City of
Rocky Mount

STORMWATER MANAGEMENT PLAN

Tar-Pamlico River Basin: Stormwater Program for Nutrient Control

City Council Action
August 9, 2004

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Appendices

1. Introduction

The Tar-Pamlico stormwater rule, 15A NCAC 2B .0258, requires that the City of Rocky Mount develop a local stormwater program. This document and its associated appendices are intended to establish the methods by which the City of Rocky Mount will comply with the substantive requirements of the rule.

The intent of this plan is to serve as a guidance document for the operation of the City's comprehensive stormwater management program as it relates to compliance with the Tar-Pamlico River Basin - Nutrient Sensitive Waters Management Strategy: Basinwide Stormwater Requirements. A map of the City's jurisdictional limits is provided in Appendix A.

In addition to the Tar-Pamlico Basin Regulations, the City of Rocky Mount is also subject to the NPDES Phase II and the Water Supply Watershed regulations. The City also has a locally delegated Erosion and Sedimentation Control Program. The intent of the City's stormwater management program is to integrate the requirements of the Tar-Pamlico regulations with the requirements of these other programs to have a single comprehensive management strategy that addresses the requirements of each program with common program elements.

Funding

Primary funding for the City's comprehensive stormwater management program is from the Stormwater Utility that began operations on July 1, 2003. When the utility began operations in July 2004 it supported 36 operational and 2 administrative positions. The utility also receives administrative support from other City departments including Engineering and Finance.

The stormwater utility is a funding mechanism which equitably distributes the cost of the stormwater management program among the users based on demand to the system. The stormwater utility will provide financial support for many of the activities outlined in the plan but is not relied upon as a legal authority to enforce any provisions of the plan. The jurisdiction of the utility is limited to the Rocky Mount Corporate limits.

New Development

Elements of the program related to new construction and maintenance of BMPs constructed to comply with the requirements of the program will be will be enforced by the City within the City Limits and ETJ as part of its existing land development regulatory process.

Illegal Discharge

The City has traditionally limited its nuisance abatement code enforcement activities to the City Limits since no supporting revenue in the form of taxes or related fees are levied in the areas outside the City Limits. The city will continue to follow this model with respect to the illegal discharge detection and elimination program and does not plan to expend City resources for mapping or dry weather screening in the ETJ. The City would be willing to provide some portion of these services under contract to the appropriate county provided an

equitable cost sharing arrangement can be made. The program is established pursuant to the authority contained in G.S. 113A Article 4 (Pollution Control Act), G.S. 143 Article 21 (Water and Air Resources); G.S. 160A- 185 (Emission of pollutants or contaminants) and the requirements of 15A NCAC 2B.0258.

Public Education

Public education and public involvement activities as a matter of policy will be limited to areas within the city limits for the reasons listed above. It should be noted however, that many of the public education and involvement activities will be done in cooperation with Nash and Edgecombe County and by their nature will not limit themselves to a particular political boundary. Direct mailings and other activities that are specific to a geographic area and require significant fund expenditures will be limited to areas inside the city unless they are done in cooperation with another supporting agency or provide some direct benefit to areas inside the city.

1-A. Purpose of the Tar-Pamlico Stormwater Rule

The Tar-Pamlico River Basin begins in Piedmont North Carolina and extends approximately 180 miles through the Coastal Plain to Pamlico Sound. Together, Pamlico Sound and neighboring Albemarle Sound constitute one of the most productive estuarine systems in the country. The 5,400 square mile Tar-Pamlico basin is comprised primarily of agricultural and forest land, and many smaller municipalities. Despite the rural character of the basin, in the mid-1970's the Pamlico River estuary began to see increasing frequencies of harmful algal blooms, fish kills, and other nutrient-related problems.

By the mid-1980's, the state began to consider actions to control nutrient inputs to the estuary. Those actions have included the following:

Phase I: In 1989, the North Carolina Environmental Management Commission designated the entire basin "Nutrient Sensitive Waters". The first phase of management through 1994 focused primarily on point sources, establishing an annually decreasing nutrient loading cap for an association of dischargers, and an innovative "trading" program that allowed dischargers to achieve reductions in nutrient loading more cost-effectively.

PCS Recycling: In 1992, a phosphate mining company then known as Texas Gulf, which is located on the Pamlico River estuary, instituted a wastewater recycling system that reduced its phosphorus discharges to the estuary by 93%.

Phase II: Modeling of estuary conditions showed that despite the gains made to that point, significant reductions in nitrogen and phosphorus loading were still needed to restore water quality standards and minimize the recurrence of harmful algal blooms. The second phase of the nutrient strategy, which runs through 2004, established a biologically based goal of 30 percent reduction in nitrogen loading from 1991 levels and holding phosphorus loading at 1991 levels. Load reductions were apportioned among point sources and the major nonpoint

sources. The point sources were given steady annual nitrogen and phosphorus loading caps. A program was designed with the nonpoint sources to achieve the goals through voluntary measures. After two years of voluntary implementation, the Commission found insufficient progress and called for rules for nonpoint sources.

Rules: Beginning in 1998, DWQ staff conducted a lengthy public input process to evaluate source categories and develop rules where needed. Over the course of 2000, the Commission adopted rules for agriculture, fertilizer application across all land uses, urban stormwater, and rules to protect the nutrient removal functions of existing riparian buffers. These rules were modeled after a similar set of rules recently adopted in the adjacent Neuse River Basin. The Neuse rules were given extensive public review and modification, and the Tar-Pamlico rules similarly received extensive scrutiny. The resulting rules provide increased flexibility for the regulated community while maintaining the focus of the nutrient reduction goals.

1-B. Requirements of the Tar-Pamlico Stormwater Rule

The Tar-Pamlico stormwater rule applies to the local governments with the greatest likelihood of contributing significant nutrient loads to the Pamlico estuary. The EMC may designate additional local governments in the future through rule amendment based on criteria given in the rule.

The affected local governments are:

Municipalities	**Counties**
Greenville	Beaufort
Henderson	Edgecombe
Oxford	Franklin
Rocky Mount	Nash
Tarboro	Pitt
Washington	

For these local governments, only their geographic areas that fall within the Tar-Pamlico River Basin are subject to the rule. In subject counties, applicable areas are those under the direct jurisdiction of the counties, which would not include incorporated cities, towns, or villages within county jurisdictional limits. Cities and counties are encouraged to coordinate to establish implementation responsibilities within municipal extraterritorial jurisdictions. Counties administering development regulations by interlocal agreement on behalf of municipalities would implement the rule within only those municipalities that are subject to the rule. The activities of state entities within subject local governments would be subject to the rule.

The rule establishes a broad set of objectives for limiting nutrient runoff from urban areas. It then lays out a set of specific elements, described below, that local governments shall include in their programs. It also sets up a process by which DWQ will work with the affected local

governments to develop a model stormwater program for meeting the objectives. Timeframes for implementation of the rule are as follows:

April 1, 2001:	Effective date of the rule.
February 13, 2003:	Target date for approval of the Model Stormwater Program by the Environmental Management Commission (modified through EMC approval from the date of April 1, 2002 established in the rule).
February 13, 2004:	Deadline for submittal of local Stormwater Programs (including ordinances) to the EMC (modified as above).
August 13, 2004:	Deadline for local governments to begin implementing local Stormwater Programs (modified as above).

Following implementation in August 2004, local governments are required to make annual progress reports to the EMC that will include nitrogen and phosphorus loading reduction estimates.

The elements that must be included in local stormwater management programs are:

1. New Development Review/Approval

New development is required to meet the 30% reduction goal through site planning and best management practices. The rule imposes a 4.0 pounds per acre per year (lb/ac/yr) nitrogen loading limit and a 0.4 lb/ac/yr phosphorus loading limit on new development. Proposals that exceed these performance standards may partially offset their load increases by treating existing developed areas offsite that drain to the same stream.

New development must also avoid causing erosion of surface water conveyances. At minimum, post-development peak flows leaving the site may not exceed pre-development for the 1-year, 24-hour storm event. The rule also provides local government with the option of using regional stormwater facilities to help meet nutrient loading and attenuation requirements under certain circumstances.

2. Illegal Discharges

Illegal discharges are substances deposited in storm sewers (that lead to streams) that should instead be handled as wastewater discharges. Illegal discharges may contain nitrogen. Local governments must identify and remove illegal discharges.

3. Retrofit Locations

There are a number of funding sources available for water quality retrofit projects, such as the Clean Water Management Trust Fund and the Wetland Restoration Program that the NC General Assembly has recently established. To assist technical experts, local governments are required to identify sites and opportunities for retrofitting existing development to reduce total nitrogen and phosphorus loads.

4. Public Education

Citizens can reduce the nitrogen pollution coming from their lawns and septic systems if they understand the impacts of their actions and respond with appropriate management measures. The local governments will develop and implement public and developer education programs for the Tar-Pamlico basin.

2. New Development Review/Approval

2-A. Requirements in the Rule

The Tar-Pamlico Stormwater Rule (15A NCAC 2B .0258) has the following requirements (see the rule in Appendix B for complete language) for new development located within the planning and zoning jurisdictions of the 11 local governments subject to these rules:

- The nitrogen load contributed by new development activities is held at 4.0 pounds per acre per year. This is equivalent to 70 percent of the estimated average nitrogen load contributed by non-urban areas in the Tar-Pamlico River basin (as defined using 1995 LANDSAT data). Similarly, the phosphorus load contributed by new development activities is held at 0.4 pounds per acre per year, which is equivalent to the estimated average phosphorus load contributed by non-urban areas in the basin. The Environmental Management Commission may periodically update these performance standards based on the availability of new scientific information.

- Property owners shall have the option of partially offsetting projected nitrogen loads by providing treatment of existing developed areas off-site that drain to the same stream. However, the total nitrogen loading rate cannot exceed 6.0 pounds per acre per year for residential development or 10 pounds per acre per year for non-residential development.

- There is no net increase in peak flow leaving the developed site from the predevelopment conditions for the 1-year, 24-hour storm.

- Local governments must review new development plans to assure compliance with requirements for protecting and maintaining riparian areas as specified in 15A NCAC 2B .0259.

Local governments may include regional stormwater facilities in their programs to provide for partial nutrient and flow control. Such facilities may not degrade surface waters.

2-B. Protecting Riparian Areas on New Development

The Tar-Pamlico Riparian Buffer Protection Rule, 15A NCAC 2B .0259, requires local governments that are subject to the stormwater rule to ensure that riparian areas on new developments are protected in accordance with the buffer rule's provisions. The buffer rule requires that 50-foot riparian buffers be maintained on all sides of intermittent and perennial streams, ponds, lakes and estuarine waters in the basin. The buffer rule provides for certain "allowable" uses within the buffer with DWQ approval, such as road and utility crossings.

The City will disapprove any new development activity proposed within the first 50 feet adjacent to a waterbody that is shown on either the USGS 7.5 minute topographic map or the NRCS Soil Survey map unless the owner can show that the activity has been approved by DWQ. DWQ approval may consist of the following:

- An on-site determination that surface waters are not present.
- An Authorization Certificate from DWQ for an "allowable" use such as a road crossing or utility line, or for a use that is "allowable with mitigation" along with a Division-approved mitigation plan. A table delineating such uses is included in the buffer rule.
- An opinion from DWQ that vested rights have been established for the proposed development activity.
- A letter from DWQ documenting that a variance has been approved for the proposed development activity.

2-C. Calculating N and P Export from New Development

- Built-upon area means that portion of a development project that is covered by impervious or partially impervious cover including buildings, pavement, and gravel area. Slatted wooden decks and the water surface area of pools shall be considered pervious.
- Land disturbance is defined as grubbing, stump removal, grading, or removal of structures.

New Development Defined: For the purposes of the Tar-Pamlico Stormwater Program, new development shall be described to include the following:

- Any activity that disturbs greater than one acre of land to establish, expand, or replace a single family or duplex residential development or recreational facility. For individual single family residential lots of record that are not part of a larger common plan of development or sale, the activity must also result in greater than ten percent built-upon area.
- Any activity that disturbs greater than one-half an acre of land to establish, expand, or replace a multifamily residential development or a commercial, industrial or institutional facility.
- New development shall not include agriculture (including intensive livestock operations), mining, or forestry activities.

Provisions for Re-development Projects: Projects that replace or expand existing structures or improvements and exceed the land disturbance limits described above are subject to the following provisions:

- Projects that replace or expand existing structures or improvements and that do *not* result in a net increase in built-upon area *shall not be required* to meet the basinwide average non-urban loading levels.

- Projects located within an area the City of Rocky Mount has designated as a redevelopment area will not be required to achieve nutrient reductions provided the City has a specific redevelopment plan in place for the area that meets the following conditions:

  - The re-development area is a historic community center, traditional central business district, historical district, educational center, or other existing developed area specifically identified by the City Council.
  - The City has an established a strategy, for reinvestment in the area that address the following criteria as appropriate:
    - A "fix it first" policy that reserves public funds for repair of existing infrastructure in these areas before investing in new infrastructure of the same type in new growth areas.
    - Mixed use/mixed density zoning provisions.
    - Retrofits are consistent with NCDOT definitions for pedestrian scale in traditional neighborhood developments (e.g., 80% of users are within a ¼ mile walk from schools, libraries, and recreational/athletic facilities, 60% of students and 50% of teachers are within ½ mile walk from schools, and 40% of congregants are within ¼ mile of churches).
    - Parking maximums or shared parking ratios.
    - Residential density bonuses where parking maximums, pedestrian scale, or "fix it first" are proposed.
  - The re-development plan is conducive to the goals of the Tar-Pamlico nutrient strategy.

- Projects that replace or expand existing structures or improvements resulting in a net increase in built-upon area shall achieve a 30 percent reduction in nitrogen loading and no increase in phosphorus loading relative to the previous development. Such projects may achieve these loads through onsite or offsite measures or some combination thereof.

  - Multi-family residential, commercial, industrial, and institutional projects may choose to achieve all of this reduction by providing treatment of off-site developed areas, or by permanently conserving land from future development in conformance with the local government's approved land conservation plan, as described in Section 2-G.

Vesting: All new development projects within the City of Rocky Mount Planning Jurisdiction that have received approval from the City of Rocky Mount, Nash or Edgecombe County for a site-specific or phased development plan by September 15, 2004, and that have implemented that development in accordance with the City of Rocky Mount vesting provisions shall be exempt from the requirements of the Tar-Pamlico stormwater rule. This vesting provision is predicated on the condition that any plats associated with such development must be recorded within a maximum of five years from the date of development approval. All new development projects that have not received such approval by September 1, 2004 or recorded any plats associated with such development within five years of the development's approval shall be subject to the requirements of the rule.

Projects that require a state permit, such as landfills, NPDES wastewater discharges, land application of residuals and road construction activities shall be considered exempt if a state permit was issued prior to the effective date of the local stormwater program.

Calculating N and P Export: The nitrogen and phosphorus export from each new development must be calculated. This export will be calculated in pounds per acre per year (lbs/ac/yr). The methodology to make this calculation is described below. The worksheets to carry out the calculations are provided in Appendix H, along with a description of their development. (A spreadsheet version of the worksheet can be downloaded from the City of Rocky Mount web site located at *http://www.ci.rocky-mount.nc.us*)

It is expected that some values provided in the methodology will be refined over time. The NCDENR Division of Water Quality plans to provide those refinements to the jurisdictions on a periodic basis as they are established. For example, additional research may lead to refined export values for the various urban land covers, particularly rooftop and transportation impervious surface. Also, stormwater management practices are typically in various stages of refinement around the country. Several nutrient reducing BMPs are being applied and studied around North Carolina toward better designs and more accurate knowledge of long-term nutrient removal efficiencies. The NCDENR Division of Water Quality will ask the jurisdictions to incorporate these refinements into their programs from time to time as they are substantiated.

For a given project, the methodology calculates a weighted annual load export for both nitrogen and phosphorus based on event mean concentrations of runoff from different urban land covers and user-supplied acreages for those land covers. The user chooses BMPs that reduce the export to rule-mandated levels. Two versions of the spreadsheet were developed based on rainfall differences between the "Piedmont" and "Coastal Plain" ; the "Piedmont" version (provided in Appendix H) is to be used for all projects in Rocky Mount's jurisdiction.

A residential worksheet is also provided in Appendix H to calculate acreages dedicated to different land covers in residential developments where impervious footprints are not shown.

2-D. BMPs for Reducing Nitrogen and Phosphorus

The rule requires that all new developments achieve a nitrogen export of less than or equal to 4.0 (and a phosphorus export of less than or equal to 0.4) pounds per acre per year. If the development contributes greater than 4.0 pounds nitrogen (or 0.4 pounds phosphorus), then the following options exist.

- If the computed nitrogen export for single family/duplex residential development is greater than 6.0 lb N/ac/yr or 10.0 lb N/ac/yr for commercial development, then the development plan must include on-site BMPs or be included in an approved regional or jurisdiction-wide stormwater strategy or some combination of these to lower the nitrogen export to at least 6.0 (or 10.0) lb N/ac/yr respectively. The owner may then use one of the following two options to reduce nitrogen from 6.0 (or 10.0) to 4.0 lb N/ac/yr.

- If the computed nitrogen export is greater than 4.0 lb/ac/yr but less than 6.0 (or 10.0) lb N/ac/yr dependant on development type, then the owner may either:
  - Provide treatment of an offsite developed area that drains to the same stream to achieve the same nitrogen mass loading reduction that would have occurred onsite. Or;
  - Install BMPs onsite or take part in an approved regional or jurisdiction-wide stormwater strategy or some combination of these to remove nitrogen down to 4.0 lb N/ac/yr. Participation in regional or jurisdiction-wide stormwater facilities and/or strategies is subject to development and approval of such facilities or strategies and any conditions and/or limitations that may be a part of the strategy or facility.

- The owner must install BMPs that also achieve a phosphorus export of less than or equal to 0.4 lb P/ac/yr, but may do so through any combination of on-site and offsite measures.

As with most resource impacts, an ounce of stormwater prevention is worth a pound of cure. A sound site planning process first considers the ability to achieve the needed reductions using site design measures that avoid or minimize runoff to begin with. The accounting method in Section 2-C provides credit for site planning practices that reduce nutrient loadings in this manner. These planning measures include reducing, disconnecting, and rerouting impervious surfaces, maximizing time of concentration for stormwater, and protecting open spaces for infiltration and evapotranspiration. More detail on planning measures that reduce hydrologic and nutrient loading is given in Appendix L.

Often, structural management practices cannot be avoided. BMP selection is an important and challenging craft. Available data indicate that most BMPs remove only 20 to 40 percent of total nitrogen or phosphorus on a consistent basis. There are a number of issues to consider to ensure this sustained performance. It is crucial to consider the issues of aesthetics, long-term maintenance, safety and reliability in BMP design. All BMPs require regular maintenance and some have varying performance depending on soil type and season. ***The efficiencies provided below and in the load calculation worksheets in Appendix H assume correct sizing and other design per the referenced manuals, and optimum***

performance based on regular, effective maintenance as well as proper siting of the practices.

The BMPs available for nutrient reduction and their removal rates based on current literature studies are provided in Table 2c below. These median values are based on a literature review conducted by a contractor that updated Neuse nitrogen efficiencies and established phosphorus values. A summary of these literature studies is given in Appendix I. Also provided in the table are the design standards to be adhered to in permitting BMP design.

The design of best management practices that remove nitrogen and phosphorus from stormwater is a developing field. Researchers throughout the country, particularly in the Southeast, are conducting studies to identify and refine effective means of controlling nitrogen and phosphorus. As stated in Section 2-C, the NCDENR Division of Water Quality plans to provide refinements in the stated BMP removal efficiencies to the jurisdictions on a periodic basis as they are substantiated.

Table 2c: BMP Types, TN and TP Removal Rates, and Design Standards

BMP Type	TN Removal Rate per Literature Review	TP Removal Rate per Literature Review	Appropriate Design Standards
Wet detention ponds	25%	40%	NC Design Manuals
Constructed wetlands	40%	35%	NC Design Manuals
Restored riparian buffers	30%	30%	Tar-Pamlico Riparian Buffer Rule (15A NCAC 2B .0259)
Grass Swales	20%	20%	NC Design Manuals
Vegetated filter strips with level spreader	30%	30%	NC Design Manuals and other literature information
Bioretention (rain gardens)	40%	35%	NC Design Manuals
Sand Filters	35%	45%	NC Design Manuals
Proprietary BMPs	Varies	Varies	Per manufacturer subject to DWQ approval
Other BMPs	Varies	Varies	Subject to DWQ approval

The design manual for the City of Rocky Mount does not currently contain any standards for design of water quality BMPs and therefore the City will defer to the design standards referenced in Table 2c for the design of water quality BMPs. The North Carolina BMP Design Manual can be accessed and downloaded from the DWQ Stormwater Unit's web page at http://h2o.enr.state.nc.us/su/stormwater.html or obtained by contacting the Stormwater Unit at 919-733-5083 ext. 545. The City may choose to incorporate water quality design standards into its manual at some point in the future but development of these standards is not a specific element of this plan.

Multiple BMPs: The worksheet provides calculation space for the case where more than one BMP is installed in series on a development. It determines the removal rate through serial rather than additive calculations. This is important to understand in projects where the automated worksheet is not used to estimate the effect of multiple BMPs.

As an example, if a wet detention pond discharges through a restored riparian buffer, then the removal rate shall be estimated to be 47.5 percent, determined as follows. The pond removes 25 percent of the influent nitrogen mass and discharges 75 percent to the buffer. The buffer then removes 30 percent of the remaining 75 percent of the original nitrogen amount that discharged from the pond, or 22.5 percent of the original influent amount. The sum of 25 and 22.5 is 47.5. The removal rate is NOT 25 percent plus 30 percent.

Assigning Values to Pervious Cover: Many development plans may involve open space that, at least initially, is shown as low maintenance pervious, wooded or reforesting condition. While it may seem logical to enter this acreage as wooded pervious, without conservation easements or some other mechanism for ensuring protection of these areas, the City of Rocky Mount has no control over their eventual condition. Thus, conservation easements (Appendix N), low maintenance easements (Appendix O) and/or operation and maintenance (O&M) agreements (Appendix M), consistent with the requirements of the BMP used, will be required for all pervious areas not declared as lawn/landscape managed pervious in the development plan.

Riparian buffers protected under the Tar-Pamlico Riparian Buffer Protection rule, 15A NCAC 2B .0259, are divided into two zones, moving landward from the surface water, that are afforded different levels of protection. Zone 1, the first 30 feet, is to remain essentially undisturbed, while zone 2, the outer 20 feet, must be vegetated but may be managed in certain ways. The user shall enter the acreage in zone 1 into the worksheet as wooded pervious, while zone 2 acreage shall be entered as managed pervious (lawn/landscape). Zone 2 may be counted as *low maintenance pervious* or *wooded area* only if placed in a conservation easement and managed in accordance with the guidelines specified therein.

2-E. Calculating Peak Runoff Volume

The Tar-Pamlico Stormwater Rule requires that new development not cause erosion of surface water conveyances. At a minimum, new development shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 1-year, 24-hour storm event. A number of Neuse local governments sought to use the 2-year rather than the 1-year storm as the design storm for peak flow control given that the 2-year storm is more consistent with current hydrologic modeling methodologies.

The main reason that the rule requires a 1-year design storm for peak flow control is to protect stream channels from erosion. Development on land causes many changes in stormwater hydrology. One of the major causes of streambank erosion in urban streams is the increase in the frequency of the bankfull-flooding event. The bankfull-flooding event generally occurs at approximately a 1.5-year frequency. The Tar-Pamlico Stormwater Rule requires control of the 1-year storm to predevelopment levels to insure that the rate of release will be below bankfull and therefore less erosive to the stream channel. Releasing the 2-year storm at predevelopment levels would likely have the effect of increasing the frequency of a storm that is just a bit larger than the most erosive storm.

Protecting streambanks from erosion is a crucial part of the overall Tar-Pamlico Nutrient Sensitive Waters Management Strategy. Riparian buffers are protected under this program because in most situations they are effective at removing nitrogen resulting from nonpoint source pollution. The use of nitrogen reducing BMPs on new development does not obviate the need to maintain valuable riparian buffers.

The 1-year Design Storm

The US Weather Bureau (Technical Paper 40) published maps of rainfall depths for the 1-year storm of duration 30 minutes to 24 hours. The 1-year, 24-hour precipitation, as given in this atlas, varies along the Tar-Pamlico River Basin as illustrated in Table 2b below.

Table 2d: Rainfall depths for the 1-year, 24-hour storm (from US Weather Bureau Technical Paper 40)

Municipality	1yr – 24hr depth (inches)	County	1yr – 24hr depth (inches)
Oxford	2.9		
Henderson	2.9	Franklin	3.0
Rocky Mount	3.2	Nash	3.1
Tarboro	3.3	Edgecombe	3.2
Greenville	3.4	Pitt	3.4
Washington	3.5	Beaufort	3.5

The Rational Method is an acceptable method for estimating peak discharge in the design of stormwater facilities for relatively small watersheds (up to 50 acres). The basic equation is:

$$Q = CIA$$

Where: Q is the peak flow for the design storm in cubic feet per second
C is the coefficient of runoff based on land cover (dimensionless)
I is the storm intensity in inches per hour
A is the drainage area in acres

The rational equation is based upon the assumption that rainfall is uniformly distributed over the entire drainage area at a steady rate, causing the flow to reach a maximum at the outlet of the watershed at a time to peak, Tp. The Rational Method typically gives a conservative estimate of runoff.

In order to use the Rational Method to determine peak flows, it is necessary to compute the storm intensity in inches per hour for the 1-year storm. The intensity is computed by the formula:

$$I = g/(h+Tc)$$

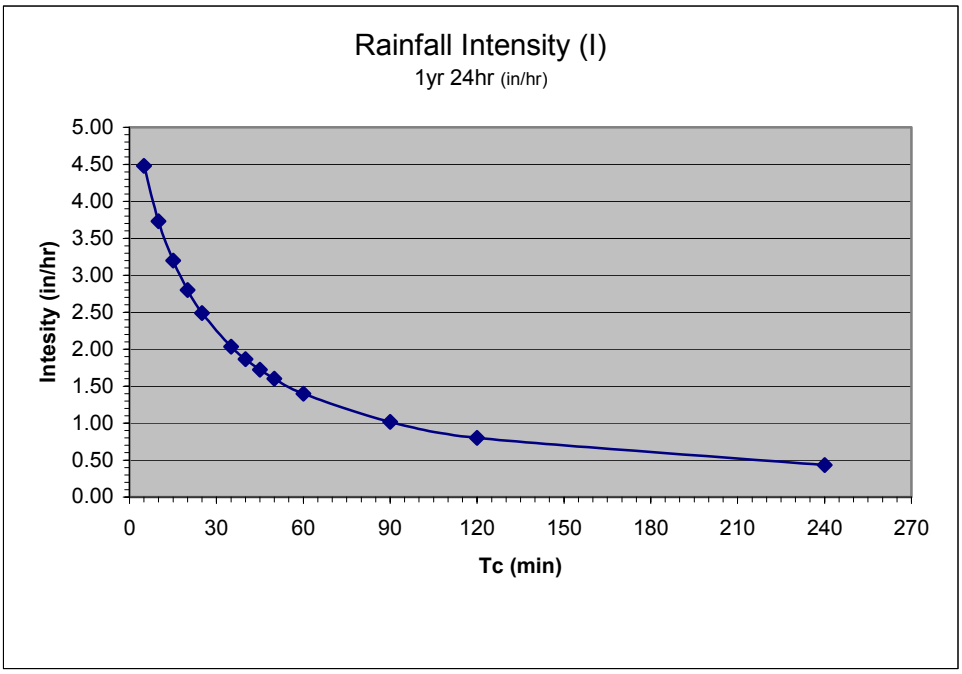
Where: I is the storm intensity in inches per hour
g and h are empirically derived constants
Tc is the duration in minutes (or $(L^3/H)^{0.385})/128$)

The values for constants g and h for the one-year storm are not presently available. The appropriate values for g and h were estimated by graphing the 2, 5, 10, 25, 50 and 100-year values of g and h for Wake and Wilson Counties as a function of return period on a log-normal scale and determining the y-intercept of the best-fit line (see Appendix J). The resulting values for g and h are directly applicable in the Tar-Pamlico River basin as follows:

Table 2e: Values of g and h for the One-Year Storm

Values From	Applicable Location in Tar-Pamlico Basin	Value of g	Value of h
Wake County	Oxford, Henderson, and Franklin County	104	18
Wilson County	Rocky Mount, Tarboro, and Greenville Nash, Edgecombe, and Pitt Counties	112	20
Craven County	Washington and Beaufort County	127	22

Subtituting the appropriate values for Rocky Mount yields the following result:



Tc (min)	I (in/hr)
5	4.48
10	3.73
15	3.20
20	2.80
25	2.49
35	2.04
40	1.87
45	1.72
50	1.60
60	1.40
90	1.02
120	0.80
240	0.43

Exceptions to the Peak Flow Requirement

Peak flow control is not required for developments that meet one or more of the following requirements:

- The increase in peak flow between pre- and post-development conditions does not exceed ten percent (note that this exemption makes it easier to conduct redevelopment activities).
- The proposed new development meets all of the following criteria: overall impervious surface is less than fifteen percent, and the remaining pervious portions of the site are utilized to the maximum extent practical to convey and control the stormwater runoff.
- The Director of Engineering makes a determination that stormwater detention in the location of the development plan will negatively impact existing drainage problems in the area. These problems may include but are not limited to creation of tailwater problems

on upstream systems, development of concurrent peaks, erosion concerns and other issues unique to the area.

Acceptable Methodologies for Computing Peak Flow

Acceptable methodologies for computing the pre- and post-development conditions for the design storm and sizing stormwater controls include:

- The Rational Method.
- Dr. Rooney Malcom, P.E., Small Watershed Method
- NRCS Methodologies applied through the Corps of Engineers HEC-1 Program
- The Peak Discharge Method as described in USDA Soil Conservation Service's Technical Release Number 55 (TR-55).

The same method must be used for both the pre- and post-development conditions. and must be appropriate to the stormwater basin size and BMP. Additional details on allowable design methodologies are provided in the City of Rocky Mount Standard Specifications and Design Manual.

2-F. Offsite Partial Offset Option

The Tar-Pamlico stormwater rule provides the option to partially offset nitrogen load increases from new development by providing treatment of offsite developed areas. The offsite area must drain to the same classified surface water as the new development, as defined in the schedule of Classifications, 15A NCAC 2B .0316 and listed in Table 2f of this chapter. The developer must also provide appropriate legal measures to ensure that the offsite area achieves and maintains the credited nutrient reduction for as long as the new development exists, including through changes of ownership on either property.
In order to take advantage of the partial offset option, the development plan must meet the following conditions:

- The offsite facility must drain to the same classified surface water as the new development.
- The new development must first reduce nitrogen export from the site to at least 6 lb N/ac-yr for residential and 10 lb N/ac-yr for other types of development. The balance of the nitrogen removal must be made by the offsite facility.
- The net phosphorus loading for the project must be reduced to 0.4 lb/ac/yr. Some or all of the reduction may be obtained through the offsite BMPs
- The offsite facility may only be used to address only the nutrient requirements, unless the development proposal demonstrates that meeting some or all attenuation requirements offsite will not result in degradation of surface waters to which the new development site discharges.
- The off site BMP may serve multiple projects provided the facility is appropriately sized and an a tracking system to allocate nutrient removal is in place and the off-site facility has been approved as a regional BMP.
- Both the development owner and the owner of the offsite facility must agree in a documented, enforceable manner that offsite facilities are dedicated to achieving the

specified nutrient and flow reductions for the life of the new development. The responsibility for maintaining these reductions as well as the provisions of any required conservation easements and operation and maintenance agreements shall run with the land and be binding upon subsequent owners of both the development project and the off site BMP.

- The operation and maintenance agreement shall require an annual inspection by a licensed professional and shall ensure that the City of Rocky Mount has the authority to inspect the stormwater facilities and make any necessary corrections if the owner fails to complete the required inspection or complete any required improvements. Any costs associated with this work, including administrative costs and fines, will be charge to the owner or party legally responsible for maintenance of the facility.

Many individual developments include stormwater designs that could be interpreted as "off-site" or "regional" under the broadest of definitions, but which are not intended for the type of review and approval process described here. Projects such as phased developments or commercial projects with outparcels may propose using shared stormwater facilities that receive runoff from more than one lot and that would be accessed by lots under different ownership at different points in time. These shared facilities are not considered "off-site" or "regional" and may be permitted as "on-site" facilities not subject to the pre-treatment limitations defined above.

The classified surface waters in the City of Rocky Mount include the following:

Table 2f: Tar River Basin Classified Surface Waters

Receiving Stream Name	Stream Segment	Water Quality Classification	Use Support Rating	Water Quality Issues
Tar River	4000' upstream of reservoir dam to dam	WS-IV, NSW, CA, (28-64)		
Tar River	Reservoir dam to Maple Creek	WS-IV, NSW (28-64.5)		
Grape Branch	Source to Tar River	WS-IV, NSW (28-65)		
Maple Creek	Source to Tar River	WS-IV, NSW (28-66)		
Tar River	Maple Creek to 100' downstream of old CRM intake of HWY 64	WS-IV, NSW (28-66.5)		
Tar River	CRM intake to RM Mills Dam	B, NSW (28-67)		
Stoney Creek	Source to Tar River	C, NSW (28-68)	PS	Cause Unknown, PPI, High
Tar River	RM Mills dam to 0.9 mi downstream Buck Swamp	WS-IV, NSW (28-69)		
Goose Branch	Source to Tar River	C, NSW (28-70)		
Cowlick Branch	Source to Tar River	C, NSW (28-71)		
Compass Creek	Source to Tar River	C, NSW (28-72)		
Hornbeam Branch	Source to Compass Creek	C, NSW (28-72-1)		
Gay branch (Indian Branch)	Source to Tar River	C, NSW (28-72.5)		
Buck Swamp	Source to Tar River	C, NSW (28-73)		
Beech Branch	Source to Hwy 301	B, NSW (28-75-(1))		
Beech Branch	Hwy 301 to Falling Run	C, NSW (28-75-(2))		
Little Cokey Swamp	Source to Cokey Swamp	C, NSW (28-83-3-1)		

2-G. Regional or Jurisdiction-Wide Approaches

The Tar-Pamlico stormwater rule provides the option for local governments to develop regional or jurisdiction-wide stormwater facilities in their programs as an alternative means for developers to address nutrient or flow control requirements. Should the City of Rocky Mount identify viable regional or jurisdiction-wide projects, it will demonstrate that such measures will not contribute to degradation of surface waters and quantify nutrient and flow reductions and provide for tracking and administration of the use of such facilities to DWQ.

Regional Facilities: Within the context of this plan, regional facility means a stormwater facility that serves a large developed area and serves more than one development draining to the same classified water. Examples of regional facilities may include but are not limited to wet detention ponds or constructed wetlands.

The regional system option will be evaluated by the City through a series of basin master plans or as specific opportunities are identified through other processes. The regional option would be pursued to provide greater flexibility to development in the impacted area by constructing stormwater management facilities on a larger scale. Two basic types of regional facilities may be described as off-stream and in-stream. While the City may pursue in-stream regional facilities, instream facilities involve a more complicated set of issues associated with protection of surface waters, they are potentially suitable to a relatively small set of circumstances.

Regional facilities provided for in this plan may serve more than one development project. They may also be publicly or privately owned, but would be proposed to DWQ with the support of the City. Basic elements of regional system proposals, to be permitted by DWQ, and other "shared-facility" individual projects permitted by local governments would be the same, and are described below. Regional facilities implemented under the authority of the City may operate as a "Jurisdiction-Wide" approach and provide offsets for projects throughout the jurisdiction.

As mandated by the rule, such strategies would demonstrate that any proposed measures will not contribute to degradation of surface water quality, degradation of aquatic or wetland habitat or biota or destabilization of conveyance structure of involved surface waters. .

Jurisdiction-Wide Approach: Within the context of the rule and this plan, means generally a nutrient-reducing management measure or strategy implemented under the authority of the City to offset one or more increases that may take place in the same <u>or a separate watershed</u> within the jurisdiction. An offsite offset project (see Section 2-F) that is implemented under the authority of the City to serve projects in multiple watersheds would be a specific type of jurisdiction-wide approach. Examples of nutrient reducing measures may include but are not limited to conventional stormwater facilities, constructed wetlands, or land conservation.

The City of Rocky Mount controls a significant amount of land that may be suitable for conservation easements and reforestation and will likely consider development of specific proposals for land conservation offsets in the future. When developing a land conservation proposal for DWQ review, the City will consider the following criteria:

- Conserved land would need to achieve the net nutrient reductions not achieved by new development that conservation is credited with offsetting. Proposals would need to quantify those reductions, including a measure of uncertainty. Land conservation would need to occur as part of some activity that would allow the conservation to achieve nutrient reductions. Examples include:
  - Conservation of a portion of a new development site to receive and treat the runoff from the development.
  - Conservation of a portion of some other, concurrent new development site to receive and treat runoff from that other site.
  - Restoration of the buffering functions of undeveloped land adjacent to existing or new development, e.g. converting pipe or ditch flow to dispersed sheetflow through forested land.

- Obtaining and retiring agricultural land to forest land.

- The conserved land should be no further from the estuary than the new development and within the same jurisdiction. Proposals to establish interlocal agreements that would provide for development and offsetting conservation in different jurisdictions shall provide adequate assurance of enforceability between jurisdictions, as well as cross-jurisdictional tracking and monitoring procedures, in addition to the proposal information called for below.
- Adjacent new development could not claim credit for conserved lands that are being credited to other new development (no double counting).
- Lands whose nutrient removal functions are established and protected through other regulatory programs, such as wetlands and riparian buffers, would not be eligible for conservation credit.
- Conserved land could be used to offset flow attenuation requirements if adequate measures are provided to ensure diffuse flow and no hydrologic degradation of the conserved features or surface waters.
- The conserved land would be established within the context of a long-term regulating plan for development in the local government's comprehensive plan.
- It should be secured in a permanent conservation easement or equivalent legal mechanism whose provisions prohibit both farming and unapproved logging practices. This conservation land should be tracked on a GIS system and recorded on the plat or deed. An example conservation easement is provided in Appendix N.

Proposal Information: Regional or jurisdiction-wide approaches will be undertaken on a project by project basis and will be incorporated into the City's comprehensive stormwater management program as they are developed provided there is appropriate supporting information to show how they will achieve the nitrogen and phosphorus loading reduction requirements applicable to new development. Whether a regional or jurisdiction-wide approach is designed, implemented, and maintained by a developer or the local government, the City will provide the following information to DWQ for any proposed regional facility.

- System location and design information, including:
  - land uses in the contributing area
  - type of facility – treatment, attenuation, both, treatment method, expected nitrogen and phosphorus removal efficiency
  - worst-case percent impervious of the contributing area at build out
  - assumptions for on-lot treatment and attenuation
  - calculations on nitrogen and phosphorus reduction needed, demonstration that facility meets needs
  - demonstration that any proposed measures will not contribute to degradation of surface water quality, degradation of aquatic or wetland habitat or biota, or destabilization of conveyance structure of involved surface waters.

- Process for tracking expenditure of treatment and attenuation capacity.

- Facility protection provisions - an easement, restricted to storm water management and containing adequate access, dedicated to the public or public entity through a platted and

recorded map. An example conservation easement is provided in Appendix N for projects where such an instrument would be appropriate.

- Operation and maintenance provisions:
  - An agreement that demonstrates that (a) the developer, (b) a local government, or (c) a private for-profit or non-profit company will operate and maintain the facilities. Example maintenance agreements are provided in Appendix M.
  - Financial guarantees for maintenance of continued performance in the event that the local government must assume maintenance.
  - an adopted ordinance providing for fines and penalties to ensure maintenance of the stormwater facilities. An example ordinance is provided in Appendix L.

2-H. BMP Maintenance

If BMPs are implemented to achieve the nitrogen and phosphorus loading and flow attenuation requirements for a development, then the City will require a maintenance plan for the BMPs at the time of construction to ensure long term maintenance of the facility. For projects under its jurisdiction, the City will ensure BMP maintenance through the following method:

- The City Land Development Code requires the formation of a property owners association, as needed, and a legal agreement with the owner or owners association for maintenance of the BMP. The provisions of agreement will be required to run with the land. The City will undertake an annual inventory of BMPs to ensure that the required inspections and maintenance activities have been completed. If the owner does not complete the required inspections by a qualified professional or required maintenance in a timely manner, the City will pursue enforcement actions consistent with the provisions of the agreement and current code enforcement provisions.

- The City will maintain an inventory of BMPs and their locations to assist in the inspection process.

2-I. Land Use Planning Provisions

This section was intended to give some background on what the City has done to reduce development impacts on water quality. The checklist provided in the model plan was used as guidance in developing this narrative. There are no specific plans for further revisions to the Land Development Code but the City will continue to evaluate the impact of development standards on water quality and will make recommendations to City Council when deemed appropriate.

Challenged by the devastation of the 1999 Hurricane Floyd flood, the City has come through adversity looking for ways to protect and improve the quality of its water resources, the preservation of the natural environment, the health and safety of it's citizens, the aesthetic quality and economic vitality of the community. A significant step to defining the issues and making initial decisions came in the form of the adopted plan, Together Tomorrow – Tier 1

Smart Growth Comprehensive Plan for the City of Rocky Mount. This document, adopted June 9, 2003, analyzes existing conditions for the community in a broad comprehensive manner, identifies outstanding issues, and provides for publicly developed goals and strategies to the horizon year of 2025. Implementation of the individual strategies was then organized in Chapter 14 by responsible parties and time frame for completion.

> The Comprehensive Plan is being used as a daily decision making guide for City. Policies, capital improvement projects and programs are evaluated for compliance against the Comprehensive Plan which in turn provides the structure to support the stormwater supportive strategies included therein. For instance, the recent Collector Street Project was reviewed for compliance with the Comprehensive Plan including the Critical and Sensitive Designation and altered to comply with these stormwater-sensitive concepts.

Without doubt, the most important implementation to the Plan is the current Land Development Code project. Currently under way, the LDC will affect every aspect of our future development. As the first new version of the City's developmental code in nearly thirty years, there are innumerable issues being considered. As with many topics, the delicate balance between optimal and sometimes-conflicting developmental forces are always to be considered. The LDC is currently under review and discussion for input to decide these issues. In general, they fall into the following broad categories:

> Floodplain Issues –
> The City's requirements in dealing with development in the floodplains has continued to be expanded providing additional support for open areas along water ways and protection of sensitive low lying areas. No development is permitted in the floodway, and the city requires additional elevation over the base flood elevation in the 100-year floodplain (freeboard). The release of the initial FIRM maps in 2003 caused concern of the proper approach to deal with these issues until the maps had been finalized. The response was to utilize both 1982 approved maps and the preliminary maps in order to provide the most protection possible and to comply with NFIP requirements.
>
> Open Space Planning and Preservation of Natural Resources-
> The recognition of natural open space as important to the quality of life and environment is central to Comprehensive Plan concepts. The Comprehensive Plan calls for the preservation or restoration of wetlands; focus on open space preservation with particular attention to the Tar River and its tributaries, and for protection of woodlands and stream corridors during construction as well as the use of conservation easements.
>
> Open space planning is currently supported with such things as reinforcement of Riparian buffer requirements and cluster development standards. The LDC supports the cluster concept by allowing increased density coupled with the dedication of open space. The opportunity to develop additional developmental forms promoting open space planning is tied to the Smart Growth Areas as identified in the Comprehensive Plan.

> Tree preservation has been an important topic for the LDC. The current draft provides for the preservation an undisturbed natural tree buffer on perimeter areas of new development. Tree coverage for non-residential areas has been expanded from the prior requirements. In addition, the development of residential lots will require planting or preservation of trees prior to issuance of the certificate of occupancy.

Developmental Standards for Subdivisions and Commercial Construction-
Together Tomorrow identifies the Traditional Neighborhood Design as being a desirable developmental pattern. This concept places activity centers such as schools and neighborhood commercial centers within easy walking and biking distances. The compact distances can work to reduce the need for impervious redundant street surfaces and parking by replacing some trips to multimodal instead of total dependence on vehicular travel. In addition, the LDC allows for Planned Density Residential (PDR) Developments with mixed uses that will also encourage the integration of residential and commercial uses and are designed to decrease dependence on driving. Smart Growth Areas provide particular opportunity for such developmental patterns coupled with open space planning to improve the overall opportunities for stormwater absorption into the natural environment and the reduction of damaging runoff into the tributary system. In promoting traditional neighborhood design and multi-modal transportation, a critical element is the appropriate use of sidewalks. While increasing the impervious surface, sidewalks contribute to the overall welfare of the system in a positive way. The LDC draft has an increased presence of sidewalks in the community for these reasons. Also under consideration includes parking requirements, widths of streets, driveway requirements.

> … "The quantity of natural and manmade pollutants draining into these systems directly affects the quality of both ground and surface water. For this reason, it is important to insure that development occurs in a manner that preserves the vital function of these waters. In some instances this means that better control of storm water runoff is needed, while in others the density development must be limited so that functional capacity of the water is not compromised." Source - Together Tomorrow-Tier 1 Comprehensive Plan

The City has shown significant commitment to stormwater management, creating a new position, a new utility fee, and increased regulation to improve the quality of response. In the future, more decisions will be made which must balance stormwater sensitive concepts to other issues of function, aesthetic, economy and cultural sensitivities. The City will continue to look at each issue with a pragmatic and critical eye to ensure we are doing our utmost to protect our water resources for the future.

2-J. References

Arendt, R. Open Space Design Guidebook: Albermarle-Pamlico Estuarine Region. 1993. Prepared for the NC Association of County Commissioners. National Lands Trust. Media, PA. 259 pp.

Environmental Protection Agency. Office of Water. November 1994. Section 319 Success Stories.

Environmental Protection Agency. Office of Water. Jan. 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. Washington, DC.

Land of Sky Regional Council. 1995. Stormwater Fact Sheet Number 8: Plan Early for Stormwater in Your New Development. Asheville, NC. 4 pp.

Schueler, T. S. Dec. 1995. Site Planning for Urban Stream Protection. Metropolitan Washington Council of Governments. Silver Spring, MD 231 pp.

Stimmel Associates. 1993. Traditional Neighborhood Development Design Guidelines. Chapel Hill, NC.

3. Illegal Discharges

3-A. Requirements in the Rule

The Tar-Pamlico Stormwater Rule requires that all municipalities establish a program to prevent, identify and remove illegal discharges. Illegal discharges are flows in the stormwater collection system that are not associated with stormwater runoff or an allowable discharge.

3-B. What is an Illegal Discharge?

