Minimum Standard 3.11C
Filterra™ Bioretention Filter System
(revised 11/01/02)

Definition

The Filterra™ treatment system is a manufactured bioretention stormwater best management practice (BMP) that filters stormwater runoff from impervious surfaces (roadways, parking lots and roof tops). The Filterra™ treatment system consists of a concrete container filled with an engineered soil filter media, a mulch layer, an under-drain system and a tree, shrub or other plant selection. This filtration system can be integrated into the site design of both new development and redeveloped projects. Runoff drains directly from the impervious surface, through the filter media, and then out of the container through the under drain system to be discharged to a receiving system or infiltrated into the surrounding soil.

Purpose

Filterra™ is designed to be a water quality filter device to remove a wide range of nonpoint source pollutants from urban runoff in the same manner as bioretention practices (refer to **Minimum Standard 3.11: Bioretenion Practice**s). Pollutants are efficiently removed by a complex combination of physical, chemical and biological processes within the mulch, soil particles, microorganisms, and the plant materials.

Filterra™ can serve as a water quality BMP in areas where discharge of stormwater runoff into the sub-soils is not desired (e.g., gas stations and karst soils). An under drain system is used to convey filtered runoff to an adjacent drainage system. Where soils are permeable and ground water recharge is desirable Filterra™ can be designed to infiltrate highly treated water into the subsurface. It can be used as a filter only or as a combination filter and infiltration device. Filterra™ is generally not used for attenuation of large volumes of runoff for stream channel erosion control and flood control purposes. However, some degree of volume / flow reduction can be achieved by combining this filter system with an adjacent under ground storage / detention system (gravel trench or pipes). Such a combined system may be useful for urban retrofit projects to address problems associated with combined sewer overflows or for stream protection.

Conditions where Practice Applies

Filterra™ takes up little space (surface area or depth) and can be used in any type of urban or suburban commercial, industrial or residential development. Filterra™ is a suitable device for urban retrofit due to its flexible design, sizing criteria and concrete container and easy drop in place construction, it can be installed within the green space or streetscapes of redevelopment projects. Filterra™ can be modified to fit any curb line as a drop inlet along roadways, parking lots, or pedestrian plaza areas, **See Figure 1.** An adjacent drainage conveyance system is necessary in order to connect the under-drain system, and accept large storm bypass flows.

Figure 1. Filterra™ Urban Streetscape Design

It is designed to be used where runoff is likely to contain high concentrations of urban pollutants such as heavy metals, oil, and organics (such as gas stations, maintenance facilities and roadways). The system can be used alone or in combination with other BMP's. When used alone, pretreatment is not necessary as the system is designed to operate effectively without clogging from typical urban runoff concentrations of sediment and other particulate matter. The nature of the surface mulch and engineered filter media is such that particles become entrained into the mulch / filter media itself without clogging at the surface. The plant root system also keeps the soil open and free from clogging. As long as the

manufacturer's operating and maintenance procedures are followed the filter device is projected to work for 20 years or more without replacement of the filter media or plant material.

Planning Considerations

Site Conditions

The enclosed non-permeable concrete container makes Filterra™ suitable for situations where infiltration is undesirable or not possible. These situations would include: karst topography, high groundwater conditions, close proximity to buildings, steep slopes, contaminated soils, brownfields sites, highly contaminated runoff or where chemical or oil spills are likely (maintenance facilities, industrial and gas stations). For "hot spots" where chemical spills are likely, the system can be fitted with a valve to quickly close the discharge drain pipe isolating the spill in the concrete container and filter media for easy clean-up, removal and replacement.

Where Filterra™ is being used to provide a combination of filtration and infiltration into the adjacent soils, planning considerations should include unique site conditions such as soil permeability, seasonal high groundwater table, depth to bedrock, karst topography, etc. Soil permeability will determine the degree to which it can be used as an infiltration device. For further discussion on planning considerations for infiltration practices, refer to the planning considerations described in the **General Infiltration Practices, Minimum Standard3.10, and Bioretention Basin Practices, Minimum Standard 3.11.**

Developed Conditions

Filterra™ is highly adaptable and can be used for most developments. Since the filter is contained in a concrete box it can be built in and around roadways sidewalks buildings and parking lots. It can be installed on many slope conditions typical of parking lots and roadways. In highly urban areas it is possible to use it in the design of an entire streetscape converting the typical non-functional streetscape into one large vegetated filter treatment device.

Location Guidelines

Filterra™ is best incorporated into the overall site, or streetscape or parking lot landscaping plan. The individual box locations represent a combination of drainage considerations (based on final grades and water quality requirements), desired aesthetics, and minimum landscaping requirements, and must be coordinated with the design of the drainage infrastructure.

Aesthetic Considerations

Aesthetic considerations must be evaluated early in the site planning process. While topography and hydraulic considerations may dictate the general placement of each structure, overall aesthetics of the site should be integrated into the site plan and stormwater concept plan from their inception. Both the stormwater engineer and the Landscape Architect must participate during the layout of facilities and infrastructure to be placed on the site.

