Barnes Aquifer Protection Advisory Committee

Best Management Practices for Groundwater Protection Factsheets

November 2010

Proper stormwater management and treatment is critical to safe groundwater recharge. Best Management Practices (BMPs) can be used to treat water for a number of pollutants including total suspended solids (TSS), total nitrogen, total phosphorus, heavy metals, harmful bacteria, volatile organic compounds (VOCs), petrochemcials, and salts. BMPS can also be used to reduce peak flows during storm events and promote groundwater infiltration. In most cases, BMPs must be combined in a treatment chain to achieve full removal of all contaminants.

Low Impact Development (LID) practices are designed to treat stormwater runoff at the source thereby reducing its impact on surface and ground waters. LID approaches generally control flow volume and pollutant loads by infiltration, evapotranspiration, reuse of rainwater, or a combination of practices.

The following is a list of selected BMPs and LID practices that have proven effective in trials at some point in the treatment chain. A factsheet on each method is available herein. Design specifications should be sought from a qualified Professional Engineer.

Pretreatment BMPs

- Sediment Forebays
- Vegetated Filter Strips

Treatment BMPs

- Extended Dry Detention Basins
- Proprietary Media Filters
- Sand and Organic Filters
- Tree Box Filters

Conveyance BMPS

- Swales
- Drainage Swales
- Vegetated Swale
- Water Quality Swales
- Dry Swales

Wet Swales

Infiltration BMPs

Dry Wells
Infiltration Basins
Infiltration Trenches
Leaching Catch Basins
Subsurface Structures

Other BMPs

Dry Detention Basins

Sediment Forebays

Description: A sediment forebay is a small pool located near the inlet of a storm basin or other stormwater management facility. These devices are designed as initial storage areas to trap and settle out sediment and heavy pollutants before they reach the main basin.

A sediment forebay slows flow so sediment can settle out before water moves to the main pool. Image courtesy Virginia Tech.

Purpose: To remove sediment or floatables from stormwater prior to treatment.

Design considerations:

- The forebay can be a separate basin formed within the retention/detention basin
- Should include sediment depth markers
- Design to make maintenance accessible and easy
- Design to dewater between storms

Information and design specification sources:

- *Massachusetts Nonpoint Source Pollution Management Manual*, 2006 http://projects.geosyntec.com/NPSManual/Fact%20Sheets/Sediment%20Forebay.pdf

Advantages:

- Provides up to 25% TSS removal
- Slows incoming water velocities

Limitations:

- Not effective at removing dissolved pollutants
- No peak flow attenuation

Maintenance:

- Inspect at least once a month
- Clean at least four times per year
- Remove sediment to prevent resuspension

