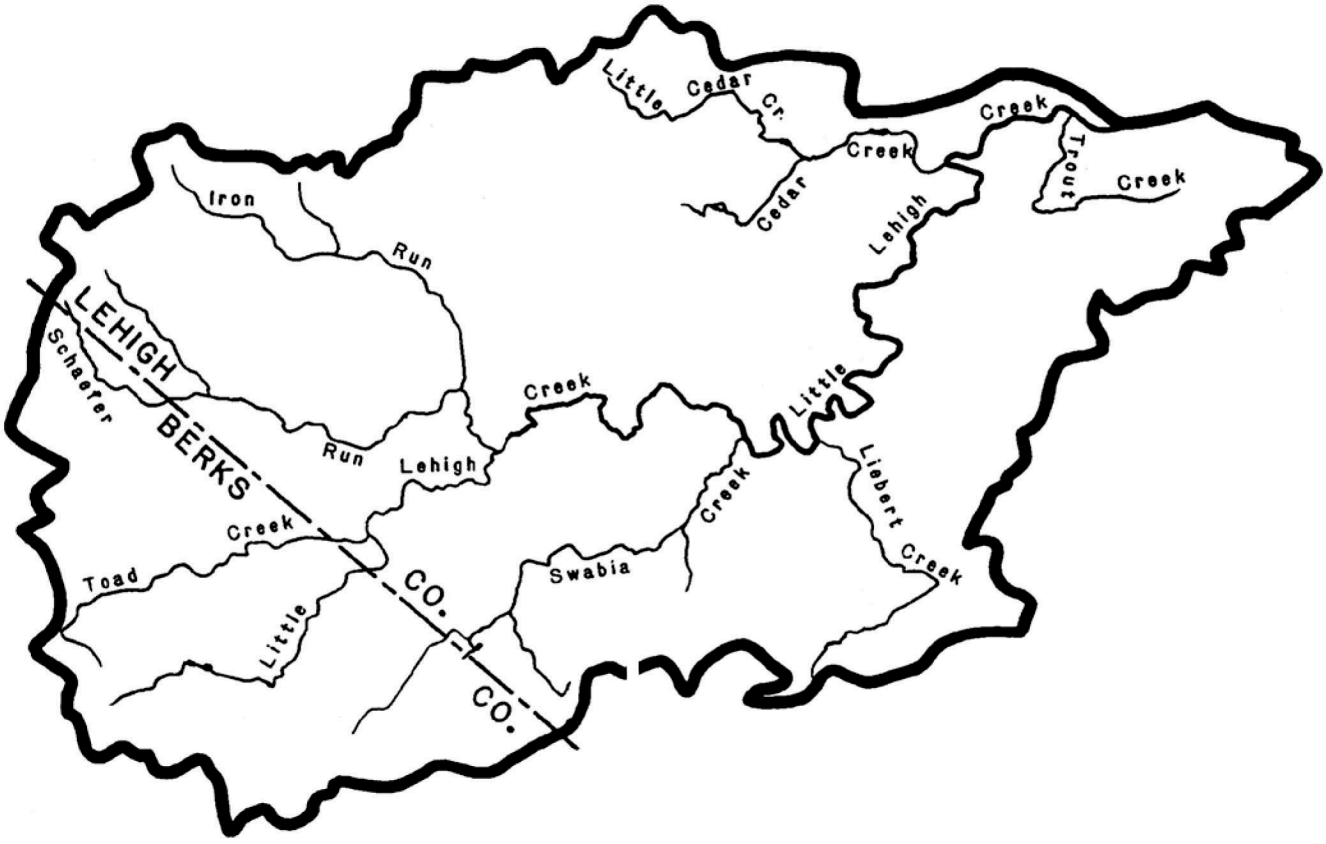
LITTLE LEHIGH CREEK WATERSHED

– ACT 167 –

STORM WATER MANAGEMENT PLAN

WATER QUALITY UPDATE



January 2005

LEHIGH VALLEY PLANNING COMMISSION

LITTLE LEHIGH CREEK WATERSHED

ACT 167

STORMWATER MANAGEMENT PLAN

WATER QUALITY UPDATE

This is the text prepared by the Lehigh Valley Planning Commission staff on behalf of Lehigh County and Berks County. It contains revisions, as necessary, based on comments received from the Little Lehigh Creek Watershed Advisory Committee, the Little Lehigh Creek Municipal Engineers Committee, the Little Lehigh Creek Legal Advisory Committee, the affected municipalities, the LVPC, general public, Lehigh County and the Department of Environmental Protection.

The Pennsylvania Stormwater Management Grant Assistance Program, administered by the Department of Environmental Protection, financed the preparation of this report. This grant program provides for seventy-five percent (75%) State funding with a twenty-five percent (25%) local match provided by Lehigh County.

Final Plan May 2004
Adopted by Lehigh County July 2004
Approved by DEP January 19, 2005

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*Staff for this report

May 2004

PREAMBLE

As written by
Little Lehigh Watershed Coalition, Inc.[1]

The Little Lehigh Creek is the beneficiary of a healthy Little Lehigh Watershed and is a recreationally valuable watercourse. Portions of the Little Lehigh Creek are designated a High Quality, Cold Water Fishery according to Pennsylvania Code Title 25, Environmental Protection, Chapter 93, Water Quality Standards. The Pennsylvania Fish and Boat Commission has designated a portion of the Little Lehigh Creek as a Class A – Wild Trout Stream and one mile stretch as Heritage Trout Waters, significant in that only twenty miles of streams within the Commonwealth have received this distinction.

The waters of the Little Lehigh support a trout hatchery and flow through a nonprofit wildlife sanctuary and refuge. Passing a registered Native America archaeological site, it enters the Lehigh Parkway, part of the Delaware-Lehigh State Heritage Park and the Delaware-Lehigh National Heritage Corridor. It flows along the Lehigh Parkway Heritage Trail, Trail No. 689 of the National Trail System. In addition, the Little Lehigh Creek is one source of potable water produced by the City of Allentown each day for the use of residents living in or near the third largest City in the Commonwealth and the commercial use of a number of companies and corporations in the watershed.

Given the significance of the Little Lehigh Creek (and its watershed) it is the intention of the Counties of Lehigh and Berks through this Little Lehigh Creek Watershed Storm Water Management Plan Update, in part, to encourage those actions that serve to protect this valuable natural resource.

This preamble is not designed to compel any municipality to take any specific action, including adoption of a standard ordinance. It is offered and intended to acquaint and remind all members of planning boards and commissions, zoning hearing boards, supervisors and commissioners, engineers, and solicitors of municipalities located in the Little Lehigh Watershed of the considerable statewide importance of the Little Lehigh Creek's high quality waters.

[1] Little Lehigh Watershed Coalition, Inc. P.O. Box 135 Emmaus, PA 18049-0135

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CHAPTER 1. INTRODUCTION

The Pennsylvania Stormwater Management Act, Act 167 of 1978, provides the framework for improved management of the storm runoff impacts associated with the development of land. The purposes of the Act are to encourage the sound planning and management of storm runoff, to coordinate the stormwater management efforts within each watershed and to encourage the local administration and management of a coordinated stormwater program. The Act also specifies the need to periodically update plans. This guarantees a dynamic system of runoff control sensitive to changing study area characteristics and changing regulatory requirements. Lehigh County adopted the original *Little Lehigh Creek Watershed Act 167 Stormwater Management Plan* in March 1988. The first Plan Update incorporated significant hydrologic changes in the watershed and was adopted by Lehigh County in September 1999. This second Plan Update is an addendum to the 1999 Plan which adds water quality criteria to the model ordinance.

In this plan, the water quality criteria have been established using a "standard practice of care" developed by the Lehigh Valley Planning Commission. This standard practice of care provides a technical basis for calculating, designing, and implementing BMPs that can be used to meet State Water Quality Requirements, including but not limited to, infiltration.

The water quality criteria are developed from runoff models using watershed parameters such as existing land use, future land use (based on zoning), the existing physical characteristics of the study area and timing relationships. Computer models of the peak flows in the watershed have been calibrated to reflect actual gage data.

Approximately 70% of the Little Lehigh Creek Watershed is underlain by carbonate geology. The use of infiltration BMPs is a particular concern in this watershed because there may be an increased potential for groundwater contamination and sinkhole formation. To minimize these concerns, Cahill Associates has developed the *Technical Best Management Practice Manual & Infiltration Feasibility Report: Infiltration of Stormwater in Areas Underlain by Carbonate Bedrock within the Little Lehigh Creek Watershed*. LVPC incorporated this manual into the development of this watershed stormwater management plan update.

Our strategy of water quality control has also been shaped by two new programs/policies at the Department of Environmental Protection (DEP). The first is the Comprehensive Stormwater Management Policy dated September 28, 2002 developed by DEP. The Policy emphasizes the reduction of stormwater runoff generated by development and other activities by encouraging the minimization of impervious cover and the use of low impact development designs. Additionally, the Policy encourages the use of innovative stormwater BMPs that provide infiltration, water quality treatment and otherwise more effectively manage the volume and rate of stormwater discharges. The Policy supports the fulfillment of the State's obligation under 25 Pa. Code Section 93.4a to protect and maintain existing uses and the level of water quality necessary to protect those uses in all surface waters. The Policy recommends that, in order to meet the regulatory requirements of 25 Pa. Code Section 93.4a, developers and engineers first prepare a comparative pre- and post-construction stormwater management analysis.

Special Protection waters are defined by DEP as Pennsylvania's highest quality surface waters and include Exceptional Value (EV) and High Quality (HQ) waters. The Little Lehigh Creek is designated as HQ waters. In Special Protection watersheds, the Comprehensive Policy states that "planners and applicants can ensure that existing water quality will be protected and maintained by demonstrating that post-construction infiltration equals or exceeds pre-construction infiltration and that any post-construction discharge will not degrade the physical, chemical or biological characteristics of the Special Protection surface water." Further, the Policy states that "infiltration BMPs should be used to the maximum extent possible" in Special Protection watersheds. To the extent that infiltration cannot be used due to site constraints or limitations, water quality treatment BMPs must be used to ensure the protection and maintenance of water quality. Finally, the rate and volume of stormwater runoff must be managed to prevent the physical degradation of receiving waters from effects such as scour and streambank destabilization.

In view of DEP's Comprehensive Stormwater Policy, the Little Lehigh Creek Water Quality Plan Update provides a methodology to satisfy State Water Quality requirements, including ways to demonstrate that post-construction infiltration equals or exceeds pre-construction infiltration. Additionally, the planning process had to define site constraints associated with carbonate bedrock and where infiltration would be recommended or not recommended. Finally, the water quality control criteria had to be integrated with the existing Release Rate criteria.

The second new program at DEP has been the implementation of the National Pollutant Discharge Elimination System (NPDES) Phase II federal stormwater management regulations. These regulations, enacted in December 1999, require municipalities with separate storm sewer systems in urbanized areas to implement a stormwater management program through the adoption of an ordinance that has the following legal provisions: prohibition of non-stormwater discharges, requirements for erosion and sediment controls, requirements to address post-construction runoff from new development and redevelopment, requirements for the operation and maintenance of stormwater BMPs and sanctions to ensure compliance with the above provisions. Since under the Act 167 planning process counties and municipalities develop a stormwater management ordinance that deals with many of these issues, DEP has stated that municipalities will satisfy the NPDES ordinance adoption requirement if they adopt a stormwater management ordinance developed under Act 167 that contains the NPDES related provisions.

To be consistent with the NPDES Phase II regulations, each of the required ordinance provisions, as listed above, were added to the Little Lehigh Creek Model Stormwater Ordinance. The DEP model ordinance provisions were used as a guide for these additions. All 10 of the Lehigh County municipalities in the Little Lehigh Creek Watershed are subject to the NPDES Phase II regulations. The 10 municipalities are Alburtis, Allentown, Emmaus, Lower Macungie, Macungie, Salisbury, South Whitehall, Upper Macungie, Upper Milford and Weisenberg. Each of these municipalities can meet two of the NPDES Phase II permit requirements by participating on the Watershed Committees and by adopting and implementing the model ordinance included at the end of the Plan Update.

The *Little Lehigh Creek Watershed Act 167 Stormwater Management Plan Water Quality Update* has been prepared for Lehigh and Berks counties by the Lehigh Valley Planning Commission (LVPC). Lehigh County has designated the LVPC to prepare the watershed plans for all watersheds in the County on its behalf.

To ensure the involvement of the municipalities and agencies that will be impacted by the Stormwater Management Plan, Act 167 requires that a Watershed Plan Advisory Committee be formed. The purposes of the Committee are to assist in the development of the Plan Update and familiarize the municipalities involved with the stormwater management concepts evolving from the planning process. Each municipality in the study area plus the County Conservation District is required to be represented on the Committee. Representation by additional agencies and interest groups is optional at the discretion of the County. Listed in Table 1 are the names and affiliations of the persons who participated on the Little Lehigh Creek Watershed Plan Advisory Committee.

TABLE 1
LITTLE LEHIGH CREEK WATERSHED PLAN ADVISORY COMMITTEE

Municipality/Organization	**Name**
Lehigh County	
Alburtis Borough	Melanie Hansen
Allentown City	Richard Rasch
Emmaus Borough	Jeff Clapper
Lower Macungie Township	William A. Erdman
Macungie Borough	Lucy Ackerman
Salisbury Township	Carl Best and Gabriel Khalife
South Whitehall Township	Rene Rodriguez
Upper Macungie Township	Thomas C. Gorr
Upper Milford Township	Daniel DeLong
Weisenberg Township	Thomas N. Wehr
Clean Water Action	Rick Loomis
Lehigh County Conservation District	John Bowman and Rebecca Hayden
Lehigh Valley Builders Association	Lou Tepes and Chuck Hamilton
Little Lehigh Watershed Coalition	Michael Siegel
Natural Resources Conservation Service	Marcia Farbotnik
Trout Unlimited	Lincoln Parmer
Wildlands Conservancy	Chris Kocher
Local Design Engineer	Andrew Bennett
Private Citizen	Scott Beiber
Berks County	
Hereford Township	Dan Solt
Longswamp Township	William G. Zollers and Harry D. Barrell
Maxatawny Township	Carl E. Zettlemoyer
Topton Borough	Kevin Tobias
Berks County Conservation District	John Ravert

There are two additional committees participating in the planning process. The Municipal Engineers Committee's purpose was to familiarize the municipal engineers with the technical background of the Plan Update and with the design standards to be implemented in their municipalities. The Legal Advisory Committee's purpose was to familiarize the municipal solicitors with the model ordinance that each municipality will be required to adopt. Each committee was given the opportunity to review and comment on the draft Plan Update and ordinance during the planning process. Tables 2 and 3 list each committee's participants and their affiliations.

TABLE 2
LITTLE LEHIGH CREEK MUNICIPAL ENGINEERS COMMITTEE

Municipality	Name	Organization
Lehigh County		
Alburtis Borough	Allison Bradbury	Martin, Bradbury & Griffith, Inc.
Allentown City	Neal Kern	City of Allentown
Emmaus Borough	Scott Muller	Barry Isett & Associates, Inc.
Lower Macungie Township	James Lancsek	Keystone Consulting Engineers, Inc.
Macungie Borough	William A. Erdman	Keystone Consulting Engineers, Inc.
Salisbury Township	J. Ralph Russek, Jr.	The Pidcock Company
South Whitehall Township	J. Ralph Russek, Jr.	The Pidcock Company
Upper Macungie Township	Dean Haas	Keystone Consulting Engineers, Inc.
Upper Milford Township	Russell Benner	Schoor DePalma
Weisenberg Township	Roy J. Stewart	Keystone Consulting Engineers, Inc.
Berks County		
Hereford Township	Jeffrey Kerlin	Technicon Enterprises II
Longswamp Township	Brian McElroy	Hanover Engineering Associates, Inc.
Maxatawny Township		Weiser Engineering Consultants
Topton Borough		Great Valley Consultants

TABLE 3
LITTLE LEHIGH CREEK LEGAL ADVISORY COMMITTEE

Municipality	Name	Organization
Lehigh County		
Alburtis Borough	David Knerr	
Allentown City	Robert Brown	
Emmaus Borough	Thomas Anewalt	McCarthy & Anewalt, LLP
Lower Macungie Township	Blake Marles	
Macungie Borough	Timothy Siegfried	
Salisbury Township	John W. Ashley	
South Whitehall Township	Blake Marles	
Upper Macungie Township	William E. Schantz	
Upper Milford Township	Marc Fisher	
Weisenberg Township	Donald H. Lipson	Tallman, Hudders & Sorrentino

TABLE 3, continued LITTLE LEHIGH CREEK LEGAL ADVISORY COMMITTEE		
Municipality	Name	Organization
Berks County		
Hereford Township	Paul Ober	
Longswamp Township	Richard Orwig	
Maxatawny Township	Richard Orwig	
Topton Borough	Francis M. Mulligan	

CHAPTER 2. WATER QUALITY

Most of the Little Lehigh Creek Watershed is underlain by carbonate bedrock. Two major concerns when proposing infiltration in carbonate geology are creation of sinkholes and groundwater contamination. There are only a small number of case studies of infiltration in carbonate bedrock areas. Given the limited data and experience with infiltration practices in carbonate bedrock, the plan does not mandate the use of infiltration BMPs in this watershed in areas of carbonate bedrock.

The stormwater management strategy does not contain a specific recharge standard. Since infiltration will not be mandated in areas of carbonate bedrock, there was no apparent way to manage recharge volume. However, conceptually, if a portion of the development sites in the watershed infiltrate the required water quality volume as defined below, then the recharge volume could be satisfied since recharge volumes are typically much smaller than water quality volumes. Additionally, for many sites that use infiltration, maintaining runoff volume will increase the recharge volume through conversion of pre-development evapotranspiration to recharge. This occurs when a non-vegetated infiltration system, like porous pavement, is used. The rainfall that was used by the pre-development vegetative cover and root systems then becomes recharge into the soil.