Stormwater collection systems are vulnerable to receiving illegal discharges (even though the person responsible for the discharge may be unaware that it is illegal). Depending on their source, illegal discharges may convey pollutants such as nutrients, phenols, and metals to receiving waters. Table 3a identifies some potential flows to the stormwater collection system that may be allowable. Table 3b identifies some discharges that are not allowed.

Table 3a: Discharges that may be allowable to the stormwater collection system

Waterline Flushing	Landscape Irrigation	Diverted Stream Flows
Uncontaminated Rising Ground Water	Uncontaminated Ground Water Infiltration to stormwater collection system	Uncontaminated Pumped Ground Water
Discharges from potable water sources	Foundation Drains	Uncontaminated Air Conditioning Condensation
Irrigation Water	Springs	Water from Crawl Space Pumps
Footing Drains	Lawn Watering	Non-commercial Car Washing
Flows from Riparian Habitats and Wetlands	NPDES permitted discharges	Street wash water
Fire Fighting Emergency Activities	Wash Water from the Cleaning of Buildings	Dechlorinated backwash and draining associated with swimming pools

Table 3b: Types of Discharges that are not allowed to stormwater collection system

Dumping of oil, anti-freeze, paint, cleaning fluids	Commercial Car Wash	Industrial Discharges
Contaminated Foundation Drains	Cooling water unless no chemicals added and has NPDES permit	Washwaters from commercial / industrial activities
Sanitary Sewer Discharges	Septic Tank Discharges	Washing Machine Discharges
Chlorinated backwash and draining associated with swimming pools		

3-C. Establishing Legal Authority

One of the first steps that each local government is required to take is establishing the legal authority to control illegal discharges. According to the policies of each individual local government, this legal authority may be carried out through ordinances, policies, city codes or charters.

By August 2004, the City is required to show that it has established the legal authority to do the following:

- Control the contribution of illegal pollutants identified in Table 3b to the stormwater collection system.
- Prohibit illegal discharges to the stormwater collection system.
- Prohibit discharge of spills and disposal of materials other than stormwater to the stormwater collection system.
- Determine compliance and non-compliance.
- Require compliance and undertake enforcement measures in cases of non-compliance.

A copy of the ordinance which establishes this authority for the City of Rocky Mount is provided in Appendix P. This ordinance will be applied within the city's corporate limits as defined in the ordinance and enforced through the provisions defined in the ordinance.

3-D. Collecting Jurisdiction-Wide Information

The City will collect geographic information at three increasing levels of detail:

- The first, most cursory level is information that shall be collected for the entire jurisdiction. The associated requirements are discussed in this section.

- The second level will be a more detailed screening for high priority areas within the jurisdiction. The associated requirements are discussed in Section 3-E.

- The third level will be a detailed investigation to be completed upon the discovery of an illegal discharge. The associated requirements are discussed in Section 3-F.

The purpose of collecting jurisdiction-wide information are to assist with identifying potential illegal discharge sources and characterizing illegal discharges after they are discovered.

The City will fulfill this requirement by compiling maps and GIS coverages that show the following information. Pursuant to the requirements of the model plan, the maps shall be at a scale no greater than 1:24,000.

- Location of sanitary sewers in areas of the major stormwater collection systems and the location of areas that are not served by sanitary sewers.

- Waters that appear on the USDA – Natural Resources Conservation Service Soil Survey Maps and the U.S. Geological Survey 1:24,000 scale topographic maps.

- Land uses. Categories, at a minimum, should include undeveloped, residential, commercial, agriculture, industrial, institutional, publicly owned open space and others.

- Currently operating and known closed municipal landfills and other treatment, storage, and disposal facilities, including for hazardous materials.

- Major stormwater structural controls.

- Known NPDES permitted discharges to the stormwater collection system (this list can be obtained from the Division of Water Quality).

Written descriptions will be provided for the map components as follows:

- A summary table of municipal waste facilities that includes the names of the facilities, the status (open/closed), the types, and addresses.

- A summary table of the NPDES permitted dischargers that includes the name of the permit holder, the address of the facility and permit number.

- A summary table of the major structural stormwater control structures that shows the type of structure, area served, party responsible for maintaining, and age of structure to the extent it can be determined.

- A summary table of publicly owned open space that identifies size, location, and primary function of each open area.

The City will complete this collection of jurisdiction-wide information by the time the second annual report is due (October 2006).

3-E. Mapping and Field Screening in High Priority Areas

Beginning in the third year after implementation of the local stormwater program (2007), the City will identify a high priority area of its jurisdiction for more detailed mapping and field screening. This high priority area shall comprise at least ten percent of the jurisdictional area. Each subsequent year, the City will screen~~ing~~ another high priority area that comprises at least ten percent of its jurisdiction.

"High priority" means the areas within a jurisdiction where it is most likely to locate illegal discharges. Based on the experiences of Raleigh and Durham, the most likely locations for identifying illegal discharges are areas with older development. Each annual report will include the basis for selection of the high priority areas screened.

The first part of the screening process for the selected high priority area will be to map the stormwater system. At a minimum, the map that is produced will include the following:

- Locations of the outfalls, or the points of discharge, of any pipes from non-industrial areas that are greater than or equal to 36 inches.

- Locations of the outfalls of any pipes from industrial areas that are greater than or equal to 12 inches.

- Locations of the outfalls of drainage ditches that drain more than 50 acres of non-industrial lands.

- Locations of the outfalls of drainage ditches that drain more than 2 acres of industrial land.

- An accompanying summary table listing the outfalls that meet the above criteria that includes outfall ID numbers, location, primary and supplemental classification of receiving water, and use-support of receiving water.

The second part of the screening process for the selected high priority area is conducting a dry weather field screening of all outfalls that meet the above criteria to detect illegal discharges. The dry weather field screening shall not be conducted during or within 72 hours following a rain event of 0.1 inches or greater. In residential areas, it is recommended to conduct the field screening either before 9:00 am or after 5:00 pm, since these are the hours that citizens are most likely to be home and thus any illegal discharges are more likely to be evident.

Figure 3a illustrates the process to be followed for conducting field screening sampling activities and following up with any findings of dry weather flow. As shown in the figure, if the field screening shows that an outfall is dry, then the outfall should be checked for intermittent flow at a later date.

If the field screening shows that an outfall has a dry weather flow, then the City will complete a screening report for the outfall. The information that should be contained in the screening report is outlined in Table 3c. Screening reports shall be kept on file for a minimum of five years. Example screening report forms are provided in Appendix Q.

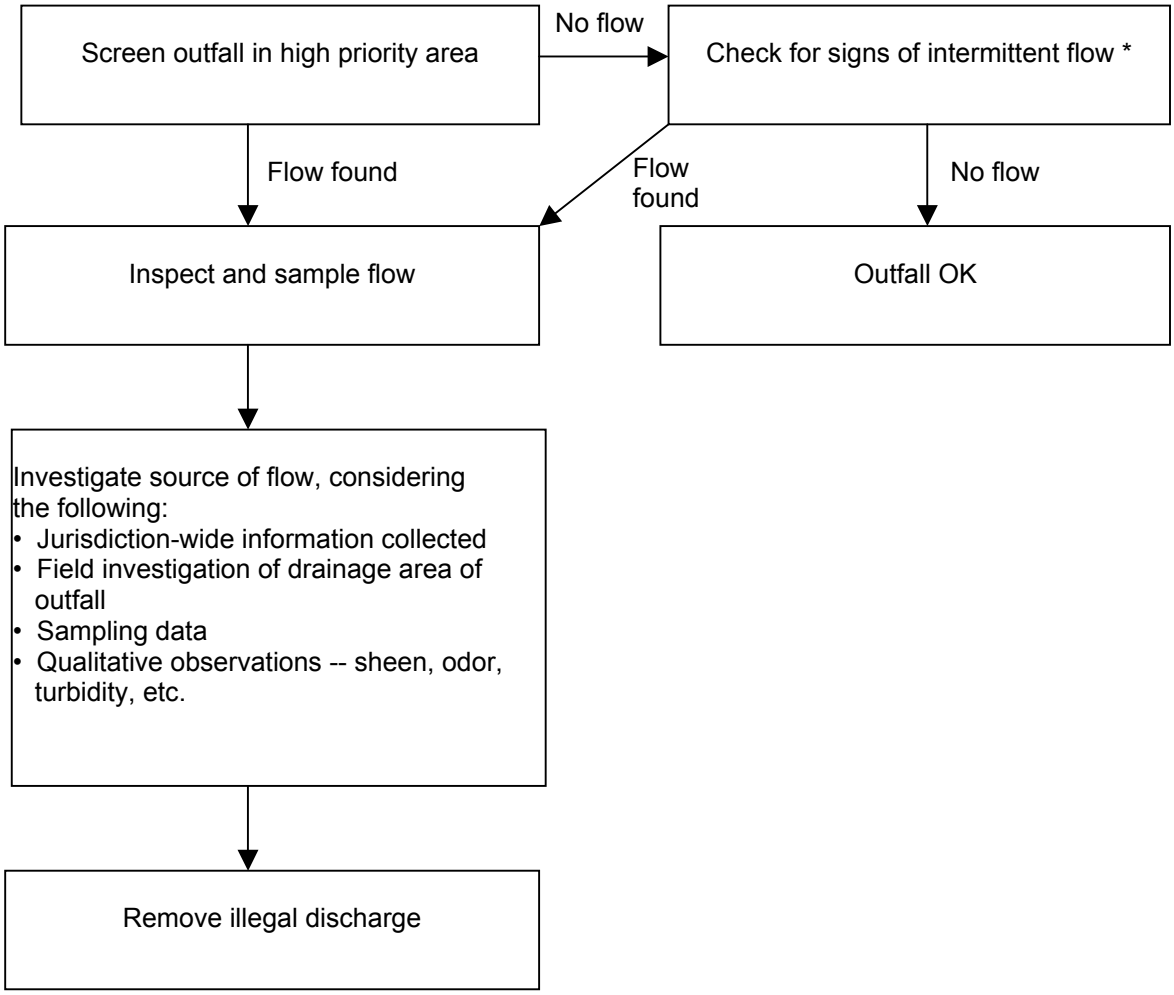
Table 3c: Field Screening Report ~~Information~~

General Information	Sheet Number Outfall ID Number Date Time Date, Time and Quantity of Last Rainfall Event	
Field Site Description	Location Type of Outfall Dominant Watershed Land Use(s)	
Visual Observations	Photograph Odor Color Clarity Floatables	Deposits/Stains Vegetation Condition Structural Condition Biological Flow Estimation
Sampling Analysis *	Temperature pH Nitrogen-Ammonia	Nitrogen-Nitrate/Nitrite Fluoride or Chlorine Total Phosphorus Ortho-Phosphate

* Analytical monitoring is required only if an obvious source of the dry weather flow cannot be determined through an investigation of the upstream stormwater collection system.

Outfalls with flow will be screened again within 24 hours for the above parameters. The tests for ammonia and nitrate/nitrate that are purchased should be sensitive for 0.1 to 10 mg/L.

Figure 3a: Field Screening Process



* Checking for intermittent flow includes rechecking outfall at a later date as well as visual observations for evidence of intermittent flow.

Note: Analytical monitoring is required only if an obvious source of the dry weather flow cannot be determined through an investigation of the upstream stormwater collection system.

The purpose of the field screening is to provide clues as to the source of the illegal discharge. The characterization should be used in conjunction with the jurisdiction-wide information and a field investigation to identify the source of the illegal discharge. The process of identifying and removing illegal discharges is discussed in the next section.

3-F. Identifying and Removing Illegal Discharges

After the field screening is complete, the City will take measures to identify and remove any illegal discharges identified. Identifying illegal discharges may require a combination of office and field work. After the field screening, City staff will consult the jurisdiction-wide information compiled (see Section 3-D) to obtain information about the land uses, infrastructure, industries, potential sources and types of pollution that exist in the drainage area of the outfall.

After potential sources have been identified, a systematic field investigation will be planned that minimizes the amount of resources required to identify the source. Methods that my be used to identify the source of the discharge include, but are not limited to:

- Site Investigation
- Additional Chemical Analysis (recommend testing for fecal coliform if the ammonia concentration was found to exceed 1.0 mg/L)
- Flow Monitoring (recommended to use multiple site visits rather than a depth indicator)
- Dye Testing (fluorescent dye is recommended)
- Smoke Testing
- Television Inspection

Documentation of the field investigations results will be kept on file for a minimum of five years with the screening report.

Upon identification of the source of an illegal discharge, the City will use the legal authority established in its ordinances to have the source removed and/or deal with non-compliance.

In addition to keeping all screening reports on file, the City will maintain a map that includes the following:

- Points of identified illegal discharges.
- Watershed boundaries of the outfalls where illegal discharges have been identified.
- An accompanying table that summarizes the illegal discharges that have been identified that includes location, a description of pollutant(s) identified, and removal status.

3-G. Preventing Discharges and Establishing a Hotline

The City of Rocky Mount has established a Stormwater Hotline (252-972-1500) that is publicized through the City web page, the news media, bill inserts and other media. The hotline is publicized as a means for citizens and stormwater customers to report flooding, clogged pipes and other drainage problems as well as illegal dumping, spills and illicit discharges. After hours calls for emergencies such as toxic spills will be referred to the Police Department for relay of dispatch to the proper department.

In addition to the Stomwater Hotline, the City will implement a public education program to inform businesses and residents about what types of discharges should not go to the stormwater collection system. The education program will be tailored to be appropriate to the intended audience and will include contacts to likely sources of illegal discharges. Some of these sources include automotive sales, rental, repair and detailing establishments, lawn care companies, cleaners and certain types of contractors.

3-H. Implementation Schedule

Implementation Schedule and Annual Reporting Requirements

Year	Implementation Requirements	Annual Report Requirements
By August 2004	• Establish legal authority to address illegal discharges	• Submit report identifying established legal authority to meet requirements.
By October 2006	• Collect jurisdiction-wide information. • Select high priority area for additional screening. • Initiate illegal discharge hotline.	• Report on completion of jurisdiction-wide information collection. • Submit map of high priority areas and reason for selection. • Report on initiation of illegal discharge hotline.
Each subsequent year after 2006	• Complete mapping and field screening for high priority area. • Select next high priority area. • Identify and remove Illegal discharges as encountered. • Continue operating illegal discharge hotline.	• Submit map of stormwater collection system in high priority area upon request by DWQ. • Document illegal discharges found and resulting action. • Report on hotline usage and actions taken. • Submit map of next high priority area and reason for selection.

3-I. References

Debo, Thomas N. and Reese, Andrew J., Municipal Stormwater Management, CRC Press, Inc. 1995

U.S. Environmental Protection Agency (EPA). 1992. Manual of Practice – Identification of Illicit Connections. EPA 833/R-90-100

U.S. Environmental Protection Agency (EPA). 1993. Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems – A User's Guide. EPA 600/R-92-238.

U.S. Environmental Protection Agency (EPA). 1991. Guidance Manual for the Preparation of Part 1 of the NPDES Permit Applications for Discharges from Municipal Separate Storm Sewer Systems. EPA 505/8-91-003A.

4. Retrofit Locations

4-A. Requirements in the Rule

The rule requires that all affected local governments establish a program to identify and prioritize places within existing developed areas that are suitable for retrofits.

4-B. Approach for Meeting the Requirements

Retrofit opportunities will be considered acceptable if all of the following conditions have been investigated:

- The retrofit, if implemented, clearly has the potential to reduce nitrogen or phosphorus loading to the receiving water.
- The watershed is clearly contributing nitrogen or phosphorus loading above background levels.
- The landowner where the retrofit is proposed is willing to have the retrofit installed on his property. Securing the landowner's cooperation is one of the most important tasks for the local government, as this is often the most difficult aspect of implementing a retrofit.
- There is adequate space and access for the retrofit.
- It is technically practical to install a retrofit at that location.

The minimum number of retrofit opportunities that each local government is required to identify is based on a sliding scale according to the population of the government. For those communities that are not completely located within the Tar-Pamlico River Basin, the number of retrofits can be based on the estimated population within the Tar-Pamlico River Basin. The local government will have to provide the data to support this population. Table 4a shows the minimum requirements for identifying retrofit opportunities for each affected jurisdiction. Sites may be carried over to meet the minimum requirements for up to two subsequent years provided that BMPs/retrofits have not been implemented and the site continues to meet the criteria above on an annual basis.

Table 4a: Minimum Number of Retrofit Opportunities that Each Local Government Must Identify on an Annual Basis

Population Category	Local Government	Estimated 2001 Basin Population	Minimum Number of Retrofit Sites to be Identified
Less than 15,000	Tarboro Oxford Washington	11,200 8,500 9,700	1
Between 15,000 and 30,000	Edgecombe County Henderson Nash County	22,400 16,300* 29,000	2
Between 30,000 and 60,000	Beaufort County Franklin County Greenville Pitt County Rocky Mount	30,600 38,500 41,700 31,800 56,000	3
Over 60,000			4

* Represents total municipal population; portion within Basin not determined.

4-C. Data Collection and Notification

Each retrofit opportunity that is identified shall be accompanied by information to describe the location of the retrofit, the type of retrofit being proposed, the property owner, as well as basic information about the watershed and the receiving water. Table 4b shows a suggested format for presenting this information for each retrofit opportunity.

The tables shall be submitted to the Division of Water Quality on October 30 of each year beginning in the year 2005 as part of the annual report.

The Division of Water Quality will take the responsibility for posting these retrofit opportunities on its Web Page and also for notifying, at a minimum, the following organizations of the opportunities for retrofitting within existing developed areas:

- Clean Water Management Trust Fund
- N.C. State University Cooperative Extension Service
- Kerr-Tar Regional Council of Governments
- Upper Coastal Plain Council of Governments
- Mid-East Commission
- Environmental programs at NCSU, Duke University, UNC, ECU and others
- N.C. Sea Grant
- USDA – Natural Resources Conservation Service
- Tar-Pamlico Basin Association
- N.C. Wetlands Restoration Program

4-D. Mapping Requirements

The City will provide maps that show the locations of retrofit opportunities. Mapping may be accomplished by using computers or with existing hard copy maps. The scale of the map should be large enough to adequately identify the following required parameters:

- Drainage area to retrofit opportunity site.
- Land uses within the drainage area.
- Location of retrofit opportunity.
- Property boundaries in the vicinity of the retrofit opportunity.
- Significant hydrography (as depicted on U.S.G.S. topographic maps and USDA-NRCS Soil Survey maps).
- Roads.
- Environmentally sensitive areas (steep slopes, wetlands, riparian buffers, endangered/ threatened species habitat – where available).
- Publicly owned parks, recreational areas, and other open lands.

Table 4b: Retrofit Opportunity Table

Location description, including directions from a major highway	
Type and description of retrofit opportunity	
Current property owner	
Is the property owner willing to cooperate?	
Land area available for retrofit (sq. ft)	
Accessibility to retrofit site	
Drainage area size (acres)	
Land use in drainage area (percent of each type of land use)	
Average slope in drainage area (%)	
Environmentally sensitive areas in drainage area (steep slopes, wetlands, riparian buffers, endangered/ threatened species habitat)	
Approximate annual nitrogen and phosphorus loading from drainage area (lbs/acre/year) *	
Potential nitrogen reduction (lbs/ac/yr)*	
Potential phosphorus reduction (lbs/ac/yr)*	
Estimated cost of retrofit	
Receiving water	
DWQ classification of receiving water	
Use support rating for receiving water	
Other important information	

* Suggested methodology: Use the methodology provided in Appendix H to compute nitrogen export from the drainage area based on the amount of impervious surface, landscaped area and forested area in the watershed.

5. Public Education

5-A. Requirements in the Rule

The Tar-Pamlico Stormwater Rule requires each of the affected jurisdictions in the Tar-Pamlico River Basin to develop a locally administered environmental education program to address nitrogen & phosphorous loading issues with the public and developers, and to address peak stormwater flow issues with developers.

5-B. Public Education Action Report and Plan

The ultimate goal of the public education program is to educate the general public, affected county and municipal staff, the development community, and elected officials. In order to meet this goal, the City is required to develop a Public Education Action Report and Plan. The Action Report and Plan will outline the proposed education activities for the upcoming year, identifying target audiences and anticipated and actual costs of the program. The City will submit an annual Action Report and Plan to DWQ for approval in its October annual report each year. A copy of the proposed 2004-05 Action Report and Plan is included in Appendix S.

The Action Report and Plan will consist of various types of activities. Innovative public education activities not included in this list are encouraged by DWQ, and will be considered for approval by DWQ on a case-by-case basis. All activities must be designed to raise awareness and educate the audience about water quality, nonpoint source pollution, and the effects of everyday activities on water quality and nutrient loading.

The Action Plan in Appendix S identifies point values for each type of education activity that may be contemplated by the City. All affected local governments required to develop a plan are must conduct activities that sum to at least 15 points each year. Ongoing activities, such as continuing programs for pet waste or storm drain marking, will receive credit for each year that they are continued.

During the first year of program implementation, affected communities are required to conduct two (2) technical workshops. One shall be designed to educate local government officials and staff and the other for the development community, including: engineers, developers, architects, contractors, surveyors, planners, and realtors. These two workshops will receive point credit toward the annual total. During subsequent years, technical workshops are considered an optional activity. Communities are encouraged to work jointly to develop and conduct the workshops, if feasible. .

6. Reporting Requirements

Annual Tar-Pamlico River Basin stormwater program reports must be submitted to the Division of Water Quality by October 30 of each year beginning in 2005. All reports shall contain the following information.

6-A. New Development Review/Approval

Under the model program for new development review/approval, local governments are responsible for submitting the following information as part of the annual reporting requirement:

- Acres of new development and impervious surface based on plan approvals.
- Acres of new development and impervious surface based on certificates of occupancy.
- Summary of BMPs implemented and use of offsite options.
- Computed baseline and net change in nitrogen and phosphorus export from new development that year.
- Summary of maintenance activities conducted on BMPs.
- Summary of any BMP failures and how they were handled.
- Summary of results from any applicable jurisdictional review of planning issues.

6-B. Illegal Discharges

Table 6a outlines the annual reporting requirements for illegal discharges.

Table 6a: Implementation Schedule and Annual Reporting Requirements

Year	Implementation Requirements	Annual Report Requirements
By August 2004	• Establish legal authority to address illegal discharges	• Submit report identifying established legal authority to meet requirements.
By October 2006	• Collect jurisdiction-wide information. • Select high priority area for additional screening. • Initiate illegal discharge hotline.	• Report on completion of jurisdiction-wide information collection. • Submit map of high priority areas and reason for selection. • Report on initiation of illegal discharge hotline.
Each subsequent year after 2006	• Complete mapping and field screening for high priority area. • Select next high priority area. • Identify and remove Illegal discharges as encountered. • Continue operating illegal discharge hotline.	• Submit map of stormwater collection system in high priority area upon request by DWQ. • Document illegal discharges found and resulting action. • Report on hotline usage and actions taken. • Submit map of next high priority area and reason for selection.

6-C. Retrofit Locations

- Data on each retrofit opportunity (Table 4b or other equivalent format),
- Maps of potential retrofit sites as specified in Section 4-D, and
- The status of any retrofit efforts that have been undertaken within the jurisdiction.

6-D. Public Education

The Report will summarize the next year's Action Plan and evaluate the implementation of the previous year's Action Plan (if applicable). The report should include goals, activities completed, realized education program costs, explanation of experienced shortfalls and a plan as to how the City will address shortfalls.

APPENDICES

Tar-Pamlico River Basin: Stormwater Program for Nutrient Control

DRAFT

August 9, 2004

Appendices

Appendix A. Implementation Schedule and Table of Responsibilities

The following table lists the various program areas of the *City of Rocky Mount Stormwater Program for Nutrient Control* and identifies the department responsible for ensuring that the requirements of the designated program are fulfilled.

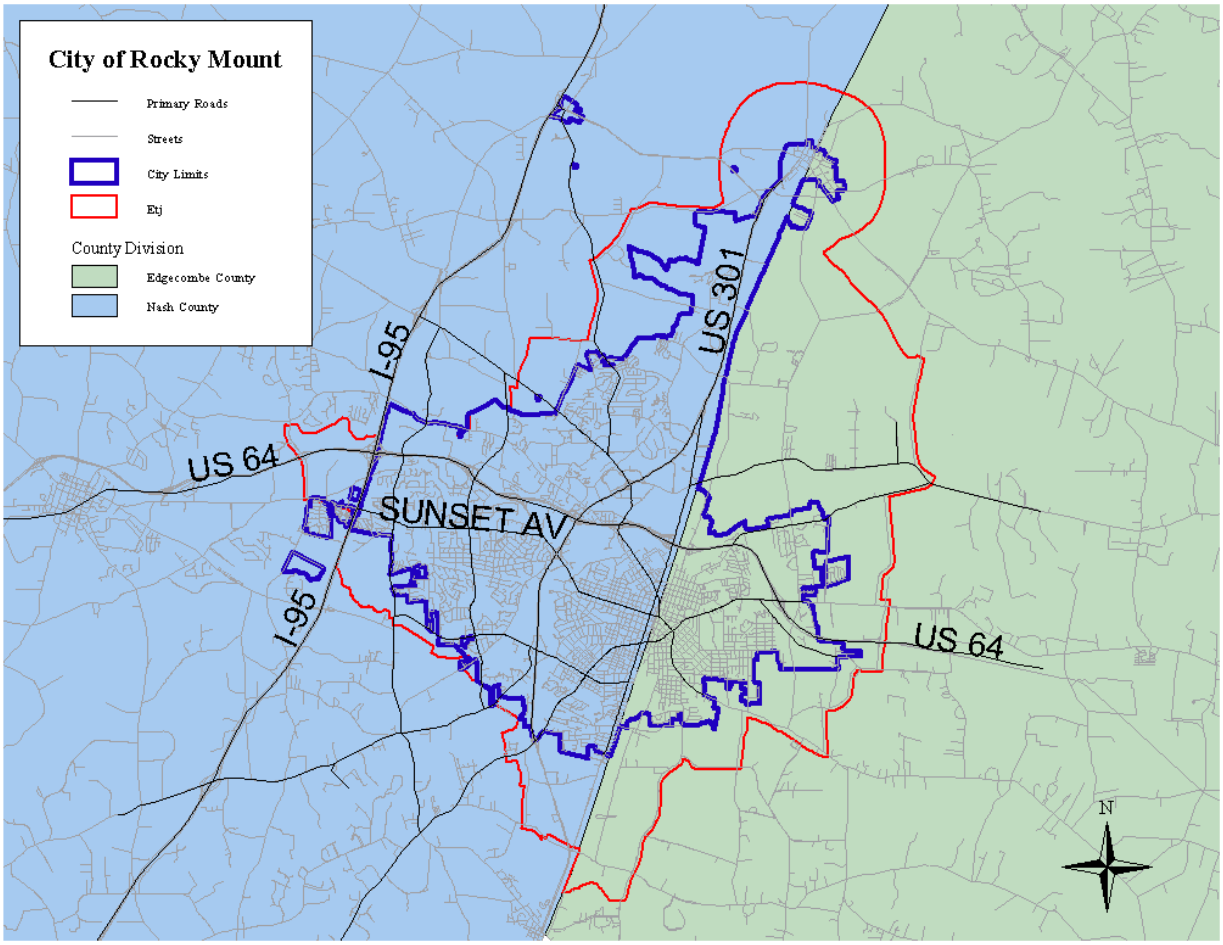
Program Area	Responsible Party
New Development	City Engineer Engineering Department PO Box 1180 Rocky Mount, NC 27802 252-972-1120
Illegal Discharge Elimination	Asst. Public Works Director Public Works Department PO Box 1180 Rocky Mount, NC 27802 252-972-1520
Retrofit Locations	City Engineer
Public Education	Asst. Public Works Director
Reporting Requirements	Asst. Public Works Director

In July of 2003 the City of Rocky Mount implemented a Stormwater Utility to help support the requirements of this program as well as the requirements of NPDES Phase II. The Utility is administered through the Public Works Department and provides new staff and financial resources dedicated to implementation of a comprehensives stormwater management program. The program includes system master planning, public outreach initiatives, new development regulation, an illegal discharge elimination program and increased investment in system maintenance and capital construction.

Implementation Schedule

	2004												2005				2006			
	J	F	M	A	M	J	J	A	S	O	N	D	1	2	3	4	1	2	3	4
Resolution of Support	x																			
Update Design Manual		x	x	x	x	x														
Engineers/Developers Workshop					x															
Ordinance Adoption								x												
Public Education/Outreach							x	x	x	x	x	x	x	x	x	x	x	x	x	x
Stormwater Hotline	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mapping				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Illegal Discharge Screening																			x	x
Retrofit Locations															x				x	
Annual Report															x				x	

New Development Permitting: New development will continue to be permitted under existing processes but will be subject to new stormwater management standards upon adoption of the Nutrient Management Requirements. Copies of the proposed plan and ordinances will be made available to the development community concurrent with consideration of the plan by City Council.



Appendix B. Local Program Submittal Checklist

Program to Assure Long-Term Maintenance of BMPs	x	x	x
Approach for Considering Land Use Planning/Design Techniques	x		
Description of Proposed Regional/Jurisdiction-Wide Approach (not required)	NA	NA	NA
Illegal Discharges Program Components			
Approach to Collecting Jurisdiction-Wide Information	x	x	x
Approach to Mapping and Field Screening in High Priority Areas	x		
Program for Identifying and Removing Illegal Discharges	x	x	x
Program for Preventing Illegal Discharges and Establishing a Hotline	x	x	x
Description of Proposed Regional/Jurisdiction-Wide Approach (not required)	NA	NA	NA
Retrofit Program Components			
Approach to Data Collection and Notification	x		
Approach for Complying With Mapping Requirements	x		
Description of Proposed Regional/Jurisdiction-Wide Approach (not required)	NA		
Public Education Program Components			
Description of Public Education Program	x		
Description of Proposed Regional/Jurisdiction-Wide Approach (not required)	NA		
Reporting Requirements			
Description of Proposed Report Contents/Format	x		
Description of Proposed Regional/Jurisdiction-Wide Approach (not required)	NA	NA	NA

Appendix C. 15A NCAC 2B .0258 Tar-Pamlico River Basin - Nutrient Sensitive Waters Management Strategy: Basinwide Stormwater Requirements

(a) PURPOSE. The purposes of this Rule are as follows.

(1) To achieve and maintain a reduction in nitrogen loading to the Pamlico estuary from lands in the Tar-Pamlico River Basin on which new development occurs. The goal of this Rule is to achieve a 30 percent reduction relative to pre-development levels;

(2) To limit phosphorus loading from these lands to the estuary. The goal of this Rule is to limit phosphorus loading to pre-development levels;

(3) To provide control for peak stormwater flows from new development lands to ensure that the nutrient processing functions of existing riparian buffers and streams are not compromised by channel erosion; and

(4) To minimize, to the greatest extent practicable, nitrogen and phosphorus loading to the estuary from existing developed areas in the basin.

(b) APPLICABILITY. This Rule shall apply to local governments in the Tar-Pamlico basin according to the following criteria.

(1) This Rule shall apply to the following municipal areas:

(A) Greenville
(B) Henderson
(C) Oxford
(D) Rocky Mount
(E) Tarboro
(F) Washington

(2) This Rule shall apply to the following counties:

(A) Beaufort
(B) Edgecombe
(C) Franklin
(D) Nash
(E) Pitt

(3) The Environmental Management Commission may designate additional local governments as subject to this Rule by amending this Rule based on the potential of those jurisdictions to contribute significant nutrient loads to the Tar-Pamlico River. At a minimum, the Commission shall review the need for additional designations as part of the Basinwide process for the Tar-Pamlico River Basin. The Commission shall consider, at a minimum, the following criteria related to local governments: population within the basin, population density, past and projected growth rates, proximity to the estuary, and the designation status of municipalities within candidate counties.

(c) REQUIREMENTS. All local governments subject to this Rule shall develop stormwater management programs for submission to and approval by the Commission according to the following minimum standards:

(1) A requirement that developers submit a stormwater management plan for all new developments proposed within their jurisdictions. These stormwater plans shall not be approved by the subject local governments unless the following criteria are met:

(A) The nitrogen load contributed by the proposed new development activity shall not exceed 70 percent of the average nitrogen load contributed by the non-urban areas in the Tar-Pamlico River basin based on land use data and nitrogen export research data. Based on 1995 land use data and available research, the nitrogen load value shall be 4.0 pounds per acre per year;

(B) The phosphorus load contributed by the proposed new development activity shall not exceed the average phosphorus load contributed by the non-urban areas in the Tar-Pamlico River basin based on land use data and phosphorus export research data. Based on 1995 land use data and available research, the phosphorus load value shall be 0.4 pounds per acre per year;

(C) The new development shall not cause erosion of surface water conveyances. At a minimum, the new development shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 1-year, 24-hour storm event; and

(D) Developers shall have the option of partially offsetting their nitrogen and phosphorus loads by providing treatment of off-site developed areas. The off-site area must drain to the same classified surface water, as defined in the Schedule of Classifications, 15A NCAC 2B .0316, that the development site drains to most directly. The developer must provide legal assurance of the dedicated use of the off-site area for the purposes described here, including achievement of specified nutrient load reductions and provision for regular operation and maintenance activities, in perpetuity. The legal assurance shall include an instrument, such as a conservation easement, that maintains this restriction upon change of ownership or modification of the off-site property. Before using off-site treatment, the new development must attain a maximum nitrogen export of six pounds/acre/year for residential development and 10 pounds/acre/year for commercial or industrial development.

(2) A public education program to inform citizens of how to reduce nutrient pollution and to inform developers about the nutrient and flow control requirements set forth in Part (c)(1).

(3) A mapping program that includes major components of the municipal separate storm sewer system, waters of the State, land use types, and location of sanitary sewers.

(4) A program to identify and remove illegal discharges.

(5) A program to identify and prioritize opportunities to achieve nutrient reductions from existing developed areas.

(6) A program to ensure maintenance of BMPs implemented as a result of the provisions in Subparagraphs (c)(1) and (c)(5).

(7) A program to ensure enforcement and compliance with the provisions in Subparagraph (c)(1).

(8) Local governments may include regional or jurisdiction-wide strategies within their stormwater programs as alternative means of achieving partial nutrient removal or flow control. At a minimum, such strategies shall include demonstration that any proposed measures will not contribute to degradation of surface water quality, degradation of aquatic or wetland habitat or biota, or destabilization of conveyance structure of involved surface waters. Such local governments shall also be responsible for including appropriate supporting information to quantify nutrient and flow reductions provided by these measures and describing the administrative process for implementing such strategies.

(d) TIMEFRAME FOR IMPLEMENTATION. The timeframe for implementing the stormwater management program shall be as follows:

(1) Within 12 months of the effective date of this Rule, the Division shall submit a model local stormwater program that embodies the minimum criteria described in Paragraph (c) of this Rule to the Commission for approval. The Division shall work in cooperation with subject local governments in developing this model program.

(2) Within 12 months of the Commission's approval of the model local stormwater program or within 12 months of a local government's later designation pursuant to Subparagraph (b)(3), subject local governments shall submit their local stormwater management programs to the Commission for review and approval. These local programs shall meet or exceed the requirements in Paragraph (c) of this Rule.

(3) Within 18 months of the Commission's approval of the model local stormwater program or within 18 months of a local government's later designation pursuant to Subparagraph (b)(3), subject local governments shall adopt and implement their approved local stormwater management program.

(4) Local governments administering a stormwater management program shall submit annual reports to the Division documenting their progress and net changes to nitrogen load by October 30 of each year.

(e) COMPLIANCE. A local government that fails to submit an acceptable local stormwater management program within the timeframe established in this Rule or fails to implement an approved program shall be in violation of this Rule. In this case, the stormwater management requirements for its jurisdiction shall be administered through the NPDES municipal stormwater permitting program per 15A NCAC 2H .0126. Any local government that is subject to an NPDES municipal stormwater permit pursuant to this Rule shall:

(1) Develop and implement comprehensive stormwater management program to reduce nutrients from both existing and new development. This stormwater

management program shall meet the requirements of Paragraph (c) of this Rule for new and existing development.

(2) Be subject to the NPDES permit for at least one permitting cycle (five years) before it is eligible to submit a local stormwater management program to the Commission for consideration and approval.

History Note: Authority G.S. 143-214.1; 143-214.7; 143-215.3(a)(1); 143-215.6A; 143-215.6B; 143-215.6C; 143-282(d);
Eff. April 1, 2001.

Appendix D. The Nitrogen Cycle

Forms of Nitrogen

Although nitrogen is the major pollutant of concern for the Tar-Pamlico River Estuary, it is also a nutrient that is essential for life. The majority of nitrogen on the planet exists as N_2 gas in the atmosphere. In fact, 78% of the volume of the air we breathe is nitrogen. Nitrogen is not a natural constituent of rocks or minerals.

$$N \equiv N$$

The N_2 molecule has a triple bond, which is the most stable bond known to science. Plants obtain all of the oxygen and carbon they need from the air. However, it is very difficult for a plant to obtain nitrogen from the atmosphere because N_2 gas is so non-reactive.

Very special circumstances are required to break the triple bond in N_2 gas and to convert the nitrogen into forms that most plants can use, as described in the next section. The majority of plants obtain nitrogen from the soil as either nitrate (NO_3) or ammonium (NH_4).

Once in the plant, ammonium can be used directly but nitrate is transformed to the ammonium form using energy derived from photosynthesis. The plant uses nitrogen to form proteins that act primarily to control plant growth processes. A good supply of nitrogen is associated with vigorous growth and a deep green color. Plants deficient in nitrogen become stunted and yellow in appearance.

Nitrogen in plant-available forms is generally scarce under natural conditions. In other words, under natural conditions, nitrogen is a limiting growth factor. Only recently have humans upset the balance by the addition of nitrogen fertilizers and NO_X emissions and by artificially concentrating nitrogen sources such as human and livestock wastes.

Nitrogen is classified as either inorganic or organic nitrogen. At any given time, most of the nitrogen in the soil is in the organic form. Inorganic nitrogen compounds are unstable and nitrogen is constantly returning to the atmosphere in gaseous forms.

Inorganic Forms of Nitrogen

N2: Inert nitrogen gas found in the atmosphere
NO2: Nitrous oxides, is found in the atmosphere and is a component of automobile exhaust and industrial processes
NH3: Ammonia is a volatile gas and often is lost from soil applied ammonium fertilizer and animal manure into the atmosphere
NH4+: Ammonium, is a positively charge cation found in the soil
NO2-: Nitrite, is a negatively charge anion found in the soil

NO3-: Nitrate, is a negatively charge anion found in the soil and at times in the atmosphere

Organic Forms of Nitrogen

Organic sources of nitrogen include proteins and other complex compounds found in living, dead, or decomposing plants and animals.

The Nitrogen Cycle

The conversion of N2 to N compounds and from nitrogen compounds back to N2 is the nitrogen cycle. It has been estimated that it takes from 44 to 220 million years for all nitrogen to pass through the cycle. In 1982, it was estimated that human activities have caused an imbalance in the nitrogen cycle that causes an accumulation of nine million metric tons per year. This accumulated nitrogen can cause pollution problems.

Figure C1 shows a simplified nitrogen cycle in an undisturbed, forested area. In an urban area, human activities add sources of nitrogen other than the ones shown here. Modified nitrogen cycles are shown in Chapter 4 for each of the appropriate nitrogen sources.

Losses of Nitrogen

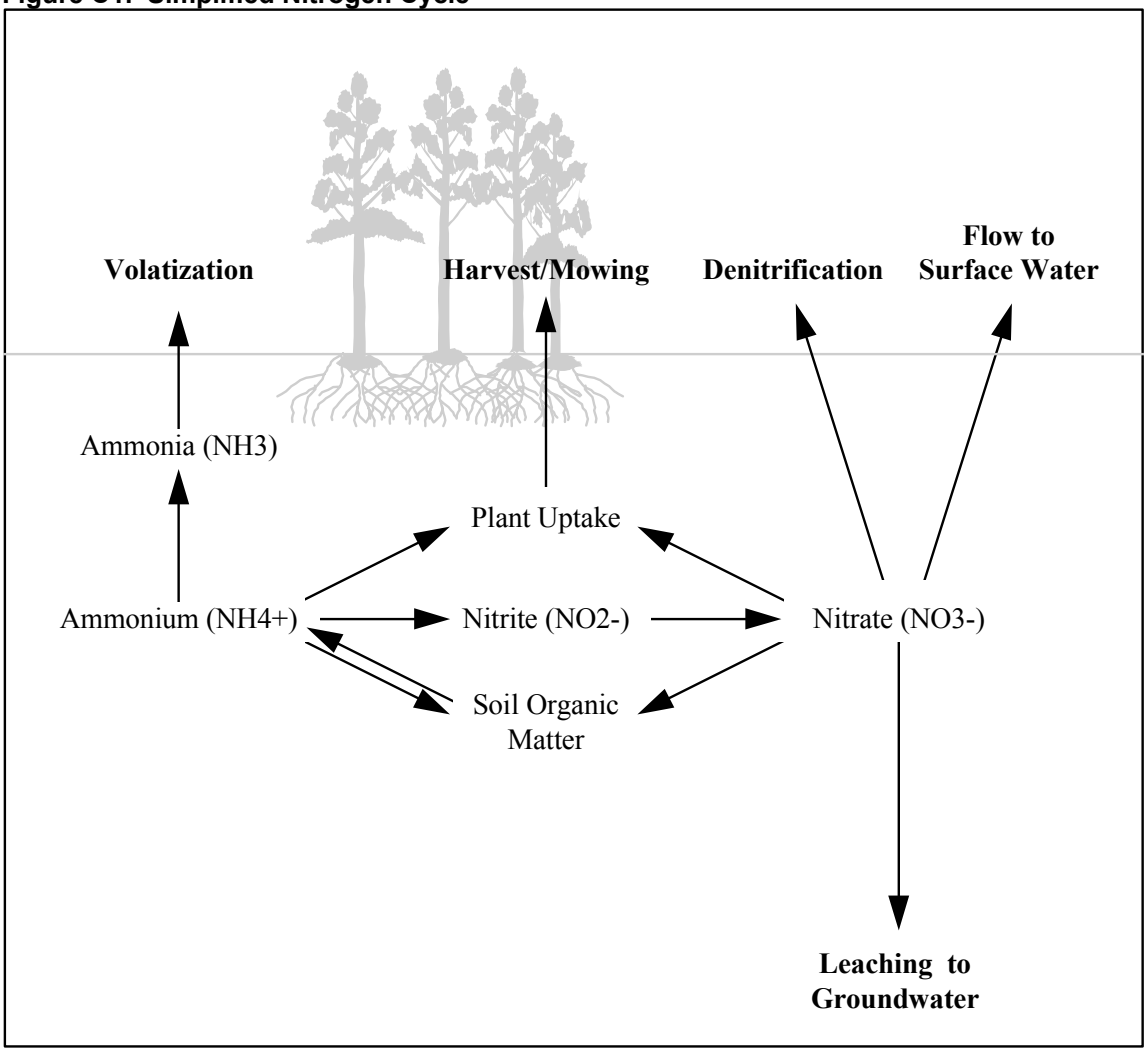
Nitrogen can be easily lost into the environment by various pathways. Those pathways include volatilization, leaching and runoff, and crop removal.

Volatilization, or the gaseous loss of ammonia, may occur under certain conditions with ammonia fertilizers. In situations where the soil is pH alkaline, or where limestone has recently been applied on acid soils, applications of ammonium fertilizer may result in the transformation of ammonium (NH4) to ammonia (NH3) which may be lost to the atmosphere. Urea fertilizers are particularly likely to volatilize. This situation can be avoided by incorporating these fertilizers into the soil in the case of soils with alkaline pH or waiting at least one month after limestone applications to surface apply ammonium fertilizers.

Leaching and Runoff are other important sources of nitrogen loss. Leaching occurs when inorganic forms of nitrogen, particularly nitrite (NO2) and nitrate (NO3) are solubilized and carried with water through the soil profile or with surface waters. Factors that contribute to nitrite and nitrate leaching or runoff include the following:

- Heavy, one-time applications of N fertilizers on sandy textured soils.
- Over applications of manure or sludge to land.
- Improperly timed applications of N fertilizer.
- Poorly designed or nonexistent soil conservation measures.
- Periods of exceptionally heavy rain.

Figure C1. Simplified Nitrogen Cycle



Harvest and Mowing are very important ways that nitrogen is lost. If crops are harvested and removed, there is a net loss to the farm's balance sheet for nitrogen. However, if crop residues or lawn clippings are saved and returned to the soil, some of the nitrogen will be recycled.

References

National Research Council. 1993. Soil and Water Quality: An Agenda for Agriculture. National Academy Press. Washington, DC.

NC Cooperative Extension Service. NCSU Nutrient Management Manual. Chapter 3. Raleigh, NC.

Appendix E. Sources of Nitrogen in Developed Areas

Water quality data from large municipalities in North Carolina clearly show that nitrogen loading is a problem in streams with entirely urban watersheds. Therefore, it is necessary and equitable for urban areas to address their nonpoint sources of nitrogen. An additional benefit of implementing practices to control nitrogen is that these practices are effective for a wide range of other pollutants, such as sediment, heavy metals, oil and grease, and bacteria.

Based on the present research, it appears that there are four major sources of nitrogen contributed by urban areas. These sources are:

- Atmospheric deposition
- Fertilizer
- Human waste
- Animal waste

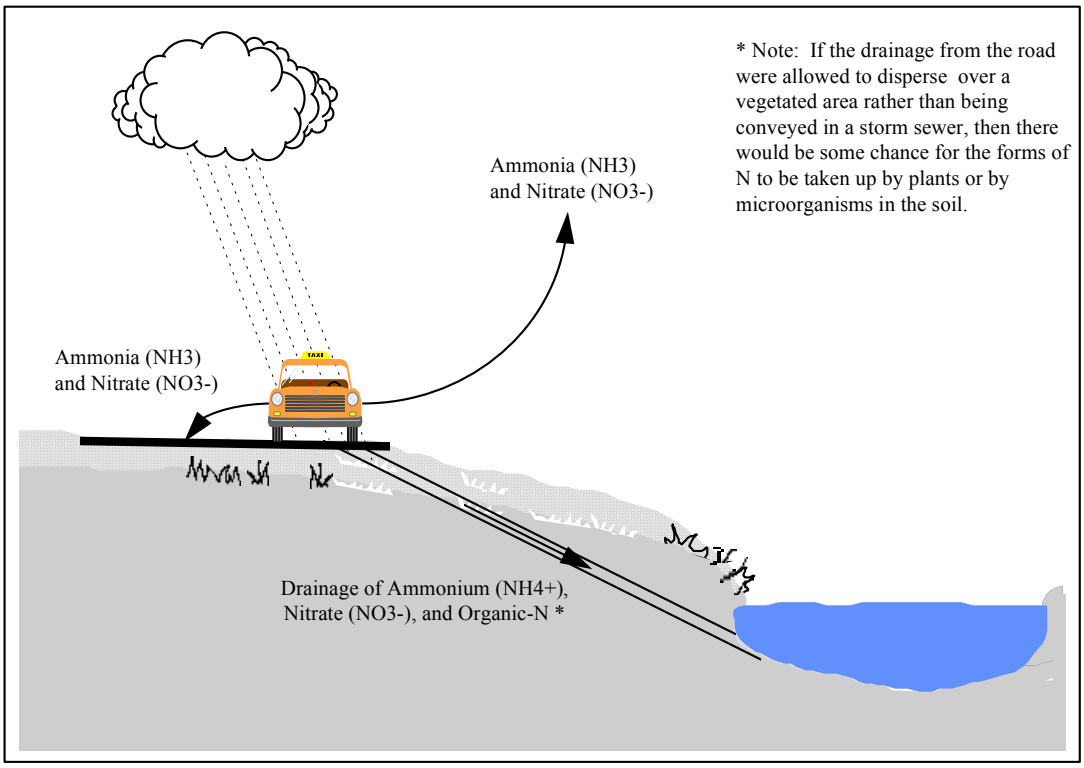
Atmospheric Deposition

Scientific evidence shows that atmospheric deposition is a significant source of nitrogen loading in urban areas. In fact, researchers in the Metropolitan Washington area believe that have shown that washoff of nitrate deposited on impervious surfaces from the atmosphere account for the *majority* of nitrogen in urban streams (MWCOG 1983).

