

WHITEMARSH TOWNSHIP

RESOLUTION 2004- 8

WHEREAS, the Whitemarsh Township Board of Supervisors has adopted Ordinance #789 entitled "Chapter 58, Grading, Erosion Control, Stormwater Management, and Best Management Practices," to be effective on FEBRUARY 24, 2004, and

WHEREAS, this Ordinance provides that the Board of Supervisors may adopt provisions by resolution to regulate the Design/Construction Requirements for Erosion and Sedimentation Control Measures, Stormwater Management, Storm Drainage Systems, and Best Management Practices (BMPs) required under the provisions of this Ordinance.

NOW, THEREFORE, BE IT RESOLVED that the following regulations are hereby adopted pursuant to this Ordinance:

I. DESIGN/CONSTRUCTION REQUIREMENTS -EROSION AND SEDIMENTATION CONTROL MEASURES

A. General Provisions and Compliance

- (1) No changes shall be made in the contour of the land and no grading, excavation, removal nor destruction of the topsoil, trees or other vegetative cover of the land shall be commenced, until such time that a plan for minimizing erosion and sedimentation has been reviewed by the Township Engineer.
- (2) In conjunction with all Minor Earth Disturbance Permit applications and BMP Operations and Maintenance Plans, the Township Engineer shall condition his approval upon the compliance with erosion and sediment control measures contained in the latest edition of the "Erosion and Sediment Pollution Control Program Manual" published by the Pennsylvania Department of Environmental Protection.
- (3) Approval of plans and specifications for the control of erosion and sedimentation shall be concurrent with the approval of the Minor Earth Disturbance Permit application and a BMP Operations and Maintenance Plan, and become a part thereof.

B. General Erosion Control Standards

- (1) Measures used to control erosion and reduce sedimentation shall, as a minimum, meet the standards and specifications contained in the latest edition of the "Erosion and Sediment Pollution Control Program

Manual," published by the Pennsylvania Department of Environmental Protection.

- (2) In cases where the "Erosion and Sediment Pollution Control Program Manual" does not have standards and specifications for erosion and sedimentation control, other known and commonly accepted standards and specifications may be used as approved by the Township Engineer.
- (3) All erosion and sedimentation control devices shall be in place and functioning prior to any earth disturbance activity. Such devices shall be inspected by the applicant immediately after any/all storm events and shall be properly maintained during the course of the work.
- (4) The following standards to minimize erosion and sedimentation shall be included where applicable in an Erosion and Sedimentation Control Plan, a Minor Earth Disturbance Plan or a BMP Operations and Maintenance Plan:
 - (a) Stripping of vegetation, regrading, or other development shall be done in a way that will minimize erosion.
 - (b) Development plans shall preserve salient natural features, keep cut and fill operations to a minimum, and ensure conformity with topography so as to create the least erosion potential and adequately control the volume and velocity of surface water runoff.
 - (c) Whenever feasible, natural vegetation shall be retained, protected, and supplemented.
 - (d) The disturbed area and the duration of exposure shall be kept to a practical minimum and shall not exceed thirty (30) days.
 - (e) Temporary vegetation and mulching shall be used to protect exposed critical areas during development.
 - (f) The permanent (final) vegetation and mechanical erosion control and drainage shall be installed as soon as practical.
 - (g) Provisions shall be made to accommodate effectively the increased runoff caused by changed soil and surface conditions during and after development within the site. [Where necessary, the rate of surface water runoff will be mechanically retarded].

- (h) Sediment in the runoff water shall be trapped until the disturbed area is stabilized by the use of debris basins, sediment basins, silt traps or similar measures.
- (i) All earth stockpiles shall be stabilized with temporary vegetation and/or mulching immediately.
- (j) All lots, tracts or parcels shall be graded to provide proper drainage away from buildings, and all land within a project area shall be graded to drain and dispose of surface water without ponding, except where ponding (detention basins, etc.) is part of the stormwater management plan for the site.
- (k) Edges of slopes shall be a minimum of five feet from property lines or right-of-way lines in order to permit the normal rounding of the edge without encroaching on the abutting property.
- (l) Concentration of stormwater runoff shall be permitted only in swales, watercourses, or detention basins. Subject to the approval of the Township Engineer, swales shall be sodded or have jute matting or other similar measures to insure proper growth of the ground cover.
- (m) Grading shall in no case be done in such a way to divert water onto the adjacent property without the expressed written consent of the Board of Supervisors and the abutting property owner.
- (n) During grading operations, necessary measures for dust control must be exercised.
- (o) Grading equipment will not be allowed to cross live streams. Provisions shall be made for the installation of temporary culverts or bridges, subject to issuance of a Dam and Waterway Encroachment Permit issued by Department of Environmental Protection (DEP) under the provisions of Chapter 105.
- (p) A tire cleaning area shall be provided and properly maintained at each point of access to the project area.
- (q) All storm pipes shall discharge to receiving channels/swales at an angle less than or equal to 30 degrees parallel to the

direction of stream flow or far side embankment stabilization shall be provided.

