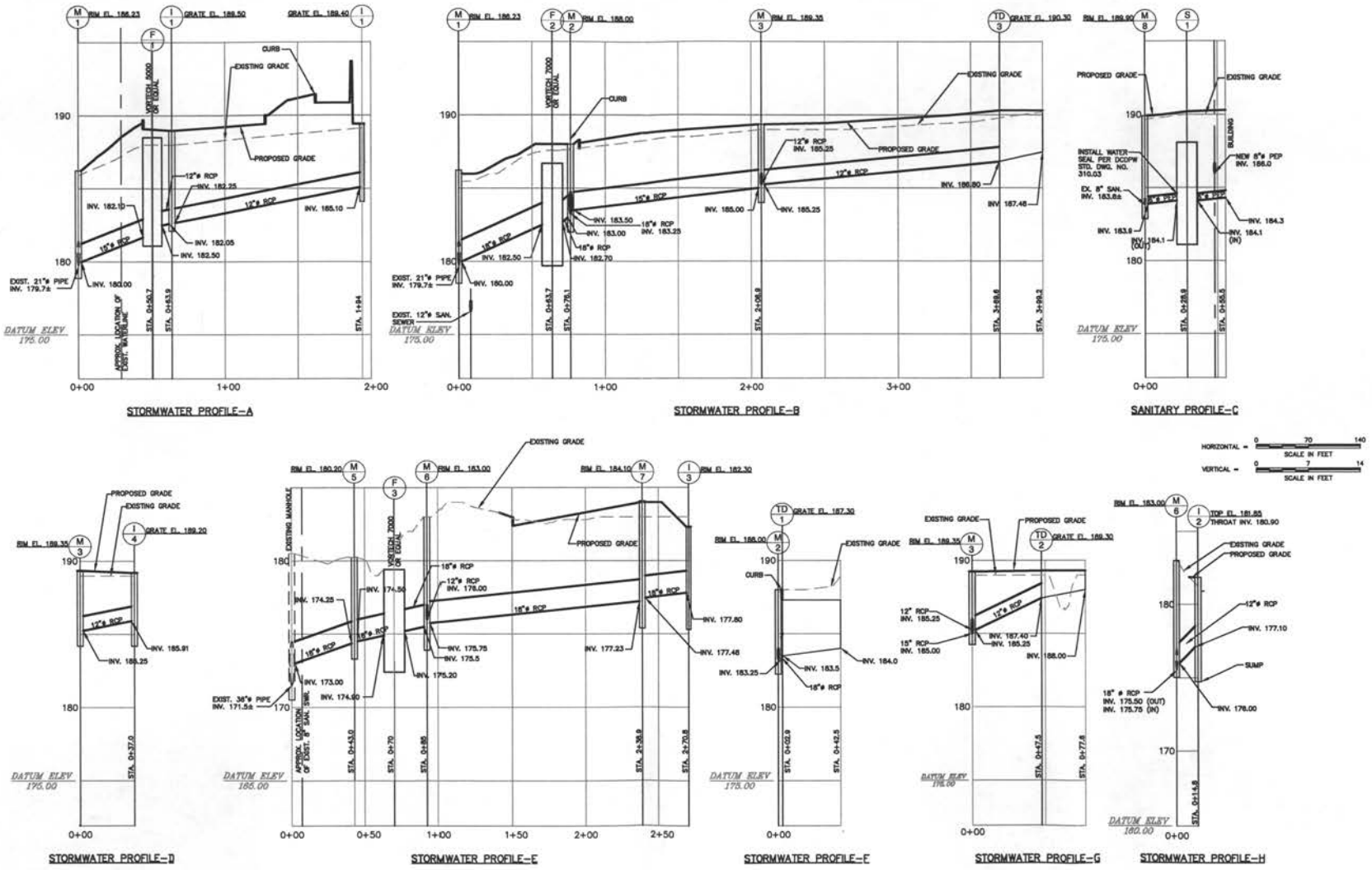


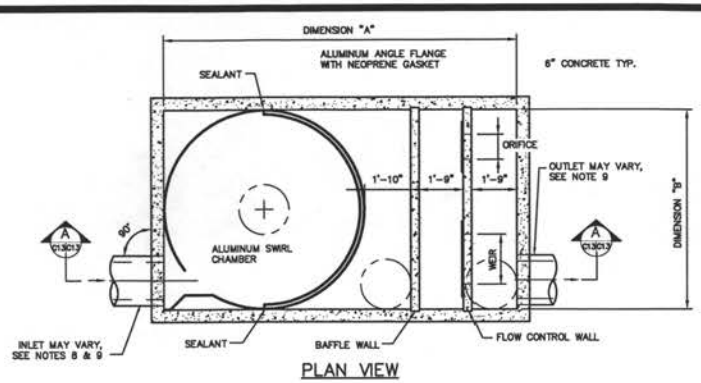
EXHIBIT A-1 SITE YARD DRAINAGE AND PIPING PLAN



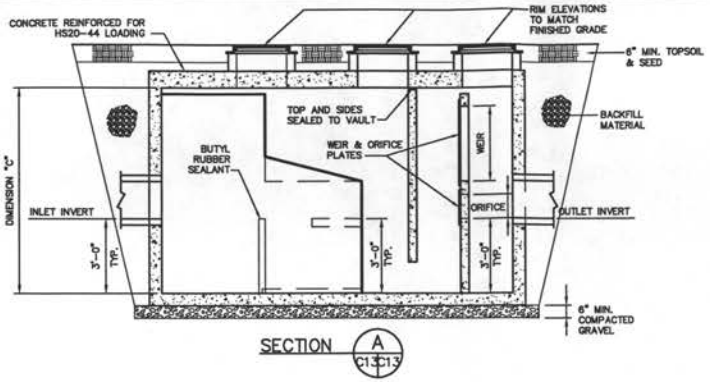
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EXHIBIT A-2 STORMWATER AND SANITARY PIPE PROFILES

