110 STORMWATER MANAGEMENT AND COLLECTION SYSTEMS

110.01 DEFINITIONS

110.01.01 Detention structure. A permanent structure for the temporary storage of stormwater runoff that is designed so as not to create a permanent pool of water.

110.01.02 Developed peak discharge rates. The peak discharge rates, in cubic feet per second, calculated using Town approved methods and based on developed land use conditions.

110.01.03 Existing land use conditions. The land use conditions existing at the time the design plans are submitted for approval, including previously approved upstream developments.

110.01.04 Impervious surface. Any material that significantly reduces and prevents natural infiltration of water into the soil. Impervious surfaces include but are not limited to roof, patios, balconies, decks, streets, parking areas, driveways, sidewalks, and any concrete, stone, brick, asphalt or compacted gravel surface.

110.01.05 Infiltration. The passage or movement of water into the soil sub-surface.

110.01.06 Maintenance. Any action necessary to preserve drainage and flood control facilities in proper working condition, so that such facilities shall continue to comply with the standards of this section and to prevent failure of such facilities. Maintenance shall not include actions taken solely for the purpose of enhancing the aesthetics aspects associated with the stormwater discharge control facilities.

110.01.07 Off-site stormwater runoff rate. The stormwater runoff resulting from a designated design storm which flows through the subject site either naturally or via storm drainage systems from off the subject site. Off-site stormwater runoff rate shall be calculated assuming contributing offsite properties are fully developed based on existing zoning at time of calculation.

110.01.08 On-site stormwater discharge control facilities. The design and construction of a facility necessary to control stormwater runoff within and for a single development.

110.01.09 Opaque Screening. A substance that cannot be seen through when viewed perpendicularly at the same elevation from the ground to at least a height of six (6) feet. Composition of the opaque screen may include a wall, fence, landscaped earthen berm, planted vegetation, existing vegetation, or any appropriate combination of the elements. At least 75 percent of the planted vegetation shall be evergreen species locally adapted to the area.

110.01.10 Predevelopment stormwater runoff rate. Stormwater runoff resulting from a designated design storm with the subject site in its natural existing condition prior to any development activity.

110.01.11 Post development stormwater runoff rate. The stormwater runoff resulting from a designated design storm after the site has been fully developed.

110.01.12 Regional retention/detention facilities. The design and construction of a facility to control stormwater runoff within or outside a development and for one or more developments.

110.01.13 Retention structures. A permanent structure that provides for the storage of runoff and is designed to maintain a permanent pool of water.

110.01.14 Storm drainage facilities. The man-made system of inlets, conduits, or other such facilities and appurtenances, which collect, store, and convey stormwater.

110.01.15 Stormwater discharge control design plan. The set of drawings and other documents that comprise all of the information and specifications for the drainage systems, structures, concepts and techniques that will be used to control stormwater discharges as required by this section. Also included are the supporting engineering calculations, input data for any computer analysis, and results of any computer analysis.

110.01.16 10-year and 100-year design storms. The stormwater runoff resulting from a rainfall intensity based on statistical data and of a duration that will produce the maximum peak rate of runoff for the watershed of interest under average moisture conditions. A 10-year storm has statistically a 10% chance of occurring in any given year and a 100-year storm has statistically a 1% chance of occurring in any given year.

110.02 STORMWATER CALCULATION PROCEDURES

110.02.01 The following procedures are acceptable means of calculating stormwater design factors. Any alternative means for calculating stormwater design factors may be approved by the Director of Engineering if the Design Professional demonstrates that the methods are appropriate for the intended use and they are properly calibrated to local conditions.

110.02.02 Peak Runoff Calculation

110.02.02.01 The Rational Method may be used for drainage areas less than 100-acres. The Design Professional shall use the Intensity-Duration-Frequency chart provided in Table 110.01.

110.02.02.02 The U.S. Geological Survey Water Resources Investigations Reports 01-4207 (Table 5 - Rural Flood-Frequency Coastal equations) and 96-4084 (Table 7 – North Carolina Flood-Frequency Equations) may be used for drainage areas 26-acres to 640-acres.

110.02.02.03 The United States Army Corps of Engineers Hydrologic Engineering Center computer programs HEC-HMS, or Haestad Methods “Pondpack”, may be used for drainage areas greater than 640-acres. These programs shall include evaluation of multiple sub-basins and storage areas.

