NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

STORMWATER RUNOFF CONTROL

(No. and Ac.)

CODE 570

DEFINITION

Controlling the quantity and quality of stormwater runoff.

PURPOSE

To control stormwater runoff to achieve one or more of the following:

- Minimize erosion and sedimentation during and following construction activities.
- Reduce the quantity of stormwater leaving developing or developed sites.
- Improve the quality of stormwater leaving developing or developed sites.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to sites where stormwater runoff causes or may cause undesirable downstream flooding, sedimentation or channel degradation and/or degradation of surface or ground water quality if left untreated. This practice may apply both to sites undergoing development as well as remedial work on already developed sites.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design and construct stormwater runoff controls to comply with applicable federal, state, and local laws and regulations.

Develop a plan to reduce the impacts of stormwater runoff from the site based on an assessment of the downstream area. As applicable, include in the plan practices or management activities that will:

Reduce onsite erosion.

Reduce offsite impacts from sedimentation.

Reduce the quantity of stormwater leaving the site to levels that will not adversely affect downstream receiving channels.

Improve the quality of runoff leaving the site.

Leave the site in a stable condition after construction.

Improve ground water recharge

Stormwater runoff practices can be installed separately or together as a system. Infiltration practices must treat the runoff from a 1 inch, 24 hour storm event. The stormwater runoff system must pass the peak runoff expected from the 10-year, 24-hour storm event. Provisions must be included to safely bypass peak runoff expected from the 100-year, 24-hour storm event without causing system failure or property damage. Peak runoff volumes will be calculated by using the method in Chapter 2 of the Natural Resources Conservation Service (NRCS) Engineering Field Handbook.

Vegetative Measures. Where appropriate, stabilize all areas disturbed by construction with vegetation as soon as possible after construction. Refer to Indiana (IN) Field Office Technical Guide (FOTG) Standard (327) Conservation Cover for areas that will be temporarily ponded and IN FOTG Standard (342) Critical Area Planting on other areas for the establishment of vegetation. If vegetation

is not appropriate for the site, use other measures to stabilize the area.

Include vegetation that can handle the condition of the practice to be installed.

Native plant species will be used whenever possible. Known invasive species will not be used.

For construction sites, watershed areas that contribute to an infiltration or water quality practice will be stabilized before the infiltration or water quality practice is installed.

Safety. Detention ponds and other areas where water is detained or flows swiftly, can present hazards to the public. Where necessary, include appropriate safety features to warn of potential dangers or deter entry to hazardous areas using fences, ledges, gates, warning signs, etc .

Additional Criteria for the Reduction of Water Quantity.

Design stormwater control systems to control flow from the area of concern to rates and volumes that will not cause degradation of downstream areas due to erosion or sedimentation. Acceptable peak rates are dependent upon the capacity and stability of the receiving channel. Local regulations may specify acceptable discharge rates for different storm frequencies.

Runoff is controlled by slowing the release of runoff from the site. This can be accomplished by onsite storage, increasing infiltration onsite, lengthening the flow path of runoff or a combination of these methods.

All runoff control methods must include provisions to safely bypass runoff in excess of the design storm.

Additional Criteria for the Improvement of Water Quality.

Runoff from developing areas can be contaminated with a variety of substances including sediment, oils, chemicals, nutrients, and trash. Runoff control systems must include provisions to reduce contaminants in the runoff leaving the site. This can include vegetated filtration areas and other biofilters, trash guards and settling areas that are readily accessible for cleanout. For runoff that is known to be contaminated with substances that may be particularly harmful to the water supply or fish and wildlife, additional measures may be necessary.

Additional Criteria for Subsurface Infiltration.

Infiltration systems provide below grade storage to allow stormwater runoff to infiltrate into the ground. These systems are a post-construction practice only. They are not to be installed for erosion control on construction sites.

The minimum drawdown time is 24 hours and the maximum drawdown time is 48 hours.

The drainage area must not exceed 5 acres, including up to 1 acre of impervious surface. The drainage area must not contain significant sources of sediment without appropriate pretreatment.

Pretreatment is mandatory to handle sediment, trash, debris and other pollutants that may damage the system. Pretreatment pollutant removal areas must be adequately designed to handle the expected load capacity. Acceptable forms of pretreatment include a roof leader sump, roof gutter guard, filter strip, vegetated swale, sediment basin or another practice which adequately removes the pollutants. Energy dissipation pretreatment is required where concentrated flow is expected.

