Ordinance No.

2003-1

DURHAM TOWNSHIP STORMWATER MANAGEMENT ORDINANCE

Durham Township
Bucks County, Pennsylvania

Adopted at a Public Meeting Held on

April 8 2003

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ARTICLE 1. GENERAL PROVISIONS

Section 101. Statement of Findings

The governing body of the municipality finds that:

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

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

Section 102. Purpose

The purpose of this comprehensive stormwater management ordinance is to promote health, safety, and welfare within the Durham Township section of the Delaware River (North) Watershed by minimizing the damages described in Section 101.A of this Ordinance through provisions designed to:

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

B. Utilize and preserve the existing natural drainage systems.

C. Encourage recharge of groundwater where appropriate and prevent degradation of groundwater quality.

D. Maintain 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 proper maintenance of all permanent stormwater management facilities that are constructed in the municipality.

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

Section 103. Statutory Authority

The municipality is empowered to regulate land use activities that affect runoff by the authority of the Act of October 4, 1978 32 P.S., P.L. 864 (Act 167) Section 680.1 et seq., as amended, the "Storm Water Management Act".

Section 104. Applicability

This Ordinance shall apply to those areas of the municipality that are located within the Delaware River (North) Watershed, as delineated in Appendix C which is hereby adopted as part of this Ordinance.

This ordinance shall only apply to permanent stormwater management facilities constructed as part of any of the regulated activities listed in this section. Stormwater management and erosion and sedimentation control during construction activities are specifically not regulated by this ordinance, but shall continue to be regulated under existing laws and ordinances.

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 (driveways, parking lots, etc.) which exceed 1,000 square feet in area (footprint).
D. Construction of new buildings or additions to existing buildings which exceed 1,000 square feet in area (footprint).
E. Diversion or piping of any natural or man-made stream channel.
F. Installation of stormwater management facilities or appurtenances thereto.

Section 105. Exemptions

Any Regulated Activity that meets the following exception criteria is exempt from the requirements of Section 303.A of this Ordinance. This exemption does not relieve the landowner or developer from complying with the water quality and groundwater recharge standards under Section 303.C and the special requirements under Section 304.L for areas within Exceptional Value and High Quality sub-watersheds. Further, this exemption shall not relieve the applicant from implementing such measurers as are necessary to protect health, safety, and property.

This exemption is cumulative such that it applies only once to a tract of land, and if the exemption amount is exceeded, (at any point in time), the exemption is not applicable and all previously exempted impervious areas must be managed. The date of adoption of this ordinance shall be the starting point for the calculation of impervious areas for a tract of land.

Stormwater Management Exemption Criteria

Total Parcel Size	Minimum Setback Distance†	Impervious Area Exemption (sq. ft.)
0 – 0.5 acre	10 ft.	1200 sq. ft
>0.5 – 1 acre	50 ft.	2500 sq. ft.
>1 –2 acres	100 ft.	4000 sq. ft.
>2 – 5 acres	250 ft.	5000 sq. ft.
>5 acres	500 ft.	7500 sq. ft.

† The minimum distance is measured between the proposed impervious area and/or Stormwater control/structure discharge point to the downslope property boundary. In lieu of meeting the minimum distance criteria, the applicant may provide documentation from a Registered Professional Engineer in the Commonwealth of Pennsylvania that the increased flows from the site leaves the site in the same manner as the pre-development condition, and that there will be no adverse effects to properties along the path of flow, or that the increased flows will reach a natural watercourse or an existing stormwater management structure before adversely affecting any property along the path of the flows. The Township may require the above referenced documentation of any site including a site meeting the minimum distance or parcel size criteria when deemed necessary at the sole discretion of the Township.

Section 106. Repealer

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

Section 107. Severability

Should a court of a competent jurisdiction, declare any section or provision of this ordinance invalid, such decision shall not affect the validity of any of the remaining provisions of this ordinance.

Section 108. Compatibility with Other Ordinance Requirements

Approvals issued 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.

ARTICLE II. DEFINITIONS

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

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

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

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

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

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

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

Agricultural activities The work of producing crops and raising livestock including tillage, plowing, disking, harrowing, pasturing and installation of conservation measures. Construction of new buildings or impervious area is not considered an agricultural activity.

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

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

BMP (Best Management Practice) Stormwater structures, facilities and techniques intended to maintain or improve the hydrologic regime or improve the water quality of surface runoff.

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

Cistern An underground reservoir or tank for storing rainwater.

Conservation District The Bucks County Conservation District.

Culvert A structure with appurtenant works, which carries surface water under or through an embankment or fill.

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

Design storm The magnitude and temporal distribution of precipitation from a storm event measured in probability of occurrence (e.g. 5-year storm) and duration (e.g. 24-hours), used in the design and evaluation of stormwater management systems.

Designee The agent of the governing body involved with the administration, review, or enforcement of any provisions of this ordinance by contract or memorandum of understanding.

Detention basin An impoundment structure designed to manage stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate.

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

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.

Downslope property line That portion of the property line of the lot, tract, or parcels of land being developed located such that all overland or pipe flow from the site would be directed toward it.

Downstream Hydraulic Capacity Analysis Any downstream capacity hydraulic analysis conducted in accordance with this ordinance shall use the following criteria for determining adequacy for accepting increased peak flow rates:

1. Natural or man-made channels or swales must be able to convey the increased rate of runoff associated with the 2-year return period event within their banks at velocities consistent with protection of the channels from erosion. Acceptable velocities shall be based upon criteria included in the DEP *Erosion and Sedimentation Control Program Manual.*

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

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

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

Drainage conveyance facility A stormwater management facility designed to transmit stormwater runoff, which shall include streams, channels, swales, pipes, conduits, culverts, storm sewers, etc.

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

Earth disturbance Any activity including, but not limited to, construction, mining, timber harvesting, and grubbing which alters, disturbs, and exposes the existing land surface.

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

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

Erosion and Sediment Pollution Control Plan A plan which is designed to minimize accelerated erosion and sedimentation.

Existing conditions The initial condition of a project site prior to the proposed construction. If the initial condition of the site is undeveloped land, the land use shall be considered as "meadow" unless the natural land cover is proven to generate lower curve numbers or Rational "C" value, such as forested lands.

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

Floodplain Any land area susceptible to inundation by the 100 year reoccurrence interval flood. Such areas may be identified on available Flood Insurance Study maps as prepared by the Federal Emergency Management Agency or where no FEMA maps or studies have defined the boundary, a HEC-1, HEC-2, or HEC-RAS study shall be required to determine the limits of the floodplain.

Floodway The channel of the watercourse and those portions of the adjoining floodplains that are reasonably required to carry and discharge the 100-year frequency flood. Unless otherwise specified, the boundary of the floodway is as indicated on maps and flood insurance studies provided by FEMA. In an area where no FEMA maps or studies have defined the boundary of the 100 year frequency floodway, a HEC-1, HEC-2, or HEC-RAS study shall be required to determine the limits of the floodway.

Forest Management/Timber Operations Planning and activities necessary for the management of forestland. These include timber inventory and preparation of forest management plans, silvicultural treatment, cutting budgets, logging road design and construction, timber harvesting, site preparation, and reforestation.

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

Grade A slope, usually of a road, channel, drainage facility, or natural ground specified in percent and shown on the plans as specified herein. "To Grade" – to finish the surface of a roadbed, top of embankment or bottom of excavation.

Grassed watercourse A natural or constructed watercourse, usually broad and shallow, covered with erosion-resistant grasses, used to convey surface water.

Groundwater recharge Replenishment of existing natural underground water supplies.

Hydric soils Soils that are categorized as poorly drained that can support hydrophytic plants, but may not do so in many cases. For the purpose of this Ordinance, hydric soils are general wetland indictor soils. (Refer Wetlands) The following soils, classified in the Soil Survey of Bucks and Philadelphia Counties, Pennsylvania, U.S. Department of Agricultural, Soil Conservation Service, July 1975, are hydric soils:

Bowmansville silt loam
Doylestown silt loam
Fallsington silt loam
Hatboro silt loam
Towhee silt loam
Towhee extremely stony silt loam

Impervious surface Impervious surfaces are those surfaces that do not absorb water. All structures, buildings, parking areas, driveways, roads, sidewalks, swimming pools, and any areas containing concrete, asphalt, packed stone, compacted soils, or other equivalent surfaces shall be considered impervious within this definition. In addition, other areas determined by the Township Engineer to be impervious within the meaning of this definition will be classified as impervious surfaces.

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

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

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

Land development Any of the following activities:

1. The improvement or change in use 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, whether proposed initially or cumulatively, or a single nonresidential building on a lot or lots regardless of the number of occupants or tenure; or

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

2. A subdivision of land.

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

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

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

Municipality Durham Township, Bucks County, Pennsylvania.