Although atmospheric deposition occurs on all types of land areas, nitrogen deposited on urban areas is more likely to enter surface waters than nitrogen deposited on forests and farms. Urban areas contain impervious surfaces such as roofs, driveways and roads that quickly channel runoff and associated pollutants directly to surface waters with no opportunity for interception or uptake. Impervious surfaces that are drained by storm sewer systems generally have pollutants carried directly into surface waters. Urban roads also have a greater number of local emissions sources, resulting in greater deposition on them than on the landscape as a whole. Figure D1 illustrates nitrogen pathways for impervious areas drained by curb and gutter.

Another reason why atmospheric deposition is a more significant source of nitrogen in urban areas is that urban soils are often heavily compacted and thus can function almost as an impervious surface themselves. Information on how to maintain urban soils and lawns is offered in the next section.

Figure D1. Nitrogen Pathways for Impervious Areas Drained by Curb and Gutter



Impervious areas associated with transportation, such as driveways, roads, and parking lots are usually greater sources of nitrogen than rooftops. Rooftop runoff, particularly in residential areas, is usually spread out over pervious yards that are not directly connected to the storm drain system. During smaller storms, rooftop runoff can infiltrate into the soil, and less runoff and pollutants are delivered to the stream.

Scientists from the Center for Watershed Protection estimate that the annual TN load from a parking lot is 15.4 lb/ac/yr (Schueler 1995). It is likely that roads with curb and gutter have similar export coefficients. According to recent DWQ estimates, the overall annual TN load from urban areas is 6.7 lb/ac/yr (1996). DWQ's estimated annual TN load includes not only contributions from parking lots and roads, but also nitrogen from construction areas, onsite wastewater treatment, and solid waste disposal (DWQ 1996). The large difference between the estimated loads suggests that transportation-related imperviousness is a significant source of nitrogen.

There is also evidence that nitrogen loads increase as average daily traffic volume increases. Runoff monitoring by the Federal Highway Administration (1990) indicates that highways with average daily traffic volume below 30,000 were found to have a 40% lower concentration of nitrate-N than highways with average daily traffic volume exceeding 30,000.

In summary, the available data indicate that:

- The transport of atmospheric nitrogen from land to surface waters is a major contributor of nitrogen to urban streams, and
- Reducing transport-related imperviousness in urban areas is likely to play a important role in reducing the deposited nitrogen that moves from urban land to surface waters.
- Minimizing the use of curb and gutter with storm sewer will also reduce the deposited nitrogen that moves from urban land to surface waters, and
- Reducing vehicle use in urban areas will reduce the amount of deposited nitrate nitrogen that could possibly be transported to surface waters.

In addition to reducing the amount of nitrogen moving into surface waters, reducing transportation-related imperviousness, minimizing curb and gutter, and reducing vehicle use all save money. For example, the cost of providing residential infrastructure such as roads, sidewalks, driveways, and parking spaces, generally constitutes about half of the cost of residential subdivision (Schueler 1995).

Reducing road widths, parking lot sizes, and the use of curb and gutter are important steps to reduce the contribution of nitrogen from atmospheric deposition. In addition, these measures will reduce loadings of many other pollutants, including phosphorous, bacteria, oxygen-demanding substances, and heavy metals. The next chapter on new approaches for planning development describes steps that can be taken on a larger scale to reduce overall impervious area.

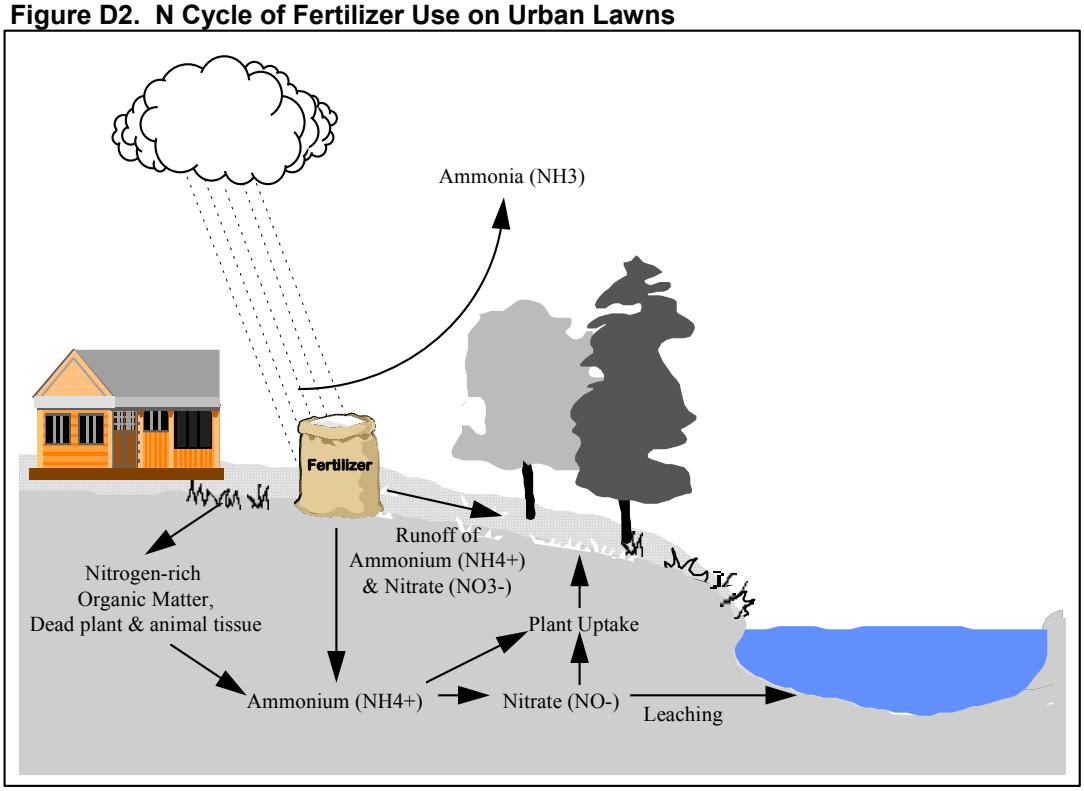
Fertilizers

Well-managed lawns and landscaped areas help protect water quality in urban areas by reducing soil erosion, moderating air temperatures, and filtering pollutants. However, the fertilizers used to maintain these natural areas can pollute urban waters. An important component of improving fertilizer and pesticide use in urban areas is public awareness and education.

Studies suggest that a large number of lawn acres are regularly fertilized without determining the need for nutrient addition. A study found that 79% of Virginia homeowners use fertilizers, but less than 20% of them had their soil tested (Aveni 1994). This study found that product labels are the number one information source for homeowners, while the Cooperative Extension Service ranked last. While all labels indicate how many square feet the label should cover, each takes a different approach on how often the product should be applied. Most label instructions do not mention soil testing.

The nitrogen cycle of fertilizer used on urban lawns is diagrammed in Figure D2.

Figure D2. N Cycle of Fertilizer Use on Urban Lawns



Considering privately and publicly managed lawns, Schueler estimates that about a third of all vegetated areas in the urban landscape can be classified as "high input," meaning that they receive high rates of irrigation and fertilizer application (1995).

Based on studies by the Center for Watershed Protection (Barth 1995):

- homeowners fertilizing their own lawns apply 44-261 pounds/acre/year of nitrogen
- home lawn companies apply 194-258 pounds/acre/year of nitrogen.

Although many homeowners are applying fertilizers with incomplete information, lawn care companies appear to be applying an equal or greater amount of fertilizer. Lawn care companies usually offer service plans that consist of five or more visits per year. Unless a customer specifically requests a soil test or a special application rate, most lawn companies give every lawn serviced the same rate of fertilization (Morton 1988).

The travel distance between lawns and impervious areas can be short. Lawns with compacted soil, bare spots, steep slopes, and channelized areas have increased flow of fertilizer off the lawn. Leaching can also be a significant source of nitrogen in areas with sandy soils where lawns are overwatered and overfertilized (Cohen et al. 1990). In areas where soils are highly compacted, fertilizer can run off lawns easily. Also, lawns in urban areas are frequently interlaced with driveways, roads, and parking lots, which increase the chance for fertilizer to enter into storm sewers.

A review of three nitrate-leaching studies by turfgrass researchers generally shows that grass, when managed properly, can retain nitrogen fertilizer at the soil surface or within the root zone and thus prevent soluble nitrates from percolating downward into the environment. All soils were sandy or silty loam. The results of the study are given in Table D1. This research strongly suggests that efforts to educate homeowners about lawn care should stress the critical connection between fertilization and overwatering. The concept that careless watering can flush nitrogen throughout the soil and away from the grass should be strongly emphasized on both economic and environmental grounds.

Another important factor that affects fertilizer use is soils. Development usually involves grading the entire site, removing topsoil, erosion during construction, compaction by heavy equipment, and filling of depressions. Thus, urban soils tend to be highly compacted, poor in structure, and low in permeability. As a result, urban areas often produce more runoff than before they were disturbed and thus have more potential to lose fertilizer. A good lawn care program should also address soil building.

Some management strategies that would contribute to a reduction in urban nitrogen from fertilizer use are:

- Use fertilizers that are composed of slow-release sources of nitrogen. Products containing slow-release sources of nitrogen are usually called one or more of the following terms: water-insoluble, slow-release, controlled-release, or slowly-available water soluble.

- Lightly water after fertilizer application to allow penetration and reduce the potential for runoff.

- Use drop (gravity) type spreaders rather than centrifugal (rotary) type spreaders so that fertilizer will not be deposited on impervious surfaces.

- Aerate lawns to reduce surface runoff. Also, aeration results in a healthier lawn that does not require as many nutrient inputs. Aerating the soil can reduce the potential for nitrogen export when the soil is compacted or the lawn is on a slope or in a natural drainage area.

- Select the appropriate grass species to reduce the need to add nitrogen to the lawn.

- Water lawns only when they need it. When lawns are very thirsty, grass will lie flat and leave footprints when walked on, shrubs will droop or drop leaves and look wilted. Watering less often actually promotes deeper, more tolerant root systems (Alliance for the Chesapeake Bay 1994).

- Do not fill fertilizer applicators over a hard surface. Make sure that the spreader is off when passing over driveway, sidewalk, patio, etc. Clean up any spills immediately.

- Expansive lawn areas can be replace with equally attractive, efficient landscape alternatives, such as appropriate shrubs or ground covers that require less maintenance (Alliance for the Chesapeake Bay 1994).

- Involve the public and golf community in decisions that affect water quality. Perhaps they would be willing to accept a few brown patches in exchange for knowing that the course is not harming water quality.

Table D1. Nitrate Levels in Soil Water Depending on Turf Management Strategies (from Schueler 1994)

Grass type	Irrigation	Management	N applied (lbs/ac/yr)	N conc. (mg/l)	Researcher
Tall Fescue/ Bluegrass	not watered	Clippings removed	none	0.33	Gross et al. 1990 Maryland
Bluegrass	overwatered	Clippings left	none	0.36	Morton et al. 1988 Rhode Island
Bluegrass	slightly watered	Clippings left	none	0.51	Morton et al. 1988 Rhode Island
Tall Fescue/ Bluegrass	not watered	Granular fert. Clippings removed	196	0.85	Gross et al. 1990 Maryland
Bluegrass	slightly watered	Clippings left	86	0.87	Morton et al. 1988 Rhode Island
Tall Fescue/ Bluegrass	not watered	Liquid fert. Clippings removed	196	1.02	Gross et al. 1990 Maryland
Kentucky bluegrass	watered	Seeded clippings left	194	1.09	Geron et al. 1993 Ohio
Bluegrass	slightly watered	Clippings left	217	1.24	Morton et al. 1988 Rhode Island
Bluegrass	overwatered	Clippings left	86	1.77	Morton et al. 1988 Rhode Island
Kentucky bluegrass	watered	slow release clippings left	194	1.84	Geron et al. 1993 Ohio
Kentucky	watered	early season	194	2.27	Geron et al.

bluegrass		fert. Clippings left			1993 Ohio
Kentucky bluegrass	watered	late season fert. Clippings left	194	2.30	Geron et al. 1993 Ohio
Kentucky bluegrass	watered	fast release clippings left	194	2.74	Geron et al. 1993 Ohio
Kentucky bluegrass	watered	Sodded clippings left	194	3.50	Geron et al. 1993 Ohio
Bluegrass	overwatered	Clippings left	217	4.02	Morton et al. 1988 Rhode Island

Human Waste

Conventional septic systems are comprised of a septic tank, a distribution system, and a soil absorption system. In the septic tank, anaerobic bacteria digest organic matter, solids settle to the bottom, and low-density compounds such as oil and grease float to the water surface. Partially-treated wastewater then leaves the septic tank and enters the distribution box, where it is discharged into the soil absorption systems, also know as the drainage field.

In the drainage field, effluent percolates through the soil and remaining pollutants -- nutrients, suspended solids, bacteria, viruses, and organic/inorganic compounds -- are removed by filtration, adsorption, and microbial degradation (AGWT 990). The absorption system consists of a network of perforated pipes located in shallow trenches covered with backfill. Gravel usually surrounds the piped to encourage even distribution of the effluent into soil.

Even properly functioning septic systems can deliver significant pollutant loads to groundwater. The most common shortcoming of conventional septic systems is their inability to remove much nitrogen. It is not uncommon for the effluent leaving a typical system to have a total nitrogen concentration of 40 to 60 mg/l, primarily in the form of ammonia and organic nitrogen (CBO 1992). Once in the drainage field, organic nitrogen forms are easily converted into nitrates, which are quite soluble and easily mobilized, thus increasing the potential for ground and surface water contamination.

Some problems with septic system performance are related to what goes into them. Household chemicals entering a septic tank can kill organic-consuming bacteria or cause sludge and scum to be flushed out into the drainfield. Such chemicals can include various readily available septic system additives, which ironically are advertised as having the ability to improve system performance. Not only are some household chemicals detrimental to the septic system itself, but they often reach ground or surface waters where they cause toxicity problems.

Normal amounts of detergents, bleaches, drain cleansers, and toilet bowl deodorizers, however, can be used without causing harm to bacterial action in the septic tank (AGWT 1990). Properly operating septic systems must be located in a way to ensure both lateral distance between surface waters and vertical separation to groundwater. Also, drainfield areas must become larger when soils are not permeable or slopes are steep. Larger volumes of wastewater require larger drainfields.

Unfortunately, many conventional septic systems have been constructed in areas poorly suited for their proper operation. Many were installed before the need for separation distance was understood or because no other wastewater treatment option was available. Septic systems are suspected of contributing nutrients through subsurface flow. Malfunctioning systems may increase the nutrient loading beyond the assimilative capacity of the site soils and vegetation. This may result in excess nutrients being conveyed to surface waters via groundwater and subsurface flow of infiltrated stormwater.

While alternative systems have some benefits over conventional septic systems, it is important to recognize that no system can simply be installed and forgotten. Regular inspection and maintenance is a necessity. For example, septic tanks should be periodically pumped out, since solids and sludge tend to accumulate over time. North Carolina does not require regular pumpouts of conventional septic systems.

Alternative on-site wastewater treatment designs are attractive because of their decreased reliance on site conditions and their ability to remove pollutants that cannot be removed by conventional systems. Two options that are particularly promising for nitrogen removal are recirculating sand filters and constructed wetlands.

Table D2. Pollutant loadings from Septic Systems (Schueler, 1995)

On-site wastewater treatment system	TN (%)	TSS (%)	BOD (%)	Pathogens (Logs)	Capital ($/house)	Maint. ($/house/yr)
Conventional septic system	28	72	45	3.5	$4,500	$70
Recirculating sand filter	64	90	92	2.9	$3,900	$145
Constructed wetlands	90	80	81	4.0	$710	$25

To reduce the contribution of nitrogen from septic systems, the following measures are recommended:

- Homeowners should not use garbage disposals or pour grease down the drain.

- Septic systems should be inspected at least once every two years and pumped as needed (time interval varies with size, use, and operation).

- DWQ, DEH, and local health departments should increase educational efforts for homeowners to properly operate and maintain septic systems and other on-site wastewater treatment systems.
- DWQ, DEH, and local health departments should encourage installation of innovative on-site wastewater treatment systems where they are appropriate and where there is a commitment to ongoing care and maintenance.

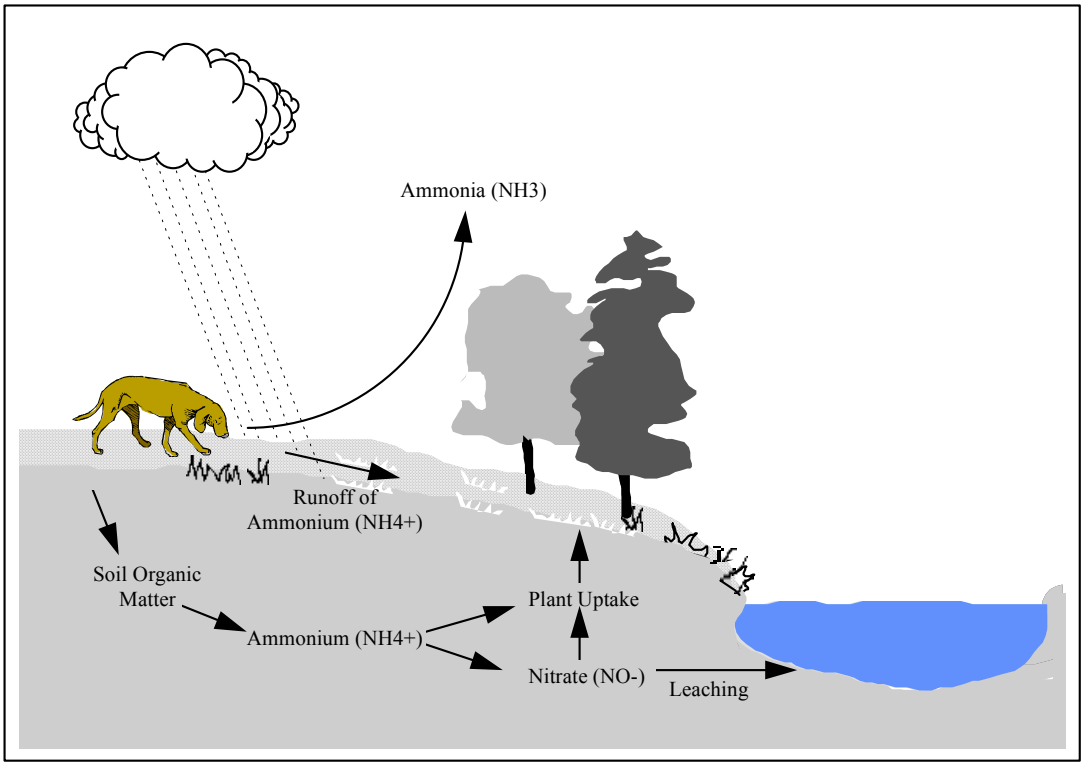
- DWQ, DEH, local health departments, and community groups should increase surveillance of their local streams to help to identify areas where on-site wastewater treatment systems are failing.

Another source of nitrogen from human waste is overflowing sanitary sewers. Often, maintaining infrastructure such as sanitary sewers does not receive a high priority for funding. Sometimes flow data at wastewater treatment plants indicates that there is a problem with leaking sewer lines, however it is extremely difficult to pinpoint the sources of the problem. It is recommended that this issue be addressed in this model program by educating citizens about how to detect and report an overflowing sanitary sewer line
.

Animal Waste

Like human wastes, pet wastes also present a concentrated source of nutrients, bacteria, and oxygen-demanding substances. If these wastes are not disposed of properly, they often enter storm sewers without any treatment. In fact, some pet owners actually deposit their pet's waste into storm drains. Figure D3 shows the nitrogen cycle of pet wastes in urban areas.

Figure D3. N Cycle of Pet Waste in Urban Areas



To reduce the contribution of nitrogen from pet wastes, the following measures are recommended:

- Pet owners should use proper disposal methods such as putting waste in the trash (some landfills prohibit animal wastes) or burying waste in the yard or using a pre-fabricated pet waste disposal unit (this may relocate the contribution from surface to subsurface nutrient loading).

- The public should be educated about proper methods of disposing of pet wastes.

- Storm drain stenciling can remind citizens that storm drains go directly to streams.

- Local ordinances should require proper pet waste disposal.

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Appendix F. The Phosphorus Cycle

(Text to be included at a later date)

Appendix G. Sources of Phosphorus in Developed Areas

(Text to be included at a later date)

Appendix H. Export Calculation Worksheets and Supporting Information

This appendix contains a set of manual worksheets for estimating nitrogen and phosphorus export from a development project prior to and following development, and following the installation of best management practices (BMPs) on the development. The worksheets are followed by supporting information that details the basis for the design of the worksheets and the values and formulas included in them. Supporting information on the development of BMP efficiencies is found in Appendix I.

An automated version of the worksheets is also available. Excel files containing the automated version may be downloaded from the Division of Water Quality's Tar-Pamlico web page at http://h2o.enr.state.nc.us/nps/tarpam.htm. The files may also be obtained from the City of Rocky Mount web page at http://www.ci.rocky-mount.nc.us/engineering.

- The worksheets in this appendix and the automated version of the worksheets both contain the following elements:
  1. Definitions of Land Use Terms Used in Spreadsheets (1 pg.)
  2. Residential Worksheet when Footprints are not Shown (1 pg.)
  3. Export Calculation Worksheet for Coastal Plain Communities (1 pg.)
  4. BMP Removal Calculation Worksheet for Coastal Plain Communities (3 pp.)
  5. Export Calculation Worksheet for Piedmont Communities (1 pg.)
  6. BMP Removal Calculation Worksheet for Piedmont Communities (3 pp.)

- The remainder of this appendix is a report describing the development of the nutrient export model, provided by contractors with North Carolina State University.

Definitions of Land Use Terms Used in Spreadsheets

Transportation impervious: The portion of the development that is taken up by roads, driveways, parking areas, wash pads or any other facility designed for vehicular use, maintenance or storage. Transportation impervious includes areas covered in pavement, gravel, pavers and dirt.

Roof impervious: The portion of the development that consists of roofs of buildings and other structures. Commercial parking garages shall be considered as transportation impervious.

Managed pervious: The portion of the development that consists of vegetated areas that the landowner could manage by mowing, clearing, applying fertilizer, etc. Although residential development may include pervious areas that are initially undisturbed, these areas must be considered as managed pervious (instead of wooded pervious) unless they have conservation easements or another mechanism to insure they will not be managed. Also, the land in Zone 2 (the outer 20 feet) of a protected riparian buffer must be considered as managed pervious area unless it is protected by a conservation mechanism.

Wooded pervious: The portion of the development that consists of forested areas that are permanently protected by a conservation easement or other binding conservation mechanism. Also, wetlands and the land in Zone 1 of a protected riparian buffer (the first 30 feet adjacent to a stream) may be considered as wooded pervious area.

Residential Worksheet when Footprints are not Shown

Use this worksheet when building footprints are not known to determine the acreage in each of the four categories - transportation impervious, roof impervious, managed pervious, and wooded pervious - in the development. You will need these acreages for both the "Export before BMPs" and "Export after BMPs" worksheets. For the "Export after BMPs" worksheet, you will need to subtract the acreage occupied by BMPs from the managed pervious acreage produced by this worksheet. Also for the "Export after BMPs" worksheet, if the development contains more than one catchment, use this worksheet for each catchment.

Project Name: _____

Date: _____

By: _____

Directions:

- In the two blanks in the box below, enter the average lot size and the percent of the right-of-way that is impervious within the development.

- **Column (2):** Determine the total area of the development that will be in lots and enter it in the top box. Next, multiply 0.089*total acreage in lots*average lot size$^{-0.48}$ to get transportation impervious - enter this in the second box. Then, multiply 0.059*total acreage in lots*average lot size$^{-0.48}$ to get rooftop impervious - enter this in the third box. In the bottom box (wooded pervious), enter any lot area that is wetlands or permanently protected by a conservation easement or the Tar-Pamlico buffer rule (enter "0" if there is none). Next, subtract the sum of the two impervious types and wooded pervious from the total lot area to get managed pervious acreage, the remaining box. NOTE: If lots are drawn to exclude protected lands that are part of the total development acreage, enter the acreage of those protected lands as wooded pervious within "Community Areas", column (4).

- **Column (3):** Enter the total acreage in the development that will be in right-of-way in the first box. Then, multiply this value by the percentage of right-of-way that is impervious from the blank below, and enter the result in the second box (Transportation Impervious in ROW). Subtract this value from the total right-of-way area and enter this in the third unshaded box (Managed Pervious in ROW).

- **Column (4):** Enter the total acreage of any community areas in the development (eg., parks, community centers) in the top box. In the next four boxes, distribute the total acreage among each type of land use.

- **Column (5):** Total each row. NOTE: Make sure that the total area in the top box accurately reflects the total area of the development and that the three lower boxes add up to the top box. If not, there is an error that must be corrected. You may then want to see if the component acreages in each column add to the top TOTAL value.

Average lot size = _____ ac (Must show building footprints if lot size < 0.13 ac.)

% impervious in right-of-way = _____ %

(1)	(2)	(3)	(4)	(5)
Type of Land Cover	**Lot area (ac)**	**Right-of-way area (ac)**	**Community areas (ac)**	**Sum of Columns (2), (3), and (4)**
TOTAL				
Transportation impervious				
Roof impervious				
Managed pervious				
Wooded pervious				

Piedmont of the Tar-Pamlico River Basin:

Includes Oxford, Henderson, Rocky Mount and Tarboro as well as Franklin, Nash and Edgecombe Counties

Nitrogen and Phosphorus Load Calculation Worksheet (Manual)

Project Name: _____

Date: _____

By: _____ Checked By: _____

Directions (same for pre-development and post-development tables):

- **Column (2):** Enter the acres in each land use in all but the bottom two boxes. Add entries to get Total Area of Development (bottom box). Divide Impervious total (Transport. + Roof) by Total Area of Development; enter in Fraction Impervious box.
- **Column (3):** Compute 0.46 + 8.3*I and enter this number in all unshaded boxes (each box will have the same number in it).
- **Column (4):** TN land use coefficients are already entered for each land use.
- **Column (5):** In each box except the bottom two, enter the product of Columns (2), (3) and (4) in that row. Determine TN loading in the next-to-last box by adding the boxes above. Divide the result by the total area of development from column (2) to determine the TN export coefficient for the bottom box.
- **Column (6):** TP land use coefficients are already entered for each land use.
- **Column (7):** In each box except the bottom two, enter the product of Columns (2), (3) and (6) in that row. Determine TP loading in the next-to-last box by adding the boxes above. Divide the result by the total area of development from column (2) to determine the TP export coefficient for the bottom box.

Pre-development:

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3*I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6)
Transportation impervious			2.60		0.40	
Roof impervious			1.95		0.15	
Managed pervious (lawn/landscaped)			1.42		0.31	
Managed pervious (cropland)			4.23		1.23	
Managed pervious (pasture)			2.04		0.62	
Wooded pervious			0.94		0.14	
Fraction Impervious (I) =			TN Loading (lb/yr) =		TP Loading (lb/yr) =	
Total Area of Development =			TN Exp. Coeff. (lb/ac/yr) =		TP Exp. Coeff. (lb/ac/yr) =	

Post-development:

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3*I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6)
Transportation impervious			2.60		0.40	
Roof impervious			1.95		0.15	
Managed pervious			1.42		0.31	
Wooded pervious			0.94		0.14	
Fraction Impervious (I) =			TN Loading (lb/yr) =		TP Loading (lb/yr) =	
Total Area of Development =			TN Exp. Coeff. (lb/ac/yr) =		TP Exp. Coeff. (lb/ac/yr) =	

Note: The nutrient loading goals are 4.0 lb/ac/yr for TN and 0.4 lb/ac/yr for TP. If the post-development nutrient loading is below these levels, then no BMP is necessary. Otherwise, the next worksheet calculates post-development TN and TP loadings after BMPs are installed.

Piedmont of the Tar-Pamlico River Basin:

Includes Oxford, Henderson, Rocky Mount and Tarboro as well as Franklin, Nash and Edgecombe Counties

BMP Removal Calculation Worksheet (Manual)

Project Name: _____

Date: _____

By: _____ Checked By: _____

BMP Nutrient Removal Efficiencies

	TN	TP
Wet Detention Pond	**25**	**40**
Stormwater Wetland	**40**	**35**
Sand Filter	**35**	**45**
Bioretention	**40**	**35**
Grass Swales	**20**	**20**
Vegetated Filter Strip w/ Level Spreader	**30**	**30**

Directions for the following pages (same for all catchments in the development):

- It may be advantageous to split the development into separate catchments to be handled by separate BMPs. This table allows for the development to be split into up to three catchments, and can be copied for greater than three. Unless runoff into the development from offsite is routed separately around or through the site, offsite catchment area running in must be included in the acreage values of the appropriate land use(s) and treated.
- **Above each table**: Enter the catchment acreage in the top blank. Next, based on a comparison of the post-development TN and TP export coefficients you calculated above to the rule requirements of 4.0 lb/ac/yr TN and 0.4 lb/ac/yr TP, select a BMP or BMPs from the table above for treating the catchment runoff. Enter the chosen BMP(s) nutrient removal rates in the blanks. If a second BMP is to be used in series, determine the TOTAL TN and TP removal rates for the series through the following equation:

  $$\text{removal rate}_1 + \text{removal rate}_2 - (\text{removal rate}_1 * \text{removal rate}_2)/100.$$
- **Column (2):** Enter the acres in each land use in the first five boxes. Add to get the total acres of development and enter it in the seventh box. Divide impervious area by total development area and enter it in the sixth box.
- **Column (3):** Compute 0.46 + 8.3*I (I = fraction impervious from column 2) and enter this number in all five boxes (each box will have the same number in it).
- **Column (4):** TN land use coefficients are already entered for each land use.
- **Column (5):** In each of the first five boxes, multiply the entries for Columns (2), (3) and (4). Determine the pre-BMP TN loading in the sixth box by adding the first five boxes. Determine the pre-BMP TN export coefficient in the seventh box by dividing the TN load by the total acreage of the catchment. Determine the post-BMP TN loading in the next-to-last box by the following equation: pre-BMP TN loading * (100 - TOTAL TN REMOVAL RATE)/100. Determine the post-BMP export coefficient in the bottom box by dividing the post-BMP TN loading by the total acreage of the catchment.
- **Column (6):** TP land use coefficients are already entered for each land use.
- **Column (7):** In each of the first five boxes, multiply the entries for Columns (2), (3) and (6). Determine the pre-BMP TP loading in the sixth box by adding the first five boxes. Determine the pre-BMP TP export coefficient in the seventh box by dividing the TP load by the total acreage of the catchment. Determine the post-BMP TP loading in the next-to-last box by the following equation: pre-BMP TP loading * (100 - TOTAL TP REMOVAL RATE)/100. Determine the post-BMP export coefficient in the bottom box by dividing the post-BMP TP loading by the total acreage of the catchment.

Catchment 1:

Total acreage of catchment 1 = _____ ac

First BMP's TN removal rate = _____ %

Second BMP's TN removal rate = _____ %

TOTAL TN REMOVAL RATE = _____ %

First BMP's TP removal rate = _____ %

Second BMP's TP removal rate = _____ %

TOTAL TP REMOVAL RATE = _____ %

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3*I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6
Transportation impervious			**2.60**		**0.40**	
Roof impervious			**1.95**		**0.15**	
Managed pervious			**1.42**		**0.31**	
Wooded pervious			**0.94**		**0.14**	
Area taken up by BMP			**1.95**		**0.15**	
Fraction Impervious (I) =			**Pre-BMP TN Load (lb/yr) =**		**Pre-BMP TP Load (lb/yr) =**	
Total Area of Development =			**Pre-BMP TN Export (lb/ac/yr) =**		**Pre-BMP TP Export (lb/ac/yr) =**	
			Post-BMP TN Load (lb/yr) =		**Post-BMP TP Load (lb/yr) =**	
			Post-BMP TN Export (lb/ac/yr) =		**Post-BMP TP Export (lb/ac/yr) =**	

Catchment 2:

Total acreage of catchment 2 = _____ ac

First BMP's TN removal rate = _____ %

Second BMP's TN removal rate = _____ %

TOTAL TN REMOVAL RATE = _____ %

First BMP's TP removal rate = _____ %

Second BMP's TP removal rate = _____ %

TOTAL TP REMOVAL RATE = _____ %

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3*I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6
Transportation impervious			**2.60**		**0.40**	
Roof impervious			**1.95**		**0.15**	
Managed pervious			**1.42**		**0.31**	
Wooded pervious			**0.94**		**0.14**	

Area taken up by BMP			**1.95**		**0.15**	
Fraction Impervious (I) =			**Pre-BMP TN Load (lb/yr) =**		**Pre-BMP TP Load (lb/yr) =**	
Total Area of Development =			**Pre-BMP TN Export (lb/ac/yr) =**		**Pre-BMP TP Export (lb/ac/yr) =**	
			Post-BMP TN Load (lb/yr) =		**Post-BMP TP Load (lb/yr) =**	
			Post-BMP TN Export (lb/ac/yr) =		**Post-BMP TP Export (lb/ac/yr) =**	

Catchment 3:

Total acreage of catchment 3 = _____ ac

First BMP's TN removal rate = _____ %

Second BMP's TN removal rate = _____ %

TOTAL TN REMOVAL RATE = _____ %

First BMP's TP removal rate = _____ %

Second BMP's TP removal rate = _____ %

TOTAL TP REMOVAL RATE = _____ %

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3*I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6
Transportation impervious			**2.60**		**0.40**	
Roof impervious			**1.95**		**0.15**	
Managed pervious			**1.42**		**0.31**	
Wooded pervious			**0.94**		**0.14**	
Area taken up by BMP			**1.95**		**0.15**	
Fraction Impervious (I) =			**Pre-BMP TN Load (lb/yr) =**		**Pre-BMP TP Load (lb/yr) =**	
Total Area of Development =			**Pre-BMP TN Export (lb/ac/yr) =**		**Pre-BMP TP Export (lb/ac/yr) =**	
			Post-BMP TN Load (lb/yr) =		**Post-BMP TP Load (lb/yr) =**	
			Post-BMP TN Export (lb/ac/yr) =		**Post-BMP TP Export (lb/ac/yr) =**	

Weighted Average of Nutrient Loadings from the Catchments:

Directions: Enter data on TN and TP export coefficients for each catchment (based on calculations above). Do a weighted average of TN and TP loads for the entire development and enter it in the shaded cells below. The weighted average equals:
[(catchment area$_1$ * export coeff.$_1$) + (catchment area$_2$ * export coeff.$_2$) + (catchment area$_3$ * export coeff.$_3$)]/(total area of development).

	Area (ac)	Post-BMP TN Export Coeff. (lb/ac/yr)	Post-BMP TP Export Coeff. (lb/ac/yr)
Catchment 1			

Catchment 2			
Catchment 3			
TOTAL FOR DEVELOPMENT			

Note: The nutrient loading goals are 4.0 lb/ac/yr for TN and 0.4 lb/ac/yr for TP. If the post-development nutrient loading is below these levels, then the BMPs planned are adequate. Otherwise, additional BMPs and/or modifications in development plans are required.

Development of a Nutrient Export Model for New Developments in the Tar-Pamlico River Basin

A study completed by
NC State University, Biological & Agricultural Engineering
Bill Hunt, PE, and Annette Lucas

For
The North Carolina Department of Environment & Natural Resources, Tar-Pamlico Stormwater Group

April 11, 2003

The Nutrient Export Model for New Developments

The Tar-Pamlico Stormwater Team worked with North Carolina State University to establish a nutrient export model for new developments. The purpose of this model is to estimate the total nitrogen (TN) and total phosphorous (TP) loadings from development sites before development, after development and after installation of BMPs. This model was constructed to allow developers and local governments to determine if proposed new development projects are in compliance with the required TN and TP loading limits of 4.0 and 0.4 pounds/acre/year, respectively.

The experience with nitrogen loading calculations in the Neuse River basin provided the foundation for the Tar-Pamlico nutrient loading model. The City of Durham made some significant improvements to the model given in the Neuse Model Stormwater Plan. In addition, new data on nutrient loadings from various types of development have become available recently. The Tar-Pamlico Nutrient Loading Model built on this new information.

Application of the Simple Method

Both the Neuse and Tar-Pamlico models are based on the "Simple Method," a model developed by the Metropolitan Washington Council of Governments during the 1980s. The Simple Method is extremely useful because it inputs event mean concentrations (EMCs) measured during storm events in mg/L and converts them to export coefficients in pounds/acre/year.

The Simple Method formula is as follows:

$$\mathbf{L = P * P_i * R_v * C * 0.227}$$

Where:
L is the nutrient load in lbs/ac/yr.
P is the average annual rainfall (45 in/yr - Piedmont, 50 in/yr - Coastal Plain).
$\mathbf{P_i}$ is a correction factor for storms with no runoff (0.9).
$\mathbf{R_v}$ is the runoff coefficient equal to 0.05 + 0.9I (I - fraction impervious from 0 to 1).
C is the flow-weighted event mean concentration in lbs/ac/yr.
(The Piedmont includes Oxford, Henderson, Rocky Mount and Tarboro as well as Franklin, Nash and Edgecombe Counties. The Coastal Plain includes Greenville and Washington as well as Pitt and Beaufort Counties. This delineation was made based on rainfall data).

The Simple Method becomes even simpler after realizing that P and P_i are known variables. R_v can be determined by determining I, the percentage of the development that is impervious. So, the only real "variable" in the equation is C, the flow-weighted event mean concentration. The majority of effort in developing the model methodology was spent determining appropriate C values (more on that later).

In order to apply the Simple Method to new developments in the Tar-Pamlico basin, the method was applied to each of the four major land use categories within a development site:

1. **Transportation impervious:** The portion of the development that is taken up by roads, driveways, parking areas, wash pads or any other facility designed for vehicular use, maintenance or storage. Transportation impervious includes areas covered in pavement, gravel, pavers and dirt.

2. **Roof impervious:** The portion of the development that consists of roofs of buildings and other structures that serve single-family homes. Commercial parking garages shall be considered as transportation impervious.

3. **Managed pervious:** The portion of the development that consists of vegetated areas that the landowner could manage by mowing, clearing, applying fertilizer, etc. Although residential development may include pervious areas that are initially undisturbed, these areas must be considered as managed pervious (instead of wooded pervious) unless they have conservation easements or another mechanism to insure they will not be managed. Also, the land in Zone 2 (the outer 20 feet) of a protected riparian buffer must be considered as managed pervious area unless it is protected by a conservation mechanism.

4. **Wooded pervious:** The portion of the development that consists of forested areas that are permanently protected by a conservation easement or other binding conservation mechanism. Also, wetlands and the land in Zone 1 of a protected riparian buffer (the first 30 feet adjacent to a stream) may be considered as wooded pervious area.

The Simple Method formulas for each land use category are as follows:

$$\mathbf{L_{transportation} = P * P_i * R_v * C_{transportation} * 0.227}$$
$$\mathbf{L_{roof} = P * P_i * R_v * C_{roof} * 0.227}$$
$$\mathbf{L_{managed} = P * P_i * R_v * C_{managed} * 0.227}$$
$$\mathbf{L_{wooded} = P * P_i * R_v * C_{wooded} * 0.227}$$

Figure 1 below is an excerpt from the Piedmont nutrient loading model. The arrows explain which part of the Simple Method formula each column represents. The Coastal Plain nutrient loading model is identical to the Piedmont except that the input for rainfall is 50 inches/year in the Coastal Plain instead of 45 inches/year used in the Piedmont (based on state climatologic data). This results in a Simple Method formula in column(3) of 0.51 + 9.1*I for the Coastal Plain, where 0.46 + 8.3*I applies to the Piedmont.

Figure 1. The Application of the Simple Method to the Nutrient Loading Model

= P * Pi * Rv * 0.227
= 45 * 0.9 * (0.05 + 0.9*I) * 0.227
= 0.46 + 8.3*I

= C (for TN)

= C (for TP)

(1) Type of Land Cover	(2) Area (acres)	(3) S.M. Formula (0.46 + 8.3I)	(4) Average EMC of TN (mg/L)	(5) Column (2) * (3) * (4)	(6) Average EMC of TP (mg/L)	(7) Column (2) * (3) * (6)
Transportation impervious			2.60		0.40	
Roof impervious			1.95		0.15	
Managed pervious			1.42		0.31	
Wooded pervious			0.95		0.14	
Fraction Impervious (I) =			TN Loading (lb/yr) =		TP Loading (lb/yr) =	
Total Area of Development =			TN Exp. Coeff. (lb/ac/yr) =		TP Exp. Coeff. (lb/ac/yr) =	

Determining Appropriate EMCs for the Land Uses

The concentrations for the land uses given above were determined based on water quality monitoring data from Durham, Fayetteville, Raleigh and Chesapeake, VA. These cities were selected for two reasons:

1. All are required to monitor different types of watersheds under their federal NPDES (National Pollutant Discharge Elimination System) stormwater permits. All of the data were collected recently using consistent EPA methodology.
2. All of these cities are geographically close to the Tar-Pamlico river basin and, in a sense, bracket it.

The data collected by these cities is summarized and graphed below. As Table 1 shows, data were sorted according to whether the pervious surfaces in the watershed were "managed" or "unmanaged" (wooded). The decision on whether to classify each site as having managed or unmanaged pervious surfaces was based on each local government's best judgments about the characteristics of the watersheds being monitored. Table 1 summarizes the monitoring data that were used to support model development.

