TOWNSHIP OF WORCESTER
MONTGOMERY COUNTY, PENNSYLVANIA

ORDINANCE 2018-278

AN ORDINANCE TO ENACT A STORMWATER MANAGEMENT ORDINANCE

NOW, THEREFORE, IT IS HEREBY ORDAINED AND ENACTED THAT the Board of Supervisors of Worcester Township does delete the Township Code Section 130-24, Stormwater Management, in its entirety, and does amend the Township Code to include Chapter 129, Stormwater Management, attached hereto as Exhibit A.

1. Miscellaneous provisions.

   a. In the event that any section, subsection or portion of this Ordinance shall be declared by any competent court to be invalid for any reason, such decision shall not be deemed to affect the validity of any other section, subsection or portion of this Ordinance. The invalidity of section, clause, sentence, or provision of this Ordinance shall not affect the validity of any other part of this Ordinance, which can be given effect without such invalid part or parts. It is hereby declared to be the intention of the Township that this Ordinance would have been adopted had such invalid section, clause, sentence, or provision not been included therein.

   b. To the extent this Ordinance is inconsistent with the Code of Worcester Township, the provisions of this Ordinance shall take precedence. All Ordinances or parts of Ordinances in conflict herewith are hereby repealed.

   c. This Ordinance shall become effective on January 1, 2019.

ENACTED AND ORDAINED by the Supervisors of the Township of Worcester, Montgomery County, Pennsylvania on this 15th day of August, 2018.

FOR WORCESTER TOWNSHIP

By: _____
Richard DeLello, Chair
Board of Supervisors

Attest: _____
Tommy Ryan, Secretary

EXHIBIT A

WORCESTER TOWNSHIP
MONTGOMERY COUNTY, PENNSYLVANIA

STORMWATER MANAGEMENT ORDINANCE
CHAPTER 129

9th Version, last revised October 19, 2017

Prepared by CKS Engineers, Inc.
Ref: #7200-120

Table of Contents

Article I.	General Provisions		
	§ 129-1	Statement of Findings	1
	§ 129-2	Purpose	2
	§ 129-3	Statutory Authority	3
	§ 129-4	Applicability and Regulated Activities	3
	§ 129-5	Exemptions	4
	§ 129-6	Repealer	7
	§ 129-7	Severability	7
	§ 129-8	Compatibility with Other Ordinance Requirements	8
	§ 129-9	Modification	8
	§ 129-10	Erroneous Permit	8
Article II	§ 129-11	Definitions and Word Usage	8
Article III	Stormwater Management		
	§ 129-12	General Requirements	21
	§ 129-13	Stormwater Management Performance Standards	25
	§ 129-14	Project Design (Sequencing to Minimize Stormwater Impacts)	26
	§ 129-15	Volume Control and Infiltration BMPs	27
	§ 129-16	Water Quality Requirements	30
	§ 129-17	Stream Bank Erosion Requirements	32
	§ 129-18	Design and Construction Criteria for Stormwater Management Facilities and Best Management Practices	32
	§ 129-19	Calculation Methodology	51
	§ 129-20	Erosion and Sedimentation Control Requirements	53
Article IV	Stormwater Management Application and Permit Requirements		
	§ 129-21	GeneralRequirements	55
	§ 129-22	Stormwater Management Site Plan (SMSP) Contents and Requirements	55
	§ 129-23	Simplified Stormwater Management Site Plan (SSMSP) Contents and Requirements	60
	§ 129-24	Plan Submission	62
	§ 129-25	Review of Stormwater Management Site Plan and Simplified Stormwater Management Site Plan	63
	§ 129-26	Modification of Plans	63
	§ 129-27	Resubmission of Disapproved Stormwater Management Site Plans and Simplified Stormwater Management Site Plans	64
	§ 129-28	As-Built Plans	64
	§ 129-29	Retention of Plans at Project Site	64
	§ 129-30	Adherence to Approved Plan	65
	§ 129-31	Certification of Completion	65
	§ 129-32	Occupancy Permit	65

Article V Inspections

§ 129-33 Schedule of Inspections 65
§ 129-34 Right-of-Entry During Construction..... 65

Article VI Fees and Expenses

§ 129-35 Stormwater Management Permit and Review Fees..... 66
§ 129-36 Expenses Covered by Fees and Escrow 66

Article VII Maintenance Responsibilities

§ 129-37 Performance Guarantee 66
§ 129-38 Maintenance Responsibilities 67
§ 129-39 Review of Stormwater Facilities and BMP Operations and Maintenance (O&M) Plan..... 68
§ 129-40 Maintenance Agreement for Privately Owned Stormwater Facilities 68
§ 129-41 Stormwater Management Easements 68
§ 129-42 Stormwater Maintenance Fund 69
§ 129-43 Post-Construction Maintenance Inspections..... 70

Article VIII Prohibitions

§ 129-44 Prohibited Discharges 70
§ 129-45 Prohibited Connections 71
§ 129-46 Roof Drains 71
§ 129-47 Waste Disposal Prohibitions 72
§ 129-48 Alterations of SWM BMPs 72

Article IX Enforcement and Penalties

§ 129-49 Right-of-Entry..... 72
§ 129-50 Notification 72
§ 129-51 Enforcement..... 72
§ 129-52 Violations Deemed a Public Nuisance 73
§ 129-53 Penalties 74
§ 129-54 Appeals 74

Appendix A Stormwater Management Design Criteria A-1
Appendix B Site Soil Evaluation and Soil Infiltration Testing B-1
Appendix C West Nile Virus Guidance C-1
Appendix D Stormwater Management/BMP Facilities Operation and Maintenance Agreement..... D-1
Appendix E Simplified Stormwater Management Site Plan (SSMSP)..... E-1

Chapter 129. STORMWATER MANAGEMENT

Article 1. General provisions

§ 129-1. Statement of Findings.

The Board of Supervisors of Worcester Township finds that:

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

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

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

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

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

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

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

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

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

§ 129-2. Purpose.

The purpose of this comprehensive stormwater management ordinance is to promote health, safety, and welfare within Worcester Township by maintaining the natural hydrologic regime and by minimizing the harms and maximizing the benefits described in § 129-1 of this Chapter through provisions designed to:

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

B. Promote nonstructural Best Management Practices (BMP).

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

D. Minimize impervious surfaces.

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

F. Utilize and preserve the existing natural drainage systems.

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

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

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

J. Minimize impacts on stream temperatures.

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

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

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

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

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

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

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

R. Prevent streambank and streambed scour and erosion.

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

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

U. Implement an illicit discharge detection and elimination program to address non-stormwater discharges into the MS4.

§ 129-3. 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,"; 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; and by the authority of the Pennsylvania Second-Class Township Code.

§ 129-4. Applicability and regulated activities

A. This Chapter shall apply to all areas of the Township that are located within the Skippack Creek, Wissahickon Creek, and Stony Creek/Saw Mill Run Watersheds.

B. All construction and development activities that may affect stormwater runoff, including land development and earth disturbance activity, are subject to regulation by this Chapter.

C. This Chapter 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 Chapter, shall continue to be regulated under existing laws and ordinances.

D. This Chapter contains the stormwater management performance standards and design criteria that are necessary or desirable from a watershed-wide perspective. Stormwater management design criteria (e.g. inlet spacing, inlet type, collection system design and details, outlet structure design, etc.) shall continue to be regulated by applicable ordinances, where not specifically identified herein.

E. The following activities are defined as "Regulated Activities" and shall be regulated by this Chapter except as may be exempt from provisions of this Chapter pursuant to § 129-5:

(1) Land development.

(2) Subdivision.

(3) Prohibited or polluted discharges.

(4) Alteration of the natural hydrologic regime.

(5) Construction of new or additional impervious surfaces (e.g. driveways, parking lots, etc.)

which cumulatively exceed one-thousand two-hundred (1,200) square feet in area since the date of adoption of this Ordinance.

(6) Construction of new buildings or additions to existing buildings which cumulatively exceed one-thousand two-hundred (1,200) square feet of impervious surface area since the date of adoption of this Ordinance.

(7) Redevelopment.

(8) Diversion piping or encroachments in any natural or man-made stream channel.

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

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

(11) Any activity requiring a Grading and Excavations Permit pursuant to Township Ordinance, 2011-229, as amended.

F. All regulated activities which result in earth disturbance shall comply with the requirements of the Worcester Township Grading and Excavations Ordinance No. 2011-229 (Chapter 81 of the Township Code), as amended.

§ 129-5. Exemptions

A. Exemption from any provision of this Chapter shall not relieve the applicant from all other applicable requirements of this Chapter, as identified herein.

B. The following regulated activities, not proposed in conjunction with a subdivision or land development, are exempt from the requirements of this Chapter (except where otherwise identified, herein):

(1) Installation of one-thousand two-hundred (1,200) square feet or less of cumulative impervious surface area since the date of adoption of this ordinance.

(2) Use of land for gardening for home consumption.

(3) Agricultural activities when operated in accordance with a conservation plan, nutrient management plan, or erosion and sedimentation control plan approved by the Montgomery 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, production areas, or other areas having impervious surfaces shall be subject to the provisions of this Chapter unless exempt pursuant to § 129-5.

(4) 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 EROSION AND SEDIMENTATION CONTROL Plan approved by the Montgomery County Conservation District and which have Zoning approval from Worcester Township.

(5) Public road replacement, replacement paving, repaving and/or maintenance, and roadway shoulder improvements. This includes shoulder improvements conducted within the existing roadway cross- section of municipally owned roadways, provided said improvements do not result in the construction of a new lane of travel. However, if the shoulder improvements require an NPDES permit, the proposed work must comply with all the requirement of this chapter.

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

(7) Repair and reconstruction of on-lot sewage disposal systems where work is performed in accordance with a valid permit issued by Montgomery County Department of Health.

(8) Lots that are part of an approved subdivision containing overall subdivision stormwater management facilities, such as detention basins, rain gardens, etc., are exempt from additional individual lot controls if the total quantity of impervious surface area on the lot (existing plus proposed) is equal to or less than that quantity allocated to the lot, in the stormwater management design approved in conjunction with the subdivision..

(9) Construction or reconstruction of buildings or additions to existing buildings or other impervious surface (regulated activities) is exempt where the following conditions are met:

(a) An area of impervious surface is removed from the site so that upon completion of the regulated activity, the total increase of impervious surface area is 1,200 square feet, or less.

(b) The area where existing impervious surface is removed pursuant to § 129-5.B.9.a above must be restored with a minimum of six (6) inches of topsoil and permanent vegetative groundcover.

(10) Grading and Excavations Permit applications (pursuant to Chapter 81 of the Worcester Township Code) where the addition of impervious surface area is 1,200 square feet, or less.

(11) Lot line adjustment subdivisions are exempt when no increase in impervious surface is proposed.

(12) No exemption shall be provided for regulated activities as defined in § 129-4.E.8 and 9 of this Chapter.

C. Any regulated activity in Worcester Township, not proposed in conjunction with a subdivision or land development, creating additional impervious surface area cumulatively in excess of 1,200 square feet (on the "parent tract") but less than or equal to 7,500 square feet as identified in table 129-5.1, and satisfying the setback criteria identified in Table 129-5.2 below are exempt from the release rate requirements of this Chapter but are required to submit a Simplified Stormwater Management Site Plan, obtain a Stormwater Management Permit (pursuant to Article IV of this Chapter) and install an infiltration/volume control BMP in accordance with Worcester Township design and construction criteria to be provided by the Township at the time of Permit application. 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 the date of adoption of this ordinance. All impervious surface area constructed after the date of adoption of this ordinance shall be considered cumulatively. Impervious surface area existing on the "parent tract" prior to this date shall not be included in cumulative impervious surface area summation for determination of an exempt regulated activity. Any area designated to be gravel or crushed stone shall be considered impervious surface unless it is part of a designed BMP.

All applicants seeking an exemption of stormwater management requirements based upon criteria contained in § 129-5.B and 129-5.C, and that are required to install an infiltration/volume control BMP in accordance with the Worcester Township design and construction criteria shall at a minimum, submit the documentation identified pursuant to § 129-23 of this Chapter, to the Township for review and approval as a prerequisite to approval of a Stormwater Management Permit and authorization to commence land disturbance activities.

Regulated activities creating impervious surface area greater than the quantities referenced in Tables 129-5.1 and 129-5.2 are NOT exempt from the requirements of this Chapter and shall submit a Stormwater Management Site Plan and Permit application pursuant to Article IV of this Chapter.

(1) Regulated activities included within § 129-5.C are exempt from certain provisions of this Chapter where the cumulative amount of additional proposed impervious surface area and the location of the impervious surface area conform to the following tables, 129-5.1 and 129-5.2:

Table 129-5.1 - Maximum Exempt Impervious Surface Area

Total Parcel Area (acres)	Maximum Exempt Impervious Surface Area (square feet)
<0.50	1,200
0.50 to 1.0	2,500
>1.0 to 2.0	4,000
>2.0 to 5.0	5,000
>5.0	7,500

(2) Maximum amount of impervious surface area permitted (pursuant to Table 129-5.1) within a setback (excluding driveway access), measured from the downslope property boundary, shall conform to the following table:

Table 129-5.2 - Maximum Exempt Impervious Surface Area Permitted within the Setback

Minimum Setback* (feet)	Maximum Exempt Impervious Surface Area (square feet) Permitted within the
10	None permitted
20	1,000
50	2,500
100	4,000

200	5,000
500	7,500

* The "Minimum Setback" is defined as that distance between the downslope property boundary (where surface stormwater runoff from the regulated activity crosses that boundary) to the nearest point of the proposed impervious improvements, or the stormwater control structure discharge point, whichever is closer. Setback distances may be adjusted at the discretion of the Township Engineer based upon factors such as topography, surface flow path, soil conditions, and location of structures.

(3) Projects meeting the exemption criteria established by Tables 129-5.1 and 129-5.2 shall provide an infiltration/volume control facility capable of storing the first 2 inches of rainfall generated by the increase in impervious area. The facility, including all necessary construction details and calculations shall be shown on the Simplified Stormwater Management Site Plan. Tree planting may also be utilized toward volume control. See Section 129-23 and Appendix "E" for plan requirements, examples of various standard facilities, and additional design criteria.

D. Additional Exemption Criteria.

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

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

(3) HQ and EV streams – An exemption or partial exemption shall not relieve the applicant from meeting special requirements for watersheds draining to high quality (HQ) or exceptional value (EV) waters.

E. All applicants seeking an exemption of stormwater management requirements based upon criteria contained in § 129-5.C shall, at a minimum, submit documentation outlined in Section 129-23 to the Township for review and approval of a Stormwater Management Exemption and authorization to commence land disturbance activities.

§ 129-6. Repealer

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

§ 129-7. Severability

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

§ 129-8. Compatibility with Other Ordinance Requirements

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

§ 129-9. Modification

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

§ 129-10. Erroneous permit

Any permit or authorization issued or approved based on false, misleading or erroneous informatioprovided by an applicant is void without the necessity of any proceedings for revocation. Any work undertaken or use established pursuant to such permit or other authorization is unlawful. No action may be taken by a board, agency or employee of the Township purporting to validate such a violation.

ARTICLE II DEFINITIONS

§ 129-11. Definitions and Word Usage

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

(1) 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.

(2) 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.

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

(4) The words "shall" and "must" are mandatory; the words "may" and "should" are permissive.

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

B. As used in this Chapter, the following terms shall have the meanings indicated:

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

AGRICULTURAL ACTIVITIES. Activities associated with agriculture such as agricultural cultivation, agricultural operation, and animal heavy use areas. This includes the work of producing crops including tillage, land clearing, plowing, disking, harrowing, planting, harvesting

crops or pasturing and raising livestock and installation of conservation measures. Construction of new buildings or impervious area is not considered an agricultural activity.

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

APPLICANT. A landowner or developer who has filed an application for approval to engage in any Regulated Activities as defined in § 129-4 of this Chapter.

AS-BUILT DRAWINGS (As-Built Plan). Drawings 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, designs, measures, or procedures used to manage stormwater impacts from regulated activities, to meet state water quality requirements, to promote groundwater recharge, and to otherwise meet the purposes of this Chapter. Stormwater BMPs are commonly grouped into one of two broad categories or measures: "structural" or "nonstructural." In this Chapter, nonstructural BMPs or measures refer to operational 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 Stormwater 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.

CONSERVATION DISTRICT. Montgomery County Conservation District.

COUNTY. Montgomery 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.

DEPARTMENT. The Pennsylvania Department of Environmental Protection.

DESIGN PROFESSIONAL (Qualified). A Pennsylvania Registered Professional Engineer, Registered Landscape Architect, or a Registered Professional Land Surveyor trained to develop Stormwater Management Site Plans or Simplified Stormwater Management Site 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 Worcester Township, Montgomery County, Montgomery County Conservation District and/or Governing Body involved with the administration, review, or enforcement of any provisions of this Chapter by contract or memorandum of understanding.

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

DETENTION/RETENTION BASIN WATERSHED. All land area whose surface runoff is captured by a detention and/or retention basin.

DETENTION 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 Chapter.

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 "development plan" when used in this Chapter 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 located such that all overland or pipe flow from the site would be directed toward it.

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

EARTH DISTURBANCE. A construction or other human activity which disturbs the surface of land, including, but not limited to, clearing and grubbing, grading, excavations, embankments, land development, agricultural plowing or tilling, timber harvesting activities, road maintenance activities, mineral extraction, and the moving, depositing, stockpiling or storing of soil, rock or earth materials.

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

EROSION AND SEDIMENTATION CONTROL PLAN. A plan which is designed to minimize accelerated erosion and sedimentation.

EXCEPTIONAL VALUE WATERS. Surface waters of high quality which satisfy Pennsylvania Code Title 25 Environmental Protection, Chapter 93 Water Quality Standards, §93.4b(b) (relating to antidegredation).

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

made impervious surfaces shall be considered as "meadow" when developing "cover complex" calculations.

EXISTING RESOURCES AND SITE ANALYSIS MAP. A base map which identifies fundamental environmental site information including floodplains, wetlands, topography, vegetative site features, natural areas, prime agricultural land and areas supportive of endangered species.

EXISTING RECHARGE AREA. Undisturbed surface area or depression where stormwater collects and a portion of which infiltrates and replenishes the groundwater.

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

FLOODPLAIN. Those areas of Worcester Township which are subject to the one hundred year flood, as identified in the Flood Insurance Study (FIS) dated December 19, 1996 and the accompanying maps prepared for the Township by the Federal Emergency Management Agency (FEMA), or most recent revision thereof; and also those areas along streams, ponds, or lakes not identified within the Flood Insurance Study which are inundated by the 100 year reoccurrence internal flood.

