# Addendum Sheet

# Complying with the Edwards Aquifer Rules

# Technical Guidance on Best Management Practices

# RG-348 (Revised July 2005)

## *BaySaver BayFilter*

June 5, 2018

The BayFilter system is a non-mechanical stormwater filtration system with filter media contained in cartridges. The BayFilter unit can act as a stand-alone device to treat stormwater in a volume-based, flow-through, or combination design configuration (equalization). Ideally, the BayFilter is located downstream of an extended detention system and acts as an integral component of a treatment train system. Field testing indicates a TSS removal efficiency of 87%.

The BayFilter cartridge design utilizes concrete (manholes, pre-cast, or cast-in-place) vaults housing cylindrical spiral wrapped filter fabric containing a mixed silica/sand media. The filter cartridges are housed in the concrete structure that evenly distributes the flow between cartridges. Pollutants are removed from water by two mechanisms: 1) interception/attachment and 2) adsorption.

Interception occurs when a pollutant becomes trapped within the filter media. A sediment particle, for example, may be carried into the filter media by the water and become stuck in the interstices of the media. Particles will typically remain trapped within the media until the media is removed or the filter is backwashed.

Attachment occurs when pollutants bind themselves to the surface of the filter media, and this happens primarily through adsorption. Adsorption is a surface process by which dissolved ions are removed from a solution and chemically bind themselves to the surface of the media. This occurs when the surface of the filter media particle contains sites that are chemically attractive to the dissolved ions. The BayFilter system uses a proprietary media containing activated alumina to enhance adsorption of dissolved ions.

The main building block of the BayFilter stormwater filtration system is the BayFilter cartridge (BFC), shown in Figure 1. The cartridges are housed in the concrete structure which contains the inlet and outlet pipes, as well as an internal manifold that delivers treated water to the outlet of the BayFilter system, shown in Figure 2.

Stormwater runoff enters the manhole or concrete structure via an inlet pipe and begins to fill the structure. Coarse sediments settle on the floor of the vault. When the water surface elevation in the vault/manhole reaches operating level, water flows through the BFC driven by hydrostatic head. Within the BFC, the water flows through an enhanced filter media and drains via a vertical pipe. The vertical drain is connected to the underdrain system which conveys filtered water to the outfall.

During a typical storm event, the BayFilter system has four cycles:

1. Vault fill and air release;
2. Uniform bed load hydrodynamic filtration;
3. Uniform bed load siphon filtration; and
4. Siphon break and hydrodynamic backwash.

