

PAUPACK TOWNSHIP
WAYNE COUNTY, PENNSYLVANIA

STORMWATER MANAGEMENT ORDINANCE
WALLENPAUPACK CREEK WATERSHED
APRIL 1991

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FORWARD

This Ordinance was prepared in order to comply with the requirements of the Pennsylvania Stormwater Management Act, Act 167 of 1978. The Ordinance is based on the Wallenpaupack Lake Watershed Stormwater Management Plan prepared by the Lake Wallenpaupack Watershed Management District (LWWMD) with the assistance of Gannet Fleming Consulting Engineers. The Act requires that all municipalities in the watershed adopt local regulations to implement the Watershed Stormwater Management Plan by adopting Ordinances which govern all land development activities. The Management District and Gannet Fleming, as part of the planning process, also developed a Model Stormwater Management Ordinance to serve as a guide to the townships in the watershed. This Ordinance is based on the LWWMD Model Ordinance with modification made to meet specific needs of Paupack Township, Wayne County. The technical aspects of the Ordinance dealing with facilities designs, construction, and operation were finalized by an ad hoc committee of LWWMD Staff and stormwater control design professionals, who provide consulting services to the townships and land developers in the watershed. The intent of the committee was to standardize the requirements from township to township to assure compliance with the plan and facilitate project plan preparation.

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STORMWATER MANAGEMENT ORDINANCE

ARTICLE I
GENERAL PROVISIONS

SECTION 101. STATEMENT OF FINDINGS

The Board of Supervisors of Paupack Township, Wayne County, Pennsylvania finds that:

- A. Inadequate management of accelerated runoff of stormwater resulting from development throughout a watershed increases flood flow volume velocities, contributes to soil erosion and sedimentation, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to carry and control storm water, undermines floodplain management and flood control efforts in down-stream communities, reduces groundwater recharge, deteriorates the water quality of the receiving waters, 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 and welfare and the protection of the people of the Township and all the people of the Commonwealth, their resources and the environment.

SECTION 102. PURPOSE

The purpose of the Ordinance is to promote the public health, safety, and welfare within the Wallenpaupack Creek Watershed in the Township by minimizing the damages described in Section 101.A of the Ordinance. To accomplish this, the Ordinance establishes a comprehensive stormwater management program designed to:

- A. Control accelerated runoff and erosion and sedimentation problems at their source by regulating activities which cause such problems.
- B. Require the installation and maintenance of soil erosion and sedimentation controls during earth disturbance and land development activities.
- C. Utilize and preserve the desirable existing natural drainage systems.
- D. Encourage recharge of groundwater.
- E. Maintain the existing flows and quality of streams and water courses in the Township and the Commonwealth.
- F. Preserve and restore the flood carrying capacity of streams.
- G. Provide for proper design, installation, and maintenance of all permanent storm water management structures which are constructed in the Township.

SECTION 103. STATUTORY AUTHORITY

The Paupack Township Board of Supervisors is hereby empowered to regulate these activities by the authority of the "Stormwater Management Act," Act 167 of October 4, 1978 (P.L. 864, No. 167); and the "Second Class Township Code", Act 69 of May 1, 1933, (P.L. 103, No. 69) as reenacted and amended.

SECTION 104. APPLICABILITY

- A. This Ordinance shall apply to all areas of the Township. No development, construction or other activity which will result in the earth disturbance of any area in the Township shall be undertaken except in conformity with this Ordinance and any other applicable local, state or federal regulations.
- B. This Ordinance contains only those stormwater runoff control criteria and standards which are necessary or desirable from a total watershed perspective. Additional storm water controls of more stringent specifications may be required by the Board of Supervisors in specific cases where such controls are necessary to protect the public health, safety and general welfare and to meet the intent of this Ordinance and the Storm Water Management Act.
- C. The following land disturbance activities are defined as Regulated Activities and shall be regulated by this Ordinance, except those individual land disturbance activities which meet the criteria to qualify for exemption, as set forth in Section 402, Exemptions; or Article IX Waivers:
1. General land disturbance activities, including clearing and excavation.
 2. Land development.
 3. Subdivision.
 4. Agricultural operations.
 5. Construction of new or additional impervious or semi-pervious surfaces (driveways, parking lots, etc.).
 6. Construction of new buildings and structures or additions to existing buildings and structures.
 7. Forest management operations and nursery operations.
 8. Diversion or piping of any natural or man-made drainage channel.
 9. Installation of stormwater systems or appurtenances thereto.
 10. Oiling of roads.
 11. Placement of fill for any purpose.

ARTICLE II
DEFINITIONS

Unless otherwise stated, the following words shall, for the purpose of this Ordinance, have the meaning herein indicated. Words in the present tense include the future tense. Words in the singular include the plural and words in the plural include the singular. The word "shall" is mandatory and not discretionary. The word "may" is permissive. Words not defined herein shall be construed to have the meaning given by common and ordinary use.

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

Act - The Pennsylvania Storm Water Management Act of October 4, 1978 (P.L. 864, No. 167).

Aggregate - Term for the stone or rock gravel needed to fill in an infiltration stormwater control facility such as a trench or porous pavement.

Agricultural Operations - All activities connected with farming including dairying, pasturage, agriculture, apiaries, horticulture, floriculture, forest management, viticulture, and animal and poultry husbandry.

Agricultural Waste - Wastes that have their origin from agriculture. Most such wastes are associated with the production of food and fiber on farms, ranges, and forests. These wastes normally include animal manure, crop residues, dead animals, and agricultural chemicals.

Bank Stabilization - Includes grade stabilization structures to stabilize soils and, in some cases, provide some stormwater infiltration.

Bedrock - The more or less solid rock in place either on or beneath the surface of the earth. It may be soft, medium or hard and have a smooth or irregular surface.

Best Management Practice (BMP) - A non-point source pollution control practice that is developed by a process that considers water quality impacts, as well as political, social, economic, and technical feasibility.

Board - The Paupack Township Board of Supervisors.

Borings - Cylindrical samples of a soil profile used to determine infiltration capacity.

Channel - A natural or artificial watercourse with a definite bed and banks which confine and conduct continuously or intermittently flowing water. See "Watercourse".

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

Channelization - Any artificial reconstruction of a stream channel such as straightening, lining, or deepening.

Cistern - An underground or above ground reservoir or tank for storing rainwater.

Commercial Land Use - Any use involving in part or in whole the sale of merchandise, materials or services, but not including home occupations.

Conduit - Any channel intended for the conveyance of water, whether open or closed.

Conservation District - A public organization created under State enabling law as a special purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries, usually a subdivision of State government with a local governing body and always with limited authorities. Often called a soil conservation district or a soil and water conservation district. For this Ordinance Conservation District applies to the County Conservation District.

Contour - An imaginary line on the surface of the earth connecting points of the same elevation. A line drawn on a map connecting points of the same elevation.

Cover Crop - A close-growing crop grown primarily for the purpose of protecting and improving soil between periods of permanent vegetation.

Critical Area - An area defined by this ordinance to require more stringent control of post-development runoff flow rates and/or pollutant loads than those specified for the general watershed area.

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

Design Storm - The magnitude of precipitation from a storm event measured in probability of occurrence (e.g., 50-yr. storm) and duration (e.g., 24-hour), and used in the planning and design of stormwater management control systems.

Detention Basin - A basin designed to retard stormwater runoff by temporarily storing the runoff and releasing it at a predetermined rate. Detention basins are designed to drain completely after a storm event.

Detention Time - The amount of time a parcel of water actually is present in a stormwater control facility. Theoretical detention time for a runoff event is the average time parcels of water residue in the basin over the period of release from the facility.

Developer - A person or persons, partnership, association, corporation or other entity, or any responsible person therein or agent thereof, that undertakes any Regulated Activities covered by this Ordinance.

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

Diversion - A channel with a supporting ridge on the lower side constructed to a predetermined grade across or at the bottom slope, and designed to collect and divert surface runoff from slopes which are subject to erosion.

Drainage - The flow of water or wastewater and the methods of directing such flow, whether natural or artificial.

Drainage Plan - The documentation of the proposed stormwater management controls, if any, to be used for the given development site, the contents of which are established in Section 403.

Earth Disturbance - Any construction or other activity which disturbs the surface of the land including but not limited to excavations, embankments, land development, subdivision development, mineral extraction and the moving, depositing or storing of soil, rock or earth.

Easement - A right granted by a land owner to a grantee, allowing the use of private land for certain public, quasi-public or private purposes such as stormwater management.

Emergent Plants - Aquatic plants that are rooted in the sediment but whose leaves are at or above the water surface. These wetland plants often have high habitat value for wildlife and waterfowl, and can aid in pollutant uptake.

Enforcement Officer - An individual designated and deemed qualified by the Township to execute the regulations set forth in this Ordinance.

Engineer - A professional engineer licensed as such in the Commonwealth of Pennsylvania, duly appointed as the Engineer for the township.

Erosion - The removal of soil particles or rock fragments of the land surface by the action of running water, wind, ice, or other geological agents.

Eutrophication - The process of over-enrichment of water bodies by nutrients often typified by the presence of algal blooms.

Evaporation - The process by which a liquid is changed to a vapor or gas.

Evapotranspiration - The combined loss of water from a given area and during a specific period of time, by evaporation from the soil surface and by transpiration from plants.

Event Mean Concentration (EMC) - The average concentration of any pollutant measured during a storm runoff event. The EMC is calculated by flow-weighting each pollutant sample measured during a storm event.

FHWA - Federal Highway Administration, United States Department of Transportation (USDOT).

Filter Fabric - Textile of relatively small mesh or pore size that is used to (a) allow water to pass through while keeping sediment out (permeable), or (b) prevent both runoff and sediment from passing through (impermeable).

Filter Strips - Long, narrow strips of close-growing vegetation at the perimeter of disturbed or impervious area which serve to intercept or retard sheet flows of surface runoff and/or collect sediment. Used often to protect other stormwater control facilities such as diversions, impoundments, etc.

First Flush - The delivery of a disproportionately large load of pollutants during the early part of storms due to the rapid runoff of accumulated pollutants. The first flush of runoff has been defined several ways (e.g., one-half inch per impervious acre).

Floodplain - The nearby level land area situated on either side of a channel which would be inundated temporarily by overflow waters caused by stormwater runoff equivalent to that which would occur from a rainfall of one hundred (100) year frequency.

Flow-Weighting - A statistical technique used to adjust a series of pollutant concentration measurements for the effect of flow.

Flume - A device constructed to convey water on steep grades lined with erosion-resistant materials.

Forebay - An extra storage area provided near an inlet of a stormwater control facility to trap incoming sediments before they accumulate in a pond facility.

Forest Management Operations - All activities connected with growing and harvesting of forest products including the site preparation, cultivation and logging of trees, and the construction and maintenance of roads. The U.S. Dept. of Agriculture and the PA DER, Bureau of Forestry recognize forestry practices and anything associated with forest management to be considered an agricultural operation. Refer to "Agricultural Operations".

Freeboard - A vertical distance between the elevation of the design highwater 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.

Frost-Heave - The upward movement of soil surface due to the expansion of ice stored between particles in the first few feet of the soil profile. May cause surface fracturing of asphalt or concrete.

Gabion - A large rectangular box of heavy gauge wire mesh which holds large cobbles and boulders. Used in streams and ponds to change flow patterns, stabilize banks, or prevent erosion.

Grade - A slope, usually of a road, channel, or natural ground, specified in percent (%) and shown on plans as specified herein. (To) Grade - To finish the surface of a roadbed, top of embankment or bottom of excavation.

Grassed Waterway - A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from cropland.

Grid/Modular Pavement - Involves using a strong concrete structural material, having regularly interspersed void areas that are filled with pervious materials such as sod, gravel, or sand which allows infiltration of rain.

Groundwater Recharge - Replenishment of existing natural underground water supplies.

Hydraulic Gradient - The slope of the hydraulic grade line, i.e. the line joining points whose vertical distance from the center of the cross section of the fluid flowing in a pipe are proportional to the pressure in the pipe at that point.

Hydrograph - A graph showing for a given point on a stream or for a given point in any drainage system the discharge, stage (water depth), velocity, or other property of water with respect to time.

Impervious Area - A surface which prevents the infiltration and percolation of water into the ground.

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

Infiltration - The flow of a liquid into a substance through pores or other openings, connoting flow into a soil in contradistinction to the word, percolation, which connotes flow through a porous substance. The infiltration capacity is expressed in terms of inches per hour.

Infiltration Pits/Trenches - An excavated area filled with sand and/or graded aggregates into which stormwater surface runoff is directed for infiltration into the ground.

Infiltration Structures - A structure designed to direct runoff into the ground, e.g. french drains, pits, trenches.

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

Land Development - Any of the following activities: (1) The improvement of one lot or two or more contiguous lots, tracts or parcels of land for any purpose involving: (i) a group of two or more residential or nonresidential buildings, whether proposed initially or cumulatively, or a single non-residential building on a lot or lots regardless of the number of occupants or tenure; or (ii) the division or allocation of land or space, whether initially or cumulatively, between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups or other features. (2) A subdivision of land.

Land Disturbance Activity - Any activity that changes existing cover or contours of land. This includes grading; tilling; excavating; filling of ground; removal or destruction of the topsoil, trees or other vegetative cover; or any other activity which causes land to be exposed to the danger of erosion.

Low Flow Channel - An incised or paved channel from inlet to outlet in a dry basin which is designed to carry low runoff flows and/or baseflow, directly to the outlet without detention.

Management District - The Lake Wallenpaupack Watershed Management District.

Manning's Equation - An equation used to predict velocity of water flow in an open channel or pipelines:

$$V = \frac{1.486r^{2/3} S^{1/2}}{n}$$

where: V = mean velocity of flow in feet per second (fps)
 r = hydraulic radius in feet (ft.);
 S = Slope of the energy gradient or, for assumed uniform flow, the slope of the channel in feet per foot (ft./ft.) and
 n = roughness coefficient or retardance factor of the channel lining

Memorandum of Understanding (NOU) - An agreement initiated by the municipality and outside agency(ies) to document the responsibilities and liabilities of concerned parties for specified task(s). The document may also include provisions for enacting a fee schedule for work performed.

Municipality - Paupack Township, Wayne County, Pennsylvania.

Nitrogen - Chemical element usually available as ammonium, nitrite, and nitrate ions, and certain simple amines for plant growth. A small fraction of organic or total nitrogen in the soil is available at any time.

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.

Nursery - A tract of land on which trees and plants are raised or stored for transplanting and sale.

Nutrients - Substances necessary for growth of algae or bacteria in water, such as nitrates and phosphates.

Obstruction - Any structure or assembly of materials which might impede, retard, or change channel flows, including fill above or below land or water surfaces.

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

Outlet - Point of water disposal from a stream, river, lake, tidewater, or artificial drain.

Overflow Rate - Detention basin release rate divided by the surface area of the basin. It can be thought of as an average flow rate through the basin.

Owner - Any person, partnership, corporation, company, or other legal entity holding a current legal title.

PA DER - Pennsylvania Department of Environmental Resources.

PA DOT - Pennsylvania Department of Transportation.

Parking Lot Storage - Involves the use of impervious parking areas as temporary impoundments with controlled release rates during rainstorms.

Peak Discharge - The maximum instantaneous rate of flow (at a given point and time) resulting from a specified storm event.

Person - An individual, trustee, executor, other fiduciary, corporation, firm, partnership, association, organization, or other entity acting as a unit.

Phosphorus - Inorganic element that is readily available for plant growth.

Plan - See Drainage Plan.

Porous Asphalt Pavement - Involves using a porous asphaltic paving material and high-void aggregate base that allows infiltration of rain falling on paved surface.

Qualified Individual - Any person who is currently licensed by the Commonwealth of Pennsylvania to prepare Drainage Stormwater control Plans in accord with the Pennsylvania Stormwater Management Act.

Rational Formula - A rainfall-runoff relation used to estimate peak flow, expressed by the following formula:

$$Q = CIA$$

Where:

- Q = peak runoff rate in cubic feet per second (cfs);
- C = runoff coefficient;
- I = design rainfall intensity in inches per hour (in/hr), lasting for a critical time, T_c;
- T_c = time of concentration in hour (hrs.); and
- A = drainage area in acres.

This methodology is applicable for computing small runoff volumes such as roof and driveway runoff flows required in the design of infiltration structures.

Regulated Activity - Action or proposed action which impacts upon proper management of stormwater runoff and which is governed by this Ordinance as specified in Section 104.

Release Rate - The rate of discharge in volume per unit time from a detention facility.

Residential Land Use - The use of land for dwelling units or rooming units, including single-family or two-family houses, multiple dwellings, boarding or rooming houses or apartments.

Retention Basin - A basin designed to retain stormwater runoff by having a controlled subsurface discharge system. Generally, its primary release of water is through ground infiltration. "Release" can also be via evaporation or, when warranted, via an emergency bypass.

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

period rainfall or runoff event would be expected to recur on the average once every twenty-five years. See "Storm Frequency"

Riparian - A relatively narrow strip of land that borders a stream or river, often coincides with the maximum water surface elevation of the 100 year storm.

Riprap - Broken rock, cobbles, or boulders placed on earth surfaces, such as the face of a dam or the bank of a stream, for protection against the action of water (waves); also applied to brush or pole mattresses, or brush and stone, or other similar materials used for soil erosion control and filtering of sediment.

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

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 - That part of precipitation which does not enter the soil but flows over the surface of the land.

SCS - Soil Conservation Service, U.S. Department of Agriculture (USDA).

Sedimentation - The process by which material, both mineral and organic, is accumulated, transported, or deposited by moving wind, water, or gravity. Once this matter is deposited (or remains suspended in water), it is usually referred to as "sediment".

Sediment Basin - A barrier, dam, retention or detention basin designed to retain sediment.

Seepage Areas - Grass-covered areas that infiltrate stormwater runoff and allow particulate contaminants to settle.

Semi-Pervious Surface - A surface such as stone, rock, concrete or other materials which permits some vertical transmission of water into the ground.

Senescence - The annual die-back of aquatic plants at the end of the growing season.

Sheetflow - Runoff which flows over the ground surface as a thin, even layer, not concentrated in a channel.

Short Circuiting - The passage of runoff through a stormwater control facility in less than the theoretical or design treatment time.

Slope - The face of an embankment or cut section; any ground whose surface makes an angle with the plane of the horizon. Slopes are usually expressed in a percentage based upon vertical difference in feet per 100 feet horizontal distance.

Soil-Cover Complex Method - A method of runoff computation developed by SCS, and found in its publication "Urban Hydrology for Small Watersheds". Technical Release No. 55, SCS, January 1975, revised 1986. It is based upon relating soil type and land use/cover to a runoff parameter called a Curve Number and abbreviated as RCN.

Soil Group, Hydrologic - A classification of soils by the Soil Conservation Service into four runoff potential groups. The groups range from A soils, which are very permeable and produce little runoff, to D soils, which are not very permeable and produce much more runoff.

