Biofiltration In Storm Water Management

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COMMUNITIES ACROSS THE NATION ARE FOCUSING ON THE NEED FOR MORE STRINGENT management of storm water runoff. Many older water treatment systems and techniques are inadequate for handling the increased volume of runoff being created by the development of sites and buildings. More roofing and paved areas are being added to portions of sites that are already impervious to rain, increasing the amount of storm water that is being prevented from infiltrating readily into the ground. This runoff, along with polluted water from parking lots, is often being discharged into outdated municipal drainage systems, and ends up in streams, rivers, lakes, and oceans.

Storm water systems are becoming essential elements in site design today. Regulatory agencies, building owners, architects, and developers recognize the need for new storm water management systems, and many are turning to LEED (Leadership in Energy and Environmental Design) criteria as benchmarks of sustainable site development. LEED site engineering guidelines include:

- The storm water system should hold, infiltrate, and filter as much water as possible on-site.
- Water should be cleaned before it is infiltrated or released off-site.
- Where appropriate, water captured on-site should be used for irrigation.
- Shade should be maximized over heat absorbent materials — such as asphalt — to reduce the "heat island" effect.

The basic premise of approval procedures related to storm water management is that a developed site should perform within the drainage basin in the same manner as the natural site. That is, a significant portion of the water should infiltrate into the soil, and the water that enters the ground water aquifer should be filtered during and by the infiltration process. The first goal is to retain the same amount of water that would have been retained by the site's natural condition. Test borings may indicate if a layer of clay or rock is close to the surface and causes an unusual amount of runoff from the natural site. Local engineering departments, however, often decline to accept this possibility as they review system designs. Rather, they imagine that the "natural" site absorbed storm water easily.

The fundamental strategy for detention is to slow the release of storm water in surface ponds or underground chambers, then allow it to be released — at a rate less than or equal to the release rate in the site's natural condition — into the municipal system or a natural stream. Generally, the retention system is designed also to promote infiltration into the ground water system.

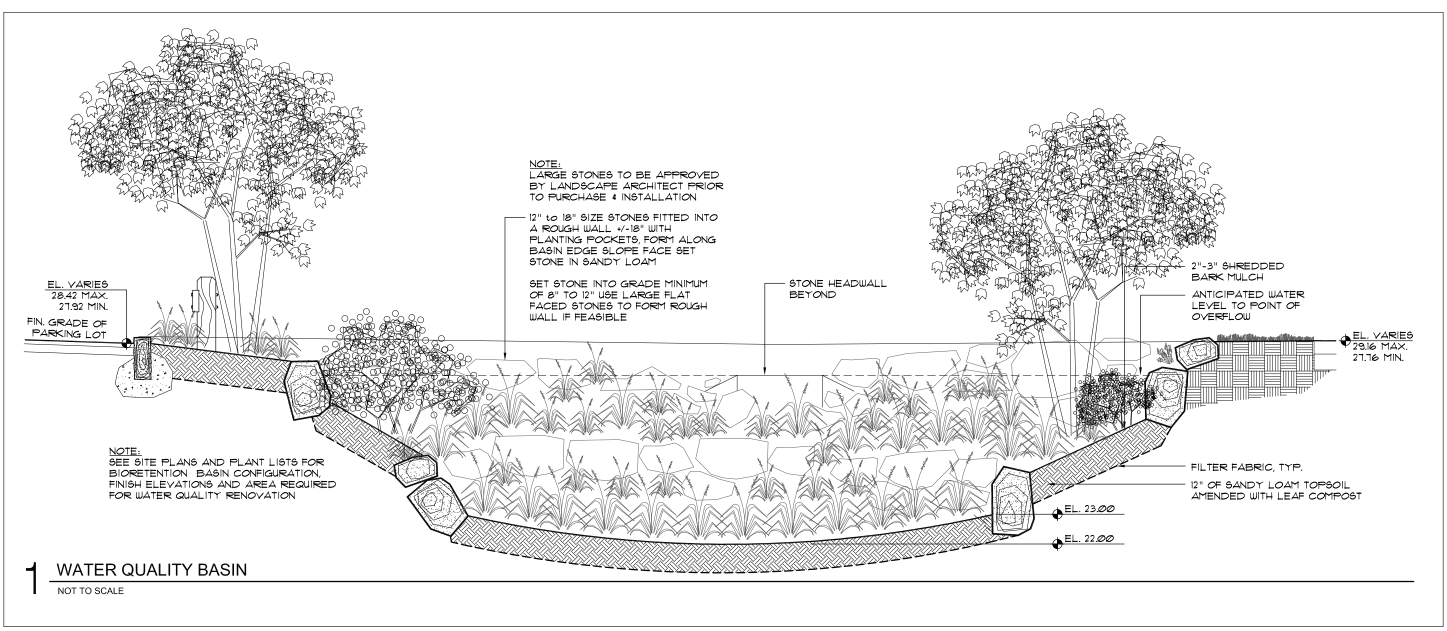

Figure 1: At the Darien Library, the biofiltration basin becomes an integral part of a naturalistic landscaped parking area.

