

Wake County Stormwater Program
Revised Submittal for Compliance
Jordan Lake New Development Rule
March 16, 2012





Environmental Services

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Water Quality Division
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March 16, 2012

Jason Robinson, P. E.
NC Division of Water Quality
Nonpoint Source Planning Unit
1617 Mail Service Center
Raleigh, NC 27699-1617

Re: Resubmittal of Stormwater Program for Compliance - Jordan Water Supply Nutrient Strategy New Development Rule

Dear Mr. Robinson:

This letter is written in response to your email dated 2/28/12 transmitting comments from NC Division of Water Quality staff on Wake County's proposed stormwater program submitted for compliance with the Jordan Lake New development Rule. As a reminder, Wake County intends to adopt the Nutrient Strategy by reference in our existing Unified Development Ordinance and will not adopt the model ordinance. We are submitting our revised proposed stormwater program for review via the website previously used for our submission:

www.wakegov.com/water/stormwater/management/jordanlake_9_10_11.htm

As requested, we have: 1) replaced the *Adoption Timeline New Development Rule* with the Jordan timeline; 2) included a note on the Jordan Timeline regarding Wake County's adoption of buffer rules exceeding the Jordan Rules; 3) modified the *Ordinance Amendment* as requested; and 4) provided a *Full Resubmittal Document, March 16, 2012 (PDF), PART 1-2* for our complete resubmittal. Due to size, the submittal document has been divided into two parts and placed on the website. Please note that we did not include excel documents in the PDF and have labeled them as "Web Access Only".

Also, we still need an unlocked version of DENR's revised tool to reconcile any differences between the Jordan Tool and the Wake County Hybrid Tool. If you could provide us with an unlocked version, Jennifer Mitchell can verify compliance with any modified methodology. If you have any questions or need additional information, please let me know.

Sincerely,

A handwritten signature in black ink that reads "Melinda Clark". The signature is written in a cursive style with a large, stylized initial "M".

Melinda Clark
Watershed Manager
Wake County Environmental Services
Water Quality Division
P.O. Box 550
Raleigh, NC 27602
919-856-5531

CC: Mr. Joe Durham, Deputy Manager, Wake County
Mr. Scott Warren, Wake County Attorney
Mr. Britt Stoddard, Director of Water Quality Division, Wake County
Ms. Jennifer Mitchell, Environmental Engineer/Consultant, Wake County

1. Proposed Adoption Timeline and Effective Date Jordan Lake New Development Rule (Wake County, NC)

Adoption of Jordan Lake New Development Rule	Tentative Schedule	Next Steps
Ordinance Amendments		
<p>OA ---/2012 - Ordinance amendment to incorporate the Jordan Water Supply Nutrient Strategy New Development Rule (15A NCAC 02B.0265) by reference in the Wake County Unified Development Ordinance, Article 9 Stormwater Management</p>	<ul style="list-style-type: none"> ▪ 5/19/2003 - Wake County Board of Commissioners adopts riparian buffer regulations that exceed those of the Jordan Rule. See UDO Article 11 Environmental Standards, Part 2 Water Supply Watershed Buffers (Complete) ▪ 7/11/2011- presented proposed options for program compliance with the Falls Lake and Jordan Lake New Development Rule to Wake County Board of Commissioners for information at their regular work session. (Complete.) ▪ 8/4/2011- presented proposed options for program compliance with the Falls Lake and Jordan Lake New Development Rule to Wake County Planning Board for information. (Complete.) 9/9/2011 Submit program proposal for compliance to DENR for staff and EMC review. ▪ 04/2012 Contingent upon approval of proposed program by the EMC, begin local process to amend the Unified Development Ordinance to incorporate the New Development Rule by reference. (Note: This is the same method Wake County used to adopt the Neuse Rules and is the method approved by the EMC for the Falls Rules.) 	<ol style="list-style-type: none"> 1. Upon notice of approval by EMC, prepare staff report and PowerPoint presentation to Planning Board. 2. Presentation of Ordinance Amendment to Planning Board and Code and Operations Committee. 3. Prepare staff report/agenda packet, revise PowerPoint for Board of Commissioners include Planning Board recommendations and minutes. 4. Publication of legal ad in N&O for public hearing per NC General Statutes. 5. Present new development ordinance proposal at Board of Commissioner public hearing. 6. Upon adoption, Planning staff revises Unified development Ordinance to incorporate changes (w/ annotations) & lists in table of amendments. 8. Prepare notification for distribution to staff/external customers 9. Note approval of New Development Rule on web page 10. Implement New Development Rule

1. Proposed Adoption Timeline and Effective Date

Jordan Lake New Development Rule (Wake County, NC)

	<ul style="list-style-type: none">▪ 04/2012 Planning Board and Code and Operations Subcommittees' review and make recommendations (may require multiple meetings)▪ 04-05/2012 Public hearing held by Wake County Board of Commissioners and action on adoption of ordinance amendment.▪ New Development Rules become effective July 1, 2012.	
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2. Other Stormwater Programs:

[Table of Water Supply Watershed Standards in Wake County](#)

[Wake County Unified Development Ordinance, Article 9 Stormwater Management](#)

