

ARTICLE 925

STORMWATER MANAGEMENT REGULATIONS

SECTION 1 GENERAL PROVISIONS

925.01 SHORT TITLE

This Ordinance shall be known and may be cited as the “City of Bethlehem Stormwater Management Ordinance”.

925.02 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 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).
- F. Non-stormwater discharges to municipal separate storm sewer systems can contribute to pollution of waters of the Commonwealth by the municipality.

925.03 PURPOSE

The purpose of this Ordinance is to promote the public health, safety and welfare within the City's Watersheds by minimizing the damages and maximizing the benefits described in Section 925.02 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 City.
- 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.

925.04 STATUTORY AUTHORITY

The City 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 "Pennsylvania Municipalities Planning Code", 53. P.S. Section 10101, et seq.

925.05 APPLICABILITY

This Ordinance shall apply to those areas of the City which are located within the Catsauqua Creek & Lehigh River Sub-Basin, Monocacy Creek, Nancy Run and Saucon Creek Watersheds as delineated on the official maps available for inspection at the City, Engineering Bureau.

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

- A. Land development.
- B. Subdivision.
- C. Construction of new or additional impervious surfaces (driveways, parking lots, etc.).
- D. Construction of new buildings or additions to existing buildings, including residential construction.
- E. Earth moving
- F. Agricultural Operations
- G. Forest Management Operations
- H. Nursery Operations
- I. Diversion or piping of any natural or man-made stream channel.
- J. Installation of stormwater systems or appurtenances thereto.
- K. Regulated Earth Disturbance Activities.

925.06 EXEMPTIONS

- A. Impervious Cover - Any proposed Regulated Activity, except those defined in Section 925.05I and 925.05J, which would create 10,000 square feet or less of additional impervious cover is exempt from the Drainage Plan preparation provisions of this Ordinance except as cited in Section 925.06C and D. The date of the City Ordinance adoption of the original Act 167 Stormwater Management Ordinances (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 this criteria. Additional impervious cover shall include, but not be limited to, 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 water quantity provisions of this Ordinance, except as cited in Section 925.06C, provided that the approved Drainage Plan included design of stormwater facilities to control runoff from the site currently proposed for development 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 and property. These measures include adequate and safe conveyance of stormwater on the site and as it leaves the site. These exemptions shall not relieve the applicant from meeting the water quality standards in this Ordinance for all development proposed since the municipal adoption date of this Ordinance.
- D. Any regulated activity that meets the exemption criteria in Section 925.06A or B, in lieu of meeting the water quality criteria in Section 925.15, will be consistent with the Ordinance if one of the BMPs listed below is employed on the site to control water quality.
1. Controlling runoff through a “sheet flow” system of vegetative or similar buffers having a minimum flow length equal to the length of the impervious areas.
 2. Disconnecting roof downspouts from direct discharge to curb/gutter or storm sewer systems and allowing the downspout discharge to flow over plant, lawn or woodland areas in such a manner as to avoid rill or gully erosion.
 3. Infiltration designed to meet the provisions of this Ordinance.
 4. Employing any one of the BMPs listed in Section 304.O.

Sites that meet the exemption criteria in Section 925.06A or B are not required to conduct a Preliminary Site Investigation (as defined in Section 925.11) as long as infiltration BMPs are not proposed. If infiltration BMPs are proposed, a Preliminary Site Investigation shall be performed. The City shall have the authority to require, review, approve, reject or recommend alternative methods for meeting the water quality requirements of this Ordinance.

- E. No exemptions shall be provided for regulated activities as defined in Sections 925.05I and 925.05J.

925.07 REPEALER

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

925.08 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.

925.09 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.

925.10 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.

925.11 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.

Act 167 – Act of October 4, 1978, P.L. 864, the “Stormwater Management Act.”

Act 247 – Act of 1968, P.L. 805, No. 247 “ Pennsylvania Municipalities Planning Code.”

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 evapotranspired, 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.

City – City of Bethlehem.

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 Northampton 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 – 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 925.21.

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 925.15P.

Hydrologic Soil Group (HSG) – Soils are classified into four HSGs (A, B, C and D) to indicate the minimum infiltration rates, which are obtained for bare soil after prolonged wetting. The Natural Resources Conservation Service (NRCS) of the US Department of Agriculture defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of the development site may be identified from a soil survey report that can be obtained from local NRCS offices or conservation district offices. Soils become less permeable as the HSG varies from A to D.

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.

Infiltration Structure – A structure designed to direct runoff into the ground, e.g. French drain, seepage pit, trench or perforated pipe or similar.

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; (iii) development in accordance with Section 503(1.1) of the Pennsylvania Municipalities Planning Code.

Loading Rate – The ratio of the land area draining to the system, as modified by the weighting factors in Section 925.18B, 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 mainstream.

LVPC – Lehigh Valley Planning Commission of Lehigh and Northampton Counties.

Mainstem (main channel) – Any stream segment or other conveyance used as a reach in the Lehigh, Monocacy, Nancy Run or Saucon 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 – City of Bethlehem, Lehigh or Northampton 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.

Open Channel – Any storm water conveyance facility through which water normally flows by gravity. An open channel may be exposed, such as a swale, street gutter, or stream; or unexposed such as a culvert.

Outfall – “Point source” as described in 40 CFR § 122.2 at the point where the City’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.

Recharge Volume (Rev) – The portion of the water quality volume (WQv) used to maintain groundwater recharge rates at development sites. (see Section 925.15J)

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 925.05.

Regulated Earth Disturbance Activities – Earth disturbance activity 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.

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 and Northampton Counties for the Lehigh, Monocacy, Nancy Run or Saucon Creek Watersheds 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, partition by the court for distribution to heirs or devisees, transfer of ownership or building or lot ownership: Provided, however, that the subdivision by lease of land for agricultural purposes into parcels of more than ten acres, not involving any new street or easement of access or any residential dwelling, shall be exempted.

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 evapotranspire the collected rooftop rainfall; overflows may be provided for larger storms.

Vegetated Swales – (1) **Vegetated earthen channels designed to convey stormwater. These swales are not considered to be water quality BMPs.** (2) Broad, shallow, densely vegetated, earthen channels designed to treat stormwater while slowly infiltrating, evapotranspiring, 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.

Water Quality Volume (WQv) – The volume needed to capture and treat 90% of the average annual rainfall volume. (see Section 925.15B)

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 Lehigh, Monocacy, Nancy Run or Saucon Creek Watersheds 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.

SECTION 2 STORMWATER MANAGEMENT REQUIREMENTS

925.12 GENERAL REQUIREMENTS

- A. All storm drainage systems shall be constructed as necessary to convey the flow of surface waters without damage to persons or property. These drainage systems shall be constructed as approved by the City Engineer to drain the storm water runoff from the applicant's land, as well as the collected runoff from development(s) at higher elevations in the same watershed. Should the land at a higher elevation be undeveloped, the design of the storm drainage system local to the applicant shall be designed as if the land above were fully developed in accordance with current zoning regulations and assuming that required runoff controls are in effect in all tributary areas.
- B. Storm drainage systems shall be provided to permit unimpeded flow in natural watercourses except as modified by stormwater detention facilities, recharge facilities, water quality facilities, pipe systems or open channels consistent with this Ordinance. Storm drainage systems shall provide positive drainage away from buildings and on-site sewage disposal systems and prevent overloading of downstream drainage systems and watercourses as a result of increased rate of runoff caused by the proposed development.
- C. The existing locations of concentrated drainage discharge onto adjacent property shall not be altered without written approval of the affected property owner(s) and the City Engineer.
- 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 925.18 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 storm drainage facilities and appurtenances shall be designed and provided in accordance with the established practices in 25 Pa. Code Chapter 102 and the specifications of this ordinance as to prevent 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 City 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 925.15), any part of the Water Quality Volume or for otherwise meeting the purposes of this Ordinance.

925.13. 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.

925.14. EROSION AND SEDIMENT CONTROL DURING REGULATED EARTH DISTURBANCE ACTIVITIES

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

It is the intent of this section of this ordinance to require that proper erosion control be maintained on all land regardless of the area of land intentionally disturbed (if any) and regardless of the status of any construction on the land. Should the City Engineer determine that erosion control on any area of land is deficient and impacting or threatening to impact on offsite land, either directly or indirectly (such as through the creation of sinkholes that may travel offsite), the City Engineer may require that corrective action be taken in an expeditious manner. This corrective action shall be completed as soon as possible, but no later than 10 days from the date of notification of the deficiency.