A. Water Quality Volume (WQv)

The Water Quality Volume (WQv) to be captured and treated will be the larger of the following:

$$WQv = c \times P \times A / 12$$

Where WQv = water quality volume in acre-feet
c = Rational Method post-development runoff coefficient for the 2-year storm
P = 1.25 inches
A = Area in acres of proposed Regulated Activity

OR

WQv = Post-development 2-yr. runoff volume – Pre-development 2-yr. runoff volume

EXCEPT that in no case shall the WQv exceed

WQv = 1.25 inches x site area in acres / 12

To control water quality, the strategy first defines the WQv that must be captured and treated. The WQv must be calculated two ways. First, WQv is calculated as the Universal Rational Hydrograph volume for the site with Precipitation (P) equal to 1.25 inches. This calculation is, in part, based on the methodology in the Maryland Stormwater Design Manual, 2000. The Maryland WQv standard uses 1.0 inch of precipitation and is based on capturing 90% of the average annual rainfall. The recommended WQv for Maryland is between 0.2 inches and

0.95 inches of runoff across a site. This is consistent with traditional "first flush" water quality standards of capturing the initial 0.5 inches to 1.0 inch of runoff. The 90% average annual capture rainfall for the Little Lehigh Creek Watershed calculated from an analysis of daily rainfall data in Allentown for the period of 1947 to 2003 is 1.25 inches. The percent of the average annual rainfall captured increases as the assumed capture depth increases (e.g. a 1 inch capture depth represents 86% of the average annual rainfall and a 2 inch capture depth represents 97% of the average annual rainfall). The Maryland WQv is calculated using a formula that has impervious cover percentage as the only variable. Pervious cover and slope variations on a site are not considered. However, we can essentially replicate the Maryland WQv using the Universal Rational Hydrograph (URH) volume for a site. The URH produces a runoff volume in inches over a site that is equal to the Rational Method runoff coefficient multiplied by the total rainfall applied. This relationship holds true regardless of the site's time of concentration or the storm return period. Therefore, the URH volume for the 90% rainfall capture storm depth is (c)(1.25) in inches over the site area. Using this relationship allows the actual site characteristics of slope, hydrologic soil group and cover to be used. The Rational Method c value replaces the volumetric runoff coefficient (Rv) term in the Maryland equation. By inspection, Rational c values of 0.05 and 0.95 for pervious and impervious areas, respectively, would allow c and Rv to match for 0% and 100% impervious. The 0.05 value can be found in our Act 167 Ordinance for Meadow/Lawn for HSG A soils. The 0.95 impervious value is currently in several Act 167 Ordinances in the Lehigh Valley. The value in making this conversion is that we have extensive experience applying the URH for Act 167 designs. It currently represents the minimum acceptable volume for both detention designs and volume controls in the Act 167 Ordinance. Also, the curve number methodology is not recommended for small rainfall amounts like 1.25 inches and can not be used to define a comparable runoff volume for the 90% rainfall depth. As such, the best use for the URH volume is as a minimum WQv as proposed. Since this WQv closely approximates the Maryland WQv, it still allows us to rely on the established procedures in the Maryland Stormwater Design Manual.

Second, the WQv must be calculated as the difference in runoff volume from pre-development to post-development for the 2-year return period storm. The Little Lehigh Creek runoff quantity design standards specifically regulate the pre- to post-development impact. One concern with the Maryland procedures and the use of the URH method is that the pre-development condition is not considered in the calculation and therefore may not accurately reflect the "impact" created by the development. If the URH method does, in fact, under-predict runoff volume then sufficient water quality treatment may not be provided if this was the sole means for determining WQv. Further, the Pennsylvania Comprehensive Stormwater Management Policy states in part that water quality can be protected and maintained if post-construction infiltration equals or exceeds pre-construction infiltration. The Comprehensive Stormwater Management Policy is in part based on the understanding that water quantity and water quality are not separable. The Policy does not specify a return period for this relationship. For purposes of the Little Lehigh strategy, the following rationale was used to determine the design event to apply to this policy:

- The 100-year, 24-hour storm is approximately 7.44 inches for the Little Lehigh Creek. Using this as the basis for a WQv would conflict with any of the scientific

evidence based on first flush and any attempt to apply cost-effective water quality controls.

- The lowest return period for which the runoff volumes calculated by the curve number methodology are valid is between the 1- and 2-year storms. This is based on making sure that the calculated runoff volumes, predevelopment, are about 0.5 inches or more as the documented minimum for use of TR-55 (see page 2-11 TR-55 June 1986). While TR-55 does not mention the 1- or 2-year storm specifically, the 1982 manual *Recommended Hydrologic Procedures for Urban Runoff from Small Developing Watersheds in PA*, written for DEP by Penn State University, indicates that, in general, the AMC II CNs tend to underestimate the smaller runoff events while providing reasonable estimates of the larger less-frequent floods (PSU, 1982). This underestimating tendency for smaller events is caused by the high initial abstractions that must be satisfied before any runoff can be produced under the NRCS/SCS rainfall-runoff equation. This reinforces not using the method for smaller events such as the 1-year storm.

- The 2-year 24-hour rainfall depth for the Little Lehigh Creek Watershed is 3.0 inches. Based on our analysis of local rainfall data, this amount represents more than 97% of the annual precipitation for the watershed. Therefore, its direct use as the WQv estimate would mean that only 3% of the annual rainfall would go untreated – clearly expensive and only marginally beneficial to both water quality treatment and groundwater recharge. Therefore, in no case would it seem reasonable to use a return period higher than the 2-year event as a basis for the WQv.

- The first flush concept has been questioned in the literature. Stormwater Magazine for September/October 2001 cites studies for Austin, Texas and Portland, Oregon that indicate that traditional first flush volumes may not achieve the desired water quality control. Rather than controlling the predominant pollutant loading these techniques may only control less than 50% of annual pollutant loads. In Austin they found that the first 0.5 inches of runoff may only contain 20% of the annual pollutant load rather than the presumed 90%. In Portland they found that 0.83 inches of runoff only treated 20% of the annual pollutant load.

- Data and graphs developed by Environmental Engineers for the City of Austin, Texas show that 90% control of total annual pollutant loadings will require the following watershed storage amounts, based upon observed water quality loading data: 0.42 inches for a 30% impervious site, 0.75 inches for a 50% impervious site, and 2.0 inches for a 90% impervious site (City of Austin, 1990). These volumes follow closely the incremental 2-year volumes based on an analysis by return period prepared by the LVPC. Stated otherwise, the incremental 2-year runoff volume can provide a WQv that achieves pollutant control effectiveness traditionally thought to be provided by the first flush concept.

- The 2-year event is the initial storm to control for water quantity purposes in the existing Little Lehigh Creek Ordinance. Applicants will need to manage this storm for peak rate control, typically in a BMP that also is sized for the 100-year event.

Therefore, using the incremental 2-year runoff volume as the WQv should not introduce significant, if any, additional costs to the developer. This is similar to using a 30% release rate for the 2-year storm. Since basins are designed to handle the 100-year event, this requirement is unlikely to add any significant costs.

- The incremental 2-year runoff volume provides a means to define the WQv for this watershed that provides a reasonable safety factor in design relative to the URH volume for development proposals with higher percent impervious cover, especially given its close fit to the Austin, Texas data.

For these reasons, the alternative WQv standard is the difference in runoff volume pre- to post-development for the 2-year storm. This volume may exceed the URH WQv or may be less. In fact, for the example of converting agricultural lands to low impervious cover development, the incremental 2-year runoff volume could be negative.

Therefore, the greater of these two calculated values will be used as the WQv except in situations where it would exceed 1.25 inches of runoff. The 90% annual rainfall capture volume of 1.25 inches provides a reasonable upper limit to the WQv given that only 10% of the annual rainfall volume from larger events is not treated. Therefore, the recommended WQv standard is limited to no more than 1.25 inches of runoff. This retains applicability of the Maryland Stormwater Design Manual while assuring that the pre- and post-development conditions are considered.

B. Preliminary Site Investigation

Each developer must conduct a preliminary site investigation on the proposed development site. The goal of the preliminary site investigation is to evaluate the feasibility of infiltrating on the site. This requires the determination of site characteristics such as the infiltration capacity of the soil mantle, the depth to bedrock and the absence or presence of any special geologic features. The preliminary site investigation may be an iterative process, testing different locations on the site to find suitable locations for infiltration. Data to be gathered as part of a preliminary site investigation includes the following:

- Bedrock composition – Any apparent boundaries between carbonate and non-carbonate bedrock must be verified through more detailed site evaluations by a qualified geotechnical professional.
- Bedrock structural geology – This includes the possible presence of faults and mapping of conspicuous fracture traces or lineaments.
- Overburden and soil mantle composition and thickness
- Permeability of the soil
- Depth to the seasonal high water table
- Presence of special geologic features – This includes sinkholes, closed depressions, fracture traces, lineaments and geologic contacts between carbonate and non-carbonate bedrock

Some of the required information, as listed above, can be found in existing published data. Suggested resources are listed below.

- Geologic maps and references for the development area
- The Little Lehigh Creek Basin Carbonate Prototype Area Closed Depression Map – available at the LVPC
- USGS topographic maps
- Lehigh and Berks County soil survey maps
- Aerial photographs from the LVPC or other sources
- Relevant Pennsylvania Geologic Survey Open File Reports (Kochanov 1987a, 1987b) that provide maps of sinkholes and Karst features for Lehigh and Berks counties

In addition to gathering data from published sources, a field inspection of the proposed site is required and the soil mantle at the development site must be examined directly with a backhoe during the preliminary site investigation. A minimum of one soil test pit and two percolation tests are required on each site proposed for development. The engineer or other qualified professional exposes the surface horizon to a depth of up to eight feet and identifies the type and condition of the soil mantle by distinct horizons or layers. If infiltration is proposed, additional testing is required. The Preliminary Site Investigation and additional testing must be conducted in accordance with the procedures outlined in Appendix G of the model ordinance included at the back of this Plan Update. If at any point in the Preliminary Site Investigation, the data (e.g. location of Karst features on the site or the published soils data for the site) indicates that the entire site will not be recommended for infiltration based on the Ordinance standards, then no further investigation is required.

Based on the results of the preliminary site investigation, it can be determined if infiltration is recommended or not recommended.

C. Non-Carbonate Area Standards

Since infiltration is the best BMP for runoff volume control, groundwater recharge and water quality control in non-carbonate areas, the WQv must be infiltrated unless the applicant demonstrates that it is infeasible to infiltrate the WQv for reasons of seasonal high water table, permeability rate, soil depth or isolation distances. Additionally, the municipality may, after consultation with DEP, approve an alternate method(s) for meeting the State Water Quality Requirements other than those described in the Ordinance. A site investigation must be performed to quantify the parameters listed below. The site investigation, including soil test pits and percolation tests, must be conducted in accordance with Appendix G of the model ordinance included at the back of this Plan Update. The Preliminary Site Investigation described above shall continue on different areas of the site until a suitable infiltration location is found or the entire site is determined to be infeasible for infiltration. The recommended site conditions, as listed below, are designed to have infiltration on sites with well drained soils and adequate soil depth for removal of pollutants:

- Depth to bedrock greater than or equal to 2 feet
- Depth to seasonal high water table greater than or equal to 3 feet (If the depth to bedrock is between 2 and 3 feet and the evidence of the seasonal high water table is not found in the soil, no further testing to locate the depth to seasonal high water table is required.)

- Soil permeability greater than or equal to 0.5 inches/hour and less than or equal to 12 inches per hour
- Setback distances or buffers as follows:
  - 100 feet from water supply wells
  - 10 feet downgradient or 100 feet upgradient from building foundations
  - 50 feet from septic system drainfields
  - 50 feet from a geologic contact with carbonate bedrock unless a preliminary site investigation is done in the carbonate bedrock to show the absence of special geologic features within 50 feet of the proposed infiltration area.
  - 100 feet from the property line unless documentation is provided to show that all setbacks from wells, foundations and drainfields on neighboring properties will be met.

If it is not feasible to infiltrate the full water quality volume, the applicant must infiltrate that portion of the WQv that is feasible based on site characteristics. The model ordinance allows a municipality to determine infiltration to be infeasible on a site if there are known existing conditions or problems that may be worsened by the use of infiltration.

D. Carbonate Area Standards

Each site located entirely in limestone must conduct a preliminary site investigation prepared by a qualified geotechnical professional to define the special geologic features present on the site. As previously discussed, the preliminary investigation must include a minimum of one test pit and *two* percolation tests on the portion of the site that is judged to be the best candidate for possible infiltration as detailed in Appendix G of the model ordinance included at the back of this plan. The preliminary investigation must include an assessment of the remainder of the site for possible infiltration based on required isolation distances from special geologic features and the likely soil depth and permeability based on published data or other site data available. The data gathered during the preliminary site investigation will then be used as input in the *Recommendation Chart for Infiltration Stormwater BMPs in Carbonate Bedrock* chart contained in Appendix D of the model ordinance.

There are five basic management principles that should be followed to minimize the risk associated with designing infiltration in carbonate areas. Each of the principles is discussed below.

1. Maintain the Natural Water Balance

   When the natural or pre-development water balance is maintained, infiltration to groundwater is maintained along with stream baseflow. This will also maintain the existing water table elevation. Carbonate rock located below the water table has an increased buoyant strength which is sacrificed when the water table drops and water is removed. De-watering of carbonate rock that results when infiltration is reduced and the water table is lowered results in an effective weakening of the carbonate rock

formations and increases the likelihood of sinkhole formation. Additional benefits of maintaining the water table elevation by maintaining pre-development infiltration include maintaining stream baseflow, maintaining spring and well yields, maintaining the temperature of the receiving stream and less of an increase in runoff from new development.

With the goal of maintaining the natural water balance in mind, the Ordinance requires that, for the site as a whole, the post-development 2-year runoff volume leaving the site must be 80% or more of the pre-development runoff volume. This 80% provision is to prevent infiltration of volumes far in excess of the pre-development infiltration volume. This is especially important since while holding infiltration constant there still may be an increase in recharge due to the conversion of evapotranspiration to recharge. The restriction on the amount of runoff volume that can be infiltrated in limestone bedrock only deals with the 2-year storm because the 2-year storm captures well over 97% of the annual rainfall volume. Note that this 80% provision should not be confused with the 30% Release Rate criteria that may apply to the 2-year storm.

2. Avoid Concentrating Stormwater Flows and Attempt to Replicate Natural Loading Rates

The overall objective when working in carbonate bedrock areas should be to maintain the pre-development water balance through the use of broad and evenly distributed stormwater. The typical practice of excavating a depression as a detention basin and concentrating many acres of runoff into a relatively small surface area may result in new hydraulic stresses on the overburden soils and accelerate sinkhole development. The added weight of the water in a rapidly filled detention basin may cause a collapse. Ideally, infiltration BMPs should simply mimic the pre-development loading rate. A loading rate is defined as the ratio of additional infiltration to natural infiltration and for ease of implementation can be calculated as the ratio of the land area draining to the system to the base area of the infiltration system. However, in reality, both the change of surface vegetation and the creation of impervious surfaces increase the amount of precipitation that the remaining land surface must infiltrate, assuming the use of BMPs. A range of loading rates has been defined along with a level of risk. A low risk loading rate is where there is up to a 100% more tributary area to the BMP versus base area of the BMP. A medium risk loading rate is where there is between 100% and 300% more tributary area to the BMP versus base area of the BMP. A high risk loading rate is where there is between 300% and 500% more tributary area to the BMP versus base area of the BMP. Loading rates exceeding a 500% increase are not recommended.

The calculation of loading rate should take into account the fact that different land uses will produce different amounts of runoff for the remaining land surface to infiltrate. Therefore, the ratio of areas used to calculate loading rate should be modified as follows:

All disturbed areas to be made impervious:	100% of measured area
All disturbed areas to be made pervious:	50% of measured area

All undisturbed pervious areas:	0% of measured area
All existing impervious areas:	100% of measured area

3. Maximize Soil Mantle Thickness and Permeability

When using infiltration BMPs, the soil mantle acts as a pollutant filter and hydraulic "buffer" that intercepts, distributes, slows, absorbs and retains infiltrating stormwater runoff before the runoff reaches the underlying carbonate formations. The risk of sinkholes decreases as the thickness of the soil increases along with the buffering and lateral dispersion potential. In the areas proposed for infiltration, the removal of top soil should be minimized.

Soil permeability in areas proposed for infiltration must be evaluated. Soil permeabilities of less than 0.5 inches/hour are not recommended for infiltration because they are not considered to be well drained. On the other hand, rapid permeabilities may increase the risk of sinkhole formation or groundwater contamination as water flows through the soil mantle with minimal lateral dispersion and slowing. Therefore, the maximum allowable permeability in areas proposed for infiltration is 12 inches/hour.

Soil thickness and permeability are accounted for through the calculation of effective soil thickness. In areas where the soil thickness is marginal but where soil permeability is relatively slow, the effective soil thickness is weighted to take into account the beneficial effect of the "heavier" soil. Conversely, because of the loss of water quality benefit occurring when permeability becomes quite rapid together with increased subsidence potential, a reverse weighting has been included in the effective soil thickness calculation, as shown below.

The effective thickness in the *Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock* in Appendix D is the measured soil thickness below a proposed infiltration area multiplied by the thickness factor based on soil permeability, as follows:

TABLE 4

PERMEABILITY RANGE*	THICKNESS FACTOR
6.0 to 12.0 inches/hour	0.8
2.0 to 6.0 inches/hour	1.0
1.0 to 2.0 inches/hour	1.4
0.75 to 1.0 inches/hour	1.2
0.5 to 0.75 inches/hour	1.0

**If the permeability rate falls on a break between two thickness factors, the smaller thickness factor shall be used.

4. Maximize Buffering of Special High Risk Geological Features

To minimize the risk associated with designing infiltration BMPs in carbonate areas, the presence of and proximity to existing sinkholes, fracture traces, lineaments, joints,

faults, geologic contacts or other special geologic features must be considered. The greater the separation distance or buffer maintained from these features, the lower the potential for sinkholes to develop in the future. Stormwater management systems should not be located on or in any special geologic feature. Therefore, a low buffer is defined as 10 to 50 feet of separation distance. It should be noted that in the *Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock* in Appendix D of the model ordinance that low buffer conditions on a site are generally not recommended for infiltration. A medium buffer is defined as 50 to 100 feet of separation distance. A high buffer is defined as over 100 feet of separation distance.

5. Interaction of Site Risk and Design Factors

   In most cases, the likelihood of sinkhole formation depends on a combination of the site risk factors discussed above. For example, proposing a 500% increase in stormwater loading rate to an infiltration basin on carbonate rock that is buffered with 3 feet of soil depth within 40 feet of faults and fracture traces, increases the risk of sinkhole formation tremendously and would not be recommended for infiltration. On the other hand, a 100% increase in stormwater loading rate with 9 feet of soil depth over carbonate rock in the absence of faults and fractures translates into a significant reduction in risk and would be recommended for infiltration.

Additional design constraints that must be met on carbonate sites include the following:

- Maintain a minimum depth to bedrock of 2 feet
- Depth to seasonal high water table greater than or equal to 3 feet (If the depth to bedrock is between 2 and 3 feet and the evidence of the seasonal high water table is not found in the soil, no further testing to locate the depth to seasonal high water table is required.)
- Soil permeability greater than or equal to 0.5 inches/hour and less than or equal to 12 inches per hour
- Setback distances or buffers as follows:
  - 100 feet from water supply wells
  - 10 feet downgradient or 100 feet upgradient from building foundations
  - 50 feet from septic system drainfields
  - 100 feet from the property line unless documentation is provided to show that all setbacks from wells, foundations and drainfields on neighboring properties will be met.

E. Sites with Both Carbonate and Non-carbonate Areas

If a site has both carbonate and non-carbonate areas, the applicant shall investigate the ability of the non-carbonate portion of the site to fully meet the Ordinance provisions to control runoff for the whole site through infiltration. If that proves infeasible, the applicant shall perform the preliminary site investigation for the carbonate area to determine the appropriate design strategy. No infiltration structure in the non-carbonate area shall be located within 50 feet of a boundary with carbonate bedrock, except when a preliminary site investigation has

been done showing the absence of special geologic features within 50 feet of the proposed infiltration area.