Municipal Engineer A professional engineer licensed by the Commonwealth of Pennsylvania and appointed by the Durham Township Board of Supervisors.

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

NRCS Natural Resource Conservation Service (previously SCS).

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

Outfall Point where water flows from a conduit, stream, or drain.

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

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

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

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

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

Planning Commission The Planning Commission of Durham Township.

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

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

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

Regulated activities Any activity to which this Ordinance is applicable pursuant to Section 104 of this Ordinance.

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

Retention basin An impoundment in which stormwater is stored and not released during the storm event. Stored water may be released from the basin at sometime after the end of the storm.

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

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

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

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

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

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

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

Seepage pit/seepage trench An area of excavated earth filled with loose stone or similar coarse material, into which surface water is directed for infiltration into the ground.

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

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

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

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

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

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

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

Stormwater The total amount of precipitation reaching the ground surface.

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

Stormwater management plan The plan for managing stormwater runoff in the Delaware River (North) Watershed adopted as required by the Act of October 4, 1978, P.L. 864, (Act 167), and known as the "Delaware River (North) Watershed Action 167 Stormwater Management Plan".

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

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

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

Subdivision The division or re-division of a lot, tract or parcel of land by any means into two or more lots, tracts, or parcels or other divisions of land including changes in existing lot lines for the purposes, whether immediate or future, of lease, transfer of ownership, or building or lot development; provided, however, that the subdivision by lease of land for agricultural purposes into parcels of more than ten (10) acres, not involving any new street or easement, access, or any residential dwelling, shall be exempted.

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

Timber operations See Forest Management.

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

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

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

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

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

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

ARTICLE III. STORMWATER MANAGEMENT

Section 301. General Requirements

A. All regulated activities in the municipality which do not fall under the exemption criteria shown in Section 105 of this ordinance, shall submit a Stormwater Management Site Plan consistent with this ordinance, to the municipality for review. This criteria shall apply to the total proposed development even if development is to take place in stages. Impervious cover shall include, but not be limited to, any roof, parking or driveway areas and any new streets and sidewalks. Any areas designed to initially be gravel or crushed stone shall be assumed to be impervious for the purposes of comparison to the waiver criteria.

B. Stormwater drainage systems shall be provided in order to permit unimpeded flow along natural watercourses, except as modified by stormwater management facilities or open channels consistent with this ordinance.

C. The existing points of concentrated drainage that discharge onto adjacent property shall not be altered without written agreement of the altered property owner(s) and shall be subject to any applicable discharge criteria specified in this ordinance. The agreement shall be recorded at the Bucks County Office of Recorder of Deeds and be assignable to future owners.

D. Areas of existing diffused drainage discharge shall be subject to any applicable discharge criteria in the general direction of existing discharge, whether proposed to be concentrated or maintained as diffused drainage areas, except as otherwise provided by this ordinance. If diffused flow is proposed to be concentrated and discharged onto adjacent property, the developer must document that adequate downstream conveyance facilities exist to safely transport the concentrated discharge, or otherwise prove that no erosion, sedimentation, flooding or other harm will result from the concentrated discharge.

E. Where a development site is traversed by watercourses, drainage easements shall be provided conforming to the line of such watercourses. The width of the easement shall be adequate to provide for the unimpeded flow of stormwater runoff from the 100-year storm event. The terms of the easement shall prohibit excavation, the placing of fill or structures, and any alterations that may adversely affect the flow of stormwater within any portion of the easement. Periodic maintenance, including mowing of vegetation within the easement, shall be required to ensure proper runoff conveyance, except as approved by the appropriate governing authority.

F. When it can be shown that, due to topographic conditions, natural drainageways on the site cannot adequately provide for drainage, open channels may be constructed conforming substantially to the line and grade of such natural drainageways. Work within natural drainageways shall be subject to approval by PA DEP through the Joint Permit Application process, or, where deemed appropriate by PA DEP, through the General Permit process.

G. Any stormwater management facilities regulated by this Ordinance that would be located in or adjacent to waters of the commonwealth or wetlands shall be subject to approval by PA DEP through the Joint Permit Application process, or, where deemed appropriate by PA DEP, the General Permit process. When there is a question whether wetlands may be involved, it is the responsibility of the Developer or his agent to show that the land in question cannot be classified as wetlands, otherwise approval to work in the area must be obtained from PA DEP.

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

I. Minimization of impervious surfaces, and infiltration of runoff through seepage beds, infiltration trenches, etc. are encouraged, where soil conditions permit, to reduce the size or eliminate the need for detention facilities.

J. Roof drains must not be connected to streets, sanitary or storm sewers, or roadside ditches in order to promote overland flow and infiltration/percolation of stormwater where advantageous to do so. When it is more advantageous to connect directly to streets or storm sewers, then it shall be permitted on a case-by-case basis by the municipality.

Section 302. Stormwater Management Districts – Peak Rate Control

A. Mapping of Stormwater Runoff Peak Rate Districts – In order to implement the provisions of the Delaware River (North) Watershed Stormwater Management Plan, Durham Township is hereby divided into Stormwater Runoff Peak Rate Districts consistent with the plan. The boundaries of the districts are indicated on the runoff peak rate district map that is available for inspection at the municipal building. A large-scale boundary map is included as Appendix D for reference.

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

C. Description of Stormwater Runoff Hydrologic Peak Rate Districts.

1. Conditional No Detention Districts. These areas may discharge post-development runoff without detention facilities without adversely affecting the total watershed peak flow. These areas are located adjacent to the Delaware River, which is capable of absorbing undetained runoff without affecting the watershed level control. In certain instances, the conveyance capabilities of the local receiving facilities may not be adequate to safely transport the increased peak flows from undetained runoff. In these cases, the developer shall ensure that 100 percent

release rate control is applied to the particular receiving stream(s), and/or the developer may provide increased capacity of those receiving facilities in order to insure safe passage of any undetained runoff.

2. 100 Percent Release Rate District. These areas are not expected to incur a great deal of development growth due to location, topography, soils, or a combination of all three factors. Also, the location in the watershed of these sub-areas is of minor importance in supporting the overall watershed level runoff control. Therefore, these areas are allowed to release development runoff at a rate that does not exceed the existing rates of runoff.

Section 303. Stormwater Management Implementation Provisions (Performance Standards)

A. General. Post-development rates of runoff from any regulated activity shall not exceed the specified Hydrologic District release rate, (section 302 of this Ordinance), calculation of the pre-development peak rate of runoff for the 1, 2, 5, 10, 25, 50, and 100 year frequency storm events.

B. Groundwater Recharge. Developed areas shall maintain groundwater recharge consistent with pre-development conditions, dependent on hydrologic soil groups and impervious cover. A minimum of one inch (1") of runoff shall be infiltrated unless the developer can prove the inability of the site to achieve this specific volume based on existing site conditions. The maximum available recharge shall be calculated based on utilizing the most capable recharge areas of the site. This volume of runoff is termed the "Recharge Volume" and is calculated in accordance with Section 305.K.

Design of the stormwater management facilities shall provide for ground water recharge to compensate for the reduction in the percolation that occurs when the ground surface is altered. A detailed geologic evaluation of the project site shall be performed to determine the suitability of recharge facilities. The evaluation shall be performed by a qualified geologist and/or soil scientist, and at minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability. Where pervious pavement is proposed for parking lots, recreational facilities, nondedicated streets, or other areas, pavement construction specifications shall be noted on the plan.

Whenever a stormwater facility will be located in an area underlain by limestone, a geological evaluation of the proposed location shall be conducted to determine susceptibility to sinkhole formations. The design of all facilities over limestone formations shall include measures to prevent ground water contamination and, where necessary, sinkhole formation. Soils used for the construction of basins shall have low-erodibility factors ("K" factors). The municipality may require the installation of an impermeable liner in detention basins. If the developer can prove through analysis that the site is in an area underlain by limestone, and such geological conditions may result in sinkhole formations, then the site is exempt from recharge requirements. However, the site shall still be required to meet all other hydrologic and water quality management standards as found in this ordinance.

It shall be the developer's responsibility to verify if the site is underlain by limestone. The following note shall be attached to all Stormwater Management Site Plans and signed and sealed by the developer's engineer/surveyor/landscape architect/architect:

"I _____, certify that the proposed detention basin (circle one) is/is not underlain by limestone."