Vegetated Filter Strips

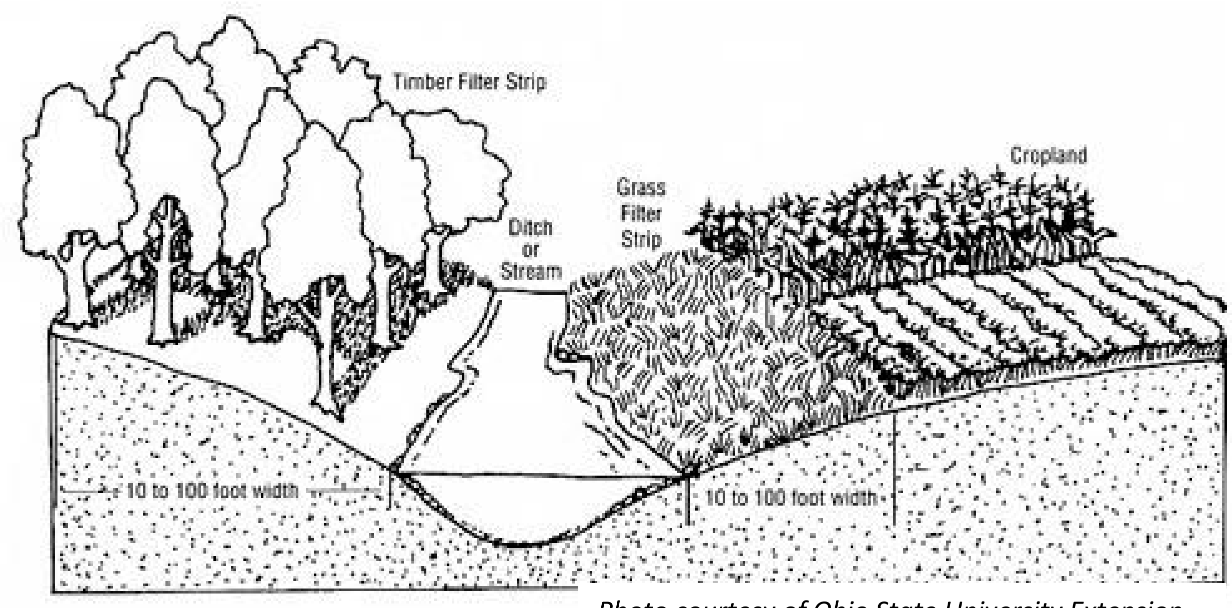


Photo courtesy of Ohio State University Extension

Description: Uniformly graded vegetated surfaces, typically grass, that are intended to treat sheet flow from adjacent impervious surfaces by slowing runoff velocities and filtering out sediment and other pollutants, and providing some infiltration. Often used as a buffer between agricultural land and surface waters as well.

Purpose: To slow runoff velocities, trap sediment, and promote infiltration.

Design considerations:

- Useful for small drainage areas
- Requires 2% - 6% slope
- Use with soils that have low clay content, poor soils that cannot sustain grass cover are also a limiting factor
- Ground water separation of 2' to 4'
- Critical design features: pea gravel diaphragm at top of slope and pervious berm of sand and gravel at the toe of the slope 25' minimum length

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 17: http://www.mass.gov/dep/water/laws/v2c2.pdf
- *Massachusetts Nonpoint Source Pollution Management Manual*, 2006 at: http://projects.geosyntec.com/NPSManual/Fact%20Sheets/Filter%20Strip%20Vegetated.pdf
- U.S. Environmental Protection Agency *Storm Water Technology Fact Sheet on Vegetated Filter Strip at:* http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse
- *Masssachusetts Low Impact Development Toolkit , Fact Sheet #3, Grass Filter Strips* at: http://www.mapc.org/sites/default/files/LID_Fact_Sheet_-_Grass_Filter_Strips.pdf

Advantages:

- Most regions except arid areas
- Good stormwater option for cold water streams
- Provides some groundwater recharge and pollutant removal

Limitations:

- Not shown to have a high pollutant removal rate
- Not useful for flood control or channel protection
- Uses large amount of space
- Difficult to properly design, slight problems, such as improper grading, can render the practice ineffective in terms of pollutant removal
- Not for treatment of hot spots

Maintenance:

- Inspect pea gravel diaphragm for clogging and remove built up sediment
- Inspect vegetation for rills and gullies and correct
- Inspect to ensure grass is established
- Remove sediment build –up within bottom 25% original capacity

Extended Dry Detention Basins

Description: Excavated basins used for the short term impoundment of stormwater runoff with controlled release through an outlet structure at predevelopment flow rates.

Purpose: To reduce peak runoff and release it over an extended period, allowing settling to occur within the basin.

Image courtesy Iowa Stormwater Partnership

Design considerations:

- Should be designed for two stages.
  One stage to regulate peak flows from large storms and another stage to detain the 2-year storm
- Pre-treatment is a must to prevent clogging
- Sediment forebay required by Massachusetts Department of Environmental Protection
- Need differential elevation between inlet and outlet
- Outlet pipe must be protected to prevent clogging
- Inlets and outlets must be placed so as to prevent short circuiting
- Drainage area should be at least 10 acres

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 49: http://www.mass.gov/dep/water/laws/v2c2.pdf
- *Massachusetts Nonpoint Source Pollution Management Manual*, 2006 http://projects.geosyntec.com/NPSManual/Fact%20Sheets/Extended%20Detention%20Basin.pdf
- U.S. Environmental Protection Agency *Storm Water Technology Fact Sheet: Dry Detention Basins* at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse

Advantages:

- High removal rate for particulate pollutants

Limitations:

- Not effective at removing dissolved pollutants

Maintenance:

- Inspect at least once a year
- Inspect during major storms to verify detention times
- Remove sediment to prevent resuspension

Proprietary Media Filters

Description: Media filters are usually proprietary two-chambered devices buried underground that include a pretreatment settling basin and a filter bed with sand or other absorptive filtering media. There are three types of proprietary media filters: the first is similar to a slow rate sand filter, the second is a simple vertical filter-slotted pipe wrapped with fabric, and the third is vertical cartridges.