F. Non-infiltration BMPs

If, after preliminary testing is completed, a site is not recommended for infiltration or if an applicant chooses not to use infiltration in carbonate bedrock areas, then the WQv must be treated by two acceptable BMPs in each drainage direction. Two BMPs are being required because no other single BMP approaches the pollutant removal efficiency of infiltration. Therefore, if infiltration is not being used, the use of two other BMPs in series will achieve comparable water quality control. Sheet flow draining across a pervious area can be considered as one BMP. This will encourage disconnection of impervious cover and will not create an undue management burden for disturbed areas proposed to be pervious cover. Sheet flow across impervious areas and concentrated flow must flow through two BMPs in series. If sheet flow from an impervious area is to be drained across a pervious area as one BMP, the flow length of the pervious area must be at least equal to the flow length of impervious area.

In no case, may the same BMP be employed consecutively to meet the two BMP requirement.

A list of acceptable BMPs is provided below. A definition for each BMP, along with a reference for design details, is provided in the model ordinance in the back of this Plan Update.

- Bioretention
- Capture/Reuse (cisterns, etc.)*
- Constructed Wetlands
- Minimum Disturbance/Minimum Maintenance Practices
- Oil/Water Separators
- Sediment Traps/Catch Basin Sumps
- Significant Reduction of Existing Impervious Cover
- Stormwater Filters (Sand, Peat, Compost, etc.)
- Trash/Debris Collectors in Catch Basins
- Vegetated Buffers/Filter Strips
- Vegetated Roofs
- Vegetated Swales/Filter Strips
- Water Quality Inserts for Inlets
- Wet Detention Ponds

*If this BMP is used to treat the entire WQv then only one BMP is required because of this BMPs superior water quality performance.

G. Temperature Sensitive BMPs

Because the Little Lehigh Creek is designated a High Quality water, BMPs shall be chosen to prevent thermal impacts on the stream and the aquatic community. Therefore, if an applicant is proposing to use a wet pond, constructed wetland or other BMP that ponds water on the

land surface and may receive direct sunlight, the discharge from that BMP must be treated by infiltration, a vegetated buffer, filter strip, bioretention, vegetated swale or other BMP that provides a thermal benefit to protect the High Quality waters of the Little Lehigh Creek from thermal impacts.

H. Hot Spot Land Uses

Hot Spot land uses are land uses or activities that generate higher concentrations of hydrocarbons, trace metals or other toxic substances than typically found in stormwater runoff. Stormwater runoff from Hot Spot land uses, because of the higher pollutant loads, needs to be pre-treated with suitable BMPs before being discharged to surface waters of the Commonwealth. The model ordinance at the back of this Plan Update prohibits infiltration of runoff from Hot Spot land uses. Acceptable methods of pre-treatment for each Hot Spot land use are listed below. In no case, may the same BMP be employed consecutively to meet the Hot Spot pretreatment requirement and the WQv treatment requirement. References for design details for the pre-treatment methods are provided in the model ordinance in the back of this Plan Update.

TABLE 5

HOT SPOT LAND USE	PRE-TREATMENT METHOD(S)
Vehicle Maintenance and Repair Facilities including Auto Parts Stores	-Oil/Water Separators -Use of Drip Pans and/or Dry Sweep Material Under Vehicles/Equipment -Use of Absorbent Devices to Reduce Liquid Releases -Spill Prevention and Response Program
Vehicle Fueling Stations	-Oil/Water Separators -Water Quality Inserts for Inlets -Spill Prevention and Response Program

TABLE 5, continued	
HOT SPOT LAND USE	**PRE-TREATMENT METHOD(S)**
Storage Areas for Public Works	-Oil/Water Separators -Sediment Traps/Catch Basin Sumps -Water Quality Inserts for Inlets -Use of Drip Pans and/or Dry Sweep Material Under Vehicles/Equipment -Use of Absorbent Devices to Reduce Liquid Releases -Spill Prevention and Response Program -Diversion of Stormwater away from Potential Contamination Areas
Outdoor Storage of Liquids	-Spill Prevention and Response Program
Commercial Nursery Operations	-Vegetated Swales/Filter Strips -Constructed Wetlands -Stormwater Collection and Reuse
Salvage Yards and Recycling Facilities*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Fleet Storage Yards and Vehicle Cleaning Facilities*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Facilities that Store or Generate Regulated Substances*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Marinas*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Certain Industrial Uses (listed under NPDES)*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit

*Regulated under the NPDES Stormwater Program

I. Alternative Approach to Meeting State Water Quality Requirements

The municipality may approve, in consultation with DEP, alternative methods for meeting the State Water Quality Requirements other than those specified in the model ordinance, provided that they meet the minimum requirements of and do not conflict with state law including but not limited to the Clean Streams Law.

J. Exemptions for "Small Projects"

An exemption from certain requirements of the Ordinance is provided in the Plan and Ordinance for new developments which are expected to have an insignificant impact on the watershed. The exemption provides that any development which would create 10,000 square feet or less of additional impervious cover will not be required to meet the Drainage Plan preparation provision of the Ordinance. The date of Municipal Ordinance adoption of the original Little Lehigh Act 167 Stormwater Management Ordinance (1988) shall be the starting point from which to compute cumulative increases in impervious cover. Examples of projects that would be exempted would include building residential sheds or patios, small building or home expansions and development of a single residential home on a small lot.

Attempting to regulate these types of projects could be burdensome to the homeowner or developer and impractical for the municipality. It should be noted that although persons responsible for these "small projects" will not be required to prepare a Drainage Plan to be reviewed against this Ordinance, they are still obligated under Section 110 of the Ordinance to implements such measures as are reasonably necessary to meet State Water Quality Requirements and to prevent injury to health, safety and property. Such measures shall include such actions as are required to manage the rate, volume, direction and quality of resulting stormwater runoff in a manner which otherwise adequately protects health and property from possible injury.

CHAPTER 3. WATER QUANTITY

A. Release Rates

The release rate concept applied in earlier versions of the Little Lehigh Creek Watershed Plan still applies in this Plan Update. The basic goal is no increase in the peak rate of runoff at any point in the watershed. However, simply controlling peak rates of runoff at-site does not guarantee an effective watershed-level control because the increase in total runoff volume could accumulate throughout the watershed and increase peak flows. As part of the *Little Lehigh Creek Watershed Act 167 Stormwater Management Plan Update, 1999*, modeling was done to study how runoff from the various parts of the watershed interact, in time, with one another. A complete discussion of the release rate concept and the modeling are contained in the 1999 Update, which is available at the LVPC offices. The release rates that were determined from that modeling effort have not changed and designs consistent with the release rates are still required as part of the model ordinance. The release rates for each location in the watershed are shown on Plate I in the back of the Plan Update.

It should be noted that the release rate concept assumes that peak rate and volume of runoff will increase with development. If, through the use of infiltration or other BMPs, an applicant can demonstrate that neither the peak rate nor the volume of runoff are increasing with development, additional controls to meet the release rates are not required. This is because if the peak rate and volume of runoff are not increasing with development, then the goal of the release rates, to maintain existing peak flows in the watershed, has been met.

B. Release Rate Implementation Provisions

In addition to the release rates discussed above, the stormwater management district implementation provisions also still apply in this Plan Update. The implementation provisions are detailed in Section 306 of the model ordinance and regulate issues like closed depressions, multiple drainage directions leaving a site, off-site areas, etc.

CHAPTER 4. MUNICIPAL ORDINANCE TO IMPLEMENT THE LITTLE LEHIGH CREEK WATERSHED ACT 167 STORMWATER MANAGEMENT PLAN WATER QUALITY UPDATE

The implementation of the runoff quality and quantity control strategy for new development will be through municipal adoption of the appropriate ordinance provisions. As part of the preparation of the water quality update to the Little Lehigh Creek Watershed Stormwater Management Plan Update, a model Ordinance has been prepared which would implement the Plan Update provisions. The Ordinance is a single purpose ordinance which could be adopted essentially as is by the municipalities. Cross-references to the provisions of this Update would also be required in the municipal Subdivision and Land Development Ordinance and the municipal Building Code to ensure that activities regulated by the Ordinance were appropriately referenced.

Additionally, the model ordinance contains all of the required NPDES Phase II criteria for post-construction stormwater management. These provisions are marked with an asterisk (*) and are not required for municipalities that are not subject to the NPDES Phase II requirements. This Ordinance will satisfy the post-construction stormwater management minimum measure for those municipalities required to apply for NPDES Phase II permit coverage. As needed, the ordinance provisions were copied from DEP's model Ordinance with some minor revisions.

The updated *Little Lehigh Creek Watershed Act 167 Stormwater Management Ordinance* will not completely replace the existing storm drainage ordinance provisions currently in effect in the Little Lehigh Creek Watershed municipalities. The reasons for this are as follows:

- Not all of the municipalities in the Little Lehigh Creek Watershed are completely within the watershed. Since the water quantity provisions (i.e. Release Rates) have been developed specifically for this watershed, for those portions of a municipality outside of the Little Lehigh Creek Watershed, the existing water quantity ordinance provisions still apply. Lehigh County municipalities with areas outside of the watershed may need to apply the water quality provisions to the entire municipality or to the entire urbanized area in the municipality to satisfy the NPDES Phase II requirements.

- The Act 167 Ordinance contains only those stormwater runoff control criteria and standards which are necessary or desirable from a total watershed perspective. Additional stormwater management design criteria (i.e. inlet spacing, inlet type, collection system details, etc.) which should be based on sound engineering practice should be regulated under the current Ordinance provisions.

- The Act 167 Ordinance contains criteria and standards for runoff control from new development that are the *minimum* criteria from a watershed perspective. Individual municipalities may adopt more stringent ordinance provisions so long as consistency with the Plan Update is maintained.

The Act 167 Ordinance is composed of the basic ordinance body and a set of appendices. The Ordinance Appendices, to be made part of a municipal ordinance, should provide maps of the Little Lehigh Creek Watershed, stormwater management districts and storm drainage problem areas as well as technical data to be used in the calculation methodology. The Ordinance is intended to be separable from the Plan Update document itself. The maps in the Ordinance Appendices would be duplicative of those already included in this Plan Update or the 1999 version of the Plan and are not included in the model Ordinance.

Although the actual stormwater control provisions may vary significantly from an existing municipal ordinance, the structure of the Ordinance itself is very similar to many ordinances. The actual ordinance adopted by a municipality to implement the Little Lehigh Creek Watershed Act 167 Plan Update may differ in form from the Ordinance provided herein so long as it includes, at minimum, all of the provisions of the suggested Ordinance. A municipality may tailor the Ordinance provisions to best fit into their current ordinance structure.

LITTLE LEHIGH CREEK WATERSHED
ACT 167 - STORMWATER MANAGEMENT ORDINANCE

ARTICLE 1
GENERAL PROVISIONS

SECTION 101. SHORT TITLE

This Ordinance shall be known and may be cited as the "Little Lehigh Creek Watershed Act 167 Stormwater Management Ordinance".

SECTION 102. STATEMENT OF FINDINGS

The governing body of the municipality finds that:

A. Inadequate management of accelerated runoff of stormwater resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, changes the natural hydrologic patterns, destroys aquatic habitat, elevates aquatic pollutant concentrations and loadings, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to carry and control stormwater, undermines floodplain management and flood control efforts in downstream communities, reduces groundwater recharge, and threatens public health and safety.

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

* C. Stormwater can be an important resource by providing groundwater recharge for water supplies and baseflow of streams, which also protects and maintains surface water quality.

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

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

*Throughout the Ordinance, these provisions are from the DEP Guidance on MS4 Ordinance Provisions and are not required for municipalities not subject to the NPDES Phase II regulations.

* F. Non-stormwater discharges to municipal separate storm sewer systems can contribute to pollution of waters of the Commonwealth by the municipality.

SECTION 103. PURPOSE

The purpose of this Ordinance is to promote the public health, safety and welfare within the Little Lehigh Creek Watershed by minimizing the damages and maximizing the benefits described in Section 102 of this Ordinance by provisions designed to:

A. Manage stormwater runoff impacts at their source by regulating activities which cause such problems.

B. Utilize and preserve the desirable existing natural drainage systems.

C. Encourage infiltration of stormwater, where appropriate, to maintain groundwater recharge, to prevent degradation of surface and groundwater quality and to otherwise protect water resources.

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

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

F. Provide for proper maintenance of all permanent stormwater management BMPs that are implemented in the municipality.

* G. Provide review procedures and performance standards for stormwater planning, design and management.

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

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

* J. Prevent scour and erosion of streambanks and streambeds.

* K. Provide standards to meet the NPDES permit requirements.

SECTION 104. STATUTORY AUTHORITY

The municipality is empowered to regulate these activities by the authority of the Act of October 4, 1978, P.L. 864 (Act 167), 32 P.S. Section 680.1, et seq., as amended, the "Stormwater Management Act" and the (appropriate municipal code).

SECTION 105. APPLICABILITY

This Ordinance shall only apply to those areas of the municipality which are located within the Little Lehigh Creek Watershed as delineated on an official map available for inspection at the municipal office. A map of the Little Lehigh Creek Watershed at a reduced scale is included in Appendix A for general reference.

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

A. Land development.

B. Subdivision.

C. Construction of new or additional impervious surfaces (driveways, parking lots, etc.).

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

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

F. Installation of stormwater systems or appurtenances thereto.

* G. Regulated Earth Disturbance Activities.

SECTION 106. EXEMPTIONS

A. Impervious Cover - Any proposed Regulated Activity, except those defined in Section 105.E. and 105.F., which would create 10,000 square feet or less of additional impervious cover is exempt from the Drainage Plan preparation provisions of this Ordinance. The date of the Municipal Ordinance adoption of the original Little Lehigh Act 167 Stormwater Management Ordinance (1988) shall be the starting point from which to consider tracts as "parent tracts" in which future subdivisions and respective impervious area computations shall be cumulatively considered. For development taking place in stages, the entire development plan must be used in determining conformance with these criteria. Additional impervious cover shall include, but not be limited to, additional indoor living spaces, decks, patios, garages, driveways, storage sheds and similar structures, any roof, parking or driveway areas and any new streets and sidewalks constructed as part of or for the proposed Regulated Activity. Any additional areas proposed to initially be gravel, crushed stone, porous pavement, etc. shall be assumed to be impervious for the purposes of comparison to the exemption criteria. Any existing gravel, crushed stone or hard packed soil areas on a site shall be considered as pervious cover for the purpose of exemption evaluation. All of the impervious cover added incrementally to a site above the initial 10,000 square feet shall be subject to the provisions of this Ordinance. If a site has previously received an exemption and is proposing additional development such that the total impervious cover on the site exceeds 10,000 square

feet, the total impervious cover on the site proposed since the original ordinance date must meet the provisions of this Ordinance.

B. Prior Drainage Plan Approval - Any Regulated Activity for which a Drainage Plan was previously prepared as part of a subdivision or land development proposal that received preliminary plan approval from the municipality prior to the effective date of this Ordinance is exempt from the Drainage Plan preparation provisions of this Ordinance, except as cited in Section 106.C., provided that the approved Drainage Plan included design of stormwater facilities to control runoff from the site currently proposed for Regulated Activities consistent with ordinance provisions in effect at the time of approval and the approval has not lapsed under the Municipalities Planning Code. If significant revisions are made to the Drainage Plan after both the preliminary plan approval and the effective date of this Ordinance, preparation of a new Drainage Plan, subject to the provisions of this Ordinance, shall be required. Significant revisions would include a change in control methods or techniques, relocation or redesign of control measures or changes necessary because soil or other conditions are not as stated on the original Drainage Plan.

C. These exemptions shall not relieve the applicant from implementing such measures as are necessary to protect health, safety, property, and State Water Quality Requirements. These measures include adequate and safe conveyance of stormwater on the site and as it leaves the site. These exemptions do not relieve the applicant from the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act or ordinance.

D. No exemptions shall be provided for regulated activities as defined in Sections 105.E. and 105.F.

SECTION 107. REPEALER

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

SECTION 108. SEVERABILITY

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

SECTION 109. COMPATIBILITY WITH OTHER ORDINANCE REQUIREMENTS

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

SECTION 110. DUTY OF PERSONS ENGAGED IN THE DEVELOPMENT OF LAND

Notwithstanding any provisions of this Ordinance, including exemption and waiver provisions, any landowner and any person engaged in the alteration or development of land which may affect stormwater runoff characteristics shall implement such measures as are reasonably necessary to prevent injury to health, safety or other property. Such measures shall include such actions as are required to manage the rate, volume, direction and quality of resulting stormwater runoff in a manner which otherwise adequately protects health and property from possible injury.

ARTICLE 2
DEFINITIONS

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

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

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

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

* **Accelerated Erosion –** The removal of the surface of the land through the combined action of human activities and natural processes, at a rate greater than would occur because of the natural process alone.

* **Best Management Practice (BMP)** – Activities, facilities, measures or procedures used to manage stormwater quantity and quality impacts from the Regulated Activities listed in Section 105, to meet State Water Quality Requirements, to promote groundwater recharge and to otherwise meet the purposes of this Ordinance.

* **Best Management Practice Operations and Maintenance Plan** – Documentation, included as part of a Drainage Plan, detailing the proposed BMPs, how they will be operated and maintained and who will be responsible.

Bioretention - Densely vegetated, depressed features that store stormwater and filter it through vegetation, mulch, planting soil, etc. Ultimately stormwater is evapotranspirated, infiltrated, or discharged. Optimal bioretention areas mimic natural forest ecosystems in terms of species diversity, density, distribution, use of native plants, etc.

Buffer – (1) Streamside Buffer - A zone of variable width located along a stream that is vegetated and is designed to filter pollutants from runoff.

(2) Special Geologic Feature Buffer – A required isolation distance from a special

geologic feature to a proposed BMP needed to reduce the risk of sinkhole formation due to stormwater management activities.

Capture/Reuse - Stormwater management techniques such as cisterns and rain barrels which direct runoff into storage devices, surface or sub-surface, for later re-use, such as for irrigation of gardens and other planted areas. Because this stormwater is utilized and no pollutant discharge results, water quality performance is superior to other non-infiltration BMPs.

Carbonate Bedrock – Rock consisting chiefly of carbonate minerals, such as limestone and dolomite; specifically a sedimentary rock composed of more than 50% by weight of carbonate minerals that underlies soil or other unconsolidated, superficial material.

Cistern - An underground reservoir or tank for storing rainwater.

Closed Depression - A distinctive bowl-shaped depression in the land surface. It is characterized by internal drainage, varying magnitude, and an unbroken ground surface.

Conservation District - The Lehigh or Berks County Conservation District, as applicable.

Constructed Wetlands - Constructed wetlands are similar to wet ponds (see below) and consist of a basin which provides for necessary stormwater storage as well as a permanent pool or water level, planted with wetland vegetation. To be successful, constructed wetlands must have adequate natural hydrology (both runoff inputs as well as soils and water table which allow for maintenance of a permanent pool of water). In these cases, the permanent pool must be designed carefully, usually with shallow edge benches, so that water levels are appropriate to support carefully selected wetland vegetation.

Culvert - A pipe, conduit or similar structure including appurtenant works which carries surface water.

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

DEP - The Pennsylvania Department of Environmental Protection (formerly the Pennsylvania Department of Environmental Resources).

Design Storm - The depth and time distribution of precipitation from a storm event measured in probability of occurrence (e.g., 50-yr. storm) and duration (e.g. 24-hour), and used in computing stormwater management control systems.

