BENNER TOWNSHIP

CENTRE COUNTY

STORMWATER MANAGEMENT ORDINANCE

Ordinance No. 84

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ARTICLE I

GENERAL PROVISIONS

Section 101. Statement of Findings

The Benner Township Supervisors find that:

A. Inadequate management of accelerated stormwater runoff resulting from development throughout a watershed increases flood flows and velocities; contributes to erosion and sedimentation; overtaxes the carrying capacity of existing streams and storm sewers; greatly increases the cost of public facilities to convey and manage stormwater; undermines floodplain management and flood reduction efforts in upstream and downstream communities; reduces groundwater recharge; and threatens public health and safety.

B. This stormwater management ordinance has been developed considering the actual hydrologic processes that occur within the Spring Creek Watershed and how these processes can best be represented in hydrologic models that are used in engineering practice to model developing areas for stormwater management purposes. Process driven stormwater management planning is critical in the Spring Creek Watershed due to the underlying geology. The Spring Creek Watershed is mainly underlain by carbonate formations. As a result, significant areas within the watershed do not produce over-land or surface runoff, but rather contribute to the storm flow component of runoff in larger tributary areas via a greater than normal interflow component.

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

Section 102. Purpose

The purpose of this Ordinance is to promote health, safety, and welfare within the Spring Creek Watershed by minimizing the damages described in *Section 101.A* of this Ordinance through provisions designed to:

A. Manage accelerated runoff and erosion and sedimentation problems at their source by regulating activities that cause these problems.

B. Utilize and preserve the existing natural drainage systems.

C. Encourage the use of low impact development techniques to promote infiltration and groundwater recharge where appropriate.

D. Maintain existing flows and quality of streams and watercourses in the Township and the Commonwealth.

E. Preserve and restore the flood-carrying capacity of streams.

F. Provide proper maintenance of all permanent stormwater management facilities that are constructed in the basin.

G. Provide performance standards and design criteria for watershed-wide stormwater management and planning.

H. Protect groundwater and surface water quality.

Section 103. Statutory Authority

The Township is empowered to regulate land use activities that affect runoff by the authority by the *Act of October 4, 1978 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq*., as amended, the *"Stormwater Management Act"*, Pennsylvania Municipalities Planning Code, Second Class Township Code, and Constitution of Pennsylvania, Article I, Section 27, as amended.

Section 104. Applicability

This Ordinance shall apply to those areas of the Township that are located within the Spring Creek Watershed, as delineated in *Appendix B*, which is hereby adopted as part of this Ordinance.

This Ordinance shall only apply to permanent stormwater management facilities constructed as part of any of the Regulated Activities listed in this Section. Stormwater management and erosion and sediment pollution control during construction activities are specifically not regulated by this Ordinance, but shall continue to be regulated under existing laws and ordinances.

This Ordinance contains only the stormwater management performance standards and design criteria that are necessary or desirable from a watershed-wide perspective. Local stormwater management design criteria (e.g. inlet spacing, inlet type, collection system design and details, outlet structure design, etc.) shall continue to be regulated by the applicable Township Ordinances or at the Township Engineer's discretion. However, these design criteria have also been provided within this sample Ordinance and may be adopted in full by Municipalities.

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

A. Land development;

B. Subdivision;

C. Construction of new or additional impervious or semi-pervious surfaces (roadways, driveways, parking lots, etc.);

D. Construction of new buildings or additions to existing buildings;

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

F. Installation of stormwater management facilities or appurtenances thereto.

Section 105. Repealer

Any ordinance or ordinance provision of the Township inconsistent with any of the provisions of this Ordinance is hereby repealed to the extent of the inconsistency only.

Section 106. Severability

Should any section or provision of this Ordinance be declared invalid by a court of competent jurisdiction, such decision shall not affect the validity of any of the remaining provisions of this Ordinance.

Section 107. Compatibility with Other Ordinance Requirements

Approvals issued pursuant to this Ordinance do not relieve the Applicant of the responsibility to comply with or to secure required permits or approvals for activities regulated by any other applicable codes, rules, statutes, or ordinances.

Section 108. Landowner Responsibility

The granting of any exemption, permit, or approval by the Township does not relieve the applicant from assuring that stormwater runoff from the development site will not cause injury or damage to other persons or property.

Section 109. References

Specific methods and publications indicated in this Ordinance shall, in all cases, refer to the latest available edition and include revisions or amendments thereto.

Section 110. Exemptions

Activities identified below are exempt from the requirement to submit a Stormwater Management Plan to the governing Municipality for review. Exemption shall not relieve the applicant from implementing such measures as are necessary to protect health, safety, and property. These measures include adequate and safe conveyance of stormwater on the site and as it leaves the site. This exemption shall not relieve the applicant from meeting the special requirements for water quality and groundwater recharge for high quality (HQ) and exceptional value (EV) watersheds *(DEP Chapter 93* and anti-degradation requirement), and *Sections 304 C and E* of this Ordinance relative recharge and water quality volume requirements.

A. All development activities having impervious coverage of less than 10% of the total site area up to a maximum impervious area of 5,000 sq. ft. However, adequate and safe conveyance of stormwater from the site must be provided. For developments that are to be constructed in phases, the sum of all final phases must be considered in establishing exemption eligibility. Impervious cover shall include, but not be limited to, any roof, parking or driveway areas, and any new streets and sidewalks, or bikeways.

B. Land disturbance associated with the construction or alteration of one- and two-family dwellings, provided that the disturbance does not alter any stormwater condition beyond the boundaries of the lot or alter provisions of a previously approved Stormwater Management Plan for the lot or encompassing subdivision.

Multiple (>2) lot subdivisions cannot be exempted.

C. Any site less than one (1) acre in size that decreases the total site impervious area following development, and:

- Is not located within a recognized sensitive area (as defined in *Article II, Definitions*, of this Ordinance);
- Is not defined as a water quality sensitive (WQS) development (as defined in *Article II, Definitions*, and *Appendix B, Maps*); or
- Is not located in an area where existing downstream stormwater problems are known to occur (the Township Engineer shall make the final determination as to pre-existing problems, but the Township must have supporting documentation of past problems).

D. In addition, the Township Engineer may waive the requirement to prepare a stormwater management plan for sites larger than 1.0 acre for which the overall site impervious area is being decreased, and which meets the other conditions identified above.

The diversion or piping of any natural or man-made stream channel and/or for the installation of stormwater management facilities or modifications thereto cannot be exempted. These activities always require the submission of a Stormwater Management Plan. Exemptions A and B, above in *Section 110* cannot be combined for use with small residential subdivisions.

In addition to the general exemptions identified above, exemptions for specific technical criteria are identified where applicable in *Article III*.

ARTICLE II

DEFINITIONS

For the purposes of this chapter, certain terms and words used herein shall be interpreted as presented below. Additional definitions are provided in the *ACT 167 Plan* definitions chapter.

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 word "person" includes an individual, firm, association, organization, partnership, trust, company, corporation, or any other similar entity.

D. The words "shall" and "must" are mandatory; the words "may" and "should" are permissive.

E. The words "used or occupied" include the words "intended, designed, maintained, or arranged to be used, occupied or maintained".

Agricultural Activities – The work of producing crops and raising livestock including tillage, plowing, disking, harrowing, pasturing and installation of conservation measures. Construction of new buildings or impervious area is not considered an agricultural activity.

Alteration – As applied to land, a change in topography as a result of the moving of soil and rock from one location or position to another; also the changing of surface conditions by causing the surface to be more or less impervious; land disturbance.

Applicant – A landowner or developer who has filed an application for approval to engage in any Regulated Activities as defined in *Section 104* of this Ordinance.

BMP (Best Management Practice) – Stormwater structures, facilities and techniques to maintain or improve the water quality of surface runoff.

Buffer Area – Area that is protected from development in order to prevent degradation of the water body or water quality.

Capture Depth – Depth of runoff captured from a given area and either allowed to evaporate, infiltrate, or be discharged through a spillway at a negligible rate.

Carbonate – A sediment formed by the organic or inorganic precipitation of mineral compounds characterized by the fundamental chemical ion CO_3, the principal element in limestone and dolomite strata.

Channel – A perceptible natural or artificial waterway, which periodically or continuously contains moving water having a definite bed and banks, which confine the water.

Closed Or Undrained Depression – In a Karst geologic area a distinct bowl-shaped depression in the land surface; size and amplitude are variable; drainage is internal. It differs from a sinkhole in that the ground surface is unbroken and usually occurs in greater density per unit area.

Conservation District – The *Centre County Conservation District*.

Credits – A deduction from the required amount. In this ordinance, implies reduction of required water quality volumes due to using a recommended practice.

Dam – An artificial barrier, together with its appurtenant works, constructed for the purpose of impounding or storing water or another fluid or semifluid, or a refuse bank, fill or structure for highway, railroad or other purposes which does or may impound water or another fluid or semifluid.

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.

Designee – The agent of a Planning Commission and/or agent of the governing body involved with the administration, review or enforcement of any provisions of this ordinance by contract or memorandum of understanding.

Detention Basin – An impoundment structure designed to manage stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

Developer – A person, partnership, association, corporation, or other entity, or any responsible person therein or agent thereof, that undertakes any Regulated Activity of this Ordinance.

Development Site – The specific tract of land for which a Regulated Activity is proposed.

Dolomite – (1) A mineral consisting of calcium magnesium carbonate found as compact lime stone; or (2) limestone or marble rich in magnesium carbonate.

Downslope Property Line – That portion of the property line of the lot, tract, or parcels of land being developed located such that all overland or pipe flow from the site would be directed towards it.

Drainage Conveyance Facility – A Stormwater Management Facility designed to transmit stormwater runoff and shall include streams, channels, swales, pipes, conduits, culverts, storm sewers, etc.

Drainage Easement – A right granted by a landowner to a grantee, allowing the use of private land for stormwater management purposes.

Drainage Permit – A permit issued by the Township governing body after the drainage plan has been approved. Said permit is issued prior to or with the final Township approval.

Drainage Plan – The documentation of the stormwater management system, if any, to be used for a given development site, the contents of which are established in *Section 403.*

Drainage-way – The natural or man-made path of surface water from a given area.

Erosion – The movement of soil particles by the action of water, wind, ice, or other natural forces.

Erosion and Sediment Pollution Control Plan – A plan that is designed to minimize accelerated erosion and sedimentation.

Exfiltration – The process by which water or moisture moves from a subsurface trench, bed, or other feature into the subsoil. Exfiltration is best measured by a soil's percolation rate.

Existing Conditions – The initial condition of a project site prior to the proposed construction.

Flood – A general but temporary condition of partial or complete inundation of normally dry land areas from the overflow of streams, rivers, and other waters of this Commonwealth.

Floodplain - Any land area susceptible to inundation by water from any natural source or delineated by applicable *Department of Housing and Urban Development, Federal Insurance Administration Flood Hazard Boundary* - Mapped as being a special flood hazard area.

Floodway – The channel of the watercourse and those portions of the adjoining floodplains that are reasonably required to carry and discharge the 100-year frequency 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 frequency floodway, it is assumed - absent evidence to the contrary - that the floodway extends from the stream to 50 ft. from the top of the bank of the stream.

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

Freeboard – A vertical distance between the elevation of the design high-water and the top of a dam, levee, tank, basin, or diversion ridge. The space is required as a safety margin in a pond or basin.

Grassed Waterway – A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from cropland.

Groundwater Recharge – Replenishment of existing natural underground water supplies.

Impervious Surface – A surface that prevents the percolation of water into the ground.

Impoundment – A retention or detention basin designed to retain stormwater runoff and release it at a controlled rate.

Infiltration Rate – The infiltration rate of a soil is related to the soil's final infiltration capacity and represents the rate at which water enters the soil/air interface at the top of the soil profile. Infiltration rates are measured in units of length / time.

Inlet – A surface connection to a closed drain. A structure at the diversion end of a conduit. The upstream end of any structure through which water may flow.

Interceptor – A channel, berm, or dike constructed across a slope for the purpose of intercepting stormwater, reducing the velocity of flow, and diverting it to outlets where it may be disposed.

Karst – A type of topography that is formed over limestone, dolomite, or gypsum by bedrock solution, and that is characterized by closed depressions or sinkholes, caves, and underground drainage (from *AGI, Glossary of Geology, 1972*).

Land Development – (i) The improvement of one lot or two (2) or more contiguous lots, tracts, or parcels of land for any purpose involving (a) a group of two (2) or more buildings, or (b) the division or allocation of land or space between or among two (2) 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 of land; (iii) Development in accordance with *Section 503(1.1)* of the *Pennsylvania Municipalities Planning Code*.

Land/Earth Disturbance – Any activity involving grading, tilling, digging, or filling of ground or stripping of vegetation or any other activity that causes an alteration to the natural condition of the land.

Land Use – The primary application employed in an area.

Limestone – A rock that, by accumulation of organic remains, consists mainly of calcium carbonate.

Lineaments – Straight or gently curved, lengthy features frequently expressed topographically as depressions or lines on the earth's surface. They can be more easily observed at a height of 100 meters or more and are usually found by researching aerial photographs or satellite photography. They are usually located in areas of faulting or in dense jointing along some rock stratigraphy.

Main Stem (Main Channel) – Any stream segment or other runoff conveyance facility used as a reach in the Spring Creek hydrologic model.

Minimum Allowable Discharge – In relation to this Stormwater Management Ordinance, the minimum rate that can be discharged for any drainage area for design storm events up to and including the 10-year event regardless of the modeled pre-development runoff estimate.

Municipality – Any of the several municipalities within the basin consisting of: Bellefonte Borough, Benner Township, Boggs Township, Centre Hall Borough, College Township, Ferguson Township, Halfmoon Township, Harris Township, Milesburg Borough, Patton Township, Potter Township, Spring Township, State College Borough, and Walker Township, Centre County, Pennsylvania.

Natural Conservation Areas – A natural area protected during development for its water quality or recharge enhancing abilities.

Outfall – Point where water flows from a conduit, stream, or drain.

Outlet – Points of water disposal from a stream, river, lake, tidewater or artificial drain.

PA DEP – *Pennsylvania State Department of Environmental Protection*.

PENN DOT – *Pennsylvania State Department of Transportation*.

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

Percolation Rate – The rate at which water moves through a soil profile. Percolation rates are measured in units of time / length.

Pipe – A culvert, closed conduit, or similar structure (including appurtenances) that conveys stormwater.

Planning Commission – The planning commission of a Municipality.

Point Discharge – The discharge from a pipe or channel that concentrates runoff at a single area.

Recharge Volume – The volume of water that is required to be recharged from developed sites.

Registered Professional – An individual registered in and licensed by the State of Pennsylvania including, for the purposes of this Ordinance, land surveyors, landscape architects, architects and engineers.

Regulated Activities – Actions or proposed actions that have an impact on stormwater runoff and that are specified in *Section 104* of this Ordinance.

Retention Basin – An impoundment in which stormwater is stored and not released during the storm event. Stored water may be released from the basin at some time after the end of the storm.

Return Period – The average interval, in years, within which a storm event of a given magnitude can be expected to recur. For example, the 25-year return period rainfall has a 4% probability of occurring in any given year.

Runoff – Any part of precipitation that flows over the land surface.

Safe Passage – The routing of peak runoff events, usually the 100-year design event, safely through a structure without failure of that structure.

Scour – Generally refers to the change in a channel configuration provoked by sediment imbalance, due to natural or man made causes, between the supply and transport capacity of the channel.

Sediment Basin – A barrier, dam, retention or detention basin located and designed to retain rock, sand, gravel, silt, or other material transported by water.

Sensitive (Water Quality) Area – An area protected because development within that area could potentially cause contamination of groundwater reservoirs. These sensitive land areas are defined in *Appendix B, Exhibit-1*.

Sheet Flow – Runoff that flows over the ground surface as a thin, even layer, not concentrated in a channel.

Sinkhole – A localized, gradual or rapid sinking of the land surface to a variable depth, occurring in areas of carbonate bedrock; generally characterized by a roughly circular outline, a distant breaking of the ground surface and downward movement of soil into bedrock voids.

Spillway – A depression in the embankment of a pond or basin that is used to pass peak discharge greater than the maximum design storm controlled by the pond.

Stabilization – The proper placing, grading and/or covering of soil, rock or earth to ensure their resistance to erosion, sliding or other movement.

Storm Sewer – A system of pipes and/or open channels that convey intercepted runoff and stormwater from other sources, but excludes domestic sewage and industrial wastes.

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 structures.

Stormwater Management Plan – The plan for managing stormwater runoff in the *Spring Creek Watershed* adopted by the Centre County Commissioners as required by the *Act of October 4, 1978, P.L. 864, (Act 167)*, and known as the *"Spring Creek Watershed Action 167 Stormwater Management Plan.*

Strata – Tabular or sheet-like mass, distinct layers of homogenous or gradational sedimentary material (consolidated rock or unconsolidated earth) of any thickness, visually separable from other layers above and below by a discrete change in the character of the material deposited or by a sharp physical break deposition or both.

Stratigraphic Unit – A stratum or body of strata recognized as a unit in the classification of the rocks of the earth's crust with respect to any specific rock character, property, attribute or for any purpose such as description, mapping, and correlation.

Structural Fill – For the purposes of this ordinance, shall imply any soil mass that is compacted in lifts to some tested criteria (standard or modified proctor) such as those under foundations or adjacent to retaining walls. Areas that for several years after construction respond to precipitation events similar to impervious areas.

Subarea – The smallest drainage unit of a watershed for which stormwater management criteria have been established in the Stormwater Management Plan.

Swale – A natural low-lying stretch of land or minor man made conveyance channel, which gathers or carries surface water runoff.

SWM – Stormwater management.

Township – Township of Benner Township, Centre County, Pennsylvania.

Township Engineer – A professional engineer licensed in the Commonwealth of Pennsylvania and duly appointed by the subject Municipality as their representative. In the event that a Stormwater Utility is formed, all references to the Township Engineer shall be considered to also imply the Stormwater Utility Engineer.

Topography – The general configuration of a land surface or any part of the earth's surface, including its relief and position of its natural and man-made features. The natural or physical surface features of a region, considered collectively as to its form.

Undetained Area – An area of a site that cannot be routed to a stormwater management facility because of its location. Generally small areas around access drives or below stormwater management facilities.

Water Quality Depth – Depth of precipitation required to be used in computing the water quality volume based on the percentage of imperviousness of a site.

Water Quality Sensitive (WQS) Development – Land development projects that have a high potential to cause catastrophic loss to local water quality and could potentially threaten ground water reservoirs. See *Section 302* for additional definition.

Water Quality Volume – Volume of runoff required to be controlled from a site in a water quality BMP.

Watershed – The entire region or area drained by a river or other body of water, whether natural or artificial, a drainage basin or sub-basin.

Waters of the Commonwealth – Any and all rivers, streams, creeks, rivulets, 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.

Water Table – Upper surface of a layer of saturated material in the soil.

Wetland – Those areas that are inundated or saturated by surface or ground water 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, ferns, and similar areas.

ARTICLE III

STORMWATER MANAGEMENT

Section 301. General Requirements

A. All regulated activities in the Spring Creek Watershed which do not fall under the exemption criteria shown in *Section 110* of this Ordinance shall submit a drainage plan to the governing Municipality for review. This plan must be consistent with the *Spring Creek Watershed Stormwater Management Plan*. These criteria shall apply to the total proposed development even if development is to take place in phases. Impervious cover shall include, but not be limited to, any roof, parking or driveway areas, and any new streets and sidewalks. Any areas designed to initially be gravel or crushed stone shall be assumed to be impervious for the purposes of comparison to the waiver criteria.

