MIDDLECREEK TOWNSHIP

STORMWATER MANAGEMENT

ORDINANCE

No. 2009 - _____

Adopted: _____

CONTENTS

ARTICLE I - GENERAL PROVISIONS

Section 101. Short Title

This Ordinance shall be known and may be cited as the "Middlecreek Township Stormwater Management Ordinance".

Section 102. Statement of Findings

The Board of Supervisors of Middlecreek finds that:

A. Inadequate management of accelerated runoff of stormwater resulting from development throughout a watershed increases flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to carry and control stormwater, undermines flood plain management and flood control efforts in downstream communities, reduces groundwater recharge, threatens public health and safety, and increases non-point source pollution of water resources.

B. A comprehensive program of stormwater management, including reasonable regulation of development and activities causing accelerated runoff, is fundamental to the public health, safety and welfare and the protection of people of the Commonwealth, their resources and the environment.

C. Stormwater is an important water resource, which provides groundwater recharge for water supplies and base flow of streams, which also protects and maintains surface water quality.

D. Federal and state regulations require certain municipalities to implement a program of stormwater controls. These municipalities are required to obtain a permit for stormwater discharges from their separate storm sewer systems under the National Pollutant Discharge Elimination System (NPDES).

Section 103. Purpose

The purpose of this Ordinance is to promote health, safety, and welfare within the Township and its watershed by minimizing the harms and maximizing the benefits described in Section 102 of this Ordinance, through provisions designed to:

A. Meet legal water quality requirements under state law, including regulations at 25 Pa. Code Chapter 93 to protect, maintain, reclaim and restore the existing and designated uses of the waters of this Commonwealth.

B. Preserve the natural drainage systems as much as possible.

C. Manage stormwater runoff close to the source.

D. Provide procedures and performance standards for stormwater planning and management.

E. Maintain groundwater recharge, to prevent degradation of surface and groundwater quality and to otherwise protect water resources.

F. Prevent scour and erosion of stream banks and streambeds.

G. Provide proper operation and maintenance of all permanent Stormwater Management (SWM) Best Management Practices (BMPs) that are implemented within the Township.

H. Provide standards to meet NPDES permit requirements.

Section 104. Statutory Authority

A. Primary Authority:

The Township is empowered to regulate these activities by the authority of the Act of October 4, 1978, P.L. 864 (Act 167), 32 P.S. Section 680.1 et seq., as amended, the Storm water Management Act" and the Second Class Township Code.

B. Secondary Authority:

The Township also is empowered to regulate land use activities that affect runoff by the authority of the Act of July 31, 1968, P.L. 805, No. 247, "The Pennsylvania Municipalities Planning Code", as amended.

Section 105. Applicability.

This Ordinance shall apply to all areas of Middlecreek Township, any Regulated Activity within Middlecreek Township

Earth disturbance activities and associated stormwater management controls are also regulated under existing state law and implementing regulations. This Ordinance shall operate in coordination with those parallel requirements; the requirements of this Ordinance shall be no less restrictive in meeting the purposes of this Ordinance than state law.

The following activities are defined as "Regulated Activities" and shall be regulated by this Ordinance:

A. Earth Disturbance Activities

B. Land Development

C. Subdivision

D. Construction of new or additional impervious or semi-pervious surfaces

E. Construction of new buildings or additions to existing buildings

F. Diversion or piping of any natural or man-made stream channel

G. Installation of stormwater management facilities or appurtenances thereto

H. Installation of stormwater BMP

See Section 302 of this Ordinance for Exemption/Modification Criteria.

Section 106. Repealer

Any other ordinance provision(s) or regulation(s) of the Township inconsistent with any of the provisions of this Ordinance is(are) hereby repealed to the extent of the inconsistency only.

Section 107. Severability

In the event that a court of competent jurisdiction declares any section or provision of this Ordinance invalid, such decision shall not affect validity of any of the remaining provisions of this Ordinance.

Section 108. Compatibility with Other Requirements

Approvals issued and actions taken under this Ordinance do not relieve the Applicant of the responsibility to secure required permits or approvals for activities regulated by any other code, law, regulation or ordinance.

ARTICLE II- DEFINITIONS

For the purposes of this Ordinance, certain terms and words used herein shall be interpreted as follows:

A. Words used in the present tense include the future tense; the singular number includes the plural, and the plural number includes the singular; words of masculine gender include feminine gender; and words of feminine gender include masculine gender,

B. The word "includes" or "including" shall not limit the term to the specific example but is intended to extend its meaning to all other instances of like kind and character.

C. The words "shall" and "must" are mandatory; the words: “may” and "should" are permissive.

Agricultural Activity — Activities associated with agriculture such as agricultural cultivation, agricultural operation, and animal heavy use areas. This includes the work of producing crops including tillage, land clearing, plowing, disking, harrowing, planting, harvesting crops, or pasturing and raising of livestock and installation of conservation measures. Construction of new buildings or impervious area is not considered an Agricultural Activity for purposes of this ordinance.

Applicant - A landowner, developer or person who has filed an application to the Township for approval to engage in any Regulated Activity at a project site in the Township.

Best Management Practice (BMP) – Activities, facilities, designs, measures or procedures used to manage stormwater impacts from Regulated Activities, to meet State Water Quality Requirements, to promote groundwater recharge and to otherwise meet the purposes of this ordinance. Stormwater BMPs are commonly grouped into one of two broad categories or measures: “structure” and “non-structure”. In this ordinance, non-structural BMPs or measures refers to operation and/or behavior-related practices that attempt to minimize the contact of pollutants with stormwater runoff, whereas structural BMPs or measures are those that consist of a physical device or practice that is installed to capture and treat stormwater runoff. Structural BMPs include, but are not limited to, a wide variety of practices and devices, from large-scale retention ponds and constructed wetlands, to small-scale underground treatment systems, infiltration facilities, riparian or forested buffers, sand filters, detention basins, and manufactured devices. Structural Stormwater BMPs are permanent appurtenances to the project site.

Conservation District - A conservation district, as defined in section 3(c) of the Conservation District Law (3 P. S. § 851(c)), as amended, that has the authority under a delegation agreement executed with the Department to administer and enforce all or a portion of the regulations promulgated under 25 Pa. Code 102.

Design Storm - The magnitude and temporal distribution of precipitation from a storm event measured in probability of occurrence (e.g. a 5-year-storm) and duration (e.g. 24 hours), used in the design and evaluation of stormwater management systems. Also see Return Period.

Detention Volume - The volume of runoff that is captured and released into the waters of this Commonwealth at a controlled rate.

DEP - The Pennsylvania Department of Environmental Protection.

Development Site (Site) - See Project Site.

Disconnected Impervious Area (DIA) - An impervious or impermeable surface which is disconnected from any stormwater drainage or conveyance system and is redirected or directed to a pervious area which allows for infiltration, filtration, and increased time of concentration as specified in Appendix B, Disconnected Impervious Area

Disturbed Area - An unstabilized land area where an Earth Disturbance Activity is occurring or has occurred.

Earth Disturbance Activity - A construction or other human activity which disturbs the surface of the land, including, but not limited to clearing and grubbing; grading; excavations; embankments; road maintenance; building construction: the moving, depositing, stockpiling or storing of soil, rock or earth materials.

Erosion - The natural process by which the surface of the land is worn away by water, wind or chemical action.

Existing Condition - The dominant land cover during the five (5) year period immediately preceding a proposed Regulated Activity.

FEMA – Federal Emergency Management Agency.

Floodplain - Any land area susceptible to inundation by water from any natural source or delineated by applicable FEMA maps and studies as being a special flood hazard area. Also includes areas that comprise Group 13 Soils, as listed in Appendix A of the Pennsylvania DEP Technical Manual for Sewage Enforcement Officers (as amended or replaced from time to time by PADEP).

Floodway - The channel of the watercourse and those portions of the adjoining floodplains that are reasonably required to carry and discharge the 100-year flood. Unless otherwise specified, the boundary of the floodway is as indicated on maps and flood insurance studies provided by FEMA. In an area where no FEMA maps or studies have defined the boundary of the 100-year floodway, it is assumed -- absent evidence to the contrary -- that the floodway extends from the stream to 50 feet from the top of the bank of the stream.

Forest Management/Timber Operations - Planning and activities necessary for the management of forestland. These include conducting a timber inventory, preparation of forest management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, site preparation and reforestation.

Hydrologic Engineering Centers River Analysis System (HEC-RAS) – An interactive computer-based software program available from the US Army Corp of Engineers, for one-dimensional river modeling using steady-flow, unsteady-flow and sediment-transport computations. The system can be downloaded fro<m the US Army Corp of Engineers [6].

Hydrologic Soil Group (HSG) - Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. The NRCS defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of the development site may be identified from a soil survey report that can be obtained from local NRCS offices or conservation district offices. Soils become less pervious as the HSG varies from A to D (NRCS[3,4])

Impervious Surface (Impervious Area) - A surface that prevents the infiltration of water into the ground. Impervious surfaces (or areas) shall include, but not be limited to, roofs, additional indoor living spaces, patios, garages, storage sheds and similar structures, and any new streets or sidewalks. Decks, parking areas, and driveway areas are not counted as impervious areas if they do not prevent infiltration.

Karst – A type of topography or landscape characterized by surface depressions, sinkholes, rock pinnacles/uneven bedrock surfaces, underground drainage and caves. Karst is formed on carbonate rocks, such as limestone or dolomite.