C. Water Quality. Developed areas will provide adequate storage and treatment facilities necessary to capture and treat the Water Quality Volume (WQ_v) consistent with Articles 3 and 4 of this ordinance. The "Water Quality Volume" is calculated in accordance with Section 305.J. The Recharge Volume may be a component of the Water Quality Volume. If the Recharge Volume is less than the Water Quality Volume, the remaining Water Quality Volume may be captured and treated by methods other than recharge/infiltration BMPs.

D. District Boundaries. The boundaries of the Stormwater Management Districts are shown on an official map, which is available for inspections at the municipal office. A copy of the office map at a reduced scale is included in Appendix C of this Ordinance. 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 topographic contours at an appropriate level of detail, but in no case less than 2-foot intervals. The municipality may determine a more frequent contour interval is necessary to adequately delineate the district boundary. This information will be provided as part of the Stormwater Management Site Plan.

E. Sites located in More Than One District- A proposed development site located within two or more release category subareas shall be handled such that the peak discharge rate from any subarea shall be the predevelopment 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.

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

G. Site Areas- 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.

H. Stormwater Conveyance Corridor Protection (Riparian Corridor Preservation and Vegetation) – Runoff from developed areas of the site, including but not limited to areas of impervious surface, shall be managed through a series of riparian corridor vegetation facilities whenever possible. This will be accomplished in a manner satisfactory to the municipality , utilizing the "Pennsylvania Handbook of Best Management Practices for Developing Areas", 1998, Riparian Forested Buffer, and the priority goal of the riparian vegetation will be the reduction of thermal impacts on stormwater runoff associated with impervious areas, with a secondary goal being the protection of capacity of existing stormwater conveyance channels. These goals will be achieved through the use of design criteria in Section 304.J of this Ordinance, and shall be in addition to any other municipal ordinance provisions.

I. Within a particular district, the municipality may require the submission of a downstream hydraulic capacity analysis to verify stormwater management routing, timing, combined

with peak effects, etc. associated with unanticipated impervious cover and development, such as may result from changes in Zoning or Conditional Uses which exceed projected growth for a particular watershed. Such analysis shall be conducted in accordance with the procedure outlined in Article II under the definition of "Downstream Hydraulic Capacity Analysis" of this Ordinance and is subject to the review and approval of the municipal engineer.

J. 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 the prospective developers. The design of any regional control facility must incorporate reasonable development of the entire upstream watershed. The peak outflow of a regional control facility would be determined on a case-by-case basis using the hydrologic model of the watershed consistent with protection of the downstream watershed areas. "Hydrologic model" refers to the calibrated model as developed for the stormwater management plan.

Section 304. Design Criteria for Stormwater Management Facilities

A. Any stormwater facility located on state highway rights-of-way shall be subject to approval by the Pennsylvania Department of Transportation, (PA DOT).

B. Any stormwater management facility designed to store runoff and requiring a berm or earthen embankment required or regulated by this ordinance shall be designed to provide an emergency spillway to handle flow up to and including the 100-year postdevelopment conditions. The height of embankment must be set as to provide a minimum 1.0 foot of freeboard above the maximum pool elevation computed when the facility functions for the 100-year postdevelopment inflow. Should any stormwater management facility require a dam safety permit under PA-DEP Chapter 105, the facility shall be designed in accordance with Chapter 105 and meet the regulations of Chapter 105 concerning dam safety which may be required to pass storms larger than 100-year event.

C. Any facilities that constitute water obstructions (e.g., culverts, bridges, outfalls, or stream enclosures), and any work involving wetlands as directed in PA DEP Chapter 105 regulations (as amended or replaced from time to time by PA DEP), shall be designed in accordance with Chapter 105 and will require a permit from PA DEP. Any other drainage conveyance facility that doesn't fall under Chapter 105 regulations must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year design storm with a minimum of 1.0 foot of freeboard measured below the lowest point along the top of the roadway. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm with a minimum 1.0-foot of freeboard measured below the lowest point along the top of roadway. Any facility that constitutes a dam as defined in PA DEP Chapter 105 regulations may require a permit under dam safety regulations. Any facility located within a PA DOT right-of-way must meet PA DOT minimum design standards and permit submission requirements.

D. Any drainage conveyance facility and/or channel that doesn't fall under Chapter 105 Regulations, must be able to convey, without damage to the drainage structure or roadway, runoff from the 25-year design storm. Conveyance facilities to or exiting from

stormwater management facilities shall be designed to convey the design flow to or from that structure. Roadway crossings located within designated floodplain areas must be able to convey runoff from a 100-year design storm. Any facility located with a PA DOT right-of-way must meet PA DOT minimum design standards and permit submission requirements.

E. Storm sewers must be able to convey post-development runoff from a 25-year design storm without surcharging inlets, where appropriate.

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

G. The design of all stormwater management facilities shall incorporate sound engineering principles and practices. Guidelines established by the *Pennsylvania Handbook of Best Management Practices for Developing Areas* shall be utilized in determining stormwater management facility design. The municipality shall reserve the right to disapprove any design that would result in the occupancy or continuation of an adverse hydrologic or hydraulic condition within the watershed.

In selecting the appropriate BMPs or combinations thereof, the land developer shall consider the following:

1. Total contributing area
2. Permeability and infiltration rate of the site soils
3. Slope and depth to bedrock
4. Seasonal high water table
5. Proximity to building foundations and wellheads
6. Erodibility of soils
7. Land availability and configuration of the topography

The following additional factors SHOULD be considered when evaluating the suitability of BMPs used to control water quality at a given development site:

1. Peak discharge and required volume control
2. Stream bank erosion
3. Efficiency of the BMPs to mitigate potential water quality problems
4. The volume of runoff that will be effectively treated
5. The nature of the pollutant being removed
6. Maintenance requirements
7. Creation/protection of aquatic and wildlife habitat
8. Recreational value
9. Enhancement of aesthetic and property value

H. Pipe or artificial swale discharge shall be set back 75 feet from a receiving watercourse, and the pipe discharge shall be immediately diffused or spread out to reduce and eliminate high-velocity discharges to the impacted ground surface. The conveyance mechanism shall minimize disturbance and minimize velocity of discharge.

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

J. Riparian Corridor Preservation – The area up to fifty feet from top of stream bank on either side of a stream shall be planted in accordance with Zone I and Zone II buffer planting requirements as depicted in *Pennsylvania Handbook of Best Management Practices for Developing Areas*, 1998, Riparian Forested Buffer. Zone I will comprise, at a minimum, the first 15 feet from the top of bank, with Zone II comprising the remaining 35 feet. This replanting may be waived by the local municipality along stream bank areas which receive overland or shallow flow from upstream, undisturbed, meadow or other existing pervious surfaces.

K. All developments which create impervious surface shall provide capacity for and treatment of the "Water Quality Volume" and "Recharge Volume", unless exempt from applicability under Section 104.

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

A long-term maintenance schedule and management plan for the thermal control BMPs is to be established and recorded for all development sites.

Section 305. Calculation Methodology

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

A. Any stormwater runoff calculations involving drainage areas greater than 200 acres, including on- and off-site areas, shall use generally accepted calculation technique that is based on the NRCS soil cover complex method. Table 1 summarizes acceptable computation methods. It is assumed that all methods will be selected by the design professional based on the individual limitations and suitability of each method for a particular site. The municipality may approve the use of the Rational Method to estimate peak discharges from drainage areas that contain less than 200 acres.

Table 1. Acceptable Computation Methodologies For Stormwater Management Plans

METHOD	METHOD DEVELOPED BY	APPLICABILITY
TR-20 or commercial package based on TR-20	USDA – NRCS	When use of full model is desirable or necessary
TR-55 or commercial package based on TR-55	USDA-NRCS	Applicable for plans within the models limitations
HEC – 1	U.S. Army Corps of Engineers	When full model is desirable or necessary
PSRM	Penn State Univ.	When full model is desirable or necessary
Rational Method or commercial package based on Rational Method	Emil Kuiching (1889)	For sites less than 200 acres when approved by the municipality
Other methods	Various	As approved by the municipal engineer

B. All calculations consistent with this Ordinance using the soil cover complex method shall use the appropriate design rainfall depths for the various return period storms presented in Table A-1 in Appendix A of this ordinance. If a hydrologic computer model such as PSRM or HEC-1 is used for stormwater runoff calculations, then the duration of rainfall shall be 24 hours. The NRCS 'S' curve shown in Figure A-1, Appendix A of this ordinance shall be used for the rainfall distribution.

C. For the purpose of predevelopment flow rate determination, undeveloped land shall be considered as "meadow" good condition, unless the natural ground cover generates a lower curve number or Rational "C" value (i.e. forest).

