SECTION 2: POST-CONSTRUCTION

Filtrexx® Bioswale (GroSoxx®)

PURPOSE & DESCRIPTION

Filtrexx® **Bioswale** is a permanent, vegetated, shallow depression or channel used to convey, slow, and filter storm water. The bioswale system combines infiltration, filtration, and flow velocity control mechanisms to reduce storm water pollutant loading and flow surges to receiving waters or areas. This Low Impact Development management practice combines the benefits of organic matter and vegetation to physically and chemically (ionic adsorption) filter storm water pollutants. Compost bioswales may use Filtrexx® Check Dams (Section 1.3) to reduce storm water flow velocity and soil erosion, and increase infiltration and filtration within the bioswale system.

APPLICATION

The bioswale system is typically designed as a permanent feature of the landscape. Applications include:

- Replacement of curb and gutters along parking lots
- Replacement of conveyance ditches along roadways
- Pollutant removal and conveyance of storm water from impervious surfaces, such as roadways, parking lots, and rooftops
- Post-treatment for detention pond discharge or emergency storm overflow
- Pretreatment for permanent storm water collection ponds and containment systems
- Sediment and soluble pollution filtration from contaminated effluent
- Storm water flow velocity reduction
- Storm water peak flow reduction
- Storm water volume reduction
- Storm water conveyance
- Low Impact Development (LID) site design goals
- Landscape aesthetic and/or wildlife habitat enhancement
- Urban and development green space expansion or improvement

ADVANTAGES AND DISADVANTAGES

Advantages

- Bioswales are easily installed and can establish vegetation in difficult areas.
- Bioswales can be easily designed and incorporated as one treatment in a treatment train approach to storm water management.
- Bioswales can slow down runoff velocity, thereby increasing sediment deposition, reducing the erosive energy of runoff and the potential for soil erosion, and pollutant transport.
- Bioswales can be used to filter pollutants and infiltrate storm water entering or leaving areas where storm water may pass, collect, drain, or be stored.
- Bioswales have the ability to bind and adsorb soluble nutrients, metals, and hydrocarbons that may be in storm water runoff, thereby reducing loading to nearby receiving waters.
- Bioswales can remove pathogens and pesticides from storm runoff preventing pollution of receiving water bodies.
- Bioswales can be seeded at time of application to provide greater stability and pollutant filtration capability once vegetation has established.
- Bioswales can support a variety of temporary and permanent vegetation.
- Bioswales can increase ground water recharge by increasing infiltration and percolation.
- Bioswales are a good option for arid and semiarid regions where germination, moisture management, and irrigation can be difficult.
- Bioswales may use Filtrexx Check Dams, which are easily maintained and/or replaced for long-term

Mature bioswale

pollutant filtration applications.
- No trenching is required for check dams; therefore soil and plant roots are not disturbed upon installation.
- Organic matter and humus colloids in Filtrexx® FilterMedia™ and GrowingMedia™ have the ability to bind and adsorb phosphorus, metals, and hydrocarbons that may be present in contaminated water.
- Microorganisms in compost FilterMedia and GrowingMedia have the ability to degrade organic pollutants and cycle captured nutrients from contaminated water.
- Compost FilterMedia and GrowingMedia improves existing soil structure, thereby increasing infiltration and plant sustainability.
- Humus colloids and organic matter in the bioswale provide physical structure for seed and establishing seedlings.
- Humus colloids and organic matter in the bioswale provide increased water holding capacity and reduced water evaporation to aid in seed germination and the potential for reduced irrigation.
- GrowingMedia provides organic nutrients that slow release for optimum efficiency to establishing vegetation.
- GrowingMedia provides organic nutrients that are less prone to runoff transport and pollution of surface waters relative to mineral nutrients supplied by fertilizers.
- GrowingMedia and FilterMedia are organic, all natural, biodegradable, and locally manufactured.
- Bioswales can be used as an integrated management practice for LID site design for runoff volume and peak flow reduction.
- Bioswales may assist in qualification for LEED® Green Building Rating and Certification credits under LEED Building Design & Construction (BD+C), New Construction v4. Awarded credits may be possible from the categories of Sustainable Sites, Water Efficiency, Materials & Resources, and Innovation. *Note: LEED is an independent program offered through the U.S. Green Building Council. LEED credits are determined on a per project basis by an independent auditing committee. Filtrexx neither guarantees nor assures LEED credits from the use of its products. LEED is a trademark of the U.S. Green Building Council.*