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

FOREST MANAGEMENT/TIMBER OPERATIONS. Planning and activities necessary for the management of forest land. These include timber inventory and preparation of forest management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, site preparation, and reforestation.

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

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

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).

HYDRIC SOILS. A soil that is saturated, flooded, or ponded long enough during the growing season to develop 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.

IMPERVIOUS SURFACE (Impervious Area). A surface that prevents the infiltration of water into the ground. Impervious surface area shall include, but not be limited to, buildings, parking areas, driveways, roads, and sidewalks. Any areas containing concrete, asphalt, compacted stone, compacted soils, or other equivalent surfaces shall be considered impervious. Decks that do not prevent infiltration shall not be considered as impervious surface. In addition, other areas determined by the Township Engineer to be impervious within the meaning of this definition shall be classified as impervious surface. Any area initially designated to be gravel or crushed stone shall be assumed to be impervious. Pervious paving, when designed above a stormwater storage/infiltration system may be considered as pervious surface as approved by the Township Engineer.

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).

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

INVERT. The inside bottom of a culvert or other conduit.

LAND DEVELOPMENT. Any of the following activities:

(1) The improvement of one (1) or two (2) or more contiguous lots, tracts or parcels of land for any purpose involving:

(a) A group of two (2) or more residential or nonresidential buildings, whether purposed initially or cumulatively, or a single nonresidential building on a lot or lots regardless of the number of occupants or tenure; or

(b) The division or allocation of land or space, whether initially or cumulatively, between or among two (2) or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups or other features.

(2) A subdivision of land.

(3) "Land development" does not include development which involves:

(a) The conversion of an existing single family detached dwelling or single family semi-detached dwelling into not more than three (3) residential units, unless such units are intended to be a condominium;

(b) The addition of a residential accessory building, including farm building, on a lot or lots subordinate to an existing principal building; or

(c) The addition or conversion of buildings or rides within the confines of an enterprise which would be considered an amusement park. For the purposes of this subsection, an amusement park is defined as a tract or area used principally as a location for permanent amusement structures or rides. This exclusion shall not apply to newly acquired acreage by an amusement park until initial plans for the expanded area have been approved by the proper authorities.

LAND/EARTH DISTURBANCE. Any activity involving grading, tilling, digging, or filling of ground or stripping of vegetation or any other activity that causes an alteration to the natural condition of the land.

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

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

(2) 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.

(3) 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 will minimize proposed conditions runoff rates and volumes, which will minimize the need for artificial conveyance and storage facilities.

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

MS4 – MUNICIPAL SEPARATE STORM SEWER SYSTEM – Pursuant to 40 CFR 122.26(b)(8), municipal separate storm sewer system is a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a state, city, town, Township, county, parish, district, association, or other public body (created to or pursuant to state law) including special districts under state law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States. (ii) Designed or used for collecting or conveying stormwater; (iii) Which is not a combined sewer; and (iv) Which is not part of a Publicly Owned Treatment Works as defined at 40 CFR 122.2.

NONPOINT SOURCE POLLUTION. Pollution that enters a watery body from diffuse origins in the watershed and does not result from discernible, confined, or discrete conveyances.

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

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

NRCS. Natural Resource Conservation Service (previously SCS).

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

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

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

PADEP. The Pennsylvania Department of Environmental Protection.

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.

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

PLANNING COMMISSION. The Planning Commission of Worcester Township.

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

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

POST-DEVELOPMENT. Period after construction during which disturbed areas are stabilized, stormwater controls are in place and functioning, and all improvements in the approved stormwater management plan are completed.

PRETREATMENT. Techniques employed in stormwater BMPs to provide storage or filtering to help trap coarse materials and other pollutants before they enter the system.

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 Chapter is applicable pursuant to § 129-4.

REGULATED EARTH DISTURBANCE ACTIVITY. Activity involving earth disturbance subject to regulation under 25 Pa. Code 92, 25 Pa. Code 102 or the Clean Streams Law.

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

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

RETENTION VOLUME/REMOVED RUNOFF. The volume of runoff that is captured and not released directly into the surface waters of the Commonwealth during or after a storm event.

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

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

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

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

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

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 occurring from the failure to design, construct, implement or maintain control measures and control facilities in accordance with the requirements of this Chapter.

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 to PA BMP Manual, December 2006, Chapter 6, Section 4).

SEPARATE STORM SEWER SYSTEM. A system of pipes, open channels, streets, and other conveyances intended to carry stormwater runoff.

SHALLOW CONCENTRATED FLOW. Stormwater runoff flowing in shallow, defined ruts prior to entering a defined channel or waterway.

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

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

SPECIAL PROTECTION WATERSHEDS. Watersheds of streams that have been designated in Pennsylvania Code Title 25 Environmental Protection, Chapter 93 Water Quality Standards as being exceptional value (EV) or high quality (HQ) waters.

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

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

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

STORM FREQUENCY. The number of times that a given storm event occurs or is exceeded on the average in a stated period of years. Refer to "Return Period."

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

STORMWATER. The surface runoff generated by precipitation reaching the ground surface.

STORMWATER CONVEYANCE FACILITY (Runoff Conveyance Facility). A stormwater management facility designed to transmit stormwater runoff which shall include streams, channels, swales, pipes, conduits, culverts, storm sewers, etc.

STORMWATER MANAGEMENT (SWM). The control of surface runoff generated by precipitation reaching the ground surface.

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

STORMWATER MANAGEMENT PERMIT. A Permit issued by the Township after the Stormwater Management Site Plan (SMSP) or the Simplified Stormwater Management Site Plan (SSMSP) 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 (SMSP). The Stormwater Management Site Plan prepared by the applicant indicating how stormwater runoff will be managed at the particular site of interest according to this Chapter.

STORMWATER MANAGEMENT SITE PLAN, SIMPLIFIED (SSMSP). The Simplified Stormwater Management Site Plan prepared by the applicant indicating how stormwater runoff will be managed at the particular site of interest according to this Chapter

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

(1) Springs or Seeps – The point where groundwater discharges to become surface water.

(2) Stream, Ephemeral – A reach of stream that flows only during and for short periods following precipitation, and flows in low areas that may or may not be a well-defined channel. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Some commonly used names for ephemeral streams include: stormwater channel, drain, swale, gully, dry stream channel, hollow, or saddle.

(3) Stream, Headwater – The beginning reach of a stream, which collects water from springs and seeps and provides a hydrologic connection to a perennial stream. These channels may be ill defined and may move from year to year depending upon groundwater input, snowmelt, and runoff, but are typified by hydric soils and hydric vegetation.

(4) Stream, Intermittent – A reach of stream that flows only during wet periods of the year and flows in a continuous well-defined channel. During dry periods, when the water table is depressed by seasonal aridity or drought, intermittent streams may go down to a trickle of water and appear dry, when in fact there is water flowing within the stream bottom or "substrate".

(5) Stream, Perennial or Watercourse, Perennial – A body of water in a channel that flows throughout a majority of the year in a defined channel and is capable, in the absence of pollution, drought, or manmade stream disturbances, of supporting a benthic macroinvertebrate community that is composed of two or more recognizable taxonomic groups of organisms, large enough to be seen by the unaided eye and can be retained by a U.S. Standard No. 30 sieve (28 meshs per inch, 0.595 mm openings) and live at least part of their life cycles within or upon available substrates in a body of water or water transport system. A perennial stream can have Q7-10 flow of zero. For the purposes of this document, a perennial stream includes lakes and ponds.

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

STREAMBANK EROSION. The widening, deepening or headward cutting of channels and waterways caused by stormwater runoff or bankfull flows.

STREAM ENCLOSURE. A bridge, culvert, or other structure, as defined by 25 Pa. Code 105, which encloses a regulated water of the Commonwealth of Pennsylvania.

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, partition by the court for distribution to heirs, or devisees, 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 10 acres, not involving any new street or easement of access or any residential dwelling shall be exempted.

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

TIMBER OPERATIONS. Refer to Forest Management.

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

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

TOWNSHIP. Worcester Township, Montgomery County, Pennsylvania.

TOWNSHIP ENGINEER. A professional engineer licensed as such in the Commonwealth of Pennsylvania and appointed by Worcester Township pursuant to the Pennsylvania Second-Class Township Code.

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 nonstructural BMPs.

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

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

WATERS OF THE UNITED STATES (or WATERS OF THE US)

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

(2) All interstate waters, including interstate "wetlands";

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

(4) All impoundments of waters otherwise defined as waters of the United States under this definition;

(5) Tributaries of waters identified in paragraphs a through d of this definition;

(6) The territorial sea; and

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

WET BASIN. Pond for runoff management that is designed to detain runoff and always contains water.

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

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

ARTICLE III. STORMWATER MANAGEMENT

§ 129-12. General Requirements.

A. All applicants proposing Regulated Activities in the Township that do not fall under the exemption criteria shown in § 129-5.B and § 129-5.C of this Chapter shall submit a Stormwater Management Site Plan, consistent with this Chapter, to the Township for review. All applicants proposing Regulated Activities that fall under the exemption criteria identified in § 129-5.C shall submit a Simplified Stormwater Management Site Plan, consistent with this Chapter, to the Township for review. These criteria shall apply to the total proposed development even if development is to take place in stages. Impervious surface shall include, but not be limited to, any roof, parking or driveway areas and any new streets and sidewalks. Any areas designed to be gravel or crushed stone shall be assumed to be impervious unless designed as a BMP (e.g. pervious paver blocks, reinforced turf, gravel filled grids, etc.). (Refer to definition of Impervious Surface within § 129-11 of this Chapter).

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

(1) Protect health, safety, and property;

(2) Meet the water quality goals of this Chapter by implementing measures to:

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

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

(c) Avoid erosive flow conditions in natural flow pathways.

(d) Minimize thermal impacts to waters of this Commonwealth.

(e) Disconnect impervious surfaces (i.e. create 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 (December 30, 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 Chapter, 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 Chapter 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 (March 2012), as amended and updated.

E. No approval of any subdivision or land development plan, or issuance of any building, zoning, Grading and Excavations Permit, occupancy permit, or the commencement of any regulated earth disturbance at a project site within the Township shall proceed until the requirements of this Chapter are met, including approval of a Stormwater Management Permit pursuant to Article IV and a permit under PADEP regulations, where applicable.

F. Erosion and sediment control during land disturbance shall be addressed as required by § 129-20.

G. Infiltration and Water quality protection shall be addressed as required by § 129-15 and § 129-16.

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

I. Low Impact Development Techniques as described in Pennsylvania Stormwater Best Management Practices Manual (December 30, 2006, as amended) are encouraged to reduce the costs of complying with the requirements of this Chapter and State Water Quality requirements. Use of nonstructural BMPs is encouraged and design and applicability of such BMPs is identified pursuant to Chapter 5 of the Pennsylvania BMP Manual. For all proposed non-structural BMPs, the applicant shall utilize and submit applicable checklists included in Chapter 8, Section 8.8 of the Pennsylvania BMP Manual, to demonstrate that the BMPs are applicable to the project and to determine the amount of volume credit that may be applied to the development activity.

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

K. 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.

L. 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 discharge criteria specified in this Chapter.

M. 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 applicant 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, as verified by the Township or Township engineer; and submit written approval from the affected adjacent property owner(s) if required by the Township or Township engineer.

N. Where a development site is traversed by watercourses, drainage easements shall be provided conforming to the line of such watercourses. The width of the easement shall be adequate to provide for the unimpeded flow of stormwater runoff from the 100 year storm event. Terms of the easement shall prohibit excavation, the placing of fill or structures, and any alterations that may adversely affect the flow of stormwater within any portion of the easement. Periodic maintenance of the easement shall be required by the landowner to ensure proper runoff conveyance, as defined by the Commonwealth of Pennsylvania.

O. 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 PADEP through the Chapter 105 Permit process, or, where deemed appropriate by PADEP, through the General Permit process.

P. Any stormwater management facilities regulated by this Chapter that will be located in or adjacent to waters of the commonwealth or wetlands shall be subject to approval by PADEP through the Chapter 105 Permit process, or, where deemed appropriate by PADEP, the General Permit process. When there is a question whether wetlands may be involved, it is the responsibility of the applicant to show that the land in question cannot be classified as wetlands, otherwise approval to work in the area must be obtained from PADEP.

Q. Any stormwater management facilities regulated by this Chapter 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).

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

S. Roof drains and sump pumps shall discharge to an infiltration structure, natural watercourse, storm sewer system, drainage swale, or stormwater easement. Roof drains and sump pumps shall not be connected to storm sewer unless the storm sewer is designed as part of a stormwater BMP facility. In no case shall roof drains or sump pumps be connected to sanitary sewer or be permitted to discharge directly across a sidewalk or walkway or onto a street. If curbing is present, no drainage pipes shall pass through the curb to discharge onto the street. Sump pump and roof drain discharge pipes shall not extend beyond the building envelope for the lot unless they are directly connected to an infiltration facility, detention basin, storm sewer pipe or as approved by the Township.

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

approved by the Township.

U. Whenever a watercourse is located within a development site, it shall remain open in its natural state and location and shall not be piped, impeded, or altered (except for permitted crossings). It is the responsibility of the applicant to stabilize existing eroded stream/channel bed and banks (Refer to § 129-17).

V. The temperature and quality of water of streams that have been declared as Exceptional Value (EV) and High Quality (HQ) are to be maintained as defined in Chapter 93, Water Quality Standards, Title 25 Pennsylvania Department of Environmental Protection Rules and Regulations. All regulated development activities within HQ or EV watersheds must provide volume controls and water quality controls pursuant to the requirements of § 129-15 and § 129-16 of this Chapter.

W. All stormwater runoff shall be pretreated for water quality prior to discharge to surface or groundwater as required by § 129-16 of this Chapter.

X. Hot Spots

(1) 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. Use of infiltration BMPs is prohibited on hot spot land use areas. Examples of hot spots include but are not limited to the following:

(a) Vehicle salvage yards and recycling facilities.

(b) Vehicle fueling stations.

(c) Vehicle service and maintenance facilities.

(d) Vehicle and equipment cleaning facilities.

(e) Fleet storage areas (bus, truck, etc.).

(f) Industrial sites (based on Standard Industrial Codes defined by the U.S. Department of Labor).

(g) Marinas (service and maintenance).

(h) Outdoor liquid container storage.

(i) Outdoor loading/unloading facilities.

(j) Public works storage areas.

(k) Facilities that generate or store hazardous materials.

(l) Commercial container nursery.

(m) Other land uses and activities as designated by the Township.

(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 The Pennsylvania Stormwater Best Management Practices Manual.

Y. West Nile Guidance Requirements. All wet basin designs shall incorporate biologic controls consistent with the West Nile Guidance found in Appendix C of this Chapter.

§ 129-13. Stormwater Management Performance Standards.

A. In the design of stormwater management facilities, post-development rates of runoff from any regulated activity shall not exceed 75% of the peak rates of runoff prior to development for two- and ten-year-frequency storms and 100% of the peak rates of runoff prior to development for the twenty-five-, fifty, and one-hundred-year frequency storms. In all other cases where un-retained stormwater directly discharges from the site by bypassing the stormwater management facilities, the post-development runoff rate shall not exceed pre-development runoff rate. The preceding requirements shall apply to each location of concentrated or diffused drainage discharge from the development site.

B. Site Areas - Where the area of a site being impacted by a proposed development activity, not associated with a subdivision or land development, differs significantly from the total site area as determined by the Township Engineer, the Township may, but is not required to, permit only the proposed impact area, which includes areas of the site that would be compacted due to construction activity, to be subject to the release rate criteria (performance standards).

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 the development site.

D. 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 Handbook of Best Management Practices for Developing Areas", 1998, Riparian Forested Buffer, and the priority goal of the riparian vegetation will be the reduction of thermal impacts on stormwater runoff associated with impervious areas, with a secondary goal being the protection of capacity of existing stormwater conveyance channels. These goals will be achieved through the use of design criteria in § 129-18.I of this Chapter, and shall be in addition to any other Township ordinance provisions.

E. For all subdivision and land development applications, the tributary area discharging drainage to any location along the site property boundary shall not increase by more than twenty-five percent (25%) over the predevelopment condition without written notification to the adjacent affected property owner(s) receiving runoff from the site, and review and approval by the Township Engineer.

§ 129-14. 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 Resources and Site Analysis Map (ERSAM), showing environmentally sensitive areas including, but not limited to, steep slopes, ponds, lakes, streams, wetlands, hydric soils, vernal pools, floodplains, riparian corridors, hydrologic soil groups A, B, C, and D, 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 and Zoning Ordinances.

(2) Prepare a draft project layout avoiding sensitive areas identified in § 129-14.B.1 and minimizing total site earth disturbance as much as possible. The ratio of disturbed area to the entire site area and measures taken to minimize earth disturbance shall be included in the ERSAM.

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

(4) Evaluate Nonstructural Stormwater Management Alternatives (Refer Pennsylvania BMP Manual).

(a) Minimize earth disturbance.

(b) Minimize impervious surfaces.

(c) Break up large impervious surface areas.

(d) Protect existing trees (not within protected areas as described in § 129-14.B.1).

(e) Direct rooftop runoff to pervious areas.

(f) Re-vegetate and re-forest disturbed areas.

(g) Utilize natural flow pathways.

(5) Satisfy volume control standards (§ 129-15).

(6) Satisfy water quality objective (§ 129-16).

(7) Satisfy stream bank erosion protection objective (§ 129-17).

(8) 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.

(9) Conduct a proposed conditions runoff analysis based on the final design, to meet the release rate criteria (performance standards).

(10) Manage any remaining runoff through treatment prior to discharge, as part of detention, biorentention, direct discharge or other structural control.

§ 129-15. Volume Control and Infiltration BMPs.

A. For all regulated activities NOT exempt from requirements of this Chapter pursuant to § 129-5.B and § 129-5.C, water volume mitigation controls shall be implemented. The total volume of runoff that must be infiltrated may be calculated based on the Design Storm Method, in which case the post-development total runoff volume shall not be increased from pre-development total runoff volume for all design storms equal to or less than the 2-year, 24-hour duration precipitation. The Design Storm Method requires detailed stormwater runoff modeling based on site conditions. The required recharge volume may also be determined based on Equation 129-15.1, described in § 129-15.D. The Recharge Volume (Re_v) must be reused, evapotranspired, or infiltrated through structural and/or nonstructural means. An Alternative Standard is allowed in this Chapter where it can be demonstrated that due to existing natural site conditions (Refer § 129-15.A.1.b), substantial infiltration and recharge are not occurring, pre-development, resulting in greater than anticipated runoff volume.

(1) Alternate Standard for Runoff Volume

(a) Applicants may request from Worcester Township that an Alternate Standard be applied, where a portion of the runoff volume requirement of § 129-15.A 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 § 129-15.A.1.

