

## Operation and Maintenance

### ***In this Chapter:***

- ▶ *Operation & maintenance requirements for stormwater treatment and flow duration control measures,*
- ▶ *Preparing documentation for maintenance agreements,*
- ▶ *Common maintenance concerns for frequently-used treatment measures*

### 8.1 Summary of O&M Requirements

Maintenance is essential for assuring that pervious pavement, stormwater treatment and flow duration control (FDC) measures continue to function effectively and do not cause flooding, provide habitat for mosquitoes, or otherwise become a nuisance. The maintenance requirements described in this chapter apply to **pervious pavement, stormwater treatment measures, and FDC measures** included in your project. The operation and maintenance (O&M) process can be organized into five phases, as described below:

- Determining ownership and maintenance responsibility,
- Identifying maintenance requirements when selecting treatment measures,
- Preparing the maintenance plan and other documentation,
- Executing a maintenance agreement or other maintenance assurance, and
- Ongoing inspections and maintenance.

O&M requirements for treatment measures also apply to **flow duration control measures** where and when they are implemented.

#### **Key Point**



#### 8.1.1. Responsibility for Maintenance

The responsibility for the maintenance of stormwater treatment and FDC measures **belongs to the project applicant and/or property owner** unless other specific arrangements have been made. Ownership and maintenance responsibility for stormwater treatment measures and FDC measures should be considered at the earliest stages of project planning, typically at the pre-application meeting with municipal staff.

The municipal stormwater permit also requires that the project applicant provide a signed statement accepting responsibility for maintenance until this responsibility is legally transferred, as well as ensuring access to municipal, Water Board, and San Mateo County Mosquito Abatement District staff.

### 8.1.2 Considerations When Selecting Treatment Measures

#### **CONSIDER OPERATION AND MAINTENANCE**



When determining which types of treatment measures to incorporate into project plans, be mindful of how maintenance intensive they are. Study the operation manual for any manufactured, proprietary system. Treatment measures must be maintained so that they continue to treat stormwater runoff effectively **throughout the life of the project** and do not provide habitat for mosquito breeding. Adequate funds must be allocated to support long-term site maintenance. Manufactured, proprietary systems tend to clog easily and therefore require frequent maintenance to ensure that they operate as intended and do not hold standing water. A properly designed and established bioretention area, by contrast, may require little maintenance beyond what is required for normal landscaped areas.

The party responsible for maintenance will also be required to **dispose of accumulated residuals properly**. Residuals are defined as trash, oil and grease, filter media and fine sediments that are collected from treatment measures that may or may not be contaminated. At present, research generally indicates that residuals are not hazardous wastes and as such, after dewatering, property owners can generally disposed of residuals in the same way they would dispose of any uncontaminated soil.

For a list of **landfills in San Mateo County** that accept sediment (“soil”), contaminated or otherwise, visit [www.ciwmb.ca.gov/SWIS/Search.asp](http://www.ciwmb.ca.gov/SWIS/Search.asp).

Alternatively, property owners may choose to contract with the treatment device manufacturer to maintain their treatment measures. Services typically provided include inspection, maintenance, handling and disposal of all residuals.

#### **CONTROL MOSQUITOES**



When selecting and installing stormwater treatment devices, you will need to consider the various environmental, construction, and local factors that may influence mosquito breeding. Except for certain treatment measures designed to hold permanent pools of standing water, treatment measures should **drain completely within five days** to effectively suppress mosquito production. The Countywide Program’s Vector Control Plan includes mosquito control design guidance and maintenance guidance for treatment measures. This guidance is included in Appendix F.