B. Stormwater drainage systems shall be provided in order to permit unimpeded flow along natural watercourses, except as modified by stormwater management facilities or open channels consistent with this Ordinance.

1. Stormwater management facilities and related installations also shall be provided:

a. To ensure adequate drainage of all low points along the curb line of streets.

b. To intercept stormwater runoff along streets at intervals reasonably related to the extent and grade of the area drained, and to prevent substantial flow of water across intersections or flooded intersections during storms, in accordance with the procedures contained in *Design Manual Part 2 (DM-2), Chapter 10, of the Pennsylvania Department of Transportation (PENN DOT).*

c. To ensure adequate and unimpeded flow of stormwater under driveways in, near, or across natural watercourses or drainage swales. Suitable pipes or other waterways shall be provided as necessary.

d. To properly drain stormwater runoff from all land development projects, except as required by recharge criteria. All lot and open areas shall be designed to drain to the nearest practical street or drainage system, existing or proposed, as defined by the respective Township Engineer, with no impact on adjoining properties, unless an area specifically designed for stormwater detention is provided.

C. The existing points of concentrated drainage that discharge onto adjacent property shall not be altered without permission of the altered property owner(s) and shall be subject to any applicable discharge criteria specified in this Ordinance.

D. Areas of existing diffused drainage discharge shall be subject to any applicable discharge criteria in the general direction of existing discharge, whether proposed to be concentrated or maintained as diffused drainage areas, except as otherwise provided by this Ordinance. If diffused flow is proposed to be concentrated and discharged onto adjacent property, the Developer must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge, or otherwise prove that no erosion, sedimentation, flooding or other harm will result from the concentrated discharge.

E. Where a development site is traversed by watercourses, drainage easements shall be provided conforming to the line of such watercourses. The terms of the easement shall prohibit excavation, the placing of fill or structures, and any alterations that may adversely affect the flow of stormwater within any portion of the easement. Also, maintenance, including mowing of vegetation within the easement shall be required, except as approved by the appropriate governing authority.

F. When it can be shown that, due to topographic conditions, natural drainage ways on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the line and grade of such natural drainage ways. Work within natural drainage ways shall be subject to approval by *PA DEP* through the *Joint Permit Application* process, or, where deemed appropriate by *PA DEP*, through the *General Permit* process.

G. Any stormwater management facilities regulated by this Ordinance that would be located in or adjacent to waters of the Commonwealth or wetlands shall be subject to approval by *PA DEP* through the *Joint Permit Application* process, or, where deemed appropriate by *PA DEP*, the *General Permit* process. When there is a question whether wetlands may be involved, it is the responsibility of the Developer or his agent to show that the land in question cannot be classified as wetlands, otherwise approval to work in the area must be obtained from *PA DEP.*

H. Any stormwater management facilities regulated by this Ordinance that would be located on State highway rights-of-way shall be subject to approval by the *PENN DOT .*

I. Minimization of impervious surfaces and infiltration of runoff through seepage beds, recharge trenches, etc., are encouraged, where soil conditions permit, to reduce the size or eliminate the need for detention facilities.

J. To promote over-land flow and infiltration/percolation of stormwater, roof drains should not be connected to streets, sanitary or storm sewers, or roadside ditches unless approved by the Township authority on a case-by-case basis.

K. Where deemed necessary by the respective Township Engineer, the applicant shall submit an analysis of the impacts of detained stormwater flows on

downstream areas within the watershed. These impacts shall be identified with concurrence from the Township Engineer. The analysis shall include hydrologic and hydraulic calculations necessary to determine the impact peak discharge modifications from the proposed development have on critical locations such as dams, tributaries, existing developments, undersized culverts, floodprone areas, etc.

L. When stormwater management facilities are proposed within 1,000 ft. of a downstream Municipality, the analysis of downstream impacts shall be submitted to the downstream Municipal's engineers for review and comment.

Section 302. Sensitive Areas and Developments

Sensitive areas and water quality sensitive developments have been identified which require special consideration with regard to stormwater management.

Sensitive areas are defined as those areas that, if developed, have the potential to cause catastrophic loss to a Water Authority well field. These areas consist of the delineated 1-year zone of contribution and direct upslope areas tributary to the wells (see *Appendix B, Exhibit 1*). Municipalities may update the sensitive area boundaries based on new research or studies as required.

Water Quality Sensitive (WQS) developments are defined as a land development project that has a high potential to cause catastrophic loss to local water quality, and could potentially threaten ground water reservoirs. The following is a provisional list of water quality sensitive developments. This list may be amended at the discretion of the local Municipality.

- Vehicle fueling stations
- Industrial manufacturing sites*
- Salvage yards
- Recycling centers
- Hazardous material storage areas*
- Interstate highways

* The Township Engineer will make the determination relative to what constitutes these classifications on a case-by-case basis. The *PA DEP* wellhead protection contaminant source list shall be used as a guide in these determinations. Industrial manufacturing site and hazardous material storage areas must provide *NPDES SIC* codes.

Section 303. Performance Standards

A. **General** - Post-development rates of runoff from any regulated activity shall not exceed the peak release rates of runoff prior to development for the design storms specified.

B. **Sensitive Area District Boundaries** – The location of sensitive areas or sensitive area districts (SAD) within the watershed are illustrated on an official map, which is available for inspection at the Township office. A reduced scale copy of this map is included as *Exhibit 1* in *Appendix B* of this Ordinance. The exact location of the boundaries of sensitive areas are set by drainage areas

tributary to each of the points of interest as illustrated in *Appendix B.* The exact location of these boundaries as they apply to a given development site, shall be determined using mapping at a scale which accurately defines the limits of the sensitive area. If the project site is within the sensitive area (in whole or in part), 2-foot contour interval mapping shall be provided to define the limits of the sensitive area. If the project site is adjacent to but within 500 linear feet of a defined Sensitive Area, a 5-foot contour interval map defining the limits of the Sensitive Area shall be included in the Stormwater Management Plan to document the site's location relative to the sensitive area.

C. **Sites Located in More Than One (1) District** - For a proposed development site which is traversed by a SAD boundary, the design criteria for sensitive areas must be applied if post-development runoff is directed towards the sensitive area.

D. **Off-Site Areas** - Off-site areas that drain from sensitive areas through a proposed development site that is located entirely in a non-sensitive area are not required to use or apply the sensitive area criteria.

E. **Site Areas** - Where the site area to be impacted by a proposed development activity differs significantly from the total site area, only the proposed impact area shall be subject to the design criteria.

F. **"Downstream Hydraulic Capacity Analysis"** - Any downstream or off-site hydraulic capacity analysis conducted in accordance with these standards shall use the following criteria for determining adequacy for accepting increased peak flow rates:

1. Natural or man-made channels or swales must be able to convey the post-development runoff associated with a 2-year return period event within their banks at velocities consistent with protection of the channels from erosion. Acceptable velocities shall be based upon criteria included in the *DEP Erosion and Sediment Pollution Control Program Manual*.

2. Natural or man-made channels or swales must be able to convey the post-development 25-year return period runoff without creating any hazard to persons or property.

3. Culverts, bridges, storm sewers or any other facilities which must pass or convey flows from the tributary area must be designed in accordance with *PA DEP, Chapter 105* regulations (if applicable) and, at a minimum, pass the post-development 25-year return period runoff.

4. It must be demonstrated that the downstream conveyance channel, other stormwater facilities, roadways, or overland areas must be capable of safely conveying the 100-year design storm without causing damage to buildings or other infrastructure.

5. Where the downstream conveyance channel or other facility is located within a special flood hazard area (as documented on the Municipal Flood Insurance Rate Map), it must be demonstrated that the limits of said flood

hazard area are not increased by the proposed activity.

6. Stormwater management ponds that fall under the *PA DEP Chapter 105* Criteria of a "Dam" must meet the criteria within *PA DEP Chapter 105*.

Section 304. Calculation Methodologies

Design criteria and calculation methodologies have been classified by functional group for presentation as follows:

1. peak runoff rate discharge requirements;
2. stormwater pond capture volumes;
3. recharge volumes;
4. storm drain design including conveyance, channel protection, and stability; and
5. water quality standards.

These criteria and calculation methodologies have been developed to simplify stormwater management designs, unify methods, remove model parameter subjectivity, remove improperly used methods, and to ensure stormwater management decisions are based more realistically on hydrologic processes. In addition, common sense should always be used as a controlling criteria.

These standards provide consistent and process oriented design procedures for application by land development professionals. It is recognized that in an attempt to generalize the computational procedures, assumptions have been made which on some occasions may be violated. If such a violation is identified, alternate standards and procedures may be applied. Both the violation and the alternate procedures to be applied must be documented by a hydrologist or hydrogeologist. Any request for use of alternate standards or procedures under this provision must be agreed to by the local Township Engineer prior to formal submission of plans for consideration by the Township.

A flow chart documenting the stormwater management design process is provided as *Exhibit-2* in *Appendix B* of this ordinance.

A. **Peak Runoff Rate Control**

1.a. Any site where the increase in post-development peak runoff rates is determined to be negligible by the Township Engineer is exempt from the requirement to provide stormwater detention. In support of this exemption, it must be shown that the downstream conveyance systems have adequate capacity to convey the additional discharge without adversely affecting downstream properties. This does not exempt the requirement for implementation of designs for water quality, stormwater conveyance, and/or recharge as required. A Stormwater Management Plan and report documenting these design elements is also required. The final definition of "negligible" shall be at the Township Engineer's discretion.

Prior to using this exemption (and prior to any land development plan submission), the Design Engineer must provide written documentation and computations as to why no peak runoff control should be required.

The Township Engineer has the right to reject any plan that uses this assumption without prior approval of the Township Engineer. The intent of this exemption is to eliminate the need for multiple or "piggyback" detention facilities as a result of minor changes in imperviousness or land use upstream of existing stormwater control facilities.

1.b. Small sites (<5 acres) located directly adjacent to the main stem of creeks or within the floodplain are not required to provide stormwater detention unless directed to do so by the Township Engineer as a result of a documented drainage problem. All other stormwater management standards must be implemented including water quality, adequate stormwater conveyance, and/or recharge as required. The Township Engineer has the right to reject any plan that uses this exemption without prior approval of the Township Engineer.

2. Stormwater management analysis must be performed using the following models. The size criteria are based on drainage area size including site area and all off-site area draining across the development.

Up to 100 acres in size NRCS's TR-55 or TR-20
Over 100 acres in size NRCS's TR-20 or HEC-1 (HEC-HMS)

The Rational Method or Modified Rational Method may be used for any site less than or equal to two (2) acres in size without prior authorization from the Township Engineer. The Rational Method or Modified Rational Method may also be used for sites between two (2) and 20 acres in size where the Township Engineer has approved the method's use. In this case the Design Engineer must make a written request to the Township Engineer explaining why the use of the Rational Method is more appropriate than the NRCS's methods for the site in question. The Design Engineer should keep in mind that the Rational Formula methodology was not calibrated to account for the karst nature of the Spring Creek Drainage Basin; and therefore, its use should be limited to the special cases identified above. In addition, since the minimum discharge criteria are based on a calibration of the NRCS runoff mode, their use is not appropriate if the Rational Method is used for runoff computations.

The Township Engineer has the right to reject any SWM design that uses hydrograph combinations with the Rational Method where the designer has not validated that the effects of the timing differences are negligible. In addition, the Township Engineer has the right to reject any SWM design that improperly uses the method for determining runoff volumes or does not properly apply the method.

More intensive physically based models may be used at the discretion of the Township Engineer, but only for sites greater than 100 acres in size. Commercial software packages that use the basic computational methods of TR-55 or TR-20 are permitted.

The NRCS models and methods recommended above are based on data collected from actual watersheds. In contrast to this, stormwater

management analysis for land development activities is often conducted using property lines to define drainage boundaries. Drainage areas based on property boundaries are not true watersheds and are referred to here as "hypothetical" drainage areas. It is known that these hypothetical drainage areas do not respond like natural watersheds. Peak runoff rates from hypothetical drainage areas are much smaller than comparable runoff rates from natural watersheds of the same size. Therefore, wherever possible, pre- and post-development stormwater analysis should be conducted for watersheds that are as nearly natural as possible. Also, conducting stormwater analysis for a lot-by-lot comparison, such as within residential developments is not permitted. Partitioning drainage areas into different sub-watersheds for the post-development scenarios is acceptable.

It is noted that natural watershed boundaries should not be used where the relative size of the watershed compared to the site size would inappropriately distort the pre- to post-development runoff comparison. In these cases a hypothetical drainage area defined by the property boundary should be used because it will allow for a better estimate of runoff changes directly downstream of the site. In addition, the designer should recognize that, within the Spring Creek Watershed, typical hypothetical drainage areas, in their pre-development or natural condition, do not produce surface runoff during minor to moderate rainfall events. Available hydrologic models do not accurately reflect this condition. This often results in post-development nuisance flooding since the models over-estimate the pre-development runoff magnitude.

3. Major natural drainage divides may not be altered without the prior consent of the Township Engineer.

4. Pre- and post-development stormwater management analysis shall be conducted using the following design storms:

1 year	2-year
10-year	100-year

The Township Engineer may waive the requirement to detain the 100-year storm as long as the discharge is to a well defined, functioning conveyance system that does not currently exhibit flooding or other conveyance problems. The downstream conveyance system must be analyzed for the 100-year event to ensure that the proposed development will not increase flooding or damage to existing buildings and/or infrastructure.

5. The following 24-hour precipitation depths shall be used for stormwater management analysis for the entire Spring Creek Basin. These values override the use of TP-40 (the basis of the NRCS 24-hr precipitation maps).

Return Period	Precip. Depth
1-year	2.2 inches
2-year	2.6 inches
10-year	3.5 inches
25-year	4.2 inches
50-year	4.7 inches
100-year	5.3 inches

6. The NRCS's Type II precipitation distribution is required for all stormwater management analyses.

7. The NRCS's dimensionless unit hydrograph "k" factor shall be 484 for both pre- and post-development stormwater analyses.

8. All undeveloped areas are to be modeled as meadow or woods in good hydrologic condition. Existing impervious areas may be modeled as being impervious for pre-development conditions. The only exception is areas that are actively in agricultural production (non-fallow). The designer may model the watershed using the actual agricultural land use/cover condition to show that increases from the site as compared to the all meadow condition are negligible.

9. The NRCS's curve number (CN) shall be used as the rainfall to runoff transformation parameter for all stormwater management analyses.

10. Curve numbers should be rounded to tenths for use in pre-packaged hydrologic models. It should be recognized that the CN is only a design tool with a large degree of statistical variability. For large sites, CN's should realistically be rounded to the nearest whole number.

11. The NRCS's method to determine unconnected impervious area adjustments for CN can be used for distinctly defined impervious land areas that flow onto pervious areas in a dispersed manner. The method may only be used to calculate runoff from site impervious areas that actually flow across pervious areas. The method cannot be applied to the entire site using average weighted CN values.

12. Soils underlain by carbonate geology (limestone or dolomite) shall have a hydrologic soil group (HSG) B used for both pre- and post-development conditions regardless of the NRCS or Soil Survey's description, except for the following two conditions:

    a. Compacted structural fill areas shall use a minimum of HSG C for post development conditions regardless of the NRCS or Soil Survey's description. For most developments compacted structural fill areas are under impervious surfaces, but may include islands within parking areas, fringe land, etc. A HSG C shall also be applied to large projects that clear and compact building pad areas for later phases of development under an initial phase. The Township Engineer shall make the final determination as to what

areas of a land development site constitute compacted structural fill. The intent is to account for large compacted areas, and not minor grading within lawn areas.

b. Soils identified as “on flood plains” or “on terraces above flood plains” in the *Centre County Soil Survey* will use the HSG as designated in the Soil Survey. Refer to Appendix A for a list of the soils.

13. Soils not underlain by carbonate geology shall use the HSG as specified by the NRCS or Soil Survey’s description, except for the following two conditions:

a. Wooded areas on HSG C and D soils shall be treated as HSG B for pre-development conditions. Disturbed post-development wooded areas shall carry the NRCS or Soil Survey's defined HSG with a minimum HSG of B.

b. Highly compacted structural fill areas shall use a minimum of HSG C for post-development conditions regardless of the NRCS or Soil Survey’s description. For most developments these areas are normally covered with impervious surfaces, but may include islands within parking areas, fringe land, etc. A HSG of C shall also be used for large projects that clear and grade land for later phases of development. The Township Engineer shall make the final determination as to what areas of a land development site constitute compacted structural fill. The intent is to account for large compacted areas, and not minor grading within lawn areas or small areas around buildings, etc.

14. Areas draining to closed depressions must be modeled by removing the storage volume from the pre-development condition. The designer may assume that infiltration in the closed depression does not occur during a design runoff event. Areas draining to closed depressions may also be used to adjust peak runoff rates to stormwater management ponds for the post-development analysis. This allowance has been developed to entice designers to intentionally design or leave in place small closed depressions that can reduce the total volume required from a stormwater management pond. The site designer is responsible to document downstream impacts if the closed depression were removed.

15. Drainage areas tributary to sinkholes shall be excluded from the modeled point-of-interest drainage areas defining pre-development peak flows. Assumptions that sinkholes spill-over during some storm events must be supported by acceptable documentation (as determined by the Township Engineer). In addition, the design professional must be aware that bypassing or sealing sinkholes will frequently result in downstream flooding and should not be done if existing downstream flooding already occurs. The site designer is responsible to document downstream impacts if the sinkhole were to stop taking stormwater runoff.

16. Ponds or other permanent pools of water are to be modeled by the methods established in the NRCS's TR-55 manual (1986). However, more rigorous documented methods are acceptable (as determined by the Township Engineer).

17. The NRCS antecedent runoff condition II (ARC II, previously AMC II) must be used for all simulations. The use of continuous simulation models that vary the ARC are not permitted for stormwater management purposes. In addition, prior to any continuous simulation model being used in the Spring Creek Basin for any other purposes, the model unit hydrograph must be modified for common events in additional to extreme events based on an in depth analysis of historical data from the basin.

18. The following Time of Concentration (Tc) computational methodologies shall be used unless another method is pre-approved by the Township Engineer:

- Pre-development – NRCS's Lag Equation.
- Post-development; commercial, industrial, or other areas with large impervious areas (>20% impervious area) – NRCS's Segmental Method.
- Post-development; residential, cluster, or other low impact designs less than or equal to 20% impervious area – NCRS's Lag Equation.

The time of concentration is to represent the average condition that best reflects the hydrologic response of the area. For example, large impervious areas bordered by small pervious areas may not consider the effect of the pervious areas in the Tc computation. If the designer wants to consider the affect of the pervious area, runoff from the pervious and impervious areas must be computed separately with the hydrographs being combined to determine the total runoff from the area.

Under no circumstance will the post-development Tc be greater than the pre-development Tc for any watershed or sub-watershed modeling purposes. This includes when the designer has specifically used swales to reduce flow velocities. In the event that the designer believes that the post-development Tc is greater, it will still be set by default equal to the pre-development Tc for modeling purposes.

* Refer to item number 28 regarding impervious area flashing (IAF).

