4/25/2018
Updated 12/20/18

The purpose of these provisional standards is to provide design guidance for new practices included in the update of Ohio's Construction General Permit on 4/23/18. These provisional standards are provided until a fully updated and edited version of the Rainwater and Land Development manual (http://epa.ohio.gov/dsw/storm/technical_guidance.aspx) can be published.

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The following provisional standards are included in this document:

- Infiltration Basin
- Pretreatment

RAINWATER AND LAND DEVELOPMENT PROVISIONAL PRACTICE STANDARD #.#

INFILTRATION BASIN

DATE: 4/20/18

Description

Infiltration basins are vegetated open impoundments located on native soils with high infiltration capacity designed to capture and infiltrate runoff into the underlying soil. Infiltration basins will infiltrate the water quality runoff event, but also can be used to meet flood control or peak discharge requirements.

Infiltration basins require sediment pretreatment practices that remove most suspended solids before entering the basin. This is typically accomplished by directing runoff through a grass filter strip, water quality swale or forebay before it is discharged to the basin.

Credits

Purpose/Objective	Credit Available	Requirements and Notes
Runoff Reduction Volume (RRv)	An infiltration basin can be used to receive a RRv credit to reduce the site's WQv requirement. Up to 100% of the WQv.	RRv must fully infiltrate within 24 hr
Groundwater Recharge Volume (GWv)	An infiltration basin can be used to help meet the Darby Watershed groundwater recharge requirement (GWv). The amount of water infiltrated within 24 hr, up to 100% of the RRv.	GWv must fully infiltrate within 24 hr [It is expected the soil profile to a depth of 24" will drain within 48 hr]

Condition Where Practice Applies

Drainage Area – Infiltration basins are well-suited for drainage areas up to 10 acres and are a preferred substitute for extended detention basins on highly permeable soils.

Soil Characteristics – Infiltration basins work well on most new development sites with hydrologic soil group (HSG) A soils, and potentially can work on HSG-B soils. Most HSG-B soils and all HSG-C and HSG-D soils are not suitable for infiltration basins because of hydraulic conductivity limitations. Soil hydraulic conductivity describes the ability of water to move through a soil. For infiltration basins to be considered, saturated hydraulic conductivity (K_{sat}) must be at least 0.5 inches per hour throughout the soil profile. Rates lower than the minimum will result in extended ponding and nuisance conditions. This typically limits infiltration basins to sandy loam or loamy sand soils, though certain loam or silt loam soils (sand content $\geq$ 50%; clay content <20%) may provide the required K_{sat}. Field tests would be needed to verify K_{sat} for loam or silt loam soils.

Sites located in gravelly soils or coarse sands (typically sites with K_{sat} > 4 in/hr) will not provide adequate runoff treatment or protection against groundwater contamination; for these sites, replacing the top 12 inches of soil with soil that meets the bioretention practice specification will provide protection against groundwater contamination. Infiltration basins should not be constructed in fill. On-site evaluation of soil parameters related to hydraulic conductivity and groundwater by a trained professional is recommended.

Previously Developed Sites - Though infiltration basins can be considered for previously developed sites, these sites present challenges (e.g., previous grading or filling of native soils, contaminated soils) that may limit their use.

Industrial or Other Areas of Potential Ground Water Contamination – This practice should not be used in heavy industrial developments, or areas with chemical storage, pesticide storage or fueling stations.

Planning Considerations

The decision to select an infiltration basin primarily depends on the following factors:

- Infiltration capacity of the underlying soil
- Presence of shallow bedrock, a shallow groundwater table or unstable slopes
- Ability to provide adequate pretreatment
- Potential for groundwater contamination

Sediment Clogging – A principle threat to infiltration basins and a common reason for their failure is clogging of the permeable soil surface. An effective pretreatment sediment trapping system is an essential part of all infiltration basin designs. Grass filter strips, grass swales and/or sediment settling forebays should be incorporated so that most sediment is removed from runoff prior to reaching the infiltration basin. Additionally, infiltration basins may not be installed until disturbance from construction has ended and soils are stabilized.

Groundwater Protection – The soils for which infiltration basins are a suitable option typically overlie high quality groundwater aquifers. Precautions must be taken to guard against the facility introducing contaminants into water supply aquifers. Excessively permeable soils (K_{sat} > 4 in/hr) will not effectively stop pollutants and should only be used for infiltration basins if a 12-in thick bioretention media cap is included to slow and treat infiltrating runoff.