C. Special Standards, Excavation and Fills

- (1) No excavation shall be made with a cut face steeper than a ratio of three (3) horizontal to one (1) vertical, except under one or both of the following conditions:
 - (a) Material in which excavation is made is sufficiently stable to sustain a slope of steeper than a ratio of three (3) horizontal to one (1) vertical. A written statement to that effect from a Registered Professional Engineer licensed by the Commonwealth of Pennsylvania and experienced in geotechnical engineering and erosion control, shall be submitted to the Township Engineer and approved by him. The statement shall affirm that the site has been inspected and a deviation from the slope shall not result in injury to persons or damage to property.
 - (b) A concrete, masonry, or other approved retaining wall, designed by a Registered Professional Engineer experienced in structural engineering, and constructed in accordance with approved standards, is provided to support the face of the excavation. Design calculations/details pertaining to the retaining wall shall be submitted for review by the Township Engineer.
- (2) Adequate provisions shall be made to prevent surface water from damaging the cut face or excavations and the sloping surfaces of fills.
- (3) Cut and fill shall not endanger adjoining property.
- (4) All fills shall be compacted to provide stability of material and to prevent undesirable settlement. The fill shall be spread in a series of layers, each not exceeding eight (8) inches in thickness, and shall be compacted in a manner approved by the Township Engineer, to a minimum 95% dry density, after each layer is spread. The Township Engineer may require compaction tests or other information if in his opinion the conditions or materials are such that additional information is necessary.
- (5) Fills shall not encroach on natural watercourses, floodways, floodway fringes, constructed channels, or on wetlands unless permitted by the

Army Corps of Engineers, Pennsylvania Department of Environmental Protection and approved by the Township.

- (6) Fills placed adjacent to natural watercourses, floodways, floodway fringes constructed channels, or wetlands shall have suitable protection against erosion during periods of flooding, where approved by the Army Corps of Engineers, the Pennsylvania Department of Environmental Protection and the Township.

II. DESIGN/CONSTRUCTION REQUIREMENTS STORMWATER MANAGEMENT, STORM DRAINAGE SYSTEMS, AND BEST MANAGEMENT PRACTICES

A. General Performance Standards

Measures used to collect and carry stormwater on any site shall be designed to meet the following minimum performance standards.

- (1) Prevent erosion damage and satisfactorily carry-off or detain and control the rate of release of surface waters.
- (2) When subsurface soil conditions warrant, encourage runoff control measures to percolate the stormwater into the ground to aid in the recharge of groundwaters.
- (3) Carry surface water to the nearest adequate street, storm drain, detention basin, natural watercourse, or drainage facility.
- (4) Take surface water from the bottom of vertical grades, to lead water away from springs, and collect water upgrade of all street intersections.
- (5) Control/accommodate not only the anticipated peak discharge from the on-site disturbed area, but also the existing runoff being contributed from all land at a higher elevation in the same watershed.
- (6) Maintain the adequacy of the natural stream channels. Accelerated bank erosion shall be prevented by controlling the rate and velocity of runoff discharged to these watercourses, so as to avoid increasing the occurrence of stream bank overflow.
- (7) Preserve the adequacy of existing culverts, and bridges by suppressing the new flood peaks created by the new earth disturbances.

- (8) If in the course of reviewing the stormwater management plan, the Township Engineer determines that off-site improvements are necessary to satisfactorily control the stormwater from the site, the applicant shall be responsible for such off-site improvements.
- (9) All stormwater detention/retention facilities shall be in place and functioning prior to the creation of any impervious surface.
- (10) Whenever a watercourse, stream, or intermittent stream is located within a grading site, it shall remain open in its natural state and location and shall not be piped unless permitted by Pennsylvania Department of Environmental Protection (DEP) and the Township Board of Supervisors.
- (11) The existing points of natural drainage discharge onto adjacent property shall not be altered without the written approval/drainage easement from the affected landowners.
- (12) No stormwater runoff or natural drainage shall be so diverted as to overload existing drainage systems, or create flooding or the need for additional drainage structures on other private properties or public lands.
- (13) All Regulated Earth Disturbance Activities, as defined in Ordinance #789, are required to have water quality protection measures after completion of the earth disturbance activities, and include operation and maintenance of the BMP. Post-construction water quality protection is addressed in Section II. F. of this Resolution. Operations and maintenance of the permanent stormwater BMPs are addressed in Ordinance #789.

B. Minor Earth Disturbance Plan and BMP Operations and Maintenance Plan Requirements

In addition to permit application requirements in Section 58-4 of the Whitemarsh Township Code, a Minor Earth Disturbance Plan and a BMP Operations and Maintenance Plan required under these regulations shall contain the following:

- (1) Mapping of the watershed area or areas in which the proposed earth disturbance is located. (U.S.G.S. Quadrangle map or similar). All drainage sub-areas analyzed in conjunction with the hydrologic study shall be clearly delineated on the plan. Additionally, the assumed flow path along the hydraulic length of each sub-area used in the sub-area Time of Concentration calculations shall be indicated on the plans.

- (2) A study shall be performed of the watershed in which the earth disturbance is located to assess the impact that the proposal will have on downstream conditions. Stormwater management plans shall address all identified impacts to the satisfaction of the Township Engineer.
- (3) Computations of the stormwater runoff for all points of runoff concentration before, during, and after earth disturbance, including all supporting data.
- (4) Complete drainage systems for the site. All existing drainage facilities which are to be incorporated in the design shall be identified with an explanation of the operations of the facilities.
- (5) Plans showing all existing and proposed drainage facilities affecting the subject property.
- (6) Plan of the proposed stormwater drainage systems including storm drain pipes and inlets, runoff control devices, and drainage channels.
- (7) Plan of the existing and proposed contours on vertical intervals of not more than two (2) feet.
- (8) Design computations for all BMPs and the sizing of the outlet control structure.
- (9) A stage storage curve for each detention/retention basin.
- (10) Multi-stage flood routing model and/or storage requirement calculations.
- (11) A plan showing the stormwater basin berm embankment and outlet structure. The plan shall also indicate the top of berm elevation, top width of berm and side slopes, emergency spillway elevation, elevations of the outlet structure including the riser, dimensions and spacing of anti-seep collars.
- (12) A cross-section through the outlet structure, emergency spillway, and the berm embankment.
- (13) A detailed plan of the trash rack and anti-vortex device if applicable.
- (14) An overall plan of the basin area at a scale of one (1) inch equals fifty (50) feet minimum showing the grading and landscaping.