DRAWN BY: BJD DATE: 1-10-04 FILE NAME: M:\2200070.05\JULY2004 SUB\ADDENDUM 2\C-13



PLAN VIEW

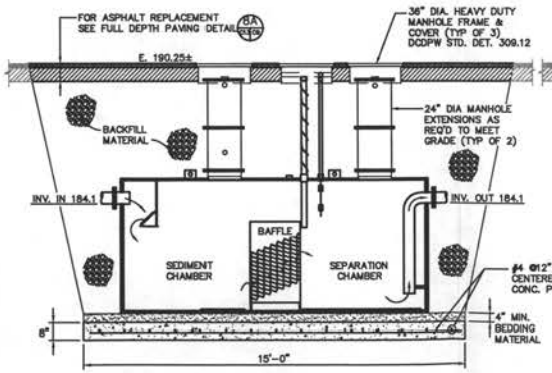


SECTION A C1.3/C1.3

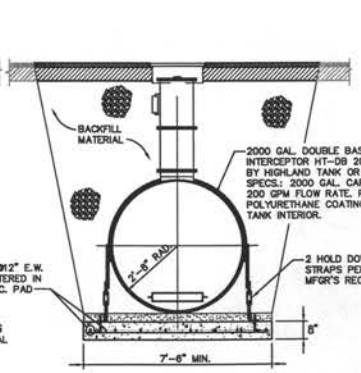
STORMWATER TREATMENT SYSTEM SCHEDULE				
SYSTEM CAPACITY	DIMENSION "A"	DIMENSION "B"	DIMENSION "C"	SEDIMENT STORAGE
8.5 CFS	13'-0"	7'-0"	7'-0"	3.25 CY
11 CFS	14'-0"	8'-0"	7'-0"	4.0 CY

NOTES:
1. STORMWATER TREATMENT SYSTEM (SWTS) SHALL HAVE: PEAK TREATMENT CAPACITY: SEE SCHEDULE THIS SHEET. SEDIMENT STORAGE: SEE SCHEDULE THIS SHEET. SEDIMENT CHAMBER DIA: 8' MIN.
2. SWTS SHALL BE CONTAINED IN ONE RECTANGULAR STRUCTURE
3. SWTS REMOVAL EFFICIENCY SHALL BE BASED ON A 50 MICRON PARTICLE
4. SWTS SHALL RETAIN FLOATABLES AND TRAPPED SEDIMENT UP TO AND INCLUDING PEAK TREATMENT CAPACITY
5. SWTS INVERT OUT SHALL BE AT THE SAME OR LOWER ELEVATION THAN INVERT IN
6. SWTS SHALL NOT BE COMPROMISED BY EFFECTS OF DOWNSTREAM TAILWATER
7. SWTS SHALL HAVE NO INTERNAL COMPONENTS THAT OBSTRUCT MAINTENANCE ACCESS
8. INLET PIPE MUST BE PERPENDICULAR TO THE STRUCTURE
9. PIPE ORIENTATION MAY VARY; SEE SITE PLAN FOR SIZE AND LOCATION
10. CONTRACTOR SHALL BE RESPONSIBLE FOR ASSEMBLY OF UNIT
11. MANHOLE FRAMES AND PERFORATED COVERS SUPPLIED WITH SYSTEM, TO BE INSTALLED BY CONTRACTOR.
12. CONTRACTOR TO PREPARE EXCAVATION AND PROVIDE LIFTING EQUIPMENT REQUIRED FOR INSTALLATION.

STORMWATER TREATMENT SYSTEM FOR PEAK TREATMENT CAPACITY OF 8.5 OR 11 CFS 1 C1.3
SCALE: 1/2"=1'-0" C5,M1



ELEVATION VIEW



END VIEW

SANITARY TREATMENT SYSTEM DETAIL 2 C5,C1.3
NO SCALE

CONTRACTOR SUPPLIED EQUIPMENT
1. VENT PIPING (SEE NOTE 1)
2. GRADE-LEVEL MANWAY AND COVER
3. GRADE-LEVEL CONCRETE HOLD-DOWN PAD
4. CONCRETE BASE PAD (OR DEAD-MAN WEIGHTS)
5. APPROVED BEDDING MATERIAL

GENERAL NOTES
1. VENT PIPING - INLET AND OUTLET MUST BE VENTED SEPARATELY; MANWAY VENT PIPING MAY BE MANIFOLDED TOGETHER
2. STANDARD SIZE MANWAYS LISTED, LARGER SIZES AVAILABLE
3. MANWAY EXTENSIONS VARY WITH SEPARATOR BURIAL DEPTH
4. LEVEL SENSOR AND OIL PUMP OUT PIPES ON 550, 1,100 & 2,000 GAL. SEPARATORS ARE LOCATED ADJACENT TO EACH OTHER ACROSS THE DIAMETER OF THE TANK.