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**CONSIDER ACCESS**

The maintenance agreement for your project will need to guarantee access permission for local municipality staff, the San Mateo County Mosquito Abatement District and Water Board staff to enter the property to verify that maintenance is being conducted in accordance with the maintenance plan, throughout the life of the project. Make sure stormwater treatment and FDC measures are **readily accessible to the inspectors**, and contact municipal staff to determine whether easements will be needed. Stormwater treatment and FDC measures must also be accessible to equipment needed to maintain them. Maintenance needs vary by the type of treatment measure that is used. Review the maintenance requirements described in Section 8.2 to identify the accessibility needs for maintenance equipment. By nature, it is more difficult to provide adequate access for below-ground treatment measures than above-ground treatment measures.

## 8.1.3 Documentation Required with Permit Application



As part of the building permit application, regulated project applicants typically need to prepare and submit the documents listed below. **Check with the local jurisdiction** for exact requirements.

- A legible conceptual plan of the site, clearly showing the locations of pervious pavement, stormwater treatment, and FDC measures. The plan should specifically identify all pervious pavements systems that total 3000 ft.<sup>2</sup> or more (excluding private-use patios for single-family homes, townhomes, or condominiums). Letter-sized plans are preferred; legal-sized plans may be accepted.
- Detailed maintenance plan for pervious pavement, stormwater treatment, and FDC measures, including inspection checklists, as appropriate.
- A standard O&M report form, to be attached to a maintenance agreement, or other maintenance assurance.

Please note that requirements may vary from one jurisdiction to another. Ask municipal staff if there are any additional requirements. Appendix G includes templates to assist project applicants in preparing their standard treatment measure O&M report form and maintenance plan. Guidance on preparing these documents is provided in Section 8.2.

## 8.1.4 Maintenance Agreement or Other Maintenance Assurance

Where a property owner is responsible for maintenance, the property owner of regulated projects is required to enter into a maintenance agreement with the municipality to ensure long-term maintenance of stormwater control measures. The agreement will be **recorded against the property** to run with the title of the land. Contact your local jurisdiction to obtain a copy of its standard maintenance agreement. The maintenance agreements require property owners to conduct maintenance inspections of all stormwater control measures, and – depending on the municipality – may require the annual submittal of a Standard Treatment Operation and Maintenance Inspection Report form.

For **residential properties** where the stormwater control measures are located within a common area that will be maintained by a homeowner's association, language regarding the responsibility for maintenance must be included in the project's conditions, covenants and restrictions (CC&Rs). Printed educational materials regarding on-site stormwater

controls are typically required to be included with the first, and any subsequent, deed transfer. The educational materials typically:

- Explain the post-construction stormwater controls requirements;
- Provide information on what stormwater controls are present;
- Describe the need for maintenance;
- Explain how necessary maintenance can be performed; and
- For the initial deed transfer, describe the assistance that the project applicant can provide.

If stormwater control measures are proposed to be located in a **public area** for transfer to the municipality, these control measures must meet the design guidelines specified in Chapter 6 and shall remain the property owner’s responsibility for maintenance until the control measures are accepted for transfer.

### 8.1.5 Ongoing Inspections and Maintenance

After the maintenance agreement is executed, or the municipality approves other maintenance assurance such as CC&Rs, the party responsible for maintenance begins to implement the maintenance plan. Inspection reports are submitted to the municipality as required by the maintenance agreement, or other maintenance assurance.

The municipality, Water Board and San Mateo County Mosquito Abatement District may conduct **operation and maintenance verification inspections** to make sure that stormwater control measures are being maintained. In the event adequate maintenance is not conducted, the municipality will take necessary steps to restore the control measures to good working order. The property owner will be responsible for reimbursing the municipality for expenditures associated with restoring the control measures to good working order.

The municipality, Water Board and San Mateo County Mosquito Abatement District staff may conduct **O&M verification inspections** to make sure that stormwater control measures are maintained.



## 8.2 Preparing Maintenance-Related Documents

This section provides instructions for preparing the following documents that are typically required as parts of the building permit application, if your project is a regulated project and includes pervious pavement (3,000 sq. ft. or more), stormwater treatment measures and/or FDC measures:

- A standard control measure O&M report form
- A maintenance plan, including a schedule of maintenance activities.