Table 1. Summary of Water Quality Data Collected to Support the Model

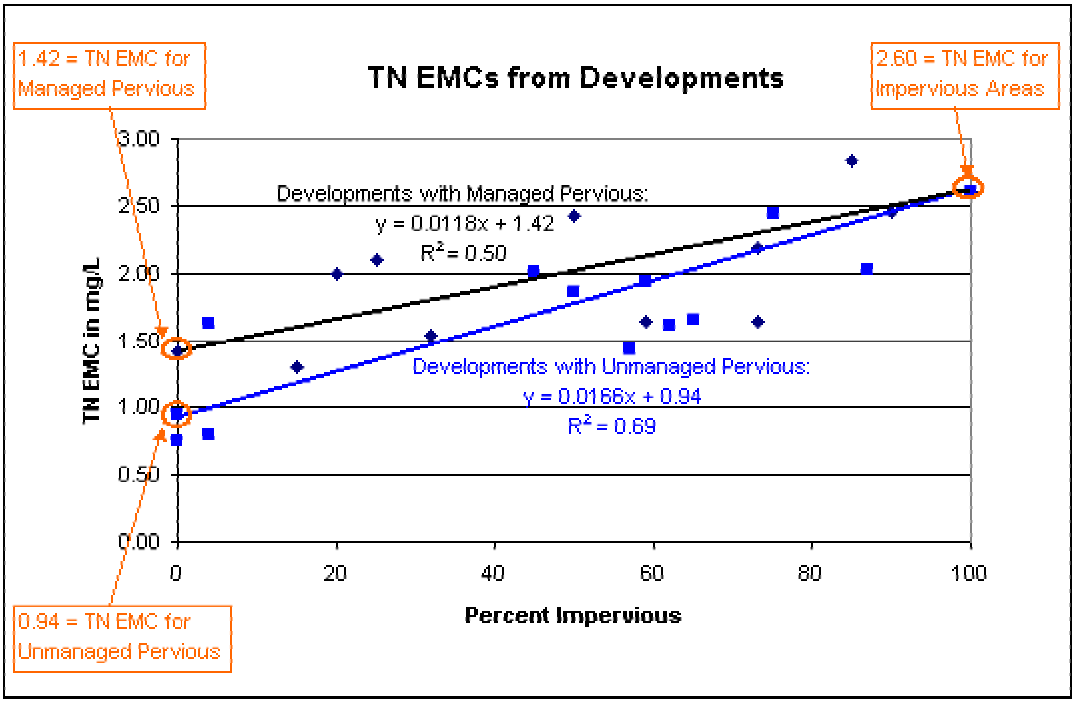
City	Managed or Unmanaged?	Outfall Name	Land Use	Imperv-ious (%)	TN EMC (mg/L)	TP EMC (mg/L)
Durham	managed	Chateau	Low Residential	15	1.30	0.32
Fayetteville	managed	clea	Low Residential	20	1.99	0.19
Chesapeake	managed	999	Med Residential	25	2.09	0.25
Durham	managed	Northgate	Med Residential	32	1.53	0.50
Chesapeake	managed	002	Med Residential	50	2.43	0.37
Raleigh	managed	7	Mixed	59	1.64	0.46
Raleigh	managed	4	Commercial	73	1.64	0.46
Durham	managed	Wortham	Commercial	73	2.18	0.39
Chesapeake	managed	007	Commercial	85	2.83	0.26
Fayetteville	managed	elms	Commercial	90	2.46	0.42
Best-fit point for 0% imperviousness:				0	1.42	0.31
Best-fit point for 100% imperviousness:				100	2.60	0.40
Fayetteville	unmanaged	strk	Open	0	0.75	0.10
Durham	unmanaged	Maplewood	Open	4	0.80	0.13
Raleigh	unmanaged	1	Open	4	1.62	0.28
Fayetteville	unmanaged	71st	Insitutional	45	2.02	0.23
Fayetteville	unmanaged	rose	Mixed	50	1.86	0.20
Chesapeake	unmanaged	008	Industrial	57	1.43	0.20
Durham	unmanaged	Academy I	High Residential	62	1.61	0.24
Durham	unmanaged	Maxwell	Industrial	65	1.66	0.31
Durham	unmanaged	Academy II	Mixed	59	1.94	0.49
Fayetteville	unmanaged	wins	Industrial	75	2.44	0.25
Raleigh	unmanaged	5	Light Industry	87	2.03	0.40
Best-fit point for 0% imperviousness:				0	0.94	0.14
Best-fit point for 100% imperviousness:				100	2.60	0.40

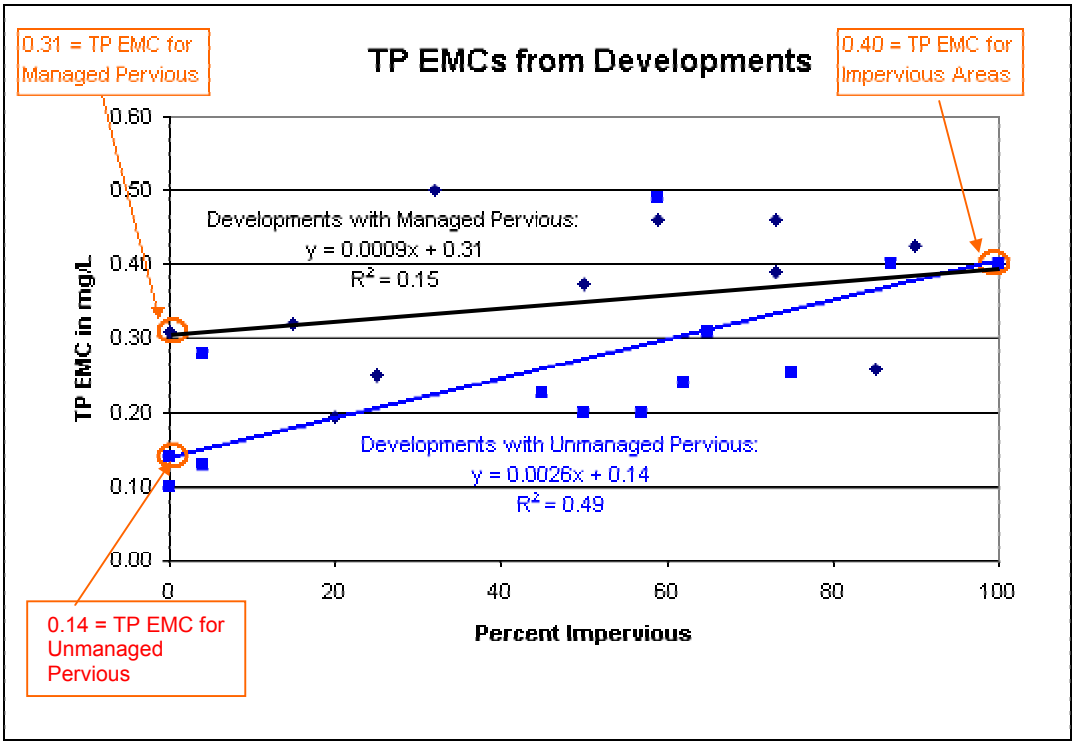
The researchers analyzed the monitoring data listed above to determine appropriate EMCs for TN and TP for impervious, managed pervious and unmanaged pervious using this process:

1. First, the monitoring data were plotted with percentage impervious on the x-axis and nutrient concentrations on the y-axis. The managed pervious sites were considered separately from the unmanaged pervious sites.
2. Then, the researchers determined the best-fit points for 100% impervious, 100% managed pervious and 100% unmanaged pervious. (Note: 100% managed pervious on the graph is equivalent to 0% impervious for the managed sites. Likewise, 100% unmanaged pervious on the graph is equivalent to 0% impervious for the unmanaged sites). The best-fit points were determined through trial and error by testing different values in the graph and determining which points resulted in the highest r-squared values.

Figure 2 below shows the graphs and illustrates how the EMCs were determined.

Figure 2. Graphs of the TN and TP EMCs from the Monitoring Sites





The graphs in Figure 2 above show a much higher correlation within the TN data than within the TP data. The researchers think this difference may be attributable to the greater influence of landscape maintenance on TP concentrations than TN concentrations. That is, developments with similar percentages of impervious surfaces will show greater variations in TP than TN concentrations if one is managed with healthy, abundant vegetation and the other has sparse vegetation and erosion problems.

In addition to the concentrations for impervious, managed pervious and wooded pervious developed as shown above, the model also splits the "impervious" category into transportation impervious and roof impervious. For TP, this decision was based on research conducted by Waschbusch et al. (1999). This research showed that the TP concentration of rooftop runoff is only 37% of the TP concentration in runoff from roads (Waschbusch et al., 1999). Unfortunately, these researchers did not collect data on TN concentrations. Therefore, researchers at NCSU used their best professional judgment to estimate that TN concentration of rooftop runoff is 75% of the TN concentration of roadway runoff. The TN "discount" was awarded based on the fact that roads receive a greater amount of organic nitrogen (leaf litter, etc.) and fertilizer than roofs. However, the majority of TN from impervious surfaces is likely to originate from deposition of NOx, which is likely to be similar for both roofs and roads. Table 2 summarizes how this information is applied to the EMC values for the various land uses.

Table 2. Summary of the EMC Values and Information Sources

Land Use	TN EMC (mg/L)	TP EMC (mg/L)	Source of Information
Transportation impervious	2.60	0.40	Best-fit points for the TN and TP graphs for managed and unmanaged pervious surfaces for the 100% impervious value of x.
Roof impervious	1.95	0.15	75% of the transportation impervious EMC (based on best professional judgment) 37% of the transportation impervious EMC (based on research by Waschbusch et al., 1999)
Managed pervious	1.42	0.31	y-intercept of graphs of TN and TP concentrations for managed pervious surfaces
Wooded pervious	0.94	0.14	y-intercept of graphs of TN and TP concentrations for managed pervious surfaces

Development of the Residential Worksheet

In order to use the Simple Method effectively, it is necessary to know how much of the development lies in each of the land uses given in the table above. This is a simple exercise when the footprints of all buildings, parking lots, roads, lawns, landscaped areas, etc. are shown on the plans. This is nearly always the case for commercial, industrial and higher-density residential development. However, for larger-lot residential developments, plans are often show only lot and right-of-way boundaries. The Tar-Pamlico model includes a "Residential Worksheet" that allows the user to input known information and determines the acreage in each of the four major land uses. The worksheet calculations are based on data developed by the City of Raleigh on the relationship between lot size and impervious area.

The information that is required in the Residential Worksheet should be fairly simple for the developer to determine based on the development plans:

- Average lot size in acres,
- Percentage of right-of-way that is impervious,
- Total acres in lots,
- Total acres in protected stream buffer area,
- Total acres in rights-of-way,
- Total acres in community space (and the land use break-down of that space), and
- Lot acreage in buffer or wetland.

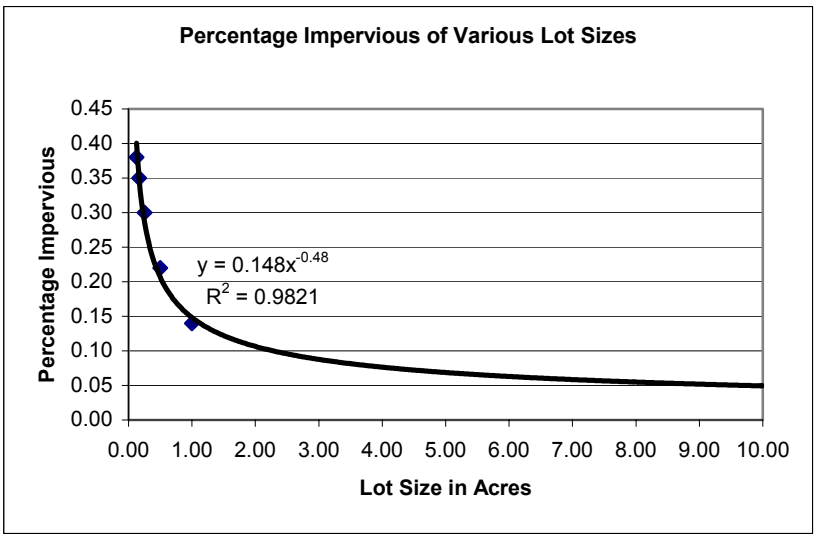
The City of Raleigh has done a study of its various zoning categories (in dwelling units per acre) and the corresponding levels of imperviousness that would be expected per lot. For the purpose of this model, the dwelling units per acre were converted to average lot size in acres and graphed with lot size on the x-axis and percentage lot area in impervious surface on the y-axis (see Figure 3 below). The equation of the best-fit line was:

Percentage impervious = 0.148 * (average lot size)$^{-0.48}$

Table 3. City of Raleigh's Data on Lot Size Versus Lot Imperviousness

Dwelling Units per acre	Size of lot (acres)	Lot area in impervious surface (percent)	Lot area in managed pervious (percent)
1	1.00	0.14	0.86
2	0.50	0.22	0.78
4	0.25	0.30	0.70
6	0.17	0.35	0.65
8	0.13	0.38	0.62

Figure 3. Graph of Lot Size Versus Percentage Impervious



Based on Schueler's Site Planning Manual (1995), researchers estimated that 60% of lot imperviousness is for transportation (driveways, parking) and 40% is for roofs. This yields the following two equations:

$$\textbf{Transportation impervious} = 0.089 * (\text{average lot size})^{-0.48}$$
$$\textbf{Roof impervious} = 0.059 * (\text{average lot size})^{-0.48}$$

The above equations are used in the Residential Worksheet to directly compute transportation and rooftop impervious areas based on values provided by the user for average lot size and total acreage in lots. The user also enters as "Wooded Pervious" the acreage of any protected buffers or wetlands within lots. The spreadsheet calculates the acreage of managed pervious areas as the total development acreage minus the sum of the impervious and the wooded pervious values.

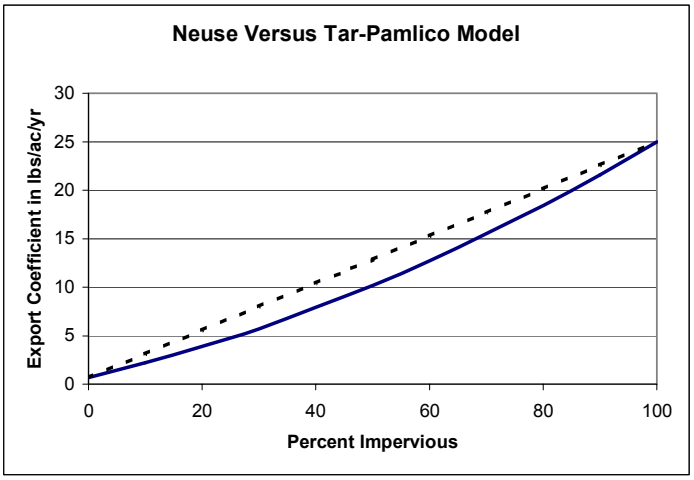
In addition to computing the pre- and post-development TN and TP export coefficients, the Tar-Pamlico model also computes export coefficients from developments after BMP installation. A review of the efficiencies follows in the next section.

Summary of Improvements to Export Calculation Method

The Tar-Pamlico model is an improvement over the Neuse model for the following reasons:

1. The model is more accurate than the Neuse model, which actually overestimates TN loading, especially for developments in the 40 to 60 percent impervious range. Figure 4 below shows the export coefficients found by the Tar-Pamlico model as a solid line and the Neuse model as a dashed line.
2. The model has an automated version for easier use by developers and local governments.
3. The model calculates TP loads and nutrient reductions resulting from BMP installation.
4. The model separates rooftop and transportation imperviousness rather than considering them as a single entity as in the Neuse model.
5. The model has separate versions for the Piedmont and Coastal Plain that consider their differing climatologic data.

Figure 4. Results of Neuse Versus Tar-Pamlico Nutrient Export Models



References: Please see the references section at the end of Appendix I.

Appendix I. Summary of BMP Literature Studies

Establishment of Nutrient Removal Rates for Stormwater BMPs in the Tar-Pamlico River Basin

A study completed by
NC State University, Biological & Agricultural Engineering
Bill Hunt, PE, and Annette Lucas

For
The North Carolina Department of Environment & Natural Resources, Tar-Pamlico Stormwater Group

April 11, 2003

Assigning Removal Efficiencies to Five Stormwater BMPs

The construction of pavement and buildings, and the clearing of land, increase the volume and speed of stormwater runoff. When impervious or disturbed areas are created by urban construction activities, and stormwater is not adequately managed, the environment may be adversely affected by: (1) changes in volume, timing, and location of the stormwater discharges, and (2) the movement of pollutants from the site to waterbodies such as tributaries reaching the Tar-Pamlico River System and the Pamlico Sound and estuarine system. This contributes to flooding and damage to property and habitat (stormwater quantity impacts). It also contributes to lowering of water quality, by increasing the flow of human pollutants such as oil, fertilizers and pesticides, and the flow of natural elements such as nitrogen, phosphorus and sediment into the water (stormwater quality impacts). Degradation of lakes, streams and wetlands due to urban stormwater reduces property values, raises bills from public water utilities and reduces tourism and related business income.

The following sections will examine several stormwater Best Management Practices (BMPs) and present a model for estimating BMP removal efficiencies. This model is intended to serve the Tar-Pamlico basin, and as such only a limited amount of data is used to estimate pollutant removal efficiencies. Only BMPs from sites with relatively similar weather to that of Central and Eastern North Carolina are included in the study. Because of this, there are some differences in pollutant removal rates reported herein and those from national studies that do not make adjustments for weather regimes. Furthermore, even when only examining studies from the Southeastern and Mid-Atlantic states, there is evidenced a very wide range of removal efficiencies within a practice type. This is due to site specific factors such as soil type, monitoring period (a wet year or a dry year), or type of sample (grab or composite). Only data from sites that are within certain standards are used to compute removal efficiencies, with data from known North Carolina studies given the most weight. Finally, as more and more data is found regarding the effectiveness of stormwater best management practices, such as bio-retention, the removal rates will be expected to change. This report illustrates this point with respect to bio-retention cells. The removal rate has been adjusted from that of the Neuse Stormwater plan due to the influx of data from new studies. The study of stormwater BMPs is dynamic and perhaps the State of North Carolina should consider annual or bi-annual updates of removal efficiencies.

Structural Stormwater BMPs

An urban stormwater BMP is believed to be a 'best' way of treating or limiting pollutants in stormwater runoff. Certain BMPs are better under certain conditions than others. The size of the watershed, the imperviousness of the watershed, and the amount of available land for the structure all influence the selection of a BMP. The stormwater treatment practices investigated in this study are solely structural devices and include wet ponds, stormwater wetlands, bio-retention areas, grassy swales and sand filters.

Wet Ponds, also called wet detention ponds or facilities, have been used in North Carolina longer than any other stormwater BMP. Wet Ponds are runoff-holding facilities that have standing water in them constantly. Storm flows are held in the pond temporarily and then released to minimize large scale flooding. Wet ponds are characterized by larger excavation volumes and have forebays located where the inflow enters the BMP. The primary removal mechanism is settling while stormwater runoff resides in the pool. Nutrient uptake also occurs through biological activity in the pond. Wet ponds can be designed to have vegetated fringes or zones (as in Figure 5), and the plant roots hold sediment and use the nutrients that are often contained in urban runoff. Developers can design the wet ponds to look like natural lakes and enhance the value of surrounding property. Mosquito larvae-eating fish live in the pond to keep mosquito problems to a minimum. Wet ponds can be used for any size of drainage area. In North Carolina, wet ponds treat watersheds as small as 0.75 acres and as large as several hundred acres. Wet ponds may cause community concerns regarding safety; there is an increased liability due to drowning risk because of their relative depth. Additionally, wet pond effluent is often warmer than base stream water, causing thermal pollution and potentially damaging downstream aquatic habitats.

Figure 5. Wet Pond with Aquatic Fringe

Stormwater Wetlands,[1] also called constructed wetlands, are comparable to wet ponds but are much shallower and more heavily vegetated with wetland plants. In many stormwater wetlands the average depth of water is approximately 1-1.5 feet. They serve as a natural filter for urban runoff and also help to slow the flow of water to the receiving waters and replenish ground water. As stormwater runoff flows through the wetland, pollutant removal is achieved by settling, adsorption and biological uptake within the practice. Wetlands are effective stormwater practices in terms of pollutant removal and also offer aesthetic value. When properly designed (Figure 6), stormwater wetlands have excellent wildlife habitat potential (MWCOG, 1992). In North Carolina, constructed stormwater wetlands have been located on watersheds as small as four to five acres, but they are most commonly used for larger drainage areas and typically serve watersheds ranging from 15 acres to over 100 acres. Thanks to its vegetative cover, wetland effluent is typically cooler than that of wet ponds, minimizing the impacts of thermal pollution.

Figure 6. Stormwater Wetlands can be designed to incorporate diverse vegetative species.

[1] For regulatory purposes under the Clean Water Act, the term wetlands means "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

There are also some limitations to stormwater wetlands. Wetlands consume a relatively large amount of space making them an impractical option on sites where surface land area is constrained or land prices are high. They have, therefore, limited applicability in highly urbanized settings. There can also be a public perception that wetlands are a mosquito source, although design features can minimize the potential of wetlands becoming a breeding area for mosquitoes (McLean, 2000).

Wetlands and Wet Ponds: When choose which?

Wetlands and Wet Ponds are similar practices in that each tends to treat larger watersheds, have standing water year round, and are sited in roughly the same types of locations. There are advantages to each that lead a designer to select one over the other. These selection guidelines are summarized below:

1. Wet Ponds are substantially deeper than stormwater wetlands. A four feet difference in average depth can lead to a 50% increase in construction cost. If land costs are relatively low, a stormwater wetland will be a less expensive stormwater BMP to construct, even though wetlands do have the added cost of vegetation purchase and planting.
2. Stormwater wetlands typically occupy more land than wet ponds. This is due to the fact that the height of water rise over normal pool (the elevation at which the water is typically) is much higher in a wet pond than a wetland. This relates to a wet pond's surface area only approaching 60-70% of that of a stormwater wetland. In areas where land costs are relatively higher, the opportunity cost of using extra land may easily offset the increased cost of constructing a wet pond, making the wet pond a more economically viable option.
3. Contrary to initial estimation, wet ponds do not cost less than wetlands to maintain. This is due to the nature of each BMP. A standard wet pond used as an amenity is often well-manicured, with the surrounding lawn mowed to the banks and all vegetation along the side (wetland plants) being killed by direct herbicide application. The wetland's plants are designed to maintain a natural state; that is, there is very little cosmetic maintenance to a wetland when compared to many wet ponds. Other maintenance needs such as outlet inspection and forebay cleaning are the same for each practice. Long term maintenance needs for a stormwater wetland do potentially include plant harvesting, but a recent study by Wossink and Hunt (2003) suggests that wet pond maintenance in the long run is substantially higher than that of stormwater wetlands.
4. Liability issues are present for each practice. Ponds tend to be much deeper so the risk of drowning is higher for wet ponds than it is for wetlands. However, wetlands are excellent environments for animals such as frogs and snakes, with the latter potentially being an issue of concern, if there is easy and uncontrolled access to the stormwater wetland by young children.
5. Aesthetics can be a determining factor in BMP selection. If an open water surface is desired for aesthetic reasons, then a wet pond will be more appropriate than a stormwater wetland. To many, a stormwater wetland is still viewed as a "swamp" and has unfavorable connotations to some.
6. The state of North Carolina counts a stormwater wetland to be a riparian buffer, but the state does not view a wet pond to be the same. This is important when a new development is required to install buffers around all blue-line (from a USGS topographic map) bodies of water. If a pond is constructed in a watershed with buffer requirements

(such as the Tar-Pamlico basin), it would then need to have a 50' buffer established around its perimeter. This land would need to be dedicated apart from a developed activity in addition to the surface area of the wet pond. A wetland, since it is vegetated already, does not need a buffer to be established in addition to itself.

7. Pollutant removal rates perhaps provide the biggest incentive to choose one practice over the other. If a stormwater wetland is credited with a better pollutant removal rate, say, for phosphorus, than a wet pond, a developer can just barely meet the nutrient reduction requirement by installing a stormwater wetland in lieu of a wet pond, then the former BMP will be selected.

Three other practices are used to treat smaller watersheds. Each of the three is reviewed below. **Sand filters** are usually two-chambered stormwater treatment practices; the first chamber is for settling, and the second is a filter bed filled with sand or another filtering media. As stormwater flows into the first chamber, large particles settle out, and the finer particles and other pollutants are removed as stormwater flows through filtering media. At the bottom of the sand layer, an underdrain pipe typically connects the treated water with the existing drainage network. Sand filters, in general, are good options for relatively small drainage areas in ultra-urban environments where space is limited and original soils have been disturbed (as in Figure 7).

Figure 7. Sand filters can be designed to sustain vehicular traffic or not as is the case at this site in Durham.

Moreover, sand filters are particularly well suited to treat runoff from stormwater hotspots[2] common in ultra urban areas because stormwater treated by sand filters has no interaction with, and thus no potential to contaminate groundwater.

Sand filters are best applied on small sites and can be used on sites with up to about 6% slopes. It is difficult to use sand filters in extremely flat terrain, as they require a significant drop in elevation (ranging from two to five feet) to allow runoff flow through the filter. There are several modifications of the basic sand filter design, including the surface sand filter, underground sand filter and the perimeter sand filter. All of these filtering practices operate on the same basic principle. Underground and perimeter sand filters are particularly well suited for ultra-urban watersheds as they consume no surface space. The perimeter sand filter can be applied with as little as 2 feet of drop in elevation. In this report we address the economics of the latter type of sand filter specifically. The first sand filter in North Carolina was installed in the early mid-1990's. Their use is currently not widespread due to the costs of construction. Sand filters are designed

[2] Stormwater hotspots are land uses or activities that generate highly contaminated runoff and include: commercial parking lots, fueling stations, industrial rooftops, outdoor container storage of liquids and loading/unloading facilities and vehicle/equipment service, maintenance/washing/steam cleaning areas.

for impervious watershed in particular, and typically one sandfilter treats a drainage catchment of less than a few acres.

Bioretention/rain gardens in many respects are landscaped and vegetated filters for storm water runoff. Surface runoff is directed into shallow, landscaped depressions (Figure 8). These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems and are strikingly similar in vegetation types to the poccosins of eastern North Carolina . Trees and shrubs are planted in bedding material consisting of a high percentage of sand, and lesser amounts of silt, clay and organic matter. During rain events, stormwater ponds above the mulch and soil in the system. Runoff from larger storms is generally diverted past the facility to the storm drain system. The remaining runoff filters through the mulch and prepared soil mix. Typically, in clay soil sites, the filtered runoff is collected in a perforated underdrain and returned to the storm drain system. Bioretention systems are generally applied to small sites and in a highly urbanized setting. Bioretention facilities are ideally suited to many ultra-urban areas as they can be fit into existing parking lot islands or other landscaped areas.

Figure 8. This Rain Garden in Kinston was the first one constructed in Eastern North Carolina. The site located at the Neuseway Education Center serves aesthetic, water quality and educational purposes.

Because bioretention can potentially fulfill two purposes, (1) water quality control and (2) landscaping requirements, their use is expected to increase. For example, in 1997 there were no bioretention areas in North Carolina; whereas today, it is the secondly most common planned practice in Greensboro, the state's third largest city (Bryant, 2001). Bio-retention areas typically serve small watersheds such as (portions of) parking lots, or residential run off areas. In North Carolina, the majority of bioretention areas served watersheds ranging from one to two acres. Their use is poised to grow further, pending several studies conducted by N.C. State University and other universities, particularly if the research shows that this BMP works to remove pollutants at a rate as high as is currently anticipated.

Grassy Swales are the simplest and most prevalent stormwater BMPs in North Carolina. Their use is typically limited by overwhelming amounts of runoff which cause erosion of swales. There are some ways to mitigate this erosion by including changing the slope of the swale or incorporating turf reinforcement matting to strengthen the grass lining (see Figure 9). Swales are often triangular in shape and are constructed by using relatively simple equipment. The use of grassy swales is very limited in ultra-urban areas, but swales are often easily installed in residential environments. Maintenance of wet swales can be particularly important in neighborhoods. It is essential that grassy swales don't become collectors of nutrient rich grass clippings, as this nutrient source is easily transported to adjoining water bodies by water flowing through the swale.

Figure 9. Turf reinforcement mats increase allowable velocities for grassy swales, making swale use more possible.

Table 4. Summary of the five structural stormwater BMPs by relative size of the associated drainage area.

BMP	Relative size of commercial/residential drainage area	
	Large	Small
Wet Pond	X	X
Stormwater Wetland	X	
Sandfilter*		X
Bioretention/Raingarden**		X
Grassy Swales		X
*Only effective with a significant drop in elevation (for perimeter sandfilter at least two feet). ** In clay soils a significant drop in elevation (4 feet) is typically required.		

Above, several structural options were described for achieving water quality improvements in stormwater runoff, all of which have various technical characteristics (design requirements and site constraints[3]), ecological characteristics (i.e. capabilities regarding pollution control) and economic characteristics (maintenance requirements and construction costs).

While each may be constructed based upon design constraints, the different BMPs are shown to remove nutrients at varying efficiencies. The next section will summarize pollutant removal abilities for TN and TP for each of the five stormwater practices discussed.

[3] BMPs should only be used in areas where the physical site characteristics are suitable. Some of the important physical site characteristics are soil type, watershed area, water table, depth to bedrock, site size and topography. If these conditions are not suitable, a BMP can loose effectiveness, require excessive maintenance or stop working.

Pollutant Removal Effectiveness

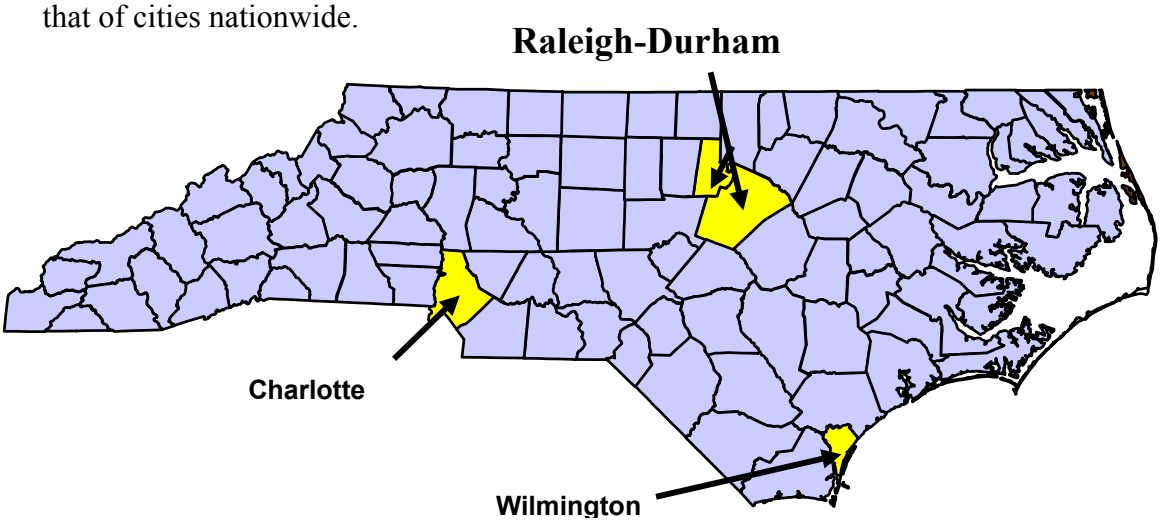
Climatologic Screening

A large body of national research data was available on the removal effectiveness of the four types of BMPs. Particularly there was a considerable amount of data for the following cities: Austin TX; Baltimore, MD; Chicago, IL; Minneapolis, MN; Seattle, WA and Tampa, FL. However, North Carolina's climate is substantially different from many other parts of the U.S. with respect to temperature and precipitation. Because of this, a screening procedure was used to decide which data to use.

The out-of-state cities' weather was compared to the weather of three cities in North Carolina: Charlotte, Raleigh-Durham and Wilmington (Figure 10). These three cities represent the weather conditions found in eastern and central North Carolina, and may best approximate weather in the Tar-Pamlico River Basin.

Temperature and rainfall data over the period of 1990 -2000 was collected for the six out-of state and the three in-state cities using both the Midwestern Climate Information System (MICIS, 2000) and the Southeastern Regional Climate Center's CIRRUS system (CIRRUSweb, 2000). Average monthly mean temperature and average monthly precipitation level were assessed for each city and statistically analyzed for significant differences.

Figure 10. Location of cities in North Carolina whose weather was compared to that of cities nationwide.



Seattle, WA; Minneapolis, MN, and Chicago, IL, were shown to have either drastically different rainfall distribution and amounts or temperatures or both. This is detailed graphically in Appendix I-1. The temperatures and precipitation levels of the remaining three cities: Austin TX, Baltimore, MD, and Tampa, FL, where similar to the climate of at least one of the three cities in North Carolina. Comparisons show that Austin and Charlotte had similar temperatures, though Charlotte was somewhat cooler in the winter. Except for the month of June, the difference in the average monthly rainfall in Charlotte and Austin, TX, was less than 1". Raleigh-Durham and Baltimore, MD were quite similar both with respect to temperature and rainfall, with Raleigh-Durham being slightly wetter and warmer. Again differences in rainfall were within 1" on a per-month basis. Finally, Wilmington, NC and Tampa, FL, were surprisingly similar. Precipitation

levels for each city were high in late summer and early fall, reflecting tropical activity at both locations. The rainfall amounts for July-September were 7-8" for both cities. Tampa was warmer in the winter but the difference with Wilmington was within 10ºF. Therefore pollution removal data collected from the Austin, TX, region, the Baltimore-Washington metropolitan area, and the northern two-thirds of Florida were all included in the analysis and were added to what had been collected in North Carolina and Virginia. Appendix I-1 provides a graphical presentation of each comparison made.

Assigning Pollution Removal Efficiencies

The two principal sources of best management practice effectiveness were (1) the ASCE/EPA joint venture National BMP pollutant removal database (found at http://www.bmpdatabase.com), and (2) The Center for Watershed Protection's National Pollutant Removal Performance Database (2000 version). Each is a collection of studies reported by either research agencies (such as universities or water management districts), or governments (state, county, or municipal). Research deemed unacceptable by the governing bodies of each database is not included in either database, making these two resources the most credible sources of this type of information in America. Other sources, particularly research projects from NC State and other regional land-grant schools, were used as noted. Appendix I-2 provides an overview of all the data sources used to assess the pollutant removal efficiencies.

Based on the data sources described above, the effectiveness of each of the five BMPs in the Southeast and Mid-Atlantic was determined. For each BMP the data on removal of total phosphorus (TP) and total nitrogen (TN) were analyzed for scale effects by relating the removal effectiveness to the size of the watershed. Linear regression was used for this purpose. Based on the results of this statistical analysis, each practice was assigned a single removal rate (the median removal efficiency) in the cost-effectiveness analysis. That is, assuming the practice is designed properly, it will work comparably well whether it serves a 10-acre watershed or a 50-acre watershed. The median pollutant removal efficiencies for each of the practices are reported in Table 5 on the following page.

There was a wide range of scatter in the data with respect to pollutant removal efficiencies. No significant relationship could be assessed between removal efficiency and watershed size (note Figures 11 and 12) and therefore median pollutant removal efficiencies were used for this report. This is certainly an area for future research and adaptation. Median efficiencies were chosen in lieu of mean efficiencies because the former discounts the impact of skewing data. Outliers, such as negative pollutant removal efficiencies have a more pronounced effect on the results. As such, median removal rates better represent the pollutant removal to expect.

Ideally, a relationship could be developed relating removal efficiency with the ratio of BMP practice size to contributing watershed size. It is generally assumed that the smaller the ratio is, i.e., a small relatively BMP with a large drainage area, the poorer the practice's performance at removing pollution. The opposite is suspected to hold true if the ratio is larger. However, there is very little data to support this assumption and the data is very widely scattered (as shown in an example of Figure 13). Because of a lack of supporting data, the BMP efficiency model can not at this time factor in practice size to watershed size with respect to pollutant removal. Perhaps a later version of the model can incorporate this relationship as new findings are added to the BMP database.

Table 5. Removal Efficiencies assigned to each of the stormwater BMPs to be utilized in the Tar-Pamlico Basin. These numbers account for prior standards, new research, and anticipated maintenance.

BMP Type	TP		TN	
	Removal Efficiency (%)	Number of Sites	Removal Efficiency (%)	Number of Sites
Wet Ponds	40	28	25	27
ormwater Vetlands	35	14	25	14
Sand Filters	45	11	35	12
Bio-retention	35	8	40	4
Grassy Swales	20	16	20	11

The TN results displayed in Table 5 vary slightly from those presented by the Neuse Stormwater Team. This is due to the increased amount of data that has been collected since the Neuse Team completed its work in early 2001. Most striking is the change associated with bio-retention. Since 2001, the number of field studies has quadrupled (from 1 to 4), giving a much firmer, though still not firm enough, idea of how well bio-retention devices work to remove both TP and TN.

Explanation of Efficiencies by BMP

Wet Ponds. A total of 28 studies contained data regarding pollutant removal from wet ponds, which is by far the most of any practice studied, reflecting the relative abundance of wet ponds throughout the Mid-Atlantic and Southeastern states. TP removal rates varied from -50 (meaning the wet pond *added* TP to the receiving stream) to 88%. TN removal rates ranged from -1 to 55%.

Stormwater Wetlands. Fourteen studies chronicled the effectiveness of stormwater wetlands. TP rates ranged from -61 to 75%. TN removal rates were lower than is nationally accepted, ranging from -12 to 55%. The median removal rate of about 25% is 15% less than what the Neuse Stormwater rules stated. These median removal rates are generally higher for appropriately sized stormwater wetlands.

Sand Filters. Twelve studies documented the efficiencies of sand filters. Removal rates for this practice are almost always initially higher due, with the rates dropping when the required maintenance is not performed. TP removal rates ranged from 10 to 80%. TN rates varied from 8 to 71%. The form of nitrogen that sand filters release into the environment is NO_3-N, which is very difficult to remove, once in the water column. It will be imperative that the practice is maintained on a regular basis to maintain such high removal efficiencies.

Bio-retention. Only eight studies (4 of them in the laboratory) document the effectiveness of bio-retention areas to remove TP. Fewer still (four) research this BMP's ability to remove TN. All of the latter are field studies. There is a significant chance these removal efficiencies will continue

to change. Several NC DENR funded demonstration research projects are studying the effectiveness of bio-retention areas and will be completed in 2003 and 2004. TP removal rates vary from -3% to 87%, while TN removal efficiencies vary from 33% to 65%. A conservative removal rate of 40% is being suggested for the latter due to the lack of studies documenting bio-retention removal efficiency. The rate is, however, 15% higher than what is given in the Neuse Stormwater report.

Grass Swales. Without a doubt grass swales have the highest variability of removal efficiencies. Swales that are maintained and from which grass clippings are removed can have relatively high removal rates for TP and TN. Those swales, however, which are unmanaged or managed poorly, will add substantial amounts of TP and TN to the environment. A total of 16 studies document swale efficiencies. TP and TN removal efficiencies both range from -100 to 99%.

Figure 11. TSS Removal Efficiency - Stormwater Wetlands

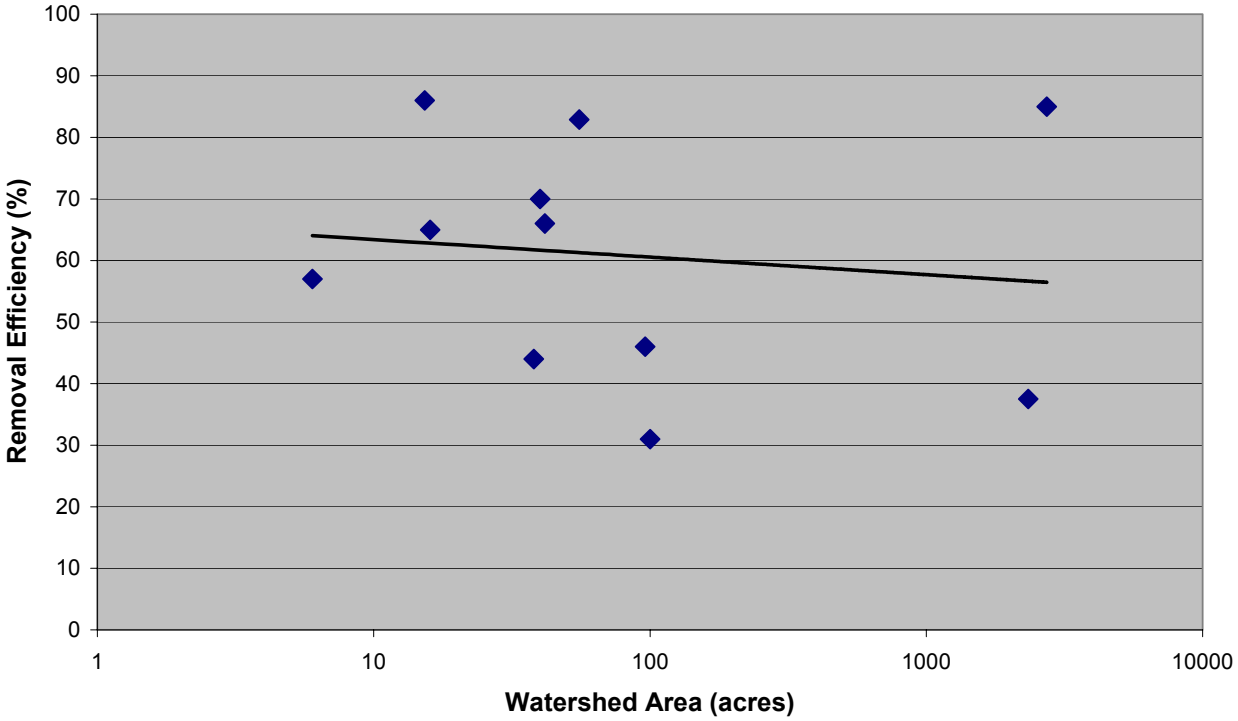


Figure 12. TP Removal Efficiency - Wet Ponds

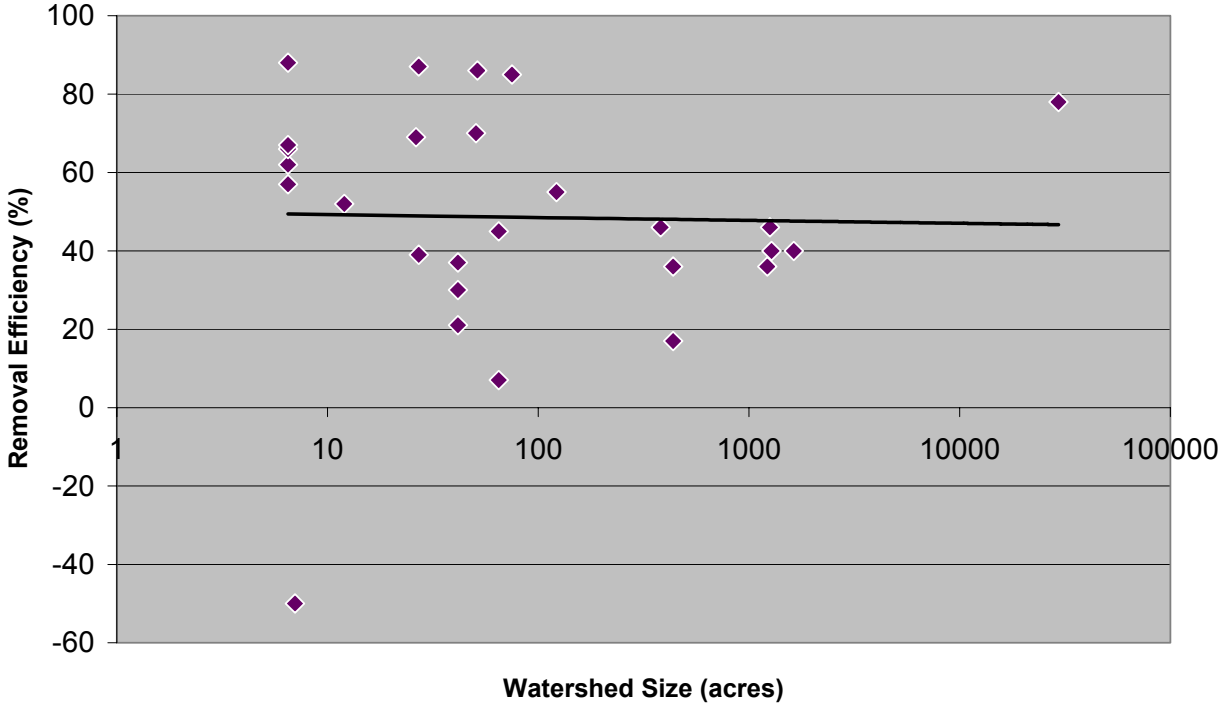
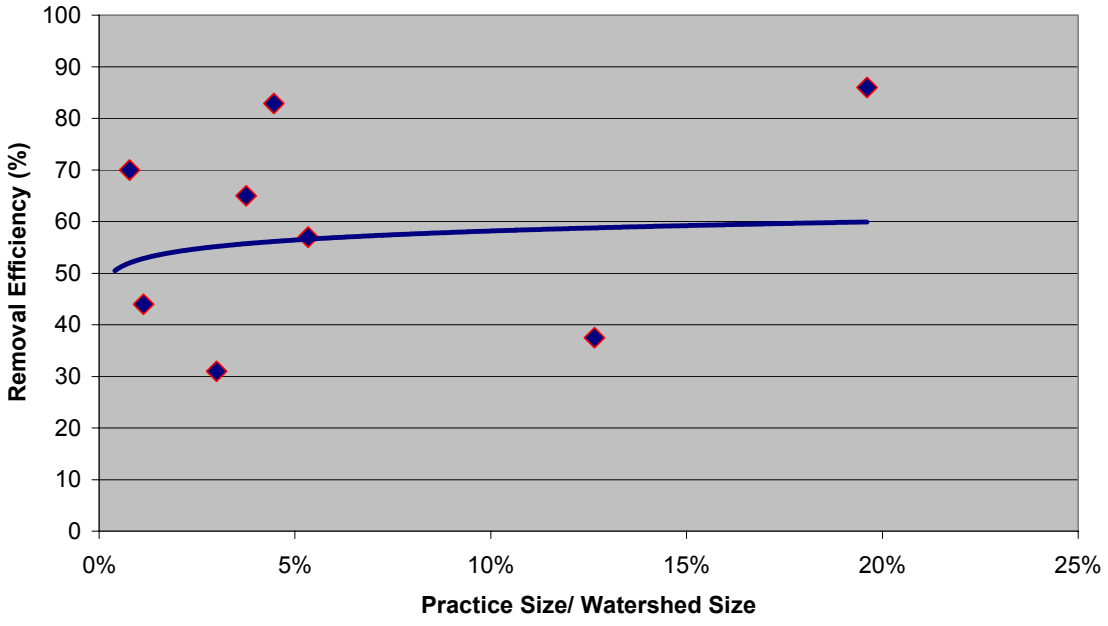


Figure 13. TSS Removal as a Function of Practice Size to Watershed Size Ratio



Acknowledgements

The authors would like to acknowledge several agencies and people who significantly contributed to the research project. The Department of Environment and Natural Resources funded the project. Ms. Desiree Tullos, Ph.D. Candidate in Biological and Agricultural Engineering at N.C. State was instrumental in obtaining pollutant loading information. Representatives from several communities were particularly helpful, including John Cox (Durham), Greg Caisson (Fayetteville), Mark Senior (Raleigh), and officials from the Hampton Roads (VA) Council of Governments. Each was able to provide data used to establish pollutant loading information for the Tar-Pamlico River Basin. Portions of this report were prepared by Dr. Ada Wossink in the department of Agriculture and Resource Economics. Finally, a special thank you goes to all the Tar-Pamlico municipalities, counties and citizen groups who helped identify content to be included and researched for this report. Without them and the leadership of NC DENR's Rich Gannon the report would not have been possible.

