VIRGINIA DCR STORMWATER
DESIGN SPECIFICATION No. 12

FILTERING PRACTICES

VERSION 1.8
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SECTION 1: DESCRIPTION

Stormwater filters are a useful practice to treat stormwater runoff from small, highly impervious sites. Stormwater filters capture, temporarily store, and treat stormwater runoff by passing it through an engineered filter media, collecting the filtered water in an underdrain, and then returning it back to the storm drainage system. The filter consists of two chambers: the first is devoted to settling, and the second serves as a filter bed consisting of a sand or organic filter media.

Stormwater filters are a versatile option because they consume very little surface land and have few site restrictions. They provide moderate pollutant removal performance at small sites where space is limited,. However, sand filters have limited or no runoff volume reduction capability, so designers should consider using up-gradient runoff reduction practices, which have the effect of decreasing the Treatment Volume (and size) of the filtering practices. Filtering practices are also suitable to provide special treatment at ~~a~~ designated stormwater hotspots. For a list of potential stormwater hotspots that merit treatment by filtering practices, consult the Stormwater Design Specification No. 8 (Infiltration).

Stormwater filters depend mainly on physical treatment mechanisms to remove pollutants from stormwater runoff, including gravitational settling in the sedimentation chamber, straining at the top of the filter bed, and filtration and adsorption onto the filter media. Microbial films often form on the surface of the filter bed, which can also enhance biological removal. Filters are usually designed only for water quality treatment.

SECTION 2: PERFORMANCE

Table 12.1. Summary of Stormwater Functions Provided by Filtering Practices

Stormwater Function	Level 1 Design	Level 2 Design
Annual Runoff Volume Reduction (RR)	0%	0%
Total Phosphorus (TP) EMC Reduction[1] by BMP Treatment Process	60%	65%
Total Phosphorus (TP) Mass Load Removal	60%	65%
Total Nitrogen (TN) EMC Reduction[1] by BMP Treatment Process	30%	45%
Total Nitrogen (TN) Mass Load Removal	30%	45%
Channel Protection	Limited – The Treatment Volume diverted off-line into a storage facility for treatment can be used to calculate a Curve Number (CN) Adjustment.	
Flood Mitigation	None. Most filtering practices are off-line and do not materially change peak discharges.	
[1] Change in the event mean concentration (EMC) through the practice..		

Sources: CWP and CSN (2008), CWP, 2007

SECTION 3: DESIGN TABLE

The major design goal is to maximize nutrient removal. To this end, designers may choose to go with the baseline design (Level 1) or choose an enhanced Level 2 design that maximizes nutrient removal. To qualify for Level 2, the filter must meet all design criteria shown in the right hand column of Table 2.

Table 12.2. Filtering Practice Design Guidance

Level 1 Design (RR:0; TP:60; TN:30)	Level 2 Design (RR:0 [1]; TP:65; TN:45)
T_V = [(1.0)(Rv)(A)] / 12 – the volume reduced by an upstream BMP	T_V = [(1.25)(Rv)(A)] / 12 – the volume reduced by an upstream BMP
One cell design	Two cell design
Sand media	Sand media with an organic layer
Contributing Drainage Area (CDA) contains pervious area	CDA is nearly 100% impervious
[1] May be increased if the 2nd cell is utilized for infiltration in accordance with Stormwater Design Specification No. 8 (Infiltration) or Stormwater Design Specification No. 9 (Bioretention). The Runoff Reduction (RR) credit should be proportional to the fraction of the T_V designed to be infiltrated.	

SECTION 4: TYPICAL DETAILS

Figures 12.1 and 12.2 provide typical schematics for a surface sand filter and organic filter, respectively.