ADVANTAGES	LOW	MED	HIGH
Installation Difficulty		✓	
Flow Capacity		✓	
Vegetation Establishment			✓
Pollution Control			✓
Aesthetic Quality			✓

Disadvantages
- If the bioswale does not use GrowingMedia and/or FilterMedia performance may be diminished.
- If not installed correctly, maintained or used for a purpose or intention that does not meet specifications, performance may be diminished.
- If vegetation does not establish or cover density is low, performance may be diminished.
- Bioswales may be impractical or exhibit low performance where vegetation establishment and sustainability is difficult, such as arid or drought-prone regions.
- Bioswales should not be the only form of site or watershed storm water management.
- Bioswales may need to be reseeded if significant storm flow occurs prior to vegetation establishment or where vegetation fails.
- Bioswale performance may be lower prior to vegetation establishment and maturity.
- Bioswale performance may be diminished or require frequent maintenance if water/storm water flows are high or exceed the design capabilities of the system.
- Bioswale performance may be diminished or require frequent maintenance if pollutant concentrations or loads are high or exceed the design capabilities of the system.
- Bioswale system may not function correctly if soils are compacted or sedimentation occurs during construction phase.
- Channeling and erosion can occur if check dams are not sized, spaced, installed, or maintained correctly.
- Maximum drainage area for a bioswale should not exceed 5 acres (2 ha).
- Bioswales should not be installed on slopes greater than 4%, or less than 0.5%.
- Flow velocities within the bioswale should not exceed 4 ft/sec (1.2 m/sec), and flow rates should not exceed 5 ft3/sec (140 L/sec).

MATERIAL SPECIFICATIONS

Check dams for bioswales use only photodegradable or biodegradable Filtrexx® Soxx™ netting materials, available from Filtrexx International, and are the only mesh materials accepted in creating bioswale check dams for any purpose. For Soxx tubular mesh material specifications see Table 1.1.

GROWINGMEDIA & FILTERMEDIA SPECIFICATIONS

Bioswales use only Filtrexx GrowingMedia. Check dams may use either compost GrowingMedia or FilterMedia. GrowingMedia is a composted material that is specifically designed for rapid establishment and sustainability of vegetation growth, water absorption, and pollutant adsorption. FilterMedia is a composted material that is specifically designed for removal of solids and soluble pollutants from storm water runoff by physical trapping, deposition, and chemical adsorption.

GrowingMedia and FilterMedia should be third party tested to verify adherence to minimum performance criteria defined by Filtrexx International. GrowingMedia performance parameters may include: percent cover of vegetation, water holding capacity, pH, organic matter, soluble salts, moisture content, biological stability, maturity bioassay, percent inert material, bulk density and particle size distribution. For information on the physical, chemical, and biological properties of GrowingMedia refer to Specification 5.2 Filtrexx® GrowingMedia™.

FilterMedia performance parameters may include: hydraulic flow through rate, total solids removal efficiency, total suspended solids removal efficiency, turbidity reduction, nutrient removal efficiency, metals removal efficiency, and motor oil removal efficiency. For information on the physical, chemical, and biological properties of FilterMedia refer to refer to Specification 6.1 Filtrexx® FilterMedia™.

PERFORMANCE

Performance testing and research on Filtrexx Soxx for check dams has been extensive. For a summary on testing and research results, and design specifications see Table 9.2. *Note: the Contractor is responsible for establishing a working erosion and sediment control, effluent filtration, hydrologic, and/or storm water management system and may, with approval of the Engineer, work outside the minimum construction requirements as needed. Where a bioswale is damaged or ineffective, it shall be repaired or replaced.*

DESIGN CRITERIA

Function

The primary functions of the compost bioswale storm water conveyance system are to: reduce storm water flow velocity and peak flow rates, reduce storm water volume through infiltration, and remove sediment and soluble pollutants, such as nutrients, heavy metals, petroleum hydrocarbons, and pesticides from storm runoff. By using organic matter and humus rich materials the bioswale system is able to filter pollutants through chemical adsorbtion processes, rendering them less toxic and less bioavailable to animals and humans. Soxx for check dams within the bioswale can be designed to increase pollutant removal in storm water, thereby reducing their concentration and load exiting the system.