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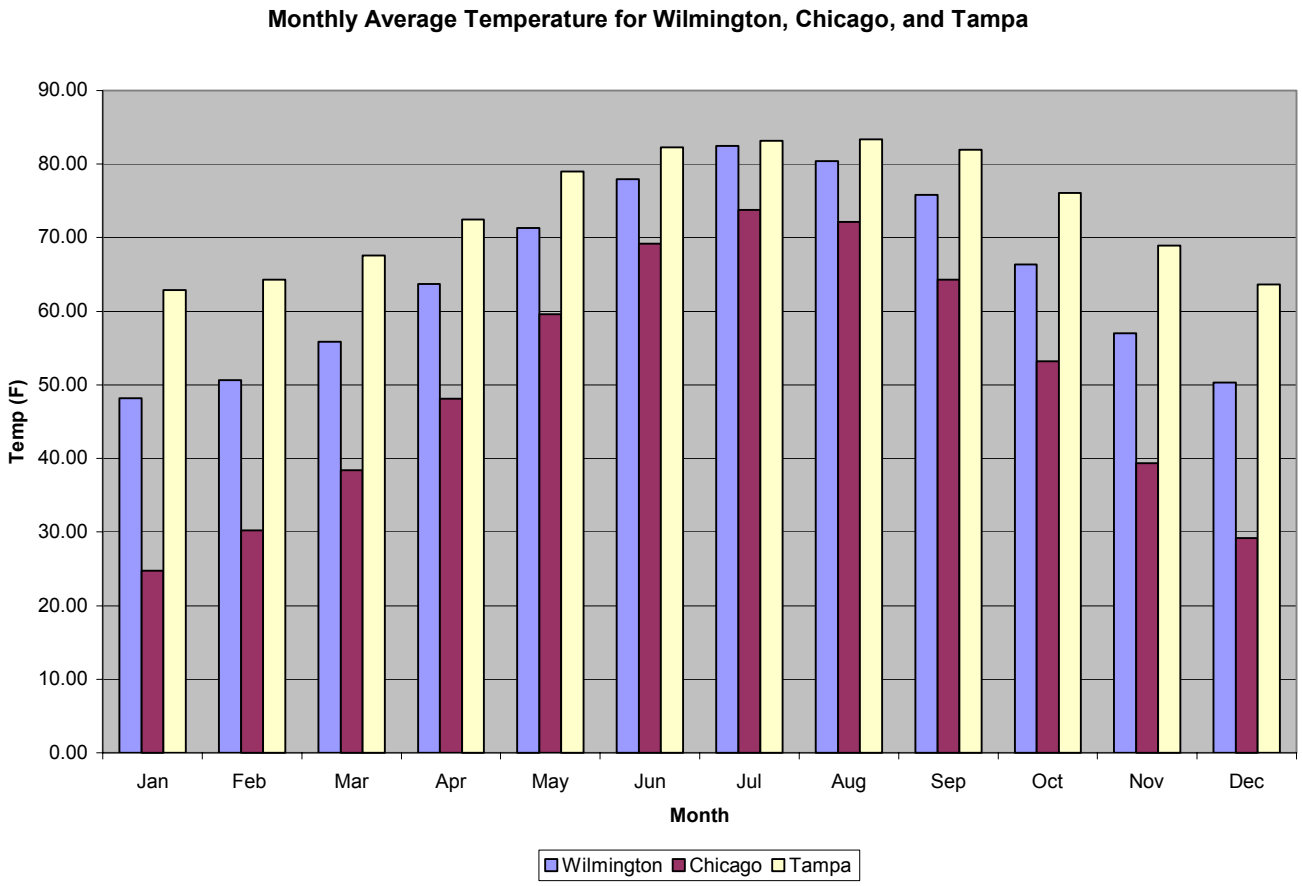
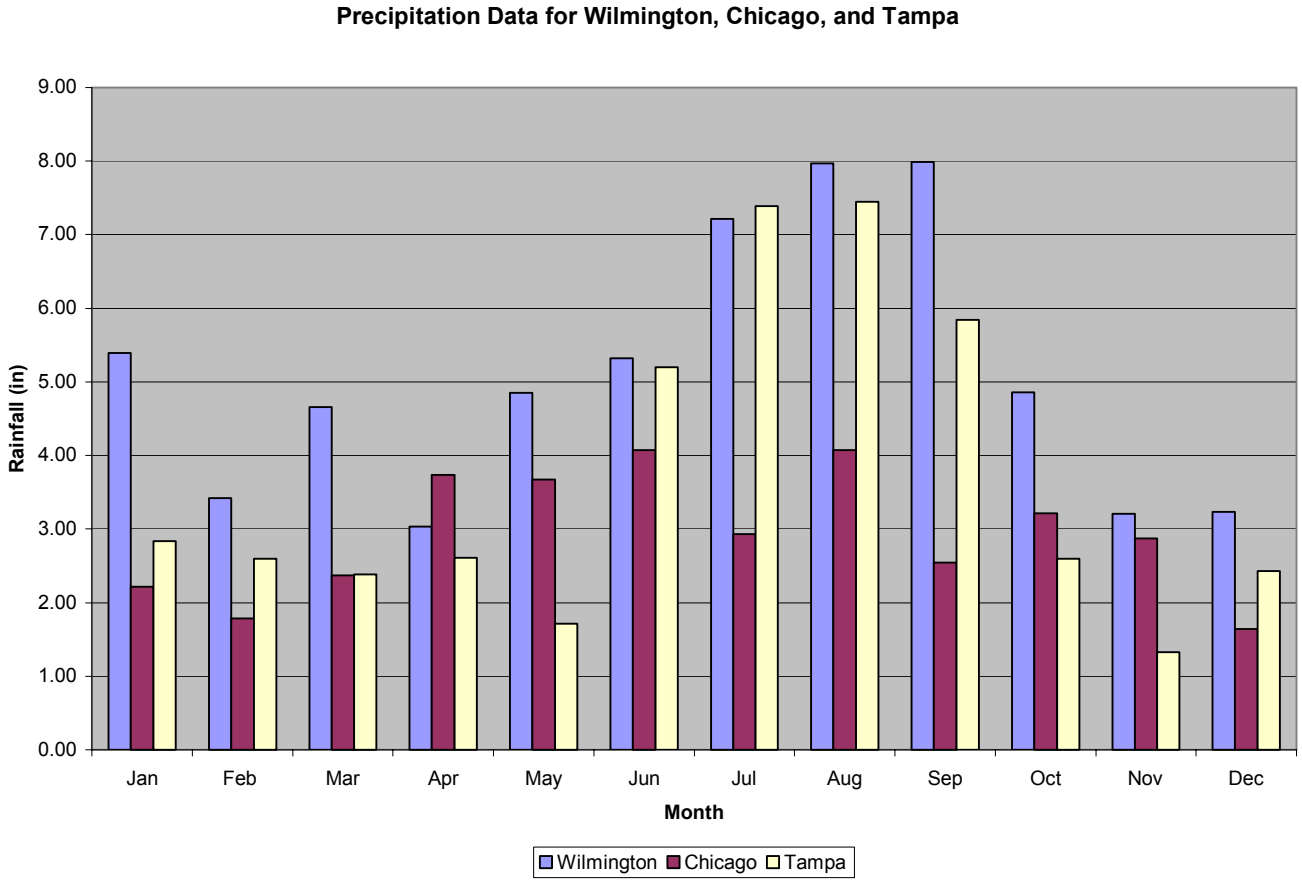
Appendix I-1. Precipitation and Temperature Comparison of Six U.S. cities with three cities in North Carolina.

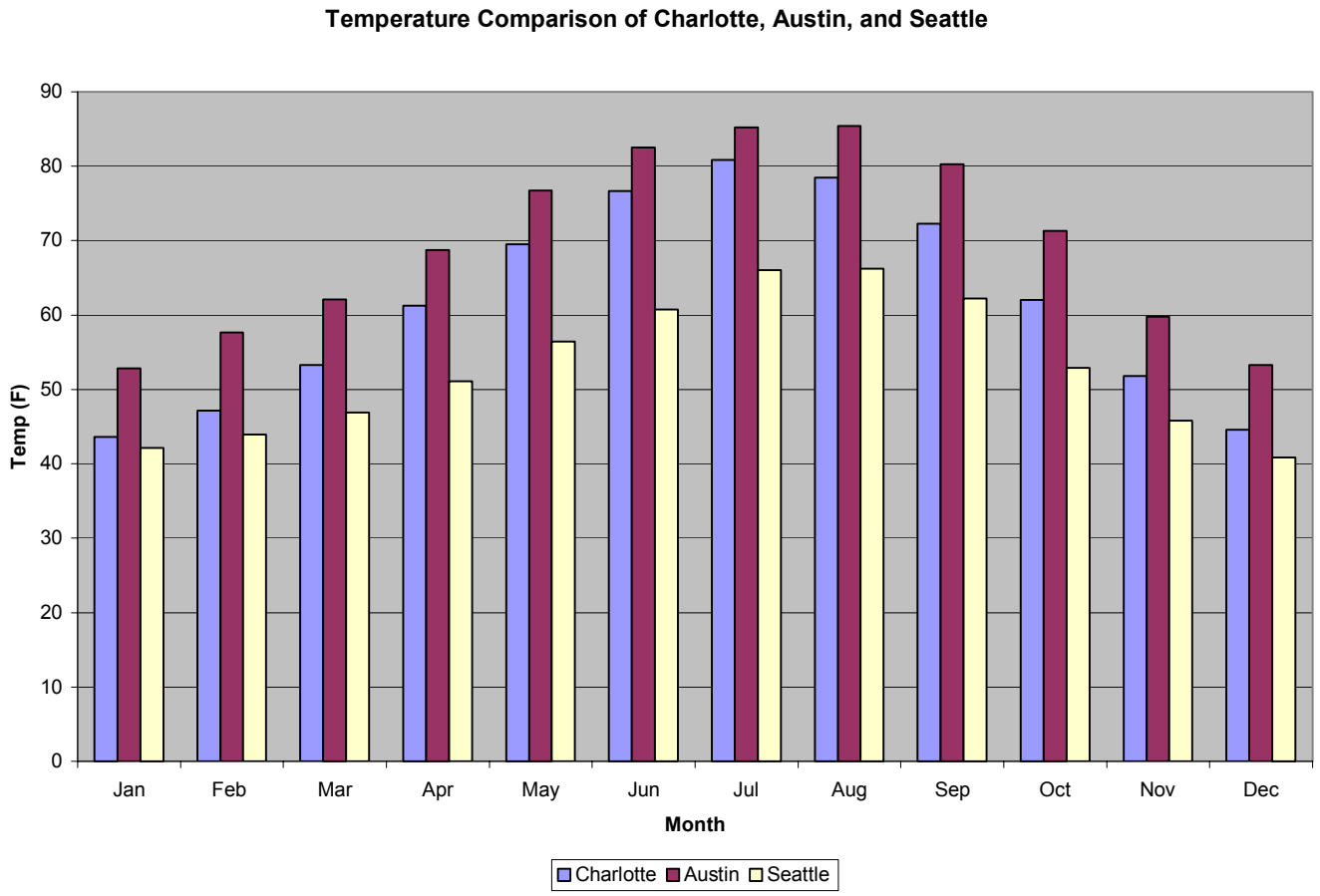
Wilmington and Tampa are shown to have very similar temperature plots (typically within 10°F of each other). Neither city has an average temperature approaching biological zero. However, Chicago's temperatures are much colder and remain either below or within biological zero (accepted around 5°C) for five of twelve months of the year. It is not reasonable to accept data from the upper Midwest as similar to that of Central and Eastern North Carolina due to this temperature discrepancy.



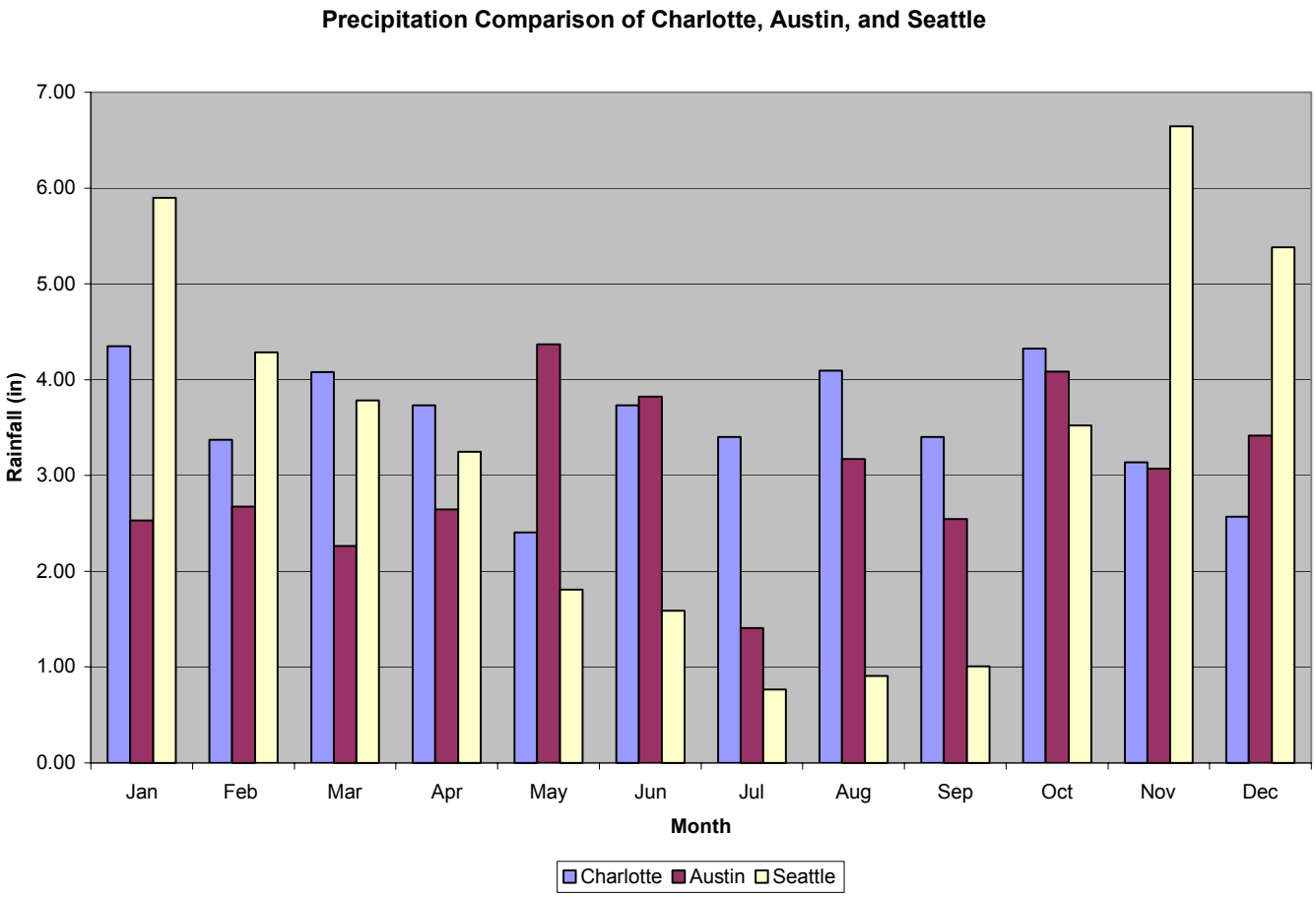
A comparison of precipitation amounts from Wilmington and Tampa show that each city received high amounts of rainfall at approximately the same times of the year, with Wilmington being slightly wetter. The relationship is particularly close during the summer and fall months reflecting tropical activity. This is particularly important because large storm events are often blamed for BMP "release" of pollutants, due to large quantities of water flushing nutrients from the system. Because Wilmington and Tampa are so similar in this regard, they are deemed to be good "paired" cities. However, as expected, Chicago's rainfall does not reflect any high monthly rainfall totals and are substantially lower than that of both Wilmington and Tampa in most months.



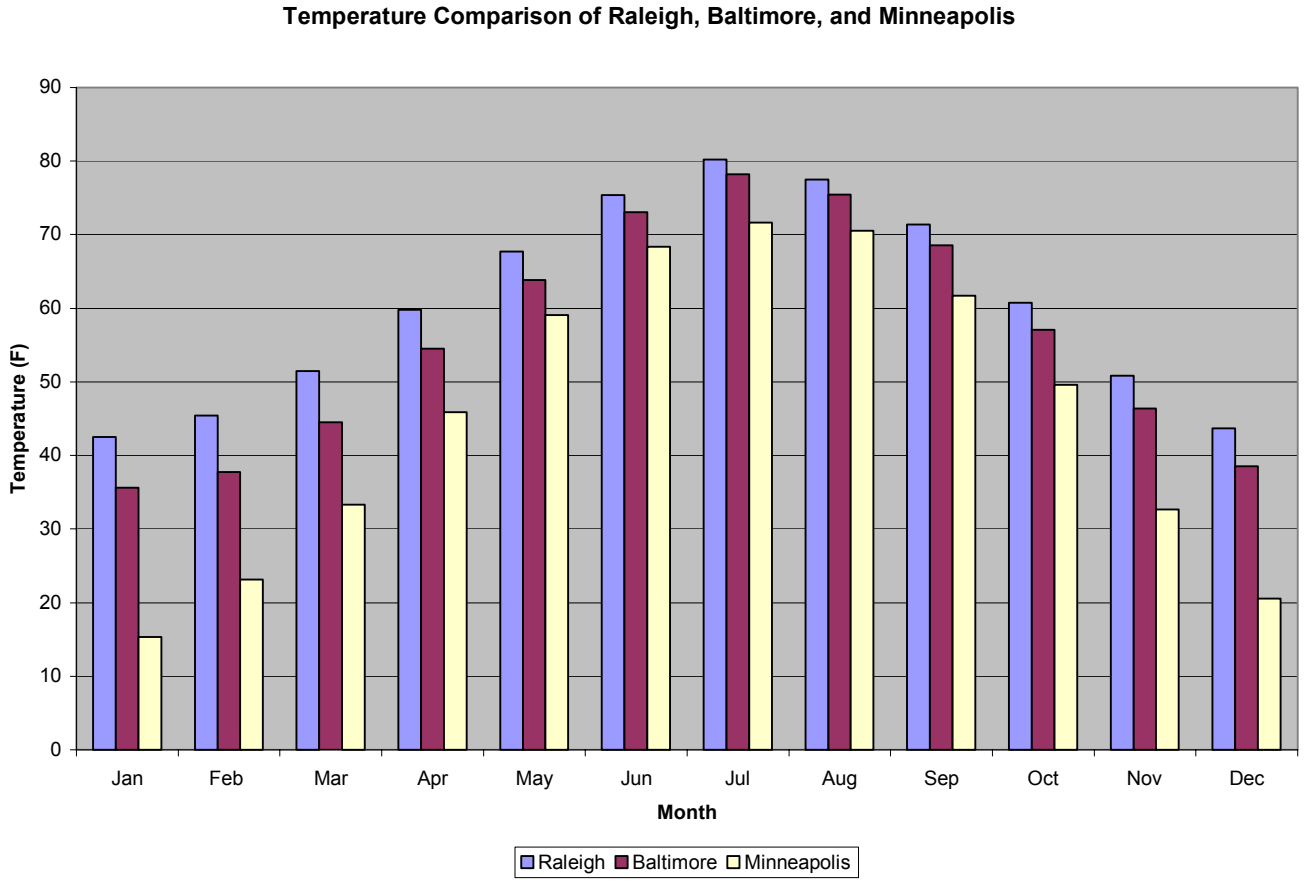
Charlotte and Austin are shown to be very similar in temperature on a monthly basis, with Austin being slightly warmer (but always within 10°F). Both cities remain at or above biological zero (5°C). Seattle, too, remains at or above biological zero, and does reflect similar temperatures to Charlotte during the late fall through early spring. However, Seattle has a much more moderate summer temperature, with differences near 15°F. Temperature alone may not cause Seattle's data to be rejected, but it does not support the use of Pacific Northwest BMP removal efficiencies, either. An examination of rainfall is necessary.



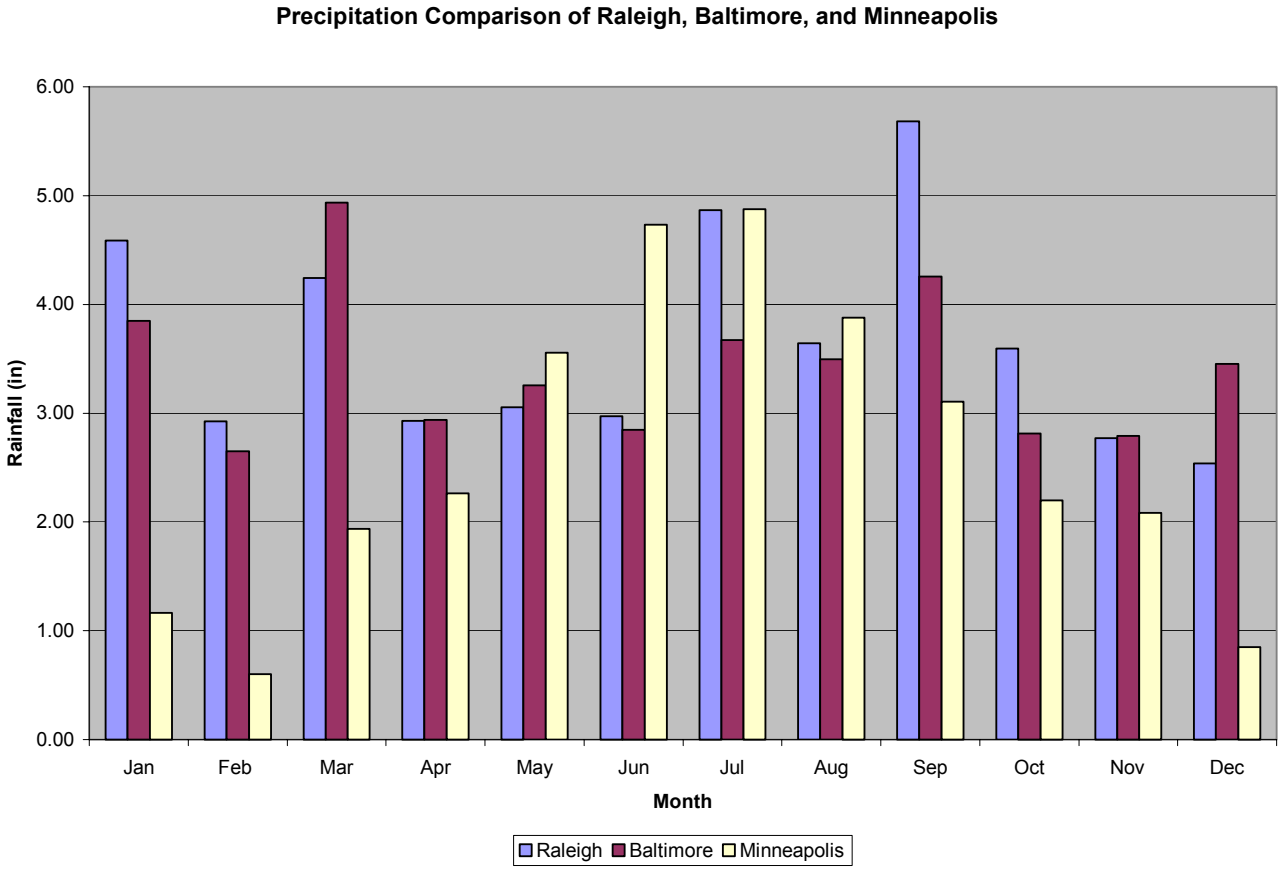
Seattle has a much different monthly rainfall distribution to that of Charlotte. While Charlotte's rainfall distribution is relatively evenly distributed throughout the year, Seattle receives the vast majority of precipitation from late fall through early spring. Rainfall differences are over two inches for much of the summer and fall. Contrastingly, Austin and Charlotte are within one inch more most of the year and only exhibit a two inch difference in March when Austin receives more rainfall. Charlotte does receive slightly more rainfall on an annual basis than Austin.



Baltimore and Raleigh have very similar temperatures, never exceeding 6°F. The temperature difference, however, between Minneapolis and Raleigh are substantially different (over 20°F) in much of the winter, as the average temperature in the latter city is below biological zero from November through March.



Raleigh and Baltimore have similar rainfall totals, often within 0.20" on a monthly basis with occasional exceptions reaching over 1 inch. Minneapolis is substantially direr in the winter, with over two inch differences in December through March. These differences coupled with substantial temperature differences prohibit the use of stormwater BMP effectiveness data from studies from states of the upper Great Plains when proposing efficiencies for North Carolina.



Appendix I-2. Sources of information for BMP Pollutant Removal Effectiveness.

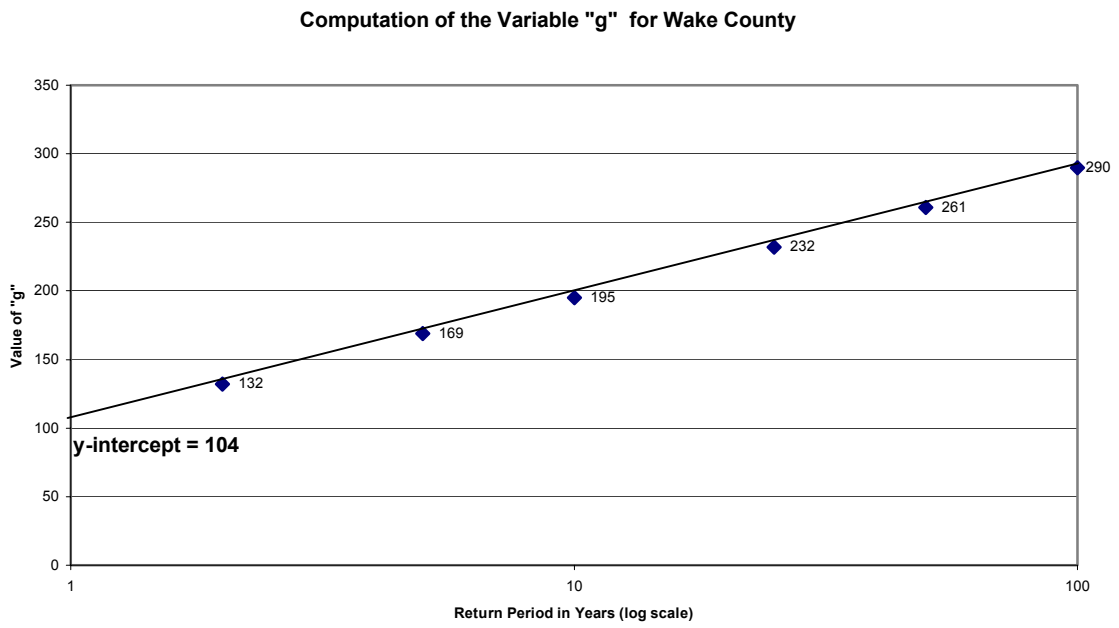
Practice Type	State	Researcher(s) or Agency	Reference
Stormwater Wetlands	FL	Rushton and Dye	CWP
Stormwater Wetlands	NC	Tweedy and Broome	Personal Communication
Stormwater Wetlands	VA	Northern VA Soil & Water District	NBMPD
Stormwater Wetlands	FL	FL DOT/ USGS	NBMPD
Stormwater Wetlands	MD	Baltimore City Water Quality Management Offic	NBMPD
Stormwater Wetlands	FL	EPA/ Florida DER	NBMPD
Stormwater Wetlands	VA	Yu	Personal Communication
Stormwater Wetlands	MD	Althanus and Stevenson	CWP
Stormwater Wetlands	MD	MD Center for Environment & Estuarine Studies	NBMPD
Stormwater Wetlands	VA	Yu	Personal Communication
Stormwater Wetlands	VA	Yu	Personal Communication
Stormwater Wetlands	FL	Carr and Rushton	CWP
Stormwater Wetlands	FL	Harper, Wanileista, Fries, and Baker	CWP
Stormwater Wetlands	NC	Bass	Personal Communication
Stormwater Wetlands	FL	Blackburn, Pimentel, and French	CWP
Stormwater Wetlands	VA	Yu	Personal Communication
Sand Filter	TX	City of Austin	CWP
Sand Filter	TX	Barton Springs/ Edwards Aquifer Conservation District	CWP
Sand Filter	TX	Tenney, Barrett, Malina, Charbeneau, Ward	CWP
Sand Filter	TX	City of Austin	CWP
Sand Filter	VA	Bell, Stokes, Gavin, and Nguyen	CWP
Sand Filter	NC	Hunt	Unpublished Data
Sand Filter	TX	City of Austin	CWP
Sand Filter	TX	City of Austin	CWP
Sand Filter	TX	City of Austin	CWP
Sand Filter	TX	Welborn and Veenhuis	CWP
Sand Filter	TX	Barrett, Keblin, Malina, Charbeneau	CWP
Sand Filter	FL	EPA/ Florida DER	NBMPD
Bio-Retention	MD	Davis	Personal Communication
Bio-Retention	MD	Davis	Personal Communication
Practice Type	**State**	**Researcher(s) or Agency**	**Reference**

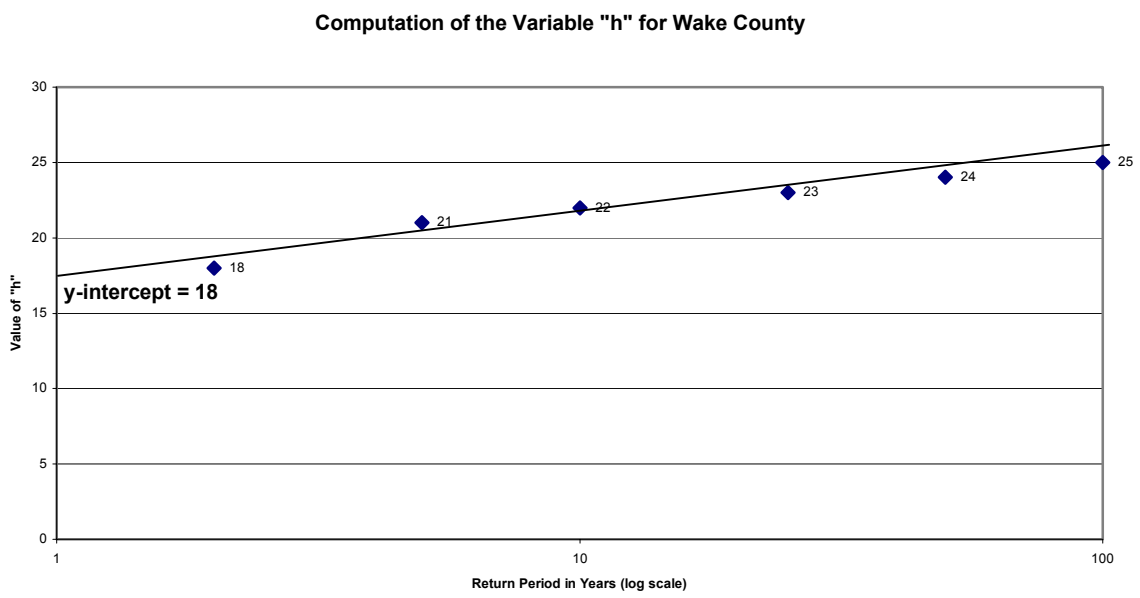
Bio-Retention	MD	Davis, Shokouhian, Sharma, Miniami	Water Environment Research
Bio-Retention	MD	Davis, Shokouhian, Sharma, Miniami	Water Environment Research
Bio-Retention	VA	Yu	Personal Communication
Bio-Retention	NC	Hunt	Unpublished data- Greensboro
Bio-Retention	NC	Hunt	Unpublished data- Chapel Hill
Bio-Retention	PA	Hunt, Jarrett, Smith	ASAE Conference Proceedings, 2002
Wet Detention Pond	FL	FL DOT/ USGS	NBMPD
Wet Detention Pond	FL	Dormman, Hartigan, Steg, Quasebarth	CWP
Wet Detention Pond	VA	Occoquan Watershed Monitoring Laboratory	CWP
Wet Detention Pond	FL	Gain	CWP
Wet Detention Pond	FL	Martin	CWP
Wet Detention Pond	FL	Florida DOT / USGS	NBMPD
Wet Detention Pond	NC	Wu	CWP
Wet Detention Pond	NC	WRRI / UNCC	NBMPD
Wet Detention Pond	TX	City of Austin	CWP
Wet Detention Pond	NC	Wu	CWP
Wet Detention Pond	NC	Borden, Dorn, Stillman, Liehr	CWP
Wet Detention Pond	FL	USGS	NBMPD
Wet Detention Pond	TX	Lower Colorado River Authority	CWP
Wet Detention Pond	TX	City of Austin	CWP
Wet Detention Pond	FL	Environmental Research and Design, Inc / St. John's River Water Mngmt. District	NBMPD
Wet Detention Pond	VA	Yu	Personal Communication
Wet Detention Pond	FL	Holler	CWP
Wet Detention Pond	VA	Yu	Personal Communication
Wet Detention Pond	FL	Rushton, Miller, Hull	CWP
Wet Detention Pond	FL	Rushton, Miller, Hull	CWP
Wet Detention Pond	VA	Occoquan Watershed Monitoring Laboratory	CWP
Wet Detention Pond	FL	Cullum	CWP
Wet Detention Pond	NC	Borden, Dorn, Stillman, Liehr	CWP

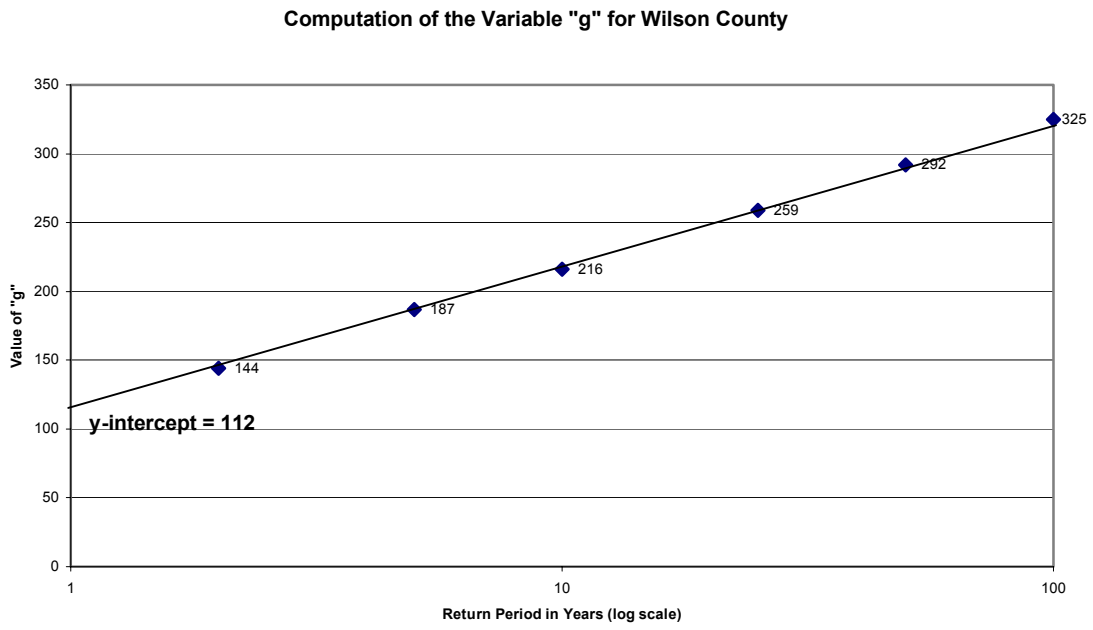
Practice Type	State	Researcher(s) or Agency	Reference
Wet Detention Pond	FL	Kantrowitz and Woodham	CWP
Wet Detention Pond	FL	Northwest FL Water Management District	NBMPD
Grassy Swale	FL	Dorman, Hartigan, Steg, Quasebarth	CWP
Grassy Swale	FL	Harper	CWP
Grassy Swale	FL	Kercher, Landon, Massarelli	CWP
Grassy Swale	FL	Harper	CWP
Grassy Swale	VA	Dorman, Hartigan, Steg, Quasebarth	CWP
Grassy Swale	MD	Occoquan Watershed Monitoring Laboratory	CWP
Grassy Swale	MD	Occoquan Watershed Monitoring Laboratory	CWP
Grassy Swale	VA	Occoquan Watershed Monitoring Laboratory	CWP
Grassy Swale	TX	Walsh, Barrett, Malina, Charbeneau, Ward	CWP
Grassy Swale	TX	Walsh, Barrett, Malina, Charbeneau, Ward	CWP
Grassy Swale	TX	Welborn, Veenhuis	CWP

References noted:
CWP – Center for Watershed Protection's National Pollutant Removal Performance Database. 2000
NBMPD – National Best Management Practice Database (http://www.bmpdatabase.com)
Much of Dr. Shaw Yu's data (from the University of Virginia) is going to be described in the National BMP pollutant database.

Appendix J. Computing the Intensity-Duration Variable for the One-Year Storm in Wake, Wilson and Craven Counties



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300
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200
150
100
50
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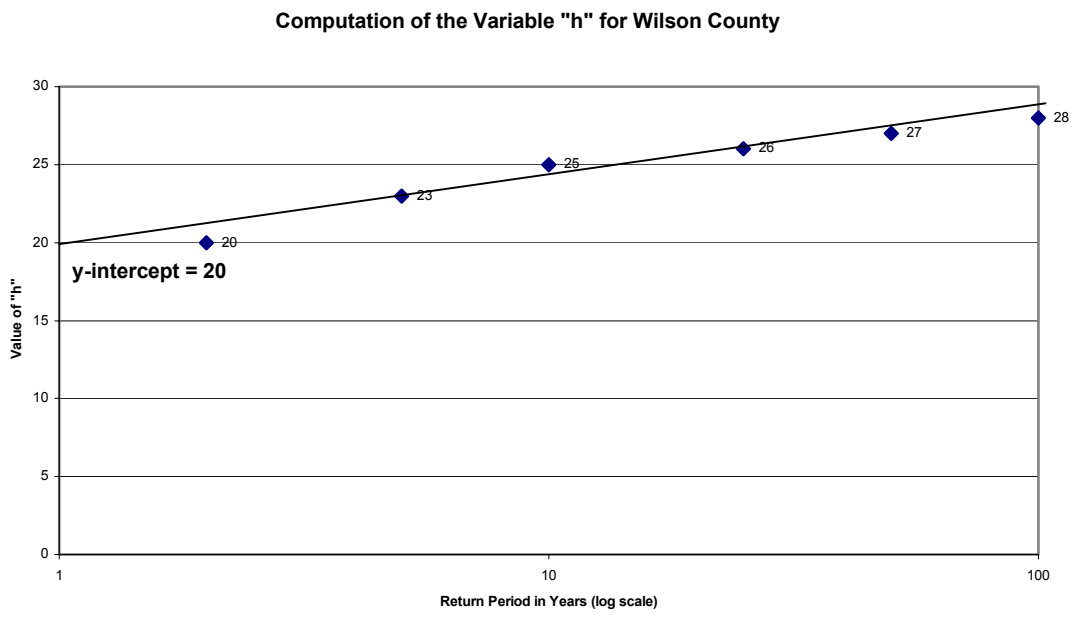
325
292
259
216
187
144
y-intercept = 112
1
10
100
Return Period in Years (log scale)


Computation of the Variable "h" for Wilson County
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25
20
15
10
5
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Value of "h"
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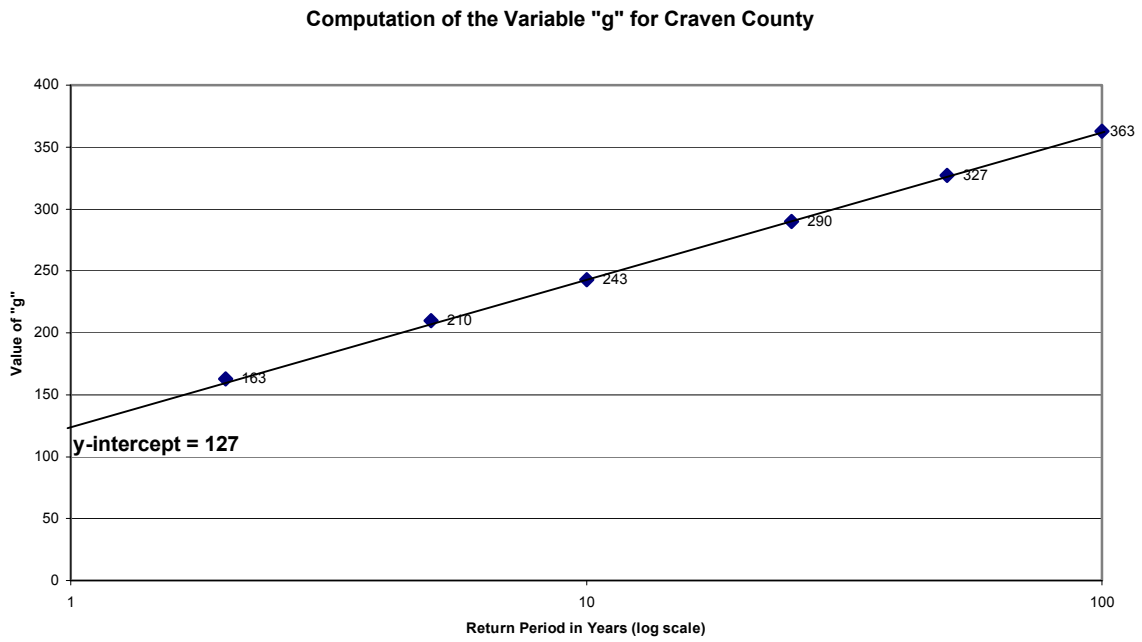
27
26
25
23
20
y-intercept = 20
1
10
100
Return Period in Years (log scale)


Computation of the Variable "g" for Craven County
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350
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250
200
150
100
50
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Value of "g"
163
210
243
290
327
363
y-intercept = 127
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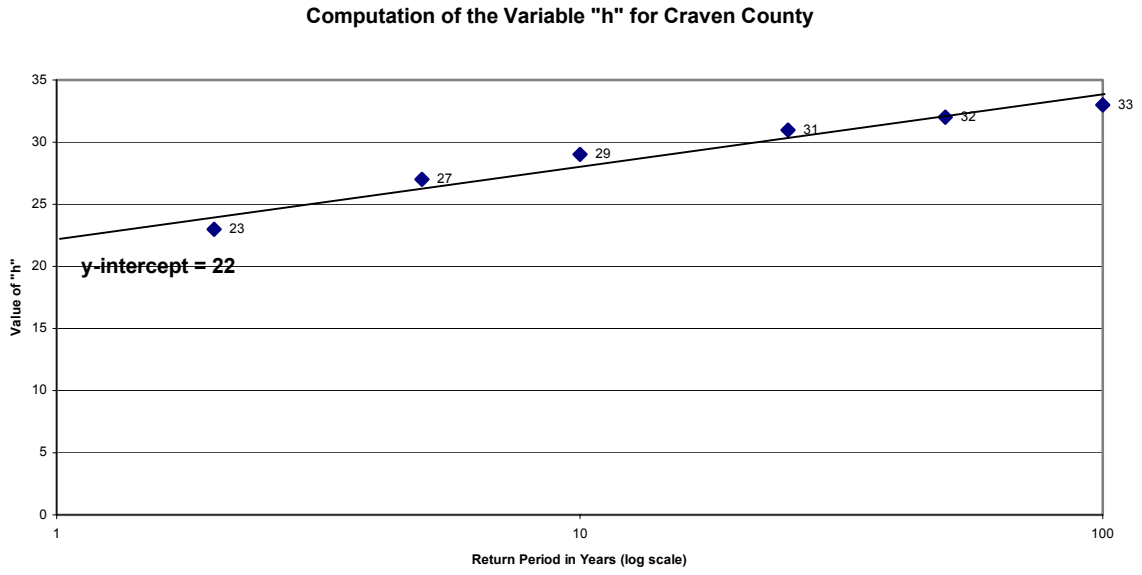
10
100
Return Period in Years (log scale)


Computation of the Variable "h" for Craven County
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30
25
20
15
10
5
0
Value of "h"
23
27
29
31
32
33
y-intercept = 22
1
10
100
Return Period in Years (log scale)

Appendix K. Land Use Planning and Design Techniques

Reducing Road Widths

In many instances, road widths are required to be wider than needed to safely convey traffic through residential and commercial areas. Although these wide widths are often adopted to increase safety for automobiles, they often increase speeds through residential areas and, in so doing, may decrease safety for pedestrians and cyclists. Also, some jurisdictions require curb and gutter for aesthetic reasons where it is not actually necessary to control stormwater runoff. This can result in increased flooding and also eliminates the potential for stormwater runoff control and treatment that can occur~~s~~ in properly designed and maintained roadside swales.

Most local governments model their residential street design standards after state and/or federal highway criteria, although the traffic capacity and function of their street system is considerably different from highways. Very few communities recognize any local road categories that are different from established state and federal street categories. Many local traffic engineers have simply accepted the notion that wider streets adequately address these concerns and that wide streets are safe streets (Schueler 1995).
Narrower road widths can reduce the road surface area by up to 35 percent.

A number of communities have implemented standards that promote narrower residential streets and have concluded this to be an attractive, safe and environmentally beneficial alternative.

Communities should also review their standards for turnarounds to reduce the need or unnecessary road surface. One of the most common types of turnaround is a cul-de-sac that may have a diameter of 80 to 100 feet or more (Schueler 1995). Some communities are recognizing that this is excessive and are choosing alternatives that create less impervious cover, such as T-shapes. A 60-foot by 30-foot T-shaped turnaround creates only about 36% as much impervious area as an 80-foot diameter cul-de-sac and is more than adequate for most vehicles.

Local governments should: (1) examine community regulations governing road width and turnaround size; (2) evaluate if the specified widths are necessary; and (3) where feasible, make changes to reduce unnecessary road surfaces.

Reducing Minimum Parking Requirements

Parking lots are often designed to accommodate parking needs on the busiest days of the year. For example, shopping center parking areas are often big enough to handle the busy holiday times, but then sit vacant for much of the rest of the year. This can result in increased nitrogen load (as opposed to maintaining open space).

Some management strategies that would contribute to a reduction in urban nitrogen from parking lots:

- Use angles and smaller parking spaces.
- Use more pervious construction materials in seldom-used parking areas (Land of Sky 1995).
- Provide public transportation to shopping centers during the peak holiday times and encourage people to use it.
- Design parking areas to drain in sheet flow into stable vegetated areas.

Minimizing Use of Curb and Gutter

Runoff is conveyed along streets and parking areas in one of two ways, either (a) in an open drainage channel located in the right of way, or (b) in an enclosed storm drain located under the street or right of way. The use of an open channel or storm drain in a particular street is determined by a number of factors, such as drainage area, slope, length, housing density, and street type. Open channels can be used on smaller streets, but at some point runoff velocities become too erosive to be adequately handled in an earthen channel and they must be enclosed in a storm drain. This erosive velocity is typically around 4 feet per second. A channel's maximum velocity is generally defined and computed using the peak discharge rate under the two year design storm event.

Open vegetated channels can have many water resource protection benefits. For example, a portion of stormwater pollutants may be removed through grass and soil as they pass through the channel. Performance monitoring has shown that open channels only realize these benefits under ideal conditions (e.g., low slope, sandy soils, dense grass cover, etc.). When these conditions are not met, drainage channels can have a low or even negative removal capability for many pollutants.

Only recently have engineers recognized the value of designing open channels explicitly for pollutant removal during small and moderate-sized storm events. Depending on the depth to the water table, they are known as either grass channels, dry swales or wet swales. Checkdams, underdrains, stone inlets, prepared soil mixes and landscaping are also used to enhance the pollutant removal capability of swales. The use of grass channels or swales along residential streets can be an economical and effective element of a BMP system, as long as the critical erosive velocity is not exceeded. In addition, open channels must be designed to prevent standing water, to ensure that mowing is convenient, and to avoid odors, mosquitoes, or other nuisances associated with standing water.

Even the moderate vertical break of a curb shelters airborne pollutants that blow in by the wind. Thus, dust, pollen, leaves, grass clippings, and other nitrogen-rich organic matter can be trapped by the curb, where they remain until they are washed into the storm drain system.

Some management strategies that may contribute to a reduction in urban nitrogen from roadside drainage systems are:

- Minimize the use of curb and gutter and maximize the use of vegetated swales where feasible.

- If curb and gutter is necessary, consider frequent curb cuts to divert manageable quantities of runoff into stable vegetated areas for infiltration. (Land of Sky 1995).

- Develop a site/landscaping plan that uses landscaped areas for infiltration or detention/retention areas (bioretention).

- Instead of grass that requires chemical applications, use trees, shrubs, ground cover, mulch or other materials that require little or no chemical applications.

Allowing Cluster or Open-Space Developments

Cluster or open-space developments rearrange density on each development tract so that a lower percentage of the tract is covered by impervious surfaces. This results in more land being retained in a natural state.

This approach respects private property rights and the ability of developers to create new homes for the expanding population. Such developments are "density-neutral" since the overall number of dwellings allowed is not less than it would be in a conventional development. This lessens the adverse impact on the remaining natural areas and cultural resources that make our communities such special places to live, work, and recreate.