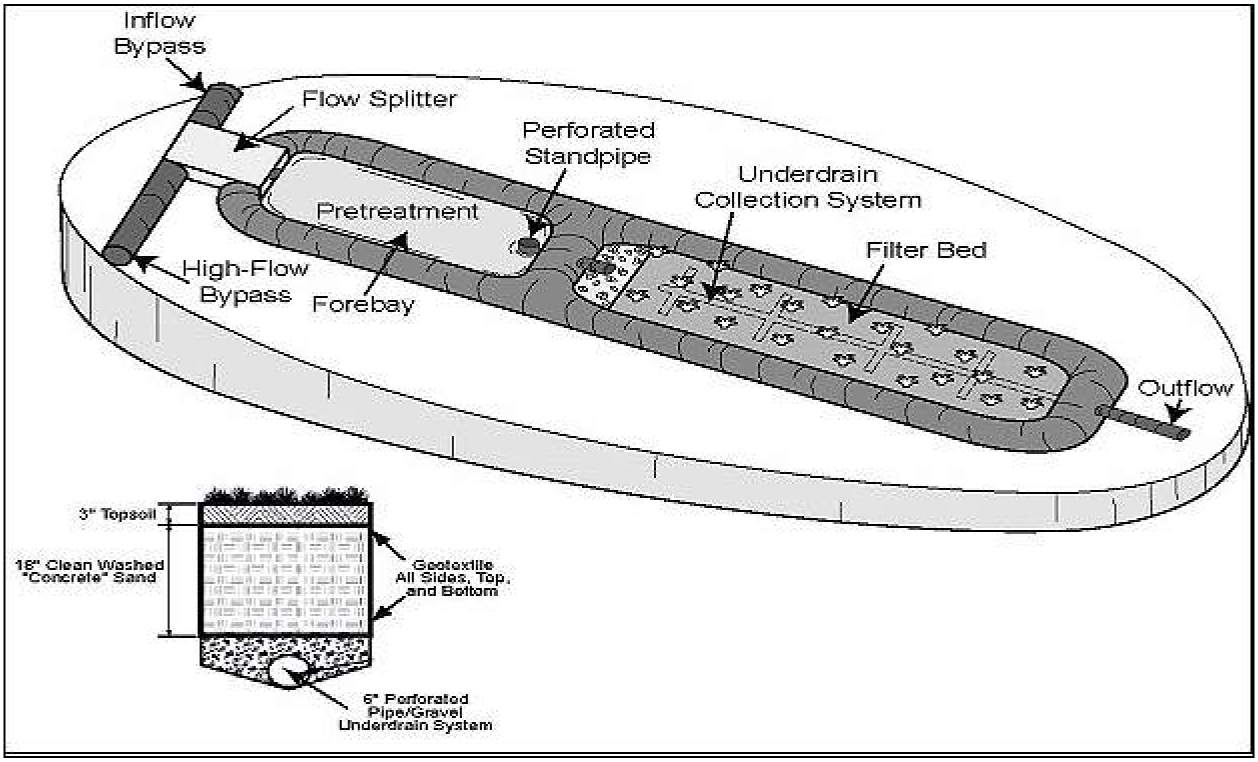

Figure 12.1. Schematic of a Surface Sand Filter

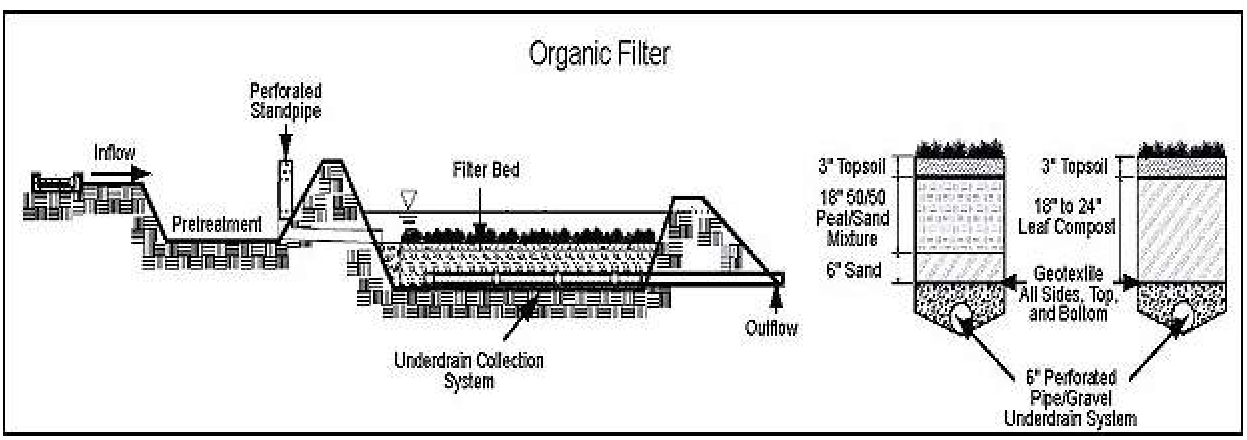

Figure 12.2. Schematic of an Organic Filter

SECTION 5: PHYSICAL FEASIBILITY & DESIGN APPLICATIONS

Stormwater filters can be applied to most types of urban land. They are not always cost-effective, given their high unit cost and small area served, but there are situations where they are clearly the best option (e.g., hotspot runoff treatment, small parking lots, ultra-urban areas etc.). The following is a list of design constraints for filtering practices.

