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SHEET NO. 1-1 OF
CALCULATED BY MKH DATE 2/18/19
CHECKED BY MJM DATE ~~2/18/19~~ 3/14/19
SCALE N/A SJB 4/19/19

Subsurface Sand Filters (SSF)

Assumptions:
- StormTech SC-740 Chambers for storage of WQV
- WQV = 1" x imp. surface (sf.) + 0.4" x landscaped (sf.)
- Req'd filter area = Impervious surface (5%) per DEP guidance

Calculations for sizing SSF 36:

1. Calculate area of subcatchment (in this case, the roof of B1M1):

B1M1 area = 278.5 sf x 404.16 sf
= 112560 sf (100% impervious, 0% landscaped)

2. Calculate water quality volume (WQV):

$WQV = (1" \times \text{imp. surface (sf)} + 0.4" \times \text{landscaped (sf)}) / 12$

$WQV = (1in \times 112560 ft^2 + 0.4in \times 0 ft^2) / 12$

WQV = 9380 cf

3. Calculate the required filter area:

Req'd filter area = Imp. surface (sf) x 5%
= 112560 sf (5%)
= 5628 sf

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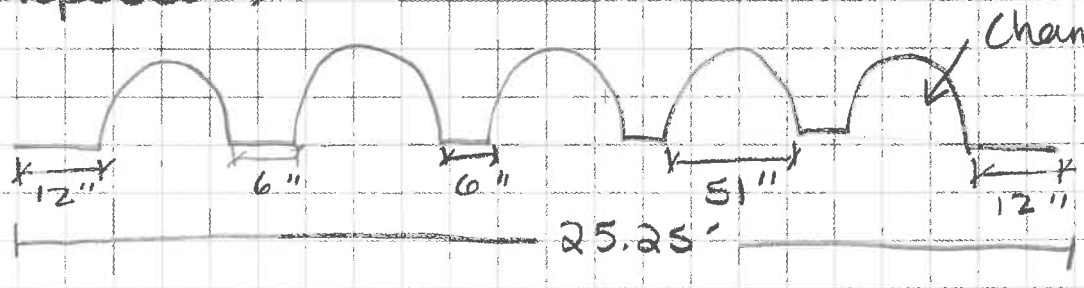
Chambers are 51"w x 7.12'l

4. Determined the dimensions of the StormTech SC-740 Chambers for storage of the WQV and MUST have a minimum filter area of 5628 sf.

- Given the space provided, width of filter area can be no greater than 28 ft.
- Based on the dimensions required for each chamber, a width of 25.25 ft was proposed.



Base width = 5rows x 51" wide x 6" spacing x 4 x 12" side Stone x 2

Base width = 25.25 ft (5 rows)

- To satisfy the 5628 sf min. filter area, base length needs to be at least

5628 sf / 25.25 ft = 222.89 ft min.

- Calculated number of chambers that could fit within dimensions and satisfy 5628 sf min. filter area.

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# of Chambers = $\frac{222.89\text{ ft} - 12\text{"end stone} \times 2 - 0.44\text{ ft row adjustment}}{7.12\text{ ft}}$

# of chambers = 30.9 ≈ 31 chambers per row.

where 222.89 ft = base length minimum
12 in. = end stone (2 ends)
0.44 ft = row adjustment
7.12 ft = length of one chamber

- When rounding up to 31 chambers per row:

Base length = 31 chambers x 7.12 ft + 0.44' + 12"(2)

Base length = 223.16 ft (31 chambers /row)

5. Calculate height of WQV storage area

Height = 6" stone base + 30" chamber height + 6" stone cover

Height = 42 in / 12 = 3.5 ft

5 rows X 31 chambers/row = 155 chambers total

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6. Calculate the storage volume in the chambers and stone - make sure it is greater than WQV (9,380 cf).

Chamber Storage Volume (CSV) = 155 chambers x 45.9 cf/~~chamber~~ + 0.44 ft x 6.45 sf x 5 rows

where 155 = # of chambers
45.9 cf = storage per chamber
0.44 ft = row adjustment
5 = # of rows (per Iteration of)

CSV = ~~7,134.9~~ 7,128.7 cf

Field volume = Length x width x height
= 223.16' x 25.25' x 3.50'
= 19721.76 cf

Stone Storage Volume (SSV) = (Field volume - chamber storage) (40% voids)
= 19721.76 cf - ~~7,134.9~~ 7,128.7 cf (40% voids)

~~Stone Volume~~ = 12593.06 cf x 0.4

SSV = ~~5,034.7 cf~~ 5037.2 cf

7. Calculate overall storage:

Overall Storage = CSV + SSV
= ~~7,134.9~~ 7,128.7 cf + ~~5,034.7~~ 5037.2 cf

Overall Storage (WQV) = ~~12,169.6 cf~~ 12165.9 cf > 9,380 cf OK ✓

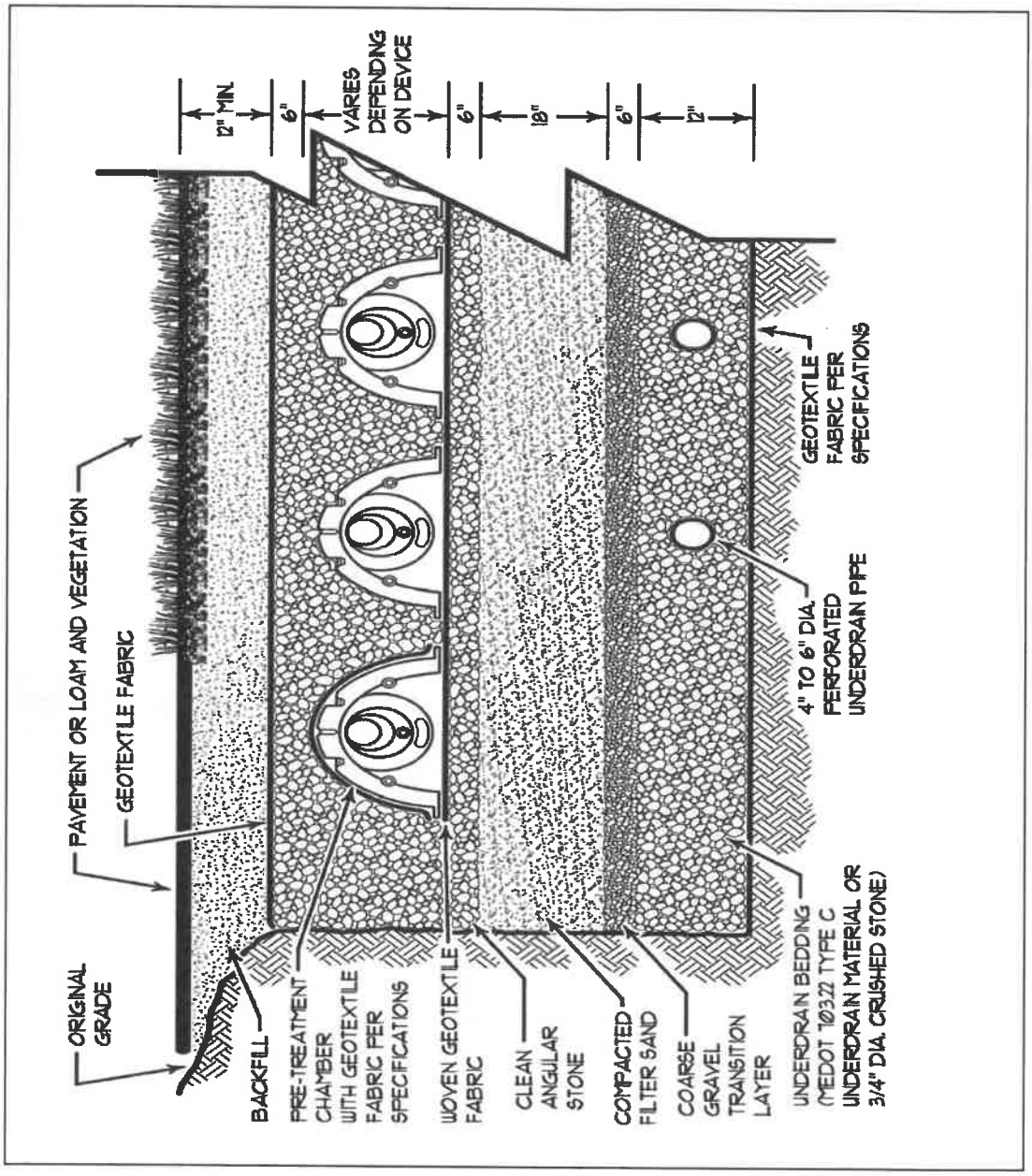

Figure 7.3.2 – Cross-Section of a Subsurface Sand Filter with Chambers

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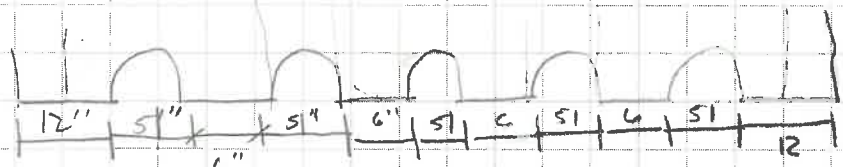
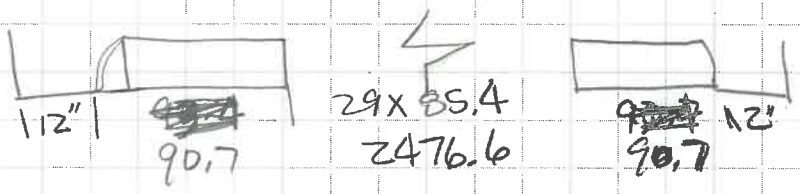
B(M)1 - SSF36

Roof area x 1" = 9,380 cf (Water Quality Volume
112560 See Sheet 1B
area x 5%
Surface area of sand filter min = 112560 x 0.05
= 5628 sf

Proposed system uses 5 rows x 31 units SC-740
155 units
h = 30"
w = 51"
L = 85.4"
Equals = 90.7"



Total width = 303"/12 = 25.25 ft.



Total length = 2682"/12 = 223.5 ft.

Surface area of sand filter = 25.25 x 223.5
= 5643.375 > 5628 okay

Assuming 6" stone above, below, between and 12" on the ends

Determine elevation for Water Quality volume.
Table includes volume per chamber w/ stone. With 6" between chambers, some need to looked @ w/no stone but this will get us close to elevation

14

SC-740 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (150 mm) Stone Base Under Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
42 (1067)	45.90 (1.300)	74.90 (2.121)
41 (1041)	45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone 45.90 (1.300)	72.64 (2.057)
39 (991)	Cover 45.90 (1.300)	71.52 (2.025)
38 (965)	45.90 (1.300)	70.39 (1.993)
37 (948)	45.90 (1.300)	69.26 (1.961)
36 (914)	45.90 (1.300)	68.14 (1.929)
35 (889)	45.85 (1.298)	66.98 (1.897)
34 (864)	45.69 (1.294)	65.75 (1.862)
33 (838)	45.41 (1.286)	64.46 (1.825)
32 (813)	44.81 (1.269)	62.97 (1.783)
31 (787)	44.01 (1.246)	61.36 (1.737)
30 (762)	43.06 (1.219)	59.66 (1.689)
29 (737)	41.98 (1.189)	57.89 (1.639)
28 (711)	40.80 (1.155)	56.05 (1.587)
27 (686)	39.54 (1.120)	54.17 (1.534)
26 (660)	38.18 (1.081)	52.23 (1.479)
25 (635)	36.74 (1.040)	50.23 (1.422)
24 (610)	35.22 (0.977)	48.19 (1.365)
23 (584)	33.64 (0.953)	46.11 (1.306)
22 (559)	31.99 (0.906)	44.00 (1.246)
21 (533)	30.29 (0.858)	41.85 (1.185)
20 (508)	28.54 (0.808)	39.67 (1.123)
19 (483)	26.74 (0.757)	37.47 (1.061)
18 (457)	24.89 (0.705)	35.23 (0.997)
17 (432)	23.00 (0.651)	32.96 (0.939)
16 (406)	21.06 (0.596)	30.68 (0.869)
15 (381)	19.09 (0.541)	28.36 (0.803)
14 (356)	17.08 (0.484)	26.03 (0.737)
13 (330)	15.04 (0.426)	23.68 (0.670)
12 (305)	12.97 (0.367)	21.31 (0.608)
11 (279)	10.87 (0.309)	18.92 (0.535)
10 (254)	8.74 (0.247)	16.51 (0.468)
9 (229)	6.58 (0.186)	14.09 (0.399)

SC-740 Cumulative Storage Volumes Per Chamber (cont.)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
8 (203)	4.41 (0.125)	11.66 (0.330)
7 (178)	2.21 (0.063)	9.21 (0.264)
6 (152)	0	6.76 (0.191)
5 (127)	0	5.63 (0.160)
4 (102)	Stone Foundation 0	4.51 (0.125)
3 (76)	0	3.38 (0.095)
2 (51)	0	2.25 (0.064)
1 (25)	0	1.13 (0.032)

Note: Add 1.13 cu. ft. (0.032 m 3) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Stone Foundation Depth in. (mm)		
		6 (150)	12 (300)	18 (450)
StormTech SC-740	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)

Note: Assumes 6" (150 mm) of stone above chambers, 6" (150 mm) row spacing and 40% stone porosity.