(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 or less). 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 (difference between the pre and post-development storm). The applicant must demonstrate that there is no area of the site where the runoff volume requirement can feasibly be infiltrated. It is not grounds for approval of the Alternate Standard that infiltrating the runoff volume requirement 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 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 § 129-15.E and Appendix B.

[4] In order to utilize the Alternate Standard, the applicant must demonstrate that the sum total of limited infiltration areas (the total of areas described in § 129-15.A.1.c.1 through § 129-15.A.1.c.3 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 requirement can be achieved.

B. If it is determined to the satisfaction of the Township that the recharge volume standard set forth in § 129-15.A cannot be achieved, then the peak rate standards for post-development runoff are

modified so that peak rate discharges from the site for all storms up to the ten (10) year frequency design storm must be additionally reduced to be equal to or less than seventy-five (75) percent of the design peak rates permitted pursuant to § 129-13.

C. Water volume controls will mitigate increased runoff impacts, protect stream channel morphology, maintain groundwater recharge, and contribute to water quality improvements. The applicant must demonstrate how the required recharge 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. The Low Impact Development practices provided in the Pennsylvania BMP Manual shall be utilized for all regulated activities to the maximum extent practicable. Volume controls provided through nonstructural BMPs may be subtracted from the required recharge volume to determine the volume of structural BMPs necessary for compliance with § 129-15.A of this Chapter. Design and applicability of nonstructural BMPs is identified pursuant to Chapter 5 of the Pennsylvania BMP Manual. For all proposed nonstructural BMPs, the applicant shall utilize and submit applicable checklists included in Chapter 8, Section 8.8 of the Pennsylvania BMP Manual, to demonstrate that the BMPs are applicable to the project and to determine the amount of volume credit that may be applied to the development activity.

D. To determine the volume of runoff that must be infiltrated at a site, the Recharge Volume (Re_v), the following calculation formula may be used:

Equation 129-15.1

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

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

Hydrologic Soil Group	Soil Specific Recharge Factor (S)
A	0.38
B	0.26
C	0.14
D	0.07

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.

E. Infiltration BMPs intended to receive runoff from developed areas shall be selected based on the suitability of soils and site conditions. All applicants proposing regulated activities that are NOT exempt from preparation and submission of a Stormwater Management Site Plan (SMSP) are required to perform a detailed soils evaluation of the project site by a qualified geotechnical engineer, geologist and/or soil scientist, pursuant to Appendix B of this Chapter, which at minimum addresses soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability. Infiltration/permeability tests shall be completed (in conjunction with the soils

evaluation) with an infiltrometer or other method approved by the Township Engineer, pursuant to Appendix B, to determine the saturated hydraulic conductivity of the soil (at the location and the level of the proposed infiltration surface(s)). "Percolation" tests are not permitted for design of infiltration BMPs, unless approved by the Township Engineer.

F. Infiltration BMPs must include safeguards against groundwater contamination for uses where it is anticipated that pollutants may enter the facility, by mishap or spill or where salt or chloride might be a non-point source contaminant since soils do little to filter this pollutant. If it is anticipated that pollutants may enter the infiltration facility (or other stormwater facility impounding water), resulting in potential groundwater contamination, Worcester Township may require the developer to submit a hydrogeologic justification study of the site and proposed infiltration BMPs, prepared by a qualified design professional, to determine the risk for such contamination. The Township may require the installation of a mitigative layer or an impermeable liner in the BMP and/or detention basins where the possibility of groundwater contamination exists.

G. Infiltration BMPs within High Quality/Exceptional Value waters shall be subject to PADEP's Title 25, Chapter 93 Antidegradation Regulations.

H. 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.

I. If on-lot infiltration structures are proposed, it must be demonstrated that the soils are conducive to infiltrate on the lots identified, or that the applicant's design includes the addition of suitable amounts of material to facilitate infiltration and support the calculations as submitted.

J. Infiltration BMPs shall be designed in accordance with the design criteria and specifications of the Pennsylvania Stormwater BMP Manual (2006) and as additionally identified pursuant to § 129-18.I.1 of this Chapter.

§ 129-16. Water Quality Requirements.

A. In addition to the performance standards and design criteria requirements of Article III of this Chapter, adequate treatment and storage facilities must be provided to capture and treat stormwater runoff from developed or disturbed areas, unless otherwise exempted by provisions of this Chapter. The Recharge Volume computed under § 129-15 may be a component of the Water Quality Volume if the applicant chooses to manage both components in a single facility. Only if the Recharge Volume is less than the Water Quality Volume may the remaining Water Quality Volume be captured and treated by methods other than recharge/infiltration BMPs. The required Water Quality Volume (WQ_v) is the storage capacity needed to capture and to treat a portion of stormwater runoff from the developed areas of the site produced from 90 percent of the average annual rainfall (P).

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

Equation 129-16.1

$WQ_v = [(P)(R_v)(A)]/12$ (inches/foot), where

P = Rainfall Amount equal to 90% of events producing this rainfall (in) – the volume of rainfall for 90% of the storm events which produce runoff in the watershed annually.

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

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

B. Provisions shall be made (such as adding a small orifice at the bottom of the BMP facility outflow control structure) so that the proposed condition, one (1) year frequency design 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). The design of the facility shall minimize clogging and sedimentation. Orifices smaller than three (3) inches in diameter are not recommended. However, if the design engineer can verify that the smaller orifice is protected from clogging by use of trash racks, etc., smaller orifices may be permitted. Trash racks are required for any primary orifice.

C. To accomplish the requirements in Subsections A and B above, the applicant may submit original and innovative designs to the Township Engineer for review and approval. Such designs may achieve the water quality objectives through a combination of BMPs. Infiltration BMPs shall be used wherever feasible. Wet ponds, artificial wetlands, or other permanent BMP acceptable to the Township shall be used to the extent that infiltration BMPs are deemed not feasible.

D. Design of BMPs used for water quality control shall be in accordance with design specifications outlined in the Pennsylvania Stormwater BMP Manual or other applicable manuals. The following factors must be considered when evaluating the suitability of BMPs used to control water quality at a given development site:

(1) Total contributing drainage area.

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

(3) Topographic slope and depth to bedrock.

(4) Seasonal high water table.

(5) Proximity to building foundations and wellheads.

(6) Erodibility of soils.

(7) Land availability and configuration of the topography.

(8) Peak discharge and required volume control.

(9) Streambank erosion.

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

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

(12) Nature of the pollutant being removed.

(13) Maintenance requirements.

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

(15) Recreational value.

(16) Enhancement of aesthetic and property value.

§ 129-17. Stream Bank Erosion Requirements.

A. In addition to the water quality volume, to mitigate the impact of stormwater runoff on downstream stream bank erosion, BMPs must be designed to detain the proposed conditions 2-year, 24-hour design storm to the existing conditions 1-year flow using the SCS Type II distribution.

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

§ 129-18. Design and Construction Criteria for Stormwater Management Facilities and Best Management Practices.

A. Stormwater runoff which may result from regulated activities identified in § 129-4 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 Chapter and the "Pennsylvania Stormwater Best Management Practice Manual", December 30, 2006, as amended, and are the preferred methods of controlling stormwater runoff. The choice of BMPs is not limited to the ones appearing in this Chapter and the Manual; however, any selected BMP must meet or exceed the runoff peak rate requirements of this Chapter.

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 Specification. 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 fifteen (15) inches (or an equivalent flow area of 1.23 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 ("environmental" type). 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 percent (0.005 ft/ft), with the exception that terminal sections of pipe shall have a minimum slope of one percent (0.01 ft/ft).

(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 Worcester Township construction requirements/specifications.

(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 adjoining public or private property, outside of a 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. Storm sewer pipes shall enter and exit the sides of inlet boxes and shall not encroach into the corner, wherever possible.

(12) Stormwater pipes shall have a minimum depth of cover of eighteen (18) 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, to achieve required cover. Stormwater pipes conveying swale flow under driveway crossings shall have a minimum cover of twelve (12) inches, including over the bell, but in no case shall the cover be less than that required for the anticipated traffic loading. For driveway culverts, cover may be less than 12 inches if the design engineer verifies proposed pipe has sufficient strength to withstand loading from anticipated design vehicles. Where cover is restricted, concrete trench drain with bolt-down metal grates may be used.

(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, pipe 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, and structures, 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 and any required access from the public road. 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.

(20) Stormwater roof drains and sump pumps shall not discharge water directly onto a sidewalk or a street and shall be constructed to discharge to a dry well/seepage pit or above ground entirely on the subject property, except where such discharge could flow across sidewalk or onto a street. If approved by the Township Engineer, roof drains and sump pumps may be discharged directly to a storm sewer system if such system discharges to a stormwater BMP or water quality facility.

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 Montgomery 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 Pollution Control Program Manual (Document No. 363-2134-008).

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 blanket 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 to 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 Chapter.

(10) Except for drainage at roadway stream crossings, artificial swale discharge shall be set back 75 feet from a receiving waterway, and shall be diffused or spread out to reduce and eliminate high-velocity discharges to the impacted ground surface.

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 (pre-existing) 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 unimpeded movement of native animal species and a normal water depth of 12 inches unless a greater depth is required by PADEP.

(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 period 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, upstream or downstream of the structure.

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.

Values for the rainfall intensity shall be based on NOAA Atlas 14, Volume 2, Version 3.0, rain data found in Table A-3 and Figure A-2 of Appendix A of this Chapter.

(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 § 129-19) 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 pipe design capacity, to the detention basin (or other approved outlet point) when the capacity of the system is exceeded. Stormwater runoff will not be permitted to surcharge from storm sewer structures (Refer § 129-18.C.19).

(7) Except for drainage at roadway stream crossings, pipe discharge shall be set back 75 feet from a receiving waterway, and the pipe discharge shall be diffused or spread out to reduce and eliminate high-velocity discharges to the impacted ground surface.

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) and final grade shall comply with Worcester Township Building Code requirements.

(3) Construction - The applicant shall construct and/or install such drainage structures and/or pipe as are necessary to prevent erosion damage and to satisfactorily disperse, infiltrate or carry off such surface waters to the nearest practical BMP, 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 Chapter, and are four (4) feet or more in height, a protective fence, no less than four (4) feet in height, 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 be permitted only where application is made, and approval is received, from the Pennsylvania Department of Environmental Protection (where applicable), the Montgomery County Conservation District, and Worcester 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 Montgomery 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 applicant shall be responsible for the placement of appropriate signage identifying construction entrances and washing stations. Construction entrances shall be maintained by the applicant 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 applicant shall demonstrate that such ponds are designed to protect the public's health and safety. Should any stormwater management facility require a dam safety permit under the PADEP Chapter 105 regulations, the facility shall be designed in accordance with Chapter 105 and meet the regulations of Chapter 105 concerning dam safety which may be required to pass storms larger than a one-hundred-year event

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

(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. To minimize the visual impact of detention basins, they shall be designed to avoid the need for safety fencing. To meet this requirement, detention basins shall be designed as follows:

(a) Maximum depth of detained runoff shall be 24 inches for a two-year or ten-year storm event.

(b) Maximum depth of detained runoff shall be 36 inches for a one-hundred-year storm event.

(c) The basin inflow and outflow structures shall not be located directly across from each other and shall not be in close proximity to one another. A length-to-width ratio in all detention/retention basins and other such storage facilities of at least 2:1 shall be provided to maximize the flow path between the inflow point and the outlet structure. The distance between these two structures must be at least 50%

of the maximum length of the basin as measured at the top of berm elevation. Alternatively, a means for extending the time of surface flow from basin inflow point to basin outlet structure, designed to the satisfaction of the Township Engineer, may be utilized.

(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 Chapter, the Subdivision and Land Development Ordinance, and as recommended by the Township Engineer. When a detention basin is not designed as a stormwater management constructed wetland, it shall be planted with low maintenance grass or similar satisfactory to the Township.

(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 Montgomery 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 on all plan sheets required to be recorded as well as the development agreement with the Township and the stormwater management facilities operation and maintenance agreement.

(7) Stormwater management basins shall be in place before the creation of any new impervious surfaces on the site. As-built drawings of the basins(s) shall be submitted to the Township for review. The basin shall not be considered functional until it is proved by the developer that the basin meets the volume requirements and the outflow characteristics of the original design of the basin(s).

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

(9) Except where otherwise identified herein, all detention or retention 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 five (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.

(10) All portions of a detention basin bottom shall have a minimum slope of two (2) percent. For portions of basin bottoms with grades less than 2%, the applicant shall provide a landscape design, which minimizes maintenance provisions and encourages infiltration. These requirements may be altered when approved by the Township Engineer.

(11) Basin Berm Construction Requirements.

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

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

(c) Embankment:

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

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

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

(12) 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).

(13) 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.

(14) The minimum top of basin berm width (at the design elevation) shall be ten (10) feet.

(15) 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.

(16) 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 in the field 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 Engineer. A minimum of two (2) collars shall be installed on each basin outlet pipe. Collars shall have a minimum thickness of twelve (12) inches and may not be installed within two (2) feet of pipe joints.

(17) A perforated sediment control structure, sized in accordance with Montgomery 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 Montgomery County Conservation District.

(18) Stormwater management facility outlet piping shall be Class III reinforced O-ring concrete pipe. All joints shall be mortared. Crushed stone bedding/backfill shall not be utilized through basin berms.

(19) The grate of the basin outlet structure shall be at least six (6) inches lower than the elevation of the earthen emergency spillway. Six (6) inches, minimum, is also required between the routed one hundred (100) year water surface elevation and top of grate of the outlet structure.

(20) 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 Pollution Control Program Manual, latest revision.

(21) Stone gabion baskets or concrete or segmental block retaining walls shall not be permitted for use in construction of detention/retention basins within the berm or within the 100-year water surface elevation (as measured through the earthen emergency spillway).

(22) An access easement and stabilized access 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 interlocked, reinforced pervious paving systems (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 reinforced concrete apron (6-inch minimum thickness) 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 from a public right-of-way or paved driveway within an access easement. The access easement shall be owned and maintained by the same entity owning the stormwater management facility and shall allow access by Worcester Township or its designee for emergency inspection and/or maintenance at any reasonable time.

(23) If the basin is not designed to meet the requirements of § 129-18.H.3, a split rail fence must be provided as follows:

(a) A level area (two-percent slope) eight feet in width shall be provided on both the inside and outside of the fence, along the entire length of the fence for proper access by maintenance equipment. The total width of this generally level area shall be at least 16 feet.

(b) Each basin fence installation shall include two points of access with ten (10) feet wide self-closing, self-latch gates to allow for maintenance equipment/vehicle access.

(c) Fence shall be split-rail consisting of locust posts (two or three rail), four (4) feet high, minimum, 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. The mesh shall be installed on the outside of the fence.

(d) Split rail fence shall also be required around any detention or retention basin, where directed by Worcester Township.

(24) Landscaping:

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

(b) Artificial wetland basins shall be designed pursuant to requirements of the Pennsylvania Stormwater BMP Manual. Plant material and arrangement shall be subject to approval of the Township Engineer.

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

water surface elevation:

[1] Three (3) evergreen trees (minimum height 5 feet)

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

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

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

(25) Special requirements for stormwater detention/retention BMPs within defined Exceptional Value and High-Quality watersheds as defined in Chapter 93, Water Quality Standards, Title 25, Pennsylvania Department of Environmental Protection Rules and Regulations:

(a) Temperature sensitive BMPs and stormwater conveyance systems are to be used and designed with storage pool areas and supply outflow channels, and shaded with trees. At a minimum, the southern half of pond shorelines shall be planted with shade or canopy trees and understory shrubs within 10 feet of the pond shoreline. In conjunction with this requirement, the maximum slope allowed on the berm area to be planted is 10 to 1. This will lessen the destabilization of berm soils due to root growth. A long-term maintenance schedule and management plan for the thermal control BMPs must be identified on the Stormwater Management Site Plan and recorded at the Montgomery County Recorder of Deeds for all development sites.

(b) As an alternative to mitigating the temperature of stormwater runoff as described in § 129-18.H.25.a, alternative temperature sensitive BMPs may be utilized, if approved by the Township Engineer, upon the applicant demonstrating such BMPs will effectively reduce the temperature of detained runoff before it is released from the development site. Such alternative BMPs may include, but are not limited to facilities that cool runoff through underground storage and filtration and retention ponds/basins where outflow from the facility is drawn from a depth of 5 feet (or greater) below the permanent pool surface.

(26) At the conclusion of all construction and after all stormwater facilities have received final approval, the applicant shall offer the facilities for dedication to the township, with the following requirements:

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

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

(c) The Applicant shall provide for the special financial burden the Township will be accepting if the Township accepts the detention basin maintenance. To help mitigate this future financial burden, the Applicant shall contribute to the Township a cash payment in an amount to be calculated by the Township

Engineer, which amount shall include all estimated costs to inspect, maintain, and repair the facilities during a ten-year period.

(27) If the township declines dedication of the basin, the applicant shall provide written assurance, satisfactory to the Township that the retention/detention basin will be properly maintained. Such assurances shall be in a form of a covenant that will run with the land and shall provide for Township maintenance at the cost of the landowner in case of default, and further provide for assessment of costs and penalties in case of default.

I. All developments that create impervious surface shall provide capacity for and treatment of the calculated Water Quality Volume and Recharge Volume unless exempt under § 129-5. In potential stormwater BMPs, the order of preference is as follows: (1) infiltration BMPs; (2) flow attenuation methods (e.g. vegetated open swales and natural depressions); (3) artificial wetlands, bioretention structures, and wet ponds; (4) minimum first flush detention or dual purpose detention (where appropriate). Infiltration BMPs shall be utilized unless the applicant can demonstrate use of infiltration techniques is not feasible due to site conditions, based upon site specific soil testing. Vegetated swales, wetlands or artificial wetlands and bioretention structures shall be utilized wherever possible if infiltration BMPs are deemed unfeasible. BMP techniques can and should be used in conjunction with each other (e.g. vegetated swales with infiltration or retention facilities).

(1) Infiltration Best Management Practices (BMPs) – Infiltration BMPs shall be designed in accordance with the design criteria and specifications of the Pennsylvania Stormwater BMP Manual (2006) and shall conform to the following minimum requirements:

(a) A soils evaluation and infiltration/permeability testing of the project site shall be conducted in accordance with Appendix B of this Chapter.

(b) A minimum soil depth of eighteen (18″) inches shall be provided between the bottom of the infiltration BMPs and the top of bedrock or seasonally high water table. The minimum required separation between the infiltration surface and these limiting zones shall be increased by the Township should project specific conditions exist (such as anticipated increased contaminants) which dictate greater prevention of groundwater contamination.