D. All calculations using the Rational Method shall use rainfall intensities consistent with appropriate times of concentration for overland flow and return periods from the Design Storm Curves from the Pennsylvania Department of Transportation Design Rainfall Curves (1986) (Figure A-2). Times of concentration for overland flow shall be calculated using the methodology presented in Chapter 3 of Urban Hydrology for Small Watersheds, NRCS, TR-55 (as amended or replaced from time to time by NRCS). Times of concentration for channel and pipe flow shall be computed using Manning's equation.

E. Runoff Curve Numbers (CN) for both existing and proposed conditions to be used in the soil cover complex method shall be obtained from Table A-2 in Appendix A of this ordinance.

F. Runoff coefficients (c) for both existing and proposed conditions for use in the Rational method shall be obtained from Table A-3 in Appendix A or this ordinance.

G. Where uniform flow is anticipated, the Manning equation shall be used for hydraulic computations, and to determine the capacity of open channels, pipes, and storm sewers. Values for Manning's roughness coefficient (n) shall be consistent with Table A-4 in Appendix A of this ordinance.

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

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

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

J. Calculation of Water Quality Volume: The Water Quality Volume (WQ_v) is the storage capacity needed to treat 90 percent of the average annual stormwater rainfall from the developed areas of the site. The following calculation is used to determine the storage volume, WQ_v, in acre-feet of storage:

$$WQ_v = \frac{(1.95)(R_v)(A)}{12}$$

WQ_v = Water Quality Volume
A = Area in acres
$R_v = 0.05 + 0.009(I)$ where I is the percent impervious cover (example: I=50 for 50 percent impervious cover)
1.95 = is a coefficient representing the 90 percent annual rainfall (PA Handbook of Best Management Practices for Developing Areas)

WQ_v shall be designed as part of a stormwater management facility which incorporates water quality BMPs as a primary benefit of using that facility, in accordance with design specifications contained in "*Pennsylvania Handbook of Best Management Practices for Developing Areas*," 1998.

K. Calculation of Recharge Volume: The Recharge Volume (Re_v) is the volume of stormwater runoff from a developed site which shall be required to maintain existing pre-development groundwater recharge at development sites. It may be part of the Water Quality volume, and is calculated on the basis of treatment and recharge by structural stormwater management practices, as follows:

$$Re_v = \frac{(S)(R_v)(A)}{12}$$

Re_v = Recharge Volume
A = Area in acres
$R_v = 0.05 + 0.009(I)$ where I is the percent impervious cover.
(example: I=50 for 50 percent impervious cover)

S is the Soil Specification Recharge factor an varies according to soil type, as follows:

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

Structural stormwater management facilities, which provide treatment and recharge of the required Recharge Volume will be designed as part of a stormwater management facility which incorporates groundwater recharge BMPs as a primary benefit of using that facility, in accordance with the design specifications contained in "*Pennsylvania Handbook of Best Management Practices for Developing Areas*," 1998.

Section 306. Erosion and Sedimentation Requirements

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

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

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

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

ARTICLE IV. STORMWATER PLAN REQUIREMENTS

Section 401. General Requirements

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

Section 402. Stormwater Management Site Plan Contents

A stormwater management site plan shall be required for all activities regulated by Section 104 of this ordinance and governed by the Delaware River (North) Watershed stormwater management plan. The stormwater management plan shall consist of all applicable calculations, maps, and plans. A note on the maps shall refer to the associated computations and erosion and sedimentation control plan by title and date. The cover sheet of the stormwater related computations and erosion and sedimentation control plan shall refer to the associated maps by title and date. All stormwater management plan materials shall be submitted to the municipality in a format that is clear, concise, legible, neat, well organized, and signed/sealed by the responsible licensed professional engineer. Otherwise, the stormwater management plan shall be disapproved and returned to the applicant.

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

A. General

1. General description of project.

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

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

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

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

2. Existing contours at intervals of 2 feet. In areas of steep slopes (greater than 15 percent), 5 feet contours may be used.

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

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

5. The locations of all existing and proposed utilities, sanitary sewers, and water lines located on the site and/or within 100 feet of property lines.

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

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

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

9. Final contours at intervals at 2 feet. In areas of steep slopes (greater than 15 percent), 5-feet contour intervals may be used.

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

11. The date of the plan preparation and any subsequent revision date(s).

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

13. A North arrow.

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

15. Existing and proposed land use(s).

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

17. Horizontal and vertical profiles of all open channels and stormwater collection systems, including hydraulic capacity.

18. Overland drainage paths.

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

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

21. A construction detail of any improvements made or proposed to be made to sinkholes and the location of all notes to be posted, as specified in this ordinance.

22. An statement signed by the landowner, acknowledging the stormwater management system to be a permanent fixture that can be altered or removed only after approval of a revised plan by the municipality.

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

C. Supplemental Information

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

   a) The overall stormwater management concept for the project.
   b) Stormwater runoff computations as specified in this ordinance.
   c) Stormwater management techniques and best management practices to be applied both during and after development.
   d) Expected project time schedule.

2. A soil erosion and sedimentation control plan, where applicable, including all reviews and approvals, as required by PA DEP.

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

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

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

D. Stormwater Management Facilities

1. All stormwater management facilities must be depicted on a plan and described in detail.

2. Maps for groundwater recharge facilities must show the locations of existing and proposed septic tank infiltration areas and wells. A separation distance of no less than 20 feet shall be used between any septic system and any facility used for stormwater management.

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

Section 403. Stormwater Management Site Plan Submission

For the purpose of complying with this ordinance, the steps below shall be followed for stormwater management site plan submission. For any activities that require a PA DEP joint permit application and regulated under Chapter 105 (Dam Safety and Waterway Management) or Chapter 106 (Floodplain Management) of PA DEP's Rules and Regulations, require a PA DOT highway occupancy permit, or require any other permit under applicable state or federal regulations, the permit(s) shall be part of the plan.

A. The stormwater management site plan shall be submitted by the developer as part of the preliminary plan submission to the Township.

B. A minimum of three (3) copies of the stormwater management plan shall be submitted.

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

1. Two (2) copies to the municipality accompanied by the requisite municipal review fee, as specified in this Ordinance.

2. One (1) copies to the Municipal Engineer.

Section 404. Stormwater Management Plan Review

A. The Municipal Engineer shall review the stormwater management plan for consistency with the adopted Delaware River (North) Watershed Act 167 Stormwater Management plan and applicable municipal ordinances. The municipality shall require receipt of a complete plan, as specified in Section 402 of this ordinance.

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

C. For activities regulated by this Ordinance, the Municipal Engineer shall notify the municipality in writing, within 45 calendar days, whether the stormwater management site plan is consistent with the municipal ordinances and the Delaware River (North) stormwater management plan. The Municipal Engineer will forward a copy of the review letter to the developer.

D. Stormwater management plans that contain deficiencies may be revised by the developer and resubmitted consistent with this Ordinance.

E. For activities specified in Section 104 of this Ordinance, the Municipal Engineer shall notify the Municipal Building Permit Officer in writing, within a time frame consistent with the building code and/or municipal Subdivision and Land Development Ordinance, whether the stormwater management site plan is consistent with the municipal ordinances and the Delaware River (North) Stormwater Management Plan and forward a copy of the review letter to the developer. Stormwater management plans that contain deficiencies may be revised by the developer and resubmitted consistent with this Ordinance.

F. The municipality shall not approve any subdivision or land development for activities specified in Section 104 of this Ordinance if the stormwater management site plan has been found to be inconsistent with the Delaware River (North) Stormwater Management Plan, as determined by the Municipal Engineer. All required permits from PA DEP must be obtained prior to final approval.

G. The Municipal Building Permit Office shall not issue a building permit for any activity specified in Section 104 of this Ordinance if the stormwater management site plan has been found to be inconsistent with the Delaware River (North) Stormwater Management Plan, as determined by the Municipal Engineer. All required permits from PADEP must be obtained prior to issuance of a building permit.

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

I. The municipality's approval of a stormwater management site plan shall be valid for a period not to exceed two (2) years. This 2-year time period shall commence on the date that the municipality signs the approved stormwater management site plan. If stormwater management facilities included in the approved stormwater management site plan have not been constructed, or if an as-built survey of these facilities has not been approved within this 2-year time-period, then the municipality may consider the stormwater management plan disapproved and may revoke any and all permits. Stormwater management site plans that are considered disapproved by the municipality shall be resubmitted in accordance with Section 406 of this ordinance.

Section 405. Modifications of Plans

A modification to a submitted stormwater management site plan for a development site that involves a change in stormwater management facilities or techniques, or that involves the relocation or redesign of stormwater management facilities, or that is necessary because soil or other conditions are not as stated on the stormwater management plan as determined by the municipality, shall require a resubmission of the modified stormwater management site plan consistent with Section 403 of this ordinance and be subject to review as specified in Section 404 of this ordinance.