Comparison of Standards By Water Supply Watershed 06.24.2010

Type of Standard	Smith Creek WSW-II	Little River WSW-II	Swift Creek WSW - III	Jordan WSW - IV	Pending Stormwater Regs for Jordan	Falls Lake WSW - IV	Pending Fall Lake Nutrient Stds.
Impervious Surface Residential	30% per zoning	30% per zoning	Varies from 6% to 30% depending on which regulation is most restrictive: Swift Creek Land Management Plan Performance Standards or 30% per zoning	30% per zoning	30% per zoning	30% per zoning	n/a
Impervious Surface Non-residential	6% critical area, 12% non-critical area	6% critical area, 12% non-critical area	6% critical area, 12% non-critical may be increased to 24% w/SW mgt. of first 1/2" or 1" rainfall runoff depending on land use classification under SCLMP Performance Standards	6% critical area, 12% non-critical area may be increased to 24% w/SW mgt. of first 1/2" rainfall runoff	n/a	6% critical area, 12% non-critical area may be increased to 24% w/SW mgt. of first 1/2" rainfall runoff	n/a
Minimum Lot size	80,000 sq. ft. in critical area (R-80W); 40,000 sq. ft. in non-critical area (R-40W)	80,000 sq. ft. in critical area (R-80W); 40,000 sq. ft. in non-critical area (R-40W)	80,000 sq. ft. in critical area (R-80W); 40,000 sq. ft. in non-critical area (R-40W)	80,000 sq. ft. in critical area (R-80W); 40,000 sq. ft. in non-critical area (R-40W)	n/a	80,000 sq. ft. in critical area (R-80W); 40,000 sq. ft. in non-critical area (R-40W)	n/a
Riparian Buffers	100' perennial streams & water supply impoundments w/drainage areas of 25 or more acres	100' perennial streams & water supply impoundments w/drainage areas of 25 or more acres	100' perennial streams & water supply impoundments w/drainage areas of 25 or more acres	100' perennial streams & water supply impoundments w/drainage areas of 25 or more acres	50' buffers on all surface waters	100' perennial streams & water supply impoundments w/drainage areas of 25 or more acres	50' buffers on all surface waters
Peak Flow Mgt.	No net increase-1 yr. 24 hr. storm	No net increase-1 yr. 24 hr. storm	No net increase-1 yr. 24 hr. storm	No net increase-1 yr. 24 hr. storm	No net increase-1 yr. 24 hr. storm	No net increase-1 yr. 24 hr. storm	No net increase-1 yr. 24 hr. storm
Total Suspended Solids	none	none	none	none	If nutrient targets are not met without stormwater controls, then engineered stormwater controls must be used to achieve 85% TSS removal	none	none
Nitrogen Export Limit - Residential & Non-residential	Limit export rate to 3.6 lbs/ac/yr	Limit export rate to 3.6 lbs/ac/yr	Limit export rate to 3.6 lbs/ac/yr	Limit export rate to 3.6 lbs/ac/yr	Upper New Hope (UNH) 2.2 lbs/ac/yr & Lower New Hope (LNH) 4.4 lbs/ac/yr	Limit export rate to 3.6 lbs/ac/yr	Limit export rate to 2.2 lbs/ac/yr
Min. residential onsite nitrogen export target that must be achieved before using offsite offsets	6 lbs/ac/yr	6 lbs/ac/yr	6 lbs/ac/yr	n/a - County applies Neuse Rules In Jordan. No buydown available.	6 lbs/ac/yr	6 lbs/ac/yr	50% removal of N from untreated condition onsite, remaining reduction can be achieved offsite
Min. non-residential onsite nitrogen export target that must be achieved before using offsite offsets	10 lbs/ac/yr	10 lbs/ac/yr	10 lbs/ac/yr	n/a - County applies Neuse Rules In Jordan. No buydown available.	10 lbs/ac/yr	10 lbs/ac/yr	50% removal of N from untreated condition onsite, remaining reduction can be achieved offsite
Phosphorus Export Limit (Residential & Non-residential)	n/a	n/a	n/a	n/a	Upper New Hope (UNH) 0.82 lbs/ac/yr & Lower New Hope (LNH) 0.78 lbs/ac/yr	n/a	Limit export rate to .33 lbs/ac/yr
Min. residential onsite phosphorus export target that must be achieved before using offsite offsets	n/a	n/a	n/a	n/a	6 lbs/ac/yr	n/a	60% removal of P from untreated condition onsite, remaining reduction can be achieved offsite
Min. non-residential on site phosphorus export target that must be achieved before using offsite offsets	n/a	n/a	n/a	n/a	10 lbs/ac/yr	n/a	60% removal of P from untreated condition onsite, remaining reduction can be achieved offsite
Volume Control Residential	1st 3" of rainfall	1st 3" of rainfall	1st 3" of rainfall	1st 3" of rainfall	n/a	1st 3" of rainfall	n/a
Volume Control Non-residential	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Stormwater Management	n/a	n/a	First 1/2" or 1" rainfall runoff if >12% impervious up to 24% max. depending on land use classification under SCLMP	1st 1/2" rainfall runoff if >12% impervious up to 24% max. (non-residential only)	1st inch of rainfall runoff	1st 1/2" rainfall runoff if >12% impervious up to 24% max.(non-residential only)	1st inch of rainfall runoff
Fertilizer Management Rules	none	none	none	none	Trained applicator or pursuant to nutrient plan. Does not apply to use by homeowner on residential prop.	none	Trained applicator or pursuant to nutrient plan. Does not apply to use by homeowner on residential prop.

Highlight indicates standard more restrictive than Falls Lake WSW

Article 9. Stormwater Management

Part 1 General Provisions

9-10 Purpose

The stormwater management regulations of this article establish minimum requirements to address adverse effects of stormwater runoff associated with new development. Proper management of stormwater runoff will protect property, control stream channel erosion, reduce flooding, protect floodplains, wetlands, water resources, riparian and aquatic ecosystems, and otherwise provide for environmentally sound use of the county's natural resources.

