Neuse River Basin: Model Stormwater Program for Nitrogen Control

August 30, 1999

Table of Contents

Appendices

1. Introduction

1-A. Purpose of the Neuse Stormwater Rule

Water quality has been an issue in the Neuse River Basin for over a century. In 1887, legislation was passed to "prevent the throwing of dead stock into the waters of the Neuse River and its tributaries." Some of the water quality initiatives that have been undertaken in the Neuse River basin between 1950 and 1995 include:

- The State Stream Sanitation Act of 1951 required a statewide survey of all surface waters.

- Since the 1960s, better regulations and technology for wastewater treatment and the development of stream classifications with accompanying water quality standards have been implemented.

- In 1983, the Falls Lake watershed Nutrient Sensitive Waters (NSW) Strategy required more stringent controls for wastewater treatment facilities.

- In 1988, the Environmental Management Commission (EMC) classified the remainder of the Neuse River Basin as NSW, which brought about more stringent nutrient limits for wastewater facilities. Some of the nutrient loading from nonpoint sources (NPS) was controlled through the Agricultural Cost Share Program. In addition, the NC General Assembly adopted a statewide phosphate detergent ban on January 1, 1988.

- In 1993, the Division of Water Quality (DWQ) completed the first Basinwide Management Plan for the Neuse River Basin. The plan recommended an accelerated schedule for reducing nitrogen runoff from nonpoint sources. Since 1993, DWQ has continued to monitor and evaluate conditions in the Neuse River.

Despite these initiatives, the Neuse River basin has continued to have water quality problems. During July, September, and October 1995, extensive fish kills occurred in the Neuse River, primarily from New Bern to Minnesott Beach. Millions of menhaden, as well as numerous flounder, croaker and rock fish, were killed. Unusual meteorological conditions in 1995 were partly responsible for the fish kills. During June, record rainfalls delivered a tremendous load of nonpoint source nutrients into the Neuse River.

Environmental conditions in the Neuse River are driven by complex interactions between rainfall, flows, temperatures, biological factors, and chemistry. Each year will bring its own variations. However, the long history of problems with nutrient pollution and algal blooms provides evidence that immediate control measures are necessary.

On February 8, 1996, the EMC approved a draft comprehensive Neuse River NSW strategy. The goal of the strategy was and still is to achieve a 30 percent nitrogen reduction from each controllable and quantifiable source of nitrogen in the basin. These sources are: Wastewater Treatment, Urban Stormwater, Agriculture and Nutrient Application. The NSW Strategy also includes a rule to protect Riparian Buffers in order to maintain their existing nitrogen removal capabilities.

The NSW Strategy was noticed for public comment several times between its initial development in February 1996 and its final adoption in August 1998. These comment periods included six public workshops in May 1996, four public hearings in November 1996 and two public hearings in October 1997. As a result of the public hearings, each rule, including the Stormwater Rule, was modified to increase flexibility for the regulated community and to improve the mechanisms to insure that the 30% nitrogen reduction goal is met. The full text of the Neuse Stormwater Rule is included in Appendix B.

1-B. Requirements of the Neuse Stormwater Rule

The Neuse stormwater rule applies only to the largest and fastest-growing local governments in the Neuse River basin (shown below). The EMC may also designate additional local governments within the Neuse River basin to comply with the stormwater rule in the future. The rule establishes a broad set of objectives for reducing nitrogen runoff from urban areas. The rule also sets up a process for DWQ to work with the affected local governments to develop a model stormwater program for meeting the objectives.

The affected local governments are:

Cary	Durham County *
Durham	Johnston County *
Garner	Orange County *
Goldsboro	Wake County *
Havelock	Wayne County *
Kinston	
New Bern	
Raleigh	
Smithfield	
Wilson	

* Applicable areas are those under the direct jurisdiction of the respective county.

The timeframes for implementation of the rule are as follows:

August 1, 1998: Effective date of the rule.

August 1, 1999:	Deadline for approval of the Model Stormwater Program by the Environmental Management Commission.
August 1, 2000:	Deadline for submittal of local Stormwater Program (including ordinances) to the Environmental Management Commission.
February 1, 2001:	Deadline for local governments to begin implementing local Stormwater Programs.

Following implementation in February 2001, local governments are required to make annual progress reports to the EMC that will include nitrogen loading reduction estimates.

The general elements that must be included in the local government stormwater management program are:

1. New Development Review/Approval

New development would have to meet the 30% reduction goal by implementing planning considerations and best management practices, such as constructed wetlands. The rule imposes a 3.6 pounds per acre per year (lb/ac/yr) nitrogen loading limit on new development. Nitrogen load from new developments that exceeds this performance standard may be offset by payment of a fee to the Wetlands Restoration Fund provided, however, that no new residential development can exceed 6.0 lb/ac/yr and no new non-residential development can exceed 10.0 lb/ac/yr.

2. Illegal Discharges

Illegal discharges are substances deposited in storm sewers (which lead directly to streams) that really should be handled as wastewater discharges. Depending on the source, 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 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 education programs for the Neuse basin.

2. New Development Review/Approval

2-A. Requirements in the Rule

The Neuse Stormwater Rule (15A NCAC 2B .0235) has the following requirements for new development located within the planning and zoning jurisdictions of the 15 local governments subject to these rules:

- The nutrient load contributed by new development activities is held at 3.6 pounds per acre per year. This is equivalent to 70 percent of the estimated average nitrogen load contributed by the non-urban areas in the Neuse River basin (as defined using 1995 LANDSAT data). The Environmental Management Commission may periodically update the performance standard based on the availability of new scientific information.

- Property owners shall have the option of partially offsetting projected nitrogen loads by funding wetland or riparian area restoration through the North Carolina Wetland Restoration Program. 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 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 .0233.

2-B. Protecting Riparian Areas on New Development

The Neuse Stormwater Rule requires local governments to ensure that riparian areas are protected on new developments in accordance with the Riparian Buffer Rule (15A NCAC 2B .0233). The Riparian Buffer Rule requires that 50-foot riparian buffers be maintained on all sides of intermittent and perennial streams, ponds, lakes and estuaries in the Neuse River basin. The rule includes some uses that are allowable within the riparian buffer, such as road and utility crossings.

Each jurisdiction has the following two choices for ensuring that riparian buffers are protected on new developments:

1. Receive a delegated program and implement all applicable provisions of the Riparian Buffer Rule within its jurisdiction, or

2. Disapprove any new development activity that is proposed to take place within the first 50 feet adjacent to a waterbody that is shown on either the USGS topographic map or the NRCS Soil Survey maps unless the owner can show that the activity has been approved by DWQ. DWQ approval may consist of the following:

    - An Authorization Certificate that documents that DWQ has approved an allowable use such as a road crossing or utility line. A detailed list of allowable uses is included in the Riparian 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 Export from New Development

For the purposes of the Neuse Stormwater Program, new development shall be defined as to include the following:

- Any activity that disturbs greater than one acre of land in order to establish, expand or modify a single family or duplex residential development or a recreational facility.

- Any activity that disturbs greater than one-half an acre of land in order to establish, expand or modify a multifamily residential development or a commercial, industrial or institutional facility.

New development shall NOT include agriculture, mining or forestry activities. Land disturbance is defined as grubbing, stump removal and/or grading.

Property owners that can demonstrate that they have vested rights as of the effective date of the Local Stormwater Program for Nitrogen Control (expected February 2001) will not be subject to the requirements for new development. Vested rights may be based on at least one of the following criteria:

(a) substantial expenditures of resources (time, labor, money) based on a good faith reliance upon having received a valid local government approval to proceed with the project, or

(b) having an outstanding valid building permit in compliance with G.S. 153A-344.1 or G.S. 160A-385.1, or

(c) having an approved site specific or phased development plan in compliance with G.S. 153A-344.1 or G.S. 160A-385.1.

Projects that require a state permit, such as landfills, NPDES wastewater discharges, land application of residuals and road construction activities shall be considered to have vested rights if a state permit was issued prior to the effective date of the Local Stormwater Program for Nitrogen Control.

The nitrogen export from each new development must be calculated. This export will be calculated in pounds per acre per year (lbs/ac/yr). Model methodologies that may be used to make this calculation are presented below; however, local governments may propose alternative approaches where it can be demonstrated to be equivalent. There are two different methodologies proposed for calculating nitrogen export from new developments. These are as follows:

- Method 1 is intended for residential developments where lots are shown but the actual footprint of buildings are not shown on site plans. This method does not require calculation of the area of building footprints. Rather, the impervious surface resulting from building footprints is estimated based on typical impervious areas associated with a given lot size. This method is shown in Figure 2a.

- Method 2 is for residential, commercial and industrial developments when the entire footprint of the roads, parking lots, buildings and any other built-upon area is shown on the site plans. This method is simpler and more accurate since it does not require estimating the impervious surface based on lot size like Method 1 does. Method 2 is shown in Figure 2b.

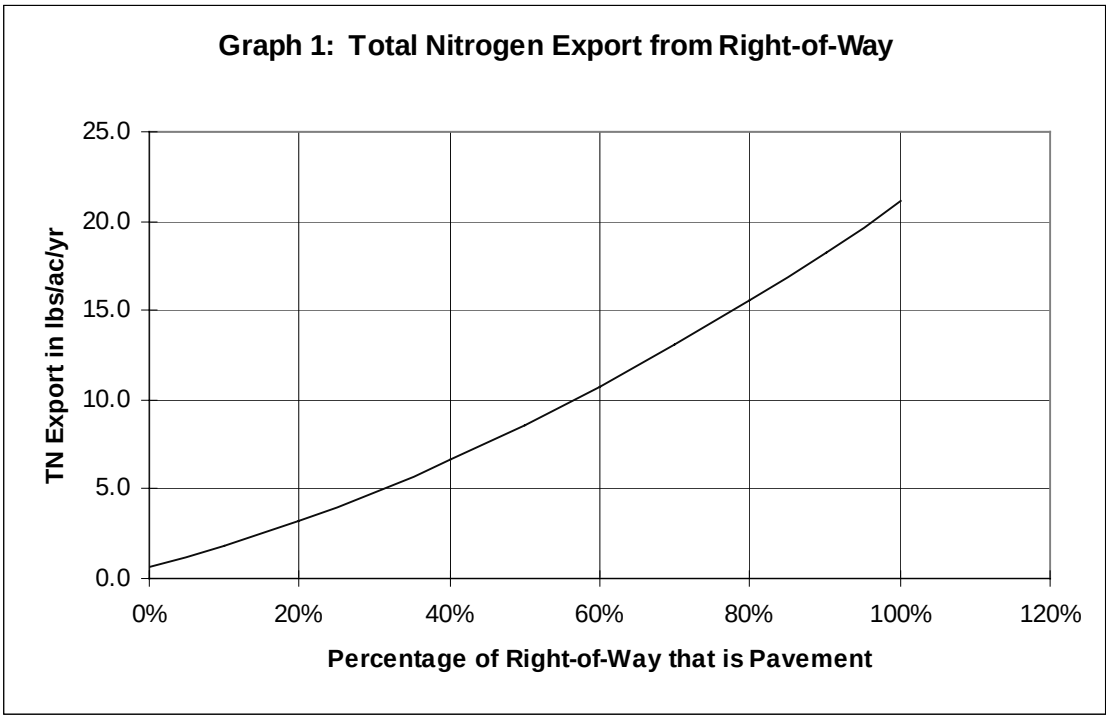
The development of these methods is described in Appendix F. During the one-year process of developing local stormwater programs, the jurisdictions may revisit the development of Methods 1 and 2 and adapt the process to be more applicable to their jurisdictions. Any changes to Methods 1 and 2 should be adequately explained and supported with appropriate technical information.

One situation that is not addressed in either of these methods is a non-residential subdivision where the impervious surfaces are not shown on the plans at the time of submittal. In this case, the local government could require that the property owner specify the areas of impervious surface, undisturbed open space and managed open space on the property in a restrictive covenant or other legal, enforceable mechanism. Then, Method 2 could be applied. An alternative is for the local government to determine a worst-case scenario for the areas of impervious surface and managed open space for the type of development specified and then apply Method 2.

Figure 2a: Method 1 for Quantifying TN Export from Residential Developments when Building and Driveway Footprints are Not Shown

Step 1: Determine area for each type of land use and enter in Column (2).
Step 2: Total the areas for each type of land use and enter at the bottom of Column (2).
Step 3: Determine the TN export coefficient associated with right-of-way using Graph 1.
Step 4: Determine the TN export coefficient associated with lots using Graph 2.
Step 5: Multiply the areas in Column (2) by the TN export coefficients in Column (3) and enter in Column (4).
Step 6: Total the TN exports for each type of land use and enter at the bottom of Column (4).
Step 7: Determine the export coefficient for site by dividing the total TN export from uses at the bottom of Column (4) by the total area at the bottom of Column (2).

(1) Type of Land Cover	(2) Area (acres)	(3) TN export coeff. (lbs/ac/yr)	(4) TN export from use (lbs/yr)
Permanently protected undisturbed open space (forest, unmown meadow)		0.6	
Permanently protected managed open space (grass, landscaping, etc.)		1.2	
Right-of-way (read TN export from Graph 1)			
Lots (read TN export from Graph 2)			
TOTAL			



Graph 2: Total Nitrogen Export from Lots

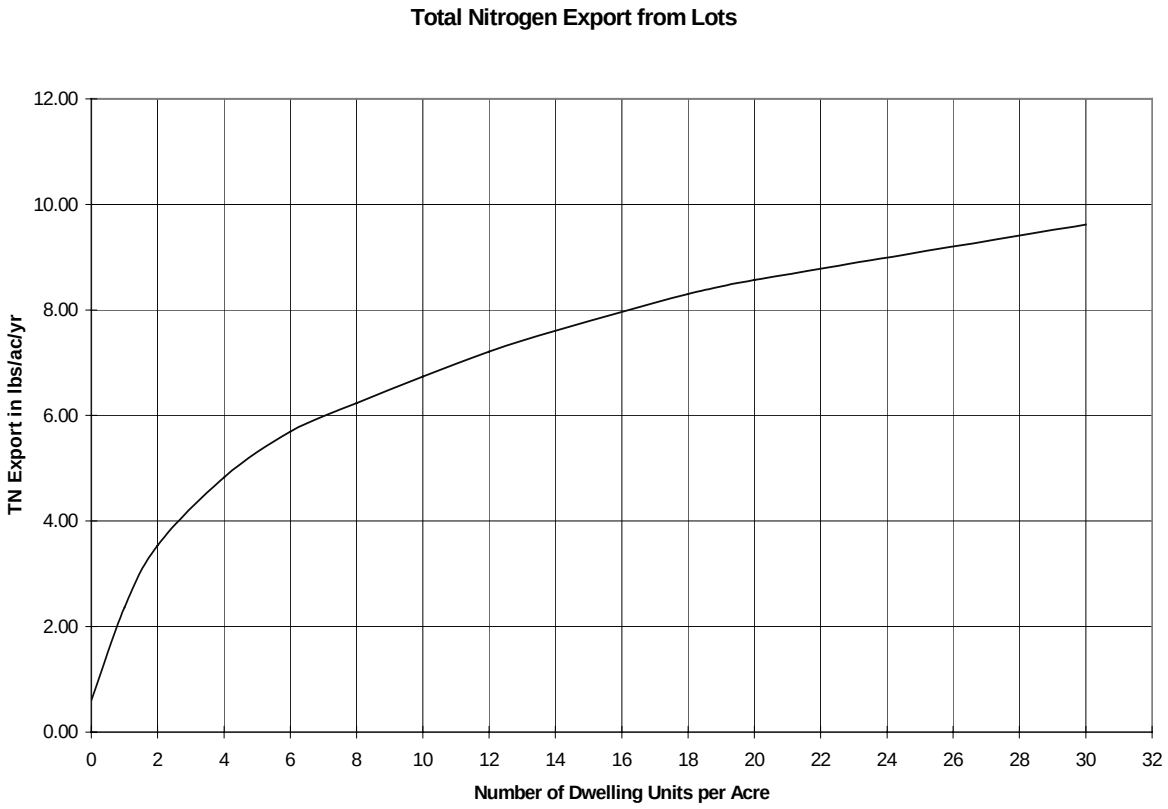


Figure 2b: Method 2 for Quantifying TN Export from Residential / Industrial / Commercial Developments when Footprints of all Impervious Surfaces are Shown

Step 1: Determine area for each type of land use and enter in Column (2).
Step 2: Total the areas for each type of land use and enter at the bottom of Column (2).
Step 3: Multiply the areas in Column (2) by the TN export coefficients in Column (3) and enter in Column (4).
Step 4: Total the TN exports for each type of land use and enter at the bottom of Column (4).
Step 5: Determine the export coefficient for site by dividing the total TN export from uses at the bottom of Column (4) by the total area at the bottom of Column (2).

