Ordinance No. _____

HILLTOWN TOWNSHIP STORMWATER MANAGEMENT ORDINANCE

Hilltown Township
Bucks County, Pennsylvania

April 25, 2011

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ARTICLE 1. GENERAL PROVISIONS

Section 134-1. Statement of Findings

The governing body of the municipality finds that:

A. Inadequate management of accelerated stormwater runoff resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, degrades water quality, 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. A comprehensive program of stormwater management (SWM), 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.

C. Through project design, impacts from stormwater runoff can be minimized to maintain the natural hydrologic regime, and sustain high water quality, groundwater recharge, stream baseflow, and aquatic ecosystems. The most cost effective and environmentally advantageous way to manage stormwater runoff is through nonstructural project design, minimizing impervious surfaces and sprawl, avoiding sensitive areas (i.e. stream buffers, floodplains, steep slopes), and designing to topography and soils to maintain the natural hydrologic regime. **[Added by Ordinance 2006-3]**

D. Inadequate planning and management of stormwater runoff resulting from land development and redevelopment throughout a watershed can also harm surface water resources by changing the natural hydrologic patterns, accelerating stream flows (which increase scour and erosion of streambeds and streambanks thereby elevating sedimentation), destroying aquatic habitat and elevating aquatic pollutant concentrations and loadings such as sediments, nutrients, heavy metals and pathogens.

E. The aforementioned impacts happen mainly through a decrease in natural infiltration of stormwater.

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

G. Public education on the control of pollution from stormwater is an essential component in successfully addressing stormwater.

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

I. Non-stormwater discharges to municipal separate storm sewer systems can contribute to pollution of Waters of the Commonwealth by the Township.

Section 134-2. Purpose

The purpose of this comprehensive stormwater management ordinance is to promote health, safety, and welfare within Hilltown Township by maintaining the natural hydrologic regime and by minimizing the harms and maximizing the benefits described in Section 134-1. of this Ordinance through provisions designed to:

A. Meet Water Quality requirements under State law, including regulations at 25 Pa. Code Chapter 93.4a to protect and maintain "existing uses" and maintain the level of water quality to support those uses in all streams, and to protect and maintain water quality in "special protection" streams.

B. Promote nonstructural Best Management Practices. **[Added by Ordinance 2006-3]**

C. Minimize increases in stormwater volume and control peak flow. **[Added by Ordinance 2006-3]**

D. Minimize impervious surfaces. **[Added by Ordinance 2006-3]**

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

F. Utilize and preserve the existing natural drainage systems.

G. Maintain the pre-development volume of groundwater recharge and prevent degradation of groundwater quality.

H. Maintain the pre-development peak and volume of stormwater runoff and prevent degradation of surface water quality.

I. Minimize nonpoint source pollutant loadings to the ground and surface waters.

J. Minimize impacts on stream temperatures.

K. Maintain existing flows and quality of streams and watercourses in the municipality and the Commonwealth.

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

M. Provide proper operations and maintenance of all permanent stormwater management facilities and Best Management Practices that are implemented in the municipality.

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

O. Provide review procedures, performance standards, and design criteria for stormwater planning and management.

P. Manage stormwater impacts close to the runoff source, requiring a minimum of structures and relying on natural processes.

Q. Infiltrate stormwater to maintain groundwater recharge, to prevent degradation of surface and groundwater quality, and to otherwise protect water resources.

R. Prevent streambank and streambed scour and erosion.

S. Provide standards to meet National Pollution Discharge Elimination System (NPDES) permit requirements.

T. Address certain requirements of the Municipal Separate Stormwater Sewer System (MS4) NPDES Phase II Stormwater Regulations.

U. Implement an illegal discharge detection and elimination program to address nonstormwater discharges into the municipal separate storm sewer system.

Section 134-3. Statutory Authority

The municipality is empowered to regulate land use activities that affect runoff by the authority of the Act of October 4, 1978 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq., as amended, the 'Storm Water Management Act,"; and by the Authority of Pennsylvania Municipalities Planning Code, Act 247 of 1968, as amended by Act 170 of 1988, as further amended by Act 209 of 1990 and Act 131 of 1992, 53 P.S. Section 10101.

Section 134-4. Applicability

This Ordinance shall apply to all areas of the municipality that are located within the Neshaminy Creek Watershed, Tohickon Creek Watershed, or East Branch Perkiomen Creek Watershed as delineated in Appendix G which is hereby adopted as Ordinance of this Ordinance.

This Ordinance shall apply to temporary and permanent stormwater management facilities constructed as Ordinance of any of the regulated activities listed in this section. Stormwater management and erosion and sedimentation control during construction activities which are specifically not regulated by this Ordinance, 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. 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 applicable ordinances.

The following activities are defined as 'Regulated Activities' and shall be regulated by this Ordinance except as exempted by Section 134-5 of this Ordinance:

A. Land development.
B. Subdivision.
C. Construction of new or reconstruction of, or addition of new impervious or semi-impervious surfaces (e.g. driveways, parking lots, roads, etc.), except for reconstruction of roads where there is no increase in impervious surface, and/or construction of new buildings or additions to existing buildings.
D. Redevelopment.
E. Diversion piping or encroachments in any natural or man-made stream channel.

F. Nonstructural and structural stormwater management Best Management Practices (BMPs) or appurtenances thereto.

G. Temporary storage of impervious or pervious material (rock, soil, etc.) where ground contact exceeds 5 percent of the lot area or 5,000 square feet (whichever is less), and where the material is placed on slopes exceeding 8 percent.

Section 134-5. Exemptions

A. Exemptions from any provision permitted by this section shall not relieve the applicant from all other requirements of this Ordinance.

B. General Exemptions**:** The following land use activities are exempt from stormwater management peak rate and plan requirements of this Ordinance. On all sites where a cumulative area of less than 1,000 square feet of impervious surface since May 8, 2003 is proposed, the applicant is exempt from stormwater management plan submission requirements of Section 134-11 of this Ordinance.

1. Use of land for gardening for home consumption.

2. Agricultural activity when operated in accordance with a conservation plan, nutrient management plan, or erosion and sedimentation control plan approved by the Bucks County Conservation District, including activities such as growing crops, rotating crops, tilling of soil, and grazing animals. Installation of new, or expansion of existing, farmsteads, animal housing, waste storage, ~~and~~ production areas, or other areas having impervious surfaces shall be subject to the provisions of this Ordinance unless exempt pursuant to Section 134-5.C.

3. Forest Management operations following the Department of Environmental Protection's management practices contained in its publication "Soil Erosion and Sedimentation Control Guidelines for Forestry" and operating under an E&S Plan approved by the Bucks County Conservation District and which have Zoning Permit approval from Hilltown Township.

4. Public road replacement, replacement paving, repaving and/or maintenance.

5. Any aspect of BMP maintenance to an existing SWM system made in accordance with plans and specifications approved by the Township.

C. All Regulated Activities as described in Section 134-4 of this Ordinance shall comply with the Stormwater Management requirements hereof except those activities listed in "Stormwater Management Exemption Criteria" table. Those activities listed in "Stormwater Management Exemption Criteria" table are, to the extent stated herein, exempt from Peak Rate Control provisions of Section 134-12 but are subject to compliance with Section 135-5.E and volume control requirements of Section 134-17 when located within the Neshaminy Creek Watershed. This requirement shall apply to the total development even if development is to take place in phases. The starting point from which to consider tracts as "parent tracts". is May 8, 2003. All impervious surface area constructed on or after May 8, 2003 shall be considered cumulatively. Impervious surface existing on the "parent tract" prior to May 8, 2003 shall not be considered in cumulative impervious area calculations for exemption purposes. An exemption shall not relieve the applicant from implementing such stormwater control measures and erosion control measures as are necessary to protect health, safety, and property.

Table 134-5.1 & Table 134-5.2 Stormwater Management Peak Rate Exemption Criteria

1. Regulated activities included within Section 134-4.C are exempt from Peak Rate Control requirements of Section 134-12 where the amount of impervious surface and proposed location on a parcel conforms to the following tables:

Table 134-5.1

Total Parcel Area (acres)		Maximum Impervious Surface Area (square feet)
<0.5		1,200
0.5 to 1.0		2,500
>1.0 to 2.0		4,000
>2.0 to 5.0		5,000
>5.0		7,500

Table 134-5.2

Maximum amount of the impervious surface area permitted pursuant to Table 1 within a setback (excluding driveway access) measured from the downslope property boundary shall conform to the following table:

Setback* (feet)		Maximum Impervious Surface Area (square feet) permitted within the setback.
10		None permitted
20		1,000
50		2,500
100		4,000
200		5,000
500		7,500

* The minimum setback distance is measured between the proposed impervious area (excluding driveway access) and/or stormwater control/structure discharge point to the downslope property boundary. The maximum allowable impervious surface area is the amount of impervious surface area permitted within the setback distance. For example: a total of 4,000 square feet of impervious surface is permitted within the 100 feet setback, of which none is permitted within the 10 feet setback, not more than 1,000 square feet is permitted within the 20 feet setback, and not more than 2,500 square feet is permitted within the 50 feet setback.

In lieu of meeting the minimum distance criteria, the applicant may provide documentation from a Design Professional that the increased flows from the site leaves the site in the same manner as the pre-development condition, and that there will be no adverse affects to properties along the path of flow(s). The Township may require the above referenced documentation on any site including a site meeting the minimum distance or parcel size criteria when deemed necessary at the sole discretion of the Township.

2. Construction or reconstruction of buildings or additions to existing buildings or other impervious surface (activities regulated pursuant to Section 134-4.C are exempt where the following conditions are met:

   a. An area of impervious surface is removed from the site equal to, or in excess of, the proposed impervious surface area.

   b. The area where existing impervious surface is removed pursuant to Item 3.a above must be restored with a minimum of twelve (12) inches of topsoil and stabilized pervious groundcover.

3. Lot line adjustment subdivisions are exempt when no increase in impervious surface is proposed.

D. Simplified Procedure for Single Family Dwellings

Individual home construction projects on existing single-family lots which result in less than two thousand five hundred (2,500) square feet of new impervious area (including the building footprint, driveway, sidewalks, swimming pools, patios, and parking areas) or less than five thousand (5,000) square feet of earth disturbance but do not meet exemption criteria of Section 134-5.C or are subject to the additional criteria of Sections 134-15, 134-16 or 134-17 may utilize the simplified procedure within Appendix I to meet requirements of the Ordinance and are not required to submit formal stormwater management plans to the Township. This procedure may <u>not</u> be utilized for proposed subdivision or land development.

E. Additional Exemption Criteria.

1. Exemption responsibilities - An exemption shall not relieve the applicant from implementing such measures as are necessary to protect the public health, safety, and property.

2. Drainage problems – Where drainage problems are documented or known to exist downstream of, or is expected from, the proposed activity, the Township may deny an exemption.

3. HQ and EV streams – An exemption shall not relieve the applicant from meeting the special requirements for watersheds draining to high quality (HQ) or exceptional value (EV) waters contained in Sections 134-15 and 134-16 of this Ordinance.

F. The municipality, upon request by the applicant, may grant an exemption from the provisions of this Ordinance for a project qualifying under Section 134-5.C. If an exemption is granted, the municipality shall require the developer to pay a fee in an amount established by separate Resolution of the Board of Supervisors to the Municipal Stormwater Management Capital Fund.

G. All applicants seeking an exemption of stormwater management peak rate requirements based upon criteria contained in Section 134-5.C shall, at a minimum, submit the following documentation for review:

1. Three (3) copies of the completed Township Stormwater Management Application form.

2. Stormwater Management Review Fee and Escrow, as established by separate resolution of the Board of Supervisors.

3. Three (3) copies of a plot plan for the parcel, which is the subject of the exemption application, containing, at a minimum, the following information:

    a. Property boundaries and area of the site, based on deed information, or field survey.

    b. Location map identifying the site relative to streets and other parcels in the vicinity of the site.

    c. Location of significant natural and existing manmade features, including wetlands, watercourses, woodlands, steep slopes, structures, parking areas, driveways, utilities, wells, and septic systems within 200 feet of proposed impervious surface, regardless of the location of the property boundary.

    d. Location and dimensions of existing and proposed impervious surface and other improvements, with setbacks drawn to relate the location of same to property lines, streets, and existing features.

    e. North Arrow.

    f. Plan scale, as applicable.

    g. Information regarding existing/proposed topography and drainage patterns, within two-hundred (200) feet of proposed impervious surface based on field survey, USGS mapping, and/or field observation.

    h. Other information deemed necessary by the Township Engineer to determine compliance with exemption criteria contained in Section 134-5.

Section 134-6. Repealer

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

Section 134-7. 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 134-8. Compatibility with Other Ordinance Requirements

Approvals issued pursuant to this ordinance do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance.

Section 134-9. Modifications

The Board of Supervisors may grant a modification of the requirements of one or more provisions of this Ordnance if the literal enforcement will exact undue hardship because of peculiar conditions pertaining to the land in question, provided that such modification will not be contrary to the public interest and that the purpose and intent of the Ordinance is observed.

ARTICLE II. DEFINITIONS

Section 134-10 Definitions

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

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

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

C. The 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".

Accelerated erosion. The removal of the surface of the land through the combined action of man's activity and the natural processes of a rate greater than would occur because of the natural process alone.

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

Alluvial soils (floodplain soils). Areas subject to periodic flooding as defined in the latest officially issued soil survey information by the U.S. Conservation and Natural Resources Service.

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 134-4 of this Ordinance.

As-Built Drawings. Those maintained by the contractor as he constructs the project and upon which he documents the actual locations of the building components and changes to the original contract documents. These, or a copy of the same, are turned over to the engineer at the completion of the project. **[Added by Ordinance 2006-3]**

Bankfull. The channel at the top of bank or point where water begins to overflow onto a floodplain. **[Added by Ordinance 2006-3]**

Base Flow. The portion of stream flow that is sustained by groundwater discharge. **[Added by Ordinance 2006-3]**

Biorentention. A stormwater retention area which utilizes woody and herbaceous plants and soils to remove pollutants before infiltration occurs. **[Added by Ordinance 2006-3]**

BMP (Best Management Practice). Activities, facilities, measures or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and groundwater recharge and to otherwise meet the purposes of this Ordinance. Stormwater BMPs are commonly grouped into one or two broad categories or measures: "structural" or "nonstructural". In this Ordinance, nonstructural BMPs or measures refer to operation and/or behavior-related practices that attempt to minimize the contact of pollutants with stormwater runoff whereas structural BMPs or measures are those that consist of a physical device or practice that is installed to capture and treat stormwater runoff. Structural BMPs include, but are not limited to, a wide variety of practices and devices, from large-scale retention ponds and constructed wetlands, to small-scale underground treatment systems, infiltration facilities, filter strips, low impact design, bioretention, wet ponds, permeable paving, grassed swales, riparian or forested buffers, sand filters, detention basins, and manufactured devices. Structural stormwater BMPs are permanent appurtenances to the project site.

BMP Manual Pennsylvania Best Management Practices Manual, December 2006, as amended.

Channel An open drainage feature through which stormwater flows. Channels include but shall not be limited to, natural and man-made watercourses, swales, streams, ditches, canals, and pipes that convey continuously or periodically flowing water.

Channel erosion. The widening, deepening, and headward cutting of channels and waterways, due to erosion caused by moderate to large floods.

Cistern. An underground reservoir or tank for storing rainwater.

Conservation District. Bucks County Conservation District.

County. Bucks County

Culvert. A pipe, conduit, or similar structure including appurtenant works which conveys surface water under or through an embankment or fill.

Curve Number (CN) Value used in the Soil Cover Complex Method. It is a measure of the percentage of precipitation which is expected to run off from the watershed and is a function of the soil, vegetative cover, and tillage method.

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.

DEP. The Pennsylvania Department of Environmental Protection. **[Added by Ordinance 2006-3]**

Department. The Pennsylvania Department of Environmental Protection. **[Added by Ordinance 2006-3]**

Design Professional (Qualified). A Pennsylvania Registered Professional Engineer, Registered Landscape Architect, or a Registered Professional Land Surveyor trained to develop stormwater management plans. **[Added by Ordinance 2006-3]**

Design storm. The magnitude and temporal distribution of precipitation from a storm event measured in probability of occurrence (e.g. 50-year storm) and duration (e.g. 24-hours), used in the design and evaluation of stormwater management systems.

Designee. The agent of Bucks County, Bucks County Conservation District and/or 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. Detention basins are designed to drain completely soon after a rainfall event.

Detention/Retention Basin Watershed All land area whose surface runoff is captured by a detention and/or retention basin.

Detention district. Those subareas in which some type of detention is required to meet the plan requirements and goals of Act 167.

Detention Volume The volume of runoff that is captured and released into the Waters of the Commonwealth at a controlled 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. Any man-made change to improved or unimproved real estate including, but not limited to, the construction or placement of buildings or other structures, mobile homes, streets and other paving, utilities, mining, dredging, filling, grading, excavation, or drilling operations, and the subdivision of land.

Development plan. The provisions for development including a planned residential development, a plat of subdivision, all covenants relating to use, location and bulk of buildings and other structures, intensity of use or density of development, streets, ways and parking facilities, common open space and public facilities. The phrase “provisions of development plan” when used in this Ordinance shall mean the written and graphic materials referred to in this definition.

Development site. The specific tract of land for which a regulated activity is proposed.

Diffused Drainage Discharge. Drainage discharge not confined to a single point location or channel, such as sheet flow or shallow concentrated flow. **[Added by Ordinance 2006-3]**

Discharge 1. (verb) To release water from a project, site, aquifer, drainage basin or other point of interest; 2. (noun) The rate and volume of flow of water such as in a stream, generally expressed in cubic feet per second (CFS).

Disconnected Impervious Area (DIA) An impervious surface that is disconnected from any stormwater drainage or conveyance system and is redirected or directed to a pervious area, which allows for infiltration, filtration, and increased time of concentration.

Disturbed Areas. Unstabilized land area where an earth disturbance activity is occurring or has occurred. **[Added by Ordinance 2006-3]**

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 toward it.

Downstream hydraulic capacity analysis. Any downstream capacity hydraulic analysis conducted in accordance with this ordinance 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 increased rate of 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 increased 25-year return period rate of 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 DEP, Chapter 105 regulations (if applicable) and, at a minimum, pass the increased 25-year return period rate of runoff.

4. No new channels or conveyance facilities shall be authorized by this language.

Drainage conveyance facility. A stormwater management facility designed to transmit stormwater runoff which 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 after the SWM Plan has been approved.
Earth Disturbance. A construction or other human activity which disturbs the surface of land, including, but not limited to, clearing and grubbing, grading, excavations, embankments, land development, agricultural plowing or tilling, timber harvesting activities, road maintenance activities, mineral extraction, and the moving, depositing, stockpiling or storing of soil, rock or earth materials. **[Amended by Ordinance 2006-3]**

Emergency Spillway. A conveyance area that is used to pass peak discharge greater than the maximum design storm controlled by the stormwater facility. **[Added by Ordinance 2006-3]**

Encroachment A structure or activity that changes, expands or diminishes the course, current or cross section of a watercourse, floodway or body of water.

Engineer. A licensed professional civil engineer registered by the Commonwealth of Pennsylvania.

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 which is designed to minimize accelerated erosion and sedimentation.

Exceptional Value Waters. Surface waters of high quality which satisfy Pennsylvania Code Title 25 Environmental Protection, Chapter 93 Water Quality Standards, §93.4b(b) (relating to antidegredation). **[Added by Ordinance 2006-3]**

Existing conditions. The initial condition of a project site prior to the proposed construction. Farm field, disturbed earth, or undeveloped cover conditions of a site or portions of a site used for modeling purposes, shall be considered "meadow" unless the natural groundcover generates lower curve numbers or Rational "C" value, such as forested land. Existing man-made impervious surfaces shall be considered as "meadow" when developing "cover complex" calculations.

Existing Resources and Site Analysis Map A base map which identifies fundamental environmental site information including floodplains, wetlands, topography, vegetative site features, natural areas, prime agricultural land and areas supportive of endangered species.

Existing Recharge Area Undisturbed surface area or depression where stormwater collects and a portion of which infiltrates and replenishes the groundwater.

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. Those areas of Hilltown Township which are subject to the one hundred year flood, as identified in the Flood Insurance Study (FIS) dated May 18, 1999, and the accompanying maps prepared for the Township by the Federal Emergency Management Agency (FEMA), or most recent revision thereof; and also those areas along streams, ponds, or lakes not identified within the Flood Insurance Study which are inundated by the 100 year reoccurrence internal flood.

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 feet from the top of the bank of the stream.

Forest Management/Timber Operations. Planning and activities necessary for the management of forest land. 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.

Grade 1. (noun) A slope usually of a street, other public way, land area, drainage facility or pipe specified in percent; 2. (verb) To finish the surface of a road bed, top of embankment or bottom of excavation.

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

Groundwater Water beneath the earth's surface that supplies wells and springs, and is often between saturated soil and rock.

Groundwater recharge. Replenishment of natural underground water supplies.

HEC-HMS. The US Army Corps of Engineers, Hydrologic Engineering Center (HEC) – Hydrologic Modeling System (HMS). **[Added by Ordinance 2006-3]**

High Quality Waters. Surface waters having quality which exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water by satisfying Pennsylvania Code Title 25 Environmental Protection, Chapter 93, Water Quality Standards, §93.4b(a). **[Added by Ordinance 2006-3]**

Hot spot – An area where land use or activity generates highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater. Typical pollutant loadings in stormwater may be found in Chapter 8 Section 6 of the *Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)*. More information concerning hot spots may be found in Appendix G of this Ordinance.

Hydric Soils. A soil that is saturated, flooded, or ponded long enough during the growing season to develop an aerobic condition in the upper part. [**Added by Ordinance 2006-3]**

Hydrologic Regime (Natural). The hydrologic cycle or balance that sustains quality and quantity of stormwater, baseflow, storage, and groundwater supplies under the natural conditions. **[Added by Ordinance 2006-3]**

Hydrologic Soil Group. A classification of soils by the Natural Resources Conservation Service, formerly the Soil Conservation Service, into four runoff potential groups. The groups range from A soils, which are very permeable and produce little runoff, to D soils, which are not very permeable and produce much more runoff. **[Added by Ordinance 2006-3]**

Hyetograph. A graphical representation of average rainfall, rainfall excess rates, or volumes over specified areas during successive units of time during a storm. **[Added by Ordinance 2006-3]**

Impervious surface. Impervious surfaces are those surfaces which prevent the infiltration of water into the ground. All buildings, parking areas, driveways, roads, sidewalks, swimming pools, and any areas containing concrete, asphalt, packed stone, compacted soils, or other equivalent surfaces shall be considered impervious within this definition. In addition, other

areas determined by the Township Engineer to be impervious within the meaning of this definition shall be classified as impervious surfaces.

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

Infill. Development that occurs on smaller parcels that remain undeveloped but are within or very close proximity to urban areas. The development relies on existing infrastructure and does not require an extension of water, sewer or other public utilities. **[Added by Ordinance 2006-3]**

Infiltration Movement of surface water into the soil, where it is absorbed by plant roots, evaporated into the atmosphere or percolated downward to recharge groundwater.

Infiltration structures. A structure designed to direct runoff into the ground (e.g. french drains, seepage pits, seepage trench, biofiltration swale).

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.

Invert The inside bottom of a culvert or other conduit.

Land development - Any of the following activities:

1. The improvement of one (1) or two (2) or more contiguous lots, tracts or parcels of land for any purpose involving:
   - A. A group of two (2) or more residential or nonresidential buildings, whether purposed initially or cumulatively, or a single nonresidential building on a lot or lots regardless of the number of occupants or tenure; or
   - B. The division or allocation of land or space, whether initially or cumulatively, 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.
2. A subdivision of land.
3. "Land development" does not include development which involves:
   - A. The conversion of an existing single family detached dwelling or single family semi-detached dwelling into not more than three (3) residential units, unless such units are intended to be a condominium;
   - B. The addition of a residential accessory building, including farm building, not greater than 600 square feet in area on a lot or lots subordinate to an existing principal building; or
   - C. The addition or conversion of buildings or rides within the confines of an enterprise which would be considered an amusement park. For the purposes of this subsection, an amusement park is defined as a tract or area used principally as a location for permanent amusement structures or rides. This exclusion shall not apply to newly acquired acreage by an amusement park until initial plans for the expanded area have been approved by the proper authorities.

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.

Limiting Zone. A soil horizon or condition in the soil profile or underlying strata which includes one of the following:

(i) A seasonal high water table, whether perched or regional, determined by direct observation of the water table or indicated by soil mottling.

(ii) A rock with open joints, fracture or solution channels, or masses of loose rock fragments, including gravel, with insufficient fine soil to fill the voids between the fragments.

(iii) A rock formation, other stratum or soil condition which is so slowly permeable that is effectively limits downward passage of effluent.

[Added by Ordinance 2006-3]

Low Impact Development (LID) Practices Practices that will minimize proposed conditions runoff rates and volumes, which will minimize the need for artificial conveyance and storage facilities.

Main Stem (Main channel). Any stream segment or other runoff conveyance facility used as a reach in the watershed hydrologic model.

Manning Equation (Manning formula). A method for calculation of velocity of flow (e.g., feet per second) and flow rate (e.g., cubic feet per second) in open channels based upon channel shape, roughness, depth of flow and slope. "Open channels" may include closed conduits so long as the flow is not under pressure.

Municipal Engineer. A professional engineer licensed as such in the Commonwealth of Pennsylvania and appointed by the Township pursuant to Article V of the Second Class Township Code.

Municipality. Hilltown Township, Bucks County, Pennsylvania.

Nonpoint source pollution. Pollution that enters a watery body from diffuse origins in the watershed and does not result from discernible, confined, or discrete conveyances.

Nonstormwater Discharges - Water flowing in stormwater collection facilities, such as pipes or swales, which is not the result of a rainfall event or snowmelt.

NPDES National Pollution Discharge Elimination System, the federal government's system for issuance of permits under the Clean Water Act, which is delegated to PADEP in Pennsylvania.

NRCS. Natural Resource Conservation Service (previously SCS).

Open channel. A drainage element in which stormwater flows with an open surface. Open channels include, but shall not be limited to, natural and man-made drainageways, swales, streams, ditches, canals, and pipes flowing partly full.

Outfall "Point source" as described in 40 CFR § 122.2 at the point where the municipality's storm sewer system discharges to surface Waters of the Commonwealth.

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

Parent Tract. The parcel of land from which a land development or subdivision originates as of the date of adoption of the original Stormwater Management Ordinance on May 22, 2000 (Ordinance No. 2000-5). **[Added by Ordinance 2006-3]**

Parking lot storage. Involves the use of impervious parking areas as temporary impoundments with controlled release rates during rainstorms.

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

Penn State runoff model (calibrated). The computer-based hydrologic modeling technique adapted to the watershed for the Act 167 Plan. The model has been "calibrated" to reflect actual recorded flow values by adjoining key model input parameters.

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

Planning Commission. The Planning Commission of Hilltown Township.

PMF (Probable Maximum Flood). The flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in any area. The PMF is derived from the probable maximum precipitation (PMP) as determined on the basis of data obtained from the National Oceanographic and Atmospheric Administration (NOAA).

Point Source Any discernible, confined and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, or conduit from which stormwater is or may be discharged, as defined in State regulations at 25 Pa. Code § 92.1.

Post Construction Period after construction during which disturbed areas are stabilized, stormwater controls are in place and functioning, and all improvements in the approved SWM plan are completed.

Pretreatment Techniques employed in stormwater BMPs to provide storage or filtering to help trap coarse materials and other pollutants before they enter the system. **[Added by Ordinance 2006-3]**

Rational Method A rainfall-runoff relation used to estimate peak flow.

Recharge Area Undisturbed surface area or depression where stormwater collects, and a portion of which infiltrates and replenishes the underground and groundwater. **[Added by Ordinance 2006-3]**

Recharge volume A calculated volume of stormwater runoff from impervious areas which is required to be infiltrated at a site and may be achieved through use of structural or non-structural BMPs.

Regulated activities Any activity to which this Ordinance is applicable pursuant to Section 134-4 of this Ordinance.

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

Release rate The percentage of predevelopment peak rate of runoff from a site or subarea to which the post development peak rate of runoff must be reduced to protect downstream areas.

Retention basin A basin designed to retain stormwater runoff so that a permanent pool is established.

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

Return period The average interval, in years, within which a storm event of a given magnitude can be expected to recur. For example, the 25-year return period rainfall would be expected to recur on the average once every 25 years.