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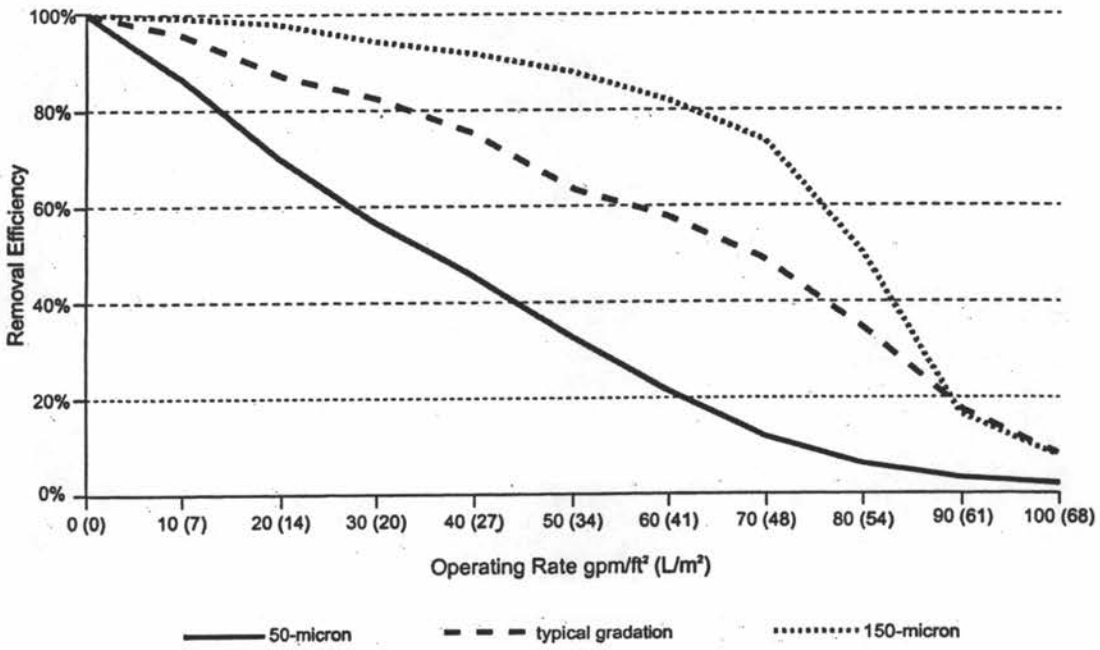
EXHIBIT A-3

EXHIBIT B
STORMWATER TREATMENT SYSTEM TECHNICAL BULLETINS

Vortechs® System Performance: Removal Efficiencies for Selected Particle Gradations

These performance curves are based on laboratory tests using a full scale Vortechs® Model 2000. The testing protocol used is summarized on the following page. The 150-micron curve demonstrates the results of tests using particles that passed through a 100-mesh sieve and were retained on a 150-mesh sieve. The 50-micron curve is based on tests of particles passing through a 200-mesh sieve and retained on a 400-mesh sieve. A gradation with an average particle size (d_{50}) of 80 microns, containing particles ranging from 38–500 microns in diameter was used to represent typical stormwater solids.

Vortechs® System Removal Efficiencies for Selected Particle Gradations



As the graph clearly shows, Vortechs® Systems maintain positive total suspended solids (TSS) 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. Vortechs® Systems are designed to treat peak flows from 1.6 cfs (45 L/s) up to 25 cfs (710 L/s) without bypassing. However, external bypasses can be configured to convey peak flows around the system if treatment capacity is exceeded. The Vortechs® System can 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.

Vortechs® Systems are sized based on flow rate rather than volume, which allows effective treatment of runoff from the entire storm, including high-intensity flows. This design basis addresses the deficiencies of conventional volume-based BMPs, which capture the first half or whole inch of runoff but may bypass prematurely, allow resuspension of previously captured pollutants, and/or wash out at higher flow rates. For more information about the Vortechnics sizing methodology, please refer to Technical Bulletin No. 3.

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Vortechs® System

Technical Bulletin 1

Vortechnics
A CONTECH Company

Laboratory Quality Control Brief

The following protocol contains standard operating procedures for Total Suspended Solids (TSS) testing in the Vortechnics laboratory. These guidelines were followed in the creation of the preceding performance curves.

Sediment Source

Sediment samples are sorted according to ASTM Special Technical Publication 477 B, which establishes sieve analysis procedures. U.S. Standard Sieves in a Gilson SS-15 sieve shaker are used to separate particles to the various fractions required for our tests. To ensure uniformity of those fractions, an unsorted sample is sieved until less than 1% of that sample passes through the sieve in one minute. All sediment recovered after a test is dried and re-sieved according to this procedure before reuse. Unless otherwise specified, mineral sediments with a density of 2.65 g/cm^3 are used.