110.02.02.04 Regional Regression Equation Analysis: Regression equations for rural and urban areas in North Carolina for various return periods are listed in the

documents WRIR 96-4114 and WRIR 96-4084, The National Flood- Frequency Program—Methods for Estimating Flood Magnitude and FINAL 2015 8-32 Frequency in Rural and Urban Areas in North Carolina, 2001, otherwise known as USGS Fact Sheet 007-00, January, 2002. Fact sheets can be found at the following USGS website http://water.usgs.gov/osw /programs/ nffpubs.html.

110.02.02.05 The Time of Concentration (tc) shall be determined using the Kirpich Equation (Bureau of Reclamation, 1974, p.71), and the storm duration shall equal tc. The Kirpich Equation is best used in areas of low development intensities.

110.02.02.06 Kinematic wave equation may also be used but is not described in this manual. Time of concentration shall be calculated using a segmented approach as reasonable based upon changes in slope, land cover conditions, or flow type.

110.02.03 Runoff Volume Calculation

110.02.03.01 The “Simple Method” as described by Schueler (1987) and referenced in NCDEQ’s “Stormwater Best Management Practices” dated April 1999 shall be used for calculating the post development runoff volume resulting from the first inch of rainfall for developments up to and including 10 acres. The Simple Method was developed by measuring the runoff from many watersheds with known impervious areas and curve-fitting a relationship between percent imperviousness and the fraction of rainfall converted to runoff (the runoff coefficient). The Simple Method shall be used for calculating first flush volumes only and shall not be used for any other purpose.

110.02.03.02 NRCS (SCS) Method: The SCS method (SCS, 1985; NRCS, 1986) is an alternative method for calculating the volume of stormwater runoff that is generated from a given amount of rainfall. It may not be used for calculating the water quality volume, but should be used for BMP routing/analysis and low impact development projects. First flush volumes for water quality treatment shall be based upon the Simple Method as described above. The following is a brief summary of the SCS Method. Refer to Technical Release 55 for a full description of this calculation methodology. This method should not be used on drainage areas exceeding 640 acres. The Urban Hydrology for Small Watersheds, TR-55 (Technical Release 55) was published by the Engineering Division, United States Natural Resource Conservation Service (formerly known as the Soil Conservation Service) United States Department of Agriculture, June 1986.

110.02.03.03 The United States Army Corps of Engineers Hydrologic Engineering Center computer programs HEC-HMS, or Haestad Methods “Pondpack”, may be used for drainage areas greater than 640-acres, except as noted above. These programs shall include evaluation of multiple sub-basins and storage areas.

110.02.04 Storage Volume

110.02.04.01 Volume control for peak flow attenuation is typically provided through detention structures with volume above the water operating level and below the required freeboard. Some BMPs do not have the capability to provide this volume control due to their design, and others can include storage volume within the media of the BMP. Each individual BMP chapter discusses the specific calculations for meeting the volume control requirements. However, since many of the BMPs use storage

volume in a detention structure, this section will discuss an acceptable method of calculating that volume.

110.02.04.02 Storage volume within a detention structure shall be calculated using a stage-storage method. A table shall be provided showing incremental elevations of the BMP with square footage values at the listed elevations. The elevation increments shall be no more than 1 foot. Columns can then be produced showing the incremental volume and cumulative volume of storage provided. The drainage areas used in this analysis shall not exceed that allowed by the methodology used to generate the runoff volumes being analyzed.

110.02.05 Hydrograph Development

110.02.05.01 A Unit Hydrograph per “Elements of Urban Stormwater Design” by H. Rooney Malcom, P.E., may be used for drainage areas less than 100-acres

110.02.05.02 The Urban Hydrology for Small Watersheds, TR-55 (Technical Release 55) published by the Engineering Division, United States Natural Resource Conservation Service (formerly known as the Soil Conservation Service) United States Department of Agriculture, June 1986, may be used for drainage areas up to 640-acres.

110.02.05.03 The United States Army Corps of Engineers Hydrologic Engineering Center computer programs HEC-HMS, or Haestad Methods “Pondpack”, may be used for drainage areas greater than 640-acres. These programs shall include evaluation for multiple sub-basins and storage areas.

110.03 STORMWATER COLLECTION SYSTEMS

110.03.01 General

110.03.01.01 Stormwater collection systems refer to those collection and piping systems for stormwater management and control that are installed in the public ROW or stormwater easements. See Section 100 for easement requirements.