Land Development (Development) – Inclusive of any or all of the following meanings: (i) the improvement of one lot or two or more contiguous lots, tracts, or parcels of land for any purpose involving (a) a group of two or more buildings, or (b) the division or allocation of land or space between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups, or other features; (ii) any subdivision or land; (iii) development in accordance with Section 503 (1.1) of the Pa Municipalities Planning Code.

Township – Middlecreek Township, Snyder County

NRCS – USDA Natural Resources Conservation Service (previously SCS).

Peak Discharge – The maximum rate of stormwater runoff from a specific storm event.

Pervious Area - Any area not defined as impervious.

Project Site - The specific area of land where any Regulated Activities in the Township are planned, conducted or maintained.

Qualified Professional - Any person licensed by the Pennsylvania Department of State or otherwise qualified by law to perform the work required by the Ordinance.

Qualified Township Representative – Any approved Engineer, Ordinance Enforcement Officer and/or Township Planning Commission member appointed as such by the Township Planning Commission

Record Drawing - Revised set of drawings submitted by a contractor upon completion of a project or a particular job. Record Drawing shall reflect all changes made in the specifications and working drawings during the construction process, and show the exact dimensions, geometry, and location of all elements of the work completed under the contract.

Regulated Activities - Any Earth Disturbances Activities or any activities that involve the alteration or development of land in a manner that may affect stormwater runoff.

Regulated Earth Disturbance Activity - Activity involving Earth Disturbance subject to regulation under 25 Pa. Code Chapter 92, Chapter 102, or the Clean Streams Law.

Retention Volume/Removed Runoff – The volume of runoff that is captured and not released directly into the surface waters of this Commonwealth during or after a storm event.

Return period – The average interval, in years, within which a storm event of a given magnitude can be expected to occur one tie. For example, the 25-year return period rainfall would be expected to occur on average once every 25 years; or stated in another way, the probability of a 25-year storm occurring in any given year is 0.04 (i.e., a 4% chance).

Runoff - Any part of precipitation that flows over the land.

Sediment - Soils or other materials transported by the surface water as a product of erosion.

State Water Quality - The regulatory requirements to protect, maintain, reclaim, and restore water quality under Pennsylvania Code Title 25 and the Clean Streams Law.

Stormwater - Drainage runoff from the surface of the land resulting from precipitation or snow or ice melt.

Stormwater Management Facility – Any structure, natural or man-made, that, due to its condition, design or construction, conveys, stores or otherwise affects stormwater runoff. Typical stormwater management facilities include, but are not limited to, detention and retention basins, open channels, storm sewers, pipes, and infiltration facilities.

Stormwater Management Plan - Such stormwater management plan for managing stormwater as may, in the future, be adopted by the County of Snyder as required by the Act of October 4, 1978, P.L. 864, amended, and known as the "Storm Water Management Act". As of the date of the adoption of this Ordinance, no such plan has been adopted by Snyder County.

Stormwater Management Best Management Practices - Is abbreviated as **BMPs** or **SWM BMPs** throughout this Ordinance.

Stormwater Management Site Plan - The plan prepared by the Developer or his representative indicating how storm water runoff will be managed at the development site in accordance with this Ordinance. **Stormwater Management Site Plan** will be designated as SWM Site Plan throughout this Ordinance.

Subdivision - As defined in The Pennsylvania Municipalities Planning Code, Act of July 31, 1968, P.L. 805, No. 247.

USDA - United States Department of Agriculture.

Waters of this Commonwealth — Any and all rivers, streams, creeks, rivulets, impoundments, ditches, watercourses, storm sewers, lakes, dammed water, wetlands, ponds, springs and all other bodies or channels of conveyance of surface and underground water, or parts thereof, whether natural or artificial, within or on the boundaries of this Commonwealth;

Watershed - Region or area drained by a river, watercourse or other surface water of the Commonwealth.

Wetland - Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs, and similar areas.

ARTICLE III - STORMWATER MANAGEMENT STANDARDS

Section 301. General Requirements

A. For all Regulated Activities, unless preparation of an SWM Site Plan is specifically exempted in Section 302:

1. Preparation and implementation of an approved SWM Site Plan is required.

2. No Regulated Activities shall commence until the Township issues written approval of a SWM Site Plan, which demonstrates compliance with the requirements of this Ordinance.

B. SWM Site Plans approved by the Township, in accordance with Section 406, shall be on site throughout the duration of the Regulated Activity.

C. The Township may, after consultation with DEP, approve measures for meeting the State Water Quality Requirements other than those in this Ordinance, providing that they meet the minimum requirements of, and do not conflict with, State law including but not limited to the Clean Streams Law.

D. The design of all stormwater management facilities shall incorporate sound engineering principles and practices. The Township shall reserve the right to disapprove any design that would result in the occupancy or continuation of an adverse hydrologic or hydraulic condition within the watershed.

E. For all Regulated Earth Disturbance Activities, erosion and sediment control BMPs shall be designed. Implemented, operated and maintained during the Regulated Earth Disturbance Activities (e.g., during construction) to meet the purposes and requirements of this Ordinance and to meet all requirements under the Pennsylvania Code Title 25 and the Clean Streams Law. Various BMPs and their design standards are listed in the Erosion and Sedimentation Pollution Control Program Manual (E&S Manual), Commonwealth of Pennsylvania, Department of Environmental Protection, No. 363-2134-008 (2000), as amended.

F. For all Regulated Activities, implementation of the Volume Controls in Section 303 is required.

G. Impervious Areas:

1. The measurement of impervious areas shall include all of the impervious areas in the total proposed development even if development is to take place in stages.

2. For development taking place in stages, the entire development plan must be used in determining conformance with this Ordinance.

3. For projects that add impervious area to a parcel, the total impervious area on the parcel is subject to the requirements of this ordinance.

H. Stormwater flows onto adjacent property shall not be created, increased, decreased, relocated, or otherwise altered without written permission of the adjacent property owner(s). Such stormwater flows shall be subject to the requirements of this Ordinance.

I. All regulated activities shall include such measures as necessary to:

1. Protect health, safety, and property;

2. Meet State Water Quality Requirements as defined in Article II;

3. Meet the water quality goals of this ordinance by implementing measures to:

a. Minimize disturbance to floodplains, wetlands, natural slopes over 8%, and existing native vegetation.

b. Preserve and maintain trees and woodlands. Maintain or extend riparian buffers and protect existing forested buffer. Provide trees and woodlands adjacent to impervious areas whenever feasible.

c. Establish and maintain non-erosive flow conditions in natural flow pathways.

d. Minimize soil disturbance and soil compaction. Over disturbed areas, replace topsoil to a minimum depth equal to the original depth of 4 inches, whichever is greater. Use tracked equipment for grading when feasible.

e. Disconnect impervious surfaces by directing runoff to pervious areas, whenever possible.

4. To the maximum extent practicable, incorporate the techniques for Low Impact Development Practices described in "The Pennsylvania Stormwater Best Management Practices Manual" (SWM Manual).

J. The design of all facilities over Karst shall include an evaluation of measures to minimize adverse effects.

K. Infiltration BMPs should be spread out, made as shallow as practicable, and located to maximize use of natural on-site infiltration features while still meeting the other requirements of this Ordinance.

L. Storage facilities should completely drain both the volume control and rate control capacities over a period of time not less than 24 and not more than 72 hours from the end of the design storm.

M. The design storm volumes to be used in the analysis of peak rates of discharge should be obtained from the Precipitation-Frequency Atlas of the United States, Atlas 14, Volume 2, U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Weather Service, Hydrometeorological Design Studies Center, Silver Spring, Maryland, 20910. NOAA's Atlas 14[5] can be accessed at Internet address: htt://hdsc.nws.noaa.gov/hdsc/pfds/.

N. For all Regulated Activities, SWM BMPs shall be designed, implemented, operated, and maintained to meet the purposes and requirements of this Ordinance and to meet all meet all requirements under Pennsylvania Code Title 25, the Clean Streams Law, and the Storm Water Management Act.

O. Various BMPs and their design standards are listed in the SWM Manual.

Section 302. Exemptions

A. An Applicant proposing Regulated Activities, after demonstrating compliance with Sections 302.A, 302.B, and 302.C, may be exempted from this Ordinance if the new proposed impervious area does not exceed quantities the specified in Table 302A:

Table 302A. Maximum New impervious Area Exemption

Total Parcel Size	Minimum Distance in Feet (see Note 4)	New Impervious Area [Since the date of Adoption of this Ordinance (square feet)
≤0.25 acre	If channel slope <2%: 25 If channel slope ≥2%: 50	2,500
> ¼ acre to 1 acre	50	5,000
>1 acre to 2 acres	100	10,000
>2 acres to 5 acres	250	15,000
>5 acres to 9.2 acres	500	20,000
>9.3 acres	750	Max 5% impervious with 1 acre max.

Table 302A Notes:

1. Any new impervious area must be disconnected from existing stormwater conveyance (pipe, swale, channel, etc.) though the use of an open channel, unconcentrated overland flow, or other mechanism that reduces velocity and enhances volume reduction.

2. For the purposes of comparison to the waiver criteria, impervious areas shall include any areas initially designed to be gravel or crushed stone.

3. These criteria shall apply to the total development even if the development is to take place in phases. The date of the adoption of this Township ordinance shall be the starting point from which to consider tracts as "parent tracts" in which future subdivision and respective impervious area computations shall be cumulatively considered.

4. Minimum distance between the proposed impervious area and/or stormwater controls/structure discharge point to the down slope property line.

5. Gravel in existing condition shall considered pervious and gravel in proposed condition shall be considered impervious.

