Description

A manufactured biotreatment BMP is a modular stormwater treatment system with vegetation and engineered media that has been optimized and standardized to provide consistent performance and simplified installation. Biotreatment systems are typically housed in a precast vault, although cast-in-place systems are available to accommodate irregular footprints. Some systems can also be installed in a lined pit with no concrete container required. Vegetation type depends on the filter media type and bed size and may include shrubs planted in media (Figure 1) wetland plants or other vegetation common to conventional biofiltration systems (TC-32).

Design Considerations

- Drainage Area Size
- Potential Pretreatment Requirements

Targeted Constituents	Removal
Sediment	High
Nutrients	Med
Trash	High
Metals	Med
Bacteria	Med
Oil and Grease	High
Organics	Low

California Experience

There are currently over 1,000 installations in California.

Advantages

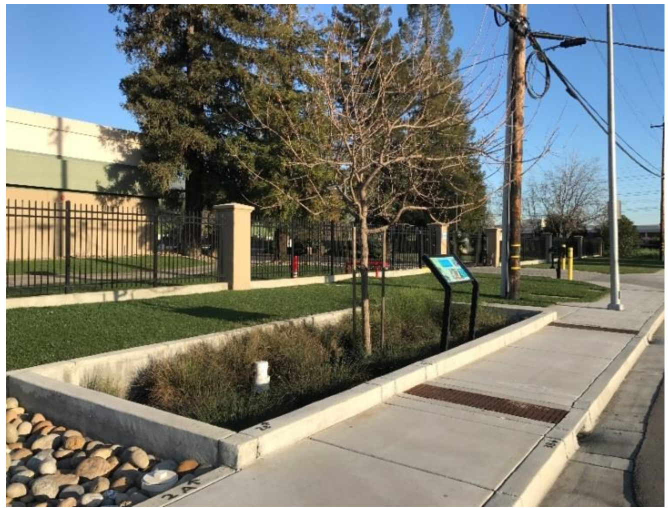
- Standardized media provides consistent performance.
- Simplified design and procurement with most systems provided to the site pre-assembled with all components and media included.
- Compact footprint resulting in more site flexibility, lower maintenance costs and lower irrigation demand where irrigation is required.
- No standing water in the biotreatment area between storms minimizing opportunity for mosquito breeding.
- Can be incorporated into the landscaping of the development.
- Provides modest habitat for insects and other small invertebrates which in turn provide food for birds and other small animals.
- Rigorous independent performance assessments are available for some biotreatment systems.

Limitations

- Individual systems typically not suitable for drainage areas greater than a few acres due to treatment flow rate limitations.
- May require irrigation during the dry season.
- Depending on drawdown time, may be a breeding ground for mosquitoes.
- Reduced evapotranspiration and infiltration potential as a result of a compact footprint.

Suitability and Design

Biotreatment consists of a modular unit that contains vegetation and media. Tree boxes typically consist of a single tree incorporated into a storm drain inlet to ensure stormwater is filtered through the media and root system. Subsurface wetland units also typically contain vegetation (e.g., trees, shrubbery) and media to allow for filtration of stormwater and may be used in conjunction with a media filter cartridges (MP-40) for flow entering the storage from a curb inlet.



Source: City of Fremont

Figure 1. Tree-well filter designed by the City of Fremont

Biotreatment devices are appropriate in ultra-urban environments where a compact treatment system footprint is desired or where reliable sources of conventional bioretention materials are unavailable. These modular systems can be integrated into the existing development or redevelopment to provide removal of particulate pollution as well as some dissolved constituents.

Design should consider local government requirements for detention and flow control. Where detention is incorporated upstream or downstream, drawdown characteristics of the biotreatment system must be compatible with the detention system.

Although many biotreatment systems exist as proprietary products, not all are. The City of Fremont has developed their own 'tree-well filter' that receives street runoff (Figure 1). This unit is designed to receive the 0.2 inch per hour intensity storm, and allows stormwater to filter through 3 inches of mulch and 18 inches of soil media before draining to a 12 inch rock layer with a raised collection pipe that leads to the storm drain network.