Amount of Stone Per Chamber

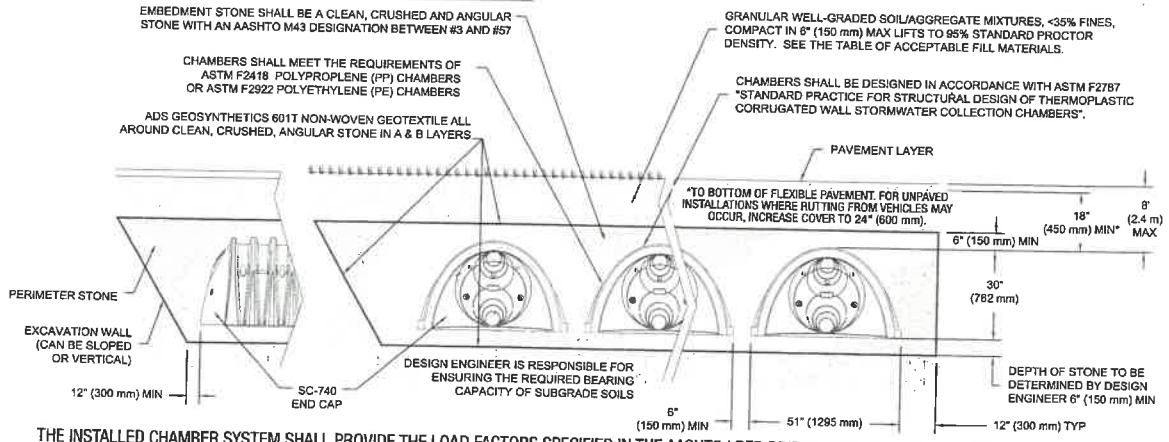
ENGLISH TONS (yds³)	Stone Foundation Depth		
	6"	12"	18"
StormTech SC-740	3.8 (2.8 yd³)	4.6 (3.3 yd³)	5.5 (3.9 yd³)
METRIC KILOGRAMS (M³)	150 mm	300 mm	450 mm
StormTech SC-740	3450 (2.1 m3)	4170 (2.5 m³)	4490 (3.0 m3)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

Volume Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6" (150 mm)	12" (300 mm)	18" (450 mm)
StormTech SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)

Note: Assumes 6" (150 mm) of row separation and 18" (450 mm) of cover. Volume of excavation will vary as the depth cover increases.



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

1B

SJB 4/4/19

Subsurface Sandfilter Chambers

Subcatchment	Subsurface Sand Filter	Total Treated Impervious Area (sq. ft)	WQ Volume (cf)	Req'd Filter Surface Area (sf)	Prop. Filter Surface Area (sq. ft)	Dimensions (length x width)		Rows x Chambers
36	B1M1 - SSF 36	112560	9380	5628	5635	223.16	25.25	5 x 31
37	B1M2 - SSF 37	112560	9380	5628	5666	515.08	11.00	2 x 72
38	B1M3 - SSF 38	112560	9380	5628	5666	515.08	11.00	2 x 72
39	B2M4 - SSF 39	112560	9380	5628	5974	102.12	58.50	12 x 14
40	B2M5 - SSF 40	112560	9380	5628	5742	280.12	20.50	4 x 39
41	B2M6 - SSF 41	112560	9380	5628	5635	223.16	25.25	5 x 31
42	B6 (Oxygen) - SSF 42	12000	1000	600	711	45.16	15.75	3 x 6
43	B5 (Generator + Processing) - SSF 43	18983	1582	949	967	87.88	11.00	2 x 12

References:

https://www.maine.gov/dep/land/stormwater/stormwaterbmps/vol3/chapter7_3.pdf

https://www.stormtech.com/product/sc740.html

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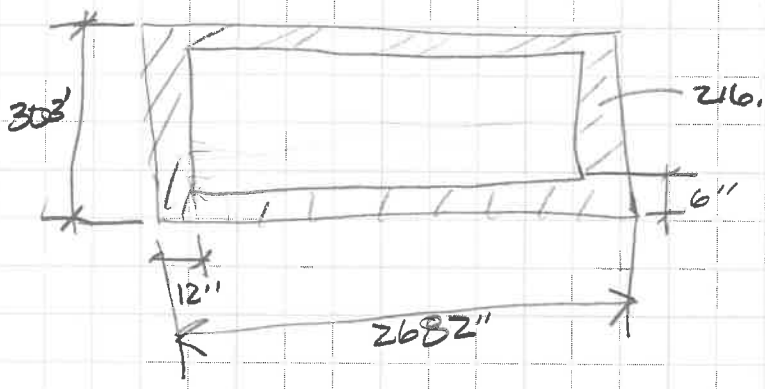
Required volume = 9380 cf / 155 units
≅ 60.5 cf storage / unit

⇒ +/- elev. 31" above sand filter

determine volume of stone on outside of system
Not in calculation or table



overall width = 303" = 25.25'
minus effective width in chamber calc. -291"
= 24.25

Overall length = 2682" = 223.5'
effective width in chamber calc. = 2658" = 221.5

Overall area - chamber area = area of stone
25.25(23.5) − 24.5(221.5) = 216.63 sf
X 31" X 40%
= storage volume
= 2238.5 cf

= 9380 − 223.85
= 9156.15 cf

each chamber w/stone volume = 61.36 cf @ 31"

~~3 rows~~ 3 rows x 31 chambers = 93 chambers
w/6" on sides

93 x 61.36 = 5706.48
9156.15 − 5706.48 = 3449.67 sf rem.

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each chamber w/ no stone @ 31" has volume = 44.01

Add 6" stone underneath
2 x 51½ x 221.5 x .40 x .05'
= 376.55

2 rows x 31 chambers x 44.01/chamber
62 chambers x 44.01 = 2728.62

3449.67 - 2728.62 = 721.05
- 376.55 = 344.5 Remain

∴ need to be higher than 31"

Try 34":

outside 216.63 x 34/12 x 0.4 = 245.5 cf

93 chambers x 65.75 = 6114.75 cf

62 chambers x 45.69 = 2832.78 cf
(stone) + 376.55
9569.59 > 9380 cf
OK

Try 36":

outside 216.63 x 36/12 x .4 = 260.0
93 chambers x 68.14 = 6337.02
62 chambers x 45.10 = 2845.8
9442.82 > 9380 ft³
OK

Water Quality Volume is 34" above surface of sand filter use this for weir elevation in Inlet Control structure

Lowest elevation @ surface in area of BMP sand filter = 68.1 ft.

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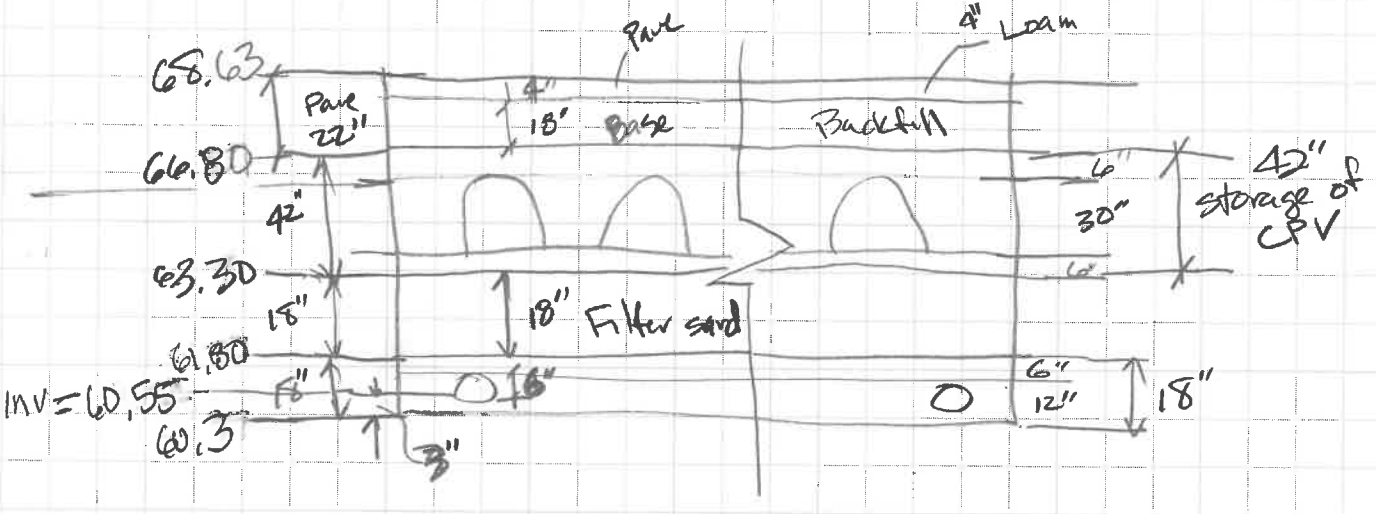


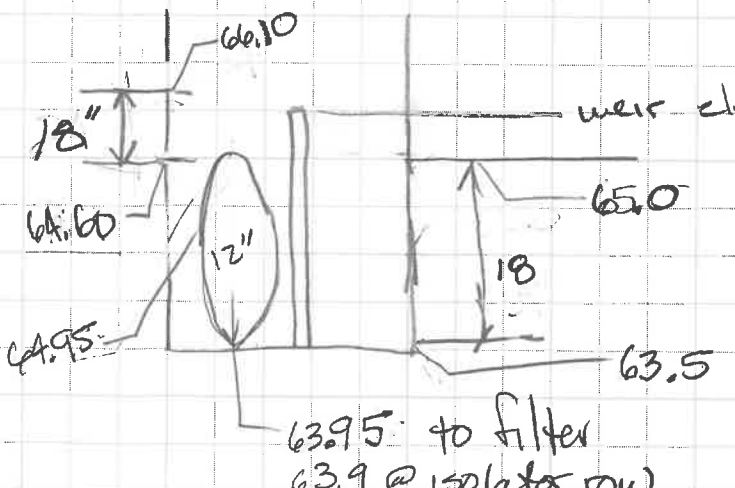
Possible inv. elevations of 12" pipe based on elev. of stormtech chamber into isolator Row
Can put into top or bottom - see page 5

Bottom chamber elevation 63.3 + 0.5 = 63.8

1" storm off of roof is 2.25cfs ∴ 12" should be large enough to filter row

12" pipe @ TOP: Bottom chamber 12.5"
63.8 + 12.5/12 = 64.04

12" pipe @ bottom: Bottom chamber + 1.2"
63.8 + .10 = 63.9



inv. out @ BMH
Grade = 69.5 - 3' cover - 1.63' (pipe)
= 64.87

5

SJB 4/19/19

7.0 Inletting the Chambers

7.6 OTHER INLET OPTIONS

While the three-tiered treatment train approach is the recommended method of inletting StormTech chambers for typical under-commercial parking applications, there are other effective inlet methods that may be considered. For instance, Isolator Rows, while adding an inexpensive level of confidence, are not always necessary. A header system with fewer inlets can be designed to further minimize the cost of a StormTech system. There may be applications where stormwater pre-treatment may not be necessary at all and the system can be inlet directly from the source. Contact StormTech's Technical Service Department to discuss inlet options.

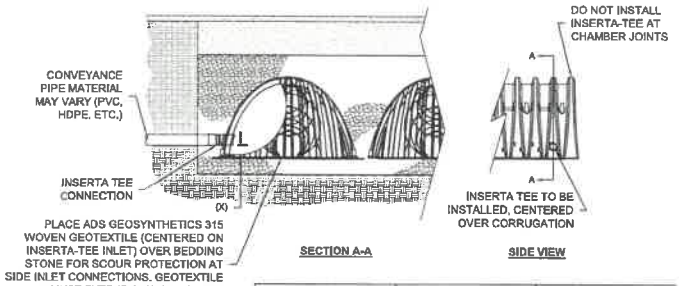
7.7 LATERAL FLOW RATES

The embedment stone surrounding the StormTech chambers allows the rapid conveyance of stormwater between chamber rows. Stormwater will rise and fall evenly within a bed of chambers. A single StormTech SC-740 chamber is able to release or accept stormwater at a rate of at least 0.5 cfs (14.2 l/s) through the surrounding stone.

7.8 INLETTING PERPENDICULAR TO A ROW OF CHAMBERS WITH INSERTA TEE

There is an easy, inexpensive method to perpendicularly inlet a row of chambers. Simply connect the inlet directly to the chamber with an Inserta Tee. **Figure 9** shows a typical detail along with the standard sizes offered for each chamber model.

Figure 9 – Inserta Tee Detail



CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" (150 mm)	4" (100 mm)
SC-740	10" (250 mm)	4" (100 mm)
DC-780	10" (250 mm)	4" (100 mm)
INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

NOTE:
PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS. CONTACT STORMTECH FOR MORE INFORMATION.

7.9 MAXIMUM INLET PIPE VELOCITIES TO PREVENT SCOURING OF THE STONE FOUNDATION

The primary function of the inlet manifold is to convey and distribute flows to a sufficient number of rows in the chamber bed such that there is ample conveyance capacity to pass the peak flows without creating an unacceptable backwater condition in upstream piping or scour the foundation stone under the chambers.

Manifolds are connected to the end caps either at the top or bottom of the end cap. High inlet flow rates from either connection location produce a shear scour potential of the foundation stone. Inlet flows from top inlets also produce impingement scour potential. Scour potential is reduced when standing water is present over the foundation stone. However, for safe design across the wide range of applications, StormTech assumes minimal standing water at the time the design flow occurs.

To minimize scour potential, StormTech recommends the installation of woven scour protection fabric at each inlet row. This enables a protected transition zone from the concentrated flow coming out of the inlet pipe to a uniform flow across the entire width of the chamber for both top and bottom connections. Allowable flow rates for design are dependent upon: the elevation of inlet pipe, foundation stone size and scour protection. An appropriate scour protection geotextile is installed from the end cap to at least 10.5' (3.2 m) for the SC-310, SC-740 and DC 780 chambers for both top and bottom feeding inlet pipes.

See StormTech's Tech Sheet #7 for guidance on manifold sizing. ADS's Technical Services department can also assist with sizing inlet manifolds for the StormTech chamber systems.

Table 7A – Standard distances from base of chamber to invert of inlet and outlet manifolds on StormTech end caps.