Should the City Engineer determine that erosion control is deficient during construction, the City Engineer may pull all construction permits acquired from the City and- except for corrective erosion control work- stop the job until, in the opinion of the City Engineer, adequate correction of erosion control deficiencies has been made.

- 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 City 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.

925.15 POST CONSTRUCTION WATER QUALITY CRITERIA

- A. No Regulated Earth Disturbance activities within the City shall commence until approval by the City of a Drainage Plan which demonstrates compliance with this Ordinance. This Ordinance provides standards to meet NPDES Permit requirements associated with construction activities and MS4 permit requirements.
- 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 = site area in acres

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. This standard does not limit the volume of infiltration an applicant may propose for purposes of water quantity/peak rate control.

- 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 dry extended detention basin, 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 Monocacy and Saucon Creeks from thermal impacts.
- E. The WQv for a site as a result of the Regulated Activities-must either be treated with infiltration or two acceptable BMPs as listed in Section 925.150, except for minor areas on the periphery of the site that cannot reasonably be drained to an infiltration facility or other BMP.

- F. Infiltration BMPs shall not be constructed on fill unless the applicant demonstrates that the fill is stable and otherwise meets the infiltration BMP standards of this Ordinance.
- 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 development 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. This investigation may be done by a certified Sewage Enforcement Officer (SEO) except that the location(s) of special geologic features shall be verified by a qualified geotechnical professional.
- I. Sites where applicants intend to use infiltration BMP's must meet the following criteria:
- 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; except for infiltration of residential roof runoff where the seasonal high water table must be below the invert of the BMP. (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 (as measured by the adapted 25 PA Code 73.15. percolation test in Appendix G) 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
 - 15 feet downgradient or 100 feet upgradient from building foundations; except for residential development where the required set back is 15 feet downgradient or 40 feet upgradient from building foundations.
 - 50 feet from septic system drainfields; except for residential development where the required setback is 25 feet from septic 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; except for one and two family residential dwellings where the required setback is 40 feet unless documentation is provided to show that all setbacks from existing or potential future 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. For entirely non-carbonate sites, the Recharge Volume (REv) shall be infiltrated unless the applicant demonstrates that it is infeasible to infiltrate the REv for reasons of seasonal high water table, permeability rate, soil depth or setback distances; or except as provided in Section 925.15U.

1. The REv shall be calculated as follows:

$$\text{REv} = (0.25) * (I)/12$$

Where REv = Recharge Volume in acre-feet
I = impervious area in acres

2. The Preliminary Site Investigation described in Section 925.15H. is required and shall continue on different areas of the site until a potentially suitable infiltration location is found or the entire site is determined to be infeasible for infiltration. For infiltration areas that appear to be feasible based on the preliminary site investigation, the Additional Site Investigation and Testing as outlined in Appendix G shall be completed.
3. If an Applicant proposes infiltration, 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.
4. The site must meet the conditions listed in Section 925.15I.
5. If it is not feasible to infiltrate the full REv, the applicant shall infiltrate that portion of the REv that is feasible based on the site characteristics. If none of the REv can be infiltrated, REv shall be considered as part of the WQv and shall be captured and treated as described in Section 925.15O.
6. If REv is infiltrated, it may be subtracted from the WQv required to be captured and treated.
- K. In entirely carbonate areas, where the applicant intends to use infiltration BMPs, the Preliminary Site Investigation described in Section 925.15H. shall be conducted. For

infiltration areas that appear feasible based on the Preliminary Site Investigation, 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 925.18, 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. In addition to the recommendation from Appendix D, the conditions listed in Section 925.15.I. are required for infiltration in carbonate areas.

Applicants are encouraged to infiltrate the REv, as calculated in Section 925.15J, but 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. Any amount of volume infiltrated can be subtracted from the WQv to be treated by non-infiltration BMPs. If infiltration is not proposed, the full WQv shall be treated by two acceptable BMPs, as specified in Section 925.15O.

- L. 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 meet the requirements for REv for the whole site through infiltration. If that proves infeasible, infiltration in the carbonate area as described in Section 304.K. or 2 other non-infiltration BMPs as described in Section 304.O. must be used. 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.
- M. 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.
- N. Site areas proposed for infiltration shall be protected from disturbance and compaction except as necessary for construction of infiltration BMPs.
- O. If infiltration is not proposed, 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 ^A	4,5,11,16
Capture/Reuse ^{1B}	4,14
Constructed Wetlands	4,5,8,10,16
Dry Extended Detention Ponds	4,5,8,12,18
Minimum Disturbance/ Minimum Maintenance Practices	1,9
Significant Reduction of Existing Impervious Cover	N/A
Stormwater Filters ^A (Sand, Peat, Compost, etc.)	4,5,10,16
Vegetated Buffers/Filter Strips	2,3,5,11,16,17
Vegetated Roofs	4,13
Vegetated Swales ^A	2,3,5,11,16,17
Water Quality Inserts for Inlets ^D	4,7,15,16,19
Wet Detention Ponds	4,5,6,8

^A This BMP could be designed with or without an infiltration component. If infiltration is proposed, the site and BMP will be subject to the testing and other infiltration requirements in this Ordinance.

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

^C See table below.

^D Water Quality Inlets include such BMPs as Oil/Water Separators, Sediment Traps/Catch Basin Sumps, and Trash/Debris Collectors in Catch Basins.

Number	Design Reference Title
1	“Conservation Design For Stormwater Management – A Design Approach to Reduce Stormwater Impacts From Land Development and Achieve Multiple Objectives Related to Land Use”, Delaware Department of Natural Resources and Environmental Control, The Environmental Management Center of the Brandywine Conservancy, September 1997
2	“A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zone”, Schueler, T. R., Kumble, P. and Heraty, M., Metropolitan Washington Council of Governments, 1992.
3	“Design of Roadside Channels with Flexible Linings”, Federal Highway Administration, Chen, Y. H. and Cotton, G. K., Hydraulic Engineering Circular 15, FHWA-IP-87-7, McLean Virginia, 1988.
4	“Draft Stormwater Best Management Practices Manual”, Pennsylvania Department of Environmental Protection, January 2005.
5	“Evaluation and Management of Highway Runoff Water Quality”, Federal Highway Administration, FHWA-PD-96-032, Washington, D.C., 1996.
6	“Evaporation Maps of the United States”, U.S. Weather Bureau (now NOAA/National Weather Service) Technical Paper 37, Published by Department of Commerce, Washington D.C., 1959.

Number	Design Reference Title
7	“Georgia Stormwater Manual”, AMEC Earth and Environmental, Center for Watershed Protection, Debo and Associates, Jordan Jones and Goulding, Atlanta Regional Commission, Atlanta, Georgia, 2001.
8	“Hydraulic Design of Highway Culverts”, Federal Highway Administration, FHWA HDS 5, Washington, D.C., 1985 (revised May 2005).
9	“Low Impact Development Design Strategies An Integrated Design Approach, Prince Georges County, Maryland Department of Environmental Resources, June 1999.
10	“Maryland Stormwater Design Manual”, Maryland Department of the Environment, Baltimore, Maryland , 2000.
11	“Pennsylvania Handbook of Best Management Practices for Developing Areas”, Pennsylvania Department of Environmental Protection, 1998.
12	“Recommended Procedures for Act 167 Drainage Plan Design”, LVPC, Revised 1997.
13	“Roof Gardens History, Design, and Construction”, Osmundson, Theodore. New York: W.W. Norton & Company, 1999.
14	“The Texas Manual on Rainwater Harvesting”, Texas Water Development Board, Austin, Texas, Third Edition, 2005.
15	“VDOT Manual of Practice for Stormwater Management”, Virginia Transportation Research Council, Charlottesville, Virginia, 2004
16	“Virginia Stormwater Management Handbook”, Virginia Department of Conservation and Recreation, Richmond, Virginia, 1999.
17	“Water Resources Engineering”, Mays, L. W., John Wiley & Sons, Inc., 2005.
18	“Urban Hydrology for Small Watersheds”, Technical Report 55, US Department of Agriculture, Natural Resources Conservation Service, 1986.
19	US EPA, Region 1 New England web site (as of August 2005) http://www.epa.gov/NE/assistance/ceitts/stormwater/techs/html .