Infiltration areas must be located a minimum of 50 feet from any private onsite wastewater treatment system and must not be hydraulically connected to the treatment system's dispersal system or cause negative impacts such as cross contamination.

Infiltration areas must be located a minimum of 10 feet down-gradient and 100 feet up-gradient of a building foundation and must not be hydraulically connected to any building or cause negative impacts to structures or pavement.

Infiltration areas must be located a minimum of 150 feet from private wells and 1200 feet from public wells. Local well head protection ordinances must be reviewed for additional requirements.

An observation well must be located within the system to monitor water drainage. The observation well must be a minimum 4 inch diameter plastic pipe with the invert at the

bottom of the infiltration bed. A lockable above-ground cap is recommended.

An overflow, or bypass system, must be included within the filtration system. Water discharged from the overflow must be conveyed to a stable outlet leading to a suitable conveyance such as a swale, storm drain, or surface water.

The field verified infiltration rate of the underlying soil must be between 0.5 and 3 inches per hour. For soils with an infiltration rate less than 0.5 inches per hour, an underdrain pipe system must be included. The minimum diameter of the underdrain pipe is 4 inches.

The minimum depth from the bottom of the infiltration area to limiting layer (including bedrock, seasonally high ground water table and dense glacial till) must be 3 feet. Where practical, a subsurface drain can be used to lower the water table.

Stone storage must be separated from soil using bedding stone or a non-woven geotextile fabric.

Side slopes of the infiltration basin must be 3 horizontal (H) to 1 vertical (V) or flatter.

Additional Criteria for Bioretention Basins.

Bioretention areas are a post-construction practice only. They are not to be installed at construction sites.

The drainage area must not exceed 5 acres, including up to 1 acre of impervious surface. The drainage area must not contain significant sources of sediment without appropriate pretreatment.

Pretreatment is mandatory when the runoff is expected to contribute excessive sediment, trash, debris and other pollutants that would be damaging to the system such as salt and oil. Pretreatment pollutant removal areas must be adequately designed to handle the expected load capacity. Energy dissipation pretreatment is required where concentrated flow is expected.

Basins must be located a minimum of 50 feet from any private onsite wastewater treatment system and must not be hydraulically connected to the treatment system's dispersal system or cause negative impacts such as cross contamination.

Basins must not be hydraulically connected to any building or cause negative impacts to structures or pavement.

The overflow system, when used, must include a weir, standpipe or other designed outlet which is used to regulate the maximum ponding depth. The weir or invert of the overflow structure must be at the elevation of the maximum ponding depth of the basin. Water discharged from the overflow must be conveyed to a stable outlet leading to a suitable conveyance such as a swale, storm drain, or surface water.

Sloped areas entering the basin must be less than 20% (excluding berms constructed as part of the bioretention basin) but greater than 0.5% for pavement and greater than 1% for vegetated areas to ensure positive flow toward the basin.

The side slopes of the berm that form the ponding area must be 3H to 1V or flatter. The outer slopes are recommended to be 5H:1V or flatter. The surface slope of the basin must not exceed 1%.

The field verified infiltration rate of the underlying soil must be between 0.5 and 3 inches per hour. For soils with an infiltration rate less than 0.5 inches per hour, an underdrain pipe system must be included. The minimum diameter of the underdrain pipe is 4 inches.

The minimum depth from the bottom of the retention area to the limiting layer (including bedrock, dense glacial till or seasonally high ground water table) must be 3 feet. Where practical, a subsurface drain can be used to lower the water table.

The design ponding depth must not exceed 18 inches. The maximum drawdown time for each basin is 48 hours. The optimal design pond depth for overall system function is 6 to 9 inches.

The planting soil mix and filter layer must be sandy loam, loamy sand or loam mixture with clay content ranging from 10 to 25 percent. The soil must have an infiltration rate of at least 0.8 inches per hour and a pH between 5.5 and 6.5. In addition the planting soil should have 1.5 to 3 percent organic content and a maximum of 500 parts per million concentration of soluble salts. Prior to

placement in the basin, the planting soil must be premixed and the moisture content must be low enough to prevent clumping and compaction during placement.

The planting soil mix and filter layer must have a sufficient depth to support the rooting depth needed for the desired vegetation and must be a minimum of 18 inches deep. Excavator buckets and vibrating plate-style compactors must not be used to induce settling.