110.03.01.02 Storm drainage systems and easements located outside the public right of way shall be maintained by the property owner(s) and shall be designated as “private drainage easement” on a recorded plat. The Town shall maintain only the stormwater collection systems within Town maintained ROW and on Town property.

110.03.01.03 Stormwater collection systems shall be prepared by a Design Professional, using acceptable engineering standards and practices.

110.03.02 Materials

110.03.02.01 Stormwater collection system pipes shall be constructed of HDPE, RCP, or CMP, as described Section 100. All storm drainage structures such as manholes, inlets, junction boxes and catch basins shall be constructed of either solid brick, solid block, or precast concrete, as described in Section 100.

110.03.02.02 Headwalls and endwalls shall be constructed in accordance with NCDOT details or precast concrete with wing walls and apron. Installation of precast headwalls and endwalls shall be in accordance with the manufacturer's recommendations.

110.03.02.03 Frame, grate & hood shall be cast iron and meet the ASTM requirements set forth in the latest edition of the NCDOT “Standard Specifications for Roads and Structures” and the dimensional requirements set forth in the latest edition of the NCDOT “Roadway Standard Drawings #840.03”. Grate shall be stamped with the NCDOT specification number as evidence of satisfying the above requirements.

110.03.02.04 Hoods shall be stamped “Drains to River”. Lettering shall be ¾-inch in height and shall be clean, crisp and free of defects.

110.03.03 Siting

110.03.03.01 See Section 100 for separation requirements between stormwater system, wastewater system, and water system pipes.

110.03.03.02 Stormwater inlets shall not be placed within travel areas of roadways or in the travel area of parking lots.

110.03.03.03 In roadways with a curb and gutter section, storm drainage pipe shall be carried to the rear property line or as close to the rear property line as feasibly possible to dissipate storm water into a natural flow area.

110.03.03.04 Where no curb and gutter is proposed, all street and development runoff that is directed to drainage easements designated between lots (this is defined as the side lot line) shall be piped to the rear property line or as close to the rear property line as feasibly possible into a natural flow area except under the following condition:

110.03.03.04.01 The drainage easement is part of an existing stream or creek designated on a USGS map (blue line) or;

110.03.03.04.02 Based on the drainage area the size of the proposed drainage pipe required exceeds 35-inch diameter based on a 25-year storm.

110.03.03.04.03 The lot width at the pipe outlet exceeds 120 linear feet.

110.03.03.05 Structures shall be spaced to intercept flow at the uphill turnout of intersections unless the street design provides a continuous downhill grade around the radius and down the intersecting street.

110.03.04 Design

110.03.04.01 Stormwater Collection Pipes

110.03.04.01.01 Systems shall be designed based on rainfall intensities of 4 inches per hour for street inlet spacing, the 10-year storm for street drainage pipe sizing, and the 25-year storm for cross-street drainage.

110.03.04.01.02 Pipe shall be sized in accordance with the Manning Equation and applicable nomographs to carry the design flow and to provide a velocity of at least 2 feet per second during the 2-year storm.

110.03.04.01.03 The minimum pipe diameter shall be 15 inches.

110.03.04.01.04 Pipe shall be installed to provide a true line and grade between structures.

110.03.04.01.05 The maximum length between access points shall be 400 feet for all pipe sizes.

110.03.04.01.06 The minimum cover for stormwater pipe shall be 2 feet measured from the top of the pipe to the finished subgrade under roads and 1 foot to finished grade in non-load-bearing areas.

110.03.04.02 Catch Basins and other Structures

110.03.04.02.01 For information on manhole design, please refer to Section 100.

110.03.04.02.02 Gutter flow calculations shall be submitted with the design.

110.03.04.02.03 Water shall be picked up before the spread into the street exceeds 8 feet for curb and gutter streets. In areas of heavy pedestrian traffic, the maximum allowable spread may be decreased by the Director of Engineering.

110.03.04.02.04 No inaccessible storm drainage structures shall be allowed.

110.03.04.02.05 Catch basins between 5 and 12 feet in depth shall have minimum interior dimensions of 4 feet by 4 feet, and those over 12 feet in depth shall have minimum interior dimensions of 5 feet by 5 feet.