Riparian Corridor A vegetated ecosystem along a waterbody that serves to buffer the waterbody from the effects of runoff by providing water quality filtering, bank stability, recharge, rate attenuation and volume reduction, and shading of the waterbody by vegetation. Riparian corridors also provide habitat and may include streambanks, wetlands, floodplains, and transitional areas.

Riser A vertical pipe extending from the bottom of a pond that is used to control the discharge rate from the pond for a specified design storm.

Road Maintenance Earth disturbance activities within the existing road cross-section, such as grading and repairing existing unpaved road surfaces, cutting road banks, cleaning or clearing drainage ditches and other similar activities.

Roof Drains A drainage conduit or pipe that collects water runoff from a roof and leads it away from a structure.

Rooftop detention Temporary ponding and gradual release of stormwater falling directly onto flat roof surfaces by incorporating controlled-flow roof drains into building designs.

Runoff Any Ordinance of precipitation that flows over the land surface.

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

Sediment pollution The placement, discharge or any other introduction of sediment into the waters of the commonwealth occurring from the failure to design, construct, implement or maintain control measures and control facilities in accordance with the requirements of this ordinance.

Sedimentation The process by which mineral or organic matter is accumulated or deposited by the movement of water.

Seepage pit/seepage trench An area of excavated earth filled with loose stone or similar coarse material, into which surface water is directed for infiltration into the underground water (refer PA BMP Manual, December 2006, Chapter 6, Section 4).

Separate Storm Sewer System A system of pipes, open channels, streets, and other conveyances intended to carry stormwater runoff.

Shallow Concentrated Flow Stormwater runoff flowing in shallow, defined ruts prior to entering a defined channel or waterway.

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

Soil-cover complex method A method of runoff computation developed by the NRCS that is based on relating soil type and land use/cover to a runoff parameter called a Curve Number (CN).

Source Water Protection Areas (SWPA) The zone through which contaminants, if present, are likely to migrate and reach a drinking water well or surface water intake.

Special Protection Subwatersheds Watersheds that have been designated in Pennsylvania Code Title 25 Environmental Protection, Chapter 93 Water Quality Standards as exceptional value (EV) or high quality (HQ) waters.

Soil group, hydrologic A classification of soils by the NRCS into four runoff potential groups. The groups range from A soils, which are very permeable and produce little runoff, to D soils, which are not very permeable and produce much more runoff.

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

Storage indication method A reservoir routing procedure based on solution of the continuity equation (inflow minus outflow equals the change in storage) with outflow defined as a function of storage volume and depth.

Storm frequency The number of times that a given storm event occurs or is exceeded on the average in a stated period of years. See "Return Period."

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 The surface runoff generated by precipitation reaching the ground surface.

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 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.

Stormwater management plan The plan for managing stormwater runoff within the Township adopted as required by the Act of October 4, 1978, P.L. 864, (Act 167).

Stormwater management (SWM) site plan The plan prepared by the Developer or his engineer indicating how stormwater runoff will be managed at the particular site of interest according to this Ordinance.

Stream Rivers, creeks, springs, and other perennial or intermittent watercourses containing water at least on a seasonal basis during an average water year. The term "stream" shall include all "Intermittent Streams" and all "Perennial Streams".

1. Springs or Seeps – The point where groundwater discharges to become surface water.
2. Stream, Ephemeral – A reach of stream that flows only during and for short periods following precipitation, and flows in low areas that may or may not be a well defined channel. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Some commonly used names for ephemeral streams include: stormwater channel, drain, swale, gully, dry stream channel, hollow, or saddle.
3. Stream, Headwater – The beginning reach of a stream, which collects water from springs and seeps and provides a hydrologic connection to a perennial stream. These channels may be ill defined and may move from year to year depending upon groundwater input, snowmelt, and runoff, but are typified by hydric soils and hydric vegetation.
4. Stream, Intermittent – A reach of stream that flows only during wet periods of the year and flows in a continuous well-defined channel. During dry periods, when the water table is depressed by seasonal aridity or drought, intermittent streams may go down to a trickle of water and appear dry, when in fact there is water flowing within the stream bottom or "substrate".
5. Stream, Perennial or Watercourse, Perennial – A body of water in a channel that flows throughout a majority of the year in a defined channel and is capable, in the absence of pollution, drought, or manmade stream disturbances, of supporting a benthic macroinvertebrate community that is composed of two or more recognizable taxonomic groups of organisms, large enough to be seen by the unaided eye and can be retained by a U.S. Standard No. 30 sieve (28 meshs per inch, 0.595 mm openings) and live at least part of their life cycles within or upon available substrates in a body of water or water transport system. A perennial stream can have $Q_{7\text{-}10}$ flow of zero. For the purposes of this document, a perennial stream includes lakes and ponds.

Stream Buffer The land area adjacent to each side of a stream, essential to maintaining water quality.

Streambank Erosion The widening, deeping or headward cutting of channels and waterways caused by stormwater runoff or bankfull flows.

Stream enclosure A bridge, culvert or other structure in excess of 100 feet in length upstream to downstream which encloses a regulated water of this commonwealth.

Subarea (Subwatershed) The smallest drainage unit of a watershed for which stormwater management criteria have been established in the stormwater management plan.

Subdivision The division or redivision of a lot, tract, or parcel of land by any means into two or more lots, tracts, parcels or other divisions of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, transfer of ownership, or building or lot development, provided, however, that the subdivision by lease of land for agricultural purposes into parcels of more than ten acres, not involving any new street or easement of access or any residential dwellings, shall be exempt.

Swale A low-lying stretch of land which gathers or carries surface water runoff.

Timber operations See Forest Management.

Time of concentration (Tc) The time for surface runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. This time is the combined total of overland flow time and flow time in pipes or channels, if any.

Top of Bank Highest point of elevation in a stream channel cross section at which a rising water level just begins to flow out of the channel and over the floodplain.

Tributary Area – The portion of a watershed that contributes runoff to a particular point in that watershed.

Vernal Pool Seasonal depressional wetlands that are covered by shallow water for variable period from winter to spring, but may be completely dry for most of the summer and fall.

Volumetric Runoff Coefficient A variable indicative of stormwater runoff volume and dependent on the impervious coverage for a site.

Water Quality Volume A calculated volume of stormwater runoff from impervious areas which is required to be captured and treated at a site and may be achieved through use of structural or non-structural BMPs. Numerically, the water quality volume is a product of the volumetric runoff coefficient, the site area, and a depth of rainfall of 1”.

Watercourse An intermittent or perennial stream of water, river, brook, creek, or swale identified on USGS or SCS mapping; and/or delineated Waters of the Commonwealth.

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.

Waters of the United States (or Waters of the US)

a. All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

b. All interstate waters, including interstate “wetlands”;

c. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, “wetlands”, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters: (1) Which are or could be used by interstate or foreign travelers for recreational or other purposes; (2) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or (3) Which are used or could be used for industrial purposes by industries in interstate commerce;

d. All impoundments of waters otherwise defined as waters of the United States under this definition;

e. Tributaries of waters identified in paragraphs a through d of this definition;

f. The territorial sea; and

g. “Wetlands” adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs a through f of this definition.

Wet Basin – Pond for runoff management that is designed to detain runoff and always contains water.

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.

Wetland Delineation The process by which wetland limits are determined. Wetlands must be delineated by a qualified specialist according to the 1989 Federal Manuals (as amended) for the Delineation of Jurisdictional Wetlands (whichever is greater) or according to any subsequent Federal or State regulation. Qualified specialist shall include those persons being Certified Professional Soil Scientists as registered with Registry of Certified Professionals in Agronomy Crops and Soils (ARCPACS); or as contained on consultant’s list of Pennsylvania Association of Professional Soil Scientists (PAPSS); or as registered with National Society of Consulting Soil Scientists (NSCSS), or as certified by State and/or Federal certification programs; or by a qualified Biologist/Ecologist.

ARTICLE III. STORMWATER MANAGEMENT

Section 134-11. General Requirements

A. All applicants proposing Regulated Activities in the municipality which do not fall under the exemption criteria shown in Section 134-5.C of this Ordinance shall submit a stormwater management plan consistent with this Ordinance to the municipality for review. These criteria shall apply to the total proposed development even if development is to take place in stages. Impervious surface shall include, but not be limited to, any roof, parking or driveway areas and any new streets and sidewalks. Any areas designed to be gravel or crushed stone shall be assumed to be impervious unless designed as a BMP (e.g. pervious paver blocks, reinforced turf, gravel filled grids, etc.). (Refer definition of Impervious Surface within Section 134-10 of this Ordinance).

B. All Regulated Activities shall include such measures as necessary to:

1. Protect health, safety, and property;

2. Meet the water quality goals of this Ordinance by implementing measures to:

   a. Minimize disturbance to floodplains, wetlands, and wooded areas.

   b. Create, maintain, repair or extend riparian buffers.

   c. Avoid erosive flow conditions in natural flow pathways.

   d. Minimize thermal impacts to waters of this Commonwealth.

   e. Disconnect impervious surfaces (i.e. Disconnected Impervious Areas, DIAs) by directing runoff to pervious areas, wherever possible.

3. To the maximum extent practicable, incorporate the techniques for Low Impact Development Practices (e.g. protecting existing trees, reducing area of impervious surface, cluster development, and protecting open space) described in the *Pennsylvania Stormwater Best Management Practices Manual,* Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006).

C. The Township may, after consultation with the Department of Environmental Protection (PADEP), approve measures for meeting the state water quality requirements other than those in this Ordinance, provided that they meet the minimum requirements of, and do not conflict with, state law including, but not limited to, the Clean Streams Law.

D. For all regulated earth disturbance activities, Erosion and Sediment (E&S) Control Best Management Practices (BMPs) shall be designed, implemented, operated, and maintained during the Regulated Earth Disturbance Activities (e.g., during construction) to meet the purposes and requirements of this Ordinance and to meet all requirements under Title 25 of the Pennsylvania Code and the Clean Streams Law. Various BMPs and their design standards are listed in the *Erosion and Sediment Pollution Control Program Manual*, No. 363-2134-008 (April 15, 2000), as amended and updated.

E. No approval of any subdivision or land development plan, or issuance of any building**,** zoning, Erosion and Sedimentation Control and Grading Permit**,** occupancy permit, or the

commencement of any earth disturbance at a project site within the Township, shall proceed until the requirements of this Ordinance are met, including approval of a Stormwater Management Plan under Section 134-24 and a permit under PADEP regulations, where applicable.

F. Erosion and sediment control during land development shall be addressed as required by Section 134-21.

G. Volume controls shall be addressed within the Neshaminy Creek Watershed as required by Section 134-17.

H. Water quality protection and infiltration shall be addressed as required by Sections 134-15 and 134-16.

I. All Best Management Practices (BMPs) shall conform to the design criteria of this Ordinance and Pennsylvania Stormwater Management Practices Manual, December 30, 2006.

J. Techniques described in Appendix D (Low Impact Development Techniques) of this Ordinance are encouraged because they reduce the costs of complying with the requirements of this Ordinance and the State Water Quality requirements.

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

L. Stormwater drainage systems shall be provided in order to permit unimpeded flow along natural watercourses, except as modified by stormwater management facilities designed to encourage infiltration, groundwater recharge, and improved water quality.

M. Existing points of concentrated drainage that discharge onto adjacent property shall not be altered without written approval of the affected property owner(s) and shall be subject to any applicable discharge criteria specified in this ordinance.

N. Areas of existing sheet flow discharge shall be maintained wherever possible. If sheet 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; and submit written approval from the affected adjacent property owner(s).

O. For all subdivision and land development applications, the tributary area discharging drainage to any location along the site property boundary shall not increase by more than twenty-five percent (25%) over the predevelopment condition without written approval from the adjacent affected property owner(s). **[Added by Ordinance 2006-3]**

P. Where a development site is traversed by watercourses, drainage easements shall be provided conforming to the line of such watercourses. The width of the easement shall be adequate to provide for the unimpeded flow of stormwater runoff from the 100 year storm event. 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. Periodic maintenance of the easement shall be required by the landowner to ensure proper runoff conveyance.

Q. When it can be shown that, due to topographic conditions, natural drainageways on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the line and grade of such natural drainageways. Work within natural drainageways 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.

R. Any stormwater management facilities regulated by this Ordinance that will 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.

S. Any stormwater management facilities regulated by this Ordinance that would be located on state highway rights-of-way, or discharge stormwater to facilities located within a state highway right-of-way, shall be subject to approval by the Pennsylvania Department of Transportation (PADOT).

T. Site disturbance and impervious surface shall be minimized. Infiltrating stormwater runoff through seepage beds, infiltration trenches, etc. shall be required, where soil conditions permit, to reduce the size or eliminate the need for retention/detention facilities.

U. Roof drains and sump pumps shall discharge to an infiltration bed, natural watercourse, storm sewer system, drainage swale, or stormwater easement. Roof drains and sump pumps shall not be connected to a storm sewer or street drainage structure unless designed as Ordinance of a stormwater management facility. In no case shall roof drains or sump pumps be connected to a sanitary sewer or permitted to discharge across a sidewalk, walkway, or to a street through the curb.

V. All storm sewer inlets must be identified with a storm drain marker. Storm drain markers shall be stainless steel affixed to the inlet hood with adhesive, rivets, or bolts. (Marker may be bolted to the grate in off road locations). Marker shall have a minimum diameter of 3 ½ inches and include "No Dumping - Drains to Waterway" and a fish symbol. Alternate designs/sizes may be used if approved by the Township. **[Added by Ordinance 2006-4]**

W. Whenever a watercourse is located within a development site, it shall remain open in the natural state and location and shall not be piped, impeded, or altered (except for road crossings). It is the responsibility of the developer to stabilize existing eroded stream/channel banks.

X. Special requirements for watersheds draining to high quality (HQ) and exceptional value (EV) waters: The temperature and quality of water and streams that have been declared as exceptional value and high quality are to be maintained as defined in Chapter 93, Water Quality Standards, Title 25 Pennsylvania Department of Environmental Protection Rules and Regulations. Temperature sensitive BMPs and stormwater conveyance systems are to be used and designed with storage pool areas and supply outflow

channels, and shaded with trees. This will require modification of berms for permanent ponds and the relaxation of restrictions on planting vegetation within the facilities, provided that capacity for volumes and rate control is maintained. At a minimum, the southern half on pond shorelines shall be planted with shade or canopy trees within 10 feet of the pond shoreline. In conjunction with this requirement, the maximum slope allowed on the berm area to be planted is 10 to 1. This will lessen the destabilization of berm soils due to root growth. A long-term maintenance schedule and management plan for the thermal control BMPs is to be established and recorded for all development sites. **[Added by Ordinance 2006-3]**

Y. All stormwater runoff shall be pretreated for water quality prior to discharge to surface or groundwater as required by Section 134-15 of this Ordinance. **[Added by Ordinance 2006-3]**

Section 134-12. Stormwater Management Districts – Peak Rate Control

A. Mapping of Stormwater Runoff Peak Rate Districts - In order to implement the provisions of this Ordinance, the Neshaminy Creek Watershed Stormwater Management Plan, Tohickon Creek Watershed Stormwater Management Plan, and East Branch Perkiomen Creek Watershed Stormwater Management Plan**,** Hilltown Township is hereby divided into Stormwater Runoff Peak Rate Districts consistent with the plan. The boundaries of the districts are indicated on the runoff peak rate district map that is available for inspection at the municipal building. A large-scale boundary map is included as Appendix F for reference.

B. The exact location of the Stormwater Runoff Peak Rate District boundary as it applies to a given development site shall be determined by mapping the boundaries using the 2-feet or 5-feet topographic contours provided as Ordinance of the stormwater management plan developed for the site in accordance with the Subdivision and Land Development Ordinance. The District boundaries as originally drawn coincide with topographic divides or, in certain instances, are drawn from the intersection of the watercourse or a potential flow obstruction to the topographic divide consistent with topography. The locations determined on the stormwater management plan shall be reviewed and verified by the municipal engineer.

C. Description of Tohickon Creek Watershed Stormwater Runoff Hydrologic Peak Rate Districts

1. Conditional No Detention Districts (Direct Discharge). Subareas identified on the official Sub-Basin Map available for inspection at the Township Office. Included in this district are 2, 3, 8-10, 18, 20, 21, 42, 43, 52, 54, 56, 57, 59, 61, 62, 67, 70-73, 76, 77, 81-83. These sub-areas may discharge post-development runoff without detention facilities without adversely affecting the total watershed peak flow. These areas are located adjacent to the Delaware River. Where the conveyance capabilities of the local receiving facilities are not adequate to safely transport the increased peak flows from undetained runoff a 100% release rate control is applied.

2. 100 Percent Release Rate District. Subareas included in this district are 4-7, 1-17, 19, 22-28, 31-34, 41, 44-51, 53, 55, 58, 60, 63, 64, 66, 68, 69, 74, 75, 84-98, 101, 109, 111 - 114, 116, 118, 119, 121-126. These subareas are not expected to incur a great deal of development growth due to location, topography, soils, or a combination of all three factors. Also, the location in the watershed of these sub-areas is of minor

importance in supporting the overall watershed level runoff control. Therefore, these areas are allowed to release development runoff at a rate that does not exceed the existing rates of runoff.

3. 90 Percent Release Rate District. Subareas included in this district are 30, 35-40, 226. These areas are located in developing areas that have adequate drainage capacity in the receiving waterways. A slight amount of reduction is necessary to preserve this integrity of the receiving waterways and increase water quality of the receiving waterways, at the request of the local municipality.

4. 75 Percent Release Rate District. Subareas included in this district are 78-80, 99, 100, 102-108, 110, 115, 117, 120. Certain subareas require the control of stormwater runoff to a portion of the existing runoff equal to 75 percent. These areas are located in upper reaches of the watershed, specifically, areas around Quakertown Borough and Richlandtown Township which are projected to incur significant development impacts and have existing inadequate storm conveyance facilities. Some of these areas are expected to incur a relatively major increase in development pressure, while some areas may not see much development at all. In order to assure uniform watershed-level runoff control; however, the assignment of this release rate on a widespread basis will uniformly restrict the future runoff in a fashion that favors no particular sub-watershed.

D. For the purpose of implementing the provisions of the Neshaminy Creek Watershed Stormwater Management Plan, District "A", and East Branch Perkiomen Creek-Watershed Stormwater Management Plan, Management District "B", design storm proposed conditions shall be controlled to design storm existing conditions as follows:

Design Storm Proposed Conditions	**to**	**Design Storm Existing Conditions**
2-year		1-year
5-year		5-year
10-year		10-year
25-year		25-year
50-year		50-year
100-year		100-year

Section 134-13. Stormwater Management District Implementation Provisions (Performance Standards)

A. General - Proposed conditions peak rates of runoff from any regulated activity shall meet the peak release rates of runoff prior to development for the design storms specified on the Stormwater Management District Watershed Map (Ordinance Appendix E) and Section 134-12, of the Ordinance. **[Amended by Ordinance 2006-3]**

B. District Boundaries - The boundaries of the Stormwater Management Districts are shown on an official map, which is available for inspection at the municipal office. A copy of the official map at a reduced scale is included in the Appendix F of this Ordinance. The exact location of Stormwater Management District boundaries as they apply to a given development site shall be determined by mapping the boundaries using topographic contours at an appropriate level of detail, but in no case less than 2 feet intervals (or 5 feet intervals as applicable). This information shall be provided as Ordinance of the Stormwater Management Plan.

C. Sites Located in More Than One District - For a proposed development site located within two or more release category subareas, the peak discharge rate from any subarea shall be the pre-development peak discharge for that subarea multiplied by the applicable release rate. The calculated peak discharges shall apply regardless of whether the grading plan changes the drainage area by subarea.

D. Off-Site Areas - Off-site areas that drain through a proposed development site are not subject to release rate criteria when determining allowable peak runoff rates or volume reduction. However, on-site drainage facilities shall be designed to safely convey off-site flows through the development site.

E. Site Areas - Where the site area to be impacted by a proposed development activity differs significantly from the total site area as determined by the municipality, the municipality may, but is not required to, permit only the proposed impact area to be subject to the release rate criteria.

F. Stormwater Conveyance Corridor Protection (Riparian Corridor Preservation and Vegetation) – Runoff from developed areas of the site, including but not limited to areas of impervious surface, shall be managed through a series of riparian corridor vegetation facilities whenever possible. This will be accomplished in a manner satisfactory to the municipality, utilizing the “Pennsylvania Handbook of Best Management Practices for Developing Areas”, 1998, Riparian Forested Buffer, and the priority goal of the riparian vegetation will be the reduction of thermal impacts on stormwater runoff associated with impervious areas, with a secondary goal being the protection of capacity of existing stormwater conveyance channels. These goals will be achieved through the use of design criteria in Section 134-19.P of this Ordinance, and shall be in addition to any other municipal ordinance provisions.

G. Regional Detention Alternatives – For certain areas within the study area, it may be more cost-effective to provide one control facility for more than one development site than to provide an individual control facility for each development site. The initiative and funding for any regional runoff control alternatives are the responsibility of prospective developers. The design of any regional control basins must incorporate reasonable development of the entire upstream watershed. The peak outflow of a regional basin would be determined on a case-by-case basis using the hydrologic model of the watershed consistent with protection of the downstream watershed areas. “Hydrologic model” refers to the calibrated model as developed for the stormwater management plan.

H. "Downstream Hydraulic Capacity Analysis"-Any downstream capacity hydraulic analysis conducted in accordance with this ordinance 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 increased 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 increased 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 DEP, Chapter 105 regulations (if applicable) and, at a minimum, pass the increased 25-year return period runoff.

Section 134-14. Nonstructural Project Design (Sequencing to Minimize Stormwater Impacts)

A. For design and applicability of non-structural BMPs refer to Chapter 5 of the "Pennsylvania Stormwater Management Practices Manual", December 2006, as amended. For the non-structural BMPs proposed, the applicant shall utilize and submit appropriate checklists included in Chapter 8, Section 8.8 of the "Pennsylvania Stormwater Best Management Practices Manual", December 2006, as amended (refer Appendix E) to demonstrate that the BMPs are applicable to the project and to determine the amount of volume or peak rate credit is applicable.

B. The applicant shall demonstrate that regulated activities are designed in the following sequence to minimize the increases in stormwater runoff and impacts to water quality:

1. Prepare an Existing Resource and Site Analysis Map (ERSAM), showing environmentally sensitive areas including, but not limited to, steep slopes, ponds, lakes, streams, wetlands, hydric soils, vernal pools, floodplains, stream buffer zones, hydrologic soil groups A, B, C, and D, any existing recharge areas and any other requirements outlined in the Subdivision and Land Development Ordinance.

2. Prepare a draft project layout avoiding sensitive areas identified in Section 134-14.B.1 and minimizing total site earth disturbance as much as possible. The ratio of disturbed area to the entire site area and measures taken to minimize earth disturbance shall be included in the ERSAM.

3. Identify site specific existing conditions drainage areas, discharge points, recharge areas, and hydrologic soil groups A and B.

4. Evaluate Nonstructural Stormwater Management Alternatives (Refer Appendix E).

    a. Minimize earth disturbance.

    b. Minimize impervious surfaces.

    c. Break up large impervious surfaces.

5. Satisfy water quality objective (Section 134-15).

6. Satisfy groundwater recharge (infiltration) objective (Section 134-16) and provide for stormwater treatment prior to infiltration.

7. Satisfy stream bank erosion protection objective (Section 134-18).

8. Determine the Watershed Management District within which the site is located (Appendix F) and conduct a predevelopment runoff analysis.

9. Prepare final project design to maintain predevelopment drainage areas and discharge points, to minimize earth disturbance and impervious surfaces, to reduce runoff to the maximum extent possible, and to minimize the use of surface or point discharges.

10. Conduct a proposed conditions runoff analysis based on the final design and to meet the release rate and in turn the overbank flow and extreme event requirements.

11. Manage any remaining runoff through treatment prior to discharge, as Ordinance of detention, biorentention, direct discharge or other structural control.

12. Prepare a stormwater management operation and maintenance plan consistent with requirements of Section 134-39 that ensures the long term viability of the stormwater control facilities.

[Added by Ordinance 2006-3]

Section 134-15. Water Quality Requirements (East Branch Perkiomen Creek and Tohickon Creek Watersheds)

A. In addition to the performance standards and design criteria requirements of this Ordinance, adequate storage and treatment facilities must be provided to capture and treat stormwater runoff from developed or disturbed areas. The Recharge Volume computed under Section 134-16 may be a component of the Water Quality Volume if the applicant chooses to manage both components in a single facility. If the Recharge Volume is less than the Water Quality Volume, the remaining Water Quality Volume may be captured and treated by methods other than recharge/infiltration BMPs. The required Water Quality Volume (WQv) is the storage capacity needed to capture and to treat a portion of stormwater runoff from the developed areas of the site produced from 90 percent of the average annual rainfall (P).

The following calculation formula is to be used to determine the water quality storage volume, (WQv), in acre-feet of storage:

$$WQv = [(P)(Rv)(A)]/12 \text{ (inches/foot)} \quad \text{Equation: 134-15.1}$$

WQv = Water Quality Volume (acre-feet).

P = Rainfall Amount equal to 90% of events producing this rainfall (in) – the volume of rainfall for 90% of the storm events which produce runoff in the watershed annually. P = 3.26 inches (Refer Appendix A, Table A-1).

A = Area of the project contributing to the water quality BMP (acres).

Rv = Volume Runoff Coefficient 0.05 + 0.009(I) where I is the percent of the area that is impervious surface (impervious area ÷ total project area) x 100%

B. Design of BMPs used for water quality control shall be in accordance with design specifications outlined in the Pennsylvania Handbook of Best Management Practices for Developing Areas or other applicable manuals. The following factors must be considered

when evaluating the suitability of BMPs used to control water quality at a given development site:

1. Total contributing drainage area.
2. Permeability and infiltration rate of the site soils.
3. Topographic slope and depth to bedrock.
4. Seasonal high water table.
5. Proximity to building foundations and wellheads.
6. Erodibility of soils.
7. Land availability and configuration of the topography.
8. Peak discharge and required volume control.
9. Streambank erosion.
10. Efficiency of the BMPs to mitigate potential water quality problems.
11. Volume of runoff that will be effectively treated.
12. Nature of the pollutant being removed.
13. Maintenance requirements.
14. Creation/protection of aquatic and wildlife habitat.
15. Recreational value.
16. Enhancement of aesthetic and property value.

C. To accomplish the above, the applicant shall submit original and innovative designs for review. Such designs may achieve the water quality objectives through a combination of BMPs (Best Management Practices).

[Added by Ordinance 2006-3]

Section 134-16. Additional Requirements Applicable to Infiltration Oriented Stormwater Management Systems (Tohickon Creek and East Branch Perkioment Creek Watersheds)

A. In calculating the volume of runoff that can be infiltrated at a site, the following methodology shall be used:

Methodology:

$\mathbf{Re_v}$ = [(S)(Rv)(A)]/12 (inches/foot)**,** where:

$\mathbf{Re_v}$ = Recharge Volume (acre-feet)
S = Soil specific recharge factor (inches)
A = Site area contributing to the recharge facility (acres)
$\mathbf{R_v}$ = Volumetric runoff coefficient, $R_v = 0.05 + 0.009$ (I), where:
I = percent impervious area, and
S shall be obtained based upon hydrologic soil group based upon the table below:

Hydrologic Soil Group	Soil Specific Recharge Factor (S)
A	0.38
B	0.25
C	0.13
D	0.06

If more than one hydrologic soil group (HSG) is present at a site, a composite recharge volume shall be computed based upon the proportion of total site area within each HSG.

B. In selecting the appropriate infiltration BMPs, the applicant shall consider the following:

1. Permeability and infiltration rate of the site soils.
2. Topographic slope and depth to bedrock.
3. Seasonal high water table.
4. Proximity and elevation relative to building foundations, basements, and well heads. (Infiltration BMP should be located downgrade of these structures).
5. Erodibility of soils.
6. Land availability, configuration, and topography.
7. Peak discharge and required volume control.
8. Streambank erosion.
9. Efficiency of the BMPs to mitigate potential water quality problems.
10. Volume of runoff that will be effectively treated.
11. Nature of the pollutant being removed.
12. Maintenance requirements.
13. Creation/protection of aquatic and wildlife habitat.
14. Recreational value.
15. Enhancement of aesthetic and property value.