B. Agricultural activity is exempt from the rate control and SWM Site Plan preparation requirements of this Ordinance provided the activities are performed according to the requirements of 25 Pa. Code Chapter 102.

C. Forest management and timber operations are exempt from the rate control and SWM Site Plan preparation requirements of this ordinance provided the activities are performed according to the requirements of 25 Pa. Code Chapter 102.

D. Exemptions from any provisions of this Ordinance shall not relieve the applicant from the requirements in Section 301D. through L.

Section 303. Volume Controls

The low impact development practices provided in the SWM Manual shall be utilized for all Regulated Activities to the maximum extent practicable.

Water volume controls shall be implemented using the *Design Storm Method* in Subsection A or the *Simplified Method* in Subsection B below. For Regulated Activity areas equal or less than one (1) acre that do not require hydrologic routing to design the stormwater facilities, this Ordinance establishes no preference for either methodology; therefore, the applicant may select either methodology on the basis of economic considerations, the intrinsic limitations on applicability of the analytical procedures associated with each methodology, and other factors.

A. *The Design Storm Method* (CG-1 in the SWM Manual[1]) is applicable to any size of Regulated Activity. This method requires detailed modeling based on site conditions.

1. Do not increase the post-development total runoff volume for all storms equal to or less than the 2-year 24-hour duration precipitation.

2. For modeling purposes:

a. Existing (pre-development) non-forested pervious areas must be considered meadow or its equivalent.

b. Twenty (20) percent of existing impervious area, when present, shall be considered meadow in the model for existing conditions.

B. *The Simplified Method* (CG-2 in the SWM Manual[1]) provided below is independent of site conditions and should be used if the Design Storm Method is not followed. This method is not applicable to Regulated Activities greater than one (1) acre or for projects that require design of stormwater storage facilities. For new impervious surfaces:

1. Stormwater facilities shall capture at least the first two inches (2") of runoff from all new impervious surfaces.

2. At least the first one inch (1") of runoff from new impervious surfaces shall be permanently removed from the runoff flow – i.e. it shall not be released into the surface waters of this Commonwealth. Removal options include reuse, evaporation, transportation, and infiltration.

3. Whenever possible, infiltration facilities should be designed to accommodate infiltration of the entire permanently removed runoff; However, in all cases at least the first one-half inch (0.5") of the permanently removed runoff should be infiltrated.

4. This method is exempt from the requirements of Section 304, Rate Controls.

5. The simplified method as described in Section 303.B.1-4 shall only be allowed with the approval of the Township.

Section 304, Rate Controls

A. Areas not covered by a Release Rate Map from an approved Act 167 Stormwater Management Plan: Post-development discharge rates shall not exceed the pre-development discharge rates for the 1-, 2-, 10-, and 100-year, 24-hour storms. If it is

shown that the peak rates of discharge indicated by the post-development analysis are less than or equal to the peak rates of discharge indicated by the pre-development analysis for 1-, 2-, 10-, and 100-year, 24-hour storms, then the requirements of this section have been met. Otherwise, the applicant shall provide additional controls as necessary to satisfy the peak rate of discharge requirement.

ARTICLE IV — EROSION AND SEDIMENT POLLUTION CONTROL STANDARDS

Section 401. Erosion and Sedimentation Requirements During Earth Disturbance Activities

A. When less then one acre of Earth Disturbance activities are proposed, or when less than 5 acres of Earth Disturbance activities are proposed with **no** point surface discharge to waters of the Commonwealth, the Applicant must implement and maintain erosion and sedimentation control BMPs to minimize the potential for accelerated erosion and sedimentation.

B. When one acre or more of Earth Disturbance activities with a point surface discharge to waters of the Commonwealth, or when more than 5 acres of Earth Disturbance are proposed, an Erosion and Sedimentation Control Plan must be submitted to the Snyder County Conservation District and the Township in accordance with 25 PA Code § 102.4(b). In addition, a letter from the Snyder County Conservation District approving the Erosion and Sedimentation Control Plan must be obtained.

C. PADEP has regulations under 25 PA Code Chapter 92, that a PADEP "NPDES Construction Activities" permit is required and must be obtained from the Snyder County Conservation District and/or PADEP for Earth Disturbance activities that will result in a point source discharge to surface waters of the Commonwealth involving 1 to 5 acres, or Earth Disturbance activities which involve 5 acres or greater.

D. Evidence of any necessary approval or permit(s) for Earth Disturbance activities from PADEP or the Snyder County Conservation District must be provided to the Township.

E. A copy of the Erosion and Sedimentation Control Plan and any other permit, as required by PADEP or the Snyder County Conservation District, shall be available at the project site at all times.

F. Construction of temporary roadways (e.g. for utility construction, timber harvesting, etc.) shall comply with all applicable standards for erosion and sedimentation control and stream crossing regulations under 25 PA Code, Chapters 102 and 105. The Erosion and Sedimentation Control Plan shall be submitted to the Snyder County Conservation District for approval and shall address the following, as applicable:

1. Design of the roadway system, including haul roads, skid roads and trails, and storage and staging areas.

2. Runoff control structures (e.g., diversions, culverts, detention ponds, etc.).

3. Stream crossings for both perennial and intermittent streams.

4. Access to public roadways, including design of rock construction entrance for mud and debris control.

5. A remediation plan for restoring the disturbed area through re-grading, topsoil placement, reseeding, and other stabilization techniques, as required.

G. Additional erosion and sedimentation control design standards and criteria that must be applied where infiltration BMPs are proposed include the following:

1. Areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase, as to maintain their maximum infiltration capacity.

2. Infiltration BMPs shall be protected from receiving sediment-laden runoff.

3. The source of protection for infiltration BMPs shall be identified (i.e. orange construction fence surrounding the perimeter of the BMP).

ARTICLE V — RIPARIAN BUFFER STANDARDS

Section 501. Buffer Requirements

Where a Riparian Buffer is required under this Ordinance, the Riparian Buffer shall be established as follows:

A. The buffer shall be a minimum of 50 feet, measured perpendicularly from the top of the stream bank landward.

B. The buffer shall be undisturbed forest consisting of appropriate native species.

C. Where wetlands are located partially or entirely within a buffer, the buffer shall be extended to encompass the wetland and shall be widened by a distance sufficient to provide a 25 foot forested buffer measured perpendicularly from the wetland boundary.

D. The following uses, and no other uses, shall be permitted in the buffer:

1. Footpaths, trails and bike paths provided that:

a. The above are limited to five (5) feet in width.

b. The width may be increased provided a corresponding increase in the buffer is provided.

c. The above shall be constructed in such a manner as to minimize the impact to the buffer during and after construction.

2. Stream crossings, provided the crossing is designed and constructed in such a manner as to minimize the impact to the buffer. The Riparian Buffer shall be restored to its original condition, to the maximum extent practical, upon completion of construction.

3. Utility lines, provided that the crossing is designed and constructed in such a manner as to minimize the impact to the inner buffer and provided that there is no practical alternative to locating the utility line within the buffer. The Riparian Buffer shall be restored to its original condition, to the maximum extent practical, upon completion of construction.

4. Removal of vegetation necessary to maintain the Riparian Buffer.

5. Maintenance and restoration of the Riparian Buffer.

6. Projects conducted with the objective of improvement, stabilization, restoration, or enhancement of the stream bank, stream channel, floodplain, watershed hydrology, riparian buffers, or aquatic habitat and maintenance activities associated with such projects. These projects include, but are not limited to agricultural and stormwater management best management practices. Such projects must receive appropriate permits and approvals from DEP prior to starting the project.

7. Minor private recreational uses for the property owner. Such uses include benches, fire rings, and similar uses. Such uses do not include structures such as cabins, sheds, pavilions, garages, dwellings or similar structures.

E. Disturbance of the Riparian Buffer shall be limited to the area necessary to perform an allowable use.

F. Where possible and practical, disturbances shall be phased with each phase restored prior to beginning the next phase.

G. Allowable activities shall not cause stormwater flow to concentrate.

H. Any vegetation removed for an allowable activity shall be replaced immediately upon completion of the activity. Where mature trees are removed, such trees shall be replaced with the largest practical tree of acceptable native species.

I. Erosion and sediment pollution control shall be installed and maintained during construction. Evidence of an approved Erosion and Sediment Control Plan and/or NPDES Permit, if required, shall be submitted prior to issuance of local permits.

J. If a permit from DEP is required for the activity, evidence of an approved permit shall be submitted prior to issuance of local permits.

K. Riparian Buffers shall be maintained as follows:

1. Removal of standing dead trees or trees that are in danger of falling is permitted. Such material shall be removed from the floodplain or from the riparian buffer, which ever is widest or cut into sections small enough so as not to present the possibility of creating obstructions downstream.

2. Trees that have fallen present a danger of obstructing downstream bridges or culverts, thereby increasing flood hazard potential. Such trees shall be removed from the floodplain or from the buffer, whichever is widest or cut into sections small enough so as not to present the possibility of creating obstructions downstream.

3. Plant species that threaten the integrity of the buffer shall be removed.

4. The use of herbicides or fertilizers within the buffer is not recommended. If necessary, such chemicals shall be used only to the extent necessary.