Sediment Control

Similar to bioretention basins and sand filters, Filterra™ if installed prior to full site stabilization and without proper inlet protection will become choked with sediment from upland construction operations, rendering it inoperable from the outset. Simply providing inlet protection or some other filtering mechanism during construction will not adequately control the sediment. One large storm may completely clog the soil media, requiring immediate maintenance.

Filterra™ should be installed AFTER the site work is complete and stabilization measures have been implemented. (External and adjacent drainage and conveyance systems are typically built along with the site utilities and other infrastructure, and later connected to the boxes when installed. If this is not possible, strict implementation of E&S protective measures must be installed and maintained in order to protect the filter media from premature clogging and failure.

Sizing Guidelines

In general, bioretention has proven successful in part because of the relatively small surface area, low construction costs and ease of maintenance. Filterra™ provides these same benefits.

The current **Minimum Standard 3.11: Bioretention Practices** establishes a target ratio of bioretention surface area to contributing impervious area of 2.5%. The manufacturer of Filterra™ in cooperation with the University of Virginia has conducted research to optimize the flow / pollutant removal characteristics of the filter media to significantly reduce this ratio. The patented filter media has both high flow rates and high pollutant removal capabilities. To establish the sizing criteria the manufacturer has examined the rainfall distribution and frequency data from the mid-Atlantic region to size the filter surface area to treat 90% of the total annual rainfall volume. Pollutant removal data was also related to the filter surface area and drainage area relationships. The optimum filter surface area to drainage area ratio is 0.33%. For example, the required minimum size filter for ¼ acre of impervious surface would be 36 square feet of filter surface area or one 6 ft. by 6 ft. filter box.

The pollutant removal rates for Filterra™ also vary as a function of the filter surface area to drainage area. At the minimum 0.33% ratio filtering 90% of the annual runoff the expected pollutant removal rates are shown below. It is not recommended that a ratio of less than 0.33% be used.

Expected Pollutant Removal (@ 0.33% filter surface area / drainage area)
Total Suspended Solids Removal = 85%
Total Phosphorous Removal = 74%
Total Nitrogen Removal = 68%
Total Metal Removal = 82%

Higher pollutant removal rates are possible by increasing the ratio of filter surface area to drainage area. See the manufactures detailed calculations for sizing and pollutant removal on their web site at: http://www.americastusa.com/filterra.html. Local jurisdictions may want to consider achieving the highest pollutant removals possible to protect water supplies (surface and ground water) or sensitive water bodies and streams. This may be achieved with Filterra™ by increasing the filter surface area to drainage area ratio.

However it is well documented that the pollutant removal efficiency of a filter device varies with the concentration of pollutants in the inflow (the higher the pollutant levels are in the inflow the higher the pollutant removal rates will be). In order to account for this variability in efficiency, the maximum allowable pollutant removal rates for Filterra™ are as follows:

Maximum Pollutant Removal Rates
Total Suspended Solids Removal = 90%
Total Phosphorous Removal = 80%
Total Nitrogen Removal = 65%
Total Metals Removal = 85%

The above guidance on calculating pollutant removal is based on review of the manufacturer's laboratory data and the best available existing body of data on bioretention systems. However, these removal rates are subject to continuing review, and evaluation of future monitoring data. These pollutant removal rates may be modified on a periodic basis by DCR as determined by ongoing field testing and future improvements to the Filterra™ system. *

Design Criteria

General

The design of Filterra™ shall be in accordance with manufacturers specifications. The designer is not only responsible for selecting the appropriate components for the particular design but also for ensuring long-term operation.

Soils Investigation

When infiltration into the surrounding subsoil is desired, refer to the **Planning Considerations and Design Criteria of General Infiltration Practices, MS-3.10**, and to local jurisdiction soil study requirements such as **Chapter 5, Section V. of the *Northern Virginia BMP Handbook***. A minimum of one soil boring log should be required for each structure where infiltration is considered.

Sizing Methodology

The designer must verify that Filterra™ has been sized and installed in accordance with the manufacturer's specifications. The distribution and sizing of the system of filters should be in accordance with the manufacturer's recommendations to achieve the most cost-effective treatment practicable while satisfying the performance-based or technology-based water quality criteria. Typical development / redevelopment streetscape or parking lot design will use a minimum of one 6'x6' filter box in an off-line configuration for every ¼of drainage area, or a combination of boxes so as to maintain a 0.33% ratio of filter surface area to drainage area.

When designing the system, consideration must be given for overflows during major storm events. Once the filter flow capacity is exceeded a backflow condition develops forcing runoff to by-pass the filter. Overflows should be diverted to a safe conveyance device (inlet, swale or green space).

Pretreatment

Pretreatment is generally not necessary as the filter's media, mulch and plant root system is designed to operate without clogging under normal conditions. Routine annual inspection and maintenance will ensure that the filter will operate for at least 20 years. Normal conditions mean a stabilized drainage area with typical concentrations of sediment and other urban pollutants. Follow the manufacturer's recommendations for unusual site conditions where high pollutant loads are expected. If it is installed when there is active construction within the

drainage area the opening to the filter should be blocked off. Follow the manufacturer's recommendations on protection of the filter box and media during construction activities.