Available Hydraulic Head. The principal design constraint for stormwater filters is available hydraulic head, which is defined as the vertical distance between the top elevation of the filter and the bottom elevation of the existing storm drain system that receives its discharge. The head required for stormwater filters ranges from 2 to 10 feet, depending on the design variant. Thus, it is difficult to employ filters in extremely flat terrain, since they require gravity flow through the filter. The only exception is the Perimeter Sand Filter, which can be applied at sites with as little as 2 feet of head.

Depth to Water Table and Bedrock. The designer must assure a standard separation distance of at least 2 feet between the seasonally high groundwater table and/or bedrock layer and the bottom invert of the filtering practice.

Contributing Drainage Area. Sand filters are best applied on small sites where the contributing drainage (CDA) area is as close to 100% impervious as possible. A maximum CDA of 5 acres is recommended for surface sand filters, and a maximum CDA of 2 acres is recommended for perimeter or underground filters. Filters have been used on larger drainage areas in the past, but greater clogging problems have typically resulted.

Space Required. The amount of space required for a filter practice depends on the design variant selected. Both sand and organic surface filters typically consume about 2% to 3% of the CDA, while perimeter sand filters typically consume less than 1%. Underground stormwater filters generally consume no surface area except their manholes.

As noted above, filters are particularly well suited to treat runoff from stormwater hotspots and smaller parking lots. Other applications include redevelopment of commercial sites or when existing parking lots are renovated or expanded. Filters can work on most commercial, industrial, institutional or municipal sites and can be located underground if surface area is not available.

There are several design variations of the basic sand filter that enable designers to use filters at challenging sites or to improve pollutant removal rates. The most common design variants include the following:

- ***Non-Structural Sand Filter.*** The Non-Structural Sand Filter is applied to sites less than 2 acres in size, and is essentially the same as a Bioretention Basin (see Stormwater Design Specification No. 9), with the following exceptions:
    - The bottom is lined with an impermeable filter fabric and always has an underdrain.
    - The surface cover is sand, turf or pea gravel.
    - The filter media is 100% sand.
    - The filter surface is not planted with trees, shrubs or herbaceous materials.

- The filter has two cells, with a dry or wet sedimentation chamber preceding the sand filter bed.

The Non-Structural Sand Filter is the least expensive filter option for treating hotspot runoff. The use of bioretention areas is generally preferred at most other sites.

Surface Sand Filter. The Surface Sand Filter is designed with both the filter bed and sediment chamber located at ground level. In most cases, the filter chambers are created using pre-cast or cast-in-place concrete. Surface Sand Filters are normally designed to be off-line facilities, so that only the desired water quality or runoff reduction volume is directed to the filter for treatment. However, in some cases they can be installed on the bottom of a Dry Extended Detention (ED) Pond (see **Figure 12.3** and Stormwater Design Specification No. 15).

Figure 12.3. Hybrid Sand filter in a Detention Basin

Organic Media Filter. Organic Media Filters are essentially the same as surface filters, but the sand is replaced with an organic filtering medium. Two notable examples are the peat/sand filter and the compost filter system. Organic filters achieve higher pollutant removal for metals and hydrocarbons due to the increased cation exchange capacity of the organic media.

Underground Sand Filter. The Underground Sand Filter is modified to install the filtering components underground and is often designed with an internal flow splitter or overflow device that bypasses runoff from larger stormwater events around the filter. Underground Sand Filters are expensive to construct, but they consume very little space and are well suited to ultra-urban areas (**Figure 12.4**).