The organic and humus rich system is also designed to reduce storm water volume by absorbing and infiltrating storm water thereby reducing mass loading of pollutants exiting the system. Check dams reduce flow velocities and peak flow rates, which allows for increased infiltration, settling of suspended solids, and increased reaction time to adsorb soluble pollutants. Selected vegetation within the bioswale system will also reduce flow velocity, physically filter storm water pollutants and remove them from the soil and water complex through phytoremediation (plant up-take). The result is a systematic reduction of storm water and storm water pollutants, preventing migration to overburdened sewer systems, sensitive receiving waters, wetlands, and wildlife habitats.

Planning Considerations:

Bioswales should be used as one treatment in a treatment train approach to site storm water management or pollution abatement. Preconstruction meetings should be conducted to educate construction site personnel about the devices/practices used and acceptable traffic patterns that avoid running over, or inadvertent compaction of the bioswale system with vehicles and heavy equipment. Vehicular traffic is not permitted in the bioswale as heavy equipment may reduce the effectiveness.

Infiltration, runoff velocity reduction, runoff diversion, or pretreatment practices may be installed upslope from the bioswale to reduce runoff peak flows and pollutant loading entering the system. Appropriate erosion and sediment control practices should be designed and installed during construction phase of the bioswale.

Discharge from any storm water conveyance system should be directed to infiltration basins or fields, level spreaders, constructed wetlands, storm water detention ponds, sediment retention or bioretention ponds. The point of discharge should be stabilized to prevent erosion.

Vegetation Selection:

Vegetation selection is a key item for success of any system and the following variables should be considered: type of soil, soil porosity, water holding capacity, drainage of site, rainfall amount, slope of site, maintenance considerations, zone hardiness of plants selected, and irrigation availability (Tyler, 1996). Vegetated storm water management practices should not be installed in areas (arid, drought prone) or soils (gravel, coarse sand, contaminated) where vegetation establishment or sustainability may be difficult.

Fast-establishing annual grasses and legumes should be specified for temporary and nurse crop applications. Native, perennial grasses should be specified for permanent applications (USDA-NRCS, 2004), as these are better adapted to local climate, native soil, and hydrology. If the bioswale system will be exposed to prolonged moisture, wetland species may be required. Generally, tall and sturdy grasses are better for reducing runoff and flow velocity and increasing pollutant removal than low growing, flexible grasses and legumes (Grismer et al., 2006; USDA-NRCS, 2004). Additionally, deep rooted grasses will be more stable under high storm runoff and, high concentrated flow velocity.

Vegetation can increase surface roughness (Manning's n), which can reduce flow velocity. Typically, the denser and taller the vegetation the greater the surface roughness, the higher the Manning's n roughness coefficient, and slower the flow velocity. Large sediment particles are typically removed in greater efficiencies than suspended particles by reducing flow velocity and constructing/maintaining vegetated filters. Many plants have the ability to take up excess nutrients and other pollutants trapped in the vegetation, while microorganisms can decompose and/or incorporate these pollutants into their biomass, making them less toxic to aquatic ecosystems. Organic matter supplied in GrowingMedia increases the diversity and population of microorganisms that can decompose and incorporate captured pollutants.

The hydraulic properties of grasses commonly used in swales and channels have been characterized and grouped. Each class, A through E, is determined by height, density and stiffness of the vegetative stand. These properties effect the vegetation's surface roughness (Manning's n) and its ability to withstand hydraulic pressure from concentrated flows (ECTC, 2006). Grass retardance classes and their corresponding permissible shear stress values are defined in the Federal Highway Administration HEC 15. See table 9.1.

