Ordinance No. 2011-06

SOLEBURY TOWNSHIP STORMWATER MANAGEMENT ORDINANCE

Solebury Township
Bucks County, Pennsylvania
Effective Date – May 24, 2011

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ARTICLE I. GENERAL PROVISIONS

Section 101. Statement of Findings

The governing body of the municipality finds that:

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

B. 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. Groundwater resources and water supply are also impacted through loss of recharge due to increased impervious surface and modification of groundcover.

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 base flow, 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.

D. These impacts happen mainly through a decrease in natural infiltration of stormwater.

E. A comprehensive program of stormwater management, including reasonable regulation of development and other activities causing loss of natural infiltration, is fundamental to the public health, safety, welfare, and the protection of the people of the Township and all the people of the Commonwealth, their resource, and the environment.

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

G. 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).

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

Section 102. Purpose

The purpose of this comprehensive Stormwater Management Ordinance is to promote the public health, safety, and welfare within Solebury Township by minimizing the damages described in Section 101.A of this Ordinance through provisions designed to:

A. Manage stormwater runoff impacts at the source by regulating activities that cause these problems.

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

C. Utilize and preserve the existing natural drainage systems as much as possible.

D. Manage stormwater impacts close to the runoff source, which requires a minimum of structures and relies on natural processes.

E. Promote alternative project designs and layouts that minimize impact to surface and groundwater.

F. Promote nonstructural Best Management Practices.

G. Infiltration of stormwater to prevent degradation of surface and groundwater quality and to otherwise protect water resources.

H. Minimize increases in stormwater volume and control peak flow.

I. Maintain existing flows and quality of streams and watercourses.

J. Meet legal 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 use in all streams, and to protect and maintain water quality in “special protection” streams.

K. Prevent streambank and streambed scour and erosion and control peak flows.

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

M. Implement an illegal discharge detection and elimination program to address non-stormwater discharges into the municipal separate storm sewer system.

N. Promote the collection and use of rainwater for irrigation, toilet flushing, and other viable, nontraditional uses.

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

Section 103. Statutory Authority

The Township 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 104. Applicability

This Ordinance shall apply to all areas of the Township that are located within the Delaware River (South) Watershed and Neshaminy Creek Watershed as delineated in Appendix F which is hereby adopted as part of this Ordinance.

This Ordinance shall apply to temporary and permanent stormwater management facilities constructed as part 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 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 105 of this Ordinance:

A. Land development.
B. Subdivision.
C. Prohibited or polluted discharges.
D. Alteration of the natural hydrologic regime.
E. Construction or reconstruction of additional impervious surfaces (e.g. driveways, parking lots, etc.) which cumulatively (refer Section 105.B for exempted activities) exceed one thousand (1,000) square feet in area since the date of adoption of this Ordinance. Refer Section 105.D for simplified procedure for single family dwelling lots which result in less than two thousand (2,000) square feet of new impervious surface and less than five thousand (5,000) square feet of earth disturbance.
F. Construction of new buildings or additions to existing buildings which cumulatively (refer Section 105. B for exempted activities) exceed one thousand (1,000) square feet in area and result in additional impervious surface since the date of adoption of this Ordinance. Refer Section 105.D for simplified procedure for single family dwelling lots which result in less than two thousand (2,000) square feet of new impervious surface and less than five thousand (5,000) square feet of earth disturbance.
G. Diversion or piping of any natural or man-made stream channel.
H. Installation of BMPs and stormwater management facilities or appurtenances thereto.
I. Temporary storage of impervious or pervious material (rock, soil, etc.) where ground contact exceeds five (5) percent of the lot area or 5,000 square feet (whichever is less), or where the material is placed on slopes exceeding eight (8) percent.
J. Any activity requiring an Erosion and Sedimentation Control and Grading Permit pursuant to Township Ordinance.

Section 105. Exemptions

A. General Exemptions**:** The following land use activities are exempt from stormwater management requirements of this ordinance.

   1. Use of land for gardening for home consumption.

   2. Agriculture 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 having impervious surfaces shall be subject to the provisions of this Ordinance unless exempt pursuant to Section 105 B.

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 which have a Zoning Permit approval by Solebury Township.
4. Public road replacement, replacement paving, repaving and/or driveway maintenance (without expansion).
5. Installation of less than one hundred (100) square feet of new impervious surface.
6. Repair and reconstruction of on-lot sewage disposal systems where work is performed in accordance with a valid permit issued by Bucks County Department of Health.
7. Any aspect of BMP maintenance to an existing SWM system made in accordance with plans and specifications approved by the Township.

B. Stormwater Peak Rate Control Exemption:

All Regulated Activities as described in Section 104 of this Ordinance shall comply with the Stormwater Management requirements hereof (refer Article III) 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 302 but are subject to compliance with Section 305 and Section 306 when located within the Delaware River (South) Watershed, and volume control requirements of Section 307 when located within the Neshaminy Creek Watershed. Any Regulated Activities that meet the exemption criteria established in this Section are exempt from Stormwater Management Plan submission requirements of Article IV of this Ordinance. 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 January 25, 2009. All impervious surface area constructed on or after January 25, 2009 shall be considered cumulatively. Impervious surface existing on the "parent tract" prior to the date of adoption of this Ordinance shall not be considered in cumulative impervious area calculations for exemption purposes. An exemption shall not relieve an applicant from implementing such stormwater control measures and erosion control measures as are necessary to protect health, safety, and property.

Table 105.1 Stormwater Management Exemption Criteria

1. Regulated activities included within Sections 104.E and F. are exempt where the amount of impervious surface and proposed location on a parcel conforms to the following Tables:

Table 1

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

Table 2

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

Setback (feet)	Maximum Exempt Impervious Surface Area (square feet)
10	0
20	1,000
50	2,000
200	4,000
500	7,500

2. Construction or reconstruction of buildings or additions to existing buildings or other impervious surface (activities regulated pursuant to Sections 104.E and F) 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 2.A above must be restored with a minimum of twelve (12) inches of topsoil and stabilized groundcover.

3. Grading Permit applications (required pursuant to Ordinance 2009-004) where the addition of impervious surface cover is 1,000 square feet, or less.

4. Regulated activities included within Sections 104.E and F proposed on a lot within a subdivision of Permanently Preserved Land as set forth in Section 4.08 of the Solebury Township Subdivision and Land Development Ordinance which conform to requirements of Stormwater Management exemption criteria 1, or the following table:

Total Parcel Area (acres)	Minimum Distance (feet)*	Maximum Impervous Surface Area (square feet.)
>5.0 to 10.0	500	7,500
>10.0 to 20.0	500	10,000
> 20.0	500	15,000

   * Refer Table 105.1, item 1.

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

C. 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. 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 305 and 306 of this Ordinance.

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

D. The municipality, upon request by an applicant, may grant an exemption from the provisions of this Ordinance for a project qualifying under Section 105.B. If an exemption is granted, the municipality may 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.

E. All applicants seeking an exemption of stormwater management requirements based upon criteria contained in Section 105.B shall be required, at a minimum, to submit the following documentation for review:

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

2. Stormwater Management Exemption 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 resources pursuant to Zoning Ordinance requirements and existing manmade features, including wetlands, watercourses, woodlands, steep slopes, structures, parking areas, driveways, utilities, wells, and septic systems within 200 feet of proposed limits of earth disturbance and/or 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 200 feet of proposed limits of earth disturbance and/or 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 105.

F. 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 impervious area (including the building footprint, driveway, sidewalks, and parking areas) or less than five thousand (5,000) square feet of earth disturbance but do not meet exemption criteria of Section 105.B may utilize the simplified procedure within Appendix J to meet requirements of the Ordinance and are not required to submit formal drainage plans to the Township.

Section 106. Repealer

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

Section 107. 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 108. Compatibility with Other Ordinance Requirements

Approvals issued and actions taken under this Ordinance do not relieve the Applicant of the responsibility to secure required permits or approvals for activities regulated by any other code, law, regulation or Ordinance. To the extent that this Ordinance imposes more rigorous requirements for stormwater management, the specific requirements contained in this Ordinance shall be followed.

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

Alluvial soils (floodplain soils) Areas subject to periodic flooding and listed in the Soil Survey of Bucks and Philadelphia Counties, Pennsylvania, U.S. Department of Agricultural Soil Conservation Service as being "on, or in, the floodplain" or subject to flooding.

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; or earth disturbance.

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

As-Built Plan Plans that are maintained during construction of the project and which document the actual locations of the site improvements. As-built plan must be prepared by a professional land surveyor, landscape architect, or professional engineer licensed in the Commonwealth of Pennsylvania.

Bankfull The channel at the top of bank or point where water begins to overflow onto a floodplain.

Base Flow The portion of stream flow that is sustained by groundwater discharge.

Biorentention A stormwater retention area which utilizes woody and herbaceous plants and soils to remove pollutants before infiltration occurs.

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.

Commercial Container Nursery - A commercial nursery that grows fifty (50) percent or more of its herbaceous plants, shrubs, and trees in containers on their lot rather than in the ground.

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 (or PADEP) - The Pennsylvania Department of Environmental Protection.

Department The Pennsylvania Department of Environmental Protection.

Design Professional (Qualified) A Professional Engineer, Landscape Architect, or a Professional Land Surveyor licensed in the Commonwealth of Pennsylvania and trained to develop stormwater management plans.

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 the governing body involved with the administration, review, or enforcement of any provisions of this Ordinance by contract or memorandum of understanding.

Detention basin - An impoundment structure designed to manage stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate. Detention basins are designed to drain completely soon after a rainfall event.

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.

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.

Downslope property line That portion of the property line of the lot, tract, or parcels of land being developed where all overland or pipe flow from the proposed development is directed.

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.

Dry Pond (Dry Extended Detention Pond) Dry extended detention ponds do not maintain a permanent pool between storm events. Outlets are designed to detain the volume of a water quality design storm for a minimum (usually 48 hours) to allow for the settling of particles and associated pollutants. In addition, dry extended detention ponds provide flood control by including additional temporary storage for peak flows above the dead storage. Extended detention ponds are also capable of managing smaller floods that contribute to channel erosion problems and occur more frequently than the annual or 2-year flood.

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

Emergency Spillway A conveyance area that is used to pass peak discharge greater than the maximum design storm controlled by the stormwater facility.

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 process by which the surface of the land, including channels, is worn away by water, wind or chemical action.

Erosion and Sediment Pollution Control Plan A site-specific plan identifying the BMPs to minimize accelerated erosion and sedimentation, pursuant to 25 Pa Code Chapter 102.

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 antidegradation).

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

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.

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

Floodplain Any land area susceptible to inundation by water from any natural source or delineated as a special flood hazard area on the applicable National Flood Insurance Program Flood Insurance Rate Map (FIRM) prepared by the Federal Emergency Management Agency (FEMA). Also included are areas that comprise Group 13 Soils, as listed in Appendix A of the Pennsylvania Department of Environmental Protection (PADEP) Technical Manual for Sewage Enforcement Officers (as amended or replaced from time to time by PADEP).

Floodway The channel of the watercourse and those portions of the adjoining floodplains that are reasonably required to carry and discharge the 100-year 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 associated activities necessary for the management of forest. These include timber inventory and preparation of forest management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, 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.

Geologist A licensed professional geologist registered in the Commonwealth of Pennsylvania.

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.

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).

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).

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 Soil A soil that is saturated, flooded, or ponded long enough during the growing season to develop an anaerobic condition in the upper part.

Hydrologic Regime (Natural) The hydrologic cycle or balance that sustains quality and quantity of stormwater, baseflow, storage, and groundwater supplies under the natural conditions.

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.

Hyetograph A graphical representation of average rainfall, rainfall excess rates, or volumes over specified areas during successive units of time during a storm.

Impervious surface - 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.

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, infiltration basins).

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.

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

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, 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 and destabilization of the natural condition of the land.

Landscape Architect A person who engages or offers to engage in the practice of landscape architecture in the Commonwealth of Pennsylvania under the authority of the Landscape Architects Registration Law (63 P.S. §§ 901-913).

Limit of Earth Disturbance The perimeter of earth disturbance on a site.

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.

Low Impact Development (LID) Practices - Practices that minimize proposed conditions runoff rates and volumes, reducing 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 when the flow is not under pressure.

Municipality Solebury 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 of regulations for the 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 - “The point source” as described in 40 CFR § 122.2 where the municipality"s storm sewer system discharges to surface Waters of the Commonwealth.

Outlet - Points of water disposal to a stream, river, lake, tidewater or artificial basin.

Parent Tract The parcel of land from which a land development or subdivision originates as of the date of adoption of this Ordinance.

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.

Permanently Preserved Land A parcel or tract of land that is subject to a recorded conservation easement, in perpetuity, in a manner acceptable to the Township

Person An individual, partnership, association, corporation or other entity.

Pervious Surface - A surface that allows the infiltration of water into the ground.

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

Planning Commission The Planning Commission of Solebury 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 as defined in State regulations at 25 Pa. Code § 92.1, is or may be discharged.

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 trap coarse materials and other pollutants before they enter the stormwater management or infiltration system.

Project Site The specific tract of land where any regulated activity in the Township is planned, conducted or maintained.

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.

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 104 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.

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 an 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.

Runoff Any part 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.

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.

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

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

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).

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.

Soil Scientist An individual trained to observe and identify soil properties that can be used to determine such things as depth to seasonal high water table, soil permeability, potential productivity, and other potentially use- limiting soil features.

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.

Surveyor An individual licensed and registered under the laws of the Commonwealth of Pennsylvania to engage in the practice of land surveying.

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. Refer "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 total amount of 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, infiltration structures, and other BMPs.

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 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 watercourses containing water at least on a seasonal basis during an average water year. The term “stream” shall include the following:

A. Springs or Seeps – The point where groundwater discharges to become surface water.

B. 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. The term often used interchangeably with intermittent stream but the difference is in the length of time of continuous flow (less than one month per year).

C. Stream, Headwater – The beginning reach of a stream that 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.

D. Stream, Intermittent – A reach of stream that flows only during wet periods of the year (30% - 90% of the time) and flows in a continuous well-defined channel. During dry periods, especially in summer months, intermittent streams may go down to a trickle of water and make it appear dry, when in fact there is water flowing through the stream bottom or "substrate". This is usually caused by the seasonal changes of the local soil water table or during periods of long-term drought.

E. Stream, 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, measured perpendicular to and horizontally from the top-of-bank.

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.

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

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.

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.

Township 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.

Township Solebury Township, Bucks County, Pennsylvania.

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 periods 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.

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

Water Quality Requirements As defined under state regulations – protection of *designated and existing* uses (Refer 25 Pa Code Chapters 93 and 96):

a. Each stream segment in Pennsylvania has a “designated use”, such as “cold water fishery” or “potable water supply”, which are listed in Chapter 93. These uses must be protected and maintained, under state regulations.

b. “Existing uses” are those attained as of November, 1975, regardless whether they have been designated in Chapter 93. Land development must be designed to protect and maintain existing uses and maintain the level of water quality necessary to protect those uses in all streams, and to protect and maintain water quality in special protection streams.

c. Water quality involves the chemical, biological, and physical characteristics of surface water bodies. After land development, these characteristics can be impacted by addition of pollutants such as sediment, and changes in habitat through increased flow volumes and/or rates. Therefore, discharge to surface waters must be designed and managed to protect the streambank, streambed, and structural integrity of the waterway, to prevent these impacts.

Watershed Region or area bounded peripherally by water parting and draining to a particular watercourse or body of water.

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

Wet Pond (Wet Extended Detention Pond) A wet extended pond combines the pollutant removal effectiveness of a permanent pool of water with the flow reduction capabilities of an extended storage volume.

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

Wetland Delineation The onsite method or process for identifying wetlands. 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 301. General Requirements for Stormwater Management

A. All applicants proposing Regulated Activities ~~for~~ within the Township which do not fall under the exemption criteria contained within Section 105 of this Ordinance shall submit a stormwater management plan consistent with this Ordinance to the Township for review. These criteria shall apply to the total proposed development even if development is to take place in stages. (Refer definition of Impervious Surface within Section 202 of this Ordinance).