SC-310 ENDCAPS				
	PIPE DIA.	INV. (IN)	INV. (FT)	INV. (MM)
TOP	6" (150 mm)	5.8"	0.48	146
	8" (200 mm)	3.5"	0.29	88
	10" (250 mm)	1.4"	0.12	37
BOTTOM	6" (150 mm)	0.5"	0.04	12
	8" (200 mm)	0.6"	0.05	15
	10" (250 mm)	0.7"	0.06	18
	12" (300 mm)	0.9"	0.08	24

SC-740 / DC-780 ENDCAPS				
	PIPE DIA.	INV. (IN)	INV. (FT)	INV. (MM)
TOP	6" (150 mm)	18.5"	1.54	469
	8" (200 mm)	16.5"	1.38	421
	10" (250 mm)	14.5"	1.21	369
	12" (300 mm)	12.5"	1.04	317
	15" (375 mm)	9"	0.75	229
	18" (450 mm)	5"	0.42	128
BOTTOM	6" (150 mm)	0.5"	0.04	12
	8" (200 mm)	0.6"	0.05	15
	10" (250 mm)	0.7"	0.06	18
	12" (300 mm)	1.2"	0.10	30
	15" (375 mm)	1.3"	0.11	34
	18" (450 mm)	1.6"	0.13	40
	24" (600 mm)	0.1"	0.01	3

See StormTech's Tech Sheet #7 for manifold sizing guidance

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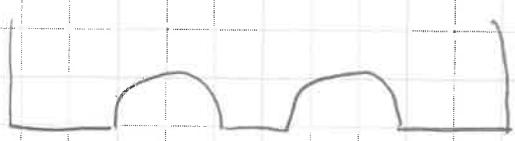
BIMZ - SSF37

Roof Area Water Quality Volume = 9,380 cf

Surface area of sand filter minimum = 5628sf

Proposed system uses 2 rows x 72 chambers



Total width
= 132 inches
= 11 feet

Total length =

70 chambers @ 85.4 = 5978"

l = 6185.4 inches / 12 = 515.45'

proposed Surface area of sand filter = 515.45 x 11
= 5669.95 sf > 5628
okay

Determine elevation for Water Quality Volume (weir in structure)

Required volume = 9380 cf / 2x72 units (144)

= 65.1 cf/unit ⇒ 34" above sand filter

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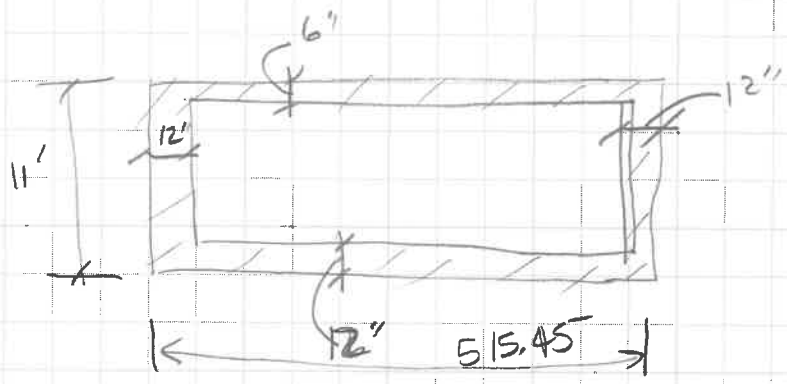
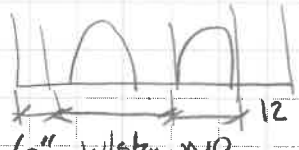




Area of extra stone:
$(11 \times 515.45) - (9.5 \times 513.45) =$

$5669.95 - 4877.76 = 792.18$ sf

$\times 34" \times 40\%$ voids

$= 897.8$ cf

@34"
each chamber w/stone = 65.75
each chamber w/o stone = 45.69

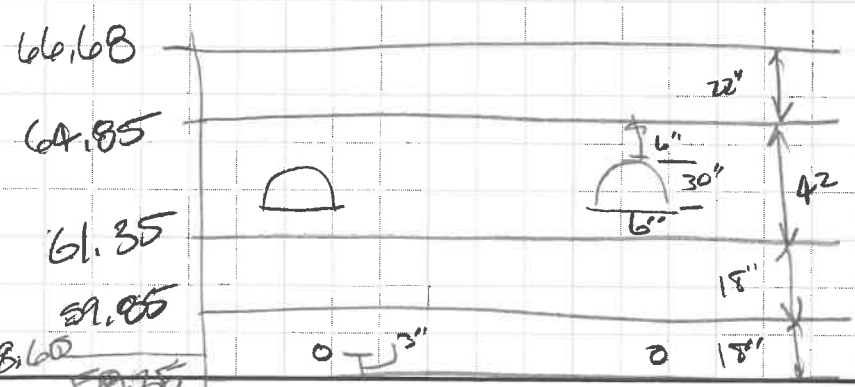
1 row w/stone x 72 chambers
1 row w/o stone x 72 chambers
$(72 \times 65.75) + (72 \times 45.69) = 8023.68$ cf
$+ 897.8$ cf

Stone under 1 row
$0.5' \times 513.45 \times 5\frac{1}{12} \times 0.4 = 436.43$

$+ 436.43$ cf

$9794.34 > 9380$
Okay

→ Weir @ 34" above sand layer
61.35 + 2.83 = 64.18



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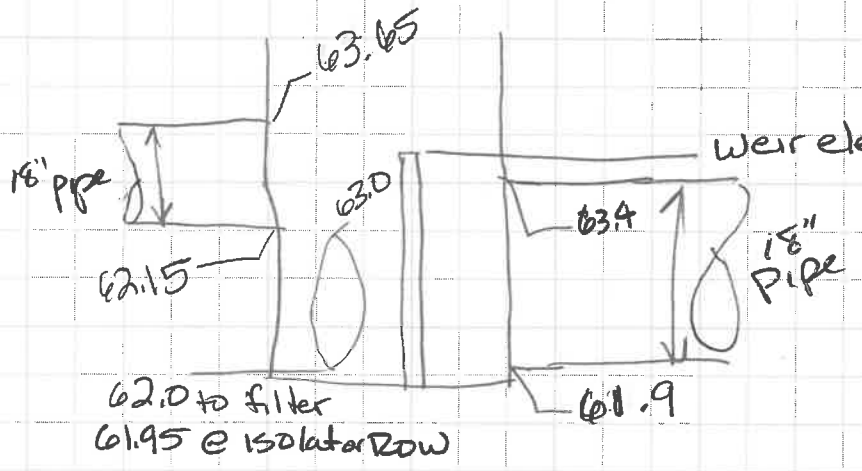
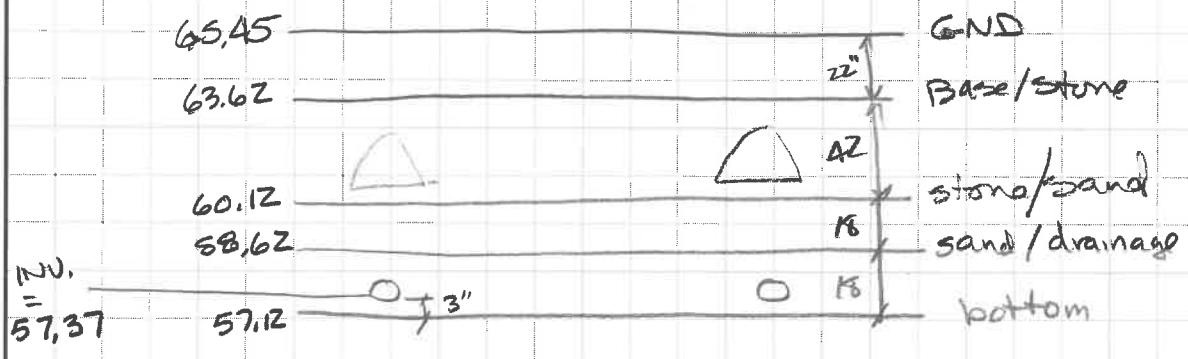
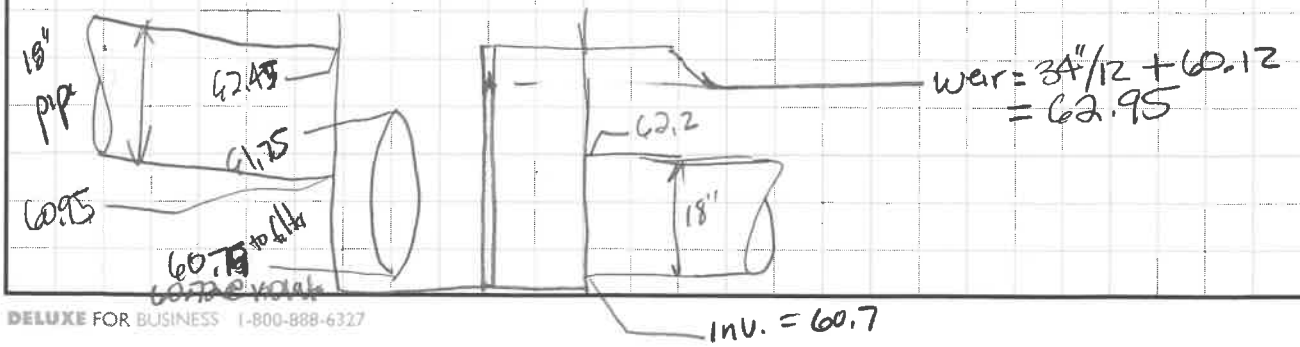
INV. elevation of 12" into Isolator Row at bottom of chamber. 61.35 + 0.6 = 61.95



B1M3 - SSF38
same design as B1M2



12" INV. elev. into Isolator = 0.6 + 60.12 = 60.72



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SSFAB for Buildings (Generator & Processing)
Roof WQV = 1582 cf
Roof Area = 18983 sf

Surface area of sand filter min = 18983 X 0.05
= 949.15 sf.

Proposed systems uses 2 rows x 12 units each
24 units

Total length = 1059.4"
= 88.3'

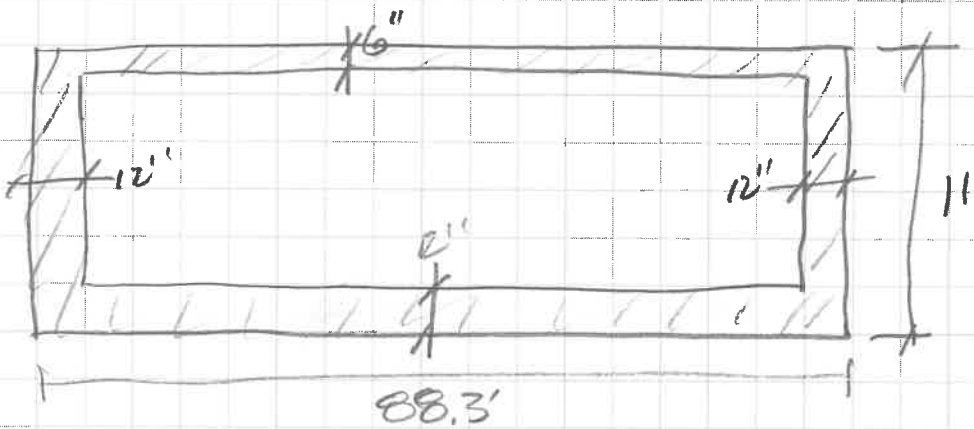
Total width = 132" = 11 ft.

Surface area of sand filter = 971.3 > 949.15 Okay

Assuming 6" above & below & between
Assuming 12" TO sides of excavation

Determine WQV Elevation
Required WQV = 1582 cf / 24 units = 65.92 cf/unit

based on table on page 1A → start w/ 35" above sand filter



Area of extra stone:
(11X88.3) -
(9.5X86.3)
= 151.45 cf
X 35" x 40% voids
= 176.7 cf

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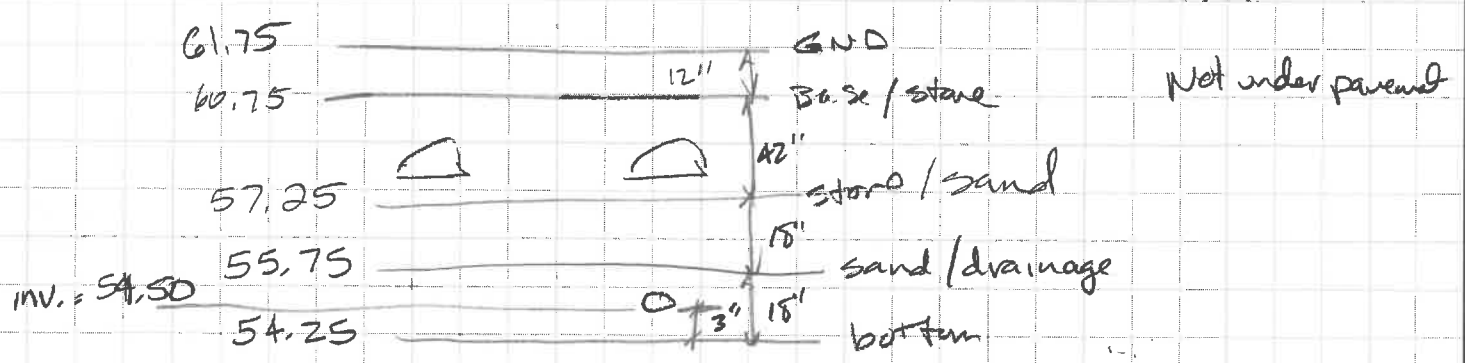
1 row w/stone x 12 chambers x 66.98 cf = 803.8 cf
1 row w/o stone x 12 chambers x 45.85 cf/unit = 550.2 cf

Stone under 1 row
0.5' x 88.3' x 51/12 x 0.4 = 75.1 cf

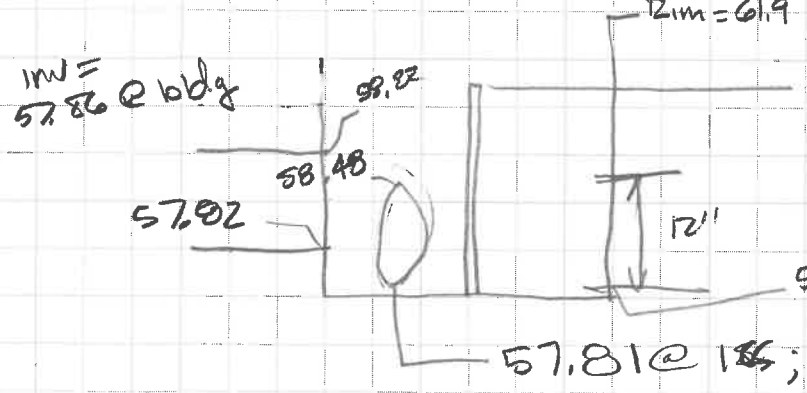
1555.8 cf < 1582 cf

2. set weir @ 36" above sand filter



weir elevation = 57.25 + 3 = 60.25

INV elevation of 8" into isolator ROW @ bottom of chamber. bottom chamber @ 57.75 +0.05 (page 5) = 57.80