P. Stormwater runoff from Hot Spot land uses, as defined in Section 925.11, shall be pre-treated. In no case, may the same BMP be employed consecutively to meet this requirement and the requirement in Section 925.15O. 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	-Water Quality Inlets -Use of Drip Pans and/or Dry Sweep Material Under Vehicles/Equipment -Use of Absorbent Devices to Reduce Liquid Releases -Spill Prevention and Response Program
Vehicle Fueling Stations	-Water Quality Inserts for Inlets -Spill Prevention and Response Program

Hot Spot Land Use	Pre-treatment Method(s)
Storage Areas for Public Works	-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

Design references for the pre-treatment methods, as necessary, are listed below. An applicant may use an alternate design reference if use of the alternate reference can be justified. Alternatives may include providing documentation demonstrating that water quality has been protected or otherwise demonstrating that due to the site characteristics the land use is not a Hot Spot as defined in Section 925.11. Where the documented design methodology conflicts with the provisions of this Ordinance, this Ordinance shall govern.

Pre-treatment Method	Design Reference^A
Constructed Wetlands	5,6,10,12,18
Diversion of Stormwater away from Potential Contamination Areas	5,13
Stormwater Collection and Reuse (especially for irrigation)	5,16
Stormwater Filters (Sand, Peat, Compost, etc.)	5,6,12,18
Vegetated Swales	2,4,6,13,18,19
Water Quality Inlets	5,9,17,18,21

^AThese numbers refer to the Design Reference Title Chart in Section 925.150

Q. The use of infiltration BMPs is prohibited on Hot Spot land uses.

- R. Stormwater infiltration facilities shall not be placed in or on a special geologic feature(s). Additionally, stormwater runoff shall not be discharged into existing on-site sinkholes.
- S. 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 925.15J and 925.15K, 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.
- T. 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, by controlling the 2-year post-development runoff to a 30% Release Rate.
- U. 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.

925.16 STORMWATER MANAGEMENT DISTRICTS

- A. Mapping of Stormwater Management Districts - To implement the provisions of the Catasauqua Creek and Lehigh River Sub-Basin 4, Monocacy, Nancy Run and Saucon Creek Watershed Stormwater Management Plans, the City is hereby divided into Stormwater Management Districts consistent with the Lehigh, Monocacy, Nancy Run and Saucon Creek Release Rate Maps presented in the Plans. The boundaries of the Stormwater Management Districts are shown on an official map which is available for inspection at the City Engineer's office.
- B. Description of Stormwater Management Districts - Two types of Stormwater Management Districts may be applicable to the municipality, namely Conditional/Provisional No Detention Districts and Dual Release Rate Districts as described below.
 - 1. Conditional/Provisional No Detention Districts - Within these districts, the capacity of the "local" runoff conveyance facilities (as defined in Section 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 925.17P. 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. Sites in these districts are still required to meet all of the water quality requirements in Section 304.

2. Dual Release Rate Districts - Within these districts, the 2-year post-development peak discharge must be controlled to 30% of the pre-development 2-year runoff peak. Further, the 10-year, 25-year and 100-year postdevelopment peak runoff must be controlled to the stated percentage of the predevelopment peak. Release Rates associated with the 10- through 100-year events vary from 50% to 100% depending upon location in the watershed. [For the Monocacy Creek and Nancy Run Watersheds, the original Single Release Rate Districts become Dual Release Rate Districts due to the channel protection standard requiring developments to meet a 2-year 30% Release Rate.]

925.17. 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 925.18.
- 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. Acceptable velocities shall be based upon criteria included in the most current DEP Erosion and Sediment Pollution Control Program Manual. Permissible velocities from the DEP manual for selected channels are presented in Appendix C of this Ordinance.
 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. A one hundred (100) year design storm is required where a storm of this return period would likely cause damage to existing or future structures or their contents were it not for implementation of proper storm water management provisions.
 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/Provisional No Detention subarea, the size of the pre-development drainage area on a site may not be changed post-development

to create potentially adverse conditions on downstream properties except as part of a “No Harm” or Hardship waiver procedure.

- H. No portion of a site may be regraded between adjacent watershed(s) 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 925.17D 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 925.17D and the detention criteria in Section 925.18.
- 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 925.17D 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 Models 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 925.17P.

Any “no harm” justifications shall be submitted by the developer to the Lehigh Valley Planning Commission and the City Engineer for review as part of the Drainage Plan submission per Section 3. Any extra submission costs resulting from the dual submission and review shall be borne by the developer. The developer completely assumes all risks in so much that the submission of “no harm” requires a rigorous review for its approval and this approval is not guaranteed.

- 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. Peak runoff rates of discharge from a regional detention basin shall be based upon maintaining existing peak runoff rates for the tributary area, except that other criteria for discharge may apply for regional detention facilities located within a watershed with a county approved Act 167 Storm Water Management Plan. Any developer relying upon regional detention facilities in lieu of on-site controls shall pay an appropriate fee to the owner of the regional facility. Any proposed regional detention facility shall have the approval of the Lehigh Valley Planning Commission as well as the City Engineer.

- P. Capacity Improvements - In certain instances, primarily within the Conditional/Provisional 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 925.17D. 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.

925.18 CALCULATION METHODOLOGY

- A. Stormwater runoff from all development sites shall be calculated using either the rational method or the soil-cover-complex methodology. Complete detailed drainage calculations and applicable charts and nomographs certified (i.e. P.E. Stamp) by the design engineer shall be submitted to the City Engineer.
- 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 measured by the adapted 25 PA Code 73.15. percolation test in Appendix G), 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 (as measured by the adapted 25 PA Code 73.15. percolation test in Appendix G) 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., as measured by the adapted 25 PA Code 73.15. percolation test in Appendix G, 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 “PIPERAT” of the Users’ Manual for the Penn State Urban Hydrology Model (1987).

Detention ponds shall be designed so that they return to normal conditions within approximately twelve (12) hours after the termination of the storm, unless the City Engineer finds that downstream conditions may warrant other design criteria for storm water release. (See Appendix ‘A’ – Stormwater Design Standards)

The developer shall demonstrate that such ponds are designed, protected and located to assure that public safety is maximized and health problems are prevented. Certain protective devices and/or screenings such as fencing and landscaping may be required at the discretion of the City Engineer or Planning Commission. The depth of the facility in conjunction with the surrounding structures shall be taken into account when considering the need for the above improvements.

The developer shall verify that the operation of the detention facilities will not aggravate potential downstream peaking conditions, unless the detention facilities have been designed in accordance with an approved Act 167 Storm Water Management Plan for the applicable watershed.

- 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. The City Engineer may allow some relief from the freeboard requirements, depending upon construction methods and other extenuating circumstances.
- 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. The minimum 3 inch diameter does not apply to the control of the WQv.
- 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 are taken from the PennDOT Intensity - Duration - Frequency Field Manual (May 1986) for Region 4:

<u>Return Period</u>	<u>24-Hour Rainfall Depth</u>
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. Stormwater runoff from watersheds of one hundred (100) or less acres may be calculated using the Rational Method as described in the latest manual of the American Society of Civil Engineers. For the Rational Method use runoff

coefficients, rainfall intensities consistent with appropriate times of concentration and return periods and the Intensity-Duration-Frequency Curves as presented in Appendix C and appropriate to this topic, as stated in the most up-to-date issue of the “Storm Water Design Policy Manual of the Department of Public Works.”

- L. Stormwater runoff from watersheds of more than one hundred (100) acres shall be calculated using the soil-cover-complex method developed by the Soil Conservation Service or other appropriate method acceptable to the City Engineer.

All calculations using the soil-cover-complex method shall use the Soil Conservation Service Type II 24-hour rainfall distribution. The 24-hour rainfall depths for the various return periods shall be from the current issue of the PennDOT Intensity – Duration- Frequency field Manual for Region 4, as indicated in the most up-to-date issue of the “Storm Water Design Policy Manual of the Department of Public Works.”

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 and storm sewers. Culverts shall be designed using standard engineering methods acceptable to the City Engineer. Manning 'n' values used in the calculations shall be consistent with the table presented in Appendix C.
- 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.

SECTION 3 DRAINAGE PLAN REQUIREMENTS

925.19 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 land disturbance activity, the owner, subdivider, developer or his agent shall submit a Drainage Plan and receive City approval of the Plan.

925.20 EXEMPTIONS

Exemptions from the Drainage Plan Requirements are as specified in Section 925.06.

