Vegetated Infiltration Basin (rain garden)

Ohio | Lake Erie Commission

SELECTION CRITERIA	
Meets Ohio EPA Criteria for New Development	Yes
Drainage Area	< 5 ac
Soils	Hydrologic Soil Group A/B
Land Required	> 5%
Cold Weather Issues	Impacts of pavement deicers on vegetation
Location Conflicts	Requires mild slopes, Separation from buildings and sanitary sewers
Mosquito and Vector Control Issues	Vector control may be necessary if facility is plugged
Pollutant Removal	Addresses particulate and dissolved constituents

DESCRIPTION

Infiltration basins are best suited for use in residential subdivisions, small commercial lots, street right-of-ways and parking lots. Infiltration basins may be too space consuming for densely populated areas where underdeveloped land is scarce. They also cannot be used to treat highly contaminated runoff where pollutants can migrate to the groundwater table.

Infiltration basins promote groundwater recharge, but the possibility for groundwater contamination must be considered where groundwater is a source of drinking water. In all circumstances, infiltration basins should be located in areas with highly porous soils where the bedrock and/or water table are located at least four feet below the bottom of the basin.

Due to potential failure as a result of sediment clogging, infiltration basins also need to be located at sites where upstream sediment control can be ensured.

Vegetated Infiltration Basin (rain garden)

OPPORTUNITIES

- Can remove up to 95-percent of suspended solids.
- Removes fine sediment, trace metals, bacteria, and oxygen-demanding substances.
- Appropriate for small sites with porous soils.
- Provide groundwater recharge and preservation of stream baseflow.

BARRIERS

- Susceptible to clogging by sediment, necessitating frequent maintenance.
- Risk of polluting groundwater depending on soil conditions and groundwater depth.
- Generally, infiltration basins should not be used where soil infiltration rates are < 0.5 in/hr.

DESIGN CONSIDERATIONS

- The underlying soils must allow drawdown of the WQv within 48 hours.
- Plans shall include a geotechnical evaluation at the site to determine field measured infiltration rates.
- The contributing drainage area to any infiltration basin should commonly be less than 10 acres of single family residential and less than 5 acres of commercial lands, depending upon amount of impervious area and runoff volume.

MAINTENANCE REQUIREMENTS

- Clear accumulated trash and debris.
- Maintain adequate vegetative cover.
- Repair any areas of erosion.

COSTS (2010 DOLLARS)

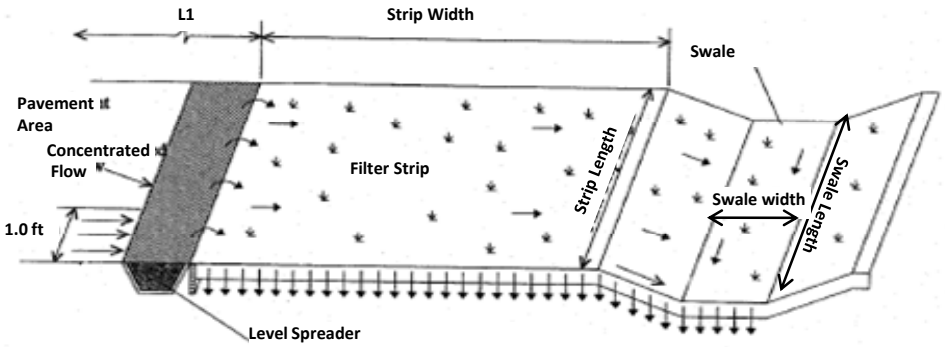
- $18 - $24 per sq.ft., $100-$3,000 / year maintenance

REFERENCES

- Hamilton County Storm Water District, 2010. Storm Water Management Guidelines for Construction and Development
- EPA Office of Water, 1999. Stormwater Technology Fact Sheet
- Ohio Department of Natural Resources, 2006. Rainwater and Land Development.
- Water Environment Research Foundation (WERF), 2009. BMP and LID Whole Life Cost Models Version 2.0
- Water Environment Federation (WEF), 2010. DRAFT Urban Runoff Quality Management Manual of Practice.

Filter Strips

Ohio Lake Erie Commission



SELECTION CRITERIA	
Meets Ohio EPA Criteria for New Development	Restricted to 1-5 acre earthwork
Drainage Area	< 5 ac
Soils	Hydrologic Soil Group A/B
Land Required	> 5%
Cold Weather Issues	Impacts of pavement deicers
Location Conflicts	Requires mild slopes
Mosquito and Vector Control Issues	Zero slopes Rutting Impermeable soils cause standing water
Pollutant Removal	Partially addresses particulate and dissolved constituents

DESCRIPTION

Strips are vegetated flat surfaces over which water flows in a thin sheet. Planted vegetation can be turf grasses, wetland plants, or a mixture of shrubs, grasses, and other landscape plants. Grass strips provide hydraulic control by maintaining sheet flow and/or shallow concentrated flow, mimicking the pre-development time of concentration. This is accomplished by laying the strip on a mild slope and passing runoff through the vegetation at depths significantly shallower than the height of the vegetation. For example, when land is limited, surrounding a basin, filter, or infiltrator with a grass strip will pretreat flows before they enter the facility directly into a stream.