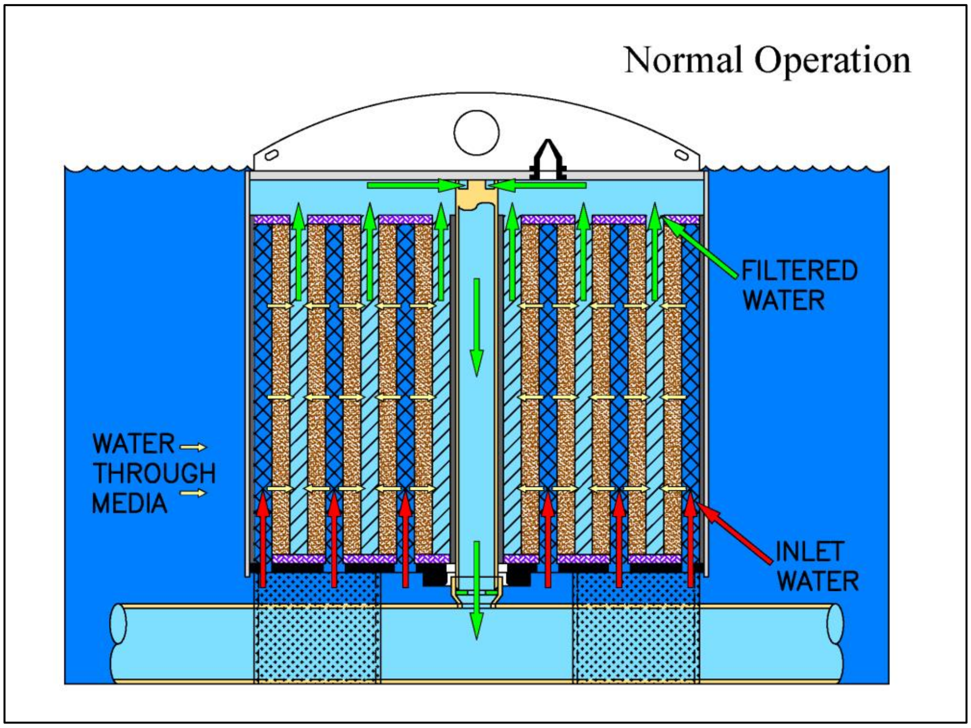


**Figure 1:** Schematic of BayFilter Cartridge (BFC).

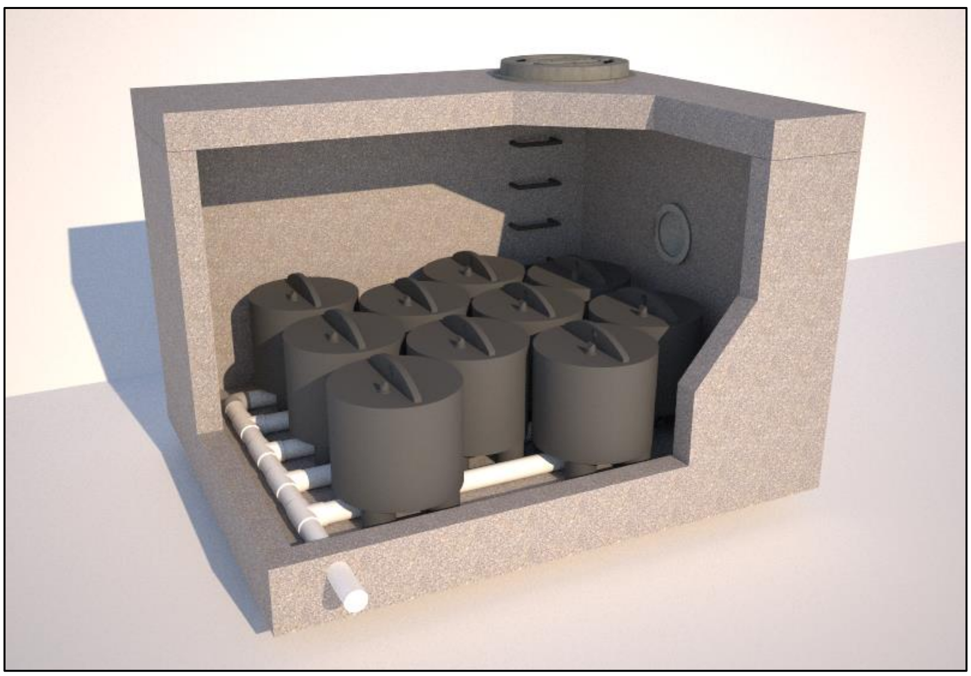

**Figure 2:** Simple schematic of BayFilter.

## *Selection Criteria*

- The BayFilter system is space efficient and requires a minimal amount of surface area since cartridges are housed underground.
- The system is scalable and appropriate for variable size drainage areas.

- Cast-in-place systems can be designed for specific site constraints such as high flow rates, shallow installations, very flat sites, limited footprints, etc.

## *Limitations*

- The system should not be used for flood control or stream erosion control.
- The system requires a drop across the system vault/cell to generate enough hydraulic head for the system to operate properly.
- The system design is offline with an external bypass that routes high intensity storms away from the system to prevent sediment resuspension. These configurations typically involve higher flow per cartridge, but reduce treated sediment load per cartridge.
- Pretreatment devices are recommended to extend the life of the cartridge cell and if a site anticipates heavy sediment load or significant oil load.
- Inspection and maintenance is required to remove trash, debris and sediment. The required maintenance interval is dependent upon the degree of pollutant loading.
- The use of highly oleophilic filter fabrics used in the BayFilter system may shorten the maintenance interval where the drainage area has the potential for significant oil loads to be present in a large portion of the drainage area.
- Revisions to any or all of the BMP maintenance requirements for BayFilter system must be promptly communicated to TCEQ. In addition, site owners/responsible parties who have BayFilter systems included in an approved Edwards Aquifer Protection Plan may be required to submit a revised and properly completed Inspection, Maintenance, Repair, and Retrofit Plan (TCEQ-0600; Attachment G) to the appropriate TCEQ Region Office upon implementation of revised maintenance procedures.