Infiltration basins should be used with caution in well-head protection areas, i.e., areas of the state where the public water supply comes from ground water. At a minimum, infiltration structures should not be located within 100 feet of an active water supply well. A minimum vertical separation of 2 feet between the bottom of the infiltration basin and the seasonal high water elevation of the groundwater must be maintained, although larger separations are recommended where achievable. Normally, infiltration through soil is a highly effective and safe means of removing pollutants and protecting groundwater from contamination. Removal mechanisms involve sorption, precipitation, trapping, and bacterial degradation or transformation.

Design Criteria

Pretreatment Required – Pretreatment is required for all infiltration basins. Recommended pretreatment practices include gravel verges, filter strips, and grass swales. Concentrated flow inlet points should be pretreated through a sediment forebay.

Drain Time Requirement – The WQv must fully drain within 24 hours.

Level Infiltration Bed – The infiltration basin surface shall be level; a stepped or terraced design can be used to locate multiple level infiltration cells on gently sloping areas.

Minimum Infiltration Bed Area – The minimum area of the level infiltration bed (A_{inf}) must exceed 0.05 times the contributing impervious drainage area (A_{imp}): $A_{inf} > 0.05*A_{imp}$.

Design Infiltration Rates – For infiltration basins, the WQv must be infiltrated into soil within 24 hours. Accurately predicting the soil infiltration rate is a key input parameter for estimating WQv drain time and assuring the intended post-construction stormwater performance of infiltrating systems. Procedures to determine appropriate design infiltration rates are outlined in Section X.XX Determining Design Infiltration Rates for Infiltrating Stormwater Practices [Section Title]

The design infiltration rate of the subgrade soil will be based on field measurements at the appropriate depth and be verified during construction (see section on measurement and verification of subgrade infiltration rate). The infiltration rate shall be based on the final, after-compaction subgrade properties, if compaction is required.

Maximum Ponding Depth - The maximum ponding depth for the WQv design volume shall be 18 inches above the infiltration bed.

Vertical Separation from High Water Table or Bedrock – The infiltration basin surface should be at least two feet higher than the seasonal high water table (SHWT) or underlying bedrock. The separation can be reduced to one foot when the applicant can prove the water table will subside to its pre-storm elevation in five days or less.

Observation Wells - A minimum of one observation well shall be provided within the infiltration basin, and located toward the center of the basin, to allow tracking of water table depth in the soil underlying the basin. Observation wells should be 5 to 6 feet in depth and constructed of 1.5 to 2.0 inch diameter PVC pipe. To allow the water table to rise in the observation well, ten to twelve 0.25-inch holes should be drilled in the bottom 2-3 feet of pipe (2 holes drilled on opposite sides of the pipe on 4-inch centers) and the length of pipe with holes wrapped with geotextile filter fabric.

Side Slopes – Basin side slopes shall be a minimum of 3:1 or flatter (4:1 or flatter is recommended) to allow mowing and other maintenance.

Vegetative Cover - A dense, vigorous vegetative cover shall be established throughout the infiltration basin within one year of basin construction. A dense vegetative cover will prevent erosion and sloughing and will also help maintain relatively high infiltration rates.

Design Calculations

The area of the level infiltration bed typically will be determined from the following equation for minimum infiltration area:

$A_{inf} \geq 0.05*A_{imp}$

Where:

A_{inf} = minimum area of the basin's level infiltration area (ft^2)
A_{imp} = impervious area within the contributing drainage area (ft^2)

To show compliance with WQv requirement determine time (T_d) for WQv to fully infiltrate:

$T_d = WQv / (f)(A_{inf})$

Where,

T_d = drawdown time (hr)
WQv = water quality volume (ft^3)
f = infiltration rate of soil (in/hr)
A_{inf} = area of infiltration bed (ft^2)

Runoff Reduction Volume (RRv):

$RRv = WQv = A_{inf} * d_{WQv}$

Where:

RRv = runoff reduction volume (ft^3)
$d_{WQv} = WQv/A_{inf}$ = depth of the water quality volume (ft)

Subject to the following criteria:
Entire RRv must infiltrate within 24 hours
If the WQv does not fully drain within 24 hr, the RRv is adjusted to include only the depth of water infiltrated in 24 hr ($d_{24\text{-}hr}$):
$RRv = A_{inf} * d_{24\text{-}hr}$
The RRv cannot exceed the WQv.

Construction

For infiltrating systems, care should be taken to minimize compaction during excavation of the basin. Any compaction will reduce the infiltration capacity of the practice. Light equipment and/or tracked equipment with low ground pressure, and construction techniques (e.g., use of plywood to distribute ground pressure) that minimize compaction should be used.