B. All applicants proposing Regulated Activities shall implement 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 the Commonwealth, and

   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**,** or occupancy permit; or the commencement of any earth disturbance at a project site within the Township, shall

proceed until the requirements of this Part are met, including approval of a Stormwater Management Plan under Section 401 and a permit under PADEP regulations, where applicable.

F. Erosion and sediment control during land development shall be addressed as required by Section 311.

G. Volume controls shall be addressed within the Neshaminy Creek Watershed as required by Section 307.

H. Water quality protection and infiltration shall be addressed as required by Sections 305 and 306

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 C (Low Impact Development Practices) 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 maximize 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 (25) percent over the predevelopment condition without written approval from the adjacent affected property owner(s).

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 one hundred (100) year storm event. However, in no case shall the easement be less than thirty (30) feet in width. 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. The developer will retain the easement until such time as one of the following is accomplished:

1. For subdivisions or land developments, the individual lot owner assumes responsibility for the maintenance of the portion of their property through which the easement passes. The record plan shall contain a description of such easement(s) and notation indicating the maintenance responsibilities.

2. A homeowner"s association or other legal entity approved by the Township, assumes responsibility for the maintenance of the development, including the watercourse easement. The record plan shall contain a description of such easement(s) and notation indicating the maintenance responsibilities.

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 Solebury Township and PADEP through the Joint Permit Application process, or, where deemed appropriate by PADEP, 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 PADEP and/or US Army Corps of Engineers through the Joint Permit Application process, or, where deemed appropriate by PADEP and/or US Army Corps of Engineers, 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 PADEP and/or US Army Corps of Engineers.

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, or drainage swale (within a stormwater easement). Roof drains and sump pumps shall be connected to a storm sewer, drainage structure, or other approved stormwater conveyance facility that is designed as part of a stormwater management BMP. 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. 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).

W. 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 determined to be 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. Maintaining the multiple values of these Special Protection Waters occurs through maintaining the pre-development or natural water cycle; not decreasing infiltration and recharge; and not increasing runoff. In so doing, critical temperature considerations are provided (optimal temperature control is achieved through infiltration of precipitation to groundwater which maximizes temperature-moderated stream base flow). In those cases where Runoff Volume Control can not be achieved as per Section 303.a.1, temperature sensitive BMPs and stormwater conveyance systems are to be used and designed with storage pool areas (drawing outflow from the bottom of the pool) and supply outflow channels shall be 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 of pond shorelines shall be planted with shade or canopy trees within ten (10) feet of the pond shoreline. In conjunction with this requirement, the maximum slope allowed on the berm area to be planted is ten (10) to one (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.

X. All stormwater runoff shall be pretreated for water quality prior to discharge to surface or groundwater as required by Section 305 of this Ordinance

Y. All Regulated Activities which result in earth disturbance shall comply with the requirements of the Solebury Township Erosion and Sedimentation Control and Grading Ordinance.

Z. Completed stormwater management facilities, including detention/retention basins, shall be surveyed by a professional land surveyor or engineer licensed in the Commonwealth of Pennsylvania, to verify compliance with the character of stormwater management facilities as depicted on the approved final plan (or subsequently approved revision, thereof). As-constructed plans shall be submitted to Solebury Township for review and approval, upon completion of construction of all facilities and prior to offer of dedication of any public facilities and/or submission of financial security for the required maintenance period. Public facilities will not be accepted by Solebury Township until such time the as-constructed plans have been reviewed and approved by the Township Engineer.

AA. The record plan and development agreement for the approved subdivision or land development shall define the ownership and maintenance responsibilities as well as access rights for all drainage related easements. Specifically, the record plan shall contain a provision permitting access to such easement(s), at any reasonable time, for inspection and/or emergency repair/maintenance, by Solebury Township or its designee, of all facilities deemed critical to public welfare. In the event the lot owner or homeowner"s association fails to honor their maintenance responsibilities set forth herein, in any manner, Solebury Township shall have the right of entry upon and within the area of the easement to undertake any required corrective or maintenance effort. The total cost of such, including administrative, engineering, and legal costs for enforcement, may be imposed upon the responsible party as determined by Solebury Township. Failure to remedy all associated costs described above, may be subject of the imposition of a lien by the Township against the owner(s) in question, in the same manner as the Township might otherwise be empowered by law to assess or impose a lien against a property for municipal improvements.

Section 302. Stormwater Management Districts – Peak Rate Control

A. Mapping of Stormwater Runoff Peak Rate Districts - In order to implement the provisions of this Ordinance, the Delaware River (South) Watershed Stormwater Management Plan and Neshaminy Creek Watershed Stormwater Management Plan, Solebury Township is hereby divided into Stormwater Runoff Peak Rate Districts consistent with the plans. The boundaries of the districts are indicated on the runoff peak rate district map that is available for inspection at the Township building. A large-scale boundary map is included as Appendix D 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 two (2) feet or five (5) feet topographic contours provided as part 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 Township engineer.

C. For the purposes of implementing the provisions of the Delaware River (South) Watershed Stormwater Management Plan, the peak release rates of runoff, predevelopment, for the design storms as specified in the table below; this table of release rates is keyed to Stormwater Management District Watershed Map (refer Appendix D).

Development site located in each of the A, B, C, or D Districts must control postdevelopment runoff rates to predevelopment runoff rates for the design storms as follows:

District	Design Storm Postdevelopment	Design Storm Predevelopment
A	2-year	1-year
	5-year	5-year
	10-year	10-year
	25-year	25-year
	50-year	50-year
	100-year	100-year
B	2-year	1-year
	5-year	2-year
	10-year	5-year
	25-year	10-year
	50-year	50-year
	100-year	100-year
C*	2-year	1-year
	5-year	2-year

* In District C, development sites which can discharge directly to the Delaware River South main channel or major tributaries or indirectly to the main channel through an existing stormwater drainage system (i.e. storm sewer or tributary) may do so without control of

postdevelopment peak rate of runoff greater than the five (5) year storm. If the postdevelopment runoff is intended to be conveyed by an existing stormwater drainage system to the main channel, assurance must be provided that such system has adequate capacity to convey the flows greater than the two (2) year predevelopment peak flow or will be provided with improvements to furnish the required capacity. When adequate capacity of downstream system does not exist and will not be provided through improvements, the postdevelopment peak rate of runoff must be controlled to the predevelopment peak rate as required in District A provisions (e.g. ten (10) year postdevelopment flows to ten (10) predevelopment flows) for the specified design storms.

D. For the purpose of implementing the provisions of the Neshaminy Creek Watershed Stormwater Management Plan, 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		2-year
10-year		5-year
25-year		10-year
50-year		25-year
100-year		50-year

Section 303. Stormwater Management Implementation Provisions (Performance Standards and Best Management Practices)

A. General Standards.

1. Runoff Volume Standard **-** Post-development stormwater runoff volume being discharged from any regulated activity shall not exceed pre-development stormwater runoff volume being discharged for up to the two (2) year frequency rainfall (for each watershed on-site). An Alternative Standard is allowed in this Ordinance where it can be demonstrated that due to existing natural site conditions (refer subsection b.), substantial infiltration and recharge are not occurring, pre-development, resulting in greater than anticipated runoff volume.

   a. Alternate Standard for Runoff Volume

      Applicants may request from Solebury Township that an Alternate Standard be applied, where a portion of the Runoff Volume Standard is not achieved but at least fifty (50) percent of the total required volume of infiltrated runoff is achieved. Use of this Alternate Standard is permitted by the Township only after thorough scrutiny has been directed toward all possible stormwater management options at all possible locations at the site, consistent with the process set forth in the following subsections.

   b. Required Analysis for Allowing Use of Alternate Standard for Runoff Volume

      The Alternate Standard shall be used only in those situations where it is demonstrated to the satisfaction of the Township that due to natural site conditions infiltration is not occurring in the pre-development condition, resulting in greater runoff volumes (than would normally be anticipated) due to

bedrock near or at the surface (less than two (2) feet in depth); presence of Seasonal High Water Table (SHWT) (less than two (2) feet in depth); and soils with low permeability (e.g. 0.20 inches per hour). Alternate Standard shall be permitted by the Township only in those cases where the applicant has demonstrated that one or all of the above described conditions exist throughout the site, such that there is no reasonable means of infiltrating required stormwater volumes and that the property cannot be reasonably developed utilizing a stormwater management system which infiltrates the two (2) year frequency storm event volume (pre to postdevelopment). The applicant must demonstrate that there is no area of the site where the Runoff Volume Standard can feasibly be infiltrated. It is not grounds for approval of the Alternate Standard that infiltrating the Standard Runoff Volume will utilize areas that could otherwise be developed to obtain the most building area or lots.

c. Applicants requesting to utilize the Alternate Standard must provide a Feasibility Study (also refer Section 402) for infiltration utilizing BMPs as well as other runoff volume stormwater management systems and provide the following information:

(1) Site plan demonstrating the extent of site area with seasonal high water table (SHWT) (less than two (2) feet): The site will be evaluated both as to the extent of site with SHWT and the actual locations of SHWT areas. Use of the Alternate Standard shall be permitted by the Township only in those cases where it is demonstrated that site areas free of SHWT are not feasible for use as stormwater BMPs (i.e., they are located upgradient from reasonable site building areas).

(2) Site plan demonstrating extent of site area with less than two (2) feet to bedrock: The site will be evaluated both as to the extent of site with shallow depth to bedrock and actual locations of shallow bedrock areas. Use of the Alternate Standard shall be permitted by the Township only in those cases where it is demonstrated that site areas free of shallow bedrock constraints are not feasible for use as stormwater BMPs (i.e., they are located upgradient from reasonable site building areas).

(3) The site plan shall demonstrate the extent of site area with less than 0.20 inches/hour of permeability in accordance with the soil testing protocol set forth in Appendix B.

(4) In order to utilize the Alternate Standard, the applicant must demonstrate that the total of infiltration “challenged” areas (the total of areas described in c(1) through c(3) hereof) exceed the following percentages of the total site:

75 percent (sites less than 5 acres)
80 percent (sites 5 to 10 acres)
85 percent (sites greater than 10 acres)

In addition, the applicant must demonstrate that there is no feasible site area free of the above described infiltration constraining features which exist in a location such that the Runoff Volume Standard can be achieved.

d. If the applicant's professional engineer can demonstrate based upon site specific soil testing to the satisfaction of the Township that due to existing soil,

bedrock, water table, or other conditions on the parcel, that such a standard is not achievable on the site (all or in part), the standard contained in Section 303.A.3 shall apply.

2. 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 D) and Section 302, of the Ordinance.

3. If it is determined to the satisfaction of the Township that the volume standard set forth in Section 303.A.1 cannot be achieved, then the peak rate standards are modified so that post-development peak rate discharges from the site for all storms up to the ten (10) year storm must be equal to or less than seventy-five (75) percent of the design peak rates permitted within Section 302.

B. 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.

C. 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 or around the development site to existing points of discharge from the property. The future use of undeveloped areas upstream shall be taken into account in the calculation of pipe sizes for storm sewer system designs. The capacity and maximum anticipated present flow of the body or system receiving the proposed system(s) discharge shall be calculated to verify its capability of receiving any additional flow caused by the development or subdivision. The runoff from any proposed development shall be subject to an evaluation that includes the anticipated runoff from other existing or proposed developments with the same watershed.

D. Where the area of a site being impacted by a proposed development activity differs significantly from the total site area, only the proposed disturbed area utilizing stormwater management measures shall be subject to the management district criteria. Unimpacted or undisturbed areas that do not flow into or are bypassing the stormwater management facilities shall not be subject to the Stormwater Management District criteria.

E. 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 Township, utilizing the “Pennsylvania Stormwater Best Management Practices Manual, December 30, 2006”, as amended. 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 within this Ordinance and the Pennsylvania Stormwater Best Management Practices Manual, and shall be in addition to any other Township ordinance provisions.

F. 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 two (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 twenty-five (25) year return period runoff without creating any hazard to persons, or property, or wildlife and aquatic habitat. Habitat impact should be minimized or avoided.

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 twenty-five (25) year return period runoff.

Section 304. Nonstructural Project Design (Sequencing to Minimize Stormwater Impacts)

A. The design of all regulated activities shall include the following steps in sequence to minimize stormwater impacts.

1. The applicant is required to find practicable alternatives to the surface discharge of stormwater, the creation of impervious surfaces, and the degradation of Waters of the Commonwealth, and must maintain as much as possible the natural hydrologic regime of the site.
2. An alternative is practicable if it is available and capable of being completed after considering cost, existing technology, and logistics in light of overall project purposes, and other Township requirements.
3. All practicable alternatives to the discharge of stormwater are presumed to have less adverse impact on quantity and quality of Waters of the Commonwealth unless otherwise demonstrated.

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 Plan (ERSAP), as required by the Subdivision and Land Development Ordinance, showing environmentally sensitive areas including, but not limited to, steep slopes, ponds, lakes, streams, wetlands, hydric soils, vernal pools, floodplains, riparian corridors, hydrologic soil groups A, B, C, and D, "prime agricultural soils" (prime farmland and farmland of statewide importance as designated in the soil survey of Bucks County), woodlands, surface waters regulated by the State or Federal Government, 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 304.B.1 (and as further defined by Article 15 of the Zoning Ordinance) 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 ERSAP**.**
3. Identify site specific existing conditions, drainage areas, discharge points (points of interest), recharge areas, and hydrologic soil groups A and B.
4. Evaluate Nonstructural Stormwater Management Alternatives (Refer Appendix B, Table B-6).
    a. Minimize earth disturbance.
    b. Minimize impervious surfaces.
    c. Break up large impervious surfaces.
5. Satisfy water quality objective (Section 305) and groundwater recharge objective (Section 306). (Delaware River [South] Watershed)
6. Satisfy volume control standards (Section 307). (Neshaminy Creek Watershed)
7. Satisfy stream bank erosion protection objective (Section 308).
8. Determine the Management District within which the site is located (refer Appendix D) 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 part of detention, biorentention, direct discharge or other structural control.

Section 305. Water Quality Requirements (Delaware River [South] Watershed)

A. The project plan shall specify permanent stormwater BMPs to be implemented, operated, and maintained to meet water quality requirements. Because water quality requirements vary depending on the "uses" of the waterbodies in the watershed, a framework methodology is provided here.

B. In order to protect and maintain water quality, additional stormwater runoff created by the development project must be captured, stored, and treated. In addition, post construction stormwater infiltration of runoff must replicate preconstruction infiltration of runoff to the maximum extent possible, in High Quality and Exceptional Value Watershed, special requirements may apply.

C. The volume of additional stormwater runoff to be captured, stored, and treated is called the Water Quality Volume ("WQ_v") in acre-feet of storage.

1. The formula for determining WQ_V is:

   $WQ_v = [(P)(Rv)(A)]/12$, where

   i. P = Rainfall depth in inches, using the "90% storm" – the volume of rainfall for 90% of the storm events which produce runoff in the watershed annually. For PennDOT Region 5, the current P value is 2.04 inches.

   ii. A = Project Area in acres

   iii. R_v = Volume Runoff Coefficient [0.05 + 0.009(I)], where I is the impervious surface percentage (impervious area ÷ total project area) X 100%

2. In Special Protection Watersheds, as described in 25 Pa Code Chapter 93, this volume is required to remain onsite through infiltration and other methods, to protect water quality. Guidance can be obtained from PADEP.

D. 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. 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.

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).

E. The applicant may, subject to approval of Solebury Township, use any of the following non-structural stormwater credits, generally described in the following table, in computing the required water quality volume.