A recently developed technique is to filter storm water that runs off from paved surfaces and roofs through grasses and other plant material on its way to a retention system. Some wetlands plants actually have the ability to absorb pollutants. This "biofiltration process" filters the runoff naturally before it is retained, so the water is clean when it is eventually released into the drainage basin.

It is especially important to clean the polluted runoff from blacktop parking lots. Asphalt is oil-based, and its surface is fouled continually by automobile emissions. In warm weather, asphalt is also hot and unpleasant. (Concrete paving reflects more heat and contributes less to the heat island effect, but concrete is costlier, and harder to repair.)

Remediation techniques which can help turn a blacktop parking lot from a detriment into a woodland include:

- Planting trees in the lot.
- Making the tree pits into biofiltration devices.
- Storing filtered water in and under the lot.
- Designing the system to have retention and filtration capacity that releases filtered water into the municipal drainage system only when there is overflow during major storm events.

Said in the simplest way, a parking lot can function almost as a natural system — and drivers get to park in the shade!

In the system for the parking lot of the new public library in Darien, Connecticut, which we designed, water collects in islands planted with trees and grasses. Biofiltration cleans the runoff before it is recharged into the aquifer (See Figure 1). Infiltration is relatively prompt on this site, as the soil is coarse and sandy. Should heavy rain fill the tree islands to capacity before it can drain into the aquifer, the water overflows into an underground retention system, and to a terraced and planted biofiltration basin area.

At the landscaped front of the library, storm water collects in a bio-swale and recharges underground before it is released into the municipal system. Only after the biofiltration and underground system are filled to capacity will the water flow through underground piping into the Town's drainage system.

Our system for the Darien Public Library provides for the biofiltration, cleaning and recharging of water on-site, and promotes the sustainability of the system through ease of maintenance. Equally important, it minimizes the release of storm water off-site, a condition that could create flooding and pollution in adjacent and downstream properties. The release of water off-site will be less than it was before the site was developed even though impervious surfaces have increased significantly.

Another storm water management design employing biofiltration is our system for the John Burroughs School, an independent school in St. Louis, Missouri. School officials had initially secured local approvals for a conventional stormwater management system. When we introduced them to the concept of biofiltration, they embraced this as an environmental and educational opportunity. The new biofiltration system we designed will be an instructional tool for the school's 600 students, who will be involved in plant selection and installation, and will learn about important environmental and sustainability issues.

The design features a tiered biofiltration system, using three sequential planted basins (See Figure 2). Storm water flows from one area into the next, and then into the campus's existing pond which serves as part of the detention system. Any overflow from the pond runs into the municipal drainage system. Infiltration of storm water into the aquifer is particularly slow on this site, as the soil is largely clay, yet runoff from the school's parking lot only reaches the pond in a major rain event. This runoff will contain much less pollution and sediment after it has been filtered through the biofiltration basin.

Drainage systems, biofiltration systems, and retention systems are not designed in a vacuum. They are parts of existing, if imperfect, ecosystems. When site development is complete, the ecosystems should not be damaged. If the combined techniques of storm water collection, filtration, and retention are used effectively, entire hydrologic systems, including surface water and ground water, can be protected, and even improved.

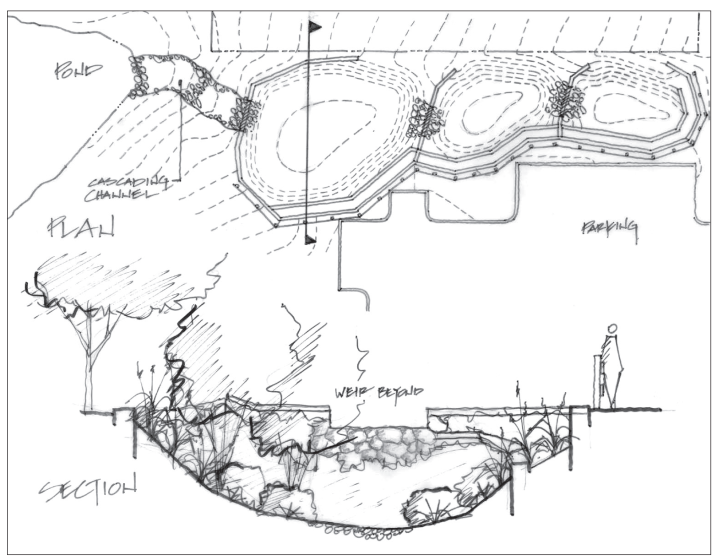

Figure 2: At the John Burroughs School in St. Louis, a sequential three-tiered bioretention basin is nestled into the site's topography.

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