Construction/Inspection Considerations

Refer to manufacturer guidelines.

Performance

Biotreatment pollutant removal during a storm is primarily a result of sedimentation and physical filtration, with some media types providing significant cation exchange or other sorptive functions that can remove dissolved pollutants. Over time, between storm events, plant uptake, microbial activity, decomposition and volatilization processes transform and sequester captured pollutants.

There are numerous biotreatment design variations and media types commercially available. Performance depends primarily on the hydraulic loading rate of the media bed and the media composition. Additionally, the presence or absence of pretreatment components and mulch can affect performance. Biotreatment systems can be combined with infiltration and detention systems to reduce runoff volume.

Protocols for testing and verifying the performance of innovative stormwater treatment systems have been developed by the Washington State Department of Ecology and the New Jersey Department of Environmental Protection. Both programs provide certification or approval of treatment systems following independent verification that those systems meet certain performance targets. Both programs have been endorsed by numerous states and public agencies including EPA and the Water Environment Federation (WEF) and have been supported by the Stormwater Equipment Manufacturers Association (SWEMA).

The Technology Assessment Protocol – Ecology (TAPE) from the Washington State Department of Ecology program requires full-scale field testing and has performance standards for sediment removal (Basic Treatment), phosphorus (Phosphorus Treatment), dissolved metals (Enhanced Treatment) and hydrocarbons (Oil Treatment). All are applicable to biotreatment performance evaluation although the Oil Treatment standard is intended for influent concentrations higher than 10 mg/L which are more common at industrial sites than sites regulated by municipal stormwater permits. A list of technologies, including some biofilters that have met these treatment standards can be found on the Ecology web page for emerging technologies at: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html.

The New Jersey DEP laboratory protocol for filter devices is applicable to biotreatment systems. It requires 80% removal of a TSS gradation with a mean particle diameter of 75 microns and an 80^{th} percentile particle diameter of 8 microns. A list of technologies, including some biofilters that have met this standard can be found on the NJ DEP web page for Stormwater Manufactured Treatment Devices at: http://www.njstormwater.org/treatment.html.

To ensure acceptable biotreatment performance and operational feasibility, selection of biotreatment systems that have been verified by the Ecology and/or NJ DEP programs is recommended. Furthermore, design and sizing should be consistent with approvals issued by those programs.

Siting Criteria

Biotreatment systems typically receive runoff from the surface through a curb inlet or curb cut. Some systems can also accept an inlet pipe. As with other vegetated systems, deep installations should be avoided. Typical sites are a fraction of an acre to a few acres per system. Irrigation is typically required at least until plants are fully established.

Maintenance

Manufacturer's guidelines vary depending on system design and must be followed to ensure proper operation and performance. In general, to maximize the pollutant removal benefits of vegetation and to maintain aesthetic appeal and hydrologic function, vegetation must be harvested each growth season. For trees and shrubs, leaf litter should be removed. Other general maintenance activities may include replacement of mulch, maintenance of pretreatment components and removal of trash, debris and invasive plants.

Cost

Manufacturers' cost vary widely depending on design and size of the biotreatment. Installation costs are generally on the order of 50 to 100% of the manufacturer's cost.

Cost Considerations

- Treatment with fewer larger systems is typically more cost effective than using multiple smaller systems.

References and Sources of Additional Information

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Netzer, A., and D.E. Hughes, 1984, Adsorption of copper, lead, and cobalt by activated carbon, Water Res., 18, 927. Shapiro and Associates and the Bellevue Utilities Department, 1999, Lakemont stormwater treatment facility monitoring report, Bellevue, Washington.