925.21 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 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. Scale shall be 1"= 40' or 1"= 30' or other scale acceptable to the City Engineer.
3. Streams, lakes, ponds or other bodies of water within the project area.
4. Other physical features including flood hazard boundaries, 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 Northampton County Soil Survey, as applicable, latest edition. Any hydric soils present on the site should be identified as such.
7. An overlay showing geologic types and boundaries .
8. Proposed changes to land surface and vegetative cover. Stormwater calculations shall show and quantify the area of additional impervious surfaces.
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 City 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. All details and specifications for the construction of the stormwater management controls and BMPs.

C. The BMP Operations and Management Plan, as required in Section 6, describing how each permanent stormwater BMP will be operated and maintained and the identity of the person(s) responsible for operations and maintenance. A statement must be included, signed by the landowner, acknowledging that the stormwater BMPs are fixtures that cannot be altered or removed without approval by the municipality.

D. An Environmental Resources Site Design Assessment that describes the following:

1. The extent to which the proposed grading and impervious cover avoid disturbance of significant environmental resources and preserve existing site hydrology.
2. An assessment of whether alternative grading and impervious cover site design could lessen the disturbance of significant environmental resources and/or make better use of the site hydrologic resources.
3. A description of how the proposed stormwater management controls and BMPs serve to mitigate any adverse impacts on environmental resources on the site.

Significant environmental resources considered in the site design assessment include, but are not limited to, steep slopes, ponds, lakes, streams, wetlands, hydric soils, floodplains, riparian vegetation, native vegetation and special geologic features.

925.22 PLAN SUBMISSION

- A. For Regulated Activities specified in Sections 925.05A and 925.05B:
1. The Drainage Plan shall be submitted by the developer to the Planning Bureau as part of the Plan submission for the subdivision or land development.
 2. Two (2) copies of the Drainage Plan shall be submitted.
 3. Distribution of the Drainage Plan will be as follows:
 - a. One (1) copy to the City Planning Bureau.
 - b. One (1) copy to the City Engineering Bureau.
 4. Drainage Plans involving more than 10,000 square feet of additional impervious cover shall be submitted by the developer to the Lehigh Valley Planning Commission as part of the Plan submission. The Lehigh Valley Planning Commission will conduct an advisory review of the Drainage Plan for consistency with the appropriate Watershed Stormwater Management Plan(s). 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 City, 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 925.05C and 925.05D, the Drainage Plan shall be submitted by the developer to the City building permit officer as part of the building permit application.
- C. For Regulated Activities specified in Sections 925.05E and 925.05F:
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 925.05 shall be conducted in accordance with the current federal and State regulations relative to the NPDES and DEP Chapter 102 regulations.

925.23 DRAINAGE PLAN REVIEW

- A. The City Engineer shall review the Drainage Plan, including the BMP Operations and Maintenance Plan, for consistency with the appropriate adopted Watershed Stormwater Management Plan as embodied by this Ordinance and with any permits issued by DEP. The City shall also review the Drainage Plan against any additional storm drainage provisions contained in the City subdivision and land development or zoning ordinance, as applicable.
- B. The City shall notify the applicant in writing whether the Drainage Plan, including the BMP Operations and Maintenance Plan is approved.
- C. The City shall not approve any subdivision or land development (Regulated Activities 925.05A and 925.05B) or building permit application (Regulated Activities 925.05C and 925.05D) if the Drainage Plan has been found to be inconsistent with the Stormwater Management Plan.
- D. The City will require an “As-Built Survey” of all stormwater BMPs and an explanation of any discrepancies with the Drainage Plan.

The developer shall ensure that current as-built records are maintained during construction. Upon completion of construction, Certified (i.e. P.E. stamped) as-built drawings shall be submitted by the developer’s engineers. These as-built drawings shall be found acceptable by the City Engineer prior to release of any remaining security. The City retains the option to require the final as-built data to be in AUTOCAD 2000 format and compatible with the City’s current GIS system.

- E. The Lehigh Valley Planning Commission shall provide an advisory review of the Drainage Plan for consistency with the applicable Storm Water Management Plan.
- F. For activities specified in Section 925.05A and 925.05B, the Lehigh Valley Planning Commission shall provide written comments to the City, within a time frame consistent with established procedures under Act 247, as to whether the Drainage Plan has been found to be consistent with the Storm Water Management Plan.
- G. For activities specified in Sections 925.05I and 925.05J, the Lehigh Valley Planning Commission shall notify PA DEP whether the Drainage Plan is consistent with the Storm Water Management Plan and forward a copy of the review letter to the City and developer.

925.24 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 925.22 subject to review per Section 925.23 of this Ordinance.

In order to maintain continuity between plan revisions, any changes to a previous plan submission shall be flagged with a triangle. Any changes not flagged may be considered not

approved. Flagged changes that have been documented shall be referenced to the appropriate revision date.

925.25 HARDSHIP WAIVER PROCEDURE

- A. The City 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 a \$1,000.00 fee. A copy of the waiver request shall be provided to each of the following: City Planning Bureau, City engineer, City solicitor and Lehigh Valley Planning Commission. The request shall fully document the nature of the alleged hardship.
- B. The City 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.
- C. For regulated activities in Section 925.05, the City shall hear requests for and decide on hardship waiver requests on behalf of the City.

In granting any waiver, the City may attach such conditions and safeguards as it may deem necessary to implement the purposes of Act 167 and this ordinance, including the requirement of a fee in lieu of detention as stipulated in APPENDIX ‘A’ Section E. 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. The City shall not grant any waiver which would result in conditions hazardous to persons or conducive to property damage, or which would significantly increase an existing potential for property damage, or which would significantly increase an already hazardous condition to persons.

SECTION 4 INSPECTIONS

925.26 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 City Engineer or his designee may inspect all phases of the construction, operations, maintenance and any other implementation of stormwater BMPs. The City Engineer or his designee may also check that as-built records are being maintained onsite.
- B. During any stage of the Regulated Earth Disturbance activities, if the City Engineer or his designee determines that any BMPs are not being implemented in accordance with this Ordinance, the City Engineer may suspend or revoke any existing permits or other approvals until the deficiencies are corrected.

SECTION 5 FEES AND EXPENSES

925.27 GENERAL

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

The applicant shall sign an agreement to pay for fees and expenses established by the City of Bethlehem to compensate the City for the cost incurred during the review and processing of the Drainage Plan.

925.28 EXPENSES COVERED BY FEES

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

- A. The review of the Drainage Plan, including the BMP Operations and Maintenance Plan by the City Engineer or his representative.
- B. The site inspections and any necessary testing, including but not limited to the following...
 - 1. The inspection of required controls and improvements during construction.
 - 2. The final inspection upon completion of the controls and improvements required in the plan.
 - 3. 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.
 - 4. Administrative and clerical costs.

- C. Any person desiring to make a connection to the City's storm sewer system shall obtain a permit from the Department of Public Works and pay a fee of fifty dollars (\$50.00). The permit application may be required to be supplemented by any plans, specifications or other information considered pertinent in the judgment of the approving authority. Permit fees for excavating in the street or sidewalk area remain in force and shall be paid in addition to the storm sewer connection permit. (Ord. 2010-35 – Passed 12/21/10.)

Each applicant shall receive an invoice which explains the labor, material, and equipment cost at the conclusion of the review and processing.

SECTION 6

STORMWATER BMP OPERATIONS AND MAINTENANCE PLAN REQUIREMENTS

925.29 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.

925.30 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 City, stormwater BMPs may also be dedicated to and maintained by the City;
 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 City shall make the final determination on the continuing operations and maintenance responsibilities. The City reserves the right to accept or reject the operations and maintenance responsibility for any or all of the stormwater BMPs.

925.31 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 City.

925.32 OPERATIONS AND MAINTENANCE AGREEMENT FOR PRIVATELY OWNED STORMWATER BMPS

- A. The property owner shall sign an operations and maintenance agreement with the City 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 City 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 City.

925.33 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 925.32.

925.34 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 Northampton County, as applicable, within 90 days of approval of the BMP Operations Plan by the City:
 - 1. The Operations and Maintenance Plan or summary thereof
 - 2. Operations and Maintenance Agreements under Section 925.32
 - 3. Easements under Section 925.33
- B. The City may suspend or revoke any approvals granted for the project site upon discovery of the failure of the owner to comply with this Section.

925.35 MUNICIPAL STORMWATER BMP OPERATION AND MAINTENANCE FUND

- A. If stormwater BMPs are accepted by the City for dedication, the City 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 City, the amount shall cover the estimated costs for operation and maintenance in perpetuity, as determined by the City.

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 City may adjust the amount due accordingly.