9-11 Scope

Except as otherwise expressly stated, the stormwater management regulations of this article apply to all development within unincorporated Wake County outside the extraterritorial jurisdiction and incorporated boundaries of any municipality.

9-12 Exemptions

The stormwater management regulations of this article do not apply to any of the following development activities:

- 9-12-1 Agriculture, forestry, or mining.
- 9-12-2 Office, institutional, commercial, or industrial development that disturbs a land area of one-half acre or less.
- 9-12-3 Any development in which the owner has accrued a vested right. Wake County recognizes a vested right if either of the following occurred:
 - (A) A subdivision plan, site plan, or development permit was officially approved by Wake County or the State before August 13, 2006 and that plan or permit remains unexpired.
 - (B) The landowner otherwise demonstrates a vested right has accrued under North Carolina Law.

Part 2 Standards for Managing Stormwater Runoff

9-20 Maximum Curve Number after Development

Developers must manage residential runoff so that after development the site will not exceed the following curve numbers, in accordance with procedures specified in the United States Department of Agriculture, Natural Resource Conservation Service, Technical Release 55, Urban Hydrology for Small Watersheds.

Zoning District	Maximum Composite Curve Number, By Soil Group			
	A	B	C	D
R-80W and R-80	37	60	73	79
R-40W and R-40	41	62	75	80
R-30, R-20, R-15, R-10, R-5, Residential Highway, General Business and Office and Institutional	43	63	76	81

Article 9 Stormwater Management
9-20 Maximum Curve Number after Development

9-20-1 Precipitation Depth

Calculations must be based on a precipitation depth of 3 inches over a 24-hour period.

9-20-2 Draw-down Period

Stored water must be drained over a period of not less than 2 days or more than 5 days.

9-20-3 Option for Minor Subdivisions

Developers of residential minor subdivisions have the option of meeting the standards in Sec. 9-20 or limiting the proposed subdivision's impervious surfaces to a maximum of 15%.

9-20-4 Stormwater Credits

(A) Purpose

The purpose of establishing a stormwater credit system is to provide incentives to implement better site design and locate new development in a manner that causes less impact to aquatic resources. Certain development practices reduce the generation of stormwater from the site; thereby reducing the size and cost of stormwater storage. In addition these practices can provide partial removal of many pollutants. The credit system directly translates into cost savings and better protection of water resources.

(B) Disconnected Impervious Surfaces

Disconnected rooftops and other disconnected impervious surfaces are encouraged. Runoff from these disconnected surfaces must be spread over pervious areas as sheet flow. As a credit, these disconnected impervious surfaces will be assigned the lower curve number specified by procedures of the United States Department of Agriculture, Natural Resource Conservation Service, Technical Release 55, *Urban Hydrology for Small Watersheds*.

(C) Reforestation

The planting of trees/shrubs is encouraged as a means of reducing runoff. As credit for such practices, reforested areas will be assigned the curve number for woods in good condition per procedures in the United States Department of Agriculture, Natural Resource Conservation Service, Technical Release 55, *Urban Hydrology for Small Watersheds*. Areas planted with trees/shrubs must meet the following standards to qualify for the credit.

(1) Tree/shrub Density and Spacing

Planted trees or shrubs must meet the minimum density and spacing standards of the USDA, Natural Resources Conservation Service, as specified in the *Field Office Technical Guide for Tree/Shrub Establishment*. Existing trees or shrubs may be used towards meeting the planting standard.

(2) Mulching

An initial application of mulch is required for the area designated for reforestation. Mulching must meet applicable standards of the USDA, Natural Resources Conservation Service, as specified in the *Field Office Technical Guide for Mulching-Temporary Protection of Critical Areas without Seeding*. Existing groundcover may be used towards meeting the mulching standard.

(D) Cluster and Open Space Subdivisions

Cluster and open space subdivisions are encouraged. In applying curve number calculations to such developments, the county may not penalize such subdivisions. Calculations must take into account the lots' proportionate share of right-of-way and permanent open space.

Article 9 Stormwater Management
9-32 Assurance that Improvements will be Maintained

9-21 Neuse Rules

State stormwater-management requirements that implement the Neuse River Basin Nutrient- Sensitive Waters Management Strategy apply in both the Neuse and Cape Fear Basins.

9-22 Stormwater Design Manual

The Wake County Department of Environmental Services may furnish additional guidance and standards for the proper implementation of the regulations of this article and may provide such information in the form of a *Stormwater Design Manual*. Stormwater management practices that are designed, constructed, or maintained in accord with the *Stormwater Design Manual* must be presumed to comply with these regulations.

9-23 Miscellaneous

9-23-1 Calculations Regarding Ponds, Lakes, and Streams

Surface water bodies may not be assigned a curve number for impervious surfaces. Instead such water bodies will be removed from calculations so that developments are not penalized for their presence.

Part 3 Completion and Maintenance of Improvements
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9-30 Party Responsible for Completion of Improvements

The developer is responsible for completing all stormwater improvements in accordance with the requirements of this article and other applicable ordinances and laws.

9-31 Assurance that Improvements will be Completed

9-31-1 Performance Guarantee

The county may not approve a record plat, or in the case of single-lot development not requiring a record plat may not issue a building permit, until those stormwater improvements required of the developer have been completed or a performance guarantee has been provided. Such performance guarantees must comply with the performance guarantee provisions of Sec. 8-22.