(1) Type of Land Cover	(2) Area (acres)	(3) TN export coeff. (lbs/ac/yr)	(4) TN export from use (lbs/yr)
Permanently protected undisturbed open space (forest, unmown meadow)		0.6	
Permanently protected managed open space (grass, landscaping, etc.)		1.2	
Impervious surfaces (roads, parking lots, driveways, roofs, paved storage areas, etc.)		21.2	
TOTAL		---	

The rule requires that all new developments achieve a nitrogen export of less than or equal to 3.6 pounds per acre per year. If the development contributes greater than 3.6 lbs/ac/yr of nitrogen, then the options shown in Table 2a are available based on whether the development is residential or non-residential.

Table 2a: Nitrogen Export Reduction Options

Residential	Commercial / Industrial
If the computed export is less than 6.0 lbs/ac/yr, then the owner may either: 1. Install BMPs to remove enough nitrogen to bring the development down to 3.6 lbs/ac/yr. 2. Pay a one-time offset payment of $330/lb to bring the nitrogen down to the 3.6 lbs/ac/yr. 3. Do a combination of BMPs and offset payment to achieve a 3.6 lbs/ac/yr export.	If the computed export is less than 10.0 lbs/ac/yr, then the owner may either: 1. Install BMPs to remove enough nitrogen to bring the development down to 3.6 lbs/ac/yr. 2. Pay a one-time offset payment of $330/lb to bring the nitrogen down to the 3.6 lbs/ac/yr. 3. Do a combination of BMPs and offset payment to achieve a 3.6 lbs/ac/yr export.
If the computed export is greater than 6.0 lbs/ac/yr, then the owner must use on-site BMPs to bring the development's export down to 6.0 lbs/ac/yr. Then, the owner may use one of the three options above to achieve the reduction between 6.0 and 3.6 lbs/ac/yr.	If the computed export is greater than 10.0 lbs/ac/yr, then the owner must use on-site BMPs to bring the development's export down to 10.0 lbs/ac/yr. Then, the owner may use one of the three options above to achieve the reduction between 10.0 and 3.6 lbs/ac/yr.

The table above discusses the option of using offset fees to meet the nitrogen export levels set for new development activities. These offset fees go to the Wetlands Restoration Program (WRP). The WRP will utilize these fees in accordance with the WRPs Basinwide Wetlands and Riparian Restoration plans. It is the policy of the WRP to utilize the funds where they are generated to the maximum extent possible as long as they can obtain the cooperation of the local government.

2-D. Calculating Peak Runoff Volume

The Neuse Stormwater Rule requires there be no net increase in peak flow leaving the site from the predevelopment conditions for the 1-year, 24-hour storm. Each jurisdiction affected by the rule may specify the methodology(ies) that shall used when determining peak flows from new development activities.

Acceptable methodologies for computing the pre- and post-development conditions for the 1-year, 24-hour storm include:

- The Rational Method.
- The Peak Discharge Method as described in USDA Soil Conservation Service's Technical Release Number 55 (TR-55).
- The Putnam Method.
- Other methods proposed by local governments and approved by the Environmental Management Commission.

The same method must be used for both the pre- and post-development conditions.

Division of Water Quality staff have computed rainfall depths for the 1-year, 24-hour storm for use with hydrologic computation methods. This information is provided in Table 2b below. In addition, the Division will continue to work with local governments in the basin to develop rainfall intensity information and other technical information that may be necessary to assist in the implementation of this requirement.

Table 2b: Rainfall depths for the 1-year, 24-hour storm

Location	1yr - 24 hr depth (inches)	1yr 24 hr intensity* (in/hr)
Raleigh	3.00	To Be Developed
Wilmington	3.70	To Be Developed
Washington	3.40	To Be Developed

* This information is currently under development

The flow control requirement is not required for developments that meet one or all 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.

It is recognized that in certain parts of drainage basins, stormwater detention can aggravate local flooding problems. Communities may need to tailor requirements or provide exemptions to those specific locations.

2-E. BMPs for Reducing Nitrogen

Designing best management practices that remove nitrogen from stormwater is a developing field. Researchers throughout the country, particularly in the Southeast, are conducting studies to determine effective means of controlling nitrogen. At the present time, current data indicate that most BMPs remove only 20 to 40 percent of total nitrogen on a consistent basis. All BMPs require regular maintenance and some have varying performance depending on soil type and the season. It is crucial to consider the issues of aesthetics, long-term maintenance, safety and reliability in BMP design.

Since it is relatively difficult to design and maintain BMPs that remove nitrogen, the TN accounting method in 2-C was designed to provide credits for site planning practices that reduce nitrogen loadings from new development. These planning measures include reducing impervious surfaces and protecting open spaces. More detail on planning measures that reduce nitrogen loading is given in Appendix G.

The following BMPs may be utilized for reducing nitrogen from new developments:

- Wet detention ponds
- Constructed wetlands
- Open channel practices
- Riparian buffers
- Bioretention
- Proprietary BMPs

The Neuse Stormwater Team estimated total nitrogen removal rates for various BMPs by conducting a literature search of studies performed on BMPs. The total nitrogen BMP removal rates based on current literature studies are provided in Table 2c below. A summary of these literature studies is given in Appendix H.

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

BMP Type	TN Removal Rate based on Current Literature Studies	Appropriate Design Standards
Wet detention ponds	25%	NC and MD Design Manuals
Constructed wetlands	40%	NC and MD Design Manuals
Open channel practices	30%	NC and MD Design Manuals
Riparian buffers	30%	Neuse Riparian Buffer Rule (15A NCAC 2B .0233)
Vegetated filter strips with level spreader	20%	NC and MD Design Manuals and other literature information
Bioretention	25%	NC and MD Design Manuals
Sand Filters	35%	NC and MD Design Manuals
Proprietary BMPs	Varies	Per manufacturer subject to DWQ approval
Other BMPs	Varies	Subject to DWQ approval

If more than one BMP is installed in series on a development, then the removal rate shall be determined through serial rather than additive calculations. For example, if a wet detention pond discharges through a riparian buffer, then the removal rate shall be estimated to be 47.5 percent. (The pond removes 25 percent of the nitrogen and discharges 75 percent to the buffer. The buffer then removes 30 percent of the nitrogen that discharged from the pond, which is 22.5 percent. The sum of 25 and 22.5 is 47.5. The removal rate is NOT 25 percent plus 30 percent.)

2-F. BMP Maintenance

If BMPs are implemented to achieve the nitrogen loading and flow attenuation requirements for a development, then the local governments must require a maintenance plan for the BMPs. The stormwater management plan must describe the local government's selected approach for assuring BMP maintenance. Possible options to be considered include, but are not limited to, the following:

- The jurisdiction can charge a stormwater maintenance fee and assume the responsibility of maintaining the stormwater BMP itself, including providing annual inspection.

- The jurisdiction can notify the owner upon finding that maintenance is needed on a BMP. If the owner does not complete the maintenance himself in a timely manner, then the jurisdiction can contract out the maintenance itself and recover costs in the manner it determines most appropriate.

- The jurisdiction can require that escrow accounts be set up to provide sufficient resources to completely replace the BMP in the event of failure.

- The jurisdiction can require a legal maintenance agreement for the BMP with the owner.

An example of a stormwater maintenance program is given in Appendix I.

Regardless of the option selected, the jurisdiction should inspect all BMPs on an annual basis. The resources needed for this may be recovered through an inspection fee or other funding source(s) determined appropriate and necessary by the local government (currently, some of the local governments are charging annual inspection fees for stormwater BMPs that range from $105 to $150). Jurisdictions should keep a list (database recommended) of BMPs and their locations to assist in the inspection process.

BMPs should never be included on a separate lot, but should be part of the development site. This prevents the landowner from foreclosing on or abandoning the lot that contains the BMP without repercussions for the entire development.

2-G. Land Use Planning Provisions

This model program is intended to provide the flexibility and incentives to use site design techniques to reduce impervious surfaces on their developments. As discussed previously, reducing impervious surfaces reduces the need for BMPs to control nitrogen and peak stormwater flows and also reduces associated BMP maintenance concerns.

Under the model stormwater program, affected jurisdictions are required to review their local ordinances with regard to the following topics and show that they have provided adequate flexibility for developers to utilize planning measures to reduce impervious surfaces. This review is intended to look for opportunities where these measures could be allowed, or obstacles to their use could be removed.

Each jurisdiction must show that they have reviewed and considered the following planning techniques and the general advantages and disadvantages of incorporating these approaches at the local level.

- Reducing road widths
- Reducing minimum parking requirements
- Minimizing use of curb and gutter
- Cluster or open-space developments
- Traditional neighborhood developments
- Mixed-use developments

Descriptions of these techniques are provided in Appendix G.

2-H. Jurisdiction-Wide and Inter-Local Approaches

Jurisdictions have the option of implementing jurisdiction-wide or inter-local approaches to achieving nitrogen reductions. Such approaches may be incorporated into an individual local government's model program if there is appropriate supporting information to show how they will achieve the nitrogen loading reduction requirements applicable to new development. Some ideas for jurisdiction-wide approaches that a local government may consider include:

- Creating regional stormwater management facilities, such as ponds, to provide some of the nitrogen removal and flow control required from new development. A regional stormwater management facility would have to be implemented in conjunction with on-site controls to locally protect against water quality degradation and flooding. The Neuse buffer requirements may impact the feasibility of using certain regional stormwater approaches.

- "Land banking" within the same watershed where development is occurring. The land to be banked should have significant water quality value, such as being contiguous with an existing floodplain, wetland or riparian area. 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.

Any jurisdiction that wishes to implement a jurisdiction-wide approach will be responsible for demonstrating and quantifying the associated nitrogen removals. This information can be submitted to the Environmental Management Commission as part of the jurisdiction's stormwater program.

2-I. 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 Neuse 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 February 2001, each local government is required to show that it has established the legal authority to do the following:

- Control the contribution of pollutants to the stormwater collection system associated with industrial activity.
- 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.

Raleigh and Durham have established legal authority in the above areas. Examples of these ordinances are provided in Appendix J. Examples from other communities may be compiled by the Triangle J Council of Governments.

3-D. Collecting Jurisdiction-Wide Information

Under the Model Program for Illegal Discharges, each jurisdiction is required to 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 is a more detailed screening for high priority areas within the jurisdiction. The associated requirements are discussed in Section 3-E.

- The third level is a very detailed investigation that shall be done 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.

Each local government shall compile maps that show the following information. It is not necessary that all of this information be shown on a single map. The maps shall be at a scale that is most useful to the jurisdiction; however, no scale may be 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 should 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.

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

The local governments shall complete this collection of jurisdiction-wide information by the time the second annual report is due (October 2002).

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

Beginning in the third year after implementation of the local stormwater program, each jurisdiction shall 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 jurisdiction's area. This requirement will begin in the third year after implementation. Each subsequent year, the jurisdiction is responsible for selecting and screening another high priority area that comprises at least ten percent of its jurisdiction.

The method for determining the high priority area will vary from jurisdiction to 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 year, the local governments should explain their basis for selection of the high priority areas.

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

- Locations of the outfalls 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 drainage ditches that drain more than 50 acres of non-industrial lands.
- Locations 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 a suggested process 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 local government is required to 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 K.

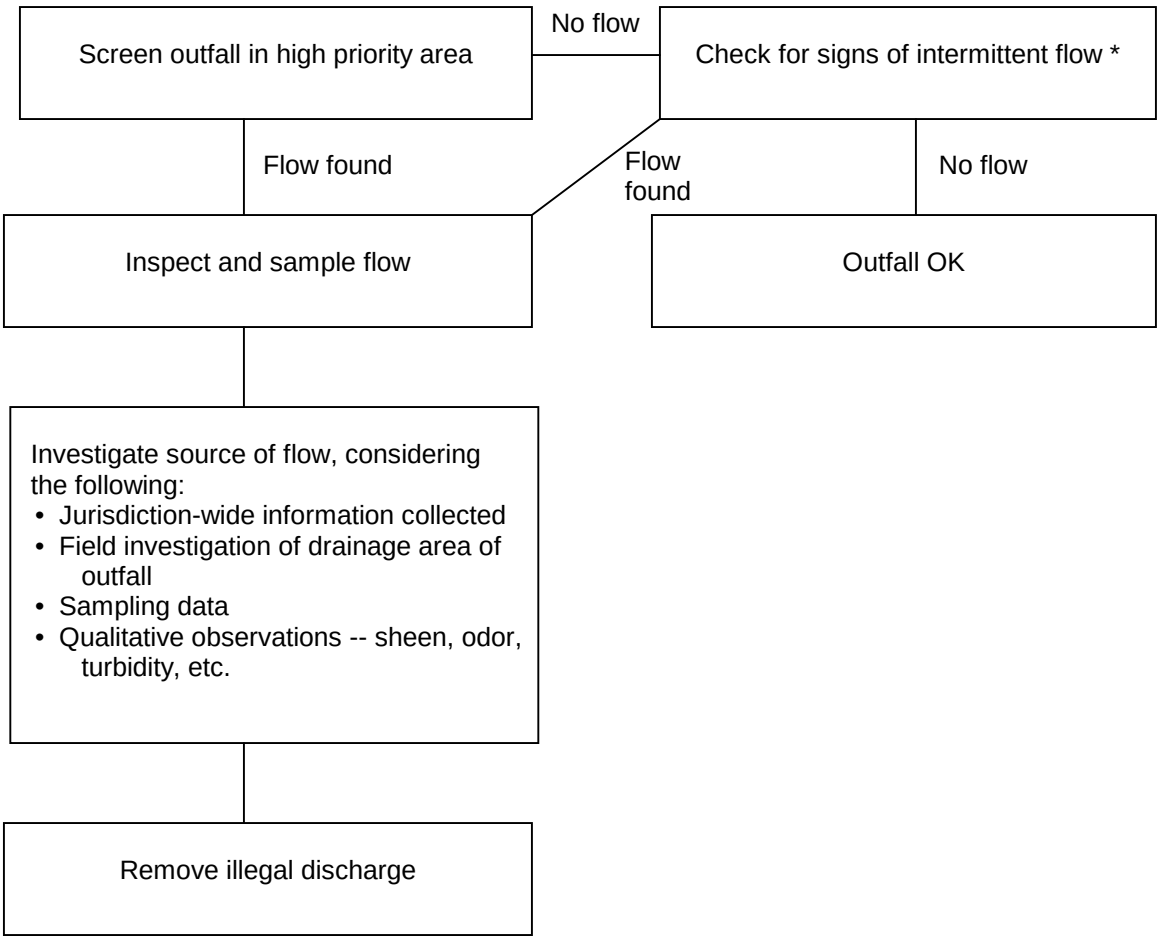
Table 3c: Field Screening Report Information

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

* 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. The cities of Raleigh and Durham can be contacted for guidance on test kit information.

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.

As part of the review process for field screening activities, the Team recognized that there were some training needs associated with performing these activities. The Education Program (outlined in Section 5) should look at the development of training materials and opportunities to assist local governments in preparing to implement these measures.

3-F. Identifying and Removing Illegal Discharges

After the field screening is complete, local governments are required to take measures to identify and remove illegal discharges. Identifying illegal discharges may require a combination of office and field work. After the field screening, local government staff should consult the jurisdiction-wide information they have 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 in the office, a systematic field investigation should be planned that minimizes the amount of resources required to identify the source. Several field methods may be used to identify illegal discharges. It is recommended that local governments use a simple approach if that will suffice. Listed below are several approaches that are recommended by Raleigh and Durham, starting with simple approaches and moving to more complex ones

- 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

One tip on identifying illegal discharges is that outfalls that do not have flow during wet weather are likely to originate from floor drains.

Documentation of the results of the office and field investigations should be kept on file for five years with the screening report.

After a local government identifies the source of an illegal discharge, it is required to take enforcement action to have the source removed. The legal authority that was established for the illegal discharge program shall provide the means to accomplish this requirement. Enforcement should include requiring the person responsible for the discharge to remove or redirect it to the sanitary sewer. There should also be remedies to deal with cases of non-compliance. Records of all compliance actions shall be kept for five years with the screening report.

In addition to keeping all screening reports on file, each jurisdiction shall 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

Local governments are required to contact persons who are responsible for establishments that are 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. Previous experience has shown that many illegal discharges are actually unintentional. A sample letter to inform owners and operators about the requirements of the illegal discharge program is included in Appendix L.

The experiences of Raleigh and Durham have shown that an illegal discharge hotline is a cost-effective way to identify illegal discharges. Part of the public education program (discussed in Chapter 5) will be to educate citizens about what types of discharges should not go to the stormwater collection system and make them aware of the hotline.

Local governments are responsible for establishing a hotline. The hotline will require them to either designate a new phone number or use an existing service. The hotline should include a recording advising citizens what to do if they call during non-business hours. There should be another number given in cases where the illegal discharge is perceived to be an emergency.

3-H. Implementation Schedule

In keeping with their goal of having an efficient and cost-effective program, the Neuse Stormwater Team has created a phased implementation schedule for illegal discharges (Table 3d). The schedule allows for collecting jurisdiction-wide information during the first year of implementation and then screening the high priority areas during future years. This phased schedule is also intended to allow communities to evaluate and make improvements to their programs as they progress through high priority areas.