### 8.2.1 Standard Treatment Measure O&M Report Form

The municipality may require the property owner, or other responsible party, to submit an annual report summarizing the maintenance and inspections of control measures included in the project. To standardize and simplify the reporting process, the property owner submits a “Standard Treatment Measure O&M Report Form” with the building permit

application, and the municipality includes the report form as an Exhibit to the maintenance agreement. After the agreement is executed, the property owner, or other responsible party, uses this form to prepare the annual report, which is typically submitted by December 31 of each calendar year. When submitting the completed report form each year, the responsible party will typically be required to attach the inspection forms that were completed during that calendar year.



To help you prepare your Standard Treatment Measure O&M Report Form, a template is included in Appendix G. **Check with the local jurisdiction** for an electronic version of the template. When using the template to prepare your report form, please insert project-specific information where you find highlighted prompts such as the following:

[[= insert name of property owner/responsible party =]]



### 8.2.2 Maintenance Plan

The maintenance plan must be sufficiently detailed to demonstrate to the municipality that pervious pavement, stormwater treatment measures, and/or FDC measures will receive **adequate inspections and maintenance** to continue functioning as designed over the life of the project. A maintenance plan typically includes the following elements:

- Contact information for the property owner or other responsible party.
- Project address and, if required, the Assessors Parcel Number and directions to the site.
- Identification of the number, type and location of all pervious pavement (3,000 sq. ft. or more), stormwater control, and/or FDC measures on the site.
- A list of specific, routine maintenance tasks that will be conducted, and the intervals at which they are conducted. (For example, “Inspect control measure once a month, using the attached checklist.”)
- An inspection checklist, specific to the control measure(s) included in your project, which indicates the items that will be reviewed during regular maintenance inspections. Completed inspection forms may be required as part of the annual Stormwater Control Measure O&M Report, described in Section 8.2.1.

The following materials are available to help you prepare your maintenance plan:

- Maintenance plan templates included in Appendix G.
- A list of common maintenance concerns for frequently-used stormwater control measures (see the following pages).

When using a template to prepare your report form, insert project-specific information where you find prompts such as: [[= insert name of property owner/responsible party =]]. The templates include sample inspection checklists for some control measures. If your project includes different control measures, you will need to customize the template. Refer to the **control measure-specific maintenance information** on the following pages to prepare your maintenance plan.

Refer to the **control measure-specific maintenance information** to prepare your maintenance plan.

**BIORETENTION AREAS (CHAPTER 6.1) – COMMON MAINTENANCE CONCERNS:**

The primary maintenance requirement for bioretention areas is the regular inspection and repair or replacement of the control measure's components. Generally, the level of effort is similar to the routine, periodic maintenance of any landscaped area. It is recommended that certain maintenance tasks be conducted monthly, annually before the rainy season, annually after the rainy season, and after large storm events.

- Depending on the control measure needs, conduct monthly inspections as follows:
  - Inspect bioretention surface area, inlets and outlets for obstructions and trash; clear any obstructions and remove weeds and trash.
  - Inspect bioretention area for standing water. If standing water does not drain within 2-3 days, remove the surface biotreatment soil and plants; replace with approved biotreatment soil and replant. If mosquito larvae are observed, contact the San Mateo County Mosquito Abatement District at 650/344-8592.
- Before and after the rainy season, conduct an evaluation of the whole control system. Inspect the vegetation to ensure that it is healthy and dense enough to provide filtering and protection from erosion.
  - Prune and weed the bioretention area and remove trash. Remove and replace any dead plants.
  - Inspect inlets for channels, exposure of soils, or other evidence of erosion. Clear any obstructions and remove any accumulation of sediment.
  - Do not use pesticides or other chemical applications to treat diseased plants, control weeds or remove unwanted growth.
  - Check the irrigation system to ensure that plants are receiving the correct amount of water. Repair or replace any improperly functioning equipment.
  - Use compost and other natural soil amendments and fertilizers instead of synthetic fertilizers, especially if the system uses an underdrain.
  - Inspect the energy dissipater at the inlet to ensure it is functioning adequately, and that there is no scour of the surface mulch. Remove any accumulation of sediment.
  - Inspect and, if needed, replace wood mulch. It is recommended that 2" to 3" of composted arbor mulch be applied once a year. Mulch should be added when erosion is evident or when the bioretention area begins to look unattractive. The entire area may need mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas.
- After large storm events, inspect the system for:
  - Erosion of biotreatment soil, loss of mulch, standing water, structural failure, clogged overflows, weeds, trash and dead plants. If using rock mulch, check for 3" of coverage.