Purpose: Removal of TSS or other pollutants, depending on filter media chosen.

Design considerations:

- Appropriate for all soil conditions and slopes
- Preferred for redevelopments or in ultra-urban settings when LID or larger conventional practices are not practical

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 54: http://www.mass.gov/dep/water/laws/v2c2.pdf

Advantages:

- Excellent for hot spot treatment
- Suitable for specialized applications, such as industrial sites, for specific target pollutants

Limitations:

- Needs swirl type pretreatment concentrator
- Maintenance and media replacement necessary

Maintenance:

- Annual maintenance required at a minimum

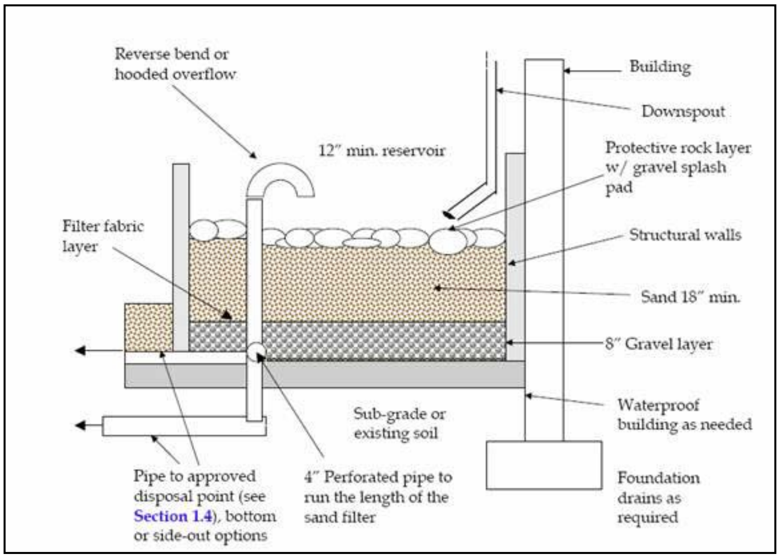
Sand and Organic Filters

Description: Designed as two-chambered stormwater practices. The first chamber is a settling chamber, and the second is a filter bed filled with sand or another filtering media. Also known as filtration basin.

Purpose: To filter stormwater through sand or other media for removal of pollutants.

Design considerations:

- Relatively small sites: 10 acres for surface sand filters and 2 acres for perimeter or underground filters
- Have been used on up to 100 acres but prone to clogging
- Slope of up to 6%
- Need 2 feet separation to groundwater
- Pretreatment occurs in sedimentation chamber



Images courtesy City of Portland, Oregon, Stormwater Manual

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 57: http://www.mass.gov/dep/water/laws/v2c2.pdf
- *Massachusetts Nonpoint Source Pollution Management Manual*, 2006 http://projects.geosyntec.com/NPSManual/Fact%20Sheets/
- Filter%20Systems_edited.pdf
- U.S. Environmental Protection Agency *Storm Water Technology Fact Sheet:*
- *Sand Filters* at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/
- index.cfm?action=browse
- University of New Hampshire Stormwater Center Treatment Unit Fact Sheets at: http://www.unh.edu/erg/cstev/fact_sheets/sand_filter_fact_sheet_08.pdf

Advantages:

- For use in most regions and most types of sites
- Uses little space
- Good for ultra-urban locations
- Excellent for hot spot treatment

Limitations:

- Modifications in cold climate conditions
- No flood control
- No stream channel erosion control
- No recharge
- Not for large areas

Maintenance:

- Make sure filter bed is free of sediments and sediment chamber is no more than half full
- General inspection of structural parts
- Ensure there is no short-circuiting

Tree Box Filters

Description: Mini bioretention systems that consist of precast concrete boxes filled with engineered soil media installed below grade at the curb line. A standard street tree or shrub is planted in the box, which resembles a curbside planter. Tree box filters are located upstream of a standard curb inlet. For low to moderate flows, stormwater enters through the tree box's inlet, filters through the soil, and exits through an underdrain into the storm drain. For high flows, stormwater will bypass the tree box filter if it is full and flow directly to the downstream curb inlet.

Purpose: To obtain good water quality treatment where space is at a premium.