Flow Calibration and Regulations

Flow calibration is accomplished by calculating the head at the baffle wall required to produce a given flow rate through the orifice and the weir in the flow control wall. Flow is regulated by a 12-inch butterfly valve located upstream of the Vortechs® System. In order to simulate field conditions, flow rates are changed gradually to avoid flow surges through the system. The test flow rate is set by observing the head in the Vortechs® System and adjusting the regulating valve accordingly. Before any samples are collected, the valve must remain fixed for a period equal to half of the detention time so that flow equalizes throughout the system. Each test group is planned so that flow rates increase incrementally in consecutive tests.

Sediment Metering

All sediment is injected into the inlet pipe via a ¼-inch flexible hose using a Watson Marlow 5058 peristaltic metering pump. For TSS tests, a known gradation of sediment and water are combined in approximately a ½ pound/gallon ratio in a holding tank and homogenized by a mixing propeller powered by a ⅓ horsepower motor. The mixer is activated at least five minutes before testing commences and runs continuously throughout the test. The metering pump is activated for a period of time equal to at least half of the detention time of the Vortechs® System at the test flow rate, before the first influent sample is taken. The pump must run continuously until the last effluent sample is taken.

Sample Collection

All influent samples are taken from a six-inch gate valve located upstream of the Vortechs® System. A collection bin housing a 500 mL sample container is positioned beneath the valve. Five seconds before each sample is taken, the valve is quickly opened and closed to eliminate any interference from particles that have settled in the low velocity region of the gate. This eliminates artificially high influent readings. The time that the influent sample was taken is recorded and the corresponding effluent sample is collected after a period of time equal to the detention time. Effluent grab samples are collected at the discharge pipe, by sweeping the mouth of a 500 mL bottle through the exiting flow stream. Samples are annotated and refrigerated until they can be analyzed.

Sample Analysis

TSS samples are analyzed in the Vortechnics laboratory, following EPA method 160.2, a method for the measurement of total non-filterable solids. Volume measurements are accurate to 0.6 mL using a 500 mL graduated cylinder. An Acculab V-1 analytical balance with a readability of 0.001 g is used to measure mass.

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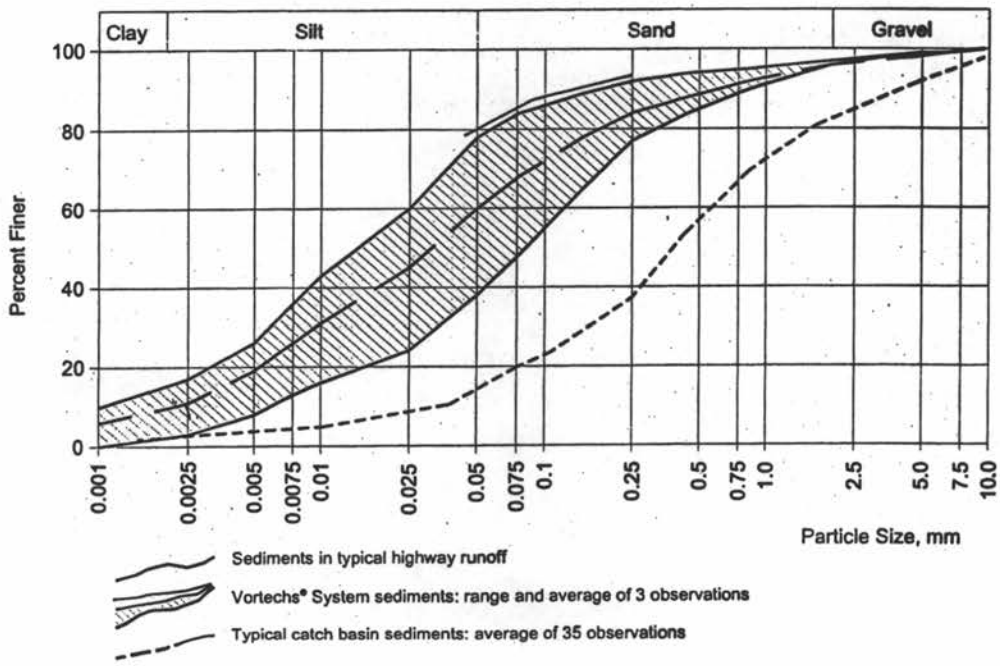
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Particle Distribution of Sediments and the Effect on Heavy Metal Removal

Sediments removed from Vortechs® Stormwater Treatment System installations in Portland and South Portland, Maine were analyzed by a soil testing laboratory to determine size and distribution. These results were compared to similar tests done on sediments carried in highway runoff[1] and on material removed from catch basins by a Vactor truck[2]. The highway runoff sediment data is useful in characterizing typical total stormwater sediment loading. The catch basin data is indicative of sediment removed by typical plug-flow tanks. The data is plotted below for graphical comparison:

Sediment Size and Distribution Comparison



The curves describing sediments extracted from Vortechs® Systems show enhanced effectiveness across the entire range of particle sizes. In the "mid-range" for example, over 80 percent of the sediment retained by a Vortechs® System is approximately 250 microns ("medium sand") and finer particles, compared with less than 40 percent of the sediment in catch basin sumps. The difference between the curves may be interpreted as sediment loss from the catch basins due to turbulence and the resuspension of previously deposited grit. These problems are widely recognized to occur in catch basins and, for that matter, conventional oil/grit separators during brief periods of high flow.