Bioswales may be designed for biotechnical engineering applications. GrowingMedia fill within the check dam system creates an optimum fertile and structural environment for establishing and sustaining live stakes, seed, tubers, rhizomes, and plugs. A live stake is a 1 to 3 ft (300-900mm) long cutting from a live hardwood tree or shrub and planted vertically at least 2 in (50mm) into growing media, and spaced 3 to 5 ft (1-1.5m) apart (KYTC, 2006). Typical live stake species include, willow, poplar, maple, cottonwood, dogwood, sycamore, and oak (KYTC, 2006). Drip tape irrigation installed within the check dam system can maintain moisture for plants used in biotechnical engineering projects, particularly

Table 9.1. FHWA HEC 15 Retardance Class, Stand Height, and Permissible Shear Stress for Grasses used in Channels, Ditches, and Concentrated Flow Applications.

Class	Example of Vegetation	Stand Density	Average Stand Height	Permissible Shear Stress
A	Weeping Lovegrass, yellow bluestem	Excellent	>=76.2 cm (>= 30 in)	177 Pascal (PA) (3.7 lbs/ft2, 18 kg/m2)
B	Bermuda, blue grama , and native grass mixtures	Good	30.5 - 61 cm (12 - 24 in)	100 Pascal (PA) (2.1 lbs/ft2, 10 kg/m2)
C	Bermuda, Kentucky blue grass, centipede grass	Good	15 — 30.5 cm (6 - 12 in)	48 Pascal (PA) (1.0 lbs/ft2, 5 kg/m2)
D	Bermuda, buffalo, grass-legume mixture	Good	5 — 15 cm (2 - 6 in)	28 Pascal (PA) (0.60 lbs/ft2, 3 kg/m2)
E	Bermuda, native grass mixture	Good	<5 cm (< 2 in)	16 Pascal (PA) (0.35 lbs/ft2, 2 kg/m2)

in drought prone regions and seasons or during establishment phase.

Local landscape architects, USDA-NRCS personnel, or cooperative extension specialists should be consulted and used as resources for local/regional seed and plant selection. Many state erosion and sediment control and storm water management manuals have specifications for seed and plant selection, seeding rates, and planting requirements. PLANTS, a database created by the USDA-NRCS, may be a helpful tool for seed and plant selection. It can be accessed at http://plants.usda.gov

Establishing & Sustaining Vegetation:
Maintenance is a key consideration, as sediment accumulation greater than 25% of the vegetation height may reduce vegetation health and the design capacity of the bioswale system. Mowing of vegetation to less than 4 in (100 mm) will ensure sunlight penetration for pathogen reduction. Taller grasses may have higher sediment removal efficiency, sediment storage capacity, and a greater ability to reduce storm flow velocity relative to low growing or low maintained grasses. To ensure pollutant filtration, vegetation should not be shorter than the design storm water flow height in the bioswale. Vegetation left unmanaged or designed for ecological succession will provide better wildlife habitat and naturalization. Higher Manning's n roughness coefficients and slow flow velocities are also associated with this type of vegetation management.

GrowingMedia supplies humus, organic matter, beneficial microbes, and slow release organic nutrients that contribute to increased fertility and nutrient availability, and water holding capacity and conservation, leading to greater plant health and sustainability.

Organic vs. Fertilizer Nutrients:
Although most specification and design manuals include fertilizer recommendations or requirements for vegetation, mineral nutrients from fertilizers may not be preferable where vegetation sustainability and water quality are a concern. Compost GrowingMedia provides organic nutrients which are slow release, provide plant micronutrients, and are less likely to be transported in storm runoff to receiving waters – which can lead to pollution and eutrophication of waterways (Faucette et al, 2005).

Weed Establishment:
Invasive weed growth has been more closely associated with mineral fertilizer than organic fertilizer fertility practices (Faucette et al, 2006). Vegetation practices should always be inspected for invasive and noxious weeds.

Soil Infiltration:
Native soils should be scarified or shallow tilled to induce infiltration. The use of check dams and GrowingMedia within the bioswale system will help increase infiltration. Avoid heavy equipment and compaction of area during construction phase. Soil infiltration rate should be greater than 0.5 in/hr (1.25 cm/hr).

Influent and Runoff Entrance:
At the system entrance, it is important to maintain sheet flow or create equalized flow conditions, reduce runoff velocity, and stabilize soil and vegetation complexes. Options include: level spreaders, gravel infiltration trenches (minimum of 12 in [300mm] wide and 12 in [300mm] deep), pretreatment forebay, turf reinforcement mats, and flexible channel liners.