110.03.04.02.06 Each drainage structure shall have an invert constructed from concrete and shaped to conform to the pipe ID, and a bench with a maximum 5:1 slope. The bench shall begin at a height of one-half the pipe diameter for 12- to 24-inch pipe, one-third the pipe diameter for 30- to 48-inch pipe, and one-fourth the diameter for pipe greater than 48 inches in diameter.

110.03.04.02.07 Precast concrete structures shall be installed only to depths certified as acceptable by the manufacturer.

110.03.04.02.08 Pipes may enter through the corner of all structure material types except precast concrete "waffle" boxes.

110.03.04.02.09 Pipes shall not project into a drainage structure but shall be finished flush with the inside of the structure.

110.03.04.02.10 A reinforced concrete slab designed by a Design Professional may be used at oversized structures to adjust an inlet to standard dimensions. They shall meet HS-20 loading.

110.03.04.02.11 Each curb inlet shall be installed such that the front wall is straight and aligned with the curb and gutter.

110.03.04.03 Culverts, Endwalls, and Headwalls

110.03.04.03.01 Culverts, endwalls, and headwalls shall be designed based on a 25-year storm.

110.03.04.03.02 Culverts shall be sized in accordance with the Energy Equation and applicable nomographs to carry the design flow and to provide a velocity of at least 2 feet per second during the 2-year storm.

110.03.04.03.03 When sizing culverts the loss of pipe cross-sectional volume caused by inclusion of natural bottom material and/or the process of natural deposition of sand/gravel/soil shall be considered.

110.03.04.03.04 Effects of the 100-year storm shall be analyzed to ensure that:

110.03.04.03.04.01 No flooding shall occur on upstream off-site properties due to backwater from the culvert.

110.03.04.03.04.02 The stability of the roadway embankment shall not be compromised in the event of overtopping.

110.03.04.03.04.03 Proposed or existing structures and utilities shall not be inundated due to backup of stormwater created by installation of a culvert or other drainage structure.

110.03.04.03.05 Stream crossings requiring greater than double culverts shall necessitate a back-water study on the 25-year storm.

110.03.04.03.06 Limit of two pipe culverts per crossing. If flows require more than two pipes, the installation shall utilize box culverts, of which there shall also be no more than two. In cases of narrow stream channels and wide flood plains, alternate designs may be considered.

110.03.04.03.07 Headwalls, endwalls or flared end sections shall be installed at all discharge points, and inlets where there is not a structure.

110.03.04.03.08 Precast headwalls and endwalls shall only be installed at single pipe culverts.

110.03.04.03.09 Flared end sections shall be installed on single pipe culverts up to and including 60 inches in diameter, and on multiple pipe culverts up to and including 36 inches in diameter.

110.03.04.03.10 Headwalls and endwalls shall be installed on single pipe culverts greater than 60 inches in diameter, and on multiple pipe culverts greater than 36 inches in diameter.

110.03.04.03.11 Headwalls and Endwalls 4 foot in height or taller must be engineered and obtain a building permit prior to construction.

110.03.04.03.12 Details and design of headwalls, endwalls and flared end sections shall be in accordance with NCDOT standard detail requirements. These details shall be shown on plan submissions.

110.03.04.03.13 Energy dissipaters shall be installed at all discharge points and shall be properly sized to ensure that stormwater is released at a nonerosive velocity. All stormwater release points shall be protected by riprap dissipation pads designed to reduce discharge velocities to non-erosive levels. Dissipation pads shall be designed and constructed with either an engineering fabric or washed stone barrier between the pad and the natural ground. Calculations shall be furnished to indicate the sufficiency of the dissipation pads specified. Riprap pad design shall be in accordance with NYDOT or NRCS methods. Filter fabric or a washed stone liner shall be used on all sediment basins, riprap dissipaters, and channels.

110.03.04.04 Open Channels and Ditches

110.03.04.04.01 Open channels, ditches, and driveway pipes shall be designed based on the 10-year storm.

110.03.04.04.02 Channels and ditches shall be designed to carry the design flow at non-erosive velocities. Calculations indicating design velocities shall be provided along with typical channel cross-sections. The maximum allowable design velocity in grass channels is 4 feet per second. Riprap design shall be in accordance with NCDOT or NRCS methods.

110.03.05 Inspection and Testing

110.03.05.01 The Contractor shall furnish all materials, labor, and equipment to perform inspections of stormwater collection systems.