Stormwater Credit	Description
Natural Area Conservation	Conservation of natural areas such as forest, wetlands, or other sensitive areas in a protected easement thereby retaining their predevelopment hydrologic and water quality characteristics. Using this credit, a designer may subtract conservation areas from total site area when computing the required water quality volume.
Vegetated Roof	Credit may be given for water quality and volume benefits for vegetated roof covers where vegetation is grown on, and completely covers, an otherwise flat or pitched roof (less than or equal to 30° slope).
Disconnection of Rooftop Runoff	Credit may be given when rooftop runoff is disconnected and then directed over a previous area where it may either infiltrate into the soil or filter over it. Credit is typically obtained by grading the site to promote overland flow or by providing bioretention on single-family residential lots. If a rooftop area is adequately disconnected, the impervious area may be deducted from the total impervious cover.
Disconnection of Non-Rooftop Runoff	Credit may be given for practices that disconnect surface impervious cover by directing it to pervious areas where it is either infiltrated or filtered through the soil. As with rooftop runoff, the impervious area may be deducted from the total impervious cover thereby reducing the required water quality volume.
Stream Buffer Credit	Credit may be given when a stream buffer effectively treats stormwater runoff. Effective treatment constitutes capturing runoff from pervious and impervious areas adjacent to the buffer and treating the runoff through overland flow across a grass or forested area. Areas treated in this manner may be deducted from total site area.
Grass Channel (Open Section Roads)	Credit may be given when open grass channels are used to reduce the volume of runoff and pollutants during smaller storms. If designed according to appropriate criteria, these channels may meet water quality criteria for certain types of residential development.
Environmentally Sensitive Rural Development	Credit may be given when a group of environmental site design techniques are applied to low density or rural residential development. This credit eliminates the need for structural practices to address water quality volume.

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.

F. The volume and rate of any stormwater discharges allowed under this Ordinance must be managed to prevent the physical degradation of receiving waters, such as by streambank scour and erosion. If a detention facility is proposed which is part of the BMPs approved for the project, the facility(ies) must be designed to provide for a twenty-four (24) hour extended detention of the one (1) year, twenty-four (24) hour storm event (i.e., the stormwater runoff will be released over a minimum twenty-four 24 hours for the one (1) year, twenty-four (24) hour storm event from the time of peak inflow to zero outflow).

Section 306. Additional Requirements Applicable to Infiltration Oriented Stormwater Management Systems (Delaware River [South] Watershed)

A. Prevention of stormwater runoff is key objective of Chapter 93 of the DEP regulations, because runoff can change the physical, chemical, and biological integrity of waterbodies thereby impacting water quality.

B. The project plan shall describe how water quality protection requirements will be met. Infiltration BMPs shall be evaluated and utilized to the maximum extent possible to manage the net change in stormwater runoff generated so that post construction discharges do not degrade the physical, chemical, or biological characteristics of the receiving waters. These BMPs may be used to satisfy all or part of the requirements in Section 305.

C. Post construction stormwater infiltration of runoff shall replicate preconstruction infiltration of runoff to the maximum extent possible. In High Quality and Exceptional Value Watersheds, special requirements apply (refer applicable sections in this Ordinance).

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

1. Methodology:

$Re_v = [(S)(Rv)(A)]/12$, where:

Re_v = Recharge Volume (acre-feet)
S = Soil specific recharge factor (inches)
A = Site area contributing to the recharge facility (acres)
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.

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

(a) Permeability and infiltration rate of the site soils.

(b) Slope and depth to bedrock.

(c) Seasonal high water table.

(d) Proximity and elevation relative to building foundations, basements, and well heads. (Infiltration BMPs should be located downgrade of these structures).

(e) Erodibility of soils.

(f) Land availability, configuration, and topography.

(g) Peak discharge and required volume control.

(h) Streambank erosion.

(i) Efficiency of the BMPs to mitigate potential water quality problems.

(j) Volume of runoff that will be effectively treated.

(k) Nature of the pollutant being removed.

(l) Maintenance requirements.

(m) Creation/protection of aquatic and wildlife habitat.

(n) Recreational value.

(o) Enhancement of aesthetic and property value.

3. A detailed soils evaluation of the project site shall be performed to determine the suitability of infiltration BMPs (refer Section 402.A). 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 one hundred (100) percent 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:

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

   (b) 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 B.

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

4. Soil characteristics: Subject to the specific considerations in Subsection **"**h**"** below,

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

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

(c) There must be a minimum depth of eighteen (18) inches between the bottom of any facility and the seasonal high water table and/or bedrock (limiting zones), except for infiltration BMPs receiving only roof runoff which shall be placed in soils having a minimum depth of twelve (12) inches between the bottom of the facility and the limiting zone. 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.

(d) 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.

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

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

(g) Infiltration rates shall not be used in computing the storage volume of the infiltration system.

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

5. The recharge volume provided at the site shall be directed to the most permeable HSG available, except where other considerations apply such as in limestone geology.

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

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

8. Infiltration is not permitted in geologically susceptible limestone areas including the Carbonate Geology Overlay Zoning District. All stormwater facilities in this overlay district must be constructed with an impermeable liner approved by the Township to prevent seepage of water into the ground. All proposed channels or swales receiving or conveying concentrated stormwater runoff must be protected with an impermeable liner approved by the Township.

9. 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.

10. The plan must include safeguards against groundwater contamination for uses which may cause groundwater contamination, should there be a mishap or spill. The Township may require the installation of a mitigative layer or 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.

11. During the period of land disturbance, runoff shall be controlled prior to entering any proposed infiltration area. Areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase, so as to maintain their maximum infiltration capacity.

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

13. 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 given the extent to which development-related disturbance leads to compaction of the soils and reduces their infiltrative capacity.

Section 307 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 310.

    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 24-hour Rainfall Event (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 310.

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 Solebury 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 a description of these 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 applicants proposing 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 involving 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 402 of this Ordinance . This procedure may not be utilized for proposed subdivision or land developments.

Section 308. Stream Bank Erosion Requirements

A. To minimize erosion, all BMPs shall be designed to comply with the following:

1. 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 two (2) year, twenty-four (24) hour design storm to the existing conditions one (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 one (1) year storm takes a minimum of twenty-four (24) hours to drain from the facility from a point where the maximum volume of water from the one (1) year storm is captured (i.e. the maximum water surface elevation is achieved in the facility).

2. 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 four (4) 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.

B. Whenever a watercourse is located within a site proposed for major subdivision or land development, 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.

Section 309. Design Criteria for Stormwater Management Facilities and Best Management Practices

A. Stormwater runoff which may result from Regulated Activities listed in Section 104 shall be controlled by permanent stormwater runoff BMPs 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 "Pennsylvania Stormwater Best Management Practice Manual", December 30, 2006, as amended. The choice of BMPs is not limited to the ones appearing in this Ordinance and the Manual, 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. Collection System Standards

1. Curb Inlets – Curb inlets shall be located at curb tangents on the uphill side of street intersections, and at intervals along the curb line to control the maximum amount of encroachment of runoff on the roadway pavement so that same does not exceed a width of four feet during the design storm event. Design and location of curb inlets shall be approved by the Township.

2. Pipe Materials – All storm sewer piping shall be Class III reinforced concrete pipe, except when pipe class and strength is required to be increased in accordance with PennDOT Specifications. Piping shall be saw-cut at ends, as needed, and not hammered or broken. All pipe joints and lift holes must be mortared except where designed for infiltration.

3. Minimum Pipe Size – Minimum pipe diameter shall be eighteen (18) inches (or an equivalent flow area of 1.76 square feet).

4. Inlet and Manhole Construction – Inlet and manhole castings and concrete construction shall be equivalent to PennDOT Design Standards. Manhole castings and covers shall have the word “STORM” cast in two (2) inch high letters on the top of the cover. All inlet grates shall be “bicycle safe” heavy duty structural steel. 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 3½ inches and include “No Dumping – Drains to Waterway” and a fish symbol. Alternate designs/sizes may be used if approved by the Township.

5. Open end pipes must be fitted with concrete endwalls or wing walls in accordance with PennDOT Standards.

6. Flow velocity – Stormwater collection systems shall be designed to produce a minimum velocity of three (3) feet per second when flowing full. The maximum permissible velocity shall be fifteen (15) feet per second. Pipe slopes shall not be less than one half of one (0.05) percent.

7. Inlets and manholes shall be spaced at intervals not exceeding three hundred (300) feet, and shall be located wherever branches are connected or sizes are changed, and wherever there is a change in alignment or grade. For drainage lines of at least thirty-six (36) inches diameter, inlets and manholes may be spaced at intervals of four hundred (400) feet. Manholes shall be equipped with open grate lids.

8. Storm sewer bedding/backfill requirements shall conform to the construction details in Appendix H.

9. Inlets shall be located to intercept concentrated runoff prior to discharge over public/private rights-of-way, sidewalks, streets, and driveways.

10. The capacity of all Type „C“ inlets shall be based on a maximum surface flow to the inlets of four (4) cfs, calculated based on the 100-year frequency design storm event. The maximum flow to Type „C“ inlets located in low points (such as sag vertical curves) shall include the overland flow directed to the inlet as well as all bypass runoff from upstream inlets. The bypass flow from upstream inlets shall be calculated using inlet efficiency curves included in PennDOT Design Manual Part 2, latest edition. If the surface flow to an inlet exceeds four (4) cfs, additional inlets shall be provided upstream of the inlet to intercept the excessive surface flow. A Type „C“ inlet at a low point of a paved area may be designed to accept a maximum of six (6) cubic feet per second (CFS). Type „M“ inlets shall be designed to accept a

maximum surface flow of six (6) CFS based on the one hundred (100) year frequency design storm event, unless otherwise approved by the Township. Double inlets will not be permitted where additional pipe and inlets can be placed upstream to intercept excessive surface flow. A maximum of twelve (12) cfs shall be permitted to be collected by a Type „M" inlet located in an isolated pervious area provided the designer can verify that such an inlet would not cause stormwater to accumulate on any adjacent public or private property, outside of an associated storm sewer easement, and that the depth of the accumulated stormwater would not exceed twelve (12) inches.

11. A minimum drop of two (2) inches shall be provided between the inlet and outlet pipe invert elevations within all inlets and manholes. When varying pipe sizes enter an inlet or manhole, the elevation of crown of all pipes shall be matched.

12. Stormwater pipes shall have a minimum depth of cover of twelve (12) inches (including over the bell) or as designated by the American Concrete Pipe Association (whichever is greater), and in no case shall any part of the pipe project into the road subbase or curb. Where cover is restricted, equivalent pipe arches may be specified in lieu of circular pipe.

13. The capacity of all stormwater pipes shall be calculated utilizing the Manning Equation for open channel flow as applied to closed conduit flow. The Manning"s roughness coefficient shall be 0.13 for all concrete pipe. In cases where pressure flow may occur, the hydraulic grade line shall be calculated throughout the storm sewer system to verify that at least one foot of freeboard will be provided in all inlets and manholes for the design storm event.

14. Culverts shall be designed based on procedures contained in Hydraulic Design of Highway Culverts, HDS #5, U.S. Department of Transportation, Federal Highway Administration. Where pressure flow is anticipated in storm sewer pipes (non-open channel flow), the applicant"s designer shall be required to calculate the elevation of the hydraulic grade line through the storm sewer system. Wherever the hydraulic grade line elevation exceeds the pipe crown elevation for the design flow, pipes with watertight joints must be specified.

15. Storm sewer structures (e.g. endwalls, inlets, and sections, etc.) may not be located on top of, or within ten (10) feet of electric, communication, water, sanitary sewer, or gas services and/or mains, unless approval is received from the Township and the Authority or Utility having jurisdiction over same.

16. Stormwater pipes must be oriented at right angles to electric, water, sanitary sewer, and gas utilities when crossing above or beneath same. Crossing angles of less than ninety (90) degrees will only be permitted at the discretion of the Township. When skewed crossings are permitted, interior angles between alignment of the storm sewer pipe and utility may not be less than forty-five (45) degrees. Vertical and horizontal design of storm sewer must be linear.

17. Roadway underdrain is required along both sides of all proposed roadways, existing roadways proposed to be widened**,** and within existing or proposed roadside swales as directed by the Township.

18. Where a public storm sewer system is not located within a right-of-way, or dedicated public property, a twenty (20) feet wide easement shall be established to encompass the storm sewer system. For multiple pipes or utilities, the width of the easement shall be a minimum of thirty (30) feet.

19. A minimum of one (1) foot of freeboard, between the inlet grate and the design flow elevation, shall be provided in all storm sewer systems (inlets and manholes) for the one hundred (100) year frequency design storm event.

D. Open Swales and Gutters – Open swales shall be designed on the basis of Manning"s Formula as indicated for collection systems with the following considerations:

1. Roughness Coefficient – The roughness coefficient shall be 0.040 for earth swales.

2. Bank Slopes – Slopes for swale banks shall not be steeper than one (1) vertical to four (4) horizontal.

3. Flow Velocity – The maximum velocity of flow as determined by Manning"s equation shall not exceed the allowable velocities as shown in the following table for the specific type of material, unless otherwise approved by the Township and the Bucks County Conservation District

   Note: Source of the following design criteria is the Pennsylvania Department of Environmental Protection, Bureau of Soil and Water Conservation Publication, Erosion and Sediment Control Program Manual.

ALLOWABLE VELOCITY

Material	Velocity in feet per second (fps)
Well established grass on good soil	
Short Pliant bladed grass	4.0 to 5.0
Bunch grass – soil exposed	2.0 to 3.0
Stiff stemmed grass	3.0 to 4.0
Earth without vegetation	
Fine sand or silt	1.0
Ordinary firm loam	2.0 to 3.0
Stiff clay	3.0 to 5.0
Clay and gravel	4.0 to 5.0
Coarse gravel	4.0 to 5.0
Soft shale	5.0 to 6.0
Shoulders	
Earth	(as defined above)
Stabilized	6.0
Paved	10.0 to 15.0

4. Swales shall be stabilized with bio-degradable erosion control matting to permit establishment of permanent vegetation. Swales shall be of such shape and size to effectively contain the one hundred (100) year, Rational Method design storm, or greater, and to conform to all other specifications of the Township.

5. To minimize sheet flow of stormwater across lots located on the lower side of roads or streets, and to divert flow away from building areas, the cross-section of the street as constructed shall provide for parallel ditches or swales or curb on the lower side which shall discharge only at drainage easements, unless otherwise approved by the Township.

6. Gutters and swales adjacent to road paving shall be permitted to carry a maximum flow of four (4) cubic feet per second prior to discharge away from the street surface, unless it is proven to the satisfaction of the Township by engineering calculations that the road slopes or other factors would allow higher gutter or swale capacity.

7. Flows larger than those permitted in gutters and roadside swales may be conveyed in swales outside the required road right-of-way in separate drainage easements, or may be conveyed in pipes or culverts inside or outside the required road right-of-way.

8. Existing and proposed swales shall be provided with underdrains as deemed necessary by the Township should overland seepage result in potential maintenance problems. Underdrains must discharge into a natural drainage channel or stormwater management system.

9. Where drainage swales are used to divert surface waters away from buildings, they shall be sodded, landscaped, or otherwise protected as required and shall be of a slope, shape, and size conforming with the requirements of the Township. Concentration of surface water runoff shall be permitted only in swales, watercourses, retention or detention basins, bioretention areas, or other areas designed to meet the objectives of this Ordinance.

E. Bridge and Culvert Design

Any proposed bridge or culvert to convey flow within a watercourse, perennial stream, intermittent stream or ephemeral 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 fifty (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, Soil Conservation Service, Technical Release No. 55. All bridges and culverts shall be designed to convey the one hundred (100) year design storm without increasing the extent and depth of the one hundred (100) year flood plain.

F. Storm Sewer Design

1. Design flow rate – The storm sewer system shall be designed to carry the one hundred (100) year frequency design storm peak flow rate. The drainage area and runoff coefficient to each inlet shall be indicated on the stormwater management plan. The one hundred (100) year flow rate shall be determined by the "Rational" method formula: Q = CIA where:

   Q = Peak runoff rate measured in cubic feet per second (cfs).
   C = Runoff coefficient - The coefficient of stormwater runoff includes many variables, such as ground slope, ground cover, shape of drainage area, etc.
   I = Intensity – Average Rainfall Intensity in inches per hour for a time equal to the time of concentration.
   A = Area – Drainage area in acres.

   Appropriate values for the rainfall intensity can be found in the Pennsylvania Department of Transportation, Design Manual Part 2 (refer Appendix A).

2. Consideration shall be given to future land use changes in the drainage area in selecting the Rational ("C") coefficient. For drainage areas containing several different types of ground cover, a weighted value of "C" shall be used.

3. In determining the peak flow rate to individual storm sewer inlets (or other collection structures) the time of concentration method (as referenced in Section 309) shall be used for inlet drainage areas in excess of one (1) acre, unless otherwise approved by the Township. For inlet drainage areas less than one (1) acre, a five (5) minute time of concentration shall be used unless otherwise approved by the Township.