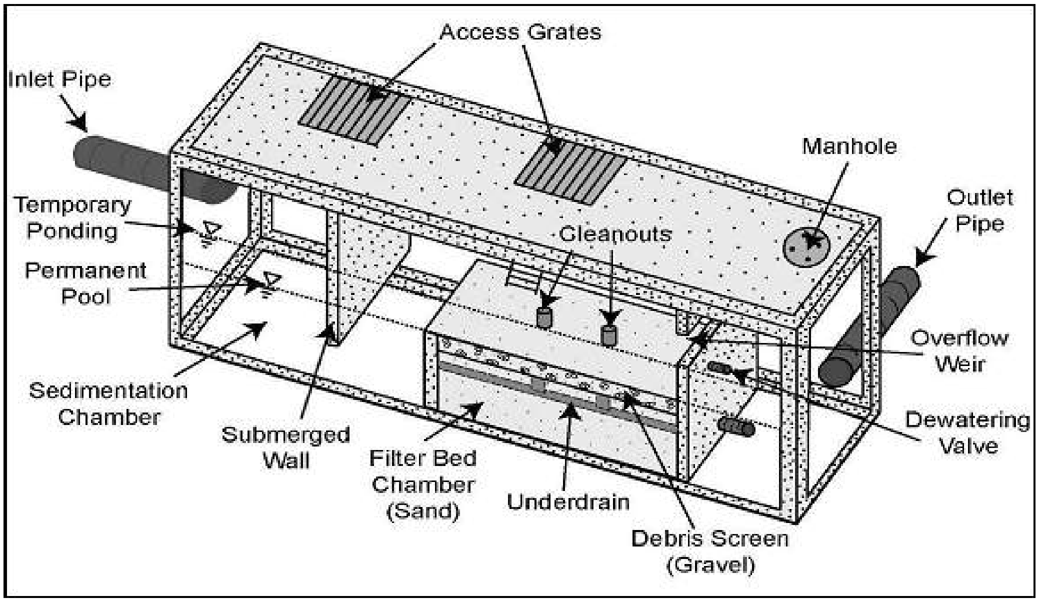

Figure 12.4. Underground Filter Schematic

Perimeter Sand Filter. The Perimeter Sand Filter also includes the basic design elements of a sediment chamber and a filter bed. However, in this design flow enters the system through grates, usually at the edge of a parking lot. The Perimeter Sand Filter is usually designed as an on-line practice (i.e., all flows enter the system), but larger events bypass treatment by entering an overflow chamber. One major advantage of the Perimeter Sand Filter design is that it requires little hydraulic head and is therefore a good option for sites with low topographic relief.

Proprietary Filters. Proprietary filters use various filter media and geometric configurations to achieve filtration within a packaged structure. In some cases, these systems can provide excellent targeting of specific pollutants. However, designers must verify that the particular product has been reviewed and accepted by the Virginia BMP Clearinghouse (http://www.vwrrc.vt.edu/swc/) for use in Virginia.

SECTION 6: DESIGN CRITERIA

6.1. Overall Sizing

Filtering devices are sized to accommodate a specified Treatment Volume. The volume to be treated by the device is a function of the storage depth above the filter and the surface area of the filter. The storage volume is the volume of ponding above the filter. For a given Treatment Volume, **Equation 12.1** is used to determine the required filter surface area:

Equation 12.1. Minimum Filter Surface Area for Filtering Practices

$$A_f = (TV)(d_f)/[(K)(h_f + d_f)(t_f)]$$

Where:

A_f = area of the filter surface (sq. ft.)
TV = Treatment Volume, volume of storage (cu. ft.)
d_f = Filter media depth (thickness) = minimum 1 ft. (ft.)
K = Coefficient of permeability – partially clogged sand (ft./day) = 3.5 ft./day
h_f = Average height of water above the filter bed (ft.), with a maximum of 5 ft./2
t_f = Allowable drawdown time = 1.67 days

The coefficient of permeability (ft./day) is intended to reflect the worst case situation (i.e., the condition of the sand media at the point in its operational life where it is in need of replacement or maintenance). Filtering practices are therefore sized to function within the desired constraints at the end of the media's operational life cycle.

A storage volume of a least 75% of the design Treatment Volume – including the volume over the top of the filter media and the volume in the pretreatment chamber(s), as well as any additional storage – is required in order to capture the volume from high-intensity storms prior to filtration and avoid premature bypass. This reduced volume takes into account the varying filtration rate of the water through the media, as a function of a gradually declining hydraulic head.

Equation 12.2. Required Treatment Volume Storage for Filtering Practices

$$V_s = 0.75(TV)$$

Where:

V_s = Volume of storage (cu. ft.)
TV = Treatment Volume (cu. ft.)

6.2. Soil Testing Requirements

At least one soil boring must be taken at a low point within the footprint of the proposed filtering practice to establish the water table and bedrock elevations and evaluate soil suitability.

6.3. Pre-treatment

Adequate pre-treatment is needed to prevent premature filter clogging and ensure filter longevity. Pre-treatment devices are subject to the following criteria:

- Sedimentation chambers are typically used for pre-treatment to capture coarse sediment particles before they reach the filter bed.
- Sedimentation chambers may be wet or dry but must sized to accommodate at least 25% of the total Treatment Volume (inclusive).