9-31-2 As-Built Plans

Upon completion of required improvements, the developer or the developer's representative must submit as-built plans of required stormwater improvements to the Wake County Department of Environmental Services. These plans must indicate whether stormwater improvements were constructed in accordance with the county approved stormwater plan.

9-32 Assurance that Improvements will be Maintained

9-32-1 Maintenance Required

All stormwater improvements must be maintained so they will continue to serve their intended functions.

9-32-2 Parties Responsible for Maintenance of Improvements

- (A) The developer must maintain stormwater improvements until accepted by a property owners association or lot owner. The developer must disclose which party will be responsible for continued maintenance on the record plat and on the stormwater management plan.

Article 9 Stormwater Management
9-41 Modifications and Waivers

- (B) Before improvements are accepted for maintenance by the property owners association or lot owner, the developer or the developer's engineer or other representative, as authorized by Statute, must certify to the property owners association or lot owner and to the county that improvements are complete and functioning as designed.

9-32-3 Maintenance Plan

- (A) The developer must record, and reference on the record plat, a maintenance plan that instructs the property owners association or lot owner about the annual maintenance tasks and associated costs for at least a 20-year period.
- (B) It will be the responsibility of the property owners association or lot owner to update the maintenance plan at least every 10 years.

9-32-4 Maintenance Agreement

- (A) The developer must record, and reference on the record plat, a maintenance agreement, or restrictive covenant that sets forth the property owners association's or lot owner's continuing responsibilities for maintenance, including specifying how cost will be apportioned among lot owners served.
- (B) The maintenance agreement must provide that the association and its individual members are jointly and severably liable for maintenance.

9-32-5 Maintenance Easements

The developer must record easements for access, maintenance and inspections by any property owners association and by Wake County Government.

9-32-6 Documents Required Before Plat Approval or Building Permit

All maintenance documents required by this article must be submitted to the Subdivision Administrator or Stormwater Engineer before record plat approval, and such documents must be referenced on the record plat, or, in the case of single-lot developments not requiring record plats, documentation must be submitted to the Zoning Administrator or Stormwater Engineer before building permit issuance.

Part 4 Administration

9-40 Application Requirements

9-40-1 Stormwater Plan Required

For any development requiring stormwater improvements, no applicant may receive a grading, building or other permit required for land disturbance without first having a county approved stormwater management plan.

9-40-2 Submittal Procedures

Stormwater management plans must be submitted and reviewed in conjunction with subdivision plans, or, in the case of single-lot developments requiring stormwater management, in conjunction with site plans.

9-41 Modifications and Waivers

Requests for modifications or waivers of the stormwater management standards of this article must be processed in accordance with the procedures of 19-36.

Article 9 Stormwater Management
9-51 Inspection of Stormwater Improvements

9-42 Appeals

9-42-1 Authority

- (A) Any person affected by any decision of the county that relates to interpretation or application of this ordinance may appeal to the hearing panel of the Wake County Human Services and Environmental Services Board.
- (B) Any alleged error of the county in making or refusing to make a decision may be basis for an appeal.

9-42-2 Filing

The appeal must be filed in writing with the Wake County Stormwater Engineer within 30 days of the decision complained of and must specify the grounds for appeal.

9-42-3 Hearing

- (A) The hearing panel of the Human Services and Environmental Services Board must fix a time and place for the hearing.
- (B) At least 10 days prior to the hearing, the hearing panel must publish notice of the hearing in a newspaper of general circulation within the county.
- (C) The hearing panel must render a decision in writing within 45 days of receiving the appeal.

9-42-4 Decision-Making Criteria

In acting on appeals the hearing panel of the Human Services and Environmental Services Board must determine, by simple majority vote, if the appellant has presented substantial evidence that the county erred and whether the county correctly interpreted the stormwater management regulations of Article 9.

9-42-5 Subsequent Appeals

The appellant may appeal the hearing panel's decision to the full Human Services and Environmental Services Board by filing an appeal within 10 days of the hearing panel's decision. Such appeals must follow the same procedure as the original hearing before the Board's hearing panel.

Part 5 Enforcement and Penalties

9-50 General

Failure to complete required improvements or failure to maintain improvements so they continue to function as required are violations and subject to a fine of up to \$1,000 per day and other penalties, remedies, and enforcement powers specified in Article 20.

9-51 Inspection of Stormwater Improvements

Wake County agents and officials have the right to inspect sites to determine whether required stormwater improvements are being installed and maintained in compliance with this ordinance.

OA 05/05 May 15, 2006

3.

Statement of Riparian Buffer Ordinance Compliance – Jordan Lake is in the Cape Fear River Basin and is designated a Water Supply Watershed. Wake County's Unified Development Ordinance, Article 11, Environmental Standards, applies 100' riparian buffers in water supply watersheds that are more restrictive than those of the Jordan Rule.

4.

State and Federal Entities Implementation – Wake County will not enforce the requirements of the Jordan Lake Rule on State or Federal Entities.

5.

Areas of Applicability – Wake County’s Planning jurisdiction in the Jordan Lake Water Supply Watershed is limited to the unincorporated area of Wake County, excluding any corporate limits or ETJ.

6.

Minimum Qualifications of Stormwater Administrator – Copies of the PDQs established by the Wake County Board of Commissioners are included with this submittal for the Watershed Manager (Program Manager) and seven (7) Environmental Engineers/Consultants that perform development review/approval/permitting/inspections and enforcement. These are minimum qualifications. Individuals filling these positions frequently have qualifications that exceed the minimum standards.