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PROJECT NO. 171.05027 SITE WAF
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SSF42 for Building 6 Oxygen-generation
May not be building, may be curbed pad

Total impervious surface = 12000 sf
Total WQV = 1000 cf
Required filter surface Area = 600 sf

Proposed system uses 3 rows X 6 units = 18 total units

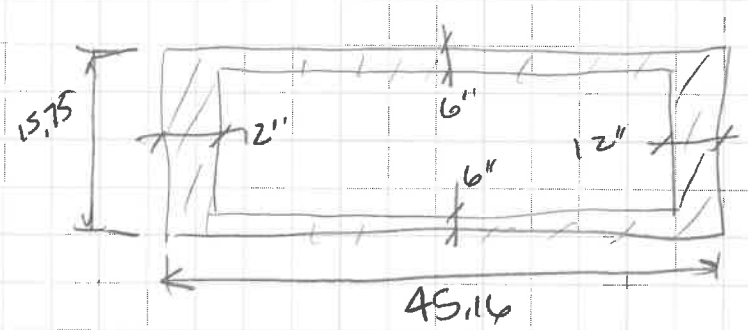
Total length = 45.16

Total width = 15.75
Surface area proposed = 711 sf > 600 okay ✓

Determine WQv Elevations

Req'd WQv = 1000 cf / 18 units ≈ 55.6 cf/unit
per Sht. 1A. start @ 28" above sand filter

assume 2 rows w/stone
1 row w/o stone



Area of xtra stone

(15.75 x 45.16) −
(14.75 x 43.16) = 74.7 sf

74.7 x 28"/12 x 0.4 = 69.7 cf

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2 rows w/stone: 2 x 6 = 12 chambers x 56.05 cf/unit
= 672.60 cf

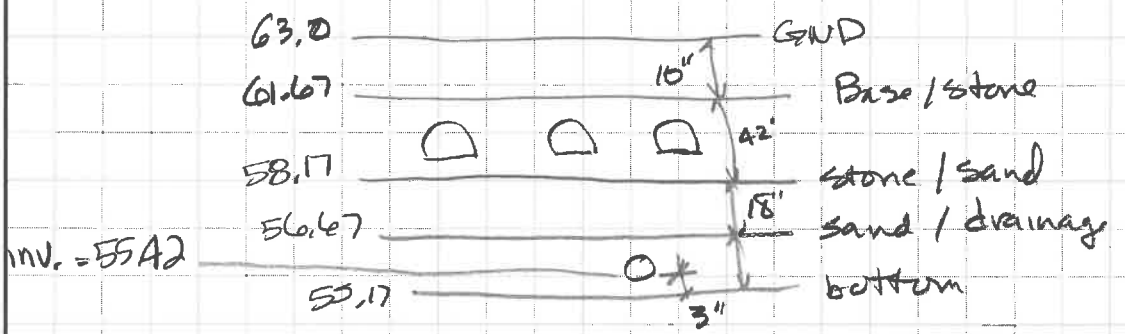
1 row w/o stone 1 x 6 = 40.8 x 6 = 244.8 cf

6" under 1 row = 0.5' x 43.16' x 51/12 x 0.4
= 36.7 cf

Total: 69.7 cf + 672.60 cf + 244.8 cf + 36.7 cf
= 1023.8 cf > 1000 cf Rqd ∴ okay ✓

Set weir elevation 2.33 ft. above sand layer

Assume grnd surface elevation @ 63.0. Assume grass paver system (made w/ concrete pavers? not plastic) Depth below surface +/- 16"



Weir elevation is 58.17 + 2.33 = 60.50

Inv. elevation of 8" into chamber/isolator row @ bottom of chamber

bottom chamber @ 58.67 + 0.05
INV. = 58.12

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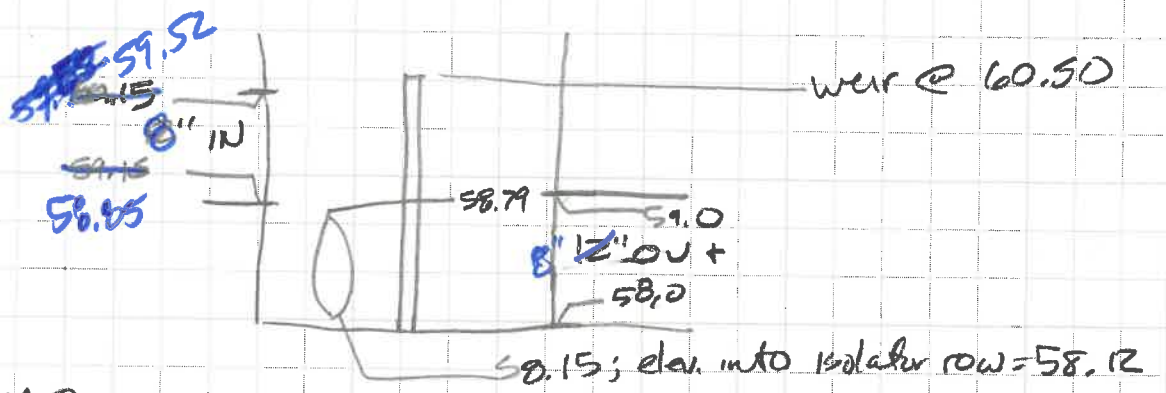


GND @
Pipe out bldg = 63.25
INV. out bldg = 59.21

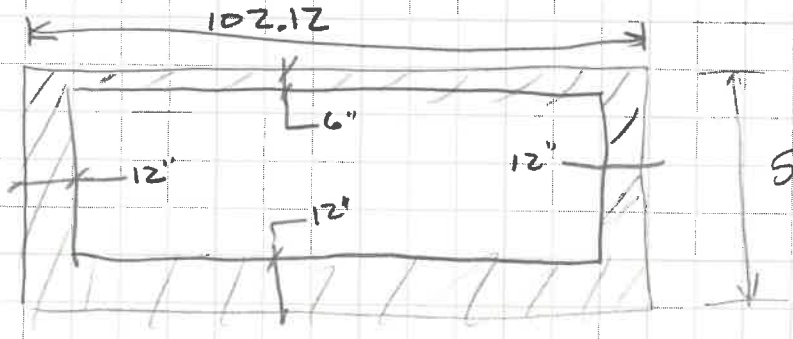
SSF 39 (B2 MA):

WQv = 9380 cf using 12 rows x 14 chambers
= 168 chambers
= 55.83 cf/chamber

Surface area of sand filter 58.5 X 102.12 = 5974 sf
> 5428 Rqd.

Determine WQv elevation
Table on page 14; start w/ 28"

6 Rows w/ stone
6 Rows w/out stone



Area stone volume
5974 sf –
(100.12 X 57)
= 267.16 X 0.5'
X 0.4
= 53.4 cf

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Add'l volume in stone under 6 Rows

0.5' x 100.12 x 51/12 x 0.4 = 85.10 cf

6 rows w/ stone (@ 28") = 6 x 56.05 x 14 = 4708.2

6 rows w/out stone = 6 x 40.80 x 14 = 3427.2

Total = 8273.9 < 9380

Need a significant jump: Try 32"

Xtra stone volume = 53.4 cf
Volume in Stone under 6 rows = 85.10 cf

6 rows w/stone (@ 32") = 6 x 14 x 62.97 = 5289.48

6 rows w/out stone (@ 32") = 6 x 14 x 44.81 = 3764.04 cf

Total = 9192.02 < 9380

Try 34"

Xtra stone volume = 53.4
Volume under 6 Rows = 85.10

6 rows w/stone @ 34" = 6 x 14 x 65.75 = 5523
6 rows w/out stone = 6 x 14 x 45.69 = 3857.96

Total = 9499.46 > 9380 Okay

Set weir @ 34" above sand filter

Lowest Gnd elevation @ filter = 57.0
∴ sand filter @ elevation = 52.17 + 2.83
< 55.0

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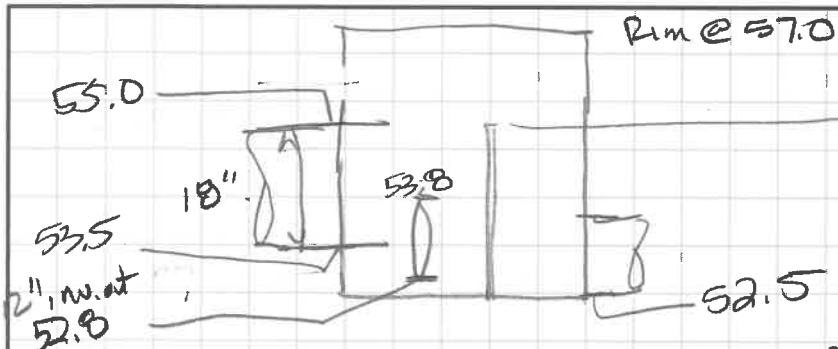


GND @ B2M4 pipe out of bldg = 59.5

w/ 3' cover + pipe (1.63); INV. = 54.87

INV. elevation of 12" into chamber/isolator row @ bottom of chamber

Elevation of chamber bottom = 52.67 + 0.10'
= 52.77 for invert of 12"

l = 33' 54.87 − 53.5 = 0.84
18" from bldg to structure

SSF #40 - B2M5

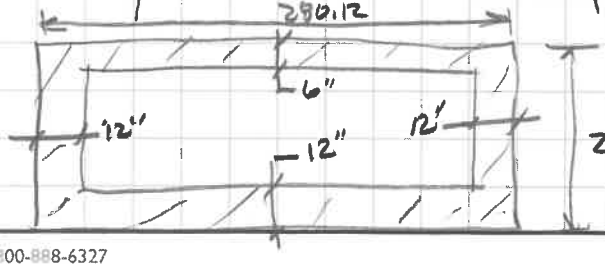
Proposing 4 rows x 39 units (156 units)

WQ_v = 9380 cf

SSF surface = 290.12 x 20.50
= 5742.46 sf > 5628 sf (Req'd) ✓

Determine WQ_v elevation

9380 cf / 156 units = 60.12 cf per unit. Per sheet 1A ≈ 31"



volume of extra stone
5742.46 − (19 x 278.12)
= 458 sf x 0.5' x 0.4
= 91.6 cf

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2 rows w/stone @ 31"
2 x 39 units x 61.36 cf/unit = 4786.1 cf

2 rows w/out stone @ 31"
2 x 39 units x 44.01 cf/unit = 3432.8 cf

6" under 2 rows: 0.5' x 278.12 x 5'/12 x 0.4
= 236.4 cf

Total: 8546.90 cf < 9380 cf

Try 36":

Xtra stone volume = 91.6 cf] 328 cf
6" under 2 rows = 236.4 cf

2 rows @ 36" = 78 units x 68.14 cf/unit
(w/ stone) = 5314.9 cf

2 rows w/o stone @ 36": 78 units x 45.90 cf/unit
= 3580.2 cf

Total: 9223 cf < 9380 cf

Δ = 157 cf; use 38" weir elevation = 38/12 = 3.2' above sand filter

W/ Lowest Gnd surface elevation = 57.0
sand filter @ 52.17
bottom of chamber @ 52.67

weir elev. = 52.17 + 3.2 = 55.37
12" inv. into chamber = 52.67 + 0.1 = 52.77
6" inv. out (underdrain) = 49.42

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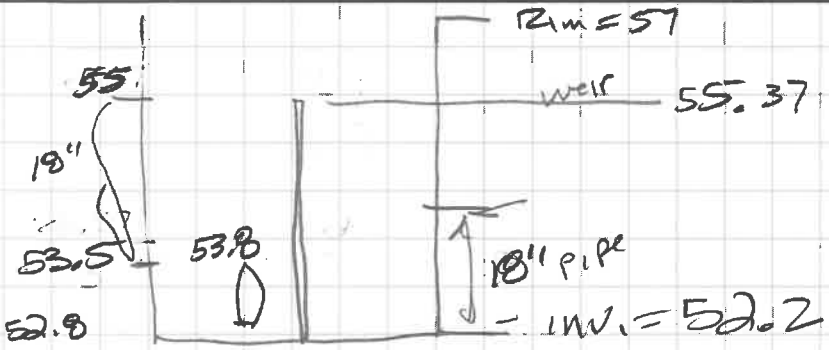


SSF41 - B2M6 ; 5 Rows @ 31 chambers
= 155 chambers

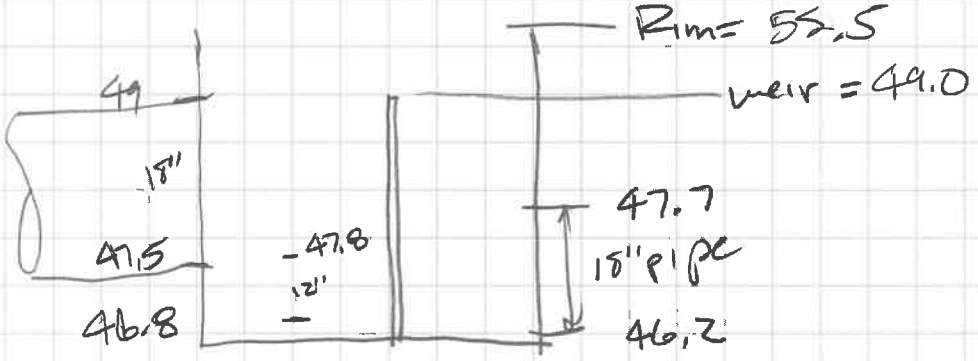
WQv = 9390 cf.