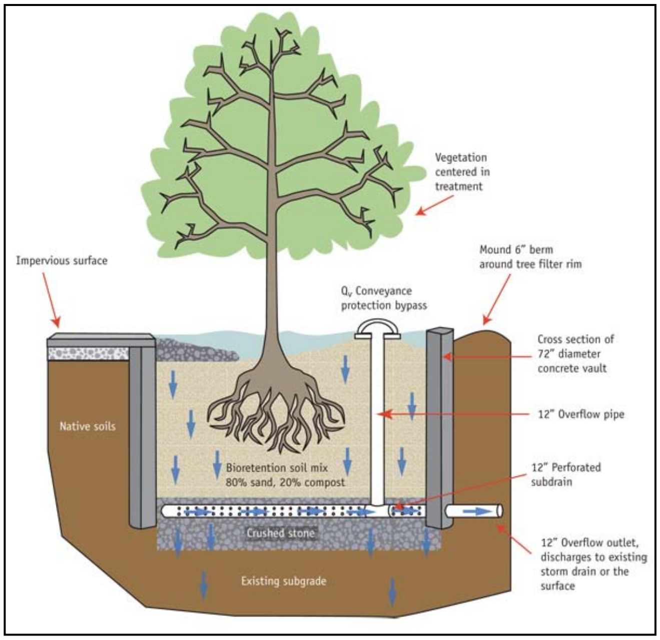


Image courtesy University of New Hampshire Stormwater Center

Design Consideration:

- Tree box filters should be regularly spaced along the length of a corridor
- Can be used in all soil conditions, and with any slope
- Can receive runoff from street or parking lots
- To treat 90% of the annual runoff, tree box filter surface area should be approximately 0.33% of the drainage area

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 61: http://www.mass.gov/dep/water/laws/v2c2.pdf
- University of New Hampshire Stormwater Center Treatment Unit Fact Sheets at: http://www.unh.edu/erg/cstev/fact_sheets/tree_filter_fact_sheet_08.pdf

Advantages:

- Ideal where infiltration is undesirable or not possible
- Hot spot locations can be fit with a shut off valve to quickly close discharge pipe
- Allows for integration of plants into landscape design
- Useful for redeveloped sites or ultra urban settings

Limitations:

- Should not be placed in a sump position
- Intended for intermittent flows and must not be used as larger event detention

Maintenance:

- Annual routine inspection and regular removal of trash and
- debris
- Mulch needs to be replenished one to two times per year
- The cleanout pipe can be used to flush the system if the underdrain becomes clogged
- With extreme drought, tree may need to be watered
- Plants may need to be replaced every 5 years

Swales

Description:

A drainage swale runs along the length of the sidewalk to capture and slow storm runoff from paved surfaces.

Drainage Swales—Vegetated open channels designed to provide for non-erosive conveyance of stormwater. Utilize existing soils – no subsurface design alterations except general grading to achieve depressed channel contour. Intended purely for conveyance of runoff.

Vegetated Swales/ Grassed Channels / Biofilter Swales—Vegetated, dry, wet or stone-lined – open, channel like structures used to convey stormwater. Runoff deliberately lagged to provide treatment.

Water Quality Swales—More complex in design and treatment efficacy than vegetated swales. Often designed with modified soils and subdrains for infiltration and recharge capacity. There are two types of water quality swales:

Check dams in this swale slow erosive flows

- *Dry Swales* – designed to temporarily hold the water quality volume of a storm in a pool or a series of pools created by permanent check dams at culverts or driveway crossings. The soil bed consists of native soils or highly permeable fill material, underlain by an underdrain system.

- *Wet Swales* – Also temporarily store and treat the required water quality volume. Unlike dry swales, wet swales are constructed directly within existing soils and are not underlain by a soil filter bed or underdrain system. Wet swales store the water quality volume within a series of cells within the channel, which may be formed by berms or check dams and may contain wetland vegetation. The pollutant removal mechanisms in wet swales are similar to those of stormwater wetlands, which rely on sedimentation, adsorption, and microbial breakdown.

Purpose:

Drainage Swales— As drainage swales provide no TSS removal, infiltration or other pollutant removal, it is meant to convey runoff from impervious surfaces to or from stormwater treatment BMPs.