The most important step in designing an "open space subdivision" is to identify the land to preserve. "Primary Conservation Areas" include unbuildable wetlands, waterbodies, floodplains, and steep slopes. "Secondary Conservation Areas" include mature woodlands, upland buffers around wetlands and waterbodies, prime farmland, natural meadows, critical wildlife habitats, and sites of historic, cultural or archeological significance.

Cluster developments can reduce road lengths by 50 to 70 percent (Arendt 1993). At an average cost of over $100 to construct a linear foot of road, such reductions are extremely cost-effective. The reduction in road length may also reduce the overall capital costs for stormwater controls. The developer may realize a significant savings in the reduced need for storm drain pipes and best management practices. It has been reported that in some cases the overall reduction in capital costs associated with these developments can be 10 to 33 percent (Schueler 1995).

Property owners can realize indirect economic benefits from reduced impervious cover. While a host of factors influence future residential property values, some evidence indicates that homes located adjacent to well designed and maintained open or green space do appreciate at a faster rate than traditional subdivision properties. This premium has been found to range from 5 to 32 percent, according to Land Ethics (1994). Another study in Massachusetts indicated that homes in cluster subdivisions with open space appreciated 13% more in value than similar homes in conventional subdivisions over a 21-year period (Arendt 1993).

For local governments, it is typically more expensive to provide public services on large residential lot developments compared to smaller ones. Clustered developments can greatly reduce the length of water and sewer pipes and roads that local governments have to construct and maintain.

Allowing Traditional Neighborhood Developments

Traditional neighborhood developments (TNDs) are designed so that dwellings, shops, and workplaces are in close proximity. They typically follow a rectilinear pattern of streets and blocks arranged to provide interesting routes of travel that also accommodate and promote pedestrian travel and bicycle travel rather than automobile travel. These developments also include greenways, landscaped streets, churches, stores, schools, and parks woven into the neighborhood for social activity, recreation, aesthetics, and environmental enhancement. See Figure G1 for a diagram of a TND.

One of the most important features of TNDs that affects water quality is their compactness. As these developments expand, they maintain their compact, rectilinear layout and their accessibility. Another environmental advantage offered by TNDs is that they may reduce automobile traffic and promote increased use of alternative forms of transportation, such as mass transit.

Environmental impacts of TNDs are affected by site conditions and the development intensity and design. Those TNDs that offer environmental benefits may also offer economic benefits. The increased value of real estate in a traditional development is illustrated in Raleigh. The "inside the beltline" neighborhoods in Raleigh that have city blocks, greenways, and accessibility to shopping areas, on the average, sell for 40 percent more per square foot than homes in North Raleigh subdivisions (pers. comm. Marilyn Marks, Simpson and Underwood Realtors, 1997).

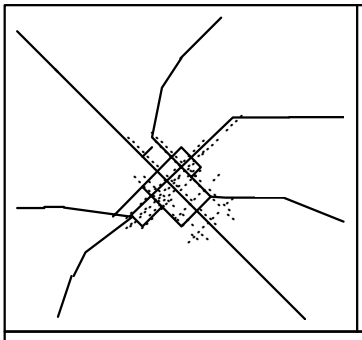
Other Techniques

In many instances, subdivision codes contain rigid requirements that govern setbacks from the property lines. These requirements increase the length of driveways, roads, and sidewalks and thus increase the proportion of impervious cover to housing units. These requirements can inadvertently increase impervious surfaces and cause expense for developers and homeowners.

Large-lot zoning also impacts overall imperviousness. Although large-lot zoning reduces rooftop impervious cover in a watershed and spreads development over a wider geographic area, it can increase transport-related impervious cover because of longer road networks. Although large-lot zoning may be wise for individual sensitive watersheds, it is probably not practical as a uniform standard. An alternative is forming more compact neighborhoods in order to decrease impervious surfaces associated with transportation, a factor that has long been overlooked. Another advantage to compact neighborhoods is that they decrease automobile use by allowing better accessibility for walkers and cyclists and facilitating public transportation.

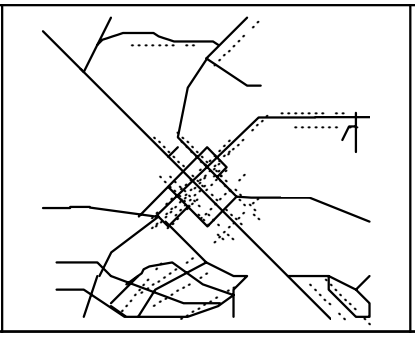
Figure G1. Maytown Before and After (adapted from Stimmel Associates, 1993)

A. Maytown in 1900



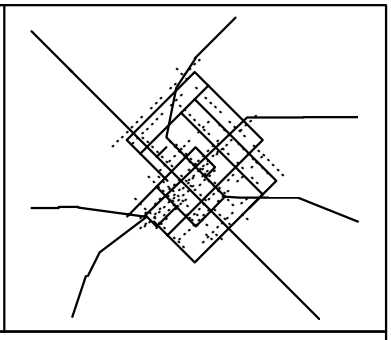
A. Maytown developed around a central square with a grid street pattern. Development was compact and there was a distinct separation between the village and the surrounding countryside.

B. Maytown today.



B. The development that has occurred over the past 30 years is not compatible with the original village. Curvilinear street and cul-de-sacs have replaced the traditional grid street pattern. The separation between the village and the surrounding countryside have been lost.

C. Maytown as it could have been.



C. The same amound of development could have been accommodated in a pattern that complements the original village. All residents could have been within walking distance of the center square, community facilities, and parks.

Appendix L. Ordinance Establishing Stormwater Nutrient Management Requirements for New Development

Chapter 8. Stormwater Management

Section 801. Soil Erosion and Sedimentation Control.

A Purpose.

This section is adopted for the purposes of:

1. Regulating certain land-disturbing activity to control accelerated erosion and sedimentation in order to prevent the pollution of water and other damage to lakes, watercourses, and other public and private property by sedimentation; and
2. Establishing procedures through which these purposes can be fulfilled.

B General.

1. Soil disturbance shall be conducted in such a manner as to minimize erosion. Soil stabilization shall consider the time of year, site conditions, and the use of temporary and permanent measures.
2. Properties and channels located downstream from development sites shall be protected from erosion and sedimentation. At point where concentrated flow leaves a site, stable downstream facilities are required.
3. Soil erosion and sediment control features shall be constructed prior to the commencement of upland disturbance.
4. If dewatering devices are used, adjacent properties shall be protected. Discharges shall enter an effective sediment and erosion control measure.
5. For detached single-family residential development occurring one lot at a time, alternative to the standards of this section may be approved by the Director of Engineering.

C Soil Stabilization.

1. Temporary soil stabilization shall be applied to disturbed areas within fourteen (14) days of the end of soil disturbance to all areas that will not be final graded and stabilized within forty-five (45) days.
2. Permanent stabilization shall be done within fourteen (14) days of final grading of the soil. Permanent soil stabilization measures shall be applied to channels (including bed and banks) within fourteen (14) days of the end of primary disturbance of the channel.
3. Permanent or temporary vegetation shall not be considered established until sufficient ground cover is mature enough to control erosion.
4. Earthen embankments shall be constructed with side slopes with a vertical to horizontal ratio no steeper than one to 3 (1: 3).

D Disturbed Areas.

1. Disturbed areas draining more than one (1) but fewer than five (5) acres shall be protected by a sediment trap or equivalent control measure at a point down slope of the disturbed area.
2. Disturbed areas draining more that five (5) acres shall be protected by a sediment basin or equivalent control measure at a point down slope of the disturbed area.

E Sediment Control.

1. All storm sewer facilities that are or will be functioning during construction shall be protected, filtered or otherwise treated to remove sediment.
2. A stabilized mat or aggregate underlain with filter cloth shall be located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley or parking area.

F Removal of Temporary Measures.

All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization is achieved or after temporary measures are no longer needed. Trapped sediment and other disturbed soil areas shall be permanently stabilized.

G Scope and Exclusions.

This Section shall not apply to the following land-disturbing activities:

1. Activities, including breeding and grazing of livestock, on agricultural land for the production of plants and animals useful to man, including, but not limited to:
    a. Forage and sod crops, grain and feed crops, tobacco, cotton, and peanuts.
    b. Dairy animals and dairy products.

c. Poultry and poultry products.
d. Livestock, including beef cattle, sheep, swine, horses, ponies, mules, and goats.
e. Bees and apiary products.
f. Fur producing animals.

2. Activities undertaken on forestland for the production and harvesting of timber and timber products and conducted in accordance with best management practices set out in Forest Practice Guidelines Related to Water Quality, as adopted by the North Carolina Department of Environment, and Natural Resources. If land-disturbing activity undertaken on forest land for the production and harvesting of timber and timber products is not conducted in accordance with Forest Practice Guidelines Related to Water Quality, the provisions of this Section shall apply to such activity and any related land-disturbing activity on the tract; and
3. Activities for which a permit is required under the Mining Act of 1971, Article 7 of Chapter 74 of the General Statutes; and
4. Land disturbing activity over which the State has exclusive regulatory jurisdiction as provided in G.S. 113A-56(a); and
5. For the duration of an Emergency, activities essential to protect human life.

H General Requirements.

1. **Plan Required.** No person shall initiate any land-disturbing activity which uncovers more than one acre without having an erosion control plan approved by the City.
2. **Protection of Property.** Persons conducting land-disturbing activity shall take all reasonable measures to protect all public and private property from damage caused by such activity.
3. **More Restrictive Rules Shall Apply.** Whenever conflicts exist between Federal, State, or local laws, or rules, the more restrictive provision shall apply.

I Basic Control Objectives.

An erosion and sedimentation control plan may be disapproved pursuant to this section if the plan fails to address the following control objectives:

1. **Identify Critical Areas**. On-site areas which are subject to severe erosion, and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation, are to be identified and receive special attention.
2. **Limit Time of Exposure.** All land-disturbing activities are to be planned and conducted to limit exposure to the shortest feasible time.
3. **Limit Exposed Areas**. All land-disturbing activity is to be planned and conducted to minimize the size of the area to be exposed at any one time.
4. **Control Surface Water**. Surface water runoff originating upgrade of exposed areas should be controlled to reduce erosion and sediment loss during the period of exposure.
5. **Control Sedimentation**. All land-disturbing activity is to be planned and conducted so as to prevent off-site sedimentation damage.
6. **Manage Stormwater Runoff**. When the increase in the velocity of stormwater runoff resulting from a land-disturbing activity is sufficient to cause accelerated erosion of the receiving watercourse, plans are to include measures to control the velocity to the point of discharge so as to minimize accelerated erosion of the site and increased sedimentation of the stream.

J Mandatory Standards for Land-disturbing Activity.

No land-disturbing activity subject to the control of this Section shall be undertaken except in accordance with the following mandatory standards:

1. **Buffer Zone**.
   a. No land-disturbing activity during periods of construction or improvement to land shall be permitted in proximity to a lake or natural watercourse unless a buffer zone is provided along the margin of the watercourse of sufficient width to confine visible siltation within the twenty-five (25) percent of the buffer zone nearest the land-disturbing activity. Waters that have been classified as trout waters by the Environmental Management Commission shall have an undisturbed buffer zone twenty-five (25) feet wide or of sufficient width to confine visible siltation within the twenty-

five (25) percent of the buffer zone nearest the land-disturbing activity, whichever is greater. Provided, however, that the City may approve plans which include land-disturbing activity along trout waters when the duration of said disturbance would be temporary and the extent of said disturbance would be minimal. This subdivision shall not apply to a land-disturbing activity in connection with the construction of facilities to be located on, over, or under a lake or natural watercourse.

b. Approved plans assume, where applicable, compliance with the Federal and State water quality laws, rules and regulations.

c. A plan may be disapproved if implementation of the plan would result in a violation of rules adopted by the Environmental Management Commission.

d. Unless otherwise provided, the width of a buffer zone is measured from the edge of the water to the nearest edge of the disturbed area, with the twenty-five (25) percent of the strip nearer the land-disturbing activity containing natural or artificial means of confining visible siltation.

e. The twenty-five (25) foot minimum width for an undisturbed buffer zone adjacent to designated trout waters shall be measured horizontally from the top of the bank.

f. Where a temporary and minimal disturbance has been permitted as an exception of this Section, land-disturbing activities in the buffer zone adjacent to designated trout waters shall be limited to a maximum of ten (10) percent of the total length of the buffer zone within the tract to be distributed such that there is not more than one hundred (100) linear feet of disturbance in each one thousand (1000) linear feet of buffer zone. Larger areas may be disturbed with the written approval of the Director, NC Division of Land Resources.

g. No land-disturbing activity shall be undertaken within a buffer zone adjacent to designated trout waters that will cause adverse temperature fluctuations in these waters, and, as set forth in 15 NCAC 2B.0211 "Fresh Surface Water Classification and Standards."

2. **Graded Slopes and Fills**. The angle for graded slopes and fills shall be no greater than the angle which can be retained by vegetative cover or other adequate erosion control devices or structures and which can be demonstrated to be stable. Stable is the condition where the soil remains in its original configuration, with or without mechanical constraints. In any event, slopes left exposed will, within fifteen (15) working days or thirty (30) calendar days of completion of any phase of grading, whichever period is shorter, be planted or otherwise provided with ground cover, devices, or structures sufficient to restrain erosion pursuant to GS §113-A-57 (2).

3. **Fill Material**. Unless a permit from the N.C. Department of Environment and Natural Resources Division of Solid Waste Management to operate a landfill is on file for the official site, acceptable fill material shall be free of organic or other degradable materials, masonry, concrete and brick in sizes exceeding twelve (12) inches, and any materials which would cause the site to be regulated or a landfill by the State of North Carolina.

4. **Ground Cover**. Whenever land-disturbing activity is undertaken on a tract comprising more than one acre, if more than one acre is uncovered, the person conducting the land-disturbing activity shall install such sedimentation and erosion control devices and practices as are sufficient to retain the sediment generated by the land-disturbing activity within the boundaries of the tract during construction upon and development of said tract, and shall plant or otherwise provide a permanent ground cover sufficient to restrain erosion after completion of construction or development. Except as provided otherwise in this Section, provisions for a ground cover sufficient to restrain erosion must be accomplished within fifteen (15) working days or ninety (90) calendar days following completion of construction or development whichever period is shorter.

5. **Prior Plan Approval**. No person shall initiate any land-disturbing activity on a tract if more than one acre is to be uncovered unless, thirty or more days prior to initiating the activity, an erosion and sedimentation control plan for such activity is filed with and approved by the City.

K Design and Performance Standards.

1. Except as provided otherwise in this Section erosion and sedimentation control measures, structures, and devices shall be so planned, designed, and constructed as to provide protection from the calculated maximum peak rate of runoff from the ten (10) year storm. Runoff rates shall be calculated using the procedures in the USDA, Soil Conservation Service's "National Engineering Field Manual for Conservation Practices", or other acceptable calculation procedures.
2. In High Quality Water (HQW) zones the following design standards shall apply:
   a. Uncovered areas in HQW zones shall be limited at any time to a maximum total area of twenty (20) acres within the boundaries of the tract. Only the portion of the land-disturbing activity within a HQW zone shall be governed by this section. Larger areas may be uncovered within the boundaries of the tract with the written approval of the Director, NC Division of Land Resources.
   b. Erosion and sedimentation control measures, structures, and devices within HQW zones shall be so planned, designed and constructed to provide protection from the run off of the twenty-five year storm which produces the maximum peak rate of run off as calculated according to procedures in the United States Department of Agriculture Soil Conservation Service's "National Engineering Field Manual for Conservation Practices" or according to procedures adopted by any other agency of this State or the United States or any generally recognized organization or association.
   c. Sediment basins within HQW zones shall be designed and constructed such that the basin will have a settling efficiency of at least seventy percent (70%) for the forty (40) micron (0.04 mm) size soil particle transported into the basin by the runoff of that two (2) year storm which produces the maximum peak rate of runoff as calculated according to procedures in the United States Department of Agriculture Soil Conservation Service's "National Engineering Field Manual for Conservation Practices" or according to procedures adopted by any other agency of this State or the United States or any generally recognized organization or association.
   d. Newly constructed open channels in HQW zones shall be designed and constructed with side slopes no steeper than two horizontal to one vertical (2:1) if a vegetative cover is used for stabilization unless soil conditions permit a steeper slope or where the slopes are stabilized by using mechanical devices, structural devices or other acceptable ditch liners. In any event, the angle for side slopes shall be sufficient to restrain accelerated erosion.
   e. Ground cover sufficient to restrain erosion must be provided for any portion of a land-disturbing activity in a HQW zone within fifteen (15) working days or sixty (60) calendar days following completion of construction or development, whichever period is shorter.

L Stormwater Outlet Protection; Permanent Downstream Protection of Stream Banks, Channels, Conduits and Slopes.

1. **Intent**. Stream banks and channels downstream from any land disturbing activity shall be protected from increased degradation by accelerated erosion caused by increased velocity of runoff from the land disturbing activity.
2. **Performance Standard.** Persons shall conduct land-disturbing activity so that the post construction velocity of the ten (10) year storm runoff in the receiving watercourse to the discharge point does not exceed the greater of:
   a. The velocity established by the Table 8-1 of this section; or
   b. The velocity of the ten (10) year storm runoff in the receiving watercourse prior to development. If conditions (1) or (2) of this Paragraph cannot be met, then the receiving watercourse to and including the discharge point shall be designed and constructed to withstand the expected velocity anywhere the velocity exceeds the "prior to development" velocity by ten percent (10%.)
3. **Acceptable Management Measures**. Measures applied alone or in combination to satisfy the intent of this section are acceptable if there are no objectionable secondary consequences. The Commission recognizes that management of stormwater runoff to minimize or control downstream channel and bank erosion is a developing technology. Innovative techniques and ideas will be considered and may be used

when shown to have potential to produce successful results. Some alternatives, while not exhaustive, are to:

a. Avoid increases in surface runoff volume and velocity by including measures to promote infiltration to compensate for increased runoff from areas rendered impervious;

b. Avoid increases in stormwater discharge velocities by using vegetated or roughened swales and waterways in lieu of closed drains and high velocity paved sections;

c. Provide energy dissipaters at outlets of storm drainage facilities to reduce flow velocities to the point of discharge. These may range from simple rip-rapped sections to complex structures;

d. Protect watercourses subject to accelerated erosion by improving cross sections and/or providing erosion-resistant lining; and

e. Upgrade or replace the receiving device structure, or watercourse such that it will receive and conduct the flow to a point where it is no longer subject to degradation from the increased rate of flow or increased velocity.

4. **Exceptions.** This rule shall not apply where it can be demonstrated that stormwater discharge velocities will not create an erosion problem in the receiving watercourse.

5. **Velocity.** The following is a table for maximum permissible velocity for stormwater discharges:

Table 8-1. Maximum Permissible Velocities.

Material	F.P.S.	M.P.S.
Fine sand (non-colloidal)	2.5	0.8
Sandy loam (non-colloidal)	2.5	0.8
Silt loam (noncolloidal)	3.0	0.9
Ordinary firm loam	3.5	1.1
Fine gravel	5.0	1.5
Stiff clay (very colloidal)	5.0	1.5
Graded, loam to cobbles (non-colloidal)	5.0	1.5
Graded, silt to cobbles (colloidal)	5.5	1.7
Alluvial silts (non-colloidal)	3.5	1.1
Alluvial silts (colloidal)	5.0	1.5
Coarse gravel (noncolloidal)	6.0	1.8
Cobbles and shingles	5.5	1.7
Shales and hard pans	6.0	1.8

Source - Adapted from recommendations by Special Committee on Irrigation Research, American Society of Civil Engineers, 1926, for channels with straight alignment. For sinuous channels, multiply allowable velocity by 0.95 for slightly sinuous, by 0.9 for moderately sinuous channels, and by 0.8 for highly sinuous channels.

M Borrow and Waste Areas.

When the person conducting the land-disturbing activity is also the person conducting the borrow or waste disposal activity, areas from which borrow is obtained and which are not regulated by the provisions of the Mining Act of 1971, and waste areas for surplus materials other than landfills regulated by the Department's Division of Solid Waste Management shall be considered as part of the land-disturbing activity where the borrow material is being used or from which the waste material originated. When the person conducting the land-disturbing activity is not the person obtaining the borrow permit and/or disposing of the waste, these areas shall be considered a separate land-disturbing activity.

N Access and Haul Roads.

Temporary access and haul roads, other than public roads, constructed or used in connection with any land-disturbing activity shall be considered a part of such activity.

O Operations in Lakes or Natural Watercourses.

Land-disturbing activity in connection with construction in, on, over, or under a lake or natural watercourse shall be planned and conducted in such a manner as to minimize the extent and duration of disturbance of the stream channel. The relocation of a stream, where relocation is an essential part of the proposed activity, shall be planned and executed so as to minimize changes in the stream flow characteristics, except when justification for significant alteration to flow characteristic is provided.

P Responsibility for Maintenance.

During the development of a site, the person conducting the land-disturbing activity shall install and maintain all temporary and permanent erosion and sedimentation control measures as required by the approved plan or any provision of this Section, the Act, or any order adopted pursuant to this Section or the Act. After site development, the landowner or person in possession or control of the land shall install and/or maintain all necessary permanent erosion and sediment control measures, except those measures installed within a road or street right-of-way or easement accepted for maintenance by a governmental agency.

Q Additional Measures.

Whenever the City determines that significant sedimentation is occurring as a result of land-disturbing activity, despite application and maintenance of protective practices, the person conducting the land-disturbing activity will be required to and shall take additional protective action.

R Existing Uncovered Areas.

1. All uncovered areas existing on the effective date of this Section which resulted from land-disturbing activity, exceeding one (1) acre, are subject to continued accelerated erosion, and are causing off-site damage from sedimentation, shall be provided with a ground cover or other protective measures, structures, or devices sufficient to restrain accelerated erosion and control off-site sedimentation.
2. The City will serve upon the landowner or other person in possession or control of the land a written notice of violation by registered or certified mail, return receipt requested, or other means. The notice will set forth the measures needed to comply and will state the time within which such measures must be completed. In determining the measures required and the time allowed for compliance, the authority serving notice shall take into consideration the economic feasibility, technology, and quantity of work required, and shall set reasonable and attainable time limits of compliance.
3. The City reserves the right to require preparation and approval of an erosion control plan in any instance where extensive control measures are required.
4. This rule shall not require ground cover on cleared land forming the future basin of a planned reservoir.

S Permits.

1. No person shall undertake any land-disturbing activity subject to this Section without first obtaining a permit therefore from the City except that no permit shall be required for any land-disturbing activity:
   a. For the purpose of fighting fires; or
   b. For the stock piling of raw or processed sand, stone, or gravel in material processing plants and storage yards, provided that sediment control measures have been utilized to protect against off-site damage; or
   c. That does not exceed forty-three thousand five hundred sixty (43,560) square feet in surface area. In determining the area, lands under one or diverse ownership being developed as a unit will be aggregated.
2. The property owner or their agent shall submit an application for a Sediment and Erosion Control Permit to the Department of Engineering.
3. Payment of a fee for review of the application is hereby required. The fee shall be as set from time to time by resolution of the City Council and published in the City's Administrative Policy Manual.
4. The City may decide that a preconstruction conference is required.
5. A permit issued under this article shall be prominently displayed until all construction is complete, all permanent sedimentation and erosion control measures are installed and the site has been stabilized.

T Erosion and Sedimentation Control Plans.

1. An erosion control plan shall be prepared for all land-disturbing activities subject to this Section whenever the proposed activity is to be undertaken on a tract comprising more than one acre, if more than one acre

is to be uncovered. The plan shall be filed with the City and a copy shall be simultaneously submitted to the Edgecombe County or Nash County Soil and Water Conservation District as applicable, at least thirty (30) days prior to the commencement of the proposed activity. The District shall forward to the Director of the Division of Water Quality a copy of each erosion and sedimentation control plan for a land-disturbing activity that involves the utilization of ditches for the purpose of de-watering or lowering the water table of the tract, pursuant to section 2 G.S. §113A-57(4).

2. Persons conducting land-disturbing activity on a tract which covers one or more acres shall file three (3) copies of the erosion control plan with the City at least thirty (30) days prior to beginning such activity and shall keep another copy of the plan on file at the job site. After approving the plan, if the City either upon review of such plan or on inspection of the job site, determines that a significant risk of accelerated erosion or off-site sedimentation exists, the City will require a revised plan. Pending the preparation of the revised plan, work shall cease or shall continue under conditions outlined by the appropriate authority.
3. No person may initiate a land-disturbing activity before notifying the agency that issued the plan approval of the date that land-disturbing activity will begin.
4. Erosion control plans may be disapproved unless accompanied by an authorized Statement of Financial Responsibility and Ownership. This statement shall be signed by the person financially responsible for the land-disturbing activity, or authorized agent, in fact. The Statement shall include the mailing and street addresses of the principal place of business of the person financially responsible and of the owner of the land or their registered agents. If the person financially responsible is not a resident of North Carolina, a North Carolina agent must be designated in the Statement for the purpose of receiving notice of compliance or non-compliance with the plan, the Act, this Section, or rules or orders adopted or issued pursuant to this Section.
5. The Edgecombe County or Nash County Soil and Water Conservation District as applicable shall review the plan and submit any comments and recommendations to the City within twenty (20) days after the soil and water conservation district received the erosion control plan, or within any shorter period of time as may be agreed upon by the soil and water conservation district and the City. Failure of the Soil and Water Conservation District to submit its comments and recommendations within twenty (20) days or within any agreed-upon shorter period of time shall not delay final action on the plan.
6. The City will review each complete plan or revised plan submitted to them and within thirty (30) days of receipt thereof will notify the person submitting the plan that it has been approved, approved with modifications, approved with performance reservations, or disapproved. Approval assumes the applicant's compliance with the Federal and State water quality laws, regulations and rules. Failure to approve, approve with modifications, approve with performance reservations, or disapprove a complete erosion and sedimentation control plan or a revised erosion control within thirty (30) days of receipt shall be deemed approval. Disapproval of a plan or a revised plan must specifically state in writing the reasons for disapproval. The City must approve, approve with modifications, approve with performance reservations, or disapprove a revised plan within fifteen (15) days of receipt, or the revised submittal shall be deemed to be approved. If, following commencement of a land-disturbing activity pursuant to an approved plan, the City determines that the plan is inadequate to meet the requirements of this Section, the City may require any revision of the plan that is necessary to comply with this Section. Failure to approve, approve with modifications, approve with performance reservations, or disapprove a plan or revised erosion control plan within fifteen (15) days of receipt shall be deemed approval of the plan.
7. A permit issued under this article shall be valid for a period not to exceed two (2) years from the date of the approval or the time required to complete the permitted project including stabilization of all disturbed areas, which ever is less.
8. Any plan submitted for a land-disturbing activity for which an environmental document is required by the North Carolina Environmental Policy Act (G.S. 113A-1, et seq.) shall be deemed incomplete until a complete environmental document is available for review. The City shall promptly notify the person submitting the plan that the thirty (30) day time limit for review of the plan pursuant to this Section shall not begin until a complete environmental document is available for review.

9. The plan required by this section shall contain architectural and engineering drawings, maps, assumptions, calculations, and narrative statements as needed to adequately describe the proposed development of the tract and the measures planned to comply with the requirements of this Section. Plan content may vary to meet the needs of specific site requirements. Guidelines for preparation may be obtained from the City on request.
10. A local government may disapprove an erosion control plan or draft erosion control plan where implementation of the plan would result in a violation of the rules adopted by the Environmental Management Commission to protect riparian buffers along surface waters, finding that an applicant, or a parent, subsidiary, or other affiliate of the applicant:
    a. Is conducting or has conducted land-disturbing activity without an approved plan, or has received notice of violation of a plan previously approved by the Commission or a local government pursuant to the Act and has not complied with the notice within the time specified in the notice;
    b. Has failed to pay a civil penalty assessed pursuant to the Act or a local ordinance adopted pursuant to the Act by the time the payment is due.
    c. Has been convicted of a misdemeanor pursuant to G.S. 113A-64(b) or any criminal provision of a local ordinance adopted pursuant to the Act or;
    d. Has failed to substantially comply with State rules or local ordinances and regulations adopted pursuant to the Act. For purposes of this subsection (i) an applicant's record may be considered for only the two years prior to the application date.
11. Applications for amendment of an erosion control plan in written and/or graphic form may be made at any time under the same conditions as the original application. Until such time as said amendment is approved by the City, the land-disturbing activity shall not proceed except in accordance with the erosion control plan as originally approved.
12. Any person engaged in land-disturbing activity who fails to file a plan in accordance with this Section, or who conducts a land-disturbing activity except in accordance with provisions of an approved plan shall be deemed in violation of this Section.
13. When deemed necessary by the approving authority, a preconstruction conference may be required.
14. The approval of an erosion control plan is conditioned upon the applicant's compliance with Federal and State water quality laws, regulations and rules pursuant to GS 113A-61(b)(1).

U Appeals.

1. Except as provided in herein, the appeal of a disapproval or approval with modifications of a plan shall be governed by the following provisions:
    a. The disapproval or modification of any proposed erosion control plan by the City shall entitle the person submitting the plan to a public hearing if such person submits written demand for a hearing within fifteen (15) days after receipt of written notice of disapproval or modifications.
    b. Hearings held pursuant to this section shall be conducted by the Board of Adjustment within forty-five (45) days after the date of the appeal or request for a hearing.
    c. If the City upholds the disapproval or modification of a proposed soil erosion and sedimentation control plan following the hearing, the person submitting the plan shall then be entitled to appeal the local government's decision to the North Carolina Sedimentation Control Commission as provided in Section 113A-61(c) of the General Statutes and Title 15A NCAC 4B.0018(d).
2. In the event that an erosion control plan is disapproved pursuant to this Section, the City shall notify the Director of the Division of Land Resources of such disapproval within ten (10) days. The City shall advise the applicant and the Director in writing as to the specific reasons that the plan was disapproved. The applicant may appeal the City disapproval of the plan pursuant to this Section directly to the Commission.

V Inspections and Investigations.

1. Agents, officials, or other qualified persons authorized by the City will periodically inspect land-disturbing activities to ensure compliance with the Act, this Section, or rules or orders adopted or issued pursuant to this Section, and to determine whether the measures required in the plan are effective in controlling

erosion and sediment resulting from land-disturbing activity. Notice of the right to inspect shall be included in the certificate of approval of each erosion control plan.

2. No person shall willfully resist, delay, or obstruct an authorized representative, employee, or agent of the City while that person is inspecting or attempting to inspect a land-disturbing activity under this section.
3. If through inspection, it is determined that a person engaged in land-disturbing activity has failed to comply with the Act, this Section, or rules, or orders adopted or issued pursuant to this Section, a notice of violation shall be served upon that person. The notice may be served by any means authorized under GS 1A-1, Rule 4. The notice shall specify a date by which the person must comply with the Act, or this Section, or rules, or orders adopted pursuant to this Section, and inform the person of the actions that need to be taken to comply with the Act, this Section, or rules or orders adopted pursuant to this Section. Any person who fails to comply within the time specified is subject to the civil and criminal penalties for a continuing violation as provided in G.S. 113A-64 provided in this Section.
4. The City shall have the power to conduct such investigation as it may reasonably deem necessary to carry out its duties as prescribed in this Section, and for this purpose to enter at reasonable times upon any property, public or private, for the purpose of investigating and inspecting the sites of any land-disturbing activity.
5. The City shall also have the power to require written statements, or filing of reports under oath, with respect to pertinent questions relating to land-disturbing activity.

W Penalties.

1. Civil Penalties
   a. Any person who violates any of the provisions of this Section, or rules or orders adopted or issued pursuant to this Section, or who initiates or continues a land-disturbing activity for which an erosion control plan is required except in accordance with the terms, conditions, and provisions of an approved plan, shall be subject to a five thousand ($5,000) dollar civil penalty. For a violation, the maximum amount that the City may assess a person is a civil penalty of up to five thousand dollars ($5,000.00). A civil penalty may be assessed from the date of service of the violation. Each day of a continuing violation shall constitute a separate violation.
   b. Any person who violates any of the provisions of this Section, or rules or orders adopted or issued pursuant to this Section, or who initiates or continues a land-disturbing activity; or who fails to acquire an approved erosion control plan shall also be subject to a single five thousand ($5,000) dollar civil penalty.
   c. The Director of Engineering or designee of the City shall determine the amount of the civil penalty to be assessed under this subsection and shall notify the person who is assessed the civil penalty of the amount of the penalty and the reason for assessing the penalty. In determining the amount of the penalty the Director of Engineering or designee shall consider the degree and extent of harm caused by the violation and the cost of rectifying the damage, the amount of money the violator saved by noncompliance, whether the violation was committed willfully, and the prior record of the violator in complying or failing to comply with this Section. The notice of assessment shall be served by any means authorized under this Section, and shall direct the violator to either pay the assessment or contest the assessment, within thirty (30) days after receipt of the notice of assessment, by written demand for a hearing.
   d. A hearing on a civil penalty shall be conducted by the City Manager or his designee within thirty (30) days after the date of the written demand for the hearing. The City Manager shall make a decision within fifteen (15) days after the date of the hearing. Appeals from the City Manager's decision will be forwarded to the Board of Adjustment, and the Board of Adjustment shall render its final decision on the civil penalty within fifteen (45) days of the receipt of the appeal request. Appeal from the final decision of the City Council shall be to the Superior Court of the County where the violation occurred, or the location of the violator's residence or principal place of business.
   e. If payment is not received or equitable settlement reached within thirty (30) days after demand for payment is made, the matter shall be referred to the City Attorney for institution of a civil action in

the name of the City, in the appropriate division of the general courts of justice for recovery of the penalty. Such civil actions must be filed within three (3) years of the date the assessment was due. An assessment that is not contested is due when the violator is served with a notice of assessment. An assessment that is contested is due at the conclusion of the administrative and judicial review of the assessment.

f. In determining the amount of the penalty the City Council shall consider the degree and extent of harm caused by the violation, the cost of rectifying the damage, the amount of money the violator saved by non-compliance, whether the violation was committed willfully and the prior record of the violator in complying or failing to comply with the Article.

g. Civil penalties collected pursuant to this Section shall be credited to the general fund of the local government as non-tax revenue.

h. Criminal Penalties: Any person who knowingly or willfully violates any provision of this Section, or rule or order adopted or issued pursuant to this Section, or who knowingly or willfully initiates or continues a land-disturbing activity for which an erosion control plan is required except in accordance with the terms, conditions, and provisions of an approved plan, shall be guilty of a Class 2 misdemeanor which may include a fine not to exceed five thousand ($5,000) dollars as provided in G.S. §113A-64.

X Injunctive Relief.

1. Whenever the City Council has reasonable cause to believe that any person is violating or threatening to violate this Section or any rule or order adopted or issued pursuant to this Section, or any term, condition, or provision of an approved erosion control plan, it may, either before or after the institution of any other action or proceeding authorized by this Section, institute a civil action in the name of the City for injunctive relief to restrain the violation or threatened violation. The action shall be brought in the Superior Court of Edgecombe or Nash County as appropriate.

2. Upon determination by a court that an alleged violation is occurring or is threatened, the court shall enter any order or judgment that is necessary to abate the violation, to ensure that restoration is performed, or to prevent the threatened violation. The institution of an action for injunctive relief under this section shall not relieve any party to the proceedings from any civil or criminal penalty prescribed for violations of this Section.

Y Restoration of Areas Affected by Failure to Comply.

The City may require a person who engaged in a land-disturbing activity and failed to retain sediment generated by the activity, as required by G.S. 113A-57(3), to restore the waters and land affected by the failure so as to minimize the detrimental effects of the resulting pollution by sedimentation. This authority is in addition to any other civil or criminal penalty or injunctive relief authorized under this Section.

Section 802 Tar-Pamlico Stormwater Nutrient Management Requirements

The Legislature of the State of North Carolina has designated specific local governments in the Tar Pamlico River Basin and has required them to develop stormwater management program in conformance with 15A NCAC 2B.0258, Tar-Pamlico River Basin-Nutrient Sensitive Waters Management Strategy. This section is adopted pursuant to the authority contained in Article 19 of Chapter 160A, Planning and Development and the requirements of 15A NCAC 2B.0258. Any modifications to this section are subject to the approval by the NC Division of Water Quality (DWQ).

A Applicability

1. The provisions of this section shall apply within the corporate limits of the City of Rocky Mount and the ETJ, as defined in section 205 of this LDC.
2. All land development activity meeting the criteria listed below must comply with the requirements of this section.
   a. Any activity that disturbs greater than one acre of land to establish, expand, or replace a single family or duplex residential development or recreational facility. For individual single family residential lots of record that are not part of a larger common plan of development or sale, the activity must also result in greater than ten percent built-upon area.
   b. Any activity that disturbs more than one half (1/2) acre of land in order to establish, expand or modify a multi-family residential development or a commercial, industrial, institutional or any other non-residential facility.

B Exceptions

1. Projects meeting the criteria listed in 802.A.2.a-c that replace or expand existing structures or improvements and that do *not* result in a net increase in built-upon area are not required to comply with the provisions of this section.
2. Projects meeting the criteria listed in 802.A.2.a-c that are located within an area that the City Council has designated as a redevelopment area will not be required to achieve nutrient reductions provided the City has a specific redevelopment strategy in place for the area that addresses the following:
   a. The redevelopment area is a historic community center, traditional central business district, historical district, educational center or other existing developed area specifically designated by the City Council.
   b. The City has an established strategy for reinvestment in the area as appropriate including one or more of the following:
      1) A “fix it first” policy that reserves public funds for repair of existing infrastructure in these areas before investing in new infrastructure of the same type in new growth areas.
      2) Mixed use/mixed density zoning provisions
      3) Retrofits that are consistent with NC DOT definition for pedestrian scale in traditional neighborhood developments.
      4) Parking maximums or shared parking ratios
      5) Residential density bonuses where parking maximums, pedestrian scale, or “fix it first” are considered.
      6) The redevelopment plan is conducive to the goals of the Tar Pamlico Nutrient Management Strategy.
3. Projects that replace or expand existing structures or improvements resulting in a net increase in built upon area shall achieve a 30 percent reduction in nitrogen loading and no increase in phosphorus loading relative to the previous development. Such projects may achieve these loads through onsite or offsite measures or some combination thereof.
4. Phased residential or commercial projects with multiple lots that propose shared stormwater facilities may be permitted as “on-site” facilities not subject to the pre-treatment limitations defined section 802 F of this LDC, provided the shared facility is designed and constructed to meet the nutrient reduction and attenuation requirements for the entire project.

C Exemptions

Agriculture, mining or forestry activities are not subject to the new development requirements of this section.

D Protection of Riparian Buffers

1. Establishment and Protection of Riparian Buffers.

New developments meeting the criteria listed in section 802 A, must protect areas adjacent to intermittent and perennial streams in accordance with the Tar Pamlico Riparian Buffer Rule. A fifty (50) ft. wide riparian buffer is established on all sides of intermittent and perennial streams, ponds, and lakes shown on the most recent version of either a Natural Resources Conservation Service Soil Survey of Nash County and Soil Survey of Edgecombe County or a 1:24,000 scale (7.5 minute quadrangle) topographic map prepared by the U. S. Geological Survey (USGS). Tar Pamlico riparian buffers must be shown on all development plans, preliminary plats and final plats that contain land area within 50 of a intermittent or perennial stream. If the plan or plat shows an encroachment into the riparian buffer, approval from the DWQ must accompany the submittal. The City will not approve new development plans that include land area within 50 feet of the banks of a regulated water body except where one of the following conditions:

a. The development plan does not propose to impact the riparian buffer or,

b. The property owner has received approval from the Division of Water Quality (DWQ) of the North Carolina Department of Environment and Natural Resources. Approval by the DWQ may be in the form of the following:

1) An on-site determination by the DWQ in writing that regulated surface waters are not present on the site.

2) A permit for the proposed construction activity.

3) An authorization certificate and approval on a mitigation plan for a use designated as allowable with mitigation

4) A variance from DWQ and/or the Environmental Management Commission.

E Nutrient Reduction Requirements

1. Nitrogen and Phosphorus Export Standards

a. All new development meeting the criteria listed in 802.A must limit nitrogen export to 4.0 pounds per acre per year (lbs/ac/yr) and phosphorus export to 0. 4 pounds per acre per year (lbs/ac/yr) through some combination of the following

1) Construction of allowable onsite or offsite stormwater management facilities. Use of offsite facilities is subject to the provisions of 802 F-G.

2) Participation in an approved “regional” or “jurisdiction-wide” facility or strategy.

3) Dedication of “open space” and/or “conservation” easements. Easements may be onsite or offsite subject to the provisions listed in section 802 F-G and section 804 of this LDC. Offsite land conservation offsets that drain to the same classified water as the new development and meet the criteria specified in 802 G.2.b may be approved by the Director of Engineering or designee.

2. Calculation of Nitrogen and Phosphorus Export and Removal Efficiencies

a. The nitrogen and phosphorus export from all new development meeting the criteria listed in 803.A must be calculated in pounds per acre per year (lb/ac/yr). The export values for various types of land use, BMP removal efficiencies and the methodologies to be used in calculating the nitrogen and phosphorus export from the development are specified in the “City of Rocky Mount Standard Specifications and Design Manual” and/or the “Tar-Pamlico River Basin: Stormwater Program for Nutrient Control.” These standards and all revisions thereto are hereby adopted by reference.

3. Allowable Best Management Practices for Nitrogen and Phosphorus Reduction

a. All stormwater management and/or BMP facilities must designed in accordance with section 804 of this LDC.

b. Allowable BMPs for Nitrogen and/or Phosphorus reduction may include but are not limited to the following:

1) Wet detention ponds

2) Constructed wetlands

3) Restored riparian buffers

4) Grass swales
5) Vegetative filter strips with level spreaders
6) Bioretention
7) Sand Filters
8) Proprietary BMP or other BMPs (subject to approval by the Director of Engineering and DWQ)

c. Specific use of any particular device or strategy is subject to the approval by Director of Engineering.

F Peak Runoff Control

1. No net increase in peak stormwater runoff
   New development shall not result in an increase in peak stormwater runoff flow leaving the site from the pre-development conditions for the 1-year 24-hour, 10-year 24-hour and the 25-year 24-hour storm events.
2. Calculation Methods
   Calculation Methods shall be in accordance with the standards specified in section 804 of this LDC.
3. Exceptions to the peak flow requirement
   Peak flow control is not required for new developments that meet one or more of the flowing requirements:
   a. The overall impervious surface area is less than fifteen (15) percent of the total site and the remaining pervious portions of the site are utilized to the maximum extent practical to convey and control the stormwater runoff, and;
   b. The increase in peak flow between the pre-development and post-development conditions does not exceed ten (10) percent, or;
   c. The Director of Engineering makes a determination that stormwater detention at this particular location will increase flooding, accelerate erosion or negatively impact existing drainage problems in the area. In such cases, an alternate method of peak attenuation management may be required.

G Offsite Partial Offset Option

The Tar-Pamlico stormwater rule provides the option to offset nutrient load increases from new development by providing treatment of offsite areas. In order for a project to use the partial offsite offset option, the development plan and offsite facility must meet the following conditions:

1. Except where the project is participating an approved jurisdiction wide facility or approach, as defined in section 802 G, the new development must first reduce nitrogen export from the site as follows:
   a. Single-family or duplex residential meeting the criteria in 802 A.2.a must limit nitrogen export to no more than 6 lb N/ac-yr.
   b. Development meeting the criteria in 802 A.2.b must limit nitrogen export to 10 lb N/ac-yr.
2. The balance of the nitrogen reduction, to 4 lb N/ac-yr, must be made by an offsite facility.
3. The offsite area must drain to the same classified surface water as the new development, as defined in the schedule of Classifications, 15A NCAC 2B .0316 and listed in Table 8-2 of this chapter, or be a part of a jurisdiction-wide facility or approach approved by DWQ as defined in section 802 G of this LDC.
4. The net phosphorus loading for the project must be reduced to 0.4 lb/ac/yr. Some or all of the reduction may be obtained through the offsite facility.
5. The offsite facility may only be used to address only the nutrient requirements, except where the development proposal provides supporting calculations, approved by Director of Engineering or designee, that demonstrate that meeting some or all attenuation requirements offsite will not result in degradation of the classified surface waters to which the new development site discharges.
6. The off-site stormwater management and/or BMP facility may serve multiple projects provided the facility is appropriately sized and has an tracking system approved by the Director of Engineering to allocate nutrient removal and flow attenuation to the participating development sites.
7. The development owner and the owner of the offsite facility, if different from the development owner, must provide a recoded enforceable agreement stating that offsite facilities are dedicated to achieving the specified nutrient and flow reductions for the life of the new development. The responsibility for

maintaining these reductions as well as the provisions of any easements and operation and maintenance agreements required in accordance with section 804 of this LDC shall run with the land and be binding upon subsequent owners of both the development project and the offsite facility.

8. Operation and maintenance plans and easements must be provided for all onsite and offsite facilities in accordance with the provisions of section 804 of this LDC.

Table 8-2: Tar River Basin Classified Surface Waters

Receiving Stream Name	Stream Segment	Water Quality Classification
Tar River	4000' upstream of reservoir dam to dam	WS-IV, NSW, CA, (28-64)
Tar River	Reservoir dam to Maple Creek	WS-IV, NSW (28-64.5)
Grape Branch	Source to Tar River	WS-IV, NSW (28-65)
Maple Creek	Source to Tar River	WS-IV, NSW (28-66)
Tar River	Maple Creek to 100' downstream of old CRM intake of HWY 64	WS-IV, NSW (28-66.5)
Tar River	CRM intake to RM Mills Dam	B, NSW (28-67)
Stoney Creek	Source to Tar River	C, NSW (28-68)
Tar River	RM Mills dam to 0.9 mi downstream Buck Swamp	WS-IV, NSW (28-69)
Goose Branch	Source to Tar River	C, NSW (28-70)
Cowlick Branch	Source to Tar River	C, NSW (28-71)
Compass Creek	Source to Tar River	C, NSW (28-72)
Hornbeam Branch	Source to Compass Creek	C, NSW (28-72-1)
Gay branch (Indian Branch)	Source to Tar River	C, NSW (28-72.5)
Buck Swamp	Source to Tar River	C, NSW (28-73)
Beech Branch	Source to Hwy 301	B, NSW (28-75-(1))
Beech Branch	Hwy 301 to Falling Run	C, NSW (28-75-(2))
Little Cokey Swamp	Source to Cokey Swamp	C, NSW (28-83-3-1)

H Regional and Jurisdiction-wide Facilities and Strategies

The Tar-Pamlico stormwater rule provides the option for local governments to develop regional or jurisdiction-wide stormwater facilities and/or approaches as an alternative means for addressing nutrient or flow control requirements. Regional or jurisdiction-wide approaches will be undertaken by the City on a project-by-project basis and will be incorporated into the City's comprehensive stormwater management program as they are developed and approved by DWQ.