Soil Strata - The various horizontal layers of sedimentary rock (soil).

Sorption - The physical or chemical binding of pollutants to sediment or organic particles.

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

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 Sewers - A system of pipes, conduits, swales, or other similar structures including appurtenant works which carries intercepted surface runoff, street water and other wash waters, or drainage, but excludes domestic sewage and industrial wastes.

Stormwater - Runoff and drainage from land surfaces resulting from precipitation including snow or ice melt.

Stormwater Management - A program of controls and measures designed to regulate the quantity and quality of stormwater from a development and/or land disturbance while promoting the protection and conservation of ground waters and groundwater recharge.

Stormwater Management Plan - The plan for managing stormwater runoff adopted by the Counties of Pike, Wayne, Lackawanna and Monroe, and the Lake Wallenpaupack Watershed Management District as required by the Pennsylvania Stormwater Management Act.

Stormwater Structures - The basins, pipes, swales, terraces, etc. designed and installed to collect, transport, detain and/or retain stormwater.

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

Subdivision Ordinance - The Subdivision and Land Development Ordinance of Paupack Township.

Subgrade - A layer of stone or soil used as the underlying base for a stormwater control facility.

Substrate - The natural soil base underlying a stormwater control facility.

Subwatershed - The smallest breakdown unit of watershed for hydrologic modeling purposes for which the runoff control criteria have been established in the Stormwater Management Plan. These areas are identified in Section 302.

Suspended Solids - Solids either floating or suspended in water, sewage, or other liquid wastes and that are removeable by filtering.

Swale - A wide shallow ditch or low-lying stretch of land characterized as a depression which gathers then temporarily stores, routes or filters surface water runoff.

Terrace - An embankment of combination of an embankment and channel across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.

Time of Concentration - (T_c) - 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.

Township - Paupack Township, Wayne County, Pennsylvania and the Board of Supervisors of Paupack Township.

TR-20 - A SCS methodology developed for evaluating the hydrologic response of a watershed to various rainfall conditions and land use development patterns using the soil-cover complex method. This methodology has been computerized for more efficient use.

TR-55 - A simplified procedure to calculate storm runoff volume, peak rate of discharge, hydrographs, and storage volumes required for floodwater reservoirs. The procedure is most applicable to small watersheds especially urban watersheds. The storage-routing curves and the graphical peak discharge and tabular hydrograph methods used by TR-55 procedure has been computerized for more efficient use.

Transpiration - The process by which vapor escapes from living plants and enters the atmosphere.

Travel Time - (T_t) - The time it takes water to travel from one location to another in a watershed. It is a component of time of concentration and includes overland flow travel time, reach (a pipe or channel) flow travel time, etc.

USDA - United States Department of Agriculture.

USDI - United States Department of Interior.

USDOT - United States Department of Transportation.

USEPA - United States Environmental Protection Agency.

USFWS - United States Fish and Wildlife Service.

Watercourse - A stream of water; river; brook; creek; or a channel or ditch for water, whether natural or manmade. See "Channel".

Watershed - The entire region or area drained by a river or other body of water, whether natural or man-made.

Water Table - The upper surface of the free groundwater in a zone of saturation (indicates the uppermost extent of groundwater); locus of points in soil water at which hydraulic pressure is equal to atmospheric pressure.

ARTICLE III
STORMWATER MANAGEMENT REQUIREMENTS

SECTION 301. GENERAL REQUIREMENTS

- A. DER - Where applicable, stormwater management facilities or programs shall comply with the requirements of Chapter 102, Erosion Control; Chapter 105, Dam Safety and Waterways Management; and Chapter 106, Flood Plain Management, of Title 25, Rules and Regulations of the PA DER.
- B. PA DOT - Stormwater management facilities which involve a state highway shall be subject to the approval of PA DOT and evidence of same shall be provided to the Township.
- C. Floodplain - Stormwater management facilities located within or affecting the floodplain of any watercourse shall also comply with the requirements of the Township ordinance which regulates construction and development within areas which are subject to flooding.
- D. Runoff Rates - Stormwater management facilities shall be designed so that the post-development runoff rates do not exceed the pre-development runoff rates. See Section 302, Identification of Critical Areas, for certain subwatershed areas where specific discharge requirements shall be applied. The pre-development and post-development runoff rates and volumes shall be calculated for the appropriate design storm events prescribed in Section 303.
- E. Additional Requirements - Additional studies, a higher level of control, or larger storm event designs than the minimum required by this Ordinance may be required by the Township to assure adequate drainage, to protect life and property and otherwise meet the intent of this Ordinance.
- F. Nutrient Loadings - Stormwater management facilities must be designed so that the post-development runoff pollutant loads for total phosphorus and sediment do not exceed the water quality criteria of the receiving waters as established by the LWWMD which are 0.5 mg/1 for phosphorus (as total soluble phosphorus) and 110 mg/1 for sediment (as total suspended solids). Exceptions to this are the Critical Areas defined in Section 302. The pre-development and post-development runoff pollutant loads for total phosphorus and sediment shall be calculated for the appropriate land use types, based on generally accepted engineering practice.
- G. Adequate Drainage - It is the responsibility of the developer to provide and maintain adequate drainage. Adequate drainage must have the hydraulic characteristics to accommodate the maximum expected flow of stormwater for the watershed or portion thereof, for the required design year storm. Adequate drainage is to be designed to:
1. Account for on-site stormwater at ultimate development with proposed controls and any runoff entering the subject site from adjacent property based on the current Township comprehensive plan and land use control regulations.
 2. Honor natural drainage divides;

3. Convey stormwater to a natural outfall;
4. Not adversely affect the adjacent or neighboring properties including the avoidance of the concentration of runoff at property boundaries.
5. Not adversely affect the water quality of receiving waters.

It shall be the responsibility of the developer to provide adequate drainage for the proposed development and upstream watershed along or through his property to a natural outfall. Staged construction will be considered for perimeter and off-site improvements where the developer's engineer can show that it is feasible. Off-site drainage improvements will be required to prevent the proposed development from having any significant detrimental effect on the downstream facilities to the point of a natural outfall.

If a developer concentrates dispersed (sheet) flow or redirects flow to exit at another location on the property, the developer shall be responsible for constructing an adequate channel on the adjacent property and on all downstream properties until a natural outfall is reached.

- H. Outfall Capacity - A natural outfall shall have sufficient capacity to receive the design storm peak runoff from the watershed without deterioration of the outfall and without adversely affecting property in the watershed. This natural outfall may be a river, creek, or other drainage facility so designated by the Township for the proposed system.
- I. Detention - Detention is the provision of acceptable storage area for stormwater with the use of a control structure providing a significant reduction in the peak discharge of stormwater. Detention of storm-water is desirable in many cases to alleviate existing downstream drainage problems and to preclude the creation of additional problems. Detention or retention is mandatory where the existing downstream drainage systems is clearly inadequate and its expansion or improvement for is either financially prohibitive or aesthetically unacceptable. The Township reserves the right to waive the requirement for detention of stormwater where the Township determines that its use is not in the public interest and where alternatives may apply and afford the control intended by this Ordinance.
- J. Innovative Methods - Innovative stormwater management methods may be used when approved by the Township. Various combinations of stormwater management systems should be developed to meet the particular, unique requirements of the development and topographic features of the development site.

Approval of a proposed stormwater management control facility using these innovative methods shall depend on the effectiveness of the facility in controlling the impacts of post-development runoff rates and volumes and in mitigating the nonpoint source pollutant loadings along with the facility's ability to meet the design criteria of Section 304, Methods of Calculation of Runoff Pollutant Parameters, and the design and construction specifications of Appendix C and other requirements of this Ordinance. The following is a partial list of control methods which can be used in stormwater management facilities where appropriate and upon approval by the Township:



1. Agricultural Waste Storage Structure
2. Bank Stabilization
3. Channel Modification
4. Cistern Storage
5. Conservation Tillage
6. Contour Farming
7. Cover Cropping
8. Critical Area Planting
9. Diversion
10. Farmland Management
11. Fencing
12. Filter Strips
13. Floodplain Management
14. Impoundments
15. Infiltration, Pits and Trenches
16. Land Surface Controls and Zoning
17. Parking Lot Storage
18. Porous and Grid/Modular Pavement
19. Road Paving
20. Rooftop Detention
21. Sediment Basin
22. Seepage Areas
23. Storm Sewers
24. Street Cleaning
25. Stripcropping
26. Terracing
27. Wetland Preservation

General descriptions, including the operation and maintenance of these stormwater management facilities, are provided in Appendix C of this Ordinance.

- K. O & M Access - Access to facilities shall be provided for operation and maintenance. Said access shall be a cleared access that is not less than twenty (20) feet wide. Proximity of facilities to public right-of-ways shall be encouraged in order to minimize the length of access-ways; and multiple accesses shall be provided for major facilities.
- L. Accepted Standards - All control facility designs shall conform to the applicable standards and specifications of the following governmental and institutional agencies:
1. American Society of Testing and Materials (ASTM).
 2. Asphalt Institute (AI).
 3. County Conservation District.
 4. Federal Highway Administration (FHWA).
 5. National Crushed Stone Association (NCSA).
 6. National Sand and Gravel Association (NSGA).

7. Pennsylvania Department of Environmental Resources (PA DER).
 8. Pennsylvania Department of Transportation (PA DOT).
 9. U.S. Department of Agriculture, Soil Conservation Service, Pennsylvania (USDA, SCS, PA).
- M. Oil and Grease Removal - Control facilities which receive stormwater from areas which are a potential source of oil and grease contamination if determined necessary by the Township to protect water quality shall include a baffle, skimmer, grease trap or other mechanism suitable for preventing oil and grease from leaving the facility in concentrations that would cause or contribute to violations of applicable water quality standards in the receiving waters.
- N. "No Harm" Option - The intent of this Section is to allow for flexibility of design when downstream storage volume is available to development projects located near lakes, streams, wetlands or other natural features.

The developer shall have the option of using a less restrictive runoff control (including no detention) if the developer can prove that "no harm" would be caused by discharging at a higher runoff rate than that specified by the criteria of this Ordinance. Proof of "no harm" shall be documented by the developer from the development site through the remainder of the downstream drainage network to the headwaters of Lake Wallenpaupack; or the "no harm" proof must be shown from the development site to the point downstream where the flow from the proposed development does not exceed 1% of the total flow at the point of interest. Proof of "no harm" must be shown using the capacity criteria specified by references of Section L above and Appendix C if downstream capacity analysis is a part of the "no harm" justification. The final determination of this "no harm" option shall rest solely and exclusively with the Township.

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

Proposals to prove "no harm" based upon downstream peak flow versus capacity analysis shall be based on a 10 year storm event for flows (not nutrient loadings) and shall be governed by the following provisions:

1. The peak flow values to be used for downstream areas for various return period storms shall be the values from the TR-20 Runoff Model for the Lake Wallenpaupack Watershed.
2. Any available capacity in the downstream conveyance system as documented by a developed acreage from the system as documented by a developer may be used by the developer only in proportion to his development site acreage relative to the total upstream acreage from the identified capacity (i.e. if his site is 10% of the upstream acreage, he may use up to 10% of the documented downstream available capacity).
3. Developer-proposed runoff controls which would generate increased peak flow rates at documented storm drainage problem areas would, by definition, be precluded from using the "no harm" option, except in conjunction with proposed capacity improvements for the problem areas.

SECTION 302. STORMWATER MANAGEMENT SUBWATERSHEDS AND CRITICAL AREAS

- A. Mapping of Stormwater Management Subwatersheds - In order to implement the provisions of the Wallenpaupack Creek Watershed Stormwater Management Plan, the Watershed is hereby divided into stormwater management subwatersheds which shall be designated as follows: (Note: Although only a number of the subwatersheds include areas of the Township, the entire subwatershed list has been included for consistency with the Watershed Management Plan. Those subwatersheds which include areas of the Township are marked by an asterisk.)

<u>Subwatershed Code</u>	<u>Subwatershed Name</u>
E-WS	Wilson Creek
E-KC	Kintz Creek
E-BC	Bridge Creek
E-WC	East Branch Wallenpaupack
E-MC	Mozette Creek
M-SHC	Sugar Hill Creek
M-TC	Taylor Creek
M-WC	Main Branch Wallenpaupack
W-WC	West Branch Wallenpaupack
M-MR	Manny Run
M-FR	Freeling Run
M-NC	Nevin Creek
M-MC	Mill Creek
M-RPC	Rock Port Creek
W-JC	Jones Creek
W-PC	Potter Creek
W-WiC	Wilcox Creek
W-WeC	Webster Creek
W-SC	Stevens Creek
W-MHC	Moss Hollow Creek
W-UC	Uban Creek
W-BC	Butternut Creek
M-WL	Waynewood Lake
L-LW	Lake Wallenpaupack *
L-PC	Purdy Creek *
L-FS	Finn Swamp *
L-SC	Swan Creek *
L-SpB	Spinner Brook *
L-UT	Unnamed Tributary *
L-SeB	Seeley Brook *
L-DC	Diamond Creek
L-ShB	Sheridan Creek
L-MB	Mill Brook
L-KC	Kleinhaus Creek
L-PL	Pine Lake
L-AC	Ariel Creek
L-GP	Goose Pond *
L-LL	Lake Lacawac *
WC	D/S Wallenpaupack Creek

* Includes areas of the Township

The boundaries of the stormwater management subwatersheds are shown on an official map which is available for inspection at the township office.

- B. Identification of Critical Areas - Critical areas for peak flow rate have been defined using the Release Rate formula. These release rates dictate the extent to which post-development runoff must be controlled. Within a given subwatershed, the post-development peak flow rate of storm runoff must be controlled to the stated percentage of the pre-development peak rate of storm runoff in order to protect downstream watershed areas. The Critical Areas and their respective release rate control design criteria for peak flow are as follows:

<u>Subwatershed Code</u>	<u>Release Rate Percentage</u>
E-WS	90
E-KC	80
E-BC	70
E-WC	70
E-MC	90
M-SHC	60
M-TC	90
M-WC ¹	70
M-WC ²	100
M-WC ³	80
M-WC ⁴	100
M-WC ⁵	80
M-WC ⁶	80
M-WC ⁷	60
M-WC ⁸	80
M-WC ⁹	100
W-WC ¹¹	80
W-WC ¹³	60
W-WC ¹⁴	60
M-WC ¹⁵	100
M-MR	60
M-FR	90
M-NC	60
M-MC	80
M-RPC	70
W-JC	90
W-WiC	70
W-WeC	90
W-SC	60
W-MHC	70
W-UC	80
W-BC	80

Superscripts 1, 3, 5, 6, 7, 8, 11, 13, and 14 refer to portions of the main branch and west branch as delineated in the subwatershed map.

Critical areas for control of post-development runoff quality have been defined based on the projected pollutant loading of the subwatersheds. These areas include subwatersheds M-WC, W-WC, M-WL, L-LW *, L-SeB *, L-DC, and L-AC. The control criteria for these critical areas are established as 0.13 mg/l for phosphorous (as total soluble phosphorous) and 65 mg/l for sediment (as total suspended solids).

SECTION 303. METHODS OF CALCULATION OF RUNOFF FLOW PARAMETERS

- A. Computation Methods - The Methods of computation used to determine peak discharge and volume of runoff shall be one of the following four (4) methods or any other method approved by Paupack Township in advance:
1. The USDA SCS Soil-Cover-Complex Method as set forth in the latest edition of "Urban Hydrology For Small Watersheds", Technical Release No. 55.
 2. The USDA SCS Soil-Cover-Complex Method as set forth in the "TR-20 Computer Program for Project Formulation Hydrology", Technical Release No. 20.
 3. The Penn State Runoff Model (PSRM) as set forth in the Penn State Runoff User's Manual, January 1987 Version.
 4. The "Rational Method" of $Q=CIA$, where Q is the peak discharge from the watershed in cubic feet per second (cfs), C is the coefficient of runoff, I is the intensity of rainfall in inches per hour and A is the area of the watershed in acres.
- B. Hydrographic Method - Where the drainage basin exceeds 200 acres or where a detention/retention facility is involved, a hydrographic method shall be used for design purposes. The method of computation shall be selected using the following guidelines:

<u>Output Requirements</u>	<u>Drainage Area</u>	<u>Hydrologic Computation To Be Used</u>
Peak Discharge Only	Up to 200 Acres	Rational Method, TR-55, TR-20, or PSRM
	Up to 20 sq. mi. Above 20 sq. mi.	TR-55, TR-20, or PSRM TR-20 or PSRM
Peak Discharge and Total Runoff Volume	Up to 20 sq. mi. Above 20 sq. mi.	TR-55, TR-20, or PSRM TR-20 or PSRM
	Up to 20 sq. mi. Above 20 sq. mi.	TR-55, TR-20, or PSRM TR-20 or PSRM

- C. Rainfall Frequency - Rainfall frequency data to be used depends on the method of computation selected.
1. When the SCS Soil-Cover-Complex Method is used, storm runoff shall be based on the most recent DER Rainfall Duration Frequency Table for Pennsylvania.

2. When the Rational Method is used, the Region 4 or Region 5 Rainfall Intensity-Duration-Frequency chart shown in the most current PA DOT Design Manual, Part 2, shall be used to determine the rainfall intensity in inches per hour. The charts are shown on Figures 2.10.4.2(D) and 2.10.4.2(E) of the manual and in Appendix B.3 of the Ordinance should be used to determine if Region 4 or Region 5 curves are to be used.
- D. Runoff Curve Number - Runoff Curve Numbers (CN's) to be used in the Soil Cover Complex shall be based upon the matrix presented in Appendix B.4 of this Ordinance. Appendix B.8 is a copy of a worksheet that can be used in estimating a subwatershed's composite runoff curve number.
 - E. Time of Travel - Time of Travel (Tt) estimates for overland flows shall be based on the average velocities determined using the chart presented in Appendix B.5 of this Ordinance. Appendix B.9 is a copy of a work-sheet that can be used in estimating a subwatershed's total Time of Concentration or Time of Travel.
 - F. Runoff Coefficients - Runoff coefficients for use in the Rational Method shall be based upon the table presented in Appendix B.6 of this Ordinance.
 - G. Manning Equation - The Manning Equation shall be used to calculate the capacity and velocity of flow in open channels and in closed drains not under pressure. Manning "n" values used in the calculations shall be consistent with the table presented in Appendix B.7 of this Ordinance.
 - H. Calculations - All runoff calculations shall include both a hydrologic and hydraulic analysis indicating: 1) rate and velocities of flow; 2) grades, dimensions, and capacities of water carrying structures and impoundment structures; and 3) sufficient design information to construct such stormwater management facilities. Runoff calculations shall include both pre-development and post-development rates of peak discharge and volumes of storm runoff from the project development site. Runoff calculations for the site's condition during development shall be used to size temporary control measures.