(c) Infiltration BMPs must have an infiltration rate sufficient to accept the design stormwater load and dewater completely as determined by field permeability tests. The minimum field-tested infiltration rate permitted for construction of infiltration BMPs shall be 0.2 inches/hour (in/hr). A safety factor of 50% shall be applied to field-tested rates to determine the infiltration rate that must be utilized for design of infiltration BMPs (e.g., for soil which measured 0.4 in/hr, the BMP design rate shall be 0.2 in/hr to insure effective infiltration after construction).

(d) Infiltration BMPs intended to receive rooftop runoff shall include appropriate measures such as leaf traps and cleanouts to prevent clogging by vegetation. Surface inflows shall be designed to prevent direct discharge of sediment into the infiltration system.

(e) Adequate storage shall be provided to accommodate the volume of runoff calculated as the difference between the pre-development runoff volume and post-development runoff volume based on the 100 year design storm.

(f) The facility shall be designed to control the post-development peak rate of runoff to the pre-development peak rate of runoff for all design storms identified in § 129-13 of this Chapter.

(g) An overflow or spillway shall be provided that safely permits the passing of runoff greater than that occurring during the 100 year design storm event.

(h) Underground infiltration basins and BMPs shall have positive overflow controls to prevent storage within one foot of the finished surface over the basin.

(i) When infiltration methods such as seepage pits, beds, or trenches are proposed, the locations of existing and proposed septic tanks, infiltration areas, and wells must be shown. A separation distance of no less than 50 feet shall be provided between any septic system and any facility used for stormwater management and infiltration.

(j) A minimum of thirty (30) feet of undisturbed soil shall separate the foundation wall of any building and an infiltration BMP, unless a lesser distance is approved by the Township or Township engineer, based on site conditions or selected BMP.

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

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

(m) The Township may require the installation of a mitigative layer or an impermeable liner in an infiltration BMP and/or other stormwater structure that impounds runoff, where the possibility of groundwater contamination exists. A detailed hydrogeologic investigation may be required by the Township

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

(o) Infiltration BMPs shall be designed based on field-tested infiltration/permeability rates at the level of the proposed infiltration surface(s) and based on a safety factor of fifty (50) percent.

(2) Non-infiltration Facilities used as Best Management Practices (BMPs). All facilities shall be designed in accordance to the design criteria and specifications in the Pennsylvania Stormwater BMP Manual.

(3) Artificial wetlands, wet ponds, and bioretention structures.

(a) Wet Pond BMPs shall meet the following requirements:

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

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

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

[4] A shallow forebay shall be provided adjacent to all inflow areas. The forebay shall be planted as a marsh with emergent wetland vegetation. The forebay serves to enhance sediment trapping and pollutant removal, as well as concentrating accumulated sediment in an area where it can be readily removed.

[5] All wet ponds shall be designed with public safety as a primary concern - An aquatic safety bench shall be provided around the perimeter of the permanent pool. The depth of the bench shall be a maximum of fifteen (15) inches and a minimum of 12 (12) inches for a width of at least ten (10) feet. A 3:1 slope shall lead from the edge of the safety bench toward the deep water portion of the pond. At least 15 feet of 3:1 slope shall be provided from the edge of the safety bench. Slopes in the remainder of the pond below the permanent pool elevation shall be a maximum of 2:1.

[6] The perimeter slope above the permanent pool shall have a maximum slope of 5:1.

[7] Wet ponds shall have a deep water zone of at least five (5) feet to encourage gravity settling of suspended fines, and prevent stagnation and possible eutrophication.

[8] Wet ponds shall be capable of being substantially drained by gravity flow. Wet ponds shall be equipped with a manually operated - drain that can be secured against unauthorized operation.

[9] A planting plan shall be developed for the wet pond, showing all proposed aquatic, emergent, and upland plantings required pursuant to this Chapter and the Zoning and Subdivision and Land Development Ordinances (where specifically identified).

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

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

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

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

(iv) Vegetative barriers;

(v) Rock barriers;

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

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

(ix) Other techniques as approved by the Township Engineer.

(b) Artificial Wetland BMPs shall meet the following requirements:

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

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

(3) A planting plan shall be developed for the artificial wetland showing all proposed aquatic, emergent, and upland plantings required pursuant to this Chapter and the Zoning and Subdivision and Land Development Ordinances (where specifically identified). The planting plan shall be developed to provide a diversity of species resulting in a dense stand of wetland vegetation.

(4) At least 75% of the surface area of the wetland shall be developed as a shallow water emergent wetland, with a water depth of less than 12". The reminder shall be constructed as open water with depths between 2 feet and 4 feet.

(4) Minimum first flush detention/dual purpose BMPs

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

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

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

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

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

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

K. 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 first to an infiltration BMP, and if that is not possible, then to a storm sewer, 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) The design of all stormwater management facilities shall incorporate sound engineering principles and practices. The Township shall reserve the right to disapprove any design that would result in the occupancy or continuation of an adverse hydrologic or hydraulic condition within the watershed.

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

(1) American Society of Testing and Materials (ASTM)

(2) Asphalt Institute (AI)

(3) Montgomery County Conservation District (MCCD)

(4) Federal Highway Administration (FHWA)

(5) National Crushed Stone Association (NCSA)

(6) National Sand and Gravel Association (NSGA)

(7) Pennsylvania Department of Environmental Protection (PADEP)

(8) Pennsylvania Department of Transportation (PADOT)

(9) U.S. Department of Agriculture, Natural Resources Conservation Service, Pennsylvania (USDA, NRCS, PA)

§ 129-19. Calculation Methodology.

A. Stormwater runoff peak discharges from all development sites with a drainage area equal to or greater than 50 acres shall be calculated using a generally accepted calculation technique that is based on the NRCS Soil Cover Complex Method. The Rational Method may be used to estimate peak discharges from drainage areas that contain less than one hundred (100) acres as approved by the Township Engineer. The Rational Method is recommended for watershed areas under fifty (50) acres.

Table 129-19.1 summarizes acceptable computation methods. The method shall be selected by the applicant based on the individual limitations and suitability of each method for a particular site.

Table 129-19.1 Acceptable Computation Methodologies for Stormwater Management Designs

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 or 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 50 acres, or as approved by the Township engineer.
Other methods	Varies	Other computation methodologies approved by the Township engineer.

B. All calculations consistent with this Chapter 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, Volume 2, Version 3.0, rain data corresponding to the Graterford 1E rain gage (No. 36-3437), Schwenksville, Pennsylvania as presented in Table A-1 of Appendix A of this Chapter. The SCS Type II rainfall curve data from NOAA is listed in Figure A-1 in Appendix A of this Chapter. This data may also be directly retrieved from the NOAA Atlas 14, Volume 2, Version 3.0 website: hdsc.nws.noaa.gov/hdsc/pfds. If a hydrologic computer model such as PSRM or HEC-1/HEC-HMS is used for stormwater runoff calculations, then the duration of rainfall shall be 24 hours.

C. Runoff Curve Numbers (CN) for both existing and proposed conditions to be used in the Soil Cover Complex Method shall be obtained from Table A-2 in Appendix A of this Chapter.

D. Suggested runoff coefficients (C) for both existing and proposed conditions for use in the Rational Method are contained in Table A-4 in Appendix A of this Chapter.

E. 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 3.0, rain data corresponding to the Graterford 1E rain gage (No. 36-3437), Schwenksville, Pennsylvania as presented in Table A-3 of Appendix A of this Chapter. The Rational Method rainfall curve data from NOAA is listed in Figure A-2 in Appendix A of this Chapter. 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.

F. For the purposes of existing conditions flow rate determination for all development activity, 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 Tables A-2 and A-4 in Appendix A of this Chapter. 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.

G. Where uniform flow is anticipated, the Manning equation shall be used for hydraulic computations, and to determine the capacity of open channels, pipes, and storm sewers. Values

for Manning's roughness coefficient (n) shall be consistent with Table A-5 in Appendix A of this Chapter.

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

I. The design of any stormwater management facilities intended to meet the performance standards of this Chapter 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.

J. 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.

K. 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.

§ 129-20. Erosion and Sedimentation Control Requirements.

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, Sub-Part C, protection of Natural Resources, Article II, Water Resources, Chapter 102, "Erosion Control," and in accordance with the Montgomery County Conservation District and the standards and specifications of the Township. Various BMPs and their design standards are identified in the PADEP Erosion and Sediment Pollution Control Program Manual (March 2012), as amended and updated.

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

C. In addition, under 25 PA Code Chapter 92, a PADEP "NPDES Construction Activities" permit is required for Regulated Earth Disturbance activities of one (1) or more acres.

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

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

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

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

(3) 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.

G. Peak discharge rates from the site during land disturbance shall comply with the appropriate sections in this Chapter related to allowable post-development stormwater runoff rates, with the following additions:

(1) For purposes of calculating required detention storage during land disturbance, peak discharges shall be calculated based upon the runoff coefficients for bare soils during the period of maximum anticipated disturbance from clearing and grading, in combination with the entire quantity of proposed impervious surface installation, indicated on the development plan. Runoff controls shall insure that the peak rate of "during construction" runoff does not exceed predevelopment runoff rates for the one (1) year frequency through one hundred (100) year frequency design storm events. Detention storage during the period of land disturbance and prior to establishment of permanent cover may require additional detention 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 compliance with this requirement.

(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.

ARTICLE IV. STORMWATER MANAGEMENT APPLICATION AND PERMIT REQUIREMENTS

§ 129-21. General Requirements.

A. For any of the development activities regulated by this Chapter as defined pursuant to § 129-4.E, the final approval of subdivision and/or land development plans, the issuance of any building, zoning, 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 a Stormwater Management Permit (Permit) or approval of a Stormwater Management Exemption by the Township. Final approval of a subdivision and/or land development plan and recordation of same with the Montgomery County Recorder of Deeds, shall constitute approval of the Stormwater Management Permit for stormwater facilities/BMPs proposed on the plan.

B. A Stormwater Management Site Plan (SMSP) shall be required in conjunction with a Stormwater Management Permit for all regulated development activities that do NOT qualify for exemption from the provisions of this Chapter pursuant to § 129-5.B and § 129-5.C. The SMSP shall include all items identified pursuant to § 129-22. The SMSP approved by the Township shall be on-site throughout the duration of the regulated activity.

C. A Simplified Stormwater Management Site Plan (SSMSP) shall be required in conjunction with a Permit for regulated development activities qualifying for exemption of the provisions of this Chapter pursuant to § 129-5.C. The SSMSP shall include all items identified pursuant to § 129-23. The SSMSP approved by the Township shall be on-site throughout the duration of the regulated activity.

D. A Stormwater Management Permit shall be issued only upon approval of a Stormwater Management Site Plan or Simplified Stormwater Management Site Plan by the Township. A Stormwater Management Permit is not required for regulated activities exempt pursuant to § 129-5.B of this Chapter, but approval of a Stormwater Management Exemption must be issued by the Township pursuant to § 129-5.B and § 129-5.F, prior to commencement of regulated activities.

§ 129-22. Stormwater Management Site Plan (SMSP) Contents and Requirements.

For all regulated activities not exempt from provisions of this Chapter, a Stormwater Management Site Plan (SMSP) is required and 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 SMSP application documents shall be submitted to the Township in a format that is clear, concise, legible, neat, and well organized; otherwise, the Stormwater Management Site Plan shall be disapproved and returned to the applicant.

The following items shall be included in the Stormwater Management Site Plan:

A. Four (4) copies of the completed Township Stormwater Management Application form.

B. Stormwater Management Review Fee and Escrow, as established by separate resolution of The Township Supervisors.

C. 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.

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 applicant. The information required in the analysis shall be detailed enough to determine the potential applicability of these BMPs for a proposed development, but general enough not to force an applicant 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. Applicants are expected to use these BMPs wherever possible and are required to provide adequate justification if these BMPs are not to be implemented. Applicants for those sites that are determined to be generally suitable from these analyses (taking into consideration the areal extent of suitable soils necessary to accommodate an infiltration or wet pond or wetland BMP for the type and size of development proposed) are required to conduct the detailed soil testing and other feasibility testing required in other sections of this Chapter which contain the description and additional design criteria of these BMPs.

This analysis shall provide:

(1) A general assessment of the anticipated additional runoff based on the design storm and post-development condition and utilizing the calculation procedures required in § 129-19;

(2) An indication of drainage areas on the development site resulting in impervious, pervious, and rooftop runoff;

(3) An indication of type of land use (residential, non-residential) generating the impervious surface runoff;

(4) A delineation of soils on the site from the NRCS, Soil Survey of Montgomery County and onsite soil study. The soil study shall be conducted by a soil scientist and shall include sufficient probes/deep holes to evaluate application of BMPs;

(5) An indication of soils generally suitable for infiltration and/or wet pond/artificial wetland BMPs;

(6) The 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) The 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 an alternative development layout which would reduce impact on suitable soil availability is unfeasible;

(8) An 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 and type of land use (items 2. and 3. above) and the general design standards and maintenance issues included in this Chapter, 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) The rationale for a decision to not proceed with implementation of infiltration BMPs or wet pond or artificial wetland BMPs such as excessive cost of implementation, insufficient soil suitability, and development constraints.

D. A detailed geologic evaluation of the project site pursuant to § 129-15.E and Appendix B of this Chapter, shall be performed to determine the suitability of recharge facilities. The evaluation shall be performed by a qualified geologist and/or soil scientist and shall address, at a minimum, soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability.

E. Whenever a stormwater management facility will be located in an area underlain by limestone, a geological evaluation of the proposed location shall be conducted to determine susceptibility to sinkhole formations. The design of all facilities over limestone formations shall include measures to prevent ground water contamination and, where necessary, sinkhole formation. Soils used for the construction of basins shall have low-erodibility factors ("K" factors). Installation of an impermeable liner shall be required in detention basins to be constructed over or in close proximity (less than 150 feet) to limestone.

It shall be the applicant's responsibility to verify whether the site is underlain by limestone. The following note shall be attached to all Stormwater Management Site Plans and signed and sealed by the applicant's professional engineer "I, _____, certify that the proposed stormwater management facility (circle one) is/is not underlain by limestone."

F. General

(1) General description of project.

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

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

G. Four (4) copies of the Stormwater Management Site Plan for the parcel 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 Montgomery County. The contents of the plan shall include, but not be limited to:

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

(2) Watershed(s) within which the project is located (e.g. Skippack Creek, Wissahickon Creek, Stony Creek/Saw Mill Run)

(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 and all drainage channels leading to such bodies of water.

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

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

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

(8) Proposed changes to the land surface and vegetative cover, including a tabulation of impervious surface area which identifies the type of surface and the quantity of existing impervious surface area, existing impervious surface area to be removed and proposed impervious surface area.

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

(10) Final contours at intervals at 2 feet.

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

(12) The date of submission.

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

(14) A North arrow.

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

(16) Existing and proposed land use(s).

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

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

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

(20) A twenty (20) feet wide access easement around all stormwater management facilities that would provide ingress to and egress from a public right-of-way or paved driveway within an existing or proposed easement that accesses a public right-of-way.

(21) A note on the plan indicating the location and responsibility for maintenance of stormwater management facilities that would be located off-site. All off-site facilities shall meet the performance standards and design criteria specified in this Chapter.

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

(23) A statement, signed by the landowner, acknowledging the stormwater management system to be a permanent fixture that can be altered or removed only after approval of a revised plan by the Township, which shall be recorded with the record plan and which shall be applicable to all future landowners.

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

(25) The following signature block for the design engineer:

___(Design engineer)_____, on this date (date of signature), has reviewed and hereby certify that the Stormwater Management Site Plan meets all design standards and criteria of the Worcester Township Stormwater Management Ordinance No. _____.

(26) The Stormwater Management Site Plan shall include an Operation and Maintenance Plan for all existing and proposed stormwater management/BMP facilities, addressing long-term ownership and maintenance responsibilities for such facilities, including schedule for Operation and Maintenance Activities.

H. 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 Chapter.

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

(d) Expected project time schedule.

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

(3) A geologic assessment of the effects of runoff on sinkholes as specified in this Chapter.

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

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

I. Stormwater Management BMPs

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

(2) When groundwater recharge methods such as seepage pits, beds, or trenches are proposed, the locations of existing and proposed septic tank infiltration areas and drinking water wells must be shown. A minimum separation distance of no less than 50 feet shall be provided between any septic system and any facility used for stormwater management. An analysis shall be submitted to verify that stormwater infiltration shall not affect groundwater elevations of the septic drain field site if this distance is approved by the Township to be less than 50 feet. In no case shall this distance be less than 20 feet.

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

(4) All stormwater management/BMP facility easements required by this Chapter must be shown on the Stormwater Management Site Plan, including the bearing and distance of each segment of the easement(s) boundary.

§ 129-23. Simplified Stormwater Management Site Plan (SSMSP) Contents and Requirements.

For all regulated activities that qualify for exemption of certain provisions of this Chapter pursuant to § 129-5.C, and that are required to install a predesigned infiltration facility(s) in accordance with Worcester Township design and construction criteria (to be provided by the Township at the time of Permit application), a Simplified Stormwater Management Site Plan (SSMSP) is required and shall include the following items:

A. Four (4) copies of the completed Township Stormwater Management Application form.

B. Stormwater Management Review Fee and Escrow, as established by separate resolution of The Township Supervisors.

C. Four (4) copies of the Simplified Stormwater Management Site Plan for the parcel containing, at a minimum, the following information:

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

(2) Location map identifying the site relative to streets and other parcels in the vicinity of the site.

(3) Location of significant natural and existing manmade features, including wetlands, watercourses, riparian corridors, woodlands, steep slopes, structures, parking areas, driveways, utilities, flood hazard boundaries, sinkholes, wells, and septic systems within 200 feet of proposed impervious surface, regardless of the location of the property boundary.

(4) 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. Impervious surface area tabulation must be provided identifying existing area of impervious surface, existing impervious surface area to be removed, and proposed impervious surface area.

(5) North Arrow.

(6) Plan scale, as applicable.

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

(8) Proposed contours at intervals at 2 feet as well as spot elevations as necessary to provide sufficient clarification of positive slope and drainage divides.

(9) Infiltration/BMP facility design calculations and construction details.

(10) An overlay on the site showing soil names and boundaries from the NRCS, Soil Survey of Montgomery and Philadelphia Counties or onsite soil study, conducted by a soil scientist. This overlay shall include a table on the map showing the recharge capabilities of each soil represented onsite in inches per hour and describe their recharge or infiltration capabilities.

(11) Watershed(s) within which the project is located (e.g. Skippack Creek, Wissahickon Creek, Stony Creek/Saw Mill Run)

(12) 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.

(13) 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.

(14) A soil erosion and sedimentation control plan, where applicable, including all reviews and approvals, as required by PADEP and/or Montgomery Conservation District.