Table 3d: Implementation Schedule and Annual Reporting Requirements

Year	Implementation Requirements	Annual Report Requirements
By February 2001	• Establish legal authority to address illegal discharges	• Submit report identifying established legal authority to meet requirements.
By October 2002	• 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 2002	• 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-J. 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 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 loading to the receiving water.
- The watershed is clearly contributing nitrogen 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 Neuse River Basin, the number of retrofits can be based on the estimated population within the Neuse 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	1997 Population	Minimum Number of Retrofit Sites to be Identified
Less than 30,000	Smithfield	11,194	2
	Garner	17,821	
	Havelock	21,374	
	New Bern	22,032	
	Kinston	25,398	
Between 30,000 and 60,000	Durham County	37,292	3
	Wilson	41,103	
	Orange County	43,913	
	Goldsboro	48,356	
	Wayne County	56,117	
Between 60,000 and 100,000	Johnston County	67,526	4
	Cary	80,751	
Between 100,000 and 250,000	Wake County	144,374	5
	Raleigh	266,530	
	Durham	159,030	

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 2001 as part of the annual report.

The Division 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
- Triangle J Council of Governments
- Kerr-Tar Council of Governments
- Eastern Carolina Council of Governments
- Environmental programs at N.C. State University, Duke University, University of N.C., East Carolina University and others
- N.C. Sea Grant

- USDA – Natural Resources Conservation Service
- Upper Neuse Basin Association
- Lower Neuse Basin Association
- N.C. Wetlands Restoration Program

4-D. Mapping Requirements

Affected local governments are required to 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 loading from drainage area (lbs/acre/year) *	
Potential nitrogen 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 Figure 2b from Chapter 2 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 Neuse Stormwater Rule requires each of the affected jurisdictions in the Neuse River Basin to develop a locally administered environmental education program to address nitrogen loading issues.

5-B. Public Education Action Plan

Each targeted community is required to develop a Public Education Action Plan. The purpose of the Action Plan is to provide local governments a platform to design their own locally unique public education effort. The Action Plan will outline the proposed education activities for the upcoming year, identifying target audiences and anticipated costs of the program. Each targeted community shall submit an annual Action Plan to DWQ for approval prior to October 1 of each year. An example Action Plan format can be found in Appendix M.

The Action Plan shall consist of activities from each of the two categories listed below in Table 5a. Innovative public education activities not included in this list may be considered for approval 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. In addition to the Category One and Two activities, all Action Plans must include two technical workshops (see below) in the first year and a toll free hotline for reporting illegal discharges.

The ultimate goal of the public education program is to utilize major media advertising (television, radio, and newspaper) to reach a broad audience. However, the model recognizes that these venues are cost prohibitive for many small local governments. If a local government chooses to use effective major media advertising, either independently or through a cooperative effort, that local government is exempted from minimum Category One and Two requirements.

Table 5a: Public Education Action Plan Categories

Category 1	Category 2
Demonstration Sites (for Best Management Practices)	Fact Sheets
"Adopt-a-Program"	Environmental Freebies
Quarterly local newspaper articles	Fertilizer Tags
Storm drain marking	Flyers
Recognition Program (recognize environment friendly participants)	Postmarks
Web page	Utility bills inserts

Local Cable TV program	Close-out Packages (new homeowners)
Toll free hotline for reporting environmental problems	Speak to civic organizations quarterly
Environmental field day	
Technical Workshop (only applicable after 1st year)	
Environmental Contest	

The number of annual activities required is dependent upon the total population of the subject local government. The number of different required activities from each category is indicated in Table 5b below. The combination of selected activities must provide a general awareness of nitrogen loading issues and address a diverse audience.

Table 5b: Minimum Number of Annual Activities

Population	Category 1 Activities	Category 2 Activities
< 60,000	2	2
> 60,000	3	4

During the first year of program implementation, targeted 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. During subsequent years, technical workshops are considered an option under Category 2 activities. Communities are encouraged to work jointly to develop and conduct the workshops, if feasible. A Sample workshop agenda, including recommended resources, is located in Appendix N.

5-C. Flexibility of Implementation/Alternative Programs

Communities may develop a locally unique program designed to meet their needs as long as the activities meet or exceed the minimum requirements set forth above. While it is not a requirement, targeted communities are encouraged to work with each other to make use of existing resources and stormwater education efforts in their areas to meet the requirements. Working together will provide a more consistent education effort for communities of all sizes, will be an efficient use of resources and will reduce duplication of efforts.

5-D. Recommended Alternative Approaches

To reduce the burden to targeted communities to meet the requirements, the creation of two (2) positions is suggested as an alternative approach that the local governments can utilize to help implement the required Action Plan. See Appendix O for a summary of this recommended approach.

6. Reporting Requirements

Annual Neuse River Basin Stormwater Program reports must be submitted to the Division of Water Quality by October 30 of each year beginning in 2001. 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 offset fees.
- Computed baseline and net change in nitrogen 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 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 February 2001	• Establish legal authority to address illegal discharges	• Submit report identifying established legal authority to meet requirements.
By October 2002	• 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 2002	• 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 years Action Plan and evaluate the implementation of the previous years 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 locality will address shortfalls.

APPENDICES TO THE NEUSE RIVER BASIN: MODEL STORMWATER PROGRAM FOR NITROGEN CONTROL

August 30, 1999

Appendices

Appendix A. Plan Submittal Checklist

PLAN SUBMITTAL CHECKLIST FOR LOCAL GOVERNMENT STORMWATER PROGRAM FOR NITROGEN CONTROL IN THE NEUSE RIVER BASIN

Prior to submitting the proposed local stormwater program for nitrogen control to the Environmental Management Commission, the local government should make sure the proposal addresses the Neuse stormwater program requirements listed below.

	Component Description	Ordinance Provisions	Monitoring/ Enforcement
New Development Nitrogen Control Program Components			
Provisions for Protecting Riparian Areas in New Developments	☐	☐	☐
Program for Calculating/Controlling TN Export From New Development	☐	☐	☐
Program for Calculating/Attenuating Flow From New Development	☐	☐	☐
Program to Assure Long-Term Maintenance of BMPs	☐	☐	☐
Approach for Considering Land Use Planning/Design Techniques	☐	☐	☐
* Description of Any Proposed Jurisdiction-Wide and Interlocal Approach	☐	☐	☐
Illegal Discharges Program Components			
Approach to Collecting Jurisdiction-Wide Information	☐	☐	☐
Approach to Mapping and Field Screening in High Priority Areas	☐		
Program for Identifying and Removing Illegal Discharges	☐	☐	☐
Program for Preventing Illegal Discharges and Establishing a Hotline	☐	☐	☐
* Description of Any Proposed Jurisdiction-Wide and Interlocal Approach	☐	☐	☐
Retrofit Program Components			
Approach to Data Collection and Notification	☐		
Approach for Complying With Mapping Requirements	☐		
* Description of Any Proposed Jurisdiction-Wide and Interlocal Approach	☐		
Public Education Program Components			
Description of Public Education Program	☐		
* Description of Any Proposed Jurisdiction-Wide and Interlocal Approach	☐		
Reporting Requirements			
Description of Proposed Report Contents/Format	☐		
* Description of Any Proposed Jurisdiction-Wide and Interlocal Approach	☐	☐	☐

* NOTE: Jurisdiction-Wide and Interlocal Approaches are not required to be addressed under the Neuse NSW rules.

Appendix B. 15A NCAC 2B .0235 Neuse River Basin - Nutrient Sensitive Waters Management Strategy: Basinwide Stormwater Requirements

The following is the urban stormwater management strategy for the Neuse River Basin:

(1) The following local governments shall be designated, based on population and other factors, for stormwater management requirements as part of the Neuse River Nutrient Sensitive Waters stormwater management strategy:

(a) Cary,
(b) Durham,
(c) Garner,
(d) Goldsboro,
(e) Havelock,
(f) Kinston,
(g) New Bern,
(h) Raleigh,
(i) Smithfield,
(j) Wilson
(k) Durham County,
(l) Johnston County,
(m) Orange County,
(n) Wake County, and
(o) Wayne County.

(2) Other incorporated areas and other counties, not listed under Item (1) of this Rule, may seek to implement their own local stormwater management plan by complying with the requirements specified in Items (5), (6) and (7) of this Rule.

(3) The Environmental Management Commission may designate additional local governments by amending this Rule based on their potential to contribute significant nutrient loads to the Neuse River. At a minimum, the Commission shall review the need for additional designations to the stormwater management program as part of the basinwide planning process for the Neuse River Basin. Any local governments that are designated at a later date under the Neuse Nutrient Sensitive Waters Stormwater Program shall meet the requirements under Items (5), (6) and (7) of this Rule.

(4) Within 12 months of the effective date of this Rule, the Division of Water Quality shall submit a model local stormwater management program plan to control nutrients to the Commission for approval. The Division shall work in cooperation with subject local

governments in developing this model plan. The model plan shall address nitrogen reductions for both existing and new development and include, but not be limited to, the following elements:

(a) Review and approval of stormwater management plans for new developments to ensure that:

(i) the nitrogen load contributed by new development activities is held at 70 percent of the average nitrogen load contributed by the 1995 land uses of the non-urban areas of the Neuse River Basin. The local governments shall use a nitrogen export standard of 3.6 pounds/acre/year, determined by the Environmental Management Commission as 70 percent of the average collective nitrogen load for the 1995 non-urban land uses in the basin above New Bern. The EMC may periodically update the design standard based on the availability of new scientific information. Developers shall have the option of partially offsetting their nitrogen loads by funding wetland or riparian area restoration through the North Carolina Wetland Restoration Fund at the rate specified in Rule .0240 of this Section. However, before using offset payments, the development must attain, at a minimum, a nitrogen export that does not exceed 6 pounds/acre/year for residential development and 10 pounds/acre/year for commercial or industrial development.

(ii) there is no net increase in peak flow leaving the site from the predevelopment conditions for the 1-year, 24-hour storm.

(b) Review of new development plans for compliance with requirements for protecting and maintaining existing riparian areas as specified in 15A NCAC 2B .0233;

(c) Implementation of public education programs;

(d) Identification and removal of illegal discharges;

(e) Identification of suitable locations for potential stormwater retrofits (such as riparian areas) that could be funded by various sources; and

(f) Submittal of an annual report on October 30 to the Division documenting progress on and net changes to nitrogen load from the local government's planning jurisdiction.

(5) Within 12 months of the EMC's approval of the model local government stormwater program or later designation (as described in Item (3) of this Rule), subject local governments shall submit their local stormwater management program plans to the Commission for review and approval. These local plans shall equal or exceed the requirements in Item (4) of this Rule. Local governments may submit a more stringent local stormwater management program plan. Local stormwater management programs and modifications to these programs shall be kept on file by the Division of Water Quality.

(6) Within 18 months of the EMC's approval of the model local government stormwater program or designation, subject local governments shall adopt and implement a local stormwater management program according to their approved plan. 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.

(7) If a local government fails to submit an acceptable local stormwater management program plan within the time frames established in this Rule or fails to properly implement an approved plan, then stormwater management requirements for existing and new urban areas within its jurisdiction shall be administered through the NPDES municipal stormwater permitting program per 15A NCAC 2H .0126.

(a) Subject local governments shall develop and implement comprehensive stormwater management programs, tailored toward nitrogen reduction, for both existing and new development.

(b) These stormwater management programs shall provide all components that are required of local government stormwater programs in Sub-items (4)(a)-(f) of this Rule.

(c) Local governments that are subject to an NPDES permit shall be covered by the permit for at least one permitting cycle (five years) before they are eligible to submit a local stormwater management program for consideration and approval by the EMC.

History Note: Authority G.S. 143-214.1; 143-214.7; 143-215.1; 143-215.3(a)(1); S.L. 1995, c. 572;

Eff. August 1, 1998.

Appendix C. The Nitrogen Cycle

Forms of Nitrogen

Although nitrogen is the major pollutant of concern for the Neuse 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

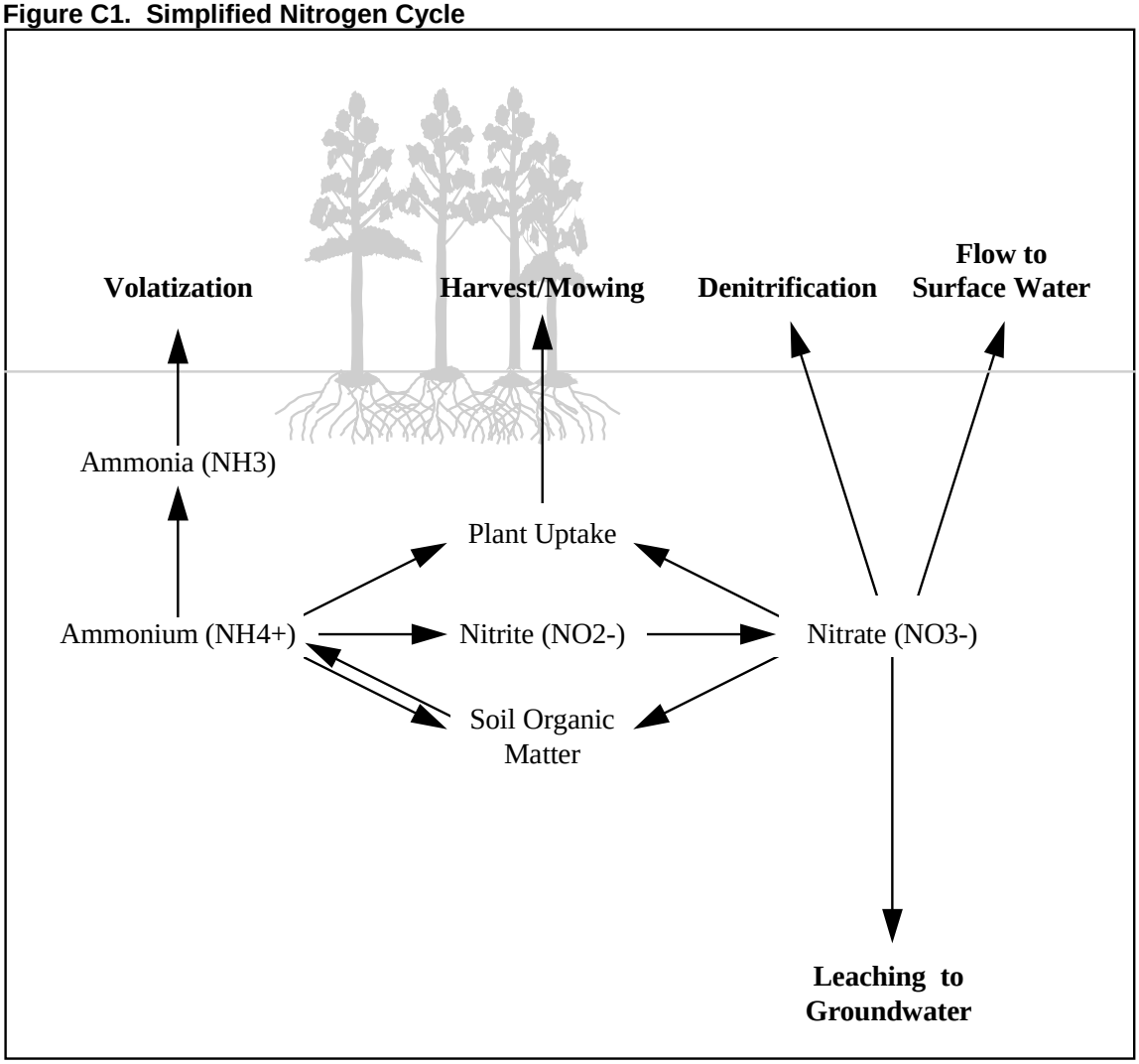
Nitrogen can be easily lost into the environment by various pathways. Those pathways include volatilization, leaching and runoff, and crop removal.

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 D. 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

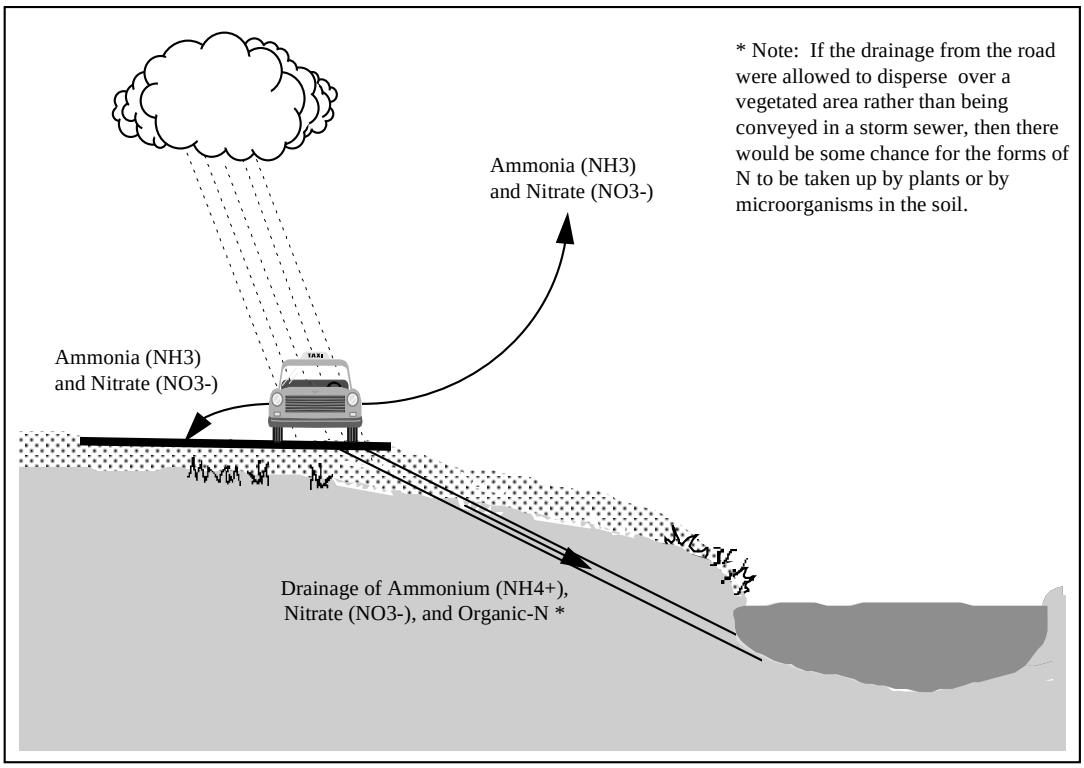
Atmospheric Deposition

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.