Vegetated Swales/ Grassed Channels / Biofilter Swales—Treatment systems with a longer hydraulic residence time than drainage channels. The removal mechanisms are sedimentation and gravity separation, rather than filtration. In systems with more robust vegetation, additional treatment via plant uptake and sorption to organic sediments may occur. Water quality performance typically increases with vegetation density, and declines during high flows when vegetation is submerged, frozen, and/or bent. Increased detention time from check dams within the channel coupled with low velocity flows will enhance filtration, sedimentation, and infiltration.

Water Quality Swales—Designed to treat the required water quality volume and incorporate specific features to enhance stormwater pollutant removal effectiveness.

Design considerations:

Drainage Swales

- Topography of site should allow for design with sufficient slope and cross-sectional area to maintain non-erosive flow velocity
- Typically designed to convey peak discharge from 10-year storm without causing erosion
- Maximize channel capacity while minimizing erosion

Vegetated Swales/ Grassed Channels / Biofilter Swales

- Design to convey both 2-year and 10-year storms
- Select grasses to produce a fine, uniform and dense cover that can withstand varied moisture conditions
- To receive TSS credit, a sediment forebay must be provided for pretreatment

Water Quality Swales

- Must be designed for required water quality volume
- Use vegetation that is water tolerant and has dense root growth to maintain bank and slope integrity

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, pages 69 through 82: http://www.mass.gov/dep/water/laws/v2c2.pdf
- *Massachusetts Nonpoint Source Pollution Management Manual*, 2006 at: http://projects.geosyntec.com/NPSManual/Fact%20Sheets/Vegetated%20Swale.pdf
- U.S. Environmental Protection Agency *Storm Water Technology Fact Sheet:*

Grassed Swales at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=75&minmeasure=5
- University of New Hampshire Stormwater Center Treatment Unit Fact Sheet on vegetated swale at: http://www.unh.edu/erg/cstev/fact_sheets/veg_swale_fact_sheet_08.pdf
- *Masssachusetts Low Impact Development Toolkit , Fact Sheet #9, Vegetated Swales* at: http://test.mapc.org/sites/default/files/LID_Fact_Sheet_-_Vegetated_Swales.pdf

Advantages:

Drainage Swales
- Less expensive than curb and gutter system
- Keeps stormwater flows away from street surfaces

Vegetated Swales/ Grassed Channels / Biofilter Swales
- Provides pretreatment if first part of treatment train
- Accepts sheet or pipe flow
- Keeps stormwater flows away from street surfaces

Water Quality Swales
- Provides water quality and quantity control benefits
- Have higher pollutant removal efficiencies that grass channels
- Keeps stormwater flows away from street surfaces

Limitations:

Drainage Swales
- Pollutant removal efficiency typically low

Vegetated Swales/ Grassed Channels / Biofilter Swales
- Cannot alone achieve 80% TSS removal
- Does not allow for full gravity separation

Water Quality Swales
- Higher degree of maintenance than curb and gutter system
- An individual dry swale treats a relatively small area
- Wet swales can produce mosquito breeding habitat

Maintenance:

Drainage Swales
- Inspect first few months after construction and then twice a year thereafter
- Repair any rills and gullies
- Regularly mow grass channels to ensure grass height does not exceed 6 inches.
- Remove sediment and debris at least once each year
- Reseed as needed

Vegetated Swales/ Grassed Channels / Biofilter Swales
- Inspect semiannually the first year and once a year thereafter

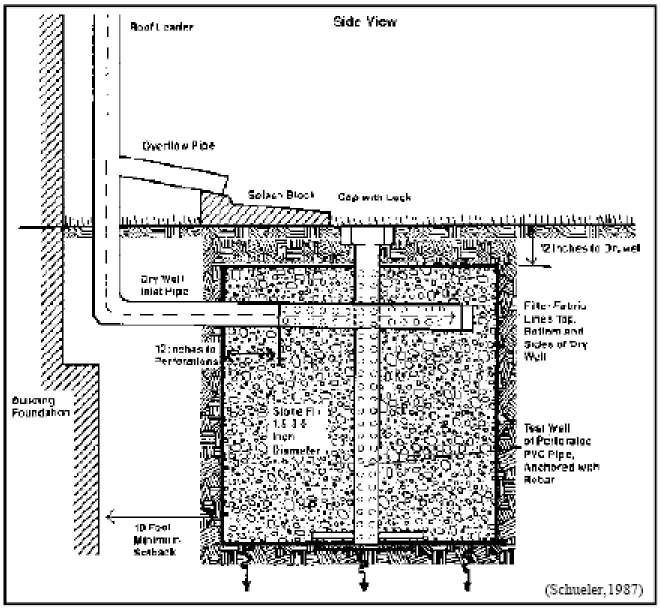
- Remove sediment from forebay annually
- When mowing, do not mow beneath the depth of the design flow during the storm associated with the water quality event (if the design flow is no more than 4 inches, do not cut the grass shorter than 4 inches).
- Repair areas of erosion and revegetate