Double shredded hardwood mulch, or equivalent non-floatable mulch, must be placed on the surface of the basin area. The mulch must be spread evenly to a maximum depth of 3 inches. The mulch must be free of foreign material.

Additional Criteria for Permeable Pavement Systems.

Permeable Pavement is a post-construction practice only. It is not to be installed at construction sites.

Porous surface options include asphalt, concrete, and pavers. Porous asphalt and concrete mixes do not include fine grade particles that are typical in their impervious counterpart. These systems must include a designed stone sub-base for infiltration to subsoil and/or to provide temporary storage.

The maximum drawdown time for the system is 48 hours.

An overflow can be used in conjunction with infiltration and storage to handle the design storm. Stone buffers, perforated pipe, and inlets are examples of overflow systems that could be used. Water discharged from the overflow must be conveyed to a stable outlet leading to a suitable conveyance such as a swale, storm drain, or surface water. The overflow must be designed with minimal chance of clogging.

Pretreatment is mandatory when the runoff is expected to contribute excessive sediment or other pollutants that would be damaging to the system such as salt and oil. Pretreatment pollutant removal areas must be adequately designed to handle the expected load capacity.

All travel surfaces must have slopes flatter than 5%.

Permeable pavement systems must be designed to handle the expected traffic load. Considerations must include weight, volume and turning movements of traffic.

The minimum depth from the bottom of the stone sub-base to a limiting layer (including bedrock, seasonally high ground water table and dense glacial till) must be 3 feet.

Sloped areas entering the permeable pavement system must be less than 20% but greater than 0.5% for pavement and greater than 1% for vegetated areas to ensure positive flow toward the system.

The field verified infiltration rate of the underlying soil must be between 0.5 and 3 inches per hour. For soils with an infiltration rate less than 0.5 inches per hour, an underdrain pipe system must be included. The minimum diameter of the underdrain pipe is 4 inches.

Do not install permeable pavement systems in a well-head protection zone. The minimum setback from on-site or off-site wells must be 100 feet; from wastewater treatment systems must be 50 feet; and from building foundations must be 100 feet up-gradient and 10 feet down-gradient. Permeable pavement must not be hydraulically connected or cause negative impacts to any well, wastewater treatment system or building.

Permeable pavement must have appropriate drainage to protect against damage caused by freeze and thaw activity.

Porous asphalt and interlocking pavers must include a choker aggregate layer to separate the stone sub-base from the surface material.

All aggregate must be uniformly graded, crushed and washed coarse aggregate. The choker course aggregate must meet the specifications of AASHTO No. 57 and the stone sub-base must meet the specifications of AASHTO No. 3.

All permeable materials must meet applicable material quality specifications and requirements for compressive strength, water absorption, and freeze-thaw resistance. Mixes and installation methods must meet appropriate American Society for Testing and Materials standards for public-use surfaces such as parking lots or roads.

Prior to construction of these systems, identify sources of storm water flow and provide a

stable bypass during the placement and curing period.

Installation must be performed by trained individuals.

Additional Criteria for Vegetated Swales.

Vegetated swales are a post-construction practice only. They are not to be installed at construction sites.

A vegetated swale is a shallow drainageway, planted with a combination of grasses and other herbaceous plants, shrubs and/or trees.

This standard does not apply if grass is the only vegetation planned for the vegetated swale - refer to the IN FOTG Standard (412) Grassed Waterway Standard.

The minimum capacity will convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Capacity will be increased as needed to account for potential volume of sediment expected to accumulate in the swale between planned maintenance activities.

Manning's equation will be used in determining the design velocity. Manning's n value will be based on channel hydraulic radius, channel alignment, an aged channel condition, and probable vegetative growth expected under normal maintenance. Unless special site studies are available to justify other values, the appropriate Manning's n factor in NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 14, Section 650.1412 (d) will be used to determine the required design capacity. During high flow events, velocities within a swale must not exceed the maximum velocity for the type of vegetation that will be used and the soil that exists at the site. The maximum permissible design velocity will ensure stability of the ditch bottom and side slopes.

The shape of a swale will be either trapezoidal or parabolic.

The bottom width of a trapezoidal shaped swale must be greater than 2 feet and less than 100 feet.

Keep the side slopes flatter than a ratio of 3H:1V. Accommodate the equipment anticipated to cross the swale in the designed width.

Provide vehicular crossings as necessary to prevent damage to the swale and its vegetation.