(15) A certification on the plan, signed by the landowner, acknowledging the stormwater management system to be a permanent fixture that cannot be altered or removed without written 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.

(16) Other information deemed necessary by the Township Engineer to determine compliance with exemption criteria contained in § 129-5.B.

(17) The following signature block for the design engineer:

(Design engineer), on this date (date of signature), has reviewed and hereby certify that the stormwater management plan meets all design standards and criteria of the Worcester Township Stormwater Management Ordinance No. _____.

(18) Locations of existing and proposed septic tank infiltration areas and all wells must be shown. A minimum separation distance of no less than 50 feet shall be provided between any septic system and any facility used for stormwater management. An analysis shall be required to verify that stormwater infiltration shall not affect groundwater elevations of the septic drain field site, if this distance is approved by the Township to be less than 50 feet. In no case shall this distance be less than 20 feet.

(19) It shall be the applicant's responsibility to verify whether the site is underlain by limestone. The following note shall be attached to all Simplified Stormwater Management Site Plans and signed and sealed by the applicant's professional engineer:

"I, _____, certify that the proposed stormwater management facility (circle one) is/is not underlain by limestone.".

§ 129-24. Plan Submission.

For all activities regulated by this Chapter, the steps below shall be followed for submission of a SMSP or SSMSP (both referred to in this section as "Plan"). For any activities that require a PADEP Permit regulated under Chapter 105 (Dam Safety and Waterway Management) or Chapter 106 (Floodplain Management) of PADEP's Rules and Regulations, a PADOT highway occupancy permit, or any other permit under applicable local, state, or federal regulations, the permit(s) shall be supplied as part of the plan.

A. The SMSP shall be submitted by the applicant as part of any preliminary subdivision and/or land development plan submission.

B. A minimum of four (4) copies of the Plan shall be submitted in conjunction with regulated activities not exempt pursuant to § 129-5.B of this Chapter. Additional copies shall be submitted if requested by the Township.

C. Distribution of the Plan will be as follows:

(1) Two (2) copies to the Township accompanied by the requisite Township review fee and escrow, as specified in this Chapter.

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

§ 129-25. Review of Stormwater Management Site Plan and Simplified Stormwater Management Site Plan.

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

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

C. For activities regulated by this Chapter (not including subdivision or land development), the Township Engineer shall review the plan for conformance with the Watershed Act 167 Stormwater Management Plan. The Township Engineer will forward a review letter to the Township with a copy to the Applicant. Any disapproved Plan may be revised by the Applicant and resubmitted consistent with this Chapter.

D. The Township shall not approve any subdivision or land development or regulated activities specified in § 129-4.E.1 and 129-4.E.2 of this Chapter if the Plan has been found to be inconsistent with the Watershed Act 167 Stormwater Management Plan. All required permits from PADEP must be obtained prior to, or as a requirement of, final approval.

E. The Worcester Township Building Code Official shall not issue a building permit for any regulated activity specified in § 129-4 of this Chapter if the Stormwater Management Site Plan has been found to be inconsistent with the adopted Watershed Act 167 Stormwater Management Plan, 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.

F. The Township's approval of a Stormwater Management Site Plan or Simplified Stormwater Management Site Plan prepared in conjunction with a Stormwater Management Permit application (for a regulated activity that is not a subdivision or land development, and which is not exempt from provisions of this Chapter pursuant to § 129-5.B), shall be valid for a period not to exceed one (1) year. This time period shall commence on the date that the Township signs and issues a Stormwater Management Permit. If stormwater management facilities included in the approved Plan have not been constructed, or if an as-built survey of these facilities pursuant to § 129-28 of this Chapter has not been approved within this time period, the Township may consider the Plan disapproved and may revoke any and all permits. Plans that are considered disapproved by the Township shall be resubmitted in accordance with § 129-27 of this Chapter.

G. The Township's approval of a Stormwater Management Site Plan prepared in conjunction with an approved subdivision or land development shall remain valid and protected from any change in Township Codes and Ordinances for a period no greater than five (5) years from the date of preliminary subdivision and/or land development plan approval, pursuant to the provisions of the Pennsylvania Municipalities Planning Code.

§ 129-26. Modification of Plans.

A. A modification to a submitted Stormwater Management Site Plan or Simplified Stormwater Management Site 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 Plan as determined by the Township Engineer, shall require a resubmission of a modified Plan consistent with § 129-27 of this Chapter and be subject to review as specified in § 129-25 of this Chapter.

B. A modification to an already approved or disapproved Plan shall be submitted to the Township, accompanied by the applicable Township review fee and escrow. A modification to a 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 and escrow.

§ 129-27. Resubmission of Disapproved Stormwater Management Site Plans and Simplified Stormwater Management Site Plans.

A disapproved Stormwater Management Site Plan or Simplified Stormwater Management Site Plan may be resubmitted, with revisions addressing the Township Engineer's concerns, documented in writing, to the Township Engineer in accordance with § 129-24 of this Chapter and be subject to review as specified in § 129-25 of this Chapter. The applicable Township review fee must accompany resubmission of a disapproved Plan.

§ 129-28. As-Built Plans.

A. The applicant for any regulated activity requiring a Stormwater Management Site Plan and Stormwater Management Permit shall be responsible for completing an as-built survey, sealed by a professional engineer licensed in the Commonwealth of Pennsylvania or a registered surveyor licensed in the Commonwealth of Pennsylvania, of all stormwater management facilities/improvements included in the approved Plan. An as-built survey is not required for infiltration BMP's installed in conjunction with a Simplified Stormwater Management Site Plan. The as-built survey and an explanation of any discrepancies with the design plans shall be submitted to the Township Engineer for approval. In no case shall the Township approve the as-built survey until the Township receives a copy of an approved declaration of adequacy, highway occupancy permit from the PADOT District Office (if applicable), any applicable permits from PADEP, and NPDES Notice of Termination (if applicable) approved by PADEP or the Montgomery County Conservation District.

B. Completed stormwater management facilities and BMPs, 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 Plan. As-constructed plans shall be submitted to Worcester 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 associated with subdivisions and land developments. Public facilities will not be accepted by Worcester Township until such time the as-constructed plans have been reviewed and approved by the Township Engineer.

§ 129-29. Retention of Plans at Project Site.

A set of 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.

§ 129-30. Adherence to Approved Plan.

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

§ 129-31. Certification of Completion.

At the completion of the project, and as a prerequisite for the release of the performance guarantee required pursuant to § 129-37, the owner or his representatives shall:

A. Provide a set of as-built drawings pursuant to § 129-28 of this Chapter and/or Subdivision and Land Development Ordinance requirements. The as-built submission shall include a Certification of Completion signed by a licensed, qualified professional verifying that all permanent stormwater management/BMP facilities have been constructed according to the approved Stormwater Management Site Plan and specifications

B. Contact the Township Engineer to request inspection of the site for completion of stormwater management facilities and compliance with the approved Plan and provisions of this Chapter. This final inspection shall be conducted by the Township after receipt of the Certification of Completion.

§ 129-32. Occupancy Permit.

A Use and Occupancy permit for any improvements constructed in conjunction with a subdivision and/or land development or other Township permit (requiring issuance of use and occupancy permit) shall not be issued unless the Certification of Completion, pursuant to § 129-31 of this Chapter, has been obtained by the Township (in conjunction with regulated development activities requiring a Stormwater Management Site Plan and stormwater improvements/BMPs).

ARTICLE V. INSPECTIONS

§ 129-33. Schedule of Inspections.

A. The Township Engineer shall inspect all phases of the installation of the permanent stormwater management facilities required pursuant to a Stormwater Management Site Plan and Simplified Stormwater Management Site Plan.

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

§ 129-34. Right-of-Entry During Construction.

A. During construction, duly authorized representatives of the Township may enter at reasonable times upon any property within the Township to inspect the implementation, condition, or

operation and maintenance of the stormwater BMPs to investigate whether construction activity is in compliance with this Chapter.

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 Chapter.

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 delay in allowing the direct access to a BMP is a violation of this Chapter.

ARTICLE VI. FEES AND EXPENSES

§ 129-35. Stormwater Management Permit and Review Fees.

The Township shall establish a fee schedule by Resolution of the governing body to defray plan review, construction inspection and administrative costs incurred by the Township from any outside agencies or entities (required to review the Plans) and the Township Engineer. The Township shall periodically update the review fee schedule to ensure that incurred costs are adequately reimbursed. The applicant shall pay all such fees and escrows.

§ 129-36. Expenses Covered by Fees and Escrow.

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

A. Administrative costs.

B. Review of the Plans 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 As-Built Plan.

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

ARTICLE VII MAINTENANCE RESPONSIBILITY

§ 129-37. Performance Guarantee

The applicant shall provide a financial guarantee to the Township for the timely installation and proper construction of all stormwater management controls as required by the approved Stormwater Management Site Plan and this Chapter equal to the full construction cost of the required controls plus construction contingency and construction inspection costs, which amount shall be calculated by the Township Engineer.

§ 129-38. Maintenance Responsibilities.

A. The Stormwater Management Site Plan for the development site shall contain a BMP operation and maintenance plan (BMP O&M Plan) prepared by the design engineer. The operation and maintenance plan shall outline required routine maintenance actions and schedules necessary to insure proper operation of the BMPs and shall be subject to review and approval of the Township. The governing body, upon recommendation of the Township Engineer, shall make the final determination on the continuing maintenance responsibilities prior to final approval of the Stormwater Management Site Plan.

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

(1) If a development consists of structures or lots that are to be separately owned and in which streets, storm sewers, and other stormwater management public improvements are to be dedicated to the Township, stormwater control facilities 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 control facilities shall be the responsibility of the owner or private management entity.

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

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

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

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

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

E. If the facilities are to be privately owned, an Operations and Maintenance Agreement that provides for maintenance responsibilities and cost sharing among the affected property owners, consistent with the O&M plan, shall be recorded against every affected property as a restrictive deed covenant that runs with the land.

F. The governing body shall have the right, at any time after completion of the stormwater management facilities, to require dedication of any or all of the stormwater management controls. The right of the Township to require dedication in the future shall be stated in the Maintenance Agreement (Refer to § 129-40).

G. The Township may take enforcement actions against an owner for any failure to satisfy any provision of this Chapter.

H. In the event a property owner or other entity responsible for maintenance (such as a homeowner's association) fails to honor their maintenance responsibilities set forth in the O&M Plan, in any manner, Worcester 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 the O&M Agreement. Failure to pay all costs described above may be subject of the imposition of a lien by the Township against the property 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.

§ 129-39. Review of Stormwater Facilities and BMP Operations and Maintenance (O&M) Plan.

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

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

§ 129-40. Maintenance Agreement for Privately Owned Stormwater Facilities.

A. Prior to final approval of the Stormwater Management Site 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 D of this Chapter. The signed O&M Agreement shall be recorded against every affected property as a restrictive deed covenant that runs with the land.

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

C. The owner is responsible for the O&M of the SWM BMPs. If the owner fails to adhere to the O&M Agreement, the Township may perform the services required and charge the owner appropriate fees. Nonpayment of fees may result in a lien against the property as described in § 129-38

§ 129-41. Stormwater Management Easements.

A. Stormwater management easements shall be granted by the property owner(s) as necessary to provide for:

(1) Access to the property by the Township for facility inspections and emergency maintenance.

(2) Preservation of stormwater runoff conveyance, infiltration, and detention areas and facilities, including flood routes for the 100-year storm event.

B. Stormwater management/BMP facilities easements are required for all areas used for off-site stormwater control, unless a waiver is granted by The Board of Supervisors.

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

D. The purpose of any easement shall be specified in the O&M Agreement signed by the property owner.

E. The record plan and development agreement for an approved subdivision or land development shall reference 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 Worcester Township or its designee, of all facilities deemed critical to public welfare.

§ 129-42. Stormwater Maintenance Fund.

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

(1) The amount shall include all estimated costs to inspect, maintain, and repair the facilities during a ten-year period, as calculated by the Township Engineer.

(2) The amount shall be converted to present worth of the annual series values. The Township Engineer shall determine the present worth equivalents, which shall be subject to the approval of the Board of Supervisors.

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

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

D. The applicant shall pay a fee to the Township Stormwater Maintenance Fund for all stormwater management facilities, storm sewer, culverts, or other such improvements required by PennDOT to be constructed within the right-of-way of public roadways or easement areas, that are to be maintained after dedication by and dedicated to the Township. The fee 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. The amount of the fee shall be converted to present worth of the annual series values. The Township Engineer shall determine the present worth equivalents, which shall be subject to the approval of the Board of Supervisors.

§ 129-43. Post-Construction Maintenance Inspections.

A. Stormwater Management BMPs shall be inspected for proper operation by the owner of the facilities on the following basis:

(1) Twelve (12) months after completion of the facility and acceptance of completion of the facility by the Township,

(2) At least once every three (3) years thereafter,

(3) During or immediately after the cessation of a 10-year frequency or greater storm, and/or

(4) As specified in the Operations and Maintenance (O&M) agreement.

B. The entity conducting the inspection shall submit a report to Worcester Township summarizing observations of inspection and necessary repairs, if any.

Article VIII PROHIBITIONS

§ 129-44. 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 shall allow or cause to allow stormwater discharges into the Township's Municipal 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:

(1) Discharges from fire-fighting activities.

(2) Potable water sources including waterline and fire hydrant flushing.

(3) Uncontaminated water from foundation or from footing drains.

(4) Flows from riparian habitats and wetlands.

(5) Lawn watering.

(6) Irrigation drainage.

(7) Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spill material has been removed) and where detergents are not used.

(8) Routine external building wash-down (which does not use detergents or other compounds).

(9) Air conditioning condensate.

(10) Water from individual residential car washing.

(11) Dechlorinated swimming pool discharges (pursuant to PADEP requirements).

(12) Springs.

(13) Uncontaminated groundwater.

(14) Water from crawl space pumps or sump pumps.

(15) Diverted stream flows.

D. In the event that the Township subsequently determines that any of the discharges identified in § 129-44.C of this Chapter degrade the quality of Waters of the Commonwealth or U.S., the Township will notify the responsible person to cease the discharge.

E. Upon notice provided by the Township under § 129-44.D, the discharger will have a reasonable time to cease the discharge consistent with the degree of pollution caused by the discharge.

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

§ 129-45. Prohibited Connections.

A. Prohibited connections. The following connections are prohibited, except as provided in § 129-44.C above:

(1) Any drain or conveyance, whether on the surface or subsurface, which allows any non-stormwater discharge, including sewage, process wastewater, and wash water, to enter the regulated small MS4 or the waters of the Commonwealth, and any connections to the storm drain system from indoor waste water drains and sinks; and;

(2) Any drain or conveyance connected from a commercial or industrial land use to the regulated small MS4 or the waters of the Commonwealth which has not been documented in plans, maps, or equivalent records, and approved by the Township.

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

§ 129-46. Roof Drains.

A. Roof drains shall not be connected to streets or sanitary sewers and shall discharge to infiltration areas or vegetative BMPs to the maximum extent practicable to satisfy the criteria for, and encourage disconnection of impervious surfaces. Roof drains may be connected to storm sewers or roadside ditches only when those facilities ultimately discharge to stormwater BMPs or water quality facilities, and only when approved by the Township Engineer.

B. Roof drains and sump pumps shall not discharge water directly onto a sidewalk, walkway, trail, or street and shall be constructed to discharge to a dry well/seepage pit or above ground entirely on the subject property Sump pump and roof drain discharge pipes shall not extend beyond the building envelope for the lot unless they are directly connected to an infiltration facility, detention basin, storm sewer pipe or as approved by the Township.

§ 129-47. Waste Disposal Prohibitions.

No person shall throw, deposit, leave, maintain, keep, or permit to be thrown, deposited, left, or maintained, in or upon any public or private property, driveway, parking area, street, alley, sidewalk, or other component of the Township's Municipal 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. Waste or recycling deposited in proper receptacles for the purposes of collection is exempted from this prohibition.

§ 129-48. Alteration of SWM BMPs.

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

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

ARTICLE IX. ENFORCEMENT AND PENALTIES

§ 129-49. Right-of-Entry.

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

§ 129-50. Notification.

In the event that a person fails to comply with the requirements of this Chapter, 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 Chapter. All such penalties shall be deemed cumulative. In addition the Township may pursue any and all other remedies available under state or federal law. It shall be the responsibility of the owner of the real property on which any regulated activity is proposed to occur, is occurring, or has occurred, to comply with the terms and conditions of this Chapter. 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.

§ 129-51. Enforcement.

Worcester Township is hereby authorized and directed to enforce all of the provisions of this Chapter. All inspections regarding compliance with the Stormwater Management Site Plan or Simplified Stormwater Management Site Plan shall be the responsibility of the Township Engineer or other qualified persons designated by the Township.

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

B. Adherence to approved plan. It shall be unlawful for any person to undertake any regulated activity under § 129-4 on any property except as provided for in the approved Stormwater Management Site Plan or Simplified Stormwater Management Site Plan and pursuant to the requirements of this Chapter. It shall be unlawful to alter or remove any control structure required by the Plan pursuant to this Chapter or to allow the property to remain in a condition which does not conform to the approved Plan.

C. Suspension and revocation of permits

(1) Any permit issued under this Chapter may be suspended or revoked by the Township for:

(a) Noncompliance with, or failure to, implement any provision of the permit.

(b) A violation of any provision of this Chapter 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 VIII of this Chapter.

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

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

(b) The violation of the Ordinance, law, or rule and regulation has been corrected.

(3) A permit that has been revoked cannot be reinstated. The applicant may apply for a new permit under the procedures outlined in this Chapter.

(4) The decision to suspend or revoke a permit may be appealed to the Board of Supervisors within thirty (30) days of the date of suspension or revocation.

§ 129-52. Violations Deemed a Public Nuisance.

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

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

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

(1) The performance of monitoring, analyses, and reporting;

(2) The elimination of prohibited discharges;

(3) Cessation of any violative discharges, practices, or operations;

(4) The abatement or remediation of stormwater pollution or contamination hazards and the restoration of any affected property;

(5) Reimbursement to Worcester Township to cover administrative and remediation costs;

(6) The implementation of stormwater BMPs to correct a violation or prevent future violations; and

(7) Operation and maintenance of approved stormwater BMPs.

D. Failure to comply within the time specified shall also subject such person to the penalty provisions of this Chapter. All such penalties shall be deemed cumulative and shall not prevent Worcester Township from pursuing any and all other remedies available in law or equity.

§ 129-53. Penalties.

A. Anyone violating the provisions of this Chapter shall be guilty of a summary offense, and upon conviction shall be subject to a fine of not more than $1,000 for each violation, recoverable with costs, or imprisonment of not more than 10 days, or both. Each day that the violation continues shall be a separate offense.