110.03.05.02 All materials used shall be approved by the Construction Inspector prior to installation. Rejected materials shall be immediately removed from the job. Town Inspector may require any materials installed without previous inspection or installed in a manner not consistent with the approved plans and specifications to be removed and reinstalled.

110.03.05.03 Stormwater collection system pipes shall be clean and free from obstructions and shall be visually inspected from every structure or opening. Pipes which do not exhibit a true line and grade or which have structural defects shall be corrected.

110.03.05.04 All stormwater collection system piping and structures shall be approved by the Construction Inspector prior to paving.

110.03.06 Piping of Public Street Ditches by Private Property Owners

110.03.06.01 Private property owners wishing to pipe open ditches along public streets are required to submit design calculations and construction plans prepared by a Design Professional.

110.03.06.02 The design calculations shall consider drainage from adjacent properties, continuation of the pipeline along the street, and plan for proposed and future catch basins/yard inlets.

110.03.06.03 The design and construction of the stormwater collection system piping shall meet all requirements of these Standard Specifications and Details.

110.03.06.04 The approval process shall follow the construction plan submittal procedures in Section 030.

110.03.06.05 An Encroachment Agreement is required prior to any construction within public street ROW.

110.03.06.06 The installation of the piping shall be inspected by the Town for compliance with the approved plans and these Standard Specifications.

110.03.06.07 After the Construction Inspector verifies acceptable construction of the stormwater collection system piping, the piping shall be dedicated to the Town, and after acceptance by the Town, it shall be maintained by the Town. See Section 040 for more details on inspection and acceptance procedures.

110.04 STORMWATER MANAGEMENT

110.04.01 Purpose

110.04.01.01 The purpose of stormwater management is to protect, maintain, and enhance the public health, safety, and general welfare by establishing minimum requirements and procedures to control the adverse effects of increased stormwater runoff associated with land development within the Town. Proper management of stormwater runoff will minimize damage to public and private property, insure a functional drainage system, reduce the effects of development on land and stream channel erosion, assist in the attainment and maintenance of water quality standards, enhance the local environment associated with the drainage system, reduce local flooding and drainage problems, maintain as nearly as possible the pre-developed runoff characteristics of the area, and facilitate economic development by mitigating associated flooding and drainage impacts.

110.04.01.02 The application of these specifications shall be the minimum stormwater discharge control requirements and shall not be deemed a limitation or repeal of any other obligations imposed by State statute or judicial decisions. Consequently, if site characteristics indicate that complying with these minimum requirements will not provide adequate designs or protection for local property or residents, it is the Design Professional's responsibility to exceed the minimum requirements as necessary.

110.04.02 Exceptions from Requirements

110.04.02.01 The Town Board may grant an exception from the requirements of this Section if there are unique circumstances applicable to the site such that strict adherence to the provisions of the policy will result in unnecessary hardship and not fulfill the intent of the policy.

110.04.02.02 A written request for an exception shall be required and shall state the specific exception sought and the justification therefore. It shall include descriptions, drawings, calculations and any other information that is necessary to evaluate the proposed exception.

110.04.02.03 Development projects not subject to stormwater management rules due to the size of the area with a disturbed area greater than 0.85 acres shall survey the placement of silt fence to delineate the allowable disturbance. Projects resulting in a disturbance of greater than 1 acre will be required to comply with the requirements of the stormwater management ordinance.

110.04.03 Minimum Runoff Control Requirements

110.04.03.01 Flow velocities from a stormwater discharge control facility shall comply with the “North Carolina Sedimentation Pollution Control Act of 1973”.

110.04.03.02 Measures shall comply with any applicable local, state, and/or federal Neuse River Basin rule.

110.04.03.03 Stormwater discharge control facilities shall reduce post-development runoff rates to pre-development runoff rates for the 1-year, 24-hour design storm, the 2-year, 24-hour design storm, and the 10-year, 24-hour design storm.

110.04.03.04 Stormwater discharge control facilities shall provide sufficient storage volume to retain on-site the runoff from the first inch of rainfall (first flush) for 48 to 72 hours.

110.04.03.05 The Town reserves the right to require additional stormwater management measures for projects complying with this policy if stormwater runoff from the project will cause adverse effects on other properties including, but not limited to, public streets, sidewalks, greenways, and utility easements.

110.04.03.06 85% Average Annual TSS: A minimum of 85% average annual removal for Total Suspended Solids (note: for most BMPs this will be based on the 1 inch run off volume, some specific BMPs may be based on alternative design criteria. On occasion NCDEQ Stormwater Design Manual will require 90% TSS removal.)