## *Cost Considerations*

The configurations offered by BayFilter system may provide potential reductions in capital and installation costs. The recommended pretreatment units may reduce maintenance cost and frequency by removing trash, debris, and sediments before reaching the BayFilter unit. The scalable system can be used to treat several acres.

## *Design Criteria for BaySaver BayFilter*

The BayFilter system will include a number of standard BFCs and at least one drain down module per BFC. The BFC has a vertically configured spiral wound media which optimizes the potential filter media area in a horizontal plane. The diameter and height will determine the effective media area. Each BayFilter system relies on a collection of individual BFCs to achieve the desired treatment rate. Accurately determining the required number of filters is important to efficient operation.

An effective stormwater treatment system will result when the following design parameters listed below are given consideration. Each parameter results in a required number of BFCs. After computing the number of filters for each parameter, determine which requires the most filters, and this will be the limiting parameter and the number of required cartridges for the drainage area.

- System configuration
- TCEQ/Edwards Aquifer Protection Program sizing requirements (equalization)
- Flow capacity of the system
- Treated sediment load of the system

# *BaySaver BayFilter RG-348 Addendum*

The BFCs are manufactured in a 45 gallon per minute (gpm)/ 0.10 cubic feet per second (cfs) (Standard Cartridge BF-545) or a 22.5 gpm/ .05 cfs per cartridge (BF-545-LP) and can provide 0.50 gpm per square feet filter area. The standard BFC provides a filter media area of 90 $ft^2$ and is approximately 30" in diameter and 35" tall. The media blend is of zeolite, perlite and activated alumina.

Standard cartridges include BF-545 and the BF-545-LP (low profile) which remove approximately 262 lbs and 131 lbs of TSS per exchange. Complete details of the design, filter type, operation, and maintenance of the BayFilter system can be found in the BayFilter Technical and Design Manual.

The design and sizing is based off calculations demonstrated in RG 348 Complying with Edwards Aquifer Rules: Technical Guidance on BMPs.

**Step 1: Calculate required TSS removal based on net increase in impervious cover**

$$L_M = 27.2(A_N * P)$$

$L_M$ = Required TSS removal (pounds)

$A_N$= Net increase in impervious area (acres)

P = Average annual precipitation (inches)

For example, a proposed development within a drainage area ($A_C$) of 2.0 acres with a net increase of impervious area ($A_N$) of 1.0 acre located in Bexar County which has the average annual precipitation (P) of 30 inches will require the following TSS removal:

$$L_M = 27.2(A_N * P) = 27.2(1.0 * 30) = 816 \text{ lbs}$$

**Step 2: Calculate the TSS load removed by the BMP(s)**

$$L_R = (\text{BMP efficiency}) * P * [(A_I * 34.6) + (A_P * 0.54)]$$

$L_R$ = Load removed by BMP

BMP efficiency = TSS removal efficiency (expressed as a decimal fraction) = 0.87

$A_I$ = impervious tributary area to the BMP (ac) = 1.0 acre

$A_P$ = pervious tributary area to the BMP (ac) = 1.0 acre

P = average annual precipitation = 30 inches

$$L_R = (0.87) * 30 * [(1.0 * 34.6) + (1.0 * 0.54)] = 917 \text{ lbs}$$

**Step 3: Calculate the fraction of annual runoff to be treated**

$$F_R = L_M / \Sigma L_R = 816/917 = 0.89$$

$F_R$ = fraction of annual runoff

Reference Table 3-5 Relationship between Fraction of Annual Rainfall and Rainfall Depth (in) of RG 348 Complying with Edwards Aquifer Rules: Technical Guidance on BMPs; .089 corresponds to a rainfall depth of 1.60 inches.