SECTION 304. METHODS OF CALCULATION OF RUNOFF POLLUTANT PARAMETERS

- A. The methods of computation used to determine total phosphorus and sediment loads shall be one of the following methods or any other method approved by the Township in advance:
 1. The application of the unit areal loading rates presented in Appendix B.10 for phosphorus and sediment loads. The total load for a given pollutant at a development site is the summation of the pollutant loads generated by each land use type for the site. The individual land use loads are calculated by multiplying the land use area (in acres) by the appropriate loading rate.
 2. The Simple Method for phosphorus pollutant export as set forth in the "A Framework for Evaluating Compliance with the 10% Rule in the Critical Area".

$$L = (P)(P_j)(R_v)/12*(C)(A)(2.72)$$

where L = phosphorus pollutant export (in pounds)
 P = rainfall depth (in inches) for the year

P_j = a factor that corrects P for storms that produce no runoff
 R_v = runoff coefficient, for the site which expresses the fraction
of rainfall that is converted into runoff
C = the average storm concentration of phosphorus for the land use
(in mg/l)
A = total area of the site (in acres)
2.72 = conversion factor to produce load in pounds.

3. The Universal Soil Loss Equation for sediment erosion.

$$A = (R)(K)(LS)(C)(P)$$

where A = computed soil loss in tonnes/ha for a given storm
R = rainfall energy factor
K = soil erodibility factor
LS = slope-length factor
C = vegetative cover factor
P = erosion control practice factor.

- B. Refer to Appendix B.11 for a sample problem that describes the typical procedure to be followed in selecting a control technique to control runoff pollutants.)

ARTICLE IV
DRAINAGE PLAN REQUIREMENTS

SECTION 401. GENERAL REQUIREMENTS

Prior to the final approval of subdivision and/or land development plans, the issuance of any permit, or the commencement of any land disturbance activity involving any of the Regulated Activities of the Ordinance, the owner, subdivider, developer or his agent shall submit a Drainage Plan to the Township for approval. The plan shall meet the requirements set forth herein, and shall also meet all requirements of Title 25 Rules and Regulations of the PA DER-Chapter 102 (Erosion Control), Chapter 105 (Dam Safety and Waterway Management), and Chapter 106 (Flood Plain Management).

SECTION 402. EXEMPTIONS

This section includes activities which may be requested for exemption from the plan preparation provisions of this Ordinance. Exemptions will be considered and granted by Paupack Township on a case-by-case basis. However, activities granted exemption from plan preparation provisions must provide for the control of soil erosion and sedimentation and for the management of stormwater as required by the other provisions of this Ordinance.

A. Residential Land Disturbance Exclusions

Any land disturbance associated with an existing or proposed single family residential dwelling to be used as the developer's (i.e. homeowner's) residence or with land used for gardening for home consumption is exempt from the Drainage Plan preparation provisions of this Ordinance. Nevertheless, any such land disturbance associated with the construction, alteration or addition to a single family residence and associated improvements shall be provided with adequate soil erosion and sedimentation controls, as prescribed by the County Conservation District. A soil erosion and sedimentation control plan for the parcel shall be submitted with the application for a zoning permit. Said plan may be prepared by the property owner for submission to the Township.

B. Agricultural Operations Exclusion

Any land disturbance associated with agricultural activities operated in accordance with a Conservation Plan or a Soil Erosion and Sedimentation Control Plan approved by the Conservation District is exempt from the Drainage Plan preparation provisions of this Ordinance.

C. Forest Management Operations Exclusion

Any land disturbance associated with any forest management operations which is following the PA DER's management practices contained in DER publication "Soil Erosion and Sedimentation Control Guidelines for Forestry" and is operating under a Conservation District approved Soil Erosion and Sedimentation Control Plan and Forest Management Plan is exempt from the Drainage Plan preparation provisions of this Ordinance.

SECTION 403. PLAN CONTENTS

The information set forth in this Section shall be included in the Drainage Plan as appropriate for the subject regulated activities. In cases where the regulated activity is governed by another Ordinance of the Township which requires the submission of development and/or construction plans or drawings, the information required by this Section 403 may be included therewith, provided that the plans, drawings and other information submitted contain all information required by the Township to make the determination of compliance with this and the other applicable Ordinance(s). The Township shall in any case have the right to require any additional information or a level of detail as needed to determine compliance with this Ordinance.

A. Narrative Report and Plans including the following information:

1. Description of project including:
 - a. General description of project
 - b. General description of stormwater controls
 - c. General description of erosion control
 - d. General description of sedimentation control
 - e. Date project is to begin and expected date final stabilization will be completed
 - f. Training and experience of person preparing the plan
2. The soils on site described as follows:
 - a. Type may be specified as in a soil survey or by name, depth, slope, texture and structure
 - b. Hydrologic soil group for each soil type
 - c. Erodibility factor for each soil type
3. The amount of runoff from the project area and the upstream watershed area including:
 - a. Method of calculation used (i.e. TR55, rational, etc...)
 - b. Description of each sub-area
 - c. Pre-development runoff for each area
 - d. Post development runoff for each area
 - e. Discussion of the effect of development and proposed method controlling run-off, detention basin, infiltration, etc.
4. The staging of earthmoving activities including:
 - a. Cover removal
 - b. Control facility installation and temporary controls used.
 - c. Installation of improvements and permanent control measures.
 - d. Schedule of operations, stabilization, clean-up, and disposal.
5. Temporary control measures and facilities for use during earthmoving as follows:

- a. Types of measures and facilities
 - b. Purpose of each measure and facility
 - c. Location of measures and facilities
 - d. Design considerations and calculations, if any
6. Permanent control measures and facilities for site restoration and long-term protection including:
- a. Types of measures and facilities
 - b. Purpose of each
 - c. Location of measures and facilities
 - d. Design considerations and calculations, if any.
7. General description of an ownership and maintenance program that clearly sets forth, to the satisfaction of the Township, the ownership and maintenance responsibility of all temporary and permanent stormwater management facilities and erosion and sedimentation control facilities, including:
- a. Description of temporary and permanent maintenance requirements
 - b. Identification of a responsible individual, corporation, association or other entity for ownership and maintenance of both temporary and permanent stormwater management and erosion and sedimentation control facilities.
 - c. Establishment of required easements for access to all facilities.
 - d. Deed covenants and restrictions shall be submitted for approval by the Township to provide for maintenance of stormwater facilities by property owner or owner's association.
- B. Plans, showing the following information:
1. General
 - a. All plans shall be on sheet sizes and at a scale consistent with the Township Subdivision and Land Development Ordinance.
 - b. Proposed name or identifying title of project.
 - c. Name and address of the landowner and developer of the project site.
 - d. Total acreage and boundary lines of the tract of land on which the project site is located.
 - e. A location map, for the purpose of locating the project site to be developed, at a minimum scale of two thousand (2,000) feet to the inch, showing the relation of the tract to adjoining property and to all highways, streets, Township boundaries, and other identifiable landmarks existing within one thousand (1,000) feet of any part of the tract of land on which the project site is proposed to be developed.
 - f. Certificate for review by the Township's Engineer, if required by the Board of Supervisors.
 - g. Certificate for review by the Township's Planning Commission.

h. Certificate for approval by the Township's Board of Supervisors.

2. Existing Features

- a. Tract boundaries showing distances, bearings and curve data, as located by field survey or by deed plotting in accord with the standards in the Township Subdivision and Land Development Ordinance.
- b. Existing contours at vertical intervals of two (2) feet for land with an average natural slope of fifteen (15%) percent or less and at vertical intervals of five (5) feet for more steeply sloping land; except that for residential and agricultural uses where a preliminary subdivision or land development plan is not required by the Township's Subdivision and Land Development Ordinance, no contours shall be required; however, the plan should indicate the natural drainage patterns of the site along with the approximate grades of all slopes. Where contours are shown, the location of the benchmark and the name of the datum shall also be indicated.
- c. The names of all owners of all immediately adjacent unplotted land, the names of all proposed or existing developments immediately adjacent, and the locations and dimensions of any streets or easements shown thereon.
- d. The names, locations and dimensions of all existing highways, streets, railroads, watercourses and bodies of water, drainage facilities, floodplains, and other significant features within [two hundred (200)] feet of any part of the buildings and approximate location of all tree masses within the tract.
- e. Locations and dimensions of overhead and underground utilities, sewers, and water lines.
- f. Boundaries and identification of soil types as designated by the USDA SCS Soil Survey of Wayne County.

3. Proposed Features

- a. The proposed land use, the number of lots and dwelling units and the extent of commercial, industrial or other non-residential uses.
- b. The locations and dimensions of all proposed streets, parks, playgrounds, and other public areas; overhead and underground utilities and sewer and water facilities; lot lines and building locations, and parking compounds and other impervious and semi-pervious surfaces.
- c. The proposed changes to land surface and vegetative cover.
- d. Areas of cuts or fills.
- e. Final contours at vertical intervals of two (2) feet for land with an average natural slope of fifteen (15%) percent or less and at vertical intervals of five (5) feet for more steeply sloping land. Where existing contours are not shown or where proposed contour lines cannot be accurately located (i.e., as in a single family detached residential

development when the building has not been determined), arrows indicating general surface runoff flow patterns shall be shown.

- f. A twenty (20) foot right-of-way around all stormwater management structures and from such structures to a public right-of-way except for stormwater structures which by design must be located near buildings to protect said building or carry stormwater away from the building.

4. Stormwater Management Facilities

- a. Subwatershed boundaries as defined in Section 302 and applicable to the development site.
- b. All storm sewers along with any proposed connections to existing facilities.
- c. Groundwater recharge methods such as seepage pits, beds or trenches. When these structures are used, the locations of septic tank infiltration areas and wells must be shown.
- d. Other control devices or methods such as roof-top storage, grass swales, parking lot ponding, vegetated strips, and detention or retention basins.
- e. Plans and profiles of all proposed stormwater management facilities including vertical and horizontal alignment, size and type of material. This information shall be of the quality required for the construction of all facilities.
- f. A certificate, signed and sealed by the qualified individual who prepared the plan and designed facilities.

5. Erosion and Sedimentation Controls

- a. The type, location and extent of all erosion and sedimentation control measures shall be shown on an erosion and sedimentation control plan that conforms to the requirements of Chapter 102 (Erosion Control) of Title 25 Rules and Regulations of the PA DER.
- C. Financial security for the completion of stormwater management facilities as set forth in Article VII of this Ordinance.
 - D. Maintenance guarantee, as set forth in Article VII of this Ordinance.
 - E. When a Drainage Plan is submitted in sections, a generalized drainage plan for the entire project site shall be submitted in addition to the detailed drainage plan for the proposed section. This generalized plan shall demonstrate how the stormwater of the proposed section will relate to the entire development. The amount and velocity at the discharge point of the section shall be included in the data submitted. If temporary facilities are required for construction of a section, such facilities shall be included in the submitted Drainage Plan.

SECTION 404. PLAN SUBMISSION

In cases where the regulated activity requires Township approval in accord with another Township Ordinance, the plans and facilities installation and construction required by this Ordinance shall be submitted, processed and conducted in accord with the procedures, including the number of copies to be submitted, required by the other governing Township Ordinance.

- A. The regulated activities listed below shall be processed in accord with and shall be subject to the provisions of the Township Subdivision and Land Development Ordinance.
1. Land Developments
 2. Subdivisions
- B. The regulated activities listed below shall be processed in accord with the Township Zoning Ordinance (See Section 912 of the Township Zoning Ordinance) with respect to plan submittal and permit issuance. In cases where the regulated activity is not classified as a principal permitted, conditional, special exception or accessory use, said regulated activity shall be considered a principal permitted use for the purpose of plan submittal, review and action.
1. General land disturbance activities, including clearing and excavation
 2. Agricultural Operations
 3. Construction of new or additional impervious or semi-pervious surfaces (driveways, parking lots, etc...)
 4. Construction of new buildings and structures or additions to existing buildings and structures not regulated as land developments by the Township Subdivision Ordinance.
 5. Forest management operations and nursery operations.
 6. Diversion or piping of any natural or man-made drainage channel.
 7. Installation of stormwater systems or appurtenances thereto.
 8. Oiling of roads.
 9. Placement of fill for any purpose.
- C. The Drainage Plan shall be accompanied by the requisite fee, as required by Article VI of this Ordinance.
- D. The Township Board of Supervisors may conduct a public hearing on any stormwater management plan application if deemed necessary by the Board. Public hearings shall be conducted in accord with the Pennsylvania Municipalities Planning Code requirements for public hearings.
- E. The Township shall maintain a record of the approved plan and all accompanying documentation at the Township office.

SECTION 405. MODIFICATION OF PLANS

A modification to an approved Drainage Plan which involves a change in control methods or techniques, or which involves the relocation or redesign of control measures, or which is necessary because soil or other conditions are not as stated on the approved plan application, as determined by the Township, shall require a resubmission of the modified Drainage Plan consistent with Section 404 of this Ordinance.

ARTICLE V
INSPECTIONS

SECTION 501. GENERAL REQUIREMENTS

- A. Prior to the initiation of the construction of stormwater management facilities as shown on of the approved Drainage Plan, the developer shall provide to the Township for approval a schedule of inspections including the provision of a final inspection and submission of "as-built" drawings to the Township. These inspection provisions pertain only to construction activities regulated by the plan preparation provisions of Article IV. However, any activities granted exemption from plan preparation provisions as described in Section 402 and Article IX, which are therefore exempt from the inspection provisions shall nevertheless control erosion and manage stormwater in the manner required by this Ordinance.

SECTION 502. SCHEDULE OF INSPECTIONS

- A. The Township Enforcement Officer shall inspect all phases of development of the site including, but not limited to:
1. Completion of preliminary site preparation including stripping of vegetation, stockpiling of topsoil, and construction of temporary stormwater management and erosion control facilities.
 2. Completion of rough grading, prior to placing top soil, permanent drainage or other site development improvements and ground covers.
 3. During construction and installation of the permanent storm water facilities at such times to be specified by the Township.
 4. Upon completion of permanent stormwater management facilities, including established ground covers and plantings.
 5. Upon completion of any final grading, vegetative control measures or other site restoration work done in accordance with the approved Drainage Plan.
- B. No work shall begin on a subsequent stage until the proceeding stage has been inspected and approved by the Township Enforcement Officer.
- C. It is the responsibility of the developer to notify the Township Enforcement Officer not less than forty-eight (48) hours in advance of the completion of each identified phase of development.
- D. In the event the Township Enforcement Officer discovers that the work does not comply with the approved Drainage Plan or any applicable laws and ordinances, the Enforcement Officer shall issue a stop work order and the developer shall cease all work until the required corrections are made. Any portion of the work that does not comply with the approved plan must be corrected by the developer within ten (10) days. No work may proceed on any subsequent phase of the Drainage Plan, the subdivision or land development or building

construction or other regulated activity until the required corrections have been made.

- E. If at any stage of the work, the Township Enforcement Officer determines that the soil or other conditions are not as stated or shown in the approved Drainage Plan, the Enforcement Officer may refuse to approve further work and the Township may revoke approvals until a revised Drainage Plan is submitted and approved, as required by Section 405 of this Ordinance. If the revised Drainage Plan cannot remedy the situation then the Township shall have the right to revoke the Township approval and halt all work except for that work required to "close-out" the activity and return the site to pre-activity conditions as much as is reasonably possible.
- F. If the Township discovers that the facilities or measures installed may be in violation of Chapter 102 (Erosion Control) of the Clean Streams Law, the Township shall refer these violations to the appropriate conservation district.

SECTION 503. FINAL INSPECTION

When the developer has completed all the required facilities, he shall notify the Township in writing by certified or registered mail, and shall send a copy of such notice to the Township Engineer. The developer shall submit therewith a certification by a Qualified Individual; which certifies that all elements of the approved Drainage Plan have been constructed as designed and shown on the approved Plan. The Township shall, within ten (10) days after receipt of such notice, inspect the required facilities. Following this final inspection, the Enforcement Officer conducting the inspection for the Township shall promptly file a report, in writing, with the Township and shall mail a copy of the report to the developer by certified or registered mail. The report shall be made and mailed within thirty (30) days after receipt by the Township of the aforesaid developer notice of facilities completion.

SECTION 504. AS-BUILTS

Following final inspection, the developer shall submit drawings bearing the seal of a Pennsylvania Registered Professional Engineer indicating the "As-Built" improvements called for in the approved plan.

ARTICLE VI
FEES AND EXPENSES

SECTION 601. GENERAL

A fee covering costs incurred by the Township for Drainage Plan review and inspections and other administrative functions required by this Ordinance shall be established by resolution of the Board of Supervisors. No approval of the Drainage Plan shall be issued until the requisite fee has been paid.

The fees payable by an applicant shall include but not be limited to:

- A. The review of the Drainage Plan by the Township as required in Section 404 of this Ordinance.
- B. The site inspection.
- C. The inspection of required controls and improvements during construction as presented in Article V of this Ordinance.
- D. The final inspection upon completion of the controls and improvements required in the plan as presented in Article V of this Ordinance.
- E. Any additional work required to enforce any provisions of this Ordinance, correct violations, and assure the completion of stipulated remedial actions.
- F. Any other fees for consulting services required by the Township for the review and administration of regulated activities.

SECTION 602. MODIFICATION OF PLANS

If it is determined that modification to the existing Drainage Plan is required under Section 405 of this Ordinance additional fees shall be assessed to cover the additional costs incurred by the Township for processing the revised Drainage Plan. The revised plan shall not be approved until the additional fee has been paid by the applicant.

ARTICLE VII
FACILITIES CONSTRUCTION AND MAINTENANCE

SECTION 701. SOIL EROSION AND SEDIMENTATION AND TEMPORARY STORMWATER FACILITIES

Prior to the initiation of preliminary site preparation for any regulated activity, the soil erosion and sedimentation control practices and any temporary stormwater management facilities as shown on the approved Drainage Plan, shall be installed in accord with said Plan. It shall be the responsibility of the Developer to maintain said control practices throughout the period of construction until such time as the site has been stabilized and all permanent controls have been installed and are approved in accord with this Ordinance. Failure of the Developer to comply with this Section 701 shall constitute a violation of this Ordinance which shall be subject to the penalties prescribed by said Ordinance.

SECTION 702. SUBDIVISIONS AND LAND DEVELOPMENTS

In the case where soil erosion and sedimentation control practices and stormwater management facilities are required for a regulated activity governed by Section 404, Subsection A, of this Ordinance and the Township Subdivision Ordinance (i.e. a subdivision or land development) said practices and facilities shall be considered to be improvements as defined by the Township Subdivision Ordinance and shall be installed and maintained in accord with the provisions of the Township Subdivision Ordinance in addition to any other applicable requirements of this Stormwater Management Ordinance. Failure to install and maintain said practices and facilities shall be considered a violation of this Ordinance and the subdivision approval for same may be revoked by the Township.