- (15) A detailed plan of all required off-site improvements.
- (16) Location and legal descriptions of rights-of-way, easements or lands offered for dedication.
- (17) Inlet Drainage Area Map - The extent of each inlet drainage area shall be outlined on a map of highest order available and submitted in duplicate to the Township Engineer with the Design Calculations for Storm Sewers. The plans shall also indicate the stormwater runoff anticipated at each proposed inlet and the slope of the street or swale used to compute the inlet capacity. Care should be taken to assure that all areas delivering runoff to the point under consideration shall be included.
- (18) All pertinent details deemed necessary by the Township Engineer for the proper construction of all erosion and sedimentation controls, stormwater management, storm sewer, and BMP facilities.

C. Design Criteria - Stormwater Management/Stormwater Piping Systems

Stormwater Management systems shall meet the following minimum design/construction standards:

- (1) All earth disturbance activities shall limit the rate of stormwater runoff so that no greater runoff is permitted from any point on the site than that of the site at its maximum development potential in its natural condition for the same frequency storm, except where deemed necessary by the Township Engineer. Where farm, field, or disturbed earth is the existing condition, meadow shall be used as the starting basis for such calculations, regardless of the actual conditions.
- (2) The increased runoff which may result from earth disturbance activities shall be controlled by permanent runoff control measures. All runoff control measures shall be evaluated for their effectiveness to maintain the above standards for all storms for the term period of up to one hundred (100) years.
- (3) All plans and designs for stormwater management systems and facilities submitted to the Township for approval shall determine stormwater peak discharge and runoff by use of the Soil Cover Complex Method as set forth in the U. S. Department of Agriculture, Soil Conservation Service Publication entitled "Urban Hydrology for Small Watersheds," Technical Release #55 (latest edition), with specific attention given to antecedent moisture conditions, flood routing, and peak discharge specifications included therein, and in the

Hydrology National Engineering Handbook, Section 4, both U. S. Department of Agriculture, Soil Conservation Service.

The Township Engineer may permit the use of the rational method for calculation of runoff on earth disturbance sites of five (5) acres or less, and for the design of storm sewers.

- (4) Stormwater shall not be transferred from one watershed to another unless:
 - (a) The watersheds are subwatersheds of a common watershed which joins together within the perimeter of the site;
 - (b) The effect of transfer does not alter the peak discharge onto adjacent lands; or
 - (c) Easements from the affected landowners are provided.
- (5) The following rainfall intensity shall be used for the twenty-four (24) hour Type II distribution form with average antecedent moisture conditions for the frequencies shown:
 - (a) One-Year - 2.6 inches
 - (b) Two-Years - 3.2 inches
 - (c) Five-Years - 4.2 inches
 - (d) Ten-Years - 5.0 inches
 - (e) Twenty-five Years - 5.7 inches
 - (f) Fifty-Years - 6.4 inches
 - (g) One-Hundred Years - 7.1 inches
- (6) All stormwater collection pipes, inlets, and swales shall be designed to handle the peak flow rate for the one hundred (100) year storm. An inlet/outlet control evaluation shall be utilized to determine all pipe sizes in accordance with the method outlined in Hydraulic Design of Highway Culverts, Federal Highway Administration, (latest edition).

(7) Storm Duration

- (a) A five (5) minute storm duration shall be used if this duration does not result in a maximum expected discharge that exceeds the capacity of a 30-inch pipe.
- (b) If a five (5) minute storm duration results in a pipe size exceeding 30 inches, the time of concentration approach shall be used in determining storm duration.
- (c) If a five (5) minute storm duration results in a pipe size exceeding 30 inches, within any run of pipe, the time of concentration approach may be used for sizing of pipes from that point on by adjusting the time of concentration.

(8) Limestone Areas

- (a) Whenever an infiltration BMP or a stormwater basin is suspected of being located in an area underlain by limestone, a geological evaluation of the proposed location shall be conducted by a Registered Professional Engineer experienced in geotechnical and soil engineering to determine susceptibility to sinkhole formations.
- (b) The design of all BMPs over limestone formations shall include measures to prevent groundwater contamination and, where necessary, sinkhole formation.
- (c) It shall be the applicant's responsibility to verify whether the site is underlain by limestone.
- (d) The following note shall be attached to all drainage plans and signed and sealed by the applicant's Registered Professional Engineer experienced in geotechnical and soil engineering if a detention facility or infiltration BMP is proposed: *"I certify that the proposed facility is/is not underlain by limestone."*

D. Design/Construction Standards - Stormwater Detention/Retention Facilities

Stormwater Detention/Retention Facilities shall meet the following minimum design/construction standards:

- (1) Detention basin shall be designed to facilitate regular maintenance mowing and periodic silt removal and reseeded. In residential

subdivisions and residential development earth disturbances, shallow broad basins are preferred to steep sided basins.