C. A detailed soils evaluation of the project site shall be performed to determine the suitability of infiltration BMPs. The evaluation shall be performed by a qualified professional, and at a minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability. The site testing shall include adequate sampling of all portions of the site not limited by 100% protected natural resources to determine areas of the property which are suitable for infiltration BMPs. The general process for designing the infiltration BMP shall be:

1. Analyze hydrologic soil groups as well as natural and manmade features within the watershed to determine general areas of suitability for infiltration BMPs.

2. Provide field testing data at the elevation of the proposed infiltration zone (bottom surface of infiltration facilities) to determine appropriate percolation rate and/or hydraulic conductivity. Field Testing guidelines are identified in Appendix C .

3. Design infiltration BMPs for required stormwater volume based on field-determined capacity at the level of the proposed infiltration surface.

D. Soil characteristics:

1. Infiltration BMPs are particularly appropriate in hydrologic soil groups A and B, as described in the Natural Resources Conservation Service Manual TR-55.

2. Low-erodibility factors ("K" factors) are preferred for the construction of basins.

3. There must be a minimum depth of twelve (12) inches between the bottom of any facility and the seasonal high water table and/or bedrock (limiting zones). The minimum required separation between the limiting zone may be increased, if required by the Township, should project specific conditions exist (such as anticipated increased contaminants) which dictate greater prevention of groundwater contamination.

4. There must be an infiltration and/or percolation rate sufficient to accept the additional stormwater load, and to drain completely as determined by field tests.

5. A minimum of thirty (30) feet of undisturbed fill shall separate the foundation wall of any building and an infiltration BMP.

6. The infiltration system shall have positive overflow controls to prevent storage within one foot of the finished surface of grade.

7. Infiltration rates shall not be used in computing the storage volume of the infiltration system.

8. Surface inflows shall be designed to prevent direct discharge of sediment into the infiltration system.

E. The recharge volume provided at the site shall be directed to the most permeable HSG (Hydrologic Soil Group) available, except where other considerations apply such as in limestone geology.

F. Any infiltration BMP shall be capable of completely infiltrating the impounded water within forty-eight (48) hours from the peak of the storm.

G. Special attention shall be paid to proper installation of infiltration oriented stormwater management systems during construction, and to careful avoidance of soil compaction during site development.

H. Extreme caution shall be exercised where salt or chloride would be a pollutant since soils do little to filter this pollutant and it may contaminate the groundwater. Extreme caution

shall be exercised where infiltration is proposed in source water protection areas. The qualified design professional shall evaluate the possibility of groundwater contamination from the proposed infiltration/recharge facility and perform a hydrogeologic justification study if necessary. The infiltration requirement in High Quality/Exceptional Value waters shall be subject to DEP's Title 25: Chapter 93 Antidegradation Regulations. The Township may require the installation of an impermeable liner in BMP and/or detention basins where the possibility of groundwater contamination exists. A detailed hydrogeologic investigation may be required by the Township.

I. The plan must include safeguards against groundwater contamination for uses which may cause groundwater contamination, should there be a mishap or spill.

J. Recharge/infiltration facilities shall be used in conjunction with other innovative or traditional BMPs, stormwater control facilities, and nonstructural stormwater management alternatives.

K. Infiltration BMPs shall not be constructed nor receive runoff until the entire contributory drainage area to the infiltration BMP has achieved final stabilization.

L. The requirements for volume control and infiltration are applied to all disturbed areas, even if they are ultimately to be a pervious or permeable land use such as lawn or other landscaped area, given the extent to which development-related disturbance leads to compaction of the soils and reduces their infiltrative capacity.

[Added by Ordinance 2006-3]

Section 134-17 Volume Control Standards – Neshaminy Creek Watershed

A. Volume Control

Volume controls will mitigate increased runoff impacts, protect stream channel morphology, maintain groundwater recharge, and contribute to water quality improvements. Stormwater runoff volume control methods are based on the net change in runoff volume for the two-year storm event.

Volume controls shall be implemented using the Design Storm Method in subsection 1. or the Simplified Method in subsection 3. below. For Regulated Activities which propose 2,500 square feet or less of impervious surface, this Ordinance establishes no preference for either methodology; therefore, the applicant may select either methodology on the basis of economic considerations, the intrinsic limitations of the procedures associated with each methodology, and other factors. All regulated activities greater than 2,500 square feet must use the Design Storm Method.

1. **Design-Storm Method (Any Regulated Activity):** This method requires detailed modeling based on site conditions. For modeling assumptions refer Section 134-20.

   a. Post-development total runoff shall not be increased from pre-development total runoff for all storms equal to or less than the 2-year 24-hour duration precipitation.

   b. To estimate the increased volume of runoff (cubic feet) for the 2-year 24-hour duration precipitation event for existing site conditions (pre-development) and

for the proposed developed site conditions (post-development), it is recommended to use the soil cover complex method as shown in this section. Appendix A is available to guide a qualified professional and/or an applicant to calculate the stormwater runoff volume. The calculated volume shall be either reused, evapotranspired, or infiltrated through structural or nonstructural means.

Soil Cover Complex Method:

Step 1: Runoff (in) = $Q = (P - 0.2S)^2 / (P + 0.8S)$ where

P = 2-year Rainfall (in) P = 3.26 inches

S = (1000 / CN) – 10, the potential maximum retention (including initial abstraction, Ia)

Step 2: Runoff Volume (Cubic Feet) = Q x Area x 1/12

Q = Runoff (in)

Area = SWM Area (sq ft), as calculated per Section 134-20.

2. **Stormwater Control Measures:**

The applicant must demonstrate how the required volume is controlled through Stormwater Best Management Practices (BMPs) which shall provide the means necessary to capture, reuse, evaporate, transpire or infiltrate the total runoff volume.

a. If natural resources exist on the site, the applicant is required to submit a SWM Site Plan and determine the total acreage of protected area where no disturbance is proposed. The acreage of the protected area is subtracted from the total site area and not included in the stormwater management site area (SWM Area) acreage used in determining the volume controls.

Stormwater Management Site Area =
Total Site Area (for both pre and post development conditions) –
Protected Area

Natural Resource Areas must be calculated based upon the natural resource protection requirements in the Hilltown Township Zoning Ordinance. Appendix A provides for guidance to assess the total protected area. For additional reference refer Chapter 5 Section 5.4.1 of the PA BMP manual.

b. Calculate the volume controls provided through nonstructural BMPs. Table A-5 in Appendix A is recommended as guidance.

c. Volume controls provided through nonstructural BMPs are subtracted from the required volume to determine the necessary structural BMPs.

Required Volume Control (ft^3)	–	Nonstructural Volume Control (ft^3)	=	Structural Volume Requirement (ft^3)

d. Calculate the volume controls provided through structural BMPs. Table A-6 in Appendix A is recommended as guidance. Refer PA BMP manual Chapter 6 for description of the BMPs.

e. Infiltration BMPs intended to receive runoff from developed areas shall be selected based on the suitability of soils and site conditions. Infiltration BMPs shall be constructed on soils that have the following characteristics:

(1) A minimum soil depth of twelve (12″) inches between the bottom of the infiltration BMPs and the top of bedrock or seasonally high water table.

(2) An infiltration rate sufficient to accept the additional stormwater load and dewater completely as determined by field tests. A minimum of 0.2 inches/hour (in/hr) should be utilized and for acceptable rates a safety factor of 50% should be applied for design purposes (e.g., for soil which measured 0.4 in/hr, the BMP design should use 0.2 in/hr to insure safe infiltration rates after construction).

(3) All infiltration facilities shall be designed to completely infiltrate runoff volume within two (2) days (48 hours) from the peak of the design storm.

f. Soils – A soils evaluation of the project site shall be required to determine the suitability of infiltration facilities. All regulated activities are required to perform a detailed soils evaluation by a qualified design professional which at minimum addresses soil permeability, depth to bedrock, and subgrade stability. The general process for designing the infiltration BMP shall be:

(1) Analyze hydrologic soil groups as well as natural and man-made features within the site to determine general areas of suitability for infiltration practices. In areas where development on fill material is under consideration, conduct geotechnical investigations of sub-grade stability; infiltration may not be ruled out without conducting these tests.

(2) Provide field tests such as double ring infiltrometer or hydraulic conductivity tests (at the level of the proposed infiltration surface) to determine the appropriate hydraulic conductivity rate. Percolation tests are not recommended for design purposes.

(3) Design the infiltration structure based on field determined capacity at the level of the proposed infiltration surface and based on the safety factor of fifty (50) percent.

(4) If on-lot infiltration structures are proposed, it must be demonstrated that the soils are conducive to infiltrate on the lots identified.

(5) An impermeable liner will be required in detention basins where the possibility of groundwater contamination exists. A detailed hydrogeologic investigation may be required by the Township.

3. **Simplified Method (Regulated activities less than 2,500 square feet of impervious surface)**

Individual home construction projects on single family lots which result in less than two thousand five hundred (2,500) square feet of new impervious area (including the building footprint, driveway, sidewalks, and parking areas) and less than five thousand (5,000) square feet of earth disturbance may utilize the simplified procedure contained in Appendix J to meet requirements of this Ordinance and are not required to submit detailed stormwater management plans prepared pursuant to Section 134-24 of this Ordinance . This procedure may not be utilized for proposed subdivision or land developments.

Section 134-18. Stream Bank Erosion Requirements

In addition to the water quality volume, to minimize the impact of stormwater runoff on downstream stream bank erosion, a BMP must be designed to detain the proposed conditions 2-year, 24-hour design storm to the existing conditions 1-year flow using the SCS Type II distribution. Additionally, provisions shall be made (such as adding a small orifice at the bottom of the outlet structure) so that the proposed conditions 1-year storm takes a minimum 24-hours to drain from the facility from a point where the maximum volume of water from the 1-year storm is captured (i.e. the maximum water surface elevation is achieved in the facility).

Release of water may begin at the start of the storm (i.e. the invert of the water quality orifice is at the invert of the facility). The design of the facility shall minimize clogging and sedimentation. Orifices smaller than 3 inches in diameter are not recommended. However, if the design engineer can verify that the smaller orifice is protected from clogging by use of trash racks, etc., smaller orifices may be permitted. Trash racks are required for any primary orifice.

Whenever a watercourse is located within a development site, it shall remain open in the natural state and location and shall not be piped, impeded, or altered (except for road crossings). It is the responsibility of the developer to restore existing eroded stream/channel banks within a subdivision or land development site and obtain all permits necessary from PADEP, to do so. The developer must submit pictorial documentation of existing stream/channel banks to determine whether existing banks must be stabilized.

[Added by Ordinance 2006-3]

Section 134-19. Design Criteria for Stormwater Management Facilities and Best Management Practices

A. Increased stormwater runoff which may result from Regulated Activities listed in Section 134-4 shall be controlled by permanent stormwater runoff control measures that will provide the required standards within Article III. The methods of stormwater control or Best Management Practices (BMPs) which may be used to meet the required standards are described in this Ordinance and are the preferred methods of controlling stormwater runoff. Additional design criteria are included in these descriptions. The choice of BMPs is not limited to the ones appearing in this Ordinance, however, any selected BMP must meet or exceed the runoff peak rate requirements of this Ordinance for the applicable Hydrologic District.

B. Any stormwater facility located on state highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation.

C. Any stormwater management facility 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 1.0 foot of freeboard above the maximum pool elevation computed when the facility functions for the 100-year post-development inflow.

D. Emergency spillways discharging over embankment fill shall be constructed of reinforced concrete checker blocks to protect the berm against erosion. The checker block lining shall extend to the toe of the fill slope on the outside of the berm, and shall extend to an elevation three (3) feet below the spillway crest on the inside of the berm.

E. Vegetated spillways may be utilized for spillways constructed entirely on undisturbed ground (i.e. not discharging over fill) if the designer can demonstrate that flow velocities through the spillways will not cause erosion of the spillway. A dense cover of vegetation shall be rapidly established in such spillways by sodding or seeding with a geotextile anchor. Such a vegetated spillway must be stabilized before runoff is directed to the basin.

F. 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 100-year event.

G. Stormwater management facility outlet piping shall be Class III reinforced O-ring concrete pipe. A minimum of one (1) concrete anti-seep collar shall be required. Pre-cast collars shall have a minimum thickness of eight (8) inches; field poured collars shall have a minimum thickness of twelve (12) inches. Collars may not be installed within two (2) feet of pipe joints. Collars must be designed to project a minimum of two (2) feet around the perimeter of the pipe. Maximum collar spacing is fourteen (14) times the design projection around the perimeter.

H. Berms shall be constructed in accordance with requirements specified in Appendix “A”.

I. No stone gabion baskets may be used in the construction of stormwater management facilities.

J. Retention/detention basins:

1. Pipe outlet shall permit complete drainage of all detained water, unless the stormwater management facility is designed as a retention basin/pond or provides for stormwater renovation with constructed wetlands.

2. When a detention basin is not designed as a stormwater management constructed wetland, the stormwater management facility shall be planted with low maintenance grass or substitute satisfactory to the Township.

3. All detention basin bottoms intended to be maintained as lawn (e.g. recreational fields) shall be designed with a minimum grade of 2%. As an alternative, the

detention basin may be designed with a minimum grade of 1% with underdrains to ensure complete drainage.

4. To minimize the visual impact of detention basins, the detention basin shall be designed to avoid the need for safety fencing. To meet this requirement, basins shall be designed to the following specifications:

   a. Maximum depth of detained runoff shall be 24 inches for a 2 year or 10 year storm event.

   b. Maximum depth of detained runoff shall be 36 inches for a 100 year storm event.

   c. Interior slopes shall not be steeper than a ratio of 4:1 horizontal to vertical.

   d. Ponded water shall never exceed a depth of 24 inches for more than four hours.

   Depths and slopes may be exceeded by permission of the Township on a case-by-case basis if lot runoff, topography and/or existing downstream systems make the required pond area unreasonably large. In such case, fence and landscape screens will be required.

5. An access ramp of 10:1, 10 feet wide, shall be provided to allow maintenance equipment to reach the basin floor. The ramp shall coincide with the required gate if fencing is needed.

6. When required by the Township, fencing shall provide a suitable barrier at least four (4) feet in height of material approved by the Township, such as split rail fencing with wire backing. Access to the basin shall be provided by a gate or gates having a total opening of at least ten (10) feet at such location(s) as to permit ready access to the detention basin with maintenance equipment.

7. Landscaping:

   a. The perimeter berms and embankments of retention/detention basins including wet ponds, and artificial wetland stormwater management facilities shall be designed to create a natural appearance and reduce future maintenance requirements. Landscaping shall include a mixture of native tall grasses and perennial plants, ground cover, shrubs, and trees to eliminate the necessity of periodic mowing.

   b. Artificial wetland basins shall be designed pursuant to requirements of the Pennsylvania Handbook of Best Management Practices for developing areas. Plant material and arrangement shall be subject to approval of the Township. (Refer Appendix C – Plant lists for Wetland Management)

   c. The perimeter of the retention/detention basin shall be landscaped with a mixture of deciduous trees, evergreens, and shrubs arranged in an informal manner. Retention basin (wet ponds) and artificial wetland basin landscaping shall be designed to create a “natural” appearance. Minimum plant material shall include the following per 100 linear feet of basin perimeter measured at the 100 year reoccurrence stormwater elevation:

(1) Three (3) evergreen trees (minimum height 4 feet)

(2) Two (2) deciduous trees (minimum caliper 2½ inches)

(3) Five (5) shrubs (minimum height 3 feet)

Retention/detention basin landscaping design is subject to approval by the municipality.

8. Retaining walls shall not be specified for use within the 100 year water surface elevation area of any detention/retention facility or as Ordinance of any embankment or cut slope that is appurtenant to the construction of a detention/retention facility.

9. The Developer shall provide written assurance, satisfactory to the Township, that the retention/detention basin will be properly maintained. Such assurances shall be in a form to act as a covenant that will run with the land, and shall provide Township maintenance at the cost of the landowner in case of default, and further provide for assessment of costs and penalties in case of default.

10. As an alternate to the above paragraph, the Township may, at their own option, assume responsibility of the basin and may accept dedication of the basin by the Developer. If the retention/detention basin is dedicated or offered to the Township for long term maintenance, the following regulations shall apply:

    a. The dedicated area shall include the entire ponded area for the 100 year storm event and the outside slope at the berm.

    b. The dedicated area shall not be considered Ordinance of the Open Space and Recreation Land required elsewhere in the Subdivision and Land Development Ordinance and Zoning Ordinance.

    c. If fencing is necessary, the basin design shall provide a level area (2% slope) eight feet in width on both the inside and outside of the fence, along the entire length of the fence for proper access by Township maintenance equipment. The total width of this generally level area shall be at least 16 feet.

    d. The Developer shall provide for the special financial burden the Township will be accepting if the Township accepts the detention basin maintenance. To help mitigate this future financial burden, the Developer shall contribute to the Township a cash payment in the amount of fifteen thousand ($15,000.00) dollars per acre, on a pro rata basis, for any detention/retention basin site or area dedicated to the Township and being accepted by the Township. The detention/retention basin site area is measured to the outside limit of grading necessary to construct the basin and basin berm. The minimum contribution for any basin, regardless of size, shall be $7,500.00. This requirement may be modified by a Resolution of the Township, from time to time, to reflect actual long term costs of detention basin maintenance in the Township.

11. Basin Berm Construction Requirements:

(1) Site preparation – Areas under the embankment and any structural works shall be cleared, grubbed, and the topsoil stripped to remove the trees, vegetation, roots or other objectionable material. In order to facilitate clean-out and restoration, the pool area will be cleared of all brush and excess trees.

(2) Cut off trench – A cut-off trench will be excavated along the centerline dam on earth fill embankments. The minimum depth shall be two feet. The cut-off trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be eight feet but wide enough to permit operation of compaction equipment. The side slopes shall be no steeper than 1:1. Compaction requirements shall be the same as those for the embankment. The trench shall be kept free from standing water during the backfilling operations.

(3) Embankment – The fill material shall be taken from the selected borrow areas. It shall be free of roots, wood vegetation, oversized stones, rocks or other objectionable material. Areas on which fill is to be placed shall be scarified prior to placement of fill.

The fill material should contain sufficient moisture so that it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction.

Fill material will be placed in 6 to 8 inch layers and shall be continuous over the entire length of the fill. Fill material must be compacted to a minimum of 95% of Modified Proctor Density as established by ASTM D-1557. Compaction testing by a certified soils engineer/geologist must be completed as directed by the Township Engineer to verify adequate compaction has been achieved.

[Added by Ordinance 2006-3]

12. Bridge and Culvert Design

Any proposed bridge or culvert to convey flow within a perennial or intermittent stream shall be designed in accordance with the following principals:

(1) Culverts and bridges shall be designed with an open bottom to maintain natural sediment transport and bed roughness, avoiding acceleration of water velocity above the natural (preexisting) condition. Rock (rip rap) lining (native material if possible) shall be installed within the culvert as needed to prevent erosion within the structure. Approximate top of rock lining must be at the level of the existing stream bottom so as to maintain normal water level and unimpeded movement of native animal species.

(2) Bottom of opening shall be designed to match the bankfull channel condition in terms of width and depth. The cross-sectional area of the bankfull channel (measured at a reference location upstream of the structure) shall be matched with area in the crossing structure.

(3) Above the bankfull elevation, the width shall increase a minimum of thirty (30) percent to disperse the energy of higher flow volumes and avoid undermining of the supporting structure by secondary currents.

(4) The total cross-sectional area of the structure opening must be equal to or greater than the flood prone area (cross-sectional stream area at a depth of twice the maximum bankfull depth, measured at a reference location upstream of the structure). The flood prone area is approximately equal to the area flooded by a 50-year return flood.

(5) All bridges, culverts, and drainage channels shall be designed to convey a flow rate equal to a one hundred (100) year, twenty-four (24) hour storm as defined by the U.S. Department of Agriculture, Natural Resource Conservation Service (previously SCS), Technical Release No. 55. All bridges and culverts shall be designed to convey the 100-year design storm without increasing the extent and depth of the 100-year floodplain.

K. 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 doesn't 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 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 1.0-foot of freeboard measured below the lowest point along surface of the 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 PA DOT right of way must meet PA DOT minimum design standards and permit submission requirements.

L. Any drainage conveyance facility and/or channel that doesn't 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. Conveyance facilities to or exiting from stormwater management facilities 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 PA DOT right-of-way must meet PA DOT minimum design standards and permit submission requirements.

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

N. Except for drainage at roadway stream crossings, pipe or artificial swale discharge shall be set back 75 feet from a receiving waterway, and the pipe discharge shall be diffused or spread out to reduce and eliminate high-velocity discharges to the impacted ground surface. The conveyance mechanism shall minimize disturbance and velocity of discharge.

O. All infiltration devices and groundwater recharge facilities shall be designed to completely drain all water in three days subsequent to any storm event.

P. Riparian Corridor Restoration – Within all major subdivisions and non-residential land developments, from the top of watercourse bank, seventy-five (75) feet on either side of the watercourse, which contains wetlands and/or floodplain, shall be planted to establish a Zone 1 and Zone 2 buffer in accordance with the Pennsylvania Handbook of Best Management Practices for Developing Areas, 1998, Riparian Forested Buffer. Where existing vegetation on the site essentially duplicates buffer requirements, this provision shall not apply. Additionally, this requirement may be modified or waived by the Board of Supervisors where existing man-made improvements or agricultural operations to be retained encroach within the buffer area.

Q. All developments which create impervious surface shall provide capacity for and treatment of the "Water Quality Volume" and "Recharge Volume", unless exempt from applicability under Section 134-5.

R. Special requirements for areas falling within defined Exceptional Value and High-Quality Sub-Watersheds: The temperature and quality of water and streams that have been declared as exceptional value or high quality is to be maintained as defined in Chapter 93 Water Quality standards, Title 25 of Pennsylvania Department of Environmental Protection Rules and Regulations. Temperature sensitive BMPs and stormwater conveyance systems are to be used and designed with storage pool areas and supply outflow channels, and shaded with trees. This will require the modification of berms for permanent ponds. At a minimum, the southern half of pond shorelines shall be planted with shade or canopy trees within ten feet of the pond shoreline. In conjunction with this requirement, the maximum slope allowed on the berm area to be planted is 10 to 1 to lessen the de-stabilization of berm soils due to root growth.

S. Developers shall utilize BMPs to provide for additional water quality improvement and groundwater recharge. In evaluating potential stormwater BMPs, the order of preference is as follows:

1. infiltration BMPs
2. flow attenuation methods (e.g. vegetated open swales and natural depressions)
3. artificial wetlands, bioretention structures, and wetponds
4. minimum first flush detention or dual purpose detention (where appropriate)

Infiltration BMPs shall be utilized unless the applicant can demonstrate use of infiltration techniques is not feasible due to site conditions based upon site specific soil testing. Vegetated swales, wetlands or artificial wetlands and bioretention structures shall be utilized wherever possible if infiltration BMPs are deemed unfeasible. BMP techniques can and should be used in conjunction with each other (e.g. vegetated swales with infiltration or retention facilities).

1. Infiltration Best Management Practices (BMPs) – Infiltration devices shall be selected based upon suitability of soils and site conditions. Soil infiltration tests shall be performed on all sites to determine suitability of the site for infiltration BMPs. Testing shall include evaluation of selected soil horizons by soil probes, deep pits and/or percolation measurements. The soil infiltration rate of discharge from the infiltration area being used in the proposed design shall be based on these measurements. Infiltration BMPs shall be designed in accordance with the design criteria and specifications in Section 5 of the *Pennsylvania Handbook o[Best Management Practices for Developing Areas* (I998) and shall meet the following minimum requirements:

a. Infiltration BMPs shall be constructed on soils with a minimum depth of 24 inches between the intended bottom of the facility and the seasonal high water table and/or bedrock (limiting zones). **[Amended by Ordinance 2006-3]**

b. Infiltration BMPs intended to receive rooftop runoff shall include appropriate measures such as leaf traps and cleanouts to prevent clogging by vegetation. **[Amended by Ordinance 2006-3]**

c. Where direct discharge is permitted under the requirements of Section 134-12, infiltration BMPs shall be designed to provide adequate storage to accommodate the post-development first flush design storm (1 year 24 storm) volume with outlet and overflow controls to convey runoff larger than the first flush design storm volume safely to a natural outfall.

d. In areas where runoff release rates are specified under the requirements of Section 134-12, regardless of the specified release rate percentage, if infiltration BMPs are intended, they shall be designed to, as a minimum:

(1) Provide adequate storage to accommodate the volume of runoff calculated as the difference between the pre-development runoff volume and post-development runoff volume based on the 100 year design storm.

(2) Control the post-development peak rate of runoff to the pre-development peak rate of runoff for all design storms identified in Section 134-12 of this Ordinance.

(3) Provide an overflow or spillway that safely permits the passing of runoff greater than that occurring during the 100 year design storm.

2. Non-infiltration Facilities used as Best Management Practices (BMPs)

All facilities shall be designed in accordance to the design criteria and specifications in the *Pennsylvania Handbook of Best Management Practices for Developing Areas* (1998). This design shall be in particular coordination with Section 8, Descriptions of Selected Best Management Practices.

3. Artificial wetlands, wet ponds, and bioretention structures

a. Wet Pond BMPs shall meet the following requirements:

(1) Wet ponds shall be constructed on hydric or wet soils and/or soils which have an infiltration rate of less than 0.2 inches/hour.

(2) A minimum drainage area of five (5) acres shall be directed to the pond unless a source of recharge is utilized such as a natural spring or well.

(3) The length of the pond between the inflow and outlet points shall be maximized. In addition, an irregular shoreline shall be provided. By maximizing the flow length through the pond and providing an irregular shoreline, the greatest water quality benefit will be achieved by minimizing “short circuiting” of runoff flowing through the pond.

(4) A shallow forebay shall be provided adjacent to all inflow areas. The forebay shall be planted as a marsh with emergent wetland vegetation.

The forebay serves to enhance sediment trapping and pollutant removal, as well as concentrating accumulated sediment in an area where it can be readily removed.

(5) All wet ponds shall be designed with public safety as a primary concern - An aquatic safety bench shall be provided around the perimeter of the permanent pool. The depth of the bench shall be a maximum of one (1) foot for a width of at least three (3) feet. A 3:1 slope shall lead from the edge of the safety bench toward the deep water portion of the pond. At least 15 feet of 3:1 slope shall be provided from the edge of the safety bench. Slopes in the remainder of the pond below the permanent pool elevation shall be a maximum of 2:1.

(6) The perimeter slope above the permanent pool shall have a maximum slope of 4:1 for a distance of at least 20 feet. The remaining areas above the permanent pool shall have a maximum slope of 3:1.

(7) Wet ponds shall have a deep water zone to encourage gravity settling of suspended fines, and prevent stagnation and possible eutrophication.

(8) Wet ponds shall be capable of being substantially drained by gravity flow. Where possible, wet ponds shall be equipped with a manually operated – drain that can be secured against unauthorized operation.

(9) A planting plan shall be developed for the wet pond, showing all proposed aquatic, emergent, and upland plantings.

(10) Wet ponds shall be designed to discourage use by Canada geese. Techniques employed shall include the following:

(a) Elimination of straight shorelines, islands, and peninsulas;

(b) Placement of walking paths (where applicable) along the shoreline;

(c) Placement of grassed areas (i.e. playing fields) at least 450 feet from the water surface;

(d) Vegetative barriers;

(e) Rock barriers;

(f) Installation of tall trees within 10 feet of the water surface;

(g) Use of ground covers not palatable to Canada geese.

b. Artificial Wetland BMPs shall meet the following requirements:

(1) Artificial wetlands shall be constructed on hydric or wet soils and/or soils which have an infiltration rate of less than 0.2 inches/hour.

(2) Runoff entering artificial wetlands shall be filtered through a sediment removal device before entering the wetland.

(3) A planting plan shall be developed for the artificial wetland showing all proposed aquatic, emergent, and upland plantings. The planting plan shall be developed to provide a diversity of species resulting in a dense stand of wetland vegetation.

(4) At least 75% of the surface area of the wetland shall be developed as a shallow water emergent wetland, with a water depth of less than 12”. The

reminder shall be constructed as open water with depths between 2 feet and 4 feet.

4. Minimum first flush detention/dual purpose BMPs

   a. Minimum first flush detention/dual purpose detention basin BMPs shall be designed to meet the following requirements:

      (1) Post-development runoff from a “water quality storm” (a 1-year, 24-hour event) shall be released over a minimum period of 24 hours.

      (2) Two stage basins shall be utilized where first flush detention will be employed for water quality and conventional detention used for peak rate control of storms exceeding the 1-year, 24-hour event.