Baffle Placement:
Storm water overflow of check dams is acceptable, as slowing storm water flow velocity is the principle objective for the baffle application. Larger diameter check dams should be constructed if high runoff depth and flow rates are anticipated. Check dams should be specified and installed so that the center height of the device is at least 6 in (150mm) lower than the banks of the ditch or channel. Additionally, the ends of the check dam should extend up the banks so that storm water moves through and/or over the check dam and not around the ends.

Place check dams on contours and even surfaces to assist in dissipating concentrated flow into sheet flow and prevent undercutting of device. Concentrated flow of water should be perpendicular to the check dam at impact.

For sizing, spacing, and placement of check dam within the bioswale system refer to Filtrexx® Check Dam Section 1.3 of this manual.

Outfall Flow:
A weir or check dam should be placed across the entire width of flow path at the exit of the bioswale, perpendicular to flow, to act as a final filtration treatment and to equalize and disperse flow as it exits the system. Depending on slope and discharge angle at outfall, it may be necessary to install turf reinforcement mats, or other stabilization practices,

until mature vegetation can provide adequate stabilization.

Location and Slope:
Bioswales are often used at property boundaries and oriented in the direction of storm water flow. Bioswales should be at least 10 ft (3 m) above ground water, or 4 ft (1.2 m) above seasonal high water table, to allow adequate infiltration and drainage.

Bioswales are typically located on natural grades and should not be placed on slopes less than 0.5% or greater than 4%. Designers should consider that water will move faster through the system as slope angle increases, which will reduce infiltration and pollutant removal efficiency. The bioswale side slopes (walls) should not exceed a 4H:1V slope and should conform to a trapezoidal or parabolic shape. This design will increase the wetted perimeter and enhance treatment of storm water.

Sizing Options:
There are several options for sizing bioswales; ultimately it depends on the goal of the application or regulatory agency. For adequate performance, the minimum dimensions of the bioswale should be 100 ft (30 m) long, and 25 ft (8 m) wide, with a 3 ft (1 m) bed width.

Design by Contributing Area:
The drainage area to the bioswale should not exceed 5 acres (2 ha). The entire surface are of the bioswale should be greater than or equal to 1% of the entire drainage area. This equates to 500 ft2/ac (115 m2/ha). Alternatively, the surface area of the bioswale should be 10-20% of the impervious area of the contributing drainage area.

Design By Flow Velocity:
Bioswale check dams should be designed and installed to reduce flow velocity. For correct sizing and spacing of baffles in a swale or channel system see Section 1.3.

Bioswales should not be used in areas where runoff velocity or shear stresses will damage or undermine the system. For most vegetation a maximum velocity of 4 ft/sec (1.2 m/sec) or a maximum hydraulic shear stress of 2 lbs/ft2 (10 kg/m2) is recommended (Maryland Storm Water Design Manual, 2000) – unless vegetation reinforcement is utilized such as turf reinforcement mats or rolled erosion control products. Without these practices, a flow velocity of 0.9 ft/sec (0.3 m/sec) is optimum to ensure vegetation sustainability.

To determine flow velocity in a swale use Manning's Equation:

$$V = (\alpha_1/n) \times R^{2/3} \times S^{1/2}$$

Where:
V = mean velocity of flow (ft/sec, m/sec)
R = hydraulic radius = A/P (ft, m)
A = cross-sectional area (sq ft, sq m)
P = wetted perimeter (ft, m)
S = slope of gradient (ft/ft, m/m)
n = roughness coefficient
α_1 = 1.0 for SI units, 1.496 for English units

To reduce velocity in the bioswale, chose vegetation or flow surfaces with higher Manning's n roughness coefficients, decrease slope angle, or increase the hydraulic radius.