Construction sequence - Timing is key to initial and long-term function of any infiltration practice. Due to their sensitivity to sediment, infiltration basins should not receive runoff from disturbed areas of the site. Runoff shall not be directed into the infiltration facility until the drainage area is stabilized and all sediment removed. A dense, vigorous vegetative cover shall be established over the contributing pervious drainage areas before runoff can be accepted into the infiltration basin.

The sequence of various phases of basin construction should be coordinated with the overall project construction schedule. Rough excavation of the basin may be scheduled with the rough grading phase of the project to permit use of the material as fill in earthwork areas. Otherwise, infiltration measures should not be constructed or placed into service until the entire contributing drainage area has been stabilized. Runoff from untreated, recently constructed areas within the drainage area may load the newly formed basin with a large volume of fine sediment. This could seriously impair the natural infiltration ability of the basin floor.

The specifications for construction of a basin should state the following: 1) the earliest point at which storm drainage may be directed to the basin, and 2) how this delay in basin use is to be accomplished. Due to the wide variety of conditions encountered among projects, each project should be evaluated separately to postpone basin use for as long as possible.

Excavation - Initially, the basin floor should be excavated to within one foot of its final elevation. Excavation to the finished grade should be delayed until all disturbed areas in the watershed have been stabilized or protected. The final phase of excavation should remove all accumulated sediment. Relatively light, tracked-equipment is recommended for this operation to avoid compaction of the basin floor. After the final grading is completed, the basin floor should be deeply tilled by means of rotary tillers or disc harrows to provide a well-aerated, highly porous surface texture.

Maintenance

For the first year of operation, infiltration basins should be inspected monthly and after each major (> 1") storm event. After the first year, quarterly inspections are recommended, preferably after a storm.

The drainage area will be carefully managed to reduce the sediment load to the infiltration basin.

Vegetation in and around the basin will be maintained at a height of six to twelve inches. Mowing is allowed only when the basin is dry (at least 72 hours after a runoff event). Mowing should occur no more than weekly and can be as infrequent as 4 to 6 mowings per year.

No portion of the infiltration basin should be fertilized after the initial fertilization required to establish the vegetation. Lime may be allowed if soil testing shows it is needed.

The top several inches of soil should be replaced (with bioretention media) when the dewatering time of the infiltration basin exceeds 24 hours. If after replacing surface media the infiltration basin still does not drain in 24 hours, more thorough investigation is required to identify and fix the operational problems.

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Detail Drawing/Specs

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RAINWATER AND LAND DEVELOPMENT PROVISIONAL PRACTICE STANDARD #.#

PRETREATMENT

DATE: 4/20/18

Description

Pretreatment practices capture coarse sediments, trash, and debris, and in some cases floatable materials and oil, prior to entry into a primary treatment practice. Pretreatment practices are part of a treatment train. On their own pretreatment practices do not meet Ohio's water quality performance standards; however, the use of properly designed pretreatment:

- limits clogging of the primary treatment practice by trash and large debris,
- protects the primary treatment practice from excessive siltation,
- extends the service life of the primary treatment practice,
- reduces overall maintenance requirements and costs, and
- increases overall pollutant removal.

Pretreatment options for concentrated flow include (1) pretreatment swales, (2) forebays, (3) flow-through treatment devices, and (4) deep sump catch basins/traps. Grass filter strips (5) are recommended pretreatment for sheetflow conditions only.

Condition Where Practice Applies

Pretreatment is recommended for all projects, especially areas with the potential to generate a high volume of trash or sediment, or where the primary treatment practice has limited maintenance access.

The principle threat to infiltration practices and a common reason for their failure is sediment clogging of the permeable soil layer. An effective pretreatment sediment trapping system is an essential part of all infiltration practices.

Many practices such as such as dry Extended Detention Basins (see chapter 2.6) require pretreatment. Underground Stormwater Management Systems require pretreatment that meets TSS removal performance standards (see chapter #.#).

Planning Considerations

Pretreatment practices:

- are NOT stand-alone treatment practices,
- should hydraulically precede one or more primary stormwater management practices, and
- should not export pollutants/sediment through re-suspension and/or flushing.

By nature, pretreatment practices may require more frequent inspections and cleaning than the primary practice. As such, they should be readily accessible for maintenance and cleaning.

If it is necessary to capture fine silts, clays, and dissolved or colloidal pollutants, advanced treatment such as filtration, chemical reactions, or biodegradation should be considered.

Design Criteria – All Practices

Capacity - All pretreatment practices shall safely overflow or bypass flow in excess of the design capacity. An offline configuration is generally recommended. Any overflow or bypass resulting from clogging of the pretreatment practice should not be diverted from the primary treatment practice or treatment train. The effects of tailwater in the receiving practice or outlet on the capacity of the pretreatment practice should be considered.