Figure 8-1: Bioretention Area in Daly City

***FLOW-THROUGH PLANTERS (CHAPTER 6.2) – COMMON MAINTENANCE CONCERNS:***

Maintenance objectives include maintaining healthy vegetation at an appropriate size; avoiding clogging; and ensuring the structural integrity of the planter and the proper functioning of inlets, outlets, and the high-flow bypass. It is recommended that certain maintenance tasks be conducted monthly, annually before the rainy season, annually after the rainy season, and after large storm events.

- Depending on the system needs, conduct monthly inspections as follows:
  - Inspect the planter surface area, inlets and outlets for obstructions and trash; clear any obstructions and remove trash.
  - Inspect planter for standing water. If standing water does not drain within 2-3 days, the surface biotreatment soil should be tilled or replaced with the approved soil mix and replanted. Use the cleanout riser to clear any underdrains of obstructions or clogging material. If mosquito larvae are observed, contact the County Vector Control District at (408) 918-4770 or (800) 675-1155.
  - Check for eroded or settled biotreatment soil media. Level soil with rake and remove/replant vegetation as necessary.
- Before and after the rainy season, conduct a complete evaluation of the system:
  - Ensure that vegetation is healthy and dense enough to provide filtering and protect soils from erosion. Prune and weed as necessary. Replace dead plants. Remove excessive growth of plants that are too close together to allow water flow and/or causing other issues. Remove trash and sediment. Do not use pesticides or other chemical applications to treat diseased plants, control weeds or remove unwanted growth.
  - Use compost and other natural soil amendments and fertilizers instead of synthetic fertilizers, especially if the system uses an underdrain.
  - Inspect the overflow pipe to make sure that it can safely convey excess flows to a storm drain. Repair or replace any damaged or disconnected piping. Use the cleanout riser to clear underdrains of obstructions or clogging material.

- Inspect the energy dissipater at the inlet to ensure it is functioning adequately, and that there is no scour of the surface mulch. Remove any accumulation of sediment.
- Inspect and, if needed, replace wood mulch. It is recommended that 2" to 3" of composted arbor mulch be applied once a year.
- After large storm events, check the system for:
  - Erosion of biotreatment soil mix, loss of mulch, trash, standing water, and structural integrity of walls, flow spreaders, energy dissipaters, curb cuts, outlets and flow splitters for cracks and breaks. If using rock mulch, check for 3" of coverage.



Figure 8-2: Flow through planter in Emeryville

***TREE WELL FILTERS (CHAPTER 6.3) – COMMON MAINTENANCE CONCERNS:***

Some manufacturers require a maintenance agreement, under which the manufacturer conducts the maintenance. The following maintenance requirements are typical:

- Conduct a biannual (twice yearly) evaluation of the health of trees and any ground cover. Remove any dead, dying, or missing vegetation.
- Do not use pesticides or other chemical applications to control weeds or unwanted growth.
- Use compost and other natural soil amendments and fertilizers instead of synthetic fertilizers, especially if the system uses an underdrain.
- Maintain vegetation and the irrigation system. Prune and weed as needed to keep the tree well filter neat and orderly in appearance. Clean up fallen leaves or debris.
- Before the wet season begins, check that the media is at the appropriate depth. Remove any accumulations of sediment, litter, and debris. Confirm that the tree well filter is not clogging and will drain per design specifications. Till or replace the media as necessary.
- Inspect tree well filter periodically, and after storms, to ensure that it has not clogged.