Detention Basin - A basin designed to retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

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

Development Site (Site) - The specific tract of land for which a Regulated Activity is proposed.

Diffused Drainage – See Sheet Flow.

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

Drainage Plan - The documentation of the proposed stormwater quantity and quality management controls to be used for a given development site, including a BMP Operations and Maintenance Plan, the contents of which are established in Section 403.

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

Erosion - The removal of soil particles by the action of water, wind, ice, or other geological agents.

Existing Uses –Those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards. (25 Pa. Code Chapter 93.1)

Fill – Man-made deposits of natural soils or rock products and waste materials.

Filter Strips – See Vegetated Buffers.

Freeboard - The incremental depth in a stormwater management structure, provided as a safety factor of design, above that required to convey the design runoff event.

Groundwater Recharge - Replenishment of existing natural underground water supplies.

Hardship Waiver Request – A written request for a waiver alleging that the provisions of this Ordinance inflict unnecessary hardship upon the applicant. Waivers from the water quality provisions of this Ordinance shall not be granted.

Hot Spot Land Uses – A Land Use or activity that generates higher concentrations of hydrocarbons, trace metals or other toxic substances than typically found in stormwater runoff. These land uses are listed in Section 304.P.

Impervious Surface (Impervious Cover) - A surface which prevents the percolation of water into the ground.

Infiltration Practice - A practice designed to direct runoff into the ground, e.g. French drain, seepage pit, seepage trench or bioretention area.

Karst – A type of topography or landscape characterized by depressions, sinkholes, limestone towers and steep-sided hills, underground drainage and caves. Karst is usually formed on carbonate rocks, such as limestones or dolomites and sometimes gypsum.

Land Development - (i) The improvement of one lot or two or more contiguous lots, tracts or parcels of land for any purpose involving (a) a group of two or more buildings, or (b) the division or allocation of land or space between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups or other features; (ii) a subdivision of land.

Loading Rate – The ratio of the land area draining to the system, as modified by the weighting factors in Section 307.B., compared to the base area of the infiltration system.

Low Impact Development – A development approach that promotes practices that will minimize post-development runoff rates and volumes thereby minimizing needs for artificial conveyance and storage facilities. Site design practices include preserving natural drainage features, minimizing impervious surface area, reducing the hydraulic connectivity of impervious surfaces, and protecting natural depression storage.

"Local" Runoff Conveyance Facilities - Any natural channel or manmade conveyance system which has the purpose of transporting runoff from the site to the mainstem.

Mainstem (main channel) - Any stream segment or other conveyance used as a reach in the Little Lehigh Creek hydrologic model.

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

Maryland Stormwater Design Manual – A stormwater design manual written by the Maryland Department of the Environment and the Center for Watershed Protection. As of January 2004, the Manual can be obtained through the following web site: www.mde.state.md.us.

Minimum Disturbance/Minimum Maintenance Practices (MD/MM) - A site design practice in which careful limits are placed on site clearance prior to development allowing for maximum retention of existing vegetation (woodlands and other), minimum disturbance and compaction of existing soil mantle and minimum site application of chemicals post-development. Typically, MD/MM includes disturbance setback criteria from buildings as well as related site improvements such as walkways, driveways, roadways, and any other improvements. These criteria may vary by community context as well as by type of development being proposed. Additionally, MD/MM also shall include provisions (e.g., deed restrictions, conservation easements) to protect these areas from future disturbance and from application of fertilizers, pesticides, and herbicides.

Municipality - [municipal name], Lehigh or Berks County (as applicable), Pennsylvania.

No Harm Option – The option of using a less restrictive runoff quantity control if it can be shown that adequate and safe runoff conveyance exists and that the less restrictive control would not adversely affect health, safety and property.

NPDES - National Pollutant Discharge Elimination System.

NRCS - Natural Resource Conservation Service - U.S. Department of Agriculture. (Formerly the Soil Conservation Service.)

Oil/Water Separator – A structural mechanism designed to remove free oil and grease (and possibly solids) from stormwater runoff.

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

Peak Discharge - The maximum rate of flow of stormwater runoff at a given location and time resulting from a specified storm event.

Penn State Runoff Model (PSRM) - The computer-based hydrologic modeling technique used in previous Act 167 Plans. PSRM was also updated to include water quality modeling capabilities and renamed PSRM-QUAL. The PSRM and PSRM-QUAL calculation methodologies were used as the basis for writing the WATERSHED model.

* **Person –** An individual, partnership, public or private association or corporation, or a governmental unit, public utility or other for or not for profit statutory entity or other legal entity whatsoever which is recognized by law as the subject of rights and duties.

* **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.

Preliminary Site Investigation – The determination of the depth to bedrock, the depth to the seasonal high water table and the soil permeability for a possible infiltration location on a site through the use of published data and on-site surveys. In carbonate bedrock areas, the location of special geologic features must also be determined along with the associated buffer distance to the possible infiltration area. See Appendix G.

Public Water Supplier – A person who owns or operates a public water system.

Public Water System – A system which provides water to the public for human consumption which has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. (See 25 Pa. Code Chapter 109)

Qualified Geotechnical Professional – A licensed professional geologist or a licensed professional engineer who has a background or expertise in geology or hydrogeology.

Rational Method - A method of peak runoff calculation using a standardized runoff coefficient (rational 'c'), acreage of tract and rainfall intensity determined by return period and by the time necessary for the entire tract to contribute runoff. The rational method formula is stated as follows: Q = ciA, where "Q" is the calculated peak flow rate in cubic feet per second, "c" is the

dimensionless runoff coefficient (see Appendix C), "i" is the rainfall intensity in inches per hour, and "A" is the area of the tract in acres.

Reach - Any of the natural or man-made runoff conveyance channels used for watershed runoff modeling purposes to connect the subareas and transport flows downstream.

Regulated Activities - Actions or proposed actions which impact upon proper management of stormwater runoff and which are governed by this Ordinance as specified in Section 105.

* **Regulated Earth Disturbance Activities** – Earth disturbance activity other than agricultural plowing or tilling of one acre or more with a point source discharge to surface waters or to the municipality's storm sewer system or earth disturbance activity of five acres or more regardless of the planned runoff. This includes earth disturbance on any portion of, part or during any stage of a larger common plan of development.

Release Rate - The percentage of the pre-development peak rate of runoff for a development site to which the post-development peak rate of runoff must be controlled to avoid peak flow increases throughout the watershed.

Return Period - The average interval in years over which an event of a given magnitude can be expected to recur. For example, the twenty-five (25) year return period rainfall or runoff event would be expected to recur on the average once every twenty-five years.

* **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.

Runoff - That part of precipitation which flows over the land.

Sediment Traps/Catch Basin Sumps – A chamber which provides storage below the outlet in a storm inlet to collect sediment, debris and associated pollutants, typically requiring periodic clean out.

Seepage Pit/Seepage Trench - An area of excavated earth filled with loose stone or similar material and into which surface water is directed for infiltration into the ground.

* **Separate Storm Sewer System –** A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains) primarily used for collecting and conveying stormwater runoff.

Sheet Flow – Stormwater runoff flowing in a thin layer over the ground surface.

Soil-Cover-Complex Method - A method of runoff computation developed by NRCS which is based upon relating soil type and land use/cover to a runoff parameter called a Curve Number.

Special Geologic Features – Carbonate bedrock features, including but not limited to closed depressions, existing sinkholes, fracture traces, lineaments, joints, faults, caves and pinnacles,

which may exist and must be identified on a site when stormwater management BMPs are being considered.

Spill Prevention and Response Program – A program that identifies procedures for preventing and, as needed, cleaning up potential spills and makes such procedures known and the necessary equipment available to appropriate personnel.

* **State Water Quality Requirements** - As defined under State regulations -- protection of designated and existing uses (See 25 Pa. Code Chapters 93 and 96)--including:

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

B. "Existing uses" are those attained as of November 1975, regardless whether they have been designated in Chapter 93. Regulated Earth Disturbance activities must be designed to protect and maintain existing uses and maintain the level of water quality necessary to protect those uses in all streams, and to protect and maintain water quality in special protection streams.

C. Water quality involves the chemical, biological and physical characteristics of surface water bodies. After Regulated Earth Disturbance activities are complete, these characteristics can be impacted by addition of pollutants such as sediment, and changes in habitat through increased flow volumes and/or rates as a result of changes in land surface area from those activities. Therefore, permanent discharges to surface waters must be managed to protect the stream bank, streambed and structural integrity of the waterway, to prevent these impacts.

Storage Indication Method – A method of routing or moving an inflow hydrograph through a reservoir or detention structure. The method solves the mass conservation equation to determine an outflow hydrograph as it leaves the storage facility.

Storm Drainage Problem Areas - Areas which lack adequate stormwater collection and/or conveyance facilities and which present a hazard to persons or property. These areas are either documented in Appendix B of this Ordinance or identified by the municipality or municipal engineer.

Storm Sewer - A system of pipes or other conduits which carries intercepted surface runoff, street water and other wash waters, or drainage, but excludes domestic sewage and industrial wastes.

Stormwater – The surface runoff generated by precipitation reaching the ground surface.

Stormwater Filters - Any number of structural mechanisms such as multi-chamber catch basins, sand/peat filters, sand filters, and so forth which are installed to intercept stormwater flow and remove pollutants prior to discharge. Typically, these systems require periodic maintenance and clean out.

Stormwater Management Plan - The plan for managing stormwater runoff adopted by Lehigh County for the Little Lehigh Creek Watershed as required by the Act of October 4, 1978, P.L. 864, (Act 167), as amended, and known as the "Stormwater Management Act".

Stream - A watercourse.

Subarea - The smallest unit of watershed breakdown for hydrologic modeling purposes for which the runoff control criteria have been established in the Stormwater Management Plan.

Subdivision - The division or redivision of a lot, tract or parcel of land by any means into two or more lots, tracts, parcels or other divisions of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, transfer of ownership or building or lot ownership.

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

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

Technical Best Management Practice Manual & Infiltration Feasibility Report, November 2002 – The report written by Cahill Associates that addresses the feasibility of infiltration in carbonate bedrock areas in the Little Lehigh Creek Watershed. The report is available at the LVPC offices.

Trash/Debris Collectors – Racks, screens or other similar devices installed in a storm drainage system to capture coarse pollutants (trash, leaves, etc.).

Vegetated Buffers - Gently sloping areas that convey stormwater as sheet flow over a broad, densely vegetated earthen area, possibly coupled with the use of level spreading devices. Vegetated buffers should be situated on minimally disturbed soils, have low-flow velocities and extended residence times.

Vegetated Roofs - Vegetated systems installed on roofs that generally consist of a waterproof layer, a root-barrier, drainage layer (optional), growth media, and suitable vegetation. Vegetated roofs store and eventually evapotranspirate the collected rooftop rainfall; overflows may be provided for larger storms.

Vegetated Swales - Broad, shallow, densely vegetated, earthen channels designed to treat stormwater while slowly infiltrating, evapotranspirating, and conveying it. Swales should be gently sloping with low flow velocities to prevent erosion. Check dams may be added to enhance performance.

Water Quality Inserts – Any number of commercially available devices that are inserted into storm inlets to capture sediment, oil, grease, metals, trash, debris, etc.

Watercourse - Any channel of conveyance of surface water having defined bed and banks, whether natural or artificial, with perennial or intermittent flow.

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

WATERSHED - The computer-based hydrologic modeling technique adapted to the Little Lehigh Creek Watershed for the Act 167 Plan. This model was written by Tarsi Software Laboratories and uses the same algorithms found in the Penn State Runoff Quality Model (PSRM-QUAL). The model has been "calibrated" to reflect actual flow values by adjusting key model input parameters.

Wet Detention Ponds – A basin that provides for necessary stormwater storage as well as a permanent pool of water. To be successful, wet ponds must have adequate natural hydrology (both runoff inputs as well as soils and water table which allow for maintenance of a permanent pool of water) and must be able to support a healthy aquatic community so as to avoid creation of mosquito and other health and nuisance problems.

ARTICLE 3
STORMWATER MANAGEMENT REQUIREMENTS

SECTION 301. GENERAL REQUIREMENTS

A. All Regulated Activities in the municipality shall be subject to the stormwater management requirements of this Ordinance.

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

C. The existing locations of concentrated drainage discharge onto adjacent property shall not be altered without written approval of the affected property owner(s).

D. Areas of existing diffused drainage discharge onto adjacent property shall be managed such that, at minimum, the peak diffused flow does not increase in the general direction of discharge, except as otherwise provided in this Ordinance. If diffused flow is proposed to be concentrated and discharged onto adjacent property, the developer must document that there are adequate downstream conveyance facilities to safely transport the concentrated discharge to the point of pre-development flow concentration, to the stream reach or otherwise prove that no harm will result from the concentrated discharge. Areas of existing diffused drainage discharge shall be subject to any applicable release rate criteria in the general direction of existing discharge whether they are proposed to be concentrated or maintained as diffused drainage areas.

E. Where a site is traversed by watercourses other than those for which a 100-year floodplain is defined by the municipality, there shall be provided drainage easements conforming substantially with the line of such watercourses. The width of any easement shall be adequate to provide for unimpeded flow of storm runoff based on calculations made in conformance with Section 307 for the 100-year return period runoff and to provide a freeboard allowance of one-half (0.5) foot above the design water surface level. The terms of the easement shall prohibit excavation, the placing of fill or structures, and any alterations which may adversely affect the flow of stormwater within any portion of the easement. Also, periodic maintenance of the easement to ensure proper runoff conveyance shall be required. Watercourses for which the 100-year floodplain is formally defined are subject to the applicable municipal floodplain regulations.

F. When it can be shown that, due to topographic conditions, natural drainage swales on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the line and grade of such natural drainage swales. Capacities of open channels shall be calculated using the Manning Equation.

G. Post-construction BMPs shall be designed, installed, operated and maintained to meet the requirements of the Clean Streams Law and implementing regulations, including the established practices in 25 Pa. Code Chapter 102 and the specifications of this ordinance as to prevent accelerated erosion in watercourse channels and at all points of discharge.

* H. No Earth Disturbance activities associated with any Regulated Activities shall commence until approval by the municipality of a plan which demonstrates compliance with the requirements of this Ordinance.

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

J. Infiltration for stormwater management is encouraged where soils and geology permit, consistent with the provisions of this Ordinance and, where appropriate, the Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock in Appendix D. Infiltration is encouraged for capturing and treating the Water Quality Volume (as calculated in Section 304), any part of the Water Quality Volume or for otherwise meeting the purposes of this Ordinance.

* SECTION 302. PERMIT REQUIREMENTS BY OTHER GOVERNMENT ENTITIES

A. The following permit requirements apply to certain Regulated and Earth Disturbance activities and must be met prior to commencement of Regulated and Earth Disturbance activities, as applicable:

1. All Regulated and Earth Disturbance activities subject to permit requirements by DEP under regulations at 25 Pa. Code Chapter 102.

2. Work within natural drainageways subject to permit by DEP under 25 Pa. Code Chapter 102.

3. Any stormwater management facility that would be located in or adjacent to surface waters of the Commonwealth, including wetlands, subject to permit by DEP under 25 Pa. Code Chapter 105.

4. Any stormwater management facility that would be located on a State highway right-of-way or require access from a State highway shall be subject to approval by the Pennsylvania Department of Transportation (PENNDOT).

5. Culverts, bridges, storm sewers or any other facilities which must pass or convey flows from the tributary area and any facility which may constitute a dam subject to permit by DEP under 25 Pa. Code Chapter 105.

* **SECTION 303. EROSION AND SEDIMENT CONTROL DURING REGULATED EARTH DISTURBANCE ACTIVITIES**

A. No Regulated Earth Disturbance activities within the municipality shall commence until approval by the municipality of an Erosion and Sediment Control Plan for construction activities. Written approval by DEP or a delegated County Conservation District shall satisfy this requirement.

B. An Erosion and Sediment Control Plan is required by DEP regulations for any Earth Disturbance activity of 5,000 square feet or more under Pa. Code § 102.4(b).

C. A DEP NPDES Stormwater Discharges Associated with Construction Activities Permit is required for Regulated Earth Disturbance activities under Pa. Code Chapter 92.

D. Evidence of any necessary permit(s) for Regulated Earth Disturbance Activities from the appropriate DEP regional office or County Conservation District must be provided to the municipality before the commencement of an Earth Disturbance activity.

E. A copy of the Erosion and Sediment Control Plan and any permit, as required by DEP regulations, shall be available at the project site at all times.

SECTION 304. POST CONSTRUCTION WATER QUALITY CRITERIA

* A. No Regulated Earth Disturbance activities within the municipality shall commence until approval by the municipality of a plan which demonstrates compliance with this Ordinance. DEP has determined that this Ordinance meets State Water Quality Requirements. Therefore, any approvals under this Ordinance would satisfy the post

construction stormwater management requirements associated with an NPDES Permit for Stormwater Discharges Associated with Construction Activities.

B. The Water Quality Volume (WQv) shall be captured and treated. The WQv shall be calculated two ways. First, WQv shall be calculated using the following formula:

$$WQv = \frac{(c)(P)(A)}{12}$$

Where WQv = water quality volume in acre-feet
c = Rational Method post-development runoff coefficient for the 2-year storm
P = 1.25 inches
A = Area in acres of proposed Regulated Activity

Second, the WQv shall be calculated as the difference in runoff volume from pre-development to post-development for the 2-year return period storm. The effect of closed depressions on the site shall be considered in this calculation. The larger of these two calculated volumes shall be used as the WQv to be captured and treated, except that in no case shall the WQv be permitted to exceed 1.25-inches of runoff over the site area.

C. The WQv shall be calculated for each post-development drainage direction on a site for sizing BMPs. Site areas having no impervious cover and no proposed disturbance during development may be excluded from the WQv calculations and do not require treatment.

D. If an applicant is proposing to use a wet pond, constructed wetland or other BMP that ponds water on the land surface and may receive direct sunlight, the discharge from that BMP must be treated by infiltration, a vegetated buffer, filter strip, bioretention, vegetated swale or other BMP that provides a thermal benefit to protect the High Quality waters of the Little Lehigh Creek from thermal impacts.

E. Any stormwater runoff from the site as a result of the Regulated Activities must either be treated with infiltration or two acceptable BMPs such as those listed in Section 304.N.

F. Infiltration BMPs shall not be constructed on fill.

G. The applicant shall document the bedrock type(s) present on the site from published sources. Any apparent boundaries between carbonate and non-carbonate bedrock shall be verified through more detailed site evaluations by a qualified geotechnical professional.

H. For each proposed Regulated Activity in the watershed, the applicant shall conduct a Preliminary Site Investigation on the portion of the site that is judged to be the best candidate hydrogeologically for possible infiltration, including gathering data from published sources, a field inspection of the site, a minimum of one test pit and a minimum of two percolation tests, as outlined in Appendix G. This investigation will

determine depth to bedrock, depth to the seasonal high water table, soil permeability and location of special geologic features, if applicable. The location(s) of special geologic features shall be verified by a qualified geotechnical professional.