Observation Well and Clean-out

Filterra™ is typically delivered to the site completely assembled or assembled by the manufacturer at the site. The system comes with an observation well installed that can also be used as a clean out to remove any blockages in the under drain piping.

Plant Materials

The plant materials used for Filterra™ should follow the manufacturer's recommendations. Generally, the manufacturer will provide and install the filter material and plants. The system can use typical readily available landscape plant materials. It is designed to use upland plants not wetland plants. Filterra™ provides a hydrologic regime where wetland plants will not survive and should not be used. The plants used for bioretention will also work for Filterra™. **See Minimum Standard 3.11a Bioretention Basin Practices.** One of the advantages of this system is that it uses commonly available nursery stock plant materials so the end user can select from a wide range of plants to also achieve aesthetic and habitat values. The types of plants used will also determine the depth and design of the concrete container. The standard 6' x 6' box is designed to accommodate a typical shrub, herbaceous material or a very small tree. If a standard street tree is used, the filter box must be larger to accommodate the larger root system, prevent wind throw and to ensure adequate filter surface area as the tree matures. A 9' x 12' box would be the minimum size needed for most street trees. In some cases the manufacturer may recommend a customized box size and configuration to accommodate special plant requirements, unique site conditions, water quality protection goals and ensure adequate performance.

It is not recommended that one filter be used to treat very large volumes of runoff from a large drainage area. Runoff should not be detained and stored in a holding tank to be metered out to the filter media over a long period of time. Exposing the soil, microbes and plants to prolonged and frequent flooding and wet conditions will significantly change the hydrologic regime reducing the effectiveness of the media to capture pollutants and the microbe's / plant's ability to cycle nutrients, break down organics and uptake heavy metals. Therefore, continuous or frequent flows (such as basement sump pump discharges, cooling water, condensate water, artesian wells, etc.) MUST BE EXCLUDED from routing through the system. If the filter media remains water logged for 3 or 4 days anaerobic conditions will develop dropping both oxygen and pH levels which may kill desirable soil microbes and the plants. Filterra™ is an upland system that must periodically dry out to maintain aerobic conditions to ensure the

productivity and vigor of the microbes and plants. The unique filtering system approach of designing for small drainage areas and distributing the filters uniformly throughout the site ensures that the filter drains properly in about one hour to maintain aerobic conditions and enable the filter to be ready to accept the next rain storm event in just a few hours. Follow the manufacturer's recommendations on sizing and distribution of the filter boxes as deviations from the manufacturer's specifications may void any manufacturer's warranty and significantly reduce the ability of the filter to perform properly.

Construction Specifications

Accepted construction standards and specifications should be followed where applicable. Specifications and the work should conform to methods and procedures applicable to the installation of a prefabricated concrete box such as an inlet or other type container structure. The construction specification of the concrete container or use of an alternative material for the container should comply with the recommendations of the manufacturer and all applicable standards by the local or state approval authority.

Sequence of Construction

Filterra™ can be constructed and installed at any convenient time during the construction of the site or after the installation of the site's infrastructure as a "drop in place" devise. However, it should not be placed in service until the contributing drainage area has been stabilized. If the device is installed during the construction of the site's infrastructure, the inlet opening must be protected from sediment. Follow the manufacturer's recommendations on sediment / erosion protection.

The specification for the construction of the system should state the following: 1) the earliest point at which the runoff can be safely directed to the device and 2) the means by which this "delay in usage" is to be accomplished. When the device is made operational will depend on a variety of unique site conditions and should be evaluated and determined on those conditions.

Excavation

When Filterra™ is to be used in conjunction with or as an infiltration device the preparation of the infiltration trench placement and type of stone used or filter fabric should conform to the **Construction Specifications of on Infiltration Trenches: Minimum Standard 3.10B.** Placement of the filter box should be on an acceptable base (gravel, sand or compacted soil) to prevent the device from settling. The filter container should be backfilled and compacted in the same

manner as any precast concrete structure. The under drain leaving the box and connecting to the receiving conveyance system should be appropriately supported to prevent deflection during backfilling operations and sealed at the connection points to prevent leakage.

Maintenance and Inspection Guidelines

The manufacturer provides for the inspection, care and maintenance of the Filterra™ device for the first two years. After this initial two year period, the owner / operator of the system should follow all of the manufacturer's maintenance and inspection guidelines. In general, annual routine inspection and maintenance activities required are of a similar nature to any landscaped area and would include removal of trash, debris and sediment, replenishment of the mulch, and care or replacement of plants. The plant material requires no special care or attention once it has acclimated. Annual maintenance and care of the plants in a 6'x6' FT may require using one bag of mulch, a hand full of all-purpose fertilizer (optional) and 20 minutes of time. Fertilization of the plants is optional since the system receives adequate nitrogen, organics and phosphorus from the runoff. During extreme droughts the plants may need to be watered in the same manner as any other landscape material. In the event of a chemical spill all of the soil and plants should be removed and properly disposed and replaced with new uncontaminated filter media and plants.

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