**Step 4: Calculate the captured volume or minimum flow rate required to remove 80% TSS**

**Example of volume based design:**

The runoff coefficient can be determined with the following equation:

$$R_C = 1.72\,(IC)^3 - 1.97\,(IC)^2 + 1.23(IC) + 0.02$$

IC = impervious cover fraction

$$IC = A_N/A_C = 1.0/2.0 = 0.5$$

$$R_C = 1.72\,(0.5)^3 - 1.97\,(0.5)^2 + 1.23(0.5) + 0.02 = 0.36$$

Based on this runoff coefficient it is necessary to determine the amount of water needed to be held back to be treated by the BMP or the Water Quality Volume (WQV):

$$WQV = (R_d/12) * R_C * (A_C * 43560)$$

$R_d$ = rainfall depth from Table 3-5 = 1.60 inches

$A_C$ = total contributing drainage area = 2.0 acres

$$WQV = (1.60/12) * 0.36 * (2.0 * 43560) = 4154\ ft^3$$

Required Storage + 20% = WQV * 1.2 = 4,154 * 1.2 = 4985 $ft^3$

The number of cartridges can be sized based on mass loading calculation:

$$\text{Number of cartridges} = \left[A_C * P * \left(0.05 + 0.9 * \left(\frac{A_I}{A_C}\right)\right) * 18.12\right] / M_R$$

$A_C$ = Total contributing drainage area = 2.0 acre

$A_I$ = Impervious area = 1.0 acre

P = Average annual precipitation = 30 inches

18.12 = units conversion factor

$M_R$ = mass removed per cartridge (262.6 pounds in NJCAT Test)

$$\text{Number of cartridges} = \left[2.0 * 30 * \left(0.05 + 0.9 * \left(\frac{1.0}{2.0}\right)\right) * 18.12\right] / M_R = 2.07$$

The following calculation table yields the number of cartridges required to remove the calculated site TSS from the example site:

| Cartridge Selection | Number of Cartridges Required | Number of Cartridges Required Rounded Up |
|---|---|---|
| BayFilter Standard (BF545) | 2.07 | 3.00 |
| BayFilter Low Profile (BF545-LP) | 4.14 | 5.00 |

**Example of Flow-through based design:**

Calculate flow rate that needs to be treated:

$$Q = I * A_e * R_C$$

Where the given design rainfall intensity is based on Figure 3-11 and fractional annual runoff of 0.89:

$$I = 1.05 \text{ in/hr}$$

Calculate the effective area:

$$A_e = (0.9 * A_i) + (0.03 * A_p) = (0.9 * 1.0) + (0.03 * 1.0) = 0.93 \text{ acres}$$

$$Q = 1.05 * 0.93 * 0.36 = 0.35 \text{ cfs} = 156.8 \text{ gpm}$$

Sizing in a flow based system is accomplished by taking the site specific flow rate and dividing it by the flow rate per cartridge or $Q_{CART}$. Utilizing BayFilter standard cartridges each cartridge is $Q_{CART}$ = 45 gpm yields the following:

$$\text{Number of cartridges} = Q/Q_{CART} = (156.8/45) = 3.48 \rightarrow 4 \text{ cartridges}$$

Utilizing BayFilter Low Profile cartridges each cartridge has a $Q_{CART}$ = 22.5 gpm yields the following:

$$\text{Number of LP cartridges} = Q/Q_{CART} = (156.8/22.5) = 6.97 \rightarrow 7 \text{ cartridges}$$

**Example of Flow-through w/ Equalization Design**

The design methodology presented in this section is based on the principles of designing detention ponds prior to treatment. In a detention pond scenario water in a post development design is flowing offsite faster than the predevelopment flow therefore it is necessary to detain the net amount of water in order to not increase water flow off of the site. BayFilter uses this principal to size the detention pond as part of a water quality system to only hold back the necessary amount of water to achieve the water quality volume (WQV), but taking into consideration that water is always being treated and exiting the BMP. As a result, reducing the storage capacity needed but still allowing for full capture of the WQV.

When employing this practice it is necessary to always maintain the minimum number of cartridges calculated from the volume based design method shown above. This will ensure minimum compliance with the guidance manual. It is at the designer's discretion to add additional filters above the minimum number specified in the volume based design. Adding filters to the system will decrease the volume requirement of the detention cell and therefore the detention cell footprint.