4. In determining the required design flow rate through a storm sewer piping system, if a five (5) minute time of concentration (storm duration) results in a pipe size exceeding a thirty (30) inch diameter pipe (or equivalent flow area of 4.9 square feet), the time of concentration approach (as defined herein) shall be used in determining storm duration.

5. In determining the required design flow rate through a storm sewer piping system, if a five (5) minute time of concentration results in a pipe size exceeding thirty (30) inches, within any run of pipe, the time of concentration approach may be used for sizing of pipes from that point on, by adjusting the time of concentration.

6. Overflow System – An overflow system shall be provided to carry all bypass flow and/or flow in excess of storm sewer design capacity, to the detention basin (or other approved outlet point) when the capacity of the storm sewer system is exceeded. Stormwater runoff will not be permitted to surcharge from storm sewer structures.

G. Grading and Drainage

1. After completion of rough grading, a minimum of eight (8) inches of topsoil shall be returned to remaining disturbed areas prior to final grading and seeding.

2. Lots shall be graded to secure proper drainage away from buildings and to prevent the collection of storm water in pools. Minimum two (2) percent slopes shall be maintained away from and around all structures. Separation between the top of foundation wall (or slab) shall comply with Township Building Code requirements.

3. Construction - The developer shall construct and/or install such drainage structures and/or pipe which are necessary to prevent erosion damage and to satisfactorily carry off such surface waters to the nearest practical street, storm drain or natural water course.

4. Excavation - No excavation shall be made with a cut face steeper in slope than four (4) horizontal to one (1) vertical (4:1 = 25 percent), except under one or more of the following conditions:

   (a) The material in which the excavation is made is sufficiently stable to sustain a slope of steeper than 4:1 and a written statement (certification) from a Professional civil engineer, licensed in the Commonwealth of Pennsylvania and experienced in erosion control, to this effect is submitted to the Township Engineer for review. This statement shall indicate the site has been inspected and that the deviation from the slope specified herein will not result in injury to persons or damage to property.

   (b) A concrete, segmental block, or stone masonry wall, constructed in accordance with Township requirements, is provided to support the face of the excavation.

5. Fill - No fill shall be made which creates any exposed surface steeper in slope than four (4) horizontal to one (1) vertical (4:1 = 25 percent) except under one or more of the following conditions:

   (a) The fill is located so that settlement, sliding, or erosion will not result in property damage or be a hazard to adjoining property, streets, alleys, or buildings.

   (b) A written statement from a Professional civil engineer, licensed in the Commonwealth of Pennsylvania and experienced in erosion control, certifying the site has been inspected and that the proposed deviation from the slope specified above will not endanger any property or result in property damage, is submitted to and approved by the Township.

   (c) A concrete, segmental block, or stone masonry wall, constructed in accordance with Township requirements, is provided to support the face of the excavation.

6. Slopes and Fences - The top or bottom edge of slopes shall be a minimum of five (5) feet from property or right-of-way lines of streets or alleys in order to permit the normal rounding of the edge without encroaching on the abutting property. Where walls or slopes (steeper than two (2) horizontal to one (1) vertical) are approved under the criteria in this Ordinance, and are five (5) feet or more in height, a protective fence shall be required at the top of the wall (or bank).

7. Clean up - All lots must be kept free of any debris or nuisances whatsoever during construction.

8. Design of erosion and sedimentation control facilities (particularly stormwater/sediment basins) shall incorporate Best Management Practices as defined herein.

9. Cut and fill operations shall be kept to a minimum. Wherever feasible, natural vegetation shall be retained, protected, and supplemented. Cut and fills shall not endanger or otherwise adversely impact adjoining property.

10. No grading equipment shall be permitted to be loaded and/or unloaded on a public street, and no grading equipment shall be permitted to travel on or across a public street unless licensed for operation on public thoroughfares.

11. Grading equipment shall not be permitted to cross intermittent and perennial streams. Temporary crossing shall only be permitted where application is made, and approval is received, from the Pennsylvania Department of Environmental Protection (where applicable), the Bucks County Conservation District, and Solebury Township.

12. Design of energy dissipation for high volume and/or high velocity discharge from storm sewer pipes and channels shall be in accordance with Hydraulic Engineering Circular No. 14, "Hydraulic Design of Energy Dissipaters for Culverts and Channels" as published by Department of Transportation, FHA, when deemed necessary by the Township, and as approved by the Bucks County Conservation District.

13. To control the dissemination of mud and dirt on to public roads and driveways, tire cleaning areas constructed of AASHTO #1 stone (underlain by geotextile structural fabric), at least fifty (50) feet in length shall be installed at each point of access to the site and individual lots (upon construction of internal streets in a binder condition). When deemed necessary by the Township, washing stations shall also be set-up at every construction entrance in order to wash mud and dirt from exiting vehicles. Appropriate measures must be taken to control runoff from such locations. The developer shall be responsible for the placement of appropriate signage identifying construction entrances and washing stations. Construction entrances shall be maintained by the developer during construction, as determined by the Township.

14. In the event any mud and/or debris is transported from the site onto a public roadway, the debris shall be removed immediately and the roadway swept and/or washed as deemed necessary by the Township at the owner's expense.

15. Adequate provision shall be made to prevent surface water from damaging the cut face of excavation and the sloping surfaces of fills.

H. Stormwater Detention/Retention Basins

1. If permanent ponds (retention basin) are proposed, the developer shall demonstrate that such ponds are designed to protect the public"s health and safety.

2. During construction, duly authorized representatives of Solebury Township may enter at any reasonable time upon any property within the Township to investigate whether construction activity is in compliance with this Ordinance.

3. When basins are provided, they shall be designed to utilize the natural contours of the land whenever possible. When such design is not practical, the construction of the basin shall utilize slopes as flat as possible to blend the structure into the terrain.

4. Except with the one (1) year design storm, basins shall be designed so that they return to normal conditions within approximately twelve (12) hours after the termination of the storm, unless the Township determines that downstream conditions may warrant other design criteria for stormwater release.

5. Landscaping and planting in and around the perimeter of basins shall be provided. Proposed planting shall also be in accordance with the provisions of this Ordinance, the Subdivision and Land Development Ordinance, and as recommended by the Township Landscape Architect/Planner.

6. If a stormwater management basin will serve as a temporary sediment control device, the temporary sediment control measures shall be shown including perforated riser pipes or standboxes, filter berms, clean-out stakes and other measures as may be required by Pennsylvania Department of Environmental Protection, Chapter 102 Regulations. Plans for such facilities shall require Bucks County Conservation District approval prior to implementation. Sedimentation basins shall be in place prior to any earthmoving activities within their tributary drainage areas. A note identifying the above criteria shall be required on the Record Plan of subdivisions and land developments as well as in the development agreement with the Township.

7. Stormwater management basins shall be in place before the creation of any new impervious surfaces on the site.

8. Runoff shall not be directed to any infiltration structure until all tributary drainage areas are stabilized.

9. Where permanent retention (pond) facilities are proposed, there shall be a safety ledge, ten (10) feet wide, no greater than fifteen (15) inches and no less than twelve (12) inches below the permanent water surface level.

10. All basins shall have slopes of four (4) horizontal to one (1) vertical (4:1 = 25 percent), or flatter on the basin"s outer berm and four (5) horizontal to one (1) vertical or less on the basin"s inner berm. The top or toe of any slope shall be located a minimum of five (5) feet from any property line. The maximum difference between the top of berm elevation and the invert elevation of the outlet structure shall be seven (7) feet.

11. All portions of a dry detention basin bottom shall have a minimum slope of two (2) percent.

12. All basin embankments shall be placed in lifts not to exceed one (1) foot in thickness and each lift shall be compacted to a minimum of ninety-five (95) percent of Modified Proctor Density as established by A.S.T.M. D-1557. Prior to proceeding to the next lift, the compaction shall be checked by a Soils Engineer employed by the applicant/developer. Compaction tests shall be run on the leading and trailing edge of the berm along with the top of the berm. Verification of required compaction shall

be submitted to the Township prior to utilization of any basin for stormwater management.

13. Emergency overflow facilities/spillway shall be provided within basins in order to convey basin inflow in excess of design flows, out of the basin, or in the event the outlet structure becomes blocked and is unable to convey flow. Emergency spillways discharging over embankments shall be constructed of reinforced concrete checker-blocks to protect the berm against erosion. The checkerblocks shall be back-filled with topsoil and seeded. Checkerblock lining shall extend to the toe of the embankment on the outside of the berm, and shall extend to an elevation of three (3) feet below the spillway crest on the inside of the berm. Vegetated spillways may be utilized for spillways constructed entirely on undisturbed ground (i.e., not discharging over fill material). A dense cover of vegetation shall be rapidly established in such spillways by sodding or seeding with a geotextile anchor. The vegetated spillway must be stabilized before runoff is directed to the basin. The minimum capacity of all emergency spillways shall be equivalent to the peak flow rate of the one hundred (100) year, post-development design storm (entering to the basin).

14. In all cases, the discharge end of the basin shall be provided with a properly designed outlet control structure (headwall, orifice structure or other approved flow control structure), culvert pipe, and endwall. Perforated riser pipes alone, without provision for permanent outlet control structure (as stated above), and culvert pipe are not permitted for permanent basins.

15. The minimum top of basin berm width (at the design elevation) shall be ten (10) feet. A cut-off trench (keyway) of impervious material shall be provided under all embankments that require fill material. The cut-off trench shall be a minimum of eight (8) feet wide, three (3) feet deep and have side slopes of one (1) horizontal to one (1) vertical.

16. The minimum freeboard through the emergency spillway shall be one (1) foot. Freeboard is defined as the difference between the design flow elevation through the spillway and the elevation of the top of the settled basin berm.

17. Anti-seep collars shall be installed around the pipe barrel and shall be centered within the normal saturation zone of the berm. The anti-seep collars and their connections to the pipe barrel shall be watertight. The anti-seep collars shall be cast-in-place and extend a minimum of two (2) feet beyond the outside of the principal pipe barrel. Precast collars shall be permitted if approved by the Township. A minimum of two (2) collars shall be installed on each basin outlet pipe.

18. A perforated sediment control structure, sized in accordance with Bucks County Conservation District requirements, shall be provided at each basin outlet structure (if more than one is to be utilized) for sediment control. Sediment control structures shall not be removed until the entire area tributary to the basin has been permanently stabilized and until approved by the Bucks County Conservation District.

19. All basin outlet pipes shall be watertight reinforced concrete having “O-Ring” joints. All joints shall be mortared. Crushed stone bedding/backfill shall not be utilized through basin berms.

20. A minimum of six (6) inches is required between the top of outlet structure box and the emergency spillway elevation. Six (6) inches, minimum, is also required between the one hundred (100) year water surface elevation and the top of outlet structure box.

21. Energy dissipating devices (rock lining/rip rap, or other approved materials) shall be provided at all basin outlets and shall be sized in accordance with Pennsylvania Department of Environmental Protection, Bureau of Soil and Water Conservation Publication, Erosion and Sediment Control Program Manual, latest revision.

22. Stone gabion baskets shall not be permitted for use in construction of detention/retention basins.

23. Access easement and stabilized drive to stormwater detention facilities shall be provided for maintenance and operation. This access easement shall be cleared and, when possible, be at least twenty (20) feet in width. Multiple accesses shall be encouraged for major facilities. The developer shall provide access easements and drives of reinforced concrete checker-block (back-filled with topsoil and seeded) or other similar paver acceptable to the Township Engineer, over a six (6) inch bed of compacted PennDOT type 3A coarse aggregate (or approved equivalent). Accessways to basins shall be a minimum of ten (10) feet wide and be no steeper in slope than ten (10) feet horizontal to one (1) feet vertical (10:1). In addition, depressed curb and concrete apron shall be provided where the accessway enters a street/driveway and the stabilized driveway shall extend from the bottom of the interior basin berm embankment to the point of access to the basin. Access easement shall be owned and maintained by the individual lot owner(s) or homeowner"s association but shall be established to permit access by Solebury Township or its designee, for emergency inspection and/or maintenance, at any reasonable time.

24. Split rail fence with wire mesh backing is may be required around all detention or retention basin where directed by Solebury Township. Fence shall consist of locust posts (two or three rail), four (4) feet high, with assorted hardwood rails (eight (8) feet to ten (10) feet long), and epoxy coated wire mesh (black or green in color) installed six (6) inches above finished grade. Each basin fence installation shall include two points of access with ten (10) feet wide self closing, self latch gates.

I. General Design Requirements

1. Prior to finish grading of a development site and final overlay of streets, roads, and driveways, temporary measures, acceptable to the Township, shall be taken to ensure that all runoff intended to be intercepted and collected by an inlet or other facility, will be collected. The plan shall include such details, notes, or specification including bituminous “eyebrows” at inlets, diversion berms, etc.

2. Water originating from other than natural sources, such as air conditioning units, sump pumps, or other dry weather flow, wherever practical and possible, shall be connected to a storm sewer, or street drainage structure, or other approved stormwater conveyance facility that is designed as part of a stormwater management BMP.

3. All stormwater runoff and floodplain calculations and stormwater management facilities design shall be prepared by a Professional Engineer licensed in the Commonwealth of Pennsylvania.

4. When subdivisions or land developments are submitted to the Township for approval in sections, a complete storm sewer design for the proposed subdivision and land development shall be submitted. The proposed design must include the entire tract and not a portion.

5.

Section 310. Calculation Methodology

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

B. Any stormwater runoff calculations shall use generally accepted calculation technique that is based on the NRCS soil cover complex method. Table 310-1 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 two hundred (200) acres. The Rational Method is recommended for drainage areas under one hundred (100) acres.

Table 310-1 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	US 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 of necessary; simpler than TR-20 or HEC-1.
Rational Method (or commercial computer package based on Rational Method)	Emil Kuichling (1889)	Applicable sites less than 200 acres, or as approved by the Township engineer.
Other methods	Varies	Other computation methodologies approved by the Township engineer.

C. 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 gage, as presented in Table A-1 of Appendix A of this Ordinance. The SCS Type 11 rainfall curve data from NOAA is listed in 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.

D. 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-2 in Appendix A of this Ordinance.

E. Suggested runoff coefficients (C) for both existing and proposed conditions for use in the Rational Method are contained in Table A-3 in Appendix A of this Ordinance.

F. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate time-of-concentration for overland flow and return periods from NOAA Atlas 14, Volume 2 Version 2.1. 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.

G. For the purposes of existing conditions flow rate determination for all subdivision and land development applications, undeveloped land and existing impervious surfaces shall be considered as “meadow” in good condition, unless the natural ground cover generates a lower curve number (CN) or Rational „C‟ value (e.g. forest), as listed in Table A-~~2~~4 or A-~~3~~7 in Appendix A of this Part. 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.

H. 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-4 in Appendix A of this Ordinance.

I. 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.

J. 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 twenty (20) acres in area, the design storm hydrograph shall be computed using a calculation method that produces a full hydrograph.

K. The Township 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 Township Engineer. Calibration shall require detailed gauge and rainfall data for the particular site in question.

L. Infrequent Storm - The rational runoff coefficients given in this Ordinance are applicable for the two (2) year through ten (10) year frequency design storm event. Less frequent, higher intensity storms require modification of the runoff coefficient because infiltration and other losses have a proportionally smaller effect on runoff (Wright-McLaughlin 1969). The adjustment of the rational method for use with major storms shall be made by multiplying the rational formula by a frequency factor Cf. Cf values are as follows: twenty-five (25) year frequency design storm – 1.1; fifty (50) year frequency design storm – 1.2; one hundred (100) year frequency design storm – 1.25. The product of Cf and Rational Coefficient C shall not exceed 1.0.

M. The time of concentration (Tc) is the time required for water to flow from the hydraulically most remote point of the drainage area to the point of interest (design point). Use of the rational formula requires calculation of a Tc for each design point within the drainage basin. Travel Time Estimation for the rational method shall be based on NRCS Technical

Release No. 55 (2nd Edition). For design purposes the time of concentration may not be less than five (5) minutes. Travel time (Tt) is the time it takes runoff to travel from one location to another in a watershed (subreach) and is a component of time of concentration. Tc is computed by summing all the travel times for consecutive components of the drainage conveyance system.

Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. Sheet flow rates shall be calculated using the NRCS TR-55 (1986) variation of the kinematic wave equation. Sheet flow length may not exceed fifty (50) feet over paved surfaces and one hundred and fifty (150) feet over unpaved surfaces. Maximum permitted sheet flow length shall be one hundred and fifty (150) feet unless site specific conditions exist (that can be demonstrated) that warrant an increase of the sheet flow length. Under no circumstances shall sheet flow length exceed three hundred (300) feet. Shallow concentrated flow time and open channel flow time shall be calculated using standard engineering methodologies.

Section 311. Standards During Land Disturbance

A. Whenever vegetation and topography are to be disturbed, such activity must be in conformance with Chapter 102, Title 25, Rules and Regulations, Part 1, Commonwealth of Pennsylvania, Department of Environmental Protection, Subpart C, protection of Natural Resources, Article II, Water Resources, Chapter 102, "Erosion Control," and in accordance with the Regulations of Bucks Conservation District and the standards and specifications of the Township.

B. No Regulated Earth Disturbance Activities within the Township shall commence until approval by the Township of an Erosion and Sediment Control and Grading Plan for construction activities.

C. Pursuant to 25 PA Code Chapter 92, a PADEP “NPDES Construction Activities” permit is required for Regulated Earth Disturbance activities.

D. Copies of any necessary permit(s) for Regulated Earth Disturbance activities from the appropriate PADEP regional office or Bucks County Conservation District must be submitted to the Township.

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.

F. Whenever infiltration BMPs are proposed, the following additional erosion and sedimentation control design standards and criteria must be applied:

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. Thirty-three (33) inch super filter fabric fence (or other approved protection mechanism) must be installed around proposed infiltration areas to prevent encroachment and compaction by construction equipment.
2. Infiltration BMPs shall not be constructed nor receive runoff until the entire contributory drainage area to the infiltration BMP has received final stabilization. If necessary, thirty-three (33) inch super filter fabric fence (or other approved protection

mechanism) must be installed in the vicinity of infiltration area to prevent contamination by runoff containing suspended sediment.

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 and discharge volumes shall be calculated based upon the runoff coefficients for bare soils during the maximum period and extent of disturbance from clearing, and impervious surface installation, indicated on the development plan. Controls shall insure that the difference in volume and rate of peak discharges before disturbance and during shall not exceed those peak discharges required in Section 303 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 areas. Calculations based on the above parameters must be submitted to verify "during construction" runoff does not exceed predevelopment runoff for the one (1) year frequency through one hundred (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 two (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. Four (4) feet high orange safety fence or other similar protection fence approved by the Township must be installed around the entire limit of disturbance/clearing prior to commencement of earthmoving activities, and maintained until completion of all construction activity.

Section 312. Water Quality Requirements After Regulated Earth Disturbance Activities Are Complete

A. No Regulated Earth Disturbance activities within the Township shall commence until approval by the Township 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 Township.

C. To control postconstruction 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 postconstruction 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 postconstruction stormwater discharges to prevent physical degradation of receiving waters (e.g. from scouring).

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

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

F. BMP operations and maintenance requirements are described in Article IV of this Ordinance.

Section 313. Delaware Canal Areas

Development on lands adjacent to the Delaware Canal which propose to discharge stormwater into the canal must obtain special right-of-way approval from Pennsylvania Department of Conservation and Natural Resources (PADCNR). The PADCNR has established a separate policy for granting right-of-way for stormwater drainage into the Delaware Canal, which shall be used in conjunction with this Ordinance. Feeder streams that flow or feed into the Delaware Canal shall be protected against soil erosion, water quality degradation, and sedimentation.

Section 314 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 401. 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 Township.

Section 402. Stormwater Management Plan Contents and Requirements

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 plant materials shall be submitted to the Township 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 site plans required in Article IV for those developments not intending the use of such facilities. This analysis shall provide:

   1. An assessment of the anticipated additional runoff based on the design storm and post-development condition and utilizing the calculation procedures required in Sections 305 and 307;

   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 County 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 "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 wet pond or artificial wetland BMPs such as insufficient soil suitability.

10. rationale for not proceeding with infiltration oriented BMPs in accordance with Section 303.A.1.c of this Ordinance.

The feasibility analysis must allow the Township 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. Taking into consideration the areal extent of suitable soils necessary to accommodate an infiltration facility, or wet pond, or wetland BMP for the type and size of development proposed, developers for those sites that are determined to be generally suitable 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 at 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 within Carbonate Geology Overlay District (refer Section 1904 of the Solebury Township Zoning Ordinance) 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 or retention basins.

D. It shall be the developer's responsibility to verify whether the development 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."

E. General

1. General description of project.
2. General description of permanent stormwater BMPs and 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.

F. Plan(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 plan(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 (Neshaminy Creek or Delaware River South).
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. The overlay shall include a table on the map showing the recharge capabilities of each soil existing onsite in inches per hour and describing 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. Overland drainage paths.

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

21. A note on the plan indicating the location of, 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 on the plan, signed by the landowner, acknowledging the stormwater BMPs and management facilities will be permanent fixtures 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.

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 certifies that the stormwater management plan meets all design standards and criteria of the Solebury Township Stormwater Management Ordinance."

G. 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 BMPs 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 County 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 and peak flow) on adjacent properties and on any existing Township stormwater collection system that may receive runoff from the project site.
5. A 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.

H. Stormwater Management BMPs

1. All stormwater management BMPs must be located on a plan and described in detail.
2. When infiltration 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 separation distance of no less than 20 feet shall be provided between any septic system and any facility used for stormwater management.
3. All calculations, assumptions, and criteria used in the design of the stormwater management BMPs 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.

I. All Stormwater Management Plans shall note the following: Stormwater management facilities are a permanent part of the development and shall not be removed, altered, or modified.

Section 403. Plan Submission

For all activities regulated by this Ordinance, the steps below shall be followed for submission of the stormwater management plan to the Township. For any activities that require a PADEP joint permit application and regulated under Chapter 102 (Erosion and Sediment Control), 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 part of the plan submission.

A. The stormwater management plan shall be submitted by the developer as part of the Preliminary plan submission for the Regulated Activity.

B. The number of copies of the Stormwater Management Plan required to be submitted to the Township, shall be determined by Resolution of the Board of Supervisors.

C. Distribution of the Stormwater Management plan shall be determined by resolution of the Board of Supervisors. The distribution list, at a minimum, shall include Solebury

Township Engineer and the Bucks County Planning Commission, as well as any other agencies or entities designated by the resolution of the Board of Supervisors.

Section 404. Stormwater Management Plan Review

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

B. The Township Engineer shall review the Stormwater Management Plan for any subdivision or land development against the Municipal Subdivision and Land Development Ordinance provisions not superseded by this Ordinance.

C. For activities regulated by this Ordinance, the Township Engineer shall notify the Solebury Township Secretary in writing, whether the Stormwater Management Plan is consistent with Township Ordinances and other relevant regulations. Should the Stormwater Management Plan submitted by the applicant be determined to be consistent with Township Ordinances and other relevant regulations, the Township Engineer will forward a review letter to the applicant with a copy to the Solebury Township Secretary.

D. For regulated activities specified in Sections 104.E, F, and J of this Ordinance, the Township Engineer shall notify the Township Secretary in writing whether the stormwater management plan is consistent with this Ordinance and forward a copy of the review letter to the developer. Any disapproved stormwater management plan may be revised by the developer and resubmitted consistent with this Ordinance.

E. The Township shall not approve any subdivision or land development or regulated activities specified in Sections 104.A and 104.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.

F. The Township Building Permit Office shall not issue a building permit for any regulated activity specified in Section 104 of this Ordinance if the stormwater management plan has been found to be inconsistent with this Ordinance, as determined by the Township Engineer, or without considering the comments of the Township Engineer. All required permits from PADEP must be obtained prior to issuance of a building permit.

G. The developer shall be responsible for completing an "as-built survey" of all stormwater management BMPs 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 Township Engineer for review. In no case shall the Township approve the as-built survey until the Township receives a copy of an approved Declaration of Adequacy, Highway Occupancy Permit from the PADOT District Office, and any applicable permits from PADEP.

H. The Township'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 Township may consider the stormwater management plan disapproved and may revoke any and all

permits. Stormwater management plans that are considered disapproved by the Township shall be resubmitted in accordance with Section 407 of this Ordinance.

Section 405. 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 406. Adherence to Approved Plan

It shall be unlawful for any person to undertake any development 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 407. Certification of Completion

At the completion of the project, and as a prerequisite for the release of the performance guarantee under Section 701, the owner or his representatives shall:

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

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

Section 408. 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 Township Engineer, shall require a resubmission of the modified stormwater management plan consistent with Section 403 of this Ordinance and be subject to review as specified in Section 404 of this Ordinance.

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

Section 409. 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 501. Schedule of Inspections

A. The Township 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 Township Engineer determines that temporary or permanent erosion and sedimentation control or stormwater management BMPs are not being implemented in accordance with the approved stormwater management plan and this Ordinance, the Township shall revoke any existing permits until a revised stormwater management plan is submitted and approved, as specified in this Ordinance.

Section 502. Right of Entry

A. During construction, duly authorized representatives of Solebury 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 whether 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 Township access to a BMP is a violation of this article.

ARTICLE VI. FEES AND EXPENSES

Section 601. Stormwater Management Plan Review Fee

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

Section 602. Expenses Covered by Fees

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

A. Administrative/clerical costs.

B. Review of the stormwater management plan by the Township and the Township Engineer.

C. Site inspections by the Township staff and/or Township 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 603. Itemization of Costs

Expenses incurred by the Township and charged to the applicant pursuant to Section 602 of this Ordinance shall be itemized. A copy of the itemized costs will be provided by the Township to the applicant.

ARTICLE VII. MAINTENANCE RESPONSIBILITIES

Section 701. Performance Guarantee

The applicant shall provide a financial guarantee to the Township for the timely installation and proper construction of all erosion and sediment control measures and stormwater management BMPs 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 702. Maintenance Responsibilities

A. The stormwater management plan for the development site shall contain an BMP Operation and Maintenance plan (BMP O&M Plan) prepared by the design engineer. The BMP O& M Plan shall be subject to review and approval of the Township.

B. The BMP O&M Plan for the development site shall outline required routine maintenance actions and schedules necessary to ensure proper operation of the BMPs and 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 improvements are to be dedicated to the Township, stormwater BMPs may also be dedicated to and maintained by the Township, if accepted by the Township.

   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 BMPs shall be the responsibility of the owner or private management entity.

C. The Stormwater Management Plan 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 such operations and maintenance.

   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 cannot be altered or removed unless such alteration or removal is approved by the Township.

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

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

F. The Board of Supervisors, upon recommendation of the Township Engineer, shall make the final determination on the continuing maintenance responsibilities prior to final

approval of the stormwater management plan. The Board of Supervisors reserves the right at anytime to accept the ownership and operating responsibility for any or all of the stormwater BMPs. The right of the Township to accept ownership in the future shall be stated in the Maintenance Agreement (refer Section 704).

Section 703 Township Review of Stormwater Management Facilities and BMP O&M Plan

A. The Township shall review the Stormwater Management 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 Management Facility and BMP O&M Plan is approved.

C. The Township shall require an as-built plan of all stormwater management facilities and BMPs.

Section 704 Maintenance Agreement for Privately Owned Stormwater BMPs

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 in Appendix M of this Ordinance.

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

C. The property owner shall be responsible for the operation and maintenance of all stormwater management BMPs located on the property owner's land. If the owner fails to adhere to the O&M Agreement, the Township may perform the services required and charge the property owner the appropriate fees and costs of these services. Nonpayment of these fees and costs may result in a lien against the property.

Section 705 Stormwater Management Easements

A. Stormwater management easements shall be granted by the property owner if necessary to provide for: (1) access to the property by the Township 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 any easement shall be specified in the O&M 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. All 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 706 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. If the BMP is to be owned and maintained by the Township, the deposit shall cover the estimated costs for maintenance and inspections required pursuant to Section 707 for ten (10) years. The Township Engineer will establish the estimated costs upon review of information submitted by the applicant, which shall be subject to the approval of the Board of Supervisors.
2. If the stormwater management facilities and BMPs are to be owned and maintained by a private entity, the deposit shall cover the estimated Township costs for inspections for ten (10) years. The amount of required deposit shall be established by separate Resolution of the 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.

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. The Township Engineer will establish the estimated cost upon review of information submitted by the applicant.

Section 707 Post-Construction Maintenance Inspections

A. BMPs shall be inspected by the responsible person or 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 801. 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
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
Flows from riparian habitats and wetlands
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 Section 801(C) degrade the quality of Waters of the Commonwealth or U.S., then the Township will notify the responsible person to cease the discharge.

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

Section 802 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. These prohibitions expressly include 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 803 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 804 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 any 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 805 Alteration of SWM BMPs

A. No person~~s~~ 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 or upon a stormwater management BMP or within a drainage easement, without the written approval of the Township.

ARTICLE IX. ENFORCEMENT AND PENALTIES

Section 901. Right-of-Entry

During construction, duly authorized representatives of Solebury Township may enter at any reasonable times upon any property within the Township investigate whether construction activity is in compliance with this Ordinance.

Section 902. Notification

In the event that a person fails to comply with the requirements of this Ordinance, or fails to conform to the requirements of any permit issued hereunder, the Township shall provide written notification of the violation. 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 Township may pursue any and all other remedies. It shall be the responsibility of the owner of the real property on which any regulated 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 903. Enforcement

The governing body 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 Township Engineer or other qualified persons designated by the Township as directed by the Board of Supervisors.

A. A set of design plans approved by the Township shall be on file at the site throughout the duration of the construction activity. Periodic inspections may be made by the Township or 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 104 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, one (1) reproducible mylar, and two (2) paper prints of as-built drawings.

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

E. Prior to revocation or suspension of a permit, the governing body 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 governing body 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 of this Ordinance.

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

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

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

c) A permit that has been revoked by the governing body 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 completion pursuant to Section 407 has been secured. The occupancy permit shall be required for each lot owner and/or developer for all subdivisions and land developments in the Township.

Section 904. Public Nuisance

A. The violation of any provision of this Ordinance is hereby deemed a public nuisance.

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

Section 905. Penalties

Any person, partnership or corporation who or which has violated or permitted the violation of the provisions of this Ordinance shall, upon being found liable therefore in a civil enforcement proceeding commenced by the Township, pay a judgment of not more than $600.00 plus all court costs, including reasonable attorneys fees incurred by the Township as a result thereof. Each day that a violation continues shall constitute a separate violation.

Section 906. 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 not involving a subdivision or land development shall be made to the Board of Supervisors within thirty (30) days of that determination or decision.

B. Appeals from the determination of the Township or its designee, and appeals from the determination of the Township engineer in the administration of this Ordinance insofar as it relates to an application for subdivision or land development shall be made to the Board of Supervisors within thirty (30) days of that determination or decision.

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

ENACTED and ORDAINED at a regular meeting of the Solebury Township Board of Supervisors on the 19th day of May, 2011. This Ordinance shall take effect in five (5) days.