- Non-structural Sand Filters may use alternative pre-treatment measures, such as a compost amended grass filter flow path, forebay, gravel diaphragm, check dam, level spreader, or combination. The filter strip must be a minimum length of 15 feet, have a slope of 3% or less, and contain compost amended soils (see Stormwater Design Specification No. 4). The check dam may be wooden or concrete and must be installed so that it extends only 2 inches above the filter strip and has lateral slots to allow runoff to be evenly distributed across the filter surface. The forebay should be designed to accommodate at least 25% of the total Treatment Volume (inclusive), and contain a non-erosive spillway that distributes the flow evenly over the filter surface.
- If proprietary devices are used for pre-treatment, designers must confirm through the Virginia BMP Clearinghouse that the practice has the capability to effectively trap and retain particles down to 20 microns in size for the design flow rate.
- Sediment chambers should be designed as level spreaders such that inflows to the sand filter bed have near zero velocity and spread runoff evenly across the bed.

6.4. Conveyance and Overflow

Most filtering practices are designed as off-line systems so that all flows enter the filter storage chamber until it reaches capacity, at which point larger flows are then diverted or bypassed around the filter to an outlet chamber and are not treated. Runoff from larger storm events should be bypassed using an overflow structure or a flow splitter. Claytor and Schueler (1996) and ARC (2001) provide design guidance for flow splitters for filtering practices.

Some underground filters will be designed and constructed as on-line BMPs. In these cases, designers must indicate how the device will safely pass the local design storm (e.g., 10 year event) without resuspending or flushing previously trapped material.

All stormwater filters should be designed to drain or dewater within 40 hours after a storm event to reduce the potential for nuisance conditions.

Stormwater filters are normally designed with an impermeable liner and underdrain system that meet the criteria provided in **Table 4 12.3** below.

6.5. Filter Media and Surface Cover

Type of Media. The normal filter media consists of clean, washed concrete sand with individual grains between 0.02 and 0.04 inches in diameter. Alternatively, organic media can be used, such as a peat/sand mixture or a leaf compost mixture. The decision to use organic media in a stormwater filter depends on which stormwater pollutants are targeted for removal. Organic media may enhance pollutant removal performance with respect to metals and hydrocarbons (Claytor and Schueler, 1996). ***However, recent research has shown that organic media can actually leach soluble nitrate and phosphorus back into the discharge water, making it a poor choice when nutrients are the pollutant of concern***.

Type of Filter. The choice of which sand filter design to apply depends on available space and hydraulic head and the level of pollutant removal desired. In ultra-urban situations where surface space is at a premium, underground sand filters are often the only design that can be used. Surface and perimeter filters are often a more economical choice when adequate surface area is available.

Surface Cover. The surface cover for structural and non-structural Surface Sand Filters should consist of a 3-inch layer of topsoil on top of a non-woven filter fabric laid above the sand layer. The surface may also have pea gravel inlets in the topsoil layer to promote filtration. The pea gravel may be located where sheet flow enters the filter, around the margins of the filter bed, or at locations in the middle of the filter bed.

Underground sand filters should have a pea gravel layer on top of a coarse non-woven fabric laid over the sand layer. The pea-gravel helps to prevent bio-fouling or blinding of the sand surface. The fabric serves to facilitate removing the gravel during maintenance operations.

Depth of Media. The depth of the filter media plays a role in how quickly stormwater moves through the filter bed and how well it removes pollutants. Recent design guidance recommends a minimum filter bed depth ranging from 12 to 18 inches. Greater depths can be used in order to facilitate the removal of 1 to 3 inches of sand during maintenance withough having to necessarily replace it.

Impervious Drainage Area. The contributing drainage area should be as close to 100% impervious as possible in order to reduce the risk that eroded sediments will clog the filter.

6.6. Maintenance Reduction Features

The following maintenance issues should be addressed during filter design to reduce future maintenance problems:

- ***Observation Wells and Cleanouts.*** Surface Sand Filters should include an observation well consisting of a 6-inch diameter non-perforated PVC pipe fitted with a lockable cap. It should be installed flush with the ground surface to facilitate periodic inspection and maintenance. In most cases, a cleanout pipe will be tied into the end of all underdrain pipe runs. The portion of the cleanout pipe/observation well in the underdrain layer should be perforated. At least one cleanout pipe must be provided for every 2000 square feet of filter surface area.
- ***Access.*** Good maintenance access is needed to allow crews to perform regular inspections and maintenance activities. “Sufficient access” is operationally defined as the ability to get a vacuum truck or similar equipment close enough to the sedimentation chamber and filter to enable cleanouts.
- ***Manhole Access (for Underground Filters).*** Access to the headbox and clearwell of Underground Filters must be provided by manholes at least 30 inches in diameter, along with steps to the areas where maintenance will occur.
- ***Visibility.*** Stormwater filters should be clearly visible at the site so inspectors and maintenance crews can easily find them. Adequate signs or markings should be provided at manhole access points for Underground Filters.
- ***Confined Space Issues.*** Underground Filters are often classified as an *underground confined space*. Consequently, special OSHA rules and training are needed to protect the workers that

access them. These procedures often involve training about confined space entry, venting, and the use of gas probes.