SECTION 7 PROHIBITIONS

925.36 PROHIBITED DISCHARGES

- A. No person in the City shall allow or cause to allow stormwater discharges into the City'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 City 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 City determines that any of the discharges identified in Section 925.36B significantly contribute to pollution of waters of the Commonwealth or is so notified by DEP, the City will notify the responsible person to cease the discharge.
- D. Upon notice provided by the City under Section 925.36C, the discharger will have a reasonable time, as determined by the City, 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.

925.37 PROHIBITED CONNECTIONS

- A. The following connections are prohibited, except as provided in Section 925.36B 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 City.

925.38 ROOF DRAINS

- A. Roof drains shall not be connected to streets, sanitary or storm sewers or roadside ditches, except as provided in Section 925.38B.
- 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 City.
- C. Roof drains shall discharge to infiltration areas or vegetative BMPs to the maximum extent practicable.

925.39 ALTERATION OF BMPS

- A. No person shall modify, remove, fill, landscape or alter any existing stormwater BMP without the written approval of the City 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 City.

SECTION 8 RIGHT OF ENTRY, NOTIFICATION AND ENFORCEMENT

925.40 RIGHT OF ENTRY

- A. Upon presentation of proper credentials, duly authorized representatives of the City may enter at reasonable times upon any property within the City 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. Unreasonable delays in allowing the City access to a BMP shall be considered a violation of this Section.
- C. In the event that the land owner refuses admission to the property, duly authorized representatives of the municipality may seek an administrative search warrant issued by a district justice to gain access to the property.

925.41 NOTIFICATION

- A. Whenever the City finds that a person has violated a prohibition or failed to meet a requirement of this Ordinance, the City 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
 - 8. The name of the owner of record and any other person against whom the City intends to take action
 - 9. The location of the property in violation
- 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 City 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 City from pursuing any and all other remedies available in law or equity.

925.42 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.

925.43 SUSPENSION AND REVOCATION OF PERMITS AND APPROVALS

- A. Any building, land development or other permit or approval issued by the City may be suspended or revoked by the City 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 City when:
 - 1. The City Engineer or designee has inspected and approved the corrections to the stormwater BMPs or the elimination of the hazard or nuisance.
 - 2. The City is satisfied that the violation of the ordinance, law or rule and regulation has been corrected.
 - 3. Payment of all City 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 City cannot be reinstated. The applicant may apply for a new permit under the procedures outlined in this Ordinance.

925.99 PENALTIES

- A. Any person violating the provisions of this Ordinance shall be guilty of a misdemeanor and upon conviction shall be subject to the following penalties:
 - 1. First violation – A fine of \$200.00, or thirty days imprisonment, or both;
 - 2. Second violation – A fine of \$500.00, or sixty days imprisonment, or both;
 - 3. Third and each subsequent violation – A fine of \$1,000.00, or ninety days imprisonment, or both.

Each day that the violation continues shall be a separate offense.

- B. This Article and the foregoing penalties shall not be construed to limit or deny the right of the City or any person to such equitable or other remedies as may otherwise be available with or without process of law, including payment of damages to the City

- by any person causing damage or injury to the City's storm sewer system.
- C. The court of common pleas, upon petition, may grant an order of stay upon cause shown, tolling the per diem judgment pending a final adjudication of the violation and judgment.
 - D. Nothing contained in this Section shall be construed or interpreted to grant to any person or entity other than the municipality the right to commence any action for enforcement pursuant to this Section.
 - E. District justices shall have initial jurisdiction in proceedings brought under this Section.
 - F. 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.

(Ord. 4304 – Passed 2/15/05; Ord. 4423 – Passed 4/17/07.)

APPENDIX ‘A’

(City of Bethlehem Stormwater Design Standards)

GENERAL DESIGN STANDARDS:

- A.) No person shall discharge into any watercourse within the City, or in any area under the jurisdiction of the City, any sewage or other pollution waters or industrial waste, except as hereinafter provided.
- B.) Residential, commercial or industrial property may be connected to the storm sewer system providing the waste to be discharged thereto conforms to the following:
 - B.1.- All discharge of waste to storm sewers shall be in compliance with the laws of Pennsylvania or the Federal Government or any agency thereof having jurisdiction over streams, rivers, waterways, or water resources.
 - B.2.- No waste other than unadulterated rain, roof, or surface drainage water or authorized industrial waste shall be discharged into a storm sewer.
 - B.3.- No storm water runoff, natural drainage or authorized industrial waste shall be so diverted as to overload existing drainage systems, or create flooding or the need for additional drainage structures on other private properties or public lands, without City approved provisions being made by the developer for properly handling such conditions.
- C.) Storm Water Flow Impedance - No storm water drainage system, including detention and retention ponds, catch basins, swales, pipes, etc., shall, with the exception of natural causes, have the water flow impeded in any manner, such as by the construction or erection of any structure, placing or dumping of dirt, leaves, grass, debris, etc., or the parking of vehicles or equipment that in any way causes a pond or channel flow to be restricted, except for properly operating design outlet structures of detention or retention ponds.
- D.) Improvement Specifications - The City Engineer may supply additional specifications necessary for the spacing and type of inlets and manholes, minimum pipe sizes, and materials and construction methods.
- E.) Storm water Discharge to A Deficient Culvert or Watercourse - Should it be evident that an offsite storm water drainage channel, into which a developer desires to discharge post-development storm water at a flow rate greater than the predevelopment storm water flow rate, is deficient either from a safety, hydraulic, or erosion control standpoint, the developer shall - as determined by the City Engineer and consistent with any applicable Act 167 watershed plans - provide an appropriate detention facility, or upgrade the deficient storm water channel to the satisfaction of the City Engineer, or provide the City a monetary compensation according to the following formula:

- (1) Monetary compensation (in dollars) = 0.1 times the Area of additional impervious surfaces in square feet.
 - (2) Monetary compensation collected herein shall be placed into a special escrow account of the City for the sole purpose of providing funds to finance construction work necessary to upgrade storm water drainage systems throughout the City
- F.) Drainage of Swimming Pools - Refer to Article 921, Sanitary Sewer Regulations (Section 921.05 – Drainage of Swimming Pools). Only de-chlorinated pool water may be allowed to discharge to the storm sewer system.

DETENTION BASIN REQUIREMENTS:

- A.) All storm drainage systems shall be constructed as necessary to convey the flow of surface waters without damage to persons or property. These drainage systems shall be constructed as approved by the City Engineer to drain the stormwater runoff from the applicants land, as well as the collected runoff from development(s) at higher elevations in the same watershed. Should the land at a higher elevation be undeveloped, the design of the storm drainage system local to the applicant shall be designed as if the land above were fully developed in accordance with current zoning regulations and assuming required runoff controls in effect in all tributary areas.
- B.) 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. The City Engineer may allow some relief from the freeboard requirements, depending upon construction methods and other extenuating circumstances.
- C.) Detention ponds shall be designed so that they return to normal conditions within approximately twelve (12) hours after the termination of the storm, unless the City Engineer finds that downstream conditions may warrant other design criteria for storm water release.
- D.) The bottom of the pond shall be sloped toward the outlet structure a minimum of 1%. Generally, the side slopes of the pond shall be no steeper than 4 units horizontal to 1 unit vertical.

- E.) All construction joints are to be watertight.
- F.) Unless a geological survey demonstrates the feasibility of encouraging infiltration in a detention pond, the detention pond shall, generally, be lined with a full 6-inch thick clay liner with a permeability of 1×10^{-7} cm/sec. or less. The City Engineer may require a full 12-inch thick clay liner with a permeability of 1×10^{-7} cm/sec. or less, where circumstances such as water depth or nearby utilities necessitate a greater degree of assurance against the formation of sinkholes. Also, the City Engineer may approve a different liner system that is – in the opinion of the City Engineer – equal to or better than the above mentioned liners. This clay liner shall, in turn, be covered by a 6-inch layer of viable topsoil on which a healthy growth of grass shall be established (unless rip-rapped). This liner system shall extend from the bottom of the pond to the elevation of the emergency spillway. The liner permeability of 1×10^{-7} cm/sec. shall be verified by lab tests on three field samples or other equivalent procedure acceptable to the City Engineer. Additional tests may be required by the City Engineer should any of the three original tests yield unacceptable results. All the testing shall be arranged and paid by the developer; however, the testing lab shall be certified in this area of testing and acceptable to the City Engineer.
- G.) Complete details and sections shall be provided for the outlet structure and only concrete outlet structures are allowed. A sectional view is also required for the spillway. A detail of an anti-seep collar around the outlet pipe may also be required.
- H.) Fencing may be required around the detention pond at the discretion of the City Engineer. The design of the fence shall be reviewed and approved by the City Engineer, Planning Bureau, and Planning Commission.