      (3) Two stage basins shall be constructed so that the lower Ordinance of the basin is graded to detain stormwater from the “water quality storm”, and the remainder of the basin graded as a flat overbank area to provide storage only for the larger, less frequent storm events. The overbank area is encouraged to be developed as an active or passive recreational area.

      (4) The area inundated by the “water quality storm” is encourage to be maintained as a wetland environment, which will increase the water quality benefits of the first flush/dual purpose detention basin, and will prevent the need for mowing of a frequently saturated area.

T. All stormwater control facility designs shall conform to the applicable standards and specifications of the following governmental and institutional agencies:

1. American Society of Testing and Materials (ASTM)
2. Asphalt Institute (AI)
3. Bucks Conservation District (BCD)
4. Federal Highway Administration (FHWA)
5. National Crushed Stone Association (NCSA)
6. National Sand and Gravel Association (NSGA)
7. Pennsylvania Department of Environmental Protection (PADEP)
8. Pennsylvania Department of Transportation (PADOT)
9. U.S. Department of Agriculture, Natural Resources Conservation Service, Pennsylvania (USDA, NRCS, PA)

U. If special geological hazards or soil conditions, such as carbonate derived soils, are identified on the site, the developer's professional engineer shall consider the effect of proposed stormwater management measures on these conditions. In such cases, the municipality shall require an in-depth report by a registered professional geologist.

V. The design of all stormwater management facilities shall incorporate sound engineering principles and practices. Guidelines established by the *Pennsylvania Handbook of Best Management Practices for Developing Areas* (1998) shall be utilized in determining stormwater management facility design except where specifically modified by this or other Municipal Ordinance. The Municipality shall reserve the right to disapprove any design that would result in the occupancy or continuation of an adverse hydrologic or hydraulic condition within the watershed.

Section 134-20. Calculation Methodology

Stormwater runoff from all development sites shall be calculated using either the rational method or a soil-cover-complex methodology.

A. Any stormwater runoff calculations shall use generally accepted calculation technique that is based on the NRCS soil cover complex method. Table 309.I summarizes acceptable computation methods. Method must be selected by the applicant based on the individual limitations and suitability of each method for a particular site.

The Rational Method may be used to estimate peak discharges from drainage areas that contain less than 200 acres. The Rational Method is recommended for drainage areas under 100 acres. **[Amended by Ordinance 2006-3]**

Table 134-20. Acceptable Computation Methodologies For Stormwater Management Plans

METHOD	METHOD DEVELOPED BY	APPLICABILITY
TR-20 (or commercial computer package based on TR-20)	USDA - NRCS	Applicable where use of full hydrology computer model is desirable or necessary
TR-55 (or commercial computer package based on TR-55)	USDA - NRCS	Applicable for land development plans within limitations described in TR-55
HEC – 1, HEC-HMS	U.S. Army Corps of Engineers	Applicable where use of full hydrologic computer model is desirable or necessary
PSRM	Penn State University	Applicable where use of a hydrologic computer model is desirable or, necessary simpler than TR-20 or HEC-1.
Rational Method (or commercial computer package based on Rational Method)	Emil Kuiching (1889)	For sites less than 200 acres or as approved by the municipal engineer.
Other methods	Various	Other computation methodologies approved by the municipal engineer

[Amended by Ordinance 2006-3]

B. All calculations consistent with this Ordinance using the Soil Cover Complex Method shall use the appropriate design rainfall depths for the various return period storms according to the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rain data corresponding to the Doylestown rain gauge. The SCS Type 11 rainfall curve from NOAA is found on Figure A-1 in Appendix A of this Ordinance. This data may also be directly retrieved from the NOAA Atlas 14 website: hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html. If a hydrologic computer model such as PSRM or HEC-1/HEC-HMS is used for stormwater runoff calculations, then the duration of rainfall shall be 24 hours.

C. Runoff Curve Numbers (CN) for both existing and proposed conditions to be used in the soil cover complex method shall be obtained from Table A-4 in Appendix A of Ordinance.

For the purposes of existing conditions flow rate determination, undeveloped land and existing impervious surfaces shall be considered as “meadow” in good condition, unless the natural ground cover generates a lower curve number of Rational ‘C’ value (e.g. forest), as listed in Table A-4 in Appendix A of this Ordinance. **[Amended by Ordinance 2006-3]** Wooded areas shall use a ground cover of "woods in good condition". An area shall be considered wooded if there is a contiguous canopy of trees existing over an area of one-quarter (1/4) acre or more.

D. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times of concentration for overland flow and return periods from NOAA Atlas 14, Volume 2, Version 2.1 (Figure A-1). Times of concentration for overland flow shall be calculated using the methodology presented in Chapter 3 of Urban Hydrology for Small Watersheds, NRCS, TR-55 (as amended or replaced from time to time by NRCS). Times of concentration for channel and pipe flow shall be computed using Manning's equation.

E. Runoff Curve Numbers (CN) for both existing and proposed conditions to be used in the soil cover complex method shall be obtained from Table A-4 in Appendix A of this Ordinance.

F. Runoff coefficients (C) for both existing and proposed conditions for use in the Rational method shall be obtained from Table A- 7 in Appendix A of this Ordinance.

G. Where uniform flow is anticipated, the Manning equation shall be used for hydraulic computations, and to determine the capacity of open channels, pipes, and storm sewers. Values for Manning's roughness coefficient (n) shall be consistent with Table A-8 in Appendix A of this Ordinance.

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

H. The design of any stormwater management facilities intended to meet the performance standards of this Ordinance shall be verified by routing the design storm hydrograph through these facilities using the Storage Indication Method. For drainage areas greater than 20 acres in size, the design storm hydrograph shall be computed using a calculation method that produces a full hydrograph. The municipality may approve the use of any generally accepted full hydrograph approximation technique that shall use a total runoff volume that is consistent with the volume from a method that produces a full hydrograph.

I. The municipality has the authority to require that computed existing runoff rates be reconciled with field observations and conditions. If the design professional engineer can substantiate through actual physical calibration that more appropriate runoff and time-of-concentration values should be utilized at a particular site, then appropriate variations may be made upon review and recommendations of the Municipal Engineer. Calibration shall require detailed gauge and rainfall data for the particular site in question.

Section 134-21. Erosion and Sediment Control During Regulated Earth Disturbance Activities

A. Whenever vegetation and topography are to be disturbed, such activity must be in conformance with Chapter 102, Title 25, Rules and Regulations, Ordinance 1, Commonwealth of Pennsylvania, Department of Environmental Protection, Sub-Ordinance

C, protection of Natural Resources, Article II, Water Resources, Chapter 102, "Erosion Control," and in accordance with the Bucks County Conservation District and the standards and specifications of the Municipality.

B. No Regulated Earth Disturbance activities within the Municipality shall commence until approval by the Municipality of an Erosion and Sediment Control Plan for construction activities. **[Added by Ordinance 2006-4]**

C. In addition, under 25 PA Code Chapter 92, a PADEP "NPDES Construction Activities" permit is required for Regulated Earth Disturbance activities. **[Added by Ordinance 2006-4]**

D. Evidence of any necessary permit(s) for Regulated Earth Disturbance activities from the appropriate PADEP regional office or County Conservation District must be submitted to the municipality. **[Added by Ordinance 2006-4]**

E. A copy of the Erosion and Sediment Control Plan and any required permit, as required by PADEP regulations shall be available at the project site at all times. **[Added by Ordinance 2006-4]**

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

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

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

G. Peak discharges and discharge volumes from the site shall comply with the appropriate sections above, with the following additions:

1. For purposes of calculating required detention storage during land disturbance, peak discharges rates and volumes shall be calculated based upon the runoff coefficients for bare soils during the maximum period and extent of disturbance which shall be clearing, grading, and impervious surface installation indicated on the development plan. Controls shall insure that the difference in volume and rate of peak discharges and volumes before disturbance and during shall not exceed those peak discharges and discharge volumes required in Section 134-12 of this Ordinance. Detention storage during the period of land disturbance and prior to establishment of permanent cover may require additional facilities on a temporary basis. Such measures shall be located so as to preserve the natural soil infiltration capacities of the planned infiltration bed areas. Calculations based on the above parameters must be submitted to verify “during construction” runoff rate does not exceed predevelopment runoff rate for the 1-year frequency through 100-year frequency design storm events.

2. Wherever soils, topography, cut and fill or grading requirements, or other conditions suggest substantial erosion potential during land disturbance, the Township may require that the entire volume of all storms up to a 2-year storm from the disturbed areas be retained on site and that special sediment trapping facilities (such as check dams, etc.) be installed.

H. Areas of the site to remain undisturbed shall be protected from encroachment by construction equipment/vehicles to maintain the existing infiltration characteristics of the soil.

Section 134-22. Water Quality Requirements After Regulated Earth Disturbance Activities Are Complete

A. No Regulated Earth Disturbance activities within the Municipality shall commence until approved by the Municipality of a plan which demonstrates compliance with State Water Quality Requirements after construction is complete.

B. The BMPs must be designed, implemented, and maintained to meet State Water Quality Requirements, and any other more stringent requirements as determined by the Municipality.

C. To control post-construction stormwater impacts from Regulated Earth Disturbance activities, State Water Quality Requirements may be met by BMPs, including site design, which provide for replication of preconstruction stormwater infiltration and runoff conditions, so that post-construction stormwater discharges do not degrade the physical, chemical or biological characteristics of receiving waters. As described in the PADEP Comprehensive Stormwater Management Policy (#392-0300-002, September 28, 2002), this may be achieved by the following:

1. Infiltration: replication of preconstruction stormwater infiltration conditions.

2. Treatment - use of water quality treatment BMPs to filter out the chemical and physical pollutants from the stormwater runoff, and

3. Streambank and Streambed Protection - management of volume and rate of post-construction stormwater discharges to prevent physical degradation of receiving waters (e.g., from scouring).

D. PADEP has regulations that require municipalities to ensure design, implementation, and maintenance of Best Management Practices ("BMPs") that control runoff from new development from new development and redevelopment after Regulated Earth Disturbance activities area complete. These requirements include the need to implement post-construction stormwater BMPs with assurance of long-term operations and maintenance of those BMPs.

E. Evidence of any necessary permit(s) for Regulated Earth Disturbance activities from the appropriate PADEP regional office must be submitted to the Municipality.

F. BMP operations and maintenance requirements are described in Article I~~V~~VII of this Ordinance.

Section 134-23 Other Requirements

A. Hot Spots

1. Use of infiltration BMPs is prohibited on hot spot land use areas. Examples of hot spots are listed in Ordinance Appendix G.

2. Stormwater runoff from hot spot land uses shall be pretreated. In no case may the same BMP be employed consecutively to meet this requirement. Guidance regarding acceptable methods of pre-treatment is located in Appendix G.

B. West Nile Guidance Requirements

All wet basin designs shall incorporate biologic controls consistent with the West Nile Guidance found in Appendix H.

ARTICLE IV. STORMWATER MANAGEMENT PLAN REQUIREMENTS

Section 134-24. General Requirements

For any of the activities regulated by this Ordinance, the final approval of subdivision and/or land development plans, the issuance of any building or occupancy permit, or the commencement of any land disturbance activity may not proceed until the property owner or developer or his/her agent has received written approval of a stormwater management plan from the municipality.

Section 134-25. Stormwater Management Plan Contents

The stormwater management plan shall consist of all applicable calculations, maps, and plans. A note on the maps shall refer to the associated computations and erosion and sedimentation control plan by title and date. The cover sheet of the computations and erosion and sedimentation control plan shall refer to the associated maps by title and date. All stormwater management plan materials shall be submitted to the municipality in a format that is clear, concise, legible, neat, and well organized; otherwise, the stormwater management plan shall be disapproved and returned to the applicant.

The following items shall be included in the stormwater management plan:

A. A feasibility analysis that evaluates the potential application of infiltration, flow attenuation, bioretention, wetland, or wet pond BMPs must be submitted with the stormwater management plans required in Article IV for those developments not intending the use of such facilities. This analysis shall provide:

   1. A general assessment of the anticipated additional runoff based on the design storm and post-development condition and utilizing the calculation procedures required in Section 134-19;
   2. indication of drainage areas on the development site resulting in impervious, pervious, and rooftop runoff;
   3. indication of type of land use (residential, non-residential) generating the impervious surface runoff;
   4. delineation of soils on the site from the NRCS, Soil Survey of Bucks and Philadelphia Counties and onsite soil study. Soil study shall be conducted by a soil scientist and shall include sufficient probes/deep holes to evaluate application of BMPs;
   5. indication of soils generally suitable for infiltration and/or wet pond/artificial wetland BMPs as shown in the table entitled: "General Soil Suitability for Infiltration, Wet Pond and Artificial Wetland Best Management Practices With Consideration to Runoff Point of Origin and Land Use Type", including specification of those soils requiring modifications;
   6. calculated acreage of suitable soils for infiltration BMPs and wet pond or artificial wetland BMPs and percentage of suitable soils based on total site acreage;
   7. calculated acreage of suitable soils for infiltration BMPs and wet pond or artificial wetland BMPs made unavailable due to proposed development layout and justification that alternative development layout which would reduce impact on suitable soil availability is unfeasible;

8. analysis of potential infiltration or wet pond or artificial wetland BMPs which could be implemented to manage the projected post-development runoff with consideration of suitable soil availability runoff point of and type of land use (items 2. and 3. above) and the general design standards and maintenance issues included in this Ordinance including an indication of how most post-development runoff can be managed by these BMPs (e.g. the entire post-development runoff or partial amount of runoff expressed as a percentage); and

9. rationale for the decision to not proceed with implementation of infiltration BMPs or wet pond or artificial wetland BMPs such as excessive cost of implementation, insufficient soil suitability, and development constraints.

The feasibility analysis must allow the municipality to review the general soil characteristics of a site and the proposed development for that site and determine if infiltration BMPs or wet pond or artificial wetland BMPs could have been more thoroughly pursued for use by the developer. The information required in the analysis is detailed enough to determine the potential applicability of these BMPs for a proposed development, but general enough not to force a developer into incurring excessive cost associated with conducting laborious field and/or laboratory soil testing for a site which ultimately may not be suitable for infiltration or wet pond or artificial wetland BMP implementation. However, with the requirements for conducting a feasibility analysis, developers will be aware that they are expected to use these BMPs wherever possible and are required to provide adequate justification if these BMPs are not to be implemented. Essentially, all developers will be conducting feasibility analysis since such analysis would become the preliminary step in evaluating the potential for implementation of these mandatory BMPs where possible. Developers for those sites that are determined to be generally suitable from these analysis (taking into consideration the areal extent of suitable soils necessary to accommodate an infiltration or wet pond or wetland BMP for the type and size of development proposed) are required to conduct the detailed soil testing and other feasibility testing required in other sections of this Ordinance which contain the description and additional design criteria of these BMPs.

B. A detailed geologic evaluation of the project site shall be performed to determine the suitability of recharge facilities. The evaluation shall be performed by a qualified geologist and/or soil scientist, and a minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability.

C. Whenever a stormwater management facility will be located in an area underlain by limestone, a geological evaluation of the proposed location shall be conducted to determine susceptibility to sinkhole formations. The design of all facilities over limestone formations shall include measures to prevent ground water contamination and, where necessary, sinkhole formation. Soils used for the construction of basins shall have low-erodibility factors ("K" factors). Installation of an impermeable liner shall be required in detention basins.

It shall be the developer's responsibility to verify if the site is underlain by limestone. The following note shall be attached to all stormwater management plans and signed and sealed by the developer's professional engineer “I, _____, certify that the proposed stormwater management facility (circle one) is/is not underlain by limestone.”

D. General

1. General description of project.

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

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

E. Map(s) of the project area shall be submitted on 24-inch x 36-inch sheets and shall be prepared in a form that meets the requirements for recording at the offices of the Recorder of Deeds of Bucks County. The contents of the maps(s) shall include, but not be limited to:

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

2. Watershed(s) within which the project is located (e.g. Tohickon Creek, Neshaminy Creek, East Branch Perkiomen Creek)

3. Existing contours at intervals of 2 feet. In areas of steep slopes (greater than 25 percent), 5 feet contours may be used.

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

5. Other physical features including flood hazard boundaries, sinkholes, streams, existing drainage courses, wetlands, areas of natural vegetation to be preserved, and the total extent of the upstream area draining through the site.

6. The locations of all existing and proposed utilities, sanitary sewers, and water lines located on the site and/or within 50 feet of property lines with minimum setback distances for all existing and proposed water supply wells and on-lot sewage disposal systems.

7. An overlay showing soil names and boundaries. This overlay shall include a table on the map showing the recharge capabilities of each soil represented onsite in inches per hour and describe their recharge or infiltration capabilities.

8. Proposed changes to the land surface and vegetative cover, including the type and amount of impervious area that would be added.

9. Proposed structures, roads, paved areas, and buildings. Where pervious pavement is proposed for parking lots, recreational facilities, non-dedicated streets, or other areas, pavement construction specifications shall be noted on the plan.

10. Final contours at intervals at 2 feet. In areas of steep slopes (greater than 25 percent), 5-feet contour intervals may be used.

11. 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.

12. The date of submission.

13. A graphic and written scale of one (1) inch equals no more than fifty (50) feet. For tracts of twenty (20) acres or more, the scale may be one (1) inch equals no more than one hundred (100) feet.

14. A North arrow.

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

16. Existing and proposed land use(s).

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

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

19. All existing and proposed stormwater management facility and/or drainage easements described by metes and bounds, including the purpose and ownership of each easement.

20. A twenty-feet wide access easement around all stormwater management facilities that would provide ingress to and egress from a public right-of-way.

21. A 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.

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

23. A 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, which shall be recorded with the record plan and which shall be applicable to all future landowners. **[Amended by Ordinance 2006-3]**

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

25. The following signature block for the design engineer:

    (Design engineer), on this date (date of signature), has reviewed and hereby certify that the stormwater management plan meets all design standards and criteria of Hilltown Township Watershed Act 167 Stormwater Management Ordinance. **[Added by Ordinance 2006-3]**

F. Required Supplemental Information

1. A written description of the following information shall be submitted.

   a) The overall stormwater management concept for the project.

   b) Stormwater runoff computations as specified in this Ordinance.

   c) Stormwater management techniques to be applied both during and after development.

   d) Expected project time schedule.

2. A soil erosion and sedimentation control plan, where applicable, including all reviews and approvals, as required by PADEP and/or Bucks Conservation District.

3. A geologic assessment of the effects of runoff on sinkholes as specified in this ordinance.

4. The effect of the project (in terms of runoff volume, peak flow, and discharge duration) on adjacent properties and on any existing municipal stormwater collection system that may receive runoff from the project site.

5. A Declaration of Adequacy and Highway Occupancy Permit from the PADOT District Office when utilization of a PADOT storm drainage system is proposed.

6. An Operations and Maintenance (O&M) Plan for all existing and proposed physical stormwater facilities, as well as schedules and costs for O&M activities. The plan shall address long-term ownership and responsibilities for O&M.

G. Stormwater Management BMPs

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 proposed, the locations of existing and proposed septic tank infiltration areas, and wells must be shown. A minimum separation distance of no less than 20 feet shall be provided between any septic system and any facility used for stormwater management. An analysis shall be submitted to verify that stormwater infiltration shall not affect groundwater elevations of the septic drain field site.

3. All calculations, assumptions, and criteria used in the design of the stormwater management facilities must be shown. If multiple facilities are proposed in conjunction with each other, such as infiltration Best Management Practices with vegetation based management practices , a summary narrative, shall be included describing any sequence and how the facilities are meant to function with each other to manage stormwater runoff.

Section 134-26. Plan Submission

For all activities regulated by this ordinance, the steps below shall be followed for submission. For any activities that require a PADEP joint permit application and regulated under Chapter 105 (Dam Safety and Waterway Management) or Chapter 106 (Floodplain Management) of PADEP's Rules and Regulations, require a PADOT highway occupancy permit, or require any other permit under applicable local, state, or federal regulations, the permit(s) shall be Ordinance of the plan.

A. The stormwater management plan shall be submitted by the developer as Ordinance of the Preliminary plan submission for the regulated activity.

B. A minimum of three (3) copies of the stormwater management plan shall be submitted. Additional copies shall be submitted if requested by the Township.

C. Distribution of the stormwater management plan will be as follows:

1. One (1) copy to the municipality accompanied by the requisite municipal review fee, as specified in this Ordinance.

2. Two (2) copies to the Municipal Engineer.

Section 134-27. Stormwater Management Plan Review

A. The Municipal Engineer shall review the stormwater management plan for consistency with the adopted Watershed Act 167 Stormwater Management Plan and applicable municipal ordinances. The municipality shall require receipt of a complete plan, as specified in this Ordinance.

B. The Municipal Engineer shall review the stormwater management plan for any subdivision or land development against the Subdivision and Land Development Ordinance provisions not superseded by this Ordinance.

C. For activities regulated by this Ordinance, the Municipal Engineer shall notify the municipality in writing, within 45 calendar days of receipt, whether the stormwater management plan is consistent with the adopted Watershed Act 167 Stormwater Management Plan. A copy of the Municipal Engineer's review letter shall be forwarded to the developer.

D. Any disapproved stormwater management plans may be revised by the developer and resubmitted consistent with this Ordinance.

E. For regulated activities specified in Sections 134-4.C and 134-4.D of this Ordinance (not including subdivision or land development applications), the Municipal Engineer shall notify the Municipal Building Permit Officer in writing, within a time frame consistent with the Building Code and/or Subdivision and Land Development Ordinance, whether the stormwater management plan is consistent with the adopted Watershed Act 167 Stormwater Management Plan and forward a copy of the review letter to the applicant. Any disapproved stormwater management plan may be revised by the applicant and resubmitted consistent with this ordinance.

F. The municipality shall not approve any subdivision or land development for regulated activities specified in Sections 134-4.A and 134-4.B of this Ordinance if the stormwater management plan has been found to be inconsistent with the adopted Watershed Act 167 Stormwater Management Plan. All required permits from PADEP must be obtained prior to, or as a requirement of, final approval.

G. The Municipal Building Permit Office shall not issue a building permit for any regulated activity specified in Section 134-4 of this Ordinance if the stormwater management plan has been found to be inconsistent with the *adopted Watershed Act 167* Stormwater Management Plan, as determined by the Municipal Engineer, or without considering the comments of the Municipal Engineer. All required permits from PADEP must be obtained prior to issuance of a building permit.

H. The developer shall be responsible for completing an "as-built survey" of all stormwater management facilities included in the approved stormwater management plan. The as-built survey and an explanation of any discrepancies with the design plans shall be submitted to the Municipal Engineer for review. In no case shall the municipality approve the as-built survey until the municipality receives a copy of an approved Declaration of Adequacy, Highway Occupancy Permit from the PADOT District Office, and any applicable permits from PADEP.

I. The municipality's approval of a stormwater management plan shall be valid for a period not to exceed two (2) years. If stormwater management facilities included in the approved stormwater management plan have not been constructed, or if an as-built survey of these facilities has not been approved within this 2-year time period, then the municipality may consider the stormwater management plan disapproved and may revoke any and all permits. Stormwater management plans that are considered disapproved by the municipality shall be resubmitted in accordance with Section 134-32of this Ordinance.

Section 134-28. Modification of Plans

A modification to a submitted stormwater management plan for a development site that involves a change in stormwater management facilities or techniques, or that involves the relocation or redesign of stormwater management facilities, or that is necessary because soil or other conditions are not as stated on the stormwater management plan as determined by the Municipal Engineer, shall require a resubmission of the modified stormwater management plan consistent with Section 134-27 of this Ordinance and be subject to review as specified in Section 134-27 of this Ordinance.

A modification to an already approved or disapproved stormwater management plan shall be submitted to the Municipality, accompanied by the applicable Township review fee. A modification to a stormwater management plan for which a formal action has not been taken by the municipality shall be submitted to the municipality, accompanied by the applicable municipal review fee.

Section 134-29. Retention of Plans at Project Site

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

Section 134-30. Adherence to Approved Plan

It shall be unlawful for any person to undertake any regulated activity on any property except as provided for in the approved stormwater management plan and pursuant to the requirements of this Ordinance. It shall be unlawful to alter or remove any BMP required by the stormwater management plan pursuant to this Ordinance or to allow the property to remain in a condition which does not conform to the approved stormwater management plan.

Section 134-31. Certification of Completion

At the completion of the project, and as a prerequisite for the release of the performance guarantee under Section 134-39, the owner or his representatives shall:

1. Contact the Township Engineer to request inspection of the site for completion of stormwater management facilities and compliance with the approved plans and specifications.

2. Provide a set of as-built drawings as required pursuant to the Township Building Code and/or Subdivision and Land Development Ordinance.

Section 134-32. Resubmission of Disapproved Stormwater Management Plans

A disapproved stormwater management plan may be resubmitted, with the revisions addressing the Municipal Engineer's concerns documented in writing, to the Municipal Engineer in accordance with Section 134-26 of this Ordinance and be subject to review as specified in Section 134-27 of this Ordinance. The applicable municipal review fee must accompany a resubmission of a disapproved stormwater management plan.

Section 134-33. Occupancy Permit

An occupancy permit shall not be issued unless the stormwater management facilities approved for the lot have been installed and found satisfactory to the Township Engineer.

ARTICLE V. INSPECTIONS

Section 134-34. Schedule of Inspections

A. The Municipal Engineer or his assignee shall inspect all phases of the installation of the permanent stormwater management facilities.

B. During any stage of the work, if the Municipal Engineer determines that temporary or permanent erosion and sedimentation control or stormwater management facilities are not being installed in accordance with the approved stormwater management plan, the municipality shall revoke any existing permits until a revised stormwater management plan is submitted and approved, as specified in this Ordinance.

Section 134-35. Right of Entry

A. During construction, duly authorized representatives of the Township may enter at reasonable times upon any property within the Township to inspect the implementation, condition, or operation and maintenance of the stormwater BMPs to investigate construction activity is in compliance with this Ordinance.

B. BMP owners and operators shall allow persons working on behalf of the Township ready access to all parts of the premises for the purposes of determining compliance with this Ordinance.

C. Persons working on behalf of the Township shall have the right to temporarily locate on any BMP in the Township such devices as are necessary to conduct monitoring and/or sampling of the facility's storm water discharge.

D. Unreasonable delays in allowing the director access to a BMP is a violation of this article.

ARTICLE VI. FEES AND EXPENSES

Section 134-36. Stormwater Management Plan Review Fee

The Municipality shall establish a review fee schedule by Resolution of the governing body to defray review costs incurred by the municipality, any outside review agencies or entities necessary to review submitted plans, and the municipal engineer. The municipality shall periodically update the review fee schedule to ensure that review costs are adequately reimbursed. The applicant shall pay all fees.

Section 134-37. Expenses Covered by Fees and Escrow

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

A. Administrative costs.

B. Review of the stormwater management plan by the municipality and the Municipal Engineer.

C. Site inspections by the municipal staff and/or Municipal Engineer.

D. Inspection of stormwater management facilities and stormwater management improvements during construction.

E. Final inspection upon completion of the stormwater management facilities and stormwater management improvements presented in the stormwater management plan.

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

Section 134-38 Itemization of Costs

Expenses incurred by the Township and charged to the applicant pursuant to Section 134-37 of this Ordinance shall be itemized. A copy of the itemized costs will be provided by the Township to the applicant.

ARTICLE VII. MAINTENANCE RESPONSIBILITY

Section 134-39. Performance Guarantee

The applicant shall provide a financial guarantee to the municipality for the timely installation and proper construction of all stormwater management controls as required by the approved stormwater management plan and this Ordinance equal to the full construction cost of the required controls plus construction contingency and construction inspection costs.

Section 134-40. Maintenance Responsibilities

A. The stormwater management plan for the development site shall contain an BMP operation and maintenance plan (BMP O&M) prepared by the design engineer. The operation and maintenance plan shall outline required routine maintenance actions and schedules necessary to insure proper operation of the BMPs and shall be subject to review and approval of the Township.

B. The BMP O&M for the development site shall establish responsibilities for the continuing operation and maintenance of all proposed stormwater control facilities, consistent with the following principles:

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

2. If a development site is to be maintained in a single ownership or if storm sewers and other stormwater management 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.

C. The stormwater facility and BMP O&M plan shall include the following:

1. Description of how each stormwater facility and BMP will be operated and maintained, and the identity and contact information associated with the person(s) responsible for O&M.

2. Name of the project site, name and address of the owner of the property, and name of the individual or firm preparing the plan.