[Watershed Manager PDO](#)

[Environmental Engineer/Consultant PDO](#)

Classification Title: Watershed Manager

FLSA Status: Exempt

BRIEF DESCRIPTION: Develops and administers programs in Soil and Water Conservation, Stormwater and Sediment and Erosion Control. Manages staff and budget for Surface Water Protection, Watershed Management Plan and Sediment Control/Management, and Soil and Water Conservation as authorized, and enforces applicable laws, rules, and regulations.

ESSENTIAL FUNCTIONS:

This information is intended to be descriptive of the key responsibilities of the position. The following examples do not identify all duties performed by any single incumbent.

S Sedentary	L Light	M Medium	H Heavy	V Very Heavy
Exerting up to 10 lbs. occasionally or negligible weights frequently; sitting most of the time.	Exerting up to 20 lbs. occasionally, 10 lbs. frequently, or negligible amounts constantly OR requires walking or standing to a significant degree.	Exerting 20-50 lbs. occasionally, 10-25 lbs. frequently, or up to 10 lbs. constantly.	Exerting 50-100 lbs. occasionally, 10-25 lbs. frequently, or up to 10-20 lbs. constantly.	Exerting over 100 lbs. occasionally, 50-100 lbs. frequently, or up to 20-50 lbs. constantly.

#	Code	Essential Functions
1	S	Administers programs in the enforcement of laws, rules and regulations pertaining to surface water, and watershed protection and cooperatively with landowners and citizens. Develops business and County budget needs and approves funds usage. Implements short and long range plans and updates as necessary. Coordinates local programs and watershed activities. Secures local, state and federal support. Analyzes program goals and objectives and produces regular reports.
2	S	Administers and enforces FEMA and local floodplain management programs.
3	S	Manages sediment and erosion control programs. Approves or denies commercial, subdivision and/or private road construction and authorizes permits.
4	S	Administers programs to conserve natural resources, stream and wetland restoration, soil, air, plant and wildlife on private and public land. Provides services to rural and urban residents to conserve natural resources Administers the Soil and Water Conservation Board activities including planning and conducting Board meetings and other Board member activities, coordination of local District programs with area, state, and national Conservation District programs, coordination of District activities with Wake County government and local municipalities, and state and federal agencies.
5	S	Directs the dissemination of educational and information services related to administered programs.

CLASSIFICATION REQUIREMENTS:

CLASSIFICATION REQUIREMENTS	
Education	Bachelor's degree or equivalent in Conservation, Business Administration, Engineering, Environmental Health or Public Administration
Experience	Seven years experience in conservation.
Equivalent Education & Experience Accepted?	Yes
Certification and Other Requirements	Valid driver's license.
Reading	Advanced
Math	Advanced
Writing	Advanced
Managerial	Receives Broad Direction.
Budget Responsibility	Prepares documents and does research to justify language used in documents for a department. May recommend budget allocations.
Supervisory / Organizational Control	Work requires supervising and monitoring performance for a regular group of employees or a work unit including providing input on hiring/disciplinary actions and work objectives/effectiveness and realigning work as needed.
Interpersonal / Human Relations Skills	Work requires very frequent and regular contact with others in a direct reporting relationship as well as others outside of a direct reporting relationship. The purpose of the contact is broad reaching and dynamic and may include the communication of specific issues and/or general policies. Interaction with others outside of the department requires exercising participative management and negotiation skills that support County strategy and organizational goals. Work also requires the communication with direct reports to ensure maximum productivity in work assignments. Makes presentations and answers questions with regard to presentation materials and findings.

OVERALL PHYSICAL STRENGTH DEMANDS:

Sedentary	X	Light	Medium	Heavy	Very Heavy
Exerting up to 10 lbs. occasionally or negligible weights frequently; sitting most of the time.		Exerting up to 20 lbs. occasionally, 10 lbs. frequently, or negligible amounts constantly OR requires walking or standing to a significant degree.	Exerting 20-50 lbs. occasionally, 10-25 lbs. frequently, or up to 10 lbs. constantly.	Exerting 50-100 lbs. occasionally, 10-25 lbs. frequently, or up to 10-20 lbs. constantly.	Exerting over 100 lbs. occasionally, 50-100 lbs. frequently, or up to 20-50 lbs. constantly.

MACHINES, TOOLS, EQUIPMENT, AND WORK AIDS:

Computers, printers and related software

PRIMARY WORK LOCATION	
X Office Environment	Shop
Clinic	Vehicle
Recreation Centers/Neighborhood Centers	Warehouse
Outdoors (see 1 below)	Other (see 2 below)

(1) N/A

(2) N/A

PROTECTIVE EQUIPMENT REQUIRED:

None.

Classification Title: Environmental Engineer - Consultant

FLSA Status: Exempt

BRIEF DESCRIPTION: Provides advanced regulatory and consultant services in areas which could include storm water management, wastewater systems, sedimentation and erosion control.

ESSENTIAL FUNCTIONS:

This information is intended to be descriptive of the key responsibilities of the position. The following examples do not identify all duties performed by any single incumbent.

S Sedentary	L Light	M Medium	H Heavy	V Very Heavy
Exerting up to 10 lbs. occasionally or negligible weights frequently; sitting most of the time.	Exerting up to 20 lbs. occasionally, 10 lbs. frequently, or negligible amounts constantly OR requires walking or standing to a significant degree.	Exerting 20-50 lbs. occasionally, 10-25 lbs. frequently, or up to 10 lbs. constantly.	Exerting 50-100 lbs. occasionally, 10-25 lbs. frequently, or up to 10-20 lbs. constantly.	Exerting over 100 lbs. occasionally, 50-100 lbs. frequently, or up to 20-50 lbs. constantly.