L. A regulated riparian buffer shall be designated consisting of the area measuring 50 feet from the stream bank, measured perpendicularly, landward consistent with the requirements of Section 311. The riparian buffer shall be located on both sides of all perennial and intermittent streams. The perennial and intermittent streams and the riparian buffer boundaries shall be shown on all applications for Building Permits, subdivision, or land development. Existing use within the buffer are permitted to continue but not be expanded. Placement of new structures or roadways within the riparian buffer shall be prohibited. Where a wetland exists within the buffer area, the buffer shall be extended landward to provide a minimum buffer of 25 feet, as measured perpendicularly from the wetland boundary.

ARTICLE VI — DESIGN CRITERIA

Section 601. Design Criteria for Stormwater Management & Drainage Facilities

A. General Design Guidelines:

1. Stormwater shall not be transferred from one watershed to another, unless (1) the watersheds are sub-watersheds of a common watershed which join together within the perimeter of the property; (2) the effect of the transfer does not alter the peak rate discharge onto adjacent lands; or (3) easements from the affected landowners(s) are provided.

2. Consideration shall be given to the relationship of the subject property to the drainage pattern of the watershed. A concentrated discharge of stormwater to an adjacent property shall be within an existing watercourse or enclosed in an easement or returned to a pre-development flow type condition.

3. Innovative stormwater BMPs and recharge facilities are encouraged (e.g. rooftop storage, drywells, cisterns, recreation areas, stream channel storage, in-line storage in storm sewers, and grading patterns). They shall be located, designed, and constructed in accordance with the latest technical guidance published by PADEP, provided they are accompanied by detailed engineering plans and performance capabilities and supporting site specific soils, geology, runoff and groundwater and infiltration rate data to verify proposed designs. Additional guidance from other sources may be accepted at the discretion of the Qualified Township Representative (a pre-application meeting is suggested).

B. Stormwater Management Facilities

1. Any stormwater management facilities (i.e. detention basins) designed to store runoff and requiring a berm or earthen embankment, shall be designed to provide an emergency spillway to handle peak rate of stormwater runoff up to an including the 100-year post–development flow, with a blocked primary outlet structure. The height of the embankment must be set as to provide a minimum one (1) foot of freeboard through the spillway, above the maximum water surface elevation, computed when the spillway functions for the 100-year post-development inflow, with a blocked outlet structure. The primary outflow structure must be designed to pass all design storms (up to and including the 100-year event) without discharging through the emergency spillway. The maximum water depth within any stormwater management facility shall be no greater than eight (8) feet when functioning through the primary outlet structure.

2. Emergency spillways shall be armored to prevent erosion during the 100-year post-development flow, with blocked primary outlet structure. Synthetic liners or riprap may be used, and calculations sufficient to support proposed armor must be provided. An earthen plug must be used to accurately control the spillway invert if riprap is the proposed armoring material. Emergency spillway armor must extend up the sides of the spillway, and continue at full width to a minimum of ten (10) feet past the toe of slope.

3. A stormwater management facility berm cross sections must be at least five (5) feet wide at the top, and eight (8) feet wide through the emergency spillway. For fill embankments, the side slopes shall be no steeper than 3:1 on the inside of the facility and 2:1 on the outside of the facility. For cut slopes, the side slopes shall be no steeper then 2:1.

4. A cutoff and key trench of impervious material shall be provided under all embankments four (4) feet or greater in height.

5. Soils used for the construction of stormwater management facilities shall have low-erodibility factors ("K" factors) (refer to PADP E & S Manual) and be identified on the SWM Site Plan.

6. Trash racks must be provided to prevent clogging of primary outflows structure stages for all orifices equivalent to twelve (12) inches or smaller in diameter.

7. Anti-seep collars must be provided on all outflow culverts in accordance with the methodology contained in the latest version of the PADP E & S Manual. An increase in seepage length of 15 percent must be used in accordance with the requirements for permanent anti-seep collars.

8. Conventional non-BMP stormwater management facilities (i.e., dry detention basins) must empty over a period of time not less than 24 hours and not more than 72 hours from the end of the facility's inflow hydrograph. Infiltration tests performed at the facility locations and proposed basin bottom depths in accordance with the BMP Manual, must support time-to-empty calculations if infiltration is a factor.

9. Impervious low-flow channels are not permitted within stormwater management facilities to promote water quality and groundwater recharge for frequent storm events. Facilities designed as water quality/infiltration BMPs may have a bottom slope of zero. Minimum maintenance, saturation tolerant vegetation must be provided in basins designed as water quality/infiltration BMPs. Conventional, non-BMP stormwater management facilities must have a minimum slope of 1% extending radially out from the primary outlet structure. Water storage below the lowest outlet structure state (i.e. dead storage) is permitted in stormwater management facilities designed as water quality/infiltration BMPs.

10. Stormwater management facilities excavated to carbonate rock must either be fitted with an impervious clay liner, or over-excavated four (4) feet and refilled with a suitable material mix. Suitable backfill material is subject to the approval of the Qualified Township Representative.

11. Stormwater management facility's bottom elevations must be greater than adjacent floodplain elevations. The adjacent floodplain elevation should be determined from the applicable FEMA Flood Insurance Study. If no floodplain elevations are available in the applicable FEMA Flood Insurance Study, the elevations within a floodplain may be determined by methods acceptable to FEMA and standard engineering practice. If no floodplain is defined, bottom elevations must be greater than existing ground elevations fifty (50) feet from top of stream bank in the facility's vicinity

12. Basin outflow culverts discharging into the floodplain must account for tailwater. Tailwater corresponding to the 100-year floodplain elevation may be used for all design storms, or the Applicant may elect to determine flood elevations of the adjacent watercourse for each design storm. The floodplain is assumed to be fifty (50) feet from top of stream bank in areas where a floodplain is not designated, or no other evidence is provided.

13. No outlet structure from a stormwater management facility or swale shall discharge directly onto a Township or State road, but may discharge to a culvert under a Township or State road.

14. The invert of all stormwater management facilities and underground infiltration/storage facilities shall be located a minimum of two (2) feet above the seasonal high groundwater table. The invert of stormwater facilities may be lowered if adequate sub-surface drainage is provided.

15. Any stormwater management facility with side slopes steeper than 3:1 is required to be fenced with a minimum of four (4) foot high fence of material acceptable to the Township. Gates shall be provided.

16. Exceptions to these requirements may be made at the discretion of the Township for BMPs that retain or detain water, but are of a much smaller scale than traditional stormwater management facilities.

C. Storm Sewer Facilities

1. All stormwater pipe systems shall be sized to convey the 10-year design event without causing pressure flow condition in any segment of the conveyance system.

2. When connecting to an existing storm sewer system, the Applicant must demonstrate that the proposed system will not exacerbate any existing stormwater problems and that adequate downstream capacity exists.

3. Minimum pipe size of eighteen (18) inches in diameter shall be used in all roadway systems (public or private) proposed for construction in the Township. Pipes shall be designed to provide a minimum velocity of two and one-half (2 1/2) feet per second when flowing full, but in all cases, the slope shall be no less then 0.5%. Arch pipe of equivalent cross-sectional area may be substituted in lieu of circular pipe where cover or utility conflict conditions exist.

4. In curbed roadway sections, the maximum encroachment of water on the roadway pavement shall not exceed half of a through travel lane or one (1) inch less than the depth of curb during the ten (10) year design storm of five (5) minute duration. Gutter depth shall be verified by inlet capture/capacity calculations that account for road slope and opening area.

5. Standard Type "C" inlets with 8" hoods shall be used along curbed roadway networks. Type "C" inlets with 10" hoods that provide a 2” sump condition may be used with approval of the Qualified Township Representative when roadway longitudinal slopes are 1.0% or less.

6. On curbed sections, a double inlet shall be placed at the low point of sag vertical curves, or an inlet shall be placed on each side of the low point at a distance not to exceed 100 feet, or at an elevation not to exceed 0.2 feet above the low point.

7. At all roadway low points, swales and easements shall be provided behind the curb or swale and through adjacent properties to channelize and direct any overflow of stormwater runoff away from dwellings and structures.

8. Inlets shall be placed so drainage cannot cross intersections or street centerlines.

9. All inlets in paved areas shall have heavy duty bicycle safe grating consistent with PENNDOT Publication 72M. A note to this effect shall be added to the SWM Site Plan or inlet details therein.

10. Inlets must be sized to accept the specified pipe sizes without knocking out any of the inlet corners. All pipes entering or exiting inlets shall be cut flush with the inlet wall. A note to this effect shall be added to the SWM Site Plan or inlet details therein.

11. Inlets shall have weep holes covered with geo-textile fabric placed at appropriate elevations to completely drain the sub grade prior to placing the base and surface course on roadways.

12. Inlets, junction boxes, or manholes greater then five (5) feet in depth shall be equipped with ladder rings and shall be detailed on the SWM Site Plan.

13. Inlets shall not have a sump condition in the bottom (unless designed as a water quality BMP. Pipe shall be flush with the bottom of the box or concrete channels shall be poured.

14. Inlets, manholes, pipes, and culverts shall be constructed in accordance with the specifications set forth in PENNDOT's Publication 408, and as detailed in the PENNDOT's Publication 72M - Standards for Roadway Construction (RC) or other detail approved by the Qualified Township Representative. All material and construction details (inlets, manholes, pipe trenches, etc.), must be shown on the SWM Site Plan, and a note added that all construction must be in accordance with PENNDOT's Publication 408 and PENNDOT's Publication 72M, latest edition. A note shall be added to the plan stating that all frames, concrete top units, and grade adjustment rings shall be set in a bed of full mortar according to Publication 408.

15. Accessible drainage structures shall be located on continuous storm sewer system at all vertical dislocations, at all locations where a transition in storm sewer pipe sizing is required, at all vertical and horizontal angle points exceeding five (5) degrees, and at all points of convergence of two (2) or more storm sewer pipes.