3. A statement, signed by the facility owner, acknowledging that the stormwater facilities and BMPs are fixtures that can be altered or removed only after approval by the municipality.

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

E. The O&M plan shall be recorded as a restrictive deed covenant that runs with the land.

F. The governing body, upon recommendation of the Municipal 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. The right of the Township to accept ownership in the future shall be stated in the Maintenance Agreement (refer Section 134-42).

Section 134-41 Municipal Review of Stormwater Facilities and BMP Operations and Maintenance (O&M) Plan

A. The Township shall review the Stormwater Facilities and BMP O&M plan for consistency with the purposes and requirements of this Ordinance, and any permits issued by PADEP.

B. The Township shall notify the Applicant in writing whether the Stormwater Facility and BMP O&M plan is approved.

C. The Township shall require a "Record Drawing" of all stormwater facilities and BMPs.

Section 134-42. Maintenance Agreement for Privately Owned Stormwater Facilities

A. Prior to final approval of the site's stormwater management plan, the applicant shall sign and record an O&M agreement prepared and approved by the Township Solicitor covering all stormwater control facilities that are to be privately owned. The form and substance of the agreement shall be consistent with the agreement Appendix L of this Ordinance. **[Amended by Ordinance 2006-3]**

B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory maintenance of all facilities. The O&M agreement shall be subject to review and approval of the Township. **[Amended by Ordinance 2006-3]**

C. The owner is responsible for the O&M of the SWM BMPs. If the owner fails to adhere to the O&M Agreement, the Township may perform the services required and charge the owner appropriate fees. Nonpayment of fees may result in a lien against the property.

Section 134-43. Stormwater Management Easements

A. Stormwater management easements shall be provided by the property owner if necessary for: (1) access for facility inspections and maintenance, or (2) preservation of stormwater runoff conveyance, infiltration, and detention areas and facilities, including flood routes for the 100-year storm event. The purpose of the easement shall be specified in the maintenance agreement signed by the property owner.

B. Stormwater management easements are required for all areas used for off-site stormwater control, unless a waiver is granted by the Township.

C. Easements shall be recorded with the Bucks County Recorder of Deeds prior to issuance of a building permit or recordation of a subdivision or land development plan.

Section 134-44. Municipal Stormwater Maintenance Fund

A. If stormwater BMPs are accepted by the Township for dedication, persons installing stormwater BMPs 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. The deposit shall cover the estimated costs for BMP maintenance, and inspections required pursuant to Section 134-45 for ten (10) years. The Township Engineer will establish the estimated costs upon review of information submitted by the applicant.
2. The amount of the deposit to the fund shall be converted to present worth of the annual series of payments. The Township engineer shall determine the present worth equivalents, which shall be subject to the approval of the Board of Supervisors.

B. If a BMP is proposed that also serves as a recreation facility (e.g., ballfield, pond), the Township may, but is not required to, reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreation purpose.

C. If stormwater BMPs are to be privately owned and maintained, the applicant shall pay an amount to the Township Stormwater Maintenance Fund, as established by separate resolution, to help defray the costs of periodic inspection by the Township.

D. A financial deposit to the Township Stormwater Management Fund shall be required to be paid by the developer to help defray costs of periodic inspections and maintenance expenses associated with all stormwater management facilities, storm sewer, culverts, and other such improvements required by PennDOT, to be constructed within the right-of-way of public roadways, that are to be maintained after dedication by the Township. The deposit shall cover the estimated cost for maintenance and inspections for ten (10) years.

Section 134-45. Post-Construction Maintenance Inspections

A. BMPs shall be inspected by the landowner/developer or responsible entity (including the Township Engineer for dedicated BMPs) on the following basis:

1. Twelve (12) months after completion of the facility and acceptance by the Township.
2. At least once every three (3) years thereafter,
3. During or immediately after the cessation of a 100-year or greater storm event.

B. The entity conducting the inspection shall submit a report to the Township regarding necessary repairs, if any.

Article VIII PROHIBITIONS

Section 134-46. Prohibited Discharges

A. Any drain or conveyance, whether on the surface or subsurface, that allows non-stormwater discharge including, but not limited to, sewage, processed wastewater, and wash water to enter the Waters of the Commonwealth is prohibited.

B. No person in the Township shall allow or cause to allow stormwater discharges into the Township's separate storm sewer system which are not composed entirely of stormwater, except discharges allowed under a state or federal permit.

C. Discharges which may be allowed under the Township's NPDES permit based on a finding by the Township that the discharge(s) do not significantly contribute to pollution to surface waters of the Commonwealth by the Township are:

Water line flushing
Landscape irrigation
Diverted stream flows
Uncontaminated pumped groundwater
Flows from riparian habitats and wetlands
Springs
Water from crawl space pumps
Dechlorinated swimming pool discharge (per PADEP requirements)
Routine external building wash down (which does not use detergents or other compounds)
Discharges from potable sources
Discharges from foundation drains
Air conditioning condensation
Irrigation water
Street wash water
Individual residential car washing
Lawn watering
Discharges from firefighting activities including training
Uncontaminated water from foundations or footing drains

D. In the event that the Township subsequently determines that any of the discharges identified in Subsection B degrade the quality of Waters of the Commonwealth or U.S. by the Township, then the Township will notify the responsible person to cease the discharge.

E. Upon notice provided by the Township under Subsection C, the discharger will have a reasonable time to cease the discharge consistent with the degree of pollution caused by the discharge.

F. Nothing in this section shall affect a discharger's responsibility under State Law.

Section 134-47. Prohibited Connections

A. The following connections are prohibited:

1. Any drain or conveyance, whether on the surface or subsurface, which allows any non-storm water discharge including sewage, process wastewater, and wash water to enter the separate storm sewer systems, and any connections to the storm drain system from indoor drains and sinks;

2. Any drain or conveyance connected from a commercial or industrial land use to the separate storm sewer system which has not been documented in plans, maps, or equivalent records, and approved by the Township.

B. This prohibition expressly includes, without limitation, connections made in the past, regardless of whether the connection, drain or conveyance was previously allowed, permitted, or approved by a government agency, or otherwise permissible under law or practices applicable or prevailing at the time of connection.

Section 134-48. Roof Drains

A. Roof drains shall discharge to infiltration areas or vegetative BMPs and to the maximum extent practicable satisfy the criteria for disconnected impervious areas (DIAs).

B. Roof drains shall not be connected to streets through the curb or to sanitary sewers**;** and shall only be connected to storm sewer or swales (located within an easement) when designed as part of a stormwater BMP.

Section 134-49. Waste Disposal Prohibitions

No person shall throw, deposit, leave, maintain, keep, or permit to be thrown, deposited, left, or maintained, in or upon any public or private property, driveway, parking area, street, alley, sidewalk, or other component of the Township's separate storm sewer system, any refuse, rubbish, garbage, litter, or other discarded or abandoned objects, articles, and accumulations, so that the same may cause or contribute to pollution. Wastes deposited in streets in proper waste receptacles for the purposes of collection are exempted from this prohibition.

Section 134-50. Alteration of SWM BMPs

A. No person shall modify, remove, fill, landscape, or alter any existing stormwater management BMP, unless part of an approved maintenance program, and written approval of the Township has been obtained.

B. No person shall place any structure, fill, landscaping or vegetation into a stormwater management BMP or within a drainage easement, which would limit or alter the functioning of the BMP, without the written approval of the Township.

ARTICLE IX. ENFORCEMENT AND PENALTIES

Section 134-51. Right-of-Entry

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

Section 134-52. 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 municipality shall provide written notification of the violation. 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. In addition the municipality may pursue 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. In the case where the violation poses an immediate threat to the health, safety, and welfare of the community, no notice under this section shall be required.

Section 134-53. Enforcement

The Board of Supervisors is hereby authorized and directed to enforce all of the provisions of this Ordinance. All inspections regarding compliance with the stormwater management plan shall be the responsibility of the Municipal Engineer or other qualified persons designated by the municipality as directed by the Board of Supervisors.

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

B. Adherence to approved plan

   It shall be unlawful for any person, firm, or corporation to undertake any regulated activity under Section 134-4 on any property except as provided for in the approved stormwater management plan and pursuant to the requirements of this Ordinance. It shall be unlawful to alter or remove any control structure required by the stormwater management plan pursuant to this Ordinance or to allow the property to remain in a condition which does not conform to the approved stormwater management 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 a professional engineer verifying that all permanent facilities have been constructed according to the plans and specifications and approved revisions thereto.
   2. Provide an electronic copy and and two paper prints of as-built drawings.

D. After receipt of the certification by the municipality, a final inspection shall be conducted by the Board of Supervisors or its designee to certify compliance with this Ordinance.

E. Prior to revocation or suspension of a permit, the Board of Supervisors will schedule a hearing to discuss the non-compliance if 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 Board of Supervisors for:

   a) Noncompliance 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~~ VIII of this Ordinance.

2. A suspended permit shall be reinstated by the Board of Supervisors when:

   a) The Municipal 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, and/or;

   b) The Board of Supervisors is satisfied that the violation of the Ordinance, law, or rule and regulation has been corrected.

3. A permit that has been revoked by the Board of Supervisors 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 134-37.D has been secured. The occupancy permit shall be required for each lot owner and/or developer for all subdivisions and land developments in the municipality.

Section 134-54. Violations Deemed 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.

C. Whenever the Municipality finds that a person has violated a prohibition or failed to meet a requirement of this Ordinance, the Municipality may order compliance by written notice to the responsible person. Such notice may require without limitation:

1. The performance of monitoring, analyses, and reporting;
2. The elimination of prohibited discharges;
3. Cessation of any violating discharges, practices, or operations;

4. The abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property;
5. Payment of a fine to cover administrative and remediation costs;
6. The implementation of stormwater BMPs; and
7. Operation and maintenance of stormwater BMPs.

[Added by Ordinance 2006-4]

D. Failure to comply within the time specified shall also subject such person to the penalty provisions of this Ordinance. All such penalties shall be deemed cumulative and shall not prevent the Municipality from pursuing any and all other remedies available in law or equity. **[Added by Ordinance 2006-4]**

Section 134-55. 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 $1,000 for each violation, recoverable with costs, or imprisonment of not more than 10 days, or both. Each day that the violation continues shall be a separate offense.

B. In addition, the municipality, 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.

Section 134-56. Appeals

A. Appeals from the determination of the Township or its designee, or from the determination of the Township Engineer in the administration of this Ordinance as it relates to stormwater management of a project shall be made to the Board of Supervisors within thirty (30) days of that determination or decision.

B. Any person aggrieved by a decision of the Board of Supervisors may appeal to the Zoning Hearing Board within thirty (30) days of the decision.

C. Any person aggrieved by a decision of the Zoning Hearing Board or Board of Supervisors may appeal to the Bucks County Court of Common Pleas within thirty (30) days of the decision of the Zoning Hearing Board or Board of Supervisors.

Section 134-57 Repealer

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

Section 134-58 Severability

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

ENACTED and ORDAINED at a regular meeting of the Hilltown Township Board of Supervisors on the ___th day of _____, 2011. This Ordinance shall take effect immediately.

_____
Chairperson

_____
Vice Chairperson

_____
Supervisor

ATTEST:

_____
Manager

I hereby certify that the foregoing Ordinance was advertised in the [name of newspaper] on _____, a newspaper of general circulation in the municipality and was duly enacted and approved as set forth at a regular meeting of the Hilltown Township Board of Supervisors held on _____.

_____
Manager

APPENDIX A:
STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE A-1
DESIGN STORM RAINFALL AMOUNT
Source: NOAA Atlas 14 website, Doylestown Gage (36-2221)
http://hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html.

FIGURE A-1
ATLAS 14 TYPE II S-CURVES FOR ALL FREQUENCY STORMS – DOYLESTOWN GAGE (36-2221)
Source: NOAA Atlas 14 website, Doylestown Gage (36-2221)
http://hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html.

TABLE A-2
NATURAL RESOURCE PROTECTION STORMWATER MANAGEMENT CONTROLS
Source: PA BMP Manual Chapter 8, pg 33

TABLE A-3
GUIDANCE TO CALCULATE THE 2-YEAR, 24-HOUR VOLUME INCREASE FROM PRE-DEVELOPMENT TO POST-DEVELOPMENT CONDITIONS
Source: PA BMP Manual Chapter 8, pg 37

TABLE A-4
RUNOFF CURVE NUMBERS
Source: NRCS (SCS) TR-55

TABLE A-5
VOLUME CONTROL CALCULATION GUIDANCE FOR NONSTRUCTURAL BMPS
Source: PA BMP Manual Chapter 8, pg 34

TABLE A-6
VOLUME CONTROL CALCULATION GUIDANCE FOR STRUCTURAL BMPS
Source: PA BMP Manual Chapter 8, pg 38

TABLE A-7
RATIONAL RUNOFF COEFFICIENTS
Source: New Jersey Department of Transportation, Technical Manual for Stream Encroachment, August, 1984

TABLE A-8
MANNING ROUGHNESS COEFFICIENTS

TABLE A-1
DESIGN STORM RAINFALL AMOUNT (INCHES)

The design storm rainfall amount chosen for design should be obtained from the National Oceanic and Atmospheric Administration Atlas 14 interactive website:
http://hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html

Source: NOAA Atlas 14 website, Doylestown Gage (36-2221)
http://hdsc.nws.noaa.gov/hdsc/pfds/orb/pa_pfds.html

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	6 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.34	0.54	0.68	0.93	1.15	1.38	1.51	1.89	2.30	2.71	3.13	3.48	4.07	4.61	6.23	7.76	9.85	11.81
2	0.40	0.64	0.81	1.12	1.40	1.67	1.83	2.28	2.78	3.26	3.78	4.19	4.87	5.51	7.39	9.14	11.57	13.83
5	0.47	0.76	0.96	1.36	1.75	2.10	2.30	2.86	3.50	4.11	4.76	5.24	6.02	6.71	8.81	10.65	13.30	15.78
10	0.53	0.84	1.06	1.54	2.01	2.42	2.66	3.32	4.11	4.81	5.57	6.09	6.96	7.68	9.93	11.83	14.60	17.23
25	0.59	0.94	1.19	1.76	2.34	2.86	3.15	3.98	4.99	5.83	6.71	7.30	8.30	9.03	11.44	13.36	16.25	19.04
50	0.63	1.00	1.27	1.92	2.60	3.21	3.54	4.52	5.74	6.70	7.66	8.29	9.41	10.11	12.61	14.52	17.46	20.35
100	0.67	1.07	1.35	2.07	2.85	3.56	3.94	5.09	6.55	7.63	8.67	9.33	10.59	11.23	13.79	15.66	18.61	21.57
200	0.71	1.13	1.42	2.21	3.11	3.92	4.35	5.69	7.43	8.64	9.75	10.44	11.83	12.39	14.98	16.79	19.69	22.70
500	0.76	1.20	1.51	2.40	3.44	4.41	4.90	6.54	8.73	10.12	11.30	12.01	13.60	14.00	16.58	18.23	21.02	24.08
1000	0.79	1.24	1.56	2.53	3.69	4.78	5.34	7.23	9.82	11.35	12.57	13.29	15.04	15.28	17.80	19.31	21.96	25.04

* These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.

FIGURE A-1
Atlas 14 Type II S-Curves for All Frequency Storms – Doylestown Gage (36-2221)

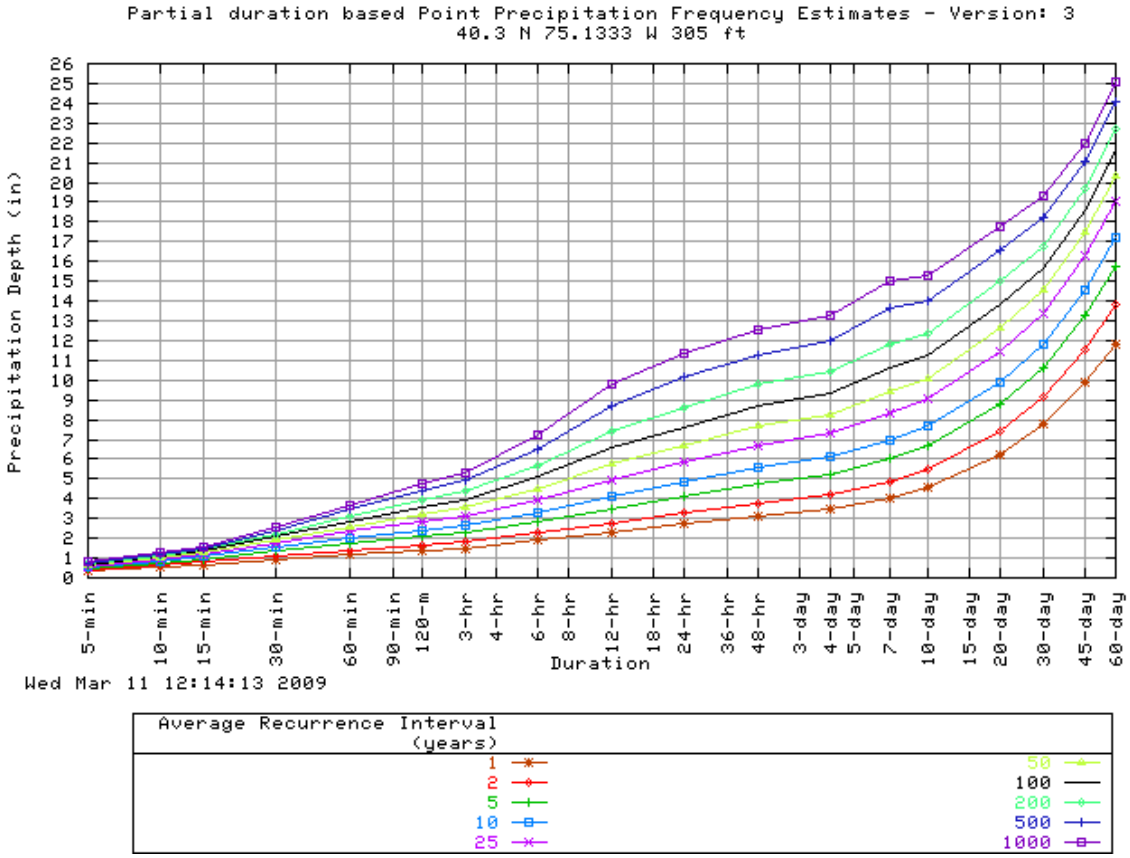


TABLE A-2: NATURAL RESOURCE PROTECTION STORMWATER MANAGEMENT CONTROLS

Existing Natural Sensitive Resource	Mapped in the ERSAM? Yes/No/n/a	Total Area (Ac.)	Area to be Protected (Ac.)
Waterbodies			
Floodplains			
Riparian Areas / Buffers			
Wetlands			
Vernal Pools			
Woodlands			
Natural Drainage Ways			
Steep Slopes, 15%-25%			
Steep Slopes, over 25%			
Other:			
Other:			
Total Existing:			

TABLE A-3: GUIDANCE TO CALCULATE THE 2-YEAR, 24-HOUR VOLUME INCREASE FROM PRE-DEVELOPMENT TO POST-DEVELOPMENT CONDITIONS

Existing Conditions: Cover Type/Condition	**Soil Type**	**Area (sf)**	**Area (ac)**	**CN**	**S**	**Ia (0.2*S)**	**Q Runoff (in)**	**Runoff Volume (ft3)**
Woodland								
Meadow								
Impervious								
Total:								

Developed Conditions: Cover Type/Condition	**Soil Type**	**Area (sf)**	**Area (ac)**	**CN**	**S**	**Ia (0.2*S)**	**Q Runoff (in)**	**Runoff Volume (ft3)**
Total:								

2-year Volume Increase (ft3): | |

TABLE A-4. Runoff Curve Numbers (from NRCS (SCS) TR-55)

LAND USE DESCRIPTION	Hydrologic Condition	HYDROLOGIC SOIL GROUP A	B	C	D
Open Space					
Grass cover < 50%	Poor	68	79	86	89
Grass cover 50% to 75%	Fair	49	69	79	84
Grass cover > 75%	Good	39	61	74	80
Meadow		30	58	71	78
Agricultural					
Pasture, grassland, or range – Continuous forage for grazing	Poor	68	79	86	89
Pasture, grassland, or range – Continuous forage for grazing.	Fair	49	69	79	84
Pasture, grassland, or range – Continuous forage for grazing	Good	39	61	74	80
Brush-weed-grass mixture with brush the major element.	Poor	48	67	77	83
Brush-weed-grass mixture with brush the major element.	Fair	35	56	70	77
Brush-weed-grass mixture with brush the major element.	Good	30	48	65	73
Fallow Bare soil	-------	77	86	91	94
Crop residue cover (CR)	Poor	76	85	90	93
	Good	74	83	88	90
Woods – grass combination (orchard or tree farm)	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
Commercial	(85% Impervious)	89	92	94	95
Industrial	(72% Impervious)	81	88	91	93
Institutional	(50% Impervious)	71	82	88	90
Residential districts by average lot size:	% Impervious				
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
Farmstead		59	74	82	86
Smooth Surfaces (Concrete, Asphalt, Gravel or Bare Compacted Soil)		98	98	98	98
Water		98	98	98	98
Mining/Newly Graded Areas (Pervious Areas Only)		77	86	91	94

* Includes Multi-Family Housing unless justified lower density can be provided.

Note: Existing site conditions of bare earth or fallow ground shall be considered as meadow when choosing a CN value.

TABLE A-5: VOLUME CONTROL CALCULATION GUIDANCE FOR NONSTRUCTURAL BMPS

Type of Nonstructural BMP

	AREA (sq ft)	*****	**Runoff Volume (in)**	*** 1/12 =**	**Volume Reduction(ft^3)**
Use of Natural Drainage Feature					
Utilize natural flow pathways	_____sq ft		* 1/4" * 1/12 =		_____cu ft
Minimum Soil Compaction					
Lawn	_____sq ft		* 1/3" * 1/12 =		_____cu ft
Meadow	_____sq ft		* 1/3" * 1/12 =		_____cu ft
Protecting existing trees (not located in protected area)					
For trees within 20 feet of impervious cover:					
Tree Canopy	_____sq ft		* 1" * 1/12 =		_____cu ft
For trees within 20-100 feet of impervious cover:					
Tree Canopy	_____sq ft		* 1/2" * 1/12 =		_____cu ft
Rooftop Disconnection					
For runoff directed to pervious and/or vegetative areas where infiltration occurs					
Roof Area	_____sq ft		* 1/4" * 1/12 =		_____cu ft
Impervious Disconnection					
For runoff from impervious surfaces such as streets and concrete directed to pervious and/or vegetative areas where infiltration occurs					
Impervious Area	_____sq ft		* 1/4" * 1/12 =		_____cu ft
Total Volume Reduction					_____**cu ft**

***** represents multiply

TABLE A-6: VOLUME CONTROL CALCULATION GUIDANCE FOR STRUCTURAL BMPS

Required Volume Control (ft^3) – **Nonstructural Volume Control (ft^3)** = **Structural Volume Requirement (ft^3)**

Table B-3 Table B-5

Type	Proposed Structural BMP	Section in BMP Manual	Area (sq ft)	Storage Volume (cu ft)
Infiltration and / or Evapotranspiration	Porous Pavement	6.4.1		
	Infiltration Basin	6.4.2		
	Infiltration Bed	6.4.3		
	Infiltration Trench	6.4.4		
	Rain Garden/Bioretention	6.4.5		
	Dry Well/Seepage Pit	6.4.6		
	Constructed Filter	6.4.7		
	Vegetative Swale	6.4.8		
	Vegetative Filter Strip	6.4.9		
	Infiltration Berm	6.4.10		
Evaporation and / or Reuse	Vegetative Roof	6.5.1		
	Capture and Re-use	6.5.2		
Runoff Quality	Constructed Wetlands	6.6.1		
	Wet Pond / Retention Basin	6.6.2		
	Dry Extended Detention Basin	6.6.3		
	Water Quality Filters	6.6.4		
Restoration	Riparian Buffer Restoration	6.7.1		
	Landscape Restoration / Reforestation	6.7.2		
	Soil Amendment	6.7.3		
Other	Level Spreader	6.8.1		
	Special Storage Areas	6.8.2		
	other			

Total Volume Control from Structural BMPs: _____

TABLE A-7 RATIONAL RUNOFF COEFFICIENTS

By Hydrologic Soils Group and Overland Slope (%)

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

[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

TABLE A-8. MANNING'S ROUGHNESS COEFFICIENTS

DESCRIPTION	Manning's n-value
Smooth-wall 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) 68 mm × 13 mm (2 2/3 in × 1/2 in) Corrugations 75 mm × 25 mm (3 in × 1 in) Corrugations 125 mm × 25 mm (5 in × 1 in) Corrugations 150 mm × 50 mm (6 in × 2 in) Corrugations	 0.024 0.027 0.025 0.033
Helically Corrugated Steel And Aluminum Alloy Pipe (Plain or polymer coated) 75 mm × 25 mm (3 in × 1 in), 125 mm × 25 mm (5 in × 1 in), or 150 mm × 50 mm (6 in × 2 in) Corrugations	 0.024
Helically Corrugated Steel And Aluminum Alloy Pipe (Plain or polymer coated) 68 mm × 13 mm (2 2/3 in × 1/2 in) Corrugations a. Lower Coefficients* 450 mm (18 in) Diameter 600 mm (24 in) Diameter 900 mm (36 in) Diameter 1200 mm (48 in) Diameter 1500 mm (60 in) Diameter or larger b. Higher Coefficients**	 0.014 0.016 0.019 0.020 0.021 0.024
Annular or Helically Corrugated Steel or Aluminum Alloy Pipe Arches or Other Non-Circular Metal Conduit (Plain or Polymer coated)	 0.024
Vitrified Clay Pipe	0.012
Ductile Iron Pipe	0.013
Asphalt Pavement	0.015
Concrete Pavement	0.014
Grass Medians	0.050
Grass – Residential	0.30
Earth	0.020
Gravel	0.030
Rock	0.035
Cultivated Areas	0.030 - 0.050
Dense Brush	0.070 - 0.140
Heavy Timber (Little undergrowth)	0.100 - 0.150
Heavy Timber (w/underbrush)	0.40
Streams: a. Some Grass And Weeds (Little or no brush) b. Dense Growth of Weeds c. Some Weeds (Heavy brush on banks)	 0.030 - 0.035 0.035 - 0.050 0.050 - 0.070

Notes:

* 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 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.

APPENDIX B

NESHAMINY CREEK WATERSHED

SWM SITE PLAN CHECKLIST

APPENDIX B NESHAMINY CREEK WATERSHED SWM SITE PLAN CHECKLIST

Project: _____
Municipality: _____
Engineer: _____
Submittal No: _____
Date: _____
Project ID: _____ (for Municipal use ONLY)

SECTION I: REGULATED ACTIVITIES

Reference: Section 134-4

1. Is the Proposed Project within the Neshaminy Creek watershed? ☐ Yes ☐ No
2. Does the Proposed Project meet the definition of a "Regulated Activity"? ☐ Yes ☐ No

STOP – If you have checked NO for either of the above questions, you are not required to submit a Stormwater Management Plan under the Neshaminy Creek Stormwater management Ordinance.