19. The following post-development minimum discharges are permitted for use with the NRCS (CN) runoff model*:

1-year return period	$Qp_{min} = 0.018\ (DA) + 0.2$
2-year return period	$Qp_{min} = 0.03\ (DA) + 0.4$
10-year return period	$Qp_{min} = 0.09\ (DA) + 1.0$

where: DA = the drainage area in acres
Qp_{min} = minimum allowable peak runoff rate in cfs

For return periods greater than 10 years, the minimum discharge shall be equal to the computed pre-development peak runoff rate.

The minimum discharge criteria above are not appropriate for use with the Rational Method. This is because these values were developed based on NRCS model corrections and do not actually represent a true physical process or discharge. However, common sense should be used by both the designer and reviewer in the evaluation of acceptable minimum discharges for use with the Rational Method.

The intent of the minimum discharge is to allow reasonable runoff release from a site when a hydrologic model has produced a pre-development runoff rate close to zero. The method is **NOT** permitted for areas that previously drained completely to sinkholes in order to bypass the sinkhole after development.

These minimum discharge values include the total of all stormwater management facilities discharges and undetained area discharges. Peak runoff rates for undetained fringe areas (where the designer has made a realistic effort to control all new impervious areas) will be computed using the pre-development time of concentration for the drainage areas tributary to them. Undetained areas are those portions of the site that cannot be routed to a stormwater management facility due to topography and typically include lower pond berms, or small areas around entrance drives. The site drainage areas used shall represent the pre-development condition, even if drainage areas are altered following development.

20. All lined stormwater management ponds in carbonate and non-carbonate areas must be considered impervious and may not be used as pervious areas for stormwater management computations. "Lined" here means lined with synthetic liners or Bentonite. All other compacted soil liners will be considered to be HSG D for hydrologic computations.

21. Stormwater management ponds that have a capture depth for the purposes of water quality or volume capture shall assume a negligible discharge from these structures during design event routing. Only discharges from the primary principal spillway or emergency spillway need to be considered. Discharges from subsurface drains that tie into a principal spillway should not be considered during design event routing.

22. Stormwater management ponds that have a capture depth for the purposes of water quality or volume capture shall assume that the pond water quality or capture volume is full at the beginning of design event routing.

23. Stormwater management ponds must provide safe passage of the 100-year return period peak runoff rate assuming that all of the principal spillway orifices are fully clogged, and the principal spillway overflow is 50% clogged. A minimum of a 6-inch freeboard must also be maintained above the resulting "maximum" water surface elevations (W.S.E.). Any

embankment emergency spillway can be assumed to be unclogged. SWM ponds with embankments completely made up of natural undisturbed soils (fully in "cut") or where roadways act as the emergency spillway, are permitted. However, the Design Engineer must verify downstream stability and control.

24. All pre- and post-development comparisons of peak flows shall be rounded to tenths of a cfs. The intent here is to recognize the accuracy and precision limitations of hydrologic modeling procedures. Again, small differences between pre- and post-development discharge rates should be permitted when no negative downstream impacts will result.

25. The full Modified Puls routing method must be used for stormwater management pond analyses. Simplified methods of determining pond size requirements such as those in TR-55 (1986) can only be used for preliminary pond size estimates. The full Modified Puls routing method must be used for stormwater management pond analyses. Simplified methods of determining pond size requirements such as those in TR-55 (1986) can only be used for preliminary pond size estimates.

26. Pre-packaged hydraulic programs are not approved for the analysis of underground stormwater management facilities unless it can be verified that the program rounding subroutines used for the stage/storage data do not affect the results. This is because, for very small storage volumes, the program may round off the volume to a significant percentage.

27. Full supporting documentation must be provided for all stormwater management designs.

28. Designs must be checked for Impervious Area Flash (IAF). This check is used to determine if flooding may occur due to poor modeling choices specifically related to the time of concentration. This analysis requires that the watershed impervious area be modeled without the pervious areas. The time of concentration should also be determined from the impervious areas only. If the IAF analysis results in a higher peak runoff rate at a culvert or discharge from a pond, this higher rate must be used for the final design/comparison. The check will frequently yield higher values if a watershed's impervious area is located primarily near the watershed outlet or point of interest.

B. Pond Capture Volumes (Cv)

To minimize nuisance flooding from small precipitation events, a runoff capture volume is required for all stormwater management ponds that do not discharge directly to natural, well-defined (with bed and banks) perennial streams. In general, natural well-defined streams in the Spring Creek Basin are limited to those delineated as USGS perennial streams. This should be treated as a guideline and not a steadfast rule. The final determination is at the discretion of the Township Engineer. The pond capture volume is a volume of runoff that will be retained in a pond below the elevation of any free surface principal spillway orifice. No principal spillway orifice (except those connected to subsurface

drains), regardless of how small, shall be below the pond elevation equivalent to this volume.

The *Centre County Conservation District* (CCCD) receives numerous complaints regarding ponds that are located at the down slope edge of a property that result in discharging runoff onto downstream properties in an uncontrolled manner or where no existing defined outlet channel exists. This is a very common problem in areas underlain by carbonate rock. These discharges can cause erosion and flooding downstream. While the Pond Capture volume is intended to minimize some of these negative effects, it cannot deter or reduce the impacts from poor design practices. Therefore, whenever possible, the CCCD recommends that the designer consider the downstream morphological changes that may occur and, when possible, consider constructing conveyance systems to a stable natural channel. In some cases this may require cooperation between land owners.

The capture volume is defined as a runoff depth of 0.25 inches from all impervious areas tributary to the stormwater management facility. This volume will be allowed to infiltrate, evaporate, or dewater from a subsurface drain system connected directly to the facility's principal spillway. Supporting computations that show that 90% of the capture volume can dewater in a maximum of 72 hours must be provided. For surface ponds, the maximum depth of ponding for the capture volume shall be 3 ft. (a health and safety precaution). However, in areas under karst influence, a limiting maximum ponding depth of 18 inches is recommended. Designers may always increase the capture volume to a value greater than the identified standard as long as the ponding depth criteria are met.

To simplify computational requirements for design event analysis, designers do not need to calculate discharges from subsurface drains related to the capture volumes if the filter media is sand, or smaller than AASHTO 57 stone. The capture volume is to control runoff rates from impervious areas and is not related to water quality. However, pond designs that include a water quality volume that is greater than the required capture volume, are assumed to have also met the required capture volume as long as it dewaters as required.

Designs that rely on the natural infiltration of insitu soils must provide documentation supporting the infiltration rates used for analysis. Infiltration rates reported in the Soil Survey of Centre County or other published rates may be used at the discretion of the Township Engineer.

The pond capture volume should always be used when up-slope areas are developed where the pond's design creates a point discharge that did not previously exist.

Stormwater Management detention facilities that connect directly to storm drain pipe networks that discharge to natural well-defined channels do not require a capture volume.

C. Recharge Volumes (Rv)

The purpose of the recharge portion of the ordinance is two-fold. First, the recharge requirement is to mitigate the loss of groundwater recharge associated

with the creation of impervious surfaces. In addition the recharge criteria is to mitigate the increase in runoff volume associated with the creation of impervious surfaces. This increase in runoff volume has significant impacts on downstream landowners. These impacts are most often exhibited in the form of increased nuisance flooding and channel or drainage-way erosion and instability. According to local Township Engineers and representatives of the *Centre County Conservation District*, these problems are of significant local concern. The magnitude of these problems increases with the percentage of impervious coverage created on a site.

Recharge mitigation shall be provided for runoff from all proposed impervious areas. The required recharge volume shall be computed as 0.5" of runoff from all proposed impervious areas. It is noted that lined detention ponds and compacted fill areas are considered to be impervious when calculating site impervious area for recharge considerations. In addition, land areas covered by paver blocks, pervious pavement, and other structural surface treatments which permit surface infiltration can be treated as pervious areas when calculating the site impervious area for recharge considerations as long as the structural infiltration practice is supported by sound design and appropriate construction specifications. The Township Engineer may require submission of supporting documentation prior to approving structural infiltration areas as pervious areas.

The following design practices can be used as credits to reduce the recharge volume requirement:

1. Residential Roof Areas (detached, duplex, and townhome dwellings) and commercial /industrial buildings with roof areas less than 5,000 sq. ft. can be removed from the computed impervious area when these roof areas are sumped to dry wells designed in accordance with the following minimum standard:

   SUMP DESIGN CRITERIA: To meet the recharge criteria, sump storage or voids volume shall be equal to 0.04 cubic feet per square foot of roof area (0.5 inch rainfall depth). If sump stone has a voids ratio of 40%, the total sump volume will be 0.10 cubic feet per square foot of roof area. When designed only to meet this recharge criteria, the maximum size for a single sump is 100 cubic feet, and the minimum sump surface area (A) to depth (D) ratio (A/D) must be a minimum of 4/1. The sump depth less any freeboard should not exceed 24". This roof sump standard shall apply unless the Township has a separate roof sump standard for water quantity or peak control.

2. All or portions of driveways, roadways, and parking areas can be removed from the impervious area calculation when sheet flow from these areas is directed to undisturbed natural buffer/ filter areas or constructed filter strips. This flow must be dispersed as sheet flow as it crosses the buffer / filter area. Sheet flow velocities should be non-erosive as they cross the impervious area / filter interface.

   To ensure proper infiltration characteristics the natural soil profile within natural buffer / filter areas cannot be disturbed during construction.

Completely undisturbed natural recharge areas serve this function best. However, minor surface scaring, seeding, and landscaping is permitted in these areas as long as natural grades are not altered. In special cases, when approved by the Township Engineer, minor grading, combined with soil profile reconstruction may be permitted in natural buffer / filter areas. In addition, the following standards apply to **natural filter / buffer areas**:

a. Natural filter / buffer areas must have a minimum width of 5 ft. or one-half of the impervious area drainage length immediately tributary to the buffer area, whichever is greater. This width is measured parallel to the direction of sheet flow.

b. To qualify for a recharge volume credit, the surface slope of natural filter / buffer areas must be conducive to recharge, and not result in flow concentration or erosion. To meet this intent, the surface slope of the area tributary to the natural buffer/filter area, and the surface slope of the natural buffer/filter area itself may not exceed 5%. In special cases steeper slopes may be used if specifically authorized by the Township Engineer.

c. The total impervious area tributary to a natural buffer / filter area cannot exceed twice the buffer / filter area.

To qualify for a recharge volume credit, **constructed filter strips** shall be designed to the following standards:

a. The minimum filter strip width shall be 5 ft. or one-half of the impervious area drainage length immediately tributary to the constructed filter strip, whichever is greater. This width is measured parallel to the direction of sheet flow.

b. The total impervious area tributary to a constructed filter strip area cannot exceed twice the constructed filter strip area.

c. The surface slope of the area tributary to the constructed filter strip area, and the surface slope of the constructed filter strip area itself may not exceed 5% and 3% respectively. In special cases steeper slopes may be used if specifically authorized by the Township Engineer.

d. The filter strip surface shall consist of a minimum of 6 inches of natural or reconstructed topsoil with a stable grass surface treatment. Reconstructed topsoil designs must be approved by the Township Engineer prior to application. Reconstructed topsoil consists of soils augmented by tillage and the addition of soil amendments such as compost, lime, animal manures, crop residues, etc.

e. To minimize erosion of the topsoil layer during construction, it is recommended that these areas be sodded. However, the

Township Engineer may permit the use of an acceptable erosion control seeding application. In this later case, any loss of topsoil and seed must be replaced until a permanent vegetative stand is achieved.

3. Sidewalks separated from roadways and / or other impervious surfaces by a grass strip of equal or greater width than the sidewalk itself can be removed from the impervious area calculation when the sidewalks are graded so that sheet flow from the walk is directed to the grass strip. Sidewalks with steep longitudinal slopes that themselves would act as channels during runoff events can not take advantage of this credit. A 5% longitudinal sidewalk slope shall be used as the benchmark defining steep slopes.

4. Impervious areas tributary to natural closed depressions can be subtracted from the total site impervious area used in the recharge volume calculation as long as a qualified geotechnical engineer or soil scientist certifies to the soundness of these site specific applications. Water quality pre-treatment may be necessary prior to the direct discharge of runoff to existing closed depressions or sinkholes.

5. Impervious areas tributary to man-made closed depressions can be subtracted from the total site impervious area as long as a qualified geotechnical engineer or soil scientist certifies to the soundness of these site-specific applications. Man-made closed depressions can be created through the use of low head berms 1 foot or less in height.

6. The entire capture volume provided in a pond without a subsurface drain may be used as a credit towards the recharge volume requirement.

7. Fifty percent (50%) of the capture volume in a pond that includes a subsurface drain may be credited towards the recharge volume requirement.

8. Additional credits may apply for undisturbed land areas that are known to have high infiltration capacity and that are maintained or enhanced. These areas must be defined and quantified from actual site data collection.

After credits, the remaining recharge volume shall be directed to a Recharge BMP such as infiltration trenches, beds, etc. These facilities can be located in open areas or under pavement structures. The appropriateness of the particular infiltration practice proposed, as well as the design parameters used, shall be supported by a geotechnical report certified by a qualified professional (soil scientist, geologist, hydrogeologist, geotechnical engineer, etc.).

Stormwater recharge requirements or credits affect stormwater management design requirements. For stormwater management computations, the reduction of site CNs based only on a weighting type analysis, as is sometimes done for cluster type developments, is not permitted. However, for stormwater

management purposes, the CN for recharged areas can be computed using the NRCS method for disconnected impervious areas. The actual hydrologic process that occurs within the basin must be stressed in all recharge situations.

These recharge requirements must be met on all sites unless it can be demonstrated that recharge would be inappropriate. Any request for such a waiver from these recharge requirements must be accompanied by a supporting report certified by a qualified professional (soil scientist, geologist, hydrogeologist, geotechnical engineer, etc.).

Developers and site design professionals are encouraged to use a higher standard for recharge volume on sites where local site conditions do not restrict a higher standard.

Water Quality Sensitive (WQS) developments must use an acceptable pre-treatment BMP prior to recharge. Acceptable pre-treated BMPs for these developments include BMPs that are based on filtering, settling, or chemical reaction processes such as chemical coagulation.

Accounting for recharge within lined stormwater management ponds is not permitted. However, if unlined, uncompacted ponds and/or depressed lawn areas are used to satisfy water quality or capture volume criteria, these areas and volumes can also be used to meet recharge requirements as previously defined. Additional recharge volume may be credited to these areas as long as it is demonstrated by a qualified professional that recharge processes can naturally occur in these areas.

Finally, because this analysis is concerned with trying to adequately represent real processes that occur within the Watershed, there will be areas that cannot physically recharge stormwater. These areas include exfiltration areas that are commonly found at the base of wooded hillsides where clay pans exist, and saturation areas near major streams or floodplains. These areas may not accept recharge during most runoff events. These areas are exempt from recharge requirements when these conditions are documented and certified by a qualified professional (soil scientist, geologist, hydrogeologist, or geotechnical engineer). In addition, stormwater management techniques relying on infiltration techniques are not permitted in these areas.

The Township Engineer may waive the recharge requirement in the following situations:

1. The Township Engineer may waive the recharge requirement in highly developed areas or areas undergoing redevelopment where the Township Engineer has determined that forced recharge could have adverse impacts on adjacent landowner structures, property, or Township infrastructure. These waivers should be limited to small land areas (generally less than 5 acres in size), where the ability to place recharge beds may be limited or may hinder redevelopment.

2. The Township Engineer may waive the recharge requirement in areas where a qualified soils scientist or geologist has determined that none of

the site soils are suitable for recharge, or that the location of the suitable soils is such that harm to adjoining properties could occur as stated under item 1 above.

3. The Township Engineer may waive the recharge requirement in areas where recharge cannot physically occur as documented by a qualified soil scientist, geologist, or hydrologist. These areas include:

    a. Exfiltration areas commonly found at the base of wooded hillsides where clay pans or fragipans exist; and

    b. Saturation areas near major streams or floodplains.

As identified above, recharge analysis and/or waiver requests must be supported by a geotechnical report sealed by a qualified professional (soil scientist, geologist, hydrogeologist, or geotechnical engineer). The intent of this report will be to establish the suitability of a particular parcel of land or area for recharge, and to identify areas on a development site appropriate for recharge. It is recommended that the geotechnical / soils consultant discuss the extent and approach to the analysis with the Township Engineer prior to initiating the field investigation. At a minimum this report should include the following information:

1. A description of the geotechnical site investigation performed including the methods and procedures used;

2. Data presentation;

3. Analysis results including the following minimum information:

    a. A map identifying site areas inappropriate for recharge along with supporting justification. In addition to illustrating topographic features, significant geologic and hydrologic features should be identified (rock outcrops, sinkholes, closed depressions, etc.

    b. Determination of the permeability coefficient for potential recharge areas.

    c. Determination of the infiltration capacity of natural site soils.

    d. Location, depth, and permeability coefficient for any restrictive layers identified.

    e. Soil uniformity.

    f. Depth to bedrock in potential recharge areas, and a statement reflecting the uniformity of the depth to bedrock across the site.

    g. A statement relating to the site's proximity to fracture zones within the bedrock.

h. Additional information deemed pertinent by the geotechnical engineer.

4. Recommendations for any special design considerations necessary for the design of recharge systems on the site. For example, required soil depth over bedrock, appropriate surface grades over recharge areas, appropriate hydraulic head over recharge areas, etc.

5. Justification as to why the site should be developed to a high impervious density if the site has adverse soil and geotechnical limitations, which prohibit the ability to induce natural recharge. Explain how these limitations will not create the potential for undue harm to the environment and the Spring Creek Watershed when the site is developed.

The following guidelines are provided relative to the use of subsurface exfiltration BMP's (often incorrectly referred to as engineered infiltration BMPs):

1. Soils should have a minimum percolation rate of 50 min/cm for effective operation of subsurface exfiltration BMPs. If no site soils have percolation rates of 50 min/cm, subsurface exfiltration BMPs should not be used.

2. A minimum of 30 inches of soil must be maintained between the bottom of a subsurface exfiltration BMP and the top of bedrock or seasonally high groundwater table. This statement is subject to the recommendation of a qualified Geotechnical Engineer.

3. If the minimum percolation rate is not met and/or the minimum soil depth cannot be maintained on a site, recharge should be accommodated by directing shallow sheet flow from impervious areas across surface filter strips and/or undisturbed natural areas, or some other innovative surface infiltration feature should be used. Limiting subsurface percolation rates and/or depth to bedrock shall not by themselves warrant a recharge waiver.

In addition, since recharge is intended as a volume control, innovative or new methods that address the significant increase in the volume of runoff from sites having large impervious areas are encouraged These volume control alternatives can be used only if they can be shown to function with the original intent through sound engineering and science. The final determination of "original intent" shall always be the right of the Township Engineer.

D. Storm Drain Conveyance System Design

Storm drainage conveyance systems consist of storm sewer pipes, swales, and open channels. Computational methods for design of storm drain conveyance systems shall be as follows:

1. Recommended computational methods (models) for storm drain design are based on site or watershed drainage area as follows:

Up to 200 acres in size	Rational Method
Between 200 acres and 1.5 Square miles	HEC-1 PSRM TR-20
Over 1.5 square miles in size	PSU-IV with the carbonate adjustment factor at the discretion of the Township Engineer Other methods as approved by the Township Engineer such as SWMM, SWIRM-ROUTE, etc.

2. Rational Coefficients used are to be *from Rawls et al. (1981), PENN DOT Design Manual 2-10* or using the Aron curves to convert CNs to C. If the Aron curves are used, all CNs must be applicable to the HSG as identified by the NRCS.