16. All storm drainage piping discharging to the ground surface shal1 be provided with either reinforced concrete headwalls and end sections or plastic and metal pipe end sections compatible with the pipe size involved in accordance with PENNDOT Publication 408 and Publication 72M.

17. Outlet protection shall be provided at all surface discharge points in order to minimize erosion consistent with the E & S Manual.

D. Swale Conveyance Facilities:

1. Swales must be able to convey post-development runoff from a 10-year design storm with six (6) inches of freeboard to top of the swale.

2. All swales shall be designed, labeled on the SWM Site Plan, and details provided to adequately construct and maintain the design dimensions of the swales.

3. Swales shall be designed for stability using velocity or shear criteria. Velocity criteria may be used for channels with less than 10% slope. Shear criteria may be used for all swales. Documentation must be provided to support velocity and/or shear limitations used in calculations.

4. Where swale bends occur, the computed velocities or shear stresses shall be multiplied by the following factor for the purpose of designing swale erosion protection:

a. 1.75 — When swale bend is 30 to 60 degrees

b. 2.00 — When swale bend is 60 to 90 degrees

c. 2.50 — When swale bend is 90 degrees or greater

5. Manning's "n" values used for swale capacity design must reflect the permanent condition.

Section 602. Calculation Methodology

A. All calculations shall be consistent with the guidelines set forth in the BMP Manual.

B. Stormwater runoff from all development sites shall be calculated using either the NRCS Soil Cover Complex methodology or the modified Rational Method (where applicable). Methods shall be selected by the design professional based on the individual limitations and suitability of each method for a particular site.

C. Rainfall Values:

1. Design runoff hydrographs shall be developed based on the most current NOAA Atlas 14 data or the following table:

Return Interval (Year)	24-hour Rainfall Total (inches)
1	2.47
2	2.96
10	4.30
25	5.29
50	6.22
100	7.31

2. Precipitation values for intensity-duration-frequency curves shall be developed on the most current NOAA Atlas 14 data.

D. Hydrographs, water quality, infiltration, and capture volumes:

1. Soil Cover Complex Method. This method is recommended for design of stormwater management facilities and where stormwater runoff volume must be taken into consideration. The following provisions shall be used in the application Complex Method:

a. The NRCS precipitation distribution shall be Type II.

b. The NRCS's dimensionless unit hydrograph "k" factor shall be 484.

c. The NRCS curve number designation and the applicable hydrologic model shall assume average antecedent runoff conditions (ARC = 2).

2. Modified Rational Method — May be used for drainage areas up to 2 acres or up to 20 acres with the approval from a Qualified Township Representative. Due to the limitations of the rational method as described in the BMP Manual, this method should not be used to calculate water quality, infiltration or capture volumes.

3. For comparison of peak flow rates, flows shall be rounded to a tenth of a cubic foot per second (cfs).

E. Peak flow rates for conveyance purposes

1. Soil Cover Complex Method — Refer to section 702.D.

2. Rational Method — May be used for drainage areas up to 200 acres in size.

3. USGS Regression Equations — within the guidelines described in *Regression Equations for Estimating Flood Flows at Selected Recurrence Intervals for Ungaged Streams in Pennsylvania,* Scientific Investigations Report 2008-5102, Roland, M.A. and M.H. Stuckey, US Department of the Interior.

F. Runoff Coefficients:

1. Soil Cover Complex Method – Use TR-55[4]

2. Rational Method – Use Table C-2 (Appendix C). For simplified conveyance calculations (i.e., in situations where hydrograph routing is not necessary), the designer may assume runoff coefficient values of 0.3 and 0.95 for pervious and impervious areas, respectively.

3. For the purposes of pre-development peak flow rate and volume determination, existing non-forested pervious area conditions shall be considered as meadow (good condition).

4. For the purposes of pre-development peak flow rate and volume determination, twenty (20) percent of existing impervious area, when present, shall be considered meadow (good condition) for pre-development hydrologic calculations for re-development.

G. Design

1. All stormwater management facilities shall be verified by routing the proposed 1-year, 2-year, 10-year, and 100-year, 24-hour hydrographs through the facility using the storage indication method or modified puls method. The design storm hydrograph shall be computed using a calculation method that produces a full hydrograph.

2. All drainage facilities (inlets, pipes, and swales) shall be designed to safely convey the 10-year storm.

3. It shall be demonstrated that the stormwater management and drainage plan will safely convey the post development 100-year storm event to stormwater detention facilities, for the purpose of meeting peak rate control.

4. All structures (culvert or bridges) proposed to convey runoff under a Township road shall be designed to pass the 50-year design storm with a minimum one (1) foot of freeboard measured below the lowest point along the top of the roadway.

5. All design within State or Federal right-of-ways or that falls under the design criteria of any higher authority must meet the requirements of that agency in addition to meeting the minimum requirements of this Ordinance.

H. Time of Concentration:

1. For sites with more than 20% imperviousness, the time of concentration shall be computed using the NRCS Segmental Method as described in TR-55 (SCS 1986 or most current update). The length of sheet flow shall be limited to 100-feet. Time of concentration for channel and pipe flow shall be computed using Manning's equation.

2. For sites with less than 20% imperviousness, the time of concentration shall be computed using the NRCS equation for lag time:

Time of Concentration = $T_c = [(T_{lag}/.6)*60]$ (minutes)

$$T_{lag} = L^{0.8} \frac{(S+1)^{0.7}}{1900\sqrt{Y}}$$

Where:
T_{lag} = lag time (hours)
L = Hydraulic length of watershed (feet)
Y = Average overland slope of watershed (percent)
S = Maximum retention in watershed as defined by: S = [(1000/CN)-10]
CN = NRCS Curve Number for water shed as defined by the NRCS Loss Method

3. Additionally, the following provisions shall apply to calculations for time of concentration:

a. The post-development time of concentration shall never be greater than the pre-development time of concentration for any watershed or sub-watershed.

b. The minimum time of concentration for any watershed shall be five (5) minutes.

c. The designer may choose to assume a five (5) minute time of concentration for any post development watershed or sub-watershed without providing any computations.

d. The designer must provide computations for all pre-development time of concentration paths. A five (5) minute time of concentration can not be assumed for pre-development.

e. Un-detained fringe areas (areas that are not tributary to a stormwater facility but where a reasonable effort has been made to detain all new impervious coverage) may be assumed to represent the pre-development conditions for purpose of time of concentration calculation.

I. Drainage areas tributary to sinkholes or closed depressions in areas underlain by limestone or carbonate shall be excluded from the modeled point of analysis defining pre-development flows. If left undisturbed during construction activities, areas draining to closed depressions may also be used to reduce peak runoff rates in the post-development analysis.

J. Where uniform flow is anticipated, the Manning's equation shall be used for hydraulic computations and to determine the capability of open channels, pipes, and storm sewers. The Manning's equation should not be used for analysis of pipes under pressure flow or for analysis of culverts. Manning's "n" values shall be obtained from PENNDOT's Drainage Manual, Publication 584. Inlet control shall be checked at all inlet boxes to ensure the headwater depth during the ten (10) year design event is contained below the top of grate for each inlet.

K. The Township has the authority to require that commuted existing runoff rates be reconciled with field observations, conditions and site history. If the designer can substantiate, through actual physical calibration, that more appropriate runoff and time of concentration values should be utilized at a particular site, then appropriate variations may be made upon review and recommendation by the Township.

L. Principal outlet structures for stormwater management facilities shall be designed to meet the performance standards of this Ordinance using any generally accepted hydraulic analysis technique or method.

ARTICLE VII - STORMWATER MANAGEMENT (SWM)
SITE PLAN REQUIREMENTS

Section 701. General Requirements

For any of the activities regulated by this Ordinance and not eligible for the exemptions provided in Section 302, the final approval of subdivision and/or land development plans, the issuance of any building or occupancy permit, or the commencement of any land disturbance activity, may not proceed until the Applicant has received written approval of a SWM Site Plan from the Township.

Section 702. SWM Site Plan & Report Contents

The SWM Site Plan & SWM Site Report shall consist of all applicable calculations, maps, and plans. All SWM Site Plan materials shall be submitted to the Township in a format that is clear, concise, legible, neat and well organized; otherwise, the SWM Site Plan shall be rejected.

Appropriate sections from the Township Subdivision and Land Development Ordinance, and other applicable local ordinances, shall be followed in preparing the SWM Site Plan.

A. SWM Site Plan shall include but not be limited to:

1. Plans no larger than 24-inch x 36-inch sheets and in a form that meets the requirements for recording in the Office of the Recorder of Deeds of Snyder County.

2. The name of the development; name and location address of the property site; name, address, and telephone number of the Applicant/Owner of the property; and name, address, telephone number, email address and engineering seal of the individual preparing the SWM Site Plan.

3. An interpretive narrative describing existing site soils and their structure as these relate to hydropedologic processes occurring on the site. In addition to providing soil and soil profile descriptions, this narrative shall identify depth to seasonal high water tables and depth to bedrock, and provide a description of all subsurface elements (fragipans and other restrictive layers, geology, etc.) that influence the direction and rate of subsurface water movement. A qualitative assessment of the site's contribution to annual aquifer recharge shall be made, along with identification of any restrictions or limitations associated with the use of engineered infiltration facilities.

4. A narrative description of the site soils investigation and justification for the level of detail included.

5. Description of and justification for field infiltration/permeability testing with respect to the type of test and test locations).