---

[1]Yousef, Y. A. et.al., 1991, Maintenance Guidelines in Accumulated Sediments in Retention/Detention Ponds Receiving Highway Runoff, Florida Department of Transportation, Tallahassee, FL, p. 17. The study included samples from Highway 50, (Sacremanto), I-81, (Harrisburg), I-94, (Milwaukee) and I-85, (Effland). The curve shown is the average of the four samples.

[2]Analysis of sediments from 35 catch basins performed under the direction of Steven Lazoff, Laboratory Director, Aquatic Research, Inc., Seattle, WA and reported to Bob Storer, King County Surface Water Management Division, Seattle, WA, June 21, 1993.

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Vortechs® System
Technical Bulletin 3

Vortechnics®
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Sizing for Net Annual Sediment Removal

One of the greatest threats to aquatic ecosystems is chronic pollution caused by stormwater runoff. Sediments and other associated pollutants accumulate over time seriously degrading surface water quality. For this reason, Vortechnics recommends sizing stormwater best management practices (BMPs) to provide a specific net reduction of pollutants on an annual basis. A typical net annual removal efficiency target is 80%, but depending on sensitivity of the receiving water body or the presence of other best management practices (BMPs), greater or lesser load reduction may be required.

This Technical Bulletin provides a simple two-step sizing methodology that will produce the most appropriate, and most cost effective Vortechs® System for your site.

Step #1 – Sizing for a Specific Net Annual Load Reduction

Vortechs® System performance is dependent on the local rainfall intensity distribution and other site-specific factors. In order to account for regional rainfall differences, Vortechnics developed the Rational Rainfall Method™ of sizing. Central to the method is the design ratio, which changes according to regional differences in precipitation patterns, as well as site and model characteristics. Maximum design ratios for different geographic regions across North America have been determined through analysis of historical precipitation records archived by the National Climatic Data Center.

To determine the minimum Vortechs® System model that will meet your treatment objective, perform the following steps:

A. Determine the net annual removal efficiency target and time of concentration that best match your site.

B Determine the design ratio for your site location that corresponds to your treatment goal and time of concentration. The design ratio for the chosen model should not exceed the target design ratio (see below equation). Please contact your local Vortechnics representative for the appropriate design ratio number.

Imperial:

$$\text{Target Design Ratio} \geq \frac{C_dA * 448.83\ \text{gpm/cfs}}{\text{Grit Chamber Area}}$$

Metric:

$$\text{Target Design Ratio} \geq \frac{C_dA * 2.78}{\text{Grit Chamber Area}}$$

Where:

A = Drainage Area (acres/hectares)
C_d = Runoff Coefficient

C. Calculate the necessary swirl chamber area and corresponding Vortechs® System model using the following equation:

Imperial:

$$\text{Minimum Swirl Chamber Area} \geq \frac{C_dA * 448.83\ \text{gpm/cfs}}{\text{Design Ratio}}$$

Metric:

$$\text{Minimum Swirl Chamber Area} \geq \frac{C_dA * 2.77}{\text{Design Ratio}}$$

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D. Based on the required swirl chamber area calculated in Step C, choose the appropriate Vortechs® System model number from Table 3.1.

This is the smallest model that can be expected to achieve your treatment goal. To decide if this Vortechs® System will be "on-line", without a bypass, or "off-line", with a bypass, proceed to Step #2.

Vortechs® Model	Grit Chamber Area	
	ft²	m²
1000	0 - 7	0 - 0.66
2000	7 - 13	0.66 - 1.7
3000	13 - 20	1.7 - 1.8
4000	20 - 28	1.8 - 2.6
5000	28 - 38	2.6 - 3.6
7000	38 - 50	3.6 - 4.7
9000	50 - 64	4.7 - 5.9
11000	64 - 79	5.9 - 7.3
16000	79 - 113	7.3 - 10.5

Table 3.1

Step #2 – On-Line vs. Off-Line Configuration

The Vortechs® System has been tested at operating rates up to 100 gpm/ft² (70 L/m²) of swirl chamber surface area, which corresponds to the peak treatment capacity for each model, and has been found to provide positive removal efficiencies of suspended solids throughout this range. Flow rates exceeding the treatment capacity of the system may cause resuspension of previously captured materials, therefore, it is recommended that flows in excess of the peak treatment capacity for each respective model be bypassed.

The appropriate configuration of the model selected in Step #1 is determined as follows:

A. Calculate the flow rate resulting from an infrequent (10 to 25-year recurrence interval) storm on your site.
B. Compare this flow rate to the peak treatment capacity (Table 3.2) of the model selected in Step #1.
   1. If it is less, the model selected in Step #1 is appropriate on-line.
   2. If it is more, either:
      a. The model selected in Step #1 should be configured with a bypass (provided by Vortechnics) in an off-line orientation, or
      b. A system should be selected from Table 3.2 with a treatment capacity equal to or greater than the flow from above. This system should be configured on-line without a bypass.