#	Code	Essential Functions
1	S	Reviews plans for land disturbing permits, including construction, flood, storm drainage and grading, to ensure compliance with County, State and Federal requirements. Issues permits and oversees all active permits.
2	M	Inspects sites for compliance. Provides technical expertise and guidance to property owners and seeks corrective measures. Documents findings.
3	M	Responds to and investigates public complaints. Issues notices of violations if warranted. Documents actions and prepares reports or studies which could be used in court proceedings.
4	M	Takes samples and performs field and lab analysis work to determine effects of construction, erosion or other environmental factors on the land or structures such as dams.
5	H	Responds to natural or other disasters and emergency situations which could include chemical spills. Provides resources and information regarding remedial activities and required cleanup.

CLASSIFICATION REQUIREMENTS:

CLASSIFICATION REQUIREMENTS	
Education	Bachelor's degree in Engineering, Geology, Environmental Science or related field.
Experience	Four years of experience in environmental planning, inspections or engineering.
Equivalent Education & Experience Accepted?	Yes
Certification and Other	A valid driver's license and a "safe" driving record required.

Requirements

CLASSIFICATION REQUIREMENTS	
Reading	Advanced
Math	Advanced
Writing	Advanced
Managerial	Receives Limited Direction.
Budget Responsibility	Prepares documents and does research to justify language used in documents for a department. May recommend budget allocations.
Supervisory / Organizational Control	No responsibility for the direction or supervision of others.
Interpersonal / Human Relations Skills	Work requires frequent and regular contact with others in a direct reporting relationship as well as others outside of a direct reporting relationship. The purpose of the contact is to address specific issues and/or general policies. Contact may involve support of controversial positions or the negotiation of sensitive issues. Evaluates customer satisfaction, develops cooperative associations and relationships, and utilizes resources to continuously improve external customer relations and satisfaction. Makes presentations and answers questions with regard to presentation materials and findings.

OVERALL PHYSICAL STRENGTH DEMANDS:

Sedentary	Light	X	Medium	Heavy	Very Heavy
Exerting up to 10 lbs. occasionally or negligible weights frequently; sitting most of the time.	Exerting up to 20 lbs. occasionally, 10 lbs. frequently, or negligible amounts constantly OR requires walking or standing to a significant degree.		Exerting 20-50 lbs. occasionally, 10-25 lbs. frequently, or up to 10 lbs. constantly.	Exerting 50-100 lbs. occasionally, 10-25 lbs. frequently, or up to 10-20 lbs. constantly.	Exerting over 100 lbs. occasionally, 50-100 lbs. frequently, or up to 20-50 lbs. constantly.

MACHINES, TOOLS, EQUIPMENT, AND WORK AIDS:

Engineering tools and equipment, cameras, geographical measuring tools, computers, printers and related software

PRIMARY WORK LOCATION	
Office Environment	Shop
Clinic	Vehicle
Recreation Centers/Neighborhood Centers	Warehouse
Outdoors (see 1 below)	X Other (see 2 below)

- (1) N/A
- (2) Various work and construction sites

PROTECTIVE EQUIPMENT REQUIRED:

Steel toed boots

7. Maintenance/Inspection Program

Wake County's stormwater maintenance/inspection requirements are outlined in the Wake County Unified Development Ordinance, Article 9, Stormwater Management, Part 3, Completion and Maintenance of Improvements. Article 9 is included with this submittal. A copy of Wake County's most recent BMP report is also attached. The BMP report includes a GIS map with the location of Wake County BMPs.

[Wake County Unified Development Ordinance, Article 9 Stormwater Management](#)

[Wake County Structural Stormwater Best Management Practices Annual Report 2011](#)

Article 9. Stormwater Management

Part 1 General Provisions

9-10 Purpose

The stormwater management regulations of this article establish minimum requirements to address adverse effects of stormwater runoff associated with new development. Proper management of stormwater runoff will protect property, control stream channel erosion, reduce flooding, protect floodplains, wetlands, water resources, riparian and aquatic ecosystems, and otherwise provide for environmentally sound use of the county's natural resources.

9-11 Scope

Except as otherwise expressly stated, the stormwater management regulations of this article apply to all development within unincorporated Wake County outside the extraterritorial jurisdiction and incorporated boundaries of any municipality.

9-12 Exemptions

The stormwater management regulations of this article do not apply to any of the following development activities:

- 9-12-1 Agriculture, forestry, or mining.
- 9-12-2 Office, institutional, commercial, or industrial development that disturbs a land area of one-half acre or less.
- 9-12-3 Any development in which the owner has accrued a vested right. Wake County recognizes a vested right if either of the following occurred:
 - (A) A subdivision plan, site plan, or development permit was officially approved by Wake County or the State before August 13, 2006 and that plan or permit remains unexpired.
 - (B) The landowner otherwise demonstrates a vested right has accrued under North Carolina Law.

Part 2 Standards for Managing Stormwater Runoff

9-20 Maximum Curve Number after Development

Developers must manage residential runoff so that after development the site will not exceed the following curve numbers, in accordance with procedures specified in the United States Department of Agriculture, Natural Resource Conservation Service, Technical Release 55, Urban Hydrology for Small Watersheds.