6. Justification for design infiltration/permeability rates used in the analysis of individual BMPs.

7. Documentation illustrating and justifying separation distances between natural or engineered infiltration practices and other critical features is needed. An appropriate separation distance should be used between engineered infiltration facilities and the following critical features:

a. Water supply wells (individual or community.)

b. On-lot septic systems;

c. Building foundations;

d. Underground utility lines and trenches; and

e. Sinkholes (unless an appropriate reverse filter is specified for the sinkhole.)

8. The date of submission and dates of all revisions.

9. A graphical and written scale on all drawings.

10. A north arrow on all drawings and maps.

11. A location map at a minimum scale of 1 inch equals 1,000 feet.

12. Metes and bonds description of the entire tract perimeter.

13. Existing and final contours at intervals of not less than two (2) feet.

14. Existing waterbodies within the project area including streams, lakes, ponds, field delineated wetlands or other bodies of water, sinkholes, flood hazard boundaries (FEMA delineated floodplains and floodways), areas of natural vegetation to be preserved, the total extent of the upstream area draining through the site, and overland drainage paths.

15. The location of all existing and proposed utilities, on-lot wastewater facilities, water supply wells, sanitary sewers, and water lines on and within fifty (50) feet of property lines.

16. A key map showing all existing man-made features beyond the property boundary that may be affected by the project.

17. Soil names and boundaries with identification of the Hydraulic Soil Group classification.

18. Proposed structures, roads, paved areas, and buildings, including plans and profiles of roads and paved areas and floor elevations of buildings.

19. Horizontal alignment, vertical profiles, and cross sections of all open channels, pipes, swales and other BMPs

20. The location and clear identification of the nature of permanent stormwater BMPs.

21. The location of all erosion and sedimentation control facilities.

22. A minimum twenty (20) foot wide access easement around all stormwater management facilities that would provide ingress and egress from a public right-of-way. In lieu of providing an easement to the public right-of-way, a note may be added to the plan granting the Township or their designees access to all easements via the nearest public right-of- way.

23. Construction details for all drainage and stormwater BMPs.

24. Construction details of any improvements made to sinkholes.

25. Identification of short-term and long-term ownership, operations and maintenance responsibilities.

26. A statement signed by the landowner, acknowledging that the stormwater BMPs are fixtures that cannot be altered or removed without prior approval by the Township.

27. A statement referencing the operation and Maintenance (O&M) Agreement and stating that the O&M Agreement is part of the SWM Site Plan.

B. SWM Site Report shall include (but not limited to):

1. The name of the development; name and location address of the property site; name, address, and telephone number of the Applicant/Owner of the property; and name, address, telephone number, email address, and engineering seal of the individual preparing the SWM Site Report.

2. Project description narrative including expected project time schedule.

3. Location map showing the project site and its location relative to release rate districts.

4. Drainage area maps for all watersheds and inlets depicting the time of concentration path.

5. A detailed description of the existing site conditions. A detailed site evaluation shall be completed for projects proposed in areas of carbonate geology or karst topography, and other environmentally sensitive areas such as brownfields.

6. Complete hydrologic, hydraulic and structural computations, calculations, assumptions, and criteria for the design of all stormwater BMPs.

7. Description of, justification, and actual field results for infiltration testing with respect to the type of test and test location for the design of infiltration BMPs.

8. The effect of the project (in terms of runoff volumes, water quality, and peak flows) on surrounding properties and aquatic features and on any existing Township stormwater collection system that may receive runoff from the project site.

9. Description of the proposed changes to the land surface and vegetative cover including the type and amount of impervious area to be added.

10. Identification of short-term and long-term ownership, operation, and maintenance responsibilities as well as schedules and costs for inspection and maintenance activities for each permanent stormwater or drainage BMP, including provisions for permanent access or maintenance easements

C. Supplemental information to be provided prior to recording of the SWM Site Plan, as applicable:

1. Signed and executed Operations & Maintenance Agreement (Appendix B).

2. Signed and executed easements, as required for all on-site and off-site work.

3. An Erosion and Sedimentation Control Plan & Approval letter form the Snyder County Soil Conservation District.

4. A NPDES Permit.

5. Permits form PADEP and USACOE.

6. A Geologic Assessment.

7. A Highway Occupancy Permit from PENNDOT when utilization of a PENNDOT storm drainage system is proposed or when proposed facilities would encroach onto a PENNDOT right-of-way.

8. Performance Guarantee: Financial Guarantee to the Township for the installation of required stormwater controls.

Section 703. SWM Site Plan Report Submission

A. The Applicant shall submit the SWM Site Plan & Report for the Regulated Activity.

B. Five (5) copies of the SWM Site Plan & Report shall be submitted and be distributed as follows:

1. Two (2) copies to the Township accompanied by the requisite Township Review Fee, as specified in this Ordinance.

2. One (1) copy to the Qualified Township Representative responsible with conducting the review.

3. One (1) copy to the Snyder County Planning Commission.

4. One (1) copy to the Snyder County Conservation District.

C. Additional copies shall be submitted as requested by the Township or PADEP.

Section 704. SWM Site Plan Report Review

A. The Township shall require receipt of a complete SWM Site Plan & Report as specified in this Ordinance. The Township shall review the SWM Site Plan & Report for consistency with the purposes, requirements, and intent of this Ordinance.

B. The Township shall not approve any SWM Site Plan & report that is deficient in meeting the requirements of this Ordinance At its sole discretion and in accordance with this Article, when a SWM Site Plan & Report is found to be deficient, the Township may disapprove the submission and require a resubmission, or in the case of minor deficiencies, the Township may accept submission of modifications.

C. The Township shall notify the Applicant in writing within forty-five (45) calendar days whether the SWM Site Plan & Report is approved or disapproved if the SWM Site Plan & Report is not part of a Subdivision or Land Development Plan. If the SWM Site Plan & Report involves a Subdivision or Land Development Plan, the timing shall follow the Subdivision and Land Development process according to the Municipalities Planning Code.

D. The Township Building Permit Office shall not issue a building permit for any Regulated Activity if the SWM Site Plan & Report has been found to be inconsistent with this Ordinance, as determined by the Township Planning Commission. All required permits from PADEP must be obtained prior to issuance of a building permit.

Section 705. Modification of Plans

A. A modification to a submitted SWM Site Plan & Report for a development site that involves a change in stormwater management facilities or techniques, or that involves the relocation or re-design of stormwater management facilities, or that is necessary because soil or other conditions are not as stated on the SWM Site Plan as determined by the Township, shall require a resubmission of the modified SWM Site Plan in accordance with this Ordinance.

Section 706. Resubmission of Disapproved SWM Site Plan and Report

A. A disapproved SWM Site Plan & Report may be resubmitted with the revisions addressing the Township's concerns documented in writing, to the Township in accordance with this Ordinance. The applicable Township review Fee must accompany a resubmission of a disapproved SWM Site Plan & Report.

Section 707. Authorization to Construct and term of Validity

A. The Township's approval of a SWM Site plan and Report authorizes the Regulated Activities contained in the SWM Site Plan & Report for a maximum term of validity of five (5) years from the date of approval. The Township may specify a term of validity shorter than five (5) years in the approval for any specific SWM Site Plan. Terms of validity shall commence on the date the Township signs the approval for a SWM Site Plan. If stormwater management facilities included in the approved SWM Site Plan have not been constructed, or if a record Drawing of these facilities has not been approved within this time, then the Township may consider the SWM Site Plan disapproved and may revoke any and all permits or approvals.

Section 708. Record Drawings, Completion Certificate and Final Inspection

A. The Applicant shall be responsible for providing a Record Drawing of all stormwater BMPs included in the approved SWM Site Plan. The Record Drawing and an explanation of any discrepancies with the approved SWM Site Plan shall be submitted to the Township. The Record Drawing must be signed and sealed by a qualified professional.

B. The Record Drawing shall include a certification of completion signed by the Township verifying that all permanent stormwater BMPs have been constructed according to the approved SWM Site Plan and Report.

ARTICLE VIII- OPERATION AND MAINTENANCE

Section 801. Responsibilities of Developers and Landowners

A. The Township shall make the final determination on the continuing maintenance responsibilities prior to final approval of the SWM Site Plan. The Township may require a dedication of such facilities as part of the requirements for approval of the SWM Site Plan. Such a requirement is not an indication that the Township will accept the facilities. The Township reserves the right to accept or reject the ownership and operating responsibility for any portion of the stormwater management controls.

B. Facilities, areas, or structures used as Stormwater Management BMPs shall be enumerated as permanent real estate appurtenances and recorded as deed restrictions or conservation easements that run with the land.

C. The Operation and Maintenance Plan shall be recorded as a restrictive deed covenant that runs with the land.

D. The Township may take enforcement actions against an owner for any failure to satisfy the provisions of this Article.

Section 802. Operation and Maintenance Agreement.

The owner is responsible for Operation and Maintenance of the SWM BMPs. If the owner fails to adhere to the Operation and Maintenance Agreement, the Township may perform the services required and charge the owner appropriate fees,. Non-payment of fees may result in a lien against the property.

ARTICLE IX - FEES AND EXPENSES

Section 901. General

A. The fee required by this Ordinance is the Township Review Fee. The Township Review Fee shall be established by the Township by Resolution to defray review costs incurred by the Township and the Qualified Township Representative. The Applicant shall pay all fees.