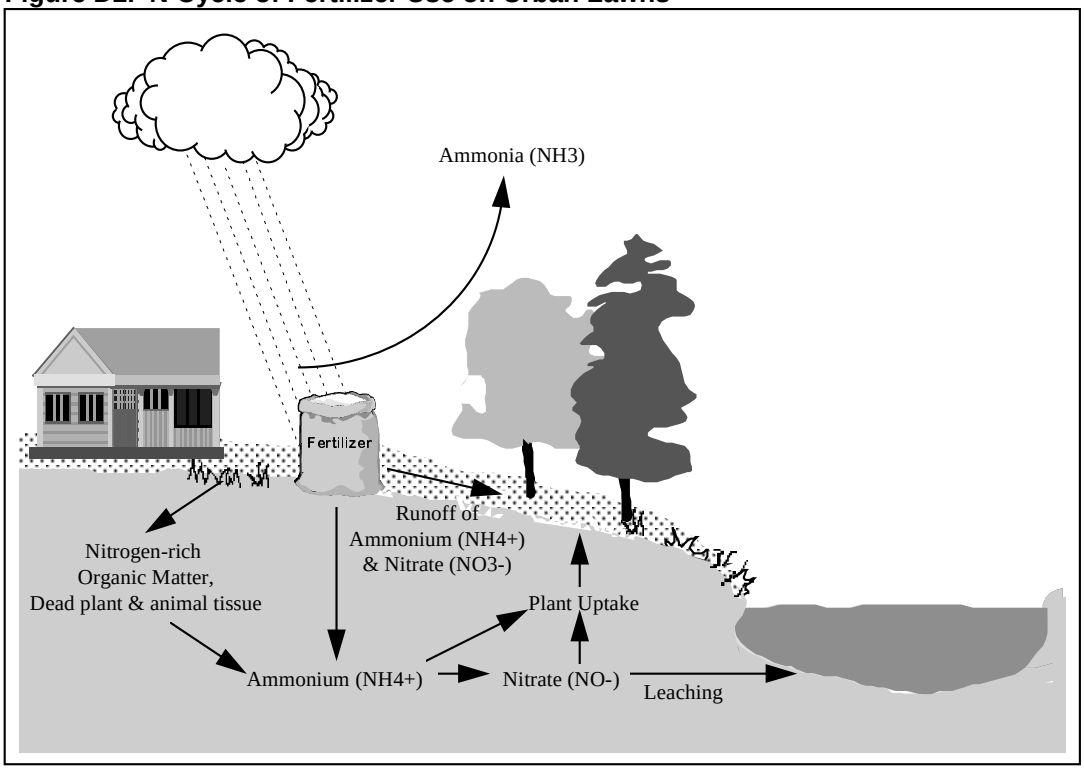
Fertilizers

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 bluegrass	watered	early season fert. Clippings left	194	2.27	Geron et al. 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.

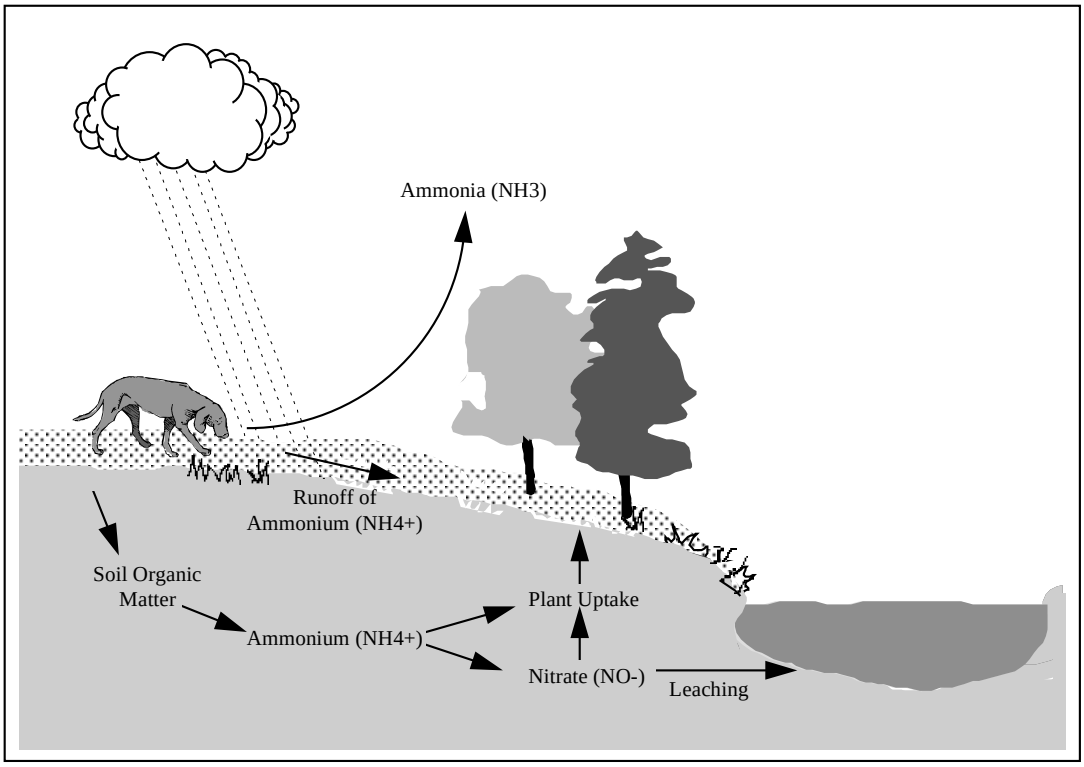
- DWQ, DEH, local health departments, and community groups should increase surveillance of their local streams to help to identify areas where on-site wastewater treatment systems are failing.

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.

References

Alliance for the Chesapeake Bay. Environmentally-Sound Landscape Management. Richmond, VA.

American Groundwater Trust (AGWT). 1990. Everything you wanted to know about septic tanks. Dublin, OH.

Aveni, M. 1994. Homeowner Survey Reveals Lawn Management Practices in Virginia. *Watershed Protection Techniques.* 1(2): 85-86.

Barth, C. A. 1995. Nutrient Movement from the Lawn to the Stream? *Watershed Protection Techniques.* 2(1): 239-246.

Cohen, S., S. Nickerson, R. Maxey, A Dupuy and J. Senita. 1990. A groundwater monitoring study of pesticides and nitrates associated with golf courses on Cape Cod. Groundwater Monitoring Review. 160-173.

Maryland Cooperative Extension Service, 1995. Green Lawns: The Smart Way. Annapolis, MD.

Metropolitan Washington Council of Governments. 1983. Urban Runoff in the Washington Metropolitan Area. Final NURP Report. Department of Environmental Programs. Washington, D.C. 212 pp.

Morton, T., A. Gold and W. Sullivan. 1988. Influence of Overwatering and Fertilization of Nitrogen Losses from Urban Lawns. *J. Environmental Quality.* 17: 124-130.

NC Division of Water Quality. July 1996. Neuse River Nutrient Sensitive Waters (NSW) Strategy. Raleigh, NC. p. 8.

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

Appendix E. Process of Developing the Model Stormwater Program

The Neuse Stormwater Team has played a key role in developing the model program for controlling nitrogen from urban stormwater in the Neuse basin. Local governments have worked in cooperation with DWQ staff to create a model program that is technically sound and implementable. In summer 1999, this program, along with the Team's recommendation, will be submitted to the Environmental Management Commission for their approval. Once approved, the program will serve as a model for all municipalities and counties in the Neuse River basin that are required to develop a local stormwater program for nitrogen control.

The team met once a month, usually on the third Thursday, to develop the model program. Different local governments hosted each meeting in their jurisdiction's facilities.

The participants agreed to the following responsibilities as team members:

1. Follow-through on commitments to the Stormwater Team, including completing background reading, preparing information and reviewing team proposals.

2. Report back to the jurisdiction/group they are representing on the progress of the Stormwater Team and bring feedback back to the team.

3. Provide constructive input into the strategies that are developed by the Stormwater Team.

4. Work within their appropriate realm of influence to contribute to the successful implementation of the local stormwater program developed by the Stormwater Team.

5. Host at least one stakeholder meeting if possible.

The deliverable of the Neuse Stormwater Team is this model stormwater management program, which will consist of the following:

1. A model program for evaluating new developments to determine if they meet nitrogen control standards.

2. Model criteria for identifying appropriate retrofit sites.

3. Guidance for implementing an illegal discharges program.

4. A model educational program to reduce nitrogen in urban stormwater.

Team members divided themselves into three workgroups as follows:

- New Development Review/Approval
- Public Education
- Stormwater Retrofits/Illegal Discharges

The majority of the work involved in gathering information and formulating proposals occurred in the three workgroups. Each of the workgroups had a "facilitator" (either from the Division of Water Quality or the Cooperative Extension Service) who was be responsible for keeping discussions running smoothly. The workgroups will be largely responsible for setting their agendas and priorities. However, they also had input from the larger team.

All decisions about the model stormwater program were made in a forum that included the entire team. All decisions about the model program were made by consensus.

The Stormwater Team met at least once a month between March 1998 and June 1999. During that time, the team developed the model stormwater program. The model was presented to the Water Quality Committee (WQC) on July 7, 1999. The WQC, upon the recommendation of some of the stakeholders, requested that the team reconvene for an additional 60 days to resolve some outstanding issues. The Stormwater Team and the workgroups held several meetings in July and August. All outstanding issues were resolved to the satisfaction of the stakeholder representatives in attendance at the final meeting on August 27, 1999, including (a) staff members representing the affected local governments; (b) DWQ staff representatives; and (c) representatives of other stakeholders. The model will be presented to the WQC on September 8, 1999. Upon their approval, the plan will be presented to the Environmental Management Commission (EMC) for final approval on September 9, 1999.

The Stormwater Team will continue to meet at a minimum of once a year in August (before the annual reports are due). The team may meet more often if it so chooses.

Approach for Meeting the New Development Review/Approval Requirements

At an early meeting, the New Development Workgroup set up some goals they called "yardsticks" for their model program. These yardsticks, or RUMBA, are the criteria that the workgroup expects the model stormwater program to meet. These goals shaped the discussion and decisions of the New Development Workgroup on issues regarding regulation of new development. The yardsticks are listed in Table E1 below.

Table E1: Yardsticks for the New Development Workgroup

Reasonable	• Acceptable to Community • Flexible • Cost-effective

Understandable	• Can be translated into specific technical guidance
Measurable	• Meets the intent of the rule
Big Picture	• Provides incentives for planning • Consistent with existing regulations • Considers future regulations • Considers other issues like transportation, safety, air quality, etc.
Achievable	• Implementable • Enforceable • Can be maintained

One of the challenges that the New Development Workgroup faced was information management. The workgroup's responsibility was to ensure that new development meets the rule requirements, including specific nitrogen export goals. There were two important tasks that the workgroup had to complete in order to meet the rule requirements:

1. Quantifying the nitrogen loading from different types of urban land uses.

2. Quantifying the nitrogen reductions that can be expected from various types of management practices.

The workgroup quickly found that it did not have ideal information to make these crucial decisions. Much of the data on the nitrogen loadings from urban areas covered fairly large and diverse watersheds and was not readily translated to individual developments. Additionally, some of the data was over 20 years old and some was collected from different regions of the country that the workgroup believed may not apply readily to the Neuse River basin. In addition, each study collected data on different forms of nitrogen and, in some cases, the workgroup believed that monitoring techniques were suspect.

The workgroup decided to utilize nitrogen loading data collected from the municipalities in this region of the state with populations exceeding 100,000. These municipalities are currently required to have a federal NPDES permit for their stormwater collection and discharge systems. One of the requirements of their permits is a stormwater monitoring program. The subject municipalities selected monitoring sites that represent specific types of urban development; for example, low and high density residential, commercial and industrial. Besides being applicable to this region and representing specific types of development, the large municipalities' monitoring data was all less than five years old.

Determining the nitrogen removal expected from BMPs was also a challenge. As Chapter 2 describes, nitrogen is a difficult pollutant to remove once it has entered the environment. The only way to completely remove it from the system is through denitrification. Denitrification requires a chain of natural events that is dependent on the presence of denitrifying bacteria, organic material and appropriate levels of oxygen, water table and temperatures. It is difficult to ensure that stormwater BMPs installed in a natural system consistently achieve high nitrogen removals.

Based on their research, the workgroup concluded that one of the best ways to manage nitrogen is NOT to remove it after it is transported from a development, but to design the new development to reduce the transport of nitrogen away from the development. Based on the information presently available, the group concluded that the nitrogen load that development transports to surface waters can be reduced by permanently protecting open space in the development and reducing the amount of impervious surface in a development.

The workgroup collected data on different types of BMPs based on studies conducted in the Southeast (states of MD, VA, NC, SC and FL). The credit given for nitrogen removal is equivalent to the average of the removals found in various studies. As the charts in Section 5-E show, the removal rates found from similar BMPs vary widely in different studies.

The workgroup also discussed maintenance of BMPs. There was consensus that maintenance of BMPs is vital to their ongoing performance and that this will not be accomplished without appropriate policies in place.

Approach for Meeting the Illegal Discharge Requirements

In crafting the model program for Illegal Discharges, the Neuse Stormwater Team relied heavily on the experiences of the communities that have already been implementing Illegal Discharge programs under their Phase I NPDES Municipal Stormwater Permits (Raleigh and Durham). The main goal of the team was to find the most cost-effective and efficient means of preventing, identifying and removing Illegal Discharges.

The team's goal for a cost-effective and efficient program is reflected in the following aspects of the model Illegal Discharges program:

- Local governments are not being asked to create new maps of their jurisdictions showing locations of infrastructure, land uses, surface waters, etc. Instead, they are required to compile existing information so it can be consulted efficiently when needed.
- Each year, local governments are required to select a high priority area (consisting of at least ten percent of their jurisdictions) where they will focus their mapping and field screening efforts. The stormwater collection system mapping and field screening will be done only in the high priority areas, not across the entire jurisdiction. This approach also attempts to build in equitability in that the size of the high priority area will be proportional to the size of the overall jurisdiction.

- Local governments are required to establish an Illegal Discharges Hotline. This effort requires minimal resources but, based on the experiences of Raleigh and Durham, is effective at identifying illegal discharges. When the discharge is of an episodic nature, it may be the only way to identify an illegal discharge.