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

Section 406. Resubmission of Disapproved Stormwater Management Plans

A disapproved stormwater management site plan may be resubmitted, with the revisions addressing the Municipal Engineer's concerns documented in writing, to the Municipal Engineer

reviewer in accordance with Section 403 of this ordinance and be subject to review as specified in Section 404 of this ordinance. The applicable municipal review fee must accompany a resubmission of a disapproved stormwater management site plan.

ARTICLE V. INSPECTIONS

Section 501. Schedule of Inspections

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

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

ARTICLE VI. FEES AND EXPENSES

Section 601. General

A review fee shall be established by the municipality to defray review costs incurred by the municipality, the Municipal Engineer, or other qualified persons designated by the municipality. The applicant shall pay all fees.

Section 602. Stormwater Management Plan Review Fee

The Municipality shall establish a review fee schedule by resolution of the municipal governing body based on the size of the regulated activity and based on the municipality's costs for reviewing stormwater management plans. The municipality shall periodically update the review fee schedule to ensure that review costs are adequately reimbursed.

Section 603. Expenses Covered by Fees

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

A. Administrative costs.

B. Review of the stormwater management site plan by the municipality and the Municipal Engineer or other qualified persons designated by the municipality.

C. The site inspections.

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

E. The final inspection upon completion of the stormwater management facilities and drainage improvements presented in the stormwater management site plan.

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

ARTICLE VII. MAINTENANCE RESPONSIBILITY

Section 701. Performance Guarantee

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

Section 702. Maintenance Responsibilities

A. The stormwater management site plan for the development site shall contain an operation and maintenance plan prepared by the developer and approved by the Municipality. The operation and maintenance plan shall outline required routine maintenance actions and schedules necessary to insure proper operation of the facility(ies).

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

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

2. If a development site is to be maintained in a single ownership or if sewers and other public improvements are to be privately owned and maintained, then the ownership and maintenance of stormwater control facilities shall be the responsibility of the owner or private management entity.

C. The governing body, upon recommendation of the Municipal Engineer, shall make the final determination on the continuing maintenance responsibilities prior to final approval of the stormwater management plan. The governing body reserves the right to accept the ownership and operating responsibility for any or all of the stormwater management controls.

Section 703. Maintenance Agreement for Privately Owned Stormwater Facilities

A. Prior to final approval of the stormwater management plan, the property owner shall sign and record a maintenance agreement covering all stormwater control facilities that are to be privately owned.

B. Other items may be included in the agreement where determined necessary to guarantee the satisfactory maintenance of all facilities. The maintenance agreement shall be subject to the review and approval of the Municipal Solicitor and governing body.

Section 704. Municipal Stormwater Maintenance Fund

A. If stormwater facilities are accepted by the municipality for dedication, persons installing stormwater storage facilities shall be required to pay a specified amount to the Municipal

Stormwater Maintenance Fund to help defray costs of periodic inspections and maintenance expenses. The amount of the deposit shall be determined as follows:

1. If the storage facility is to be owned and maintained by the municipality, the deposit shall cover the estimated costs for maintenance and inspections for ten (10) years. The municipal engineer will establish the estimated costs utilizing information submitted by the applicant.

2. The amount of the deposit to the fund shall be converted to present worth of the annual series values. The municipal engineer shall determine the present worth equivalents, which shall be subject to the approval of the municipal governing body.

B. If a storage facility is proposed that also serves as a recreation facility (e.g., ball field, lake), the municipality may reduce or waive the amount of the maintenance fund deposit based upon the value of the land for public recreation purpose.

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

ARTICLE VIII. ENFORCEMENT AND PENALTIES

Section 801. Right-of-Entry

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

Section 802. Notification

In the event that a person fails to comply with the requirements of this Ordinance, or fails to conform to the requirements of any permit issued hereunder, the municipality shall provide written notification of the violation. Such notification shall set forth the nature of the violation(s) and establish a time limit for correction of these violation(s). Failure to comply within the time specified shall subject such person to the penalty provision of this Ordinance. All such penalties shall be deemed cumulative. In addition, the municipality may pursue any and all other remedies. It shall be the responsibility of the owner of the real property on which any regulated activity is proposed to occur, is occurring, or has occurred, to comply with the terms and conditions of this ordinance.

Section 803. Enforcement

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

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

B. Adherence to approved plan

It shall be unlawful for any person, firm, or corporation to undertake any activity under Section 104 on any property except as provided for in the approved stormwater management site plan and pursuant to the requirements of this ordinance. It shall be unlawful to alter or remove any control structure required by the stormwater management site plan pursuant to this ordinance or to allow the property to remain in a condition which does not conform to the approved stormwater management site plan.

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

1. Provide a certification of completion from a professional engineer, architect, surveyor or other qualified persons verifying that all permanent facilities have been constructed according to the plans and specifications and approved revisions thereto.

2. Provide one reproducible and two paper prints of as-built drawings.

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

E. Prior to revocation or suspension of a permit, the governing body will schedule a hearing to discuss the non-compliance if there is no immediate danger to life, public health or property.

F. Suspension and revocation of permits

1. Any permit issued under this Ordinance may be suspended or revoked by the governing body for:

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

   b) A violation of any provision of this ordinance or any other applicable law, ordinance, rule, or regulation relating to the project.

   c) The creation of any condition or the commission of any act during construction or development which constitutes or creates a hazard or nuisance, pollution or which endangers the life or property of others.

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

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

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

   c) A permit revoked by the governing body cannot be reinstated. The applicant may apply for a new permit under the procedures outlined in this ordinance.

G. Occupancy Permit

An occupancy permit shall not be issued unless the certification of compliance has been secured. The occupancy permit shall be required for each lot owner and/or developer for all subdivisions and land developments in the municipality.

Section 804. Public Nuisance

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

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

Section 805. Penalties

A. Anyone violating the provisions of this ordinance shall be guilty of a misdemeanor, and upon conviction shall be subject to a fine of not more than $1,000 for each violation,

recoverable with costs, or imprisonment of not more than 10 days, or both. Each day that the violation continues shall be a separate offense.

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

Section 806. Appeals

A. Any person aggrieved by any action of the municipality or its designee, relevant the provisions of this ordinance, may appeal to the Municipal Zoning Hearing Board within thirty (30) days of that action.

B. Any person aggrieved by any decision of the Zoning Hearing Board, relevant to the provisions of this Ordinance, may appeal to the County Court of Commons Pleas in the county where the activity has taken place within thirty (30) days of the Zoning Hearing Board's decision.

ENACTED and **ORDAINED** at a regular meeting of the Durham Township Board of Supervisors on the 8th day of April 2003. This Ordinance shall take effect immediately.

Bartley E. Millett - Chairman

Richard M. Johnson – Vice Chairman

Manfred Marschewski - Member

ATTEST: (Township Seal)

Janet M. Davis -Township Manager & Secretary

ENACTED and ORDAINED at a regular meeting of the Durham Township Board of Supervisors on the 8th day of April 2003. This Ordinance shall take effect immediately.

Bartley E. Millett - Chairman

Richard M. Johnson - Vice Chairman

Manfred Marschewski - Member

ATTEST: (Township Seal)

Janet M. Davis -Township Manager & Secretary

APPENDIX A

STORMWATER MANAGEMENT DESIGN CRITERIA

TABLE A-1

DESIGN STORM RAINFALL AMOUNT (INCHES)

Design Storm

An important factor in developing consistent stormwater runoff values is the consistent use of acceptable design storm frequencies and runoff values. This report incorporates the use of rainfall depths as found in the PennDOT Intensity-Duration-Frequency (IDF) Curves from their design manuals. The accepted values for differing storm events, and the associated rainfall (for Region 4) are as follows:

Rainfall Return Period Years	Rainfall Depth in inches, 24-hour period
1	2.4
2	3.1
5	3.7
10	4.5
25	5.5
50	7.0
100	7.5

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

Runoff curve numbers for urban areas[1]

Cover description		Curve numbers for hydrologic soil group-			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 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
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
¼ acre	38	61	75	83	87
1/3 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
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c.)					

[1] Average runoff condition, and $I_n = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and previous areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

TABLE A-2 CONTINUED

Runoff curve numbers for other agricultural lands[1]

Cover description		Curve numbers for hydrologic soil group-			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range-continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow-continuous grass, protected from grazing and generally mowed for hay.	--	30	58	71	78
Brush-brush-weed grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	65	73
Woods – grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	70	77
Farmsteads-buildings, lands, driveways, and surrounding lots.	--	59	74	82	86

[1] Average runoff condition, and $I_n = 0.2S$.