Section 902. Expenses Covered by Fees

A. The fees required by this Ordinance shall, at a minimum, cover:

1. Administrative and Clerical costs.

2. Review of the SWM Site Plan & Report by the Township.

3. Pre-construction meetings.

4. Inspection of stormwater management facilities/BMPs and drainage improvements during construction.

5. Final inspection upon completion of the stormwater management facilities/BMPs and drainage improvements presented in the SWM Site Plan.

6. Any additional work required to enforce any permit provisions regulated by this Ordinance, correct violations, and assure proper completion of stipulated remedial actions.

Section 903. Recording of Approved SWM Site Plan and Related Agreements.

A. The owner of any land upon which permanent BMPs will be placed, constructed, or implemented, as described in the SWM Site Plan, shall record the following documents in the Office of the Recorder of Deeds of Snyder County, within 90 days of approval of the SWM Site Plan by the Township:

1. The SWM Site Plan.

2. Operations and Maintenance (O&M) Agreement (Appendix B).

3. Easements under Section 801.

B. The Township may suspend or revoke any approvals granted for the project site upon discovery of the failure of the owner to comply with this Section.

ARTICLE X – PROHIBITIONS

Section 1001. Roof Drains

Roof drains and sump pumps shall discharge to infiltration or vegetative BMPs and to the maximum extent practicable satisfy the criteria for Disconnected Impervious Areas.

Section 1002. Alteration of SWM BMPs

No person shall modify, remove, fill, landscape, or alter any SWM BMPs, facilities, areas, or structures, without the written approval of the Township.

ARTICLE XI- ENFORCEMENT AND PENALTIES

Section 1101. Right-of-Entry

Upon presentation of proper credentials, the Township may enter at reasonable times upon any property within the Township to inspect the condition of the stormwater structures and facilities in regard to any aspect regulated by this Ordinance.

Section 1102. Inspection

SWM BMPs should be inspected by the landowner, or the owner's designee (including the Township for dedicated and owned facilities) according to the following list of minimum frequencies:

1. Annually for the first 5 years.

2. Once every 3 years thereafter.

3. During or immediately after the cessation of a 10-year or greater storm.

Section 1103. Enforcement

A. It shall be unlawful for a person to undertake any Regulated Activity except as provided in an approved SWM Site Plan, unless specifically exempted in Section 302.

B. It shall be unlawful to violate Section 1002 of this Ordinance.

C. Inspections regarding compliance with the SWM Site Plan are a responsibility of the Township.

Section 1104. Suspension and Revocation.

A. Any approval or permit issued by the Township may be suspended or revoked for:

1. Non-compliance with or failure to implement any provision of the approved SWM Site Plan or Operation and Maintenance Agreement.

2. A violation of any provision of this Ordinance or any other applicable law, Ordinance, rule or regulation relating to the Regulated Activity.

3. The creation of any condition or the commission of any act during the Regulated Activity which constitutes or creates a hazard or nuisance, pollution, or which endangers the life or property of others.

B. A suspended approval may be reinstated by the Township when:

1. The Township has inspected and approved the corrections to the violations that caused the suspension.

2. The Township is satisfied that the violation has been corrected.

C. An approval that has been revoked by the Township cannot be reinstated. The applicant may apply for a new approval under the provisions of this Ordinance.

D. If a violation causes no immediate danger to life, public health or property, at its sole discretion, the Township may provide a limited time period for the owner to correct the violation. In these cases, the Township will provide the owner or the owner's designee, with a written notice of the violation and the time period allowed for the owner to correct the violation. If the owner does not correct the violation within the allowed time period, the Township may revoke or suspend any, or all, applicable approvals and permits pertaining to any provision of this Ordinance.

Section 1105. Penalties

A. Any person, partnership, or corporation who or which has violated any provision of this Ordinance shall, upon being found liable therefore in a civil enforcement proceeding commenced by the Township, pay a judgment of $500 plus all court costs, including reasonable attorney fees incurred by the Township as a result thereof. No judgment shall commence or be imposed, levied or payable until the date of the determination of a violation by the magisterial district judge. If the defendant neither pays nor timely appeals the judgment, the Township may enforce the judgment pursuant to the applicable rules of civil procedure. Each day that a violation continues shall constitute a separate violation, unless the magisterial district judge determining that there has been a violation, further determines that there was a good faith basis for the person, partnership or corporation violating the ordinance to have believed that there was no such violation, in which event there shall be deemed to have been only one such violation until the fifth day following the date of the determination of a violation by the magisterial district judge and thereafter each day that a violation continues shall constitute a separate offense.

B. In the event that a judgment entered pursuant to the above is timely appealed to the Court of Common Pleas, the Court of Common Pleas, upon petition, may grant an order of stay, upon cause shown, tolling the per diem judgment pending a final determination of the violation and judgment.

C. In addition, the Township may institute injunctive, mandamus or any other appropriate action or proceeding at law or in equity for the enforcement of this Ordinance. Any court of competent jurisdiction shall have the right to issue restraining orders, temporary or permanent injunctions, mandamus or other appropriate forms of remedy or relief.

Section 1106. Appeals

A. Any person aggrieved by any action of the Township or its designee, relevant to the provisions of this Ordinance, may appeal to the Township within thirty (30) days of that action.

B. Any person aggrieved by any decision of the Township, relevant to the provisions of this Ordinance, may appeal to the Court of Common Pleas within thirty (30) days of the Township's decision.

ARTICLE XII – EFFECTIVE DATE

Section 1201. Effective Date.

This ordinance shall become effective from and after the date of its approval and adoption as provided by law.

ENACTED AND ORDAINED by the Board of Supervisors of Middlecreek Township, Snyder County, Pennsylvania, this _____ day of _____, 2009.

MIDDLECREEK TOWNSHIP SUPERVISORS

ATTEST:

_____

_____

_____

_____

APPENDIX A

REFERENCES

1. Pennsylvania Department of Environmental Protection (DEP). No. 363-0300-002 (2006), as amended and updated. *Pennsylvania Stormwater Best Management Practices Manual*. Harrisburg, PA.

2. The Pennsylvania Department of Environmental Protection (DE 363-2134-008 (2000), as amended and updated. *Erosion and Sediment Pollution Control Program Manual*. Harrisburg, PA.

3. United States Department of Agriculture (USDA), National Resources Conservation Service (NRCS). *National Engineering Handbook*. Part 360:Hydrology, 1969-2001. Originally published as the *National Engineering Handbook*. Section 4:Hydrology. Available online at: http://www.wcc.nrcs.usda.gov/hydro/hydro-techref-neh-630.html.

4. United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), 1986. *Technical Release 55: Urban Hydrology for Small Watersheds*, 2nd Edition. Washington D.C.

5. US Department of Commerce (USDC), National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), Hydrometeorological Design Studies Center, 2004-2006. Precipitation-Frequency Atlas of the United States, Atlas 14, Volume 2, Silver Spring, Maryland., 20910. Internet address: http://hdsc.nws.noaa.gov/hdsc/pdfs.

6. US Army Corp of Engineers. Hydrologic Engineering Center, River Analysis System. http://www.hec.usace.army.mil/publications/TechnicalPapers/TP-147.pdf ; http://www.hec.usace.army.mil/software/hec-ras/hecras-hecras.html

APPENDIX B

OPERATION AND MAINTENANCE AGREEMENT

OPERATION AND MAINTENANCE (O&M) AGREEMENT
STORMWATER MANAGEMENT BEST MANAGEMENT PRACTICES
(SWM BMPs)

THIS AGREEMENT, made and entered into this ____ day of _____,20___, by and between:

_____

_____,

(hereinafter the "Landowner")

and

MIDDLECREEK TOWNSHIP, Snyder County, Pennsylvania, (hereinafter "Township");

WITNESSETH, that:

WHEREAS, the Landowner is the owner of certain real property situate in Middlecreek Township, Snyder County, Pennsylvania, consisting of _____ acres, and being more particularly bounded and described in Deed recorded in Snyder County Deed Book _____, page _____., (or as set forth in the attached Property Description) (hereinafter "Property"); and

WHEREAS, the Landowner is proceeding to build and develop the property; and

WHEREAS, the StormWater Management (SWM) Site Plan approved by the Township (hereinafter referred to as the "Plan") for the Property identified herein, a copy of which is recorded in Snyder County Map File _____, and made a part hereof, as approved by the Township, provides for management of stormwater within the confines of the property through the use of Best Management Practices (BMPs); and

WHEREAS, the Township and the Landowner, his successors and assigns, agree that the health, safety, and welfare of the residents of the Township and the protection and maintenance of water quality require that on-site SWM BMPs be constructed and maintained on the Property; and

WHEREAS, the Township requires, through the implementation of the SWM Site Plan that stormwater BMPs as required by said Plan and the Township Stormwater Management Ordinance be constructed and adequately operated and maintained by the Landowners, his successors and assigns.

NOW, THEREFORE, in consideration of the foregoing promises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The Landowner shall construct the BMPs in accordance with the plans and specifications identified in the SWM Site Plan.

2. The Landowner shall operate and maintain the BMPs as shown on the Plan in good working order in accordance with the specific maintenance requirements noted on the approved SWM Site Plan.

3. The Landowner hereby grants permission to the Township, its authorized agents, and employees, to enter upon the property, at reasonable times and upon presentation of proper credentials, to inspect the BMPs whenever necessary. Whenever possible, the Township shall notify the Landowner prior to entering the property.

4. In the event the Landowner fails to operate and maintain the BMPs per paragraph 2, the Township or its representatives may enter upon the Property and take whatever action is deemed necessary to the Township to maintain said BMPs. It is expressly understood and agreed that the Township is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Township.