<u>Water Quality Swales</u>

- Inspect first few months after construction to make sure vegetation gets established and then twice a year thereafter
- Regular maintenance includes mowing and pruning
- Do not cut grass shorter than three to four inches, otherwise effectiveness of reducing flow velocity and removing pollutants may be reduced.

Vegetated swale drains to outfall at lake. Pedestrian footbridge provides access over swale to public picnic area.

Dry Wells



(Schueler, 1987)

Description: A drywell is a gravel-filled excavation that is sized to manage specific rainfall events. Void space between the gravel provides underground storage for stormwater running off of impervious surfaces such as roofs. This stormwater can then gradually soak into the ground.

Purpose: To infiltrate uncontaminated runoff from non-metal roofs.

Design considerations:

- Applicable only for non-metal roofs in a Zone 2
- Only use in small drainage areas
- Should be located away from building foundations and soils must be well-drained to ensure quick infiltration of stormwater into the soils
- Direct overflow away from sidewalks and roadways
- Should include an observation well made of perforated PVC pipe to measure water depth and calculate drainage times
- Certain types of stormwater drainage wells are considered Class V Injection Wells and require registration through the Underground Injection Control Program (UIC) at the Massachusetts Department of Environmental Protection

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 84: http://www.mass.gov/dep/water/laws/v2c2.pdf
- *Masssachusetts Low Impact Development Toolkit , Fact Sheet #5, Infiltration Trenches and Drywells* at: http://www.mapc.org/sites/default/files/LID_Fact_Sheet_-_Infiltration_Trenches_and_Dry_Wells.pdf

Advantages:

- Provides groundwater recharge

Limitations:

- Only use to infiltrate runoff from non-metal roofs
- Susceptible to clogging

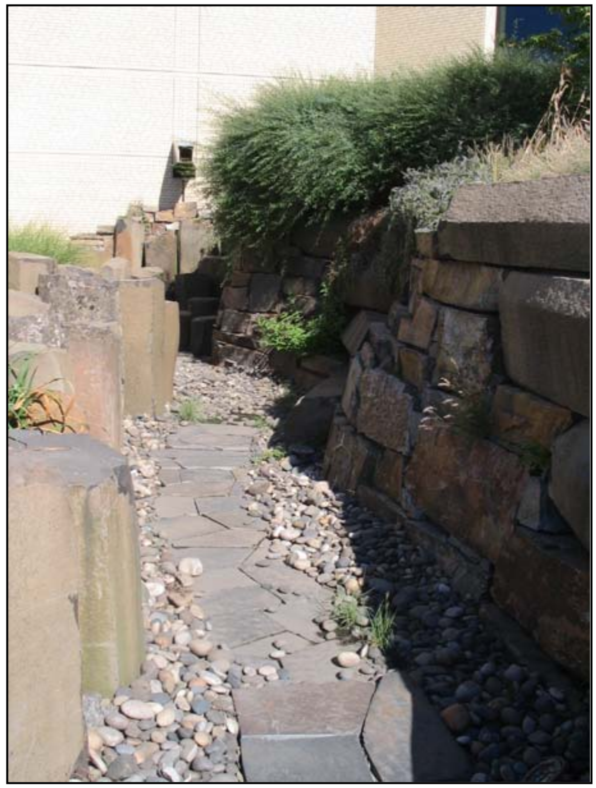
Maintenance:

- Inspect at least once a year
- Clean as needed

Infiltration Basins

Description: A shallow impoundment constructed over permeable soils to provide infiltration of stormwater into the soil. Infiltration basins can provide good pollutant removal efficiency when designed and working properly, although can have relatively high failure rates.

Purpose: To retain stormwater runoff until it infiltrates through the soil at the bottom of the basin.



A downspout from a large roof outlets to a stone-lined infiltration basin.