Maintenance – All Practices

Because of the generally limited sediment storage capacity and limited ability to accumulate trash, inspection of pretreatment practices should be performed quarterly and after every significant (>1") rainfall event.

PRETREATMENT SWALE

Description

Pretreatment swales are shallow, grass-lined earthen channels designed to convey flow while capturing a limited amount of sediment and associated pollutants. A Pretreatment Swale differs from a grass swale for treatment in that the Pretreatment Swale is not designed for a specified hydraulic residence time, but only for a minimum length.

To utilize Runoff Reduction credits, a grass swale must be designed to the criteria in the Grass Swale standard (Runoff Reduction Practice #.#)

Design Criteria – Pretreatment Swale

Capacity - Design the pretreatment swale to discharge the WQf at less than 1 ft/s and at a flow depth of 4" or less.

Stability – Pretreatment swales should be non-erosive for 10-yr, 24-hr event. An energy dissipater and level spreader should be used if the swale receives concentrated flow.

Cross-section Shape – Pretreatment swales shall be trapezoidal in cross-sectional shape with a 4 foot to 8-foot bottom width and minimum side slopes of 3:1. The swale bottom should be flat perpendicular to the direction of flow.

Length – Pretreatment swales receiving all or 90% of their inflow from a single inlet at the top of the swale shall be a minimum of 50 ft. in length. Swales receiving inflow distributed along one or both edges shall be a minimum of 100 ft. long such that the average flow length is 50 ft.

Slope – The maximum longitudinal grade is 4%.

Design Considerations – Pretreatment Swale

See Chapter #.#.

Maintenance – Pretreatment Swale

See Chapter #.#.

FOREBAY

Description

A forebay is an impoundment or basin located at the inlet of the primary treatment practice. A properly designed forebay includes measures to both:

(1) dissipate the energy and prevent scouring from incoming concentrated flow, and

(2) promote initial settling of coarse sediments.

Design Criteria - Forebay

Energy Dissipation – A forebay must include energy dissipation when receiving concentrated flow from a pipe or channel. Energy dissipation can be achieved through a submerged outlet pipe, rock apron or plunge pool.

Settlement Zone – A forebay should include a basin large enough to avoid resuspension of trapped sediment with a minimum depth of 3 ft. The depth of the forebay should gradually decrease towards the forebay's outlet {graphic}. A minimum length to width ratio of 1:1 is recommended to prevent short-circuiting.

Forebay Size – A forebay for a single inflow point should be 10 to 20% of the Water Quality volume. The forebay volume may be divided among multiple outlets with no single forebay less 5% of the normal pool area. Multiple inlets may require total forebay volume in excess of the minimum.

Forebay Outlet – Provide an outlet consisting of a level spreader or submerged level dike. A submerged dike separating the forebay from the main pool should be 6" to 12" below the normal water surface elevation and provide a non-erosive overflow. It should be planted with hardy emergent wetland vegetation. See the wetland extended detention pond section below for more information on planting. The design outlet discharge (q_o) should be equal to the inlet discharge (q_i).

A permanent vertical sediment depth marker should be included to facilitate inspection and cleanout.

Design Considerations - Forebay

To accommodate relatively frequent sediment cleanout, easy equipment access should be provided to the forebay (i.e. gradual slopes and free of obstructions). An access easement is recommended. A concrete or block-mat forebay bottom can facilitate cleanout. If necessary, a drain under the dike may also be included to facilitate maintenance.

Fully vegetated (wetland) forebays are effective in dissipating energy and retaining sediment.

Storage above the permanent pool may be included in the WQv.

Maintenance – Forebay

Construction – Forebay

FLOW-THROUGH TREATMENT DEVICES

Description

Several manufacturers offer a number of proprietary treatment devices that can provide pretreatment of stormwater runoff by settling, vortex flow, and/or filtration to separate trash and coarse and, in some cases, fine sediment before it enters the primary treatment practice. These devices typically treat stormwater as it flows through the practice with no significant storage or extended detention. Flow-Through Treatment Devices are often referred to as Manufactured Treatment Devices and can be classified as:

- Hydrodynamic separators,
- Oil/grit separators,
- Media filters,
- Treatment chambers, or
- Water quality inlets.

Design Criteria – Flow-Through Treatment Devices

Note: Design criteria are provided to assure compliance with post-construction stormwater requirements and sustain the stormwater system function over the long-term. Engineers shall follow design specifications and recommendations provided by the manufacturer(s) of all proprietary pretreatment devices.