[2] *Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

[3] *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4] Actual curve number is less than 30; use CN = 30 for runoff computations.

[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

TABLE A-2. CONTINUED

Runoff curve numbers for cultivated agricultural lands[1]

Cover description				Curve numbers for hydrologic soil group-			
Cover type	Treatment[2]	Hydrologic condition[3]		A	B	C	D
Fallow	Bare Soil	--		77	86	91	94
	Crop residue cover (CR)	Poor		76	85	90	93
		Good		74	83	88	90
Row crops	Straight row (SR)	Poor		72	81	88	91
		Good		67	78	85	89
	SR + CR	Poor		71	80	87	90
		Good		64	75	82	85
	Contoured (C)	Poor		70	79	84	88
		Good		65	75	82	86
	C + CR	Poor		69	78	83	87
		Good		64	74	81	85
	Contoured & terraced (C&T)	Poor		66	74	80	82
		Good		62	71	78	81
	C&T + CR	Poor		65	73	79	81
		Good		61	70	77	80
Small Grain	SR	Poor		65	76	84	88
		Good		63	75	83	87
	SR + CR	Poor		64	75	83	86
		Good		60	72	80	84
	C	Poor		63	74	82	85
		Good		61	73	81	84
	C + CR	Poor		62	73	81	84
		Good		60	72	80	83
	C&T	Poor		61	72	79	82
		Good		59	70	78	81
	C&T + CR	Poor		60	71	78	81
		Good		58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor		66	77	85	89
		Good		58	72	81	85
	C	Poor		64	75	83	85
		Good		55	69	78	83
	C&T	Poor		63	73	80	83
		Good		51	67	76	80

[1] Average runoff condition, and $I_a = 0.2S$.

[2] *Crop residue cover* applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydrologic condition is based on combination of factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes in rotations, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

TABLE A-2 CONTINUED

Runoff curve numbers for arid and semiarid ranglands[1]

Cover description		Curve numbers for hydrologic soil group-			
Cover type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous-mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen - mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper – pinyon, juniper, or both; grass understory	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub – major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1] Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.

[2] *Poor*: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3] Curve numbers for group A have been developed only for desert shrub.

TABLE A-3

RATIONAL RUNOFF COEFFICIENTS

Runoff Coefficients for the Rational Formula
By Hydrologic Soil Group and Overland Slope (%)

Land Use	A			B			C			D		
	0-2%	2-6%	8% +	0-2%	2-6%	6% +	0-2%	2-6%	6% +	0-2%	2-6%	6% +
Cultivated Land	0.00[a]	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
	0.14[b]	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Pasture	0.12	0.20	0.30	0.18	0.28	0.37	0.24	0.34	0.44	0.30	0.40	0.50
	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Meadow	0.10	0.16	0.25	0.14	0.22	0.30	0.20	0.28	0.36	0.24	0.30	0.40
	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Forest	0.05	0.08	0.11	0.08	0.11	0.14	0.10	0.13	0.16	0.12	0.16	0.20
	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Residential Lot Size 1/8 Acre	0.25	0.28	0.31	0.27	0.30	0.35	0.30	0.33	0.38	0.33	0.36	0.42
	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Lot Size ¼ Acre	0.22	0.26	0.29	0.24	0.29	0.33	0.27	0.31	0.36	0.30	0.34	0.40
	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
Lot Size 1/3 Acre	0.19	0.23	0.26	0.22	0.26	0.30	0.25	0.29	0.34	0.28	0.32	0.39
	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
Lot Size ½ Acre	0.16	0.20	0.24	0.19	0.23	0.28	0.22	0.27	0.32	0.26	0.30	0.37
	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.48
Lot Size 1 Acre	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.29	0.35
	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Industrial	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.71	0.71	0.72	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets	0.70	0.71	0.72	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78
	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Open Space	0.05	0.10	0.14	0.08	0.13	0.19	0.12	0.17	0.24	0.16	0.21	0.20
	0.11	0.16	0.20	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Parking	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97

[a] Runoff coefficients for storm recurrence intervals less than 25 years.
[b] Runoff coefficients for storm recurrence intervals of 25 years or more.
Source: Rawls, W.J., S.L. Wong and R.H. McCuen, 1981, "Comparison of Urban Flood Frequency Procedures," Preliminary Draft, U.S. Department of Agriculture, Soil Conservation Service, Beltsville, MD.

TABLE A-4
MANNING ROUGHNESS COEFFICIENTS

Values of *n* to Be Used with the Manning Equation

Surface	Best	Good	Fair	Bad
Uncoated cast-iron pipe	0.012	0.013	0.014	0.015
Coated cast-iron pipe	0.011	0.012*	0.013*	
Commercial wrought-iron pipe, black	0.012	0.013	0.014	0.015
Commercial wrought-iron pipe, galvanized	0.013	0.014	0.015	0.017
Smooth brass and glass pipe	0.009	0.010	0.011	0.013
Smooth lockbar and welded "OD" pipe	0.010	0.011*	0.013*	
Riveted and spiral steel pipe	0.013	0.015*	0.017*	
Vitrified sewer pipe	0.010	0.013*	0.015	0.017
Common clay drainage tile	0.011	0.012*	0.014*	0.017
Glazed brickwork	0.011	0.012	0.013*	0.015
Brick in cement mortar; brick sewers	0.012	0.013	0.015*	0.017
Neat cement surfaces	0.010	0.011	0.012	0.013
Cement mortar surfaces	0.011	0.012	0.013*	0.015
Concrete pipe	0.012	0.013	0.015*	0.016
Wood stave pipe	0.010	0.011	0.012	0.013
Plank Flumes:				
Planed	0.010	0.012*	0.013	0.014
Unplaned	0.011	0.013*	0.014	0.015
With battens	0.012	0.015*	0.016	
Concrete-lined channels	0.012	0.014*	0.016*	0.018
Cement-rubble surface	0.017	0.020	0.025	0.030
Dry-rubble surface	0.025	0.030	0.033	0.035
Dressed-ashlar surface	0.013	0.014	0.015	0.017
Semicircular metal flumes, smooth	0.011	0.012	0.013	0.015
Semicircular metal flumes, corrugated	0.0225	0.025	0.0275	0.030
Canals and Ditches:				
Earth, straight and uniform	0.017	0.020	0.0225*	0.025
Rock cuts, smooth and uniform	0.025	0.030	0.033*	0.035
Rock cuts, jagged and irregular	0.035	0.040	0.045	
Winding sluggish canals	0.0225	0.025*	0.0275	0.030
Dredged earth channels	0.025	0.0275*	0.030	0.033
Canals with rough stony beds, weeds on earth banks	0.025	0.030	0.035*	0.040
Earth bottom, rubble sides	0.028	0.030*	0.033*	0.035
Natural Stream Channels				
(1) Clean, straight bank, full stage, no rifts or deep pools	0.025	0.0275	0.030	0.033
(2) Same as (1), but some weeds and stones	0.030	0.033	0.035	0.040
(3) Winding, some pools and shoals, clean	0.033	0.035	0.040	0.045
(4) Same as (3), lower stages, more ineffective slope and sections	0.040	0.045	0.050	0.055
(5) Same as (3), some weeds and stones	0.035	0.040	0.045	0.050
(6) Same as (4), stony sections	0.045	0.050	0.055	0.060
(7) Sluggish river reaches, rather weedy or with very deep pools	0.050	0.060	0.070	0.080
(8) Very weedy reaches	0.075	0.100	0.125	0.150

* Values commonly used in designing.

FIGURE A-1.
NRCS (SCS) TYPE II RAINFALL DISTRIBUTION

Scaled SCS Type II Design Storm
By Gert Aron
Penn State University

The SCS Type II storm distribution is widely accepted for the construction of a design storm. A problem in the practical application of the distribution, however, is the steepness of the SCS curve, shown in Figure 1, which makes it difficult to read relative rainfall amounts at short time intervals.