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

§ 129-54. Appeals.

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

B. Any person aggrieved by a decision of the Supervisors may appeal to the Montgomery County Court of Common Pleas within thirty (30) days of the date of the decision.

APPENDIX A

STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE A-1
DESIGN STORM RAINFALL AMOUNT (INCHES)
Graterford 1E Gage (36-3437)
Source: NOAA Atlas 14 website

FIGURE A-1
ATLAS 14 TYPE II S-CURVES FOR ALL FREQUENCY STORMS (INCHES)
Graterford 1E Gage (36-3437)
Source: NOAA Atlas 14 website

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

TABLE A-3
DESIGN STORM RAINFALL AMOUNT (INCHES PER HOUR)
Graterford 1E Gage (36-3437)
Source: NOAA Atlas 14 website

FIGURE A-2
ATLAS 14 TYPE II S-CURVES FOR ALL FREQUENCY STORMS (INCHES PER HOUR)
Graterford 1E Gage (36-3437)

TABLE A-4
RATIONAL RUNOFF COEFFICIENTS
Source: Rawls et al, 1981

TABLE A-5
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/pfds_map_cont.html?bkmrk=pa

Point Precipitation Frequency Estimates (inches)
Graterford 1E Gage (36-3437)

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]										
	Average recurrence interval (years)									
Duration	**1**	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	0.339 (0.311-0.370)	0.403 (0.370-0.440)	0.472 (0.431-0.515)	0.520 (0.475-0.567)	0.576 (0.524-0.627)	0.614 (0.555-0.668)	0.650 (0.586-0.708)	0.682 (0.611-0.744)	0.716 (0.637-0.783)	0.741 (0.655-0.812)
10-min	0.541 (0.497-0.591)	0.645 (0.591-0.704)	0.756 (0.691-0.824)	0.832 (0.760-0.907)	0.918 (0.834-1.00)	0.978 (0.884-1.07)	1.03 (0.931-1.13)	1.08 (0.968-1.18)	1.13 (1.01-1.24)	1.17 (1.03-1.28)
15-min	0.677 (0.621-0.739)	0.811 (0.743-0.885)	0.956 (0.874-1.04)	1.05 (0.961-1.15)	1.16 (1.06-1.27)	1.24 (1.12-1.35)	1.31 (1.18-1.42)	1.36 (1.22-1.49)	1.43 (1.27-1.56)	1.46 (1.30-1.61)
30-min	0.928 (0.851-1.01)	1.12 (1.03-1.22)	1.36 (1.24-1.48)	1.52 (1.39-1.66)	1.72 (1.57-1.88)	1.86 (1.69-2.03)	2.00 (1.80-2.18)	2.12 (1.90-2.32)	2.27 (2.02-2.48)	2.37 (2.10-2.60)
60-min	1.16 (1.06-1.26)	1.41 (1.29-1.53)	1.74 (1.59-1.90)	1.99 (1.81-2.17)	2.30 (2.09-2.50)	2.53 (2.28-2.75)	2.75 (2.48-3.00)	2.98 (2.67-3.25)	3.26 (2.89-3.56)	3.46 (3.06-3.80)
2-hr	1.37 (1.24-1.51)	1.66 (1.51-1.83)	2.07 (1.88-2.28)	2.38 (2.16-2.62)	2.79 (2.51-3.06)	3.12 (2.79-3.42)	3.44 (3.06-3.77)	3.76 (3.33-4.13)	4.20 (3.67-4.62)	4.52 (3.92-4.98)
3-hr	1.49 (1.35-1.65)	1.81 (1.64-2.00)	2.26 (2.04-2.50)	2.60 (2.34-2.87)	3.05 (2.74-3.37)	3.40 (3.04-3.75)	3.76 (3.34-4.14)	4.12 (3.62-4.54)	4.59 (3.99-5.07)	4.95 (4.27-5.48)
6-hr	1.86 (1.69-2.07)	2.25 (2.04-2.50)	2.79 (2.53-3.10)	3.24 (2.92-3.58)	3.85 (3.45-4.25)	4.34 (3.86-4.78)	4.86 (4.29-5.35)	5.40 (4.71-5.93)	6.14 (5.28-6.76)	6.72 (5.71-7.42)
12-hr	2.26 (2.06-2.53)	2.73 (2.48-3.05)	3.41 (3.09-3.80)	3.98 (3.59-4.43)	4.80 (4.29-5.31)	5.48 (4.85-6.05)	6.21 (5.45-6.86)	7.00 (6.06-7.73)	8.13 (6.91-8.99)	9.06 (7.58-10.0)
24-hr	2.66 (2.44-2.92)	3.21 (2.93-3.52)	4.02 (3.67-4.41)	4.69 (4.28-5.14)	5.67 (5.14-6.19)	6.49 (5.85-7.07)	7.37 (6.61-8.02)	8.32 (7.42-9.05)	9.70 (8.55-10.5)	10.8 (9.47-11.8)
2-day	3.09 (2.82-3.40)	3.72 (3.39-4.11)	4.68 (4.26-5.16)	5.45 (4.95-6.00)	6.54 (5.91-7.19)	7.44 (6.70-8.17)	8.40 (7.52-9.22)	9.42 (8.37-10.3)	10.9 (9.57-11.9)	12.1 (10.5-13.2)
3-day	3.26 (2.98-3.58)	3.92 (3.59-4.32)	4.91 (4.49-5.40)	5.71 (5.20-6.27)	6.84 (6.21-7.50)	7.78 (7.02-8.51)	8.76 (7.87-9.59)	9.81 (8.76-10.7)	11.3 (10.0-12.4)	12.5 (11.0-13.7)
4-day	3.43 (3.14-3.75)	4.13 (3.78-4.52)	5.15 (4.71-5.64)	5.98 (5.46-6.54)	7.15 (6.50-7.80)	8.11 (7.35-8.85)	9.13 (8.23-9.95)	10.2 (9.15-11.1)	11.7 (10.4-12.8)	13.0 (11.4-14.2)
7-day	3.99 (3.69-4.35)	4.79 (4.43-5.21)	5.91 (5.46-6.43)	6.83 (6.29-7.42)	8.14 (7.47-8.83)	9.22 (8.43-9.99)	10.4 (9.43-11.2)	11.6 (10.5-12.5)	13.3 (11.9-14.4)	14.7 (13.1-15.9)
10-day	4.53 (4.21-4.89)	5.41 (5.03-5.84)	6.59 (6.12-7.11)	7.53 (6.98-8.12)	8.85 (8.17-9.53)	9.90 (9.12-10.7)	11.0 (10.1-11.8)	12.1 (11.1-13.1)	13.7 (12.4-14.8)	14.9 (13.5-16.1)
20-day	6.12 (5.69-6.58)	7.26 (6.75-7.80)	8.65 (8.05-9.30)	9.75 (9.05-10.5)	11.2 (10.4-12.0)	12.4 (11.4-13.3)	13.5 (12.5-14.5)	14.7 (13.5-15.8)	16.3 (14.9-17.5)	17.4 (15.9-18.8)
30-day	7.62 (7.17-8.09)	8.97 (8.44-9.52)	10.5 (9.83-11.1)	11.6 (10.9-12.3)	13.1 (12.3-13.9)	14.2 (13.3-15.1)	15.3 (14.3-16.3)	16.4 (15.3-17.5)	17.8 (16.5-19.0)	18.9 (17.5-20.1)
45-day	9.67 (9.16-10.2)	11.3 (10.8-12.0)	13.0 (12.3-13.8)	14.3 (13.5-15.1)	15.9 (15.0-16.8)	17.1 (16.1-18.1)	18.2 (17.2-19.2)	19.2 (18.1-20.3)	20.5 (19.3-21.7)	21.5 (20.1-22.7)
60-day	11.6 (11.0-12.2)	13.6 (12.9-14.3)	15.5 (14.7-16.3)	16.9 (16.0-17.8)	18.7 (17.7-19.7)	19.9 (18.9-21.0)	21.1 (20.0-22.3)	22.2 (21.0-23.5)	23.6 (22.2-24.9)	24.5 (23.1-25.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
Please refer to NOAA Atlas 14 document for more information.

FIGURE A-1

Atlas 14 Type II S-Curves for All Frequency Storms – Graterford 1E Gage (36-3437)

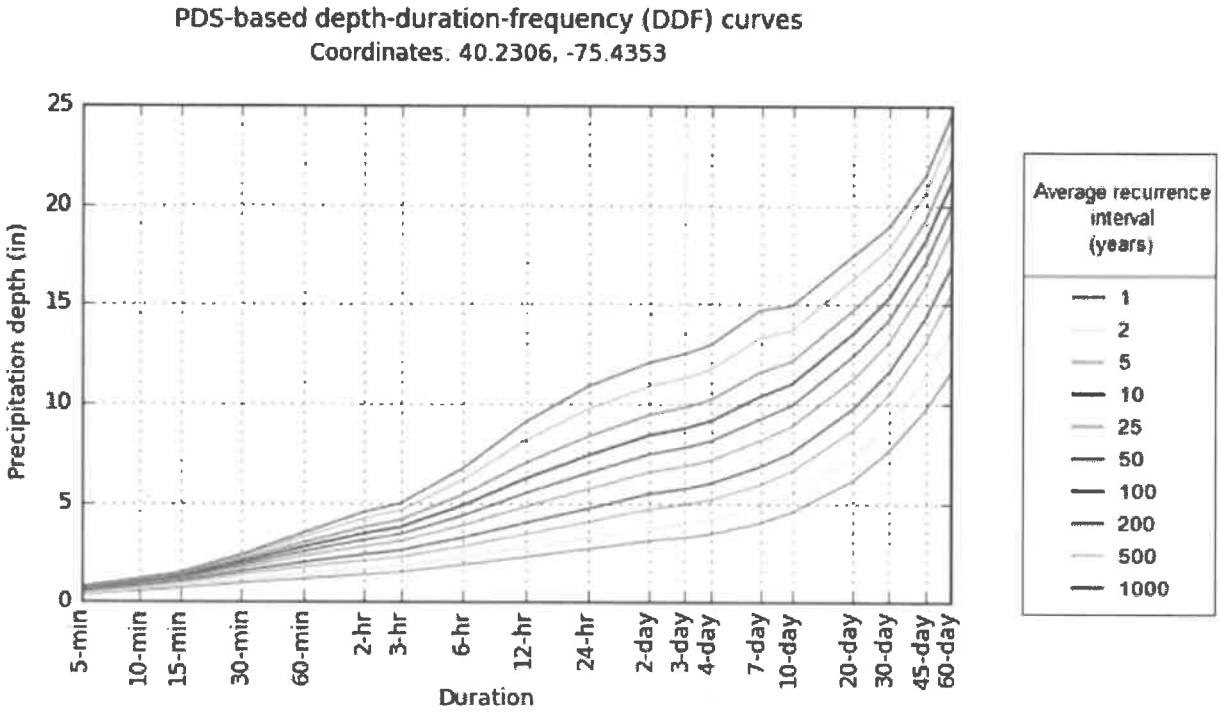


TABLE A-2

RUNOFF CURVE NUMBERS
Source: 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-3

DESIGN STORM RAINFALL AMOUNT (INCHES PER HOUR)

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/pfds_map_cont.html?bkmrk=pa

Point Precipitation Frequency Estimates (inches per hour)
Graterford 1E Gage (36-3437)

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]										
Duration	Average recurrence interval (years)									
	1	**2**	**5**	**10**	**25**	**50**	**100**	**200**	**500**	**1000**
5-min	4.07 (3.73-4.44)	4.84 (4.44-5.28)	5.66 (5.17-6.18)	6.24 (5.70-6.80)	6.91 (6.29-7.52)	7.37 (6.66-8.02)	7.80 (7.03-8.50)	8.18 (7.33-8.93)	8.59 (7.64-9.40)	8.89 (7.86-9.74)
10-min	3.25 (2.98-3.55)	3.87 (3.55-4.22)	4.54 (4.15-4.94)	4.99 (4.56-5.44)	5.51 (5.00-6.00)	5.87 (5.30-6.39)	6.20 (5.59-6.76)	6.48 (5.81-7.07)	6.80 (6.04-7.43)	7.00 (6.19-7.67)
15-min	2.71 (2.48-2.96)	3.24 (2.97-3.54)	3.82 (3.50-4.17)	4.21 (3.84-4.59)	4.66 (4.23-5.07)	4.95 (4.48-5.39)	5.22 (4.70-5.69)	5.45 (4.88-5.95)	5.70 (5.07-6.24)	5.86 (5.18-6.42)
30-min	1.86 (1.70-2.03)	2.24 (2.05-2.45)	2.72 (2.48-2.96)	3.05 (2.78-3.33)	3.45 (3.13-3.75)	3.73 (3.37-4.06)	4.00 (3.60-4.36)	4.24 (3.80-4.63)	4.54 (4.03-4.96)	4.74 (4.19-5.20)
60-min	1.16 (1.06-1.26)	1.41 (1.29-1.53)	1.74 (1.59-1.90)	1.99 (1.81-2.17)	2.30 (2.09-2.50)	2.53 (2.28-2.75)	2.75 (2.48-3.00)	2.98 (2.67-3.25)	3.26 (2.89-3.56)	3.46 (3.06-3.80)
2-hr	0.684 (0.622-0.754)	0.830 (0.755-0.914)	1.03 (0.938-1.14)	1.19 (1.08-1.31)	1.40 (1.26-1.53)	1.56 (1.39-1.71)	1.72 (1.53-1.89)	1.88 (1.66-2.07)	2.10 (1.83-2.31)	2.26 (1.96-2.49)
3-hr	0.497 (0.451-0.550)	0.602 (0.546-0.666)	0.751 (0.680-0.831)	0.865 (0.781-0.955)	1.02 (0.911-1.12)	1.13 (1.01-1.25)	1.25 (1.11-1.38)	1.37 (1.21-1.51)	1.53 (1.33-1.69)	1.65 (1.42-1.82)
6-hr	0.311 (0.283-0.345)	0.375 (0.341-0.417)	0.467 (0.423-0.517)	0.541 (0.488-0.598)	0.643 (0.576-0.709)	0.725 (0.645-0.799)	0.811 (0.716-0.893)	0.901 (0.787-0.991)	1.03 (0.882-1.13)	1.12 (0.953-1.24)
12-hr	0.188 (0.171-0.210)	0.227 (0.206-0.253)	0.283 (0.257-0.315)	0.330 (0.298-0.368)	0.398 (0.356-0.441)	0.455 (0.403-0.502)	0.515 (0.452-0.570)	0.581 (0.503-0.642)	0.675 (0.573-0.746)	0.752 (0.629-0.831)
24-hr	0.111 (0.102-0.122)	0.134 (0.122-0.147)	0.167 (0.153-0.184)	0.196 (0.178-0.214)	0.236 (0.214-0.258)	0.270 (0.244-0.295)	0.307 (0.275-0.334)	0.347 (0.309-0.377)	0.404 (0.356-0.439)	0.452 (0.394-0.491)
2-day	0.064 (0.059-0.071)	0.078 (0.071-0.086)	0.097 (0.089-0.108)	0.113 (0.103-0.125)	0.136 (0.123-0.150)	0.155 (0.140-0.170)	0.175 (0.157-0.192)	0.196 (0.174-0.215)	0.226 (0.199-0.248)	0.251 (0.220-0.275)
3-day	0.045 (0.041-0.050)	0.055 (0.050-0.060)	0.068 (0.062-0.075)	0.079 (0.072-0.087)	0.095 (0.086-0.104)	0.108 (0.098-0.118)	0.122 (0.109-0.133)	0.136 (0.122-0.149)	0.157 (0.139-0.172)	0.174 (0.153-0.190)
4-day	0.036 (0.033-0.039)	0.043 (0.039-0.047)	0.054 (0.049-0.059)	0.062 (0.057-0.068)	0.074 (0.068-0.081)	0.084 (0.077-0.092)	0.095 (0.086-0.104)	0.106 (0.095-0.116)	0.122 (0.109-0.133)	0.135 (0.119-0.148)
7-day	0.024 (0.022-0.026)	0.028 (0.026-0.031)	0.035 (0.032-0.038)	0.041 (0.037-0.044)	0.048 (0.044-0.053)	0.055 (0.050-0.059)	0.062 (0.056-0.067)	0.069 (0.062-0.075)	0.079 (0.071-0.086)	0.088 (0.078-0.095)
10-day	0.019 (0.018-0.020)	0.023 (0.021-0.024)	0.027 (0.025-0.030)	0.031 (0.029-0.034)	0.037 (0.034-0.040)	0.041 (0.038-0.044)	0.046 (0.042-0.049)	0.051 (0.046-0.054)	0.057 (0.052-0.061)	0.062 (0.056-0.067)
20-day	0.013 (0.012-0.014)	0.015 (0.014-0.016)	0.018 (0.017-0.019)	0.020 (0.019-0.022)	0.023 (0.022-0.025)	0.026 (0.024-0.028)	0.028 (0.026-0.030)	0.031 (0.028-0.033)	0.034 (0.031-0.036)	0.036 (0.033-0.039)
30-day	0.011 (0.010-0.011)	0.012 (0.012-0.013)	0.015 (0.014-0.015)	0.016 (0.015-0.017)	0.018 (0.017-0.019)	0.020 (0.018-0.021)	0.021 (0.020-0.023)	0.023 (0.021-0.024)	0.025 (0.023-0.026)	0.026 (0.024-0.028)
45-day	0.009 (0.008-0.009)	0.011 (0.010-0.011)	0.012 (0.011-0.013)	0.013 (0.013-0.014)	0.015 (0.014-0.016)	0.016 (0.015-0.017)	0.017 (0.016-0.018)	0.018 (0.017-0.019)	0.019 (0.018-0.020)	0.020 (0.019-0.021)
60-day	0.008 (0.008-0.008)	0.009 (0.009-0.010)	0.011 (0.010-0.011)	0.012 (0.011-0.012)	0.013 (0.012-0.014)	0.014 (0.013-0.015)	0.015 (0.014-0.015)	0.015 (0.015-0.016)	0.016 (0.015-0.017)	0.017 (0.016-0.018)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
Please refer to NOAA Atlas 14 document for more information.