110.04.03.07 Each phase of development shall be designed to meet the performance standards upfront to eliminate the need for retrofitting. These performance standards apply to the parent parcel of the development at the time of the first phase of development for any new development project. The overall development must remain in full compliance with the stormwater performance standards with each phase. In special cases, the Director of Engineering may allow proposed development that will disturb only a small fraction of a larger parcel to phase the project with the understanding that all of the standards must still be met as the project is developed.

110.04.03.08 Some development sites may have impervious cover that was in-place prior to the enactment of the Ordinance. In such situations, this impervious cover may be considered on the pre-development side of the peak stormwater runoff calculations. Also, this impervious cover or an equivalent impervious area is exempt from 85% TSS removal requirements. However, in many cases, it may be more difficult and costly to by-pass this impervious cover around proposed BMPs. This is particularly true when the existing impervious cover is small relative to the impervious area associated proposed conditions.

110.04.03.09 Built-upon area shall be considered the portion of a development project that is covered by impervious or partially impervious coverage including buildings, pavement, gravel roads and parking areas, recreational facilities (e.g. tennis courts), etc. (Note: Wooden slatted decks and the water area of a swimming pool are considered pervious.) The design engineer shall use conservative assumptions when creating a stormwater management plan, allowing some consideration for future individual lot or home improvement projects, such as a home addition.

110.04.04 Stormwater Control Facilities

110.04.04.01 Stormwater discharge control facilities may include both structural and nonstructural elements. Natural swales and other natural runoff conduits shall be retained where practicable, but where additional stormwater discharge control facilities are required to satisfy the minimum control requirements, the following measures are examples of what may be used:

110.04.04.01.01 Stormwater detention structures (dry basins).

110.04.04.01.02 Stormwater retention structures (wet ponds).

110.04.04.01.03 Detention swales.

110.04.04.01.04 Bio-retention areas (requires geotechnical report to establish suitability of fill material for bioretention area).

110.04.04.01.05 Other methods acceptable to the Director of Engineering that meets the policy requirements and assures no harm to downstream properties.

110.04.04.02 Structural BMP’s and stormwater control measures should be designed according to the latest version of NCDEQ Stormwater Design Manual. Additional design requirements may be necessary for BMP’s that are utilized as detention basins for flood control. The general design, operation, and maintenance requirements are as follows and apply to all structural BMPs in the Town of Fuquay-Varina:

110.04.04.02.01 Sizing shall take into account all runoff at ultimate build-out including offsite drainage that is not diverted

110.04.04.02.02 Pretreatment, or the removal of sediment or other suspended solids through velocity dissipating devices such as check-dams, forebays, sumps, vegetation, etc. is required for all BMPs.

110.04.04.02.03 All structural stormwater BMPs shall be designed to be aesthetically pleasing (to the extent the BMP type allows, and defined by compliance with the UDO) and not include fencing (i.e. chain link or privacy) unless approved by the Engineering Department and under special circumstances where the public health and safety is a reasonable concern. All fences must meet UDO design requirements applicable for the specific project.

110.04.04.02.04 All BMPs must be designed with an emergency bypass or overflow system, where applicable.

110.04.04.02.05 All BMPs shall be located in a recorded drainage easement with a recorded access easement to a public right-of-way.

110.04.04.02.06 Adequate access to the entire BMP structure is mandatory and must be provided for maintenance, access to forebay and outlet.

110.04.04.02.07 All BMPs shall have an Operations and Maintenance Agreement signed by the responsible party or owner and recorded with the deed.

110.04.04.02.08 Infiltration BMPs shall be designed and constructed with smooth walled perforated underdrains, unless the in-situ soils meet the required permeability standards. All underdrain systems shall have clean-outs.

110.04.04.02.09 Infiltration BMPs shall be designed and constructed with soils (existing or engineered) that meet the specifications for texture and permeability, testing and certifications of the soils used in the construction of the BMP shall be submitted to the TOFV with the Engineer’s Certification of the BMP installation.

110.04.04.02.10 All BMPs shall be certified by a registered PE for BMP installation. BMPs that will be used as an erosion control device during construction shall be certified twice: 1.) to verify that the volume and surface area has been established and the outlet has been constructed in accordance with the approved plan. 2.) at the time of the final construction of the BMP. Mylar and digital as-builts and soil certifications shall be provided at the time of final construction with the PE certification.