6.7. Filtering Material Specifications

The basic material specifications for filtering practices are outlined in **Table 12.3**.

Table 12.3. Filtering Practice Material Specifications

Material	Specification
Sand	Clean AASHTO M-6/ASTM C-33 medium aggregate concrete sand with a particle size range of 0.02 to 0.04 inch in diameter.
Organic Layer	The compost shall generally conform to the requirements contained in Stormwater Design Specification No. 4 (Soil Compost Amendments). Leaf compost should be made exclusively of fallen deciduous leaves with less than 5% dry weight of woody or green yard debris materials. The compost shall contain less than 0.5% foreign material, such as glass or plastic contaminants, and shall be certified as pesticide free. The use of leaf mulch, composted mixed yard debris, biosolids, mushroom compost or composted animal manures is prohibited. The compost shall be matured (i.e., composted for a period of at least 1year) and exhibit no further decomposition. Visual appearance of leaf matter in the compost is not acceptable. The compost should have a dry bulk density ranging from 40 to 50 lbs/cu. ft., a pH of 6 to 8, and a Cation Exchange Capacity (CEC) equal to or greater than 50 meq/100 grams of dry weight.
Underdrain	High Density Polyethylene (HDPE) smooth or corrugated flexible-wall pipe is acceptable to some local governments. Pipes must comply with ASHTO M252 and ASTM F405. Underdrains meeting ASTM F758 should be perforated with slots that have a maximum width of 3/8 inch and provide a minimum inlet area of 1.76 square inches per linear foot of pipe. Underdrains meeting ASTM F949 should be perforated with slots with a maximum width of 1/8 inch that provide a minimum inlet area of 1.5 square inches per linear foot of pipe. Underdrain pipe supplied with precision-machined slots provides greater intake capacity and superior clog-resistant drainage of fluids, as compared to standard round-hole perforated pipe. Slotted underdrain reduces entrance velocity into the pipe, thereby reducing the possibility that solids will be carried into the system. Slot rows can generally be positioned symmetrically or asymmetrically around the pipe circumference, depending upon the application.
Filter Fabric	Use needled, non-woven, polypropylene geotextile meeting the following specifications: Grab Tensile Strength (ASTM D4632) = $\geq$ 120 lbs Mullen Burst Strength (ASTM D3786) = $\geq$ 225 lbs/sq. in. Flow Rate (ASTM D4491) = $\geq$ 125 gpm/sq. ft. Apparent Opening Size (ASTM D4751) = US #70 or #80 sieve NOTE: Heat-set or heat-calendared fabrics are not recommended.
Stone Jacket for Underdrain	Use gravel that meets VDOT #57 stone specifications or the ASTM equivalent (1 inch maximum).

SECTION 7: REGIONAL & SPECIAL CASE DESIGN ADAPTATIONS

7.1. Karst Terrain

Stormwater filters are a good option in karst areas, since they are not connected to groundwater and therefore minimize the risk of sinkhole formation and groundwater contamination. Construction inspection should certify that the filters are indeed water tight and that excavation will not extend into a karst layer.

7.2. Coastal Plain

The flat terrain, low head and high water table of the coastal plain make several filter designs difficult to implement. However, the Perimeter Sand Filter and the Non-Structural Sand Filter generally have low head requirements and can work effectively at many small coastal plain sites, subject to the following criteria:

- The combined depth of the underdrain and sand filter bed can be reduced to from 24 to 30 inches.
- The designer may wish to maximize the length of the stormwater filter or provide treatment in multiple connected cells.
- The minimum depth to the seasonally high groundwater table may be relaxed to 1 foot, as long as the filter is equipped with a large diameter underdrain (e.g., 6 inches) that is only partially efficient at dewatering the filter bed.
- It is important to maintain at least a 0.5% slope of the underdrain to ensure drainage and to tie it into the receiving ditch or conveyance system.

7.3. Steep Terrain

The gradient of slopes contributing runoff to sand filters can be increased to 15% in areas of steep terrain, as long as a two cell, terraced design is used to dissipate erosive energy prior to filtering. The drop in elevation between cells should be limited to 1 foot and the slope should be armored with river stone or a suitable equivalent.