- Periodically inspect the overflow pipe to make sure that it can safely convey excess flows to a storm drain. Repair or replace any damaged or disconnected piping.



Figure 8-3: Non-proprietary tree well filter (Source: University of New Hampshire)

***INFILTRATION TRENCHES (CHAPTER 6.4) – COMMON MAINTENANCE CONCERNS:***

The primary maintenance objective is to prevent clogging, which may lead to trench failure. Typical inspection and maintenance tasks are as follows:

- Inspect infiltration trench after large storm events and remove any accumulated debris or material.
- Check the observation well 2 to 3 days after storms to confirm drainage.
- Repair any erosion at inflow or overflow structures.
- Conduct thorough inspection annually, including monitoring of the observation well to confirm that the trench is draining within the specified time.
- Trenches with filter fabric should be inspected annually for sediment deposits by removing a small section of the top layer.
- If inspection indicates that the trench is partially or completely clogged, it should be restored to its design condition.
- Mow and trim vegetation around the trench as needed to maintain a neat and orderly appearance.
- Do not use pesticides or other chemical applications to control weeds or unwanted growth of vegetation near the trench.
- Routinely remove trash, grass clippings and other debris from the trench perimeter and dispose of these materials properly. Trees or other large vegetation should be prevented from growing adjacent to the trench to prevent damage to the trench.



Figure 8-4: Infiltration Trench (Source: California Stormwater Quality Association)

**EXTENDED DETENTION BASINS (CHAPTER 6.5) – COMMON MAINTENANCE CONCERNS:** Primary maintenance activities include vegetation management and sediment removal, although mosquito control is a concern in extended detention basins that are designed to include pools of standing water. The typical maintenance requirements include:

- Harvest vegetation annually, during the summer.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and mosquito control reasons.
- Do not use pesticides or other chemical applications to control weeds or unwanted growth.
- Conduct a biannual (twice yearly) evaluation of the health of the vegetation and remove and replace any dead or dying plants.
- Conduct semiannual inspection as follows
  - Inspect the outlet, embankments, dikes, berms, and side slopes for structural integrity and signs of erosion.
  - Examine outlets and overflow structures and remove any debris plugging the outlets. Identify and minimize any sources of sediment and debris. Check rocks or other erosion control and replace, if necessary.
  - Check inlets to make sure piping is intact and not plugged. Remove accumulated sediment and debris near the inlet.
  - Inspect for standing water and correct any problems that prevent the extended detention basin from draining as designed.

- If mosquito larvae are observed, contact the San Mateo County Mosquito Abatement District at 650/344-8592.
- Check for slope stability and the presence of rodent burrows. Fill in any holes detected in the side slopes.
- Maintenance activities at the bottom of the basin should not be performed with heavy equipment, which would compact the soil and limit infiltration.
- Remove sediment from the forebay when the sediment level reaches the level shown on the fixed vertical sediment marker.
- Remove accumulated sediment and regrade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume.
- Remove accumulated trash and debris from the extended detention basin at the middle and end of the wet season (January and April), or as needed.
- Inspect for and remove any trash and debris.
- Confirm that any fences around the facility are secure.
- Check for sediment accumulation.



Figure 8-5: Extended Detention Basin, Palo Alto

#### ***PERVIOUS PAVEMENTS (CHAPTER 6.6 AND 6.7)– COMMON MAINTENANCE CONCERNS:***

Types of pervious pavement include pervious concrete, porous asphalt, and permeable interlocking concrete pavement (PICP), concrete grid pavers, and plastic reinforcement grid pavers. All pervious pavement can become clogged with sediment over time if routine maintenance is not performed. Sources of sediment include vehicles and eroding soil, leaves and mulch from adjacent landscaped areas. Regular surface cleaning will help maintain a high surface permeability and keep out vegetation.