SECTION 703. OTHER REGULATED ACTIVITIES

In the case where erosion and sedimentation control practices and stormwater management facilities are required for a regulated activity governed by Section 404, B of this Ordinance and the Township Zoning Ordinance (i.e. regulated activities which are not subdivisions or land developments) the installation and maintenance of said practices and facilities shall be considered a "condition of approval" attached to the zoning approval of the subject regulated activity. Failure to install and maintain said practices and facilities shall be considered a violation of this Ordinance and the zoning approval and permits for same may be revoked by the Township.

Pursuant to the authority of the Pennsylvania Stormwater Management Act, the Township may require the applicant to provide to the Township financial security to guarantee the installation and maintenance for any or all required practices and facilities. If a financial guarantee is required, said guarantee shall be provided and all practices and facilities shall be installed and maintained in accord with the Township Subdivision Ordinance and all applicable provisions of the Pennsylvania Municipalities Planning Code.

The Township may also attach as a condition of approval a time limit for the completion of said practices and facilities.

A. Construction Maintenance Bond

The Township may require the posting of a maintenance bond to secure the structural integrity of said facilities as well as the functioning of said facilities in accordance with the design and specifications as depicted on the approved Drainage Plan for a term not to exceed eighteen (18) months from the date of acceptance of dedication. Said financial security shall be the same type as required with regard to installation of such facilities, and the amount of the financial security shall not exceed fifteen percent (15%) of the actual cost of installation of said facilities.

B. Long-term Maintenance Bond

The long-term maintenance bond shall be in an amount equal to the present worth of maintenance of the facilities for a ten (10) year period at current prime interest rate. The estimated annual maintenance cost for the facilities shall be based on a fee schedule provided by the Township Engineer and adopted by resolution of the Township Board of Supervisors.

ARTICLE VIII
ENFORCEMENT AND PENALTIES

SECTION 801. ENFORCEMENT

The Township shall designate by resolution an individual, agency, or combination thereof to act as the Enforcement Officer, who shall have the authority and responsibility to enforce the regulations set forth in this Ordinance. In the event that the Enforcement Officer is unable to perform his duties, or in the event of a conflict of interest, the Township may appoint an alternate to fulfill his responsibilities.

SECTION 802. RIGHT-OF-ENTRY

Upon presentation of proper credentials, duly authorized representatives of the Township may enter at reasonable times upon any property within the Township to investigate or ascertain the condition of the subject property in regard to any aspect regulated by this Ordinance. This includes property housing stormwater management facilities for which the Township is not directly responsible for maintenance as provided in Article VII.

SECTION 803. VIOLATIONS

The following actions shall be considered violations of this Ordinance and shall be subject to the penalties prescribed herein:

- A. The initiation of any regulated activity without first obtaining the required approvals and permits.
- B. The failure to install or maintain any and all required soil erosion and sedimentation control practices; and any and all required stormwater management facilities.
- C. The failure to abide by any other applicable provisions of this Ordinance.

SECTION 804. NOTICE, PENALTIES, REMEDIES, AND APPEALS

Notice of any violation, penalties prescribed for violations, remedies available to the Township, and appeals by the violator shall be governed by the applicable ordinances as follows:

- A. Subdivisions and Land Developments as regulated by Section 404, Subsection A of this Ordinance shall be governed by the Township Subdivision Ordinance.
- B. Other regulated activities as governed by Section 404, Subsection B of this Ordinance shall be governed by the Township Zoning Ordinance.

ARTICLE IX
WAIVERS

SECTION 901. HARDSHIP WAIVER PROCEDURE

- A. The Township's Board of Supervisors may hear requests for waivers where it is alleged that the provisions of this Ordinance inflict unnecessary hardship upon the applicant. The waiver request shall be in writing using an application form promulgated by the Township and accompanied by the requisite fee based upon a fee schedule adopted by resolution of the Township Board of Supervisors. A copy of the completed application form shall be provided to each of the following: Paupack Township, Township Engineer, Township Solicitor, Township Planning Commission, and County Planning Commission. The application shall state in full the grounds and facts of unreasonableness or hardship on which the request is based, the provision or provisions of the Ordinance involved and the minimum waiver necessary.
- B. The Township may grant a waiver of one or more provisions of this Ordinance provided that such waiver shall not be contrary to the public interest and that all of the following findings are made in a given case:
1. That there are unique physical circumstances or conditions, including irregularity of lot size or shape, or exception topographical or other physical conditions peculiar to the particular property, and that the unnecessary hardship is due to such conditions, and not the circumstances or conditions generally created by the provisions of this Ordinance;
 2. That because of such physical circumstances or conditions, there is no possibility that the property can be developed in strict conformity with the provisions of this Ordinance, including the "no harm" provision documented in Section 301, and that the authorization of a waiver is therefore necessary to enable the reasonable use of the property;
 3. That such unnecessary hardship has not been created by the applicant;
 4. That the waiver, if authorized, will represent the minimum waiver that will afford relief and will represent the least modification possible of the regulation in issue.
- C. In granting any waiver, the Township may attach such reasonable conditions and safeguards as it may deem necessary to implement the purposes of this Ordinance. The Township shall keep a record of all action on all requests for waivers.

ARTICLE X
ENACTMENT

SECTION 1001. REPEALER

Any ordinance of the Township which is less stringent or less restrictive than any of the provisions of this Ordinance is hereby repealed to the extent of the inconsistency only.

SECTION 1002. COMPATIBILITY WITH OTHER PERMIT AND 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. If more stringent requirements concerning regulation of stormwater or erosion and sedimentation control are contained in the other code, rule, act or ordinance, the more stringent regulation shall apply. Refer to Appendix A for a list of related regulations, codes, and ordinances. Appendix A is not a part of the Ordinance.

SECTION 1003. TOWNSHIP LIABILITY

The making of an administrative decision shall not constitute a representation, guarantee or warranty of any kind by the Township or by any official or employee thereof, of the practicability or safety of any proposed structure or use with respect to damage from erosion, sedimentation, storm water runoff or floods, and shall create no liability upon, or cause of action against, the Township, its officials or employees.

SECTION 1004. SEVERABILITY

If any section, subsection, or requirement of this Ordinance shall be held to be unconstitutional or invalid by any court of competent jurisdiction, such decision shall not affect the legality of the remaining provisions of this Ordinance or of this Ordinance as a whole.

SECTION 1005. AMENDMENTS

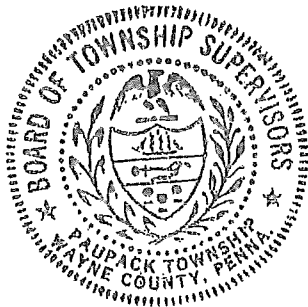
Amendments to this Ordinance may be initiated by the Township Planning Commission or the Board of Supervisors. If the amendments are initiated by the Board of Supervisors, the proposed amendment or amendments shall be submitted to the Planning Commission for review and comment at least thirty (30) days prior to a public hearing. Before enactment of a proposed amendment or amendments the Board of Supervisors shall hold a public hearing thereon pursuant to public notice.

SECTION 1006. EFFECTIVE DATE

This Stormwater Management Ordinance, Paupack Township Ordinance No. 341, is hereby ordained and enacted by vote of the Board of Supervisors of Paupack Township, Wayne County, Pennsylvania at a duly convened meeting of the Board of Supervisors this 10th day of APRIL, 1991. This Ordinance shall become effective on MAY 1ST, 1991.

ATTEST:

Joanna Pawlowski
Secretary



Paupack Township Board of Supervisors

[Signature]
Chairman

[Signature]
Vice-Chiarman

[Signature]
Supervisor

Solicitor

APPENDIX A

APPENDIX A

LIST OF RELATED TOWNSHIP REGULATIONS, CODES, AND ORDINANCES

- A.1 Subdivision/Land Development Ordinance
- A.2 Zoning Ordinance
- A.3 Floodplain Management Regulations
- A.4 Road Ordinance
- A.5 Building code
- A.6 Comprehensive Plan

APPENDIX B

APPENDIX B.1

STANDARD SCS 24-HOUR, TYPE II DISTRIBUTION
 CUMULATIVE RAINFALL TABLE
 (REVISED MAY 1982)

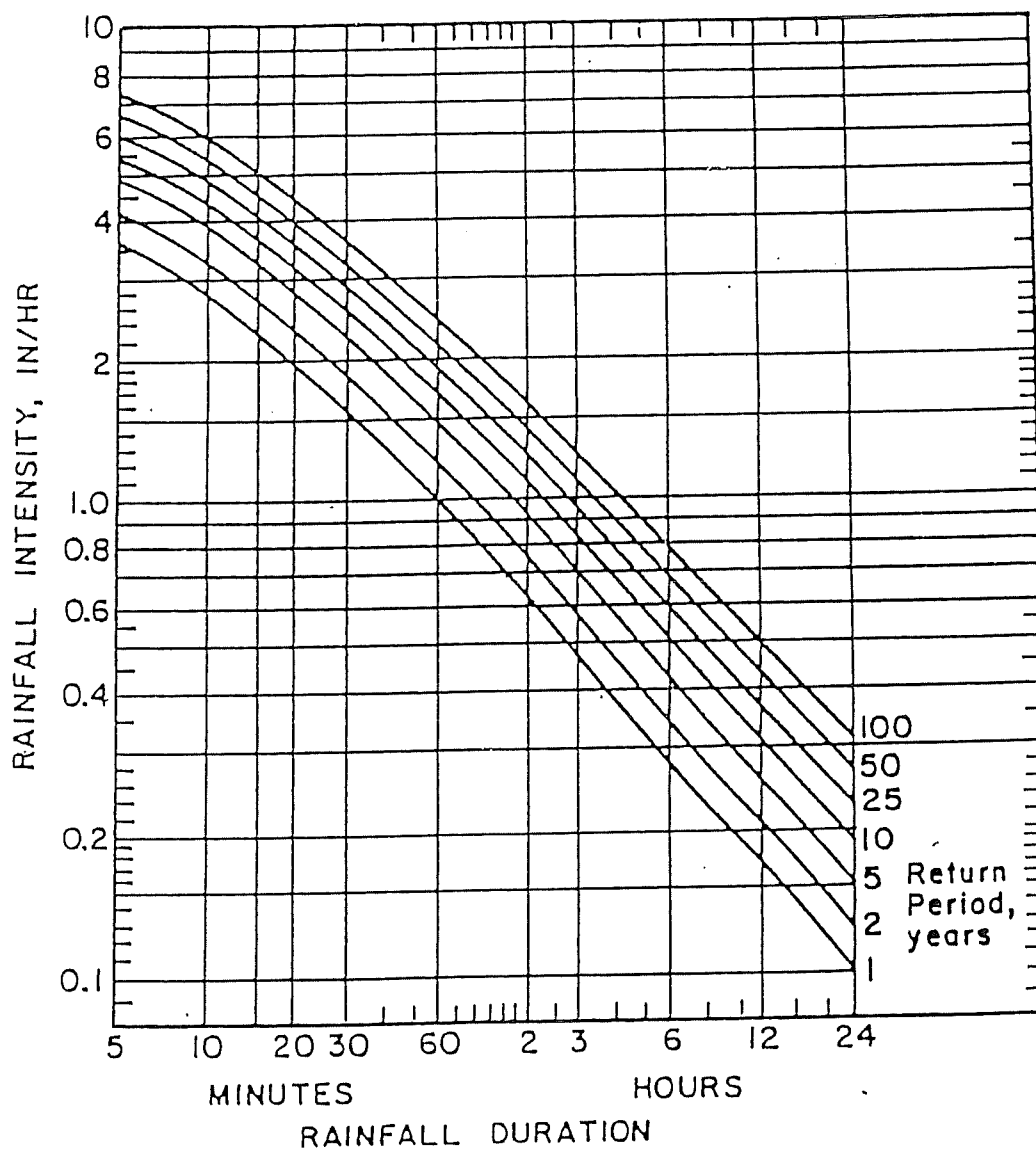
Time Increment = 15 minutes (0.25 hour)

0.0	0.0020	0.0050	0.0080	0.01110
0.0140	0.0170	0.0200	0.0230	0.0260
0.0290	0.0320	0.0350	0.0380	0.0410
0.0440	0.0480	0.0520	0.0560	0.0600
0.0640	0.0680	0.0720	0.0760	0.0800
0.0850	0.0900	0.0950	0.1000	0.1050
0.1100	0.1150	0.1200	0.1260	0.1330
0.1400	0.1470	0.1550	0.1630	0.1720
0.1810	0.1910	0.2030	0.2180	0.2360
0.2570	0.2830	0.3870	0.6630	0.7070
0.7350	0.7580	0.7760	0.7910	0.8040
0.8150	0.8250	0.8340	0.8420	0.8490
0.8560	0.8630	0.8690	0.8750	0.8810
0.8870	0.8930	0.8980	0.9030	0.9080
0.9130	0.9180	0.9220	0.9260	0.9300
0.9340	0.9380	0.9420	0.9460	0.9500
0.9530	0.9560	0.9590	0.9620	0.9650
0.9680	0.9710	0.9740	0.9770	0.9800
0.9830	0.9860	0.9890	0.9920	0.9950
0.9980	1.0000	1.0000	1.0000	1.0000

APPENDIX B.3

STORM INTENSITY-DURATION-FREQUENCY CURVES FOR REGION 4

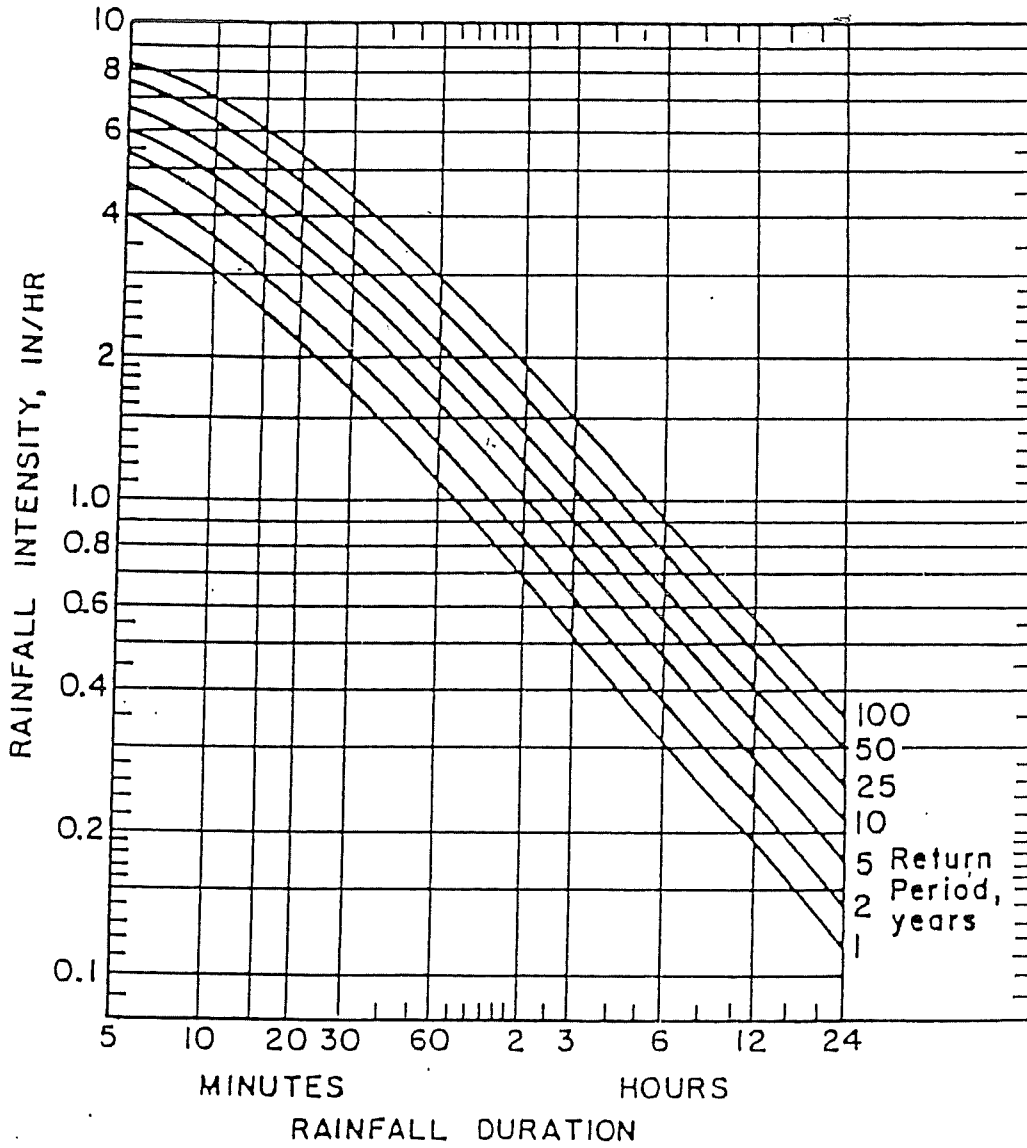
REGION 4



APPENDIX B.3

STORM INTENSITY-DURATION-FREQUENCY CURVES FOR REGION 5

REGION 5



APPENDIX B.4

RUNOFF CURVE NUMBERS AND PERCENT IMPERVIOUS COVER

URBAN AREAS

Cover Description	Average Percent Impervious Area	Curve Numbers for Hydrologic Soil Group -			
		A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.):					
Poor condition (grass cover < 50%)	0	68	79	86	89
Fair condition (grass cover 50% to 75%)	0	49	69	79	84
Good condition (grass cover > 75%)	0	39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	100	98	98	98	98
Streets and roads:					
Paved: curbs and storm sewers (excluding right-of-way)	100	98	98	98	98
Paved: open ditches (including right-of-way)	100	83	89	92	93
Gravel (including right-of-way)	100	76	85	89	91
Dirt (including right-of-way)	100	72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)	0	63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	100	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
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)	0	77	86	91	94

APPENDIX B.4 (Cont'd.)

RUNOFF CURVE NUMBERS AND PERCENT IMPERVIOUS COVER

AGRICULTURAL LANDS (PERCENT IMPERVIOUS = 0%)

Cover Description		Hydrologic Condition	Curve Numbers for Hydrologic Soil Group -			
			A	B	C	D
Tillage (1)	Bare soil	-	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops (1)	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 (1)	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

APPENDIX B.4 (Cont'd.)

RUNOFF CURVE NUMBERS AND PERCENT IMPERVIOUS COVER

AGRICULTURAL LANDS (PERCENT IMPERVIOUS = 0%)

Cover Description		Hydrologic Condition	Curve Numbers for Hydrologic Soil Group -			
			A	B	C	D
Cover Type						
Close-seeded or broadcast legumes or rotation meadow (1)	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
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	30	48	65	73
Woods - grass combination (orchard or tree farm)		Poor	57	73	82	86
		Fair	43	65	76	82
		Good	32	58	72	79
Woods (4)		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	30	55	70	77
Farmsteads - buildings, lanes, driveways, and surrounding lots			59	74	82	86

Footnotes:

(1) 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 \geq 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.

