

**Description** Biofiltration refers to several techniques including vegetated filter strips, buffers, and swales. They are zones of vegetation, either natural or planted, which are used to receive runoff from upslope impervious areas, slow water flow and remove suspended materials by filtration, absorption, and gravity sedimentation.

**General Information** Vegetated filter strips, buffers, and swales can function as biofiltration systems. Filter strips and buffers are zones of vegetation, either natural or planted, which are used to receive runoff in the form of sheet flow from upslope impervious areas. Such strips slow overland water flow and remove suspended materials by filtration, absorption, and gravity sedimentation. The objective is to intercept stormwater flows before they have become substantially concentrated and then to distribute this flow evenly through the vegetated filter strip.

Filter strips often include some form of level spreading device to ensure an even distribution of storm water across the vegetated area. Level spreading into natural areas of undisturbed vegetation such as riparian zones performs a similar function. A level spreader typically is an outlet designed to convert concentrated runoff to sheet flow and disperse it uniformly across a slope to prevent erosion. One type of level spreader is a shallow trench filled with crushed stone (Coffman, 2000).

Redirecting stormwater runoff from impervious surfaces to filter strips could be categorized as “hydrologic disconnection” where the objective is to disconnect flow paths and provide for runoff distribution close to the point of generation. Sidewalks and driveways can be designed to drain evenly onto adjacent vegetated zones.

Site suitability and slope are critical considerations in the use of filter strips. Applications are residential developments and campus-type commercial and office developments offering expanses of grassed or otherwise vegetated zones distributed among the building and parking areas (Delaware, 1997). Filter strips may be placed between parking bays and integrated into overall design in other ways. Filter strips function best when slopes are kept at five percent or less.

*Swales* slow water, trap sediment, and increase infiltration. Swales can be used for conveyance or infiltration facilities. When used as storm water conveyance systems, vegetated swales are located adjacent to a roadside, in a highway median, in a parking lot, or on the back or side of residential properties. Stormwater is directed into these channels and then conveyed to a storm water treatment area or off-site.

When used primarily as infiltration systems, swales are designed to move

stormwater runoff as slowly as possible along a gentle incline, keeping the runoff on the site as long as possible and allowing it to soak into the ground, boosting the soil's water retention by as much as 75 percent (Shapiro and Harrison, 2000). Swales are all built on contour or level survey lines. Check dams can be integrated into the design if necessary to increase infiltration and provide for management of larger volumes of runoff. The swale depth and width can be varied according to the site's infiltration rate, so that wider and shallower swales are made in sands, narrower and deeper swales in clay-fraction soils. Swales are ripped, graveled, sanded, or planted at the base to assist rapid water infiltration. They should be large enough to take all pavement run-off, and additional harvested and diverted overland water from the drainage area.

Along with the infiltrating function, swales cleanse runoff via their plants and soil microbes. Swales can be designed to be dry most of the time or normally wet and rely on wetland vegetation to provide water quality treatment. Trees can be used as essential components of swale planting systems to avoid waterlogged soils, even in arid areas (Mollison, 1988). Early in the life of an unplanted swale, water absorption can be slow, but the efficiency of absorption increases with age due to tree root and humus effects. As this happens, it is possible to admit water to swales from other areas, leading it in via diversion drains.

There are many examples in European cities of projects incorporating natural drainage as a key design element. The Dutch now frequently utilize what they call wadis, natural drainage ditches, as key ecological features in a number of residential projects. In Oikos, an ecological project in Enschede, the wadis are a main feature. Here, instead of conventional storm sewers, water is directed into these green swales from sidewalks and rooftops. Within these linear swales is a perforated drainpipe, surrounded by a fabric cocoon of clay pellets. The pellets actually accommodate the growth of bacteria, which provide a treatment function for collected storm water (Beatley, 2001).

Also see Idaho Stormwater BMP Catalog, Volume 4, Post-Construction BMPs: BMP #1 – Biofiltration Swale and BMP #3 – Vegetative Filter Strip.

## Additional Resources

Beatley, Timothy, 2000. *Green Urbanism, Learning from European Cities*, Island Press, Washington, D.C.

Municipality of Metropolitan Seattle, *Biofiltration Swale Performance, Recommendations, and Design Considerations*

Schueler, 1995. *Site Planning for Urban Stream Protection*. Available on Center for Watershed Protection website.

Storm Water Managers Resource Center Fact Sheets: Stormwater Management - grassed channel. Available on Stormwater Center website.

USEPA, *Storm Water BMPs: grassed filter strips*. Available on EPA web site.

USEPA, *Storm Water BMPs: grassed swales*. Available on EPA web site.

USEPA, *Storm Water Technology Fact Sheet: vegetated swale*. Available on EPA web site.

Figure 33.1. Biofiltration