   The Design Engineer may choose to use the following Rational C coefficients without regard to soil HSG for small sites. However, it is recommended that they be used only for storm drains up to 24" in diameter. The use of these conservative values shall fully be the choice of the Design Engineer.

   All impervious areas: C = 0.95
   All pervious areas: C = 0.30

3. Storm drains shall be designed at a minimum using a 10-year runoff event without surcharging inlets. Storm drains tributary to a multiple site SWM facility across Township roads or crossing other properties must convey, at a minimum, a 25-year runoff event without surcharging inlets. Runoff events in excess of the indicated design event must be conveyed safely downstream.

4. Inlets on grade cannot assume a sumped condition for hydraulic modeling (i.e., top of inlet casting set below pavement surface in parking areas).

5. The Township Engineer may require the analysis of the 100-year peak runoff rates for conveyance purposes in some instances where regional SWM facilities are employed.

6. Any storm drain within State or Federal rights-of-ways or that falls under the design criteria of any higher authority must meet the requirements of that agency in addition to the minimum requirements of this ordinance.

7. The time of concentration (Tc) can be computed by any method which best represents the subject watershed. However, the NRCS's segmental method is not recommended for use with drainage areas that are predominately undeveloped and are greater than 100 acres in size. The

NRCS Lag Equation or another more appropriate method should be used under these conditions.

8. For any drainage area smaller than 5 acres in size, a Tc of 5 minutes may always be assumed at the discretion of the Design Engineer (for the post-development condition), without needing to provide supporting documentation.

9. Precipitation values applicable to the entire Spring Creek Drainage Basin are those reflected in the PENN DOT's IDF curves for Region 2, regardless if the area was formerly considered in Region 3.

10. Storm drain conveyance system stability (swales, open channels, and pipe discharge aprons) shall be computed using a 10-year return period peak runoff rate.

11. Storm sewers, where required by zoning and land use densities, shall be placed under or immediately adjacent to the roadway side of the curb, or as directed by the Township, when parallel to the street within the right-of-way.

12. When located in undedicated land, they shall be placed within a drainage easement not less than 20 ft. wide as approved by the Township Engineer.

13. The use of properly designed, graded and turfed drainage swales is encouraged in lieu of storm sewers in commercial and industrial areas and, where approved by the Township Engineer, in residential areas.

    Such swales shall be designed not only to carry the required discharge without excessive erosion, but also to increase the time of concentration, reduce the peak discharge and velocity, and permit the water to percolate into the soil, where appropriate.

14. Inlet types and inlet assemblies shall conform to the *Pennsylvania Department of Transportation Standards for Roadway Construction* as approved by the Township Engineer.

    a. Inlets shall, at a minimum, be located at the lowest point of street intersections to intercept the stormwater before it reaches pedestrian crossing; or at sag points of vertical curves in the street alignment which provide a natural point of ponding of surface stormwater.

    b. Where the Township deems it necessary because of special land requirements, special inlets may be approved.

    c. The interval between inlets collecting stormwater runoff shall be determined in accordance with *DM-2, Chapter 10, Section 5, "Capacity of Waterway Areas".*

In curbed sections, the maximum encroachment of water on the roadway pavement shall not exceed half of a through traffic lane or 1 inch less than the depth of curb during the 10-year design storm of 5 minute duration. Inlets shall be provided to control the encroachment of water on the pavement. When inlets are used in a storm system within the right-of-way limits of a street in lieu of manholes, the spacing of such inlets shall not exceed the maximum distance of 450 ft.

15. Accessible drainage structures shall be located on a 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 5 degrees, and at all points of convergence of two or more influent storm sewer mains. The construction locations of accessible drainage structures shall be as indicated on the land development drainage plan or area drainage plan approved by the Township.

16. When evidence available to the Township indicates that existing storm sewers have sufficient capacity as determined by hydrograph summation and are accessible, the subdivider may connect their stormwater facilities to the existing storm sewers so long as the peak rate of discharge does not exceed the amount permitted by this Ordinance.

17. All other storm drain design methods are to be the same as specified in existing local ordinances.

18. Computational procedures other than those indicated here should follow the methods of the *Federal Highway Administration's Urban Drainage Design Manual [Hydraulic Engineering Circular No 22. (HEC-22)].*

E. Water Quality Standards

Water Quality Performance Standards

To minimize adverse impacts to stream health resulting from stormwater non-point source (NPS) pollution, standards are provided for the implementation of Water Quality Best Management Practices (BMPs) to reduce NPS pollutant loadings resulting from land development activities. The following performance standards and guidelines shall be addressed at all sites where stormwater management is required.

1. Site designs shall minimize the generation of stormwater runoff through the use of low-impact design techniques.

2. Stormwater runoff from all land development activities should be treated through the use of non-structural and structural BMPs to effectively treat the adverse impacts of stormwater runoff including NPS pollutants.

3. Water Quality BMPs shall be incorporated into site designs to treat the required Water Quality volume as defined below.

4. The use of non-structural BMPs shall always take priority over the use of structural BMPs. The use of innovative BMPs and low-impact site

planning is encouraged to reduce the generation of stormwater runoff and effectively treat pollutants transported in stormwater from the site.

5. The use of multiple non-structural water quality techniques along with new, emerging, and innovative techniques is encouraged to improve the quality of stormwater runoff to receiving areas and reduce and/or eliminate the need for structural BMPs. The Township Engineer should be consulted to clarify the design concept for meeting or exceeding the intent of this section.

6. Where non-structural BMPs are unable to effectively treat all of the stormwater runoff generated from land development activities, structural BMPs shall be designed to capture and treat the computed water quality volume (WQ_v).

7. The priority pollutant source areas to be treated with BMPs are streets, parking lots, driveways, and roof areas.

8. Due to the karst nature of the Watershed, stormwater discharges from water quality sensitive developments and discharges to sensitive wellhead protection areas (defined in *Appendix B, Exhibit-1)* will require special consideration. In these instances the applicant shall provide water quality pre-treatment (use of a filtering BMP and/or special structural design features) to prevent the discharge of stormwater contaminants to groundwater resources. In addition, hydrogeologic studies may be required to document potential karst related impacts.

9. Prior to stormwater management and water quality design, applicants should consult with the Township Engineer to verify stormwater quality criteria and present proposed features and concepts for the treatment of stormwater runoff. Following this meeting, the Township Engineer shall define any needed support studies or documentation.

Water Quality Volume (WQv)

The required water quality volume that must be treated for **non-sensitive areas underlain by carbonate rock** (see exhibits in *Appendix B)* within the Spring Creek Basin shall be computed as:

$$WQ_{depth} = 0.25+(0.012)2.9^{(0.044(SIA))}$$

$$WQ_v = WQ_{depth}(A)/12$$

Where: WQ_v = water quality volume in acre-feet
Wq_{depth} = depth in inches that must be captured for impervious areas
SIA = percent of site impervious area (all paved areas and roof with asphalt-based roofs)
A = total of all paved areas and asphalt-based roofs on site in acres

The required water quality volume that must be treated **for any WQS development, on sites in sensitive areas underlain by carbonate rock, and all areas not underlain by carbonate rock** is to be computed within the entire Spring Creek Basin as:

$$WQ_{depth} = \text{the larger of } 0.5 \text{ inches or } 0.25+(0.012)2.9^{(0.044(SIA))}$$

$$WQ_v = WQ_{depth}(A)/12$$

Where:
- WQ_v = water quality volume in acre-feet
- Wq_{depth} = depth in inches that must be captured for impervious areas
- SIA = percent of site impervious area (all paved areas and roof with asphalt-based roofs)
- A = total of all paved areas and asphalt-based roofs on site in acres

For designs in which the final roof material is unknown, the Design Engineer must assume an asphalt-based roof.

The water quality volume must be captured and treated through a water quality BMP over an extended period of time as per the specific requirements of each structure.

Credits to reduce the effective impervious area are applicable as presented in Chapter 4 of the Stormwater Management Plan.

Water Quality Credits

Due to the karst nature of the Spring Creek Basin, the non-structural water quality credits and techniques identified below may be limited for suitability and use based on development type and location. These limitations for use are specified in the restrictions section for each credit. The Township Engineer may require additional documentation or investigation prior to use of each specific credit to reduce the risks of sinkhole development or groundwater contamination for sensitive areas and development types. No area may be double counted for use with credits. The combined credits of natural area conservation and vegetated filter strips is limited to 50% of the site's impervious area. The drainage-way credit is limited to 50% of the site's impervious area. The drainage-way protection credit is limited to 50% of the site's impervious area. The maximum total water quality credit for any site may therefore be 100% of the site's impervious area.

Non-Structural Technique	Water Quality Credit
Drainage-way Protection (DWP)	Subtract Drainage-way Protection Areas from impervious site area in WQ_v computation.
Natural Area Conservation (NAC)	Subtract Conserved Natural Areas from impervious site area in WQ_v computation.
Filter / Buffer Area	Subtract impervious areas discharged over pervious areas from impervious site area in WQ_v computation.

Drainage-way Protection

A water quality credit is given for the protection of natural drainage-ways on a development site. Natural karst drainage-ways within the Spring Creek Watershed often do not exhibit a defined channel bed and banks. More often, these drainage-ways appear as wide, shallow parabolic swales. These drainage-ways are an integral part of the natural drainage system, and often exhibit significant infiltration capacity. Protection of these drainage-ways is critically important to the health of the watershed.

The drainage-way protection (DWP) area is defined as an area centered on the drainage-way and having a maximum width of 300 ft. The Township Engineer may modify the defined minimum width in cases where natural land forms define an appropriate alternate width.

The impervious area used in the WQ_v equation for the development site may be reduced by twice the area of the preserved drainage-way (2 to 1 ratio).

1. Restrictions on the Credit:

   - Drainage-way protection areas must remain in an undisturbed condition during and after construction activities. There can be no construction activity within these areas including temporary access roads or storage of equipment or materials. Temporary access for the construction of utilities crossing this protection area may be permitted at the Township Engineer's discretion. However, the alignment of any such crossing must be perpendicular to the drainage-way.

   - These areas should be placed in a conservation easement or be permanently preserved through a similarly enforceable agreement with the Township.

   - The limits of the undisturbed DWP area and conservation easement must be shown on all construction plans.

   - The DWP area must be located on the development site.

   - The maximum total DWPA credit is 100% of the site impervious area.

- Water quality credits are not permitted for Water Quality Sensitive (WQS) developments.

2. Sensitive Area and Development Restrictions:

- DWP areas may not be counted as a credit in sensitive areas unless the impervious area actually flows across the area as sheet flow.

- Untreated urban runoff from sensitive development types may not be directed to DWP areas without pretreatment.

Natural Area Conservation

A water quality credit is given for natural areas that are conserved at the development site, thereby maintaining pre-development water quality characteristics. The impervious area used in the WQ_v equation for the development site may be reduced by the natural area conserved in the water quality volume computations. Natural area conservation is different than vegetated filter strip/recharge area and drainage-way protection in that in some cases surface runoff may never be directed over the natural area (i.e., if upslope wooded areas are conserved).

1. Restrictions on the Credit:

- Natural areas must remain in an undisturbed condition during and after construction activities. Temporary incidental land disturbance activities associated with utility construction may be permitted within the conservation area.

- These areas should be placed in a conservation easement or similarly enforceable agreement with the Township.

- The limits of the undisturbed area and conservation easement must be shown on all construction plans.

- The area must be located on the development site.

- Water quality credits are not permitted for Water Quality Sensitive (WQS) developments.

- The maximum total NAC credit is 50% of the site impervious area. However, the combination of NAC VFRS is also 50%.

2. Sensitive Area and Development Restrictions:

- NAC areas may not be counted as a credit in sensitive areas unless the impervious area actually flows across the area as sheet flow.

- Untreated urban runoff from sensitive development types may not be directed to natural areas without pretreatment.

Filter / Buffer Area

A water quality credit is given when stormwater runoff is effectively treated via a filter / buffer area or strip. A filter / buffer area is a vegetated boundary characterized by uniform mild slopes. Filter strips may be forested or vegetated with turf grass. Effective treatment is achieved when impervious area runoff is directed as sheet flow across vegetative filter or buffer areas (i.e., concentrated flow discharged to a filter strip does not meet water quality reduction criteria).

The area draining via overland sheet flow to an undisturbed, natural, vegetated filter strip (natural unmaintained meadow or forested area) can be subtracted from the site impervious area (IA) on a 1:1 area ratio in the water quality volume computation. Impervious areas draining across constructed (disturbed or regarded) pervious areas can be subtracted from the site impervious area (IA) on a 1:1/2 area ratio in the water quality volume computation.

1. Restrictions on the Credit:

   - The maximum impervious area that can be included in this credit, shall be computed as follows:

$$IA_c = W_{IA}$$

   Where: IA_c = Impervious area recharge credit (L_2).
   L_{IA} = Length of impervious area measured perpendicular to the sheet flow direction (L).
   W_{IA} = Width of impervious area (L). Maximum width permitted for credit is the smaller of 100 ft. or twice the width of the vegetated filter strip.

   - To qualify for a water quality credit, natural and constructed filter areas or strips must meet the same restrictions identified for natural or constructed recharge areas with regard to width, length, slope, tributary drainage length, and construction. These restrictions are presented in Chapter 3.

   - Runoff shall enter the filter / buffer strip as overland sheet flow.

   - Filter/ buffer areas shall remain undisturbed/unmanaged other than to remove accumulated trash and debris.

   - Water quality credits are not permitted for Water Quality Sensitive (WQS) developments.

- The maximum total water quality credit for vegetative filter / buffer areas is 50% of the site impervious area. However, the combination of NAC and filter / buffer areas is also 50%.

2. Sensitive Area and Development Restrictions:

   - Untreated urban runoff from WQS developments may not be directed to filter / buffer areas without pretreatment.

Comments Related to Water Quality Credits

Concurrence of the Township Engineer is required prior to the use of all water quality credits for the reduction of the water quality treatment volume. The Township Engineer may approve the use of additional credits based upon sufficient documentation regarding suitability for sensitive development types and areas, pollutant removal effectiveness, and maintenance criteria. Multiple water quality credits cannot be claimed for the identical area of the site (i.e., a stream buffer credit and disconnecting roof recharge area cannot both be claimed for the same area).

Additional impervious coverage reduction using low impact development techniques (development practices which reduce the impact of urban runoff such as narrower residential road sections, smaller cul-de-sacs, smaller parking stalls, smaller building set-backs to reduce driveway lengths, etc.) will also reduce the required water quality treatment volume. Many of these techniques require prior approval by the Township before implementation into land development design.

Section 305. Erosion and Sedimentation Requirements

A. Whenever the vegetation and topography are to be disturbed, such activity must be in conformance with *Chapter 102, Title 25, Rules and Regulations, Part I, Commonwealth of Pennsylvania, Department of Environmental Protection, Subpart C, protection of Natural Resources, Article II, Water Resources, Chapter 102, "Erosion Control,"* and in accordance with the Centre County Conservation District and the standards and specifications of the appropriate Township.

B. Additional erosion and sedimentation control design standards and criteria that must be or are recommended to be applied where recharge or water quality BMPs are proposed and include the following:

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

   2. These BMPs shall not be constructed nor receive runoff until the entire contributory drainage area to the BMP has received final stabilization.

C. Adequate erosion protection shall be provided along all open channels and at all points of discharge.

Section 306. Sinkhole Protection

The use of sinkholes for stormwater management must be carefully planned, because discharging runoff directly into existing sinkholes is not an engineered stormwater solution. Aside from potential water quality effects, cover collapse sinkholes that exist throughout the watershed can be unstable, and it should be assumed that they could stop taking water at any time. Numerous sinkholes throughout the region already flood during larger runoff events. Nonetheless, in the watershed there are large drainage areas that completely drain to existing sinkholes and all upslope development tributary to them cannot be realistically stopped. Therefore the following sections have been developed.

A. Stormwater from roadways, parking lots, storm sewers, roof drains, or other concentrated runoff paths shall not be discharged directly into sinkholes without prior filtration in accordance with *Section 308, B,* below.

B. Sinkholes capable of absorbing substantial amounts of stormwater shall be protected by diverting such runoff around the sinkhole (refer to *306.F)* or, upon recommended approval of the Township Engineer, by planting and maintaining a dense filter path of suitable vegetative material in such a manner and location to disperse and slow the runoff to a sheet flow condition to promote the maximum possible filtration and sedimentation of impurities.

   The filter path must be at least 100 ft. in length and 20 ft. in width. Ten-foot wide filter paths are acceptable if land slope is less than 2%.

   Filter paths shall be designed and installed so that they filter sheet flow rather than concentrated flow. If concentrated flow occurs, grading and shaping or the use of best management practices such as grass waterways or drop structures may be required.

   Sedimentation basins designed to *DEP Chapter 102* Standards or permanent stormwater storage criteria, whichever is larger, and proposed vegetative filter paths, in conjunction with temporary stone filter check dams, shall be installed prior to subdivision or land development construction activities, where sinkholes are used to accept stormwater discharges.

C. If increased runoff is to be discharged into a sinkhole, even in filtered conditions, a hydrogeologic assessment of the effects of such runoff on the increased risk of land subsidence and adverse impacts to existing sinkhole flood plains and groundwater quality shall be made by a qualified professional and submitted with the stormwater management plan. Such discharge shall be prohibited if the Township Engineer determines that such poses a hazard to life, property or groundwater resources.

D. All sinkholes shall be posted by permanent on-site notices clearly visible at the sinkhole prohibiting any disposal of refuse, rubbish, hazardous wastes, organic matter or soil into the sinkhole. Rockfill may be permitted in the sinkhole for the purpose of preventing dumping of said materials.

E. To protect sensitive Karst areas, the Township Engineer may require basins to contain an impervious liner. The liner may be of the impervious membrane type, placed in accordance with the manufacturer's recommendations, or may be constructed by mixing Bentonite, or an approved alternative, with existing soil available at the site as approved by the Township Engineer.

F. If it is determined that runoff from upslope developing areas should be diverted around a sinkhole due to existing problems, the Township Engineer may require additional upstream volume controls as required to protect downstream areas.

Section 307. Design Criteria for Stormwater Management Facilities

Materials, Workmanship and Methods: All materials, workmanship and methods of work shall comply at a minimum with the *PENN DOT Form 408* specifications, as accepted and commonly used by the respective Municipality, and shall be considered to be incorporated into this article as if copied in full. In the event a conflict arises between the requirements of this article and the *PENN DOT Form 408 Specifications*, the Township Engineer shall resolve the difference, and his opinion shall be binding.

A. General

1. Facilities in State Right-of-Ways – Any stormwater facility located on State highway rights-of-way shall be subject to approval by the *Pennsylvania Department of Transportation (PENN DOT)*. Any stormwater facility that discharges directly onto state highway rights-of-way shall be subject to review by the *PENN DOT.*

2. Water Obstructions – Any facilities that constitute water obstructions (e.g., culverts, bridges, outfalls, or stream enclosures), and any work involving wetlands as directed in *PA DEP Chapter 105* regulations (as amended or replaced from time-to-time by *PA DEP*), shall be designed in accordance with *Chapter 105* and will require a permit from *PA DEP*. Any other drainage conveyance facility that does not fall under *Chapter 105* regulations must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year design storm with a minimum of 1.0-foot of freeboard measured below the lowest point along the top of the roadway. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm with a minimum of 1.0-foot of freeboard measured below the lowest point along the top of roadway. Any facility that constitutes a dam as defined in *PA DEP Chapter 105* regulations may require a permit under dam safety regulations. Any facility located within a *PENN DOT* right-of-way must meet *PENN DOT* minimum design standards and permit submission requirements.