110.04.04.02.11 Infiltration BMP construction shall avoid the use of heavy equipment on the bottom of the basin, or any areas of the BMP where infiltration is a design component.

110.04.04.02.12 The entire system must be designed to safely pass the 10-year storm event without causing scour, rills, gulleys or other reasonably expected failure, unless otherwise indicated in the design manual or ordinance.

110.04.04.02.13 Drought tolerant species of vegetation and warm weather grasses should be use on the BMPs.

110.04.04.02.14 Trees/woody vegetation shall not be planted on the BMP dam, planting of trees/woody vegetation is allowable around other perimeter slopes of the BMP.

110.04.04.02.15 Reference the most recent NCDEQ Stormwater Design Manual and N.C. State University Cooperative Extension Office for further design considerations, specifically BMP plantings.

110.04.04.02.16 Sand Filters must be designed as a “Closed-Basin” as described in the NCDEQ Stormwater Design Manual.

110.04.04.02.17 Both barrel and riser structure shall be concrete and the riser shall be located in or near the embankment.

110.04.04.02.18 On-site disposal areas capable of receiving sediment from at least two clean-out cycles shall be reserved in adjacent open space if area is available. In the event that area is not available sediment must be taken to an approved off site location. Method and location of sediment removed from BMPs shall be outlined in the O&M document for the project.

110.04.04.02.19 A one-time application of fertilizer shall be allowed for new construction to establish vegetation for the purpose of stabilization with regard to erosion control or establishment of plantings associated with Structural Stormwater BMPs. Soil testing may be required for proper application rates of fertilizer for vegetation establishment. Fertilization f existing lawns should be preceded by soil testing and recommended application rates should be followed. Any Person(s) that is found to be over-fertilizing may be subject to penalty in accordance with the Illicit Discharge Detection and Elimination Ordinance.

110.04.04.02.20 Cross sections of all BMPs will be required on Construction Drawings.

110.04.04.03 Non-Structural BMPs are passive or programmatic and tend to be source control or pollution prevention policies and programs that reduce pollution in runoff by reducing the opportunity for the stormwater runoff to be exposed to the pollutants. Non-structural BMPs usually work by changing behavior through government regulation (e.g., planning and ordinances), and/or economic instruments (density, etc.). Non-structural BMPs also include institutional, educational or pollution prevention practices.

110.04.04.04 Where detention and retention structures are used, designs that consolidate these facilities into a limited number of large structures shall be preferred over designs that utilize a large number of small structures.

110.04.04.05 Stormwater discharge control design plans can be rejected by the Director of Engineering if they incorporate structures and facilities that will demand considerable maintenance, will be difficult to maintain, or utilize numerous small structures, if other alternatives are physically possible.

110.04.04.06 Retention/Detention outlet structures shall be cast in-place or precast concrete or aluminum pipe only.

110.04.04.07 Wet detention ponds shall reference and adhere to standards set forth by NCDEQ in “Stormwater Best Management Practices.” Additional requirements by the Town include a maximum of 3:1 slopes on all sides of the ponds, unless exempted by the Director of Engineering.

110.04.05 Stormwater Discharge Control Design Plan and Report Requirements

110.04.05.01 Stormwater discharge control design plans shall be prepared by a Design Professional, using acceptable engineering standards and practices. Final Stormwater Management Report and Calculations: Shall be a bound document and include at a minimum the following items:

110.04.05.01.01 Cover Sheet: Name of project, name of developer, name of engineering firm, date of first issuance, all subsequent revision dates, and seal/signature of a registered professional engineer.

110.04.05.01.02 Project Narrative: Narrative with a brief description of existing drainage patterns, environmental features, topography, proposed improvements, proposed drainage patterns, stormwater management objectives, and proposed stormwater management approach.

110.04.05.01.03 Existing and Proposed Drainage Area Maps: Maps showing and labeling land cover conditions, sub-shed drainage areas, proposed BMP's, time of concentration segments, drainage patterns/pipe networks, and interconnectivity of sub-shed areas. Separate maps maybe needed for stormwater management and storm drainage design purposes.

110.04.05.01.04 All surface waters, FEMA 100-year floodplain and floodway lines, flood hazard soils areas, wetlands, reserved open spaces, and the location, dimensions and arrangements of all drainage way, watershed, riparian, and other buffers including associated setbacks.