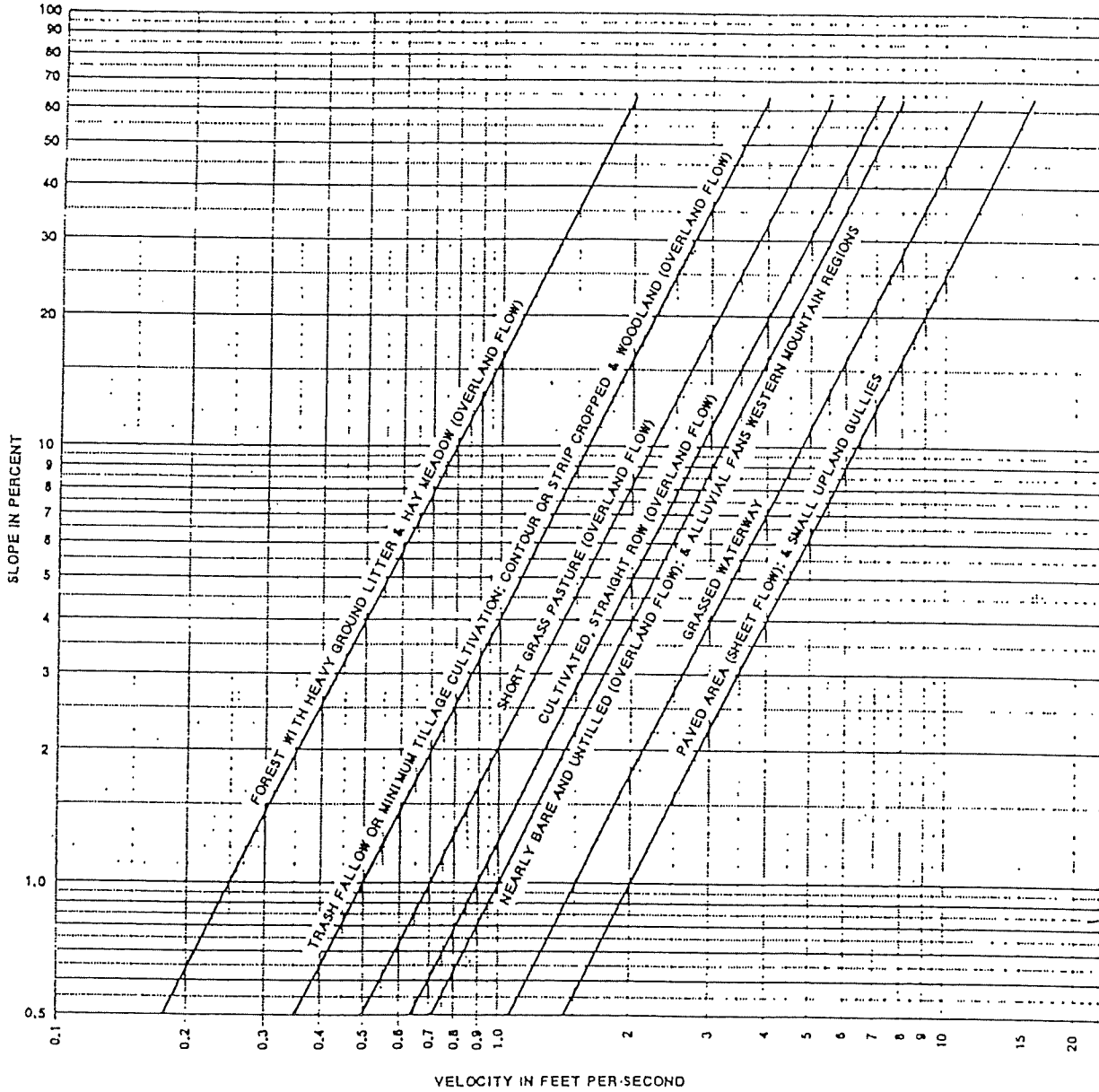
) Poor: <50% ground cover or heavily grazed with no mulch.

Fair: 50 to 75% ground cover and not heavily grazed.

Good: > 75% ground cover and lightly or only occasionally grazed.

APPENDIX B.5

AVERAGE VELOCITIES FOR ESTIMATING OVERLAND FLOW AND TIME OF TRAVEL



APPENDIX B.4 (Cont'd.)

RUNOFF CURVE NUMBERS AND PERCENT IMPERVIOUS COVER

Footnotes: (Cont'd.)

- (3) Poor: < 50% ground cover.
Fair: 50 to 75% ground cover.
Good: > 75% ground cover.
- (4) 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.

APPENDIX B.6

RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD

<u>Type of Surface</u>	<u>Normal Range</u>	<u>Recommended Value</u>
Pavement:		
Concrete or Bituminous Concrete	0.75 - 0.95	0.90
Bituminous Macadam or Surface Treated Gravel	0.65 - 0.80	0.75
Gravel, Macadam, etc.	0.25 - 0.60	0.50
Brick	0.70 - 0.85	
Roofs	0.70 - 0.95	
Sandy Soil:		
Cultivated or Light Growth	0.15 - 0.30	0.20
Woods or Heavy Brush Lawns	0.14 - 0.30	0.20
Flat, less than 2%	0.05 - 0.10	
Average, 2-7%	0.10 - 0.15	
Steep, 7% or more	0.15 - 0.20	
Clay Soil:		
Bare or Light Growth	0.35 - 0.75	0.50
Woods or Heavy Growth Lawns	0.25 - 0.60	0.40
Flat, less than 2%	0.13 - 0.17	
Average, 2-7%	0.18 - 0.22	
Steep, 7% or more	0.25 - 0.35	
<u>Type of Area</u>		
Business		
Downtown	0.70 to 0.95	0.90
Neighborhood	0.50 to 0.70	
Residential		
Single Family	0.30 to 0.50	
Multunits, detached	0.40 to 0.60	
Multunits, attached	0.60 to 0.75	
Residential, suburban	0.25 to 0.40	
Apartment	0.50 to 0.70	
Industrial		
Light	0.50 to 0.80	
Heavy	0.60 to 0.90	
Parks, Cemeteries, Golf Courses	0.10 to 0.25	
Railroad Yard	0.20 to 0.35	
Unimproved	0.10 to 0.30	

APPENDIX B.7
MANNING "n" VALUES

<u>Surface</u>	<u>n</u>
Uncoated cast-iron pipe	0.013
Coated cast-iron pipe	0.012
Commercial wrought-iron pipe, black	0.013
Commercial wrought-iron pipe, galvanized	0.014
Smooth brass and glass pipe	0.010
Smooth lockbar and welded "OD" pipe	0.011
Riveted and spiral steel pipe	0.015
Vitrified sewer pipe	0.013
Common clay drainage tile	0.012
Glazed brickwork	0.013
Brick in cement mortar; brick sewers	0.015
Neat cement surfaces	0.011
Cement mortar surfaces	0.013
Concrete pipe	0.012
Wood stave pipe	0.011
Plank flumes:	0.012
Planed	0.013
Unplaned	0.015
With battens	0.014
Concrete-lined channels	0.012
Cement-rubble surface	0.020
Dry-rubble surface	0.030
Dressed-ashlar surface	0.014
Semicircular metal flumes, smooth	0.012
Semicircular metal flumes, corrugated	0.025
Canals and ditches:	0.025
Earth, straight and uniform	0.033
Rock cuts, smooth and uniform	0.040
Rock cuts, jagged and irregular	0.025
Winding sluggish canals	0.0275
Dredged earth channels	0.035
Canals with rough stony beds, weeds on earth banks	0.030
Earth bottom, rubble sides	0.030
Natural stream channels:	0.029
(1) Clean, straight bank, full stage, no rifts or deep pools	0.035
(2) Same as (1), but some weeds and stones	0.039
(3) Winding, some pools and shoals, clean	0.047
(4) Same as (3), lower stages, more ineffective slope and sections	0.042
(5) Same as (3), some weeds and stones	0.052
(6) Same as (4), stony sections	0.065
(7) Sluggish river reaches, rather weedy or with very deep pools	0.112
(8) Very weedy reaches	0.112

For additional "n" values, refer to Table 2.10.5.1 in PDT Publication B.



Worksheet 2: Runoff curve number and runoff

Project _____ By _____ Date _____

Location _____ Checked _____ Date _____

Circle one: Present Developed _____

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN ^{1/}			Area <input type="checkbox"/> acres <input type="checkbox"/> mi ² <input type="checkbox"/> %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
Totals =						

^{1/} Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = _____ = _____; Use CN =

2. Runoff

Frequency yr
 Rainfall, P (24-hour) in
 Runoff, Q in
 (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)

Storm #1	Storm #2	Storm #3

APPENDIX B.10

UNIT AREAL LOADING RATES FOR PHOSPHORUS AND
TOTAL SUSPENDED SOLIDS

Land Use	Main Stem		West Branch		Purdy Creek	
	Phosphorus (lb/ac/yr)	TSS (lb/ac/yr)	Phosphorus (lb/ac/yr)	TSS (lb/ac/yr)	Phosphorus (lb/ac/yr)	TSS (lb/ac/yr)
Residential	0.85	175	0.72	200	0.83	100
Cropland	1.63	300	1.10	275	1.30	200
Pasture	0.50	90	0.43	50	0.50	50
Commercial	0.92	300	0.90	250	0.92	150
Forest	0.10	9	0.10	30	0.12	36

	Ariel Creek		Mill Brook		Immediate Drainage	
	Phosphorus (lb/ac/yr)	TSS (lb/ac/yr)	Phosphorus (lb/ac/yr)	TSS (lb/ac/yr)	Phosphorus (lb/ac/yr)	TSS (lb/ac/yr)
Residential	0.89	150	0.80	53	0.85	175
Cropland	1.72	325	-	-	1.67	270
Pasture	0.62	79	0.44	34	0.55	60
Commercial	1.10	200	-	-	0.93	209
Forest	0.18	31	0.04	11	0.25	50

Note: TSS = Total Suspended Solids.

APPENDIX B.11

SAMPLE PROBLEM
SELECTION OF CONTROL TECHNIQUE
TO MEET DESIGN CRITERIA FOR RUNOFF POLLUTANTS

Step 1: Identify the type of development activity.

Example - A small shopping center is proposed for a 15 acre lot in the Manny Run (M-MR) subwatershed. 4 acres of the lot will be covered by a single, flat roof commercial structure. 6 acres of the lot will be an asphalt parking lot. The remaining 5 acres are grass-covered with some small shrubbery and trees.

Step 2: Using Table B-1 of this appendix, determine the control design criteria to be used.

Example - For subwatershed M-MR, release rate for peak flow rate = 60%. Maximum loading rates for pollutants are 16.68 lb/MG for phosphorus and 918 lb/MG for sediment.

Step 3: Using the computational methods presented in Sections 303 and 304, calculate the storm runoff's peak flow rate and pollutant loadings for pre- and post-development conditions.

Example - Calculate peak flow rates - Assume calculated peak flow rates are equal to 2,000 gpd for pre-development and 4,600 gpd (0.0046 MG/day) for post-development for the 100-year storm event. The design peak flow rate, based on the release rate percentage is $.60 * 2,000 \text{ gpd} = 1,200 \text{ gpd}$.

Calculate pollutant loadings - Using the unit areal loading rates presented in Appendix B.10 for the Main Stem and commercial land use (P = 0.92 lb/ac/yr and TSS = 300 lb/ac/yr) calculate loading in lb/MG for post-development conditions.

P loading in lb/MG =

$$\frac{0.92 \text{ lb}}{\text{acreyear}} * \frac{\text{day}}{.0046 \text{ MG}} * \frac{(4+6) \text{ acres}}{1} * \frac{\text{Year}}{365 \text{ days}} = 5.48 \frac{\text{lb}}{\text{MG}}$$

Since the P loading estimate of 5.48 lb/MG is less than the maximum allowable loading rate of 16.68 lb/MG, P control is not considered a problem for this sample.

TSS loading in lb/MG =

$$\frac{300 \text{ lb}}{\text{acreyear}} * \frac{\text{day}}{.0046 \text{ MG}} * \frac{(4+6) \text{ acres}}{1} * \frac{\text{Year}}{365 \text{ days}} = 1787 \frac{\text{lb}}{\text{MG}}$$

Step 4: Select potential stormwater control techniques based on physical suitability for the particular development site using Tables C-1 to C-4 of the Plan.

APPENDIX B.11 (Cont'd.)

SAMPLE PROBLEM
SELECTION OF CONTROL TECHNIQUE
TO MEET DESIGN CRITERIA FOR RUNOFF POLLUTANTS

Example -

- o Infiltration pits and trenches
- o Porous pavement (asphalt)
- o Seepage areas
- o Cistern storage
- o Impoundment (dry)
- o Impoundment (wet)
- o Parking lot storage
- o Rooftop detention
- o Filter strips

Step 5: Evaluate the potential control techniques based on the techniques' control and pollutant removal capabilities to determine which techniques meet the control criteria. Use the performance estimates of Table B-2 of this appendix.

Example -

Infiltration pits and trenches:

Runoff Peak Rate
 $4,600 - .90 (4600) = 460 \text{ gpd}$ (ok)

Sediment
 $1,787 - .45 (1787) = 983 \text{ lb/MG}$ (over)

Phosphorus
 $5.48 - .40 (5.48) = 3.28 \text{ lb/MG}$ (ok)

Porous Pavement (asphalt):

Runoff Peak Rate
 $4,600 - 1.00 (4600) = 0 \text{ gpd}$ (ok)

Sediment
(unknown)

Phosphorus
 $5.48 - .40 (5.48) = 3.29 \text{ lb/MG}$ (ok)

Seepage Areas:

Runoff Peak Rate
 $4,600 - .45 (4600) = 2,070 \text{ gpd}$ (over)

APPENDIX B.11 (Cont'd.)

SAMPLE PROBLEM
SELECTION OF CONTROL TECHNIQUE
TO MEET DESIGN CRITERIA FOR RUNOFF POLLUTANTS

Sediment
1,787 - .45 (1787) = 983 lb/MG (over)

Phosphorus
5.48 - .45 (5.48) = 3.01 lb/MG (ok)

Cistern Storage:

Runoff Peak Rate
4,600 - .80 (4600) = 920 gpd (ok)

Sediment
1,787 - .48 (1787) = 929 lb/MG (over)

Phosphorus
5.48 - .45 (5.48) = 3.01 lb/MG (ok)

Impoundment (dry):

Runoff Peak Rate
4,600 - .80 (4600) = 920 gpd (ok)

Sediment
1,787 - .15 (1787) = 1519 lb/MG (over)

Phosphorus
5.48 - .10 (5.48) = 4.93 lb/MG (ok)

Impoundment (wet):

Runoff Peak Rate
4,600 - .80 (4600) = 920 gpd (ok)

Sediment
1,787 - .60 (1787) = 715 lb/MG (ok)

Phosphorus
5.48 - .30 (5.48) = 3.29 lb/MG (ok)

Parking Lot Storage:

Runoff Peak Rate
4,600 - .80 (4600) = 920 gpd (ok)

APPENDIX B.11 (Cont'd.)

SAMPLE PROBLEM
SELECTION OF CONTROL TECHNIQUE
TO MEET DESIGN CRITERIA FOR RUNOFF POLLUTANTS

Sediment
 $1,787 - .45 (1787) = 983 \text{ lb/MG}$ (over)

Phosphorus
 $5.48 - .45 (5.48) = 3.01 \text{ lb/MG}$ (ok)

Rooftop Detention:

Runoff Peak Rate
 $4,600 - .80 (4600) = 920 \text{ gpd}$ (ok)

Sediment
(not applicable)

Phosphorus
(not applicable)

Filter Strip:

Runoff Peak Rate
 $4,600 - .45 (4600) = 2530 \text{ gpd}$ (over)

Sediment
 $1,787 - .85 (1787) = 268 \text{ lb/MG}$ (ok)

Phosphorus
 $5.48 - .80 (5.48) = 1.10 \text{ lb/MG}$ (ok)

Based on these calculations, the following alternative control techniques are recommended:

Alternative 1 - Construct a wet impoundment in the 5 acres of undeveloped area to receive runoff from the flat roof and the parking lot.

Alternative 2 - Use rooftop detention in conjunction with filter strips which are constructed around the perimeter of the parking lot to receive its runoff. The water detained in the rooftop should be recycled for water uses during dry weather (cleaning parking lot and/or watering grassland) or released to the filter strips after the storm.

Step 6: Evaluate the alternatives based on the control techniques' implementation and operation features. A preliminary design of the alternatives could also be done at this time to better evaluate the control capabilities in order to select a preferred alternative.

APPENDIX B, 12

Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute T_t :

$$T_t = \frac{0.007 (nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \quad [\text{Eq. 3-3}]$$

Table 3-1.—Roughness coefficients (Manning's n) for sheet flow

Surface description	n ¹
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses ²	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: ³	
Light underbrush	0.40
Dense underbrush	0.80

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

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

³When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

where

- T_t = travel time (hr),
- n = Manning's roughness coefficient (table 3-1),
- L = flow length (ft),
- P_2 = 2-year, 24-hour rainfall (in), and
- s = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

APPENDIX B.12

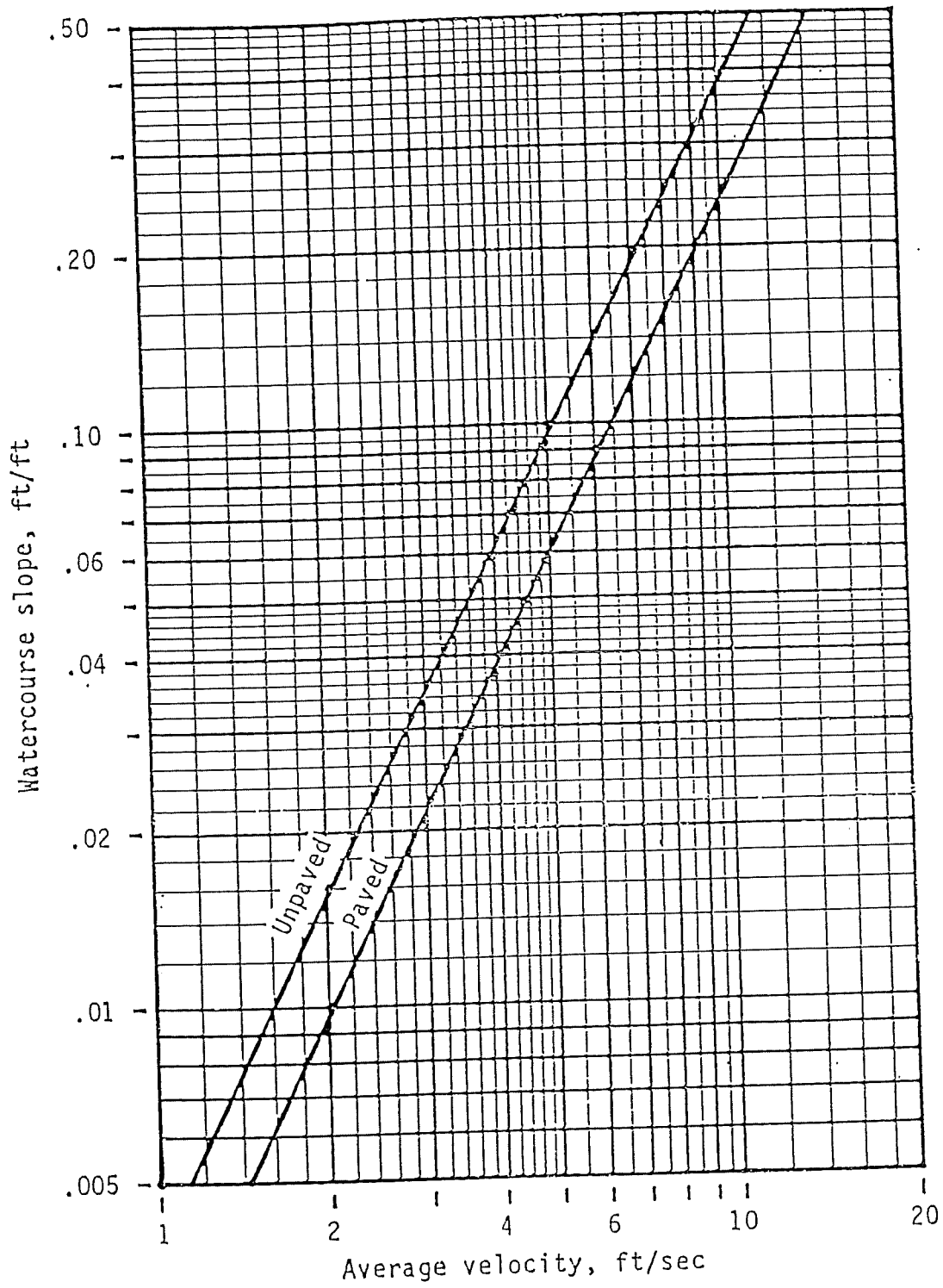


Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.