The capacity of the swale must be large enough so that the water surface of the swale is below the water surface of the tributary channel, terrace, or diversion that flows into the waterway at design flow.

Provide a half foot of freeboard above the designed depth when flow must be contained to prevent damage. Provide freeboard above the designed depth when the vegetation has the maximum expected retardance.

Pretreatment is mandatory when the runoff is expected to contribute excessive sediment, trash, debris and other pollutants such as salt and oil that would be damaging to the system. Pretreatment pollutant removal areas must be adequately designed to handle the expected load capacity. Energy dissipation pretreatment is required where concentrated flow is expected.

When needed to help or keep vegetation established on sites having prolonged flows, high water tables, or seepage problems, include Subsurface Drains (refer to IN FOTG Standard (606) Subsurface Drains), Underground Outlets (refer to IN FOTG Standard (620) Underground Outlets), stone center waterways, or filtering substrate (for example, a mixture of 1/3 each soil, sand and organic matter) or other suitable measures in swale designs.

Where used, subsurface drains will be located near the outer edge of the top width and at least 1-foot below the centerline grade.

Surface inlets (risers, blind inlets) will only be installed and designed up to the level needed to convey trickle flow or upstream tile outlet flow to subsurface drains, and inlets will have designed restricted flow (as with an orifice plate). Ensure that existing tile will handle additional capacity.

Provide a stable outlet with adequate capacity. The outlet can be another vegetated channel, an earthen ditch, a grade-stabilization structure, filter strip or other suitable outlet.

The minimum depth from the bottom of the retention area to bedrock or seasonally high ground water table must be 2 feet.

Newly constructed outlets must meet an appropriate NRCS standard. Existing outlets and surrounding areas (such as emergency flow areas) must be in good condition and meet one of the following criteria to be considered "stable and adequate":

1. Has required capacity specified in the IN FOTG Standard (410) Grade Stabilization Structure or other applicable standard.

2. The water flow pattern and amount flowing through the existing outlet and surrounding areas will not be significantly altered by the new vegetated swale.

Any spoil placed adjacent to the vegetated swale will have a positive grade toward the swale and will be vegetated.

An erosion control blanket (ECB) will be installed on all vegetated swale sections where either of the following exists:

1. The design velocity during establishment is 3.0 feet per second (fps) or greater.

2. Earthfill is used to fill an eroded area.

The blanket will cover at least half of the design depth.

Where soil and/or site conditions will limit the establishment, growth or vigor of vegetation, apply straw mulch on full design widths of swales where ECB is not used and the outer edges of swales with ECB.

Areas where unsuitable subsurface, subsoil, or substratum material that limits plant growth such as salts, acidity, root restrictions, etc. must be avoided unless provisions are being made and a soil scientist is involved in ameliorating the condition.

If ponding is designed using check dams or berms within the swale for increased infiltration, the ponding depth must not exceed 18 inches. The maximum drawdown time for the basin created is 48 hours. The optimal design pond depth for overall system function is 6 to 9 inches. In addition, the field verified infiltration rate of the underlying soil must be between 0.5 and 3 inches per hour. For soils with an infiltration rate less than 0.5 inches per hour, an underdrain pipe system must be included. The minimum diameter of the underdrain pipe is 4 inches.

Additional Criteria for Erosion and Sediment Control.

Control erosion on the site by limiting the amount and length of time that bare soil is exposed to precipitation. This can be accomplished by staging construction and only removing vegetation from a portion of the site at a time, revegetating areas incrementally during construction or using temporary seeding and mulching to stabilize areas until permanent vegetation can be established. Structural erosion control practices can also be installed to reduce the flow length and velocity of runoff to limit erosion.

When erosion cannot be stopped at the source, sediment laden runoff must be filtered or detained to allow sediment particles to settle out to acceptable levels before runoff is released from the site. This can be accomplished by sediment traps, sediment basins and other structures designed to detain or filter runoff. Refer to IN FOTG Standard, (350) Sediment Basin for design requirements for sediment basins.

CONSIDERATIONS

Research has shown that the first runoff from a site is often the most contaminated. After this initial flush, fewer pollutants are available for removal and dilution lessens the impact. Consequently treatment of this "first flush" of runoff is often sufficient to address the water quality concern. The exact amount of runoff to treat varies depending upon the surface and level of contamination. Determine the amount of runoff to treat based on appropriate research or experience.