Same size as SSF36 ∴ weir elevation @ 34" above filter

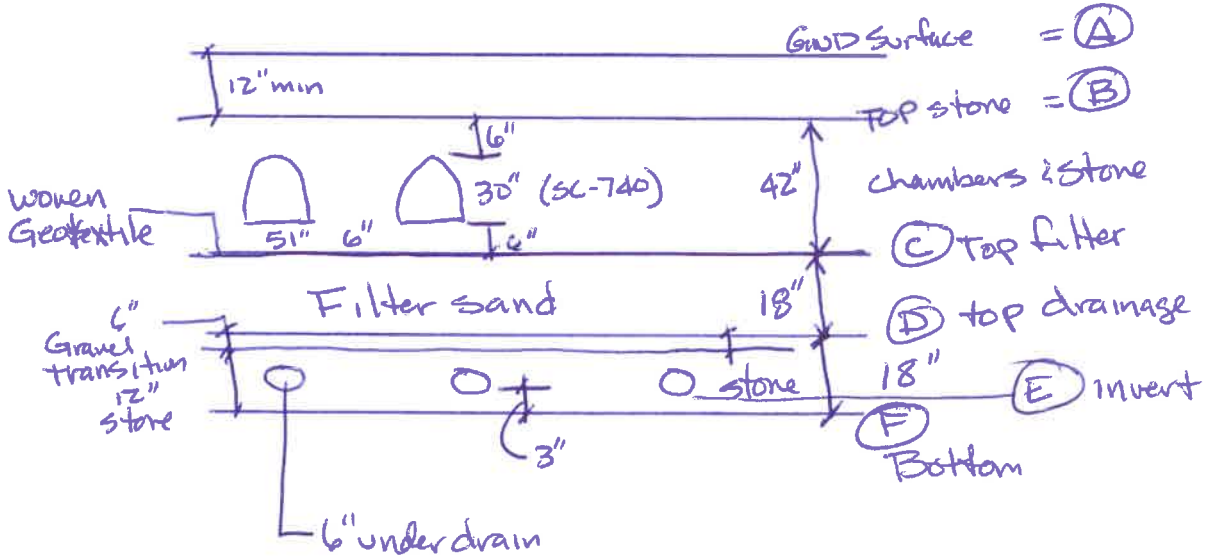
w/ lowest Grade @ surface of sand filter = 51.0

Sand filter elev. = 46.17
bottom of chamber = 46.67

weir elevation = 46.17 + 34/12 = 49.0
12" INV. in to chamber = 46.67 + 0.1
= 46.77
6" INV. out of drainage = 43.43



	B1M1	B1M2	B1M3	B2M4	B2M5	B2M6	B6 (oxygen)	B5 (CUP)
SSF	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**
A	68.10	66.68	65.45	57.00	57.00	51.00	63.00	61.90
B	66.27	64.85	63.62	55.67	55.67	49.67	61.67	60.90
C	62.77	61.35	60.12	52.17	52.17	46.17	58.17	57.40
D	61.27	59.85	58.62	50.67	50.67	44.67	56.67	55.90
E	60.02	58.60	57.37	49.42	49.42	43.42	55.42	54.65
F	59.77	58.35	57.12	49.17	49.17	43.17	55.17	54.40



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17A

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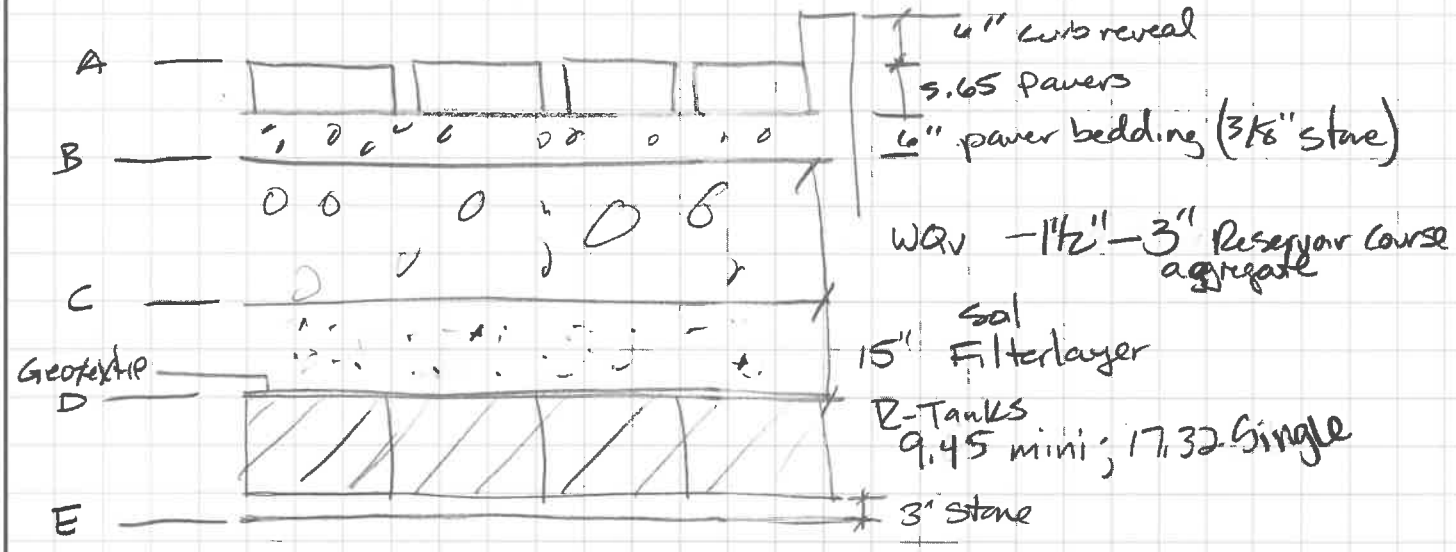
MANMADE PERVIOUS PAVERS

Required Paver Surface = 20% impervious area
+ 10% landscaped area

Run on length +/- 50'
Section 7.7 Vol III stormwater design manual

Subcatchment 10 (north of Bldg. 1) : Refer to sheet (19)



WQv = 2578 cf ⇒ Volume storage in stone = 2578cf / 0.4 (voids) = 6445cf
Surface Area of filter = 7,509sf

Depth of stone layer = 6445cf / 7509sf = 0.86' say 0.9ft.

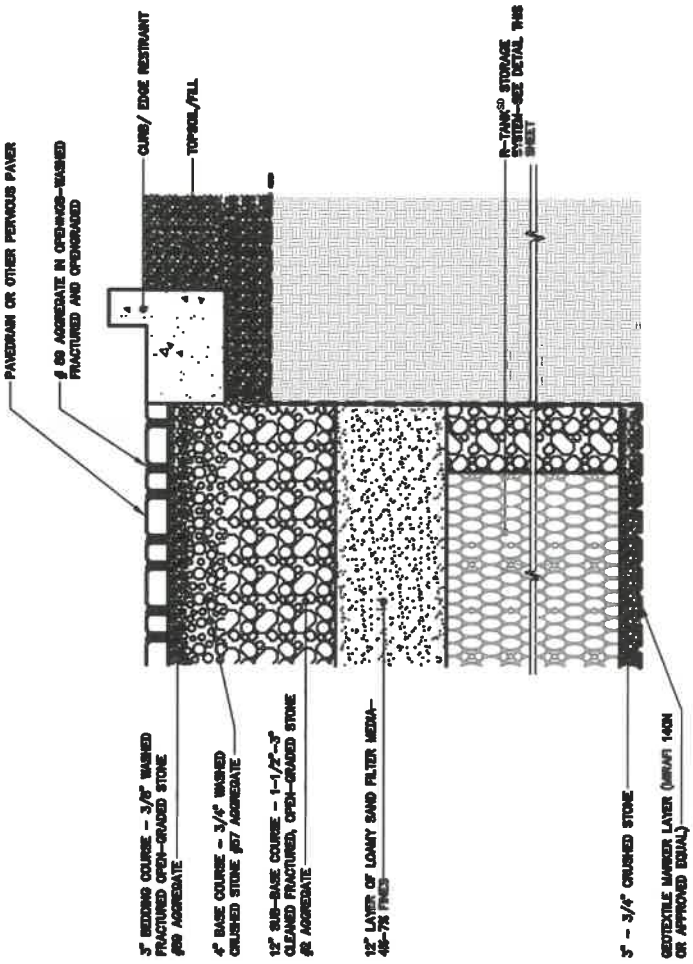
Subcatchment 14:

WQv = 755cf ⇒ volume of stone = 1888 cf
Surface area = 1868 sf

depth = 1888 / 1868 = 1.01 ft. say 1 ft.

18A

SJB 4/19/19



PERVIOUS PAVER ABOVE R-TANK^SD (TYPICAL)

NOT TO SCALE

Pervious Pavement

Input knowns or use standards from MEDEP stormwater design manual:											
Subcatchment Area #	Total Area (sq.ft)	Landscaped Area (sq.ft)	Impervious Area (sq. ft)	Water Quality Volume (cf)	Req'd Paver Area (sf)	Provided Paver Area (sf)*	% Treated	Treated Imp (sq. ft)	Untreated Imp sf)	Treated Land (sf)	Untreated Land (sf)
10	30,932	0	30932	2,578	6,186	7,509	100	30,932	-	0	0
14	9,378	529	8849	755	1,823	1,868	100	8,849	-	529	0
19	13,711	2501	11210	1,018	2,492	3240	100	11,210	-	2501	0
21	9,994	1633	8361	751	1,836	1620	88	7,379	982	1441	192
22	13,511	3185	10326	967	2,384	3240	100	10,326	-	3185	0
26	3,816	0	3816	318	763	1296	100	3,816	-	0	0
30	31,472	6931	24541	2,276	5,601	5720	100	24,541	-	6931	0
50	30,173	-	30,173	2,514	6,035	6035	100	30,173	-	0	0

*area calculated using AutoCad

19

SJB 4/9/19

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Subcatchment 19:

WQ_v = 1018 cf ⇒ volume stone = 2545 cf

Surface area = 3240 sf

depth = 0.78 ⇒ say 0.8 ft.

Subcatchment 22:

WQ_v = 967 ⇒ volume stone = 2418 cf

Surface area = 3240 sf

Depth = 2418/3240 = 0.75'

Subcatchment 26:

WQ_v = 318 cf ⇒ Vdme stone = 795 cf

surface area = 1296 sf

Reqd depth = 795/1296 = 0.61 say 0.65

Subcatchment 30

WQ_v = 2276 cf ⇒ volume of stone = 5690 cf

Surface Area = 5720 sf

depth = 5690/5720 = 0.99 say 1 ft.

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Subcatchment 50:

WQv = 2514 cf ⇒ volume stone = 6285 cf

Surface area = 6035 sf

Depth = 6285/6035 = 1.04 ft say 1.05

Subcatchment 21:

This subcatchment is only treating 88% of area

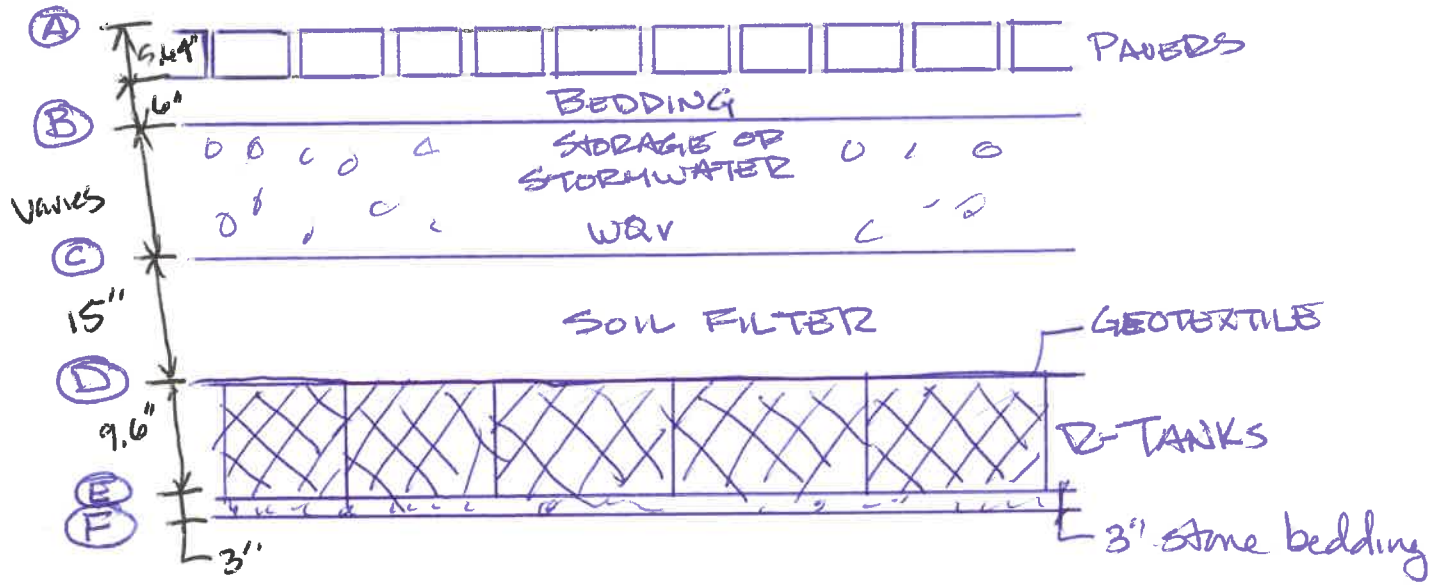
∴ WQv = 751 cf × 0.88 = 661 cf ⇒ volume of stone = 1652 cf

Surface area = 1620

depth = 1652/1620 = 1.02 ft. say 1.05 ft.

Manmade Pervious Paver Elevations

MPP	10	14	19	21	22	26	30	50
A	65.40	60.25	58.90	58.80	58.82	38.29	35.00	58.65
B	64.43	59.28	57.93	57.83	57.85	37.32	34.03	57.68
C	63.53	58.28	57.13	56.78	57.10	36.67	33.03	56.63
D	62.28	57.03	55.88	55.53	55.85	35.42	31.78	55.38
E	61.48	56.23	55.08	54.73	55.05	34.62	30.98	54.58
F	61.23	55.98	54.83	54.48	54.80	34.37	30.73	54.33



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Grassed Underdrain Soil Filter Sizing

Assumptions:

- Vol III - Maine Stormwater Manual; Section 7.1 Grassed Underdrained Soil Filters

Subcatchment 1A

Total Area = 17,785 ft²
Impervious = 6,203 ft²
Landscaped = 11,582 ft²

Soil Filter depth = 18 in.