Appendix F. Development of Nitrogen Export Methodologies

Method for Quantifying TN Export from New Developments

1. Based on water quality monitoring data from Fayetteville, Raleigh and Durham, estimate that:

Cpervious	1.4 mg/L
Cimpervious	2.6 mg/L

2. Utilize Schueler's "Simple Method" for determining pollutant export in lbs/ac/yr from new development:

$L = [(P) (P_j) (R_v) / 12] (C) (2.72)$

where:

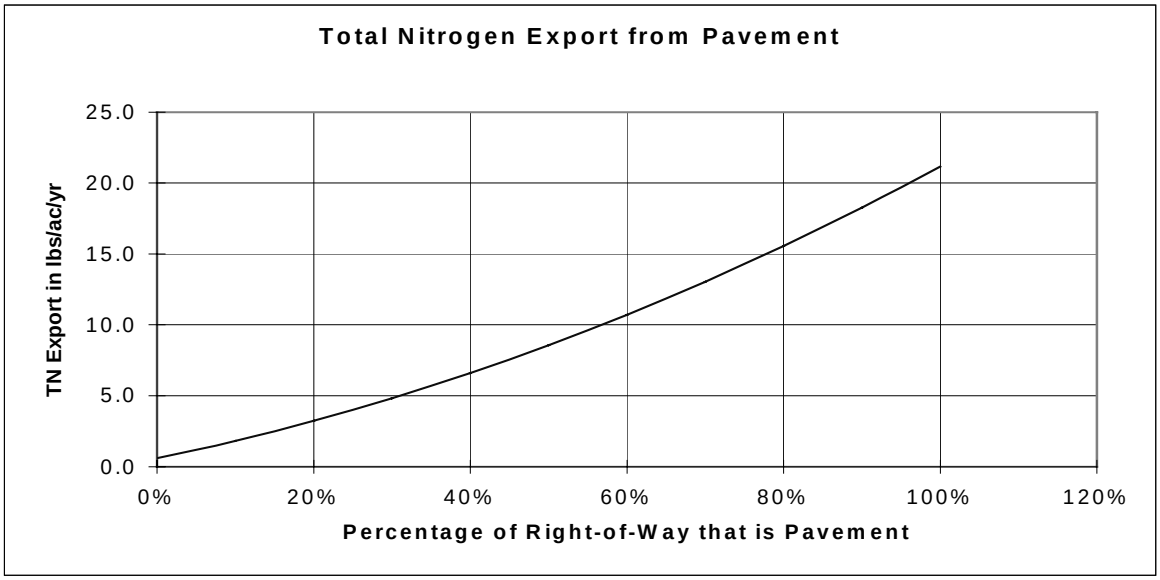
P =	42 in	(rainfall expected in one year)
P_j =	0.9	(correction factor for storms w/no runoff)
R_v =	0.05 + 0.009*I	(runoff coefficient, the fraction of rainfall converted to runoff, I = percent impervious)
C =	1.4 to 2.6 mg/L	(flow-weighted mean concentration of the pollutant -- see above)

3. Figure out the concentrations and export coefficients associated with different percentage impervious covers on a right-of-way or lot.

Portion Impervious	C * (mg/L)	Exp. Coeff. ** (lbs/ac/yr)
0%	1.40	0.6
10%	1.52	1.8
20%	1.64	3.2
30%	1.76	4.8
40%	1.88	6.6
50%	2.00	8.6
60%	2.12	10.7
70%	2.24	13.1
80%	2.36	15.6
90%	2.48	18.3
100%	2.60	21.2

* This is a weighted average of the pervious and impervious concentrations given in Step 1.
** This results from applying the formula given in Step 2 with the appropriate concentration.

4. Graph the result to get relationship between percentage of right-of way that is pavement and TN export in lbs/ac/yr.

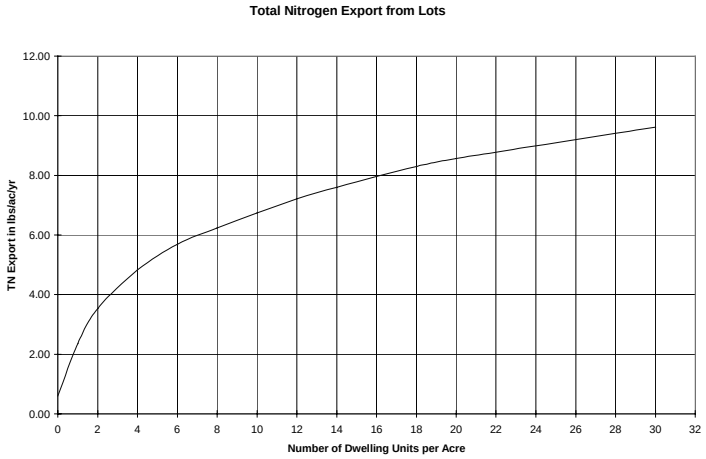


5. Utilize information from the City of Raleigh on percent impervious cover expected on each lot for various zoning categories.

Dwelling units per acre	Portion Impervious	C * (mg/L)	Exp. Coeff. ** (lbs/ac/yr)
0	0.00	1.40	0.6
1	0.14	1.57	2.4
2	0.22	1.66	3.5
4	0.30	1.76	4.8
6	0.35	1.82	5.7
8	0.38	1.86	6.2
10	0.41	1.89	6.7
12	0.43	1.92	7.2
14	0.45	1.94	7.6
16	0.47	1.96	8.0
18	0.49	1.98	8.3
20	0.50	2.00	8.6
30	0.55	2.06	9.6

* This is a weighted average of the pervious and impervious concentrations given in Step 1.
** This results from applying the formula given in Step 2 with the appropriate concentration.

6. Graph the relationship between number of dwelling units per acre and TN export in lbs/ac/yr.



Appendix G. 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 occurs 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).

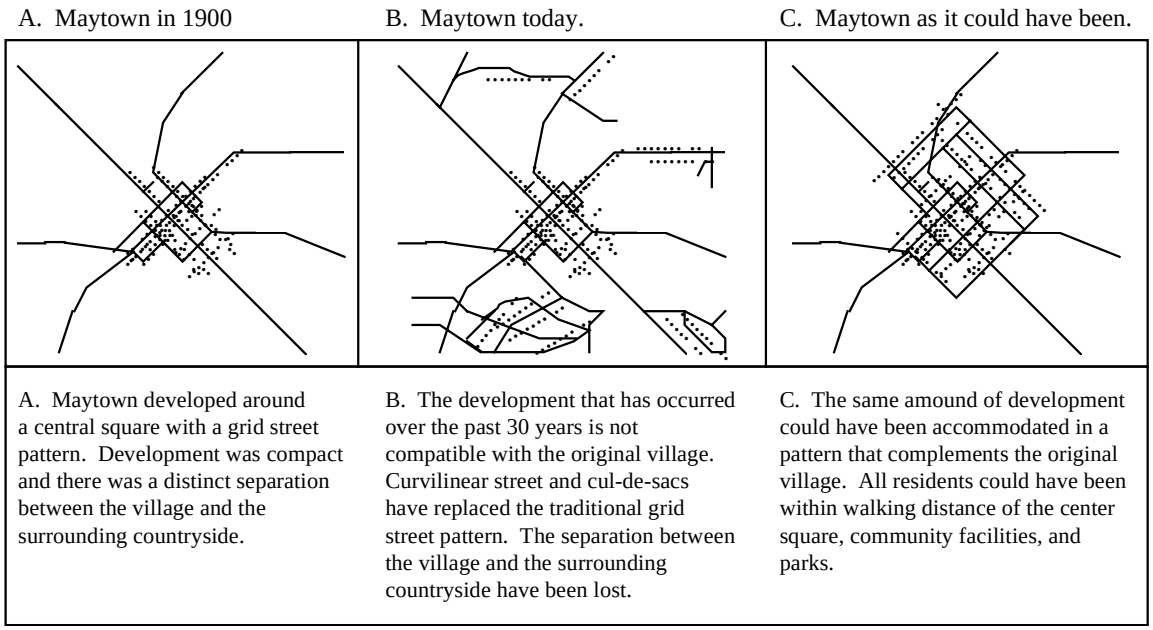
Other Techniques

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)



Appendix H. Summary of BMP Literature Studies

Wet Ponds

Summary of Research Conducted in the Southeast, 1983 - Present

Study	Location	No. of Samples	Drainage Area	Land use	TN (%)	ON (%)	NH4 (%)	TKN (%)	NO3 (%)	Notes
Borden et al., 1998	NC	22	1258 ac	farmland	16	---	2	---	16	used continuous samplers during storms total P=46% DP=58%
Borden et al., 1998	NC	25	1221 ac	industrial	36	---	-64	---	66	total P=40% DP=15%
City of Austin, 1991	TX	14	381 ac		39	---	28	26	45	
City of Austin, 1996	TX	7	27.1 ac	Industrial, 66% imp.	19	---	---	47	-17	WQV = 0.5
Cullum, 1985	FL	9	122 ac	comm.	15	---	---	---	80	3.11 in/ac
Dorman et al., 1989	FL	6	26.3 ac	highway	---	---	---	68	97	2.35 in/ac
Driscoll, 1983	MD	32	48 ac	---	37	---	---	27	---	1.27 in/ac, high algal uptake
Gain, 1996	FL	22	41.6 ac	---	16	20	17	---	24	0.55 watershed-inches of storage
Holler, 1989	FL	8	105.7 ac	mall	---	---	55	58	87	First 1" of runoff, detention storage volume = 2.2", 90% impervious watershed
Kantrowitz and Woodham, 1995	FL	6	1280 ac	---	---	2	40	---	23	0.21-0.26 watershed-inches of storage
Martin, 1988	FL	11	41.6 ac	highway	30	34	34	---	28	0.55 in/ac
MWCOG, 1983	VA	28	88 ac	---	10	---	---	---	9	
OWML, 1983 (b)	VA	29	27.1 ac	---	32	---	---	---	---	1.22 in/ac
Wu, 1989(a)	NC	11	437 ac	res.	---	---	---	21	---	0.33 watershed-inches, 38% impervious watershed
Wu, 1989(b)	NC	11	65 ac	mixed res.	---	---	---	32	---	7.1 watershed-inches, 46% impervious watershed, geese pop. increased N values
Yousef et al., 1986	FL	30-40	49 ac	mixed	---	---	82	---	87	3.65 in/ac, multiple-cell pond
AVERAGES	**---**	**---**	**---**	**---**	**25**	**19**	**24**	**40**	**45**	

Stormwater Wetlands

Summary of Research Conducted in the Southeast, 1983 - Present

Study	Location	No. of Samples	Drainage Area	Land use	TN (%)	ON (%)	NH4 (%)	TKN (%)	NO3 (%)	Notes
Athansas and Stevenson, 1991	MD		16 ac	School roof, p. lot, field	23	-5.4	56	---	55	0.5 in/ac
Rushton et. Al, 1995	FL	37-42	6.5 ac	Office park	--	43	72	---	73	Res. Time = 14 days, 1 watershed-inch
Athanas and Stevenson, 1986	MD		97 ac		---	---	43	---	35	0.1 inch/ac, extended detention WL
Egan et. Al, 1995	FL	15	121 ac	Industrial	63	---	---	63	75	Packed bed filter – 0.1 to .05 acre-ft of runoff treated per day
OWML and GMU, 1990	VA		40 ac	Res/comm, 30% imp.	36	---	68	81	68	0.1 watershed-inch, extended detention WL
Rushton and Dye, 1993	FL	23-27	6 ac	Office park	---	3	20	---	67	WQV = 0.5 inch of runoff, mean res. Time = 3.7 days, C= 0.32
Blackburn et al., 1992	FL	72	2340 ac	Golf course	---	---	15	12	26	
AVERAGES	**---**	**---**	**---**	**---**	**41**	**14**	**46**	**52**	**57**	

Sand Filters

Summary of Research Conducted in the Southeast, 1983 - Present

Study	Location	No. of Samples	Drainage Area	Land use	TN (%)	ON (%)	NH4 (%)	TKN (%)	NO3 (%)	Notes
Bell et. Al, 1995	VA	20	0.7 ac	Parking lot	47	---	---	71	-53	Perimeter sand filter, 95’ length, filter bed area = 238 sq. feet
Welborn and Veehuis, 1987	TX	22	80 ac	Commercial	27	---	---	57	-100	Surface sand filter
City of Austin, 1990	TX	18	79 ac	Mall – 86%	44	---	43	64	-13	Surface sand filter, 0.5 inch
City of Austin, 1990	TX	17	50 ac	66% imp.	71	---	94	90	23	Surface sand filter, 1.7 inch
Barton Springs, 1996	TX	8	4.9 ac	Highway – 59% imp.	15	---	---	35	-87	Vegetated filter of 36” limestone and gabion, preceded by filtration pond.
AVERAGES	**---**	**---**	**---**	**---**	**39**	**---**	**43**	**64**	**-55**	

Open Channel Practices

Summary of Research Conducted in the Southeast, 1983 - Present

Study	Location	No. of Samples	Drainage Area	Land use	TN (%)	ON (%)	NH4 (%)	TKN (%)	NO3 (%)	Notes
Barrett, et al	TX	423	32	highway				33	50	total P=44%
Barrett, et al	TX	423	258	highway				44	23	total P=34%
Dorman et Al, 1989	VA	9	1.27 ac	Highway, 67% imp.	---	---	---	17	11	2-yr erosive velocity, 10-yr capacity
Harper, 1988	FL	16	0.83 ac	Highway, 70% imp.	84	86	78	---	80	2-yr erosive velocity, 10-yr capacity, Tc = 45 min., Swale age = 16 yrs.
Harper, 1988	FL	11	1.17 ac	Highway, 100% imp.	40	39	-11	---	52	2-yr critical velocity, 10-yr capacity, Tc = 9 mins., Swale age = 23 yrs.
OWML, 1983	MD	50	19 ac	Residential	-18	---	---	---	---	2-yr control velocity, 10-yr capacity
OWML, 1983	MD	8	12 ac	Res., lg. Lot	37	---	---	---	---	2-yr control velocity, 10-yr capacity
Yousef et. Al, 1985	FL	6	---	Highway	13	---	---	-20	11	30-60 min. residence time, 0-2.8 watershed-inches
AVERAGES	**---**	**---**	**---**	**---**	**31**	**63**	**34**	**17**	**39**	

References

Barrett, M.E., Walsh, P.M., Malina, J.F., Charbeneau, R. J.; Performance of Vegetative Controls for Treating Highway Runoff. J. of Env. Eng. November 1998, Vol. 124, No. 11

Bordon, R., J. Dorn, J. Stillman, S. Lier. Effect of In-Lake Water Quality on Pollutant Removal in Two Ponds; J. of Env. Eng. August 1998, Vol. 124, No. 8

Cahoon, L.B., Water Quality Variability in Stormwater Detention Ponds in New Hanover County, NC.

City of Austin, TX. 1991. Design Guidelines for Water Quality Control Basins. Public Works Department, Austin, TX. 64 pp.

City of Austin, TX. 1996. Evaluation of Nonpoint Source Controls; a 319 Grant Project. Draft Water Quality Report Series. COA-ERM-196-03.

Cullum, M. 1985. Stormwater Runoff Analysis at a Single-Family Residential Site. University of Central Florida at Orlando. Publication 85-1: 247-256.

Dorman, M.E., J. Hartigan, R.F. Steg, and T. Quasebarth. 1989. Retention, Detention and Overland Flow for Pollutant Removal from Highway Stormwater Runoff. Vol. 1 Research Report. Federal Highway Administration. FHWA/RD 89/202. 179 p.

Driscoll, E. D. 1983. Performance of Detention Basins for Control of Urban Runoff Quality. Presented at the 1983 International Symposium on Urban Hydrology, Hydraulics and Sediment Control. University of Kentucky, Lexington, KY. 40 p.

Gain, W.S. 1996. The Effects of Flow Path Modification on Water Quality Constituent Retention in an Urban Stormwater Detention Pond and Wetland System. Orlando, FL. U.S. Geological Survey. Water Resources Investigation Report 95-4297. Tallahassee, FL

Holler, J.D. 1989. Water Quality Efficiency of an Urban Commercial Wet Detention Stormwater Management System at Boynton Beach Mall in South Palm Beach County, FL. Florida Scientist. Winter 1989. Vol. 52(1): 48-57

Kantrowitz, I. and W. Woodham. 1995. Efficiency of a Stormwater Detention Pond in Reducing Loads of Chemical and Physical Constituents in Urban Streamflow. Pinellas County, Florida. U.S. Geological Survey. Water Resources Investigation Report: 94-4217. Tallahassee, FL. 18 p.

Martin, E.H. 1988. Effectiveness of an Urban Runoff Detention Pond/ Wetland System. Journal of Environmental Engineering. Vol. 114(4): 810-827.

Metropolitan Washington Council of Governments. 1983. Final Report: Pollutant Removal Capability of Urban BMPs in the Washington Metropolitan Area. Prepared for the U.S. Environmental Protection Agency. 64 p.

Occoquan Washington Monitoring Laboratory. 1983 (b). Final Report: Metropolitan Washington Urban Runoff Project. Prepared for the Metropolitan Washington Council of Governments. Manassasas, VA. 460 p.

Rushton, B. T. and Dye, C. W. January 1993. An In-depth Analysis of a Wet Detention Stormwater System. Southwest Florida Water Management District, Brooksville, FL.

Rushton, B., C. Miller, C. Hull and J. Cunningham. June 1997. Three Design Alternatives for Stormwater Detention Ponds. Southwest Florida Water Management District, Brooksville, FL.

Schehl, T.P. and T.J. Grizzard. 1995. Runoff Characterization From an Urban Commercial Catchment and Performance of an Existing Underground Detention Facility in Reducing Constituent Transport. Proceedings of the 4th Biennnial Stormwater Research Conference. October 18-20, 1995. Clearwater, FL. Sponsored by the Southwest Florida Water Management District. p. 190-199.

Wu, J. S. July 1989. Evaluation of Detention Basin Performance in the Piedmont Region of North Carolina. Water Resources Research Institute, Charlotte, NC.

Wu, J. S., B. Holman and J. Dorney. 1988. Water Quality Study on Urban Wet Detention Ponds. (in) "Design of Urban Runoff Quality Controls." L. A. Roesner, B. Urbonas and M. B. Sonnen, eds. American Society of Civil Engineers. New York, New York. pp. 280-289.