INLET DESIGN AND CONSTRUCTION REQUIREMENTS:

- A.) Inlets shall be designed and located to prevent hazardous conditions for vehicles, bicycles and pedestrians.
- B.) Inlets shall be spaced to collect design flows from the catchment areas allowing 10% maximum bypass. In no instance shall inlet spacing be greater than 400 feet.
- C.) Inlets shall be depressed appropriately below the grade of the gutter or ground surface.
- D.) As a rule, inlets shall be either City Standard No. 9, 7 or 7A, or a curb-opening inlet approved by the City Engineer. PennDOT Type C inlet is generally not acceptable, unless specifically approved by the City Engineer.
- E.) Developers are required to place inlet markers on all new and existing inlet hoods in public right-of-way, that adjoin their development tract and within fifty feet (50') of their tract. The design of the inlet markers shall be approved by the City Engineer.

F.) New inlets may have a casting placed on the hood instead of the inlet marker. Approval of the hood casting must be secured from the City Engineer.

G.) Inlets adjacent to a developers tract shall be cleaned after construction is completed.

STREET DRAINAGE DESIGN REQUIREMENTS:

- A.) Street Drainage - Storm drainage systems shall, among other requirements,
- (a) Ensure adequate drainage of all low points along the line of streets
 - (b) Take surface water from the bottom of vertical grades, lead water from springs, and avoid excessive use of cross-gutters at street intersections and elsewhere
 - (c) Provide for the eventual discharge of surface water away from the street rights-of-way
 - (d) Intercept storm water runoff along streets at intervals related to the extent and grade of the area drained.

STORM SEWER PIPES DESIGN REQUIREMENTS:

- A.) Generally, the minimum diameter of a storm sewer pipe shall be 18 inches. If considered hydraulically acceptable, the City Engineer may allow a smaller size storm sewer pipe for onsite drainage.
- B.) Generally, storm sewer pipes shall be watertight, o-ring joint, reinforced concrete pipe (RCP). The City Engineer may allow a plastic or other type of pipe under certain conditions.
- C.) Storm sewer pipe slopes shall be sufficient to provide a minimum velocity of flow of 2 feet per second for a 1-year storm. If feasible, the maximum velocity of flow shall be no more than 15 feet per second.
- D.) Where outlet velocities exceed five (5) feet per second, approved energy dissipaters and/or outlet protection shall be designed and installed.
- E.) Storm sewer pipes shall be designed for a 25-year design storm.

NATURAL DRAINAGE SWALE DESIGN REQUIREMENTS:

A.) Modification of Natural Drainage Swales

When it can be shown that, due to topographic conditions, natural drainage swales on the site cannot adequately provide for drainage, open channels - subject to the approval of the City Engineer - may be constructed conforming substantially to the line and grade of such natural drainage swales. The City Engineer may require an unexposed open channel (i.e. storm sewer pipe), if an exposed open channel places

nearby residencies and their occupants at risks due to the volume and/or velocity of water flow in the channel. Should a storm sewer pipe be required, it shall be designed for a 25-year storm event unless other conditions in this ordinance require a greater capacity. In general, any unexposed open channel that receives storm water from an open swale and is greater than 200 feet in length shall have a trash rack, or other similar protective device, placed at its entrance. This trash rack or similar protective device shall protect persons from being inadvertently swept into the channel by hydraulic forces while the channel is carrying storm water. Capacities of open channels shall be calculated using the Manning equation or other acceptable engineering equation/method as approved by the City Engineer. (See definition of Open Channel.)

SINKHOLE PREVENTION DESIGN REQUIREMENTS:

- A.) General - Unless a geological survey demonstrates the feasibility of encouraging storm water infiltration, grading shall be adequate to ensure the continuous flow of storm water across appropriate watercourses without excessive ponding or other conditions conducive to storm water infiltration and subsequent sinkhole formations.

- B.) Active Sinkhole or Land Subsidence - Any area of sinkhole activity or land subsidence shall be corrected in a reasonable period of time, and if such activity is impacting or threatens to impact offsite property (or a nearby street), the corrections shall be performed as soon as possible but no later than 10 days from the date of notification from the City Engineer. Such corrections shall be to the satisfaction of the City Engineer.

APPENDIX 'B'

(City of Bethlehem Required Plan Notes)

PLAN NOTES:

A.) Detention Pond Liner Note

The following note regarding the specification of the detention pond liner shall be included on the plans, whenever a detention pond is required:

"Unless a geological survey demonstrates the feasibility of encouraging infiltration in a detention pond, the detention pond shall, generally, be lined with a full 6-inch thick clay liner with a permeability of 1×10^{-7} cm/sec. or less. This clay liner shall, in turn, be covered by a 6-inch layer of viable topsoil on which a healthy growth of grass shall be established (unless rip-rapped). This liner system shall extend from the bottom of the pond to the elevation of the emergency spillway. The liner permeability of 1×10^{-7} cm/sec. shall be verified by lab tests on three field samples or other equivalent procedure acceptable to the City Engineer. Additional tests may be required by the City Engineer should any of the three original tests yield unacceptable results. All the testing shall be arranged and paid by the developer; however, the testing lab shall be certified in this area of testing and acceptable to the City Engineer."

The City Engineer may require a full 12-inch thick clay liner with a permeability of 1×10^{-7} cm/sec. or less, where circumstances such as water depth or nearby utilities necessitate a greater degree of assurance against the formation of sinkholes. Also, the City Engineer may approve a different liner system that is - in the opinion of the City Engineer - equal to or better than the above mentioned liners.

B.) Pond cleanout at the end of construction

The following note shall be included in the erosion control section of the plans whenever a detention pond is utilized as a sedimentation pond during construction:

"The Contractor shall clean all accumulated sediment and silt from the pond at the end of the construction, and return the pond to its original design condition."

C.) Maintenance Note

The following note regarding maintenance of the storm water facilities

shall be included on the plans unless these facilities are dedicated to the City in accordance with Section 6 of this ordinance:

"The maintenance of the storm water facilities, including the detention pond, shall be the owner's responsibility. The owner's deed, and the deeds to any subsequent owner, shall note that the owner shall accept the maintenance responsibilities. The City of Bethlehem shall be permitted to inspect the storm water facilities on at least an annual schedule to ensure that any necessary corrective work is performed in a timely manner."

D.) As-built Note

The following note regarding as-built records shall be included on the plans:

"The developer shall ensure that current as-built records are maintained during construction. Upon completion of construction, Certified (i.e. P.E. Stamped) as-built drawings shall be submitted by the developer's engineers. These as-built drawings shall be found acceptable by the City Engineer prior to release of any remaining security."

E.) Revision Note

The following note regarding future revisions to the plans shall be included on the plans upon initial submission:

"In order to maintain continuity between plan revisions, any changes to a previous plan submission shall be flagged with a triangle. Any changes not flagged may be considered not approved. Flagged changes shall be referenced to the appropriate revision date."

F.) NPDES Note

"By submission of these plans the engineer on record certifies that these plans are in complete conformance with the City of Bethlehem Storm Water Management Ordinance."

G.) Inlet Marker Note

"All public inlets shall have inlet markers. The design of the inlet markers shall be approved by the City Engineer."