Vortechs® Model	Peak Treatment Flow	
	cfs	L/s
1000	1.6	45
2000	2.8	80
3000	4.5	130
4000	6.0	170
5000	8.5	240
7000	11	310
9000	14	400
11000	17.5	500
16000	25	710

Table 3.2

The choice between an off-line model and an on-line model is usually determined by economics. For example the cost savings gained by using the smaller off-line unit must be weighed against the cost of additional manholes typically required to split and rejoin bypassed flows. For pricing information please contact your Vortechnics representative.

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Determining Bypass Weir Elevation for Off-Line Vortechs® Systems

Proper bypass configuration maximizes the amount of flow treated by a Vortechs® System while ensuring that the system's treatment capacity is not exceeded. Since the crest elevation of the bypass weir is dependant on the design of the Vortechs® System, Vortechnics Inc. prefers to recommend the bypass design. To optimize the bypass function, the following design methodology is typically followed.

Calculating the Bypass Weir Crest Elevation

1. Determine peak conveyance capacity of the stormwater collection system (minimum 10-year event).
2. Subtract the treatment capacity of the Vortechs® System from the peak flow rate determined in Step 1. The result (Q_{bypass}) is the flow rate that must be bypassed to avoid surcharging the Vortechs® System.
3. Use the bypass weir length, as dictated by the diversion structure, to calculate the depth required to pass the flow calculated in Step 2 with the following arrangement of the Francis formula (which assumes a rectangular broad crested weir).

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

Where:
C_d = 3.3 = Discharge Coefficient for Broad Crested Weir
L = Length of Bypass Weir Crest

4. Subtract the depth calculated in Step 3 from the elevation at the top of the weir opening in the Vortechs® System flow control wall (supplied by Vortechnics). The result is the crest elevation of the bypass weir.

In cases where tailwater elevations exceed the crown of the outlet pipe, or where other site conditions require special consideration, some variation of this method may be used. If a specific water quality flow must be treated before bypass, the length of the bypass weir and the flow controls within the Vortechs® System can be modified accordingly. For all designs, Vortechnics engineers complete a stage discharge worksheet, which is available on request.

Bypass Weir Calculations

Q_{bypass}	=	Flow over bypass weir (cfs)
Q_{design}	=	Vortechs® System treatment capacity (cfs)
Q_{convey}	=	Estimated peak conveyance capacity of collection system (cfs)
L	=	Length of bypass weir crest (ft)
C_d	=	Discharge Coefficient = 3.3 for rectangular weir
E_{bypass}	=	Elevation of bypass weir crest (ft)
WSE_{peak}	=	Water surface elevation for Q_{convey} (generally equal to the elevation at the top of the Cippoletti weir, ft)
H	=	Depth of flow over bypass weir crest (ft)
Q_{bypass}	=	$Q_{convey} - Q_{design}$ (Calculate the flow over the bypass weir during peak conveyance event)
Q_{bypass}	=	$C_d L H^{3/2}$ (Francis formula for rectangular weir)
H	=	$(Q_{bypass}/3.3L)^{2/3}$ (Use this arrangement of the Francis formula to solve for H)
E_{bypass}	=	WSE_{peak} - H (Solve for bypass weir crest levation – E_{bypass})

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Modeling Long Term Load Reduction: The Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydrologically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. To estimate efficiencies as accurately as possible, Vortechnics has developed the Rational Rainfall Method™ which combines site-specific information with laboratory generated performance data (see Technical Bulletin 1 for more information), and local historical precipitation records.

Short duration rain gauge records from across the United States and Canada were analyzed by Vortechnics to determine the percent of the total annual rainfall that fell at a range of intensities. At U.S. 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 intense storms contributed relatively little to the total depth.

These intensities along with the total drainage area and runoff coefficient for each specific site are translated into flow rates using the Rational Method. The flow rates are then used to calculate operating rates for a proposed Vortechs® System. Finally, operating rates are paired with their corresponding removal efficiencies. See figure 4 for a graphic illustration this relationship between operating rate, removal efficiency and intensity distribution.

The net annual TSS removal efficiency is then calculated by summing the relative efficiencies at each intensity (see Table 4.1 and 4.2).

How the Vortechs® System Removal Efficiencies and Operating Rates Relate to Rainfall Intensity Distribution