- (2) The maximum slope of the earth and detention basin embankment shall be three-to-one (3:1). The top or toe of any slope shall be located a minimum of five (5) feet from a property line. Whenever possible the side slope and basin shape shall conform to the natural topography.
- (3) Unless permitted as a Special Exception by the Zoning Hearing Board, detention basins shall not be located within the Township's Floodplain Conservation or Riparian Corridor Conservation Districts as provided under the Whitemarsh Township Zoning Ordinance. Additionally, the location of detention/retention basins within any front, side or rear yard area shall be subject to the provisions of Section 116-31.1 of the Whitemarsh Township Zoning Ordinance.
- (4) Detention basins shall be designed so that they provide for a 24-hour extended detention of the 1-year, 24-hour storm event (i.e., the stormwater runoff will be released over a minimum 24 hours for the 1-year, 24-hour storm event).
- (5) If retention basins are used, the applicant shall demonstrate that such ponds are designed to protect public health, safety and welfare.
- (6) The minimum top width of the retention or detention basin berm shall be 10 ft. A cutoff trench (keyway) of relative impervious material shall be provided beneath all embankments requiring fill material. The keyway shall be a minimum 8 ft. wide, 1 ft. deep, and have 1:1 side slopes.
- (7) All detention/retention basin embankments shall be placed in 8-inch maximum lifts to a minimum 95% dry density. Prior to proceeding to the next lift, compaction shall be verified by a Registered Professional Engineer experienced in geotechnical engineering and acceptable to the Township Engineer. Compaction tests shall be performed using the Modified Proctor Method in accordance with ASTM D-1557. Compaction tests shall be run on the leading and trailing edge, as well as the top of the berm.
- (8) Emergency overflow facilities shall be provided for detention facilities to accommodate runoff in excess of design flows. Whenever possible, emergency spillway for the detention basins shall be constructed on undisturbed ground. Emergency spillways shall be constructed of concrete pavers or other materials approved by the

Township Engineer. All emergency spillways shall be constructed so that the detention basin berm is protected against erosion. The minimum capacity of all emergency spillways shall be the peak flow rate of the one hundred (100) year design storm after development. The construction material of the emergency spillway shall extend along the upstream and downstream berm embankment slopes. The upstream edge of the emergency spillway shall be a minimum of three (3) feet below the spillway crest elevation. The downstream slope of the spillway shall, as a minimum, extend to the toe of the berm embankment. The emergency spillway shall not discharge over earthen fill or easily erodible material.

- (9) The minimum freeboard shall be one (1) foot. The freeboard is the difference between the design flow elevation in the emergency spillway and the top of the compacted detention basin embankment.
- (10) Anti-seep collars shall be poured-in-place and installed around the pipe barrel within the normal saturation zone of the detention basin berms. The anti-seep collars and their connections to the pipe barrels shall be watertight. The anti-seep collars shall extend a minimum of two feet beyond the outside of the outlet pipe. The maximum spacing between collars shall be fourteen (14) times the minimum projection of the collar measured perpendicular to the pipe. A minimum of two (2) anti-seep collars shall be installed on each outlet pipe.
- (11) All outlet pipes through the basin berm shall be reinforced concrete pipe, designed to withstand the loading caused by a fully saturated berm and shall have watertight joints using O-ring joint pipe.
- (12) The invert of the inlet pipe(s) into a basin shall be a minimum of six (6) inches above the basin floor or lining so that it can adequately drain during and after rainstorms. Inlet pipe(s) shall discharge to areas of the basin that slope toward the outlet structure.
- (13) Energy dissipaters and/or level spreaders shall be installed at points where pipes or drainage ways drain to or from the basin. Energy dissipaters shall comply with criteria in the Erosion and Sediment Control Program Manual, published by the Pennsylvania Department of Environmental Protection or the Engineering Field Manual for Conservation Practices, SCS. Energy dissipating device calculations shall be submitted for Township review/approval.
- (14) Inlet and outlet structures shall be located at a maximum distance from one another in order to promote water quality benefits. The Township Engineer may require a rock filter or rock filled gabion for

entrapping sediments carried in stormwater if sufficient separation of inlet and outlet structures cannot be achieved.

- (15) A perforated riser, skimmer or similar sediment control device shall be provided at each outlet of all detention basins during construction for sediment control. The design shall conform to the Erosion and Sediment Pollution Control Manual, as published by the Department of Environmental Protection.
- (16) All drainage channels shall be designed to prevent erosion of the bed and banks. The maximum permissible flow velocity shall not exceed those outlined in Table 1 to these regulations. Suitable stabilization shall be provided where required to prevent erosion of the drainage channels.
- (17) Any vegetated drainage channel requiring mowing of the vegetation shall have a maximum grade of three (3) horizontal to one (1) vertical on those areas to be mowed.
- (18) Because of the critical nature of vegetated drainage channels, the design of all vegetated channels shall, as a minimum, conform to the design requirements outlined in the current "Erosion and Sediment Pollution Control Program Manual," published by the Pennsylvania Department of Environmental Protection.
- (19) Landscaping
 - (a) Disturbed areas resulting from the detention/retention basin construction shall be planted with cover vegetation such as grass, crown vetch, native grasses and appropriate shrubs and trees. The choice of cover vegetation must be approved by the Township and will be based upon the intended use of the basin, maintenance requirements, structural integrity of the berm area and conformity with surrounding landscaping. All seeding shall be applied by hydroseeding disturbed areas, unless otherwise approved by the Township Engineer.
 - (b) Specialized plantings suitable for wet conditions should be planted in portions of the basin which retain water or which contain soils under saturated conditions.
 - (c) Landscaping design should reduce overall maintenance requirements for the basin. The use of native grass and shrubs are encouraged.