3. Conveyance Facilities – Any drainage conveyance facility and/or channel that does not fall under *Chapter 105 Regulations*, must be able to convey, without damage to the drainage structure or roadway, runoff from the return period design storm as specified in *Section 311*, A. Conveyance facilities to or exiting from stormwater management facilities (i.e., detention basins) shall be designed to convey the design flow to or from

that structure. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm. Any facility located within a *PENN DOT* right-of-way must meet *PENN DOT* minimum design standards and permit submission requirements.

B. Stormwater Basin Design Considerations

Stormwater management basins for the control of stormwater peak discharges shall meet the following minimum requirements.

1. The design of all facilities over limestone formations shall include measures to prevent groundwater contamination and where required, sinkhole formation. Soils used for the construction of basins shall have moderate to low erodibility factors (i.e., "K" factors of 0.32 or less). Any basin greater than 4 ft., in height, measured from the top of berm to the downslope toe of the abutment, must also contain:

    a. Berm soil specifications;

    b. A determination if site soils are available for the construction of the berm or cutoff trench;

    c. An impervious cutoff trench, which extends the full length of the downstream berm located in fill.

2. Energy dissipators and/or level spreaders shall be installed at points where pipes or drainageways discharge to or from basins. Generally, outlet pipes designed to carry the pre-development, 1-year storm flow will be permitted to discharge to a stream with only an energy dissipator. Discharges to drainage swales shall be spread with a level spreader or piped to an acceptable point.

3. <u>Outlet structures:</u>

    a. Outlet structures within detention/retention basins shall be constructed of reinforced concrete or an approved alternate. With the exception of those openings designed to carry perennial stream flows, design openings shall have childproof, non-clogging trash racks over all openings 9 inches or smaller in any dimension. Outlet aprons shall be designed and shall extend at a minimum to the toe of the basin slope. Where spillways will be used to control peak discharges in excess of the 10-year storm, the control weirs shall be constructed to withstand the pressures of impounded waters and convey flows at computed outlet velocities without erosion.

    b. All metal risers, where approved for use, shall be suitably coated to prevent corrosion. A trash rack or similar appurtenance shall be provided to prevent debris from entering the riser. All metal risers shall have a concrete base attached with a watertight connection. The base shall be sufficient weight to prevent flotation of the riser.

An anti-vortex device, consisting of a thin vertical plate normal to the basin berm, shall be provided on the top of all metal risers.

4. Emergency Spillway:

a. Any stormwater management facility (i.e., detention basin) designed to store runoff and requiring a berm or earthen embankment required or regulated by this Ordinance shall be designed to provide an emergency spillway to handle flow up to and including the 100-year post-development conditions. The height of embankment must be set as to provide a minimum 0.5 foot of freeboard above the elevation required to safely pass the 100-year post-development inflow. Should any stormwater management facility require a dam safety permit under *PA DEP Chapter 105,* the facility shall be designed in accordance with *Chapter 105* and meet the regulations of *Chapter 105* concerning dam safety which may be required to pass storms larger than a 100-year event.

Any underground stormwater management facility (pipe storage systems) must have a method to bypass flows higher than the required design (up to a 100-year post-development inflow) without structural failure or causing downstream harm or safety risks.

Any stormwater management facility that has a paved roadway as the lower berm, and therefore cannot provide a traditional berm emergency spillway, is not required to provide 0.5 feet of freeboard above the elevation required to safely pass the 100-year post-development inflow, but is required to show that the design is stable and no significant undermining, scour or erosion will occur.

b. Emergency spillways shall be constructed of reinforced concrete, vegetated earth, or riprap in accordance with generally accepted engineering practices. All emergency spillways shall be constructed so that the detention basin berm is protected against erosion. The minimum capacity of all emergency spillways shall be the peak flow rate from the 100-year design storm. The dimensions of the emergency spillways can be determined from the *Centre County Erosion and Sediment Control Handbook*. Emergency spillways shall extend along the upstream and downstream berm embankment slopes. Protection should be provided on the upstream embankment a minimum of 3 ft. below the spillway crest elevation. The downstream slope of the spillway shall, as a minimum, extend to the toe of the berm embankment. The emergency spillway shall not be located on or discharge over uncompacted earthen fill and/or easily erodible material.

c. Rock-filled gabions may be used where combination berm and emergency spillway structures are required to prevent

concentrated flows. The Township Engineer may require the use of open concrete lattice blocks, stone riprap, or concrete spillways when slopes would exceed 4 ft. horizontal to one (1) foot vertical and spillway velocities might exceed Soil Conservation Service standards for the particular soils involved.

5. Antiseep Collars: Antiseep collars shall be installed around the principal pipe barrel within the normal saturation zone of the detention basin berms. The antiseep collars and their connections to the pipe barrel shall be watertight. The antiseep collars shall extend a minimum of 2 ft. beyond the outside of the principal pipe barrel. The maximum spacing between collars shall be 14 times the minimum projection of the collar measured perpendicular to the pipe.

6. Slope of Detention Basin Embankment: The top or toe of any slope shall be located a minimum of 10 ft. from any property line. Whenever possible the side slopes and basin shape shall be amenable to the natural topography. Straight side slopes and rectangular basins shall be avoided whenever possible.

   a. Exterior slopes of compacted soil shall not exceed 3 ft. horizontal to one (1) foot vertical, and may be further reduced if the soil has unstable characteristics.

   b. Interior slopes of the basin shall not exceed 3 ft. horizontal to one (1) foot vertical, except with approval of the Township.

7. Width of Berm: The minimum top width of detention basin berms shall be 10 ft.

8. Slope of Basin Bottom: In order to ensure proper drainage of the detention basin, a minimum grade of 2% shall be maintained for all basins used exclusively for peak runoff control. Water quality or recharge basins with filtration systems incorporated into them may have a minimum grade of 0.5%.

9. The lowest floor elevation of any structure constructed adjacent to a detention basin or other stormwater facility shall be 2 ft. above the detention basin berm. The distance between any structure and any stormwater facility shall be a minimum of 25 ft.

10. Landscaping and planting specifications must be provided for all stormwater management basins and be specific for each type of basin.

11. Basins should be lined with impervious liners only in areas with a high risk of sinkhole formation or potential groundwater contamination as determined by a geotechnical engineer. However, where a liner is deemed necessary or appropriate, the use of controlled, compacted natural clay liners, for SWM basins should be considered. Locally available clay, when properly installed, can provide near impervious

conditions (approximately E-6 cm/s or less). Some of the advantages of using controlled, compacted, natural clay soil liners are:

a. Can offer better long-term solution as a basin liner versus geosynthetics because of greater thickness and the ability to withstand settlement;

b. Can be constructed to allow relatively uniform leakage rates to facilitate ground-water recharge but not to an excessive degree that overloads karst bedrock;

c. When properly constructed in two or more 8- to 10-inch thick lifts, rapid movement of surface water through the clay liner is eliminated (rapid leaks can occur in geosynthetic lined basins due to poor seaming, punctures, or other factors);

d. Cleaning/maintenance of clay-lined stormwater basins will be easier/safer versus geosynthetic liners which could easily be damaged during maintenance operations; and

e. The abundance of clayey soils (derived from limestone residuum) within the Spring Creek Watershed can provide adequate, cost effective, soil resources for construction of clay liner systems at most development projects.

However, the installation of any low permeability clay liner system needs to be carefully controlled and the designer needs to ensure that specifications meet standards to ensure integrity.

C. Construction of Basins

1. Basins shall be installed prior to or concurrent with any earthmoving or land disturbances, which they will serve. The phasing of their construction shall be noted in the narrative and on the plan. Basins that include water quality or recharge components, shall have those components installed in such a manner as to not disturb or diminish their effectiveness.

2. Construction specifications in accordance with the minimum criteria of the Township must be provided for all embankments pursuant to *Section 1b* of this Ordinance.

3. Compaction test reports shall be kept on file at the site and be subject to review at all times with copies being forwarded to the Township Engineer upon request.

4. When rock is encountered during the excavation of a pond, it shall be removed to an elevation of at least 12 inches below the proposed basin floor (for a manufactured liner, 24 to 30 inches). All exposed cracks and fissures are to be structurally filled.

5. Temporary and permanent grasses or stabilization measures shall be established on the sides and base of all earthen basins within 15 days of construction.

D. Construction Inspection

Inspections may be conducted by the Township Engineer during the construction of the stormwater management basin and facilities. Such inspections do not constitute approval of construction methods or materials.

E. Special Use Basins

1. The design and construction of multiple use stormwater detention facilities are strongly encouraged. In addition to stormwater management, facilities should, where appropriate, allow for recreational uses including: ball fields, play areas, picnic grounds, etc. Provision for parking facilities within basins and permanent wet ponds with stormwater management capabilities may also be appropriate. Prior approval and consultation with the Township are required before design. Multiple use basins should be constructed so that potentially dangerous conditions are not created.

   Water quality basins or recharge basins that are designed for a slow release of water or other extended detention ponds are not permitted for recreational uses, unless the ponded areas are clearly separated and secure.

2. Multiple Development Basins: Stormwater management facilities designed to serve more than one property or development in the same watershed are encouraged. Staged construction of existing or proposed multiple-use detention facilities by several developers in conjunction with watershed development is encouraged. Each developer shall be responsible for the incremental increase in runoff generated by the respective development and incremental construction improvements necessary for the overall detention facility. Prior approval and consultation with the Township is required before design of such facilities.

3. Alternative Detention Facilities: Alternative stormwater detention facilities including rooftop, subsurface basins or tanks and in-pipe detention storage, or other approved alternative designs are permitted as determined by the Township Engineer.

Section 308. Easements

Stormwater management facilities located outside of existing or proposed right-of-ways shall be located within and accessible by easements as follows:

A. Drainage Easements: Where a tract is traversed by a watercourse, drainage-way, channel or stream, there shall be provided a drainage easement paralleling the line of such watercourse, drainage-way, channel or stream. The width of the drainage easement will be adequate to preserve the unimpeded flow of natural drainage in the 100-year flood plain, in accordance with computed top widths for water surface elevations determined under *Section 1.1*. of this Article.

B. Access Easements: Where proposed stormwater management facilities are not adjacent to proposed or existing public right-of-ways or are not accessible due to physical constraints, as determined by the Township Engineer, a 20 foot wide passable access easement specifying rights of entry shall be provided. Access easements shall provide for vehicle ingress and egress on grades of less than 10% for carrying out inspection or maintenance activities.

C. Maintenance Easements: A maintenance easement shall be provided which encompasses the stormwater facility and appurtenances and provides for access for maintenance purposes. The maintenance easement must be located outside of 100-year surface elevation and the stormwater facility and appurtenances.

D. Easements shall stipulate that no trees, shrubs, structures, excavation or fill be placed and no regrading shall be performed within the area of the easement without written approval from the Township upon review by the Township Engineer. Upon approval of the Township Engineer, such landscaping may be placed in maintenance easements, provided it does not impede access.

E. Whenever practicable, easements shall be parallel with and conjunctive to property lines of the subdivision.

F. All easement agreements shall be recorded with a reference to the recorded easement indicated on the site plan. The format and content of the easement agreement shall be reviewed and approved by the Township Engineer and Solicitor.

G. When stormwater conveyance pipes or channels are located in undedicated land, they shall be placed within a drainage easement not less than 20 ft. wide as approved by the Township Engineer.

ARTICLE IV

DRAINAGE PLAN REQUIREMENTS

Section 401. General Requirements

From and after the date of enactment of this Ordinance, a stormwater management plan and other information specified herein, shall be submitted to the Township for all lands subdivided or for which land development plans are prepared after the enactment of this Ordinance. A stormwater management plan and other information specified herein shall be submitted at the same time and together with submission of a preliminary subdivision or land development plan, along with a completed checklist supplied by the Township indicating the items contained within the submission.

Such plans and information shall be considered part of said zoning and subdivision documents and shall be reviewed in accordance with procedures established thereunder. Preliminary approval or final approval of a subdivision or land development plan, or the issuance of a zoning permit, shall be contingent upon submission of a stormwater management plan and other materials specified herein, and approval of the stormwater management plan in accordance with provisions of this Ordinance.

All stormwater management plans shall be submitted to the Township Engineer for review and comment. Such review shall include a statement by the Township Engineer specifying the provisions of this Ordinance, which have not been met by the plan as submitted.

Once a stormwater management plan has been approved together with a subdivision or land development plan approval, or together with the issuance of a zoning permit, said stormwater management plan shall be valid only for the subdivision, land development, or zoning permit approved. Any further development on the lot or lots requiring a revision of the approved plan or other construction or activities as defined by Township Zoning Regulations shall require the submission of a new, amended, or revised stormwater management plan and other information specified herein.

Section 402. Drainage Plan Contents

The Drainage Plan shall consist of all applicable calculations, maps, and plans. A note on the maps shall refer to the associated computations and erosion and sediment pollution control plan by title and date. The cover sheet of the computations and erosion and sediment pollution control plan shall refer to the associated maps by title and date.

All Drainage Plan materials shall be submitted to the Township in a format that is clear, concise, legible, neat, and well organized; otherwise, the Drainage Plan shall be disapproved and returned to the Applicant.

Said plan shall be prepared by a registered professional land surveyor, qualified geologist, landscape architect, architect, or engineer licensed in the State of Pennsylvania, with said preparer's seal and registration number affixed to the plan.

The following items shall be included in the Drainage Plan:

A. Stormwater Management Report

1. General description of project.

2. General description of permanent stormwater management techniques, including construction specifications and materials to be used for stormwater management facilities.

3. Complete hydrologic, hydraulic, and structural computations for all stormwater management facilities.

4. A written maintenance plan for all stormwater features including detention facilities and other stormwater management elements.

5. Identification of ownership and maintenance responsibility for all permanent stormwater management facilities.

6. The stormwater management report must include a narrative which clearly discusses the project and summary tables which, at a minimum, provides the following information:

a. Narrative

- The overall stormwater management concept
- The expected project schedule
- Location map
- Total site area – pre and post, which must be equal or have an explanation as to why it is not
- Total site impervious area
- Total off-site areas
- Number of stormwater management facilities (ponds), if applicable
- Type of development
- Pre-development land use
- Whether site is underlain by carbonate geology
- Whether site is a water quality sensitive (WQS) development
- Whether site is in a defined sensitive area
- Types of water quality and recharge systems used, if applicable
- Other pertinent information, as required

b. Summary Tables

- **Pre-development**
  1. Hydrologic soil group (HSG) assumptions, curve numbers (CN)

2. Computation of average slope, hydraulic length, computed time of concentration
3. Required peak rate of runoff

- **Post-development**
  1. Undetained areas, areas to ponds
  2. Land use for each subarea
  3. Hydrologic soil group (HSG) assumptions, curve numbers (CN)
  4. Time of concentration computed for each subarea
  5. Post-development peak rate of runoff routed to ponds and out
  6. Pond maximum return period design data including: maximum water surface elevation, berm elevation, and emergency spillway elevation
  7. Water quality depth and volume requirements
  8. Recharge volume requirements
  9. Morphology requirements
  10. Capture volumes required

Reports that do not clearly indicate the above information may be rejected for review by the Township's Engineer or representative and will be returned to the applicant.

B. Plans for tracts of less than 20 acres shall be drawn at a scale of one inch equals no more than 50 ft.; for tracts of 20 acres or more, plans shall be drawn at a scale of one inch equals no more than 100 ft. Plans shall be submitted on the following sheet sizes: 18 inches x 24 inches, 24 inches x 36 inches, or 36 inches x 42 inches. All lettering shall be drawn to a size to be legible if the plans are reduced to half size. All sheets comprising a submission shall be on one size.

The following information, unless specifically exempted in writing by the Township Engineer, must be shown on the plans, prepared in a form that meets the requirements for recording in the *Office of the Recorder of Deeds of Centre County, Pennsylvania*. The contents of the map(s) shall include, but not be limited to:

1. The name of the development, the name and address of the owner of the property, and the name of the individual or firm preparing the plan.

2. The date of submission and revision.

3. The location of the project relative to highways, municipalities or other identifiable landmarks.

4. Existing contours at intervals of two feet. In areas of steep slopes (greater than 15%), 5-foot contour intervals may be used.

5. Existing streams, lakes, ponds, or other bodies of water within the project area.

6. Other physical features including flood hazard boundaries, sinkholes, closed depressions, wetlands, streams, existing drainage courses, areas of natural vegetation to be preserved, and the total extent of the upstream area draining through the site. In Addition, any areas necessary to determine downstream impacts, where required for proposed stormwater management facilities must be shown.

7. The locations of all existing and proposed utilities, sanitary sewers, and water lines within 20 ft. of property lines.

8. An overlay showing soil names and boundaries, including rock outcrops.

9. Total area of impervious surfaces proposed.

10. Proposed structures, roads, paved areas, and buildings.

11. Final contours at intervals of two feet. In areas of steep slopes (greater than 15%), 5-foot contour intervals may be used.

12. Graphic and written scale.

13. A north arrow.

14. The total tract boundary and size with distances marked to the nearest foot and bearings to the nearest degree.

15. Existing and proposed land use(s).

16. Key map showing all existing man-made features beyond the property boundary that would be affected by the project and the extent of the watershed or sub-area that drains through the project site.

17. Horizontal and vertical profiles of all open channels, including hydraulic capacity.

18. Overland drainage paths.

19. Access easements around all stormwater management facilities that would provide ingress to and egress from a public right-of-way.

20. Note on the plan indicating the location and responsibility for maintenance of stormwater management facilities that would be located off-site. All off-site facilities shall meet the performance standards and design criteria specified in this Ordinance.

21. Construction detail of any improvements made to sinkholes and the location of all notes to be posted, as specified in this Ordinance.

22. Complete drainage systems for the site, including details for construction. All existing drainage features, which are to be incorporated in the design, shall be so identified. If the site is to be developed in stages, a general

drainage plan for the entire site shall be presented with the first stage and appropriate development stages for the drainage system shall be indicated.

23. Location and selected plan material used for vegetative filter paths to sinkholes, and the location of all notices to be posted.

24. Statement, signed by the landowner, acknowledging the stormwater management system to be a permanent fixture that can be altered or removed only after approval of a revised plan by the Township.

25. A note indicating that As-Built drawings will be provided by the Developer for all stormwater facilities prior to occupancy, or the release of the surety bond.

26. The following signature block for the registered professional preparing the Stormwater Management Plan:

> "I, _____, hereby certify that the Stormwater Management Plan meets all design standards and criteria of the *Spring Creek Act 167 Stormwater Management Ordinance*."

27. The following signature block for the Township Engineer reviewing the Stormwater Management Plan:

> "I, _____, have reviewed this Stormwater Management Plan in accordance with the Design Standards and Criteria of the *Spring Creek Act 167 Stormwater Management Ordinance."*

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

C. Supplemental Information

1. A soil erosion and sediment pollution control plan, where applicable, including all reviews and approvals, as required by *PA DEP*.

2. Soils investigation report, including boring logs, compaction requirements, and recommendations for construction of detention basins.

3. Karst Features Identification and Analysis Reports and a hydrogeologic assessment of the effects of runoff on sinkholes.