For this example the minimum of 4 standard cartridges or a minimum of 7 Low Profile Cartridges need to be installed downstream of a detention unit.

This example is a continuation of the numbers calculated in the above example using the standard cartridges for the volume based design. The following is an example of a flow-through of the BayFilter system w/Equalization using 3 standard cartridges:

$Q_{SYSTEM} = (Q_{CART}/448.8)$ * NUMBER OF CARTRIDGES = (45/448.8) * 3 = 0.3 cfs

448.8 = conversion from gallons per minute (gpm) to cubic feet per second (cfs)

The result gives a BayFilter system flow rate of 0.3 cfs. Based on the provided hyetograph shown in Table 3-1

## *Table 3-1 Hyetograph for Calculating Incremental Rainfall Depth*

| Row | Time (min) | Incremental Rainfall Depth (in) | Row | Time (min) | Incremental Rainfall Depth (in) |
|---|---|---|---|---|---|
| 1. | 0 | 0.000 | 20. | 95 | 0.088 |
| 2. | 5 | 0.007 | 21. | 100 | 0.077 |
| 3. | 10 | 0.007 | 22. | 105 | 0.057 |
| 4. | 15 | 0.008 | 23. | 110 | 0.046 |
| 5. | 20 | 0.009 | 24. | 115 | 0.035 |
| 6. | 25 | 0.009 | 25. | 120 | 0.028 |
| 7. | 30 | 0.011 | 26. | 125 | 0.023 |
| 8. | 35 | 0.012 | 27. | 130 | 0.019 |
| 9. | 40 | 0.013 | 28. | 135 | 0.016 |
| 10. | 45 | 0.015 | 29. | 140 | 0.014 |
| 11. | 50 | 0.018 | 30. | 145 | 0.013 |
| 12. | 55 | 0.021 | 31. | 150 | 0.011 |
| 13. | 60 | 0.025 | 32. | 155 | 0.010 |
| 14 | 65 | 0.031 | 33. | 160 | 0.009 |
| 15. | 70 | 0.040 | 34. | 165 | 0.008 |
| 16. | 75 | 0.053 | 35. | 170 | 0.008 |
| 17. | 80 | 0.064 | 36. | 175 | 0.007 |
| 18. | 85 | 0.077 | 37. | 180 | 0.007 |
| 19. | 90 | 0.088 | | Blank | Blank |

From this figure it is possible to calculate the amount of storage required for the pretreatment design through the following calculations:

$IRD = (I/2) * IRD_{HYETOGRAPH@Time}$

IRD = Incremental Rainfall Depth (inches)

I = based on the fraction runoff coefficient above (0.89) to give rainfall intensity = 1.05 inches/hr

## *Table 3-2 Corresponding Rainfall Intensity for a given Fraction of Annual Runoff*

| Row | Fraction of Annual Runoff | Rainfall Intensity | Row | Fraction of Annual Runoff | Rainfall Intensity |
|---|---|---|---|---|---|
| 1. | 0.11 | 0.03 | 28. | 0.82 | 0.70 |
| 2. | 0.23 | 0.05 | 29. | 0.83 | 0.75 |
| 3. | 0.34 | 0.08 | 30. | 0.84 | 0.80 |
| 4. | 0.45 | 0.10 | 31. | 0.85 | 0.85 |
| 5. | 0.48 | 0.12 | 32. | 0.86 | 0.90 |
| 6. | 0.51 | 0.14 | 33. | 0.87 | 0.95 |
| 7. | 0.55 | 0.16 | 34. | 0.88 | 1.00 |
| 8. | 0.58 | 0.18 | 35. | 0.89 | 1.05 |
| 9. | 0.61 | 0.20 | 36. | 0.90 | 1.10 |
| 10. | 0.62 | 0.22 | 37. | 0.91 | 1.15 |
| 11. | 0.63 | 0.24 | 38. | 0.92 | 1.20 |
| 12. | 0.64 | 0.26 | 40. | 0.92 | 1.25 |
| 13. | 0.65 | 0.28 | 41. | 0.93 | 1.30 |
| 14. | 0.66 | 0.30 | 42. | 0.93 | 1.35 |
| 15. | 0.67 | 0.32 | 43. | 0.93 | 1.40 |
| 16. | 0.68 | 0.34 | 44. | 0.94 | 1.45 |
| 17. | 0.70 | 0.36 | 45. | 0.94 | 1.50 |
| 18. | 0.71 | 0.38 | 46. | 0.95 | 1.60 |
| 19. | 0.72 | 0.40 | 47. | 0.95 | 1.70 |
| 20. | 0.73 | 0.42 | 48. | 0.96 | 1.80 |
| 21. | 0.74 | 0.44 | 49. | 0.96 | 1.90 |
| 22. | 0.75 | 0.46 | 50. | 0.97 | 2.00 |
| 23. | 0.76 | 0.48 | 51. | 0.98 | 2.50 |
| 24. | 0.77 | 0.50 | 52. | 0.99 | 3.00 |
| 25. | 0.78 | 0.55 | 53. | 0.99 | 3.50 |
| 26. | 0.79 | 0.60 | 54. | 1.00 | 4.00 |
| 27. | 0.81 | 0.65 | | Blank | Blank |