1. Regional Facilities
   a. Regional Facility within the context of this section means a stormwater management facility or approach that provides a portion of the nutrient and/or flow control requirements for multiple developments in a specified area within the City's jurisdiction. Examples of regional facilities may include but are not limited to wet detention ponds or constructed wetlands.
   b. Regional facilities may be publicly or privately owned and operated, but must be approved by DWQ if the facility is proposed to serve more than one classified stormwater basin.
2. Jurisdiction-wide Approach
   a. Jurisdiction-Wide Approach within the context of this section means a nutrient-reducing management measure or strategy implemented under the authority of the City and approved by DWQ to offset nutrient and/or flow increases throughout the jurisdiction. Examples of nutrient reducing measures may include but are not limited to conventional stormwater facilities, constructed wetlands, or land conservation.
   b. **Land Conservation Offsets** are an available option provided the following criteria are met:
      1) The conserved land must achieve the net nutrient reductions not achieved by the new development that conservation is credited with offsetting.
      2) Proposals must quantify the reductions including identification of any actions to be taken to achieve nutrient reductions. Examples include:

(a) Removal of existing impervious area
(b) Reforestation of managed open space such as agricultural land, cleared or vacant lots.
(c) Restoration of the buffering functions of land adjacent to existing or new development, e.g. converting pipe or ditch flow to dispersed sheet flow through forested land.

3) The conserved land should be no further from the estuary than the new development and within the same jurisdiction except where there is an interlocal agreement that provides for development and offsetting conservation in different jurisdictions. The agreement shall provide assurance of enforceability between jurisdictions, as well as cross-jurisdictional tracking and monitoring procedures.
4) There must be adequate protection to ensure that the conserved lands will not be credited to other new developments.
5) Lands whose nutrient removal functions are established and protected through other regulatory programs, such as wetlands and riparian buffers, would not be eligible for conservation credit.
6) Conserved land may be used to offset flow attenuation requirements if adequate measures are provided to ensure diffuse flow and no hydrologic degradation of the conserved features or surface waters.
7) Conserved land must be secured in a recorded permanent conservation easement or equivalent legal mechanism with provisions to prohibit both farming and unapproved logging practices.

c. **Stormwater Management Facilities** must provide the following information to gain DWQ approval as a regional or jurisdiction-wide system:

1) Land uses in the contributing area.
2) Type of facility.
3) Expected nitrogen and phosphorus removal efficiency and peak shaving capacity.
4) Worst-case percent impervious of the contributing area at build out
5) Assumptions for on-lot treatment and attenuation
6) Calculations of nitrogen and phosphorus reduction needed, demonstration that facility meets needs.
7) Process for tracking expenditure of treatment and attenuation capacity.
8) Easement, restricting land use to protect stormwater management facility and containing adequate access for maintenance where such an instrument would be appropriate.
9) An agreement that demonstrates that (a) the developer, (b) a local government, or (c) a private for-profit or non-profit company will operate and maintain the facilities.
10) Maintenance guarantees in conformance with the provisions of section 804. If facility is not owned or operated by the City.

I Vested Rights

Projects such as landfills, NPDES wastewater discharges, and road construction that have obtained valid state permits prior to August 13, 2004 and projects that can demonstrate that they have vested rights in accordance with chapter 12 of this LDC as of August 13, 2004 will not be required to comply the requirements of this section for the for the time periods specified by this LDC except that all vested right granted by this provision shall expire five years from the date that local or state approval of the project was granted.

Section 803. Water Supply Watershed Protection Regulations.

This section is adopted pursuant to the authority contained in Article 19 of Chapter 160A, Planning and Development, and G.S. Chapter 143, Section 214.5, Water Supply Watershed Protection. The provisions of this section shall apply within the areas designated as a public water supply watershed by the North Carolina Environmental Management Commission and shall be defined and established on the map entitled, "Watershed Protection Map of Rocky Mount, North Carolina" ("the watershed map"), which is adopted simultaneously herewith. The watershed map and all explanatory matter contained thereon accompanies and is hereby made a part of this LDC. The provisions of this section shall amend any and all LDC, resolutions or regulations of the City which are in conflict with or may be construed to impair or reduce the effectiveness of the City's watershed regulations.

A Watersheds General.

1. The provisions of this LDC relating to watershed protection are adopted pursuant to the authority contained in G.S. Article 19 of Chapter 160A, Planning and Development, and G.S. Chapter 143, Section 214.5, Water Supply Watershed Protection. The provisions of this section shall apply within the areas designated as a public water supply watershed by the North Carolina Environmental Management Commission and shall be defined and established on the map entitled, "Watershed Protection Map of Rocky Mount, North Carolina" ("the watershed map"), which is adopted simultaneously herewith. The watershed map and all explanatory matter contained thereon accompanies and is hereby made a part of this LDC. In addition, so long as the only watershed areas in the City''s jurisdiction are WS-IV-CA and WS-IV-PA, only activities that require a sedimentation and erosion control plan for the proposed development pursuant to the ' Sedimentation and Erosion Control section of the LDC or State erosion/sedimentation law are required to meet the provisions of this section.
2. Existing development, as defined in this LDC, is not subject to the requirements of this section. Expansions to structures classified as existing development must meet the requirements of this section, however, the built-upon area of the existing development is not required to be included in the density calculations.
3. A pre-existing lot owned by an individual prior to the effective date of this section, regardless of whether or not a vested right has been established, may be developed by such individual owner or any subsequent owner for single-family residential purposes without being subject to the restrictions of this Section.

B Standards and Required Improvements.

1. All lots shall provide adequate building space in accordance with the development standards contained in this LDC. Lots which are smaller than the minimum required for residential lots shall be identified on the plat as, "not for residential purposes."
2. For the purpose of calculating built-upon area, total project area shall include total acreage in the tract on which the project is to be developed.
3. Where possible, roads should be located outside of critical areas and watershed buffer areas. Roads constructed within these areas shall be designed and constructed so to minimize their impact on water quality.

C Exceptions.

1. Existing development, as defined in this section, is not subject to the requirements of this section.
2. A pre-existing lot owned by an individual prior to the effective date of this section, regardless of whether or not a vested right has been established, may be developed by such individual owner or any subsequent owner for single-family residential purposes without being subject to the restrictions of this section.

D Establishment of Watershed Areas.

1. For the purposes of this section the City and its extraterritorial jurisdiction is hereby divided into the following areas as delineated on the watershed map:
   a. WS-IV-CA (critical area)
   b. WS-IV-PA (protected area)

E Watershed Areas Described.

1. **WS-IV Watershed Areas—Critical Area (WS-IV-CA).** Only new development activities that require a sedimentation and erosion control plan under the City''s sedimentation and erosion control LDC or state erosion/sedimentation law are required to meet the provisions of this section In order to address a medium

to high land use intensity pattern, single-family residential uses are allowed at a maximum of two (2) dwelling units per acre. All other residential and nonresidential development shall be allowed twenty-four (24) percent built-upon area. New sludge application sites and landfills are specifically prohibited.

a. **Permitted Uses.**

1) Agriculture subject to the provisions of the Food Security Act of 1985 and the Food, Agriculture, Conservation and Trade Act of 1990. Agricultural activities conducted after January 1, 1993 shall maintain a minimum ten-foot vegetative buffer, or equivalent control as determined by the soil and water conservation Commission, along all perennial waters indicated on the most recent versions of U.S.G.S 1:24,000 (7.5 minutes) scale topographic maps or as determined by the Director of Engineering. Animal operations greater than one hundred (100) animal units shall employ best management practices by July 1, 1994 as recommended by the soil and water conservation Commission.

2) Silviculture, subject to the provisions of the Forest Practices Guidelines Related to Water Quality (15 NCAC 1I.6101.0209).

3) Residential development.

4) Nonresidential development, excluding:

(a) The storage of toxic and hazardous material unless a spill containment plan is implemented;

(b) Landfills; and

(c) Sites for land application of sludge/residuals or petroleum contaminated soils.

b. **Low Density and Built-upon Limits.**

1) Single-family residential development shall not exceed two (2) dwelling units per acre on a project-by-project basis.

2) All other residential and nonresidential development shall not exceed twenty-four (24) percent built-upon area on a project-by-project basis. For the purpose of calculating the built-upon area, total project area shall include total acreage in the tract on which the project is to be developed.

c. **High Density and built-upon Limits.**

High density and built-upon limits are permitted in this watershed area pursuant to the provisions of Chapter 8 of this LDC**.**

2. **WS-IV Watershed Areas—Protected Area (WS-IV-PA).** Only new development activities that require a sedimentation and erosion control plan under the City's sedimentation and erosion control LDC or State erosion/sedimentation law are required to meet the provisions of this LDC. In order to address a medium to high land use intensity pattern, residential and nonresidential uses are permitted in this watershed area, subject to the requirements of this LDC, including the following:

a. **Uses Permitted**.

1) Agriculture, subject to the provisions of the Food Security Act of 1985 and the Food, Agriculture, Conservation and Trade Act of 1990.

2) Silviculture, subject to the provisions of the Forest Practices Guidelines Related to Water Quality (15 NCAC 1I.6101-.0209).

3) Residential development.

4) Nonresidential development, excluding the storage of toxic and hazardous material unless a spill containment plan is implemented.

b. **Low Density and Built-upon Limits.**

1) Single-family residential development shall not exceed two (2) dwelling units per acre or twenty-four (24) percent built-upon area, on a project-by-project basis. For projects without a curb and gutter street system, development shall not exceed three (3) dwelling units per acre or thirty-six (36) percent built-upon area, on a project-by-project basis.

2) All other residential and nonresidential development shall not exceed twenty-four (24) percent built-upon area, on a project-by-project basis. For projects without a curb and

gutter street system, development shall not exceed thirty-six (36) percent built-upon area, on a project-by-project basis.

3) For the purpose of calculating built-upon area, total project area shall include total acreage in the tract on which the project is to be developed.

c. **High Density and Built-upon Limits.**

High density and built-upon limits are permitted in this watershed area pursuant to the provisions of Chapter 8 of this LDC.

F Clustering Development in Watershed Areas.

Clustering of development is allowed in all watershed areas under the following conditions:

1. Minimum lot sizes are not applicable to single-family cluster development projects; however, the total number of lots shall not exceed the number of lots allowed for single-family detached developments in Chapter 8 of this LDC**.** Built-upon area or stormwater control requirements of the project shall not exceed that allowed for the critical area or protected area, whichever applies.
2. All built-upon areas shall be designed and located to minimize stormwater run-off impact to the receiving waters and minimize concentrated stormwater flow.
3. The remainder of the tract shall remain in a vegetated or natural state. Where the development has an incorporated property owners association, the title of the open space area shall be conveyed to the association for management. Where a property association is not incorporated, a maintenance agreement shall be filed in the appropriate county.

G Buffer Areas Required.

1. A minimum one hundred (100) foot vegetative buffer is required for all new development activities that exceed the low density option; otherwise, a minimum thirty (30) foot vegetative buffer for development activities is required along all perennial waters indicated on the most recent versions of U.S.G.S 1:24,000 (7.5 minute) scale topographic maps or as determined by the Director of Engineering. Desirable artificial stream bank or shoreline stabilization is permitted.
2. No new development is allowed in the buffer except for water development structures and public projects such as road crossings and greenways where no practical alternative exists. These activities should minimize built-upon surface area, direct runoff away from the surface waters and maximize the utilization of stormwater best management practices.

H Rules Interpretation of Watershed Boundaries.

Where it is believed that the majority of an existing or proposed lot in its natural, undisturbed, predevelopment State actually drains outside of the watershed (as indicated on the official watershed map), a topographic survey prepared by a registered land surveyor may be submitted to the director of the department of planning and development as evidence that the lot should be excluded from the official watershed area boundaries. Where uncertainty exists as to the boundaries of the watershed area, as shown on the watershed map, the following rules shall apply:

1. Where area boundaries are indicated as approximately following either street, alley, railroad or highway lines or centerlines thereof, such lines shall be construed to be said boundaries.
2. Where area boundaries are indicated as approximately following lot lines, such lot lines shall be construed to be said boundaries. However, a surveyed plat prepared by a registered land surveyor may be submitted to the Director as evidence that one (1) or more properties along these boundaries do not lie within the watershed area.
3. Where the watershed area boundaries lie at a scaled distance more than twenty-five (25) feet from any parallel lot line, the location of watershed area boundaries shall be determined by use of the scale appearing on the watershed map.
4. Where the watershed area boundaries lie at a scaled distance of twenty-five (25) feet or less form any parallel lot line, the location of watershed area boundaries shall be construed to be the lot line.
5. Where other uncertainty exists, the Inspection Services Administrator shall interpret the watershed map as to location of such boundaries. This decision may be appealed to the Board of Adjustment.

I Existing Development.

Any existing development as defined in this section, may be continued and maintained subject to the conditions provided herein. Expansions to structures classified as existing development must meet the requirements of this section, however, the built-upon area of the existing development is not required to be included in the density calculations.

J Compliance Prior to Issuance of Permits.

1. Except where a single-family residence is constructed on a lot of record prior to the effective date of this section, no building or built-upon area shall be erected, moved, enlarged or structurally altered, nor shall any building permit be issued nor shall any change in the use of any building or land be made until the provisions of this section have been complied with.
2. No building or structure which has been erected, moved or structurally altered may be occupied nor shall a certificate of occupancy/compliance be issued until the provisions of this section have been complied with.

K High Density Development.

1. The Planning Board may approve high density development proposed consistent with the following standards:
   a. WS-IV watershed areas—critical area (WS-IV-CA). Where new development exceeds either two (2) dwelling units per acre or twenty-four (24) percent built-upon area, engineered stormwater controls shall be used to control runoff from the first inch of rainfall and development shall not exceed fifty (50) percent built-upon area.
   b. WS-IV watershed areas—protected areas (WS-IV-PA). Where new development requires a sedimentation and erosion control plan and exceeds either two (2) dwelling units per acre or twenty-four (24) percent built-upon area, or three (3) dwelling units per acre or thirty-six (36) percent built-upon area for projects without curb and gutter street system, engineered stormwater controls shall be used to control runoff from the first inch of rainfall and development shall not exceed seventy (70) percent built-upon area.
   c. The engineered stormwater management and/or BMP facilities shall be designed and constructed in accordance with the criteria listed in section 804 of this LDC.
2. High density development shall meet the requirements of this LDC and the provisions of the LDC relating to watershed protection.

Section 804 Design, Construction and Maintenance of Stormwater Management and/or BMP Facilities.

A Stormwater Management Facility Design.

1. All stormwater management and/or best management practices (BMP) facilities shall be designed by a North Carolina registered professional with qualifications appropriate for the type of system required; these registered professionals are defined as professional engineers, landscape architects, to the extent that G.S. 89A allows, and land surveyors, to the extent that the design represents incidental drainage within a subdivision, as provided in G.S. 89C-3(7).
2. The standards used for the design and construction of all stormwater management and/or BMP facilities shall be in accordance with the "City of Rocky Mount Standard Specifications and Design Manual," latest edition and "The North Carolina Department of Environment and Natural Resources, Division of Water Quality, Water Quality Section, Stormwater Best Management Practices Manual," 1999. These standards and all amendments thereto and are hereby adopted by reference.
3. Stormwater management facilities for nutrient reduction and water quality, may consist of one (1) treatment option or a combination of treatment options so long as the following conditions are met:
   a. Eighty-five (85) percent average annual removal of total suspended solids, and;
   b. Facility shall be designed in accordance with the provisions of 804 A1-2 and to meet the nutrient reduction requirements of section 802, and
   c. The discharge rate shall meet the following criteria:

1) The discharge rate for constructed wetlands, wet detention basins bioretention areas and other extended detention facilities following the one-inch design storm shall be such that the runoff draws down to the pre-storm design stage within five (5) days, but not less than two (2) days; and

2) The post development peak discharge rate shall equal the predevelopment rate for the one-year, twenty-four-hour storm.

4. In addition to any required vegetative filters all land areas outside of the stormwater management facility shall be provided with a ground cover sufficient to restrain erosion within thirty (30) days after any land disturbance. Upon completion of the stormwater control structure, a permanent ground cover shall be established and maintained as part of a maintenance agreement.

5. A legal description of the area containing the stormwater control structure shall be prepared and included in a separate deed to the owning entity to be filed with the Register of Deeds in the appropriate county along with any easements necessary for general access to the stormwater management structure. The deeded area shall include the stormwater management structure, vegetative filters, all pipes and water control structures, berms, dikes, etc., and sufficient area to perform inspections, maintenance, repairs and reconstruction.

6. Qualifying areas of the stormwater management structure may be considered pervious when computing total built-upon area. However, if the structure is used to compute the percentage built-upon area for one (1) site, it shall not be used to compute the built-upon area for any other site or area.

B Posting of Financial Security Required.

1. Plan approval for new stormwater control structures shall be conditioned on the posting of a financial assurance as provided in section 1310 of this LDC for 110% of the estimated construction cost for the purpose of construction, repair, or reconstruction necessary for adequate performance of the stormwater management and/or BMP facility.

2. Default under the financial assurance. Upon default of the applicant to complete and/or maintain the stormwater control structure as spelled out in the performance bond or other security, the Director of Engineering may obtain and use all or any portion of the funds necessary to complete the improvements based on an engineering estimate. The Director of Engineering shall return any funds not spent in completing the improvements to the owning entity; provided, however, no funds shall be returned to the owning entity until the Director of Engineering is satisfied that adequate provisions have been made for the future maintenance, repair, and if necessary, reconstruction of the stormwater controls.

3. Default under cash security. Upon default of the owning entity to maintain, repair and, if necessary, reconstruct the stormwater control structure in accordance with the operation and maintenance agreement, the Director of Engineering shall obtain and use all or any portion of the cash security to make necessary improvements based on an engineering estimate. Such expenditure of funds shall only be made after exhausting all other reasonable remedies seeking the owning entity to comply with the terms and conditions of the operation and maintenance agreement. The Director of Engineering shall not return any of the deposited cash funds.

C Maintenance and Upkeep.

1. All stormwater management facilities and/or best management practice (BMPs) facilities that are constructed or implemented to meet the requirements of this LDC must be maintained in a manner that maintains the nutrient reduction levels and flow attenuation levels anticipated in the design of the facility.

2. Prior to final plat approval or issuance of a certificate of compliance, the applicant shall enter into a binding operation and maintenance agreement between the City and all interests in the development. Such agreement shall

   a. Require the owning entity to maintain, repair and, if necessary, reconstruct the stormwater control structure in accordance with the operation and management plan provided by the developer.

   b. The operation and maintenance agreement shall be in recordable form and shall be filed with the Register of Deeds in the appropriate county.

   c. The owning entity or entities will be responsible for submitting an annual inspection report of the stormwater management and/or BMP facility performed by a knowledgeable professional in the

field to the Director of Engineering. The annual report shall include an assessment of the condition of the facility including any improvements needed to insure that the facility operates safely and achieves the necessary nutrient reduction and flow attenuation levels anticipated in the design of the facility.

d. The Stormwater Management Agreement shall clearly delineate the penalties for failure to complete the required inspections, maintenance or improvements and shall grant the City authority to enter the property for the purposes of ensuring compliance with the provisions of the agreement and this LDC. If the owner and/or operator fails to complete the required inspections or any required improvements, the City shall inspect the facilities and make any necessary corrections. Any costs associated with this work, including administrative costs and fines, will be charged to the owner and/or party legally responsible for maintenance of the facility.

e. Maintenance agreements shall run with the land and be binding upon subsequent owners of both the development project and/or any offsite facilities.

3. As part of the operation and maintenance agreement, an operation and maintenance plan shall be provided by the developer for each stormwater control structure indicating what operation and maintenance actions are needed, what specific quantitative criteria will be used for determining when those actions are to be taken and, consistent with the operation and maintenance agreement, who is responsible for those actions. The plan shall clearly indicate the steps that will be taken for restoring a stormwater control structure to design specifications if a failure occurs.

4. Landscaping and grounds management shall be the responsibility of the owning entity. However, vegetation shall not be established or allowed to mature to the extent that the integrity of the control structure is diminished or threatened, or to the extent of interfering with an easement or access to the stormwater control structure.

5. Except for general landscaping and grounds management, the owning entity shall notify the Director of Engineering prior to any repair or reconstruction of the stormwater control structure. All improvements shall be made consistent with the approved plans and specifications of the stormwater control structure and the operation and maintenance plan. After notification by the owning entity, the Director of Engineering or designee shall inspect the completed improvements and shall inform the owning entity of any required additions, changes, or modifications and of the time period to complete such improvements. The Director of Engineering may consult with an engineer or landscape architect (to the extent that G.S. Chapter 89A allow) designated by the Planning Board.

6. Amendments to the plans and specifications of the stormwater management and/or BMP facility, the operation and maintenance agreement or the operation and maintenance plan shall be approved by the Planning Board. Proposed changes shall be prepared by a North Carolina registered professional engineer or landscape architect (to the extent that the G.S. ch. 89A allow) and submitted to and review by the department of planning and development prior to consideration by the Planning Board.

   a. If the Planning Board approves the proposed change, the owning entity of the stormwater control structure shall file sealed copies of the revisions with the department of planning and development.

   b. If the Planning Board disapproves the changes, the proposal may be revised and resubmitted to the Board as a new proposal. If the proposal has not been revised and is essentially the same as that already reviewed, it shall be returned to the owning entity.

7. If the Planning Board finds that the operation and maintenance plan is inadequate for any reason, the Board shall notify the owning entity of any required changes and the owning entity shall prepare and file copies of a revised operation and maintenance agreement with the department of planning and development and such revised plan shall be the plan for the development.

D Release of the Performance Bond.

1. The Director of Engineering shall inspect the stormwater management and/or BMP facility after the developer notifies him that all work has been completed. At or prior to this inspection, the developer shall provide to the City:

   a. Certified as-built drawings of the stormwater management and/or BMP facility.

b. Final plat(s) creating a separate lot of record for the stormwater management facility ready for filing with the Register of Deeds;

c. Signed deed(s) and related easements, as required, to convey the stormwater controls to the owning entity, and

d. A certification sealed by an engineer or landscape architect (to the extent that the G.S. Chapter 89A allow) stating that the stormwater management and/or BMP facility is complete and consistent with the approved plans and specifications.

2. If the Director of Engineering approves the inspection report and accepts the items listed in 804 D1, the Director may release up to seventy-five (75) percent of the value of the performance bond or other security, and authorize the issuance of a certificate of compliance for the stormwater management and/or BMP facility. If deficiencies are found, the Director of Engineering shall direct that improvements and inspections be made and/or documents corrected.

3. No sooner than one (1) year after year after the filing date of the deed, easements, and maintenance agreement issuance of the certificate of compliance, the developer may request that the Director of Engineering release the remaining value of the performance bond or other security. Upon receipt of such request the Director of Engineering shall inspect the stormwater control structure to determine whether the controls are performing as designed and intended.

   a. If the Director of Engineering approves the report and accepts the request, the Director of Engineering shall release the remaining performance bond or other security.

   b. If the Director of Engineering does not accept the report and rejects the request, he shall provide the developer with instructions to correct any deficiencies and all steps necessary for the release of the performance bond or other security.

4. In the event the Director of Engineering discovers the need for corrective action or improvements, he shall notify the owning entity of the needed improvements and the date by which the corrective action is to be completed. All improvements shall be made consistent with the plans and specifications of the stormwater control structure and the operation and maintenance plan . After notification by the owning entity, the Director of Engineering shall inspect and approve the completed improvements.

Section 805 Permits and Enforcement

A Permits

Permits for all development activities covered by this chapter shall be issued in accordance with section 717 of this LDC.

B Enforcement

Except as otherwise provided in this chapter, enforcement of the provisions of this chapter shall be in accordance with chapter 12 of this LDC.

C Appeals

Except as otherwise noted in this chapter, appeals of any order, requirement, decision or determination made by the Director of Engineering may be made to and decided by the Board of Adjustment as provided in Chapter 3 of this LDC.

Appendix M. City of Rocky Mount Standard Stormwater Facility Operation and Maintenance Agreement

NORTH CAROLINA ***STORM WATER FACILITY OPERATION***
NASH COUNTY ***AND MAINTENANCE AGREEMENT***

THIS AGREEMENT, made and entered into this 29 day of December, 2003, by and between ____ _____, and the City of Rocky Mount, a North Carolina municipal corporation located in Nash and Edgecombe Counties (the "City");

W I T N E S S E T H:

WHEREAS, the City has adopted certain storm water management regulations applicable to the property of Permittee located in the City of Rocky Mount, Nash County, North Carolina, and more particularly described In Book _____, Page _____, _____County Registry (the "Property); and

WHEREAS, such regulations require the Permittee to operate and maintain an engineered storm water control facility as part of the development of the Property; and

WHEREAS, Permittee has constructed a private on-site engineered storm water control facility (the "Facility") to satisfy the requirements of such regulations, the boundaries of such Facility being describe in Appendix 1 attached hereto and incorporated herein by reference; and

WHEREAS, a separate deed vesting title to the real estate on which the Facility is located in Permittee has been recorded in the Nash County Registry; and

WHEREAS, as a condition of the development of the Property, Permittee is required to enter into an operation and maintenance agreement providing for the continued operation and maintenance of the Facility.

NOW, THEREFORE, for and in consideration of the premises and the approval by the City of the development activities on the Property, the Permittee does hereby covenant and agree with the City that the Facility shall be held, operated, maintained, and encumbered pursuant to the covenants and conditions hereinafter set forth;

1. No conveyance of Facility without New Agreement. Permittee covenants and agrees that it will not convey, transfer, assign, lease, or otherwise release or relinquish ownership or control of the Facility, in whole or in part, unless and until the proposed new owner of the Facility, or any interest therein, has entered into a Storm Water Facility Operation and Maintenance Agreement with the City containing substantially the same terms and conditions as this Agreement, and a copy thereof has been recorded in the _____County Register of Deed's Office.
2. Operation and Maintenance Plan. Permittee has prepared and submitted to the City an Operation and Maintenance Plan for the Facility which has been approved by the City. Permittee shall operate, maintain, repair, and, if necessary, reconstruct the Facility in accordance with the Operation and Maintenance Plan.
3. Inspection and Maintenance of Facility. In addition to the maintenance provided for in the Operation and Maintenance Plan, Permittee shall undertake and provide the following inspection, repair, and maintenance of the Facility:
   a. Grassing around the Facility shall be maintained to prevent the erosion of these areas. The areas shall be periodically mowed to maintain the aesthetic quality of the site and to prevent a reduction in capacity of the stormwater system. Grass should to exceed a height of 15 inches. All eroded areas shall be repaired.
   b. Open ditches shall be kept free of undesirable growth and mowed or maintained to the design cross-section and area as shown on the construction plans approved by the City Engineer and on file in the office of the City Engineer. Growth on the slopes and bottom should not exceed a height of 8 inches.
   c. Landscaping of the area around the Facility shall not reduce the capacity or hinder operation and maintenance of the Facility. Landscaping shall be maintained to ensure that landscape materials live and prosper. Re-vegetation of areas may be required by the City Engineer.
   d. The Facility shall be routinely checked as directed by the City Engineer for, and cleared of, all accumulation of debris and the Facility's outlet structure cleared of any blockage that is present.

e. Storm drainage pipes and culverts shall be periodically inspected on a schedule established by the City Engineer for debris and sand build-up. T hey shall be cleaned as necessary to provide for the free conveyance of stormwater as designed.
f. The Facility shall be maintained at the design depth as shown on the construction plans approved by the City Engineer and on file in the office of the City Engineer. The pond shall be inspected and maintained by the Permittee on a regular basis. Debris and sedimentation shall be removed by the Permittee when:

    1. The primary outlet capacity is impaired and/or;
    2. The depth of the Facility has been reduced by more than one foot from the original depth or the Facility volume is reduced by 20% of the design impoundment volume. Sediment bays and forebays shall be kept clean of any sediment.

g. The Facility shall be maintained in a manner to control insects, odors and algae as determined necessary by the City Engineer.
h. Any fencing or other security measures shall be maintained in good condition. If no fencing or security measures are included with the original construction, they shall be added at the Permittee's expense at such time as the City Engineer determines that unauthorized persons are disturbing the Facility and that security measures will help prevent such unauthorized activity.

4. Right of Inspection by City. The Permittee hereby grants the City the right, privilege and easement over and cross the Property lying between any public street or right of way and the Facility for the purpose of inspecting, correcting, repairing, replacing or maintaining the Facility as provided in this Agreement. This right, privilege and easement is appurtenant to and shall run with the Property.
5. Remedies for Violations of this Agreement.

    a. If the Permittee shall fail to maintain or repair the Facility as set forth herein, or otherwise violates this Agreement, the city may order the Permittee to undertake the necessary repair or maintenance or to correct such violation. If the Permittee shall fail to comply with such order within thirty (30) days from the date thereof, the permitee shall be considered in violation of this agreement and Chapter 8 of the LDC and will be subject to penalties as provided in section 1205 of the LDC and pursuant to the authority contained in Article 19 of Chapter 160A, Planning and Development and 15A NCAC 2B.0258. Should the permitee fail to make the required corrections within 30 days of the issuance of the civil penalty, the City may enter the Property and perform all necessary work to place the Facility in proper working condition. The full cost of performing the work including administrative costs and penalties shall be assessed as a lien on the property.
    b. The City shall have the right to bring an action and recover sums due, damages, seek injunctive relief, and/or such other and further relief as may be just and appropriate.
    c. The remedies provided by this paragraph are cumulative; and are in addition to any other remedies provided by law.

6. No Waiver of Breach. In the event of a breach of any term of this Agreement, any delay or failure on the part of the City to exercise any rights, powers, or remedies herein provided shall not be construed as a waiver thereof or acquiescence of such breach or any future breach.
7. Amendments. This Agreement may be amended, revised or modified only by a written document signed by the parties.
8. Binding Effect. The conditions and restrictions set forth herein with regard to the Facility shall run with the land and shall bind the Permittee and its successors and assigns and all parties claiming by, through, or under them shall be taken to hold, agree, and covenant with the City, with its successors and assigns, and with each of them to conform to and observe said conditions and restrictions. The City shall be deemed a beneficiary of the conditions and restrictions set forth herein and such conditions and restrictions shall run with the land in favor of the City.
9. Warranties of Title. The Permittee covenants and warrants that it is lawfully seized and possess of the Facility and real estate described in Appendix 1, that it has good right and lawful authority to enter into this Agreement for the purposes herein expressed, and that no consent or waiver by the holder of any mortgage,

deed of trust, or other security instrument, or any other person, firm, or corporation is required prior to entering into this Agreement.

10. Interpretation. Use of the masculine gender herein includes the feminine and neuter, and the singular number used herein shall equally include the plural. The captions preceding the various provisions of this Agreement are for the convenience of reference only, and shall not be used as an aid in interpretation or construction of this Agreement.
11. Severability. Invalidation of any one of these covenants or conditions by judgement or order of any court shall in no way affect any of the other provisions, which shall remain in full force and effect.

IN WITNESS WHEREOF, the parties have hereunto set their hands and seals this the day and year first above written.

Owner

_____

Name of Owner
Address

_____

City of Rocky Mount

ATTEST:

_____

_____

CITY CLERK

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, a notary public in and for said county and state, certify that _____ personally appeared before me this date, stated that he or she is _____ of _____, and acknowledged the execution of the foregoing instrument with the City of Rocky Mount on behalf of said _____.

This the _____ day of _____, 20___.

_____

Notary Public

My Commission Expires: _____

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, a notary public in and for said county and state, certify that Jean M. Bailey personally appeared before me this day, stated that he or she is the City Clerk of the City of Rocky Mount, a municipal corporation, and that by authority duly given and as the act of the City, foregoing contract was signed in its corporate name by its _____, sealed with its corporate seal, and attested by herself as its said City Clerk.

This the _____ day of _____, 20___.

_____
Notary Public

My Commission Expires: _____

(SEAL)

APPROVED AS TO FORM:

_____
City Attorney

Appendix N. City of Rocky Mount Standard Conservation Easement

Tax Parcel ID #_____

NORTH CAROLINA
_____ **COUNTY**

CONSERVATION EASEMENT
Tar River Watershed - Rocky Mount, North Carolina

THIS CONSERVATION EASEMENT (this "Conservation Easement") made and entered into this _____ day of _____, _____, by and between _____ _____with an address at _____ (whether one or more, "Grantor"), and the **CITY OF ROCKY MOUNT**, a North Carolina municipal corporation with an address of Post Office Drawer 1180, Rocky Mount, North Carolina 27802 ("Grantee").

RECITALS AND CONSERVATION PURPOSES

A. Grantor is the sole owner in fee simple of certain real estate containing approximately _____acres located in _____ County, North Carolina, more particularly described in Exhibit A, attached hereto and by this reference incorporated herein (the "Property"); and

B. The Property is located in the Tar/Pamlico River Basin, which has been designated nutrient sensitive by the North Carolina Division of Water Quality and the North Carolina Environmental Management Commission; and

D. The Property possess natural and scenic values which Grantor intends to conserve and maintain by the continuation of land use patterns existing at the time of this grant; and

E. Grantor as owner of the Property intends to convey to Grantee the right to preserve and protect the conservation values of the Property in perpetuity; and

F. Grantee agrees by accepting this grant to honor the intentions of Grantor stated herein and to preserve and protect in perpetuity the conservation values of the Property for the benefit of the current generation and the generations to come;

NOW, THEREFORE Grantor, for valuable consideration paid by Grantee, the receipt of which is hereby acknowledged, has and by these presents, does hereby unconditionally and irrevocably grant, bargain, sell, and convey to Grantee a perpetual Conservation Easement of the nature, character, and extent hereinafter set forth in, over, under, through and across the Property, as described in Exhibit A attached hereto, together with the right of ingress to and egress from the Property over the adjoining property of Grantor, including the right with regard to said Conservation Easement to preserve and protect the conservation values thereof as described herein.

ARTICLE I - PURPOSE

It is the purpose of this Conservation Easement to assure that the Property will be retained forever in its natural state and to prevent any use of the Property which will impair or interfere with the conservation of the Property.

ARTICLE II - DURATION OF EASEMENT

This Conservation Easement shall be perpetual. It is an easement in gross, runs with the land, and is enforceable by Grantee against Grantor, his, her, its, or their representatives, successors, assigns, lessees, agents, and licensees.

ARTICLE III - PROHIBITED AND RESTRICTED ACTIVITIES

Any activity on, or use of, the Property inconsistent with the purpose of this Conservation Easement is prohibited. The Property shall be maintained in its natural, scenic, wooded and open condition and restricted from any development or other use that would impair or interfere with the conservation purpose of this Conservation Easement set forth above.

All rights reserved by Grantor are reserved for Grantor, Grantor's representatives, successors, and assigns and are considered to be consistent with the conservation purpose of this Conservation Easement, and, unless specifically stated otherwise herein, require no prior notification to or approval by Grantee.

Notwithstanding the foregoing, Grantor and Grantee shall have no right to agree to any activity that would result in the termination of this Conservation Easement.

Without limiting the generality of the foregoing, the following activities and uses by Grantor, Grantee, or any other person are expressly prohibited or restricted:

A. Industrial and Commercial Use. Industrial and commercial activities of any type or kind and any right of access or passage for such purposes are prohibited.

B. Agricultural, Timber Harvesting, Grazing and Horticultural Use. Agricultural, farming, timber harvesting, grazing, horticultural and animal husbandry operations are prohibited; provided, however, those trees which are damaged or fallen as a result of disease, blight, or some weather related event such as a hurricane or other severe storm may be removed, including stumps.

C. Disturbance of Natural Features, Plants and Animals. There shall be no cutting or removal of trees, or the disturbance of other natural features.

D. Construction of Buildings and Use. There shall be no constructing or placing of any residence, building, mobile home, asphalt or concrete pavement, antenna or any other temporary or permanent structure or facility on , above, or under the Property.

E. Mineral Use, Excavation, Dredging. There shall be no filling, excavation, dredging, mining or drilling; no removal of topsoil, sand, gravel, rock, peat, minerals or other materials, and no change in the topography of the land in any manner except as necessary for the purpose of combating erosion or incidental to any conservation management activities otherwise permitted in this Conservation Easement.

F. Wetlands and Water Quality. There shall be no pollution or alteration of water bodies and no activities that would be detrimental to water purity or that would alter natural water levels, drainage, sedimentation and/or flow in or over the Property or into any surface waters, or cause soil degradation or erosion; in addition, there shall be no diking, dredging, alteration, draining, filling or removal of wetlands, except for activities to restore natural hydrology or wetlands enhancement as permitted by state and any other appropriate authorities.

G. Dumping. Dumping of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, or machinery, or other materials on the property is prohibited.

H. Conveyance and Subdivision. The Property shall not be subdivided, partitioned, or conveyed except in its current configuration as an entity.

I. Other Activities or Use. Any use or activity not expressly permitted in ARTICLE IV – PERMITTED ACTIVITIES of this Conservation Easement is prohibited.

ARTICLE IV – PERMITTED ACTIVITIES

The following activities or uses on the Property are not inconsistent with the purpose of this Conservation Easement and are reserved to Grantor:

A. Fencing. The Property may be fenced, provided the same can be accomplished without cutting or removing trees, or disturbing the natural features of the land.

B. Hunting, Fishing, and Recreational Activities. Hunting, fishing, and recreational activities may be conducted on and from the Property provided the same are conducted in conformity with all applicable laws, rules, and regulations governing the same, and provided further, that there shall be no surface alteration or other development of the Property in connection therewith.

C. Existing Buildings and Structures. Existing buildings and structures, including billboards located on the Property as of the date hereof, may remain on the Property and be repaired and maintained, but may not be enlarged or expanded. In addition, “No Trespassing”, “For Sale”, For Lease” signs, or similar informational signs no larger than eight (8) square feet may be placed on the Property.

D. Public Utilities. Public utility easements may be granted and facilities, including, without limitation, lines, wires, cables, pipes, meters, pumps, and lift stations may be placed on the Property, and, to the extent necessary, but only to the extent necessary, trees, undergrowth, and other natural and man made obstructions may be removed to install such public utility facilities.

ARTICLE V - ENFORCEMENT & REMEDIES

A. Grantee's Remedies. If Grantee determines that Grantor is in violation of any of the terms of this Conservation Easement or that a violation is threatened, Grantee shall give written notice to Grantor of such violation and demand corrective action sufficient to cure the violation and, where the violation involves injury to the Property resulting from any use or activity inconsistent with the purpose of this Conservation Easement, to restore the portion of the Property so injured. If Grantor fails to cure the violation within thirty (30) days after receipt of notice thereof from Grantee, or, if the circumstances are such that the violation cannot reasonably be cured within a thirty (30) day period, fails to begin curing such violation within the thirty (30) day period, or, if having commenced actions to cure the violation, fails to continue diligently to complete the cure, Grantee may bring an action at law or in equity in any court of competent jurisdiction to enforce the terms of this Conservation Easement, to enjoin the violation, ex parte as necessary, by temporary or permanent injunction, to recover any damages to which it may be entitled for violation of any term of this Conservation Easement or for injury to any conservation values protected by this Conservation Easement, including damages for the loss of scenic, aesthetic, or environmental values, and to require the restoration of the Property to the condition that existed prior to any such injury. Without limiting Grantor's liability therefore, Grantee, in its sole discretion, may apply any damages recovered to the cost of undertaking any corrective action on the Property. If Grantee, in its sole discretion, determines that circumstances require immediate action to prevent or mitigate significant damage to the conservation values of the Property, Grantee may pursue its remedies under this paragraph without prior notice to Grantor or without waiting for the period provided for cure to expire. Grantee's rights under this paragraph apply equally in the event of either actual or threatened violations of the terms of this Conservation Easement, and Grantor agrees that Grantee's remedies at law for any violation of the terms of this Conservation Easement are inadequate and that Grantee shall be entitled to the injunctive relief described in this paragraph, both prohibitive and mandatory, as well as specific performance of the terms of this Conservation Easement, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. Grantee's remedies described in this paragraph shall be cumulative and shall be in addition to all remedies now or hereafter existing at law or in equity.

B. Right of Entry: Grantee, its employees and agents, shall have the right to enter the Property (including the concomitant right to cross the adjoining property of Grantor) at any reasonable time for the purpose of preparing baseline documentation with respect to the Property and for inspecting the Property to determine whether Grantor is complying with the terms, conditions, and restrictions of this Conservation Easement.

C. Costs of Enforcement. Any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor, including, without limitation, costs of suit and attorneys' fees, and any costs of restoration necessitated by Grantor's violation of the term of this Conservation Easement, shall be paid by Grantor.

D. Grantee's Discretion. Enforcement of the terms of this Conservation Easement shall be at the discretion of Grantee, and any forbearance by Grantee to exercise its rights hereunder shall not be deemed or construed to be a waiver by Grantee of such term or of any subsequent breach of the same or any other term of this Conservation Easement or of any of Grantee's rights hereunder. No

delay or omission by Grantee in the exercise of any right or remedy upon any breach by Grantor shall impair such right or remedy or be construed as a waiver.

E. Waiver of Certain Defenses. Grantor hereby waives any defense of laches, estoppel, or prescription.

F. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury to or change in the Property resulting from causes beyond Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken by Grantor under emergency conditions to prevent, abate, or mitigate significant injury to the Property or to persons resulting from such causes.

ARTICLE VI - DOCUMENTATION AND TITLE

A. Property Condition The parties acknowledge that the Property is currently undeveloped land, with no improvements other than the following buildings and structures: _____
_____
_____
_____
_____.

B. Easements and Rights of Way. The Property is subject to the following easements and rights of way: _____
_____
_____.

C. Covenants of Title. Grantor covenants with Grantee that Grantor is seized of the Property in fee simple and has the right to grant and convey this Conservation Easement; that there is legal access to the Property; that the Property is free and clear of any and all encumbrances except as stated herein; and that Grantor will warrant and defend Grantee's right to use and enjoy all of the benefits derived from and arising out of this Conservation Easement against the claims of all persons whomsoever.

D. Subordination. At the time of conveyance of this Conservation Easement, the Property is subject to the following mortgages and deeds of trust: _____
_____
_____ incorporated by this reference, the holder or holders of which have agreed by separate instrument, which will be recorded immediately after this Conservation Easement, to subordinate their rights in the Property to this Conservation Easement in perpetuity and to prevent any modification or extinguishment of this Conservation Easement by the exercise of any rights under any mortgage or deed of trust. The priority of the any mortgage or deed of trust with respect to any valid claim on the part of the existing holder to the proceeds of any sale, condemnation proceedings, or insurance or to the leases, rents, and profits of the Property shall not be affected thereby, and any lien that may be created by Grantee's exercise of any of its rights under this Conservation Easement shall be junior to any existing mortgage or deed of trust. Upon request, Grantee agrees to subordinate its rights under this Conservation Easement to the

rights of any future mortgage holders or beneficiaries of deeds of trust to the proceeds, leases, rents, and profits described above and likewise to subordinate its rights under any lien and to execute any documents required with respect to such subordination, except that the priority of any lien created by Grantee's exercise of any of its rights under this Conservation Easement prior to the creation of a mortgage or deed of trust shall not be affected thereby, nor shall this Conservation Easement be subordinated in any other respect.

E. No. Forfeiture: Nothing contained herein will result in a forfeiture or reversion of Grantor's title in any respect.

ARTICLE VII. MISCELLANEOUS

A. Subsequent Transfers. Grantor shall incorporate the terms of this Conservation Easement in any deed or other legal instrument by which Grantor transfers any interest in the Property, including, without limitation, any liens or leasehold interest. Grantor further agrees to give written notice to Grantee of the proposed transfer of any interest at least thirty (30) days prior to the date of such transfer. The failure of Grantor to perform any act required by this paragraph shall not impair the validity of this Conservation Easement or limit its enforceability in any way.

B. Conservation Purpose.

(1) The Grantee, for itself, its successors and assigns, agrees that this Conservation Easement shall be held exclusively for conservation purposes.

(2) The parties hereto recognize and agree that the benefits of this Conservation Easement are in gross and assignable, provided, however that Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the transferee or assignee receiving the interest will be a qualified organization as that term is defined in Section 170(h)(3) of the Internal Revenue Code of 1954, as amended (the "Internal Revenue Code"), or any successor section, and the regulations promulgated thereunder, which is organized or operated primarily for one of the conservation purposes specified in Section 170 (h)(4)(A) of the Internal Revenue Code, and Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue to carry out in perpetuity the conservation purpose that this Conservation Easement was originally intended to advance, set forth herein.

C. Extinguishment. If circumstances arise in the future that render the purpose of this Conservation Easement impossible to accomplish, this Conservation Easement may only be terminated or extinguished, whether in whole or in part, by judicial proceedings in a court of competent jurisdiction, and the amount of the proceeds to which Grantee shall be entitled, after the satisfaction of prior claims, from any sale, exchange, or involuntary conversion of all or any portion of the Property subsequent to such termination or extinguishment, shall be determined, unless otherwise provided by law, in accordance with subparagraph D below. Grantee shall use all such proceeds in a manner consistent with the conservation purposes of this grant.

D. Proceeds. This Conservation Easement constitutes a real property interest immediately vested in Grantee, which, for the purposes of subparagraph C above and subparagraph E below, the

parties stipulate to have a fair market value determined by multiplying the fair market value of the Property unencumbered by the Conservation Easement (minus any increase in value after the date of this grant attributable to improvements) by the ratio of the fair market value of the Conservation Easement on the date of this grant to the fair market value of the Property, without deduction for the value of the Conservation Easement, on the date of this grant. The values at the time of this grant shall be those values used to calculate the deduction for federal income tax purposes allowable by reason of this grant, pursuant to Section 170(h) of the Internal Revenue Code, or if purchased by Grantee, the total consideration paid to Grantor for the Conservation Easement, or if part gift and part purchase, the total amount of the deductible value and the amount of the purchase. For purposes of this paragraph, the ratio of the value of the Conservation Easement to the value of the Property unencumbered by the Conservation Easement shall remain constant.

E. Condemnation: Whenever all or part of the Property is taken in exercise of eminent domain by public, corporate, or other authority so as to abrogate the restrictions imposed by this Conservation Easement, Grantor and Grantee shall join in appropriate actions at the time of such taking to recover the full value of the taking and all incidental or direct damages resulting from the taking, which proceeds shall be divided in accordance with the proportionate value of Grantee's and Grantor's interests as provided in subparagraph D above. All expenses including attorneys' fees incurred by Grantor and Grantee in this action shall be paid out of the recovered proceeds to the extent not paid by the condemning authority.

F. Access. No right of access to the general public to any portion of the Property is conveyed by this Conservation Easement.