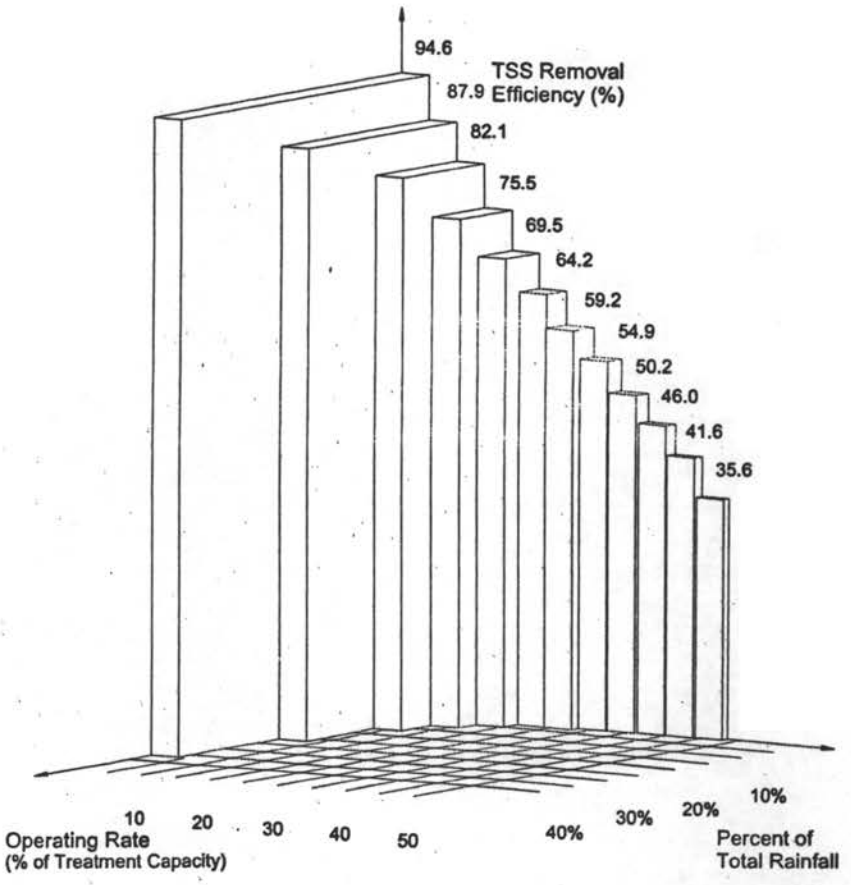


Figure 4

The same process was used to develop the Vortechnics sizing methodology described in Technical Bulletin 3. The design ratio was created as a tool to help calculate an operating rate from an intensity. Maximum design ratios for different geographic regions across North America have been determined through analysis of historical precipitation records archived by the National Climatic Data Center. Depending on climatic regime, design ratio thresholds vary, with higher design ratio thresholds in areas like the Gulf Coast where high intensity precipitation is common and lower thresholds in areas like the Pacific Northwest where the vast majority of rain falls at very low intensities.

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Table 4.1: Vortechs® Model 5000 Net Annual TSS Removal Efficiency in Portland, ME

$$\text{Design Ratio}^1 = \frac{(4.5 \text{ acres}) * (0.95) * 449 \text{ gpm/ft}^2)}{38.5 \text{ ft}^2} = 50$$

Rainfall Intensity		Operating Rate[2]	% Total Rainfall Volume[3]	Removal Efficiency[4]	Relative Efficiency
in/0.25 hr	in/hr	gpm/ft²			
0.02	0.08	4	36.9%	94%	34.7%
0.04	0.16	8	21.9%	88%	19.3%
0.06	0.24	12	11.9%	82%	9.8%
0.08	0.32	16	7.6%	76%	5.8%
0.10	0.40	20	5.0%	70%	3.5%
0.12	0.48	24	2.9%	64%	1.9%
0.14	0.56	28	3.0%	60%	1.8%
0.16	0.64	32	2.0%	55%	1.1%
0.18	0.72	36	1.8%	51%	0.9%
0.20	0.80	40	1.4%	46%	0.7%
0.22	0.88	44	1.2%	41%	0.5%
0.24	0.96	48	0.8%	36%	0.3%
				subtotal:	80.2%
				% rain falling at 0.96 in/hr:	3.5%
				assumed removal efficiency of remaining %:	0.0%
				net annual TSS removal efficiency:	80%

1 - Design Ratio = (Total Drainage Area) * (Runoff Coefficient) * (cfs to gpm conversion) / Grit Chamber Area
- Total Drainage Area and Runoff Coefficient are specified by the site engineer.
- The conversion factor from cfs to gpm is 449.

2 - Operating Rate (gpm/ft²) = Intensity (in/hr) * Design Ratio
3 - Based on 5 years of rainfall data recorded at 15 minute intervals in Portland, ME.
4 - Based on Vortechnics laboratory verified removal of 50 micron particles.

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Table 4.2: Vortechs® Model 5000 Net Annual TSS Removal Efficiency in Toronto, ON, Canada

$$\text{Design Ratio}^1 = \frac{(2.3 \text{ hectare}) * (100\%) * (2.78)}{3.58 \text{ m}^2} = 1.79$$

Rainfall Intensity mm/hr	Operating Rate[2] (L/s)	% Total Rainfall Volume[3]	Removal Efficiency[4]	Relative Efficiency
1	1.8	19.7%	97%	19%
2	3.6	18.4%	93%	17%
3	5.4	10.8%	90%	9.7%
4	7.2	9.3%	86%	8.0%
5	8.9	7.3%	80%	5.9%
6	11	6.0%	77%	4.7%
7	13	5.8%	72%	4.2%
8	14	3.2%	68%	2.2%
9	16	1.9%	65%	1.3%
10	18	4.2%	62%	2.6%
11	20	2.5%	60%	1.5%
12	21	1.9%	56%	1.0%
15	27	3.5%	47%	1.6%
20	36	2.1%	31%	0.7%
25	45	2.4%	16%	1.4%
			subtotal:	**81%**
			% rain falling at > 25 mm/hr:	**1.0%**
			assumed removal efficiency of remaining %:	**0.0%**
			net annual TSS removal efficiency:	**81%**

1 - Design Ratio = (Total Drainage Area) * (Runoff Coefficient) * (2.77) / Grit Chamber Area
- Total Drainage Area and Runoff Coefficient are specified by the site engineer.