5. In the event that the Township, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Township for all expenses (directly and indirectly) incurred within ten (10) days of receipt of invoice from the Township.

6. The intent and purpose of this Agreement is to ensure the proper maintenance of the onsite BMPs by the Landowner; provided, however, that this Agreement shall not be deemed to create or effect any additional liability of any party for damages alleged to result from or be caused by stormwater runoff.

7. The Landowner, its executors, administrators, assigns, and other successors in interest, shall release the Township and does hereby release the Township from all damages, accidents, casualties, occurrences or claims which might arise or be asserted against said employees and representatives from, construction, presence, existence, or maintenance of the BMPs by the Landowner or Township.

8. The Township may inspect the BMPs at a minimum of once every three years to ensure their continued functioning.

9. This Agreement shall be recorded in the office of the Recorder of Deeds of Snyder County, Pennsylvania, and shall constitute a covenant running with the Property and/or equitable servitude, and shall be binding on the Landowner, his administrators, executors, assigns, heirs and any other successors in interest, in perpetuity.

IN WITNESS WHEREOF, and intending to be legally bound hereby, the Landowner has hereunto set his hand and seal as of the day and year first above written.

Landowner(s)

Witness:

_____ _____

_____ _____

Middlecreek Township

Attest:

_____ _____

_____ _____

COMMONWEALTH OF PENNSYLVANIA :

ss

COUNTY OF SNYDER :

On this, the _____ day of _____, 20___, before me, a Notary Public in and for the Commonwealth and County aforesaid, personally appeared _____, being the Landowner above referenced, personally known (or satisfactorily proven) to me to be the person whose name is subscribed to the within instrument, and acknowledged that he executed the same for the purposes therein contained.

In Witness Whereof, I have hereunto set my hand and official seal.

_____

Notary public

APPENDIX C

LOW IMPACT DEVELOPMENT PRACTICES

LOW IMPACT DEVELOPMENT PRACTICES

ALTERNATIVE APPROACHES FOR MANAGING STORMWATER RUNOFF

Natural hydrologic conditions may be altered radically by poorly planned development practices, such as introducing unneeded impervious surfaces, destroying existing drainage swales, constructing unnecessary storm sewers, and changing local topography. A traditional drainage approach of development has been to remove runoff from a site as quickly as possible and capture it in a detention basin. This approach leads ultimately to the degradation of water quality, as well as expenditure of additional resources for detaining and managing concentrated runoff at some downstream location.

The recommended alternative approach is to promote practices that will minimize post-development runoff rates and volumes, which will minimize needs for artificial conveyance and storage facilities. To stimulate pre-development hydrologic conditions, forced infiltration is often necessary to offset the loss of infiltration by creation of impervious surfaces. The ability of the ground to infiltrate runoff depends upon the soil types and its conditions.

Preserving natural hydrologic conditions requires careful alternative site design considerations. Site design practices include preserving natural drainage features, minimizing impervious surface area, reducing the hydraulic connectivity of impervious surfaces, and protecting natural depression storage. A well-designed site will contain a mix of all those features. The following describes various techniques to achieve the alternative approaches:

- **Preserving Natural Drainage Features**. Protecting natural drainage features, particularly vegetated drainage swales and channels, is desirable because of their ability to infiltrate and attenuate flows and to filter pollutants. However, this objective is often not accomplished in land development. In fact, commonly held drainage philosophy encourages just the opposite pattern – streets and adjacent storm sewers typically are located in the natural headwater valleys and swales, thereby replacing natural drainage functions with a completely impervious system. As a result, runoff and pollutants generated from impervious surfaces flow directly into storm sewers with no opportunity for attenuation, infiltration or filtration. Developments designed to fit site topography also minimize the amount of grading on site.

- **Protecting Natural Depression Storage Areas**. Depressional storage areas have no surface outlet, or drain very slowly following a storm event. They can be commonly seen as ponded areas in farm fields during the wet season or after large runoff events. Traditional development practices eliminate these depressions by filling or draining, thereby obliterating their ability to reduce surface runoff volumes and trap pollutants. The volume and release-rate characteristics of depressions should be protected in the design of the development site. The depressions can be protected by simply

avoiding the depression or by incorporating its storage as additional capacity in required detention facilities.

- **Avoiding Introduction of Impervious Areas**. Careful site planning should consider reducing impervious coverage to the maximum extent possible. Building footprints, sidewalks, driveways, and other features producing impervious surfaces should be evaluated to minimize impacts on runoff.

- **Reducing the Hydraulic Connectivity of Impervious Surfaces**. Impervious surfaces are significantly less of a problem if they are not directly connected to an impervious conveyance system (such as storm sewer). Two basic ways to reduce hydraulic connectivity are: routing of roof runoff over lawns; and reducing the use of storm sewers. Site grading should promote increasing travel time of stormwater runoff and should help reduce concentration of runoff to a single point in the development.

- **Routing Roof Runoff Over Lawns**. Roof runoff can be easily routed over lawns in most site designs. The practice discourages direct connection of downspouts to storm sewers or parking lots. The practice also discourages sloping driveways and parking lots to the street. The routing of roof drains and crowning the driveway to allow runoff to discharge to pervious areas is desirable as the pervious area essentially acts as a filter strip.

- **Reducing the Use of Storm Sewers**. By reducing use of storm sewers for draining streets, parking lots, and back yards, the potential for accelerating runoff from the development can be greatly reduced. The practice requires greater use of swales and may not be practical for some development sites, especially if there are concerns for areas that do not drain in a "reasonable" time. The practice requires educating local citizens and public works officials, who expect runoff to disappear shortly after a rainfall event.

- **Reducing Street Widths.** Street widths can be reduced by either eliminating on-street parking or by reducing cart-way widths. Township planners and traffic designers should encourage narrower neighborhood streets, which ultimately could lower maintenance and maintenance related costs.

- **Limiting Sidewalks to One Side of the Street**. A sidewalk on one side of the street may suffice in low-traffic neighborhoods. The lost sidewalk could be replaced with bicycle/recreational trails that follow back-of-lot lines. Where appropriate, backyard trails should be constructed using pervious materials.

- **Using Permeable Paving Materials**. These materials include permeable

interlocking concrete paving blocks or porous bituminous concrete. Such materials should be considered as alternatives to conventional pavement surfaces, especially for low use surfaces such as driveways, overflow parking lots, and emergency access roads..

- **Constructing Cluster Developments**. Cluster developments can also reduce the amount of impervious area for a given number of lots. The biggest savings is in street length, which also will reduce costs of the development. Cluster development "clusters" the construction activity onto less-sensitive areas without substantially affecting the gross density of development.

In summary, careful consideration of the existing topography and implementation of a combination of the above mentioned techniques may avoid construction of costly stormwater control measures. Other benefits include: reduced potential of downstream flooding, reduced water quality degradation of receiving streams and water bodies, enhancement of aesthetics, and reduction of development costs. Beneficial results include: more stable baseflows in receiving streams, improved groundwater recharge, reduced flood flows, reduced pollutant loads, and reduced costs for conveyance and storage.

APPENDIX D - STORMWATER MANAGENT DESIGN DATA

TABLE C-1 RUNOFF CURVE NUMBERS - REFER TO MOST RECENT VERSION OF APPENDIX A, REFERENCE 4

TABLE C-2 RATIONAL METHOD RUNOFF COEFFICIENTS - attached

TABLE C-2 - RATIONAL METHOD RUNOFF COEFFICIENTS

Hydrologic Soil Group and Slope Range

		A			B			C			D	
Land Use	0 to 2%	2 to 6%	6+%	0 to 2%	2 to 6%	6+%	0 to 2%	2 to 6%	6+%	0 to 2%	2 to 6%	6+%
Cultivated	0.08[a]	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
Land	0.14[b]	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Pasture	0.12	0.20	0.30	0.18	0.28	0.37	0.24	0.34	0.44	0.30	0.40	0.50
	0.15	0.25	0.37	0.23	.034	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Meadow	0.10	0.16	0.25	0.14	0.22	0.30	0.20	0.28	0.36	0.24	0.30	0.40
	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Forest	0.05	0.08	0.11	0.08	0.11	0.14	0.10	0.13	0.16	0.12	0.16	0.20
	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Residential	0.25	0.28	0.31	0.27	0.30	0.35	0.30	0.33	0.38	0.33	0.36	0.42
1/8 acre	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
1/4 acre	0.22	0.26	0.29	0.24	0.29	0.33	0.27	0.31	0.36	0.30	0.34	0.40
	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
1/3 acre	0.19	0.23	0.26	0.22	0.26	0.30	0.25	0.29	0.34	0.28	0.32	0.39
	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
1/2 acre	0.16	0.20	0.24	0.19	0.23	0.28	0.22	0.27	0.32	0.26	0.30	0.37
	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.48
1 acre	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.29	0.35
	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Industrial	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.71	0.71	0.72	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets	0.70	0.71	0.72	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78
	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Open Space	0.05	0.10	0.14	0.08	0.13	0.19	0.12	0.17	0.24	0.16	0.21	0.28
	0.11	0.16	0.20	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Parking	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97

NOTES:

[a] Runoff coefficients for storm recurrence intervals less than 25 years.

[b] Runoff coefficients for storm recurrence intervals of 25 years or more.

Source: Rawls, W.J., S.L. Long, and R.H. McCuen, 1981. Comparison of Urban Flood Frequency Procedures. Preliminary Draft Report prepared for the Soil Conservation Service, Beltsville, Maryland.