- (d) Stormwater management facilities shall be appropriately screened in a manner which compliments the existing landscape and provides sufficient access for maintenance. The Township Engineer may waive this requirement if existing vegetation is adequate to ensure complete perimeter screening.
 - (e) Plantings shall consist of clusters of evergreens interspersed with grouping of deciduous trees and shrubs. Single species planting is prohibited. Where stormwater management facilities adjoin wooded areas, trees and shrubs shall be selected and planted so as to blend with existing surroundings.
 - (f) Plants that attract wildlife are encouraged. Landscape designs should not encourage burrowing animals.
 - (g) No woody plant material or trees shall be located on a constructed or natural berm acting as the impoundment structure of a detention/ retention basin. Trees shall be located on the downstream side of an impoundment berm a sufficient distance from the toe of the constructed slope to assure that the toe of the slope is outside the drip line of the mature species planted.
 - (h) In order to reduce runoff and erosion of existing topsoil, trees and shrubs should be preserved within, and surrounding, the stormwater basin, excluding the earth berm.
 - (i) Vegetation shall be planted during appropriate times of the year, predominantly between late March and mid-May or from early October until evidence of ground freezing, depending upon the species selected. Most deciduous trees and shrubs can be planted in either spring or fall. Evergreens are best planted in late summer or early fall.
 - (j) Topsoil - A minimum of six (6) inches of topsoil material shall be placed on all areas affected by the basin construction (bottom of basin, side slopes, top of berm, etc.). The material must meet the requirements of the Pennsylvania Department of Transportation Form 408 Specifications as amended.
- (20) Fencing shall be provided around the perimeter of all detention/retention basins capable of holding water to a depth of four (4) feet or more at any point in accordance with the requirements of Section 116-31.1.C of the Whitemarsh Township Zoning Ordinance.

E. Design/Construction Standards - Storm Sewer Facilities

(1) General

- (a) Storm sewers, culverts, and related installations shall be provided:
 - (i) To permit unimpeded flow of natural watercourses and in such a manner as to protect the natural character of the watercourses and to provide regulated discharge;
 - (ii) To ensure adequate drainage of all low points along the line of streets; and
 - (iii) To intercept stormwater runoff along streets at intervals reasonably related to the extent and grade of the area drained and to prevent substantial flow of water across intersections.
- (b) All storm sewer system components shall conform to current PennDOT standards.
- (c) Proposed drainage structures, which drain watershed areas in excess of one half square mile (320 acres), or which have a span of eight (8) feet or more, shall be designed for a maximum expected runoff as calculated using the Soil Conservation Service Technical Release 55 "Urban Hydrology for Small Watersheds (less than 2,000 acres)." The design storm shall be a minimum 100-year storm. A Water Obstruction Permit shall be obtained from the Pennsylvania Department of Environmental Protection for the waterway opening before final design is undertaken.

The cartway area over the bridge shall be as wide as the widest road connecting with the bridge, or if the character of the road is expected to change for future planning, the cartway of the bridge shall be made to anticipate this condition.

2. Specific Storm Drainage Features

- (a) Shoulders in Cut Areas (without swales)
 - (i) Water flowing in the shoulder shall not encroach more than two-thirds the shoulder width during a one hundred (100) year frequency storm of five minute duration.

- (ii) The maximum velocity as determined by Manning's equation shall not exceed the allowable velocities as shown in Table 1 for the specific type of shoulder material.
 - (iii) Inlets shall be provided to control the shoulder encroachment and water velocity.
- (b) Swales adjacent to shoulders
 - (i) Swales in cut areas shall be designed to prevent the passage of water on the cartway during a one hundred (100) year frequency storm of five (5) minute duration.
 - (ii) The maximum velocity, as determined by Manning's equation, shall not exceed the allowable velocities as shown in Table 1 for the specific type of shoulder material.
- (c) Curbed Sections
 - (i) The maximum encroachment of water on the roadway pavement shall not exceed 4 inches in depth at the curb during a one hundred (100) year frequency storm of five (5) minute duration.
 - (ii) Inlets shall be provided to control the encroachment of water on the pavement.
- (d) Inlets - General
 - (i) At street intersections, inlets shall be placed in the tangent portion rather than the curved portion of the curbing.
 - (ii) When there is a change in pipe size in the inlet, the elevation for the top of pipes should be the same or the smaller pipe higher. A minimum drop of two inches should be provided in the inlet between the lowest inlet pipe invert elevation and the outlet pipe invert elevation.
 - (iii) If the capacity of the shoulder, swale, curb section or depressed median section exceeds the assumed inlet capacities, the inlet capacities shall govern the spacing of inlets.

- (iv) If the capacity of the shoulder, swale, curb section, or depressed median section is less than the inlet capacities, then the shoulder, swale, curb section or depressed section capacity shall govern the spacing of inlets.
- (e) Type C Inlets
- (i) This type inlet is designated for installation in non-mountable curb.
 - (ii) In order to achieve greater efficiency, Type C Inlets shall be spaced so as to permit five percent (5) of the gutter flow to bypass the inlet.
 - (iii) Inlet capacities shall be based on a maximum flow of 5.5 cfs.
 - (iv) The capacity of an inlet at a low point of a street vertical curve may be designed to accept 4.0 cfs from each direction, or a maximum of 8.0 cfs.
- (f) Type M and S Inlets
- (i) Type S Inlets shall be installed in shoulder swale areas with back slopes six-to-one (6:1) and steeper. Type M Inlets shall be used in swale areas where the back slope is flatter than six-to-one (6:1).
 - (ii) Inlet capacities shall be based on a maximum flow of 5.5 cfs, except in sump conditions where the inlets may be designed to accept 4.0 cfs from each direction, or a maximum of 8.0 cfs.
 - (iii) Where a drainage dike is used, the side slope of the dike shall be eight-to-one (8:1) or flatter.
- (g) Storm Pipes
- (i) Pipes shall be sized by use of inlet/outlet control calculations.
 - (ii) The roughness coefficient shall be in compliance with the Pennsylvania Department of Transportation Design Manual, Part 2, as amended.