Design by Flow Rate:
Using a known flow rate (Q), the Rational Formula (shown below) can be used to determine the maximum allowable drainage area contributing to a bioswale. The peak flow rate should not exceed 5 ft3/sec (140 L/sec). Use runoff coefficients associated with the surface drainage area and 24-hr design storm intensities appropriate for your watershed. Runoff coefficients (C) for CECBs range from 0.26 to 0.35.

$$Q = C*I*A$$

Where:
Q = peak flow rate (cfs, cms)
C = runoff coefficient
I = rainfall intensity (in/hr, mm/hr)
A = drainage area (acres, hectares)

Design By Hydraulic Residence Time:
Using a known minimum hydraulic residence time and maximum flow rate, the volume of the bioswale can be designed. The minimum hydraulic residence time of a bioswale should be 10 min. The flow rate should not exceed 5 ft3/sec (140 L/sec).

$$R = V/Q$$

Where:
R = hydraulic residence time
V = spillway volume (cubic ft, cubic m)
Q = flow rate (cubic ft/sec, cubic m/sec)

Where:
V = length * width * height

Design by Pollutant Removal:
See Table 3.2 for various pollutant removal efficiency rates for Filtrexx Soxx for check dams that use FilterMedia.

INSTALLATION

1. Bioswale shall meet all specifications and use GrowingMedia and FilterMedia.
2. Bioswale will be placed at locations indicated on plans as directed by the Engineer.
3. Bioswale shall be placed parallel to water flow in a manner that allows storm water to flow, percolate, and/or gravitate through the system.
4. Bioswale must be installed and stabilized before water flow is allowed to enter the system. Use runoff diversion practices prior to construction completion and vegetation maturity.
5. Land surface shall be cleared of debris, including rocks, roots, large clods, and sticks prior to bioswale installation.
6. Bioswale soil bed shall be scarified or shallow tilled to increase infiltration in the system.
7. Land surface shall not be compacted prior to installation.
8. Bioswales shall be placed on slopes between 0.5 and 4%.
9. Check dams shall be installed across the entire width of the flow path, perpendicular to flow, to force water to flow through or over the check dam, not around.
10. Check dams (with GrowingMedia) may be injected with seed to increase vegetation and phytoremediation within the bioswale system.
11. Once in place, check dams shall be lightly compacted to prevent water undercutting.
12. Stakes shall be installed through the middle of the check dams on a minimum of 5 ft (1.5m) centers, using 2 in (50mm) by 2 in (50mm) by 3 ft (1m) wooden stakes.
13. Stakes shall also be placed at the ends of check dams to hold them in place.
14. Minimum staking depth for sand and silt loam soils shall be 12 in (300mm), and 8 in (200mm) for clay soils.
15. Once all check dams are in place a turf reinforcement mat (TRM) or rolled erosion control product (RECP) may be placed on the soil surface.
16. TRMs and RECPs should follow manufacturers' installation and stapling procedures.
17. TRMs and RECPs shall be installed under the entire area of a Filtrexx® Compost Erosion Control Blanket™ (CECB).
18. CECBs shall use GrowingMedia applied to 100% of the TRM or RECP area.
19. CECBs shall be 1 to 2 in (25-50mm) thick.
20. CECBs shall be seeded at the time of application; seed selection will be determined by the engineer.
21. Bioswales should not be installed prior to seasons where growing vegetation is difficult.
22. Seed shall be thoroughly mixed with the CECB prior to construction or injected into CECB at time of application.
23. After CECBs have been applied another RECP may be installed on top of the CECB to prevent erosion.
24. Installation procedures for RECPs on top of CECB shall be the same as the installation underneath the CECB.
25. Optional biotechnical engineering with live stakes, tubers, seedlings, or plugs should be conducted after staking of check dams (with GrowingMedia) is complete.
26. Live stakes should be from a live hardwood species and cuttings should be 1 to 3 ft (300-900mm) long.
27. Live stakes should be spaced 3 to 5 ft (1-1.5m) apart, and planted vertically with one end planted through the check dam and at least 2 in (50mm) into soil surface.
28. Seeded and/or live staked check dam shall be thoroughly watered after installation and allowed to settle for one week.
29. Drip tape may be installed within the check dam during construction to provide irrigation for establishing vegetation.
30. If drip irrigation system is installed, a reliable water source should be located and secured.
31. If drip irrigation system is installed and municipal water or a pump will be utilized, a pressure reducer may be required to manage flow.