FIGURE A-2

Atlas 14 Type II S-Curves for All Frequency Storms – Graterford 1E Gage (36-3437)

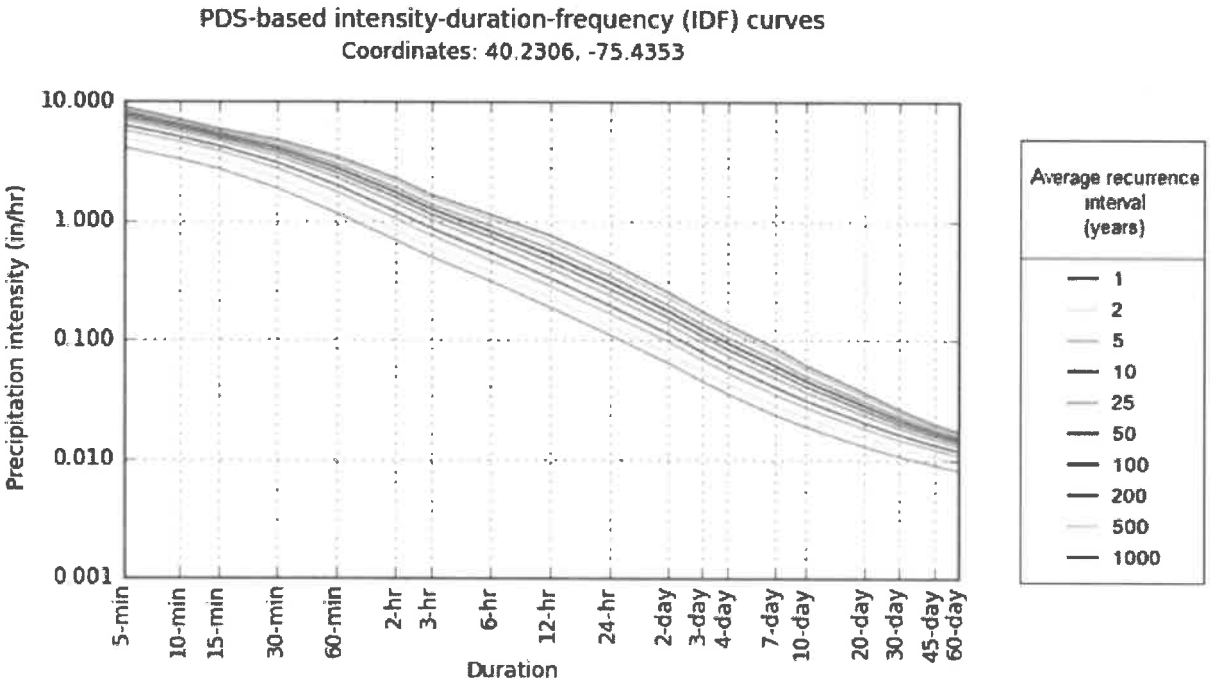


TABLE A-4

RATIONAL RUNOFF COEFFICIENTS
By Hydrologic Soils Group and Overland Slope (%)
Source: Rawls, et al, 1981

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

NOTES:
* Runoff coefficients for storm recurrence intervals of less than 25 years.
** Runoff coefficients for storm recurrence intervals of 25 years or more.

TABLE A-5

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 SOIL EVALUATION AND SOIL INFILTRATION TESTING

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

SITE SOIL EVALUATION AND SOIL INFILTRATION TESTING

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**:

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

With: d_1 = Initial Water Depth (in.)
Δd = 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.*

APPENDIX C

WEST NILE VIRUS GUIDANCE

Source: Monroe County, Pennsylvania, Conservation District: Stormwater Management and West Nile Virus: Brodhead McMichaels Creeks Watershed Act 167 Stormwater Management Ordinance Final Draft 2/23/04.

WEST NILE VIRUS GUIDANCE

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 due to 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 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 outweigh their potential to become breeding grounds for mosquitoes.

APPENDIX D

STORMWATER MANAGEMENT FACILITIES OPERATION AND MAINTENANCE AGREEMENT

Stormwater Management Facilities
Operation and Maintenance Agreement

THIS AGREEMENT, made and entered into this _____day of _____, 20____, by and between _____, (hereinafter the "Owner"), and Worcester Township, Montgomery County; Pennsylvania, (hereinafter "Township");

WITNESSETH

WHEREAS, the Owner is the owner of certain real property located in Worcester Township, Montgomery County, Pennsylvania (TMP #_____ as recorded by deed in the land records of Montgomery County, Pennsylvania, Deed Book _____at Page _____) (hereinafter "Property"), on which it intends to develop _____ (hereinafter "Development") in accordance with a plan titled _____, dated_____, 20____, and last revised _____, 20____ (hereinafter "Plan"). The Plan is attached to this agreement and marked "Exhibit A"; and

WHEREAS, for the purposes of this agreement, the following definition shall apply: "Best Management Practices" (hereinafter "BMPs") - Activities, facilities, designs, measures, or procedures used to manage stormwater impacts from regulated activities, to meet state water quality requirements, to promote groundwater recharge, and to otherwise meet the purposes of the Worcester Township Stormwater Management Ordinance. Stormwater BMPs are commonly grouped into one of two categories: "structural" or "nonstructural." Nonstructural BMPs or measures refer to operational 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 retention ponds and constructed wetlands, underground treatment systems, infiltration facilities, filter strips, low impact design, bioretention, wet ponds, permeable paving, grassed swales, riparian or forested buffers, rain gardens, sand filters, detention basins, and manufactured devices. Structural stormwater BMPs are permanent appurtenances to the project site; and

WHEREAS, Township and Owner agree that the health, safety, and welfare of the residents of the Township require that on-site stormwater management facilities/BMPs (hereinafter "Stormwater Management Facilities") be constructed and maintained on the Property; and

WHEREAS, Township requires, through the implementation of the Stormwater Management Site Plan (hereinafter "Plan") as approved by Township, that Stormwater Management Facilities as required

by the Plan and Worcester Township Stormwater Management Ordinance be constructed and adequately operated and maintained by Owner, and replaced at the end of the facility's lifespan; and

WHEREAS, Owner is required to and intends to install and maintain the Stormwater Management Facilities in accordance with the Plan and the conditions of approval by Worcester Township; and

WHEREAS, Owner is proceeding to build and develop the Property with certain improvements, including the installation of certain Stormwater Management Facilities, including but not limited to components to control the quantity and quality of stormwater discharge within the confines of the Property, all as depicted on the Plan.

NOW, THEREFORE, in consideration of the foregoing premises, Owner, for itself, its successors-in-interest, successors-in-title, grantees and assigns, intending to be legally bound hereby, hereby covenants, declares, agrees, confirms and provides as follows:

1. Inspection, Maintenance and Replacement. Owner shall continuously and perpetually inspect, maintain and/or replace the Stormwater Management Facilities in accordance with the conditions of project approval, the Plan, and with manufacturer's specifications. In addition, Owner shall do the following:

   A. Twelve (12) months after the Stormwater Management Facilities are accepted by Township as complete, Owner will inspect same in accordance with Sections 1.B.1 through 1.B.5, below, as applicable.

   B. Routine maintenance shall be performed after a major rainfall event of 4.75 inches of rainfall or more in a 24-hour period (equivalent of a 10-year frequency storm) as follows:

      (1) Runoff collection inlets, drains, gutters and downspouts shall be kept clear of accumulated debris such as leaves, grass clippings, sticks and trash.

      (2) Outflow control structures shall be inspected to ensure they are free and clear of debris and are structurally intact. Any debris shall be cleared immediately. If structural failures or leaks exist, Owner shall contact Township immediately to report the problem, receive instructions on how to correct the problem and schedule an inspection for the necessary repair work. Surface stormwater management basins shall drain and return to normal conditions within 12 hours of the termination of the rainfall event.

      (3) The basin Impoundment devices (earthen berms, dams, or wet pond edges) shall be inspected for structural integrity, leaks and proper stabilization (adequate vegetation). If structural failures or leaks exist, Owner shall contact Township immediately to report the problem, receive instructions on how to correct the problem and schedule an inspection for the necessary repair work.

      (4) Impoundment areas shall be inspected for debris, accumulated sediments and inadequate vegetation/erosion. All sediments and debris shall be removed promptly and the impoundment area shall be maintained in a stable condition (adequate vegetation or other permanent surface stabilization).

      (5) Runoff collection inlets located close to and within underground infiltration/seepage beds/basins shall be inspected. The standing water in an

underground basin shall drain in 48 hours or less. If collection inlets within the underground bed/basin do not drain, Owner shall contact Township immediately to report such a problem, receive instructions on how to correct the problem and schedule an inspection for the necessary repair work.

C. At least once every three (3) years, Owner shall perform a complete inspection of Stormwater Management Facilities. This inspection shall occur immediately following a significant rainfall event and shall include, at a minimum, monitoring of stormwater impoundment areas (underground and surface basins) to confirm that the system is draining and returning to normal conditions in less than 48 hours for underground basins and 12 hours for surface basins. The date, time and corresponding total rainfall amount shall be documented as part of the inspection.

D. Owner shall all submit inspection reports to the Township, including a description of the inspections and maintenance activities performed during the required inspection term. If the Stormwater Management Facilities malfunctioned during the inspection term, the report shall include photographic evidence of the malfunction and subsequent repair. The report shall be submitted to the Township not later than February 1st of the year following the end of the three (3) year inspection term.

E. All materials collected by the Stormwater Management Facilities, including but not limited to oil and sediment, shall be disposed of in accordance with PADEP, US EPA and any other applicable regulations. The inspection report to be submitted at the end of each three (3) year inspection term shall include a list of all materials disposed and certification of regulatory compliance with disposal requirements, where applicable.

F. If a Stormwater Management Facility malfunctions, Township shall be notified in writing within 10 days of the discovery of the malfunction. All maintenance, repairs or modifications shall be made in accordance with the specifications of the manufacturer or designer of the structure and as shown on the Plan. If a repair or modification is not made pursuant to manufacturer or designer's specifications and/or Plan, said repair or modification shall be approved in writing by the manufacturer or designer and Township. The maintenance and repair of malfunctioning facilities shall be completed within 30 days of discovery of the malfunction, or immediately upon discovery if the malfunction poses a threat to the public health or safety as determined by Township.

G. Township reserves the right to require the installation of additional SWM structures if the facilities as designed do not function properly, to insure that the Stormwater Management Facility(s) conforms to the intent of the Plan approved by Township.

2. Prohibition of Alteration or Removal. Owner shall not alter or remove any Stormwater Management Facility depicted on the Plan unless prior written approval is obtained from Township.

3. Township Inspection. Owner hereby grants permission to Township, its authorized agents and employees, to enter upon the Property at reasonable times and upon presentation of proper identification, to inspect the Stormwater Management Facilities whenever necessary. Whenever possible, Township shall notify Owner prior to entering the Property.

4. Fees & Securities. Owner hereby agrees to pay any fee established by the Township to provide for the reviews and other inspections conducted by the Township Engineer, and the Owner agrees to post any required securities permitted under Township Code or other law.

5. Failure to Maintain Facilities. In the event that Owner fails to operate and maintain the Stormwater Management Facilities as shown on the Plan in good working order acceptable to Township, Township or its representatives may enter upon the Property and take whatever action is deemed necessary to maintain said facilities. This provision shall not be construed to allow Township to erect any permanent structure on Owner's Property. It is expressly understood and agreed that Township is under no obligation to maintain or repair the Stormwater Management Facilities, and in no event shall this Agreement be construed to impose any such obligation on Township.

6. Township Maintenance Reimbursement. In the event that Township, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, Owner shall reimburse Township for all such expenses (direct and indirect) incurred within thirty (30) calendar days of receipt of invoice from Township. If the Township is not reimbursed the Township is authorized to register a lien against the property for the amount to be reimbursed plus all associated legal and other costs.

7. Liability. This Agreement shall not be deemed to create or affect any additional liability of any party for damage alleged to result from or be caused by stormwater runoff from the Property.

8. Township Indemnification. Owner, its heirs, executors, administrators, and assigns, hereby releases Township, its employees and designated representatives, from all damages, casualties, occurrences or claims (including reasonable attorneys' fees) arising from the construction, presence, existence, or maintenance of the Stormwater Management Facilities by Owner or Township, unless caused by the negligence or malfeasance of Township, its employees or designated representatives.

9. Default; Cure. In the event that Owner fails to comply with the terms of this Agreement, Township shall send written notice to Owner specifying the areas of noncompliance ("Deficiencies") and the steps that must be taken to comply. In the event that Owner does not comply with the terms of the notice within 30 days of the date thereof, or diligently pursue compliance in circumstances where compliance is not possible within 30, Township shall have the right, but not the obligation, to enforce this Agreement at law or in equity, and/or to enter upon the Property and correct the Deficiencies, and collect the cost thereof from Owner by municipal lien against the Property or otherwise.

10. Use and Occupancy Permit. The requirements of this Agreement are part of the conditions for issuance of Township's Use and Occupancy Permit for the improvements depicted on the Plan. Should Owner fail to comply with the requirements of this Agreement, Township reserves the right to revoke the Use and Occupancy Permit after providing the Deficiencies notice and after the cure period as set forth in Paragraph 4 above.

11. Covenants Running With the Land; Successors and Assigns Bound. This Agreement and the provisions hereof (1) shall run with the land, and be appurtenant to title to the Property and every portion thereof; and (2) shall be binding upon and inure to the benefit of Owner, and each and all of its respective heirs, successors and assigns, and successors in title to the Property and every portion thereof. Any and all conveyances, leases or encumbrances of any part of the Property shall be subject to the provisions hereof.

12. Recording. This Agreement shall be recorded in the Office of the Recorder of Deeds of Montgomery County, Pennsylvania.

13. Notices; Entry. Any notice required to be given by Township to Owner under the terms of this Agreement shall be sufficiently given if sent by United States certified mail, return receipt requested, postage prepaid, addressed to the then owner of the Property and to the address as set forth in the records for the Property maintained by the Montgomery County Board of Assessment. In the event of an emergency or the occurrence of special or unusual circumstances or situations, Township may enter the Property, if the Owner 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 in jeopardy. Township shall notify Owner of any such inspection, maintenance, or repair undertaken within five days of the activity. Owner shall reimburse Township for its costs.

14. Future Dedication of Stormwater Management Facilities. Worcester Township reserves the right, but is not required, to accept the ownership of any or all of the Stormwater Management Facilities shown on the Plan at any time, pursuant to Section 129-38 of Chapter 129 (Stormwater Management Ordinance) of the Worcester Township Code.

15. Miscellaneous Provisions.

A. Severability. If any provision of this Agreement shall to any extent be invalid or unenforceable, the remainder of this Agreement (or the application of such provision to persons or circumstances other than those in respect of which it is invalid or unenforceable) shall not be affected thereby, and each provision of this Agreement, unless specifically conditioned upon such invalid or unenforceable provision, shall be valid and enforceable to the fullest extent permitted by law.

B. Amendment. This Agreement may not be amended except by written instrument signed and acknowledged by Owner, and Township and recorded in the Office of the Recorder of Deeds of Montgomery County, Pennsylvania.

C. Governing Laws. This Agreement shall be construed and governed by the laws of the Commonwealth of Pennsylvania.

D. Integration. This Agreement sets forth the entire agreement between Owner and Township with respect to the subject matter hereof.

IN WITNESS WHEREOF, being duly authorized and empowered to do so, Owner and Township have duly executed and delivered this Agreement as of the date and year first above written.

WITNESS:

OWNER:

_____
For Owner

By:_____
Owner

OWNER:

By:_____
Owner

Worcester Township executes this Agreement to acknowledge its rights and obligations set forth above.

(SEAL)

WORCESTER TOWNSHIP:

By:_____
Township Manager

Attest:_____

COMMONWEALTH OF PENNSYLVANIA :
: ss
COUNTY OF MONTGOMERY :

On this, the _____ day of _____, 20_____, before, the undersigned notary public, personally appeared _____ and _____ who acknowledged themselves to be the owner(s), respectively, of _____ and as such they did sign the foregoing instrument for the purposes therein contained.

IN WITNESS WHEREOF, I hereunto set my hand and official seal.

(Notarial Seal)

_____
Notary Public

My Commission Expires:

COMMONWEALTH OF PENNSYLVANIA :
: ss
COUNTY OF MONTGOMERY :

On this, the _____ day of _____, 20____, before, the undersigned notary public, personally appeared _____who acknowledged himself/herself to be the Manager of Worcester Township, Montgomery County, Pennsylvania, and as such he/she did sign the foregoing instrument on behalf of Worcester Township, for the purposes therein contained.

IN WITNESS WHEREOF, I hereunto set my hand and official seal.

(Notarial Seal)

_____
Notary Public

My Commission Expires:

APPENDIX E
SIMPLIFIED STORMWATER MANAGEMENT SITE PLAN (SSMSP)

This simplified stormwater management site plan has been developed to assist those applicants whose projects propose between 1,200 and 7,500 square feet of new impervious surface and must meet the exemption requirements. This small project site plan is only permitted for projects as noted in Ordinance Section 129-5.

A. What is an applicant required to submit?

A brief description of the proposed stormwater facilities, including types of materials to be used, total square footage of proposed impervious areas, volume calculations, and a simple sketch plan showing the following information:

- 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.
- Montgomery County Conservation District erosion and sediment control "Adequacy" letter as required by Municipal, County or State regulations.

B. Determination of Required Volume Control and Sizing Stormwater Facilities

By following the simple steps outlined below in the provided example, an applicant can determine the runoff volume that is required to be controlled and how to choose the appropriate stormwater facility to permanently remove the runoff volume from the site. 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 impervious surfaces such as sidewalks, driveways, parking areas, patios or swimming pools.