110.04.05.01.05 Final BMP Sizing Calculations: Basic sizing calculations only to demonstrate compliance with required footprint (square feet) or length and NCDEQ Stormwater BMP Manual sizing documents.

110.04.05.01.06 First Flush Volume Calculations: Calculations demonstrating the first flush volume.

110.04.05.01.07 Stormwater Management Routing Calculations: Calculations for routing of stormwater through each BMP. Include a system schematic, flow summaries for each node, design storm data used, Tc calculations, runoff coefficient calculations, hydrograph summaries or hydrographs, bmp volume calculations (elevation/area table), outlet structure design data, outlet structure flow calculations, and drawdown time calculations (first flush and 1-year storm).

110.04.05.01.08 TSS Removal Calculations: In many situations, this will simply be a statement of how 85% TSS is being removed. However, if impervious area is being bypassed from proposed BMPs or BMPs in series are being utilized to achieve 85% TSS, then calculations demonstrating compliance shall be provided.

110.04.05.01.09 A determination that the proposed stormwater discharge control facility shall not create flooding or drainage problems for adjacent structures for the 10- and 100-year flood events.

110.04.05.01.10 Erosion Control Calculations: Detailed calculations for all erosion control measures such as sediment basins, channels/diversion ditches, skimmers, etc.

110.04.05.01.11 Soils Information: Site boundary overlay on USGS Quadrangle Maps and USDA Soils Maps. Where BMP design requires infiltration, provide appropriate geotechnical soils information such as infiltration testing.

110.04.05.01.12 A designation of all easements needed for inspection and maintenance of the stormwater discharge control facilities. The location of all stormwater management facilities shall be specified prior to recording of easements.

110.04.05.01.13 A plan for maintenance of all stormwater discharge control facilities shall be included as part of the stormwater discharge control design plan. The maintenance plan shall include an estimated maintenance budget.

110.04.05.01.14 Landscaping/screening to enhance the aesthetic qualities of the stormwater discharge control facilities. Landscaping inside detention/retention basins side slopes is allowed as long as the landscaping does not significantly decrease storage volume or create maintenance problems. Any screening used shall be opaque in nature. Vegetative screening shall not be used on dam structures.

110.04.05.02 The hydrologic criteria to be used for the stormwater discharge control design plans and calculations included on the plans or in the report shall be as follows:

110.04.05.02.01 Post development discharge shall be at pre-development levels for the 1-year, 24-hour, 2-year, 24-hour, and 10-year, 24-hour design storms for all stormwater discharge facilities.

110.04.05.02.02 Emergency spillways shall be designed at a minimum for 50-year storms.

110.04.05.02.03 All stormwater discharge control designs shall be checked using the 100-year storm for analysis of local flooding and possible flood hazards to adjacent structures and/or property.

110.04.05.03 Record Drawings for all stormwater management facilities depicting as-built conditions including, but not limited to, size, depth, field location and elevations, shall be certified by an Design Professional as to the completeness of the as-builts, that the stormwater management devices and their installation are in compliance with this policy and the approved plans, and that a copy of the record drawings has been provided to the Town for permanent record.

Table 110.01 - I-D-F Table*						
Duration (minutes)	1-year (inches/hour)**	2-year (inches/hour)	10-year (inches/hour)	25-year (inches/hour)	50-year (inches/hour)	100-year (inches/hour)
5	5.10	5.82	7.44	8.23	8.77	9.28
10	4.20	4.65	5.95	6.56	6.98	7.37
15	3.50	3.90	5.02	5.55	5.90	6.21
30	2.38	2.69	3.64	4.11	4.44	4.76
60	1.50	1.69	2.37	2.73	3.01	3.27
120	0.89	1.00	1.43	1.67	1.85	2.03
180	0.65	0.70	1.02	1.20	1.35	1.50
360	0.38	0.42	0.61	0.73	0.82	0.91
720	0.23	0.25	0.36	0.43	0.49	0.55
1440	0.13	0.15	0.21	0.25	0.29	0.32
24-hour rainfall	3.00	3.51	5.13	6.11	6.89	7.69

*- Based on NOAA – National Weather Service Atlas 14 Volume 2 Version 2.1
** - The 1-year storm is a misnomer, since this would result in a 100% occurrence in any given year, but it is so named herein for ease of reference.