- Routine maintenance (two to four times annually):
  - Prevent soil from washing or blowing onto the pavement. Do not store sand, soil, mulch or other landscaping materials on pervious pavement surfaces.
  - Conduct preventative surface cleaning, using commercially available regenerative air or vacuum sweepers, to remove sediment and debris.
- Inspection (two to four times annually):
  - Check for sediment and debris accumulation on pervious pavement.
  - Check for standing water on the pavement surface within 30 minutes after a storm event if possible. Standing water indicates that restorative cleaning may be required.
  - Inspect pervious paving for any signs of pavement failure.
  - Inspect underdrain outlets and cleanouts annually, preferably before the wet season. Remove accumulated trash/debris.
- As needed maintenance:
  - Remove weeds from permeable pavement as needed. Do not use pesticides or other chemical applications to control weeds or unwanted growth near pavement

or between pavers. Vegetation in grid pavements (such as turf block) should be mowed as needed.

- Repair any surface deformations or broken pavers. Replace missing joint filler in PICP.
- If routine cleaning does not maintain the permeability, then restorative surface cleaning with a vacuum sweeper and/or reconstruction of part of the pervious surface may be required. Adjust the vacuum sweeper suction to a level that does not remove portions of the pervious pavement base layer or joint filler.
- Power washing with simultaneous vacuuming also can be used to restore surface permeability to highly clogged areas of pervious concrete, porous asphalt or PICP, but is not recommended for grid pavements.
- Replenish aggregate in PICP joints or grids as needed after restorative surface cleaning.



Figure 8-6: Permeable Interlocking Concrete Pavers (PICP) in Berkeley

***RAINWATER HARVESTING (CHAPTER 6.9) – COMMON MAINTENANCE CONCERNS:***

- Conduct annual inspections of all components, including pumps, valves, tanks, and backflow prevention systems, and verify operation.
- Inspect and clean filters and screens every three months and replace when necessary.
- Inspect and verify that disinfection, filters, and other water quality treatment devices are operational, in accordance with manufacturer’s recommendations or local jurisdiction requirements.
- If rainwater is provided for indoor use, conduct annual water quality testing per the requirements of the local jurisdiction.
  - Inspect and clear debris from rainwater gutters, roof surfaces, downspouts, roof washers, and first-flush devices every six months, or as needed, to prevent clogging. Remove tree branches and vegetation overhanging roof surfaces to reduce amount of debris.

- Maintenance requirements specific to cisterns:
  - Flush cisterns annually to remove sediment. Flushed water should drain to landscaping or to the sanitary sewer.
  - For buried structures, vacuum removal of sediment is required.
- Maintenance requirements specific to rain barrels:
  - Regularly inspect the gutters and gutter guards, downspouts, spigots, and rain barrels, and clean or replace parts as needed.
  - Inspect screens and seals prior to the wet season to make sure debris is not collecting on the surface and that there are not holes allowing mosquitoes to enter the rain barrel. Inspect screens more frequently if there are trees that drop debris on the roof.
  - Clean the inside of the rain barrel once a year (preferably at the end of the dry season when the rain barrel has been fully drained) to prevent buildup of debris. If debris cannot be removed by rinsing, use vinegar or another non-toxic cleaner. Use a large scrub brush on a long stick, and avoid actually entering the rain barrel. Drain washwater to landscaping.