I. For entirely non-carbonate sites, the WQv shall be infiltrated unless the applicant demonstrates that it is infeasible to infiltrate the WQv for reasons of seasonal high water table, permeability rate, soil depth or isolation distances; or except as provided in Section 304.T. The Preliminary Site Investigation described in Section 304.H. shall continue on different areas of the site until a suitable infiltration location is found or the entire site is determined to be infeasible for infiltration. For proposed infiltration areas, the Additional Site Investigation and Testing as outlined in Appendix G shall be completed. The municipality may determine infiltration to be infeasible if there are known existing conditions or problems that may be worsened by the use of infiltration. The following conditions are suitable for infiltration in non-carbonate areas:

- Depth to bedrock below the invert of the BMP greater than or equal to 2 feet
- Depth to seasonal high water table below the invert of the BMP greater than or equal to 3 feet (If the depth to bedrock is between 2 and 3 feet and the evidence of the seasonal high water table is not found in the soil, no further testing to locate the depth to seasonal high water table is required.)
- Soil permeability greater than or equal to 0.5 inches/hour and less than or equal to 12 inches per hour
- Setback distances or buffers as follows:
  - 100 feet from water supply wells
  - 10 feet downgradient or 100 feet upgradient from building foundations
  - 50 feet from septic system drainfields
  - 50 feet from a geologic contact with carbonate bedrock unless a Preliminary Site Investigation is done in the carbonate bedrock to show the absence of special geologic features within 50 feet of the proposed infiltration area.
  - 100 feet from the property line unless documentation is provided to show that all setbacks from wells, foundations and drainfields on neighboring properties will be met.

If it is not feasible to infiltrate the full WQv, the applicant shall infiltrate that portion of the WQv that is feasible based on the site characteristics.

J. In entirely carbonate areas, in addition to the testing required in Section 304.H., the Preliminary Site Investigation shall include an assessment of the remainder of the site for possible infiltration based on required isolation distances from special geologic features and the likely soil depth and permeability based on published data or other site data available. Where infiltration BMPs are proposed, the applicant shall conduct the Additional Site Investigation and Testing as outlined in Appendix G. The soil depth, percolation rate and proposed loading rate, each weighted as described in Section 307, along with the buffer from special geologic features shall be compared to the Recommendation Chart for Infiltration Stormwater Management BMPs in

Carbonate Bedrock in Appendix D to determine if the site is recommended for infiltration. If at any point in the Preliminary Site Investigation the data (e.g. location of Karst features on the site or the published soils data for the site) indicates that the entire site will not be recommended for infiltration based on the ordinance standards, then no further investigation is required. In addition to the recommendation from Appendix D, the following conditions are required for infiltration in carbonate areas:

- Depth to bedrock below the invert of the BMP greater than or equal to 2 feet
- Depth to seasonal high water table below the invert of the BMP greater than or equal to 3 feet (If the depth to bedrock is between 2 and 3 feet and the evidence of the seasonal high water table is not found in the soil, no further testing to locate the depth to seasonal high water table is required)
- Soil permeability greater than or equal to 0.5 inches/hour and less than or equal to 12 inches per hour
- Setback distances or buffers as follows:
  - 100 feet from water supply wells
  - 10 feet downgradient or 100 feet upgradient from building foundations
  - 50 feet from septic system drainfields
  - 100 feet from the property line unless documentation is provided to show that all setbacks from wells, foundations and drainfields on neighboring properties will be met.

Applicants are not required to use infiltration BMPs on a carbonate site even if the site falls in the "Recommended" range on the chart in Appendix D. If infiltration is not proposed, the WQv shall be treated by two acceptable BMPs, as specified in Section 304.O.

K. If a site has both carbonate and non-carbonate areas, the applicant shall investigate the ability of the non-carbonate portion of the site to fully meet this Ordinance to control runoff for the whole site through infiltration. If that proves infeasible, the applicant shall perform the Preliminary Site Investigation for the carbonate area to determine the appropriate design strategy. No infiltration structure in the non-carbonate area shall be located within 50 feet of a boundary with carbonate bedrock, except when a Preliminary Site Investigation has been done showing the absence of special geologic features within 50 feet of the proposed infiltration area.

L. If infiltration BMPs are proposed in carbonate areas, the post-development 2-year runoff volume leaving the site shall be 80% or more of the pre-development runoff volume for the carbonate portion of the site to prevent infiltration of volumes far in excess of the pre-development infiltration volume.

M. Site areas proposed for infiltration shall be protected from disturbance and compaction except as necessary for construction of infiltration BMPs.

N. If infiltration of the entire WQv is not proposed, the remainder of the WQv shall be treated by two acceptable BMPs in series for each discharge location. Sheet flow draining across a pervious area can be considered as one BMP. Sheet flow across

impervious areas and concentrated flow shall flow through two BMPs. If sheet flow from an impervious area is to be drained across a pervious area as one BMP, the length of the pervious area must be equal to or greater than the length of impervious area. In no case, may the same BMP be employed consecutively to meet this requirement. Acceptable BMPs are listed below along with the recommended reference for design.

Best Management Practice	**Design Reference**
Bioretention	Low Impact Development Design Strategies, Prince George's County, Md., June 1999[2]
Capture/Reuse[1]	Texas Guide to Rainwater Harvesting, 2nd Edition. Texas Water Development Board, Center for Maximum Potential Building Systems, 1997[3]
Constructed Wetlands	2000 Maryland Stormwater Design Manual, Maryland Department of the Environment[4]
Minimum Disturbance/ Minimum Maintenance Practices	Conservation Design for Stormwater Management. Delaware Dept. of Natural Resources and Brandywine Conservancy, September 1997[5]
Oil/Water Separators	Georgia Stormwater Management Manual Volume 2 Technical Handbook, August 2001[6]
Sediment Traps/Catch Basin Sumps	US Environmental Protection Agency's Post-Construction Storm Water Management in New Development & Redevelopment BMP Fact Sheet for "Catch Basins/Catch Basin Insert"[7]
Significant Reduction of Existing Impervious Cover	N/A
Stormwater Filters (Sand, Peat, Compost, etc.)	Design of Stormwater Filtering Systems. Claytor, R. and Schueler, T., Center for Watershed Protection, December 1996[8]
Trash/Debris Collectors in Catch Basins	Pennsylvania Handbook of BMPs for Developing Areas[9] or Latest PA Dept. of Environmental Protection Manual
Vegetated Buffers/Filter Strips	Pennsylvania Handbook of BMPs for Developing Areas[9] or Latest PA Dept. of Environmental Protection Manual
Vegetated Roofs	Roof Gardens: History, Design, and Construction. Osmundson, T., W.W. Norton & Co., 1998[10]
Vegetated Swales/Filter Strips	2000 Maryland Stormwater Design Manual, Maryland Department of the Environment[4]

Best Management Practice	Design Reference
Water Quality Inserts for Inlets	Pennsylvania Handbook of BMPs for Developing Areas[9] or Latest PA Dept. of Environmental Protection Manual
Wet Detention Ponds	Pennsylvania Handbook of BMPs for Developing Areas[9] or Latest PA Dept. of Environmental Protection Manual

[1] If this BMP is used to treat the entire WQv then only one BMP is required because of this BMPs superior water quality performance.
[2] Available at www.co.pg.md.us/Government/AgencyIndex/DER/PPD/LID/LiDNatl.pdf as of January 2004
[3] Available at www.twdb.state.tx.us/publications/reports/RainHarv.pdf as of January 2004
[4] Available at www.mde.state.md.us as of January 2004
[5] Available at www.dnrec.state.de.us/dnrec2000/Divisions/Soil/Stormwater/Apps/DesignManualRequest.htm as of January 2004
[6] Available at www.georgiastormwater.com as of January 2004
[7] Available at http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post_7.cfm as of January 2004
[8] Available from the Center for Watershed Protection (www.cwp.org) as of January 2004
[9] Available at www.dep.state.pa.us (keyword Stormwater) as of January 2004
[10] Available at www.wwnorton.com as of January 2004

O. Stormwater runoff from Hot Spot land uses shall be pre-treated. In no case, may the same BMP be employed consecutively to meet this requirement and the requirement in Section 304.N. Acceptable methods of pre-treatment are listed below.

Hot Spot Land Use	Pre-treatment Method(s)
Vehicle Maintenance and Repair Facilities including Auto Parts Stores	-Oil/Water Separators -Use of Drip Pans and/or Dry Sweep Material Under Vehicles/Equipment -Use of Absorbent Devices to Reduce Liquid Releases -Spill Prevention and Response Program
Vehicle Fueling Stations	-Oil/Water Separators -Water Quality Inserts for Inlets -Spill Prevention and Response Program
Storage Areas for Public Works	-Oil/Water Separators -Sediment Traps/Catch Basin Sumps -Water Quality Inserts for Inlets -Use of Drip Pans and/or Dry Sweep Material Under Vehicles/Equipment -Use of Absorbent Devices to Reduce Liquid Releases -Spill Prevention and Response Program -Diversion of Stormwater away from Potential Contamination Areas
Outdoor Storage of Liquids	-Spill Prevention and Response Program
Commercial Nursery Operations	-Vegetated Swales/Filter Strips -Constructed Wetlands -Stormwater Collection and Reuse

Hot Spot Land Use	Pre-treatment Method(s)
Salvage Yards and Recycling Facilities*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Fleet Storage Yards and Vehicle Cleaning Facilities*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Facilities that Store or Generate Regulated Substances*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Marinas*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit
Certain Industrial Uses (listed under NPDES)*	-BMPs that are a part of a Stormwater Pollution Prevention Plan under an NPDES Permit

*Regulated under the NPDES Stormwater Program

Design references for the pre-treatment methods, as necessary, are listed below. The applicant may demonstrate that due to the site characteristics the land use is not a Hot Spot land use.

Pre-treatment Method	Design Reference
Constructed Wetlands	2000 Maryland Stormwater Design Manual, Maryland Department of the Environment[1]
Diversion of Stormwater away from Potential Contamination Areas	Pennsylvania Handbook of BMPs for Developing Areas[2] or Latest PA Dept. of Environmental Protection Manual
Oil/Water Separators	Georgia Stormwater Management Manual Volume 2 Technical Handbook, August 2001[3]
Sediment Traps/Catch Basin Sumps	US Environmental Protection Agency's Post-Construction Storm Water Management in New Development & Redevelopment BMP Fact Sheet for "Catch Basins/Catch Basin Insert"[4]
Stormwater Collection and Reuse (especially for irrigation)	Texas Guide to Rainwater Harvesting, 2nd Edition, Texas Water Development Board, Center for Maximum Potential Building Systems, 1997[5]
Stormwater Filters (Sand, Peat, Compost, etc.)	Design of Stormwater Filtering Systems. Claytor, R. and Schueler, T., Center for Watershed Protection, December 1996[6]
Trash/Debris Collectors in Catch Basins	Pennsylvania Handbook of BMPs for Developing Areas[2] or Latest PA Dept. of Environmental Protection Manual
Vegetated Swales/Filter Strips	2000 Maryland Stormwater Design Manual, Maryland Department of the Environment[1]
Water Quality Inserts for Inlets	Pennsylvania Handbook of BMPs for Developing Areas[2] or Latest PA Dept. of Environmental Protection Manual

[1] Available at www.mde.state.md.us as of January 2004
[2] Available at www.dep.state.pa.us (keyword Stormwater) as of January 2004
[3] Available at www.georgiastormwater.com as of January 2004
[4] Available at http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post_7.cfm as of January 2004
[5] Available at www.twdb.state.tx.us/publications/reports/RainHarv.pdf as of January 2004
[6] Available from the Center for Watershed Protection (www.cwp.org) as of January 2004

P. The use of infiltration BMPs is prohibited on Hot Spot land use areas.

Q. Stormwater infiltration BMPs shall not be placed in or on a special geologic feature(s). Additionally, stormwater runoff shall not be discharged into existing on-site sinkholes.

R. Applicants shall request, in writing, Public Water Suppliers to provide the Zone I Wellhead Protection radius, as calculated by the method outlined in the Pennsylvania Department of Environmental Protection Wellhead Protection regulations, for any public water supply well within 400 feet of the site. In addition to the setback distances specified in Section 304.I. and 304.J., infiltration is prohibited in the Zone I radius as defined and substantiated by the Public Water Supplier in writing. If the applicant does not receive a response from the Public Water Supplier, the Zone I radius is assumed to be 100 feet.

S. The volume and rate of the net increase in stormwater runoff from the Regulated Activities must be managed to prevent the physical degradation of receiving waters from such effects as scour and streambank destabilization, to satisfy State Water Quality Requirements.

T. The municipality may, after consultation with DEP, approve alternative methods for meeting the State Water Quality Requirements other than those in this Section, provided that they meet the minimum requirements of and do not conflict with State law including but not limited to the Clean Streams Law.

SECTION 305. STORMWATER MANAGEMENT DISTRICTS

A. Mapping of Stormwater Management Districts - To implement the provisions of the Little Lehigh Creek Watershed Stormwater Management Plan, the municipality is hereby divided into Stormwater Management Districts consistent with the Little Lehigh Creek Release Rate Map presented in the Plan. The boundaries of the Stormwater Management Districts are shown on an official map which is available for inspection at the municipal office. A copy of the official map at a reduced scale is included in Appendix A for general reference.

B. Description of Stormwater Management Districts - Two types of Stormwater Management Districts may be applicable to the municipality, namely Conditional No Detention Districts and Dual Release Rate Districts as described below.

1. Conditional No Detention Districts - Within these districts, the capacity of the "local" runoff conveyance facilities (as defined in Article 2) must be calculated to determine if adequate capacity exists. For this determination, the developer must calculate peak flows assuming that the site is developed as proposed and that the remainder of the local watershed is in the existing condition. The developer must also calculate peak flows assuming that the entire local watershed is developed per current zoning and that all new development would use the runoff controls specified by this Ordinance. The larger of the two peak flows calculated will be used in determining if adequate capacity exists. If

adequate capacity exists to safely transport runoff from the site to the main channel (as defined in Article 2), these watershed areas may discharge post-development peak runoff without detention facilities. If the capacity calculations show that the "local" runoff conveyance facilities lack adequate capacity, the developer shall either use a 100% release rate control or provide increased capacity of downstream elements to convey increased peak flows consistent with Section 306.P. Any capacity improvements must be designed to convey runoff from development of all areas tributary to the improvement consistent with the capacity criteria specified in Section 306.D. By definition, a storm drainage problem area associated with the "local" runoff conveyance facilities indicates that adequate capacity does not exist.

2. Dual Release Rate Districts - Within this district, the 2-year post-development peak runoff must be controlled to 30% of the pre-development 2-year runoff peak. Further, the 10-year, 25-year and 100-year post-development peak runoff must be controlled to the stated percentage of the pre-development peak. Release Rates associated with the 10- through 100-year events vary from 50% to 100% depending upon location in the watershed.

SECTION 306. STORMWATER MANAGEMENT DISTRICT IMPLEMENTATION PROVISIONS

A. Applicants shall provide a comparative pre- and post-construction stormwater management hydrograph analysis for each direction of discharge and for the site overall to demonstrate compliance with the provisions of this Ordinance.

B. Any stormwater management controls required by this Ordinance and subject to a dual release rate criteria shall meet the applicable release rate criteria for each of the 2-, 10-, 25- and 100-year return period runoff events consistent with the calculation methodology specified in Section 307.

C. The exact location of the Stormwater Management District boundaries as they apply to a given development site shall be determined by mapping the boundaries using the two-foot topographic contours provided as part of the Drainage Plan. The District boundaries as originally drawn coincide with topographic divides or, in certain instances, are drawn from the intersection of the watercourse and a physical feature such as the confluence with another watercourse or a potential flow obstruction (e.g. road, culvert, bridge, etc.). The physical feature is the downstream limit of the subarea and the subarea boundary is drawn from that point up slope to each topographic divide along the path perpendicular to the contour lines.

D. Any downstream capacity analysis conducted in accordance with this Ordinance shall use the following criteria for determining adequacy for accepting increased peak flow rates:

1. Natural or man-made channels or swales must be able to convey the increased

runoff associated with a 2-year return period event within their banks at velocities consistent with protection of the channels from erosion.

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

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

E. For a proposed development site located within one release rate category subarea, the total runoff from the site shall meet the applicable release rate criteria. For development sites with multiple directions of runoff discharge, individual drainage directions may be designed for up to a 100% release rate so long as the total runoff from the site is controlled to the applicable release rate.

F. For a proposed development site located within two or more release category subareas, the peak discharge rate from any subarea shall be the pre-development peak discharge for that subarea multiplied by the applicable release rate. The calculated peak discharges shall apply regardless of whether the grading plan changes the drainage area by subarea. An exception to the above may be granted if discharges from multiple subareas re-combine in proximity to the site. In this case, peak discharge in any direction may be a 100% release rate provided that the overall site discharge meets the weighted average release rate.

G. For a proposed development site located partially within a release rate category subarea and partially within a conditional no detention subarea, a significant portion of the site area subject to the release rate control may not be drained to the discharge point(s) located in the no detention subarea except as part of a "No Harm" or Hardship waiver procedure.

H. No portion of a site may be regraded between the Little Lehigh Creek Watershed and any adjacent watershed except as part of a "No Harm" or Hardship Waiver procedure.

I. Within a release rate category area, for a proposed development site which has areas which drain to a closed depression(s), the design release from the site will be the lesser of (a) the applicable release rate flow assuming no closed depression(s) or (b) the existing peak flow actually leaving the site. In cases where (b) would result in an unreasonably small design release, the design discharge of less than or equal to the release rate will be determined by the available downstream conveyance capacity to the main channel calculated using Section 306.D. and the minimum orifice criteria.

J. Off-site areas which drain through a proposed development site are not subject to release rate criteria when determining allowable peak runoff rates. However, on-site drainage facilities shall be designed to safely convey off-site flows through the development site using the capacity criteria in Section 306.D. and the detention criteria in Section 307.

K. For development sites proposed to take place in phases, all detention ponds shall be designed to meet the applicable release rate(s) applied to all site areas tributary to the proposed pond discharge direction. All site tributary areas will be assumed as developed, regardless of whether all site tributary acres are proposed for development at that time. An exception shall be sites with multiple detention ponds in series where only the downstream pond must be designed to the stated release rate.

L. Where the site area to be impacted by a proposed development activity differs significantly from the total site area, only the proposed impact area shall be subject to the release rate criteria. The impact area includes any proposed cover or grading changes.

M. Development proposals which, through groundwater recharge or other means, do not increase either the rate or volume of runoff discharged from the site compared to pre-development are not subject to the release rate provisions of this Ordinance.

N. "No Harm" Water Quantity Option - For any proposed development site not located in a conditional no detention district, the developer has the option of using a less restrictive runoff control (including no detention) if the developer can prove that special circumstances exist for the proposed development site and that "no harm" would be caused by discharging at a higher runoff rate than that specified by the Plan. Special circumstances are defined as any hydrologic or hydraulic aspects of the development itself not specifically considered in the development of the Plan runoff control strategy. Proof of "no harm" would have to be shown from the development site through the remainder of the downstream drainage network to the confluence of the creek with the Lehigh River. Proof of "no harm" must be shown using the capacity criteria specified in Section 306.D. if downstream capacity analysis is a part of the "no harm" justification.

Attempts to prove "no harm" based upon downstream peak flow versus capacity analysis shall be governed by the following provisions:

1. The peak flow values to be used for downstream areas for the design return period storms (2-, 10-, 25- and 100-year) shall be the values from the calibrated WATERSHED Model for the Little Lehigh Creek or as calculated by an applicant using an alternate method acceptable to the municipality. The flow values from the WATERSHED Model would be supplied to the developer by the municipality upon request.