Stormwater control practices can affect downstream hydrology. While this is the point of most stormwater control systems the effect of changing the peak rate and volume of runoff should be considered on downstream areas. The effect of a single project should also be considered in context with other projects in the watershed to determine the cumulative effect. Generally peak rates of runoff should be kept at or below pre-development rates of runoff from the site for the 2 year 24 hour storm. For

already developed areas consider reducing the peak flow from the current developed condition.

Where possible, stormwater control practices should be constructed with excavating equipment operating from the side of the practice to avoid excessive compaction.

Design stormwater control practices to fit into the visual landscape as well as to function for runoff control. Since stormwater control practices are generally installed in public spaces, consider how the space will be used and the visual impact the practices will have.

If properly designed, stormwater control practices can be beneficial to wildlife. Avoid using invasive species and when possible use native vegetation to provide food and habitat for wildlife and pollinators. Since most stormwater control practices are in aquatic environments, they can inhibit the movements of aquatic organisms. When designing these structures include provisions for the safe passage of aquatic organisms that may inhabit the site.

To be most effective, stormwater control should include a system of practices working together. This might include detention along with infiltration areas and the maintenance of natural, undisturbed areas. However, it could also include managing the development of the site to limit the disturbed area, ensuring that revegation occurs in a timely manner and controlling where heavy equipment is allowed to travel on a site.

Large storms can quickly fill stormwater runoff practices with sediment that must be removed in order for the practices to function correctly. Consequently these practices should be designed for easy access and maintenance.

Since stormwater control practices are often installed in urban and public spaces, vandalism may be a problem. Consider using practices that cannot be easily vandalized such as grouting rock in place and installing barriers and locks where appropriate.

A Bioretention or infiltration basin should be placed such that it is visible to encourage routine maintenance.

Consider using trash or animal guards where appropriate at the inlet or outlet of pipes.

In areas where permeable pavement is not an option due to heavy traffic loads and/or excessive turning movements, consider installing porous pavement adjacent to impervious surfaces. Grade the impervious surface in a manner in which surface water is directed to the porous surface. The impervious area should not exceed 5 times the area of the porous pavement receiving the runoff.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for stormwater runoff control systems that describe the requirements for applying the practice according to this standard. As a minimum the plans and specifications will include:

A plan view showing the extent of the practice.

Where appropriate, cross-sections and/or profiles showing elevations and distances.

Where appropriate, plans for structural details.

Where appropriate, seeding and/or planting requirements.

Construction specifications that describe in writing site specific installation requirements for the stormwater runoff control systems.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator. The minimum requirements to be addressed in the operation and maintenance plan are:

Periodic inspections, especially immediately following significant rainfall events.

Prompt repair or replacement of damaged components especially surfaces that are subjected to wear or erosion.

Regular inspection of settling basins, trash guards and other practices to collect and remove accumulated sediment and debris. Dredged material must be disposed of properly.

Any plant species, whose presence or overpopulation may jeopardize the practice, will be controlled. Spraying or other control methods will be performed on a “spot” basis to

protect forbs/legumes that benefit native pollinators and other wildlife.

Maintenance measures must be adequate to control noxious weeds and other invasive species.

Inspections, reseeding, or replanting, fertilization, and pest control may be needed to insure that the practice functions as intended throughout its expected life. Any use of fertilizers, pesticides and other chemicals will not compromise the intended purpose.

Do not use porous pavement areas for equipment or material storage. Soil must not be deposited on these surfaces at any time.

Porous asphalt or concrete surfaces must be vacuumed a minimum of two times per year.

Avoid using deicing agents on permeable pavement surfaces.

REFERENCES

Bannerman, Roger, and E. Considine, 2003. Rain Gardens: A How-to Manual for Homeowners. University of Wisconsin Extension Publication GWQ037 or Wisconsin Department of Natural Resources Publication PUB-WT-776 2003. Madison, WI

U. S. Environmental Protection Agency. 2007. Developing Your Stormwater Pollution Prevention Plan. Washington, DC

United States Environmental Protection Agency. 1999. Stormwater Technology Fact Sheet: Bioretention. Publ. EPA-832-F-99-012. Office of Water, Washington, D.C.

Indiana Department of Environmental Management. 2007. Indiana Stormwater Quality Manual. Indianapolis, Indiana.

City of Indianapolis. 1995 (with updated revisions). Stormwater Design and Specification Manual.