- (iii) Where headroom is restricted, equivalent pipe arches may be used in lieu of circular pipe.
 - (iv) The minimum diameter of all storm drainage pipes shall be eighteen (18) inches or equivalent thereto. All storm pipe shall be reinforced concrete pipe which conforms to the Pennsylvania Department of Transportation Specifications, or Whitemarsh Township Specifications, whichever are more stringent.
 - (v) Storm pipes will be provided in industry standard increments of diameter.
 - (vi) Abrupt changes in direction or slope of pipe shall be avoided. Where such abrupt changes are required, an inlet or manhole shall be placed at the point of change. In no case will pipes be permitted to enter a structure at an angle less than ninety (90) degrees to the outflow pipe.
 - (vii) The minimum slope in a pipe shall provide a minimum velocity of 2.5 fps, but shall not have a minimum slope of less than 0.5%.
 - (viii) Storm pipes shall have a minimum 18-inch depth of cover over the top of pipe.
 - (ix) Storm pipes shall be designed to maintain a minimum of one (1) foot of freeboard within each inlet box/manhole.
- (h) Manholes
- (i) Manholes shall neither be more than 300 feet apart on sizes up to and including 24 inches nor more than 450 feet apart on greater sizes.
 - (ii) Inlets may be substituted for manholes, on approval of the Township Engineer, at the same spacing as required for manholes.

F. Design/Construction Standards - Water Quality Requirements for Regulated Earth Disturbance Activities

- (1) No Regulated Earth Disturbance Activities within the Township shall commence until approval by the Township of a BMP Operations and Maintenance Plan which demonstrates compliance with State Water Quality Requirements after construction is complete. The plan shall contain all documentation required in Section 58-10 of Ordinance 2004-___ and Section II. B. of this Resolution.
- (2) The BMPs must be designed, implemented and maintained to meet State Water Quality Requirements, and any other more stringent requirements as determined by the Township.
- (3) To control post-construction stormwater impacts from Regulated Earth Disturbance Activities, State Water Quality Requirements can be met by BMPs, including site design, which provide for replication of pre-construction stormwater infiltration and runoff conditions, so that post-construction stormwater discharges do not degrade the physical, chemical or biological characteristics of the receiving waters, as follows:
 - (a) Any regulated earth disturbance shall specify permanent stormwater BMPs to be implemented, operated and maintained to meet legal Water Quality requirements.
 - (b) In order to protect and maintain Water Quality, additional stormwater runoff created by the development project must be captured, stored and treated. In addition, post-construction stormwater infiltration of runoff must replicate pre-construction infiltration of runoff to the maximum extent possible.
 - (c) The volume of additional stormwater runoff to be captured, stored and treated is called the Water Quality Volume ("WQ_v").

(1) The formula for determining WQ_v is:

$$WQ_v = [(0.17)(R_v)(A)], \text{ where}$$

- A = Project Area in acres
- R_v = Volumetric Runoff Coefficient [0.05 + 0.009(I)], where I is the percent impervious cover (impervious area ÷ total project area) X 100%

(2) Runoff treatment BMPs must be employed where necessary to ensure the Water Quality requirements are met.

(3) Water temperature is a particular concern in High Quality and Exceptional Value watersheds. Temperature-sensitive BMPs and stormwater conveyance systems are to be used and designed with storage pool areas and supply outflow channels, and should be shaded with trees. Vegetation shall be planted within the facilities, provided that capacity for volumes and rate control as required by the Ordinance is maintained.

- At a minimum, the southern half on pond shorelines shall be planted with shade or canopy trees within ten (10) feet of the pond shoreline.
- In conjunction with this requirement, the maximum slope allowed on the berm area to be planted is 10 to 1. This will lessen the destabilization of berm soils due to root growth.
- A long term maintenance schedule and management plan for the thermal control BMPs is to be established and recorded for all development project sites.

(4) The applicant may, subject to approval of the Township, use any of the following stormwater credits, described in the following table, in computing the required Water Quality Volume:

Stormwater Credit	Description
Natural Area Conservation	Conservation of natural areas such as forest, wetlands, or other sensitive areas in a protected easement thereby retaining their pre-development hydrologic and water quality characteristics. Using this credit, a designer may subtract conservation areas from total site area when computing the required water quality volume.
Disconnection of Rooftop runoff	Credit is given when rooftop runoff is disconnected and then directed over a pervious area where it may either infiltrate into the soil or filter over it. Credit is typically obtained by grading the site to promote overland flow or by providing bioretention on single-family residential lots. If a rooftop area is adequately disconnected, the impervious area may be deducted from the total impervious cover.
Disconnection of Non-Rooftop Runoff	Credit is given for practices that disconnect surface impervious cover by directing it to pervious areas where it is either infiltrated or filtered through the soil. As with rooftop runoff, the impervious area may be deducted from the total impervious areas adjacent to the buffer and treating the runoff through overland flow across a grass or forested area. Areas treated in this manner may be deducted from total site area.
Stream Buffer Credit	Credit is given when a stream buffer effectively treats stormwater runoff. Effective treatment constitutes capturing runoff from pervious and impervious areas adjacent to the buffer and treating the runoff through overland flow across a grass or forested area. Areas treated in this manner may be deducted from total site area.
Grass Channel (Open Section Roads)	Credit may be given when open grass channels are used to reduce the volume of runoff and pollutants during smaller storms. If designed according to appropriate criteria, these channels may meet water quality criteria for certain types of residential development.

- (5) The volume and rate of any stormwater discharge permitted under this Ordinance must be managed to prevent the physical degradation of receiving waters, such as by streambank scour and erosion. If a detention facility is proposed which is part of the BMPs approved for the project, the facility(ies) must be designed to provide for a 24-hour extended detention of the 1-year, 24-hour storm event (i.e., the stormwater runoff will be released over a minimum 24 hours for the 1-year, 24-hour storm event).