H.) Drainage Easement Note

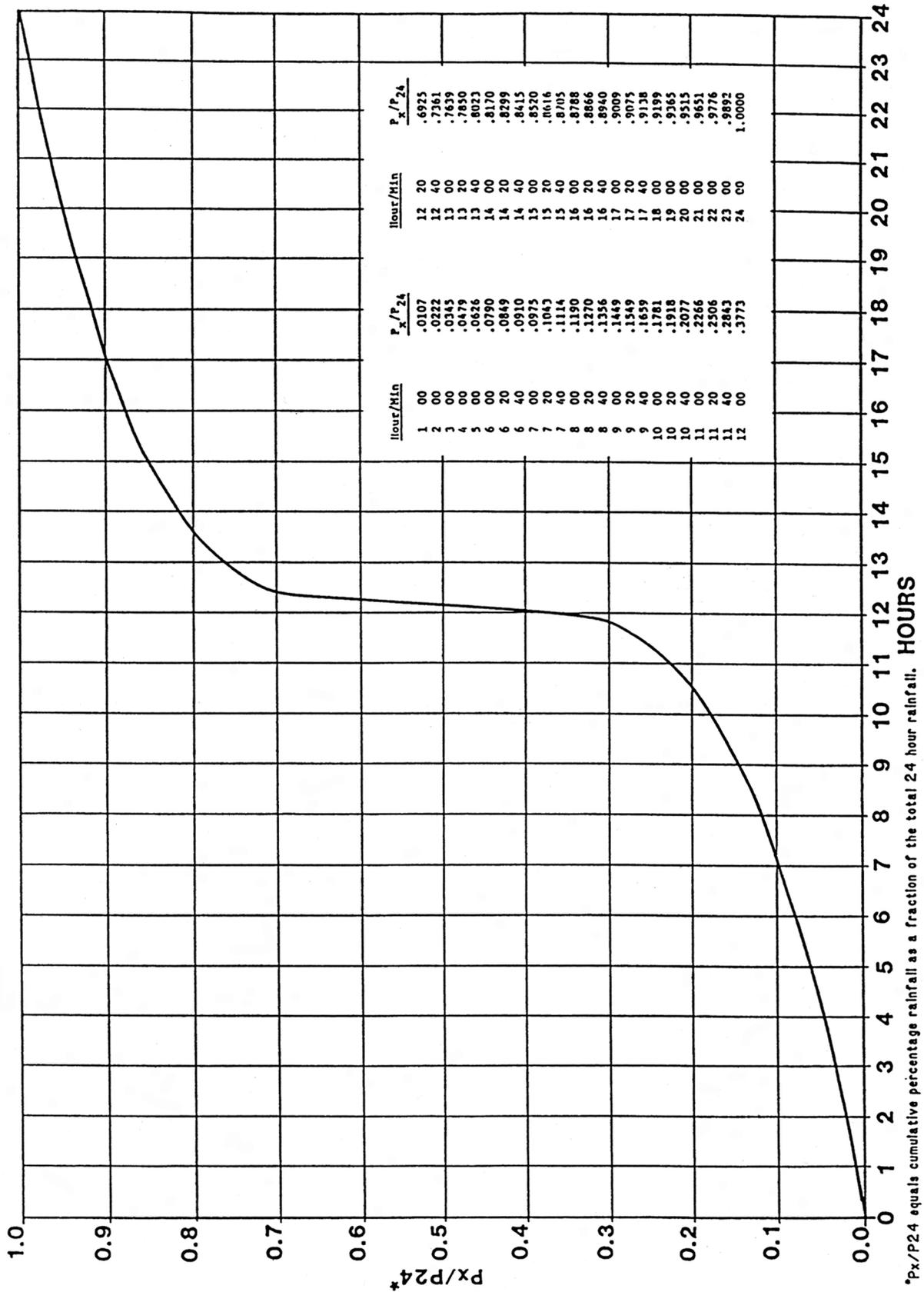
"The drainage easement provides for the flow of stormwater across lots, and may not be altered without the written permission of the City

Engineer. No obstructions such as planting berms or fences may be installed in the drainage easements areas without sufficient provision for the passage of stormwater, and any such proposed provision shall be approved in writing by the City Engineer.”

APPENDIX C

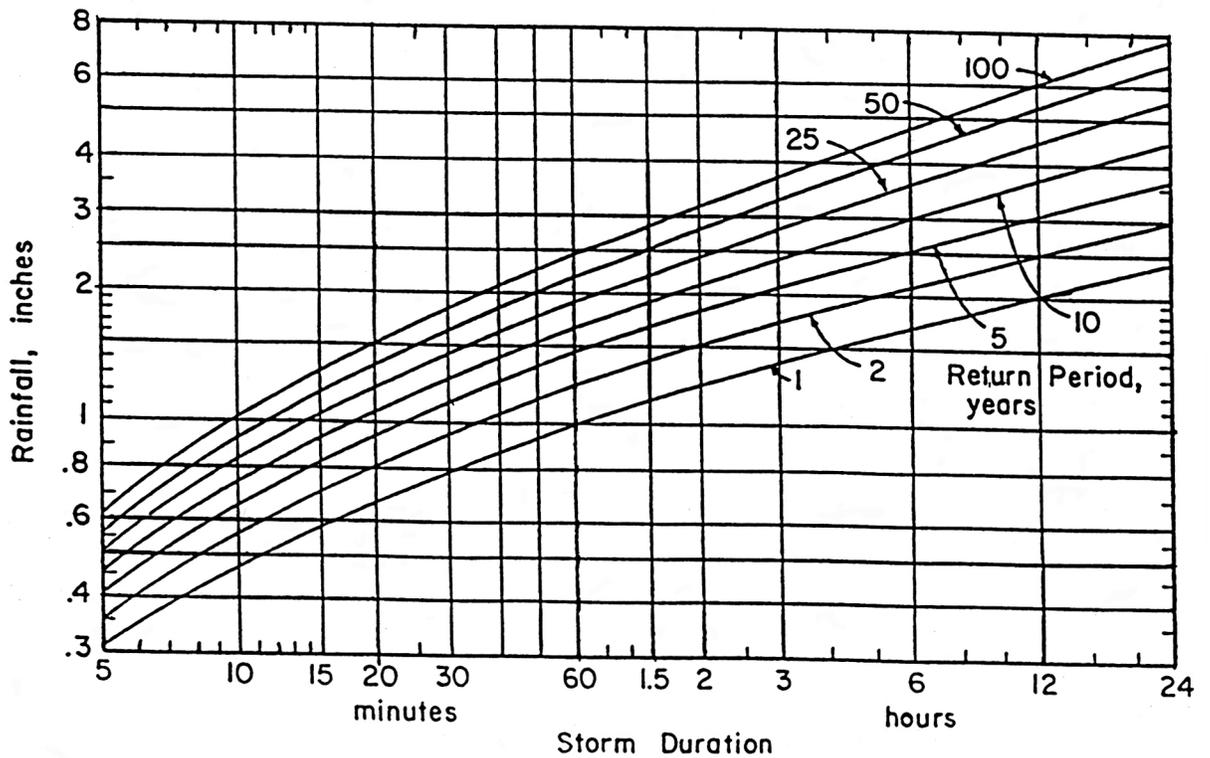
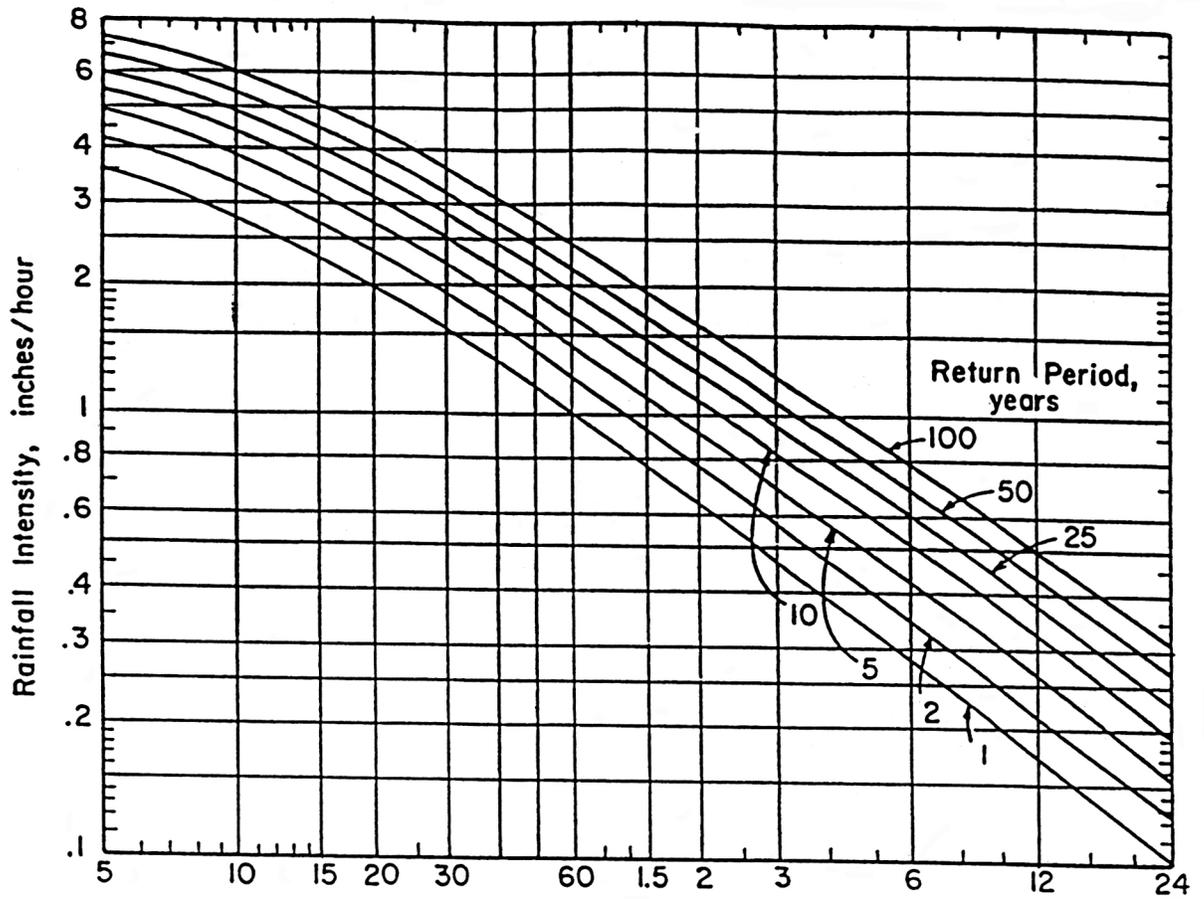
- C-1 NRCS Type II 24-Hour Rainfall Distribution
(Graphic & Tabular)**
- C-2 Intensity-Duration-Frequency Curves**
- C-3 Runoff Curve Numbers and Percent Imperviousness
Values**
- C-4 Runoff Coefficients for the Rational Method**
- C-5 Manning 'n' Values**
- C-6 Permissible Velocities for Channels**