G. Liberal Construction. Any general rule of construction to the contrary notwithstanding, this Conservation Easement shall be liberally construed in favor of the grant to effect the purpose of this Conservation Easement and the policy and purpose set forth in Section 170(h)(4)(A) of the Internal Revenue Code.

H. Severability. If any provision of this Conservation Easement, or the application thereof to any person or circumstance, is found to be invalid, the remainder of the provisions of this Conservation Easement, or the application of such provision to persons or circumstances other than those as to which it is found to be invalid, as the case may be, shall not be affected thereby.

I. Entire Agreement. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of this Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

J. Recording. Grantees shall record this instrument and any amendment hereto in a timely fashion in the official records of _____ County, North Carolina, and may re-record it at any time as may be required to preserve its rights.

K. Joint Obligations. The obligations imposed by this Conservation Easement upon Grantor shall be joint and several.

L. Successors. The covenants, terms, conditions, and restrictions of this Conservation Easement shall be binding upon, and inure to the benefit of the parties hereto and their respective personal representatives, heirs, successors, and assigns and shall continue as a servitude running in perpetuity with the Property.

M. Termination of Rights and Obligations. A party's rights and obligations under this Conservation Easement terminate upon transfer of the party's interest in the Conservation Easement or Property, except that liability for acts or omissions occurring prior to transfer shall survive transfer.

N. Captions. The captions in this instrument have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon construction or interpretation.

O. Counterparts. The parties may execute this instrument in two or more counterparts, which shall, in the aggregate, be signed by both parties; each counterpart shall be deemed an original instrument as against any party who has signed it. In the event of any disparity between the counterparts produced, the recorded counterpart shall be controlling.

P. Notices. Any notices shall be sent by registered or certified mail, return receipt requested, addressed to the parties as set forth above, or to such other addresses such party may establish in writing to the other. In any case where the terms of this Conservation Easement require the consent of any party, such consent shall be requested by written notice. Such consent shall be deemed denied unless, within thirty (30) days after receipt of notice, a written notice of approval and the reason therefore has been mailed to the party requesting consent.

Q. Amendments. Grantor and Grantee are free to jointly amend this Conservation Easement to meet changing conditions, provided that no amendment will be allowed that is inconsistent with the purpose of this Conservation Easement, affects the perpetual duration of this Conservation Easement, the status of Grantee under any applicable law, or that will affect the qualification of this Conservation Easement under Section 170(h) of the Internal Revenue Code. Such amendment(s) shall be effective upon recording in the public records of _____ County, North Carolina.

R. Environmental Condition of Property. Grantor warrants and represents to Grantee that to the best of Grantor's knowledge after appropriate inquiry and investigation: (a) the Property described herein is and at all times hereafter will continue to be in full compliance with all federal, state, and local environmental laws and regulations, and (b) as of the date hereof there are no hazardous materials, substances, wastes, or environmentally regulated substances (including, without limitation, any materials containing asbestos) located on, in, or under the Property or used in connection therewith, and that there is no environmental condition existing on the Property that may prohibit or impede use of the Property for the purposes set forth herein.

S. Signs. Grantee shall have the right to post visible signs along the boundaries of the Property recognizing the participation of the Fund in the acquisition and protection of the Property and that the Property will remain in its protected state.

T. Costs and Liabilities. Grantor shall retain all responsibilities and shall bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance of the Property, including, without limitation, the payment of all taxes and assessments levied on or assessed against the Property by any competent authority and the maintenance of adequate comprehensive general liability insurance coverage. Grantor shall keep the Property free of any liens arising out of any work performed for, materials furnished to, or obligations incurred by, Grantor or anyone claiming under Grantor.

TO HAVE AND TO HOLD the Conservation Easement unto Grantee, its successors and assigns, forever.

IN WITNESS WHEREOF, Grantor and Grantee have executed this Conservation Easement, each having adopted the type written word ("SEAL") as their personal/corporate seal, as of the day and year first written above.

GRANTOR:

_____ (SEAL)

NORTH CAROLINA

_____ COUNTY

I,_____, a Notary Public in and for said County and State so hereby certify that _____ personally appeared before me this day and being duly sworn, acknowledged that he/she executed the foregoing instrument for the purposes contained within.

WITNESS my hand and official stamp or seal, this the _____ day of _____, _____.

_____
Notary Public

My Commission Expires: _____

EXHIBIT A

CONSERVATION EASEMENT

DESCRIPTION

Appendix O. City of Rocky Mount Standard Low Maintenance Conservation Easement

Tax Parcel ID # _____

NORTH CAROLINA
_____ COUNTY

LOW MAINTENANCE CONSERVATION EASEMENT
Rocky Mount, North Carolina

THIS LOW MAINTENANCE CONSERVATION EASEMENT (this "Low Maintenance Conservation Easement") made and entered into this _____ day of _____, _____, by and between _____with an address at _____ (whether one or more, "Grantor"), and the **CITY OF ROCKY MOUNT**, a North Carolina municipal corporation with an address of Post Office Drawer 1180, Rocky Mount, North Carolina 27802 ("Grantee").

RECITALS AND CONSERVATION PURPOSES

A. Grantor is the sole owner in fee simple of certain real estate containing approximately ____ acres located in _____ County, North Carolina, more particularly described in Exhibit A, attached hereto and by this reference incorporated herein (the "Property"); and

B. The Property is located in the Tar/Pamlico River Basin, which has been designated nutrient sensitive by the North Carolina Division of Water Quality and the North Carolina Environmental Management Commission; and

C. The Property possess natural and scenic values which Grantor intends to conserve and maintain by the continuation of land use patterns approved at the time of this development; and

D. Grantor as owner of the Property intends the property to be maintained in perpetuity, such that it maintains its nutrient removal properties intended by the approved development plan; and

E. Grantor agrees to operate and maintain the Property such a manner to not increase the amount of nitrogen and phosphorus discharged in the stormwater runoff from the site.

NOW, THEREFORE Grantor, for valuable consideration paid by Grantee, the receipt of which is hereby acknowledged, has and by these presents, does hereby unconditionally and irrevocably grant, bargain, sell, and convey to Grantee a perpetual Low Maintenance Conservation Easement of the nature, character, and extent hereinafter set forth in, over, under, through and across the Property, as described in Exhibit A attached hereto, together with the right of ingress to and egress from the Property over the adjoining property of Grantor, including the right with regard to said easement to preserve and protect the conservation values thereof as described herein.

ARTICLE I - PURPOSE

It is the purpose of this Low Maintenance Conservation Easement to assure that the Property will be retained forever in an open vegetative condition as shown on the approved plans and to prevent any use of the Property which will impair or interfere with the nutrient removal properties of the Property.

ARTICLE II - DURATION OF EASEMENT

This Low Maintenance Conservation Easement shall be perpetual. It is an easement in gross, runs with the land, and is enforceable by Grantee against Grantor, his, her, its, or their representatives, successors, assigns, lessees, agents, and licensees.

ARTICLE III - PROHIBITED AND RESTRICTED ACTIVITIES

Any activity on, or use of, the Property inconsistent with the purpose of this Low Maintenance Conservation Easement is prohibited. The Property shall be maintained in an open vegetative condition in the form and state shown on the approved plan and restricted from any development or other use that would impair or interfere with the nutrient removal purpose of this easement set forth above. Any alterations of the property must be approved by the Grantee in writing

The Grantor shall not undertake any action including the application of fertilizer, pesticides or herbicides that may increase the nitrogen and/or phosphorus contained in the stormwater runoff from the Property.

All rights reserved by Grantor are reserved for Grantor, Grantor's representatives, successors, and assigns and are considered to be consistent with the conservation purpose of this easement, and, unless specifically stated otherwise herein, require no prior notification to or approval by Grantee.

Notwithstanding the foregoing, Grantor and Grantee shall have no right to agree to any activity that would result in the termination of this Conservation Easement.

Without limiting the generality of the foregoing, the following activities and uses by Grantor, Grantee, or any other person are expressly prohibited or restricted:

A. Industrial and Commercial Use. Industrial and commercial activities of any type or kind and any right of access or passage for such purposes are prohibited.

B. Agricultural, Timber Harvesting, Grazing and Horticultural Use. Agricultural, farming, grazing, horticultural and animal husbandry operations are prohibited;

C. Construction of Buildings and Use. There shall be no constructing or placing of any residence, building, mobile home, asphalt or concrete pavement, antenna or any other temporary or permanent structure or facility on , above, or under the Property.

D. Mineral Use, Excavation, Dredging. There shall be no filling, excavation, dredging, mining or drilling; no removal of topsoil, sand, gravel, rock, peat, minerals or other materials, and no change in the topography of the land in any manner except as necessary for the purpose of combating erosion or incidental to any conservation management activities otherwise permitted in this Conservation Easement.

E. Wetlands and Water Quality. There shall be no pollution or alteration of water bodies and no activities that would be detrimental to water purity or that would alter natural water levels, drainage, sedimentation and/or flow in or over the Property or into any surface waters, or cause soil degradation or erosion; in addition, there shall be no diking, dredging, alteration, draining, filling or removal of wetlands, except for activities to restore natural hydrology or wetlands enhancement as permitted by state and any other appropriate authorities.

F. Dumping. Dumping of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, or machinery, or other materials on the property is prohibited.

G. Conveyance and Subdivision. The Property shall not be subdivided, partitioned, or conveyed except in its current configuration as an entity.

H. Other Activities or Use. Any use or activity not expressly permitted in ARTICLE IV – PERMITTED ACTIVITIES of this Conservation Easement is prohibited.

ARTICLE IV – PERMITTED ACTIVITIES

The following activities or uses on the Property are not inconsistent with the purpose of this Conservation Easement and are reserved to Grantor:

A. Fencing. The Property may be fenced, provided the same can be accomplished without cutting or removing trees, or disturbing the natural features of the land.

B. Hunting, Fishing, and Recreational Activities. Hunting, fishing, and recreational activities may be conducted on and from the Property provided the same are conducted in conformity with all applicable laws, rules, and regulations governing the same, and provided further, that there shall be no surface alteration or other development of the Property in connection therewith.

C. Public Utilities. Public utility easements may be granted and facilities, including, without limitation, lines, wires, cables, pipes, meters, pumps, and lift stations may be placed on the Property.

ARTICLE V - ENFORCEMENT & REMEDIES

A. Grantee's Remedies. If Grantee determines that Grantor is in violation of any of the terms of this Conservation Easement or that a violation is threatened, Grantee shall give written notice to Grantor of such violation and demand corrective action sufficient to cure the violation and, where the violation involves injury to the Property resulting from any use or activity inconsistent with the purpose of this Conservation Easement, to restore the portion of the Property so injured. If Grantor fails to cure the violation within thirty (30) days after receipt of notice thereof from Grantee, or, if the circumstances are such that the violation cannot reasonably be cured within a thirty (30) day period, fails to begin curing such violation within the thirty (30) day period, or, if having commenced actions to cure the violation, fails to continue diligently to complete the cure, Grantee may bring an action at law or in equity in any court of competent jurisdiction to enforce the terms of this Low Maintenance Conservation Easement, to enjoin the violation, ex parte as necessary, by temporary or permanent injunction, to recover any damages to which it may be entitled for violation of any term of this Low Maintenance Conservation Easement or for injury to any conservation values protected by this easement, including damages for the loss of scenic, aesthetic, or environmental values, and to require the restoration of the Property to the condition that existed prior to any such injury. Without limiting Grantor's liability therefor, Grantee, in its sole discretion, may apply any damages recovered to the cost of undertaking any corrective action on the Property. If Grantee, in its sole discretion, determines that circumstances require immediate action to prevent or mitigate significant damage to the conservation values of the Property, Grantee may pursue its remedies under this paragraph without prior notice to Grantor or without waiting for the period provided for cure to expire. Grantee's rights under this paragraph apply equally in the event of either actual or threatened violations of the terms of this Conservation Easement, and Grantor agrees that Grantee's remedies at law for any violation of the terms of this Conservation Easement are inadequate and that Grantee shall be entitled to the injunctive relief described in this paragraph, both prohibitive and mandatory, as well as specific performance of the terms of this Conservation Easement, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. Grantee's remedies described in this paragraph shall be cumulative and shall be in addition to all remedies now or hereafter existing at law or in equity.

B. Right of Entry: Grantee, its employees and agents, shall have the right to enter the Property (including the concomitant right to cross the adjoining property of Grantor) at any reasonable time for the purpose of preparing baseline documentation with respect to the Property and for inspecting the Property to determine whether Grantor is complying with the terms, conditions, and restrictions of this Low Maintenance Conservation Easement.

C. Costs of Enforcement. Any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor, including, without limitation, costs of suit and attorneys' fees, and any costs of restoration necessitated by Grantor's violation of the term of this Conservation Easement, shall be paid by Grantor.

D. Grantee's Discretion. Enforcement of the terms of this Conservation Easement shall be at the discretion of Grantee, and any forbearance by Grantee to exercise its rights hereunder shall not be deemed or construed to be a waiver by Grantee of such term or of any subsequent breach of the same or any other term of this Conservation Easement or of any of Grantee's rights hereunder. No

delay or omission by Grantee in the exercise of any right or remedy upon any breach by Grantor shall impair such right or remedy or be construed as a waiver.

E. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury to or change in the Property resulting from causes beyond Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken by Grantor under emergency conditions to prevent, abate, or mitigate significant injury to the Property or to persons resulting from such causes.

ARTICLE VI. MISCELLANEOUS

A. Subsequent Transfers. Grantor shall incorporate the terms of this Conservation Easement in any deed or other legal instrument by which Grantor transfers any interest in the Property, including, without limitation, any liens or leasehold interest. Grantor further agrees to give written notice to Grantee of the proposed transfer of any interest at least thirty (30) days prior to the date of such transfer. The failure of Grantor to perform any act required by this paragraph shall not impair the validity of this Conservation Easement or limit its enforceability in any way.

B. Successors. The covenants, terms, conditions, and restrictions of this Conservation Easement shall be binding upon, and inure to the benefit of the parties hereto and their respective personal representatives, heirs, successors, and assigns and shall continue as a servitude running in perpetuity with the Property.

C. Counterparts. The parties may execute this instrument in two or more counterparts, which shall, in the aggregate, be signed by both parties; each counterpart shall be deemed an original instrument as against any party who has signed it. In the event of any disparity between the counterparts produced, the recorded counterpart shall be controlling.

D. Notices. Any notices shall be sent by registered or certified mail, return receipt requested, addressed to the parties as set forth above, or to such other addresses such party may establish in writing to the other. In any case where the terms of this Conservation Easement require the consent of any party, such consent shall be requested by written notice. Such consent shall be deemed denied unless, within thirty (30) days after receipt of notice, a written notice of approval and the reason therefore has been mailed to the party requesting consent.

E. Amendments. Grantor and Grantee are free to jointly amend this Low Maintenance Conservation Easement to meet changing conditions, provided that no amendment will be allowed that is inconsistent with the purpose of this easement, affects the perpetual duration of this easement, the status of Grantee under any applicable law. Such amendment(s) shall be effective upon recording in the public records of _____ County, North Carolina.

F. Costs and Liabilities. Grantor shall retain all responsibilities and shall bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance of the Property, including, without limitation, the payment of all taxes and assessments levied on or assessed against the Property by any competent authority and the maintenance of adequate comprehensive general

liability insurance coverage. Grantor shall keep the Property free of any liens arising out of any work performed for, materials furnished to, or obligations incurred by, Grantor or anyone claiming under Grantor.

TO HAVE AND TO HOLD the Conservation Easement unto Grantee, its successors and assigns, forever.

IN WITNESS WHEREOF, Grantor and Grantee have executed this Conservation Easement, each having adopted the type written word ("SEAL") as their personal/corporate seal, as of the day and year first written above.

GRANTOR:

_____ (SEAL)

_____ (SEAL)

NORTH CAROLINA

_____ COUNTY

I,_____, a Notary Public in and for said County and State so hereby certify that _____ personally appeared before me this day and being duly sworn, acknowledged that he/she executed the foregoing instrument for the purposes contained within.

WITNESS my hand and official stamp or seal, this the _____ day of _____, _____.

_____
Notary Public

My Commission Expires: _____

NORTH CAROLINA

_____ COUNTY

I,_____, a Notary Public in and for said County and State so hereby certify that _____ personally appeared before me this day and being duly sworn, acknowledged that he/she executed the foregoing instrument for the purposes contained within.

WITNESS my hand and official stamp or seal, this the _____ day of _____, _____.

_____
Notary Public

My Commission Expires: _____

GRANTEE:

CITY OF ROCKY MOUNT

Accepted By: _____
Frederick E. Turnage - Mayor

ATTEST:

_____
Jean M. Bailey – City Clerk
(SEAL)

EXHIBIT A

CONSERVATION EASEMENT

DESCRIPTION

Appendix P. Ordinance Establishing Legal Authority For Illegal Discharge Program

ARTICLE V. ILLEGAL DISCHARGES INTO THE STORMWATER SYSTEM

The Legislature of the State of North Carolina has designated specific local governments in the Tar Pamlico River Basin and has required them to develop stormwater management in conformance with 15A NCAC 2B.0258, Tar-Pamlico River Basin-Nutrient Sensitive Waters Management Strategy. This section is adopted pursuant to the authority contained in G.S. 113A Article 4 (Pollution Control Act), G.S. 143 Article 21 (Water and Air Resources); G.S. 160A- 185 (Emission of pollutants or contaminants) and the requirements of 15A NCAC 2B.0258. Any modifications to this section are subject to the approval by the NC Division of Water Quality (DWQ).

Section 10-210. Purpose

(a) This chapter is adopted for the purposes of:

(1) Protecting the public health, safety and welfare by controlling the discharge of pollutants into the stormwater conveyance system;

(2) Promoting activities directed toward the maintenance and improvement of surface and ground water quality;

(3) Satisfying the requirements imposed upon the City of Rocky Mount under its National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Discharge Permit issued by the State, and the North Carolina Department of Environment and Natural Resources Tar Pamlico Nutrient Management Regulations.; and

(4) Establishing administration and enforcement procedures through which these purposes can be fulfilled.

Section 10-211. Applicability

The terms of this ordinance shall apply only within the areas within the City limits and shall not apply within the City's ETJ unless expressly approved in an agreement between the City and the appropriate County.

Section 10-212. Acronyms

DENR:	North Carolina Department of Environment and Natural Resources.
DWQ:	North Carolina Division of Water Quality.
MS4:	Municipal Separate Storm Sewer System.
NPDES:	National Pollutant Discharge Elimination System

Section 10-213. Definitions:

As used in this chapter, unless the context clearly indicates otherwise, the following definitions apply:

Illicit Connection. Any physical connection, actual or potential flow discharge, or other condition, which could permit non-stormwater to enter the stormwater conveyance system or waters of the State in violation of this chapter.

Illicit Discharge. Any unlawful disposal, placement, emptying, dumping, spillage, leakage, pumping, pouring, emission, or other discharge of any substance other than stormwater into a stormwater conveyance, the waters of the State, or upon the land in such proximity to the same, such that the substance is likely to reach a stormwater conveyance or the waters of the State.

Improper Disposal. The releasing of matter or fluids other than atmospheric precipitation at a location where the matter or fluid can enter the stormwater system.

Municipal Separate Storm Sewer System (MS4). A stormwater conveyance or unified stormwater conveyance system (including without limitation: roads with drainage systems, municipal streets, catch basins, stormwater detention facilities, curbs, gutters, ditches, natural or man-made channels, or storm drains), that:

(1) Is located within the corporate limits of Rocky Mount, North Carolina; and
(2) Is owned or operated by the State, County, the City, or other public body; and
(3) Discharges to waters of the State, excluding publicly owned treatment works, and lawful connections thereto, which in turn discharge into the waters of the State.

National Pollutant Discharge Elimination System. A permitting system established pursuant to §402 of the Clean Water Act et seq.

Non-stormwater. Any flow, which is not from a form of natural precipitation

Pollution. Man-made or man-induced alteration of the chemical, physical, biological, thermal, and/or radiological integrity of water.

Receiving Stream. The body of water, stream, or watercourse receiving the discharge waters from the stormwater system, or formed by the water discharged from the stormwater system.

Stormwater. Any flow resulting from, and occurring during or following, any form of natural precipitation.

Stormwater Conveyance or Stormwater Conveyance System. Any feature, natural or man-made, that collects and transports stormwater, including but not limited to roads with drainage systems, streets, catch basins, curbs, gutters, ditches, man-made and natural channels, pipes, culverts, and storm drains, and any other natural or man-made feature or structure designed or used for collecting or conveying stormwater.

Waters of the State. Any stream, river, brook, swamp, lake, sound, tidal estuary, bay, creek, reservoir, waterway, or other body or accumulation of water, whether surface or underground, public or private, or natural or artificial, that is contained in, flows through, or borders upon any portion of this State, including any portion of the Atlantic Ocean over which the State has jurisdiction. Treatment systems, consisting of man-made bodies of water, which were not originally created in waters of the State and which are not the result of impoundment of waters of the State, are not waters of the State.

Section 10-214. Objectives

The objectives of this chapter are to:

(1) Regulate the discharge of substances which may contaminate or cause pollution of stormwater, stormwater conveyances, or waters of the State;
(2) Regulate connections to the stormwater conveyance system;
(3) Provide for the proper handling of spills; and
(4) Provide for the enforcement of same.

Section 10-215. Non-Stormwater Discharge Controls

(a) ***Illicit Discharge***

No person shall cause or allow the discharge, emission, disposal, pouring, or pumping directly or indirectly to any stormwater conveyance, the waters of the State, or upon the land in such proximity to the same (such that the substance is likely to reach a stormwater conveyance or the waters of the State), any fluid, solid, gas, or other substance, other than stormwater; provided that non-stormwater discharges associated with the following activities are allowed provided that they do not significantly impact water quality:

(1) Dechlorinated filter backwash and draining associated with swimming pools;
(2) Filter backwash and draining associated with raw water intake screening and filtering devices;
(3) Condensate from residential or commercial air conditioning;
(4) Residential vehicle washing;
(5) Flushing and hydrostatic testing water associated with utility distribution systems;
(6) Discharges associated with emergency removal and treatment activities, for hazardous materials, authorized by the federal, State, or local government on-scene coordinator;
(7) Uncontaminated ground water [including the collection or pumping of springs, wells, or rising ground water and ground water generated by well construction or other construction activities];
(8) Collected infiltrated stormwater from foundation or footing drains;
(9) Collected ground water and infiltrated stormwater from basement or crawl space pumps;
(10) Flows from springs, riparian habitats and wetlands;
(11) Irrigation water, including landscape irrigation and lawn watering;
(12) Street wash water;
(13) Flows from fire fighting;
(14) Discharges from the pumping, diverting or draining of natural watercourses or waterbodies;
(15) Flushing and cleaning of stormwater conveyances with unmodified potable water;
(16) Wash water from the cleaning of the exterior of buildings, including gutters, provided that the discharge does not pose an environmental or health threat;
(17) Other discharges from unmodified potable water sources; and
(18) Other non-stormwater discharges for which a valid NPDES discharge permit has been approved and issued by DWQ, and provided that any such discharges to the municipal separate storm sewer system shall be authorized by the City.

Illicit discharges include, but are not limited to, pipelines, ditches and overland flow carrying non-stormwater flow from wastewater lines such as those from washing machines or sanitary sewers, commercial wash water from cleaning vehicles or equipment, flushing water such as that from industrial operations, floor drains, overflowing septic systems, and misuse of fertilizers, pesticides and herbicides, oil, anti-freeze, chemicals, paints, garbage, and litter.

Any Illicit discharges into, or having the potential to be indirectly transported to, the stormwater conveyance system shall be contained, controlled, collected, and removed promptly. Any areas determined by the Director of Public Works or his designee to be damaged as a result of said discharge shall be restored to their preexisting condition.

(b) ***Illicit Connections***

(1) Connections to a stormwater conveyance or stormwater conveyance system which allow the discharge of non-stormwater, other than the exclusions described in section (a) above, are unlawful. Illicit connections include, but are not limited to: floor drains, waste water from washing machines or sanitary sewers, wash water from commercial vehicle washing or steam cleaning, and waste water from septic systems.

(2) Where such connections exist, and said connections were made prior to the adoption of this provision or any other ordinance prohibiting such connections, the property owner or the person using said connection shall remove the connection within one (1) year following application of this regulation; provided that, this grace period shall not apply to connections which may result in the discharge of hazardous materials or other discharges which pose an immediate threat to health and safety, or are likely to result in immediate injury and harm to real or personal property, natural resources, wildlife, or habitat.

(3) Where it is determined that said connection was made in violation of any applicable regulation or ordinance or where said connection may result in the discharge of hazardous materials or may pose an immediate threat to health and safety, or is likely to result in immediate injury and harm to real or personal property, natural resources, wildlife, or habitat, the Director of Public Works or his designee shall designate the time within which the connection shall be removed. In setting the time limit for compliance, the City shall take into consideration:

a. The quantity and complexity of the work,
b. The consequences of delay,
c. The potential harm to the environment, to the public health, and to public and private property, and
d. The cost of remedying the damage.

(c) ***Improper Storage and Disposal***

Polluting substances, which may be harmful to biological life, shall not be stored or disposed of in or near the stormwater system or at a location exposed to wind or rain, which could transport

the substances to the stormwater system. Prohibited substances include, but are not limited to, oil, grease, fertilizer, household, and industrial chemical waste.

(d) ***Hazardous Material Spills and Discharges***

Persons associated with the spill or leak of hazardous materials shall immediately notify the City of Rocky Mount Fire Chief or his designee in accordance with the provisions of City Code Article IV, Hazardous Material and Substance Abatement. Notification shall not relieve any person of any expenses related to the restoration, loss, damage, or any other liability which may be incurred as a result of said spill or leak, nor shall such notification relieve any person from other liability which may be imposed by State or other law.

(e) ***Solid Waste, Yard Waste and Other Obstructions***

(1) It shall be unlawful for any person to throw, dump, roll or in any manner place or cause to be placed any objects or materials in a drainage pipe, culvert, drainage ditch or any other stormwater carrier receiving street runoff which may cause a blockage, reduction in flow capacity or build up of excess nutrients or pollutants. These objects and materials include but are not limited to leaves, pine straw, grass clippings, tree limbs, lumber, construction and landscaping debris, bulky items or any other type of solid waste capable of causing an obstruction or otherwise degrading water quality and/or the stormwater conveyance system.

(2) The Director of Public Works or his representative may grant temporary authority to block or obstruct a drainage system for construction, repair or maintenance activity. This temporary authority is for limited duration and does not relieve the grantee of responsibility for any damages caused by such blockage or obstruction.

Section 10-216. Enforcement

(a) ***Powers and authority for inspection and correction***

City personnel or other duly authorized representative(s), bearing proper identification, shall be permitted to enter upon all properties for the purpose of inspection, observation, measurement, sampling and testing in accordance with the provisions of this article. No person shall obstruct, hamper, or interfere with any such representative while carrying out official duties. If an illicit connection is found or evidence of an illicit discharge or improper disposal is found, City personnel or other duly authorized representative bearing proper identification shall be permitted to enter upon all properties for the purpose of determining the corrective actions required for said violations including but not limited to removal of said violations and restoration or repair of any damages caused by said violations. If the required actions are not completed within the time period specified in the notice of violation the property owner will become subject to further enforcement action in accordance with the provisions of this section.

(b) ***Civil Penalties***

(1) ***Illicit Discharges***

Any designer, engineer, contractor, agent, or any other person who allows, acts in concert with, participates, directs, or assists directly or indirectly in the creation of a violation of this chapter shall be subject to civil penalties as follows:

a. For first time offenders, if the quantity of the discharge is equal to or less than five (5) gallons and consists of domestic or household products in quantities considered ordinary for household purposes, said person shall be assessed a civil penalty not to exceed one hundred dollars ($100.00) per violation or per day for any continuing violation, and if the quantity of the discharge is greater than five (5) gallons or contains non-domestic substances, including but not limited to process waste water, or if said person cannot provide clear and convincing evidence of the volume and nature of the substance discharged, said person shall be assessed a civil penalty not to exceed one thousand dollars ($1,000.00) per violation or per day for any continuing violation.
b. For repeat offenders, the amount of the penalty shall be double the amount assessed for the previous penalty, not to exceed ten thousand dollars ($10,000.00) per violation or per day for any continuing violation.
c. In determining the amount of the penalty, the City Manager or his/her designee shall consider:
    1. The degree and extent of harm to the environment, the public health, and public and private property;
    2. The cost of remedying the damage;
    3. The duration of the violation;
    4. Whether the violation was willful;
    5. The prior record of the person responsible for the violation in complying or failing to comply with this chapter;
    6. The costs of enforcement to the public; and
    7. The amount of money saved by the violator through his, her, or its noncompliance.

(2) ***Illicit Connection.***

Any person found with an illicit connection in violation of this chapter and any designer, engineer, contractor, agent, or any other person who allows, acts in concert, participates, directs, or assists directly or indirectly in the establishment of an illicit connection in violation of this chapter, shall be subject to civil penalties as follows:

a. First time offenders shall be subject to a civil penalty not to exceed five hundred dollars ($500.00) per day of continuing violation.
b. Repeat violators shall be subject to a civil penalty not to exceed one thousand dollars ($1,000.00) per day of continuing violation.
c. In determining the amount of the penalty, the City Manager or his designee shall consider:
    1. The degree and extent of harm to the environment, the public health, and public and private property;
    2. The cost of remedying the damage;
    3. The duration of the violation;
    4. Whether the violation was willful;

5. The prior record of the person responsible for the violation in complying or failing to comply with this chapter;
6. The costs of enforcement to the public; and
7. The amount of money saved by the violator through his, her, or its noncompliance.

(3). Procedures for assessing penalties pursuant to violations of this Article.
Said penalties shall be assessed by the Director of Public Works or his designee. No penalty shall be assessed until the person alleged to be in violation is served written notice of the violation by registered mail, certified mail-return receipt requested, or personal service. Refusal to accept the notice shall not relieve the violator of the obligation to pay the penalty. The notice shall describe the violation with particularity and specify the measures needed to come into compliance. The notice shall designate the time within which such measures must be completed. In setting the time limit for compliance, the City shall take into consideration:

1. The quantity and complexity of the work;
2. The consequences of delay;
3. The potential harm to the environment, the public health, and public and private property; and
4. The cost of remedying the damage.

The notice shall warn that failure to correct the violation within the specified time period will result in the assessment of a civil penalty and/or other enforcement action. If after the allotted time period has expired, and the violation has not been corrected, the penalty shall be assessed from the date of receipt of notice of violation and each day of continuing violation thereafter shall constitute a separate violation under this section.

(3) ***Other Violations***
Any person found in violation of other provisions of this chapter, not specifically enumerated elsewhere, shall be subject to a civil penalty not to exceed one hundred dollars ($100.00) per violation or per day for any continuing violation.

(4) ***Payment/Collection Procedures***
The Director of Public Works or his/her designee shall make written demand for payment upon the person in violation. If the payment of the penalty assessed under section 216(b)(3) is not received or an equitable settlement reached within thirty (30) days after demand for payment is made, the matter shall be referred to the City Attorney for institution of a civil action in the name of the City, in the appropriate division of the general court of justice in Nash or Edgecombe County, as appropriate, for recovering the penalty.

(c) **Injunctive Relief**

(1) Whenever the City Manager has a reasonable cause to believe that any person is violating or threatening to violate this chapter, rule, regulation, order duly adopted or issued pursuant to this chapter or making a connection to a stormwater conveyance or stormwater conveyance system other than in accordance with the terms, conditions, and provisions of approval, the City may, either before or after the institution of any other

action or proceeding authorized by the Code, institute a civil action in the name of the City for injunctive relief to restrain and abate the violation or threatened violation.

(2) The institution of an action for injunctive relief under subsection (c) shall not relieve any party to such proceeding from any further civil or criminal penalty prescribed for violations of this Code.

(d) **Criminal Penalties**

Any person who knowingly or willfully violates any provision of this chapter, rule, regulation, order duly adopted or issued pursuant to this chapter shall be guilty of a misdemeanor, punishable by a fine not to exceed five hundred dollars ($500.00) or imprisonment for not longer than thirty (30) days. Each violation shall be a separate offense.

(e) **Corrective Actions by the City**

If the party that receives a notice as described above fails, neglects, or refuses to remedy the condition(s) outlined in the notice within the time specified in the notice, the Public Works Director or designee may elect to enter the property and cause such condition to be removed, abated or remedied in order to prevent further damage or escalation of the cost to remedy the violation. The cost of such action shall be paid by the owner of the property or other responsible party and if not paid shall be a lien against the real estate or premises upon which the illicit connection was constructed or improper occurred and shall be collected as unpaid taxes. The initiation of such actions by the City does not relieve the offending party of any liability for fines or criminal penalties related to the offense.

Appendix Q. Illicit Discharge Screening Report Forms

Field Screening Report

General Information	Sheet Number Outfall ID Number Date Time Date, Time and Quantity of Last Rainfall Event	
Field Site Description	Location Type of Outfall Dominant Watershed Land Use(s)	
Visual Observations	Photograph Odor Color Clarity Floatables	Deposits/Stains Vegetation Condition Structural Condition Biological Flow Estimation
Sampling Analysis *	Temperature pH Nitrogen-Ammonia	Nitrogen-Nitrate/Nitrite Fluoride or Chlorine Total Phosphorus Ortho-Phosphate

* Analytical monitoring is required only if an obvious source of the dry weather flow cannot be determined through an investigation of the upstream stormwater collection system.

Appendix R. List of Education Resources

Education Activity Options for Tar-Pamlico Local Programs

VWIN Water Quality Monitoring Program
This is a Volunteer Water Information Network, a program which allows volunteers to collect water samples, and send them to the lab for certified laboratory analysis. The cost of the program is $4500 per year, for a 10 site program plus about $300 - $500 per year for 2-day shipment of samples.

Contact: UNC-Asheville, Asheville, NC 28804
Dr. Rick Maas, EQI Research Director
(828) 251-6366 maas@unca.edu
Marilyn Westphal, VWIN Coordinator
(828) 251-6823 mwestphal@unca.edu

Home*A*Syst
Homeowner self-assessments developed by the Cooperative Extension Service for a variety of home activities, including protecting your water quality and your septic system.

Grace Lawrence, Extension Associate
Department of Soil Science, NC State University
(919) 513-0414 grace_lawrence@ncsu.edu
www.soil.ncsu.edu/assist

- a local government can link their website to this website, and receive educational points for each year that the link is in effect
- a local government could use a Home*A*Syst presentation in their workshops
- a local government could have publications available for the public, and / or distribute packages to new homeowners.

Adopt-A Stream
www.adopt-a-stream.org

Funding Resources

NOAA Grants
www.rdc.noaa.gov/~grants/index.html

North Carolina '319' Nonpoint Source Grant Program
Funds innovative BMP demonstration and education efforts, as well as watershed restoration projects.
http://h2o.enr.state.nc.us/nps/Section_319_Grant_Program.htm

NC Clean Water Management Trust Fund
http://www.cwmtf.net/

State Stormwater Programs under NC Department of Environment & Natural Resources

- **Tar-Pamlico Nutrient Strategy**
  The NC Division of Water Quality web site for the Tar-Pamlico nutrient strategy. Includes a history and status of the strategy and its elements, both point and nonpoint source, as well as links to rules and supporting information. This model and appendices are also available on the site.
  http://h2o.enr.state.nc.us/nps/tarpam.htm

- **Neuse Local Stormwater Programs**
  - Town of Cary
    www.townofcary.org/depts/dsdept/engineering/engproj/stormwater/stormwatermain.htm

  - Orange County
    www.co.orange.nc.us/planning/erosion.htm

- **Division of Water Quality Stormwater and General Permits Unit**
  Includes links to the Neuse stormwater model and Neuse local programs, information on Phase I and II NPDES Stormwater programs, the State Stormwater Management Program (coastal, ORW, and HQW), stormwater manuals and other resources, and useful links.
  h2o.enr.state.nc.us/su/stormwater.html

- **Division of Water Quality, Nonpoint Source Management Program**
  Includes Tar-Pamlico and Neuse nutrient strategies, the NC Coastal Nonpoint Source Program, the Section 319 grant program, information about nonpoint source pollution, other programs and links.
  h2o.enr.state.nc.us/nps/

- **NC Water Supply Watershed Program**
  The oversight program for local water supply ordinances. Includes links to local programs, model ordinances, forms, and fact sheets, the Streamlines newsletter that details program options and discusses salient issues, and other information.
  h2o.enr.state.nc.us/wswp/index.html

- **Office of Environmental Education**
  www.ee.enr.state.nc.us/Index.htm

- **Division of Water Resources,**
  Includes links to Stream Watch & Project Wet, and a slide presentation on BMPs
  www.dwr.ehnr.state.nc.us
  www.dwr.ehnr.state.nc.us/Reports_and_Publications/Stream_Watch/bmps.pdf

- **Albemarle-Pamlico National Estuary Program (APNEP)**
  Includes information on the Citizen's Water Quality Monitoring Program (CWQMP)
  h20.enr.state.nc.us/nep/

Low Impact Development

Maryland Stormwater Management Program

Home page explains impacts of runoff and steps individuals can take to help. It also has links to homeowner and other materials including a model stormwater ordinance and technical manuals, including the Maryland Stormwater Design Manual

www.mde.state.md.us/Programs/WaterPrograms/SedimentandStomwater/home.index.asp

Low Impact Development Program, Prince George's County, Maryland

The originators of LID. Includes links to their LID manuals and bioretention info.

www.co.pg.md.us/Government/AgencyIndex/DER/PPD/lid.asp?h=20&s=&n=50&n1=160

Low Impact Development Center, Inc.

Non-Profit whose mission is to "provide information to individuals and organizations dedicated to protecting the environment and our water resources through proper site design techniques that replicate pre-existing hydrologic site conditions".

www.lowimpactdevelopment.org

Stormwater Strategies: Community Responses to Runoff Pollution

This Natural Resources Defense Council report, originally published in 1999, was updated in 2001 with a chapter on Low Impact Development.

www.nrdc.org/water/pollution/storm/stoinx.asp

Smart Growth

NOAA Smart Coastal Growth

Includes links to smart growth documents and organizations

www.csc.noaa.gov/themes/communities

Smart Growth America

A nationwide coalition of over 80 national and local organizations promoting a better way to grow: one that protects farmland and open space, revitalizes neighborhoods, keeps housing affordable, and provides more transportation choices.

www.smartgrowthamerica.com

USEPA Office of Smart Growth

Information including initiatives, events, publications, and helpful links.

www.epa.gov/smartgrowth/index.htm

Congress for the New Urbanism

www.cnu.org

Smart Growth Network

In 1996, the US EPA joined with several non-profit and government organizations to form the Smart Growth Network (SGN). The Network was formed in response to increasing community concerns about the need for new ways to grow that boost the economy, protect the environment, and enhance community vitality. The Network's partners include environmental groups, historic preservation organizations, professional organizations, developers, real estate interests, local and state government entities.

www.smartgrowth.org/default.asp

Broad Stormwater Information

Storm Water Strategies

To help communities implement better storm water controls, the Natural Resources Defense Council (NRDC) recently released a CD-ROM version of its 1999 report, Storm Water Strategies: Community Responses to Run-off Pollution. The new CD-ROM is very user-friendly and includes updated case studies on storm water management issues (including new information on Low Impact Development), and web site links to storm water leaders across the country. For more information:

www.nrdc.org/ publications
212-727-2700.

NCSU Stormwater Education

The web site of North Carolina State University stormwater specialist and Biological and Agricultural Engineering faculty member Bill Hunt that includes:

- general and specific stormwater management training,
- upcoming stormwater education events,
- online and regular university courses,
- stormwater publications.

www.bae.ncsu.edu/people/faculty/hunt

NCSU Water Quality Group

Exclusively focused on nonpoint source pollution, this site includes a wealth of information on the subject, including a searchable, annotated bibliography of NPS literature, a watershed management decision support system, an education component with extensive information on BMPs for different NPS categories, and extensive links.

www.bae.ncsu.edu/programs/extension/wqg/index.html

NCSU Water Quality Program

A web site with information and links on all aspects of water quality protection and management.

www.water.ncsu.edu

USEPA Office of Water – Urban Stormwater page

Urban Stormwater Runoff Program includes model ordinances, economic benefits of prevention, and program development guides.

www.epa.gov/owow/nps/urban.html

Army Corps of Engineers

Includes information on Navigation, Flood Damage Reduction, Environmental Missions, Wetlands and Waterways Regulation and Permitting, Water Supply and Public Services.

www.usace.army.mil/
www.usace.army.mil/public.html#Navigation

Center for Watershed Protection
A non-profit stormwater education organization out of Maryland. Site offers an abundance of information on the management of stormwater, including "The Importance of Imperviousness" and "The Peculiarities of Imperviousness" by Tom Schueler, and links to other reports.
www.cwp.org

Stormwater Center Website
Supported by the Center for Watershed Protection, the site offers information about watershed and stormwater planning, including free example stormwater maintenance agreements and slideshows for viewing and purchase.
http://www.stormwatercenter.net/

NC Cooperative Extension Service
Centered at North Carolina State University, the NC Cooperative Extension Service offers a variety of educational information useful to local governments, industry, businesses and homeowners. The site includes links to county Extension offices across the state.
www.ces.ncsu.edu

Stormwater Magazine
Includes information from Stormwater Publications, including a search feature allowing the reader to search for articles of interest
www.stormh2o.com

Pamlico Tar River Foundation
The Pamlico-Tar River Foundation was founded in 1981. It is a private, non-profit organization dedicated to protecting, preserving and promoting the environmental quality of the Tar-Pamlico River and its watershed. PTRF is a grassroots organization, supported by nearly 1,500 citizen members -- "River Givers." PTRF achieves its mission through education, advocacy, and research.
www.ptrf.org

Appendix S.
Public Education Action Report and Plan: Proposed 2004-05

Public Education Action Report and Plan

Jurisdiction:_____Date Submitted:_____

	Activity	Point Value	# Done Last Yr (7/__ - 6/__)	Points	Cost	# Planned Next Yr (7/__ - 6/__)	Points Anticipated	Anticipated Cost (out of pocket)
1	Demonstration Sites (for BMPs)	4 each						
2	Local Newspaper Article	2 each					4	$0
3	Technical Workshop (1st year, 2 required)	4 each					8	$2000
4	Environmental Contest / Field Day	4 each						
5	Arrange Speakers For Civic Organizations	1 each						
6	Clean Water Proclamation, with Newspaper Article	2						
7	Web Page / Web Site Links	2 / year					2	$0
8	Pet Waste Ordinance	5 / year						
9	Factsheets/Brochures/Flyers/Enviro freebies (public places)	2 / year						
10	Utility Bill Inserts or Messages on Bills	3 / year						
11	Close-out Packages / Info for New Homeowners	3 / year						
12	Storm Drain Marking (24 minimum per year)	2 / year					2	2500
13	Sponsor new/expand Adopt-A-(Street-or-Stream) Program	4 / year					4	2500
14	Recognition Program (environmentally friendly participants)	1 / year						
15	Toll Free Environmental Hotline (1-800 or Local)	3 / year					3	$0
16	VWIN Monitoring Force (Water Quality Reporting)	6 / year						
17	Other Water Quality Reporting Program	3 / year						
18	Major Media Advertising	6 / year						
19	Local Access TV or Radio Spots	3 / year						
			Total Points Reported:			Total Points Planned:	23	

Please attach copies of articles, flyers, photographs, etc. documenting your activities, labeled for each type of activity.

Note: Ongoing Activities will continue to receive the education points for each year that they are in effect.

Note: If your locality has put together an exceptional effort for any of the above activities, you may be entitled to additional points for that activity. Please attach a description of the activity, a merit rationale, and a point proposal.

	Submitted By:		Title:					
			Date:					
			Signature:					

Detail of Reported Activities				
Brief Description of Activity	Targeted Audience	Date	Cost	Comments / Attachments

Detail of Planned Activities				
Brief Description of Activity	Targeted Audience	Date Planned	Anticipated Cost	Comments / Attachments
Technical Workshop for Developers	Engineers, Designers and Developers	Summer 2004	$2,000	
Technical Workshop for Staff	Operational Supervisors	Summer 2004	$500	
Newspaper Articles	General Public	Fall 2004/Spring 2005	$0	
Web Page	Varied	On Going	$0	
Storm Drain Marking	Civic Groups/General Public	Start up Spring 2004	$2000	
Adopt-A-Stream	Civic Groups/General Public	Ongoing	$2000	
Stormwater Hotline	All, Publicized with all outreach material	Ongoing	$0	

Appendix T.

City of Rocky Mount

Tar-Pamlico River Basin: Stormwater Program for Nutrient Control

New Development Annual Report Form BMP Review, Approval and Maintenance

City of Rocky Mount: Annual Report
New Development BMP Review, Approval and Maintenance

(a) Development Activity Summary

FY 2004-5 (July 1 through June 30)

	Disturbed Area (ac)		Impervious Area (sf)		Dwelling Units (ea)	
	Approved	Complete	Approved	Complete	Approved	Complete
Public/Private Streets						
Sinlge Family/Duplex			NA			
Multi-Family						
Non-residential						
Total						

Stormater BMP Summary Table

On-Site BMPs Approved

BMP Type	QTY	BMP Area (Ac)	Dev. Area (Ac)
Wet Detention Pond			
Stormwater Wetland			
Sand Filter			
Bioretention			
Grass Swale			
Vegetated Filter Strip w/ L Spread			
Conserv. Easement			
Open Space Easement			
Total			

Off-Site BMP's Approved

BMP Type	QTY	BMP Area (Ac)	Dev. Area (Ac)
Wet Detention Pond			
Stormwater Wetland			
Sand Filter			
Bioretention			
Grass Swale			
Vegetated Filter Strip w/ L Spread			
Conserv. Easement			
Open Space Easement			
Total			

	(lb/ac/yr)	
	N	P
Total Pre-Deveoped Export		
Total Post-Deveoped Export		

(b) BMP Maintenance

Number of Inspections:	
Number of BMP Failures:	
Number of Enforcement Actions:	

(c) Summary of maintenance activities conducted on BMPs.

(d) Summary of any BMP failures and how they were handled.

(e) Summary of results from any applicable jurisdictional review of planning issues.

(f) Summary of Program administrative changes, updates.

(g) Implementation Schedule Status

	2004												2005				2006			
	J	F	M	A	M	J	J	A	S	O	N	D	1	2	3	4	1	2	3	4
Resolution of Support	x																			
Update Design Manual		x	x	x	x	x														
Engineers/Developers Workshop					x															
Ordinance Adoption								x												
Public Education/Outreach							x	x	x	x	x	x	x	x	x	x	x	x	x	x
Stormwater Hotline	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mapping				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Illegal Discharge Screening																			x	x
Retrofit Locations															x				x	
Annual Report															x				x	