(d) Infiltration

- (1) Prevention of stormwater runoff is key objective of Chapter 93 of the DEP regulations, because runoff can change the physical, chemical and biological integrity of waterbodies thereby impacting Water Quality.
- (2) Any Regulated Earth Disturbance Activities shall describe how these Water Quality protection requirements will be met. Infiltration BMPs shall be evaluated and utilized to the maximum extent possible to manage the net change in stormwater runoff generated so that post construction discharges do not

degrade the physical, chemical or biological characteristics of the receiving waters.

- (3) Post construction stormwater infiltration of runoff shall replicate pre-construction infiltration of runoff to the maximum extent possible.
- (4) In calculating the volume of runoff that can be infiltrated at a site, the following methodology shall be used:

[a] $Re_v = [(S)(R_v)(A)]/12$, where:

Re_v = Recharge Volume (acre-feet)

S = Soil specific recharge factor (inches)

A = Site area contributing to the recharge facility (acres)

R_v = Volumetric runoff coefficient, $R_v = 0.05 + 0.009(I)$, where:

I = percent impervious area, and

S shall be obtained based upon hydrologic soil group based upon the table below:

Hydrologic Soil Group	Soil Specific Recharge Factor (S)
A	0.38
B	0.25
C	0.13
D	0.06

- [b] If more than one hydrologic soil group (HSG) is present at a site, a composite recharge volume shall be computed based upon the proportion of total site area within each HSG.
- [c] In selecting the appropriate infiltration BMPs, the applicant shall consider the following:
 - [1] Permeability and infiltration rate of the site soils.
 - [2] Slope and depth to bedrock.
 - [3] Seasonal highwater table.

[4] Proximity to building foundations and well heads.

[5] Erodibility of soils.

[6] Land availability and topography.

[d] A detailed soils evaluation of the project site shall be performed to determine the suitability of infiltration BMPs. The evaluation shall be performed by a Registered Professional Engineer experienced in geotechnical engineering or a Certified Professional Soil Scientist, and at a minimum, address soil permeability, depth to bedrock, susceptibility to sinkhole formation, and subgrade stability. The general process for designing the infiltration BMP shall be:

[1] Analyze hydrologic soil groups, as well as natural and manmade features within the watershed, to determine general areas of suitability for infiltration BMPs.

[2] Provide field testing data to determine appropriate percolation rate and/or hydraulic conductivity.

[3] Design infiltration BMPs for required stormwater volume based on field-determined capacity at the level of the proposed infiltration surface.

[e] Soil characteristics:

[1] Infiltration BMPs are particularly appropriate in hydrologic soil groups A and B.

[2] Low-erodibility factors ("K" factors) are preferred for the construction of basins.

[3] There must be a minimum depth of 48 inches between the bottom of any infiltration BMP and the seasonal

highwater table and/or bedrock (limiting zones), except for infiltration BMPs receiving only roof runoff which shall be placed in soils having a minimum depth of 24 inches between the bottom of the facility and the limiting zone.

- [4] There must be an infiltration and/or percolation rate sufficient to accept the additional stormwater load, and to drain completely as determined by field tests.
 - [5] Infiltration BMPs shall be located a minimum of 10 feet away from the foundation wall of any building.
 - [6] The infiltration system shall have positive overflow controls to prevent storage within 1 foot of the finished surface or grade.
 - [7] Infiltration rates shall not be used in computing the storage volume of the infiltration system.
 - [8] Surface inflows shall be designed to prevent direct discharge of sediment into the infiltration system.
- [f] The recharge volume provided at the site shall be directed to the most permeable HSG available, except where other considerations apply such as in limestone geology.
 - [g] Any infiltration BMP shall be capable of completely infiltrating the impounded water within 96 hours.
 - [h] Extreme caution shall be exercised where infiltration is proposed in geologically susceptible areas such as:

- [1] Strip mines.
 - [2] Where salt or chloride may be applied in deicing and other winter applications, causing groundwater pollution since soils do little to filter this pollutant, and
 - [3] Limestone areas. Any BMP proposed in area suspected of being located in a limestone area shall conform to Section II.C.8. of this resolution.
- [i] During the period of land disturbance, runoff shall be controlled prior to entering any proposed infiltration area, areas proposed for infiltration BMPs shall be protected from sedimentation and compaction during the construction phase, so as to maintain their maximum infiltration capacity.
 - [j] Infiltration BMPs shall not be constructed nor receive runoff until the entire contributory drainage area to the infiltration BMP has received final stabilization.

G. Design/Construction Standards - Best Management Practices

- (1) General. All plans and designs for best management practices submitted to the Township shall be designed in accordance with the Pennsylvania Department of Environmental Protection's Comprehensive Stormwater Management Policy. The following manuals may be used for guidance in the selection, design and maintenance requirements of the BMPs.
 - (a) Delaware Stormwater Guidance Manual.
 - (b) Maryland Stormwater Handbook.
 - (c) New Jersey BMP Manual.
 - (d) New York Stormwater Manual.
 - (e) Pennsylvania's Handbook of Best Management Practices for Developing Areas.

(2) BMPs - The following BMPs can be used to replicate the pre-construction runoff and infiltration on the site.

(a) Groundwater Recharge.

- [1] Permeable paving.
- [2] Stormwater infiltration.
- [3] Grass swale.
- [4] Bioretention.
- [5] Filter strip

(b) Water Quality.

- [1] Permeable paving.
- [2] Stormwater infiltration.
- [3] Grass swale.
- [4] Bioretention.
- [5] Filter strip.
- [6] Stormwater wetlands.
- [7] Water quality structures.
- [8] Sand filter.
- [9] Wet pond (extended detention pond).
- [10] Rooftop runoff management.

(c) Rate and Volume Control.