NRCS TYPE II RAINFALL DISTRIBUTION



* P_x/P_{24} 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	Average percent impervious area	Curve numbers for hydrologic soil group**			
		A	B	C	D
<u>Land Use/Cover Type</u>					
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: c acre or less (townhouses) .	65	77	85	90	92
¼ acre	38	61	75	83	87
a 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**									
LAND USE	A			B			C		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
Cultivated ^A	^a 0.18	0.23	0.28	0.24	0.29	0.33	0.30	0.34	0.38
	^b 0.23	0.29	0.34	0.30	0.36	0.40	0.36	0.41	0.45
Pasture ^B	0.09	0.13	0.17	0.19	0.24	0.29	0.27	0.31	0.36
	0.12	0.17	0.23	0.24	0.30	0.36	0.33	0.38	0.43
Meadow, Lawn ^C	0.05	0.08	0.12	0.15	0.20	0.24	0.23	0.28	0.32
	0.07	0.12	0.17	0.19	0.25	0.30	0.28	0.34	0.39
Forest, Woods	0.03	0.05	0.08	0.11	0.16	0.20	0.20	0.25	0.29
	0.04	0.08	0.12	0.15	0.21	0.26	0.25	0.31	0.36
Gravel	0.24	0.29	0.33	0.32	0.36	0.40	0.35	0.39	0.43
	0.30	0.36	0.40	0.38	0.43	0.47	0.42	0.46	0.50
Parking, Other Impervious	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97
Residential, Commercial, Industrial And Other “Developed”	Runoff coefficients should be calculated based upon weighted average of impervious area coefficients from above based upon soil type, slope and the proposal.								

*Coefficients for all land uses except parking and other impervious cover are based on the Rossmiller Equation for translating NRCS curve numbers into Rational Method ‘c’ values. The source for the parking and other impervious cover coefficients is RAWLS, W.J., S.L. WONG and R.H. McCUEN, 1981.

Comparison of urban flood frequency procedures. Preliminary draft report prepared for the Soil Conservation Service, Beltsville, MD.

**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.

^aRepresents 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.

^bRepresents grasslands in fair condition with 50% to 75% grass cover.

^cRepresents grasslands in good condition with greater than 75% grass cover.

MANNING 'n' VALUES BY TYPICAL REACH DESCRIPTION

<u>Reach Description</u>	<u>Manning 'n'</u>
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

<u>Surface Description</u>	<u>Manning 'n'¹</u>
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

¹The n values are a composite of information compiled by Engman (1986).

²Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass and native grass mixtures.

³When 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.

PERMISSIBLE VELOCITIES FOR SELECTED CHANNELS

CHANNEL LINING	PERMISSIBLE CHANNEL VELOCITY (FEET PER SECOND)		
Vegetation ¹			
Grass Mixture	4.0	-	5.0
Kentucky Bluegrass	5.0	-	7.0
Red Fescue	2.5	-	3.5
Redtop	2.5	-	3.5
Reed Canarygrass	3.0	-	4.0
Serecea Lespedeza	2.5	-	3.5
Sudangrass	2.5	-	3.5
Tall Fescue	3.0	-	6.0
Weeping Lovegrass	2.5	-	3.5
Bare Earth, Easily Eroded ²			
Fine Sand	1.5		
Sand Loam	1.75		
Silt Loam or Alluvial Silts, Loose	2.0		
Firm Loam	2.50		
Bare Earth, Erosion Resistant ²			
Fine Gravel	2.5		
Stiff Clay or Alluvial Silts, Firm	3.75		
Loam to Cobbles (Graded)	3.75		
Silt to Cobbles (Graded or Course Gravel)	4.0		
Cobbles and Stones or Shales and Hardpans	6.0		
Rock Lined			
6" Rip Rap	9.0		
9" Rip Rap	11.5		
12" Rip Rap	13.0		

¹ Maximum permissible velocities dependent on soil erodibility and slope.

² Maximum permissible velocities in bare earth channels - for straight channels where slopes <0.02 ft./ft.

Source: Department of Environmental Protection, *Erosion and Sediment Pollution Control Program Manual*, April 15, 2000.

APPENDIX D

D-1 Recommendation Chart for Infiltration Stormwater Management BMPs in Carbonate Rock

APPENDIX D

Art 925-Appendix
D.pdf

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.

9. 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.

IN WITNESS WHEREOF, the parties hereto have duly executed this Agreement as of the day and year first above written.

WITNESS/ATTEST:

Secretary

ATTEST:

City Controller

For the Landowner:

BY: _____
Title:

For the Municipality:
CITY OF BETHLEHEM

BY: _____
Mayor

The within Agreement is certified to be Needed, necessary and appropriate.

By: _____
City of Bethlehem Department Head
Print Name: _____

COMMONWEALTH OF PENNSYLVANIA)
 : SS:
COUNTY OF _____)

On this _____ day of _____, _____, before me,
_____, a Notary Public, appeared _____, who duly
acknowledged the foregoing instrument to be his/her/their act and deed to the end that the same
may be recorded as such.

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

COMMONWEALTH OF PENNSYLVANIA)
 : SS:
COUNTY OF NORTHAMPTON)

On this _____ day of _____, _____, before me,
_____, a Notary Public, personally appeared _____, Mayor of
the City of Bethlehem, Pennsylvania, known to me to be the person described in the foregoing
instrument, and acknowledged that he executed the same in his official capacity therein stated
and for the purposes therein contained.

IN WITNESS WHEREOF, I hereunto set my hand and official 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 REQUIREMENTS

Required Data and Site Information: *The following data shall be gathered 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 Northampton County soil survey maps*
- *Aerial photographs from the LVPC or other sources*
- *Relevant Pennsylvania Geologic Survey Open File Reports that provide maps of sinkholes and karst features for Lehigh County (OF 87-01) and Northampton County (OF 87-02)*
- *Kochanov and Reese (2003). Density of Mapped Karst Feature in South-Central and Southeastern Pennsylvania (Map 68)*
- *DCNR Online Sinkhole Inventory –*
(<http://www.dcnr.state.pa.us/topogeo/hazards/sinkhole/default.asp>)

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 and can be conducted by a certified Sewage Enforcement Officer.*

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 reading are completed or until a stabilized rate of drop is obtained, whichever occurs first. A stabilized rate of drop means a difference of 1/4-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:*

<i>Effective Soil Thickness (ft.)</i>	<i>Test Pit Density (per acre of proposed infiltration area)*</i>	<i>Percolation Tests (per acre of proposed infiltration area)**</i>	<i>Auger Grid Spacing (Feet On-Center)***</i>
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*

****Auger testing is only required on Carbonate sites.*

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: *For each proposed infiltration area, a minimum of six percolation tests shall be conducted with a vertical component permeability test 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 the vertical component percolation rate. For larger infiltration areas, percolation tests shall be conducted at the densities listed in the table above.*

(Ordinance 4423 – passed April 17, 2007)