New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device: http://www.njstormwater.org/pdf/filter-protocol-1-25-13.pdf

New Jersey Department of Environmental Protection, Stormwater Manufactured Treatment Devices: http://www.njstormwater.org/treatment.html

New Jersey manufactured stormwater devices' performance verification database: http://www.njcat.org/verification-process/technology-verification-database.html

Washington State manufactured stormwater devices' performance verification: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html

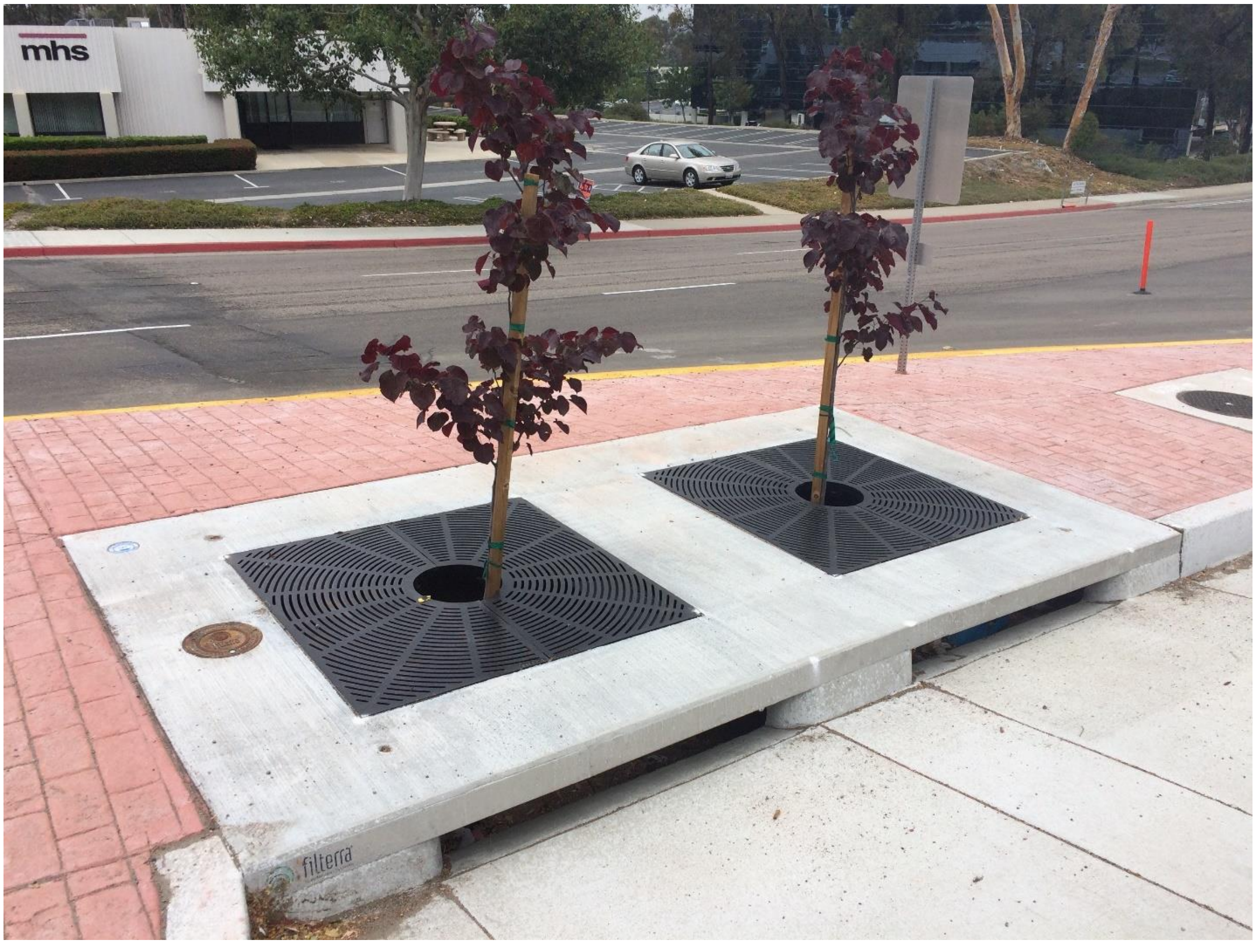

Figure 2. Tree box incorporated into a storm drain inlet in San Diego, CA