4. The effect of the project (in terms of runoff volumes and peak flows) on adjacent properties and on any existing Township stormwater collection system that may receive runoff from the project site.

5. A Declaration of Adequacy and Highway Occupancy Permit from the

PENN DOT District Office when utilization of a *PENN DOT* storm drainage system is proposed.

6. All permits required by the *PA DEP, Army Corps of Engineers*, and other regulatory agencies.

D. Stormwater Management Facilities

1. All stormwater management facilities must be located on a plan and described in detail.

2. When groundwater recharge methods such as seepage pits, beds or trenches are used, the locations of existing and proposed septic tank infiltration areas and wells must be shown.

3. All calculations, assumptions, and criteria used in the design of the stormwater management facilities must be shown.

   a. A sketch of the berm embankment and outlet structure indicating the embankment top elevation, embankment side slopes, top width of embankment, emergency spillway elevation, perforated riser dimensions, pipe barrel dimensions and dimensions and spacing of antiseep collars.

   b. Design computations for the pipe barrel and riser.

   c. A plot or table of the stage-storage (acre-feet vs. elevation) and all supporting computations.

   d. Flood routing computations.

   e. A detailed plan of the trash rack and anti-vortex device.

4. Record Set (As-Built) Plans: At the completion of the project, and as a prerequisite for the release of the guarantee or issuance of an occupancy permit, the owner or his representative shall:

   a. Provide certification of completion from a registered professional verifying that all permanent facilities have been constructed according to the plans and specifications and approved revisions thereto; and

   b. Provide a set of approved stormwater management plan drawings showing all approved revisions and elevations and inverts to all manholes, inlets, pipes, and stormwater control facilities.

Section 403. Plan Submission

For all activities regulated by this Ordinance, the steps below shall be followed for submission. For any activities that require a *PA DEP Joint Permit Application* and regulated under *Chapter 105 (Dam Safety and Waterway Management) or Chapter 106*

(Floodplain Management) of *PA DEP's Rules and Regulations*, require a *PENN DOT Highway Occupancy Permit*, or require any other permit under applicable state or federal regulations, the permit(s) shall be part of the plan.

A. The Drainage Plan shall be submitted by the Developer as part of the Preliminary Plan submission for the Regulated Activity.

B. Four (4) copies of the Drainage Plan and Stormwater Management Report shall be submitted.

C. Distribution of the Drainage Plan will be as follows:

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

2. One (1) copy to the Township Engineer.

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

Section 404. Drainage Plan Review

A. The Township Engineer shall review the Drainage Plan for consistency with the adopted *Spring Creek Watershed Act 167 Stormwater Management Plan*. The Township shall require receipt of a complete plan, as specified in this Ordinance.

B. The Township Engineer shall review the Drainage Plan for any submission or land development against the Township subdivision and land development ordinance provisions not superseded by this Ordinance.

C. For activities regulated by this Ordinance, the Township Engineer shall notify the Township in writing, within 60 calendar days, whether the Drainage Plan is consistent with the Stormwater Management Plan. Should the Drainage Plan be determined to be consistent with the Stormwater Management Plan, the Township Engineer will forward an approval letter to the Developer, or Developer's agent who submitted the Plan, with a copy to the Township.

D. Should the Drainage Plan be determined to be inconsistent with the Stormwater Management Plan, the Township Engineer will forward a disapproval letter to the Developer, or Developer's agent who submitted the Plan, with a copy to the Township citing the reason(s) for the disapproval. Any disapproved Drainage Plans may be revised by the Developer and resubmitted consistent with this Ordinance.

E. For Regulated Activities specified in *Sections 104.C* and *104.D* of this Ordinance, the Township Engineer shall notify the Township in writing, within a time frame consistent with the Township Building Code, Zoning Ordinance and/or Township Subdivision Ordinance, as applicable, whether the Drainage Plan is consistent with the Stormwater Management Plan and forward a copy of the approval/disapproval letter to the Developer. Any disapproved drainage plan may be revised by the Developer and resubmitted consistent with this Ordinance.

F. For Regulated Activities requiring a *PA DEP Joint Permit Application*, the Township Engineer shall notify *PA DEP* whether the Drainage Plan is consistent with the Stormwater Management Plan and forward a copy of the review letter to the Township and the Developer. *PA DEP* may consider the Township Engineer's review comments in determining whether to issue a permit.

G. The Township shall not approve any subdivision or land development for Regulated Activities specified in *Sections 104.A and 104.B* of this Ordinance if the Drainage Plan has been found to be inconsistent with the Stormwater Management Plan, as determined by the Township Engineer. All required permits from *PA DEP* must be obtained prior to approval.

H. The Township Office shall not issue any zoning and/or building permits for any Regulated Activity specified in *Section 104* of this Ordinance if the Drainage Plan has been found to be inconsistent with the Stormwater Management Plan, as determined by the Township Engineer, or without considering the comments of the Township Engineer. All required permits from *PA DEP* must be obtained prior to issuance of a zoning and/or building permit.

I. The Developer shall be responsible for completing an "As-Built Survey" of all stormwater management facilities included in the approved Drainage Plan. The As-Built Survey and an explanation of any discrepancies with the design plans shall be submitted to the Township Engineer for final approval. In no case shall the Township approve the As-Built Survey until the Township receives a copy of an approved Declaration of Adequacy, *Highway Occupancy Permit*, and any applicable permits from *PA DEP*.

J. The Township's approval of a Drainage Plan shall be valid for a period not to exceed three (3) years. This three-year time period shall commence on the date that the Township signs the approved Drainage Plan. If stormwater management facilities included in the approved Drainage plan have not been constructed, or if an As-Built Survey of these facilities has not been approved within this three-year time period, then the Township may consider the Drainage plan disapproved and may revoke any and all permits. Drainage Plans that are considered disapproved by the Township shall be resubmitted in accordance with *Section 406* of this Ordinance.

Section 405. Modification of Plans

A modification to a submitted Drainage Plan 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 Drainage Plan as determined by the Township Engineer, shall require a resubmission of the modified Drainage Plan consistent with *Section 403* of this Ordinance and be subject to review as specified in *Section 404* of this Ordinance.

A modification to an already approved or disapproved Drainage Plan shall be submitted to the Township, accompanied by the applicable review. A modification to a Drainage Plan for which a formal action has not been taken by the Township shall be submitted to

the Township, accompanied by the applicable Township Review Fee.

Section 406. Resubmission of Disapproved Drainage Plans

A disapproved Drainage Plan may be resubmitted, with the revisions addressing the Township Engineer's concerns documented in writing, to the Township Engineer in accordance with *Section 404* of this Ordinance and be subject to review as specified in *Section 405* of this Ordinance. The applicable Municipal Review Fee must accompany a resubmission of a disapproved Drainage Plan.

ARTICLE V

INSPECTIONS

Section 501. Schedule of Inspections

A. The Township Engineer or the Engineer's designated assignee shall inspect all phases of the installation of the permanent stormwater management facilities.

B. During any stage of the work, if the Township Engineer determines that the permanent stormwater management facilities are not being installed in accordance with the approved Stormwater Management Plan, the Township shall revoke any existing permits until a revised Drainage Plan is submitted and approved, as specified in this Ordinance.

ARTICLE VI

FEES AND EXPENSES

Section 601. General

The fees required by this Ordinance are the Township's Review Fees. The Township Review fee shall be established by the Township to defray review costs incurred by the Township and the Township Engineer. All fees shall be paid by the Applicant.

Section 602. Township Plan Review Fee

The Township Supervisors shall establish a Review Fee Schedule by resolution based on the size of the Regulated Activity and based on the Township's costs for reviewing Plans. The Township shall periodically update the Review Fee Schedule to ensure that review costs are adequately reimbursed.

Section 603. Expenses Covered by Fees

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

A. Administrative costs for plan review.

B. The review of the Drainage Plan by the Township and the Township Engineer.

C. The site inspections.

D. The inspection of stormwater management facilities and drainage improvements during construction.

E. The final inspection upon completion of the stormwater management facilities and drainage improvements presented in the Drainage Plan.

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

ARTICLE VII

MAINTENANCE RESPONSIBILITIES

Section 701. Stormwater Management Controls and Facilities
Stormwater management controls and facilities as defined here include all structural and non-structural stormwater conveyance and management controls including water quantity and quality Best Management Practices.

Section 702. Performance Guarantee
The applicant may be required provide a financial guarantee to the Township for the timely installation and proper construction of all stormwater management controls as required by the approved stormwater plan and this ordinance equal to the full construction cost of the required controls.

Section 703. Maintenance Responsibilities

A. The Drainage Plan for the development site shall contain an operation and maintenance plan prepared by the developer and approved by the Township Engineer. The operation and maintenance plan shall outline required routine maintenance actions and schedules necessary to ensure proper operation and function of the facility(ies).

B. The responsible party or entity responsible for the maintenance must also be identified. The Drainage Plan for the development site shall establish responsibilities for the continuing operation and maintenance of all proposed stormwater control facilities and temporary permanent erosion control facilities, consistent with the following principals:

1. If a development consists of structures or lots that are to be separately owned and in which streets, sewers and other public improvements are to be dedicated to the Township, stormwater control facilities may also be dedicated to and maintained by the Township.

2. If a development site is to be maintained in a single ownership or if sewers and other public improvements are to be privately owned and maintained, then the ownership and maintenance of stormwater control facilities shall be the responsibility of the owner or private management entity.

   Facilities may be incorporated within individual lots so that the respective lot owners will own and be responsible for maintenance in accordance with recorded deed restriction. A description of the facility or system and the terms of the required maintenance shall be incorporated as part of the deed to the property.

   Ownership and maintenance may be the responsibility of a Property Owners Association. The stated responsibilities of the Property Owners Association in terms of owning and maintaining the stormwater

management facilities shall be submitted with final plans for determination of their adequacy, and upon their approval shall be recorded with the approved subdivision plan among the deed records of Centre County, Pennsylvania. In addition, the approved subdivision plan and any deed written from said plan for a lot or lots shown herein shall contain a condition that it shall be mandatory for the owner or owners of said lot to be members of said Property Owners Association.

For stormwater management facilities that are proposed as part of the site development plan, the developer will be required to execute a developer agreement and a maintenance agreement with the Township for the construction and continued maintenance of the facilities prior to the signature approval on the final plan. Access for inspection by the Township of all such facilities deemed critical to the public welfare at any reasonable time shall be provided.

C. The Township, upon recommendation of the Township Engineer, shall make the final determination on the continuing maintenance responsibilities prior to final approval of the stormwater management plan. The governing body reserves the right to accept the ownership and operating responsibility for any or all of the stormwater management controls.

Section 704. Maintenance Agreement for Privately Owned Stormwater Facilities

A. Prior to final approval of the site's stormwater management plan, the property owner shall sign and record a maintenance agreement covering all stormwater control facilities that are to be privately owned.

B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory maintenance of all facilities. The maintenance agreement shall be subject to the review and approval of the Township solicitor and Township.

Section 705. Township Stormwater Maintenance Fund

A. If stormwater facilities are accepted by the Township for dedication, persons installing stormwater facilities shall be required to pay a specified amount to the Township Stormwater Maintenance Fund to help defray costs of periodic inspections and maintenance expenses. The amount of the deposit shall be determined as follows:

1. If the stormwater facility is to be owned and maintained by the Township, the deposit shall cover the estimated costs for maintenance and inspections for 10 years. The Township Engineer will establish the estimated costs utilizing information submitted by the applicant.

2. The amount of the deposit to the fund shall be converted to present worth of the annual series values. The Township Engineer shall determine the

present worth equivalents, which shall be subject to the approval of the Township.

B. If a stormwater facility is proposed that also serves as a recreation facility (e.g., ballfield, lake), the Township may reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreation purpose.

C. If at some future time a stormwater facility (whether publicly or privately owned) is eliminated due to the installation of storm sewers or other facilities, the unused portion of the maintenance fund deposit will be applied to the cost of abandoning the facility and connecting to the storm sewer system or other facility. Any amount of the deposit remaining after the costs of abandonment are paid will be returned to the depositor.

Section 706. Post-Construction Maintenance Inspections

A. Stormwater facilities should be inspected by the land owner/developer or responsible entity (including the Township Engineer for dedicated facilities) on the following basis:

1. Annually
2. During or immediately after every 10-year or greater storm event.

B. The entity conducting the inspection should be required to submit a report to the Township regarding the condition of the facility and recommending necessary repairs, if needed.

C. Maintenance inspections may be performed by the Township to ensure proper functioning of all stormwater facilities. These inspections may, at a minimum, be performed annually and/or following major storm events.

If the Township determines at any time that any permanent stormwater facility has been eliminated, altered or improperly maintained, the owner of the property shall be advised of corrective measures required and given 3 days to initiate appropriate action in accordance with a time schedule dictated by the Township. If such action is not taken by the property owner, the Township may cause the work to be done and backcharge all costs to the property owners.

ARTICLE VIII

ENFORCEMENT AND PENALTIES

Section 801. Right-of-Entry

Upon presentation of proper credentials, duly authorized representatives of 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 802. Notification

In the event that a person fails to comply with the requirements of this Ordinance, or fails to conform to the requirements of any permit issued hereunder, the Township shall provide written notification of the violation. The notice will direct the responsible party to comply with all the terms of this Ordinance within 7 days, or such additional period, not to exceed 30 days, as the designated Township representative shall deem reasonable. In addition, the designated Township representative shall give notice to the owner, applicant, developer, property manager or other person responsible for the property or the violation that if the violation is not corrected, the Township may correct the same and charge the landowner or other person responsible the cost thereof plus penalties as specified herein for failure to comply.

Such notice may be delivered by the United States mail, first class, postage prepaid, or by certified or registered mail; or by personal service; or if the property is occupied, by posting the notice at a conspicuous place upon the affected property.

Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of these violations(s). Failure to comply within the time specified shall subject such person to the penalty provision of this Ordinance. All such penalties shall be deemed cumulative and resort by the Township from pursuing any and all other remedies. It shall be the responsibility of the owner of the real property on which any Regulated Activity is proposed to occur, is occurring, or has occurred, to comply with the terms and conditions of this Ordinance.

Section 803. Enforcement

The Township is hereby authorized and directed to enforce all of the provisions of this Ordinance. All inspections regarding compliance with the drainage plan shall be the responsibility of the Township Engineer or other qualified persons designated by the Township.

A. A set of design plans approved by the Township shall be on file at the site throughout the duration of the construction activity. Periodic inspections may be made by the Township or designated assignee during construction.

B. Adherence to Approved Plan

It shall be unlawful for any person, firm or corporation to undertake any regulated activity under *Section 104* on any property except as provided for in the approved drainage plan and pursuant to the requirements of this Ordinance. It shall be unlawful to alter or remove any control structure required by the drainage plan pursuant to this Ordinance or to allow the property to remain in a condition that does not conform to the approved drainage plan.

C. At the completion of the project, and as a prerequisite for the release of the performance guarantee, the owner or his representatives shall:

1. Provide a certification of completion from an engineer, architect, surveyor or other qualified person verifying that all permanent facilities have been constructed according to the plans and specifications and approved revisions thereto.

2. Provide a set of as-built drawings.

D. After receipt of the certification by the Township, a final inspection shall be conducted by the Township or its designated assignee to certify compliance with this Ordinance.

E. Prior to revocation or suspension of a permit, the Township will schedule a hearing to discuss the non-compliance **i**f there is no immediate danger to life, public health or property.

F. Suspension and Revocation of Permits

1. Any permit issued under this ordinance may be suspended or revoked by the Township for:

a. Non-compliance with or failure to implement any provision of the permit.

b. A violation of any provision of this ordinance or any other applicable law, ordinance, rule or regulation relating to the project.

c. The creation of any condition or the commission of any act during construction or development which constitutes or creates a hazard or nuisance, pollution or which endangers the life or property of others, or as outlined in *Article IX* of this Ordinance.

2. A suspended permit shall be reinstated by the Township when:

a. The Township Engineer or his designee has inspected and approved the corrections to the stormwater management and erosion and sediment pollution control measure(s), or the elimination of the hazard or nuisance;

b. The Township is satisfied that the violation of the ordinance, law, or rule and regulation has been corrected.

A permit that has been revoked by the Township cannot be reinstated. The applicant may apply for a new permit under the procedures outlined in this Ordinance.

G. Occupancy Permit

An occupancy permit shall not be issued unless the certification of compliance pursuant to *Section 902.D* has been secured. The occupancy permit shall be required for each lot owner and/or developer for all subdivisions and land development in the Township.

Section 804. Public Nuisance

A. The violation of any provision of this Ordinance is hereby deemed a Public Nuisance.

B. Each day that a violation continues shall constitute a separate violation.

Section 805. Penalties

A. Anyone violating the provisions of this Ordinance shall be guilty of a misdemeanor, and upon conviction shall be subject to a fine of not more than $ 600.00 for each violation and recoverable with costs. Each day that the violation continues shall be a separate offense.

B. In addition, the Township, through its solicitor, 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.

C. The cost of removal, fine and penalties hereinabove mentioned may be entered by the Township as a lien against such property, or properties of individual members of a Property Owners Association, in accordance with the existing provisions of the law.

Section 806. Appeals

A. Any person aggrieved by any action of the Township or its designated assignee, relevant to the provisions of this Ordinance, may appeal to the Township Zoning Hearing Board within 30 days of that action.

B. Any person aggrieved by any decision of the Township Zoning Hearing Board, relevant to the provisions of this Ordinance, may appeal to the County Court of Common Pleas in the county where the activity has taken place within 30 days of the Zoning Hearing Board's decision.

ARTICLE IX

ENACTMENT

Section 901. Repealer
Ordinance No. 58, the existing Stormwater Management Ordinance of Benner Township, and all other existing ordinances or parts of ordinances which are contrary to the provisions of this Ordinance are hereby repealed to the extent necessary to give this Ordinance full force and effect.

Section 902. Severability
If any sentence, clause, section, or part of this Ordinance is for any reason found to be unconstitutional, illegal or invalid, such unconstitutionality, illegality or invalidity shall not affect or impair any of the remaining provisions, sentences, clauses, sections or parts of this Ordinance. It is hereby declared the intent of the Board of Supervisors of Benner Township that this Ordinance would have been adopted had such unconstitutional, illegal or invalid sentence, clause, section or part thereof not been included herein.

Section 903. Effective Date
This Ordinance shall become effective immediately after enactment.

Section 904. Enacted
Enacted and ordained by the Board of Supervisors of Benner Township, Centre County, Pennsylvania, this 3rd day of March 2003 A. D.