Zoning District	Maximum Composite Curve Number, By Soil Group			
	A	B	C	D
R-80W and R-80	37	60	73	79
R-40W and R-40	41	62	75	80
R-30, R-20, R-15, R-10, R-5, Residential Highway, General Business and Office and Institutional	43	63	76	81

Article 9 Stormwater Management
9-20 Maximum Curve Number after Development

9-20-1 Precipitation Depth

Calculations must be based on a precipitation depth of 3 inches over a 24-hour period.

9-20-2 Draw-down Period

Stored water must be drained over a period of not less than 2 days or more than 5 days.

9-20-3 Option for Minor Subdivisions

Developers of residential minor subdivisions have the option of meeting the standards in Sec. 9-20 or limiting the proposed subdivision's impervious surfaces to a maximum of 15%.

9-20-4 Stormwater Credits

(A) Purpose

The purpose of establishing a stormwater credit system is to provide incentives to implement better site design and locate new development in a manner that causes less impact to aquatic resources. Certain development practices reduce the generation of stormwater from the site; thereby reducing the size and cost of stormwater storage. In addition these practices can provide partial removal of many pollutants. The credit system directly translates into cost savings and better protection of water resources.

(B) Disconnected Impervious Surfaces

Disconnected rooftops and other disconnected impervious surfaces are encouraged. Runoff from these disconnected surfaces must be spread over pervious areas as sheet flow. As a credit, these disconnected impervious surfaces will be assigned the lower curve number specified by procedures of the United States Department of Agriculture, Natural Resource Conservation Service, Technical Release 55, *Urban Hydrology for Small Watersheds*.

(C) Reforestation

The planting of trees/shrubs is encouraged as a means of reducing runoff. As credit for such practices, reforested areas will be assigned the curve number for woods in good condition per procedures in the United States Department of Agriculture, Natural Resource Conservation Service, Technical Release 55, *Urban Hydrology for Small Watersheds*. Areas planted with trees/shrubs must meet the following standards to qualify for the credit.

(1) Tree/shrub Density and Spacing

Planted trees or shrubs must meet the minimum density and spacing standards of the USDA, Natural Resources Conservation Service, as specified in the *Field Office Technical Guide for Tree/Shrub Establishment*. Existing trees or shrubs may be used towards meeting the planting standard.

(2) Mulching

An initial application of mulch is required for the area designated for reforestation. Mulching must meet applicable standards of the USDA, Natural Resources Conservation Service, as specified in the *Field Office Technical Guide for Mulching-Temporary Protection of Critical Areas without Seeding*. Existing groundcover may be used towards meeting the mulching standard.

(D) Cluster and Open Space Subdivisions

Cluster and open space subdivisions are encouraged. In applying curve number calculations to such developments, the county may not penalize such subdivisions. Calculations must take into account the lots' proportionate share of right-of-way and permanent open space.

Article 9 Stormwater Management
9-32 Assurance that Improvements will be Maintained

9-21 Neuse Rules

State stormwater-management requirements that implement the Neuse River Basin Nutrient- Sensitive Waters Management Strategy apply in both the Neuse and Cape Fear Basins.

9-22 Stormwater Design Manual

The Wake County Department of Environmental Services may furnish additional guidance and standards for the proper implementation of the regulations of this article and may provide such information in the form of a *Stormwater Design Manual*. Stormwater management practices that are designed, constructed, or maintained in accord with the *Stormwater Design Manual* must be presumed to comply with these regulations.

9-23 Miscellaneous

9-23-1 Calculations Regarding Ponds, Lakes, and Streams

Surface water bodies may not be assigned a curve number for impervious surfaces. Instead such water bodies will be removed from calculations so that developments are not penalized for their presence.

Part 3 Completion and Maintenance of Improvements
--

9-30 Party Responsible for Completion of Improvements

The developer is responsible for completing all stormwater improvements in accordance with the requirements of this article and other applicable ordinances and laws.

9-31 Assurance that Improvements will be Completed

9-31-1 Performance Guarantee

The county may not approve a record plat, or in the case of single-lot development not requiring a record plat may not issue a building permit, until those stormwater improvements required of the developer have been completed or a performance guarantee has been provided. Such performance guarantees must comply with the performance guarantee provisions of Sec. 8-22.

9-31-2 As-Built Plans

Upon completion of required improvements, the developer or the developer's representative must submit as-built plans of required stormwater improvements to the Wake County Department of Environmental Services. These plans must indicate whether stormwater improvements were constructed in accordance with the county approved stormwater plan.

9-32 Assurance that Improvements will be Maintained

9-32-1 Maintenance Required

All stormwater improvements must be maintained so they will continue to serve their intended functions.

9-32-2 Parties Responsible for Maintenance of Improvements

- (A) The developer must maintain stormwater improvements until accepted by a property owners association or lot owner. The developer must disclose which party will be responsible for continued maintenance on the record plat and on the stormwater management plan.

Article 9 Stormwater Management
9-41 Modifications and Waivers

- (B) Before improvements are accepted for maintenance by the property owners association or lot owner, the developer or the developer's engineer or other representative, as authorized by Statute, must certify to the property owners association or lot owner and to the county that improvements are complete and functioning as designed.

9-32-3 Maintenance Plan

- (A) The developer must record, and reference on the record plat, a maintenance plan that instructs the property owners association or lot owner about the annual maintenance tasks and associated costs for at least a 20-year period.
- (B) It will be the responsibility of the property owners association or lot owner to update the maintenance plan at least every 10 years.

9-32-4 Maintenance Agreement

- (A) The developer must record, and reference on the record plat, a maintenance agreement, or restrictive covenant that sets forth the property owners association's or lot owner's continuing responsibilities for maintenance, including specifying how cost will be apportioned among lot owners served.
- (B) The maintenance agreement must provide that the association and its individual members are jointly and severably liable for maintenance.