$IRD_{HYETOGRAPH@Time}$ = Incremental Rainfall Depth at time (t) from the hyetograph. For this example t=85 minutes, which results in 0.146 inches.

IRD = (1.05/2) * 0.146 = 0.077

Using the IRD it is possible to calculate the flow rate coming into the system at the specified time using the following equation:

$Q_{IN}$ = ($IRD_{@Time=?}$)* $A_{E\,*}$ 12.1

$Q_{IN}$ = flow rate into the system
$A_{E\,=}$ effective area
12.1 = unit conversion factor

$Q_{IN}$ = 0.077 * 0.93 * 12.1 = 0.87 cfs

From this equation we can determine that $Q_{in}$ = 0.87 cfs. The maximum flow for the system as defined by $Q_{system}$ = 0.30 cfs shown above, therefore the ΔQ is calculated by:

$$\Delta Q = Q_{IN} - Q_{SYSTEM} = 0.87 - 0.3 = 0.57 \text{ cfs}$$

ΔQ is always a positive number

Lastly the amount of storage must be calculated for the specified time interval from 85 minutes to 90 minutes. This Δt will always be 5 minutes from 0 minutes to 180 minutes to capture the entire storm event. Storage for the time interval will be given by the following equation:

$$\text{Storage}_{@time=?} = \Delta Q * \Delta t$$

Therefore at t = 85 minutes with a Δt = 5 minutes or 300 seconds:

$$\text{Storage}_{@t=85} = \Delta Q * \Delta t = 0.57 * 300 = 168.5 \text{ ft}^3$$

These calculations shall be repeated for all times given on the hyetograph and then all subsequent storage volumes calculated should be summed up to give an overall system storage capacity or total capture volume (TCV).

$$TCV = \Sigma \text{ Storage}_{@time = 0 \rightarrow 180}$$

For Flow-Through Configuration w/ Equalization the TCV = 1218 $ft^3$. The following table presents all of the data for this example in a tabular format.