Peter Augenblick, Chairman

Dominic Mariano, Vice Chairman

Edward McGahan, Jr., Member

Robert Heath, Jr., Member

Michael A. Kennerley, Member

ATTEST:

Gretchen K. Rice
Assistant Manager/Secretary/Treasurer

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)

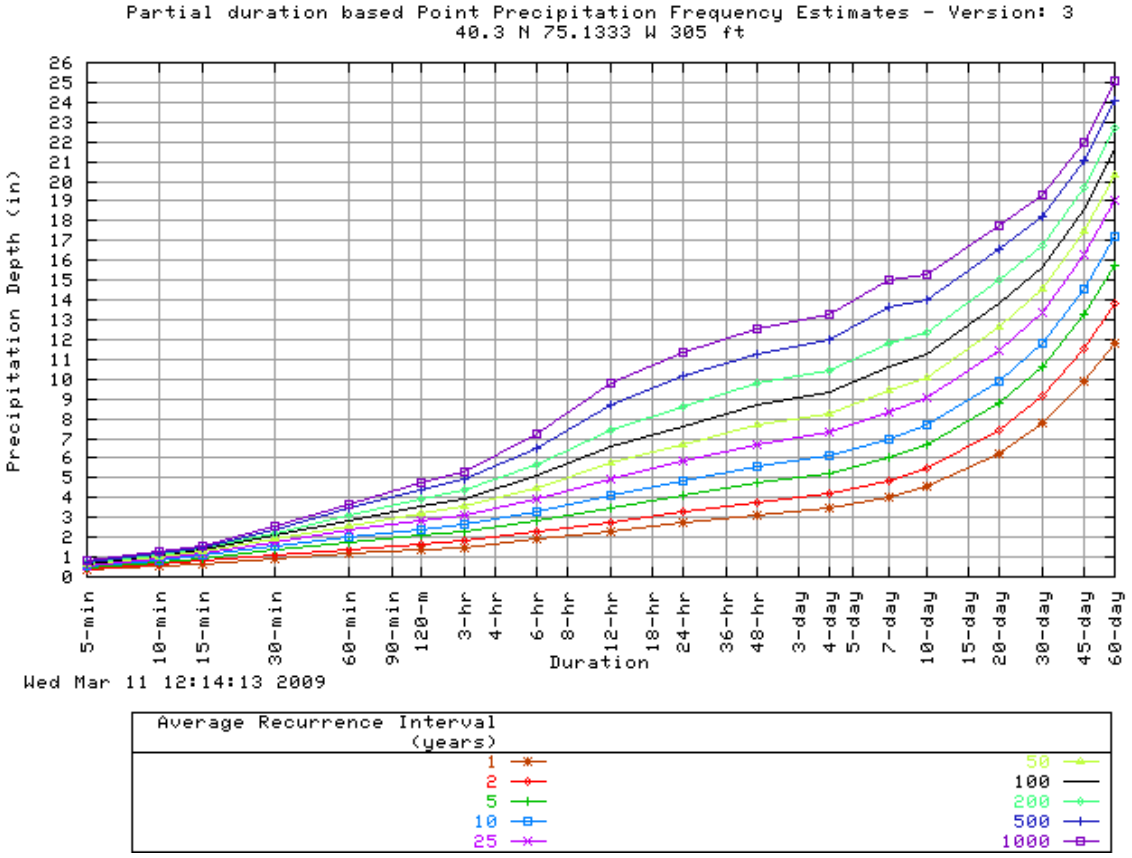


TABLE A-2: **NATURAL RESOURCE PROTECTION STORMWATER MANAGEMENT CONTROLS**

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) (Table B-3) **– Nonstructural Volume Control (ft^3)** (Table B-5) **= Structural Volume Requirement (ft^3)**

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

Land Use	A			B			C			D		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Cultivated Land	0.08[a]	0.13	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

SITE EVALUTION 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:

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

b. 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 can not 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. May 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 not be subject to a building program that precludes infiltration BMPs. An exemption will not be permitted for development of suitable soils otherwise exist for 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.

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.

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.). 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.

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.

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, especially in Karst topography*. 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 in Karst topography.

The designer and contractors shall limit 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 strongly discouraged, as a homogeneous laboratory sample does not represent field conditions. Infiltration tests should 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. Metholodology 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 large. (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 (i.e. an eight (8) inch ring and a twelve (12) inch ring). Material typically available at a hardware store may be acceptable.

___ 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 between June 1 and December 31. The presoak is done primarily to simulate saturated conditions in the environment (generally Spring) 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 C

LOW IMPACT DEVELOPMENT PRACTICES

APPENDIX C

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 the need for artificial conveyance and storage facilities. To simulate predevelopment hydrologic conditions, forced infiltration is often necessary to offset the loss of existing 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 no ~~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. Such depressions can be protected by simply avoiding them or by incorporating their 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 Cluster Development. 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. Other benefits included reduced potential of downstream flooding, water quality degradation of receiving streams/water bodies, and enhancement of aesthetics and reduction of development costs. Beneficial results include more stable baseflows in receiving streams, improved groundwater recharge, reduced flood flows, reduced pollutant loads, and reduced costs for conveyance and storage.

(Reference*: Pennsylvania Stormwater Best Management Practices Manual, December 2006)*

APPENDIX D

NONSTRUCTURAL STORMWATER MANAGEMENT ALTERNATIVES

Nonstructural Stormwater Management BMPs and Stormwater Methodological Issues

Chapter 8 of the Pennsylvania Stormwater Best Management Practices Manual, December 2006, provides a variety of straightforward and conservative ways to take credit for applying Nonstructural BMPs, provided that the "specifications" defined for each BMP is Chapter 5 of the manual are followed.

Because so many of the Nonstructural BMPs seem so removed from the conventional practice of stormwater engineering, putting these BMPs into play may be a challenge. Many of these Nonstructural BMPs ultimately require a more sophisticated approach to total site design. Some of the Nonstructural BMPs don't easily lend themselves to stormwater calculations as conventionally performed. How do we get stormwater credit for applying any of these techniques? Taking BMPs 5.6.1 and 5.6.2 as examples, minimizing impervious cover by reducing road width or impervious parking area directly translates into reduced stormwater volumes and reduced stormwater rates of runoff. Site planners and designers will also recognize that many of the other Nonstructural BMPs, such as clustering of uses, conserving existing woodlands and other vegetative cover, and disconnecting impervious area runoff flows, all translate into reduced stormwater volume and rate calculations. As such, these BMPs are self crediting (refer Chapter 5 of the manual).

(Reference: *Pennsylvania Stormwater Best Management Practices Manual, December 2006.*)

BMP 5.4.1: Protect Sensitive and Special Value Features

To minimize stormwater impacts, land development should avoid affecting and encroaching upon areas with important natural stormwater functional values (floodplains, wetlands, riparian areas, drainageways, others) and with stormwater impact sensitivities (steep slopes, adjoining properties, others) wherever practicable. This avoidance should occur site-by-site and on an area wide basis. Development should not occur in areas where sensitive/special value resources exist so that their valuable natural functions are not lost, thereby doubling or tripling stormwater impacts. Resources may be weighted according to their functional values specific to their municipality and watershed context.

Key Design Elements

- Identify and map floodplains and riparian area
- Identify and map wetlands
- Identify and map woodlands
- Identify and map natural flow pathways/drainage ways
- Identify and map steep slopes
- Identify and map other sensitive resources
- Combine for Sensitive Resources Map (including all of the above)
- Distinguish between including Highest Priority Avoidance Areas and Avoidance Areas
- Identify and Map Potential Development Areas (all those areas not identified on the Sensitive Resources Map)
- Make the development program and overall site plan conform to the Development Areas Map to the maximum; minimize encroachment on Sensitive Resources.

Potential Applications

Residential:
Commercial: Ultra Yes Yes
Urban: Industrial: Yes Yes
Retrofit: Yes Yes
Highway/Road:

Stormwater Functions

Volume Reduction: Very High
Recharge: Very High
Peak Rate Control: Very High
Water Quality: Very High

Water Quality Functions

TSS: Preventive
TP: Preventive
NO3: Preventive

BMP 5.4.2: Protect /Conserve/Enhance Riparian Areas

The Executive Council of the Chesapeake Bay Program defines a Riparian Forest Buffer as "an area of trees, usually accompanied by shrubs and other vegetation, that is adjacent to a body of water and which is managed to maintain the integrity of stream channels and shorelines, to reduce the impact of upland sources of pollution by trapping, filtering and converting sediments, nutrients, and other chemicals, and to supply food, cover, and thermal protection to fish and other wildlife."

Key Design Elements

- Linear in Nature
- Provide a transition between aquatic and upland environments
- Forested under natural conditions in Pennsylvania
- Serve to create a "Buffer" between development and aquatic environment
- Help to maintain the hydrologic, hydraulic, and ecological integrity of the stream channel.
- Comprised of three "zones" of different dimensions:
  - **Zone 1**: Adjacent to the stream and heavily vegetated under ideal conditions (Undisturbed Forest) to shade stream and provide aquatic food sources.
  - **Zone 2**: Landward of Zone 1 and varying in width, provides extensive water quality improvement. Considered the Managed Forest.
  - **Zone 3**: Landward of Zone 2, and may include BMPs such as Filter Strips.

Potential Applications

Residential:
Commercial: Ultra Yes Yes
Urban: Industrial: Yes Yes
Retrofit: Yes Yes
Highway/Road:

Stormwater Functions

Volume Reduction: Medium
Recharge: Medium
Peak Rate Control: Low/Med.
Water Quality: Very High

Water Quality Functions

TSS: Preventive
TP: Preventive
NO3: Preventive

There are two components to Riparian Buffers to be considered in the development process:

1. Protecting, maintaining, and enhancing existing Riparian Forest Buffers.
2. Restoring Riparian Forest Buffers that have been eliminated or degraded by past practices.

BMP 5.4.3: Protect/Utilize Natural Flow Pathways in Overall Stormwater Planning and Design

Identify, protect, and utilize the site's natural drainage features as part of the stormwater management system.

Key Design Elements

- Identify and map natural drainage features (swales, channels, ephemeral streams, depressions, etc.)
- Use natural drainage features to guide site design
- Minimize filling, clearing, or other disturbance of drainage features
- Utilize drainage features instead of engineered systems whenever possible
- Distribute non-erosive surface flow to natural drainage features
- Keep non-erosive channel flow within drainage pathways
- Plant native vegetative buffers around drainage features

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: No
Industrial: Yes
Retrofit: Yes
Highway/Road: Yes

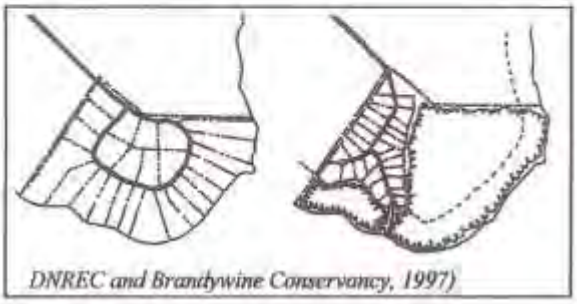
Stormwater Functions

Volume Reduction: Low/Med.
Recharge: Low
Peak Rate Control: Med./High
Water Quality: Medium

Water Quality Functions

TSS: 30%
TP: 20%
NO3: 0%

BMP 5.5.1: Cluster Uses at Each Site; Build on the Smallest Area Possible



DNREC and Brandywine Conservancy, 1997)

As density is held constant, lot size is reduced, disturbed area is decreased, and undisturbed open space is increased.

Key Design Elements

* Reduce total site disturbance/total site maintenance and increase undisturbed open space by clustering proposed uses on a total site basis through moving uses closer together (i.e., reducing lot size) and/or through stacking uses (i.e., building vertically), even as amount of use (i.e., gross density) is held constant as per existing zoning (or any other gross density determination). As density is held constant (Example A), lot size is reduced, disturbed area decreases, and undisturbed open space increases (Example B).
* Per lot values/prices may decline marginally; however, development costs also decrease.
* Cluster provisions may/may not be allowed by municipal zoning; if no zoning exists, ability to cluster may not be clear (lacking zoning, has the municipality in any way set standards for site uses, gross densities of these uses, etc.?).
* Pending answers to above questions, have lot sizes been reduced to the minimum, given proposed uses? Given existing ordinance provisions? Given other development feasibility factors such as public water/sewer vs. on-site water and sewer and others?
* Is the applicant maximizing clustering as much as possible legally?
* Is the applicant maximizing clustering functionally within municipal ordinance limits?

Potential Applications

Residential: Yes
Commercial: Yes*
Ultra Urban: Limited
Industrial: Limited
Retrofit: Yes
Highway/Road: No

*Depending on site size, constraints and other factors.

Stormwater Functions

Volume Reduction: Very High
Recharge: Very High
Peak Rate Control: Very High
Water Quality: Very High

Water Quality Functions

TSS: Preventive
TP: Preventive
NO3: Preventive

BMP 5.6.1: Minimize Total Disturbed Area - Grading

Without changing the building program, you can reduce site grading, removal of existing vegetation (clearing and grubbing) and total soil disturbance. This eliminates the need for re-establishment of a new maintained landscape for the site and lot-by-lot, by modifying the proposed road system and other relevant infrastructure as well as the building location and elevations to better fit the existing topography.

Key Design Elements

- Identify and avoid special value and environmentally sensitive areas
- Minimize overall disturbance at the site
- Minimize disturbance at the individual lot level
- Maximize soil restoration to restore permabilities
- Minimize construction-traffic locations
- Minimize stockpiling and storage areas

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Limited
Industrial: Yes
Retrofit: Limited
Highway/Road: Limited

Stormwater Functions

Volume Reduction: High
Recharge: High
Peak Rate Control: High
Water Quality: High

Water Quality Functions

TSS: 40%
TP: 0%
NO3: 0%

BMP 5.6.2: Minimize Soil Compaction in Disturbed Areas

Minimizing Soil Compaction and Ensuring Topsoil Quality is the practice of enhancing, protecting, and minimizing damage to soil quality caused by land development.

Image Source: "Developing an Effective Soil Management Strategy: Healthy Soil Is At the Root Of Everything", Ocean County Soil Conservation District

Key Design Elements

* Protecting disturbed soils areas from excessive compaction during construction
* Minimizing large cleared areas and stockpiling of topsoil
* Using quality topsoil
* Maintaining soil quality after construction
* Reducing the Site Disturbance Area through design and construction practices
* Soil Restoration for areas that are not adequately protected or have been degraded by previous activities (Section 6)

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Yes
Industrial: Yes
Retrofit: Yes
Highway/Road: Yes

Stormwater Functions

Volume Reduction: Very High
Recharge: Very High
Peak Rate Control: High
Water Quality: Very High

Water Quality Functions

TSS: 30%
TP: 0%
NO3: 0%

BMP 5.6.3: Re-Vegetate and Re-Forest Disturbed Areas, Using Native Species

Sites that require landscaping and re-vegetation should select and use vegetation (i.e., native species) that does not require significant chemical maintenance by fertilizers, herbicides, and pesticides.

Image: Rose Mallow, Bowman's Hill Wildflower Preserve, www.bhwp.org

Key Design Elements

* Preserve all existing high quality plant materials and soil mantle wherever possible
* Protect these areas during construction
* Develop Landscape Plan using native species
* Reduce landscape maintenance, especially grass mowing
* Reduce or eliminate chemical applications to the site, wherever possible
* Reduce or eliminate fertilizer and chemical-based pest control programs, wherever possible

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Limited
Industrial: Yes
Retrofit: Yes
Highway/Road: Limited

Stormwater Functions

Volume Reduction: Low/Med.
Recharge: Low/Med
Peak Rate Control: Low/Med.
Water Quality: Very High

Water Quality Functions

TSS: 85%
TP: 85%
NO3: 50%

BMP 5.7.1: Reduce Street Imperviousness

Reduce impervious street areas by minimizing street widths and lengths.

Key Design Elements

* Evaluate traffic volume and on-street parking requirements.
* Consult with local fire code standards for access requirements.
* Minimize pavement by using alternative roadway layouts, restricting on-street parking, minimizing cul-de-sac radii, and using permeable pavers.

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Limited
Industrial: Yes
Retrofit: Limited
Highway/Road: Limited

Stormwater Functions

Volume Reduction: Very High
Recharge: Very High
Peak Rate Control: Very High
Water Quality: Medium

Water Quality Functions

TSS: Preventive
TP: Preventive
NO3: Preventive

BMP 5.7.2: Reduce Parking Imperviousness

Reduce imperviousness by minimizing imperviousness associated with parking areas.

Key Design Elements

- Evaluate parking requirements considering average demand as well as peak demand.
- Consider the application of smaller parking stalls and/or compact parking spaces.
- Analyze parking lot layout to evaluate the applicability of narrowed traffic lanes and slanted parking stalls.
- Where appropriate, minimize impervious parking area by utilizing overflow parking areas constructed of pervious paving materials.

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Limited
Industrial: Yes
Retrofit: Limited
Highway/Road: Limited

Stormwater Functions

Volume Reduction: Very High
Recharge: Very High
Peak Rate Control: Very High
Water Quality: High

Water Quality Functions

TSS: Preventive
TP: Preventive
NO3: Preventive

BMP 5.8.1: Rooftop Disconnection

Minimize stormwater volume by disconnecting roof leaders and directing rooftop runoff to vegetated areas to infiltrate.

