Determining Bypass Weir Elevation for Off-Line Vortechs® Systems

Proper bypass configuration maximizes the amount of flow treated by a CONTECH Stormwater Solutions 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 CONTECH Stormwater Solutions system, CONTECH Stormwater Solutions 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 CONTECH Stormwater Solutions 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 CONTECH Stormwater Solutions 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:

Cd = 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 CONTECH Stormwater Solutions). 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 CONTECH Stormwater Solutions system can be modified accordingly. For all designs, CONTECH Stormwater Solutions engineers complete a stage discharge worksheet, which is available on request.

Bypass Weir Calculations

Q_{bypass} = Flow over bypass weir (cfs)
Q_{design} = CONTECH Stormwater Solutions system treatment capacity (cfs)
Q_{convey} = Estimated peak conveyance capacity of collection system (cfs)
L = Length of bypass weir crest (ft)
Cd = Discharge Coefficient = 3.3 for rectangular weir
E_{bypass} = Elevation of bypass weir crest (ft)
WSE_{peak} = Water surface elevation for Qconvey (generally equal to the elevation at the top of the Cippoletti weir, ft)
H = Depth of flow over bypass weir crest (ft)
Q_{bypass} = Qconvey – Qdesign (Calculate the flow over the bypass weir during peak conveyance event)
Q_{bypass} = CdLH3/2 (Francis formula for rectangular weir)
H = (Qbypass /3.3L)2/3 (Use this arrangement of the Francis formula to solve for H)
E_{bypass} = WSEpeak - H (Solve for bypass weir crest levation – Ebypass)

CONTECH® ENGINEERED SOLUTIONS

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 Contech Engineered Solutions 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:

1. Calculate the flow rate resulting from an infrequent (10 to 25-year recurrence interval) storm on your site.
2. 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 Contech Engineered Solutions) 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 Contech Engineered Solutions representative.