OPPORTUNITIES

- Consider retrofitting grass strips in developed areas to act as vegetated filter strips.
- It may also be appropriate to use a vegetated strip for “backyard” drainage to avoid directing to a central BMP.
- Strips may be integrated into a stream setback area if sheet flow is maintained.

Filter Strips

BARRIERS

- Filter strips require relatively mild slopes and soil / climatic conditions that support dense vegetated cover.
- The use of filter strips is limited to area where a shallow flow regime is preserved prior to entering the strip.
- Typically, grass strips do not provide large reductions in storm water runoff volume unless the travel time is long and the underlying soil has a high infiltration rate.

DESIGN CONSIDERATIONS

- Grass strips are gently sloping areas between 1 and 15 percent with a vegetative cover.
- Concentrated flow should not be allowed to occur along the strips, as it causes erosion that effectively eliminates water quality benefits.
- The upstream flow path should be limited to 150 feet if vegetated and 75 feet if paved to maintain sheet flow.
- Average depth of flow no more than 1.0 in.
- Minimum length of 15 feet.
- Average velocity not greater than 1.0 ft/sec.
- Manning's n = 0.20 to 0.30.

MAINTENANCE REQUIREMENTS

- Clear accumulated trash and debris.
- Maintain adequate vegetative cover.
- Repair any areas of erosion.

COSTS (2010 DOLLARS)

- $0.40 – 0.60 per sq.ft., $300 -$2,000 / year maintenance

REFERENCES

- Hamilton County Storm Water District, 2010. Storm Water Management Guidelines for Construction and Development
- Ohio Department of Natural Resources, 2006. Rainwater and Land Development.
- American Rivers, 2006.Catching the Rain.
- Water Environment Federation (WEF), 2010. DRAFT Urban Runoff Quality Management Manual of Practice.

Filter BMPs (Bioretention, sand filter, etc.)

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SELECTION CRITERIA	
Meets Ohio EPA Criteria for New Development	Yes
Drainage Area	< 5 ac (Typical)
Soils	Hydrologic Soil Group C/D
Land Required	2-7 %
Cold Weather Issues	Impacts of pavement deicers Clogging from icing
Location Conflicts	Separation from buildings and sanitary sewers if infiltration is present Minimum elevation difference across filter
Mosquito and Vector Control Issues	Filter media clogging causes stagnant water
Pollutant Removal	Address particulates and dissolved constituents

DESCRIPTION

Filter BMPs accept and treat stormwater runoff by providing contact between the runoff and specified porous media. The degree of treatment is time-dependant; longer contact times result in better pollutant removal. Residence time is primarily controlled by outlet structures, but is also influenced by pretreatment devices and filter media. Filter BMPs can be designed inline or offline. The ability of filter BMPs to adsorb and remove runoff volumes can be enhanced through the use of native vegetation.

Filter BMPs must be located in areas with low sediment loading. Incoming sediment may clog the filter media and decrease the BMP treatment capabilities. Filter BMPs can be easily incorporated into developed areas because the space requirements are generally low.

Two commonly used filter BMPs include bioretention cells and sand filters.

Filter BMPs (Bioretention, sand filter, etc.)

OPPORTUNITIES

- High removal of sediment, trash, metals, bacteria, organics, and oil and grease.
- Filtration is the preferred technology for sites with high groundwater tables or where groundwater contamination exists.
- Flexibility in media design allows filter BMPs to be tailored to site-specific requirements for infiltration rates
- Vegetated filter BMPs may provide habitat for wildlife and become an aesthetic amenity to a community.

BARRIERS

- Susceptible to clogging by sediment, necessitating frequent maintenance.
- Risk of groundwater pollution, degree of risk depends on underlying soil conditions and groundwater table elevations.

DESIGN CONSIDERATIONS

- Include pretreatment device to dissipate runoff energy and capture large particles.
- Inline filter BMPs should be controlled by a gravity-driven stone or perforated/slotted pipe underdrain.
- Filter bed is sized according to Darcy's Law and may include multiple layer types to guide hydraulic movement and achieve desired infiltration rates.

MAINTENANCE REQUIREMENTS

- Clear accumulated trash and debris.
- Maintain adequate vegetative cover for vegetated filters.
- Repair any areas of erosion.
- For systems with an underdrain, flush clean out risers annually or as needed

COSTS (2010 DOLLARS)

- $12 per sq.ft. for open bioretention; $19 - $23 per sq.ft. for curb-contained bioretention, $700 - $6,000 / year maintenance

REFERENCES

- California Stormwater Quality Association. 2003. California Stormwater BMP Handbook New Development and Redevelopment-Bioretention.
- Pennsylvania Stormwater Best Management Practices Manual. 2006.
- Clark, Shirley and Robert Pitt, 1999, Stormwater Runoff Treatment: Evaluation of Filtration Media. US EPA Water Supply and Water Resources Division, National Risk Management Research Laboratory, Cincinnati, OH.
- Urbonas, Ben R., 2003, Stormwater Sand Filter Sizing and Design: A Unit Operations Approach, Urban Drainage and Flood Control District, Denver, CO.
- Water Environment Federation (WEF), 2010. DRAFT Urban Runoff Quality Management Manual of Practice.
- Center for Watershed Protection, 1996. Design of Stormwater Filtering Systems