2 - Operating Rate (L/s) = Intensity (mm/hr) * Design Ratio

3 - Based on 10 years of rainfall data from Canadian Station 6158350, Toronto, Ontario, Canada.

4 - Based on Vortechnics laboratory verified removal of 50 micron particles.

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Vortechs® System
Technical Bulletin 5

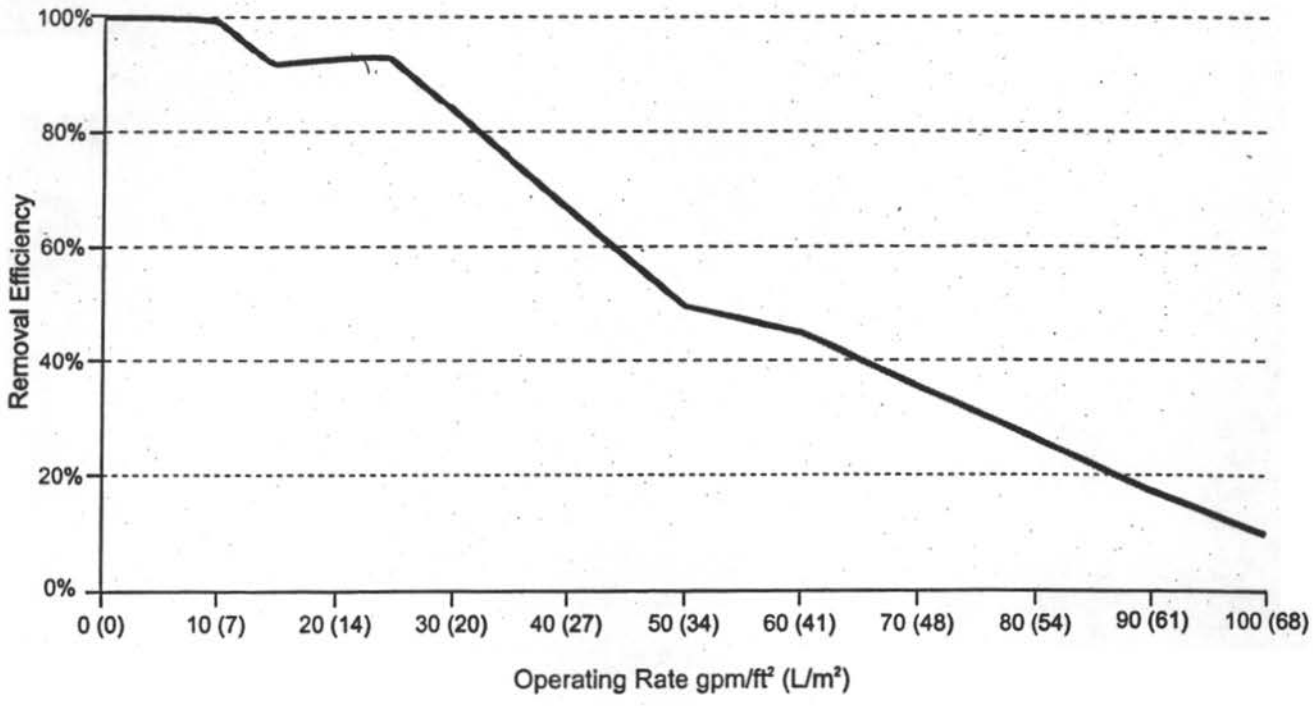
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Vortechs® System Performance: Oil Removal Efficiency

Petroleum based hydrocarbons are transported in stormwater at event mean concentrations typically ranging from two to five mg/L in residential areas to greater than 40 mg/L in concentrated traffic areas. Primary sources include leakage from improperly maintained vehicles; direct dumping of used oil and accidental spillage during maintenance and refueling of vehicles. The following Vortechs® System performance curve was generated from tests performed in the Vortechnics laboratory, with a full scale Vortechs® Model 2000, using 10w40 motor oil. Oil was metered into the system using a variable speed peristaltic pump, producing influent concentrations between 15 mg/L and 90 mg/L. Influent concentrations decreased with operating rates, to simulate field conditions where the majority of oil is transported in the first flush and diluted at high flow rates. All samples were taken in one liter tinted glass bottles, fixed with H_2SO_4, and analyzed according to EPA Method 1664 by an independent laboratory.

Many localities recognize the potentially lethal effects of oil and grease in aquatic systems and require treatment of stormwater from high-risk areas. The Vortechs® System can help protect sensitive watersheds by removing very high percentages of incoming free oil. All Models provide emergency spill containment and can be designed to detain specific volumes. The graph below shows the removal efficiencies of the System over the range of operating rates. Routine storm events (about 80 to 90 percent of annual runoff volume) typically produce operating rates of less than 25 gpm/ft². At these lower operating rates, removal efficiencies are very high. Peak design storm flow rates (e.g., 10-year storms) may cause Vortechs® Systems to operate at up to 100 gpm/ft².

Vortechs® System Removal Efficiency of 10W40 Motor Oil



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