2. Any available capacity in the downstream conveyance system as documented by a developer may be used by the developer only in proportion to his development site acreage relative to the total upstream undeveloped acreage from the identified capacity (i.e. if his site is 10% of the upstream undeveloped acreage, he may use up to 10% of the documented downstream available capacity).

3. Developer-proposed runoff controls which would generate increased peak flow

rates at storm drainage problem areas would, by definition, be precluded from successful attempts to prove "no harm", except in conjunction with proposed capacity improvements for the problem areas consistent with Section 306.P.

Any "no harm" justifications shall be submitted by the developer as part of the Drainage Plan submission per Article 4.

O. Regional Detention Alternatives - For certain areas within the study area, it may be more cost-effective to provide one control facility for more than one development site than to provide an individual control facility for each development site. The initiative and funding for any regional runoff control alternatives are the responsibility of prospective developers. The design of any regional control basins must incorporate reasonable development of the entire upstream watershed. The peak outflow of a regional basin would be determined based on the required release rate at the point of discharge.

P. Capacity Improvements - In certain instances, primarily within the conditional no detention areas, local drainage conditions may dictate more stringent levels of runoff control than those based upon protection of the entire watershed. In these instances, if the developer could prove that it would be feasible to provide capacity improvements to relieve the capacity deficiency in the local drainage network, then the capacity improvements could be provided by the developer in lieu of runoff controls on the development site. Peak flow calculations shall be done assuming that the local watershed is in the existing condition and then assuming that the local watershed is developed per current zoning and using the specified runoff controls. Any capacity improvements would be designed using the larger of the above peak flows and the capacity criteria specified in Section 306.D. All new development in the entire subarea(s) within which the proposed development site is located shall be assumed to implement the developer's proposed discharge control, if any.

Capacity improvements may also be provided as necessary to implement any regional detention alternatives or to implement a modified "no harm" option which proposes specific capacity improvements to provide that a less stringent discharge control would not create any harm downstream.

SECTION 307. CALCULATION METHODOLOGY

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

B. Infiltration BMP loading rate percentages in the Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock in Appendix D shall be calculated as follows:

$$\left(\frac{\text{Area Tributary to infiltration BMP}}{\text{Base area of infiltration BMP}} \right) * 100\%$$

The area tributary to the infiltration BMP shall be weighted as follows:

All disturbed areas to be made impervious:	weight at 100%
All disturbed areas to be made pervious:	weight at 50%
All undisturbed pervious areas:	weight at 0%
All existing impervious areas:	weight at 100%

C. Soil thickness is to be measured from the bottom of any proposed infiltration system. The effective soil thickness in the Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Bedrock in Appendix D is the measured soil thickness multiplied by the thickness factor based on soil permeability, as follows:

PERMEABILITY RANGE*	THICKNESS FACTOR
6.0 to 12.0 inches/hour	0.8
2.0 to 6.0 inches/hour	1.0
1.0 to 2.0 inches/hour	1.4
0.75 to 1.0 inches/hour	1.2
0.5 to 0.75 inches/hour	1.0

*If the permeability rate falls on a break between two thickness factors, the smaller thickness factor shall be used.

Sites with soil permeability greater than 12.0 in./hr. or less than 0.5 in./hr. are not recommended for infiltration.

D. The design of any detention basin intended to meet the requirements of this Ordinance shall be verified by routing the design storm hydrograph through the proposed basin using the storage indication method or other methodology demonstrated to be more appropriate. For basins designed using the rational method technique, the design hydrograph for routing shall be either the Universal Rational Hydrograph or the modified rational method trapezoidal hydrograph which maximizes detention volume. Use of the modified rational hydrograph shall be consistent with the procedure described in Section "PIPE.RAT" of the Users' Manual for the Penn State Urban Hydrograph Method (1987).

E. BMPs designed to store or infiltrate runoff and discharge to surface runoff or pipe flow shall be routed using the storage indication method.

F. BMPs designed to store or infiltrate runoff and discharge to surface runoff or pipe flow shall provide storage volume for the full WQv below the lowest outlet invert.

G. Wet Detention Ponds designed to have a permanent pool for the WQv shall assume that the permanent pool volume below the primary outlet is full at the beginning of design event routing for the purposes of evaluating peak outflows.

H. All stormwater detention facilities shall provide a minimum 1.0 foot freeboard above the maximum pool elevation associated with the 2- through 25-year runoff events. A 0.5 foot freeboard shall be provided above the maximum pool elevation of the 100-year runoff event. The freeboard shall be measured from the maximum pool elevation to the invert of the emergency spillway. The 2- through 100-year storm events shall be controlled by the primary outlet structure. An emergency spillway for each basin shall be designed to pass the 100-year return frequency storm peak basin inflow rate with a minimum 0.5 foot freeboard measured to the top of basin. The freeboard criteria shall be met considering any offsite areas tributary to the basin as developed, as applicable. If this detention facility is considered to be a dam as per DEP Chapter 105, the design of the facility must be consistent with the Chapter 105 regulations, and may be required to pass a storm greater than the 100-year event.

I. The minimum circular orifice diameter for controlling discharge rates from detention facilities shall be three (3) inches. Designs where a lesser size orifice would be required to fully meet release rates shall be acceptable provided that as much of the site runoff as practical is directed to the detention facilities.

J. Runoff calculations using the soil-cover-complex method shall use the Natural Resources Conservation Service Type II 24-hour rainfall distribution. The 24-hour rainfall depths for the various return periods to be used consistent with this Ordinance may be taken from NOAA Atlas 14, Volume 2 or the PennDOT Intensity - Duration - Frequency Field Manual ("PDT-IDF") (May 1986) for Region 4. The following values are taken from the PDT-IDF Field Manual:

Return Period	24-Hour Rainfall Depth
1-year	2.40 inches
2-year	3.00 inches
5-year	3.60 inches
10-year	4.56 inches
25-year	5.52 inches
50-year	6.48 inches
100-year	7.44 inches

A graphical and tabular presentation of the Type II-24 hour distribution is included in Appendix C.

K. Runoff calculations using the Rational Method shall use rainfall intensities consistent with appropriate times of concentration and return periods and the Intensity-Duration-Frequency Curves as presented in Appendix C.

L. Runoff Curve Numbers (CN's) to be used in the soil-cover-complex method shall be based upon the matrix presented in Appendix C.

M. Runoff coefficients for use in the Rational Method shall be based upon the table presented in Appendix C.

N. All time of concentration calculations shall use a segmental approach which may include one or all of the flow types below:

1. Sheet Flow (overland flow) calculations shall use either the NRCS average velocity chart (Figure 3-1, Technical Release-55, 1975) or the modified kinematic wave travel time equation (equation 3-3, NRCS TR-55, June 1986). If using the modified kinematic wave travel time equation, the sheet flow length shall be limited to 50 feet for designs using the Rational Method and limited to 150 feet for designs using the Soil-Cover-Complex method.

2. Shallow Concentrated Flow travel times shall be determined from the watercourse slope, type of surface and the velocity from Figure 3-1 of TR-55, June 1986.

3. Open Channel Flow travel times shall be determined from velocities calculated by the Manning Equation. Bankfull flows shall be used for determining velocities. Manning 'n' values shall be based on the table presented in Appendix C.

4. Pipe Flow travel times shall be determined from velocities calculated using the Manning Equation assuming full flow and the Manning 'n' values from Appendix C.

O. If using the Rational Method, all pre-development calculations for a given discharge direction shall be based on a common time of concentration considering both on-site and any off-site drainage areas. If using the Rational Method, all post-development calculations for a given discharge direction shall be based on a common time of concentration considering both on-site and any off-site drainage areas.

P. The Manning Equation shall be used to calculate the capacity of watercourses. Manning 'n' values used in the calculations shall be consistent with the table presented in Appendix C or other appropriate standard engineering 'n' value resources. Pipe capacities shall be determined by methods acceptable to the municipality.

Q. The Pennsylvania DEP, Chapter 105, Rules and Regulations, apply to the construction, modification, operation or maintenance of both existing and proposed dams, water obstructions and encroachments throughout the watershed. Criteria for design and construction of stormwater management facilities according to this Ordinance may not be the same criteria that are used in the permitting of dams under the Dam Safety Program.

ARTICLE 4
DRAINAGE PLAN REQUIREMENTS

SECTION 401. GENERAL REQUIREMENTS

For any of the Regulated Activities of this Ordinance, prior to the final approval of subdivision and/or land development plans, or the issuance of any permit, or the commencement of any Regulated Earth Disturbance activity, the owner, subdivider, developer or his agent shall submit a Drainage Plan and receive municipal approval of the Plan.

SECTION 402. EXEMPTIONS

Exemptions from the Drainage Plan Requirements are as specified in Section 106.

SECTION 403. DRAINAGE PLAN CONTENTS

The following items shall be included in the Drainage Plan:

A. General

1. General description of project.

2. General description of proposed permanent stormwater controls.

3. The name and address of the project site, the name and address of the owner of the property and the name of the individual or firm preparing the Drainage Plan.

B. Map(s) of the Project Area Showing:

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

2. Existing contours at intervals of two (2) feet. In areas of steep slopes (greater than 15%), five-foot contour intervals may be used. Off-site drainage areas impacting the project including topographic detail.

3. Streams, lakes, ponds or other bodies of water within the project area.

4. Other physical features including existing drainage swales, wetlands, closed depressions, sinkholes and areas of natural vegetation to be preserved.

5. Locations of proposed underground utilities, sewers and water lines. The locations of all existing and proposed utilities, sanitary sewers and water lines within 50 feet of property lines of the project site.

6. An overlay showing soil types and boundaries based on the Lehigh or Berks County Soil Survey, as applicable, latest edition.

7. An overlay showing geologic types and boundaries.

8. Proposed changes to land surface and vegetative cover.

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

10. Final contours at intervals of two (2) feet. In areas of steep slopes (greater than 15%), five-foot contour intervals may be used.

11. Stormwater Management District boundaries applicable to the site.

12. Clear identification of the location and nature of permanent stormwater BMPs.

13. An adequate access easement around all stormwater BMPs that would provide municipal ingress to and egress from a public right-of-way.

14. A schematic showing all tributaries contributing flow to the site and all existing man-made features beyond the property boundary that would be affected by the project.

15. The location of all public water supply wells within 400 feet of the project and all private water supply wells within 100 feet of the project.

C. Stormwater Management Controls and BMPs

1. All stormwater management controls and BMPs shall be shown on a map and described, including:

   a. Groundwater recharge methods such as seepage pits, beds or trenches. When these structures are used, the locations of septic tank infiltration areas and wells shall be shown.

   b. Other control devices or methods such as roof-top storage, semi-pervious paving materials, grass swales, parking lot ponding, vegetated strips, detention or retention ponds, storm sewers, etc.

2. All calculations, assumptions and criteria used in the design of the BMPs shall be shown.

3. All site testing data used to determine the feasibility of infiltration on a site.

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

D. A description of how each permanent stormwater BMP will be operated and maintained and the identity of the person(s) responsible for operations and maintenance.

SECTION 404. PLAN SUBMISSION

A. For Regulated Activities specified in Sections 105.A. and 105.B.:

1. The Drainage Plan shall be submitted by the developer to the municipal secretary (or other appropriate person) as part of the Preliminary Plan submission for the subdivision or land development.

2. Four (4) copies of the Drainage Plan shall be submitted.

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

   a. One (1) copy to the municipal governing body.

   b. One (1) copy to the municipal engineer.

   c. **(Lehigh County Municipalities only)** Two (2) copies to the Lehigh Valley Planning Commission, except for Drainage Plans involving less than 10,000 square feet of additional impervious cover.

4. **(Lehigh County Municipalities only)** Drainage Plans involving more than 10,000 square feet of additional impervious cover shall be submitted by the developer (possibly through the municipality) to the Lehigh Valley Planning Commission as part of the Preliminary Plan submission. The Lehigh Valley Planning Commission will conduct an advisory review of the Drainage Plan for consistency with the Little Lehigh Creek Watershed Stormwater Management Plan. The LVPC will not review details of the Erosion and Sedimentation Plan or the BMP Operations and Maintenance Plan.

   a. Two (2) copies of the Drainage Plan shall be submitted.

   b. The LVPC will provide written comments to the developer and the municipality, within a time frame consistent with established procedures under the Municipalities Planning Code, as to whether the Drainage Plan has been found to be consistent with the Stormwater Management Plan.

B. For Regulated Activities specified in Sections 105.C. and 105.D., the Drainage Plan shall be submitted by the developer to the municipal building permit officer as part of the building permit application.

C. **(Lehigh County Municipalities only)** For Regulated Activities specified in Sections 105.E., 105.F. and 105.G.:

1. The Drainage Plan shall be submitted by the developer to the Lehigh Valley Planning Commission for coordination with the DEP permit application process under Chapter 105 (Dam Safety and Waterway Management), Chapter 106 (Flood Plain Management) of DEP's Rules and Regulations and the NPDES regulations.

2. One (1) copy of the Drainage Plan shall be submitted.

D. Earthmoving for all regulated activities under Section 105 shall be conducted in accordance with the current federal and State regulations relative to the NPDES and DEP Chapter 102 regulations.

SECTION 405. DRAINAGE PLAN REVIEW

A. The municipality shall review the Drainage Plan, including the BMP Operations and Maintenance Plan, for consistency with the adopted Little Lehigh Creek Watershed Stormwater Management Plan as embodied by this Ordinance and with any permits issued by DEP. The municipality shall also review the Drainage Plan against any additional storm drainage provisions contained in the municipal subdivision and land development or zoning ordinance, as applicable.

B. The municipality shall notify the applicant in writing whether the BMP Operations and Maintenance Plan is approved.

C. The municipality shall not approve any subdivision or land development (Regulated Activities 105.A. and 105.B.) or building permit application (Regulated Activities 105.C. and 105.D.) if the Drainage Plan has been found to be inconsistent with the Stormwater Management Plan.

D. The municipality may require an "As-Built Survey" of all stormwater BMPs and an explanation of any discrepancies with the Drainage Plan.

SECTION 406. MODIFICATION OF PLANS

A modification to a submitted Drainage Plan for a proposed development site which involves a change in control methods or techniques, or which involves the relocation or redesign of control measures, or which is necessary because soil or other conditions are not as stated on the Drainage Plan (as determined by the municipality) shall require a resubmission of the modified Drainage Plan consistent with Section 404 subject to review per Section 405 of this Ordinance.

SECTION 407. HARDSHIP WAIVER PROCEDURE

The municipality may hear requests for waivers where it is alleged that the provisions of this Ordinance inflict unnecessary hardship upon the applicant. The waiver request shall be in writing and accompanied by the requisite fee based upon a fee schedule adopted by the municipality. A copy of the waiver request shall be provided to each of the following: municipality, municipal engineer, municipal solicitor and Lehigh Valley Planning Commission. The request shall fully document the nature of the alleged hardship.

The municipality may grant a waiver provided that all of the following findings are made in a given case:

1. That there are unique physical circumstances or conditions, including irregularity of lot size or shape, or exceptional topographical or other physical conditions peculiar to the particular property, and that the unnecessary hardship is due to such conditions, and not the circumstances or conditions generally created by the provisions of this Ordinance in the Stormwater Management District in which the property is located;

2. That because of such physical circumstances or conditions, there is no possibility that the property can be developed in strict conformity with the provisions of this Ordinance, including the "no harm" provisions, and that the authorization of a waiver is therefore necessary to enable the reasonable use of the property;

3. That such unnecessary hardship has not been created by the applicant;

4. That the waiver, if authorized, will represent the minimum waiver that will afford relief and will represent the least modification possible of the regulation in issue; and

5. That financial hardship is not the criteria for granting of a hardship waiver.

In granting any waiver, the municipality may attach such conditions and safeguards as it may deem necessary to implement the purposes of this Ordinance. If a Hardship Waiver is granted, the applicant must still manage the quantity, velocity, direction and quality of resulting storm runoff as is necessary to prevent injury to health, safety or other property.

A. For regulated activities described in Section 105.A. and B., the [municipal governing body] shall hear requests for and decide on hardship waiver requests on behalf of the municipality.

B. For regulated activities in Section 105.C., D., E., and F., the Zoning Hearing Board shall hear requests for and decide on hardship waiver requests on behalf of the municipality.

C. The municipality shall not waive the water quality provisions of this Ordinance.

ARTICLE 5
INSPECTIONS

* SECTION 501. SCHEDULE OF INSPECTIONS

A. DEP or its designees (e.g. County Conservation District) normally ensure compliance with any permits issued, including those for stormwater management. In addition to DEP compliance programs, the municipality or its designee may inspect all phases of the construction, operations, maintenance and any other implementation of stormwater BMPs.

B. During any stage of the Regulated Earth Disturbance activities, if the municipality or its designee determines that any BMPs are not being implemented in accordance with this Ordinance, the municipality may suspend or revoke any existing permits or other approvals issued by the municipality until the deficiencies are corrected.

ARTICLE 6
FEES AND EXPENSES

SECTION 601. GENERAL

The municipality may charge a reasonable fee for review of BMP Operations and Maintenance Plans to defray review costs incurred by the municipality. The applicant shall pay all such fees.

SECTION 602. EXPENSES COVERED BY FEES

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

A. The review of the BMP Operations and Maintenance Plan by the municipality.

B. The site inspection.

C. The inspection of required controls and improvements during construction.

D. The final inspection upon completion of the controls and improvements required in the plan.

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

F. Administrative and clerical costs.

ARTICLE 7
STORMWATER BMP OPERATIONS AND MAINTENANCE PLAN REQUIREMENTS

* SECTION 701. GENERAL REQUIREMENTS

A. No Regulated Earth Disturbance activities within the municipality shall commence until approval by the municipality of the BMP Operations and Maintenance Plan which describes how the permanent (e.g. post-construction) stormwater BMPs will be properly operated and maintained.

* SECTION 702. RESPONSIBILITIES FOR OPERATIONS AND MAINTENANCE OF BMPS

A. The BMP Operations and Maintenance Plan for the project site shall establish responsibilities for the continuing operation and maintenance of all permanent stormwater BMPs, as follows:

1. If a Plan includes structures or lots which are to be separately owned and in which streets, sewers and other public improvements are to be dedicated to the municipality, stormwater BMPs may also be dedicated to and maintained by the municipality;

2. If a Plan includes operations and maintenance by a single ownership or if sewers and other public improvements are to be privately owned and maintained, then the operation and maintenance of stormwater BMPs shall be the responsibility of the owner or private management entity.

B. The municipality shall make the final determination on the continuing operations and maintenance responsibilities. The municipality reserves the right to accept or reject the operations and maintenance responsibility for any or all of the stormwater BMPs.

* **SECTION 703. ADHERENCE TO APPROVED BMP OPERATIONS AND MAINTENANCE PLAN**

It shall be unlawful to alter or remove any permanent stormwater BMP required by an approved BMP Operations and Maintenance Plan or to allow the property to remain in a condition which does not conform to an approved BMP Operations and Maintenance Plan unless an exception is granted in writing by the municipality.