SECTION II: EXEMPTION

Reference: Section 134-5

1. Does the regulated activity create an Impervious Surface less than or equal to 1,000 square feet? ☐ Yes ☐ No
2. Does the regulated activity create an Impervious Surface greater than 1,000 square feet but less than 2,500 square feet? ☐ Yes ☐ No
3. Does the regulated activity involve an Agricultural Activity? ☐ Yes ☐ No
4. Does the regulated activity involve Forest Management or Timber Operations? ☐ Yes ☐ No

Parcel IS Exempt from the SWM Site Plan and Peak Rate Control ☐
Parcel IS Exempt from Peak Rate Control ☐
Parcel IS NOT Exempt ☐

SECTION III: VOLUME CONTROLS

Reference: Section 134-17

A. Site Disturbance Minimization

1. Has an Existing Resource and Site Analysis Map (ERSAM) been prepared?

☐ Yes ☐ No, Explain _____
_____
_____

2. Are any of the following environmentally sensitive areas identified on site?

Steep Slopes	☐ Yes	☐ No	☐ Unknown
Ponds / Lakes / Vernal Pools	☐ Yes	☐ No	☐ Unknown
Streams	☐ Yes	☐ No	☐ Unknown
Wetlands	☐ Yes	☐ No	☐ Unknown
Hydric Soils	☐ Yes	☐ No	☐ Unknown
Flood plains	☐ Yes	☐ No	☐ Unknown
Stream Buffer Zones	☐ Yes	☐ No	☐ Unknown
Hydrologic Soil Groups A or B	☐ Yes	☐ No	☐ Unknown
Recharge Areas	☐ Yes	☐ No	☐ Unknown
Others: _____	☐ Yes	☐ No	☐ Unknown

3. Does the site layout plan avoid environmentally sensitive areas identified on site?

☐ Yes ☐ No, Explain _____

_____

_____

_____

B. Post-development Runoff Volume Control

1. What method is used to calculate the required volume control?

☐ Design-storm method ☐ Simplified method

2. What is the level of runoff volume (ft^3) required to be controlled from the post-development site? _____(ft^3)

C. Stormwater runoff control measures

1. What is the level of runoff volume (ft^3) controlled through nonstructural BMPs? _____(ft^3)

2. What is the level of runoff volume (ft^3) controlled through structural BMPs? _____(ft^3)

3. Have provisions been installed to promote infiltration on site?

☐ Yes ☐ No, Explain _____

_____

_____

4. Have provisions been installed to promote evapotranspiration, capture or reuse on site?

☐ Yes ☐ No, Explain _____

_____

_____

SECTION V: PEAK RATES

Reference: Section 134-12

1. In which of the following Storm Water Management District(s) is the site located?

☐	A
☐	B
☐	C

2. Does the Proposed Conditions Runoff meet the Criteria established in Section 134-12.D?

   ☐ Yes ☐ No, if you answered Yes proceed to Section VI.

   _____

SECTION VI: CALCULATION METHODOLOGY

Reference: Section 134-20 and Ordinance Appendix A

1. Which method(s) are utilized in the site stormwater management plan for computing stormwater runoff rates and volumes?

   ☐ TR-20 ☐ PSRM
   ☐ TR-55 ☐ Rational Method
   ☐ HEC-1 /HEC-HMS ☐ Other:_____

2. Was Table A-1 or Figure A-1 utilized in rainfall determination?

   ☐ Yes ☐ No, Explain_____

   _____

   _____

3. Was Table A-4 (Runoff Curve Numbers) or Table A-7 (Rational Runoff Coefficients) utilized in calculations for runoff?

   ☐ Yes ☐ No, Explain_____

   _____

   _____

SECTION IX: OTHER REQUIREMENTS

Reference: Section 134-23

1. Is the proposed activity considered a “Stormwater hot spot” as defined in Ordinance Appendix H?
   ☐ Yes ☐ No, If yes, what pre-treatment BMPs are planned?

   _____

2. Have proposed wet detention basins incorporated biologic control consistent with the West Nile Virus Guidelines presented in Ordinance Appendix I?

☐ Yes ☐ No ☐ Not Applicable

_____

SECTION X: FACILITY OPERATION AND MAINTENANCE PLAN

Reference: Section 134-40

1. Has a Stormwater Control and BMP Operations and Maintenance Plan been approved by the Municipality?

☐ Yes ☐ No, Explain _____

_____

2. Who shall assume responsibility for implementing the Stormwater Control and BMP Operations and Maintenance Plan?

☐ Municipality ☐ Homeowner Association

☐ Private Owner ☐ Other _____

APPENDIX C

SITE EVALUATION AND SOIL INFILTRATION TESTING

SITE EVALUATION AND SOIL INFILTRATION TESTING PROTOCOL

A. Purpose of this Protocol

The purpose of the *Site Evaluation and Soil Infiltration Testing Protocol* is to describe evaluation and field testing procedures to:

1. Determine if infiltration BMPs are suitable at a site, and at what locations.

2. Obtain the required data for infiltration BMP design.

B. When to Conduct Testing

The site development process outlined in Chapters 4 and 5 of the Pennsylvania Stormwater Management Best Management Practices Manual, December 2006, as amended ("Manual") describe a process for site development and BMPs. Soil Evaluation and Investigation shall be conducted early in the preliminary design of the project so that information developed in the testing process can be incorporated into the design. The Soil Evaluation and Investigation shall be conducted prior to development of the preliminary plan. The design engineer should possess a preliminary understanding of potential BMP locations prior to testing. Prescreening test may be carried out in advance of site potential BMP locations.

C. Who Should Conduct Testing

Qualified professionals who can substantiate by qualifications/experience their ability to carry out the evaluation shall conduct the test pit soil evaluations. A professional, experienced in observing and evaluating soils conditions is necessary to ascertain conditions that might affect BMP performance, which cannot be thoroughly assessed with the testing procedures. Such professionals must conduct these evaluations in risk areas, and areas indicated in the Manual as non-preferred locations for testing or BMP implementation.

D. Importance of Stormwater BMP Areas

Sites are often defined as unsuitable for infiltration BMPs and soil based BMPs due to proposed grade changes (excessive cut or fill) or lack of suitable areas. Many sites will be constrained and unsuitable for infiltration BMPs. However, if suitable areas exist, these areas must be identified early in the design process and <u>not</u> be subject to a building program that precludes infiltration BMPs. An exemption will not be permitted for development of suitable soils that may be necessary for stormwater infiltration.

E. Safety

As with all field work and testing, attention must be given to all applicable OSHA regulations related to earthwork and excavation. Digging and excavation shall not be conducted without adequate notification through the Pennsylvania One Call system (**PA One Call** 1-800-242-1776

or www.paonecall.org). Excavations shall not be left unsecured and unmarked, and all applicable authorities must be notified prior to any work.

F. Infiltration Testing: A Multi-Step Process

Infiltration Testing is a four-step process to obtain the necessary data for design of the stormwater management plan. The four steps include:

1. Background Evaluation

   - Based on available published and site specific data
   - Includes consideration of proposed development plan
   - Used to identify potential BMP locations and testing locations
   - Prior to field work (desktop)
   - On-site screening test

2. Test Pit (Deep Hole) Observation

   - Includes Multiple Testing Locations
   - Provides an understanding of sub-surface conditions
   - Identifies limiting conditions

3. Infiltration Testing

   - Must be conducted onsite
   - Different testing methods available
   - Alternate methods for – additional – Screening and Verification testing

4. Design Considerations

   - Determination of suitable infiltration rate for design calculations
   - Consideration of BMP drawdown
   - Consideration of peak rate attenuation

Step 1. Background Evaluation

Prior to performing testing and developing a detailed site plan, existing conditions at the site must be inventoried and mapped including, but not limited to:

- Existing mapped individual soils and USDA Hydrologic Soil Group classifications.
- Exiting geology, including the location of any dikes, faults, fracture traces, solution cavities, landslide prone strata, or other features of note.
- Existing streams (perennial and intermittent, including intermittent swales) water bodies, wetlands, hydric soils, floodplains, alluvial soils, stream classifications, headwaters and 1st order streams.
- Existing topography, slope, and drainage patterns.
- Existing and previous land uses.
- Other natural or man-made features or conditions that may impact design, such as past uses of site, existing nearby structures (building, walls), etc.

In Step 1, the designer should determine the potential location of infiltration BMPs. The approximate location of these BMPs should be identified on the proposed development plan and serve as the basis for the location and number of tests to be performed onsite. A sketch plan or preliminary layout plan for development should be evaluated, including:

- Preliminary grading plan and areas of cut and fill.
- Location and water surface elevation of all existing and location of proposed water supply sources and wells.
- Location of all existing and proposed onsite wastewater systems.
- Location of other features of note such as utility right-of-ways, water and sewer lines, etc.
- Existing data such as structural borings, drillings, and geophysical testing.
- Proposed location of development features (buildings, roads, utilities, walls, etc.).

Important: If the proposed development program is located on areas that may otherwise be suitable for BMP location, or if the proposed grading plan is such that potential BMP locations are eliminated, the designer must revisit the proposed layout and grading plan and adjust the development plan as necessary. Development on areas suitable for infiltration BMPs may *not* preclude the use of BMPs for volume reduction and groundwater recharge.

Step 2. Test Pits (Deep Holes)

A Test Pit (Deep Hole) allows visual observation of the soil horizons and overall soil conditions both horizontally and vertically in that portion of the site. An extensive number of Test Pit observations can be made across a site at a relatively low cost and in a short time period. The use of soil borings as a substitute for Test Pits is not permitted as visual observation is narrowly limited in a soil boring and the soil horizons cannot be observed in-situ, but must be observed from the extracted borings. Borings and other procedures, however, might be suitable for initial screening to develop a plan for testing, or verification testing.

A Test Pit consists of a backhoe-excavated trench, two and one half (2½) to three (3) feet wide, to a depth of between seventy two (72) inches and ninety (90) inches, or until bedrock or fully saturated conditions are encountered. The trench should be benched at a depth of two (2) to three (3) feet for access and/or infiltration testing.

At each Test Pit, the following conditions shall be noted and described. Depth measurements shall be described as depth below the ground surface:

___ Soil horizons (upper and lower boundary)

___ Soil texture and color for each horizon

___ Color patterns

___ Depth to water table

___ Depth to bedrock

___ Observance of pores or roots (size, depth)

___ Estimated type and percent coarse fragments

___ Hardpan or limiting layers

___ Strike and dip of horizons (especially lateral direction of flow at limiting layers)

___ Additional comments or observations

The Sample Soil Log Form at the end of this protocol may be used for documentation of each Test Pit. (Refer Appendix C of the Pennsylvania Stormwater Best Management Practices Manual)

At the designer's discretion, soil samples may be collected at various horizons for additional analysis. Following testing, the test pits must be refilled with the original soil and the surface replaced with the original topsoil. A Test Pit should *never* be accessed if soil conditions are unsuitable for safe entry, or if site constraints preclude entry.

It is important that the Test Pit provide information related to conditions at the bottom of the proposed infiltration BMP. If the BMP depth will be greater than ninety (90) inches below existing grade, deeper excavation will be required. However, *such depths are discouraged.* Except for surface discharge BMPs (filter strips, etc.) the designer is cautioned regarding the proposal of systems that are significantly lower than the existing topography. The suitability for infiltration may decrease, and risk factors are likely to increase. *Locations that are not preferred* for testing *and* subsurface infiltration BMPs include swales, the toe of slopes for most sites, and soil mantels of less than three feet.

The designer and contractors shall limit proposed grading and earthwork to reduce site disturbance and compaction so that a greater opportunity exists for testing and stormwater management.

The number of Test Pits varies depending on site conditions and the proposed development plan. General guidelines are as follows:

- For single-family residential subdivisions with on-lot BMPs, one test pit per lot is recommended, preferably within twenty five (25) feet of the proposed BMP area. Verification testing should take place when BMPs area sited at greater distances.
- For multi-family and high density residential developments, one test pit per BMP area or acre is recommended.
- For large infiltration areas (basins, commercial, institutional, industrial, and other proposed land uses), multiple test pits should be evenly distributed at the rate of four (4) to six (6) tests per acre of BMP area.

The recommendations above are guidelines. Additional tests will be required if local conditions indicate significant variability in soil types, geology, water table levels, bedrock, topography, etc. Similarly, uniform site conditions may indicate that fewer test pits are necessary. Excessive testing and disturbance of the site prior to construction is not recommended.

Step 3. Infiltration Tests/Permeability Tests

A variety of field tests exist for determining the infiltration capacity of a soil. Laboratory tests are not permitted, as a homogeneous laboratory sample does not represent field conditions. Infiltration tests shall be conducted in the field. Tests should not be conducted in the rain or within twenty four (24) hours of a significant rainfall events (>0.5 inches), or when the temperature is below freezing. However, the preferred testing *is*

between January and June, the wet season. This is the period when infiltration is likely to be diminished by saturated conditions. Percolation tests carried out between June 1 and December 31 shall use a twenty four (24) hour presoaking before the testing. This procedure is not required for infiltrometer testing, or permeometer testing.

At least one test shall be conducted at the proposed bottom elevation of an infiltration BMP, and a minimum of two tests per Test Pit is recommended. More tests may be warranted if the results for first two tests are substantially different. The highest rate (inches/hour) for test results should be discarded when more than two are employed for design purposes. The geometric mean should be used to determine the average rate following multiple tests.

Based on observed field conditions, the proposed bottom elevation of BMP may be revised. Infiltration testing should be proposed to adjust locations and depths depending upon observed conditions.

Methodologies discussed in this protocol include:

- Double-ring infiltrometer tests.
- Percolation tests (such as for onsite wastewater systems and described in PA Code Chapter 73).

There are differences between the two methods. A double-ring infiltrometer test estimates the vertical movement of water through the bottom of the test area. The outer ring helps to reduce the lateral movement of water in the soil. A percolation test allows water movement through both the bottom and sides of the test area. For this reason, the measured rate of water level drop in a percolation test must be adjusted to represent the discharge that is occurring on both the bottom and sides of the percolation test hole.

For *infiltration basins,* an infiltration test should be completed with an infiltrometer (not percolation test) to determine the saturated hydraulic conductivity rate. This precaution is taken to account for the fact that only the surface of the basin functions to infiltrate, as measured by the test. Alternatively, permeability test procedures that yield a saturated hydraulic conductivity rate can be used (see formulas developed by Elirick and Reynolds (1992), or others for computation of hydraulic conductivity and saturated hydraulic conductivity.

Other testing methodologies and standards that are available but not discussed in detail in this protocol include (but are not limited to):

- Constant head double-ring infiltrometer.
- Testing as described in the Maryland Stormwater Manual Appendix D.1 using five (5) inch diameter casing.
- ASTM 2003 Volume 4.08, Soil and Rock (I): Designation D3385-03, Standard Test Method for Infiltration Rate of Soils in Field Using a Double-Ring Infiltrometer.
- ASTM 2002 Volume 4.09, Soil and Rock (II): Designation D 5093.90, Standard Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed-Inner Ring.
- Guelph Permeameter.
- Constant Head Permeameter (Amoozemeter).

a. Methodology for Double-Ring Infiltrometer Field Test

A Double-ring Infiltrometer consists of two concentric metal rings. The rings are driven into the ground and filled with water. The outer ring helps to prevent divergent flow. The drop in water level or volume in the inner ring is used to calculate an infiltration rate. The infiltration rate is determined as the amount of water per surface area and time unit that penetrates the soils. The diameter of the inner ring should be approximately fifty (50) percent to seventy (70) percent of the diameter of the outer ring, with a minimum inner ring size of four (4) inches, preferably much larger. (Bouwer, 1986).

Equipment for Double-Ring Infiltrometer Test:

___ Two concentric cylinder rings six (6) inches or greater in height. Inner ring diameter equal to fifty (50) percent – seventy (70) percent of outer ring diameter (e.g. an eight (8) inch ring and a twelve (12) inch ring).

___ Water supply.

___ Stopwatch or timer.

___ Ruler or metal measuring tape.

___ Flat wooden board for driving cylinders uniformly into soil.

___ Rubber mallet.

___ Log sheets for recording data.

Procedure for Double-Ring Infiltrometer Test:

___ Prepare level testing area.

___ Place outer ring in place; place flat board on ring and drive ring into soil to a minimum depth of two (2) inches.

___ Place inner ring in center of outer ring; place flat board on ring and drive ring into soil a minimum of two (2) inches. The bottom rim of both rings should be at the same level.

___ The test area should be presoaked immediately prior to testing. Fill both rings with water to water level indicator mark or rim at thirty (30) minute intervals for one (1) hour. The minimum water depth should be four (4) inches. The drop in water level during the last thirty (30) minutes of the presoaking period should be applied to the following standard to determine the time interval between readings.

- If water level drop is two (2) inches or more, use ten (10) minute measurement intervals.
- If water level drop is less than two (2) inches, use thirty (30) minute measurement intervals.

___ Obtain a reading of the drop in water level in the center ring at appropriate time intervals. After each reading, refill both rings to water level indicator mark or rim. Measurement to the water level in the center ring shall be made from a fixed reference point and shall continue at the interval determined until a minimum of

eight readings are completed or until a stabilized rate of drop is obtained, whichever occurs first. A stabilized rate of drop means a difference of one quarter (¼) inch or less of drop between the highest and lowest readings of four consecutive readings.

___ The drop that occurs in the center ring during the final period or the average stabilized rate, expressed as inches per hour, shall represent the infiltration rate for that test location.

b. Methodology for Percolation Test

Equipment for Percolation Test:

___ Post hole digger or auger.

___ Water supply.

___ Stopwatch or timer.

___ Ruler of metal measuring tape.

___ Log sheets for recording data.

___ Knife blade or sharp pointed instrument (for soil scarification).

___ Course sand or fine gravel.

___ Object for fixed reference point during measurement (nail, toothpick, etc.).

Procedure for Percolation Test

This percolation test methodology is based largely on the Pennsylvania Department of Environmental Protection (PADEP) criteria for onsite sewage investigation of soils (as described in Chapter 73 of the Pennsylvania Code). This must include the twenty four (24) hour presoak procedure. The presoak is done primarily to simulate saturated conditions in the environment and to minimize the influence of unsaturated flow.

Prepare level testing area.

___ Prepare hole having a uniform diameter of six (6) to ten (10) inches and depth of eight (8) to twelve (12) inches. The bottom and sides of the hole should be scarified with a knife blade or sharp pointed instrument to completely remove any smeared soil surfaces and to provide a natural soil interface into which water may percolate. Loose material should be removed from the hole.

___ (Optional) two (2) inches of coarse sand or fine gravel may be placed in the bottom of the hole to protect the soil from scouring and clogging of the pores.

___ Test holes should be presoaked immediately prior to testing. Water should be placed in the hole to a minimum depth of six (6) inches over the bottom and readjusted every thirty (30) minutes to one (1) hour.

___ The drop in the water level during the last thirty (30) minutes of the final presoaking period should be applied to the following standard to determine the time interval between readings for each percolation hole:

- If water remains in the hole, the interval for readings during the percolation test should be thirty (30) minutes.
- If no water remains in the hole, the interval for readings during the percolation test may be reduced to ten (10) minutes.

___ After the final presoaking period, water in the hole should again be adjusted to a minimum depth of six (6) inches and readjusted when necessary after each reading. A nail or marker should be placed at a fixed reference point to indicate the water refill level. The water level depth and hole diameter should be recorded.

___ Measurement to the water level in the individual percolation holes should be made from a fixed reference point and should continue at the interval determined from the previous step for each individual percolation hole until a minimum of eight readings are completed or until a stabilized rate of drop means a difference of one quarter (¼) inch or less of drop between the highest and lowest readings of four consecutive readings.

___ The drop that occurs in the percolation hole during the final period, expressed as inches per hour, shall represent the percolation rate for that test location.

___ The average measured rate must be adjusted to account for the discharge of water from both the sides and bottom of the hole to develop a representative infiltration rate. The average/final percolation rate should be adjusted for each percolation test according to the following formula:

Infiltration Rate = (Percolation Rate) / (Reduction Factor)

Where the Reduction Factor is given**:

$$R_f = \frac{2d_1 - \blacktriangle d}{DIA} + 1$$

With:

d_1 = Initial Water Depth (in.)
$\blacktriangle d$ = Average/Final Water Level Drop (in.)
DIA = Diameter of the Percolation Hole (in.)

The Percolation Rate is simply divided by the Reduction Factor as calculated above or shown in the table below to yield the representative Infiltration Rate. In most cases, the Reduction Factor varies from about two (2) to four (4) depending on the percolation hole dimensions and water level drop – wider and shallower tests have lower Reduction Factors because proportionately less water exfiltrates through the sides. For design purposes additional safety factors are employed (see Protocol 2, Infiltration Systems Design and Construction Guidelines).

** *The area Reduction Factor accounts for the exfiltration occurring through the sides of percolation hole. It assumes that the percolation rate is affected by the depth of water in the hole and that the percolating surface of the hole is in uniform soil. If there are significant problems with either of these assumptions then other adjustments may be necessary.*

Source: *Pennsylvania Stormwater Best Management Practice Manual, December 2006*.

APPENDIX D

LOW IMPACT DEVELOPMENT TECHNIQUES

APPENDIX D

LOW IMPACT DEVELOPMENT PRACTICES

ALTERNATIVE APPROACH FOR MANAGING STORMWATER RUNOFF

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

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

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

A. Protect Sensitive and Special Value Resources: (Refer Section 5.4 of the Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)

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

2. **Protecting Natural Depression Storage Areas.** Depressional storage areas have not surface outlet or drain very slowly following a storm event. They can be commonly seen as ponded areas in farm fields during the wet season or after large runoff events. Traditional development practices eliminate these depressions by filling or draining, thereby obliterating their ability to reduce the surface runoff volumes and trap pollutants. The volume and release rate characteristics of depressions should be protected in the design of the development site. The depressions can be protected by

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

B. Reduce Impervious Coverage: (Refer Section 5.7 of the Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)

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

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

C. Disconnect/Distribute/Decentralize: (Refer Section 5.8 of the Pennsylvania Stormwater Best Management Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)

1. **Routing Roof Runoff Over Lawns.** Roof runoff can be easily routed over lawns in most site designs. The practice discourages direct connections of downspouts to storm sewers or parking lots. The practice also discourages sloping driveways and parking lots to the street. By routing roof drains and crowning the driveway to run off to the lawn, the lawn is essentially used as a filter strip.

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

3. **Reducing Street Widths.** Street widths can be reduced by either eliminating on-street parking or by reducing roadway widths. Municipal planners and traffic designers should encourage narrower neighborhood streets which ultimately could lower maintenance.

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

5. **Using Permeable Paving Materials.** These materials include permeable interlocking concrete paving blocks or porous bituminous concrete. Such materials should be considered as alternatives to conventional pavement surfaces, especially for low use surfaces such as driveways, overflow parking lots, and emergency access roads.

6. **Reducing Building Setbacks.** Reducing building setbacks reduces driveway and entry walks and is most readily accomplished along low traffic streets where traffic noise is not a problem.

D. Constructing and Concentrate: (Refer Section 5.5 of the Pennsylvania Stormwater Best Practices Manual, Pennsylvania Department of Environmental Protection (PADEP) no. 363-0300-002 (2006)**.** Cluster developments can also reduce the amount of impervious area for a given number of lots. The biggest savings is in street length, which also will reduce costs of the development. Cluster development clusters the construction activity onto less-sensitive areas without substantially affecting the gross density of development.

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

APPENDIX E

NONSTRUCTURAL STORMWATER MANAGEMENT BMPs

Non-Structural BMPs

1. Tree Plantings and Preservation

Trees and forests reduce stormwater runoff by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. Tree roots and leaf litter also create soil conditions that promote the infiltration of rainwater into the soil. In addition, trees and forests reduce pollutants by taking up nutrients and other pollutants from soils and water through their root systems. A development site can reduce runoff volume by planting new trees or by preserving trees which existed on the site prior to development. The volume reduction calculations either determine the cubic feet to be directed to the area under the tree canopy for infiltration or determine a volume reduction credit which can be used to reduce the size of any one of the planned structural BMPs on the site.

Tree Considerations**:**

- Existing trees must have at least a 4″ trunk caliper or larger.
- Existing tree canopy must be within 100 ft. of impervious surfaces.
- A tree canopy is classified as the continuous cover of branches and foliage formed by a single tree or collectively by the crowns of adjacent trees.
- New tree plantings must be at least 6 ft. in height and have a 2″ trunk caliper.
- All existing and newly planted trees must be native to Pennsylvania. See http://www.dcnr.state.pa.us/forestry/commontr/commontrees.pdf for a guide book titled *Common Trees of Pennsylvania* for a native tree list.
- When using trees as volume control BMPs, runoff from impervious areas should be directed to drain under the tree canopy.

Determining the required number of planted trees to reduce the runoff volume:

1. Determine contributing impervious surface area:

Garage Roof (Right)	6 ft. x 24 ft.	=	144	ft

2. Calculate the required control volume:

   (144 sq. ft. x 2 inches of runoff) / 12 inches = 24 cu. ft.

3. Determine the number of tree plantings:

   - A newly planted deciduous tree can reduce runoff volume by 6 cu. ft.
   - A newly planted evergreen tree can reduce runoff volume by 10 cu. ft.

   24 cu. ft./ 6 cu. ft. = 4 Deciduous Trees

Determining the volume reduction for preserving existing trees:

1. Calculate approximate area of the existing tree canopy:

~22 sq. ft. x ~23 sq. ft = 500 sq. ft.

2. Measure distance from impervious surface to tree canopy: 35 ft.

3. Calculate the volume reduction credit by preserving existing trees:

   - For Trees within 20 feet of impervious cover:
     Volume Reduction cu. ft. = (Existing Tree Canopy sq. ft. x 1 inch) / 12

   - For Trees beyond 20 feet but not farther than 100 feet from impervious cover:
     Volume Reduction cu. ft. = (Existing Tree Canopy sq. ft. x 0.5 inch) / 12

   (500 sq. ft. x 0.5 inches) / 12 = 21 cu. ft.

This volume credit can be utilized in reducing the size of any one of the structural BMPs planned on the site. For example, the 21 cu. ft. could be subtracted from the required infiltration volume when sizing the infiltration trench;

510 cu. ft – 21 cu. ft. = 489 cu. ft.

489 cu. ft. / 3 ft (Depth) = 163 / 6 ft. (Width) = 27.1 ft (Length)

Using the existing trees for a volume credit would decrease the length of the infiltration trench to 27.1 ft. instead of 28.3 ft.

2. Minimize Soil Compaction and Replant with Lawn or Meadow

When soil is overly compacted during construction it can cause a drastic reduction in the permeability of the soil and rarely is the soil profile completely restored. Runoff from vegetative areas with highly compacted soils similarly resembles runoff from an impervious surface. Minimizing soil compaction and re-planting with a vegetative cover like meadow or lawn, not only increases the infiltration on the site, but also creates a friendly habitat for a variety of wildlife species.

Design Considerations:

- Area shall not be stripped of topsoil.
- Vehicle movement, storage, or equipment/material lay down shall not be permitted in areas preserved for minimum soil compaction.
- The use of soil amendments and additional topsoil is permitted.
- Meadow should be planted with native grasses. Refer to *Meadows and Prairies: Wildlife-Friendly Alternatives to Lawn* at

http://pubs.cas.psu.edu/FreePubs/pdfs/UH128.pdf for reference on how to properly plant the meadow and for a list of native species.

Determining the volume reduction by minimizing soil compaction and planting a meadow:

1. Calculate approximate area of preserved meadow:

   ~22 sq. ft. x ~23 sq. ft = 500 sq. ft.

2. Calculate the volume reduction credit by minimizing the soil compaction and planting a lawn/meadow:

   - For Meadow Areas: Volume Reduction (cu. ft.) = (Area of Min. Soil Compaction (sq. ft.) x 1/3 inch of runoff) / 12

     (500 sq. ft. x 1/3 inch of runoff) / 12 = 13.8 cu. ft.

   - For Lawn Areas: Volume Reduction (cu. ft.) = (Area of Min. Soil Compaction (sq. ft.) x 1/4 inch of runoff) / 12

     (500 sq. ft. x 1/4 inch of runoff) / 12 = 10.4 cu. ft.

This volume credit can be used to reduce the size of any one of the structural BMPs on the site. See explanation under the volume credit for preserving existing trees for details.

Alternative BMP to Capture and Reuse Stormwater

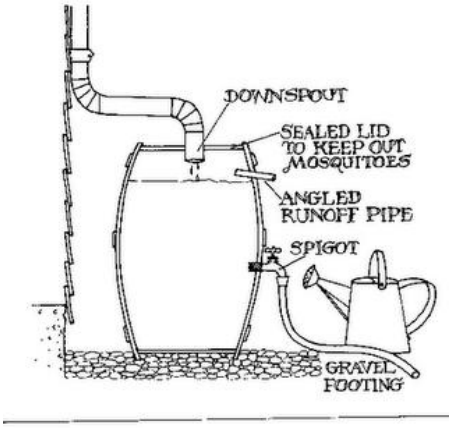
Rain Barrels

Rain barrels are large containers that collect drainage from roof leaders and temporarily store water to be released to lawns, gardens, and other landscaped areas after the rainfall has ended. Rain barrels are typically between 50 and 200 gallons in size. It is not recommended for rain barrels to be used as a volume control BMP because infiltration is not guaranteed after each storm event. For this reason, a rain barrel is not utilized in the site plan example. However, the information is included to provide an alternative for a homeowner to utilize when considering capture and reuse stormwater methods.

Design Considerations:

- Rain barrels should be directly connected to the roof gutter/spout.
- There must be a means to release the water stored between storm events to provide the necessary storage volume for the next storm.
- When calculating rain barrel size, rain barrels are typically assumed to be 25% full because they are not always emptied before the next storm.
- Use screens to filter debris and cover lids to prevent mosquitoes.
- An overflow outlet should be placed a few inches below the top with an overflow pipe to divert flow away from structures.
- It is possible to use a number of rain barrels jointly for an area.