Key Design Elements

* Stormwater collection systems.
* Redirect rooftop overland flow to minimize rapid transport to conveyance structures and impervious areas, such as ditches and roadways.
* Direct runoff to vegetated areas designed to receive stormwater.

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Limited
Industrial: Limited
Retrofit: Limited
Highway/Road: Limited

Stormwater Functions

Volume Reduction: High
Recharge: High
Peak Rate Control: High
Water Quality: Low

Water Quality Functions

TSS: 30%
TP: 0%
NO3: 0%

BMP 5.8.2: Disconnection from Storm Sewers

Courtesy Pierce County, WA

Minimize stormwater volume by disconnecting impervious roads and driveways and directing runoff to grassed swales and/or bioretention areas to infiltrate.

Key Design Elements

- Disconnect road and driveways from stormwater collection systems.
- Redirect road and driveway runoff into grassed swales or other vegetated systems designed to receive stormwater.
- Eliminate curbs/gutters/conventional collection and conveyance.

Potential Applications

Residential:	Yes
Commercial: Ultra	Yes
Urban: Industrial:	Limited
Retrofit:	Limited
Highway/Road:	Limited
	Limited

Stormwater Functions

Volume Reduction:	High
Recharge:	High
Peak Rate Control:	High
Water Quality:	Low

Water Quality Functions

TSS:	30%
TP:	0%
NO3:	0%

BMP 5.9.1: Streetsweeping

Use of one of several modes of sweeping equipment (e.g., mechanical, regenerative air, or vacuum filter sweepers) on a programmed basis to remove larger debris material and smaller particulate pollutants, preventing this material from clogging the stormwater management system and washing into receiving waterways/waterbodies.

Key Design Elements

* Use proper equipment; dry vacuum filters demonstrate optimal results, significantly better than mechanical and regenerative air sweeping, though move slowly and are most costly
* Develop a proper program; vary sweeping frequency by street pollutant load (a function of road type, traffic, adjacent land uses, other factors); sweep roads with curbs/gutters
* Develop a proper program; restrict parking when sweeping to improve removal.
* Develop a proper program; seasonal variation for winter applications as necessary.

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Yes
Industrial: Yes
Retrofit: Yes
Highway/Road: Yes

Stormwater Functions

Volume Reduction: Low/None
Recharge: Low/None
Peak Rate Control: Low/None
Water Quality: High

Water Quality Functions

TSS: 85%
TP: 85%
NO3: 50%

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. For reference on how to properly plan the meadow, and a list of native grasses refer to *Meadows and Prairies: Wildlife-Friendly Alternatives to Lawn* at http://pubs.cas.psu.edu/FreePubs/pdfs/UH128.pdf .

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

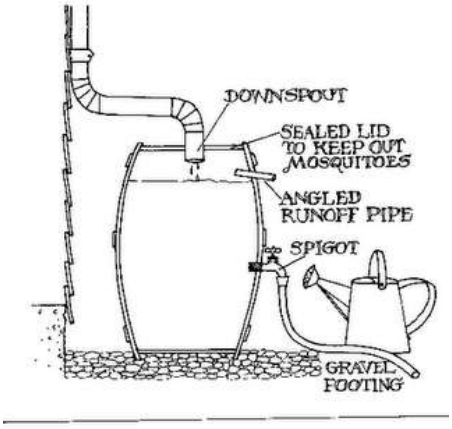
Rain Barrels

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

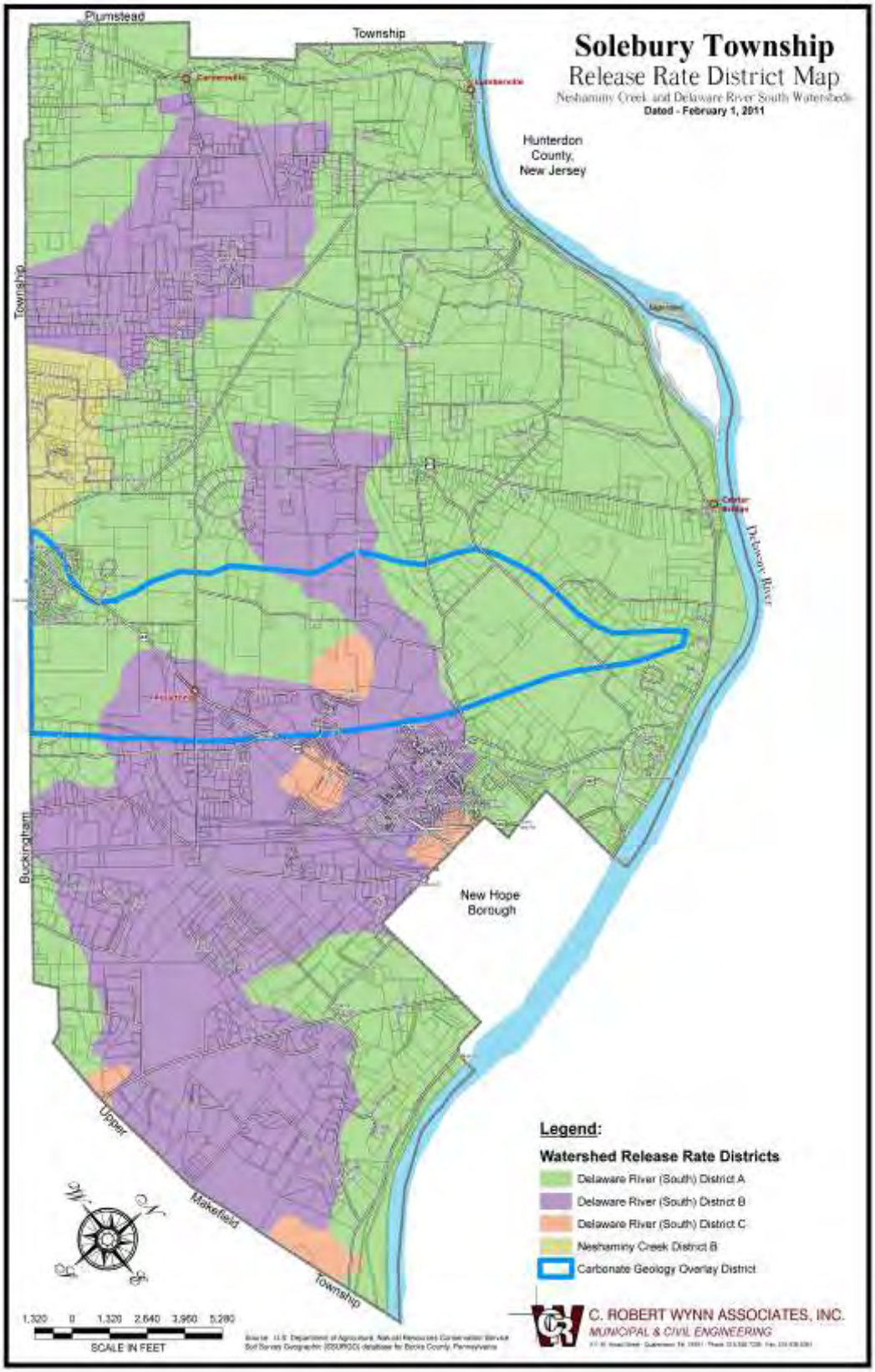
Delaware County Planning Commission. (2010). *Draft Crum Creek Watershed Act 167 Stormwater Management Plan. Ordinance Appendix B. Simplified Approach to Stormwater Management for Small Projects.*

Solebury Township. (2008). *Solebury Township Stormwater Management Ordinance. "Appendix J Simplified Stormwater Management Procedures for Existing Single Family Dwelling Lots*"

APPENDIX F

DELAWARE RIVER SOUTH AND NESHAMINY CREEK WATESHED MANAGEMENT DISTRICT MAP

STORMWATER MANAGEMENT DISTRICT WATERSHED MAP AND CARBONATE GEOLOGY OVERLAY ZONING DISTRICT BOUNDARY



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 to be used in conjunction with hot spot land uses. 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
Minimum Disturbance/ Minimum Maintenance Practices	1, 9

Best Management Practice	Design Reference Number
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

Hot Spot Land Use	Pre-treatment Method(s)
Commercial Container Nursery Operations	-Vegetated Swales/Filter Strips -Constructed Wetlands -Stormwater Collection and Reuse
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

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 Solebury 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. 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)

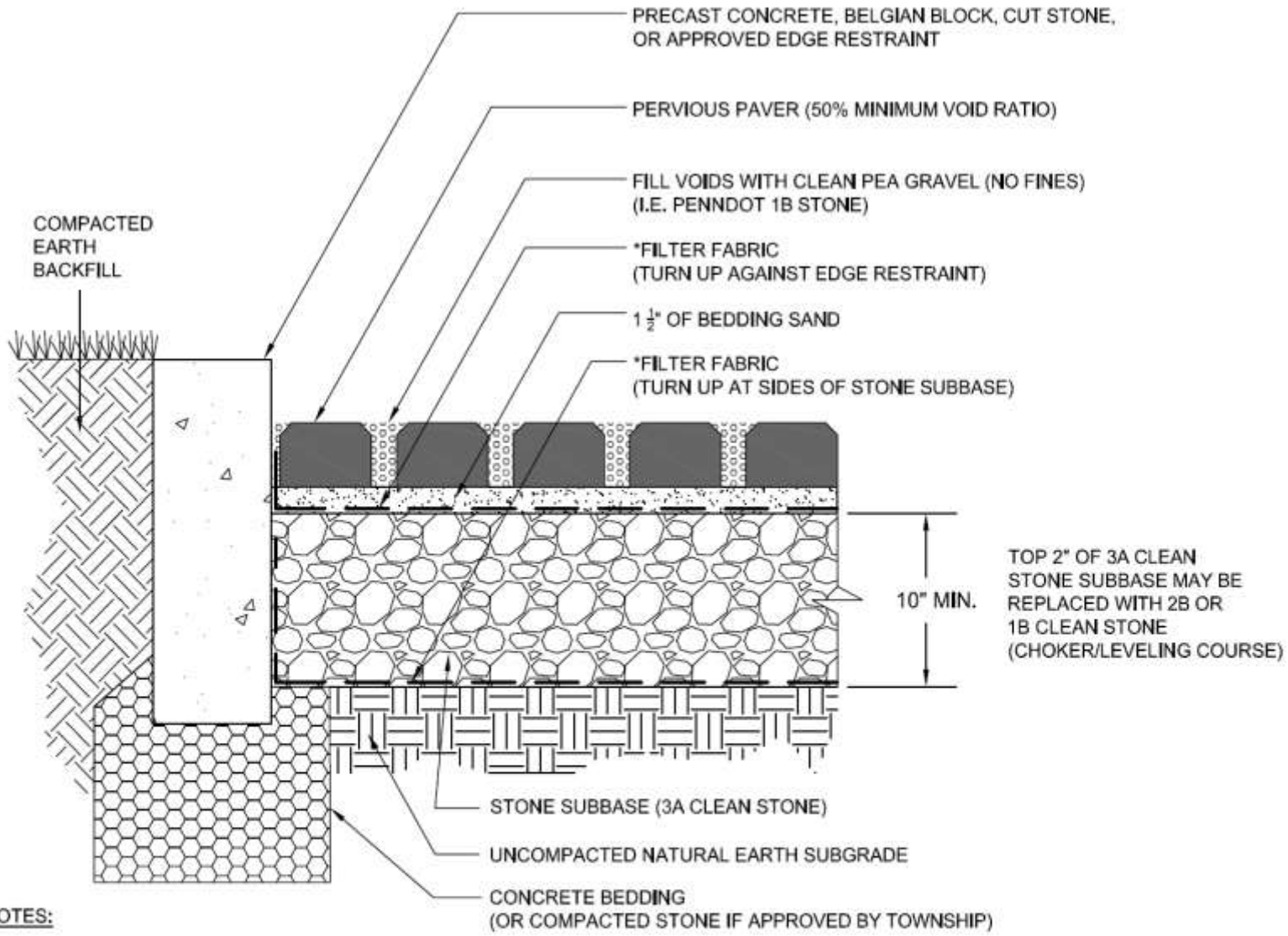
SAMPLE CALCULATIONS:

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



NOTES:

1. EDGE RESTRAINT SHOULD BE MINIMUM 6 IN. WIDE FOR STREET APPLICATIONS.
2. EDGE RESTRAINT MAY BE EVEN WITH TOP OF PAVERS.
3. SOIL PERCOLATION TESTING MAY BE REQUIRED BY TOWNSHIP IF DEEMED NECESSARY.

* FILTER FABRIC IS REQUIRED AT ALL SOIL/STONE/SAND INTERFACES.

TO BE DISTRIBUTED WITH PERVIOUS HARDSCAPING SYSTEM DESIGN PACKET

DETAIL PLAN
PERVIOUS PAVEMENT SYSTEM
SOLEBURY TOWNSHIP, BUCKS COUNTY, PENNSYLVANIA

C. ROBERT WYNN ASSOCIATES, INC.
CONSULTING ENGINEERING
311 W. Broad Street
Quakertown, PA 18951
(215) 536-7336

DRAWING NO. 1

DWN. BY	CHK. BY	DATE	SCALE	JOB NUMBER
CJG	EJJ	JUNE 22 2007	NTS	83-009

OF 1

APPENDIX J

SIMPLIFIED STORMWATER MANAGEMENT PROCEDURES FOR EXISTING SINGLE FAMILY DWELLING LOTS

SIMPLIED 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 impervious area (including the building footprint, driveway, sidewalks, and parking areas) and less than five thousand (5,000) square feet of earth disturbance but do not meet exemption criteria of Section 105.B may utilize the simplified procedure contained in this Appendix to meet requirements of this Ordinance and are not required to submit formal drainage plans to the Township.

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 individual homeowner will not require professional services to comply with these water quality and groundwater recharge goals.

What do I need to send to the Solebury Township?

Even though a formal drainage 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 = $\frac{\text{2.0 inches x (total impervious area in square feet)}}{12}$ = _____ cubic feet of recharge

Rv = $\frac{\text{2.00 x 1,976 sq. ft.}}{12}$ = 329 cu. ft.

Note: This example is located within the Delaware River South Watershed. Use 3.26 inches for projects in the Neshaminy Creek Watershed.

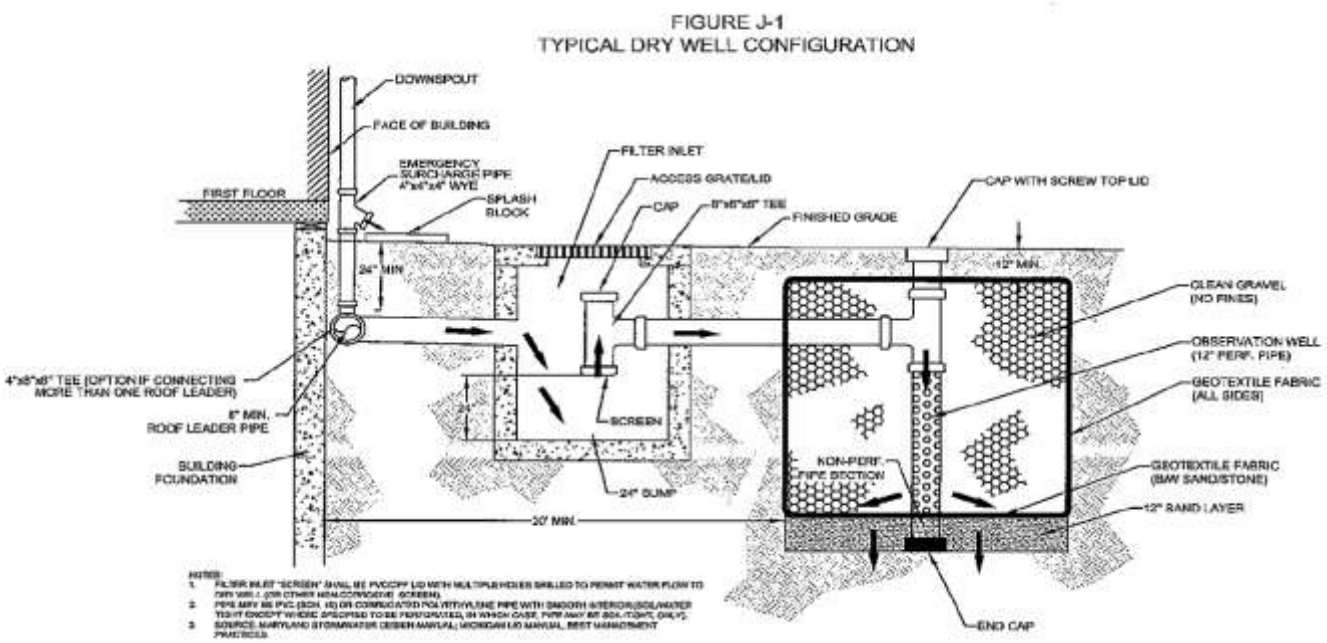
STEP 3 – Sizing of Selected Infiltration Method

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 J-1
TYPICAL DRY WELL CONFIGURATION



Example Sizing For Drywells:

STEP 1 – Determine Total Impervious Surfaces

House Roof Area: 12 ft. x 48 ft. = 576 sq. ft.