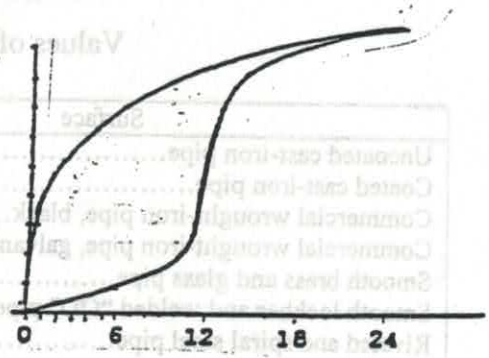


Fig. 1. SCS Storm Distribution

For the purpose of developing a systematic procedure to generate design storms of any desired time interval, equations were fitted to the SCS Type II storm distribution. A method fro constructing a center peak storm is described below. To develop a useful equation, the storm distribution was rearranged to an early peaking pattern, starting with the steepest portion of the SCS curve and progressively decreasing in the slope with time. The rearranged distribution is also shown in Figure 1, and can be expressed by the equations

$$P_t = 2.25\, P_{24}\, (t/24)^{0.46} \qquad \text{for } t < \tfrac{1}{2} \text{ hour} \qquad (1)$$

$$P_t = P_{24}\, (t/24)^{0.25} \qquad \text{for } t > \tfrac{1}{2} \text{ hour} \qquad (2)$$

where P = total precipitation in duration t
t = storm duration in hours

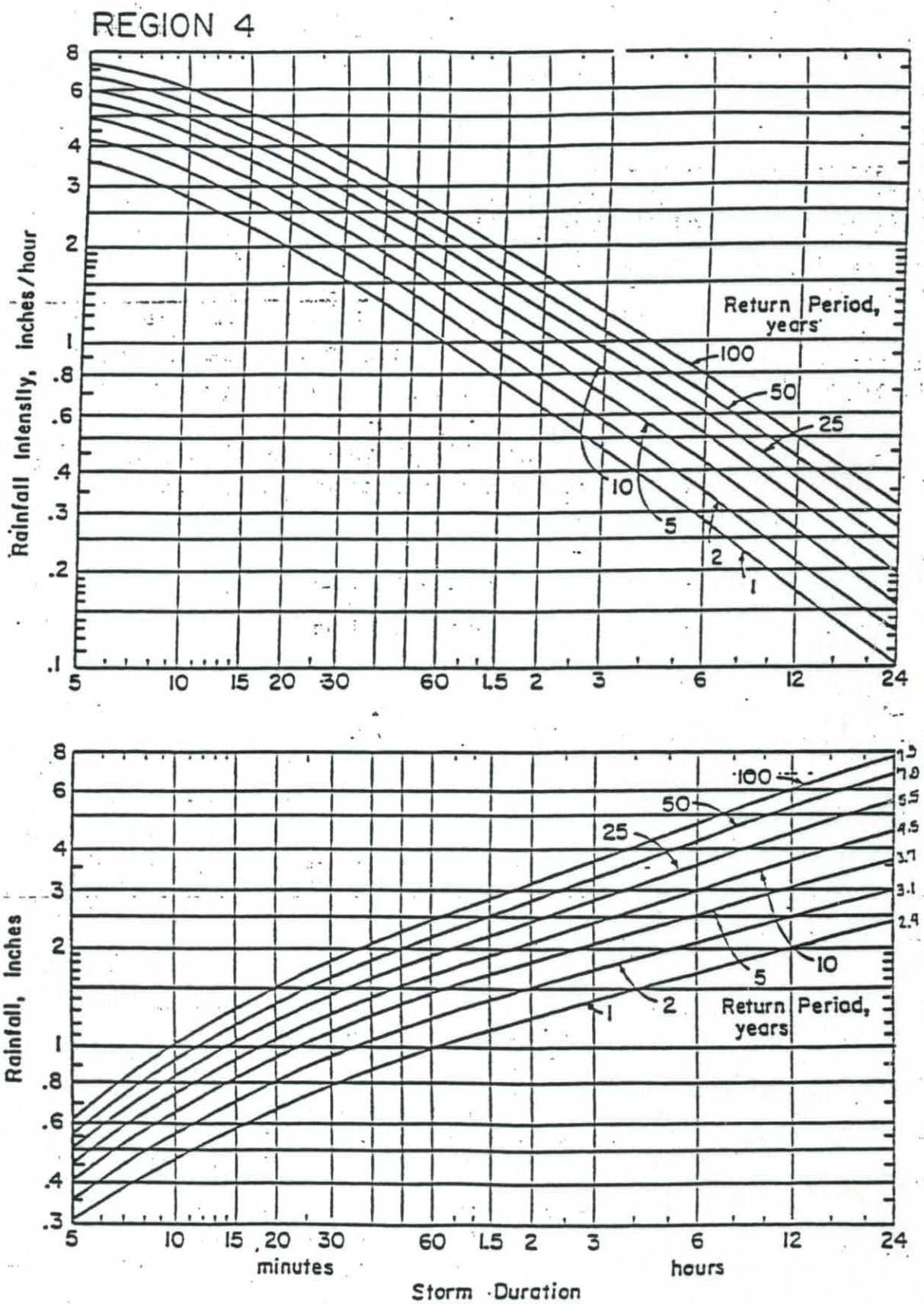
Design Storm Construction.

The design storm construction procedure is best described by an example as follows:

A 25-year design storm of 2 hours duration, expressed in 15-minute intervals, is needed. From an appropriate source, like TP-40 or similar maps, the corresponding 24-hour rainfall amount is 4.0 inches. A table with five columns is required.

(1) Col. 1 is time t in minutes or hours. In column 2 the relative rainfall P / P_{24} is shown as computed by eq.'s 1 or 2 for durations t.
(2) In column 3, the relative amounts from column 2 are multiplied by 4.0, the 24-hr rainfall. These values represent the storm amounts from the steepest portions of the SCS curve, of duration t.
(3) The rainfall increments between successive durations are computed from column 3 and listed in column 4. These values would constitute the successive rainfall increments, and thus they hyetograph for an early-peaking storm.
(4) To generate a center-peaking, roughly symmetrical storm, the increments in column 4 are rearranged in column 5, placing the larges increment, of 1.10 inches in the 5th time interval, the second largest in the 4th time interval, the third-largest in the 3rd time interval, and so forth until a rainfall increment is assigned to each time interval.

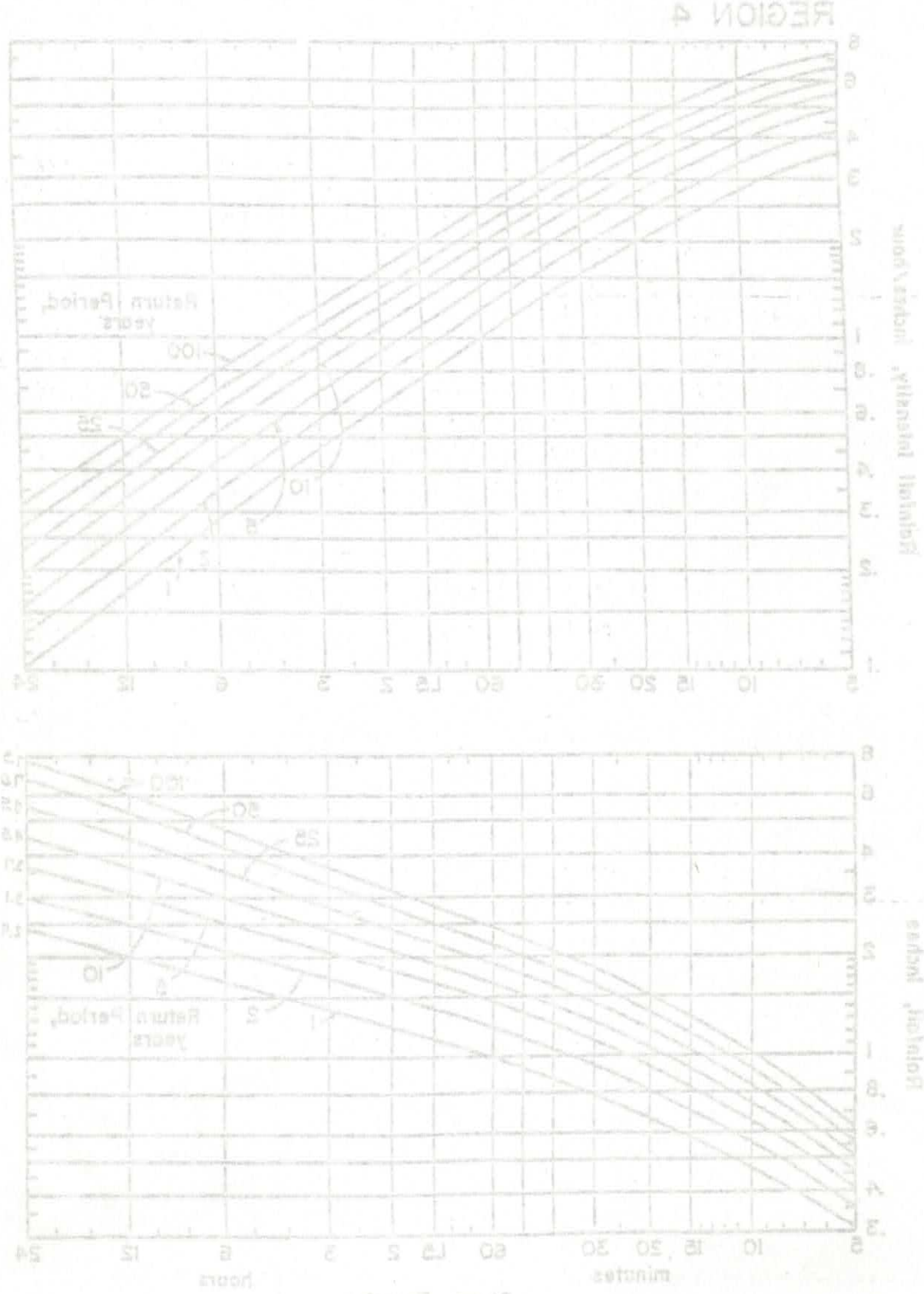
FIGURE A-2.
PENNDOT STORM INTENSITY-DURATION-FREQUENCY CURVE, REGION 4



Rainfall intensity-duration-frequency curves for Region 4.