***Table 3-3 Tabular Data for Calculating Required TCV***

| Time (min) | Incremental Rainfall Depth (in) | Flow Rate In (cfs) | Flow Rate Out (cfs) | Δ Flow (cfs) | Storage |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.00 | 0.30 | 0.00 | 0.00 |
| 5 | 0.007 | 0.08 | 0.30 | 0.00 | 0.00 |
| 10 | 0.007 | 0.08 | 0.30 | 0.00 | 0.00 |
| 15 | 0.008 | 0.09 | 0.30 | 0.00 | 0.00 |
| 20 | 0.009 | 0.10 | 0.30 | 0.00 | 0.00 |
| 25 | 0.009 | 0.11 | 0.30 | 0.00 | 0.00 |
| 30 | 0.011 | 0.12 | 0.30 | 0.00 | 0.00 |
| 35 | 0.012 | 0.14 | 0.30 | 0.00 | 0.00 |
| 40 | 0.013 | 0.15 | 0.30 | 0.00 | 0.00 |
| 45 | 0.015 | 0.17 | 0.30 | 0.00 | 0.00 |
| 50 | 0.018 | 0.20 | 0.30 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| 55 | 0.021 | 0.24 | 0.30 | 0.00 | 0.00 |
| 60 | 0.025 | 0.28 | 0.30 | 0.00 | 0.00 |
| 65 | 0.031 | 0.35 | 0.30 | 0.05 | 14.33 |
| 70 | 0.040 | 0.45 | 0.30 | 0.15 | 44.46 |
| 75 | 0.053 | 0.59 | 0.30 | 0.29 | 86.99 |
| 80 | 0.064 | 0.71 | 0.30 | 0.41 | 124.21 |
| 85 | 0.077 | 0.86 | 0.30 | 0.56 | 168.52 |
| 90 | 0.088 | 0.99 | 0.30 | 0.69 | 205.74 |
| 95 | 0.088 | 0.99 | 0.30 | 0.69 | 205.74 |
| 100 | 0.077 | 0.86 | 0.30 | 0.56 | 168.52 |
| 105 | 0.057 | 0.64 | 0.30 | 0.34 | 101.17 |
| 110 | 0.046 | 0.52 | 0.30 | 0.22 | 65.73 |
| 115 | 0.035 | 0.40 | 0.30 | 0.10 | 28.51 |
| 120 | 0.028 | 0.31 | 0.30 | 0.01 | 3.69 |
| 125 | 0.023 | 0.25 | 0.30 | 0.00 | 0.00 |
| 130 | 0.019 | 0.21 | 0.30 | 0.00 | 0.00 |
| 135 | 0.016 | 0.18 | 0.30 | 0.00 | 0.00 |
| 140 | 0.014 | 0.16 | 0.30 | 0.00 | 0.00 |
| 145 | 0.013 | 0.14 | 0.30 | 0.00 | 0.00 |
| 150 | 0.011 | 0.12 | 0.30 | 0.00 | 0.00 |
| 155 | 0.010 | 0.11 | 0.30 | 0.00 | 0.00 |
| 160 | 0.009 | 0.10 | 0.30 | 0.00 | 0.00 |
| 165 | 0.008 | 0.09 | 0.30 | 0.00 | 0.00 |
| 170 | 0.008 | 0.09 | 0.30 | 0.00 | 0.00 |
| 175 | 0.007 | 0.08 | 0.30 | 0.00 | 0.00 |
| 180 | 0.007 | 0.08 | 0.30 | 0.00 | 0.00 |
| TCV | | | | | 1218 |

For a flow-through w/equalization design all of the above calculations will be used with one additional step dealing with the storage capacity of the system. An equalization design is based on the detention system which can accumulate sediment over time by allowing the sediment to settle out in the detention cell thus decreasing the capacity over time. This methodology is based on previous sections of this guidance.

Therefore a flow-through w/equalization design with a detention cell upstream of the BayFilter unit, the storage volume is increased 20% to account for the accumulation of sediment. The minimum required equalization capture volume (ECV) is given by the following equation:

$$ECV = TCV * 1.2$$

Therefore with a TCV calculated above as 1218 $ft^3$

$$ECV = 1218 * 1.2 = 1461.6\ ft^3 \rightarrow 1462\ ft^3$$

If a 2-3 year system O&M lifespan is required you would multiply the annual precipitation by the number of years before you did an O&M cycle on the system and divide it by the mass load removed per cartridge type. Fractional results would be rounded up to the next whole number.

## *Inclusion of Offsite Drainage*

The exclusion of offsite drainage is sometimes not feasible to prevent this runoff from entering the BayFilter system. It is necessary to include offsite drainage in the site design it should be done so in accordance with Section 3.3.3 of the guidance manual.

## *Maintenance on BaySaver BayFilter*

Due to the high level of pollutant variation and specifically sediment loading, the unit shall be inspected at least every other month during the first year of operation to determine loading and required maintenance intervals. This information can be used to establish an appropriate maintenance schedule for subsequent years. If soil disturbing activities are being conducted within the unit's drainage area, inspection frequencies must be increased to once each month and after rain events of 0.5" and larger. The maintenance cycle of the BayFilter system will be driven mostly by the actual solids load on the filter. The system should be periodically monitored to be certain it is operating correctly.