- [1] Permeable paving.
- [2] Stormwater infiltration.
- [3] Grass swale.
- [4] Bioretention.
- [5] Dry pond.
- [6] Stormwater wetlands.
- [7] Wet pond (extended detention pond).
- [8] Rooftop runoff management.

TABLE 1

ALLOWABLE WATER VELOCITIES

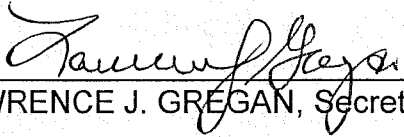
<u>MATERIAL</u>	<u>ALLOWABLE VELOCITY FEET PER SECOND</u>
1. Well established grass on good soil	
a. Short Pliant Bladed Grass	5 - 6
b. Bunch Grass - Soil Exposed	2 - 4
c. Stiff Stemmed Grass	2 - 3
2. Earth Without Vegetation	
a. Fine Sand or Silt	1 - 2
b. Ordinary Firm Loam	2 - 3
c. Stiff Clay	3 - 5
d. Clay and Gravel	4 - 5
e. Course Gravel	4 - 5
f. Soft Shale	5 - 6
3. Shoulders	
a. Earth	See 2 Above
b. Stabilized	6
c. Paved	10 - 15

ADOPTED AS A RESOLUTION by the Board of Supervisors of Whitemarsh this

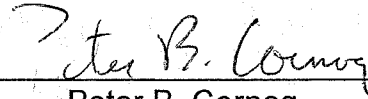
26TH day of FEBRUARY 2004.

ATTEST

WHITEMARSH TOWNSHIP
BOARD OF SUPERVISORS



LAWRENCE J. GREGAN, Secretary



Peter B. Cornog
Chairman

Appendix A

STORMWATER BEST MANAGEMENT PRACTICES
SAMPLE OPERATIONS AND MAINTENANCE AGREEMENT

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

WITNESSETH

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

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

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

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

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

- BMP - "Best Management Practices," activities, facilities, designs, measures or
procedures used to manage stormwater impacts from land development, to protect and
maintain water quality and groundwater recharge and to otherwise meet the purposes
of the Whitemarsh Township Grading, Erosion Control, Stormwater Management and
Best Management Practices Ordinance, including, but not limited to, infiltration
trenches, seepage pits, filter strips, bioretention, wet ponds, permeable paving, rain
gardens, grassed swales, forested buffers, sand filters and detention basins.

- Infiltration Trench - A BMP surface structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,
- Seepage Pit - An underground BMP structure designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or groundwater aquifer,
- Rain Garden - A BMP overlain with appropriate mulch and suitable vegetation designed, constructed, and maintained for the purpose of providing infiltration or recharge of stormwater into the soil and/or underground aquifer, and

WHEREAS, the Municipality requires, through the implementation of the Plan, that stormwater management BMPs as required by said Plan and the Grading, Erosion Control, Stormwater Management and Best Management Practices Ordinance be constructed and adequately operated and maintained by the Landowner, his successors and assigns, and

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

1. The BMPs shall be constructed by the Landowner in accordance with the plans and specifications identified in the Plan.
2. The Landowner shall operate and maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality and in accordance with the specific maintenance requirements noted on the Plan.
3. The Landowner hereby grants permission to the Municipality, its authorized agents and employees, to enter upon the property, at reasonable times and upon presentation of proper identification, to inspect the BMP(s) whenever it deems necessary. Whenever possible, the Municipality shall notify the Landowner prior to entering the property.
4. In the event the Landowner fails to maintain the BMP(s) as shown on the Plan in good working order acceptable to the Municipality, the Municipality or its representatives may enter upon the property and take whatever action is deemed necessary to maintain said BMP(s). This provision shall not be construed to allow the Municipality to erect any permanent structure on the land of the Landowner. It is expressly understood and

agreed that the Municipality is under no obligation to maintain or repair said facilities, and in no event shall this Agreement be construed to impose any such obligation on the Municipality.

5. In the event the Municipality, pursuant to this Agreement, performs work of any nature, or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Landowner shall reimburse the Municipality for all expenses (direct and indirect) incurred within 10 calendar days of receipt of invoice from the Municipality.
6. The intent and purpose of this Agreement is to ensure the proper maintenance of the on-site BMP(s) by the Landowner; provided, however, that this Agreement shall not be deemed to create or affect any additional liability of any party for damage alleged to result from or be caused by stormwater runoff.
7. The Landowner, its executors, administrators, assigns, and other successors in interests, shall release the Municipality's employees and designated representatives from all damages, accidents, casualties, occurrences or claims which might arise or be asserted against said employees and representatives from the construction, presence, existence, or maintenance of the BMP(s) by the Landowner or Municipality. In the event that a claim is asserted against the Municipality, its designated representatives or employees, the Municipality shall promptly notify the Landowner and the Landowner shall defend, at his own expense, any suit based on the claim. If any judgment or claims against the Municipality's employees or designated representatives shall be allowed, the Landowner shall pay all costs and expenses regarding said judgment or claim.
8. The Municipality shall inspect the BMP(s), at a minimum of once every 3 years, to ensure their continued functioning.

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

ATTEST:

WITNESS the following signatures and seals:

(SEAL)

For the Municipality:

(SEAL)

For the Landowner:

ATTEST

_____ (City, Borough, Township)

County of _____, Pennsylvania

I, _____ a Notary Public in and for the County and State aforesaid, whose commission expires on the _____ day of _____, 20____, do hereby certify that

_____ whose name(s) is/are assigned to the foregoing Agreement bearing date of the _____ day of _____, 20____, has acknowledged the same before me in my said County and State.

GIVEN UNDER MY HAND THIS _____ day of _____, 20____.

NOTARY PUBLIC

(SEAL)