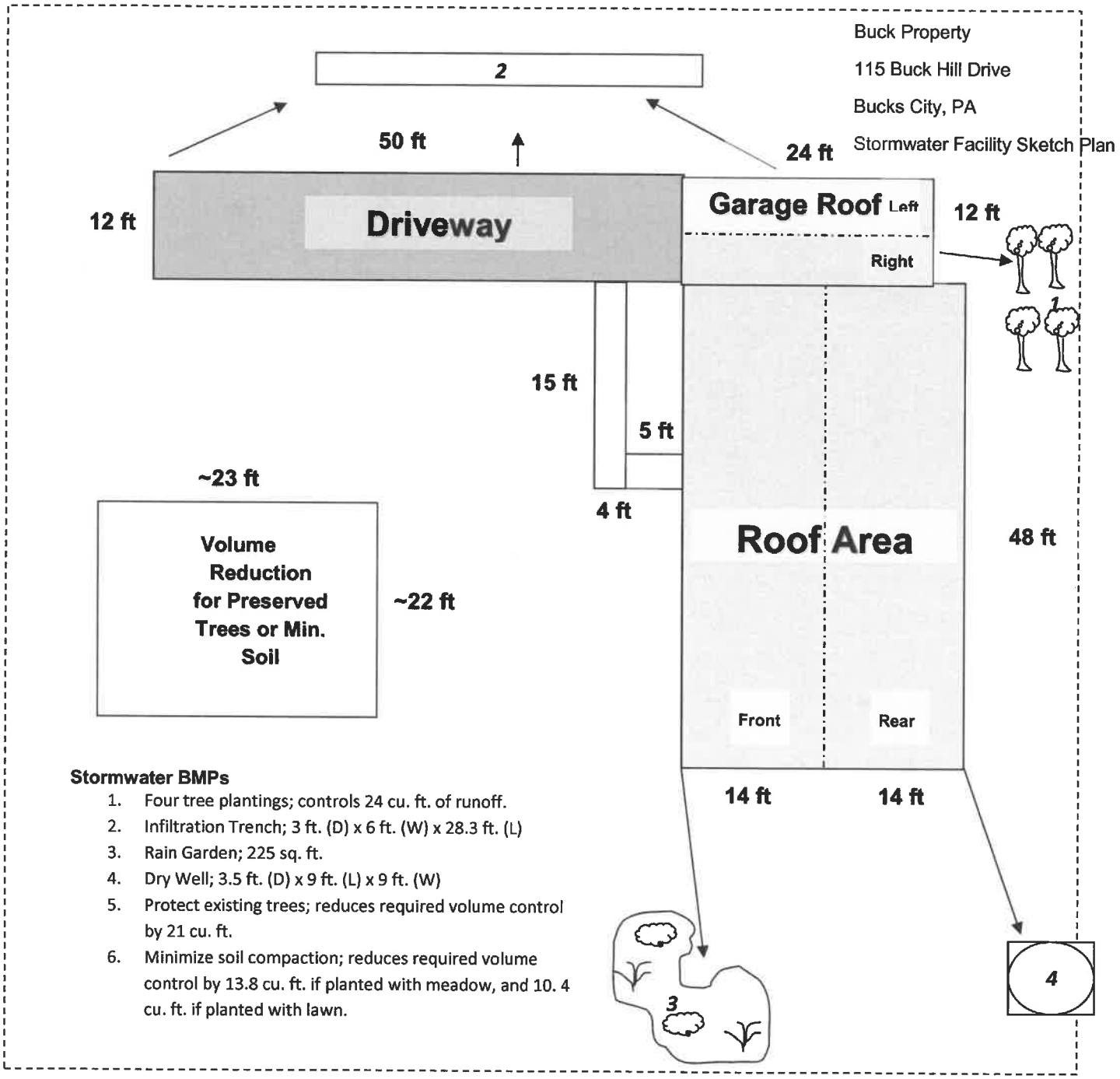
Site Plan Example: Controlling runoff volume from a proposed home site

Step 1: Determine Total Impervious Surfaces

Impervious Surface			**Area (sq. ft.)**
House Roof (Front)	14 ft. x 48 ft.	=	672 sq. ft.
House Roof (Rear)	14 ft. x 48 ft.	=	672 sq. ft.
Garage Roof (Left)	6ft. x 24 ft.	=	144 sq. ft.
Garage Roof (Right)	6 ft. x 24 ft.	=	144 sq. ft.
Driveway	12 ft. x 50 ft.	=	1000 sq. ft.
Walkway	4 ft. x 20 ft.	=	80 sq. ft.

	Total Impervious		3000 sq ft

Figure 1: Sample Site Sketch Plan



Stormwater BMPs

1. Four tree plantings; controls 24 cu. ft. of runoff.
2. Infiltration Trench; 3 ft. (D) x 6 ft. (W) x 28.3 ft. (L)
3. Rain Garden; 225 sq. ft.
4. Dry Well; 3.5 ft. (D) x 9 ft. (L) x 9 ft. (W)
5. Protect existing trees; reduces required volume control by 21 cu. ft.
6. Minimize soil compaction; reduces required volume control by 13.8 cu. ft. if planted with meadow, and 10. 4 cu. ft. if planted with lawn.

Step 2: Determine Required Volume Control (cubic feet) using the following equation:

Volume (cu. ft.) = (Total impervious area in square feet x 2 inches of runoff) /12 inches

(3,000 sq. ft. x 2 inches of runoff) /12 inches = 500 cu. ft.

Step 3: Sizing the Selected Volume Control BMP

Several Best Management Practices (BMPs), as described below, are suitable for small stormwater management projects. However, their application depends on the volume required to be controlled, how much land is available, and the site constraints. Proposed residential development activities can apply both non-structural and structural BMPs to control the volume of runoff from the site. A number of different volume control BMPs are described below. Note that Figure 1 is an example of how these BMPs can be utilized in conjunction to control the total required volume on one site. In addition, the applicant may utilize methods other than those recommended, upon approval by the Township Engineer. The examples given are commonly used, but other BMP measures may be acceptable.

Structural BMPs

Test pits are required at or near the proposed facility location. A note must be added to the plan that identifies that a responsible professional observed the test pits and soil conditions, and can verify that no unsuitable conditions, i.e. high groundwater table, bedrock, etc. exist. The depth of the pit must be at least a foot below the proposed depth of the infiltration trench, rain garden, etc.

1. Infiltration Trench

An Infiltration Trench is a linear stormwater BMP consisting of a continuously perforated pipe at a minimum slope in a stone-filled trench. During small storm events, infiltration trenches can significantly reduce volume and serve in the removal of fine sediments and pollutants. Runoff is stored between the stones and infiltrates through the bottom of the facility and into the soil matrix. Runoff should be pretreated using vegetative buffer strips or swales to limit the amount of coarse sediment entering the trench which can clog and render the trench ineffective. In the event that the Infiltration Trench is overwhelmed in an intense storm event, an overflow mechanism (riser with discharge pipe, connection to a larger infiltration area, etc.) will ensure that additional runoff is safely conveyed downstream.

Design Considerations:

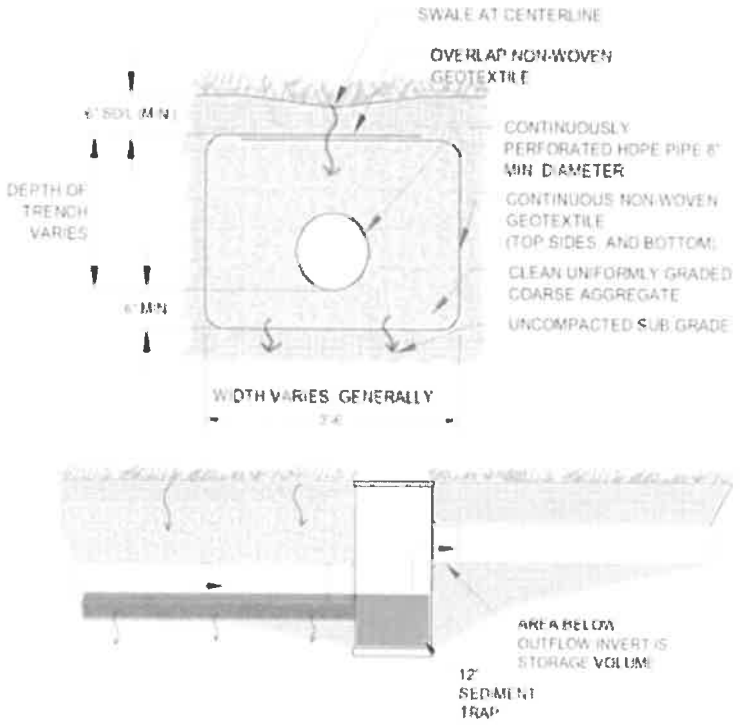
- Although the width and depth can vary, it is recommended that Infiltration Trenches be limited in depth to not more than six (6) feet of stone.
- Trench is wrapped in nonwoven geotextile (top, sides, and bottom).
- Trench needs to be placed on uncompacted soils.
- Slope of the Trench bottom should be level or with a slope no greater than 1%.
- A minimum of 6" of topsoil is placed over trench and vegetated.

- The discharge or overflow from the Infiltration Trench should be properly designed for anticipated flows.
- Cleanouts or inlets should be installed at both ends of the Infiltration Trench and at appropriate intervals to allow access to the perforated pipe.
- Volume of facility = Depth x Width x Length x Void Space of the gravel bed (assume 40%).

Maintenance:

- Catch basins and inlets should be inspected and cleaned at least two times a year.
- The vegetation along the surface of the infiltration trench should be maintained in good condition and any bare spots should be re-vegetated as soon as possible.
- Vehicles should not be parked or driven on the trench and care should be taken to avoid soil compaction by lawn mowers.

Figure 3: Infiltration Trench Diagram



Source: PA BMP Guidance Manual, Chapter 6, page 42.

Figure 4: Example of Infiltration Trench Installation

Source: PA BMP Guidance Manual, Chapter 6, Page 46.

Sizing Example for Infiltration Trench

1. Determine Total Impervious Surface to drain to Infiltration Trench:

Garage Roof (Left)	6 ft. x 24 ft.	=	144 sq ft
Driveway	12 ft. x 50 ft.	=	1000 sq ft
Walkway	4 ft. x 20 ft.	=	80 sq ft

2. Determine the required infiltration volume:

   (1224 sq. ft. x 2 inches of runoff)/12 ft. = 204 cu. ft. / 0.4* = 510 cu. ft.

   (*0.4 assumes 40% void ratio in gravel bed)

3. Sizing the infiltration trench facility:

   Volume of Facility = Depth x Width x Length

Set Depth to 3 feet and determine required surface area of trench.

510 cu. ft / 3 ft = 170 sq ft.

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

Determine trench length: L = 170 sq. ft. / 6 ft. = 28.3 ft.

Final infiltration trench dimensions: 3 ft. (D) x 6 ft. (W) x 28.3 ft. (L)

2. Rain Garden

A Rain Garden is a planted shallow depression designed to catch and filter rainfall runoff. The garden captures rain from a downspout or a paved surface. The water sinks into the ground, aided by deep rooted plants that like both wet and dry conditions. The ideal location for a rain garden is between the source of runoff (roofs and driveways) and the runoff destination (drains, stream, low spots, etc).

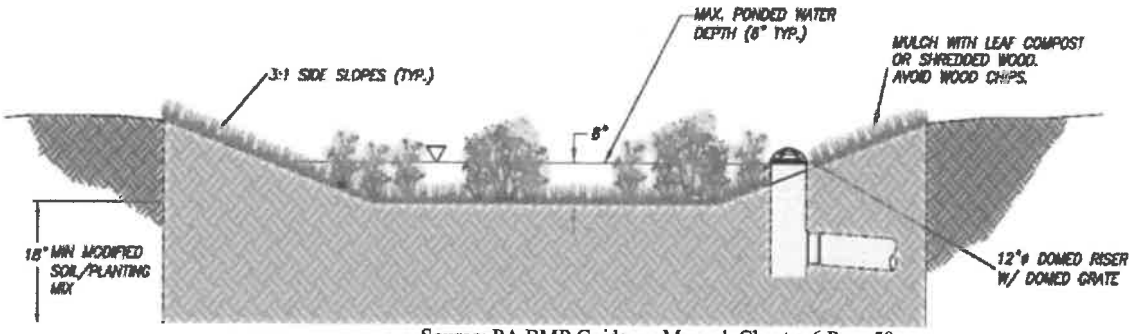
Design Considerations:

- A maximum of 3:1 side slope is recommended.
- The depth of a rain garden can range from 6 - 8 inches. Ponded water should not exceed 6 inches.
- The rain garden should drain within 72 hours.
- The garden should be at least 10-20 feet from a building's foundation and 25 feet from septic system drainfields and wellheads.
- If the site has clay soils, soil should be amended with compost or organic material.
- Choose native plants. See http://pa.audubon.org/habitat/PDFs/RGBrochure_complete.pdf for a native plant list. To find native plant sources go to www.pawildflower.org.
- At the rain garden location, the water table should be at least 2' below the soil level. If water stands in an area for more than one day after a heavy rain you can assume it has a higher water table and is not a good choice for a rain garden.
- Gravity overflow must be provided, i.e. riser with discharge pipe, for volume collected that exceeds the design volume.

Maintenance:

- Water plants regularly until they become established.
- Inspect twice a year for sediment buildup, erosion and vegetative conditions.
- Mulch with hardwood when erosion is evident and replenish annually.
- Prune and remove dead vegetation in the spring season.
- Weed as you would any garden.
- Move plants around if some plants would grow better in the drier or wetter parts of the garden.

Figure 5: Rain Garden Diagram



Source: PA BMP Guidance Manual, Chapter 6 Page 50

Sizing Example for Rain Garden

1. Pick a site for the rain garden between the source of runoff and between a low lying area, a.k.a., a drainage area.

2. Perform an infiltration test to determine the depth of the rain garden:
   - Dig a hole 8" x 8"
   - Fill with water and put a popsicle stick at the top of the water level.
   - Measure how far it drains down after a few hours (ideally 4).
   - Calculate the depth of water that will drain out over 24 hours.

3. Determine total impervious surface area to drain to rain garden:

House Roof (Front)	14 ft. x 48 ft.	=	672 sq ft

4. Sizing the rain garden:

For this example the infiltration test determined 6" of water drained out of a hole in 24 hours. The depth of the rain garden should be set to the results of the infiltration test so 6" is the depth of the rain garden. The sizing calculation below is based on controlling 1" of runoff. First divide the impervious surface by the depth of the rain garden.

(672 sq ft / 6 ft.) = 112 sq. ft.

In order to control 2" of runoff volume, the rain garden area needs to be multiplied by 2.

112 sq. ft. * 2 = 224 sq. ft.

The rain garden should be about 225 sq. ft. in size and 6" deep.

3. Dry Well (a.k.a., Seepage Pit)

A Dry Well, sometimes called a Seepage Pit, is a subsurface storage facility that temporarily stores and infiltrates stormwater runoff from the roofs of structures. By capturing runoff at the source, Dry Wells can dramatically reduce the increased volume of stormwater generated by the roofs of structures. Roof leaders connect directly into the Dry Well, which may be either an excavated pit filled with uniformly graded aggregate wrapped in geotextile, or a prefabricated storage chamber or pipe segment. Dry Wells discharge the stored runoff via infiltration into the surrounding soils. In the event that the Dry Well is overwhelmed in an intense storm event, an overflow mechanism (riser with discharge pipe, connection to a larger infiltration are, etc.) will ensure that additional runoff is safely conveyed downstream.

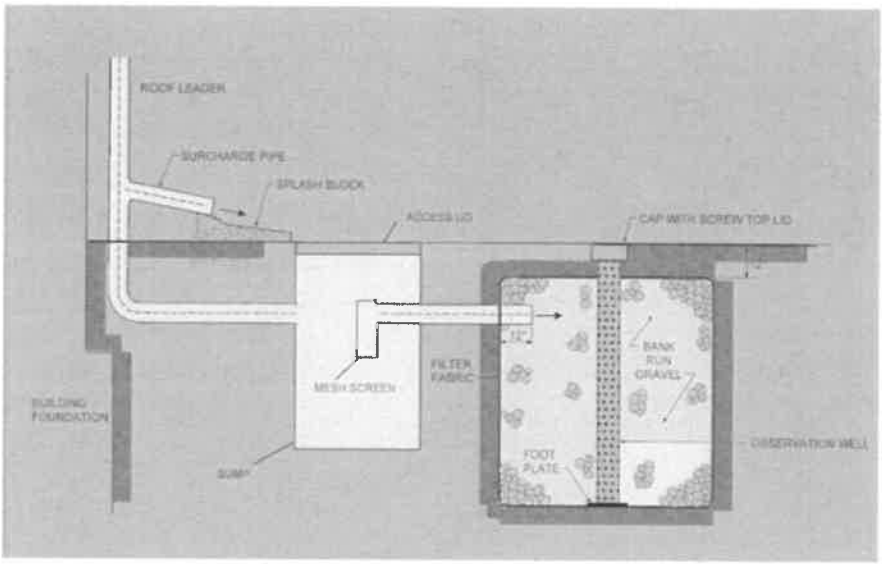
Design Considerations:

- Dry Wells typically consist of 18 to 48 inches of clean washed, uniformly graded aggregate with 40% void capacity (AASHTO No. 3, or similar). "Clean" gravel fill should average one and one-half to three (1.5 – 3.0) inches in diameter.
- Dry Wells are not recommended when their installation would create a significant risk for basement seepage or flooding. In general, 10 - 20 feet of separation is recommended between Dry Wells and building foundations.
- The facility may be either a structural prefabricated chamber or an excavated pit filled with aggregate.
- Depth of dry wells in excess of three-and-a-half (3.5) feet should be avoided unless warranted by soil conditions.
- Stormwater dry wells must never be combined with existing, rehabilitated, or new septic system seepage pits. Discharge of sewage to stormwater dry wells is strictly prohibited.

Maintenance:

- Dry wells should be inspected at least four (4) times annually as well as after large storm events.
- Remove sediment, debris/trash, and any other waste material from a dry well.
- Regularly clean out gutters and ensure proper connections to the dry well.
- Replace the filter screen that intercepts the roof runoff as necessary.

Figure 6: Dry Well Diagram



Source: PA BMP Guidance Manual, Chapter 6, Page 65.

Sizing Example for Dry Wells:

1. Determine contributing impervious surface area:

House Roof (Rear)	14 ft. x 48 ft.	=	672 sq. ft.

2. Determine required volume control:

   (672 sq. ft. * 2 inches of runoff) / 12 inches = 112 cu. ft.

112 cu ft / 0.4 = 280 cu. ft. (assuming the 40% void ratio in the gravel bed)

3. Sizing the dry well:

   Set depth to 3.5 ft; Set width equal to length for a square chamber.

   280 cu. ft. = 3.5 ft. x L x L; L = 9 ft.

   Dimensions = 3.5 ft. (D) x 9 ft. (L) x 9 ft. (W)

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. Any trees planted or preserved (retained) that are taken as volume credits must be identified in the Stormwater Management Agreement for preservation and maintenance and may not be altered without approval of the Township.

Tree Considerations:

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

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

1. Determine contributing impervious surface area:

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

2. Calculate the required control volume:

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

3. Determine the number of tree plantings:

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

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

Determining the volume reduction for preserving existing trees:

1. Calculate approximate area of the existing tree canopy:

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

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

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

- For Trees within 20 feet of impervious cover:

Volume Reduction cu. ft. = (Existing Tree Canopy sq. ft. x 1 inch) / 12

- For Trees beyond 20 feet but not farther than 100 feet from impervious cover:

Volume Reduction cu. ft. = (Existing Tree Canopy sq. ft. x 0.5 inch) / 12

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

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

510 cu. ft – 21 cu. ft. = 489 cu. ft.

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

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

2. Minimize Soil Compaction and Replant with Lawn or Meadow

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

Design Considerations:

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

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

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

1. Calculate approximate area of preserved meadow:
~22 sq. ft. x ~23 sq. ft = 500 sq. ft.

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

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

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

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

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

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

Ordinance 2018-279 was not adopted