APPENDIX B.13

CHARACTERISTICS OF PENNSYLVANIA SOILS

Soil Series	G	K _e	T ₀	I	D	Soil Series	G	K _e	T ₀	I	D	Soil Series	G	K _e	T ₀	I	D
Abbottstown	C	.43	3	9	6	Caivert	D	.49	3	10	8	Eik	B	.32	4	1	1
Albia	C	.32	3	7	5	Calvin	C	.24	3	5	4	Elkins	D	.49	3	10	3
Albrights	C	.43	3	7	5	Cambridge	C	.37	3	7	5	Elkinsville	B	.37	4	1	1
Alden	D	.32	3	10	9	Canadice	D	.49	3	10	8	Eilery	D	.32	3	10	6
Aldino	C	.43	3	7	5	Caneacea	D	.49	3	10	6	Eiliber	A	.24	4	3	1
Allegheny	B	.32	4	1	1	Canfield	C	.22	3	7	5	Elsincoro	B				1
Allenwood	B	.32	4	1	1	Caprina		.43	3	7	5	Emceyville	C	.24	3	7	5
Allis	D	.43	3	8	3	Caroiff	B	.23	3	5	5	Erie	C	.32	3	10	6
Altavista	C	.32	4	7	4	Catoccin	C	.32	3	5	5	Ernest	C	.43	3	7	5
Alton	B	.20	3	3	3	Cattaraugus	C	.24	3	7	7	Evencale		.37	3	10	1
Alvira	C	.32	3	9	6	Cavcoe	C	.43	3	10	6	Fallsington	D	.23	4	9	7
Amaranth		.43	3	5	5	Chacrin	B	.49	4	1	1	Fleetwood		.23	3	2	1
Ancover	D	.43	3	10	8	Chalfont	C	.43	3	10	6	Focelsville	B	.32	4	1	1
Arenotsville	B	.32	4	2	2	Chambersburg		.23	3	4	4	Frankstown	B	.32	3	1	1
Ariel		.32	3			Chavies	B	.24	4	1	1	Fredon	C	.24	3	9	7
Armagn	D	.43	3	10	8	Chanango	A	.24	3	3	3	Frenchtown	D	.37	3	10	3
Armenia		.20	3			Chester	B	.32	4	1	1	Ganoga		.20	2		
Arnot	C/D	.20	2	5	5	Chewacia	C	.49	4	7	1	Gatasburg	A	.17	5	3	1
Ashton	B	.23	4	1	1	Chili	B	.24	3	3	3	Germania		.24	3	2	1
coarse variant				2	2	Chillisqueaque		.43	3	10	6	Gilpin	C	.32	3	4	1
Atherton	B/D	.32	3	9	9	Chilo	B/D	.32	3	10	9	Ginat	D	.43	4	9	7
Athol	B	.37	4	1	1	Chippewa	B/D	.32	3	10	8	Glencig	B	.32	3	1	1
Atkins		.49	4	9	2	Christiana	B	.43	3	7	7	Glennville	C	.32	3	7	5
Baile	D	.49	3	10	8	Chrome	C	.32	2	4	4	Gresham	C	.37	3	10	6
Barbour	B	.49	4	1	1	Clarksbury	C	.43	3	7	5	Guernsey	C	.43	3	7	4
Barcla	D	.43	3	9	8	Clymer	B	.23	3	2	2	pr dr var					10
Basher	B	.49	4	7	1	Codorus	C	.49	4	7	1	Guthrie	D	.43	3	10	3
Bath	C	.24	3	7	7	Collamer	C	.49	3	3	3	Hagerstown	C	.32	4	1	1
Bedford	C	.43	3	7	5	Conly	C	.37	3	7	5	mod deep					4
Bedington	B	.32	4	1	1	Conestoga	B	.43	4	1	1	shallow					6
Belmont	B	.37	3	1	1	Congaree	B	.49	4	1	1	Halsey	D	.24	3	9	9
Beltsville	C	.43	3	7	5	Conotton	B	.23	3	3	3	Hanover	C	.37	4	1	1
Benson	C/D	.23	2	6	6	mod wl dr var						Hartleton	B	.24	3	3	1
Berks	C	.23	3	5	5	Conowingo	C	.43	3	7	6	Hartsells	B	.23	3	2	1
Bermudian	B	.43	4	1	1	Conyngnam		.32	3	10	6	Hatboro	D	.49	4	10	2
Berrien		.17	5	9	5	Cooksport		.37	3	7	5	Hazleton	B	.24	3	2	1
Birosail	D	.49	3	10	9	Corycon	C			6	6	Hignfield	B	.23	3	1	1
Birdsboro	B	.23	4	1	1	Cossayuna	C	.24	3	7	7	Hollinger	B	.43	3	4	1
Blago	D	.43	3	10	9	Croton	D	.43	3	10	8	Holly	D	.49	4	9	2
Blairton	C	.43	3	7	5	Culvers		.23	3	7	5	Holston	B	.32	4	1	1
Boxmansville	C	.49	4	10	2	Dalton	C	.49	3	10	6	Hornell	D	.43	3	2	6
Boynton		.32	3	10	3	Dannemora	D	.23	3			Howard	B	.24	3	3	1
Braceville	C	.24	3	7	5	Dekalb	C	.24	3	5	5	Howell	C	.43	3	1	1
Brandywine	C	.24	3	5	5	Dilldown		.17	3	5	5	Hublersburg	C	.32	4	1	1
Brecknock	B	.32	3	1	1	Doylestown	D	.43	3	10	8	Huntington	B	.49	4	1	1
channery var.				3	3	Drab		.37	3	7	1	coarse var					2
Brinkerton	D	.43	3	10	8	Drifton	C	.23	3	7	5	local alluvium					1
Brooke	C	.43	3	4	4	Duffield	B	.32	4	1	1	Imier		.43	3	7	5
shallow var.				6	6	Duncannon	B	.43	3	1	1	Iva	C				5
Buchanan	C	.32	3	2	5	Dunning	D	.43	3	10	3	Kedron (see Albright)					
Bucks	B	.32	4	1	1	Edgemont	B	.23	3	2	2	Kerrtown		.49	4	1	1
Burgin	D	.49	3	10	9	Edon	C	.23	3	4	4						
Butlertown	C	.43	3	7	5	Elfoak	C	.32	4	1	1						

G Hydrologic Soil Group (SCS)
X/X - Drained/Un drained
K_e Soil-Erodibility Factor (USLE)
T₀ Erosion Tolerance (tons/acre)
I Irrigation Group Number
D Drainage Group Number

APPENDIX B.13

CHARACTERISTICS OF PENNSYLVANIA SOILS -2

Soil Series	G	K ₁	K ₂	t	l	l ₀	Soil Series	G	K ₁	K ₂	t	l	l ₀	Soil Series	G	K ₁	K ₂	t	l	l ₀
Keyport	C	.43	3	7	5		Natalie	C	.28	3	7	5		Troy	C	.28	3	7	5	
Kinrossville	C/DL	.28	2	6			Mesnaminy	B	.32	4	1			Trumbull	D	.49	3	10	18	
Kremer		.28	3	7	5		Newark	C	.49	4	9	1		Tugmill	D	.24	3	10	19	
pr dr var				10			Nolo	B	.43	3	10	8		Tunkhannock	A	.24	3	3		
Lackawanna	C	.24	3	7			Northumberland	C/D	.28	2				Tygart	D	.43	3	10	16	
Laidig	C	.22	4	7			Norton	C	.32	3	1			Tyler	D	.43	3	10	16	
Lakin	A	.17	5	3			Norwich	D	.32	3	10	9		Unadilla	B	.49	3	1		
Lamington	D	.43	3	10	8		Obedon	C/D	.43	2	6			Ungers	B	.32	4	2		
Landisburg	C	.43	3	7	5		Oouaca	C	.28	3	5			Upsnur	C	.43	3	7		
Langford	C	.28	3	7	5		Oothello	D	.37	3	9	7		Vandergrift	C	.37	3	7	4	
Lansdale	B	.28	4	1			Ottawa		.17	5	3		Vanderlip	A	.24	3	3			
Lansdowne	C	.43	3	7	5		Papakating	D	.49	3	9	3		Venango	C	.37	3	10	16	
Lawrence	C	.49	3	9	6		Pekin	C	.37	3	7	5		Volusia	C	.32	3	10	16	
Lawrenceville	C	.43	3	7	5		Penn	C	.32	3	4		Vrooman	B	.49	3				
Leadvale	C	.43	3	7	5		very shallow				5		Wallington	C	.49	3	10	16		
Leck Kill	B	.28	3	1			Pequea	C	.43	3	4		Wallkill	C/DL	.49	3	9	13		
Leetonia	C	.24	3	5			Phebus	B	.24	3	7	4		Warners	A/DL	.49	3	10	13	
Legore	B	.24	3	1			Philo	B	.49	4	7	1		Washington	B	.32	4	1		
Lenex	C	.24	3	5			Plainfield	A	.17	5	3		coarse var							
Lehigh	C	.43	2	10	6		Plateau	C	.43	3	10	6		Watchung	D	.43	2	10	13	
Leonardtown	D	.43	2	10	8		Pocono	B	.49	4	1		Watson	C	.32	3	7	5		
Letcher		.43	4	1			Purcy	D	.43	3	10	8		Wauseon	B/DL	.49	3	9	9	
Lewisberry	B	.20	3	2			Quakertown	B	.32	3	1		Wayland	C/DL	.49	4	9	2		
Library	D	.43	3	10	16		Rainsboro	C	.37	4			Weeksville	B/DL	.49	3	9	9		
Lickdale	D	.32	3	10	19		Ramsey	D	.28	2	6		Wenackee	D	.49	4	9	2		
Lindside	C	.49	4	7	1		Raritan	C	.43	3	7	5		Weikert	C/DL	.32	2	6		
Litz	C	.49	4	7	1		Ravenna	C	.37	3	10	5		Wellboro	C	.28	3	7	5	
Lobdell	C	.49	4	7	1		Rayne (Wellston)	B	.28	4	1		Wellston	B	.37	3	1			
Lorain	C/DL	.49	3	10			Readington	C	.43	3	7	5		Westmoreland	C	.43	3	10	15	
Lordstown	C	.28	3	5			Reaville	C	.43	2	8	6		Wharton	C	.43	3	10	15	
Loudenville	C	.32	3	4			Red Hook	C	.43	2	8	6		Wheeling	B	.32	4	1		
Loysville	D	.43	3	10	13		Rimer	C	.24	3	9	7		Whiteford	B	.32	3	2		
Luray	C/DL	.49	3				Robertsville	C	.24	4	10	6		Whitwell	C	.32	3	7	5	
Lyles	B			9			Ronnerville	D	.43	3	10	18		Hickham	B	.23	4	1		
Mahoning	D	.49	3	10	6		Rowland	C	.43	3	10	16		Williamson	C	.49	3	7	5	
Manlius	C	.37	2	5			Rushtown	C	.43	4	9	1		Wiltsnare	C	.43	3	7	5	
Manor	B	.43	3	2			Ryder	A	.17	4	3		Woodglenn	D	.49	3	10	19		
Mardin	C	.28	3	7	5		Sassafras	C	.37	3	4		Woodstown	C	.28	4	7	4		
Markes	D	.43	3	8	8		Scio	B	.28	4	2		Wooster	C	.32	4	2			
Mazeppa	B	.32	3	2			Sciotoville	B	.49	3	7	5		Woostern	B	.17	3	3		
Meckesville	C	.32	4	7			Sedan	C	.43	3	7	5		Worsham	D	.43	3	10	18	
Mehoopany		.20	2				Sequatchie		.32	4	2		Worth	C	.17	2	3			
Melvin	D	.49	4	9	2		Sheffield	B	.24	5	1		Wurtsboro	C	.24	3	7	5		
Mertz	D	.22	4	1			Shelmadine	D	.37	3	10	8		Wyalusing	D	.49	4	2		
Middlebury	B	.49	4	7	1		Shelocca	D	.32	3	10	18		Zipp	C/DL	.43	3	10	16	
Millheim	(E)	.28	3				Sloan	B	.23	4	1		Zoar	C	.43	3	7	5		
Miner	D	.49	3	10	9		Stainsburg	D	.49	3	9	3								
Minora	C	.49	4	4			Swartswood	C	.28	2	5									
Monongahela	C	.43	3	7	5		Sweden	C	.20	3	3									
Montalto	C	.37	2	1			Thorndale	B	.32	3	7									
Montevallo	D	.32	4	6			Tilisc	D	.43	3	10	18								
Montgomery	D	.43	3	10	19		Tiooga	C	.43	3	7	5								
Morris	C	.32	3	10	16		Titusville	C	.43	3	7	5								
Morrison	B	.17	3	3			Trexler	B	.49	4	1									
Mount Lucas	C	.32	3	10	15		mod shallow	C	.32	3	7	5								
Murrill	B	.28	4	1					C	.28	4	1								
Myersville	B	.32	4	1							5									

References:
 G SCS TR-55 1975
 K PA Tech. Guide III-3 1971
 L PA Tech. Guide III-3 1971
 I PA Irrigation Guide 1972
 D PA Drainage Guide 1971
 mdsnaw mar '82

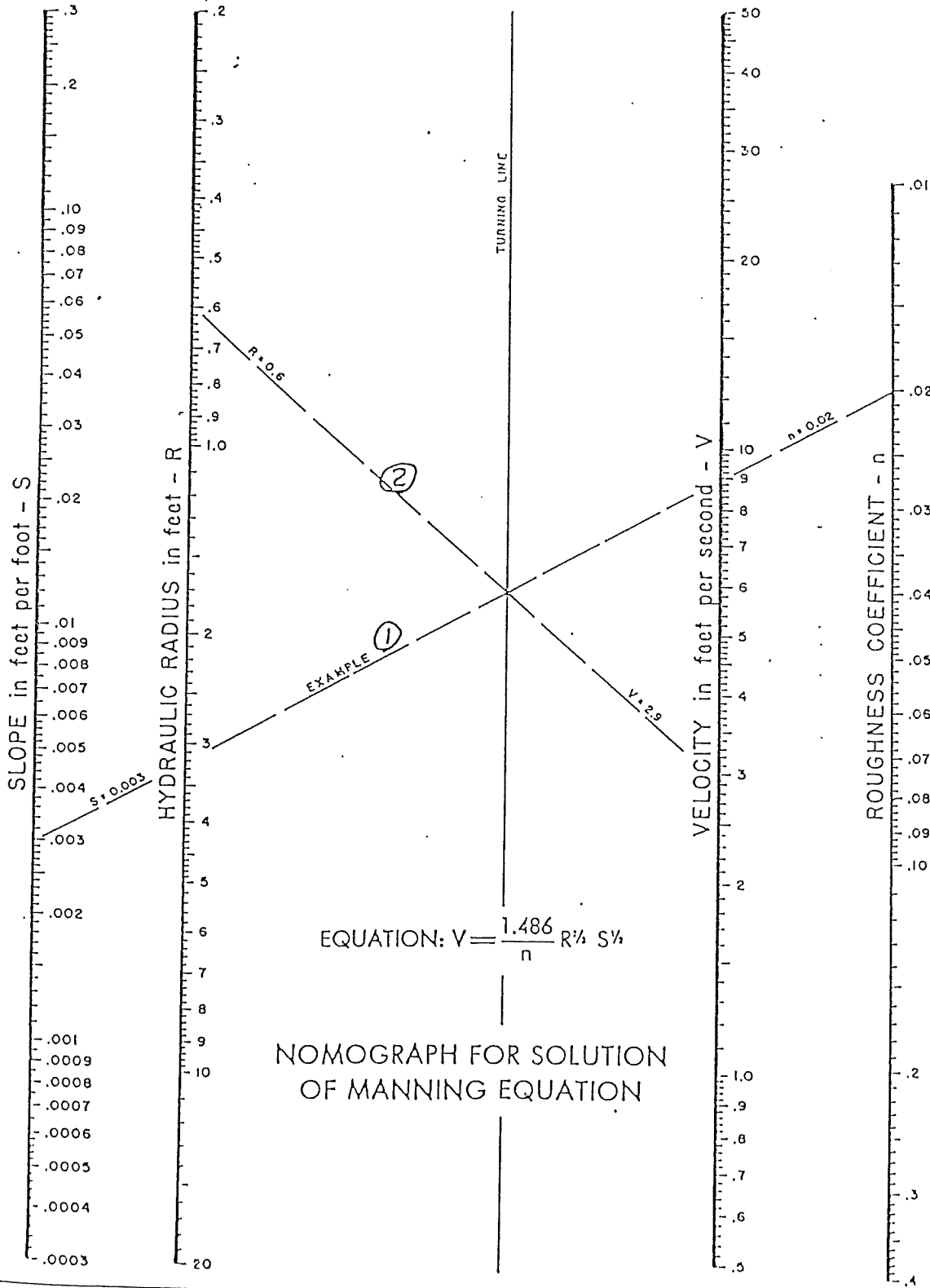


Fig. 4-8. Nomograph for solution of Manning's equation, (4)

Table B-1
Control Design Criteria

Subwatershed	Peak Flow Rate ^a	Maximum Loading Rates (lb/MG) ^c	
		Phosphorus	Sediment
General Criteria for Non-Critical Areas	Pre-Development	16.68	918
<u>Critical Areas:</u>			
	90	16.68	918
E-WS	80	16.68	918
E-KC	70	16.68	918
E-BC	70	16.68	918
E-WC	90	16.68	918
E-MC	60	16.68	918
M-SHC	90	16.68	542
M-TC	70	4.17	542
M-WC1	100 ^b	4.17	542
M-WC2	80	4.17	542
M-WC3	100 ^b	4.17	542
M-WC4	80	4.17	542
M-WC5	80	4.17	542
M-WC6	60	4.17	542
M-WC7	80	4.17	542
M-WC8	100 ^b	4.17	542
M-WC9	Pre-development	4.17	542
W-WC10	80	4.17	542
W-WC11	Pre-development	4.17	542
W-WC12	60	4.17	542
W-WC13	60	4.17	542
W-WC14	100 ^b	4.17	542
W-WC15	60	16.68	918
M-MR	90	16.68	918
M-FR	60	16.68	918
M-NC	80	16.68	918
M-MC	70	16.68	918
M-RPC	90	16.68	918
W-JC	70	16.68	918
W-WiC	90	16.68	918
W-WeC	60	16.68	918
W-SC	70	16.68	918
W-MHC	80	16.68	918
W-UC	80	16.68	542
W-BC	Pre-development	4.17	542
M-WL	Pre-development	4.17	542
L-LW	Pre-development	4.17	542
L-SeB	Pre-development	4.17	542
L-DC	Pre-development	4.17	542
L-AC	Pre-development	4.17	542

^a The numbers presented in this column represent the percent of the pre-development peak flow rate. Therefore, 90 means that the post-development peaks should be controlled to 90% of the pre-development peaks. Pre-development in this column means that post-development peaks should be controlled to equal pre-development peaks.