Yousef, Y.A., M.P. Wanielista, and H. H. Harper. 1986. "Design and Effectiveness of Urban Retention Basins." (in): Urban Runoff Quality - Impact and Quality Enhancement Technology. B. Urbonas and L.A. Roesner, eds. American Society of Civil Engineers. New York, New York. pp. 338-350.

Appendix I. Example of a Stormwater Maintenance Program

This space intentionally left blank

CHAPTER 6.
HEALTH, SANITATION AND PUBLIC NUISANCES*

Sec. 12-6001.
ENFORCEMENT BY INSPECTION DEPARTMENT.

The Department of Inspections is charged with the duty of full enforcement of this chapter and any inspector thereof is clothed with full power and authority imposed by this chapter and is hereby authorized and directed to proceed to carry out its provisions; provided that the identification of nuisances and the required abatement as described in §12-6002(r) *shall* be the responsibility of the transportation director or his designee.
(Ord. No. 1995-785, §1, 11-21-95)

Sec. 12-6002.
NUISANCES PROHIBITED; ENUMERATION.

The *following* enumerated and described conditions are hereby found, deemed and declared to constitute a detriment, danger and hazard to the health, safety, morals, and general welfare of the inhabitants of the *City* and are found, deemed and declared to be public nuisances wherever the same *may* exist and the creation, maintenance, or failure to abate any nuisances is hereby declared unlawful.

(a) Any condition which is a breeding ground or harbor for mosquitoes or a breeding ground or harbor for rats or other pests, or

(b) Is a place of heavy growth of weeds or grasses over eight (8) inches in height which lie less than one hundred (100) feet from any abutting open *street* or which lie less than one hundred (100) feet from any adjoining *property* line which contains a structure; or is a place of heavy growth of weeds or grasses over eight (8) inches in height which lies within fifty (50) feet of any occupied dwelling; provided that the nuisance defined by this subsection (b) *shall* be cleared and cut not less than three (3) inches in height, or

(c) Is a place of vines, shrubs, or other vegetation over eigh (8) inches in height when:

(1) Such vines or vegetation lie less than one hundre (100) feet from any adjoining *property* line an when such conditions are not located within floodplain or not located on any slope that i steeper than three (3) to one (1) (horizontal t vertical), which has ground cover planted specifi cally for erosion purposes, and when such condi tion is causing a breeding ground for rodents and hazard detrimental to public health, or

(2) Such vines, shrubs, or vegetation are a focal poin for any other nuisance enumerated in this code provided that the nuisance herein defined by this subsection (c)(2) *shall* be cleared and cut only when it is necessary to abate any other nuisance described in this section, or

(d) Is a place of growth of poison sumac *(Rhus vernix)*, poison ivy *(Rhus radicans)*, or poison oak *(Rhus toxicodendron)* and other noxious vegetation; or

(e) Is an open place of collection of stagnant water where insects tend to breed; or

(f) Any concentration of combustible items such as mattresses, boxes, paper, automobile tires and tubes, garbage, trash, refuse, brush, old clothes, rags, or any other combustible materials or objects of a like nature; or

(g) Any concentration of building materials including concrete, steel or masonry which are not suitable for building construction, alterations or repairs, and which are in open places; or

(h) Is an open place of collection of garbage, food waste, animal waste, or any other rotten or putrescible matter of any kind; however, nothing in this subsection *shall* be construed to prevent the generally accepted use of a properly maintained compost pile or storage of animal manure being used as fertilizer for lawns and gardens and for other agricultural or horticultural purposes; or

(i) Privies; or

(j) Hides, dried or green; provided the same *may* be kept for sale in the *City* when thoroughly cured and odorless; or

(k) Any household or office furniture, appliances, or other metal products of any kind or kept in open places; or

(l) Any products which have jagged edges of metal or glass or areas of confinement which are kept in open places; or

(m) Any open place of concentration of discarded bottles, cans or medical supplies; or

*Editor's note: Former Ch. 5 of Part 7 was renumbered as Ch. 6 of Part 12 by §51 of Ord. No. 1983-245-TC-205, adopted Dec. 6, 1983. Subsequently, Ord. No. 1995-785, §1, adopted Nov. 21, 1995, set out a new Ch. 6 and repealed the old Ch. 6, §§12-6001—12-6004, which had pertained to similar subject matter and derived from *Code 1959*, §§12-1—12-3; Ord. No. [illegible]11, §§1—12, adopted May 3, 1977; Ord. No. 1985-577-TC-232, §34, adopted March 5, 1985; Ord. No. 1991-747, §§2, 3, adopted March 19, 1991; and Ord. No. 1995-573, §1, adopted March 7, 1995.

(n) Any improper or inadequate drainage on private *property* which causes flooding, interferes with the use of, or endangers in any way the *streets*, sidewalks, parks or other *City* owned *property* of any kind; provided, the notices required and powers conferred by this chapter by and on the Department of Inspections in abating the nuisances defined by this subsection (n) *shall* be given and exercised by the Director of Public Works; or

(o) Any condition which blocks, hinders or obstructs, in any way the natural flow of branches, streams, creeks, surface waters, ditches or drains; or

(p) Any collection of water for which no adequate natural drainage is provided and which is or is likely to become a nuisance and a menace to health; or

(q) Any stormwater retention or impoundment device which is operating improperly; or

(r) Any condition whereby any *person* owning or having the legal control of any land within the corporate limits of the *City* maintains or permits upon any such land any fence, sign, billboard, shrubbery, bush, tree, mailbox, or other object or combination of objects which obstructs the view of motorists using any *street*, private driveway, or approach to any *street* intersection adjacent to and abutting such land so as to constitute a traffic hazard as a condition dangerous to public safety upon any such *street*, private driveway, or at any such *street* intersection; or

(s) Any other condition specifically declared to be a danger to the public health, safety, morals, and general welfare of inhabitants of the *City* and public nuisance by the *Council*;

which proceeding *may* be initiated by the Department of Inspections before the *Council* after giving *written* notice in conformity with §12-6003(a) hereof, which notice will state the condition existing, the location, and that the *Council* will be requested on a day certain, after a public hearing at which the *person* notified *may* appear and be heard, to declare that the conditions existing constitute a danger to the public health, safety, morals, and general welfare of the inhabitants of the *City* and a public nuisance, and that after such declaration by the *Council* in the form of an ordinance the condition will be abated as provided for in §12-6003(b) hereof; provided no appeal *shall* lie from a proceeding initiated by the Department of Inspections before the *Council* of the *City* as provided in this subsection.

(Ord. No. 1995-785, §1, 11-21-95)

Sec. 12-6003. NUISANCE ABATEMENT PROCEDURES.

When any public nuisance as set out in §12-6002 is found to exist on any *property*, including rights-of-way and easements within the *City* and one (1) mile beyond the *City* limits, the *following* procedures *shall* be followed:

(a) The Department of Inspections of the *City shall* notify the *owner* of the premises where the nuisance is located that conditions exist which constitute a public nuisance and unless the condition is abated within fifteen (15) days from the mailing of the notice which *shall* be sent by registered mail, return receipt requested, the conditions constituting a nuisance will be abated and the cost of abatement, including an administrative fee of one hundred twenty-five dollars ($125.00), also including the cost, if any to reseed areas which were formerly a nuisance, *shall* constitute a lien against the premises. Provided, the costs of abating nuisances so declared by §12-6002(o) and (p) under the condition described in subsection (d) hereof *shall* be limited to the amounts indicated therein.

(b) The Department of Inspections is hereby given full power and authority to enter upon the premises involved for the purpose of abating the nuisance found to exist as herein set out. Within the fifteen-day period mentioned in subsection (a) hereof the *owner* of the *property* where the nuisance exists *may* appeal the findings of the Department of Inspections made pursuant to subsection (a) hereof to the *Council* by giving *written* notice of appeal to the Department of Inspections, the appeal to stay the abatement of the nuisances by the Department of Inspections until a final determination by the *Council*. In the event no appeal is taken, the Department of Inspections *may* proceed to abate the nuisance.

(c) The *Council* in the event an appeal is taken as provided in subsection (b) hereof *may*, after hearing all interested *persons* and reviewing the findings of the Department of Inspections, reverse the finding made pursuant to subsection (a) hereof; but if the *Council shall* determine that the findings of the Department of Inspections made pursuant to said subsection is correct and proper it *shall* adopt an ordinance specifically declaring the condition existing on the *property* to be a danger and hazard to the health, safety, morals, and general welfare of the inhabitants of the *City* and a public nuisance and directing the Department of Inspections to cause the conditions to be abated.

(d) After the abatement of the nuisance as provided in subsection (a), (b) or (c) hereof the cost of such abatement *shall* become a lien against the premises

upon confirmation of the cost thereof by the *Council*, which said confirmation *shall* take place only after ten (10) days' *written* notice to the *owner* of the premises where the nuisance existed of the proposed confirmation. Provided, when a nuisance, described and declared by §12-6002(o) and (p) results from the present inadequacy, due to subsequent development, of a storm drainage pipe, which was adequate when installed and which is directly connected to a public facility owned and maintained by the *City*, the materials portion of the confirmed cost of abating the nuisance by replacing the inadequate pipe with an adequate one *shall* not exceed the difference between the replacement cost of a pipe the size of the existing one and the new cost of a larger pipe thirty-six (36) inches in diameter. The full labor costs of the project *shall* also be assessed. Upon confirmation the cost of abatement *shall* be a lien against the premises from which the nuisance was abated the same to be recorded as provided in *G.S.* 160A-216 et seq. and to be collected as unpaid taxes.

(Ord. No. 1995-785, §1, 11-21-95)

Sec. 12-6004.
NUISANCES PROHIBITED; ENUMERATION; ABATEMENT IN GREENWAY PROPERTIES.

(a) Greenway *properties shall* mean any interest in *real property* owned by the *City*, leased to the *City*, or any dedicated greenway easement to the *City* which:

(1) Is actually used as a linear park network and is primarily left in its natural state except for the introduction of a connector system of trails for use by pedestrians and bicyclists; and

(2) Appears on the *Council* approved Greenway Plan which is on file in the office of the City Clerk and Treasurer.

(b) The *following* enumerated and described conditions are hereby found, deemed, and declared to constitute a detriment, danger, and hazard to the health, safety, morals, and general welfare of the inhabitants of the *City* and are found, deemed, and declared to be public nuisances wherever the same *may* exist and the creation, maintenance, or failure to abate said nuisances is hereby declared unlawful:

(1) Any concentration of combustible items such as mattresses, boxes, paper, automobile tires, and tubes, garbage, trash, refuse, old clothes, rags, or any other combustible materials or objects of a like nature in open places;

(2) Any concentration of building materials including concrete, steel or masonry which are not suitable for building construction, alterations or repairs and which are in open places; or

(3) An open place of collection of garbage, foc waste, animal waste, or any other rotten or putrescib matter of any kind; however, nothing in th subsection *shall* be construed to prevent the ge: erally accepted use of a properly maintained cor post pile or storage of animal manure being used : fertilizer for lawns and gardens and for oth: agricultural or horticultural purposes; or

(4) Privies;

(5) Hides, dried or green; provided the same *may* b kept for sale in the *City* when thoroughly cured an odorless;

(6) Any household or office furniture, appliances, c other metal products of any kind or nature kept i open places;

(7) Any products which have jagged edges of metal c glass or areas of confinement which are openl kept in places including porches and carports; or

(8) Any open place of concentration of discarde bottles, cans or medical supplies; or

(9) Any improper or inadequate drainage which cause flooding on private *property*, interferes with th use of or endangers in any way *City*-owned *street:* sidewalks; provided, the notices required and pow ers conferred by this chapter by and on the Depart ment of Inspections for abating the nuisance defined in this subsection (9) *shall* be given an: exercised by the Director of Public Works; or

(10) Any other condition specifically declared to be : danger to the public health, safety, morals, an: general welfare of inhabitants of the *City* and : public nuisance by the governing body of the *Cit* which proceeding *may* be initiated by the Depart ment of Inspections before the *Council* after givin: *written* notice in conformity with subsection (c hereof, which notice will state the condition exist ing, the location, and that the *City Council* will b: requested on a day certain, after a public hearing a which the *person* notified *may* appear and b: heard, to declare that the conditions existing con stitute a danger to the public health, safety, morals and general welfare of the inhabitants of the *Cit* and a public nuisance, and that after such declara tion by the *Council* in the form of an ordinance th condition will be abated as provided in subsectior (d) hereof; provided no appeal *shall* lie from a proceeding initiated by the Department of Inspec tions before the *Council* of the *City* as provided ir this subsection.

(c) When any public nuisance as set out in subsection (b hereof is found to exist on any *property* includin:

upon confirmation of the cost thereof by the *Council*, which said confirmation *shall* take place only after ten (10) days' *written* notice to the *owner* of the premises where the nuisance existed of the proposed confirmation. Provided, when a nuisance, described and declared by §12-6002(o) and (p) results from the present inadequacy, due to subsequent development, of a storm drainage pipe, which was adequate when installed and which is directly connected to a public facility owned and maintained by the *City*, the materials portion of the confirmed cost of abating the nuisance by replacing the inadequate pipe with an adequate one *shall* not exceed the difference between the replacement cost of a pipe the size of the existing one and the new cost of a larger pipe thirty-six (36) inches in diameter. The full labor costs of the project *shall* also be assessed. Upon confirmation the cost of abatement *shall* be a lien against the premises from which the nuisance was abated the same to be recorded as provided in *G.S.* 160A-216 et seq. and to be collected as unpaid taxes.

(Ord. No. 1995-785, §1, 11-21-95)

Sec. 12-6004.

NUISANCES PROHIBITED; ENUMERATION; ABATEMENT IN GREENWAY PROPERTIES.

(a) Greenway *properties shall* mean any interest in *real property* owned by the *City*, leased to the *City*, or any dedicated greenway easement to the *City* which:

(1) Is actually used as a linear park network and is primarily left in its natural state except for the introduction of a connector system of trails for use by pedestrians and bicyclists; and

(2) Appears on the *Council* approved Greenway Plan which is on file in the office of the City Clerk and Treasurer.

(b) The *following* enumerated and described conditions are hereby found, deemed, and declared to constitute a detriment, danger, and hazard to the health, safety, morals, and general welfare of the inhabitants of the *City* and are found, deemed, and declared to be public nuisances wherever the same *may* exist and the creation, maintenance, or failure to abate said nuisances is hereby declared unlawful:

(1) Any concentration of combustible items such as mattresses, boxes, paper, automobile tires, and tubes, garbage, trash, refuse, old clothes, rags, or any other combustible materials or objects of a like nature in open places;

(2) Any concentration of building materials including concrete, steel or masonry which are not suitable for building construction, alterations or repairs and which are in open places; or

(3) An open place of collection of garbage, food waste, animal waste, or any other rotten or putrescible matter of any kind; however, nothing in this subsection *shall* be construed to prevent the generally accepted use of a properly maintained compost pile or storage of animal manure being used as fertilizer for lawns and gardens and for other agricultural or horticultural purposes; or

(4) Privies;

(5) Hides, dried or green; provided the same *may* be kept for sale in the *City* when thoroughly cured and odorless;

(6) Any household or office furniture, appliances, or other metal products of any kind or nature kept in open places;

(7) Any products which have jagged edges of metal or glass or areas of confinement which are openly kept in places including porches and carports; or

(8) Any open place of concentration of discarded bottles, cans or medical supplies; or

(9) Any improper or inadequate drainage which causes flooding on private *property*, interferes with the use of or endangers in any way *City*-owned *streets*, sidewalks; provided, the notices required and powers conferred by this chapter by and on the Department of Inspections for abating the nuisances defined in this subsection (9) *shall* be given and exercised by the Director of Public Works; or

(10) Any other condition specifically declared to be a danger to the public health, safety, morals, and general welfare of inhabitants of the *City* and a public nuisance by the governing body of the *City* which proceeding *may* be initiated by the Department of Inspections before the *Council* after giving *written* notice in conformity with subsection (c) hereof, which notice will state the condition existing, the location, and that the *City Council* will be requested on a day certain, after a public hearing at which the *person* notified *may* appear and be heard, to declare that the conditions existing constitute a danger to the public health, safety, morals, and general welfare of the inhabitants of the *City* and a public nuisance, and that after such declaration by the *Council* in the form of an ordinance the condition will be abated as provided in subsection (d) hereof; provided no appeal *shall* lie from a proceeding initiated by the Department of Inspections before the *Council* of the *City* as provided in this subsection.

(c) When any public nuisance as set out in subsection (b) hereof is found to exist on any *property* including

Appendix J. Examples of Ordinances to Establish Legal Authority for Illegal Discharge Programs

This space intentionally left blank

Sec. 23-135. Publication of public notice of significant violations of pretreatment standards by industrial users.

The approving authority or his authorized representative shall publish public notice on a semi-annual basis in the largest daily newspaper in the City, pursuant to 40 CFR Part 25 and Section 403.8(f)(2)(vii), and 15 NCAC 2H.0905, of industrial users who have had any significant violations of federal categorical pretreatment standards during the preceding six-month period. Such industrial users will be billed for and shall pay the cost of publication. (Ord. No. 7478, § 1, 4-5-88)

Secs. 23-136—23-139. Reserved.