Figure 8-7: Rainwater Harvesting Cistern in Oakland at Mills College

***MEDIA FILTERS (CHAPTER 6.10) – COMMON MAINTENANCE CONCERNS:***

Clogging is the primary maintenance concern for media filters, although mosquito control is also an issue. Typical maintenance requirements are as follows:

- During the wet season, inspect periodically for standing water, sediment, trash and debris, and to identify potential problems.
- Remove accumulated trash and debris in the sedimentation basin, from the riser pipe, and the filter bed during routine inspections.
- Inspect the media filter once during the wet season after a large rain event to determine whether the facility is draining completely within five days.
- If the facility drain time exceeds five days, remove the top 50 millimeters (2 inches) of sand and dispose of sediment. Restore media depth to 450 millimeters (18 inches) when overall media depth drops to 300 millimeters (12 inches).

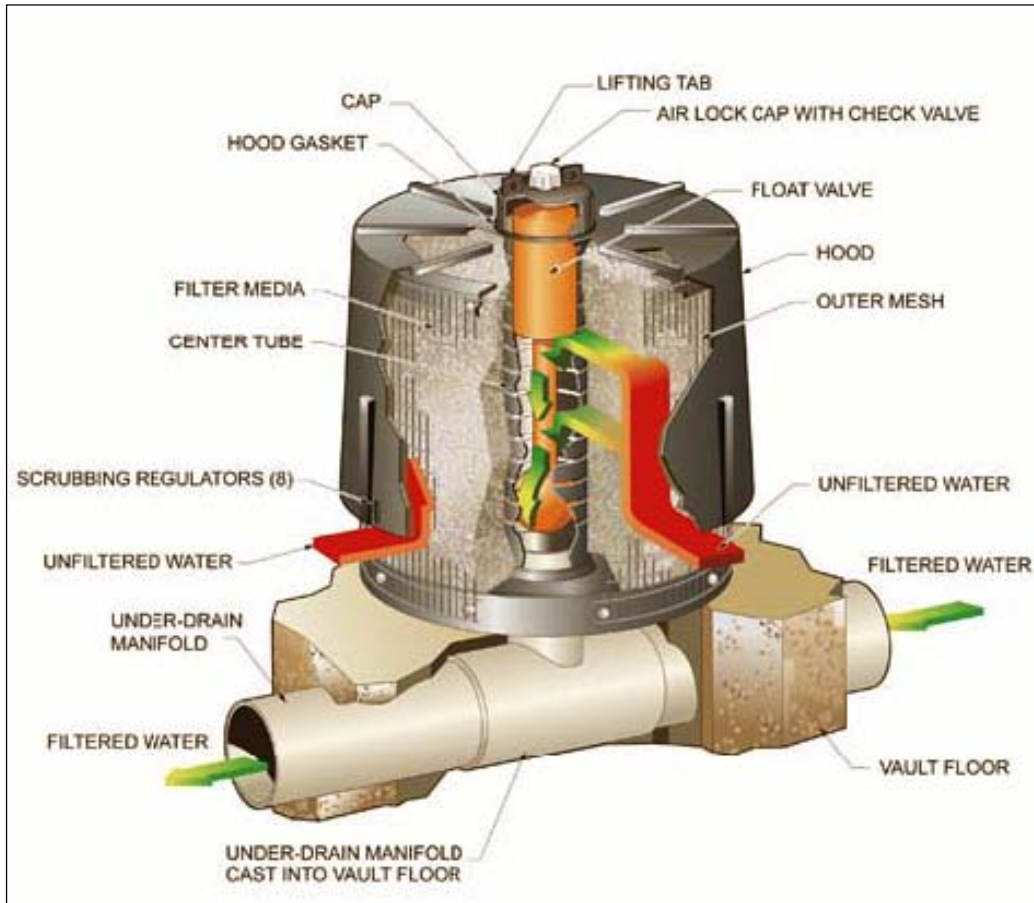


Figure 8-8: Example of a media filter cartridge (Type C, as described in Section 6.10), which is typically used as part of an array. Source: [www.stormwaterinc.com](http://www.stormwaterinc.com). This drawing is shown for general information only; its use is not an endorsement of any proprietary product.