Capacity - Devices must be sized for the required efficiency at the appropriate water quality flow (WQf) for the contributing drainage area. Devices must be placed offline or fitted with an internal high-flow bypass. In some cases, flows exceeding the design rate may continue to receive reduced treatment; however, this must be weighed against the risk of resuspension at high flows. An off-line configuration is recommended. The effects of tailwater from the bypass, outlet or primary practice should be evaluated. Hydraulic losses within the system should also be evaluated.

Access – All flow-through treatment devices must have sufficient access for inspection and maintenance. Manholes provided for access should be of sufficient diameter to permit needed access as well as be labeled or identified. All sediment storage zones, filters, cartridges, or removable components must be easy to access.

All pipe joints and other connections must be watertight connections.

Design Considerations – Flow Through Treatment Devices

Underground practices should be designed for the appropriate traffic loading and dead loading at the surface.

Consider clearance and accessibility for maintenance.

Underground practices may not be suitable for locations where spill control is necessary.

Maintenance – Flow-Through Treatment Devices

All flow-through treatment devices must be inspected and maintained in accordance with the manufacturer's instructions and/or recommendations.

DEEP SUMP TRAP OR CATCH BASIN

Description

A deep sump trap or catch basin is an overly deep manhole or vault-like structure designed to intercept trash and debris, as well as collect coarse sediment through limited settling. The sump may receive surface flow from an open grate or curb inlet or be a closed sump within a piped drainage system.

Design Criteria – Deep Sump Trap / Catch Basin

Capacity – Individual deep sump traps / catch basins should not receive more than 1 acre of impervious area runoff.

Outlet - The outlet pipe must be fitted with a "hood" designed to prevent floating materials from exiting the structure.

Sump – The minimum sump depth is 4 ft. or 4 times the outlet pipe diameter, whichever is greater. The inlet should be no more than 6 in. above the outlet pipe invert. The sump volume should be 10% of the WQv for the drainage area of the sump.

Cover – Unless receiving surface flow through a properly designed grate or curb inlet, the sump should be tightly covered to limit mosquito breeding.

Design Considerations – Deep Sump Trap / Catch Basin

Underground practices should be designed for the appropriate traffic loading and dead loading at the surface.

Consider clearance and accessibility for maintenance.

Maintenance – Deep Sump Trap / Catch Basin

PRETREATMENT GRASS FILTER STRIP

Description

Pretreatment grass filter strips are uniform areas of dense turf or meadow grasses with mild slopes that receive diffuse runoff from impervious surfaces. The dense turf within a grass filter strip improves the water quality of sheet flows from developed areas by slowing runoff velocity and causing deposition and filtration of suspended solids. Other pollutant removal mechanisms include nutrient uptake, adsorption and infiltration. Grass filter strips are generally not very effective for treating soluble pollutants.

To utilize Runoff Reduction credits, a grass filter strip must be designed according to the Sheet Flow to Grass Filter Strip or Conservation Area standard (Practice #.#)

Design Criteria – Pretreatment Grass Filter Strip

Filter Area - The filter width (perpendicular to direction of flow) should be equal to the width of the area draining onto it and flat. The minimum flow length (parallel to direction of flow) should be a minimum of 10 feet at slopes steeper than 10:1 (see figure). The flow length on slopes flatter than 10:1 may be as little as 5 ft.

Slope - To avoid concentrating flow, longitudinal slopes of 5:1 to 10:1 are recommended, slope should not be steeper than 4:1.

Grass Establishment – Maintain a dense, turf-forming grass cover at 4 in. to 6 in. in height. Recommend a mixture of climate appropriate grasses (may include: perennial ryegrass, tall fescue, red fescue, Kentucky bluegrass). Filter strips should be protected from vehicle or constant pedestrian traffic through the use of parking blocks and designated walkways. Flow should be diverted from the filter strip until 80% cover is established or an Erosion Control Blanket or matting should be used.

Flow Dispersion – The filter strip must receive only sheetflow from the contributing drainage area. A gravel verge or level spreader should be used at the beginning of the filter strip. Runoff may need to be redistributed where flow is restricted by parking stops/bumpers.

Design Considerations – Pretreatment Grass Filter Strip

See Sheet Flow to Grass Filter Strip or Conservation Area (Chapter #.#)

Construction – Pretreatment Grass Filter Strip

See Sheet Flow to Grass Filter Strip or Conservation Area (Chapter #.#)

Maintenance – Pretreatment Grass Filter Strip

See Sheet Flow to Grass Filter Strip or Conservation Area (Chapter #.#)

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