By: Benner Township Board of Supervisors

David C. Breon, Chairman

John J. Elnitski, Jr. Vice Chairman

Richard C. Lahr, Supervisor

Attest

Sharon Royer, Secretary

(SEAL)

APPENDIX A

STORMWATER MANAGEMENT

DESIGN CHARTS AND TABLES

TABLE A-1: IDF REGION 2 DESIGN STORM RAINFALL

TABLE A-2: RUNOFF CURVE NUMBERS (FROM NRCS (SCS) TR-55)

TABLE A-3: RATIONAL RUNOFF COEFFICIENTS (ARON CURVES)

TABLE A-4: RATIONAL RUNOFF COEFFICIENTS (RAWLS, WONG, McCUEN)

TABLE A-5 MANNING ROUGHNESS COEFFICIENTS FOR OPEN CHANNELS AND MANNING N VALUES FOR SHEET FLOW

TABLE A-6: MANNING ROUGHNESS COEFFICIENTS FOR PIPES

TABLE A-7: PERMISSIBLE VELOCITIES FOR CHANNELS

TABLE A-8: SOILS IDENTIFIED IN THE CENTRE COUNTY SOIL SURVEY AS ON FLOOD PLAINS OR ON TERRACES ABOVE FLOOD PLAINS

Allegheny Series Allegheny silt loam (AlB)
Atkins Series Atkins silt loam (At)
Basher Series Basher loam (Ba)
Chagrin Series Chagrin Soils (Ch)
Dunning Series Dunning silty clay loam (Du)
Lindside Series Lindside soils (Lx)
Melvin Series Melvin silt loam (Mm)
Monongahela Series Monongahela silt loam (MoB)
Philo Series Philo loam (Ph), Philo and Atkins very stony soils (Pk)
Pope Series Pope soils (Po)
Purdy Series Purdy silt loam (Pu)
Tyler Series Tyler silt loam (Ty)

TABLE A-1
IDF REGION 2 DESIGN STORM RAINFALL

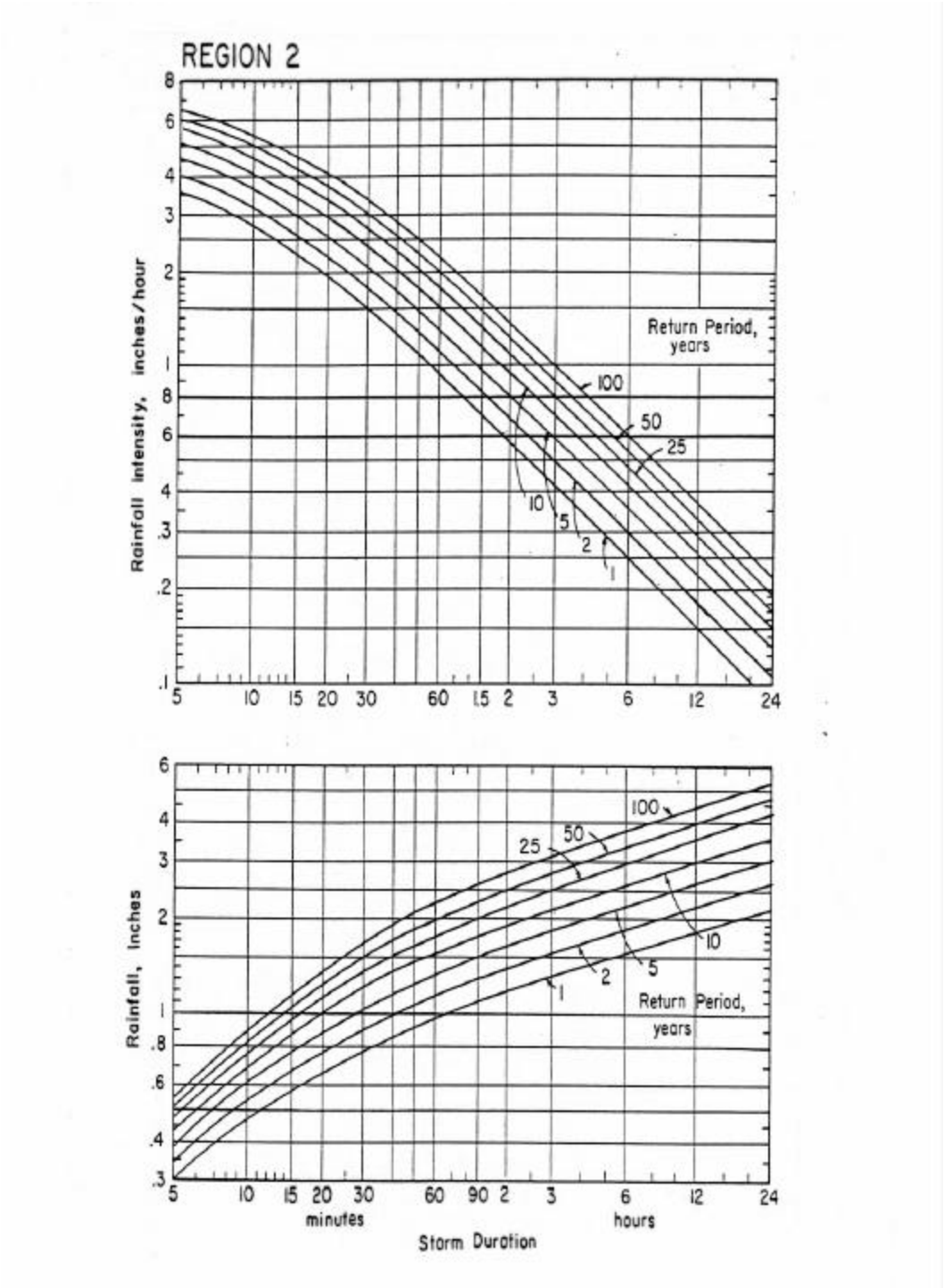


TABLE A-2
RUNOFF CURVE NUMBERS
(FROM NRCS (SCS) TR-55)

TR-55

Cover Description Land/Use Cover Type	Average Imperviousness (percent)	Curve Numbers For Hydrologic Soil Group A	B	C	D
Open space (lawns, parks, golf courses, cemeteries, etc.):					
Good condition (grass cover greater than 75%	n/a*	39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	n/a	98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)	n/a	98	98	98	98
Paved; open ditches (including right-of-way)	n/a	98	98	98	98
Gravel (including right-of-way)		76	85	89	91
Urban Districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential Districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Woods:	n/a	30	55	71	77
Brush:		35	56	70	77
Meadow: (In good condition)		30	58	71	78

* Not applicable

Source: United States Department of Agriculture, Soil Conversation Service, Engineering Division, 1986, "Urban Hydrology for Small Watersheds," Technical Release 55, Washington, DC.

TABLE A-3
RATIONAL RUNOFF COEFFICIENTS
(ARON CURVES)

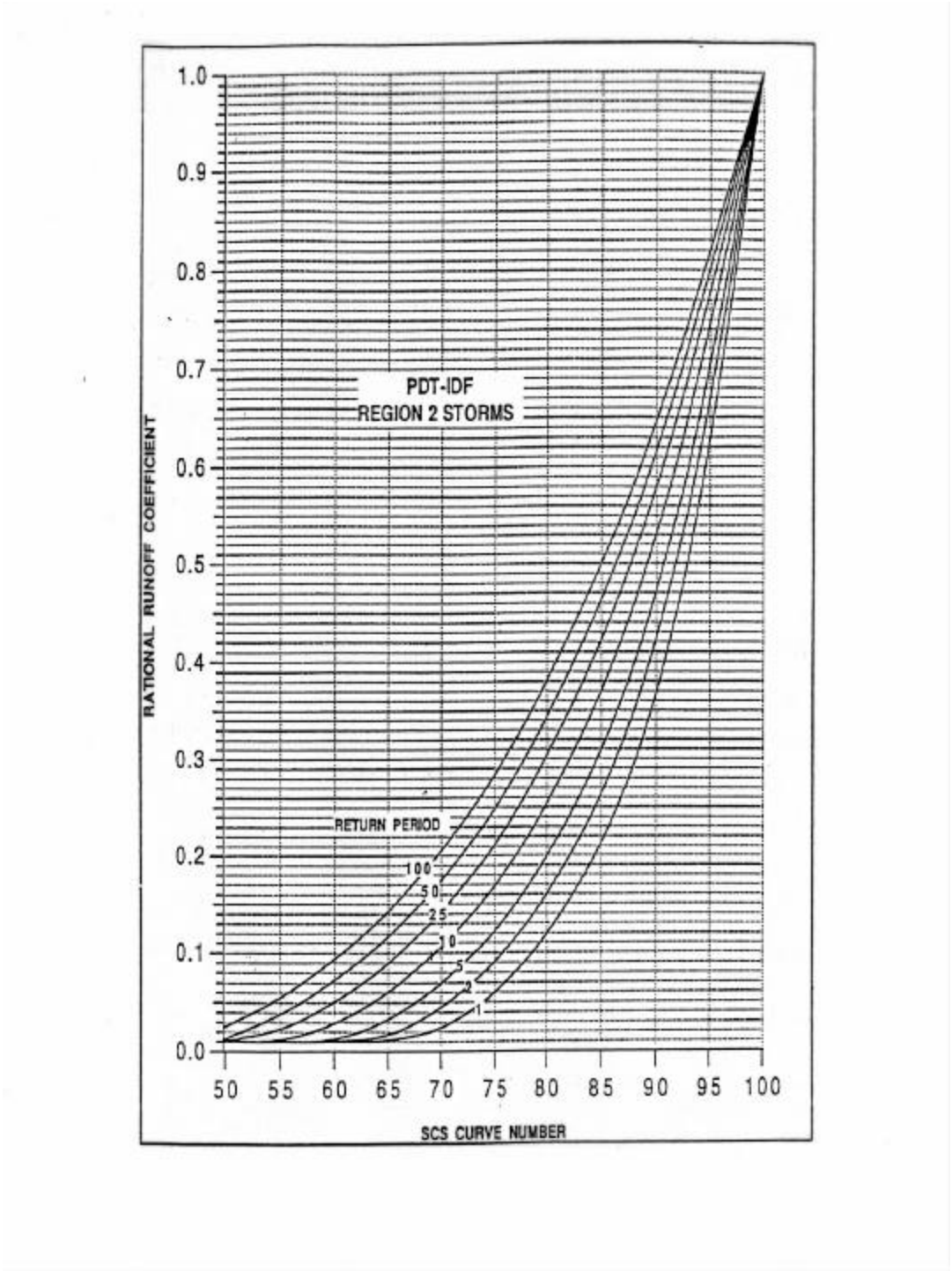


TABLE A-4
RATIONAL RUNOFF COEFFICIENTS
(RAWLS, WONG, McCUEN)

Runoff Coefficients for the Rational Formula
By Hydrologic Soil Group and Overland Slope (%)

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

[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. Wong and R.H. McCuen, 1981, "Comparison of Urban Flood Frequency Procedures," Preliminary Draft, U.S. Department of Agriculture, Soil Conservation Service, Beltsville, MD.

TABLE A-5
MANNING ROUGHNESS COEFFICIENTS
FOR OPEN CHANNELS AND MANNING N VALUES FOR SHEET FLOW

	Manning's n range
I. Closed conduits:	
A. Concrete pipe	0.011-0.013
B. Corrugated-metal pipe or pipe arch:	
1. 2 1/2 by 1/2 inch corrugation (riveted) pipe:	
a. Plain or fully coated	0.024
b. Paved invert (range values are for 25 and 50 percent of circumference paved):	
(1) Flow full depth	0.021-0.018
(2) Flow 0.8 depth	0.021-0.016
(3) Flow 0.6 depth	0.019-0.013
2. 6 by 2-inch corrugation (field bolted)	0.030
C. Cast-iron pipe, uncoated	0.013
D. Steel pipe	0.009-0.011
E. Monolithic concrete:	
1. Wood forms, rough	0.015-0.017
2. Wood forms, smooth	0.012-0.014
3. Steel forms	0.012-0.013
F. Cemented rubble masonry walls:	
1. Concrete floor and top	0.017-0.022
2. Natural floor	0.019-0.025
II. Open channels, lined (straight alignment):	
A. Concrete, with surfaces as indicated:	
1. Formed, no finish	0.013-0.017
2. Trowel finish	0.012-0.014
3. Float finish	0.013-0.015
4. Float finish, some gravel on bottom	0.015-0.017
5. Gunite, good section	0.016-0.019
6. Gunite, wavy section	0.018-0.022
B. Concrete, bottom float finished, sides as indicated:	
1. Dressed stone in mortar	0.015-0.017
2. Random stone in mortar	0.017-0.020
3. Cement rubble masonry	0.020-0.025
4. Cement rubble masonry, plastered	0.016-0.020
5. Dry rubble (riprap)	0.020-0.030
C. Gravel bottom, sides as indicated:	
1. Formed concrete	0.017-0.020
2. Random stone in mortar	0.020-0.023
3. Dry rubble (riprap)	0.023-0.033
D. Asphalt	
1. Smooth	0.013
2. Rough	0.016
E. Concrete-lined excavated rock:	
1. Good section	0.017-0.020
2. Irregular section	0.022-0.027

	Manning's n range
III. Open channels, excavated (straight alignment, natural lining):	
A. Earth, uniform section:	
1. Clean, recently completed	0.016-0.018
2. Clean, after weathering	0.018-0.020
3. With short grass, few weeds	0.022-0.027
4. In gravely soil, uniform section, clean	0.022-0.025
B. Earth, fairly uniform section:	
1. No vegetation	0.022-0.025
2. Grass, some weeds	0.025-0.030
3. Dense weeds or aquatic plants in deep channels	0.030-0.035
4. Sides clean, gravel bottom	0.025-0.030
5. Sides clean, cobble bottom	0.030-0.040
C. Dragline excavated or dredged:	
1. No vegetation	0.028-0.033
2. Light brush on banks	0.035-0.050
D. Rock:	
1. Based on design section	0.035
2. Based on actual mean section:	
a. Smooth and uniform	0.035-0.040
b. Jagged and irregular	0.040-0.045
E. Channels not maintained, weeds and brush uncut:	
1. Dense weeks, high as flow depth	0.080-0.120
2. Clean bottom, brush on sides	0.050-0.080
3. Clean bottom, brush on sides, highest stage of flow	0.070-0.110
4. Dense brush, high stage	0.100-0.140
IV. Channels and swales w/maintained Vegetation (values shown are for velocities of 2 & 6 f.p.s.):	
A. Depth of flow up to 0.7 foot:	
1. Bermudagrass, Kentucky bluegrass, buffalograss	
a. Mowed to 2 inches	0.045-0.070
b. Length 4-6 inches	0.050-0.090
2. Good stand, any grass:	
a. Length about 12 inches	0.090-0.180
b. Length about 24 inches	0.150-0.300
3. Fair stand, any grass:	
a. Length about 12 inches	0.080-0.140
b. Length about 24 inches	0.130-0.250
B. Depth of flow 0.7-1.5 feet:	
1. Bermudagrass, Kentucky bluegrass, buffalograss:	
a. Mowed to 2 inches	0.035-0.050
b. Length 4 to 6 inches	0.040-0.060
2. Good stand, any grass:	
a. Length about 12 inches	0.070-0.120
b. Length about 24 inches	0.100-0.200
3. Fair stand, any grass:	
a. Length about 12 inches	0.060-0.100
b. Length about 24 inches	0.090-0.170

	Manning's n range
V. Street and expressway gutters:	
A. Concrete gutter, troweled finish	0.012
B. Asphalt pavement:	
1. Smooth texture	0.013
2. Rough texture	0.016
C. Concrete gutter with asphalt pavement	
1. Smooth	0.013
2. Rough	0.015
D. Concrete pavement:	
1. Float finish	0.014
2. Broom finish	0.015
E. For gutters with small slope, where sediment may accumulate, increase above values of n by	0.002
VI. Natural stream channels:	
A. Minor streams (surface width at flood stage less than 100 feet):	
1. Fairly regular section:	
a. Some grass & weeds, little or no brush	0.030-0.035
b. Dense growth of weeds, depth of flow materially greater than weed height	0.035-0.050
c. Some weeds, light brush on banks	0.035-0.050
d. Some weeds, heavy brush on banks	0.050-0.070
e. Some weeds, dense willows on banks	0.060-0.080
f. For trees within channel with branches submerged at high stage, increase all above values by	0.010-0.020
2. Irregular sections, with pools, slight channel meander; increase given in 1 a-e about	0.010-0.020
3. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage	
a. Bottom of gravel, cobbles and few boulders	0.040-0.050
b. Bottom of cobbles, with large boulders	0.050-0.070
B. Floodplains (adjacent to natural streams):	
1. Pasture, no brush:	
a. Short grass	0.030-0.035
b. High grass	0.035-0.050
2. Cultivated areas:	
a. No crop	0.030-0.040
b. Mature row crops	0.035-0.045
c. Mature field crops	0.040-0.050
3. Heavy weeds, scattered brush	0.050-0.070
4. Light brush and trees:	
a. Winter	0.050-0.060
b. Summer	0.060-0.080
5. Medium to dense brush:	
a. Winter	0.070-0.110
b. Summer	0.100-0.160
6. Dense willows, summer, not bent over by current	0.150-0.200
7. Cleared land w/tree stumps, 100-150 per acre:	
a. No sprouts	0.040-0.050
b. With heavy growth of sprouts	0.060-0.080
8. Heavy stand of timber, a few down trees, little undergrowth:	
a. Flood depth below branches	0.100-0.120
b. Flood depth reaches branches	0.120-0.160
C. Major streams (surface width at flood stage more than 100 feet): Roughness coefficient is usually less than for minor streams of less effective resistance offered by irregular banks or vegetation on banks. Values of n may be somewhat reduced. Follows recommendation in publication cited if possible. The value of n for larger streams of most regular section, with no boulders or brush, may be in the range of	0.028-0.033

MANNING'S ROUGHNESS COEFFICIENTS FOR SHEET FLOW

SURFACE DESCRIPTION	n^1
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover 20%	0.06
Residue cover 20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:	
Light underbrush	0.40
Dense underbrush	0.80

Source: Chow, V.T., 1959, "Open Channel Hydraulics," McGraw Hill, New York.

TABLE A-6
MANNING ROUGHNESS COEFFICIENTS FOR PIPES

Description	"n"
Smooth-roll plastic pipe	0.011
Concrete pipe	0.012
Smooth-lined corrugated metal pipe	0.012
Corrugated plastic pipe	0.024
Annular corrugated steel and aluminum Alloy pipe (plain or polymer coated)	
2 2/3" x 1/2" corrugations	0.024
3" x 1" corrugations	0.027
5" x 1" corrugations	0.025
6" x 2" corrugations	0.033
Helically corrugated steel and aluminum Alloy pipe (plain or polymer coated) 3" x 1", 5" x 1" or 6" x 2" corrugations	0.024
Helically corrugated steel and aluminum Alloy pipe (plain or polymer coated) 2 2/3" x 1/2" corrugations	
a. lower coefficients●	
18" diameter	0.014
24" diameter	0.016
36" diameter	0.019
48" diameter	0.020
60" diameter or larger	0.021
b. Higher coefficients▲	0.024
Annular or Hhlically corrugated steel or aluminum alloy pipe arches or other on-circular conduit (plain or polymer coated)	0.024
Vitrified clay pipe	0.012
Ductile iron pipe	0.013

●Use the lower coefficient if any one of the following conditions apply:

a. A storm pipe longer than 20 diameters, which directly or indirectly connects to an inlet or manhole, located in swales adjacent to shoulders in cut areas, shoulders in cut areas or depressed medians.

b. A storm pipe which is specially designed to perform under pressure.

▲Use the higher coefficient if any one of the following conditions apply:

a. A storm pipe which directly or indirectly connects to an inlet or manhole located in highway pavement sections or adjacent to curb or concrete median barrier.

b. A storm pipe which is shorter than 20 diameters long.

c. A storm pipe which is partly lined helically corrugated metal pipe.

In considering each factor more critical, judgement is necessary if it is kept in mind that any condition that causes turbulence and retards flow results in a greater value of "n."

Outlet velocity for bituminous paved invert shall be determined based on a 25% reduction in Manning's roughness coefficient, "n."

Source: Pennsylvania Department of Transportation Design Manual, Part 2, January 1990.