FIGURE A-2.

PENNDOT STORM INTENSITY-DURATION-FREQUENCY CURVE, REGION 4



Rainfall Intensity-duration-frequency curves for Region 4.

APPENDIX B

STORMWATER MANAGEMENT SITE PLAN APPLICATION AND FEE SCHEDULE

DURHAM TOWNSHIP, BUCKS COUNTY
P.O. Box 4 – 215 Old Furnace Road
Durham, PA 18039
Phone: (610) 346-8911 – Fax: (610) 346-8941

For Township Use Only:
FILE NO._____
Date Received:_____
Fees Received:_____

STORMWATER MANAGEMENT PLAN APPLICATION

A completed application and application fee must be submitted with three (3) copies of all design plans, reports, and supporting documents.

Name of Proposal:_____

Tax Parcel No.: _____ Date of Application:_____

Applicant's Name:_____ Telephone No.:_____

Address:_____

Owner of Record:_____ Telephone No.:_____

Address:_____

Engineer:_____ Telephone No.:_____

Address:_____

Type of development proposed: _____Residential _____Industrial _____Commercial _____Other

Impervious Surface Areas:

Total parcel size (in acres): _____

Existing Impervious Surface Areas (in square feet): _____

Proposed Impervious Surface Areas (in square feet): _____

Has an erosion and sedimentation control plan been submitted to the Bucks County Conservation District: _____Yes _____No Total area of earth disturbance: _____

Have wetlands been delineated on the site: _____Yes _____No _____Not Applicable

The undersigned represents that to the best of his or her knowledge, all of the above statements are true, correct and complete. Employees and/or agents of Durham Township are authorized to enter the lands proposed for development, for site inspections, if necessary. Further, the undersigned agrees to reimburse Durham Township for such fees and expenses as incurred for engineering and legal services in reviewing this application.

All plans and required supplemental information must be submitted to the Township Manager.

Signature of Owner and/or Applicant _____ Date _____

LINTHAM TOWNSHIP, BUCKS COUNTY, PA

P.O. Box 4 – 313 Old Forrest Road
Gardenia, PA 18029
Phone: (610) 345-6911 – Facsimile: 345-6911

STORMWATER MANAGEMENT PLAN APPLICATION

A completed application and application fee must be submitted with three (3) copies of all design plans, reports, and supporting documents.

Name of Proposal: _____

Tax Parcel No.: _____ Date of Application: _____

Applicant's Name: _____ Telephone No.: _____

Address: _____

Owner of Record: _____ Telephone No.: _____

Address: _____

Engineer: _____ Telephone No.: _____

Address: _____

Type of development proposed: ___ Residential ___ Industrial ___ Commercial ___ Other

Impervious Surface Areas:

Total pre-dev. site (in acres): _____

Existing impervious on site Areas (in square feet): _____

Proposed Impervious Surface Areas (in square feet): _____

Has an erosion and sedimentation control plan been submitted to the Bucks County Conservation District: ___Yes ___No Total area of earth disturbance: _____

Have wetlands been delineated on the site: ___Yes ___No ___Not Applicable

The undersigned represents that to the best of his or her knowledge, all of the above statements are true, correct and complete. Employees and/or agents of Lintham Township are authorized to enter the lands proposed for development, to make inspections, if necessary. Further, the undersigned agrees to reimburse Lintham Township for such fees and expenses as incurred for engineering and legal services in reviewing this application.

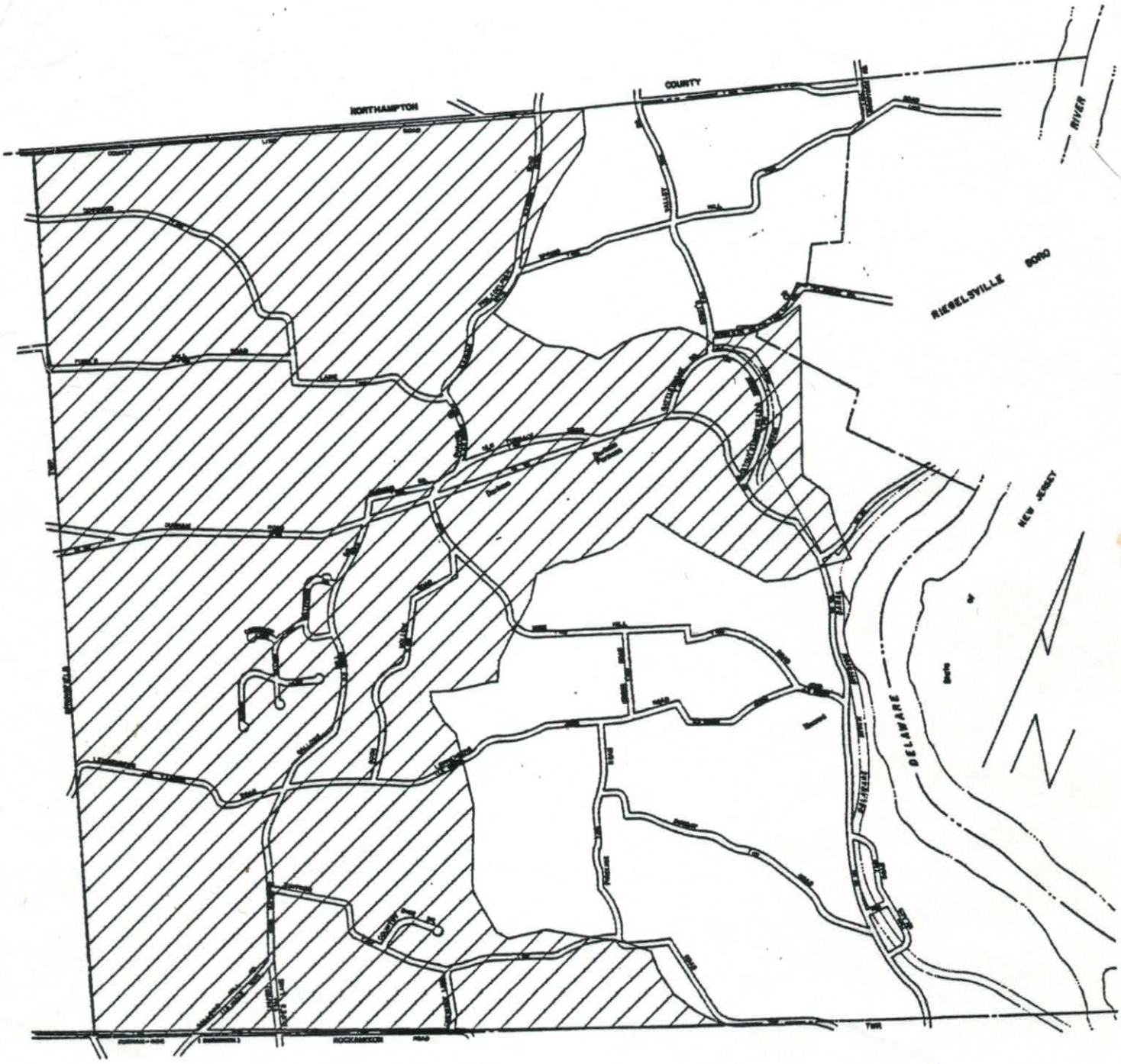
All plans and required supplemental information must be submitted to the Township Manager.

Signature of Owner and/or Applicant: _____ Date: _____

APPENDIX C

STANDARD STORMWATER FACILITIES MAINTENANCE AND MONITORING AGREEMENT

WATERSHED BOUNDARY MAP



100% Release Rate District

Direct Discharge District