Water quality Volume = $\left(\frac{\text{Impervious Area} \times 1\text{ in.}}{12}\right) + \left(\frac{\text{Landsc. Area} \times 0.4\text{ in.}}{12}\right)$

$WQV = \left(\frac{(6203\text{ ft}^2)(1\text{ in.})}{12}\right) + \left(\frac{11582\text{ ft}^2 \times 0.4\text{ in.}}{12}\right)$

$WQV = 903\text{ ft}^3$

Required Surface Area = $\left(\frac{\text{Imperv. Area}}{} \times 0.05\right) + \left(\frac{\text{Landsc. Area}}{} \times 0.02\right)$

Req. surface area = $6203\text{ ft}^2(0.05) + 11,582(0.02)$

$= 542\text{ ft}^2$

Provided Surface Area = 1598 ft² > 542 ft² OK

* See sheet 24 for sizing Remaining GSF's. Surface Area calculated in AutoCAD

100% treated

SJB 4/19/19 38

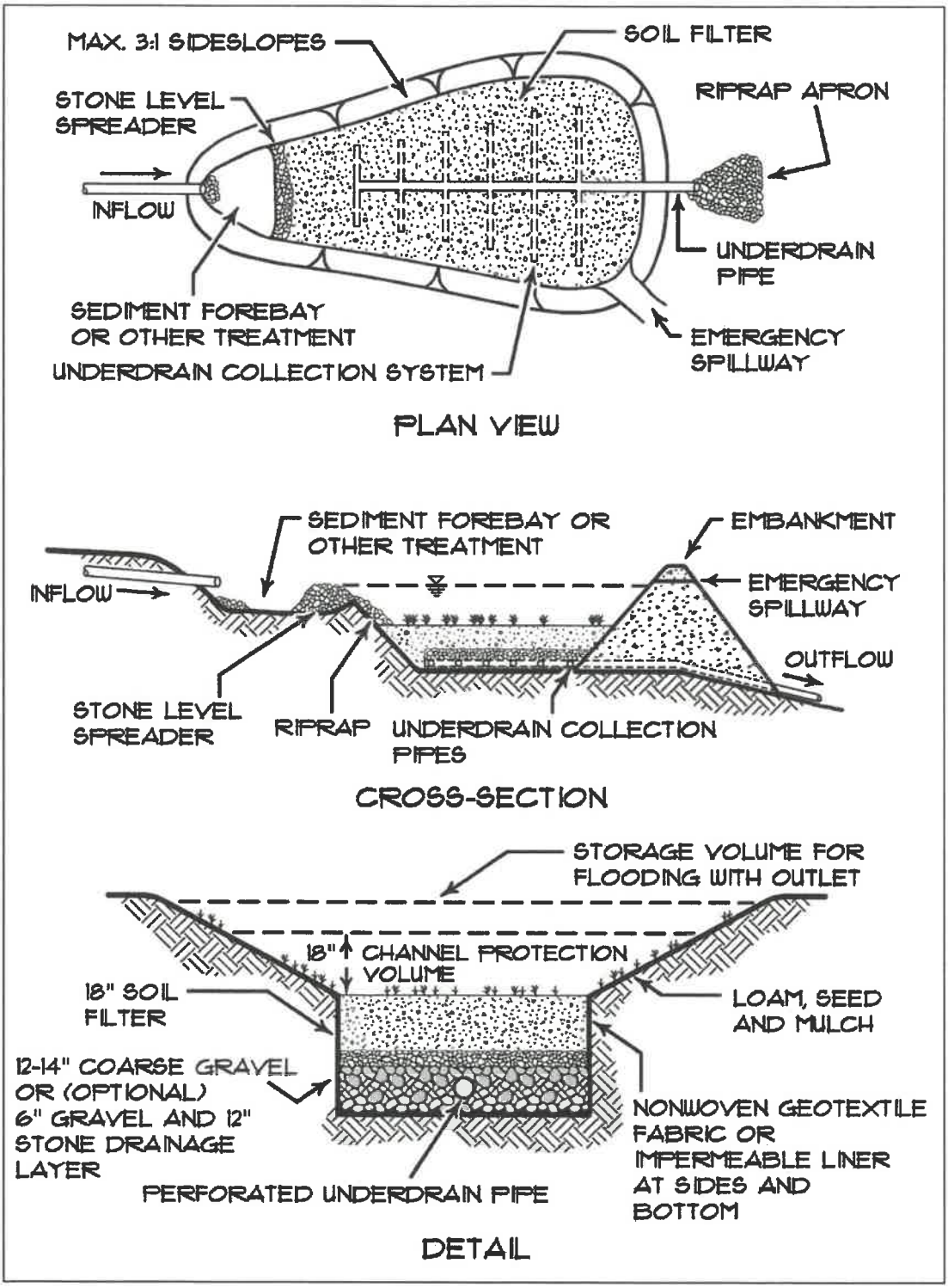

Figure 7.1.1 – Grassed Underdrained Soil Filter

Grassed Underdrain Filter Sizing

Input knowns or use standards from MEDEP stormwater design manual:

Subcatchment Area #	Total Subcatchment Area (sf)*	Impervious Area (sf)*	Landscaped Area (sf)*	Soil Filter Depth (in.) (minimum 18")	Water Quality Volume (cubic ft)	Req'd Surface Area (sf)	Provided Surface Area (sf)*	% Treated	Treated Impervious (sq. ft)	Untreated Impervious (sq. ft)	Treated Landscaped (sq. ft)	Untreated Landscaped (sq. ft)
1A	17,785	6,203	11,582	18	903	542	1598	100	6203	-	11,582	-
1B	22,308	6,832	15,476	18	1085	651	773	100	6832	-	15,476	-
2	26,280	8,052	18,228	18	1279	767	1503	100	8052	-	18,228	-
3	28,605	13,091	15,514	18	1608	965	1610	100	13091	-	15,514	-
4	8,448	-	8,448	18	282	169	457	100	0	-	8,448	-
5	10,807	-	10,807	18	360	216	600	100	0	-	10,807	-
6	13,985	4,484	9,501	18	690	414	1004	100	4484	-	9,501	-
7	30,345	7,846	22,499	18	1404	842	2037	100	7846	-	22,499	-
8	45,551	25,409	20,142	18	2789	1673	2601	100	25409	-	20,142	-
9	28,191	17,843	10,348	18	1832	1099	1905	100	17843	-	10,348	-
11	43,174	15,881	27,293	18	2233	1340	2198	100	15881	-	27,293	-
12	12,920	7,491	5,429	18	805	483	887	100	7491	-	5,429	-
13	45,163	20,981	24,182	18	2554	1533	2501	100	20981	-	24,182	-
15	4,359	176	3,184	18	121	72	599	100	176	-	3,184	-
16	15,110	5,161	9,949	18	762	457	1001	100	5161	-	9,949	-
18A	6,339	2,593	3,746	18	341	205	912	100	2593	-	3,746	-
18B	4,023	2,348	1,675	18	252	151	294	100	2348	-	1,675	-
24	18,261	12,270	5,991	18	1222	733	1401	100	12270	-	5,991	-

* calculated with AutoCAD

Represents area treated by GSF. Remainder is green roof

Ref: Maine DEP Stormwater Management Design Manuals

https://www.maine.gov/dep/land/stormwater/stormwaterbmps/vol2/volume%20II%20March%202016.pdf

https://www.maine.gov/dep/land/stormwater/stormwaterbmps/vol3/chapter7_2.pdf

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Grass Soil Filter CB Rim elevation

- Basin to hold WQv before discharging
Rim elevation set @ WQv or above

Water Quality Volume computed on sheet 24

Surface area of cell computed using a polyline in AutoCAD

To be conservative, assume WQv = Surface area x depth
(Even though there are 3:1 slopes) with out considering side slopes

GSF #1A: Surface area = 1598 sf
WQv = 903 cf

depth = 903cf / 1598 sf = 0.56ft.

Surface elevation = 65.75 ∴ Rim = 66.3

GSF #1B: Surface Area = 773 sf
WQv = 1085 cf.

depth = 1085/773sf = 1.4 ft

Surface elev. = 65.5 ∴ Rim = 66.9

GSF #2: Surface Area = 1503 sf
WQv = 1279 cf
depth = 1279cf/1503sf = 0.85

Surface elev. = 56.75 ∴ Rim = 57.60

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GSF #3: Surface area = 1610 sf

WQ_V = 1608 cf

depth = 1608 cf / 1610 sf = 1 ft.

Surface elev. = 54.75 ∴ Rim = 55.75

GSF #4: Surface Area = 457 sf

WQ_V = 282 cf

depth = 282 cf / 457 sf = 0.62'

surface elev. = 54.5 ∴ Rim = 55.1

GSF #5: Surface Area = 600 sf

WQ_V = 360 cf

depth = 360 cf / 600 sf = 0.6 ft.

Surface elev. = 54.0 ∴ Rim = 54.6

GSF #6: Surface area = 1004 sf

WQ_V = 690 cf

depth = 690 cf / 1004 sf = 0.69 ft

Surface elev. = 47.50 ∴ Rim = 48.2

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GSF #7: Surface Area = 2037 sf

WQv = 1404 cf

depth = 1404 cf / 2037 sf = 0.69 ft.

surface elev. = 54.0 ∴ Rim = 54.7

GSF #8: Surface Area = 2601 sf

WQv = 2789 cf

depth = 2789 cf / 2601 sf = 1.07 ft.

surface elev. = 56.5 ∴ Rim = 57.6

GSF #9: Surface Area = 1905 sf

WQv = 1803 cf

depth = 1803 cf / 1905 sf = 0.95 ft.

surface elev. = 62.0 ∴ Rim = 62.95

GSF #11: Surface Area = 2198 sf

WQv = 2233 cf

depth = 2233 cf / 2198 sf = 1.01 ft.

Surface elev. = 61.0 ∴ Rim = 62.0

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GSF # 12: Surface Area = 887 sf

WQ_V = 805 cf

depth = 805 cf / 887 sf = 0.91 ft.

Surface elev. = 61.0 ∴ Rim = 61.9

GSF # 13: Surface Area = 2501 sf

WQ_V = 2554 cf

depth = 2554 cf / 2501 sf = 1.02 ft.

Surface elev. = 61.0 ∴ Rim = 62.0

GSF # 15: Surface Area = 599 sf

WQ_V = 126 cf

depth = 126 cf / 599 sf = 0.21

Surface elev. = 63.50 ∴ Rim = 63.7

GSF # 16: Surface Area = 1001 sf

WQ_V = 880 cf

depth = 880 cf / 1001 sf = 0.88

Surface Elev. = 63.5 ∴ Rim = 64.4

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GSF #18A: Surface Area = 912 sf

WQv = 341 cf

depth = 341 cf / 912 sf = 0.37'

Surface = 57.0 ∴ Rim = 57.4

GSF 18B: Surface Area = 294 sf

WQv = 252 cf

depth = 252 cf / 294 sf = 0.86 ft.

Surface = 57.0 ∴ Rim = 57.9

GSF #24: Surface Area = 1401 sf

WQv = 1222 cf

depth = 1222 cf / 1401 sf = 0.87 ft.

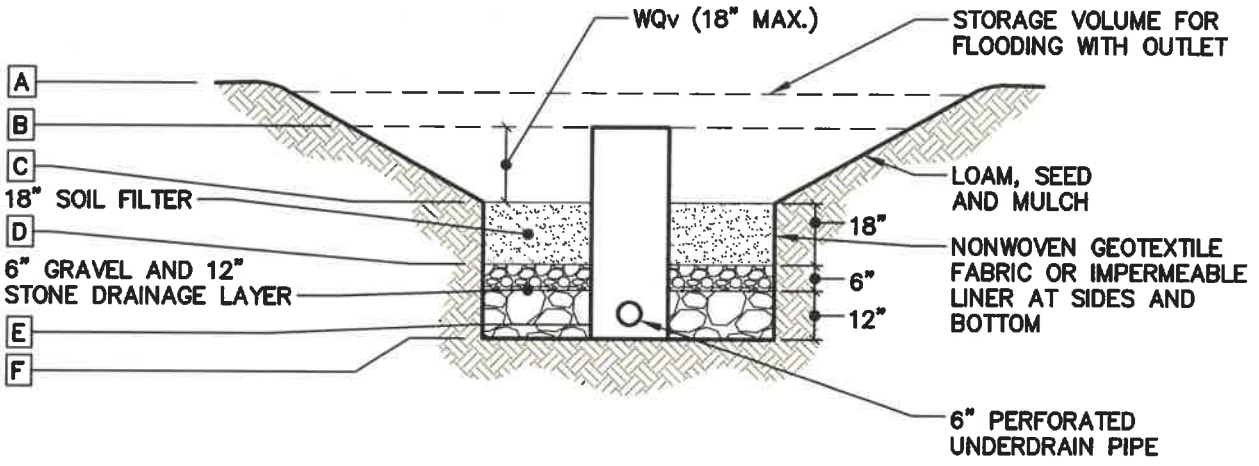
Surface = 31.75 ∴ Rim = 40.6

Some of these GSFs have Rim close to top of pond; may want to look @ other options

Grassed Underdrained Soil Filter Elevations

GSF	1A	1B	2	3	4	5	6	7	8	9	11	12	13	15	16	18A	18B	24
A	68.00	67.50	59.00	57.00	56.00	55.00	50.00	56.00	58.50	64.00	63.00	62.50	63.00	65.00	65.00	58.00	58.00	42.00
B	66.30	66.90	57.60	55.75	55.10	54.60	48.20	54.70	57.60	62.95	62.00	61.90	62.00	63.70	64.40	57.40	57.90	40.60
C	65.75	65.50	56.75	54.75	54.50	54.00	47.50	54.00	56.50	62.00	61.00	61.00	61.00	63.50	63.50	57.00	57.00	39.75
D	64.25	64.00	55.25	53.25	53.00	52.50	46.00	52.50	55.00	60.50	59.50	59.50	59.50	62.00	62.00	55.50	55.50	38.25
E	63.00	62.75	54.00	52.00	51.75	51.25	44.75	51.25	53.75	59.25	58.25	58.25	58.25	60.75	60.75	54.25	54.25	37.00
F	62.75	62.50	53.75	51.75	51.50	51.00	44.50	51.00	53.50	59.00	58.00	58.00	58.00	60.50	60.50	54.00	54.00	36.75

30A


WQv (18" MAX.)
STORAGE VOLUME FOR FLOODING WITH OUTLET
A
B
C
18" SOIL FILTER
D
6" GRAVEL AND 12" STONE DRAINAGE LAYER
E
F
LOAM, SEED AND MULCH
18"
6"
12"
NONWOVEN GEOTEXTILE FABRIC OR IMPERMEABLE LINER AT SIDES AND BOTTOM
6" PERFORATED UNDERDRAIN PIPE

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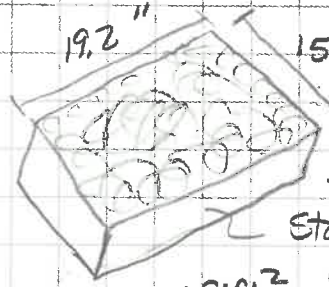
2/25/19

Vegetated Roofing

Assumptions:

1. Building penthouse occupies 20% of roof (impervious)
2. Intensive Pregrown systems (see Firestone Green Roof Skyscape Brochure as reference.)
   a. 8" media depth
   b. 9.75" total height w/ moisture reservoirs
   c. est. weight at max holding capacity: 52-60 lb/ft³
   d. est. storage volume: 0.26 ft³
   e. 15" x 20" platform (see page 32)
   f. Vegetation is combination of succulent grand cover
   g. irrigation system may be used.