Design considerations:

- Need to ensure that the soils on the site are appropriate for infiltration
- Must drain in 72 hours
- Design to minimize the potential for groundwater contamination, and long term maintenance problems
- Bottom of infiltration basins needs to be completely flat to allow infiltration throughout the entire basin bottom
- Drainage area should be 15 acres or less
- Pretreatment required and multiple pretreatment BMPs preferred
- Must remove 44% TSS for land uses with Higher Potential Pollutant Loads
- Sediment forebay required
- Can be designed to control peak runoff discharges
- Inlet velocities must be controlled to prevent scouring of basin
- Requires emergency spillway
- Runoff from stockpiled snow and ice must be prevented from entering the basin

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 86: http://www.mass.gov/dep/water/laws/v2c2.pdf
- U.S. Environmental Protection Agency *Storm Water Technology Fact Sheet* on *Infiltration Basin* at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/ index.cfm?action=browse

Advantages:

- Provides groundwater recharge

- Can control peak runoff
- High removal of particulate contaminants
- Moderate removal of soluble contaminants, but low removal of soluble contaminants in courser soils (soluble pollutant removal is a function of uptake vegetation, retention time, bacterial transformation and soil bonding)

Limitations:

- Highest failure rate of any BMP
- Requires frequent maintenance due to clogging

Maintenance:

- Inspect at least twice a year
- Aerate and thatch basin bottom annually
- Cultivate vegetation for pollutant removal (tall fescue, native grasses)

Eroded stormwater outfall on lake replaced with infiltration basin and vegetated swale.

Infiltration Trenches

An infiltration trench captures sheet flow off the roof of a facility at Nasami Farm in Whately.

Description: An excavated trench filled with stone aggregate that can be designed to capture sheet flow or piped inflow. Stormwater is stored in the void space between the stone until it percolates gradually down into the subsoil.

Purpose: To infiltrate stormwater runoff

Design considerations:

- Need to ensure that the soils on the site are appropriate for infiltration
- Trench surface must be kept free of compacted snow and ice
- Pretreatment to remove sediment and hydrocarbons is required
- Drainage area should be 5 acres or less
- Multiple Pretreatment BMPs preferred
- Must remove 44% TSS for land uses with Higher Potential Pollutant Loads
- Can be designed to control peak runoff discharges
- Emergency overflow channel required to discharge runoff in excess of design storm
- Observation well required at center to monitor infiltration rates

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 94: http://www.mass.gov/dep/water/laws/v2c2.pdf
- *Masssachusetts Low Impact Development Toolkit , Fact Sheet #5, Infiltration Trenches and Drywells* at: http://www.mapc.org/sites/default/files/LID_Fact_Sheet_-_Infiltration_Trenches_and_Dry_Wells.pdf
- U.S. Environmental Protection Agency *Storm Water Technology Fact Sheet: Infiltration Trench* at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse

Advantages:

- Provides groundwater recharge
- Can provide some control of peak runoff

Limitations:

- High failure rate due to inadequate pretreatment and maintenance
- Requires frequent maintenance due to susceptibility to clogging with sediment
- Some risk of groundwater contamination
- Not suitable for sites that use or store chemicals or hazardous materials

Maintenance:

- Inspect at least twice a year and after all major storms
- Monitor observation well for design drainage rates

Leaching Catch Basins

Description: Pre-cast concrete barrel and riser with open bottom, or perforated sides that allow for infiltration of stormwater into the ground.

Purpose: To infiltrate stormwater runoff.

Design considerations:

- Need to ensure that the soils on the site are appropriate for infiltration
- Leaching catch basins must contain no outlet pipes
- Provide safe overflow for severe storms or in the event of clogging
- Not for land uses with Higher Potential Pollutant Loads
- Certain types of stormwater drainage wells are considered Class V Injection Wells and require registration through the Underground Injection Control Program (UIC) at the Massachusetts Department of Environmental Protection.