Figure 2: Rain Barrel Diagram and Examples



Sources: (top picture) http://www.citywindsor.ca/DisplayAttach.asp?AttachID=12348
(bottom picture on left) http://repurposinglife.blogspot.com/2009/05/rainwater-harvesting.html
(bottom picture on right) http://www.floridata.com/tracks/transplantedgardener/Rainbarrels.cfm

Sizing Example for a Rain Barrel

1. Determine contributing impervious surface area:

Garage Roof (Right)	6 ft. x 24 ft.	=	144 sq ft

2. Determine the amount of rainfall to be captured by the Rain Barrel. A smaller storm, no more than 2″, is recommended to calculate the runoff to be captured. This example chose the 1″ storm event.

3. Calculate the volume to be captured and reused:

   (144 sq. ft. x 1 inch of runoff) / 12 inches = 12 cu. ft.

4. Size the rain barrel:

1 cu. ft. = 7. 48 gallons

12 cu. ft. x 7.48 = 90 gallons
90 gallons x (0.25*) = 22.5 gallons (*assuming that the rain barrel is always at least 25% full)

90 gallons + 22.5 gallons = 112 gallons

The rain barrel or barrels should be large enough hold at least 112 gallons of water.

REFERENCES:

Center for Watershed Protection and US Forest Service. (2008). *Watershed Forestry Resource Guide*. Retrieved on May 26, 2010 from http://www.forestsforwatersheds.org/reduce-stormwater/.

Department of Environmental Protection. (2006). *Pennsylvania Stormwater Best Management Practices Manual.*

Wissahickon Watershed Partnership. *Pennsylvania Rain Garden Guide*. Retrieved on May 4, 2010 from http://pa.audubon.org/habitat/PDFs/RGBrochure_complete.pdf.

Building a Backyard Rain Garden. North Carolina Cooperative Extension. Retrieved on May 4, 2010 from http://www.bae.ncsu.edu/topic/raingarden/Building.htm

Delaware County Planning Commission. (2010). *Draft Crum Creek Watershed Act 167 Stormwater Management Plan. Ordinance Appendix B. Simplified Approach to Stormwater Management for Small Projects.*

Solebury Township. (2008). *Solebury Township Stormwater Management Ordinance. "Appendix J Simplified Stormwater Management Procedures for Existing Single Family Dwelling Lots*"

APPENDIX F

WATERSHED MAP

APPENDIX G

HOT SPOTS

APPENDIX G: HOT SPOTS

Hot spots are sites where the land use or activity produces a higher concentration of trace metals, hydrocarbons, or priority pollutants than normally found in urban runoff.

1. EXAMPLES OF STORMWATER HOT SPOTS

- vehicle salvage yards and recycling facilities
- vehicle fueling stations
- vehicle service and maintenance facilities
- vehicle and equipment cleaning facilities
- fleet storage areas (bus, truck, etc.)
- industrial sites (based on Standard Industrial Codes defined by the U.S. Department of Labor)
- marinas (service and maintenance)
- outdoor liquid container storage
- outdoor loading/unloading facilities
- public works storage areas
- facilities that generate or store hazardous materials
- commercial container nursery
- other land uses and activities as designated by an appropriate review authority

2. LAND USE AND ACTIVITIES NOT NORMALLY CONSIDERED HOT SPOTS

- residential streets and rural highways
- residential development
- institutional development
- office developments
- nonindustrial rooftops
- pervious areas, except golf courses and nurseries (which may need an Integrated Pest Management (IPM) Plan).

3. **LIST OF ACCEPTABLE BMPs for Hot Spot Treatment:** The following BMP's listed under the Best Management Practice column are BMPs appropriate for application on hot spot sites. BMPs which facilitate infiltration are prohibited by this ordinance. In many design manuals the BMPs with a * designation are designed with infiltration, however it is possible to design these without infiltration.

   The numbers listed under the Design Reference Number column correlate with the Reference Table which lists materials that can be used for design guidance.

Best Management Practice	**Design Reference Number**
Bioretention*	4, 5, 11, 16
Capture/Reuse	4, 14
Constructed Wetlands	4, 5, 8, 10, 16
Dry Extended Detention Ponds	4, 5, 8, 12, 18

Best Management Practice	Design Reference Number
Minimum Disturbance/ Minimum Maintenance Practices	1, 9
Significant Reduction of Existing Impervious Cover	N/A
Stormwater Filters* (Sand, Peat, Compost, etc.)	4, 5, 10, 16
Vegetated Buffers/Filter Strips	2, 3, 5, 11, 16, 17
Vegetated Roofs	4, 13
Vegetated Swales*	2, 3, 5, 11, 16, 17
Water Quality Inlets (Oil/Water Separators, Sediment Traps/Catch Basin Sumps, and Trash/Debris Collectors in Catch Basins)	4, 7, 15, 16, 19
Wet Detention Ponds	4, 5, 6, 8

Reference Table

Number	Design Reference Title
1	"Conservation Design For Stormwater Management – A Design Approach to Reduce Stormwater Impacts From Land Development and Achieve Multiple Objectives Related to Land Use", Delaware Department of Natural Resources and Environmental Control, The Environmental Management Center of the Brandywine Conservancy, September 1997
2	"A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zone", Schueler, T. R., Kumble, P. and Heraty, M., Metropolitan Washington Council of Governments, 1992.
3	"Design of Roadside Channels with Flexible Linings", Federal Highway Administration, Chen, Y. H. and Cotton, G. K., Hydraulic Engineering Circular 15, FHWA-IP-87-7, McLean, Virginia, 1988.
4	"Draft Stormwater Best Management Practices Manual", Pennsylvania Department of Environmental Protection, January 2005.
5	"Evaluation and Management of Highway Runoff Water Quality", Federal Highway Administration, FHWA-PD-96-032, Washington, D.C., 1996.
6	"Evaporation Maps of the United States", U.S. Weather Bureau (now NOAA/National Weather Service) Technical Paper 37, Published by Department of Commerce, Washington D.C., 1959.
7	"Georgia Stormwater Manual", AMEC Earth and Environmental, Center for Watershed Protection, Debo and Associates, Jordan Jones and Goulding, Atlanta Regional Commission, Atlanta, Georgia, 2001.
8	"Hydraulic Design of Highway Culverts", Federal Highway Administration, FHWA HDS 5, Washington, D.C., 1985 (revised May 2005).
9	"Low Impact Development Design Strategies *An Integrated Design Approach*, Prince Georges County, Maryland Department of Environmental Resources, June 1999.

Number	Design Reference Title
10	"Maryland Stormwater Design Manual", Maryland Department of the Environment, Baltimore, Maryland, 2000.
11	"Pennsylvania Handbook of Best Management Practices for Developing Areas", Pennsylvania Department of Environmental Protection, 1998.
12	"Recommended Procedures for Act 167 Drainage Plan Design", LVPC, Revised 1997.
13	"Roof Gardens History, Design, and Construction", Osmundson, Theodore. New York: W.W. Norton & Company, 1999.
14	"The Texas Manual on Rainwater Harvesting", Texas Water Development Board, Austin, Texas, Third Edition, 2005.
15	"VDOT Manual of Practice for Stormwater Management", Virginia Transportation Research Council, Charlottesville, Virginia, 2004.
16	"Virginia Stormwater Management Handbook", Virginia Department of Conservation and Recreation, Richmond, Virginia, 1999.
17	"Water Resources Engineering", Mays, L. W., John Wiley & Sons, Inc., 2005.
18	"Urban Hydrology for Small Watersheds", Technical Report 55, US Department of Agriculture, Natural Resources Conservation Service, 1986.
19	US EPA, Region 1 New England web site (as of August 2005) http://www.epa.gov/NE/assistance/ceitts/stormwater/techs/html.

4. RECOMMENDED PRE-TREATMENT METHODS FOR "HOT SPOT" LAND USES: The following table recommends what is considered the best pre-treatment option for the listed land use. These methods are either a BMP or can be applied in conjunction with BMPs.

Hot Spot Land Use	Pre-treatment Method(s)
Vehicle Maintenance and Repair Facilities including Auto Parts Stores	-Water Quality Inlets -Use of Drip Pans and/or Dry Sweep Material Under Vehicles/Equipment -Use of Absorbent Devices to Reduce Liquid Releases -Spill Prevention and Response Program
Vehicle Fueling Stations	-Water Quality Inlets -Spill Prevention and Response Program
Storage Areas for Public Works	-Water Quality Inlets -Use of Drip Pans and/or Dry Sweep Material Under Vehicles/Equipment -Use of Absorbent Devices to Reduce Liquid Releases -Spill Prevention and Response Program -Diversion of Stormwater away from Potential Contamination Areas
Outdoor Storage of Liquids	-Spill Prevention and Response Program
Commercial Nursery Operations	-Vegetated Swales/Filter Strips -Constructed Wetlands -Stormwater Collection and Reuse

Hot Spot Land Use	Pre-treatment Method(s)
Salvage Yards and Recycling Facilities*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Fleet Storage Yards and Vehicle Cleaning Facilities*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Facilities that Store or Generate Regulated Substances*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Marinas*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Certain Industrial Uses (listed under NPDES)*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit

*Regulated under the NPDES Stormwater Program

APPENDIX H

WEST NILE VIRUS GUIDANCE

APPENDIX H: WEST NILE VIRUS GUIDANCE

(This source is from the Monroe County, PA Conservation District, who researched the potential of West Nile Virus problems from BMPs due to a number of calls they were receiving.)

Monroe County Conservation District Guidance:
Stormwater Management and West Nile Virus

Source: Brodhead McMichaels Creeks Watershed Act 167 Stormwater Management Ordinance Final Draft 2/23/04

The Monroe County Conservation District recognizes the need to address the problem of nonpoint source pollution impacts caused by runoff from impervious surfaces. The new stormwater policy being integrated into Act 167 Stormwater Management regulations by the PA Department of Environmental Protection (PADEP) will make nonpoint pollution controls an important component of all future plans and updates to existing plans. In addition, to meet post-construction anti-degradation standards under the state National Pollution Discharge Elimination System (NPDES) permitting program, applicants will be required to employ Best Management Practices (BMPs) to address non-point pollution concerns.

Studies conducted throughout the United States have shown that wet basins and in particular constructed wetlands are effective in traditional stormwater management areas such as channel stability and flood control, and are one of the most effective ways to remove stormwater pollutants (United States Environmental Protection Agency 1991, Center for Watershed Protection 2000). From Maryland to Oregon, studies have shown that as urbanization and impervious surface increase in a watershed, the streams in those watersheds become degraded (CWP 2000). Although there is debate over the threshold of impervious cover when degradation becomes apparent (some studies show as little as 6% while others show closer to 20%), there is agreement that impervious surfaces cause non-point pollution in urban and urbanizing watersheds, and that degradation is ensured if stormwater BMPs are not implemented.

Although constructed wetlands and ponds are desirable from a water quality perspective there may be concerns about the possibility of these stormwater management structures becoming breeding grounds for mosquitoes. The Conservation District feels that although it may be a valid concern, **municipalities should not adopt ordinance provisions prohibiting wet basins for stormwater management.**

Mosquitoes

The questions surrounding mosquito production in wetlands and ponds have intensified in recent years by the outbreak of the mosquito-borne West Nile Virus. As is the case with all vector-borne maladies, the life cycle of West Nile Virus is complicated, traveling from mosquito to bird, back to mosquito and then to other animals including humans. *Culex pipiens* was identified as the vector species in the first documented cases from New York in 1999. This species is still considered the primary transmitter of the disease across its range. Today there are some 60 species of mosquitoes that inhabit Pennsylvania. Along with *C. pipiens*, three other species have been identified as vectors of West Nile Virus while four more have been identified as potential vectors.

The four known vectors in NE Pennsylvania are *Culex pipiens*, *C. restuans*, *C. salinarius* and *Ochlerotatus japonicus*. All four of these species prefer, and almost exclusively use, artificial

containers (old tires, rain gutters, birdbaths, etc.) as larval habitats. In the case of *C. pipiens*, the most notorious of the vector mosquitoes, the dirtier the water the better they like it. The important factor is that these species do not thrive in functioning wetlands where competition for resources and predation by larger aquatic and terrestrial organisms is high.

The remaining four species, *Aedes vexans*, *Ochlerotatus Canadensis*, *O. triseriatus* and *O. trivittatus* are currently considered potential vectors due to laboratory tests (except the *O. trivittatus*, which did have one confirmed vector pool for West Nile Virus in PA during 2002). All four of these species prefer vernal habitats and ponded woodland areas following heavy summer rains. These species may be the greatest threat of disease transmission around stormwater basins that pond water for more than four days. This can be mitigated however by establishing ecologically functioning wetlands.

Stormwater Facilities

If a stormwater wetland or pond is constructed properly and a diverse ecological community develops, mosquitoes should not become a problem. Wet basins and wetlands constructed as stormwater management facilities, should be designed to attract a diverse wildlife community. If a wetland is planned, proper hydrologic soil conditions and the establishment of hydrophytic vegetation will promote the population of the wetland by amphibians and other mosquito predators. In natural wetlands, predatory insects and amphibians are effective at keeping mosquito populations in check during the larval stage of development while birds and bats prey on adult mosquitoes.

The design of a stormwater wetland must include the selection of hydrophytic plant species for their pollutant uptake capabilities and for not contributing to the potential for vector mosquito breeding. In particular, species of emergent vegetation with little submerged growth are preferable. By limiting the vegetation growing below the water surface, larvae lose protective cover and there is less chance of anaerobic conditions occurring in the water.

Stormwater ponds can be designed for multiple purposes. When incorporated into an open space design a pond can serve as a stormwater management facility and a community amenity. Aeration fountains and stocked fish should be added to keep larval mosquito populations in check.

Publications from the PA Department of Health and the Penn State Cooperative Extension concerning West Nile Virus identify aggressive public education about the risks posed by standing water in artificial containers (tires, trash cans, rain gutters, bird baths) as the most effective method to control vector mosquitoes.

Conclusion

The Conservation District understands the pressure faced by municipalities when dealing with multifaceted issues such as stormwater management and encourages the incorporation of water quality management techniques into stormwater designs. As Monroe County continues to grow, conservation design, groundwater recharge and constructed wetlands and ponds should be among the preferred design options to reduce the impacts of increases in impervious surfaces. When designed and constructed appropriately, the runoff mitigation benefits to the community from these design options will far out-weigh their potential to become breeding grounds for mosquitoes.

APPENDIX I

SIMPLIFIED STORMWATER MANAGEMENT PROCEDURES FOR EXISTING SINGLE FAMILY DWELLING LOTS

SIMPLIFIED STORMWATER MANAGEMENT PROCEDURES FOR EXISTING SINGLE FAMILY DWELLING LOTS

Projects eligible for this procedure

Individual home construction projects on single family lots which result in less than two thousand five hundred (2,500) square feet of new impervious area (including the building footprint, driveway, sidewalks, and parking areas) and less than five thousand (5,000) square feet of earth disturbance may utilize the simplified procedure contained in this Appendix to meet volume requirements of this Part and are not required to submit detailed stormwater management plans as required by Article IV to the Township. This procedure may not be utilized for proposed subdivisions or land developments.

Are professional services necessary to meet these requirements?

This Appendix has been developed to assist the individual homeowner in meeting the water quality and groundwater recharge goals of the Stormwater Management Ordinance. If the guidelines are followed, the homeowner will not require professional services to comply with these water quality and groundwater recharge goals.

What do I need to submit to Hilltown Township?

Even though a formal stormwater management plan is not required for individual lot owners, a brief description of the proposed infiltration facilities, including types of material to be used, total impervious areas and volume calculations, and a simple sketch plan showing the following information shall be submitted to the Township prior to construction:

- Location of proposed structures, driveways or other paved areas with approximate surface area in square feet.
- Location of any existing or proposed onsite septic system and/or potable water wells showing proximity to infiltration facilities.
- Bucks County Conservation District erosion and sediment control “Adequacy” letter.

Determination of Recharge Volume

The amount of recharge volume that must be provided is determined by following the simple steps below. Impervious area calculations must include all areas on the lot proposed to be covered by roof area or pavement which would prevent rain from naturally percolating into the ground, including sidewalks, driveways or parking areas. Sidewalks, driveways or patios that are constructed with turf pavers and are not included in this calculation.

Example Recharge Volume:

STEP 1 – Determine Total Impervious Surfaces:

House Roof (Front)	12 ft. x 48 ft.	=	576 sq. ft.
House Roof (Rear)	12 ft. x 48 ft.	=	576 sq. ft.
Driveway	12 ft. x 50 ft.	=	600 sq. ft.
Parking Pad	12 ft. x 12 ft.	=	144 sq. ft.
Walkway	4 ft. x 20 ft.	=	80 sq. ft.

			1,976 sq. ft.

STEP 2 – Determine Required Infiltration Volume (Rv) Using the Following Equation

$$Rv = \frac{3.26 \text{ inches x (total impervious area in square feet)}}{12} = _____ \text{ cubic feet of recharge}$$

$$Rv = \frac{3.26 \text{ x } 1{,}976 \text{ sq. ft}}{12} = 537 \text{ cu. ft.}$$

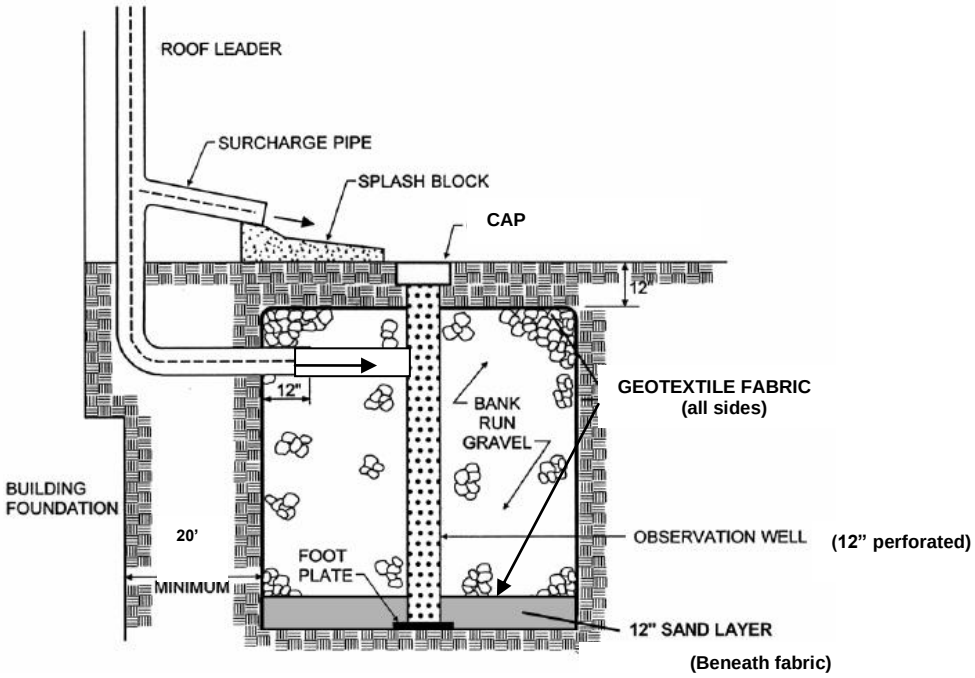
STEP 3 – Sizing of Selected Infiltration Method

The following pages identify several methods to infiltrate stormwater runoff. Their appropriateness depends on the amount of required infiltration volume and amount of available land. More than one method may be implemented on a site, depending on site constraints. Dry wells may be used only for receiving runoff from roof drains. Infiltration trenches are appropriate for receiving runoff from driveways, sidewalk or parking areas. Other methods may be appropriate, but these must be reviewed with the Township Engineer prior to installation.

Dry Wells

Dry wells are effective methods to infiltrate runoff from roof leaders. These facilities must be located based upon a determination by the design professional to reduce potential basement seepage problems but not less than a minimum of twenty (20) feet from the building foundation. A dry well maybe either a structural prefabricated chamber or an excavated pit filled with aggregate. Dry well shall not be constructed until all other areas of the site are stabilized, to avoid clogging. During construction, compaction of the subgrade soil shall be avoided, and construction may be performed with only light machinery. Depth of dry wells in excess of three and one-half (3 ½) feet should be avoided unless warranted by soil conditions. “Clean” gravel fill should average one and one half to three (1.5 – 3.0) inches in diameter. Dry wells should be inspected at least four (4) times annually as well as after large storm events.

FIGURE 1
TYPICAL DRY WELL CONFIGURATION



Source: Maryland Stormwater Design Manual

Example Sizing For Drywells:

STEP 1 – Determine Total Impervious Surfaces

House Roof Area: 12 ft. x 48 ft. = 576 sq. ft.

STEP 2 – Determine Required Infiltration Volume using Equation

$$3.26 \frac{\text{in. x 576 sq. ft.}}{12} = 156 \text{ cu. ft.}$$

$$\frac{156 \text{ cu. ft.}}{0.4^*} = 390 \text{ cu. ft. (*assumes 40\% void ratio in gravel}$$

STEP 3 – Sizing of Selected Infiltration Method

Volume of facility = Depth x Width x Length

Set D = 3.5 ft; Set W = L for a square chamber

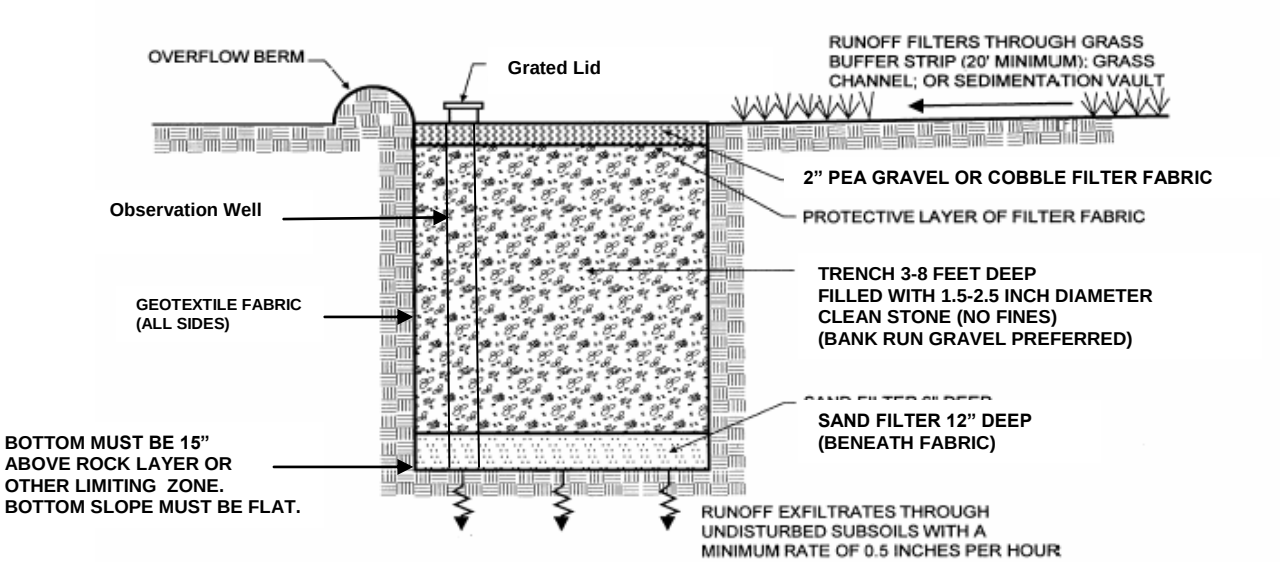
390 cu. ft. = 3.5 x L X L ; L = 10.5 ft.

Final Facility Dimensions: 3.5 ft. (D) x 10.5 ft. (W) x 10.5 ft. (L)

Infiltration Trenches

An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. Runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Pretreatment using buffer strips, swales, or detention basins is important for limiting amounts of coarse sediment entering the trench which can clog and render the trench ineffective.

FIGURE 2
TYPICAL INFILTRATION TRENCH CONFIGUATION



Source: Maryland Stormwater Design Manual, 2000

Example Sizing For Infiltration Trenches:

STEP 1 – Determine Total Impervious Surfaces

Driveway	12 ft. x 50 ft.	=	600 sq. ft.
Parking Pad	12 ft. x 12 ft.	=	144 sq. ft.
Walkway	4 ft. x 20 ft.	=	80 sq. ft.
			----------
			824 sq. ft.

STEP 2 – Determine Required Infiltration Volume using Equation

$$\frac{3.26 \text{ in. x } 824 \text{ sq. ft.}}{12} = 224 \text{ cu. ft.}$$

$$\frac{224 \text{ cu. ft.}}{0.4^*} = 560 \text{ cu. ft. (*assumes 40\% void ratio in gravel bed)}$$

STEP 3 – Sizing of Selected Infiltration Method

Volume of facility = Depth x Width x Length

Set D = 3 ft; determine required surface area of trench

560 cu. ft. / 3 ft. = 187 sq. ft.

The width of the trench should be greater than 2 times it depth (2 x D); therefore, in this example a trench width of 6 feet is selected;

Determine trench length: L = 187 sq. ft. / 6 ft. = 31 ft.

Final trench dimensions: 3 ft. (D) x 6 ft. (W) x 31 ft. (L)

Rain Gardens

A Rain Garden is a planted shallow depression designed to catch and filter rainfall runoff. The garden captures rain from a downspout or a paved surface. The water sinks into the ground, aided by deep rooted plants that like both wet and dry conditions. The ideal location for a rain garden is between the source of runoff (roofs and driveways) and the runoff destination (drains, stream, low spots, etc).

Design Considerations:

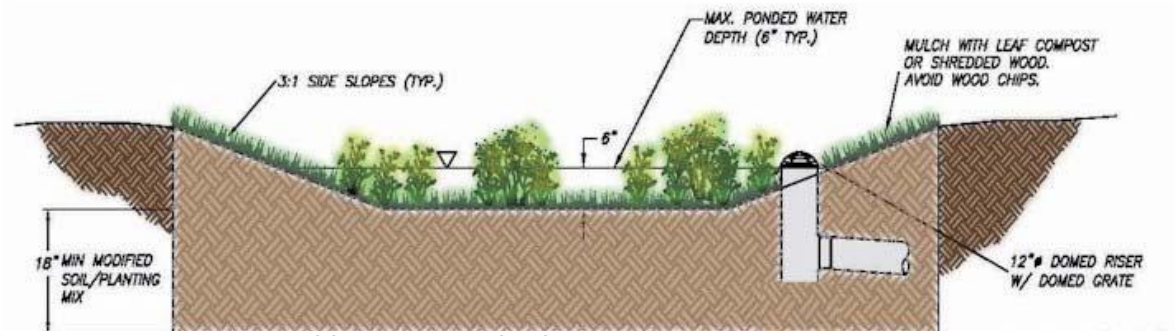
- A maximum of 3:1 side slope is recommended.
- The depth of a rain garden can range from 6 - 8 inches. Ponded water should not exceed 6 inches.
- The rain garden should drain within 72 hours.
- The garden should be at least 10-20 feet from a building's foundation and 25 feet from septic system drainfields and wellheads.
- If the site has clay soils, soil should be amended with compost or organic material.
- Choose native plants. See http://pa.audubon.org/habitat/PDFs/RGBrochure_complete.pdf for a native plant list. To find native plant sources go to www.pawildflower.org.
- At the rain garden location, the water table should be at least 2' below the soil level. If water stands in an area for more than one day after a heavy rain you can assume it has a higher water table and is not a good choice for a rain garden.

Maintenance:

- Water plants regularly until they become established.
- Inspect twice a year for sediment buildup, erosion and vegetative conditions.
- Mulch with hardwood when erosion is evident and replenish annually.

- Prune and remove dead vegetation in the spring season.
- Weed as you would any garden.
- Move plants around if some plants would grow better in the drier or wetter parts of the garden.

Figure 3: Rain Garden Diagram



Source: PA BMP Guidance Manual, Chapter 6 Page 50

Sizing Example for Rain Garden

1. Pick a site for the rain garden between the source of runoff and between a low lying area, a.k.a., a drainage area.

2. Perform an infiltration test to determine the depth of the rain garden:
   - Dig a hole 8″ x 8″
   - Fill with water and put a popsicle stick at the top of the water level.
   - Measure how far it drains down after a few hours (ideally 4).
   - Calculate the depth of water that will drain out over 24 hours.