Subcatchment 33 (small roof)

1. Total area of roof = 107,893 ft², 18033.08ft²
2. Area of veg. roof = 107893 ft² − = 89860 ft²
3. Module platform surface area : 15" x 19.2", = 288 in² or 2 ft²
4. Treatment volume (for 100% of roof) = $\left[\frac{\left(\text{Total area} \times \%\text{Imperv} \times 1"\right) + \left(\text{Total area} \times \%\text{landsc.} \times 0.4"\right)}{12}\right] \div 100$

$= \left[\frac{(107893\text{ft}^2 \times 100 \times 1) + 0}{12}\right] \div 100$

$= 8991\text{ ft}^3$

35

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SkyScape Pregrown Modular Systems

All modules are made from 100% recycled HDPE materials, and are FM approved for fire resistance.

Extensive Pregrown Modular Systems

- 2.5" media depth *(4.25" total height with moisture reservoirs)*
  - » Estimated weight at maximum water holding capacity: 19-22 lb/ft²
  - » Estimated module water storage volume - 0.09 ft³ or 0.71 gal/ft²
  - » Wind rating: Not applicable
  - » Available in 15" x 20" platform only
  - » Vegetation are drought tolerant plant communities, such as those found in dry mountain environments, coasts, semi-arid deserts, and or dry meadows. Succulent ground cover species found in the genus Sedum, Delosperma perform the best at this media depth.
  - » Depending on project location, an irrigation system may be recommended.

- 4" media depth *(5.75" total height with moisture reservoirs)*
  - » Estimated weight at maximum water holding capacity: 28-32 lb/ft²
  - » Estimated module water storage volume - 0.14 ft³ or 1.05 gal/ft²
  - » Wind rating: 133 psf
  - » Available in 15" x 20" and 12" x 24" platforms
  - » Vegetation are drought tolerant plant communities, such as those found in dry mountain environments, coasts, semi-arid deserts, and or dry meadows. For accent species, conventional perennials and grasses can also be used to add diversity. Careful selection and appropriate ratios of succulents to accents should be adhered to.
  - » Depending on project location, an irrigation system may be recommended.

Semi-Intensive Pregrown Modular Systems

- 6" media depth *(7.75" total height with moisture reservoirs)*
  - » Estimated weight at maximum water holding capacity: 38-45 lb/ft²
  - » Estimated module water storage volume - 0.20 ft³ or 1.51 gal/ft²
  - » Wind rating: ≥ 133
  - » Available in 15" x 20" platform only
  - » Vegetation is a combination of succulent ground cover; conventional perennials, grasses, and native forbs can also be used to create a very diverse vegetative roof.
  - » Depending on the vegetation used, an irrigation system may be necessary.

Intensive Pregrown Modular Systems

- 8" media depth *(9.75" total height with moisture reservoirs)*
  - » Estimated weight at maximum water holding capacity: 52-60 lb/ft²
  - » Estimated module water storage volume - 0.26 ft³ or 1.97 gal/ft²
  - » Wind rating: ≥ 133
  - » Available in 15" x 20" platform only
  - » Vegetation is a combination of succulent ground cover; conventional perennials, grasses, and native forbs can also be used to create a very diverse vegetative roof.
  - » Depending on the vegetation used, an irrigation system may be necessary.

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5. # of platform modules proposed = Treatment volume / Storage per module
= 8991 ft³ / 0.26 ft³
= 34,581 platform modules

6. Surface area needed to fit platform modules:
34581 modules × 2 ft² = 69,162 sq. ft
< 89,860 sq. ft.
OKAY

Vegetated Roof

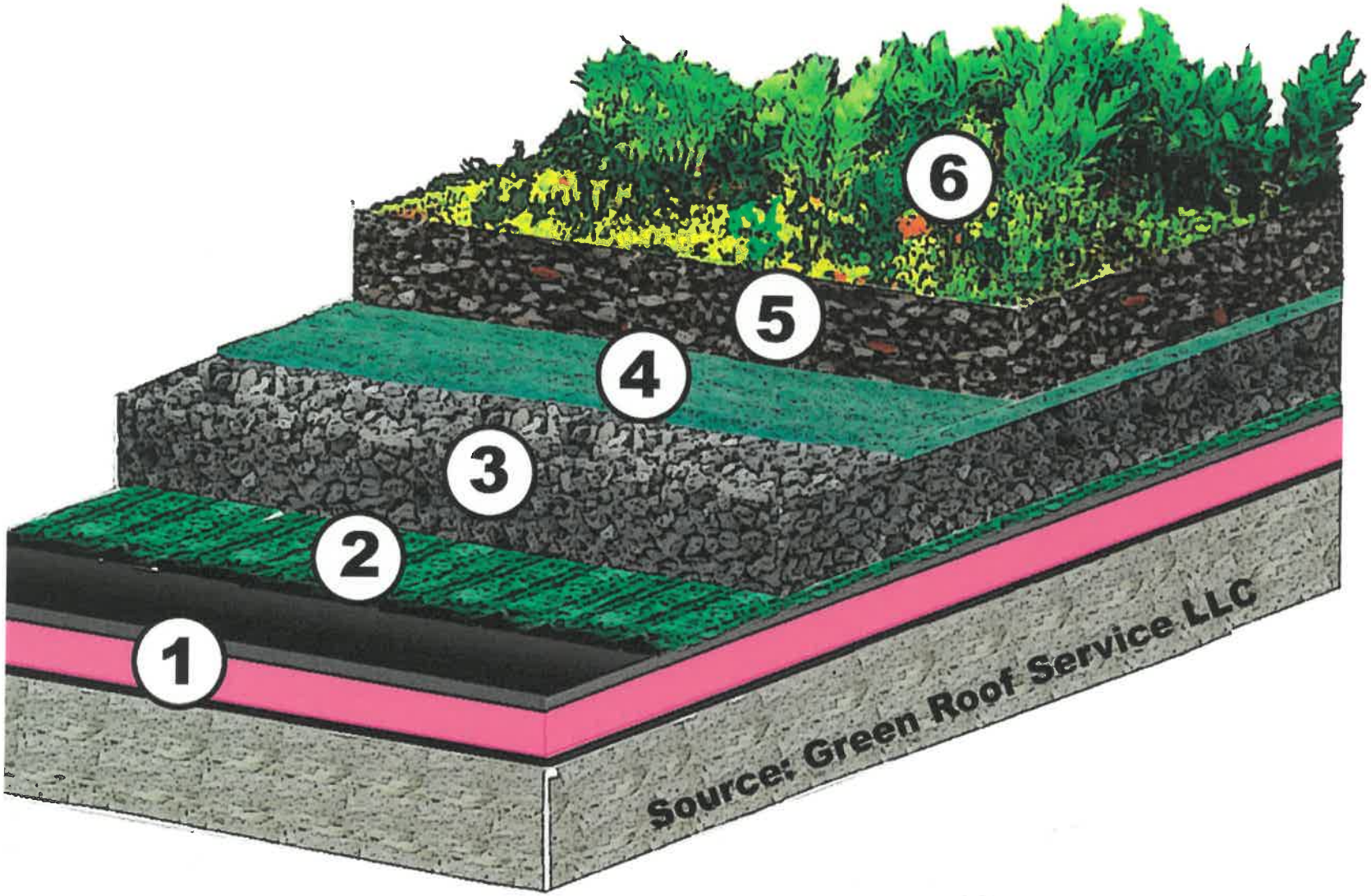
Input knowns or use standards from MEDEP stormwater design manual:					Intensive Pregrowth Modular System Specifications:					
Subcatchment Area #	**Total Area (sf)**	**Access Areas - unvegetated (sf)**	**Available Vegetated* (sf)**	**Water Quality Volume (cf)**	**Media Depth (in.)**	**Module Platform Surface Area Size (sq. ft)**	**Module Platform Storage Capacity (cf)**	**Number of Platform Modules Proposed**	**Req'd Surface Area (sq. ft)**	**Treated (%)**
15	4,810	-	4,810	401	6	2	0.2	2,004	4,008	100
28	1,407	-	1,407	117	6	2	0.2	586	1,173	100
33	107,893	17,933	89,960	8,991	6	2	0.2	44,955	89,911	100
34	24,099	4,820	19,279	2,008	8	2	0.26	7,724	15,448	100
35	20,997	4,199	16,798	1,750	8	2	0.26	6,730	13,460	100

* Available vegetated area approximated by current roof drawings

References:
https://www.maine.gov/dep/land/stormwater/stormwaterbmps/vol3/chapter7_6.pdf
See: Firestone Green Roof Skyscape-Brochure.pdf
https://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/Ch3.1GreenRoofs_0.pdf
https://www.wbdg.org/resources/extensive-vegetative-roofs
https://dec.vermont.gov/watershed/cwi/green-infrastructure/gsi/evaptrans#GreenRoofs
https://stormwater.pca.state.mn.us/index.php?title=General_characteristics_of_extensive_and_intensive_green_roofs

Functional layers of a typical extensive Green Roof

35



SJB
4/19/19

1 Roof deck, Insulation, Waterproofing

2 Protection- and Storage Layer

3 Drainage- and Capilarity Layer

4 Root permeable Filter Layer

5 Extensive Growing Media

6 Plants, Vegetation

36

SJB 4/19/19

Green Roofs

Courtesy of The Green Institute - Minneapolis, MN

Definition:
Green roofs consist of a series of layers that create an environment suitable for plant growth without damaging the underlying roof system. Green roofs create green space for public benefit, energy efficiency, and stormwater retention/ detention.

KEY CONSIDERATIONS

Design Criteria:

- Structural load capacity, how much weight the roof can hold, is a major factor in determining whether the green roof is "extensive" or "intensive" (see next page).
- Vegetation selection is based on numerous factors including, growth medium depth, microclimate, irrigation availability and maintenance.
- A leak detection system is recommended to quickly detect and locate leaks.
- Modular products can increase installation and repair efficiency.

Benefits:

- Reduce, delay, and cool stormwater runoff.
- Insulate buildings and lower energy consumption and costs.
- Provide habitat for birds and insects.
- Increase longevity of traditional roofing systems by protecting from ultraviolet rays.
- Reduce carbon dioxide levels and heat island effect.

Limitations:

- Cost is higher than traditional roofing systems – can be significant for retrofits.
- Leaks can cause significant damage and can be hard to locate and repair without an electronic leak detection system.
- Conditions can be harsh for vegetation establishment.
- Maintenance needs can be higher than traditional roofing system.