* **SECTION 704. OPERATIONS AND MAINTENANCE AGREEMENT FOR PRIVATELY OWNED STORMWATER BMPS**

A. The property owner shall sign an operations and maintenance agreement with the municipality covering all stormwater BMPs that are to be privately owned. The agreement shall include the terms of the format agreement referenced in Appendix E of this Ordinance.

B. Other items may be included in the agreement where determined by the municipality to be reasonable or necessary to guarantee the satisfactory operation and maintenance of all permanent stormwater BMPs. The agreement shall be subject to the review and approval of the municipality.

* **SECTION 705. STORMWATER MANAGEMENT EASEMENTS**

Stormwater management easements shall be provided by the property owner if necessary for access for inspections and maintenance or for preservation of stormwater conveyance, infiltration, detention areas and other BMPs by persons other than the property owner. The purpose of the easement shall be specified in any agreement under Section 704.

* **SECTION 706. RECORDING OF APPROVED BMP OPERATIONS AND MAINTENANCE PLAN AND RELATED AGREEMENTS**

A. The owner of any land upon which permanent BMPs will be placed, constructed or implemented, as described in the BMP Operations and Maintenance Plan, shall record the following documents in the Office of the Recorder of Deeds for Lehigh or Berks County, as applicable, within 90 days of approval of the BMP Operations Plan by the municipality:

1. The Operations and Maintenance Plan or a summary thereof

2. Operations and Maintenance Agreements under Section 704

3. Easements under Section 705

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

* SECTION 707. MUNICIPAL STORMWATER BMP OPERATION AND MAINTENANCE FUND

A. If stormwater BMPs are accepted by the municipality for dedication, the municipality may require persons installing stormwater BMPs to pay a specified amount to the Municipal Stormwater BMP Operation and Maintenance Fund to help defray costs of operations and maintenance activities. The amount may be determined as follows:

1. If the BMP is to be owned and maintained by the municipality, the amount shall cover the estimated costs for operation and maintenance in perpetuity, as determined by the municipality.

2. The amount shall then be converted to present worth of the annual series values.

B. If a BMP is proposed that also serves as a recreation facility (e.g. ball field, lake), the municipality may adjust the amount due accordingly.

ARTICLE 8
PROHIBITIONS

* SECTION 801. PROHIBITED DISCHARGES

A. No person in the municipality shall allow or cause to allow stormwater discharges into the municipality's separate storm sewer system which are not composed entirely of stormwater except as provided in subsection B below or as allowed under a State or Federal permit.

B. Discharges that may be allowed based on the municipality finding that the discharge(s) do not significantly contribute pollution to surface waters of the Commonwealth are listed below.

1. Discharges from fire fighting activities

2. Potable water sources including dechlorinated water line and fire hydrant flushings

3. Irrigation drainage

4. Routine external building washdown which does not use detergents or other compounds

5. Air conditioning condensate

6. Water from individual residential car washing

7. Springs

8. Water from crawl space pumps

9. Uncontaminated water from foundation or from footing drains

10. Flows from riparian habitats and wetlands

11. Lawn watering

12. Pavement washwaters 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

13. Dechlorinated swimming pool discharges

14. Uncontaminated groundwater

C. In the event that the municipality determines that any of the discharges identified in Section 801.B. significantly contribute to pollution of waters of the Commonwealth or is so notified by DEP, the municipality will notify the responsible person to cease the discharge.

D. Upon notice provided by the municipality under Section 801.C., the discharger will have a reasonable time, as determined by the municipality, to cease the discharge consistent with the degree of pollution caused by the discharge.

E. Nothing in this Section shall affect a discharger's responsibilities under state law.

* SECTION 802. PROHIBITED CONNECTIONS

A. The following connections are prohibited, except as provided in Section 801.B. 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 separate storm sewer system and any connections to the storm drain system from indoor drains and sinks

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

* SECTION 803. ROOF DRAINS

A. Roof drains shall not be connected to streets, sanitary or storm sewers or roadside ditches, except as provided in Section 803.B.

B. When it is more advantageous to connect directly to streets or storm sewers, connections of roof drains to streets or roadside ditches may be permitted by the municipality.

C. Roof drains shall discharge to infiltration areas or vegetative BMPs to the maximum extent practicable.

* SECTION 804. ALTERATION OF BMPS

A. No person shall modify, remove, fill, landscape or alter any existing stormwater BMP without the written approval of the municipality unless it is part of an approved maintenance program.

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

ARTICLE 9
RIGHT OF ENTRY, NOTIFICATION AND ENFORCEMENT

* SECTION 901. RIGHT OF ENTRY

A. Upon presentation of proper credentials, duly authorized representatives of the municipality may enter at reasonable times upon any property within the municipality to inspect the implementation, condition or operation and maintenance of the stormwater BMPs or to investigate or ascertain the condition of the subject property in regard to any aspect regulated by this Ordinance.

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

C. Persons working on behalf of the municipality shall have the right to temporarily locate on any BMP in the municipality such devices as are necessary to conduct monitoring and/or sampling of the discharges from such BMPs.

D. Unreasonable delays in allowing the municipality access to a BMP is a violation of this Article.

* SECTION 902. NOTIFICATION

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

1. The performance of monitoring, analyses and reporting

2. The elimination of prohibited connections or discharges

3. Cessation of any violating discharges, practices or operations

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

5. Payment of a fine to cover administrative and remediation costs

6. The implementation of stormwater BMPs

7. Operation and maintenance of stormwater BMPs

B. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of the violation(s). Said notice may further advise that should the violator fail to take the required action within the established deadline, the work will be done by the municipality or designee and the expense thereof, together with all related lien and enforcement fees, charges and expenses, shall be charged to the violator.

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

* SECTION 903. PUBLIC NUISANCE

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

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

* SECTION 904. SUSPENSION AND REVOCATION OF PERMITS AND APPROVALS

A. Any building, land development or other permit or approval issued by the municipality may be suspended or revoked by the municipality for:

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

2. A violation of any provision of this Ordinance

3. 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.

B. A suspended permit or approval shall be reinstated by the municipality when:

1. The municipality or designee has inspected and approved the corrections to the stormwater BMPs or the elimination of the hazard or nuisance.

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

3. Payment of all municipal fees, costs and expenses related to or arising from the violation has been made.

C. A permit or approval which has been revoked by the municipality cannot be reinstated. The applicant may apply for a new permit under the procedures outlined in this Ordinance.

* **SECTION 905. PENALTIES**

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

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

* **SECTION 906. APPEALS**

Any person aggrieved by any action of the municipality or its designee relevant to the provisions of this Ordinance may appeal using the appeal procedures established in the Pennsylvania Municipalities Planning Code.

APPENDIX A

(Not Included in Plan Copy of Ordinance)

A-1 Map of Little Lehigh Creek Watershed

A-2 Municipal Map of Stormwater Management Districts

APPENDIX B

(Not Included in Plan Copy Text)

B-1 Map of Storm Drainage Problem Areas

B-2 Description of Storm Drainage Problem Areas

APPENDIX C

C-1 NRCS Type II 24-Hour Rainfall Distribution (Graphic & Tabular)

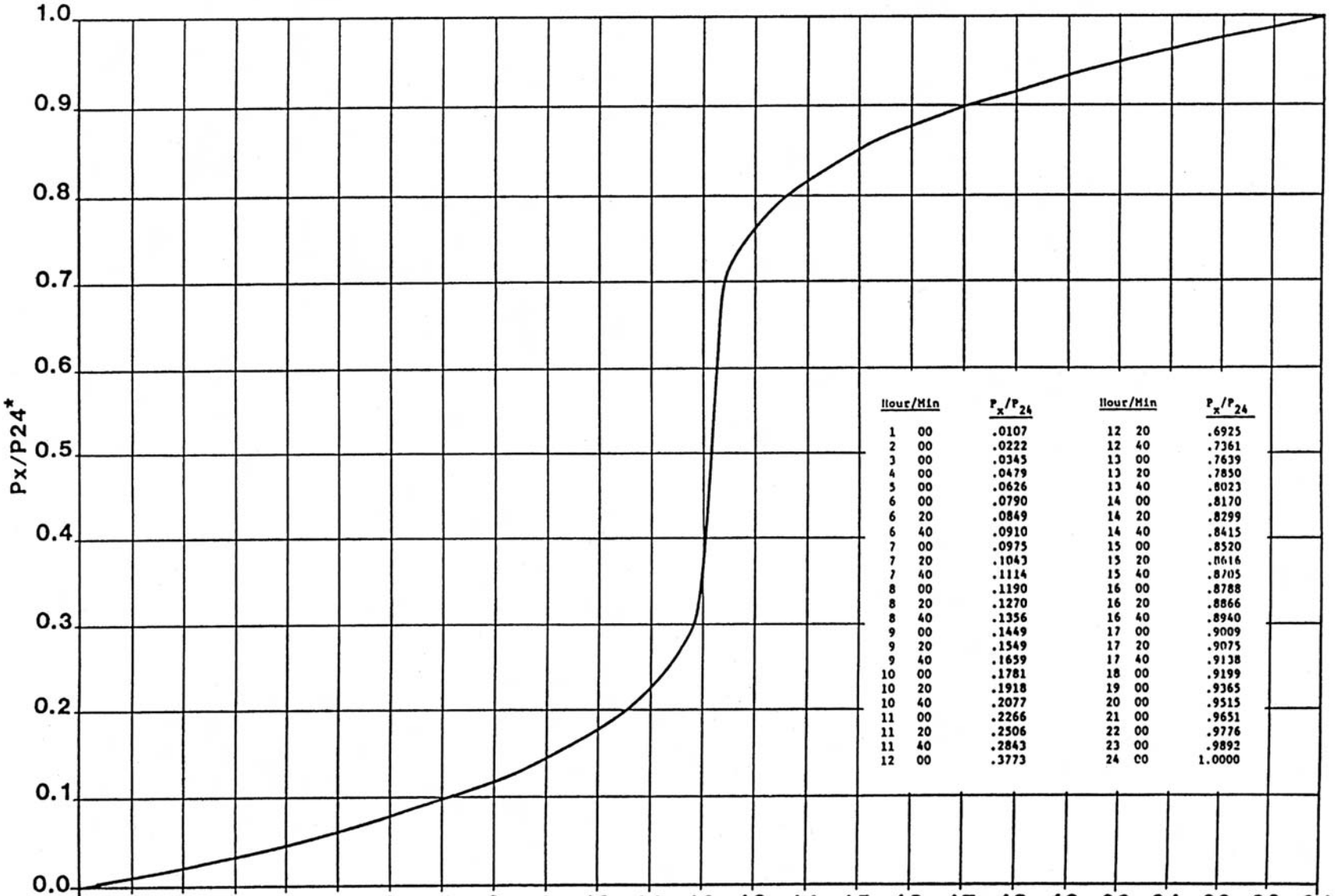
C-2 Intensity-Duration-Frequency Curves

C-3 Runoff Curve Numbers and Percent Imperviousness Values

C-4 Runoff Coefficients for the Rational Method

C-5 Manning ‘n’ Values

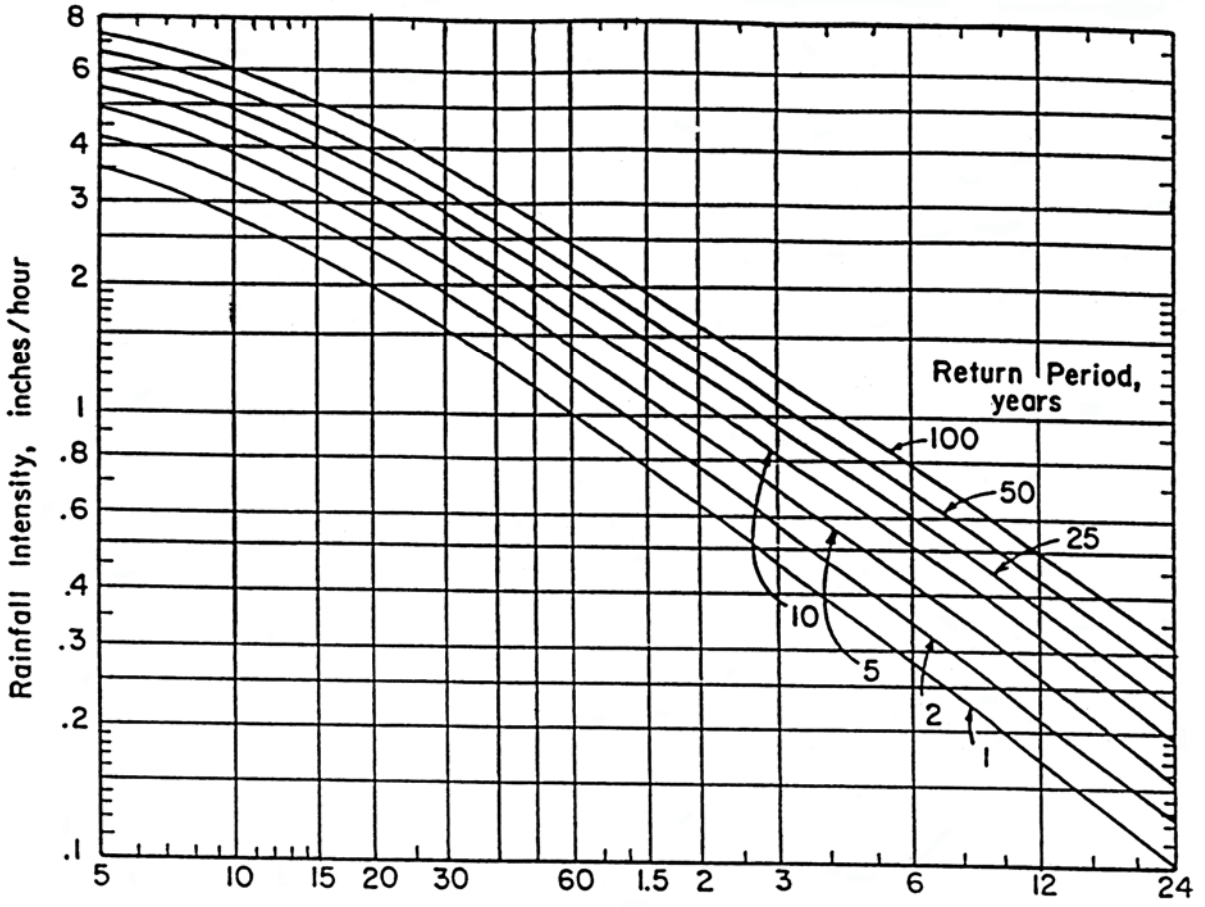
NRCS TYPE II RAINFALL DISTRIBUTION

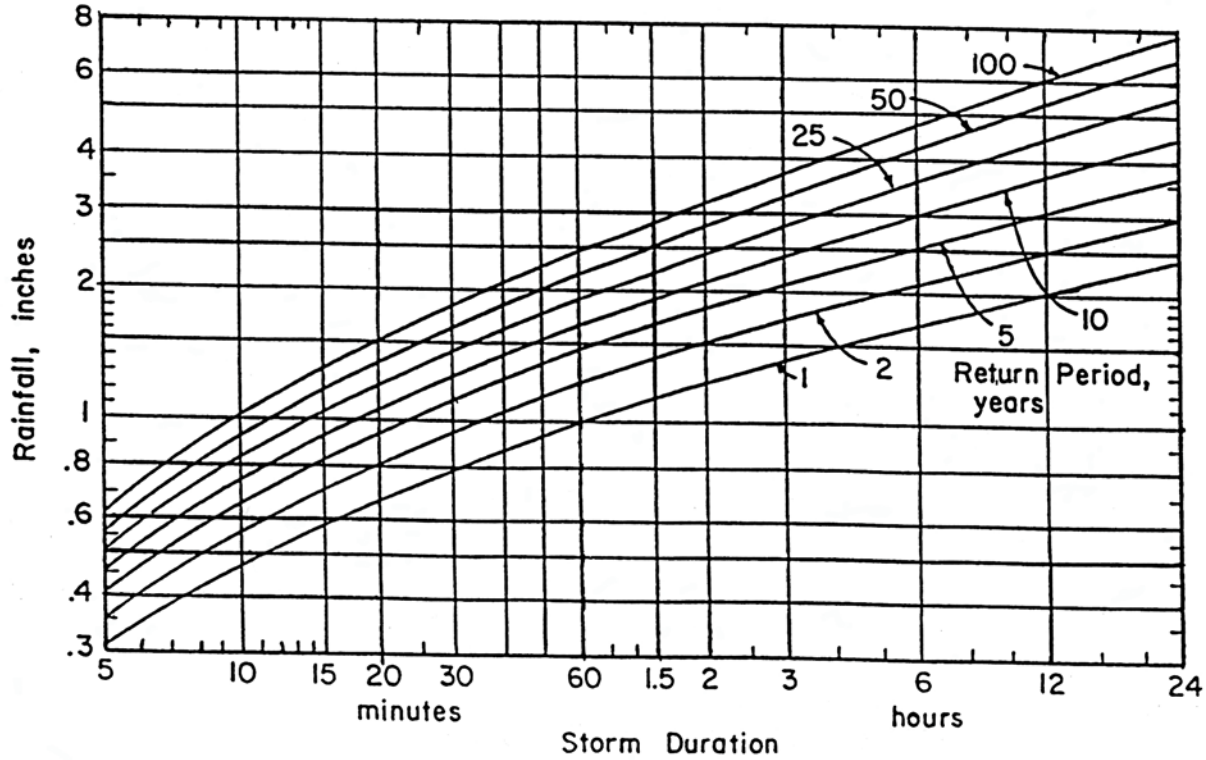


Hour/Min	P_x/P_{24}	Hour/Min	P_x/P_{24}
1 00	.0107	12 20	.6925
2 00	.0222	12 40	.7361
3 00	.0345	13 00	.7639
4 00	.0479	13 20	.7850
5 00	.0626	13 40	.8023
6 00	.0790	14 00	.8170
6 20	.0849	14 20	.8299
6 40	.0910	14 40	.8415
7 00	.0975	15 00	.8520
7 20	.1043	15 20	.8616
7 40	.1114	15 40	.8705
8 00	.1190	16 00	.8788
8 20	.1270	16 20	.8866
8 40	.1356	16 40	.8940
9 00	.1449	17 00	.9009
9 20	.1549	17 20	.9075
9 40	.1659	17 40	.9138
10 00	.1781	18 00	.9199
10 20	.1918	19 00	.9365
10 40	.2077	20 00	.9515
11 00	.2266	21 00	.9651
11 20	.2506	22 00	.9776
11 40	.2843	23 00	.9892
12 00	.3773	24 00	1.0000

*Px/P24 equals cumulative percentage rainfall as a fraction of the total 24 hour rainfall.

INTENSITY–DURATION–FREQUENCY CURVES*





*Source:Pennsylvania Dept. of Transp. Design Rainfall Curves (1986).

RUNOFF CURVE NUMBERS AND PERCENT IMPERVIOUSNESS VALUES*

Cover Description		Curve numbers for hydrologic soil group**			
Land Use/Cover Type	Average percent impervious area	A	B	C	D
Open space (lawns, parks, golf courses, cemeteries, etc.):					
Good condition (grass cover greater than 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
⅛ acre or less (townhouses)	65	77	85	90	92
¼ acre	38	61	75	83	87
⅓ acre	30	57	72	81	86
½ acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Woods		30	55	70	77
Agriculture		Refer to Table 2-2b in source document (TR55) by crop type and treatment.			