^b These were determined to be critical areas. (Sub-minimum release rate areas) and are described in Appendix B, Section 4 of the Plan.

^c The critical areas for runoff quality control parameters are assigned loading rates of 4.17 lb/MG (0.5 mg/l) for total soluble phosphorus which is based on the Lake Wallenpaupack Watershed Management District voluntary effluent guidelines and the 542 lb/MG (65 mg/l) for total suspended solids which is based on Federal Water Pollution Control Act (NPDES) for secondary effluent discharge standards.

1 to 9 represent portions of the main branch subwatershed, (M-WC).
10 to 15 represent portions of the west branch subwatershed, (W-WC).

Table B-2

Stormwater Management Alternatives
Performance Estimates

<u>Control Practice</u>	<u>Type of Control(1)</u>		
	<u>Runoff Peak Rate</u>	<u>Sediment</u>	<u>Phosphorus</u>
VOLUME CONTROLS			
Infiltration Pits and Trenches	90%	30-60%	40%
Land Surface Control and Zoning	UK	UK	UK
Porous Pavement (Asphalt)	100%	UK	40%
Porous Pavement (Concrete)	75%	UK	30-60%
Seepage Areas	30-60%	30-60%	30-60%
PEAK RATE CONTROLS			
Channel Modification	30-60%	N	N
Cistern Storage	>60%	25-70%	30-60%
Floodplain Management	UK	N	N
Impoundment (Dry Detention)	>60%	<30%	10%
Impoundment (Wet Detention)	>60%	60%	30%
Parking Lot Storage	>60%	30-60%	30-60%
Rooftop Detention	>60%	N	N
EROSION CONTROLS			
Bank Stabilization	<30%	>60%	>60%
Conservation Tillage, General	30-60%	>60%	30-60%
No-Till	30-60%	>60%	>60%
Contour Plowing	30-60%	15-55%	30-60%
Cover Cropping, Alone	<30%	50-60%	30-60%
With Conservation Tillage	30-60%	95%	>60%
Critical Area Planting	30-60%	>60%	>60%
Diversion	<30%	30-60%	30-60%
Farmland Management	30-60%	>60%	>60%
Fencing	N	>60%	60-80%
Road Paving	N	UK	UK
Storm Sewers (Without Treatment)	60%	N	N

Table B-2 (Cont'd.)

Stormwater Management Alternatives
Performance Estimates

<u>Control Practice</u>	<u>Type of Control(1)</u>		
	<u>Runoff Peak Rate</u>	<u>Sediment</u>	<u>Phosphorus</u>
Stripcropping - Contour	30-60%	>60%	>60%
Terracing	30-60%	>60%	>60%
			Avg. 80%

SOURCE POLLUTION CONTROLS

Agricultural Waste	>60%	>60%	>60%
Storage Structure	30-60%	85%	>60%
Filter Strips	N	>60%	>60%
Sediment Basin			
Street Cleaning	N	50%	30-60%
Mechanical Sweepers	N	95%	30-60%
Vacuum Sweepers	30-60%	75%	50%
Wetland Preservation			

- (1) N - not applicable or negligible preventive effect or reduction capability.
 V - variable preventive effect or reduction capability where performance is exclusively dependent on application.
 UK - unknown preventive effect or reduction capability.

Sources: Chesapeake Bay Foundation, Best Management Practices for Stormwater Control, Harrisburg, PA, (November 1988).

Metropolitan Washington Council of Governments, Department of Environmental Programs, A Framework for Evaluating Compliance with the 10% Rule in the Critical Area, (April 1987).

Metropolitan Washington Council of Governments, Department of Environmental Programs, Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMP's, (1987).

Metropolitan Washington Council of Governments, Department of Water Resources, Controlling Stormwater Runoff in Developing Areas. Selected Best Management Practices, (1979).

Virginia State Water Control Board, Best Management Practices Handbook - Urban Planning Bulletin 321, (1979).

APPENDIX C

APPENDIX C

STORMWATER MANAGEMENT FACILITIES
DESIGN AND CONSTRUCTION SPECIFICATIONS

C.1 Facilities.

1. All stormwater management facilities including storm sewer pipes, open channels, ditches, swales and any other water carrying facilities shall be designed for the ten (10) year post-development storm event unless the Township requires a larger storm event because of special conditions. In cases where the applicant proposes the use of stormwater management facilities for control of stormwater on the property prior to discharge off the property, such facilities (cisterns, roof-top storage, etc...) may be designed for storm events of less than 10 years, provided however, that the total effect will be the control of the 10 year storm, at the specified release rate, at the discharge point(s) on the project property line.
2. Level of control and Design Parameter Calculations.
 - a. The time of concentration is defined as the interval of time required for water from the most remote portion of the drainage area to reach the point in question. Calculations of the time of concentration include calculations of travel times for sheet flow, shallow concentrated flow, open channel, or some combination of these. Chapter 3 of the SCS Technical Release No. 55, Second Edition (June 1986) shall be used to determine average velocities for estimating travel times for the various flow segments.
 - b. The capacity and velocity of flow in open channels and in closed drains not under pressure shall be determined by the Manning equation. Maximum permissible open channel velocities and design standards shall be in accordance with good engineering practice as documented in the "Engineering Field Manual for Conservation Practices", Hydraulic Design series No. 3, U.S. Department of Transportation.
 - c. Storm sewer pipes shall be installed on sufficient slopes to provide a minimum flow velocity of three (3) feet per second when flowing full.
3. Design and construction Specifications.
 - a. Width requirements for public easements shall be as follows for storm drains: $W=2d+D+2$ where W is the easement width in feet, d is the depth of pipe from the invert to finished grade and D is the inside pipe diameter. The calculated easement width shall be rounded up to the next five (5) feet increment with the minimum required width being ten (10) feet.
 - b. For ditches, at a minimum, the easement shall be ten (10) feet wider than the top width of the ditch, with a least ten (10) feet required on one side for future access. The easement width required shall be rounded up to the next five (5) feet increment. Additional width may be required, as necessary, by the Township.

- c. Storm sewer pipes and culverts, other than those used as basin outlets, which are intended to be dedicated to the Township shall have a minimum diameter of fifteen (15) inches. All pipes and culverts shall be made of reinforced concrete culvert pipe (RCP), corrugated metal pipe (CMP) corrugated aluminum alloy pipe, corrugated polyethylene pipe (AASHTO - M252 and M294). Corrugated metal pipe shall be helical, 16-gage minimum, galvanized steel pipe. When conditions are such that the pipe requires coating (see Table 2.10.5.6, PA DOT Publication No. 13, Design Manual, Part 2, August 1981), galvanized steel pipes and fittings shall be fully-coated, inside and out, with either polymer or asphaltic cement in accordance with PA DOT Publication No. 408 Specifications. All storm sewer pipes shall be laid to a minimum depth of one (1) foot from subgrade to the crown of the pipe.
- d. Pressure flow is permitted in storm sewers. The elevation of the hydraulic gradient shall be a least one (1) foot below ground level. Pressure heads up to twenty-five (25) feet can be used with concrete pipe with rubber gasketed joints.
- e. Manholes, inlets, headwalls and endwalls proposed for dedication to the Township or located along streets shall conform to the PA DOT Bureau of Design, "Standards for Roadway Construction", Publication No. 72, in effect at the time the design is submitted. The design may be modified by adopted municipal construction standards. Headwalls and endwalls shall be used where storm runoff enters or leaves the storm sewer horizontally from either a natural or manmade channel.
- f. Inlets shall be placed on both sides of the street at low points; at a maximum interval of six hundred (600) feet along any one continuous line; at points of abrupt changes in either the horizontal or vertical directions of storm sewers; and at points where the depth of flow in the street gutters exceeds three (3) inches, or where the spread exceeds 10 feet on the typical street section calculated on a 2.33-year storm recurrence frequency. Inlets shall normally be along the curb line at or beyond the curb radius points. At intersections, the depth of flow across the through streets shall not exceed one (1) inch. For inlets on continuous grades the maximum amount of water that should be bypassed onto the next downstream inlet is ten (10) percent. Inlets shall be of the Type C, M, or S type, as discussed in PA DOT Publication 13 and the "Standards for Roadway Construction", Publication No. 72. Inlet grates shall be cast iron or structural steel. A bicycle-safe grate shall be installed in areas where bicycle traffic is anticipated, such as curbed roadways or for roadways specifically established and signed as bikeways or having bike lanes.
- g. Manholes may be substituted for inlets at locations where inlets are not required to handle surface runoff. Manholes shall be located on a continuous storm sewer system at all abrupt changes of grade, at all locations where a transition in storm sewer pipe sizing is required, at all angle points exceeding fifteen (15) degrees, and at all points of convergence of two or more influent storm sewer mains. Where storm sewer pipe is designed on a radius, the pipe shall be manufactured to the design radius.

4. Operation Specifications

- a. Wherever possible, roof drains and pipes shall discharge water into a dispersion or infiltration control facility and not into street gutters or storm sewers.
- b. All existing natural watercourses, channels, drainage systems and areas of surface water concentration shall be maintained in their existing condition unless an alteration is approved by the Township.
- c. Flow velocities from any storm sewer outlet shall not result in a deflection of the receiving channel. Energy dissipators shall be placed at the outlets of all storm sewer pipes where flow velocities exceed maximum permitted water carrying velocities.

C.2 Impoundment facilities.

1. Permanent detention basins shall be designed with a primary outlet discharge that is less than or equal to the predevelopment peak discharge for a ten (10) year storm event. A greater peak discharge may be permitted by the use of secondary outlets when the developer or his engineer show that (1) the increased peak discharge can be properly handled by the existing or proposed downstream stormwater management facilities; (2) the increased peak discharge will not be detrimental to the downstream areas; and (3) for any specified storm event the post-development peak discharge will not be greater than the pre-development peak discharge of an equivalent storm event. However, in any case, the basin shall be designed so that the emergency spillway is capable of passing the 100 year storm without failure of the facility.
2. General Design
 - a. All basins shall be structurally sound and shall be constructed of sound and durable materials. The completed structure and foundation of all basins shall be stable under all probable conditions of operation. Where dam permits are required, the design must meet the provisions of the Dam Safety and Encroachment Act as outlined in Chapter 105, Dam Safety and Waterways Management Rules and Regulations.
 - b. The effect of embankment failure on downstream areas shall be considered in the design of all basins. Where possible, the basin shall be designed to minimize the potential damage of embankment failure.
 - c. In some cases, separate detention facilities for a number of sites may be more expensive and difficult to maintain than a joint facility. In such cases the Township may consider joint detention facilities that fulfill the detention requirements.
 - d. No basin shall be located within the one hundred (100) year flood hazard area of the floodplain. Construction of basins within the one hundred (100) year floodplain shall be avoided, where possible. If construction is unavoidable, the situation shall be examined for proper functioning.

- e. To facilitate drainage prior to stream flooding, impoundments may be waived by the Township upon the recommendation of the Township Engineer. Such a decision depends on the proximity of the proposed impoundment to major streams, and the hydrology of the watershed.
- f. An easement for maintenance crew access to the pond and outlet areas shall be established around basins requiring maintenance. The limits of such easements shall be fifteen (15) feet from the outside toe of the dams and embankments and the top of all basin side slopes. The maintenance easement shall be connected to a public right-of-way.
- g. A specific maintenance plan shall be formulated outlining the schedule and scope of maintenance operation. Items to be included in the maintenance plan are sediment removal, inspection of inlets and outlets, vegetation and insect control, ponding area prevention and safety inspections.

3. Basin Design

- a. A basin shall, when site dimensions allow, have a length to width ratio of at least 2:1 to 3:1 and the distance between basin inflow and outflow points shall be maximized to maximize the travel time through the pond.
- b. A riprap apron of adequate length and flare shall be provided at all surface discharge points to disperse and slow down flow to minimize erosion, promote settling, and minimize resuspension of settled pollutants. The apron shall extend to the crown of the pipe and be sized according to the procedure set forth in Appendix D - Design of Outlet Protection or similar procedure. Riprap size shall be determined by the flow velocity at the discharge point as follows:

<u>Flow Velocity</u> <u>(feet/second)</u>	<u>Average Stone Size</u> <u>(inches)</u>
Up to 6	6-8
6 to 9	8-12
Greater than 9	(a)

- (a) Shall use design procedure presented in Appendix D - Design of Outlet Protection or similar procedure approved by the Township or Borough.
- c. A cutoff trench of relatively impervious material shall be provided within all basin embankments whose side slope ratios are steeper than three (3) horizontal to one (1) vertical.
- d. All culverts through basin embankments shall have properly spaced concrete cutoff collars or factory welded anti-seep collars according to the guidelines set forth in the USDA SCS (PA) "Standards and Specifications for Ponds" (#378).
- e. The Township shall make the decision to require fencing based on potential hazards at the site. Basins with water-edge side slopes

steeper than three (3) feet may require six (6) foot high fencing of a material acceptable to the municipality. A locked gate shall be supplied to allow restricted access to the basin for maintenance. For impoundments subject to freezing of detained runoff, some means of "thin ice" warning shall be incorporated in the overall operations plan established for the basin.

- f. The basins shall have a minimum bottom slope of one (1) percent towards the primary outlet to assure positive drainage and prevent saturated conditions and maintenance problems. Low flow channels may be required to convey small inflows to the basin outlet.
- g. Safety ledges shall be constructed on the side slopes of all detention basins having a permanent pool of water. The ledges shall be four (4) to six (6) feet in width and located approximately two and one half (2 1/2) to (3) feet below and one (1) to one and one half (1 1/2) feet above the permanent water surface.
- h. The minimum top width of all dams and embankments shall be as follows:

<u>Height (feet)</u>	<u>Top Width (feet)</u>
0-5	8
5-15	10

- i. The design top elevation of all dams and embankments shall be equal to or greater than the maximum water surface in the basin resulting from the routed one hundred (100) year storm, plus twelve (12) inches of freeboard. The design height of the dam shall be increased by the amount needed to insure that the design top elevation will be maintained following settlement. This increase shall not be less than five (5) percent.

4. Inlet and Outlet Design

- a. Dry detention basins shall have an outlet structure designed to drain the basin within 24 hours. All outlet structures and emergency spillways shall include a satisfactory means of dissipating the energy of discharge without endangering both the safety and integrity of either the basin or the downstream drainage channel and drainage area. If riprap is used to dissipate energy, the design criteria presented previously shall govern.

C.3 Infiltration Facilities.

- 1. Infiltration pits and trenches shall be designed to provide control for the ten (10) year storm event, seepage areas and filter strips shall be designed to provide control for the 5 year storm event.
- 2. Level of Control and Design Parameter Calculations

- a. A seepage analysis must be made for infiltration pits and trenches to determine any adverse effects of seepage on nearby building foundations, roads, and parking lots. Pits and trenches must never be located next to foundation walls.
- b. A soil analysis shall be submitted with the design plans of infiltration facilities. Surrounding soils shall have a percolation rate of at least 0.6 inch per hour. A groundwater quality analysis shall also be made and shall include depth of water table (with seasonal variations), probable runoff pollutants, and the uses of the local groundwater.

3. Design and Construction Specifications

- a. Infiltration facilities shall not be considered in fill areas due to the lack of infiltration capacity in areas of controlled fill and the potential slope slippage problems in areas of uncontrolled fill.
- b. Seepage areas shall not allow ponding to exceed eighteen (18) inches of depth. Soil percolation rates for these areas shall be at least 0.6 inches per hour. Areas shall be graded to allow positive drainage but slopes shall be as slight as possible to minimize velocities. Seepage areas should also include overflow systems such as flanking grass diversion swales graded to catch and transport excess water without subjecting nearby structures to flood waters.
- c. Filter strips widths shall be at least twenty-five (25) feet and should be designed with the following parameters:
 - Land use and treatment above the strip,
 - Slope of land above and in the strip,
 - Length of slope above strip,
 - Erodibility of soil above strip,
 - Type of vegetation in strip, and
 - Degree of maintenance the strip will receive.
- d. Infiltration trenches shall have a side area to bottom area ratio less than or equal to 4:1. Wheel stops or segmented curbs shall be used to keep vehicular traffic off the trenches when they are not protected by grating.
- e. Volume storage calculations for pits and trenches depends on the intended purpose of the facility. A pit or trench designed to store all site runoff would be sized for the maximum runoff volume. A second option is to design the facility to store only the flow generated in excess of the pre-development condition. In this option some method of diverting flow into the facility is needed. This could be a weir device incorporated into base flow channels sized only to carry the pre-development runoff rates.

- f. The aggregate filler of trenches and pits shall be stone with a size range of one (1) to two (2) inches. These stones shall be poorly graded to include a few stones smaller than the selected size. Rounded stone is preferable to crushed stone. The side walls of the facility shall be lined with a filter cloth or other permeable material to prevent soil from creeping into the void space.