TABLE A-7
PERMISSIBLE VELOCITIES FOR CHANNELS

Maximum Permissible Velocities in Bare Earth Channels -For Straight Channels where slope < .02 ft/ft

Soil Materials	n*	Clear Water (V fps)	Water Transporting Colloidal Silts (V fps)
Fine sand, noncolloidal	.020	1.50	2.50
Sandy loam, noncolloidal	.020	1.75	2.50
Silt loam, noncolloidal	.020	2.00	3.00
Alluvial silts, noncolloidal	.020	2.00	3.50
Ordinary firm loam	.020	2.50	3.50
Stiff clay, very colloidal	.025	3.75	5.00
Alluvial silts, colloidal	.025	3.75	5.00
Shales and hardpan	.025	6.00	6.00
Fine Gravel	.020	2.50	5.00
Graded loam - cobbles (when noncolloidal)	.030	3.75	5.00
Graded silt - cobbles (when noncolloidal)	.030	4.00	5.50
Coarse gravel noncolloidal	.025	4.00	6.00
Cobbles and shingles	.035	5.00	5.50

* Listed n values assume good to excellent construction techniques which produce uniform channel dimensions. Values should be adjusted, by use of SCS Engineering Handbook #5, Supplement B, for other construction conditions.

TABLE A-5.2 Maximum Permissible Velocities for Channels Lines with Vegetation

Cover	Slope Range Percent	Permissible Velocity ft/sec. Erosion[1] Resistant Soil	Easily[2] Eroded Soil
Kentucky Bluegrass Tall Fescue	<5 5-10 >10	7[3] 6[3] 5	5 4 3
Grass Mixture Reed Canarygrass	<5 5-10	5 4	4 3
Sericea Lespedeza Weeping Lovegrass Redtop Red Fescue	<5	3.5	2.5
Annuals temporary cover only Sudangrass	<5	3.5	2.5

[1] Cohesive (clayey) fine grain soils and coarse grain soils with a plasticity index of 10 to 40 (CL, CH, SC, & GC).
[2] Soils that do not meet the requirements for erosion resistant soils.
[3] Use velocities exceeding 5 ft./sec. only where good cover and proper maintenance can be obtained.

TABLE A-8
SOILS IDENTIFIED IN THE CENTRE COUNTY SOIL SURVEY
AS ON FLOOD PLAINS OR ON TERRACES ABOVE FLOOD PLAINS

Allegheny Series	Allegheny silt loam (AlB)
Atkins Series	Atkins silt loam (At)
Basher Series	Basher loam (Ba)
Chagrin Series	Chagrin Soils (Ch)
Dunning Series	Dunning silty clay loam (Du)
Lindside Series	Lindside soils (Lx)
Melvin Series	Melvin silt loam (Mm)
Monongahela Series	Monongahela silt loam (MoB)
Philo Series	Philo loam (Ph), Philo and Atkins very stony soils (Pk)
Pope Series	Pope soils (Po)
Purdy Series	Purdy silt loam (Pu)
Tyler Series	Tyler silt loam (Ty)

APPENDIX B

WATERSHED MAPS

Sensitive Land Areas for Well Head Protection Data Source

Well Fields 1 and 3: Harter and Thomas Well Fields

Municipality: Harris, Ferguson, and College Townships
Well Owner: State College Water Authority
Includes wells: H7, H8, H11, H14, H22, H25
Protection Area: One-year zone of contribution
Source: Nittany Geoscience, February 1992, Figure 4

Well Field 5

Municipality: Ferguson Township
Well Owner: State College Water Authority
Includes wells: F55, F57
Protection Area: One-year zone of contribution
Source: Nittany Geoscience, February 1992, Figure 4

Well Field 6

Municipality: Benner and Patton Townships
Well Owner: State College Water Authority
Includes wells: B62, B63, B64, B65
Protection Area: One-year zone of contribution + direct upslope lands
Source: Nittany Geoscience, February 1992, Figure 4

PSU Golf Course Well Field

Municipality: Ferguson Township and the Borough of State College
Well Owner: Penn State University
Includes wells: PS28A, PS 37
Protection Area: One-year zone of contribution
Source: Nittany Geoscience, January, Figure 5

PSU Big Hollow Well Field

Municipality: Patton, Ferguson, and College Townships
Well Owner: Penn State University
Includes wells: PS2, PS14, PS16, PS17, PS24, PS26
Protection Area: One-year zone of contribution
Source: Nittany Geoscience, January, Figure 5

PSU Houserville Well Field

Municipality: Ferguson Township
Well Owner: Penn State University
Includes wells: PS33, PS 34, PS35
Protection Area: One-year zone of contribution
Source: Nittany Geoscience, January, Figure 5

Existing Well and Spring

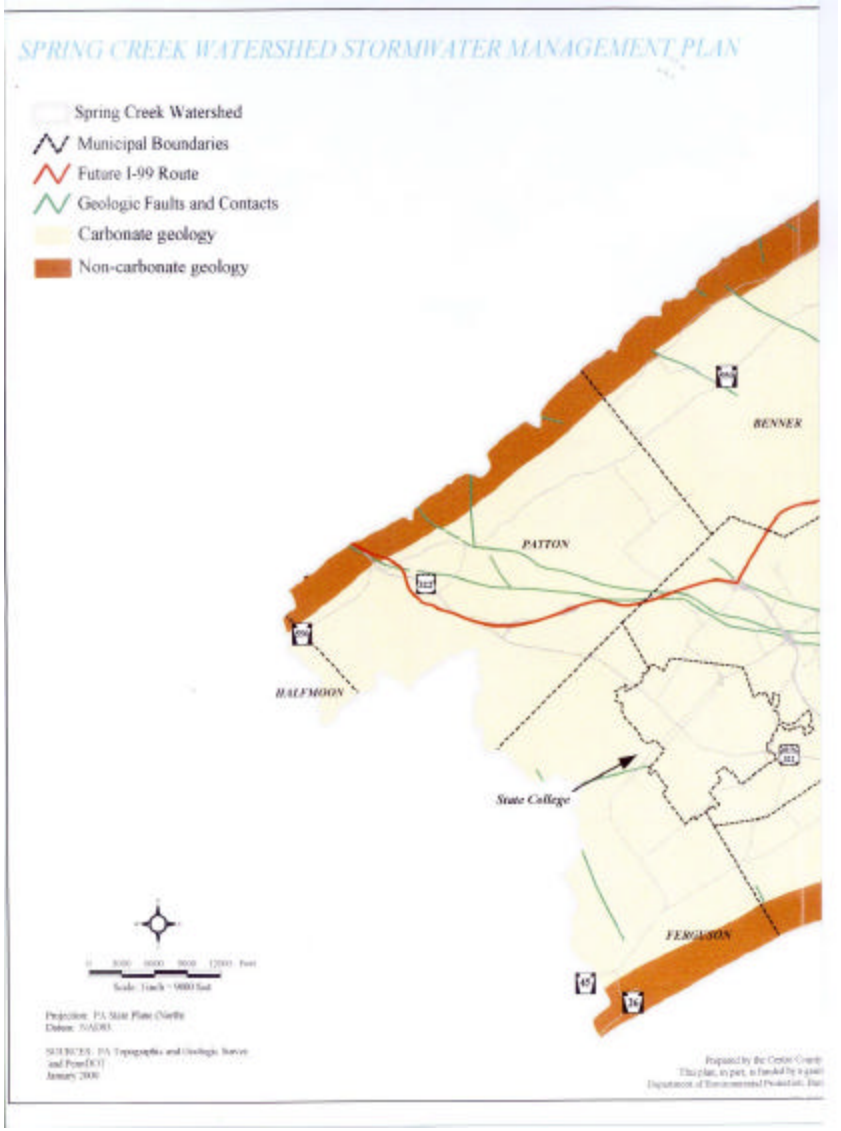
Municipality: Ferguson Township
Well Owner: State College Water Authority
Includes wells: F3
Protection Area: 400’ Radius + direct upslope lands

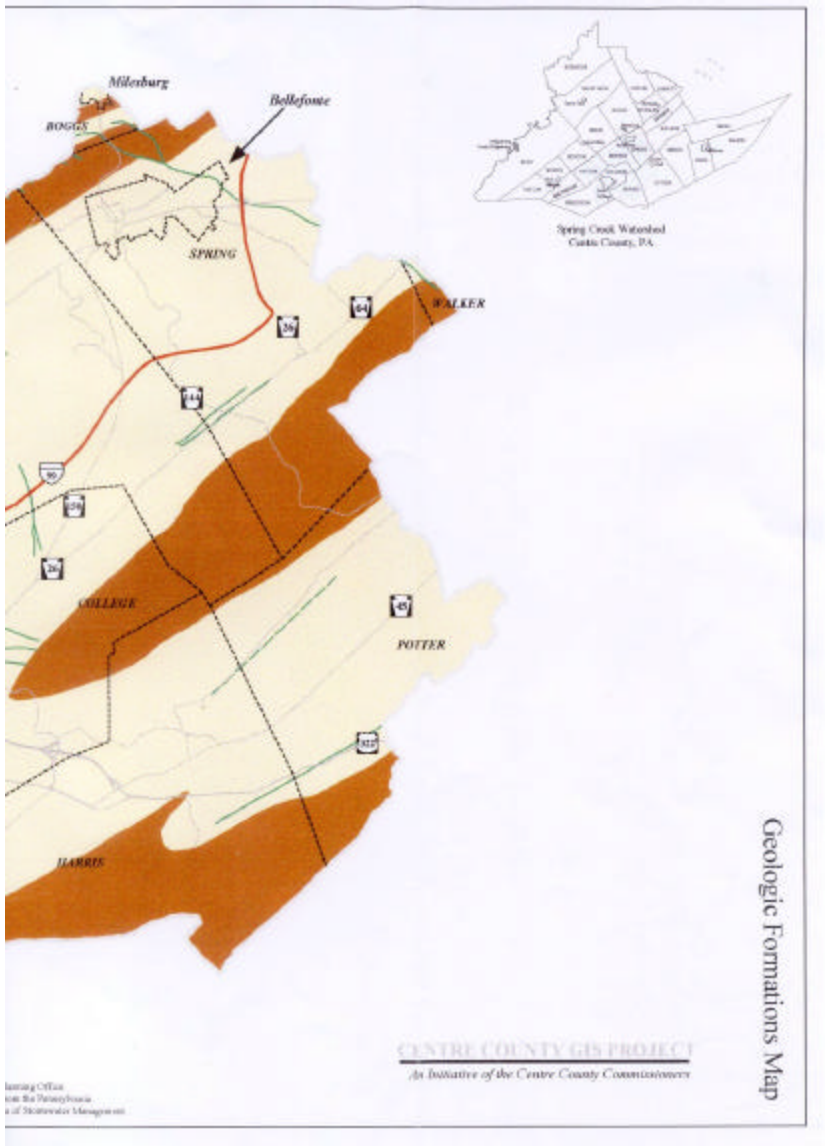
Ridgemont Wells

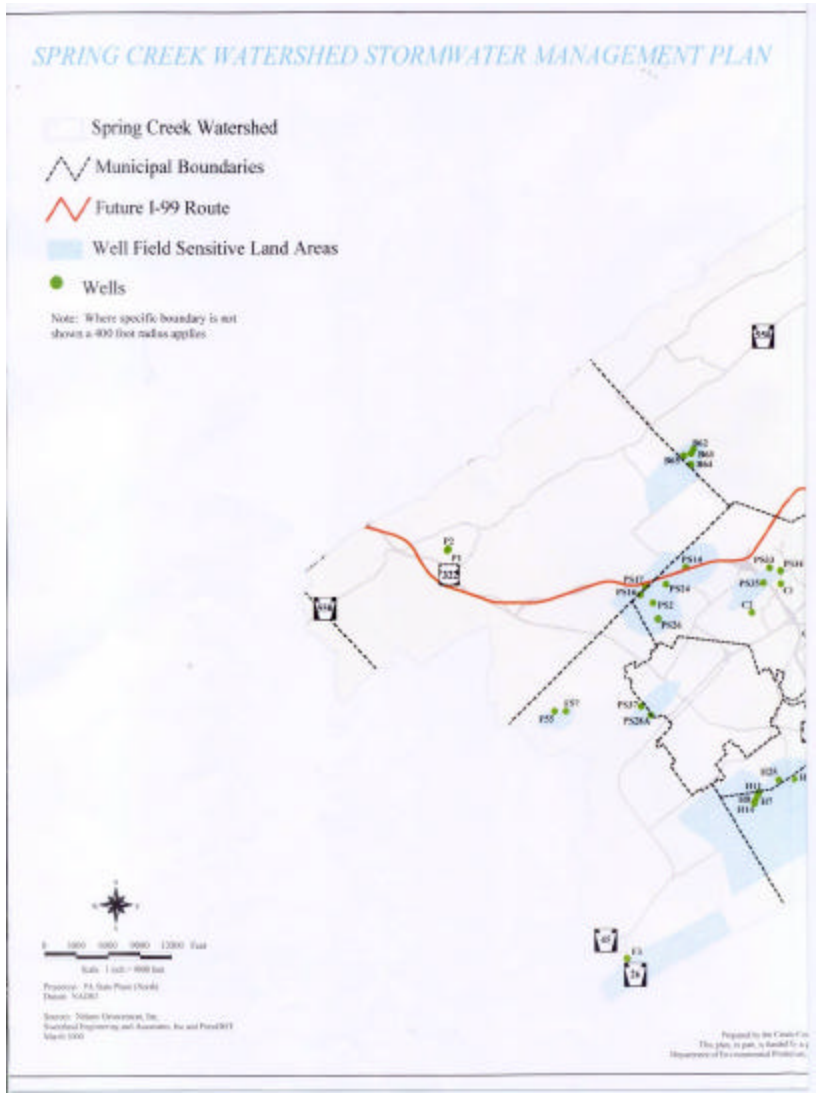
Municipality: Patton Township
Well Owner: Ridgemont Water Authority
Includes wells: P1, P2
Protection Area: 400’ Radius

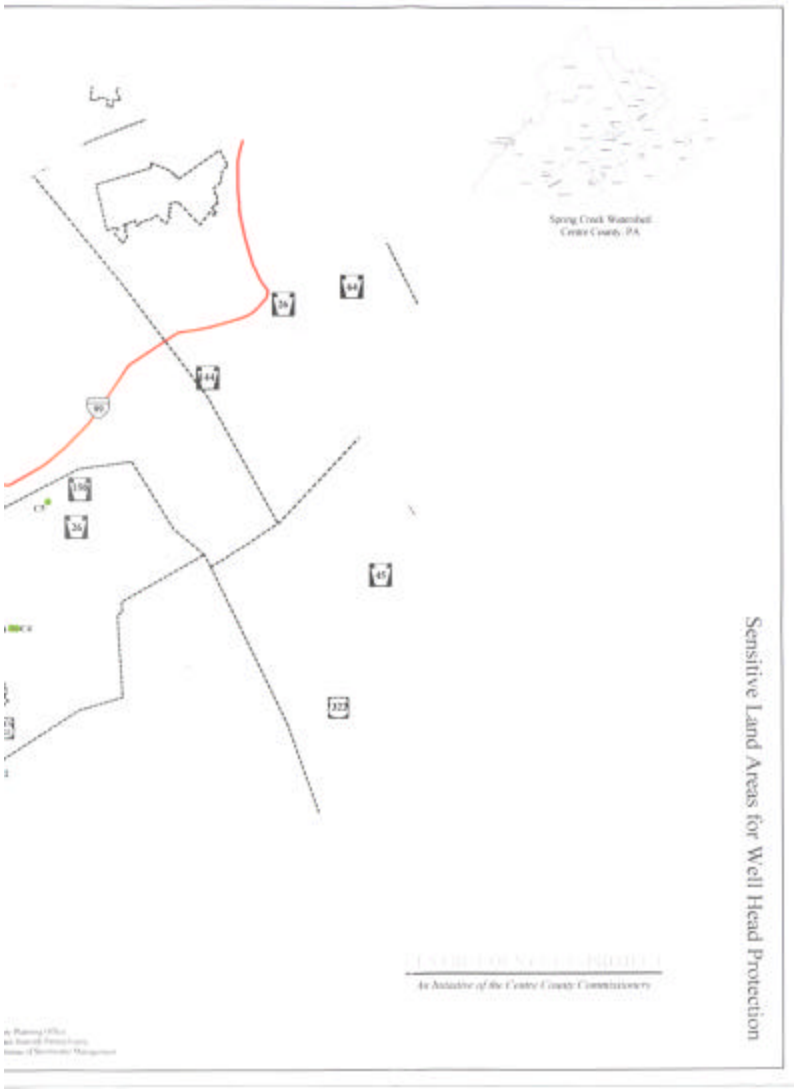
Spring Creek Park, Lemont #4, Lemont #5,and Rogers Wells, and Bathgate Springs

Municipality: College Township
Well Owner: College Township Water Authority
Includes wells: C1, C2, C3, C4, C5
Protection Area: 400’ Radius


SPRING CREEK WATERSHED STORMWATER MANAGEMENT PLAN
Spring Creek Watershed
Municipal Boundaries
Future I-99 Route
Geologic Faults and Contacts
Carbonate geology
Non-carbonate geology
BENNER
PATTON
HALFMOON
State College
FERGUSON


Millesburg
Bellefonte
BOGGS
SPRING
WALKER
COLLEGE
POTTER
HARRIS
Spring Creek Watershed
Centre County, PA
CENTRE COUNTY GIS PROJECT
An Initiative of the Centre County Commissioners
Geologic Formations Map


SPRING CREEK WATERSHED STORMWATER MANAGEMENT PLAN
Spring Creek Watershed
Municipal Boundaries
Future I-99 Route
Well Field Sensitive Land Areas
Wells
Note: Where specific boundary is not shown a 400 foot radius applies


Sensitive Land Areas for Well Head Protection

APPENDIX C

LIST OF VARIATIONS WITH MODEL ORDINANCE

1. In paragraph A of Section 110 Exemptions, changed the maximum impervious area from 20,000 sq. ft. to 5,000 sq. ft.
2. 2. In paragraph A.1.a of Section 304 Calculation Methodologies, deleted "The Township Engineer shall use a 5% increase as a general benchmark for defining "negligible"".
3. In paragraph A.4 of Section 304 Calculations Methodologies, deleted the following subparagraph, "For sites less than one (1) acre in total area that connect directly to existing storm sewer systems, surface or subsurface (underground) stormwater detention facilities only need to be designed to control storm events up to the design return period of the existing pipes (usually 10 years). However, it must be demonstrated that adequate conveyance capacity (overland or within the existing storm sewer system) exists to ensure that flooding or damage from proposed releases will not exceed the existing potential for the system. If warranted by historic flooding in the tributary storm sewer system, the Township may require more stringent criteria."
4. In paragraph B.6.b of Section 307. Design Criteria for Stormwater Management Facilities, change the minimum slope of the interior of the pond from 2:1 to 3:1.
5. In paragraph C of Section 404 Drainage Plan Review, added 60 day review period and added "or Developer's agent who submitted Plan" as entity to be notified of Plan approval.
6. In paragraph D of Section 404 Drainage Plan Review, added "or Developers agent who submitted Plan" as entity to be notified of Plan disapproval.
7. In paragraph J of Section 404 Drainage Plan Review, added the time period of 3 years in which the improvements must be completed.
8. In Section 805 Penalties, added $600.00.