7.4. Cold Climate and Winter Performance

Surface or perimeter filters may not always be effective during the winter months. The main problem is ice that forms over and within the filter bed. Ice formation may briefly cause nuisance flooding if the filter bed is still frozen when spring melt occurs. To avoid these problems, filters should be inspected before the onset of winter (prior to the first freeze) to dewater wet chambers and scarify the filter surface. Other measures to improve winter performance include the following:

- Place a weir between the pre-treatment chamber and filter bed to reduce ice formation; the weir is a more effective substitute than a traditional standpipe orifice.
- Extend the filter bed below the frost line to prevent freezing within the filter bed.

- Oversize the underdrain to encourage more rapid drainage and to minimize freezing of the filter bed.
- Expand the sediment chamber to account for road sand. Pre-treatment chambers should be sized to accommodate up to 40% of the Treatment Volume.

7.5. Linear Highway Sites

Non-Structural Sand Filters are a preferred practice for constrained highway rights-of-way when designed as a series of individual on-line or off-line cells. In these situations, the final design closely resembles that of Dry Swales. Salt-tolerant grass species should be selected if the contributing roadway will be salted in the winter.

SECTION 8: CONSTRUCTION

8.1. Construction Sequence

The following is the typical construction sequence to properly install a structural Sand Filter. This sequence can be modified to reflect different filter designs, site conditions, and the size, complexity and configuration of the proposed filtering application.

Step 1: Use of Filtering Practices as an E&S Control. The future location of a filtering practice may be used as the site of a temporary sediment basin or trap during site construction, as long as design elevations are set with final cleanout and conversion in mind. The bottom elevation of the filtering practice should be lower than the bottom elevation of the temporary sediment basin. Appropriate procedures should be implemented to prevent discharge of turbid waters when the temporary basin is converted to a filtering practice.

Step 2: Stabilize Drainage Area. Filtering practices should only be constructed after the contributing drainage area to the facility is completely stabilized, so sediment from the CDA does not flow into and clog the filter. If the proposed filtering area is used as a sediment trap or basin during the construction phase, the construction notes should clearly specify that, after site construction is comlete, the sediment control facility will be dewatered, dredged and regraded to design dimensions for the post-construction filter.

Step 3: Install E&S Controls for the Filtering Practice. Stormwater should be diverted around filtering practices as they are being constructed. This is usually not difficult to accomplish for off-line filtering practices. It is extremely important to keep runoff and eroded sediments away from the Sand Filter throughout the construction process. Silt fence or other sediment controls should be installed around the perimeter of the Sand Filter, and erosion control fabric may be needed during construction on exposed side-slopes with gradients exceeding 4H:1V. Exposed soils in the vicinity of the filtering practice should be rapidly stabilized by hydro-seed, sod, mulch or other locally approved method of soil stabilization.

Step 4: Assemble Construction Materials on-site, make sure they meet design specifications, and prepare any staging areas.

Step 5: Clear and Strip the project area to the desired subgrade.

Step 6: Excavate/Grade until the appropriate elevation and desired contours are achieved for the bottom and side slopes of the filtering practice.

Step 7: Install the Filter Structure and check all design elevations (concrete vaults for surface, underground and perimeter sand filters). Upon completion of the filter structure shell, inlets and outlets should be temporarily plugged and the structure filled with water to the brim to demonstrate watertightness. Maximum allowable leakage is 5% of the water volume in a 24-hour period. If the structure fails the test, repairs must be performed to make the structure watertight before any sand is placed into it.

Step 8: Install the gravel, underdrains, and choker layer of the filter.

Step 9. Spread Sand Across the Filter Bed in 1 foot lifts up to the design elevation. Backhoes or other equipment can deliver the sand from outside the sand filter structure. Sand should be manually raked. Clean water is then added until the sedimentation chamber and filter bed are completely full. The facility is then allowed to drain, hydraulically compacting the sand layers. After 48 hours of drying, refill the structure to the final top elevation of the Sand Filter bed.

Step 10: Install the Permeable Filter Fabric over the sand, add a 3-inch topsoil layer and pea gravel inlets, and immediately seed with the permanent grass species. The grass should be watered, and the facility should not be switched on-line until a vigorous grass cover has become established.

Step 11:. Stabilize Exposed Soils on the perimeter of the structure with temporary seed mixtures appropriate for a buffer. All areas above the normal pool should be permanently stabilized by hydroseeding or seeding over straw.

Step 12. Conduct the final construction inspection (see **Section 8.2**).

8.2. Construction Inspection

Multiple construction inspections are critical to ensure that stormwater filters are properly constructed. Inspections are recommended during the following stages of construction:

- Pre-construction meeting.
- Initial site preparation (including installation of project E&S controls).
- Excavation/grading to design dimensions and elevations.
- Installation of the filter structure, including the watertightness test.
- Installation of the underdrain and sand filter bed.
- Check off that turf cover is vigorous enough to switch the facility on-line.
- Final Inspection (after a rainfall event to ensure that it drains properly and all pipe connections are watertight. Develop a punch list for facility acceptance. Log the filtering practice's GPS coordinates and submit them for entry into the local BMP maintenance tracking database.