*Source: Natural Resources Conservation Service Technical Release No. 55, Second Edition, June 1986.

**Hydrologic Soil Group based on the County Soil Survey latest edition.

RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD* HYDROLOGIC SOIL GROUP AND SLOPE RANGE**												
	A			B			C			D		
LAND USE	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Cultivated[A]	[a]0.18 [b]0.23	0.23 0.29	0.28 0.34	0.24 0.30	0.29 0.36	0.33 0.40	0.30 0.36	0.34 0.41	0.38 0.45	0.33 0.39	0.37 0.44	0.41 0.48
Pasture[B]	0.09 0.12	0.13 0.17	0.17 0.23	0.19 0.24	0.24 0.30	0.29 0.36	0.27 0.33	0.31 0.38	0.36 0.43	0.31 0.37	0.35 0.42	0.39 0.46
Meadow, Lawn[C]	0.05 0.07	0.08 0.12	0.12 0.17	0.15 0.19	0.20 0.25	0.24 0.30	0.23 0.28	0.28 0.34	0.32 0.39	0.28 0.33	0.32 0.39	0.36 0.43
Forest, Woods	0.03 0.04	0.05 0.08	0.08 0.12	0.11 0.15	0.16 0.21	0.20 0.26	0.20 0.25	0.25 0.31	0.29 0.36	0.25 0.31	0.30 0.37	0.34 0.41
Gravel	0.24 0.30	0.29 0.36	0.33 0.40	0.32 0.38	0.36 0.43	0.40 0.47	0.35 0.42	0.39 0.46	0.43 0.50	0.37 0.44	0.41 0.48	0.44 0.51
Parking, Other Impervious	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
Residential, Commercial, Industrial And Other "Developed"	Runoff coefficients should be calculated based upon weighted average of impervious area coefficients and pervious area coefficients from above based upon soil type, slope and the particular development proposal.											

*Based on Rossmiller Equation for translating NRCS curve numbers into Rational Method 'c' values.
**Hydrologic Soil Group based on the county soil survey latest edition.

a – Runoff coefficients for storm recurrence intervals less than 25 years.
b – Runoff coefficients for storm recurrence intervals of 25 years or more.

[A]Represents average of cultivated land with and without conservation treatment from TR-55, January 1975. These values are consistent with several categories of cultivated lands from TR-55, June 1986.
[B]Represents grasslands in fair condition with 50% to 75% grass cover.
[C]Represents grasslands in good condition with greater than 75% grass cover.

MANNING 'n' VALUES BY TYPICAL REACH DESCRIPTION

Reach Description	Manning 'n'
Natural stream, clean, straight, no rifts Or pools	0.030
Natural stream, clean, winding, some pools And shoals	0.040
Natural stream, winding, pools, shoals, Stony with some weeds	0.050
Natural stream, sluggish with deep pools And weeds	0.070
Natural stream or swale, very weedy or With timber under brush	0.100
Concrete pipe, culvert or channel	0.012
Corrugated metal pipe	0.012-0.027*

*Depending upon type and diameter.

ROUGHNESS COEFFICIENTS (MANNING 'n') FOR SHEET FLOW

Surface Description	Manning 'n'[1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.050
Cultivated soils:	
Residue cover <= 20%	0.060
Residue cover > 20%	0.170
Grass:	
Short grass prairie	0.150
Dense grasses[2]	0.240
Bermuda grass	0.410
Range (natural)	0.130
Woods:[3]	
Light underbrush	0.400
Dense underbrush	0.800

[1]The n values are a composite of information compiled by Engman (1986).
[2]Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass and native grass mixtures.
[3]When selecting n, consider cover to a height of about 0.1 ft. this is the only part of the plant cover that will obstruct sheet flow.

APPENDIX D

Recommendation Chart for Infiltration Stormwater Management BMP's in Carbonate Bedrock

SITE RISK FACTORS	Geology Type	CARBONATE BEDROCK																											
	Effective Soil Thickness	Less than 2 Feet	2 to 4 Feet							Over 4 Feet to 8 Feet									Over 8 Feet										
	Special Geologic Features*	Low/Med/High Buffer	Low Buffer			Medium Buffer			High Buffer			Low Buffer			Medium Buffer			High Buffer			Low Buffer			Medium Buffer			High Buffer		
SITE INVESTIGATION RECOMMENDED		(Unacceptable)	Preliminary			Preliminary			Preliminary			Preliminary			Preliminary			Preliminary			Preliminary			Preliminary			Preliminary		
DESIGN FACTORS	Infiltration Loading Rates (% Increase) **	(Unacceptable)	0-100%	100-300%	300 - 500%	0-100%	100-300%	300 - 500%	0-100%	100-300%	300 - 500%	0-100%	100-300%	300 - 500%	0-100%	100-300%	300 - 500%	0-100%	100-300%	300 - 500%	0-100%	100-300%	300 - 500%	0-100%	100-300%	300 - 500%	0-100%	100-300%	300 - 500%
PROGRAM SUMMARY GUIDANCE ***						1	1				1	2								1	2					1			

RECOMMENDED

NOT RECOMMENDED

* Special Geologic Feature Buffer widths are as follows:

Low Buffer is less than 50 feet

Medium Buffer is 50 feet to 100 feet

High Buffer is greater than 100 feet

** Rates greater than 500% not recommended.

*** Assumes adequately permeable soils and lack of natural constraints as required for all infiltration systems.

1 Infiltration systems may be allowed at the determination of the Engineer and/or Geologist, provided that a Detailed Site Investigation is undertaken which confirms nature of rock, location of Special Geologic Features, and adequacy of the buffer between the SGF and the proposed stormwater system(s).

2 In these Special Geologic Features: Low Buffer situations, infiltration systems may be allowed at the determination of the Engineer and/or Geologist, provided that a Detailed Site Investigation is undertaken and a 25 foot buffer from SGFs is maintained.

* APPENDIX E

STORMWATER BEST MANAGEMENT PRACTICES OPERATIONS AND MAINTENANCE AGREEMENT

THIS AGREEMENT, made and entered into this _____ day of _____, 200__, by and between _____, (hereinafter the "Landowner"), and _____, _____ County, Pennsylvania, (hereinafter "municipality");

WITNESSETH

WHEREAS, the Landowner is the owner of certain real property as recorded by deed in the land records of _____ County, Pennsylvania, Deed Book _____ at Page _____, (hereinafter "Property").

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

WHEREAS, the stormwater management BMP Operations and Maintenance Plan approved by the municipality (hereinafter referred to as the "Plan") for the property identified herein, which is attached hereto as Appendix A and made part hereof, as approved by the municipality, provides for management of stormwater within the confines of the Property through the use of Best Management Practices (BMP's); and

WHEREAS, the municipality, and the Landowner, his successors and assigns, agree that the health, safety, and welfare of the residents of the municipality and the protection and maintenance of water quality require that on-site stormwater Best Management Practices be constructed and maintained on the Property; and

WHEREAS, for the purposes of this agreement, the following definitions shall apply:

- BMP – "Best Management Practice;" activities, facilities, designs, measures or procedures used to manage stormwater impacts from land development, to protect and maintain water quality and groundwater recharge and to otherwise meet the purposes of the Municipal Stormwater Management Ordinance, including but not limited to infiltration trenches, seepage pits, filter strips, bioretention, wet ponds, permeable paving, rain gardens, grassed swales, forested buffers, sand filters and detention basins.
- Infiltration Trench – A BMP surface structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,
- Seepage Pit – An underground BMP structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,
- Rain Garden – A BMP overlain with appropriate mulch and suitable vegetation designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or underground aquifer, and

WHEREAS, the municipality requires, through the implementation of the Plan, that stormwater management BMPs as required by said Plan and the Municipal Stormwater

Management Ordinance be constructed and adequately operated and maintained by the Landowner, his successors and assigns. And

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

1. The BMPs shall be constructed by the Landowner in accordance with the plans and specifications identified in the Plan.
2. The Landowner shall operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the municipality and in accordance with the specific maintenance requirements noted on the Plan.
3. The Landowner hereby grants permission to the municipality, its authorized agents and employees, to enter upon the property, at reasonable times and upon presentation of proper identification, to inspect the BMP(s) whenever it deems necessary. Whenever possible, the municipality shall notify the Landowner prior to entering the property.
4. In the event the Landowner fails to operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the municipality, the municipality or its representatives may enter upon the Property and take whatever action is deemed necessary to maintain said BMP(s). This provision shall not be construed to allow the municipality to erect any permanent structure on the land of the Landowner. It is expressly understood and agreed that the municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the municipality.
5. In the event the municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the municipality for all expenses (direct and indirect) incurred within 10 days of receipt of invoice from the municipality *and if not timely paid, a municipal lien shall be placed upon the premises for 110% of the invoice amount, plus statutorily allowed fees, expenses and costs*.
6. The intent and purpose of this Agreement is to ensure the proper maintenance of the onsite BMP(s) by the Landowner; provided, however, that this Agreement shall not be deemed to create or effect any additional liability of any party for damage alleged to result from or be caused by stormwater runoff.
7. The Landowner, its executors, administrators, assigns, and other successors in interests, *hereby* release *and hold harmless* the municipality's employees and designated representatives from all damages, accidents, casualties, occurrences or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or municipality. In the event that a claim is asserted against the municipality, its designated representatives or employees, the municipality shall promptly notify the Landowner and the Landowner shall defend, at his own expense, any suit based on the claim. If any judgment or claims against the municipality's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.
8. The municipality shall inspect the BMP(s) *as necessary* to ensure their continued functioning.

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

ATTEST:

WITNESS the following signatures and seals:

(SEAL) For the municipality:

_____

(SEAL) For the Landowner:

_____

ATTEST:

_____ (City, Borough, Township)

County of _____, Pennsylvania

I, _____, a Notary Public in and for the County and State aforesaid, whose commission expires on the _____ day of _____, 20__, do hereby certify that _____ whose name(s) is/are signed to the foregoing Agreement bearing date of the _____ day of _____, 20__, has acknowledged the same before me in my said County and State.

GIVEN UNDER MY HAND THIS _____ day of _____, 200_.

_____ _____

NOTARY PUBLIC **(SEAL)**

APPENDIX F

LOW IMPACT DEVELOPMENT PRACTICES

ALTERNATIVE APPROACH FOR MANAGING STORMWATER RUNOFF

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

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

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

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

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

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

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

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

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

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

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

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

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

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

APPENDIX G

PRELIMINARY SITE INVESTIGATION AND TESTING REQUIRMENTS

Required Data and Site Information: The following data shall be gathered utilizing standard testing procedures as part of a Preliminary Site Investigation:

- Bedrock composition – Any apparent boundaries between carbonate and non-carbonate bedrock must be verified by a qualified geotechnical professional.
- Bedrock structural geology – This includes the possible presence of faults and mapping of conspicuous fracture traces or lineaments.
- Overburden and soil mantle composition and thickness
- Permeability of the soil
- Depth to the seasonal high water table
- Presence of special geologic features – This includes sinkholes, closed depressions, fracture traces, lineaments and geologic contacts between carbonate and non-carbonate bedrock

Investigation Required for All Sites

Review of Available Data, Maps and Reports: Some of the required information, as listed above, can be found in existing published data. Suggested resources include the following:

- Geologic maps and references for the development area
- The Little Lehigh Creek Basin Carbonate Prototype Area Closed Depression Map – available at the LVPC
- USGS topographic maps
- Lehigh and Berks County soil survey maps
- Aerial photographs from the LVPC or other sources
- Relevant Pennsylvania Geologic Survey Open File Reports (Kochanov 1987a, 1987b) that provide maps of sinkholes and Karst features for Lehigh and Berks counties

Field Inspections: In addition to gathering data from published sources, a field inspection of the proposed site is required. A field inspection can provide additional information relating to site features such as carbonate bedrock features, indicators of seasonal high stream-level or water table levels, streams, springs, etc.

Soil Test Pit and Percolation Test Requirements: A minimum of one test pit and a minimum of 2 percolation tests are required for every site. A test pit is a 2-3 foot wide, 8 foot deep trench excavated with a backhoe for observing subsurface conditions. The test pits will be used to describe soil depth and quality, including soil horizons, and testing of permeability or percolation rates.

Percolation tests are to be conducted as follows (adapted from § 73.15. "Percolation Tests" of the Pennsylvania Code)

1. The percolation tests shall be made in separate holes uniformly spaced over the possible infiltration area.

2. An "Initial Presoak" should not be performed.

3. Percolation holes located within the possible infiltration area shall be used in the calculation of the average percolation rate.

4. Holes having a uniform diameter of 6 to 10-inches shall be bored or dug as follows:
   a. To the depth of the bottom of the possible infiltration BMP
   b. Alternate depths if the test pits/auger holes indicate that the soils are more suitable at a different depth (i.e., if a clay horizon is identified and more suitable soils are located beneath the horizon, and infiltration test should be performed in the suitable horizon).

5. The bottom and sides of the hole shall 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 shall be removed from the hole. Two inches of coarse sand or fine gravel shall be placed in the bottom of the hole to protect the soil from scouring and clogging of the pores.

6. Immediately before the percolation test, as a final presoak, water shall be placed in the hole to a minimum depth of 6-inches over the gravel and readjusted every 30 minutes for 1 hour.

7. The drop in the water level during the last 30 minutes of the final presoaking period shall be applied to the following standard to determine the time interval between readings for each percolation hole:
   a. If water remains in the hole, the interval for readings during the percolation test shall be 30 minutes.
   b. If no water remains in the hole, the interval for readings during the percolation test may be reduced to 10 minutes.

8. After the final presoaking period, water in the hole shall again be adjusted to approximately 6-inches over the gravel and readjusted when necessary after each reading.
   a. Measurement to the water level in the individual percolation holes shall be made from a fixed reference point and shall continue at the interval determined from step No. 7 (above) for each individual percolation hole 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 ¼-inch or less of drop between the highest and lowest readings of four consecutive readings.
   b. The drop that occurs in the final period in percolation test holes, expressed as inches per hour, shall be used to calculate the average percolation rate.
   c. When the rate of drop in a percolation test is too slow to obtain a measurable rate, the rate of 0.25 inches per hour shall be assigned to that hole for use in calculating the average percolation rate. The infiltration area may be placed over holes with no measurable rate when the average percolation rate for the possible infiltration area is within the acceptable range.

When a percolation test hole yields a percolation rate of greater than 12-inches per hour, the proposed infiltration area may not be designed or installed within 25-feet of this hole unless the

municipality determines that a testing anomaly caused the fast percolation rate and a retest of the area yields acceptable percolation rates. This percolation rate limit is established to protect groundwater quality and to minimize the risk of subsidence.

Additional Site Investigation and Testing Required if Infiltration is Proposed

Soil Test Pit Requirements: The required number of test pits varies with Effective Soil Thickness. As risk factors increase, the number of test pits increases. A minimum of 2 test pits, uniformly spaced within the proposed infiltration area (e.g. the 2 pits should be centered on each half of the proposed infiltration area), are required for any site proposing infiltration unless the applicant can demonstrate that one test pit is adequately representative of the area proposed for infiltration. For larger infiltration areas, multiple test pits shall be developed at the densities as listed below:

Effective Soil Thickness (ft.)	Test Pit Density (per acre of proposed infiltration area)*	Percolation Tests (per acre of proposed infiltration area)**	Auger Grid Spacing (Feet On-Center)
8	4	8	50
4 to 8	6	12	35
2 to 4	8	16	25

*No. of Test Pits required = Infiltration sq. ft./43,560 sq. ft. x test pit density from chart rounded up to the nearest whole number

** No. of Percolation Tests required = Infiltration sq. ft./43,560 sq. ft. x percolation tests from chart rounded up to the nearest whole number

Soil Auger Testing Requirements for Carbonate Areas: Because soil depth is not uniform in many carbonate areas, test pits will not be sufficient to accurately determine the depth to bedrock. Augering provides this essential data as inexpensively as possible. Track-rig rotary soil auger test drilling allows relatively inexpensive, qualitative determination of the presence of overburden voids and will generally penetrate to the top-of-bedrock. Augers typically extend to depths of 20 feet. Special augers extend to as much as 50 feet. Augers do not extend into the bedrock. Auger testing should be performed in a grid pattern across the proposed infiltration area, spaced as indicated in the above table.

Percolation Testing Requirements: A minimum of six percolation tests shall be conducted in accordance with the procedures listed above unless the applicant can demonstrate that fewer tests accurately represent the percolation rate of the proposed infiltration area. Additional testing shall be required if the initial test results show significant variability in percolation rate. For larger infiltration areas, percolation tests shall be conducted at the densities listed in the table above.

PLATE I
LITTLE LEHIGH CREEK WATERSHED
RELEASE RATE MAP

RELEASE RATE SUMMARY TABLE

Dual Release Rate catagories (30/--) define a 30% Release Rate for the 2-year storm and indicated Release Rate for the 10-, 25-, and 100-year storms.

Subarea	Release Rate	Subarea	Release Rate	Subarea	Release Rate	Subarea	Release Rate
1	30/90	49-50	30/60	127-133	30/100	181	30/100
2-3	30/100	51-57	30/50	134-135	CND*	182-184	30/90
4-6	30/90	58-59	30/90	136-138	30/100	185	30/70
7-8	30/80	60-63	30/80	139-141	CND*	186	30/90
9-11	30/60	64-67	30/70	142-143	30/100	187	30/70
12-13	30/100	68-75	30/50	144-147	30/80	188	30/90
14-16	30/90	76	30/60	148	30/60	189	30/60
17	30/100	77-88	30/50	149-150	30/70	190-192	30/50
18	30/90	89-93	30/100	151-154	30/60	193-200	30/100
19	30/70	94-95	30/50	155-156	CND*	201-202	CND*
20	30/80	96-99	30/100	157	30/100	203	30/100
21-27	30/50	100-102	CND*	158	CND*	204	CND*
28	30/100	103-104	30/100	159-162	30/100	205	30/100
29-35	30/90	105-107	CND*	163-164	CND*	206-209	CND*
36-39	30/80	108-109	30/100	165	30/100	210	30/100
40-41	30/90	110-111	30/90	166-171	CND*	211-216	30/90
42	30/80	112	30/80	172-173	30/100	217	30/80
43	30/60	113-114	30/100	174	30/90	218	30/100
44	30/80	115-119	30/80	175-176	30/70	219	30/60
45-47	30/60	120-121	30/60	177	30/60	220-221	30/50
48	30/50	122-126	30/50	178-180	30/50	222-226	CND*

*Conditional No Detention Areas do not need detention controls provided that adequate downstream capacity can be shown for increased peak flows. (See Plan for additional details.)

The source of the topographic data is USGS Digital Elevation Model (DEM), 30 meter spacing. These contours do not exactly match the USGS quad sheet topography that was used to create the subarea boundaries.

- Dual Release Rate Areas (See Summary Table)
- Conditional No Detention
- Watershed and Subarea Boundaries
- Municipal Boundaries
- Major Roads
- Other Roads
- Streams
- 20' Contour
- Route 222 Relocation

N

0 3,200 6,400 Feet