MANAGEMENT SUITABILITY

High	Water Quality (V_{wq})
Med	Channel Protection (V_{cp})
Low	Overbank Flood Protection (V_{p10})
Low	Extreme Flood Protection (V_{p100})
Low	Recharge Volume (V_{re})

MECHANISMS

	Infiltration *with appropriate soil & conditions
X	Screening/ Filtration
X	Temperature Control
	Settling
X	Evaporation
X*	Transpiration *if vegetated
X	Soil Adsorption
X	Biological/ Micro. Uptake

POLLUTION REMOVAL

90%	Total Suspended Solids
100%/ 20%	Nutrients - Total Phosphorus/ Total Nitrogen
80%	Metals - Cadmium, Copper, Lead, and Zinc
65%	Pathogens - Coliform, Streptococci, E. Coli
NA	Toxins - Chloride, Hydrocarbons, Pesticides

Note: Pollution removal percentages apply to volume of runoff treated, and not to volume by-passed

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R-Tanks - Storage / Flooding @ Sb 30 & 35

- R-Tank Stormwater Detention System (ACF Environmental)
- Used HydroCAD to determine runoff volumes for 25-year storms
  - Subcatchment 30 = 10,936 cf
  - Subcatchment 35 = 7,667 cf
  -] 18603 cf total

1. Determine storage volume for R-Tank Minis

MPP30 surface area = 5720 sf ∴ See sheet (19)

Req'd R-Tank Mini height = 9.45" ∴ Refer to Sheet (35)

R-tank mini storage volume = 5720 sf x 9.45 in/12
= 4,504.5 cf

Volume left to store = 18603 cf - 4504.5 cf
= 14,098.5 cf

2. Determine storage volume for R-Tank singles under porus pavers

Assumed surface area = 1022.64 sf

Volume Stored = 1022.64 sf (16.53"/12) ∴ Refer to Sheet (35)
= 1,408.68 cf

Volume left to store = 14098.5 cf - 1408.68 cf
= 12689.82 cf say 12690 cf

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4. Determine storage Volume for Single + Mini R-Tanks

Volume Stored = 12690 cf min.
Surface Area req'd = 12690 cf / (25.98"/12)
= 5861.4 sf
Say 5862 sf
∴ Refer to sheet (35)

5. Determine # of R-Tank Minis

# of modules = 4504.5 cf / 2.42 cf
= 1861.3 mods Say 1862 mini mods
∴ Each module can store 2.42 cf

6. Determine # of Singles under pavers

# of modules = 1408.68 cf / 4.44 cf
= 317.3 mods
Say 318 single mods
∴ Each single module can store 4.44 cf

7. Determine # of single + mini modules

# of modules = 12690 cf / 6.67 cf
= 1902.5 mods
Say 1903 single + mini mods
∴ Single + Mini modules store 6.67 cf each.

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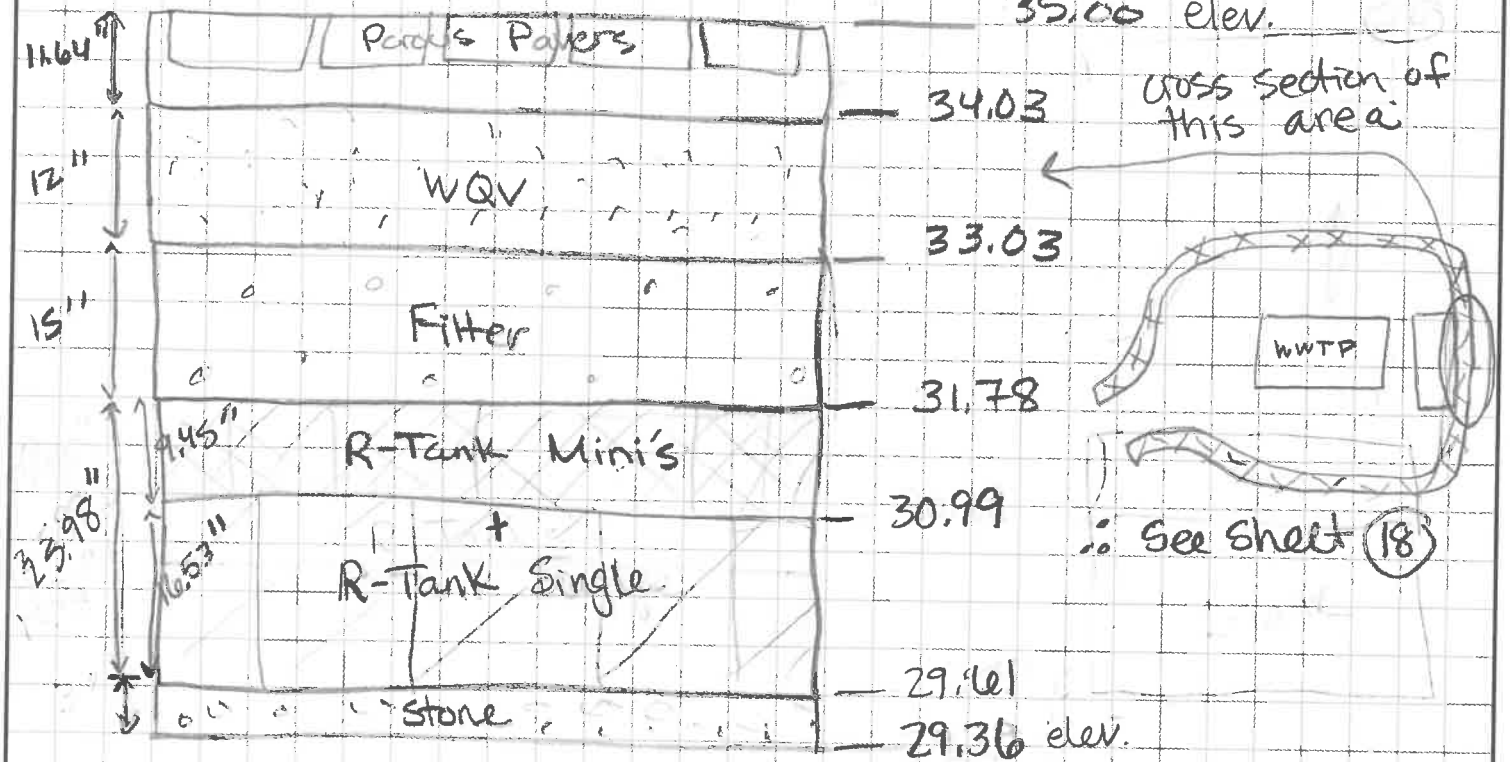
Byfield, Massachusetts	978-465-1822
Providence, Rhode Island	401-433-2160
Portsmouth, New Hampshire	603-436-1490
Portland, Maine	207-772-2891
Hamilton, New Jersey	609-584-0090

PROJECT NO. 171.05027 SITE NAF
SHEET NO. 39 OF
CALCULATED BY MKH DATE 3/1/19
CHECKED BY DATE
SCALE SJB 4/19/19

R-Tanks

- R-Tank Stormwater Detention System (ACF Environmental)
- HydroCAD to calculate runoff volumes.



Cross section of this area

∴ See Sheet (18)

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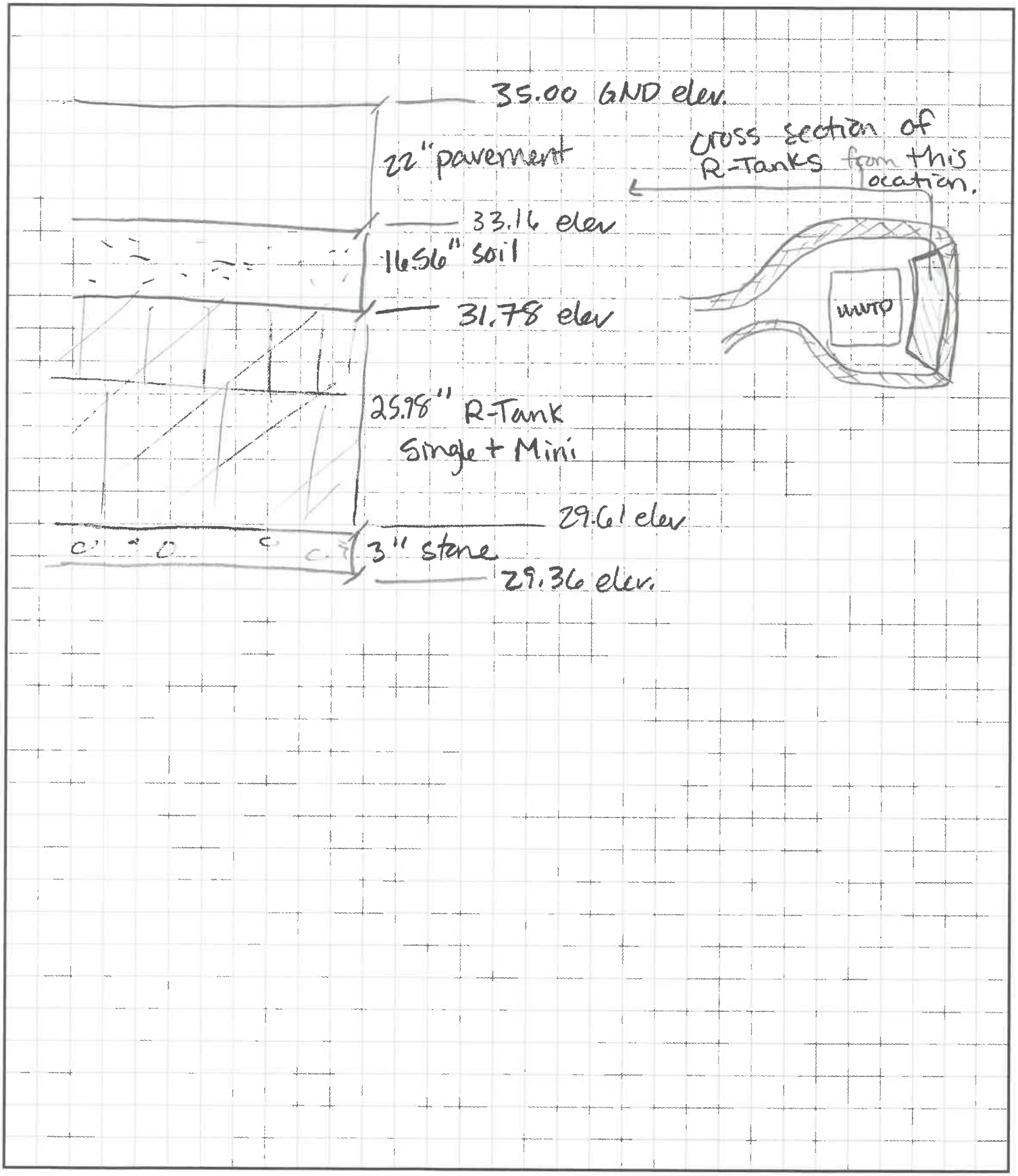
Portland, Maine 207-772-2891
Hamilton, New Jersey 609-584-0090

PROJECT NO. 171.05027 SITE NAF
SHEET NO. 40 OF
CALCULATED BY MKH DATE 3/1/19
CHECKED BY MPR DATE 3/19/19
SCALE SJB 4/19/19



R-TANK SPECIFICATIONS

SJB 4/19/19

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LD HD

DIMENSIONS & CAPACITY

Module (Segments)	Width (inch)	Length (inch)	Height (in/ft)	Volume (cf)	Capacity (cf)	Weight* (lbs)
Mini	15.75	28.15	9.45"/0.79'	2.42	2.30	10.1/10.9
Single(1)	15.75	28.15	17.32"/1.44'	4.44	4.22	15.7/17.3
Single + Mini(1.5)	15.75	28.15	25.98"/2.17'	6.67	6.33	23.6/25.9
Double (2)	15.75	28.15	33.86"/2.82'	8.69	8.25	29.1/32.3
Double + Mini(2.5)	15.75	28.15	42.52"/3.54'	10.91	10.36	37.0/41.0
Triple (3)	15.75	28.15	50.39"/4.20'	12.93	12.28	42.5/47.4
Triple + Mini(3.5)	15.75	28.15	59.06"/4.92'	15.15	14.39	50.4/56.0
Quad(4)	15.75	28.15	66.93"/5.58'	17.17	16.31	55.9/62.4
Quad + Mini(4.5)	15.75	28.15	75.59"/6.30'	19.39	18.42	63.8/71.0
Pent(5)	15.75	28.15	83.46"/6.96'	21.41	20.34	69.3/77.4

*Weights shown are for LD/HD modules.

SD

DIMENSIONS & CAPACITY

Module (Segments)	Width (inch)	Length (inch)	Height (in/ft)	Volume (cf)	Capacity (cf)	Weight (lbs)
Single (1)	15.75	28.15	9.45"/0.79'	2.42	2.30	10.95
Double (2)	15.75	28.15	18.12"/1.51'	4.64	4.41	19.58
Triple (3)	15.75	28.15	26.79"/2.23'	6.86	6.52	28.21
Quad (4)	15.75	28.15	35.46"/2.96'	9.08	8.63	36.84
Pent (5)	15.75	28.15	44.13"/3.68'	11.30	10.74	45.47
Hex (6)	15.75	28.15	52.80"/4.40'	13.52	12.84	54.10
Septa (7)	15.75	28.15	61.47"/5.12'	15.74	14.95	62.73
Octo (8)	15.75	28.15	70.14"/5.85'	17.96	17.06	71.36
Nono (9)	15.75	28.15	78.81"/6.57'	20.18	19.17	79.99
Decka (10)	15.75	28.15	87.48"/7.29'	22.40	21.28	88.62

UD

DIMENSIONS & CAPACITY

Module (Segments)	Width (inch)	Length (inch)	Height (in/ft)	Volume (cf)	Capacity (cf)	Weight (lbs)
Single (1)	23.62	23.62	14.17"/1.18'	4.57	4.35	21.2
Double (2)	23.62	23.62	27.17"/2.26'	8.77	8.33	39.0
Triple (3)	23.62	23.62	40.16"/3.35'	12.97	12.32	56.8
Quad (4)	23.62	23.62	53.15"/4.43'	17.16	16.30	74.6
Pent (5)	23.62	23.62	66.14"/5.5'	21.35	20.29	92.4

XD

DIMENSIONS & CAPACITY

Module (Segments)	Width (inch)	Length (inch)	Height (inch)	Volume (cf)	Capacity (cf)	Weight (lbs)
Single (1)	19.68	23.62	1.97	0.53	0.48	4
Double (2)	19.68	23.62	3.94	1.06	0.95	8
Triple (3)	19.68	23.62	5.91	1.59	1.43	12
Quad (4)	19.68	23.62	7.87	2.12	1.91	16
Pent (5)	19.68	23.62	9.84	2.65	2.38	20

Note: XD modules may be stacked up to 10' tall (60 layers).

SPECIFICATIONS

Item	Description	LD	HD	SD	UD	XD
		Value	Value	Value	Value	Value
Void Area	Volume available for water storage	95%	95%	95%	95%	90%
Surface Area Void	% of exterior available for infiltration	90%	90%	90%	90%	90%
Compressive Strength	ASTM D 2412/ ASTM F 2318	30.0 psi	33.4 psi	42.9 psi	134.2 psi	240.2 psi
Unit Weight	Weight of plastic per cubic foot of tank	3.29 lbs/cf	3.62 lbs/cf	3.96 lbs/cf	4.33 lbs/cf	7.55 lbs/cf
Rib Thickness	Thickness of load-bearing members	0.18"	0.18"	0.18"	-	-
Service Temperature	Safe temperature range for use	-14 - 167° F	-14 - 167° F	-14 - 167° F	-14 - 167° F	-14 - 167° F
Recycled Content	Use of recycled polypropylene	100%	100%	100%	100%	100%
Minimum Cover	Cover required for HS-20 loading	Not traffic rated	20"	18"	12" - 14"	6"
	Cover required for HS-25 loading	Not traffic rated	24"	18"	15" - 17"	6"
Maximum Cover	Maximum allowable cover depth	36"	6.99'	9.99'	5.0'	16.7'