ARTICLE V. STORM SEWERS*

DIVISION 1. REGULATION

Sec. 23-140. Definitions.

(a) The provisions of section 23-90 concerning definitions, apply to this article.

(b) The following definitions, in addition to those to which reference is made in subsection (a) may apply when the following words are used in this article:

Storm sewer system means catch basins, pipes, sewers, drains, culverts, open ditches, creeks and rivers which carry surface water and unpolluted water. A "storm sewer system" may be located on public or private property or both.

Surface water means runoff from rainfall or ground watering which finds its way naturally into ditches and creeks. (Ord. No. 6720, § 1, 5-6-85)

Sec. 23-141. Enforcement and administration of article.

The city manager or his designee is hereby authorized to enforce and administer the provisions of this article and other laws

*Editor's note—Ord. No. 6720, § 1, adopted May 6, 1985, amended Art. V, §§ 23-140—23-152, relative to storm sewers in its entirety to read as herein set out in new Art. V, Div. 1, §§ 23-140—23-149, Div. 2, §§ 23-150—23-154. Former Art. V derived from Code 1964, §§ 18-87—18-99.

and regulations of the city concerning storm sewers unless a contrary intention is expressed in such other laws and regulations. (Ord. No. 6720, § 1, 5-6-85)

Sec. 23-142. Depositing certain substances in storm sewer system.

It is unlawful for any person to empty or deposit in any storm sewer system in the city, directly or indirectly, any substance, liquid or solid, which by reason of its nature, it:

(1) Is or may become a public health hazard endangering human or animal health.

(2) Is a nuisance, including substances which are unsightly or malodorous or may become so.

(3) Interferes or may interfere with free and rapid flow of surface water.

(4) Is inflammable or explosive.

(5) Is toxic to plant or animal life.

(6) Is corrosive or has properties which may damage or render unsightly the storm sewer system.

(7) Affects adversely the State of North Carolina classification of the stream into which the storm sewer system discharges. (Ord. No. 6720, § 1, 5-6-85)

Sec. 23-143. Obstructing storm sewer systems.

It is unlawful for any person to place any obstruction in any storm sewer system. This section does not apply to the construction, reconstruction or alteration of storm sewer systems in a manner consistent with sound engineering practices. (Ord. No. 6720, § 1, 5-6-85)

Cross reference—See also § 18-7.

Sec. 23-144. Obstructing free flow of surface water.

It is unlawful for any person to construct, install or maintain any storm sewer system in such a manner as to obstruct or impede the free flow of surface water. This section does not apply to the construction, reconstruction or alteration of storm sewer systems in a manner consistent with sound engineering practices. (Ord. No. 6720, § 1, 5-6-85)

Sec. 23-145. Permit required for construction, repair or alteration of storm sewer systems.

No person shall construct, repair or alter any storm sewer for the purpose of draining water from any land or premise unless he shall have first applied for and obtained therefor a permit from the city manager. The application shall be in writing and on a

form provided by the city manager. The city manager shall issue the permit unless the city manager finds that the construction or repair work or alterations proposed would be contrary to the provisions of this article. The city manager may impose reasonable conditions upon the issuance of the permit to insure compliance with this article which conditions may include, but shall not be limited to, specifications of the materials to be used and the manner in which the work or alteration is to be performed. It is unlawful for any person to perform any work or make any alteration for which a permit is required under this section except in compliance with said permit. (Ord. No. 6720, § 1, 5-6-85)

Sec. 23-146. Inspection by city manager or designee.

Consistent with applicable law, the city manager or his designee is authorized to go upon private property for the purpose if inspecting storm sewer systems. (Ord. No. 6720, § 1, 5-6-85)

Sec. 23-147. Nuisances.

(a) The existence of any condition which obstructs or impedes the free flow of surface water contrary to the provisions of this article shall constitute a nuisance.

(b) Any condition which violates the provisions of section 23-142 constitutes a nuisance. (Ord. No. 6720, § 1, 5-6-85)

Sec. 23-148. Notice to property owner of obstruction.

If the city manager finds any storm sewer system to be constructed, arranged, clogged or in such disrepair as to impede, obstruct or hinder the free flow of surface water in a manner which conflicts with acceptable engineering practices, he shall give notice in writing to the owner of the premises on which the condition exists to remedy the condition within such time as the city manager may reasonably prescribe. It shall be the duty of said owner to remedy or cause to be remedied the said condition within the time prescribed by the city manager, provided however, said owner may request an informal hearing before the city manager or his designee by giving written notice of such request to the city manager within the time prescribed by the city man-

ager. The city manager or his designee shall fix the time and place for such informal hearing. A timely request for informal hearing made pursuant to this section suspends the requirements of the city manager's earlier notice until the city manager or his designee issues a further notice subsequent to the informal hearing. (Ord. No. 6720, § 1, 5-6-85)

Sec. 23-149. Violations; penalties.

(a) A violation of section 23-142 shall be a misdemeanor punishable in the manner prescribed by G.S. 14-4 for each separate violation.

(b) A violation of section 23-143 shall be a misdemeanor punishable in the manner prescribed by G.S. 14-4 for each separate violation.

(c) A violation of section 23-144 shall be a misdemeanor punishable in the manner prescribed by G.S. 14-4 for each separate violation.

(d) Any person who fails to comply with a notice issued by the city manager pursuant to section 23-148 shall upon conviction be guilty of a misdemeanor as provided by G.S. 14-4. Each day a person continues to fail to comply with said notice shall be a separate and distinct offense.

(e) Each day a violation prescribed under subsections (a), (b) and (c) of this section continues shall be a separate and distinct offense.

(f) This article may be enforced by any remedy prescribed by G.S. 160A-175. (Ord. No. 6720, § 1, 5-6-85)

Cross reference—Additional penalties, § 23-132.

DIVISION 2. LIMITED ACCEPTANCE OF STORM SEWERS FOR PUBLIC MAINTENANCE

Sec. 23-150. Purpose.

The purpose of this division 2 is to provide for acceptance of private drainage pipes which have a diameter of twelve (12) inches or more by the city for the limited purpose of removing obstructions from such pipes. The provisions of this division 2 do

cess to the *property* and who can deactivate the system. Failure to so appear will result in the assessment of a civil penalty pursuant to §13-4003(d).

(Ord. No. 1990-652, §1. 10-2-90)

Editor's note: Ord. No. 1990-652, §1. adopted Oct. 2. 1990, amended this chapter by renumbering former §13-4002 as §13-4003 and adding new provisions as §13-4002.

Sec. 13-4003. PENALTY PROVISIONS.

(a) If, within any twelve-*month* calendar *year*, the Raleigh Police Department responds to a second and third *alarm* at the same premises or location where no evidence indicates that an unauthorized entry, burglary, robbery or other crime was committed or attempted, the Chief of Police *shall* send a letter to the *alarm subscriber* informing him of the *false alarms*, encouraging the review or repair of the *alarm* system, and explaining that future *false alarms* could result in the assessment of civil penalties.

(b) Beginning with the fourth *false alarm* within any twelve-*month* calendar *year* at the same premises or location where no evidence indicates that an unauthorized entry, burglary, robbery or other crime was committed or attempted, the Chief of Police or his designee *shall* issue to the known *owner* or *person* having control of any place of business or *residence* a civil penalty citation giving notice of the violation of this chapter. Citations *may* be served in *person* or mailed by registered mail to the *person* charged.

(c) All audible *alarms* must be reset and cease to sound after thirty (30) minutes of continuous activation. An *alarm* that sounds continuously in excess of thirty (30) minutes from the time officers arrive at the *alarm* location *shall* constitute a violation of this chapter. Every subsequent sixty-minute period *following* the initial thirty (30) minutes during which the *alarm* continues to sound *shall* constitute a separate violation. The *subscriber* will be assessed a ten dollar-civil penalty for each sixty-minute period of continuous operation of an *alarm*. not to exceed two hundred dollars ($200.00) for any twenty-four-hour period. This fee will be in addition to a fifty-dollar-penalty which *may* be assessed for a *false alarm* under subsection (d).

(d) Each citation issued *shall* impose upon the *person* cited a civil penalty of fifty dollars ($50.00) which *shall* be paid to the City Revenue Collector within fourteen (14) days of issuance in full satisfaction of the assessed civil penalty. If the civil penalty is not paid within the time prescribed in the citation. the *City* may initiate a civil action in the nature of debt to collect such civil penalty.

(Ord. No. 1990-533, §3. 4-17-90; Ord. No. 1990-652, §1. 10-2-90)

Note: See the editor's note *following* §10-4002.

CHAPTER 5. OFFENSES AGAINST THE ENVIRONMENT*

Sec. 13-5001. TITLE.

This chapter *shall* be known and *may* be cited as the City of Raleigh's "Illicit Discharge Ordinance."

(Ord. No. 1995-573, § 2, 3-7-95)

Sec. 13-5002. PURPOSES.

(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 Raleigh under its *National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4)* discharge permit issued by the *State*; and

(4) Establishing administration and enforcement procedures through which these purposes can be fulfilled.

(b) The provisions of this regulation are supplemental to regulations administered by Federal and *State* governments.

(Ord. No. 1995-573, § 2, 3-7-95)

Sec. 13-5003. ACRONYMS.

DEHNR: North Carolina Department Environment Health and Natural Resources.

*State law references: G.S. Chapter 113A Article 4 (Pollution Control Act); G.S. Chapter 143 Article 21 (Water and Air Resources); Emission of pollutants and contaminants. G.S. 160A-185; Raleigh City Charter §2.14(50); 1989 Session Law, Chapter 1043 (Authorizes City of Raleigh to regulate stormwater).

DEM: North Carolina Division of Environmental Management.

MS[4]: Municipal separate storm sewer system.

NPDES: National Pollutant Discharge Elimination System.
(Ord. No. 1995-573, § 2, 3-7-95)

Sec. 13-5004. DEFINITIONS.

As used in this chapter, unless the context clearly indicates otherwise, the *following* definitions apply:

Illicit connection. Any unlawful connection which allows the discharge of non-*stormwater* to 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*.

Municipal separate storm sewer system (MS[4]). 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 Raleigh, 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.

Federal law reference: National Pollutant Discharge Elimination System Permits, 33 USC §1342.

Pollution. Man-made or man-induced alteration of the chemical, physical, biological, thermal, and/or radiological integrity of water.

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. Surface waters within or flowing through the boundaries of the *State* including the *following*: any intermittent or perennial stream, river, creek, brook, swamp, lake, sound, tidal estuary, bay, reservoir, wetland, or any other surface water or any portion thereof that is mapped as solid or dashed blue lines on United States Department of the Interior Geological Survey 7.5 minute series topographic maps. 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*.
(Ord. No. 1995-573, § 2, 3-7-95)

Sec. 13-5005. SCOPE AND EXCLUSIONS.

This chapter *shall* apply within the territorial jurisdiction of the *City*, with the *following* exclusions:

(1) Federal, *State*, and local governments, including their agencies, unless intergovernmental agreements have been established giving the *City* enforcement authority.

(Ord. No. 1995-573, § 2, 3-7-95)

Sec. 13-5006. 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.

(Ord. No. 1995-573, § 2, 3-7-95)

Sec. 13-5007. NON-STORMWATER DISCHARGE CONTROLS.

(a) ***Illicit discharges.***

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) 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) Irrigation water;

(11) *Street* wash water;

(12) Flows from fire fighting;

(13) Discharges from the pumping or draining of natural watercourses or waterbodies;

(14) Flushing and cleaning of *stormwater conveyances* with unmodified potable water;

(15) Wash water from the cleaning of the exterior of buildings, including gutters, provided that the discharge does not pose an environmental or health threat; and

(16) Other non-*stormwater* discharges for which a valid NPDES discharge permit has been approved and issued by DEM, and provided that any such discharges to the *municipal separate storm sewer system shall* be authorized by the *City*.

Prohibited substances include but are not limited to: oil, anti-freeze, chemicals, animal waste, paints, garbage, and litter.

State law references: Emission of pollutants and contaminants, *G.S.* 160A-185, Raleigh *City* Charter §2.14(50), and 1989 Session Laws, Chapter 1043.

Cross reference: Discharge onto *City streets*, sidewalks, or gutters, §12-1032 and depositing waste on land in the *City*, §7-3005(c)(2), (3).

(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. Prohibited 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 in violation of §13-5007 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:

a. *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, or

b. Was made in violation of any applicable regulation or ordinance.

the City Manager 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.

Editor's note: This regulation first became applicable on March 12, 1995.

Permits are issued by the Inspections Department for connection to or modification of storm sewers located in *City* owned rights-of-way.

State law reference: Emission of pollutants and contaminants. *G.S.* 160A-185.

(c) **Spills.**

Spills or leaks of polluting substances discharged to, or having the potential to be indirectly transported to the *stormwater conveyance system, shall* be contained, controlled, collected, and removed promptly. All affected areas *shall* be restored to their preexisting condition.

Persons associated with the spill or leak *shall* immediately notify the City of Raleigh Fire Chief or his designee of all spills or leaks of polluting substances. 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.

(Ord. No. 1995-573, § 2, 3-7-95)

Sec. 13-5008. ENFORCEMENT.

(a) **Authority to enter.**

Any authorized *City* personnel *shall* be permitted to enter upon public or private *property* for the purposes of observation, inspection, sampling, monitoring, testing, surveying, and measuring compliance. Should the *owner* or occupant of any *property* refuse to permit such reasonable access, the City Manager or his designee *shall* proceed to obtain an administrative search warrant pursuant to *G.S.* 15-27.2 or its successor.

No *person shall* obstruct, hamper or interfere with any such representative while carrying out his official duties.

(b) **Civil penalties.**

(1) *Illicit discharges.*

Any designer, engineer, contractor, agent, or any other *person* who allows, acts in concert, 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 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 connections.**

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.

d. Procedures for assessing penalties pursuant to *illicit connections*.

Said penalties *shall* be assessed by the City Manager 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.

Penalties *shall* be assessed by the City Manager 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 City Manager or his designee *shall* make *written* demand for payment upon the *person* in violation. If the 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 court of justice in Wake County for recovering the penalty.

(c) Injunctive relief.

(1) Whenever the City Council 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.

(Ord. No. 1995-573, § 2, 3-7-95)

Cross reference: Declaration of public nuisance, §12-6002(p).

Appendix K. Example Screening Report Forms

This space intentionally left blank

NPDES FIELD INVENTORY LOG-SHEET

COMPLETED BY: _____ DATE: _____

TAX MAP: _____

STREAM: _____ TRIB: _____ STRUCTURE: _____

DESCRIPTION

Location: _____

_____

Pipe_____ Box_____ Arch _____ Ellips_____ Channel_____ Other_____

Diameter_____ Height_____ Width_____ Material: _____

AM Flow: ___yes ____No

Color: _____

Odor: _____

Turbidity: _____

Oil Sheen: _____

Surface Scum: _____

PM Flow: ___yes ____No

Color: _____

Odor: _____

Turbidity: _____

Oil Sheen: _____

Surface Scum: _____

Adjacent Land Use: _____

DRY WEATHER SAMPLE

DAYS SINCE LAST SIGNIFICANT RAIN (>0.1 in) 3 minimum: _____

	SAMPLE 1	SAMPLE 2
TIME (minimum 4 hrs. between)	_____	_____
FLOW RATE (gpm)/cfs.....	____/____	____/____
OR - Depth of Flow	_____	_____
Width of Flow	_____	_____
Velocity fps.	_____	_____

Flow rate = area x velocity

POLLUTANT		
Temperature.....	_____ C	_____ C
pH.....	_____	_____
Total Chlorine.....	_____mg/l	_____mg/l
Total Copper.....	_____mg/l	_____mg/l
Total Phenol.....	_____mg/l	_____mg/l
Detergents / Surfactants..	_____mg/l	_____mg/l

City of Durham
Stormwater Services Division

Flow Inspection & Analysis Record

Insp. Team: _____
Date: _____
ADC Map #: _____

Outfall ID #: _____

☐ Citizen's Request? File No. _____

Time: _____

☐ Dry Weather Flow Analysis? ID No. _____

Air Temp: _____ °C

☐ Rain within 72 hrs?

Flow:
☐ None ☐ Trickle
☐ Intermittent ☐ Continuous
☐ Standing water

Sky:
☐ Clear
☐ P. Cloudy
☐ Cloudy
☐ Overcast

☐ **Physical Observations Different From Last Visit:**

Odor:	**Color:**	**Turbidity:**	**Floatables:**	**Deposits/stains:**	**Vegetation conditic**
☐ none	☐ none	☐ clear	☐ none	☐ none	☐ normal
☐ musty	☐ yellow	☐ cloudy	☐ petro. sheen	☐ sediment	☐ excessive growth
☐ sewage	☐ brown	☐ opaque	☐ sewage	☐ oily	☐ inhibited growth
☐ sulfide	☐ red	☐ particles	☐ foam	☐ rust	☐ other: see below
☐ oil	☐ green	☐ black floc		☐ other: _____	
☐ gas	☐ gray		☐ other: _____		
☐ rancid-scur	☐ other: _____				
☐ other: _____					

Extent of Effect on Vegetation: _____

Field Analysis:

Field Instrument

☐ Temperature Pens
☐ YSI
Temp: _____ °C
☐ pH Pens
☐ YSI
pH: _____

Chemetrics Field Test Kits

		Sample Filtered?
Total Chlorine:	_____ mg/L	☐
Total Copper:	_____ mg/L	☐
Phenols:	_____ mg/L	☐
MBAS:	_____ mg/L	☐
Phosphate:	_____ mg/L	☐
Ammonia:	_____ mg/L	☐

Field Measurements

TDS: _____ g/L
DO: _____ %
DO: _____ mg
Spec Cond: _____ µs/c

Comments: _____

☐ Entered in Database?