A construction inspection form for Filtering Practices can be accessed at the CWP website at:

http://www.cwp.org/Resource_Library/Controlling_Runoff_and_Discharges/sm.htm
(scroll to Tool6: Plan Review, BMP Construction, and Maintenance Checklists)

SECTION 9: MAINTENANCE

9.1. Maintenance Agreements

Section 4 VAC 50-60-124 of the regulations specifies the circumstances under which a maintenance agreement must be executed between the owner and the local program. This section sets forth inspection requirements, compliance procedures if maintenance is neglected, notification of the local program upon transfer of ownership, and right-of-entry for local program personnel.

9.2. Maintenance Inspections

Regular inspections are critical to schedule sediment removal operations, replace filter media, and relieve any surface clogging. Frequent inspections are especially needed for underground and perimeter filters, since they are out of sight and can be easily forgotten. Depending on the level of traffic or the particular land use, a filter system may either become clogged within a few months of normal rainfall, or could possibly last several years with only routine maintenance. Maintenance inspections should be conducted within 24 hours following a storm that exceeds 1/2 inch of rainfall, to evaluate the condition and performance of the filtering practice, including checking for the following:

- Check to see if sediment accumulation in the sedimentation chamber has exceeded 6 inches. If so, schedule a cleanout.
- Check to see if inlets and flow splitters are clear of debris and are operating properly.
- Check the dry sediment chamber and sand filter bed for any evidence of standing water or ponding more than 48 hours after a storm, and take neceesary corrective action to restore permeability.
- Inspect whether the contributing drainage area to the filter is stable and not a source of sediment.
- Dig a small test pit in the sand filter bed to determine whether the first 3 inches of sand are visibly discolored and need replacement.
- Check whether turf on the filter bed and buffer is more than 12 inches high, and schedule necessary mowing operations.
- Check the integrity of observation wells and cleanout pipes.
- Check concrete structures and outlets for any evidence of spalling, joint failure, leakage, corrosion, etc.
- Ensure that the filter bed is level and remove trash and debris from the filter bed. Sand or gravel covers should be raked to a depth of 3 inches. Filters with a turf cover should have 95% vegetative cover.

The results of the inspection will then determine the level of maintenance required (routine or major – see **Table 12.4**) Example maintenance inspection checklists for Filtering Practices can be accessed in Appendix C of Chapter 9 of the *Virginia Stormwater Management Handbook* (2010) or at CWP website at:

http://www.cwp.org/Resource_Library/Controlling_Runoff_and_Discharges/sm.htm
(scroll to Tool6: Plan Review, BMP Construction, and Maintenance Checklists)

9.3. Routine Maintenance Tasks

A cleanup should be scheduled at least once a year to remove trash and floatables that accumulate in the pretreatment cells and filter bed. Frequent sediment cleanouts in the dry and wet sedimentation chambers are recommended every 2 to 3 years to maintain the function and performance of the filter. If the filter treats runoff from a stormwater hotspot, crews may need to test the filter bed media before disposing of the media and trapped pollutants. Testing is not needed if the filter does not receive runoff from a designated stormwater hotspot, in which case the media can be safely disposed by either land application or land filling.

Table 12.4. Suggested Annual Maintenance Activities for Filtering Practices

Maintenance Tasks	Frequency
• Mow grass filter strips and perimeter turf.	At least four times a year
• Remove blockages and obstructions from inflows • Relieve clogging • Stabilize contributing drainage area and side-slopes to prevent erosion	As needed
• Inspection and cleanup	Annually
• Cleanout wet sedimentation chambers • Remove sediments from dry sedimentation chamber	Once every 2 to 3 years
• Replace top sand layer • Till or aerate surface to improve infiltration/grass cover	Every 5 years

SECTION 10: COMMUNITY & ENVIRONMENTAL CONCERNS

Stormwater filters have a few community and environmental concerns. Their main drawback is their appearance – many filtering practices are imposing concrete boxes that tend to accumulate a lot of trash and debris. Designers should focus on aesthetics to make sure filtering practices are integrated aesthetically into the landscape. Also, there is a small risk that underground and perimeter filters may create a potential habitat for mosquitoes to breed. If this is a community concern, designers should shift to dry sedimentation chambers rather than wet chambers.

SECTION 11: REFERENCES

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