4. Operation Specifications

- a. Maintenance tasks shall include maintenance of a dense grass buffer strip for surface facilities, removal of accumulated sediments within the pre-treatment devices of underground facilities, and partial or total reconstruction of facility in the event of clogging.

C.4 Cistern Facilities.

1. The design of the cistern storage volume and release rate is dependent upon the purpose of the structure. For reducing peak runoff rates, the facility shall be designed to detain the post-development 2.33-year storm event and release it at the pre-development peak rate and velocity. For controlling non-point source pollution, additional storage is needed to capture a predetermined initial volume of runoff which is to be released at a very slow rate.
2. For underground cisterns more than one access point for ventilation and cleaning shall be provided. Access manholes or drop boxes shall be sufficiently large to allow maintenance equipment to reach the facility. At least one access opening shall be a minimum of sixty (60) inches in diameter.
3. To ensure complete drainage of the facility, the minimum slope of the tank floor shall be one (1) percent. If a pumping system is included, provisions shall be made to prevent pump clogging and standby pumping capability shall be provided.
4. The outlet pipe shall not be less than five (5) inches in diameter to lessen the possibility of it becoming clogged. When low release rates are designed for the outlet to enhance the water quality obtained through sedimentation, special maintenance considerations must be made for removing the accumulated sediments.

C.5 Rooftop Detention.

1. The rooftop detention storage volume shall be designed to detain the post-development 2.33-year storm event and release it at the pre-development peak rate and velocity.
2. Roof design shall meet all Building and Occupational Code Act (B.O.C.A.) building code standards. Depth of rooftop ponding shall not exceed three (3) inches. Rooftops shall be capable of supporting a "live" load equal to thirty (30) pounds per square foot. These requirements allow

for a reasonable safety factor because thirty (30) pounds allow for 5.8 inches of water. Roof drain requirements are as follows:

<u>Minimum Number of Drains</u>	<u>Roof Area (Square Feet)</u>
2	≤10,000
4	>10,000 and ≤40,000
1/10,000 SF	>40,000

- Maintenance shall consist of inspecting and cleaning inlets and of removing accumulated debris, ice, and fallen leaves.

C.6 Parking Lot Storage.

- The parking lot storage volume shall be designed to detain the post-development 2.33-year storm event and release it at the pre-development peak rate and velocity.
- The storage area shall have a minimum one (1) percent slope to the control outlet to ensure positive drainage following a storm. The maximum depth of ponded water within the storage area shall not exceed six (6) inches for pedestrian safety and to avoid wet brakes and other vehicle maintenance problems. The storage system shall be designed so that an overflow resulting from either clogging of the principle release structure or runoff in excess of the design storm does not result in flooding of nearby buildings or thoroughfares. The control orifice at the discharge control structure shall not be less than four (4) inches in diameter.

C.7 Erosion and Sediment Control.

- All earth moving activities shall be conducted in such a way as to minimize accelerated erosion and resulting sedimentation. Measures to control erosion and resulting sedimentation shall, at a minimum, meet the standards of Chapter 102 (Erosion Control) of Title 25, Rules and Regulations of the PA DER and the standards of the Conservation District. An erosion and sediment control plan must be prepared and submitted to the Conservation District for their review and approval before any development activity begins.
- The erosion and sedimentation control plan must be available at the development site. When required, all permits allowing earth moving activity shall be obtained by the developer before any construction on the development site shall begin.
- Approval of an erosion and sedimentation plan by the municipality shall not be construed as an indication that the plan complies with the standards of any agency of the Commonwealth of Pennsylvania.
- If the developer proposes to use a wetlands for stormwater treatment and control, the Township in its review of the drainage plan shall evaluate:

- a. If dredging or filling are proposed, the adverse effects of the dredging or filling on the treatment capability of the wetland.
- b. If the normal range of water level fluctuation of the wetland as it existed prior to construction of the wetlands stormwater discharge facility, is adversely affected. Normal range of water level fluctuation is defined as the maintenance of the fluctuating water surface changes between the normal low water and the normal high water of the wetland system so as to prevent the desiccation or over impoundment of the wetland.
- c. The discharge method of stormwater into the wetlands. The discharge shall be such that channelized flow of stormwater is minimized by employing methods including, but not limited to, sprinklers, overland flow, or spreader swales.

APPENDIX D

APPENDIX D

DESIGN OF OUTLET PROTECTION

Outlet protection as presented here is a level apron of sufficient length and flare such that the expanding flow (from pipe or conduit to channel) loses sufficient velocity and energy that it will not erode the next downstream channel reach. The design curves are based on circular conduits flowing full. The curves provide the apron size and if riprap is to be used, the minimum d_{50} size for the riprap. There are two curves, one for a low or minimum tailwater condition and the other a high or maximum tailwater condition. The minimum condition applies to a tailwater surface elevation less than the center of the pipe whereas the maximum condition applies to a tailwater surface elevation equal to or higher than the center of the pipe.

The first requirement in using this procedure is to determine the tailwater condition as required in the Standard and Specifications. Then, for circular conduits, enter the appropriate chart with the discharge and the pipe diameter to find the riprap size and apron length. Then calculate apron width.

Example 1:

A circular conduit is flowing full
 $Q = 280$ cfs, diam. = 66", and tailwater (surface) is 2 ft. above pipe invert.

This is a minimum tailwater condition.

Read $d_{50} = 1.2'$, and apron length = 38'

Apron width = diam + $L_a = 38 + 5.5 = \underline{43.5'}$

Maximum stone size in the riprap mixture = $1.5 \times d_{50} = 1.5 \times 1.2 = \underline{1.8'}$.

The curves may also be used for the design of outlet protection for rectangular conduits but the procedure is slightly different. Depth of flow and velocity are the two flow parameters to be used. Enter the lower set of curves with velocity and depth (using the diameter curves for depth), then read to the right to find d_{50} and up and left for the length of apron. To find the apron width substitute conduit width for diameter in the apron width equations.

Example 2:

A concrete box 5.5' x 10' is flowing 5.0' deep, $Q = 600$ cfs and tailwater surface 5' above invert (Max. tailwater condition).

$$V = \frac{Q}{A} = \frac{600}{5.0 \times 10} = 12 \text{ fps}$$

At the intersection of the curve $d=60''$ and $V=12$ fps, read $d_{50} = 0.4'$.

Then reading up to the $d = 60''$ curve, read apron length = 40'.

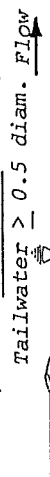
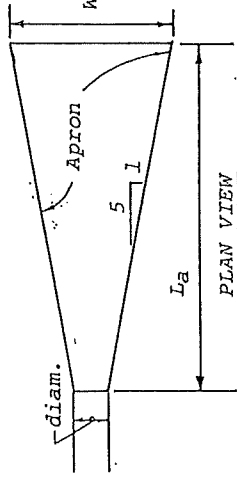
Apron width, $W =$ conduit width + $0.04 L_a = 10 + (0.4)(40) = \underline{26'}$,

Largest stone size = $0.4 \times 1.5 = \underline{0.6'}$ or 7"

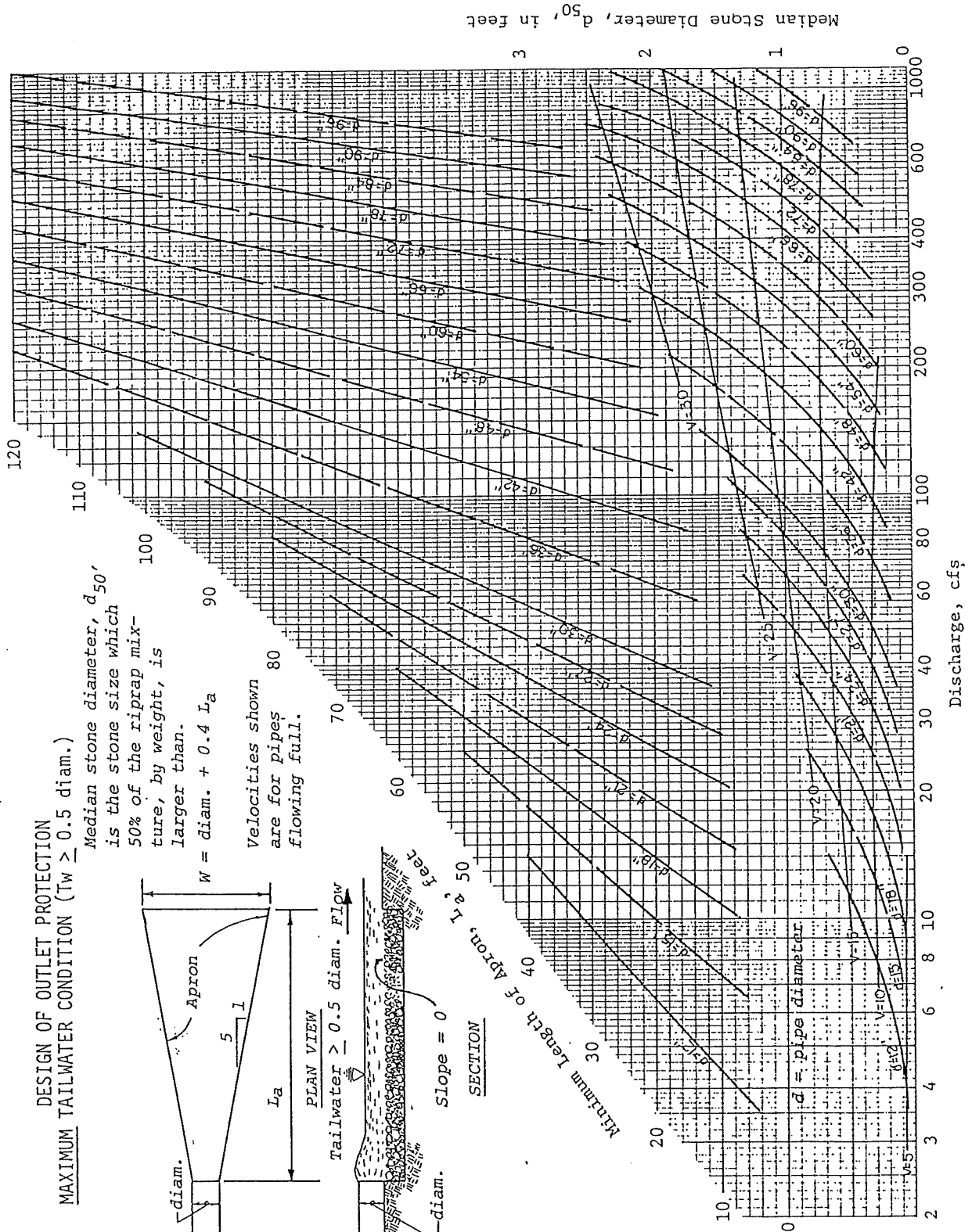
DESIGN OF OUTLET PROTECTION
MAXIMUM TAILWATER CONDITION ($T_w \geq 0.5$ diam.)

Median stone diameter, d_{50} ,
 is the stone size which
 50% of the riprap mix-
 ture, by weight, is
 larger than.
 $W = \text{diam.} + 0.4 L_a$

Velocities shown 80
 are for pipes
 flowing full.



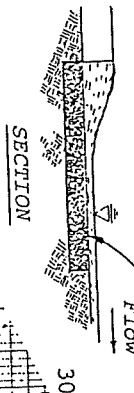
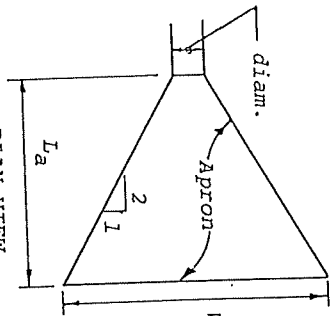
Minimum length of Apron, L_a , feet
 Slope = 0
 Tailwater ≥ 0.5 diam. Flow



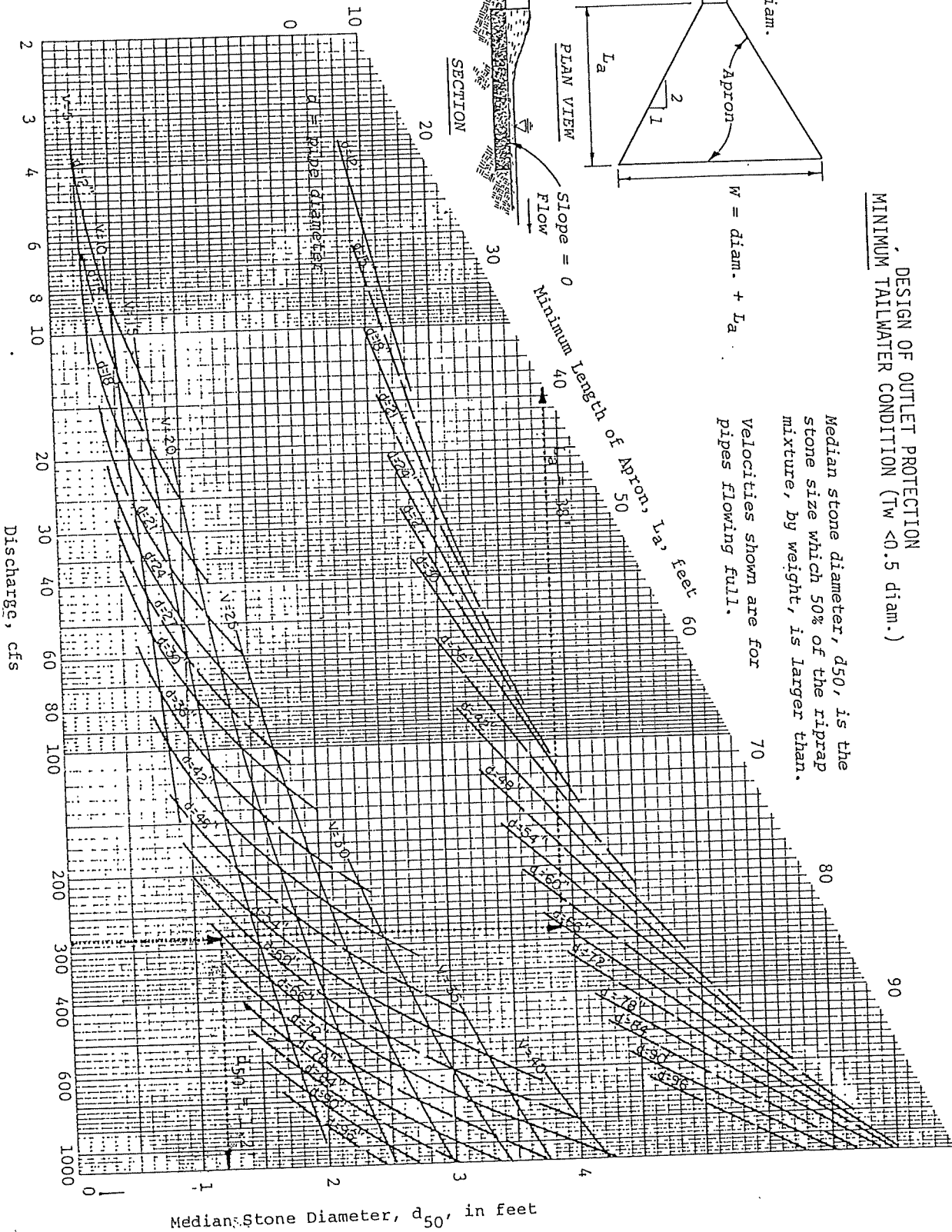
DESIGN OF OUTLET PROTECTION
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ diam.)

Median stone diameter, d_{50} , is the stone size which 50% of the riprap mixture, by weight, is larger than.

Velocities shown are for pipes flowing full.



D-3



Median Stone Diameter, d_{50} , in feet

Discharge, cfs

PAUPACK TOWNSHIP
WAYNE COUNTY, PENNSYLVANIA
RESOLUTION # - 1991-5

WHEREAS, The Paupack Township Board of Supervisors has adopted a Stormwater Management Ordinance pursuant to the Pennsylvania Stormwater Management Act; and,

WHEREAS, the Stormwater Management Ordinance and the Pennsylvania Stormwater Management Act provide the authority for the Township to charge fees for review of subdivision and land development plans; and,

WHEREAS, said Ordinance provides for the Board of Supervisors to set fees for the review of subdivision and land development plans, said fees to cover the following:

- A. The review of the Drainage Plan by the Township as required in Section 404 of this Ordinance.
- B. The site inspection.
- C. The inspection of required controls and improvements during construction as presented in Article V of this Ordinance.
- D. The final inspection upon completion of the controls and improvements required in the plan as presented in Article V of this Ordinance.
- E. Any additional work required to enforce any provisions of this Ordinance, correct violations, and assure the completion of stipulated remedial actions.
- F. Any other fees for consulting services required by the Township for the review and administration of regulated activities.

NOW, THEREFORE, BE IT RESOLVED, that the following fees shall apply to the review of stormwater management plans as required by the Paupack Township Stormwater Management Ordinance.

I. BASIC FEES

- A. Fees for determining compliance with the Stormwater Management Ordinance of facilities associated with any subdivision or land development shall be assessed and collected in accord with the provisions of the Township Subdivision and Land Development Ordinance.

B. General land disturbance activities, including clearing and excavation

Basic fee: \$35.00, plus \$20.00 per acre or fraction thereof over one acre

C. Agricultural operations shall be exempt from all fees.

D. Construction of new or additional impervious or semi-pervious surfaces (driveways, parking lots, etc...)

Basic fee: \$35.00, plus \$20.00 per acre or fraction thereof over one acre

E. Construction of new buildings and structures or additions to existing buildings and structures not regulated as land developments by the Township Subdivision Ordinance but which are regulated by the Township Zoning Ordinance shall be assessed and collected in accord with the provisions of the Township Zoning Ordinance.

F. Forest management operations and nursery operations.

Basic fee: \$35.00, plus \$2.00 per acre or fraction thereof over one acre

G. Diversions or piping of any natural or man-made drainage channel.

Basic fee: \$35.00, plus \$40.00 per 200 lineal feet of piping or channel

H. Installation of stormwater systems or appurtenances thereto.

Basic fee: \$35.00, plus \$40.00 per 200 lineal feet of the system or appurtenance

I. Oiling of roads.

Basic fee: \$35.00

J. Placement of fill for any purpose.

Basic fee: \$35.00

II. ENGINEERING AND CONSULTANT REVIEW FEES

In accordance with Article VI of the Stormwater Management Ordinance, fees shall be assessed in order to pay, in addition to the basic fees, all of the Township's costs for review of any application, including the charges by the Township Engineer or any

other professional consultant retained by the Township. Prior to any final approval by the Township of any proposal governed by the Stormwater Management Ordinance, all review costs associated with the subject proposal in excess of the basic fee shall be paid by the applicant.

RESOLVED this 10 day of APRIL, 1991 by the Board of Supervisors of Paupack Township, Wayne County, Pennsylvania.

[Signature]
Chairman

[Signature]
Vice Chairman

[Signature]
ATTEST

Apr 10, 1991
Date

[Signature]

