Stormwater Best Management Practice

Sediment Filters and Sediment Chambers

Minimum Measure: Construction Site Stormwater Runoff Control
Subcategory: Sediment Control

Description

Construction sites typically use sediment filters—a type of sediment-trapping device—to remove pollutants (mainly particulates) from stormwater discharges. Sediment filters have four components: 1) inflow regulation, 2) pretreatment, 3) filter bed and 4) outflow mechanism. Sediment chambers are one component (pretreatment) of a sediment filter system.

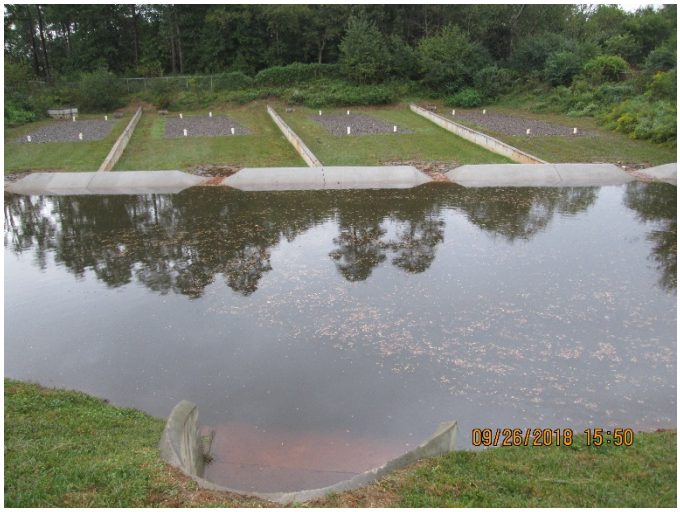
Stormwater enters the filter system or practice through the inflow regulator, which then directs it to a pretreatment sedimentation chamber. This chamber is a preliminary settling area for large debris and sediments. Construction staff can maintain the settling area like a wet detention facility or construct it to draw down over a given interval—generally 24 to 48 hours. When water reaches a predetermined level, it flows over a weir into the bed of a filter medium. The medium is typically sand, but it can consist of soil, gravel, peat, compost or a combination of these materials. The filter bed removes small sediments and other pollutants from the stormwater. Finally, treated stormwater exits the sediment filter system via an outflow mechanism. The treated stormwater discharges off-site or to a stormwater conveyance system.

Common Term

Pretreatment plays an important role in stormwater treatment. Construction staff install pretreatment structures immediately upgradient to a stormwater control to reduce flow rates and remove sediment and debris before stormwater enters the stormwater control. This helps to improve the stormwater control's pollutant removal efficiency and reduces maintenance requirements.

Applicability

Sediment filters can be a good alternative for small construction sites due to size limitations. Sediment filters are also widely applicable in urban areas with large amounts of highly impervious area. When considering whether to install this device for construction site stormwater management, site developers typically consider the size of the drainage area and sediment type. Generally, the drainage area should be no greater than 10 acres, and design engineers often recommend a size of 5 acres or less.



Water flows from a stormwater inlet into the pre-treatment basin of a sediment chamber, then overflows through weirs into four separate gravel sediment filters.
Credit: Taylor Fontaine for USEPA, 2018

The type of filter system that site developers select depends on the amount of land available and the desired location. The Austin and Delaware sand filters are examples of sediment filter systems. The Austin sand filter is a surface filter system suitable for areas with space restrictions. If space is at a premium, an underground filter might be the best choice. A Delaware sand filter can effectively remove sediment from stormwater at the perimeter of a site. It consists of two parallel, trench-like chambers that construction staff install at the site perimeter. The first trench (sediment chamber) provides pretreatment sediment settling before the stormwater spills into the second trench (filter medium).