3. Determine total impervious surface area to drain to rain garden:

House Roof (Front)	14 ft. x 48 ft.	=	672 sq ft

4. Sizing the rain garden:

   For this example the infiltration test determined 6″ of water drained out of a hole in 24 hours. The depth of the rain garden should be set to the results of the infiltration test so 6″ is the depth of the rain garden. The sizing calculation below is based on controlling 1″ of runoff. First divide the impervious surface by the depth of the rain garden.

   (672 sq ft / 6 ft.) = 112 sq. ft.

   In order to control 2″ of runoff volume, the rain garden area needs to be multiplied by 2.

   112 sq. ft. * 2 = 224 sq. ft.

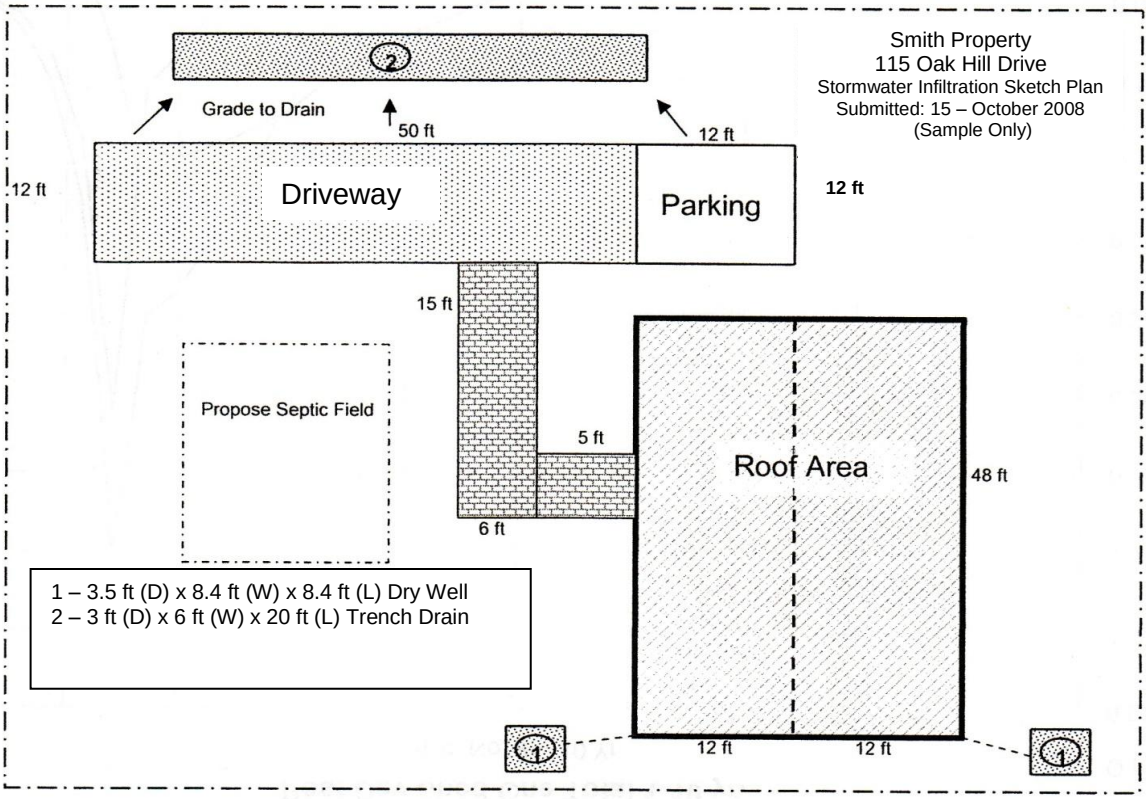
   The rain garden should be about 225 sq. ft. in size and 6″ deep.

Field Conditions/Construction

Construction of the stormwater management facility must be observed by the Township Engineer pursuant to Section 26-141 of this Part. If soil conditions indicate a limiting zone (e.g. high water table, depth to bedrock) will encroach within the infiltration/dry well, the stormwater management facility construction details (width/depth/length) must be revised as determined by the Township Engineer and field documented.

FIGURE 4

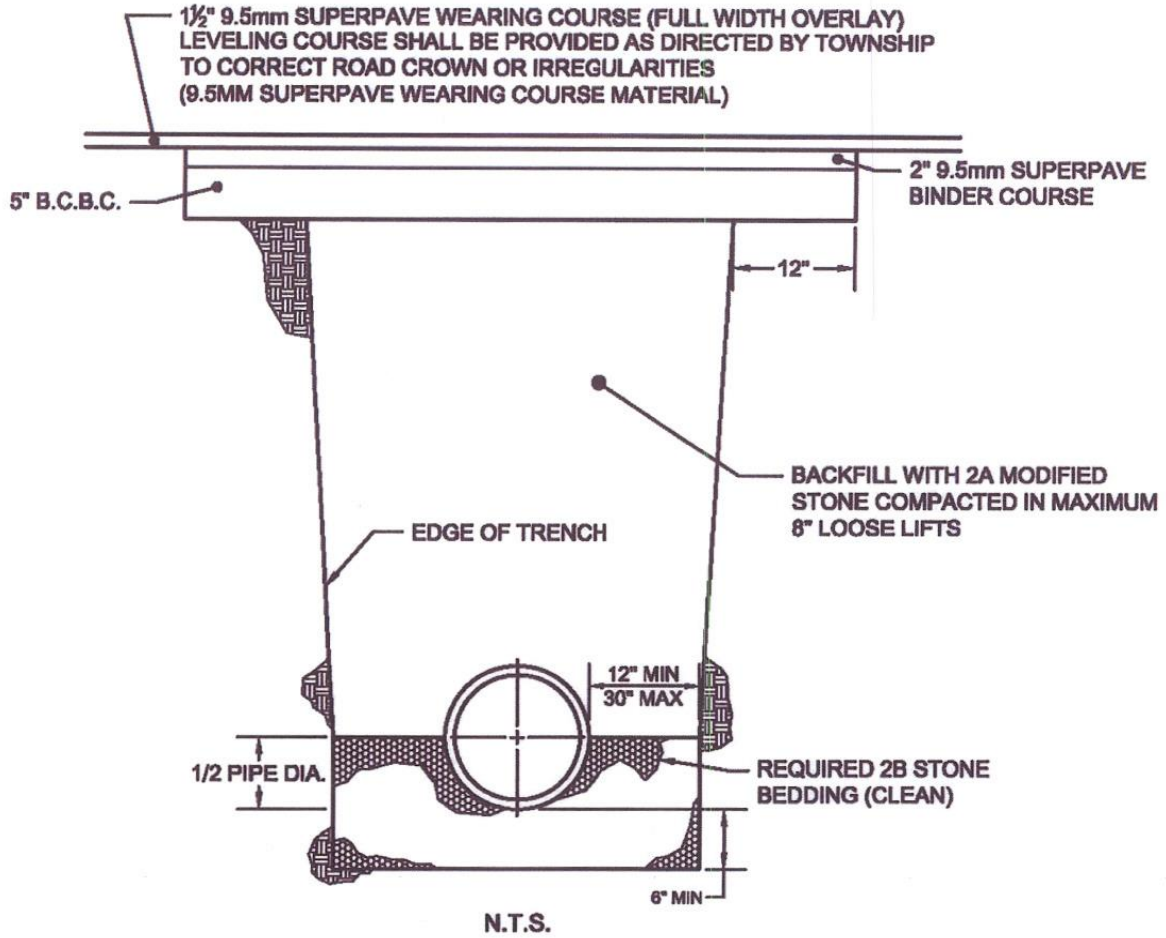
SAMPLE SITE SKETCH PLAN



Source: Maryland Stormwater Design Manual

APPENDIX J

STORMSEWER BEDDING/BACKFILL REQUIREMENTS



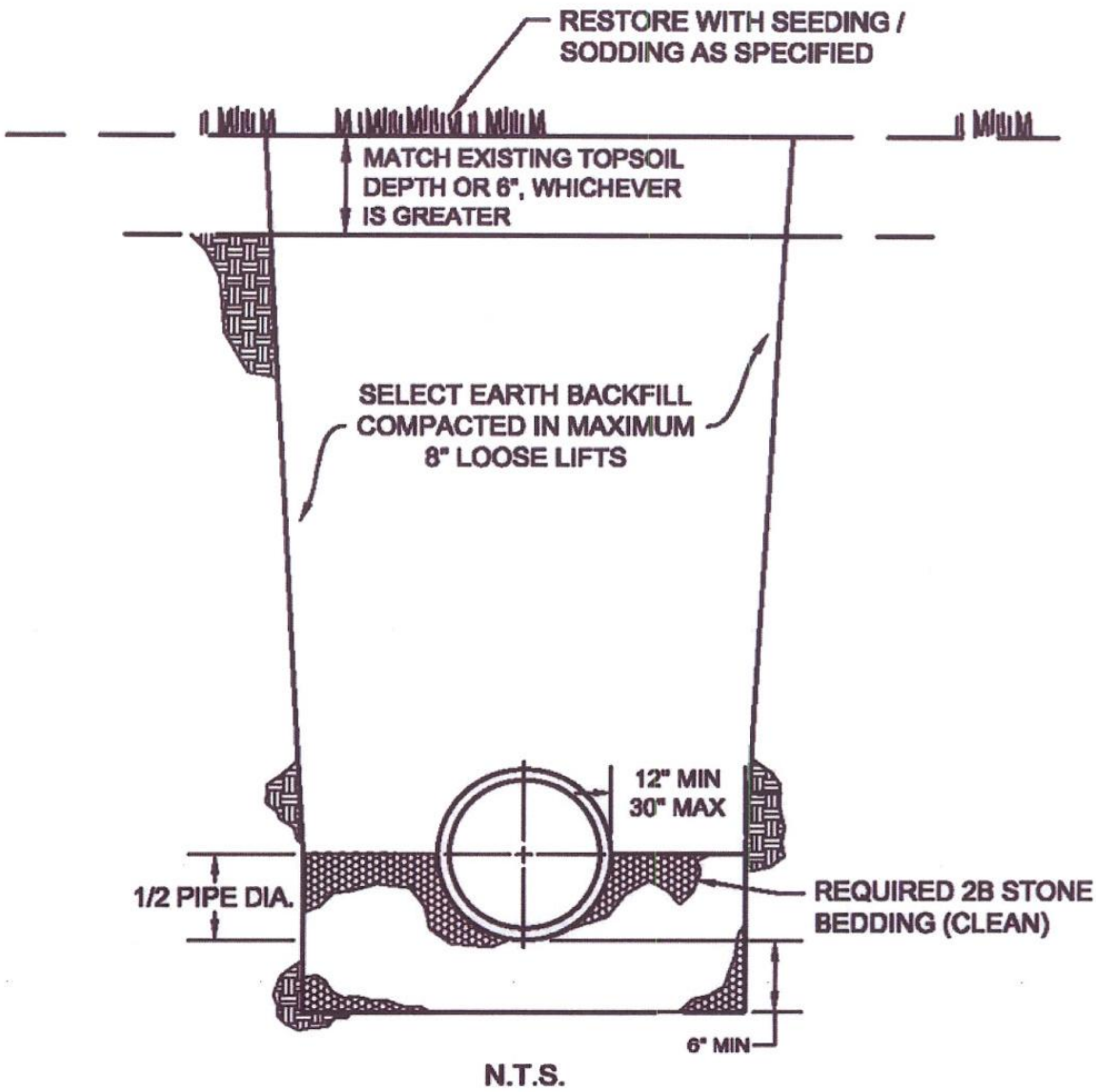
N.T.S.

NOTES:

1. Developer/Contractor shall be responsible for proper implementation of safety requirements in conformance to all Federal and State Department of Labor and Occupational Safety and Hazard Administrative Regulations.
2. Backfill for new road construction may be select earth backfill when suitable material is available as determined by the Township.
3. Full depth 2A stone backfill shall be required for all storm sewer, sanitary sewer and utility trenching when edge of trench is within 15 feet of existing roadway edge of paving; and for all trenching within area of roadway widening.
4. Roadway crown shall be 3/8 inch per foot.
5. 3 inch temporary patch of BCBC shall be provided and maintained for less than 30 days prior to final restoration of existing roadway or driveway. Temporary patch shall be removed with final restoration performed no more than 90 days from date of sewer installation providing testing has been satisfactorily accomplished and no settlement has occurred.
6. All work and materials shall conform to PennDot Publication 408, latest edition.

STORM SEWER BEDDING DETAIL

(WITHIN RIGHT-OF-WAY, BENEATH ALL EXISTING ROADWAYS AND DRIVEWAYS, PUBLIC OR PRIVATE)



STORM SEWER BEDDING DETAIL

(EARTHEN AREA)

APPENDIX K

PERVIOUS HARDSCAPING DESIGN AND CREDIT CRITERIA

PERVIOUS HARDSCAPING SYSTEM DESIGN & IMPERVIOUS SURFACE AREA CREDIT CRITERIA

Applicants for Erosion and Sedimentation Control and Grading Permit, Subdivision, and Land Development may request approval of an impervious surface area credit for construction of pervious hardscaping systems provided they comply with the design guidelines herein and approval is received from Hilltown Township.

An impervious surface credit shall only be considered by the Township for driveways, parking areas, and other hardscaping surfaces that are constructed at a slope greater than 1%, but less than 5%.

Numbers shown in the following table are the percentage of hardscaping surface area (proposed) that must be considered "IMPERVIOUS" based on factors such as paver block open void area and the material installed in the voids/openings of these surfaces.

TABLE 1.0
HARDSCAPING SURFACE AREA THAT MUST BE CONSIDERED IMPERVIOUS SURFACE:

FILL MATERIAL IN PAVER BLOCK VOIDS	**HARDSCAPING MATERIAL**				
	PAVER/ BLOCK →		→		CLEAN STONE OR STRUCTURAL "GEOWEB"**(1)**
	SURFACE OPEN AREA PERCENTAGE (%)				
	50-59.99	60-69.99	70-79.99	80-89.99	90-100
SOIL/GRASS	67%	60%	54%	48%	**NOT PERMITTED**
CLEAN STONE (no fines) or other CLEAN, NON-ERODIBLE FILL	52%	43%	33%	24%	14%

TABLE FOOTNOTE:

(1) Driveways and parking areas must either be bituminous paving, stone (residential driveways, only), or some other combination of load bearing paver block backfilled with stone or soil. Geoweb, alone, with earth backfill may not be used for driveways and parking areas; therefore, is not eligible for an impervious surface area credit.

NOTES:

1. An impervious surface area credit, if approved by the Township, will only be valid if a proper sub-base is used and when filter fabric is installed to separate all soil/stone interfaces and clean stone/sand leveling bed surfaces, as more particularly shown on the attached conceptual installation detail.
2. Pervious hardscaping systems with less than 50% open surface void percentage is not eligible for an impervious surface credit and the entire surface of such hardscaping will be considered 100% impervious for the purpose of calculating on-site impervious surface area and stormwater runoff. However, such systems may be considered a "Best Management Practice" if constructed in compliance with the criteria herein.

3. The hardscaping surface area which is intended and approved for impervious credit must be fully protected (by super silt fence) during the entire construction process to prevent compaction of the underlying soils by construction equipment and vehicles. A note must be added to the plan indicating this requirement.

4. The sequence of construction must specify the area of pervious hardscaping may only be constructed upon stabilization of the remainder of the site to prevent sediment from contaminating the surface.

5. General design and construction of these surfaces must conform to the attached construction detail and installation and maintenance procedures for the designated pervious hardscaping system must be identified on the plan.

6. Each request for impervious credit must include the manufacturer, style/product number, surface open area percentage (as identified by the manufacturer), and product data sheets. This information must also be shown on the plan including a notation that hardscaping system may only be modified with the written approval of the Township. No other "paver" block or stone may be substituted for that approved.

7. If the impervious surface credit is approved by the Township, the resulting ("net") total of impervious surface area from the "paver" must be included in the impervious surface tabulation which must also identify the total area of "paver" block and percentage of hardscaping area that must be considered impervious (refer Table 1.0). The calculation of impervious surface area (refer sample herein) must be shown on the plan.

8. All applications for impervious surface area credit shall be reviewed by the Township Engineer for completeness and technical content to satisfy the above requirements and any other applicable ordinance requirements. Design and installation must be permanent and will be evaluated based on criteria herein, feasibility, effectiveness, and longevity. The Township retains the right to require infiltration testing at pervious paver locations, as well as the right to deny any application due to unforeseen circumstances unique to the site or application. Finally, Construction of the pervious hardscaping system must be inspected by the Township Engineer with advance notice of 48-hours to schedule required inspections.

CALCULATON OF HARDSCAPING SURFACE THAT MUST BE CONSIDERED IMPERVIOUS SURFACE AREA:

Proposed Pervious Hardscaping Surface Area = PHSA
Percentage of (Hardscaping) surface that must be considered Impervious (from **Table 1.0**)= PI
Total Area of Hardscaping Surface that must be considered Impervious = TI
TI = PHSA x (PI ÷ 100)

SAMPLE CALCULATIONS:

1. If 1,250 SF of lot area is covered with "Hastings Checkerblock" (70% open area) with voids backfilled with clean stone, the quantity of hardscaping area that must be considered impervious surface area is:

   1,250 SF x (33% ÷ 100) (from **Table 1.0**) = 413 SF = TI; therefore the "impervious surface credit" would be: 1,250 SF – 413 SF = 837 SF

2. If 1,436 SF of lot area is covered with “Presto Geoweb” and backfilled with clean stone, the quantity of hardscaping area that must be considered impervious surface is:

   1,436 SF x (14% ÷ 100) (from **Table 1.0**) = 201 SF; therefore the “impervious surface credit” would be: 1,436 SF – 201 SF = 1,235 SF

APPENDIX L

STANDARD STORMWATER FACILITIES MAINTENANCE AND MONITORING AGREEMENT

STANDARD STORMWATER FACILITIES MAINTENANCE AND MONITORING AGREEMENT

THIS AGREEMENT, made and entered into this _____ day of _____, 20__, by and between _____, (hereinafter the "Landowner"), and Hilltown Township, Bucks County; Pennsylvania, (hereinafter "Municipality");

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property as recorded by deed in the land records of Bucks County, Pennsylvania, Deed Book _____ at Page _____, (hereinafter "Property").

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

WHEREAS, the Stormwater Controls and BMP Operation and Maintenance Plan (hereinafter "Plan") for the property identified herein, as approved or to be approved by the Municipality, provides for management of stormwater within the confines of the Property through the use of Best Management Practices (BMPs); and

WHEREAS, the Municipality and the Landowner, his successors and assigns agree that the health, safety, and welfare of the residents of the Municipality require that on-site stormwater management facilities be constructed and maintained on the Property: and

WHEREAS, for the purposes of this agreement, the following definitions shall apply:

BMP - "Best Management Practice;" activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and groundwater recharge and to otherwise meet the purposes of the Municipal Stormwater Management Ordinance, including, but not limited to, infiltration trenches, seepage pits, filter strips, bioretention, wet ponds, permeable paving, rain gardens, grassed swales, forested buffers, sand filters, and detention basins.

WHEREAS, the Municipality requires, through the implementation of the plan that stormwater management facilities BMPs as required by the Plan and Municipal Stormwater Management Ordinance be constructed and adequately operated and maintained by the Landowner, his successors and assigns.

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

1. **The BMPs shall be constructed by the Landowner, his successors and assigns, in accordance with the terms, conditions and specifications identified in the Plan.**

2. **The Landowner, his successors and assigns, shall operate and maintain the BMPs as shown on the plan in good working condition, acceptable to the Municipality so that they are performing their design functions, and in accordance with the specific maintenance requirements noted on the plan.**

3. **The Landowner, his successors and assigns, hereby grants permission to the Municipality, his authorized agents and employees, to enter upon the Property at reasonable times, such as following a storm of the intensity for which the facility was designed to control, and to inspect the stormwater management facilities whenever the Municipality deems necessary. The purpose of the inspection is to ensure safe and proper functioning of the facilities. The inspection shall cover the entire facilities, berms, outlet structures, pond areas, access roads, etc. When inspections are conducted, the Municipality shall give the Landowner, his successors and assigns, copies of the inspection report with findings and evaluations. At a minimum, maintenance inspections shall be performed in accordance with the following schedule:**

   - **Twelve (12) months after completion of the facility and acceptance by the Township,**
   - **At least once every ~~2~~ three (3) years thereafter, and**
   - **During or immediately upon the cessation of a 100-year or greater precipitation event.**

4. **All reasonable costs for said inspections shall be born by the Landowner and payable to the Municipality.**

5. **The owner shall convey to the municipality easements and/or rights-of-way to ensure access for periodic inspections by the Municipality and maintenance, if required.**

6. **In the event the Landowner, his successors and assigns, fails to maintain the BMPs in good working condition acceptable to the Municipality, the Municipality may enter upon the property and take such necessary and prudent action to maintain said stormwater management facilities and to charge the costs of the maintenance and/or repairs to the Landowner, his successors and assigns. This provision shall not be construed as to allow the Municipality to erect any structure of a permanent nature on the land of the Landowner, outside of any easement belonging to the Municipality. It is expressly understood and agreed that the Municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.**

7. **The Landowner, his successors and assigns, will perform maintenance in accordance with the maintenance schedule for the stormwater management facilities including sediment removal as outlined on the approved schedule and/or drainage plan.**

8. **In the event the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like on account of the Landowner's or his successors' and assigns' failure to perform such work, the Landowner, his successors and assigns, shall reimburse the Municipality upon demand, within 30 days of receipt of invoice thereof, for all costs incurred by the Municipality hereunder. If not paid within said 30-day period, the Municipality may enter a lien against the property in the amount of such costs, or may proceed to recover his costs through proceedings in equity or at law as authorized under the provisions of the Second Class Township Code.**

9. **The Landowner, his successors and assigns, shall indemnify the Municipality and its agents and employees against any and all damages, accidents, casualties, occurrences or claims that might arise or be asserted against the Municipality for the construction, presence, existence or maintenance of the stormwater management facilities by the Landowner and his successors and assigns.**

10. **In the event a claim is asserted against the Municipality, its agents, or employees, the Municipality shall promptly notify the Landowner and his successors and assigns, and they shall defend, at their own expense, any suit based on such claim. If any judgment or claims against the Municipality, his agents or employees shall be allowed, the Landowner and his successors and assigns shall pay all costs and expenses in connection therewith.**

11. **In the advent of an emergency or the occurrence of special or unusual circumstances or situations, the Municipality may enter the property, if the Landowner is not immediately available, without notification or identification, to inspect and perform necessary maintenance and repairs, if needed, when the health, safety or welfare of the citizens is at jeopardy. However, the Municipality shall notify the Landowner of any inspection, maintenance, or repair undertaken within five days of the activity. The Landowner shall reimburse the Municipality for its costs.**

This Agreement shall be recorded among the land records of Bucks County, Pennsylvania and shall constitute a covenant running with the Property and/or equitable servitude, and shall be binding on the Landowner, his administrators, executors, assigns, heirs, and any other successors in interests, in perpetuity.

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the Municipality:

(SEAL) For the Landowner:

ATTEST:

_____

County of Bucks, Pennsylvania

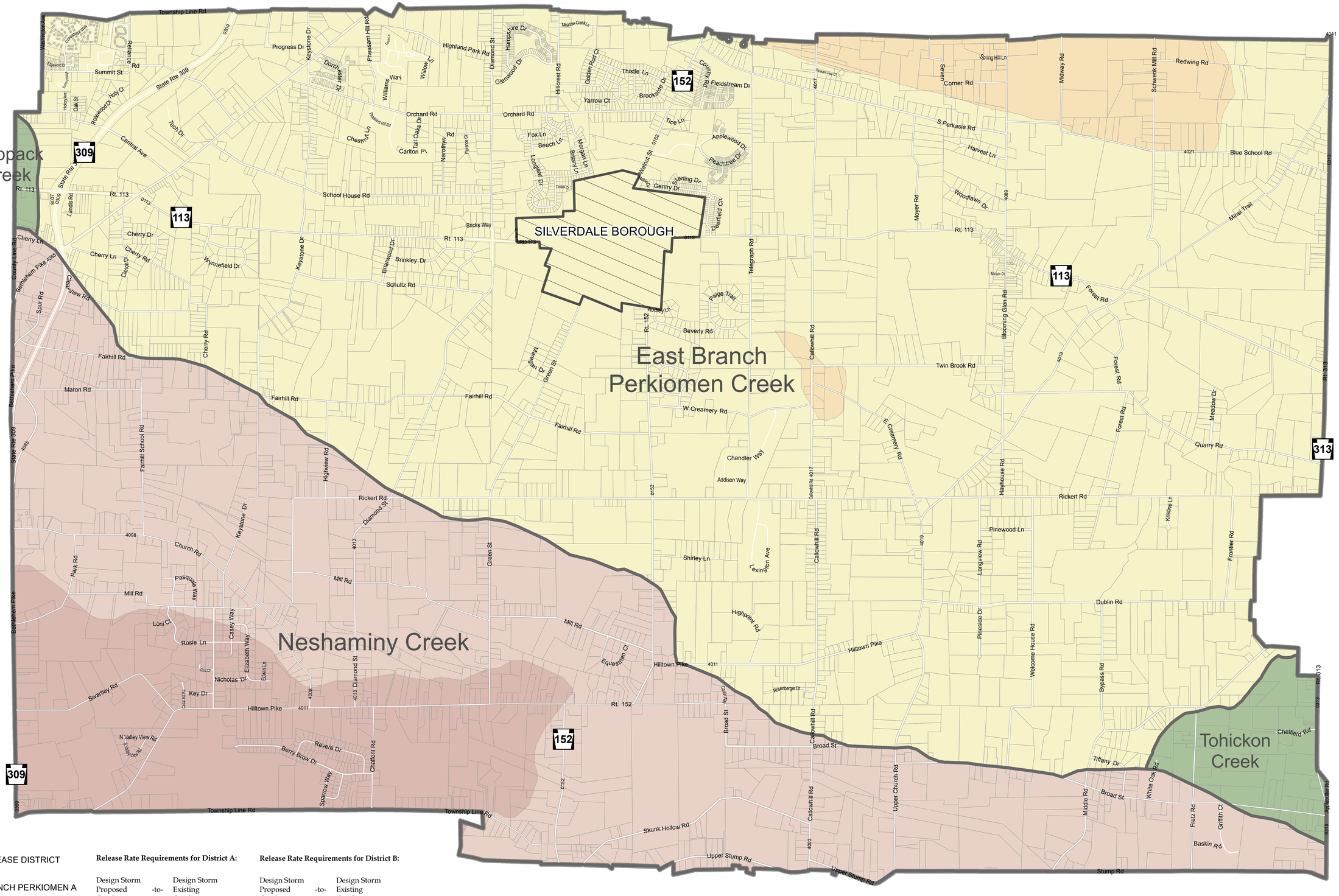
I, _____, a Notary Public in and for the County and State aforesaid, whose commission expires on the _____ day of _____, 20__, do hereby certify that _____ whose name(s) is/are signed to the foregoing Agreement bearing date of the _____ day of _____, 20__, has acknowledged the same before me in my said county and state.

GIVEN UNDER MY HAND THIS _____ day of _____, 20___.

_____

NOTARY PUBLIC

(SEAL)



LEGEND:

- 100% RELEASE DISTRICT
- EAST BRANCH PERKIOMEN A
- EAST BRANCH PERKIOMEN B
- NESHAMINY CREEK A
- NESHAMINY CREEK B

Release Rate Requirements for District A:

Design Storm Proposed Conditions	-to-	Design Storm Existing Conditions
2-year		1-year
5-year		5-year
10-year		10-year
25-year		25-year
50-year		50-year
100-year		100-year

Release Rate Requirements for District B:

Design Storm Proposed Conditions	-to-	Design Storm Existing Conditions
2-year		1-year
5-year		2-year
10-year		5-year
25-year		10-year
50-year		25-year
100-year		50-year

Source: Pennsylvania Spatial Data Access - Pennsylvania Small Sheds.
Map is not intended to replace site specific investigations

HILLTOWN TOWNSHIP WATERSHED MANAGEMENT DISTRICT MAP

C. ROBERT WYNN ASSOCIATES, INC.
CONSULTING ENGINEERING
211 W. Broad Street
Quakertown, PA 18951
(215) 536-7336

DWN BY:	CHK BY:	DATE	SCALE:	JOB NUMBER	DRAWING NO.
GKL	CRW	3/3/2011	1:14,000	03-011	1 OF 1