Indications of the need for maintenance:

- Effluent flow decreasing to below the design flow rate or decrease in treatment below required levels (e.g., greater than 24hr drain down for a volume based system, or the detention drain down time- whichever is greater).
- Filter cartridge replacement should also be considered when sediment levels are at or above the level of the manifold system which is 6 inches and 3 inches for a BayFilter 545 and 545-LP, respectively.
- Bypass occurs during storm events
- If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not filter media replacement.
- If standing water above the bottom of the filter cartridge is present in the vault 96 hours after a 2 year rainfall event.
- Removal of trash and silt from the pretreatment chamber

## *Maintenance & Inspection Procedure*

- Remove the manhole covers and open all access hatches.
- Before entering the system make sure the air is safe per OSHA Standards or use a breathing apparatus. Use low O2, high CO, or other applicable warning devices per regulatory requirements.
- Using a vacuum truck remove any liquid and sediments that can be removed prior to entry.

- Using a small lift or the boom of the vacuum truck, remove the used cartridges by lifting them out.
- Any BayFilters that cannot be readily lifted directly out of the vault should be removed from their location and carried to the lifting point using the Trolley system installed in the vault (if applicable).
- When all BayFilters are removed, remove the balance of the solids and water; then loosen the stainless clamps on the Fernco couplings in the pipe manifold; remove the drain pipes as well. Carefully cap the manifold and the Ferncos and rinse the floor removing the balance of the collected solids.
- Clean the manifold pipes, inspect, and reinstall.
- Install the exchange BayFilters and close all covers.
- BaySaver Technologies, LLC. states that used BayFilter cartridges may be sent back to them for exchange/recycling and credit on undamaged units. Contact BaySaver Technologies at 1.800.229.7283 for more information.
- According to 30 TAC 330 or 30 TAC 335, identify any special disposal requirements associated with spent media, absorbents, or other material to be generated during routine cleaning/maintenance operations.
- Removed media will be disposed of according to local and state regulations.

## ***Maintenance on Storage System***

Underground detention vaults are similar in function as open detention basins. They have moderate to high maintenance requirements, depending on the extent to which future maintenance needs are anticipated during the design stage. Responsibilities for both routine and non-routine maintenance tasks need to be clearly understood and enforced. If regular maintenance and inspections are not undertaken, the basin will not achieve its intended purposes.

*Inspections*. Storage vaults should be inspected at least twice a year (once during or immediately following wet weather) to evaluate facility operation. When possible, inspections should be conducted during wet weather to determine if the vault is meeting the target detention times. In particular, the vault's flow control device should be regularly inspected for evidence of clogging, or conversely, for too rapid a release. If the design drawdown times are exceeded by more than 24 hours, then repairs should be scheduled immediately.

*Debris and Litter Removal*. Debris and litter will accumulate near the vault's flow control device. Particular attention should be paid to floating debris that can eventually clog the control device or riser or orifice.

*Structural Repairs and Replacement*. With each inspection, any damage to the structural elements of the system (pipes, concrete drainage structures, etc.) should be identified and repaired immediately.

*Nuisance Control*. Standing water within the bottom of the basin can create nuisance conditions for nearby residents. Odors, mosquitoes, and litter are all occasionally perceived to be problems. Most of these problems are generally a sign that regular inspections and maintenance are not being performed.

*Sediment Removal.* When properly designed, storage vaults will accumulate quantities of sediment over time. Sediment accumulation is a serious maintenance concern in vaults for several reasons. First, the sediment gradually reduces available stormwater management storage capacity within the vault. Second sediment tends to accumulate around the control device. Sediment deposition increases the risk that the orifice will become clogged, and gradually reduces storage capacity reserved for pollutant removal. Sediment can also be re-suspended if allowed to accumulate over time. For these reasons, accumulated sediment needs to be removed from the lower stage when sediment buildup fills 20% of the volume of the vault or at least every 10 years.

## *Manufacturer Contact Information:*

ADS/BaySaver Technologies Engineering Department
Email: info@baysaver.com
Phone: 1.800.229.7283
Website: http://www.baysaver.com/

Mail or other: 1030 Deer Hollow Drive
Mount Airy, MD 21771