Staff initials: _____

Form Dryinsp6

11/21/96

City of Durham
Stormwater Services Division

Outfall Identification and Inspection Record

Field Outfall ID: _____ *(AC)*
Ogden's ID: _____ *(if known)*
ADC Map #: _____ *(##J-##)*
Land Use in Drainage Area:
☐ Res ☐ Com ☐ Ind
☐ Ag ☐ Forest ☐ Open

Location:
Nearest Block/Street(s): _____
Major Sub-Basin: _____ Creek: _____
Map Number: _____ GIS Outfall ID: _____ (if known)
Specific Location:
_____
_____

Outfall Description:
Size: _____ ☐ in/ ☐ ft
(diameter or width x height)
Type *(check one)*:
☐ Corrugated Metal Pipe
☐ Box culvert
☐ Concrete
☐ Cast Iron
☐ Other: _____

Team: _____
Date: _____
Time: _____
(24 hour clock)
☐ Citizen's Request?
File No. _____
☐ Dry Weather Flow Analysis?
ID No. _____

Weather:
Air Temp: _____ °C
☐ Rain within 72 hrs?
☐ Ground wet?

Sky *(check one)*:
☐ Clear
☐ P. Cloudy
☐ Cloudy
☐ Overcast

ow: *heck)*
☐ No flow (or very little)
☐ Continuous, trickle
☐ Continuous, moderate
☐ Intermittent, no baseflow
☐ Intermittent w/ low baseflow
☐ Intermittent w/ mod baseflow

☐ Standing water?
☐ Flow source identified?
_____

Field Comments: _____
_____
_____

Physical Observations *(outfall or discharge)*:

Odor:	Color:	Floatables:	Turbidity:	Deposits/stains:	Vegetation conditions:
☐ none	☐ none	☐ none	☐ clear	☐ none	☐ N/A
☐ musty	☐ yellow	☐ petrol sheen	☐ cloudy	☐ sediment	☐ normal
☐ sewage	☐ brown	☐ sewage	☐ opaque	☐ oily	☐ excessive growth
☐ sulfide	☐ red	☐ foam	☐ particles	☐ rust	☐ inhibited growth
☐ oil	☐ green		☐ black floc	☐ algae	☐ other: _____
☐ gas	☐ gray	☐ other: _____		☐ other: _____	
☐ rancid-sour	☐ other: _____				
☐ other: _____					

Extent of Effect on Vegetation: _____

Biological Observations: *(at discharge & downstream, check all that apply)*
mosquito larvae
snails
'adpoles
.sh
☐ other _____

Damage to Outfall Structure:
☐ none
☐ concrete cracking/spalling
☐ concrete erosion
extent: _____
☐ N/A
☐ paint peeling
☐ metal corrosion
☐ other: _____

☐ Entered in Database? By: (Staff initials) Photo: Roll# Photo #

City of Durham
Stormwater Services Division

WATER QUALITY COMPLAINT / INSPECTION RECORD

Note: Shaded areas should be filled in before going out to field

CR File Number: _____ *(9:CR99)*

ADC Map #: _____ *(##L-##)*

Description of Problem and Location:

Complaint Description: _____

Complaint Location: _____

Team: ☐ CO ☐ New ☐ MF ☐ BH ☐ PW ☐ JC ☐ other

Investigation
Date: _____
Time: _____ *(24 hour clock)*

Complaint from:
Name: _____
Address: _____
Home Phone #: _____
Work Phone #: _____
Other: _____ *(pager, e-mail, etc.)*

Complaint Source*(check one)*:
☐ Hotline ☐ Staff Initiated
☐ Walk-In ☐ Emerg. Mgmt.
☐ Call In ☐ Health Dept.
☐ WWW ☐ Erosion Ctrl.
☐ Other _____
Call date: _____ Time: _____ *(24 hour clock)*

Field Observations *(if different):*

Investigator's Description: _____

Street Address (Nearest): _____

Property Type*(check one)*:
☐ Public
☐ Residential
☐ Commercial
☐ Industrial
☐ Unimproved

Water Quality Problem:
☐ Sheen Present.....Describe: _____
☐ Odor Present.....Describe: _____
☐ Floatables Present .Describe: _____
☐ Other..... Describe: _____
☐ Discharge to creek....Creek Name: _____

Probable Source of Water Quality Problem *(check main items that apply)*:
☐ Illicit Connection
☐ Improper Housekeeping
☐ Trash/Garbage in Channel
☐ Other (see details)
☐ None found
☐ Petroleum spill/release
☐ Other Spill _____
☐ Failing Septic System
☐ Sewer lateral (house, apt, etc.)
☐ Washing machine discharge

City Sanitary Sewer System:
☐ Overflow
☐ Broken pipe
☐ Other _____
Sub: _____ Basin: _____
Manhole: Up-MH: _____
Down-MH: _____

Chemetrics Test Performed ☐ Yes ☐ No..... Flow Inspection Record No.: _____

☐ Water Quantity Problem.....Condition: _____

Details:

Findings:

Actions:

Referrals:
☐ Health Dept. ☐ Planning&Zng
☐ W&S Maint.. ☐ Housing Srvcs
☐ W&S Engr. ☐ NC-DWQ

☐ Picture Taken:
Roll #: _____ Photo #: _____

Respond to Complainant By: (date)_____
☐Phone ☐ Letter ☐In Person

☐ Field Sketch

Tax Map #: _____ **Property Owner Name:** _____ **Mailing Address:** _____

☐ Entered In Database ? By: _____(staff initials)

CITY OF RALEIGH
STORMWATER MANAGEMENT

ILLICIT DISCHARGE COMPLAINT FORM

I. ILLICIT DISCHARGE INFORMATION SOURCE:

ID NUMBER: .....DATE: .....

METHOD: ...H...(HOT LINE)...L...(LETTER)...IP...(IN PERSON)...D...(DEPT. REF.)...O...(OTHER).....

LAST NAME: .....FIRST NAME: .....

STREET NAME: .....STREET NO: .....CITY: .....ZIP: .....DAY PHONE: .....

SOURCE: ...C...(CITIZEN)....G....(GOVT. AGENCY)....D...(CITY DEPT).....O...(OTHER).....

DEPARTMENT REFERRAL: .....

SOURCE RECONTACTED(Y/N; DATE): .....P...(PHONE)....L...(LETTER).....IP....(IN PERSON).....

COMMENTS: .....

REFFERED TO ANOTHER DEPT.(Y/N): DEPT:.....DATE: .....

II ILLICIT DISCHARGE LOCATION:

STREET NAME: .....STREET NO.: .....

DRAINAGE BASIN: .....TRIBUTARY: .....STRUCTURE: .....

TAX MAP NO.: .....PARCEL: .....PIN NO.: .....

DESCRIPTION: .....

III. ILLICIT DISCHARGE CHARACTERISTICS:

LAND USE:..R..(RESIDENTIAL)....C...(COMMERCIAL)...I...(INDUSTRIAL)....OS...(OPEN SPACE)....O...(OTHER).....

OWNERSHIP: .....PUBLIC.....PRIVAT

DEVELOPMENT AGE:.....0-5.....5-20..... >20

ODOR(Y/N).....COLOR(Y/N) .....pH: .....TEMP: .....

FIELD TEST: .....

FIELD SAMPLE TAKEN: .....Y/N.....DATE: .....TIME: .....

SAMPLE DELIVERED TO E.M. J.W.T.P LAB:.....Y/N.....DATE: .....TIME: .....

RESULTS RECEIVED FROM LAB (DATE).....INDICATORS :.....

.....

.....

SOURCE?:.....

COMMENTS:.....

.....

.....

..ILLICIT DOC

Appendix L. Letter to Prevent Illegal Discharges

This space intentionally left blank

4/20/99

Ms. Laura Garraway
Raleigh Chamber of Commerce
PO Box 2978
Raleigh, NC 27602

City Of Raleigh
North Carolina

Re: City of Raleigh's Illicit Discharge Ordinance

Dear Ms. Garraway,

I have enclosed the information that our office (Central Engineering) would like to disseminate to certain business categories within your organization. This information could be added to any of your general mailings or as you deem appropriate. We feel that the Chamber of Commerce may be a valuable asset for educating these businesses.

The following is a listing of the business types that we would like to reach;

Vehicle rental agencies
Painting contractors
Carpet cleaners
Automotive repair and service shops
Automobile body repairing and painting
Automobile dealers new and used
Automobile service stations
Car washing and detailing
Oil change services
Limousine service
Lawn care companies
Lawn maintenance companies
Pest control companies
Kennels
Janitor service
Air conditioning/heating contractors
Apartments
Boilers-repair and cleaning
Building cleaning-exterior
Ready-mixed concrete suppliers
Swimming pool service and repair
Parking area maintenance

If you have any questions or are not able to disseminate this information, please call (890-3030).

Thank you for your assistance,

Mac Smith
Water Quality Technician

cc:File(3)

The City of Raleigh adopted an "Illicit Discharge Ordinance" on March 7, 1995 in order to satisfy requirements of the State and EPA and protect the water quality of local streams and the Neuse River. This ordinance prohibits illicit connections and/or discharges to the City's storm drain system (streets, catch basins, curbs, gutters, ditches, man-made and natural channels, pipes, culverts, etc.). Illicit discharges include any discharge other than stormwater, except for the activities listed below (*provide they do not significantly impact water quality*).

(1) 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 crawlspace pumps;

(10) Irrigation water;

(11) *Street* wash water;

(12) Flows from fire fighting;

(13) Discharges from the pumping or draining of natural watercourses or waterbodies;

(14) Flushing and cleaning of *stormwater conveyances* with unmodified potable water;

(15) Wash water from the cleaning of the exterior of buildings, including gutters, provided that the discharge does not pose an environmental or health threat; and

(16) Other non-*stormwater* discharges for which a valid NPDES discharge permit has been approved and issued by DEM, and provided that any such discharges to the *Municipal Separate Storm Sewer System shall* be authorized by the *City*.

Prohibited substances include but are not limited to: oil, anti-freeze, chemicals, animal waste, paints, garbage, and litter.

A copy of the ordinance can be obtained by calling Central Engineering with the City of Raleigh (890-3030).

Appendix M. Sample Public Education Action Plan

Public Education Action Plan for _____*(year)*			
Jurisdiction:	**Date:**	**Submitted by:**	
Category One	**# selected**	**Category Two**	**# selected**
Demonstration sites (for BMP's)		Fact sheets/brochures	
Sponsor new/Encourage expansion of "Adopt-a-Program"		Utility bill inserts or messages on bills	
Coordinate local newspaper articles		Arrange speakers for civic organizations (minimum audience of 50 people)	
Storm drain marking		Environmental freebies	
Recognition program (recognize environment friendly participants)		Postmarks	
Web page		Fertilizer tags	
Local cable TV program		Close-out packages (for new owners)	
Violation hotline (1-800 or local)			
Environmental contest			
TOTAL:		**TOTAL:**	
Minimum required (see Model Plan)		*Minimum required (see Model Plan)*	

Detail of Planned Activities		
Brief description of Activity	**Targeted Audience***	**Anticipated Cost**
Total Anticipated Cost:		

*** Note: Target Audience includes children, residents, business/industry, and civic organizations.**

Appendix N. Sample Technical Workshop Agenda

Sample Technical Workshop Agenda

Purpose:

a. Review of state model stormwater management program
b. Implementation of the local stormwater management program
c. Presentation of stormwater guidebook
d. Planning and designing for stormwater, and
e. Structural BMPs

The following is an outline of a recommended Introductory Staff Workshop agenda:

Session	Time	Resources
Session 1	**3 ¼ hours**	
I) Problems & Effects of Urbanization	15 minutes	CES, COG, DWQ
II) Why do We Need a Stormwater Program?	15 minutes	CES, COG, DWQ
III) Review Stormwater Guidance Document: New Development Illegal Discharge/Retrofit Education Enforcement	1 hour	DWQ
IV) How to Handle Rules Locally	1 hour	CES, NEG
V) Responsibilities of State and Localities	30 minutes	DWQ, NEG
VI) Implementation Timeline of Rules	15 minutes	DWQ, NEG
Session 2	**3 hours**	
VII) Presentation of Guidebook	15 minutes	DWQ, NEG
VIII) Planning & Design BMPs	45 minutes	CES (Nancy White)
IX) Structural BMPs	1 hour	CES (Bill Hunt)
X) Homeowner Technical Assistance	15 minutes	CES (Deanna Osmond)
XI) Local Implementation	15 minutes	Johnston & Craven Co, Raleigh or Durham Staff
XII) General Q&A	30 minutes	All Presenters

NEG=Neuse Education Workgroup
DWQ=Division of Water Quality
COG=Council of Governments
CES=Cooperative Extension Service
NET=Neuse Education Team

Appendix O. Alternative Approach to Public Education

New Proposed Positions: Public Information Specialist and Education Agent

To enhance basinwide education, the creation of two positions is recommended. The two positions would work closely with the local governments of the targeted communities to help implement the Model Education Plan. It is recommended that targeted communities have an opportunity to participate in this type of arrangement to lessen the burden the Model Plan requirements will impose on local governments.

There are many on-going education efforts in the Neuse River Basin, refer to North Carolina Department of Environment and Natural Resources, including the divisions of the Office of Environmental Education (OEE) and the Division of Water Quality (DWQ) and/or the NCSU Cooperative Extension Service for information on existing appropriate resources and efforts. These two positions will serve to unify the ongoing efforts and target new educational and assistance opportunities. The Specialist and Agent would work with groups currently conducting environmental programs within the basin. The Specialist and Agent could serve to build a cohesive and unified basinwide stormwater education program.

1. **Public Information Specialist (to be referred to as Specialist)**
   The Specialist would conduct basinwide media efforts that will include working closely with local television, radio, and newspapers along the entire Neuse Basin including the Triangle and New Bern-Kinston-Havelock TV markets. Therefore, the Specialist will be required to have a marketing background. A similar position has been developed successfully by the City of Greensboro.

   The Specialist will develop and utilize existing public service announcements and informative videos that would be shown, heard, or read throughout the Neuse River Basin. The Specialist shall also work closely with a newly hired Education Agent (described below), the Office of Environmental Education, the N.C. Cooperative Extension Service's Neuse Education Team, Oversight Board members, and other groups or agencies in the field of water quality.

2. **Education Agent: (to be referred to as Agent)**
   The Agent would develop and utilize existing videos and other teaching tools for teachers in the classroom; provide technical assistance to the general public; and, maintain a clearinghouse of resources for technical professionals. Whereas the Specialist is positioned to reach great populations with multi media tools, the Agent would serve in an outreach, hands-on capacity. Example activities for which the agent could be responsible:

   - Organize a county and/or basinwide educational contest, examples include speaking, poster or web-design contests.
   - Conduct environmental field days for schools or interested focus groups.
   - Conduct tours to water quality demonstration sites.
   - Organize/Conduct water quality education training workshops for educators.
   - Develop homeowner water quality Best Management Practice materials.

The Specialist and the Agent could work together to pick an environmental education focus so that a targeted, unified educational effort can be made.

Funding for the two positions is imperative and funding options are summarized below. Similar and existing work in Greensboro that involves only one TV market, one radio market, and one major newspaper requires an operating budget of approximately $300,000. The majority of the budget is spent to buy discounted time on local TV and radio and the remainder is utilized for video production and other educational materials. The same amount is recommended as a working budget for the Public Information Specialist and the Education Agent. The amount of $300,000 is minimal considering that two main TV and radio markets will be targeted in addition to at least ten local newspapers.

Oversight Board

It is suggested that if this approach is implemented, an "oversight board" be created from one representative of each targeted community. The purpose of this Board would be to serve in an administration capacity to the two (2) positions. The board will determine how to measure the success of the educational efforts and whether to renew the contracts of each position.

Housing of Positions

It is recommended that agencies or organizations interested in facilitating these positions submit an application and proposal to the Oversight Board. The Oversight Board will have the authority to select the most appropriate persons or organizations to facilitate these positions.

Funding

It is recommended that funding for the operating budget be grant generated. The persons or organization selected to facilitate the two positions would be responsible for securing operating budget funds and would need to include the plan to secure funds as part of their proposal to the Oversight Board.

It is further recommended that the budget for the two positions' salaries and benefits be funded by the participating targeted communities. The anticipated cost of this is $100,000. It is suggested that the total budget amount be equally divided between the participating communities.