INSPECTION

Routine inspection should be conducted within 24 hrs of a runoff or flow event for the first year after installation, until permanent vegetation has established, or as designated by the regulating authority. If check dam dislodgement, erosion or bank sloughing occur, system should be repaired immediately. If vegetation does not establish or has been removed, the area should be reseeded and/ or planted. Vegetation practices should always be inspected for noxious or invasive weeds. If sediment accumulation is 50% of the height of the check dam, 25% of the height of the vegetation, or 25% of the original design volume of the bioswale sediment removal is recommended. Storm debris and trash should be removed immediately.

MAINTENANCE

1. The Contractor shall maintain the bioswale in a functional condition at all times and it shall be routinely inspected.
2. If the system has been damaged, it shall be repaired, or replaced if beyond repair.
3. The Contractor shall remove sediment at the base of the upslope side of the baffle when accumulation has reached 1/2 of the effective height of the baffle, 25% of the height of the vegetation, or 25% of the original design volume, or as directed by the Engineer.
4. The system shall be kept free of debris.
5. If check dam becomes clogged with sediment or hydraulic flow is significantly reduced it may be replaced.
6. The bioswale shall be maintained until disturbed area above the device has been permanently stabilized and construction activity has ceased.
7. Once bioswale is vegetated, the Contractor shall mow or maintain the vegetation in a functional condition at all times and it shall be routinely inspected.
8. Vegetation shall be maintained until a uniform minimum cover of 70% of the applied area has been vegetated, permanent vegetation has established, or as required by the jurisdictional agency.
9. Vegetation may need to be irrigated in hot and dry weather and seasons, or arid and semi-arid climates to ensure vegetation establishment.
10. Where vegetation does not establish, fails, or rilling occurs, the Contractor will repair, reseed, or provide an approved and functioning alternative.
11. No additional fertilizer or lime is required for vegetation establishment and maintenance.
12. Regular mowing of vegetation to a minimum height of 4 in (100mm) and a maximum height of 10 in (250mm) will deter invasive weeds, and allow sunlight to kill captured pathogens.

METHOD OF MEASUREMENT

Bid items shall show measurement as Filtrexx® Bioswale per square ft, square yd, or square m installed. Bid items may show measurement for Filtrexx® Soxx™ Check Dam, as part of the system, per linear ft or linear meter installed, per diameter (8 in [200mm], 12 in [300mm], 18 in [450mm], 24 in [600mm]), or 32 in (800mm).

ADDITIONAL INFORMATION

For other references on this topic, including additional research reports and trade magazine and press coverage, visit the Filtrexx website at www.filtrexx.com

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TABLES & FIGURES:

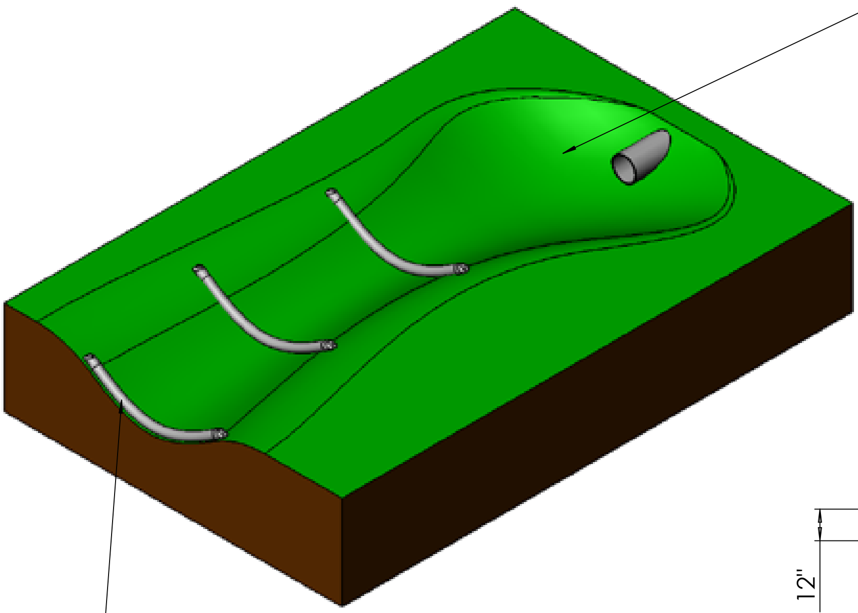
Table 9.2. Filtrexx® Soxx™ for Check Dam Bioswale Performance and Design Specifications Summary