Note: This example is located within the Delaware River South Watershed. Use 3.26 inches for projects in the Neshaminy Creek Watershed.

STEP 2 – Determine Required Infiltration Volume using Equation

$$\frac{2.00 \text{ in.} \times 576 \text{ sq. ft.}}{12} = 96 \text{ cu. ft.}$$

$$\frac{96 \text{ cu. ft.}}{0.4^*} = 240 \text{ cu. ft. (*assumes 40\% void ratio in gravel bed)}$$

STEP 3 – Sizing of Selected Infiltration Method

Volume of facility = Depth x Width x Length

Set D = 3.5 ft; Set W = L for a square chamber

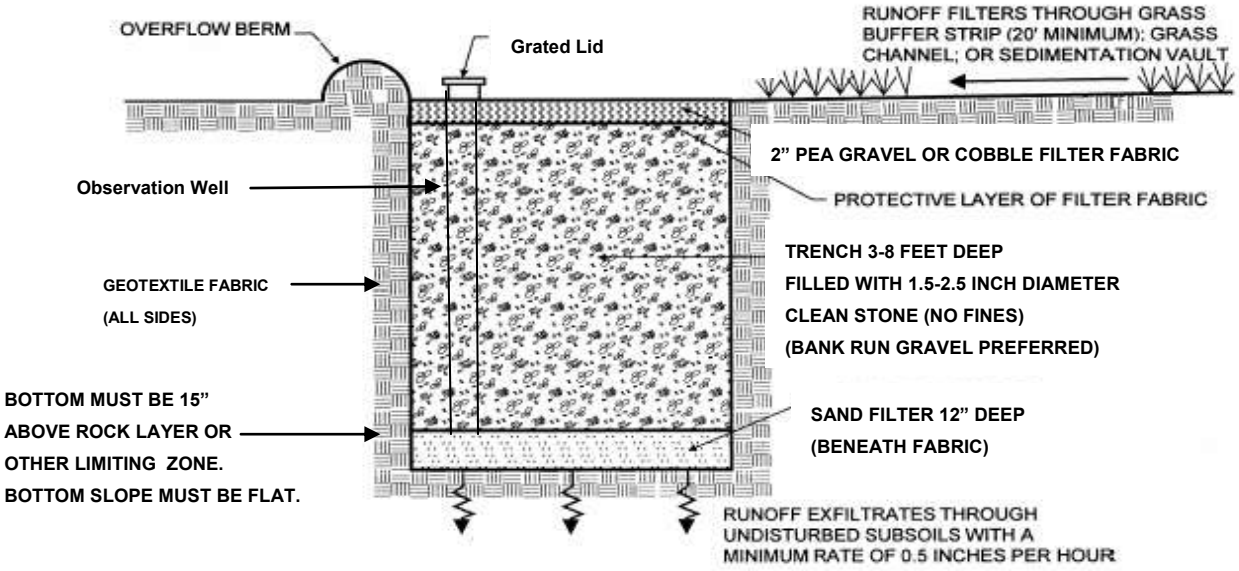
240 cu. ft. = 3.5 x L X L ; L = 8.4 ft.

Final Facility Dimensions: 3.5 ft. (D) x 8.3 ft. (W) x 8.3 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 J-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

$\frac{2.00 \text{ in.} \times 824 \text{ sq. ft.}}{12}$ = 137 cu. ft.

$\frac{137 \text{ cu. ft.}}{0.4^*}$ = 343 cu. ft. (*assumes 40% void ratio in gravel bed)

Note: This example is located within the Delaware River South Watershed. Use 3.26 inches for projects in the Neshaminy Creek Watershed.

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

343 cu. ft. / 3 ft. = 114 sq. ft.

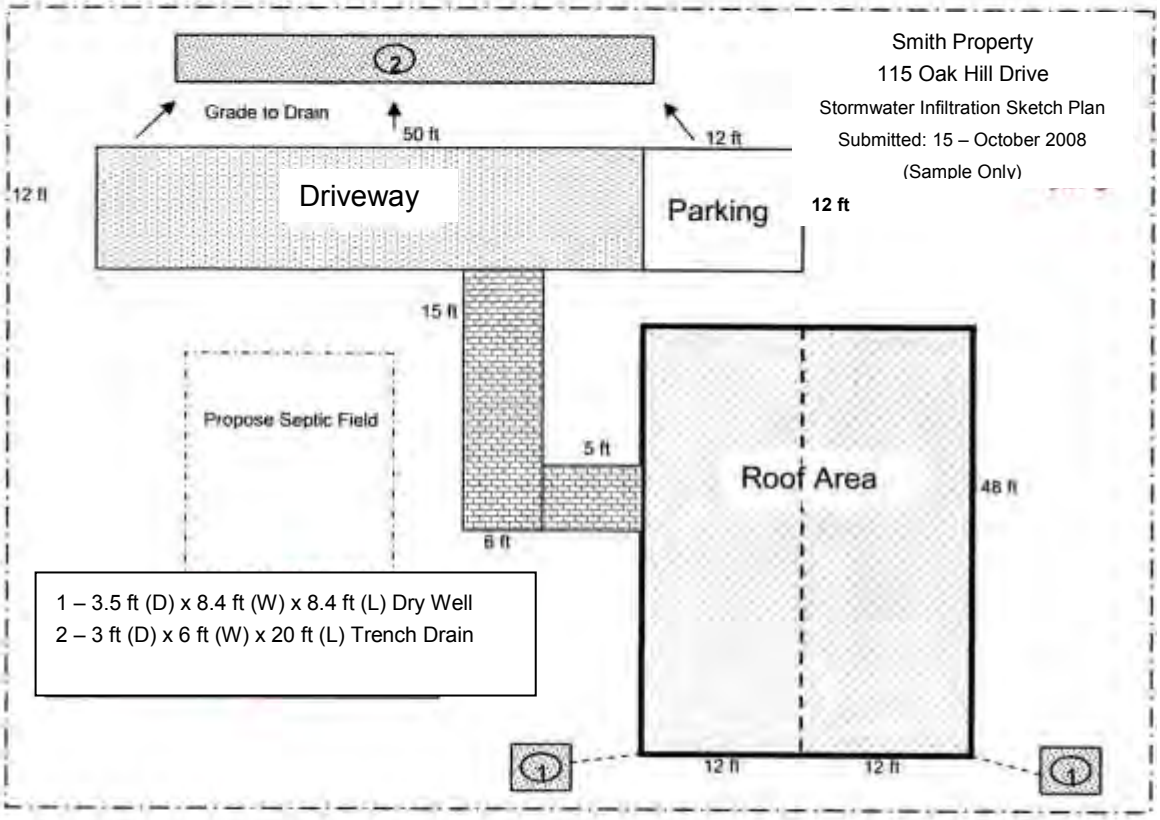
The width of the trench should be greater than 2 times it depth (2 x D); therefore, in this example a trench width of 6 feet is selected;

Determine trench length: L = 117 sq. ft. / 6 ft. = 20 ft.

Final trench dimensions: 3 ft. (D) x 6 ft. (W) x 19 ft. (L)

FIGURE B-3

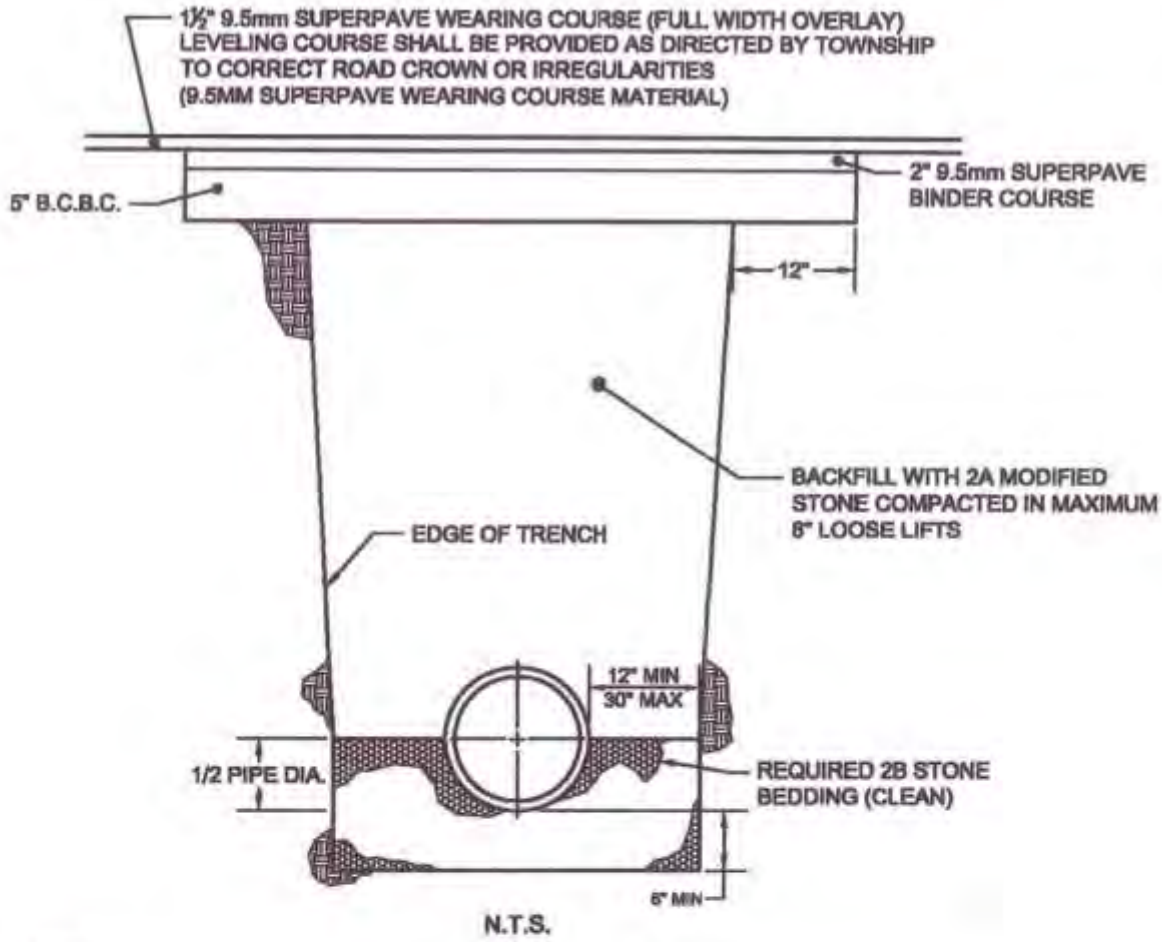
SAMPLE SITE SKETCH PLAN



Source: Maryland Stormwater Design Manual

APPENDIX K

STORMSEWER BEDDING/BACKFILL REQUIREMENTS

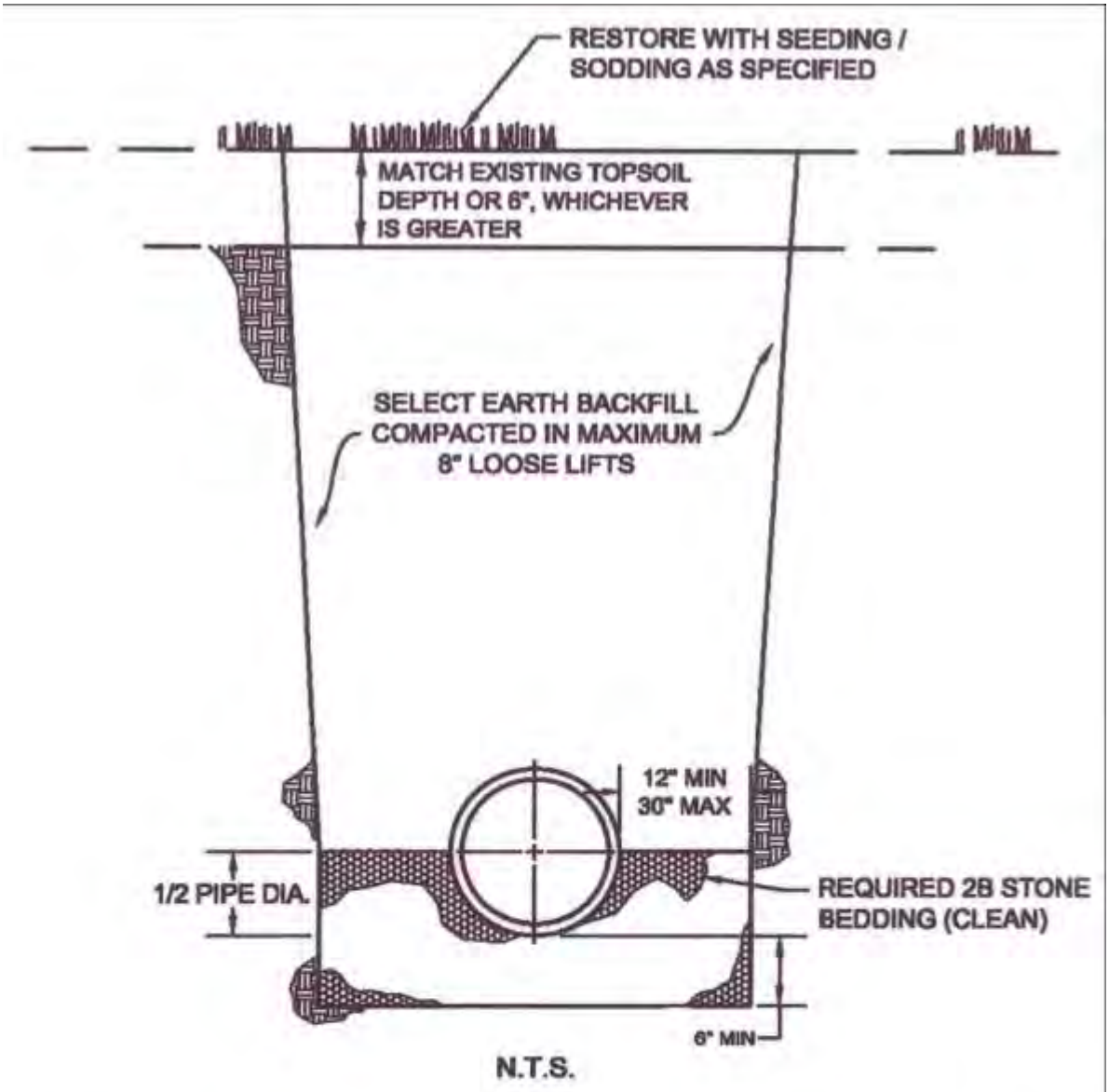


NOTES:

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 L

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 104

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 105

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 307

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 302

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 302.D.

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

SECTION VI: CALCULATION METHODOLOGY

Reference: Section 310 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 314

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 H.

   ☐ Yes ☐ No ☐ Not Applicable

   _____

SECTION X: FACILITY OPERATION AND MAINTENANCE PLAN

Reference: Section 702

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

   ☐ Yes ☐ No, Explain _____

   _____

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

   ☐ Municipality ☐ Homeowner Association
   ☐ Private Owner ☐ Other _____

APPENDIX M

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 Solebury Township, Bucks County; Pennsylvania, (hereinafter "Municipality");

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property (TMP #_____) 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 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)