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 100: http://www.mass.gov/dep/water/laws/v2c2.pdf
- *Massachusetts Nonpoint Source Pollution Management Manual*, 2006 at: http://projects.geosyntec.com/NPSManual/Fact%20Sheets/Leaching%20Basin.pdf

Advantages:

- Provides groundwater recharge

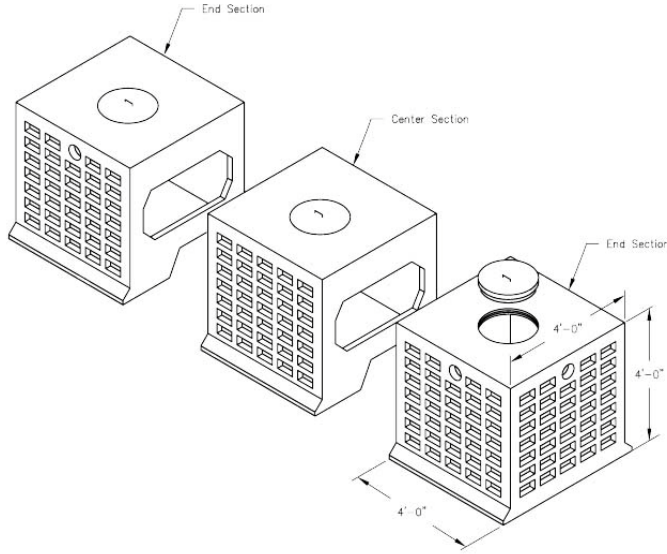
Limitations:

- Requires frequent maintenance due to susceptibility to clogging with sediment
- Can become a source of pollutants due to resuspension
- No soluble pollutant removal or fine particle removal
- Risk of groundwater contamination

Maintenance:

- Inspect at least annually
- Remove sediment when 50% full

Subsurface Structures



Description: An underground system used to capture runoff and gradually infiltrate it. Can be per-cast concrete or plastic pits, perforated pipes or galleys.

Purpose: To store and infiltrate stormwater runoff.

Design considerations:

- Need to ensure that the soils on the site are appropriate for infiltration
- Pretreatment to remove sediment and hydrocarbons is required
- Must drain within 72 hours
- Pre treatment required, and multiple pretreatment BMPs preferred
- Can be designed to control peak runoff discharges
- Emergency overflow or bypass channel required to discharge runoff in excess of design storm
- Observation well required at center to monitor infiltration rates
- Certain types of stormwater drainage wells are considered Class V Injection Wells and require registration through the Underground Injection Control Program (UIC) at the Massachusetts Department of Environmental Protection.

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 103: http://www.mass.gov/dep/water/laws/v2c2.pdf
- University of New Hampshire Stormwater Center Treatment Unit Fact Sheet on Advanced Drainage System Water Quality Unit and Infiltration System at: http://www.unh.edu/erg/cstev/fact_sheets/ads_fact_sheet_08.pdf

Advantages:

- Provides groundwater recharge
- Can provide some control of peak runoff

Limitations:

- High failure rate due to inadequate pretreatment and maintenance
- Requires frequent maintenance due to susceptibility to clogging with sediment
- Some risk of groundwater contamination
- Not suitable for sites that uses or stores chemicals or hazardous materials

- Limited pollutant removal capabilities

Maintenance:
- Inspect at least twice a year and after all major storms
- Monitor observation well for design drainage rates

Dry Detention Basins

Description: Excavated basins used for the short term impoundment of stormwater runoff with controlled release through an outlet structure at predevelopment flow rates.

Purpose: To attenuate peak flows.

Design considerations:

- Should be designed with two stage outlet structure. One stage to regulate peak flows from large storms and another stage to detain the 2-year and 10-year storm.
- Sediment forebay required by Massachusetts Department of Environmental Protection
- Need differential elevation between inlet and outlet
- Outlet pipe must be protected to prevent clogging
- Emergency spillway required to bypass runoff from large storms
- Need inlet transition structure to prevent scour

Information and design specification sources:

- *Volume 2, Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook*, page 108: http://www.mass.gov/dep/water/laws/v2c2.pdf
- *Massachusetts Nonpoint Source Pollution Management Manual*, 2006 http://projects.geosyntec.com/NPSManual/Fact%20Sheets/Dry%20Detention-Recharge%20Basin.pdf
- U.S. Environmental Protection Agency *Storm Water Technology Fact Sheet: Dry Detention Ponds* at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse

Advantages:

- Controls peak runoff for 2 and 10-year storms

Limitations:

- Not effective at removing dissolved pollutants
- Limited ability to remove TSS with limited settling of solids
- Potential for resuspension of solids
- Susceptible to frequent clogging
- Limited or no recharge

Maintenance:

- Inspect at least once a year
- Inspect sediment forebay twice a year
- Remove sediment to prevent resuspension