Design Diameter / Design & Performance	8 in (200mm)	12 in (300mm)	18 in (450mm)	24 in (600mm)	32 in (800mm)
Effective Height	6.5 in (160mm)	9.5 in (240mm)	14.5 in (360mm)	19 in (480mm)	26 in (650mm)
Effective Circumference	25 in (630mm)	38 in (960mm)	57 in (1450mm)	75 in (1900mm)	100 in (2500mm)
Density	20 lbs/ft (30 kg/m)	48 lbs/ft (73 kg/m)	110 lbs/ft (167 kg/m)	200 lbs/ft (300 kg/m)	300 lbs/ft (450 kg/m)
Maximum continuous length	unlimited	unlimited	unlimited	unlimited	unlimited
Staking Requirement	10 ft (3m)	10 ft (3m)	10 ft (3m)	10 ft (3m)	10 ft (3m)
Maintenance Requirement (sediment removal at X height)	3.25 in (80mm)	4.75 in (120mm)	7.25 in (180mm)	9.5 in (240mm)	13 in (325mm)
Functional Longevity*	6 mo – 5 yr	6 mo – 5 yr	6 mo – 5 yr	6 mo – 5 yr	6 mo – 5 yr
Hydraulic Flow Through Rate (sediment-laden water)	< 1 gpm /linear ft (<1 L /min/m)	< 1 gpm /linear ft (<1L/min/m)	< 1 gpm /linear ft (<1L /min/m)	< 1 gpm /linear ft (<1L /min/m)	< 1 gpm /linear ft (<1L /min/m)
Max Runoff Flow Height	3 in (75mm)	6 in (150mm)	11 in (275mm)	15 in (375mm)	22 in (550mm)

* Functional Longevity is dependent on mesh material type, UV exposure, freeze/thaw frequency, region of US/Canada, runoff-sediment frequency/duration/loading, and adherence to specified maintenance requirement. Functional longevity ranges are estimates only. Site specific environmental conditions may result in significantly shorter or longer time periods.

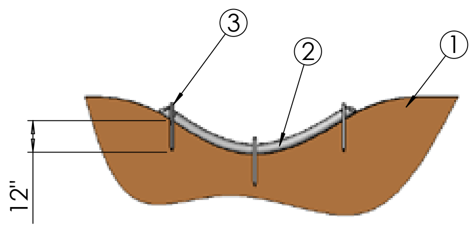
Figure 9.1. Engineering Design Drawing for Filtrexx® Bioswale

FILTREXX® BIOSWALE



Influent and Runoff Entrance:
At the system entrance, it is important to maintain sheet flow or create equalized flow conditions, reduce runoff velocity, and stabilize soil and vegetation complexes. Options include: level spreaders, gravel infiltration trenches (minimum of 12 in [300mm] wide and 12 in [300mm] deep), pretreatment forebay, turf reinforcement mats, Filtrexx Channel Protection (see Filtrexx Design Manual Section 2.4), or rip rap.

Outfall Flow:
A weir or Soxx Baffle™ should be placed across the entire width of flow path at the exit of the Bioswale system, perpendicular to flow, to act as a final filtration treatment and to equalize and disperse flow as it exits the system. Depending on slope and discharge angle at outfall, it may be necessary to install turf reinforcement mats, or other stabilization practices, until mature vegetation can provide adequate stabilization.



Minimum staking depth for sand and silt loam soils shall be 12 in (300mm), and 8 in (200mm) for clay soils.

ITEM NO.	DESCRIPTION	QTY.
1	SWALE	1
2	SOXX™	3
3	2" X 2" X 36" WOODEN STAKE	3

DIMENSIONS ARE IN INCHES
ANGULAR: BEND ± 2°
TWO PLACE DECIMAL ± .015
THREE PLACE DECIMAL ± .005

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	KJN	03/10/09
CHECKED		
ECO		

FILTREXX INTERNATIONAL
61 N CLEV-MASS RD STE E
AKRON, OH 44333
877-542-7699
WWW.FILTREXX.COM

SIZE: A | TITLE: BIOSWALE | REV. A
DWG./PART NO. 1000007 | SHEET 1 OF 1