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Siting and Design Considerations

Sediment filter systems can be a good sediment control option for urban areas with close to 100-percent impervious drainage areas or for treatment of stormwater hotspots (VDEQ, 2011). They can be confined or unconfined, online or offline, and aboveground or belowground. Confined sediment filters feature a filter medium that is contained in a structure—often a concrete vault. Unconfined sediment filters do not have a confining structure. For example, construction staff might place sand on the banks of a permanent wet pond detention system to create an unconfined filter. Online systems retain stormwater in its original stream channel or storm drain system. Offline systems divert only a portion of the main stormwater flow to a side-stream treatment location.

Space and head availability are important siting and design considerations. Head is the vertical distance between the inflow of the system and the outflow point. Because most filtering systems depend on gravity to move water through the system, if enough head is not available (2 to 10 feet depending on the design variant), the system will not be effective. Additional factors to consider include the depth-to-water table and soil infiltration capacity, especially where groundwater contamination is a concern. In all cases, maintain at least 2 feet of space between the bottom of the filter and the seasonal high groundwater table (VDEQ, 2011).

The sediment chamber area and filter bed area are the most important design parameters, as they have the largest effect on sedimentation and filtration, respectively (City of Austin, n.d.). However, as sedimentation and filtration are also a function of stormwater sediment size and type, design engineers should also consult local specifications. In addition, the depth of filter media will vary depending on media type. For sand filters, the sand (0.04-inch diameter or smaller) should be at least 18 inches deep, with at least 4 to 6 inches of gravel for the filter bed. Throughout the life of a sediment filter system, frequent access is necessary to assess the system's effectiveness and perform routine maintenance and emergency repairs. Because most maintenance requires manual rather than mechanical removal of sediments and debris, filter systems should be located to allow easy access.

Lastly, design flow rates should be carefully considered. The filter capacity should adequately ensure that sediments and debris in stormwater do not overwhelm or clog the filter medium and that the filter can handle the desired hydraulic loading (Hirschman, Seipp, & Schueler, 2017).

Limitations

Sediment filters can be costly, do not provide stormwater volume or flood control, and can be prone to clogging in cases of overloading or under-design. In addition, sediment filters may lose effectiveness in cold regions because of freezing conditions.

Maintenance Considerations

Maintenance costs of stormwater sediment filters can be relatively high compared to other sediment-trapping devices. Often, operators should perform routine and long-term maintenance activities by hand rather than mechanically due to the size of the filter. Depending on actual rainfall intensity and sediment loading, sediment chambers may require clearing and filter media may require replacing several times a year. Local guidance documents generally recommend clearing sediment chambers when more than 50 percent of the storage volume is filled and replacing filter media if standing water persists for more than 36 hours. Sometimes, replacing the top 3 to 4 inches of a filter medium may effectively restore proper infiltration rates, though this depends on specific site conditions.

Because filter media can experience high loadings of metals and petroleum hydrocarbons, site operators should analyze them periodically to ensure that those loadings do not reach levels that would classify the media as hazardous waste. This is especially true at sites that use solvents or other potentially hazardous chemicals. Regardless, site operators should appropriately remove, collect and dispose of waste that they remove from the filter.

Effectiveness

Treatment effectiveness depends on factors like treatment surface area; whether the filter is online or offline, confined or unconfined; and the type of land use in the contributing drainage area. Studies have shown that sediment filters and chambers can remove 40 to 90 percent of total suspended solids, heavy metals and organics (VDEQ, 2011).

Cost Considerations

The installation and maintenance costs of sediment filters and chambers can be high, as they are more permanent than other temporary erosion and sediment control practices (e.g., silt fence and filter socks). Costs also vary widely—reflecting the wide range of design variations—and may include costs associated with basin excavation, inflow and outflow structures, piping, concrete vaults, and filter media. The high costs may be warranted for specific sites because sediment filters and sediment chambers can more effectively control concentrated sources of stormwater sediment and pollutants.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

City of Austin. (n.d.). *Watershed protection department: Sedimentation filtration ponds*.

Hirschman, D. J., Seipp, B., & Schueler, T. (2017). *Performance enhancing devices for stormwater best management practices.*

Virginia Department of Environmental Quality (VDEQ). (2011). *Stormwater design specification no. 12: Filtering practices*.