9-32-5 Maintenance Easements

The developer must record easements for access, maintenance and inspections by any property owners association and by Wake County Government.

9-32-6 Documents Required Before Plat Approval or Building Permit

All maintenance documents required by this article must be submitted to the Subdivision Administrator or Stormwater Engineer before record plat approval, and such documents must be referenced on the record plat, or, in the case of single-lot developments not requiring record plats, documentation must be submitted to the Zoning Administrator or Stormwater Engineer before building permit issuance.

Part 4 Administration

9-40 Application Requirements

9-40-1 Stormwater Plan Required

For any development requiring stormwater improvements, no applicant may receive a grading, building or other permit required for land disturbance without first having a county approved stormwater management plan.

9-40-2 Submittal Procedures

Stormwater management plans must be submitted and reviewed in conjunction with subdivision plans, or, in the case of single-lot developments requiring stormwater management, in conjunction with site plans.

9-41 Modifications and Waivers

Requests for modifications or waivers of the stormwater management standards of this article must be processed in accordance with the procedures of 19-36.

Article 9 Stormwater Management
9-51 Inspection of Stormwater Improvements

9-42 Appeals

9-42-1 Authority

- (A) Any person affected by any decision of the county that relates to interpretation or application of this ordinance may appeal to the hearing panel of the Wake County Human Services and Environmental Services Board.
- (B) Any alleged error of the county in making or refusing to make a decision may be basis for an appeal.

9-42-2 Filing

The appeal must be filed in writing with the Wake County Stormwater Engineer within 30 days of the decision complained of and must specify the grounds for appeal.

9-42-3 Hearing

- (A) The hearing panel of the Human Services and Environmental Services Board must fix a time and place for the hearing.
- (B) At least 10 days prior to the hearing, the hearing panel must publish notice of the hearing in a newspaper of general circulation within the county.
- (C) The hearing panel must render a decision in writing within 45 days of receiving the appeal.

9-42-4 Decision-Making Criteria

In acting on appeals the hearing panel of the Human Services and Environmental Services Board must determine, by simple majority vote, if the appellant has presented substantial evidence that the county erred and whether the county correctly interpreted the stormwater management regulations of Article 9.

9-42-5 Subsequent Appeals

The appellant may appeal the hearing panel's decision to the full Human Services and Environmental Services Board by filing an appeal within 10 days of the hearing panel's decision. Such appeals must follow the same procedure as the original hearing before the Board's hearing panel.

Part 5 Enforcement and Penalties

9-50 General

Failure to complete required improvements or failure to maintain improvements so they continue to function as required are violations and subject to a fine of up to \$1,000 per day and other penalties, remedies, and enforcement powers specified in Article 20.

9-51 Inspection of Stormwater Improvements

Wake County agents and officials have the right to inspect sites to determine whether required stormwater improvements are being installed and maintained in compliance with this ordinance.

OA 05/05 May 15, 2006

Wake County
Structural Stormwater Best Management Practices
(BMPs)
3rd Annual Inspections Report
05.05.11



Regulatory Background

Stormwater management devices mandated by Wake County stormwater regulations began with the implementation of the State's Neuse River Nutrient Management Strategy or "Neuse Rules" in July 2001. Related regulations were incorporated in the *Wake County Stormwater Control Management and Watercourse Buffer Regulations* adopted on July 2, 2001. This ordinance required stormwater management if a development proposed an impervious surface coverage (ISC) of greater than 15%. Developments with proposed impervious surfaces in excess of 15% were required to install stormwater management devices to handle the stormwater runoff. Most residential subdivisions met the stormwater requirements by stating the development would not exceed the 15% impervious surface limit. Impervious surface coverage (ISC) limits were established and recorded for individual lots to ensure that the cumulative ISC for a new development would not exceed 15% upon build-out.

The *Wake County Stormwater Control Management and Watercourse Buffer Regulations* were repealed and replaced with Article 9 Stormwater Management of the Unified Development Ordinance (UDO) in May 2006. This existing ordinance requires residential development to meet post development runoff volumes established by target curve numbers. The Neuse Rules continue to apply to both residential and non-residential development and regulate peak flow management and nitrogen reduction.



Commercial Dry Detention Pond

BMPs Generated by Individual Lot Impervious Surface Limit Deviations

The *Wake County Stormwater Control Management and Watercourse Buffer Regulations* (2001) allowed developers to passively be exempted from ordinance requirements by committing to limit the total impervious surface coverage (ISC) of the development to 15%. This required the establishment of maximum ISC limits for individual subdivision lots, so that the aggregate ISC for the subdivision as a whole did not exceed 15%. By agreeing to record impervious surface coverage (ISC) limits on the record plat for individual lots, the development was exempted from the stormwater management requirements and was allowed to record the subdivision plat and sell the newly created lots.

After recording the subdivision plats with impervious surface limits (ISC) limits and trying to sell lots to builders and individuals, it soon became apparent that the 15% ISC limit was insufficient in some cases to meet market demand. Developers, builders and lots owners then sought quick fixes to the ISC limits through a variety of methods: 1) deviations that required installation of BMPs on individual lots to manage excess runoff; 2) rerecording lots to reassign ISC (taking a portion of ISC allotment assigned to unsold lots and adding it to other lots; and 3) retrofitting subdivisions with regional devices.

The County established a de facto policy of allowing individual lot deviations by approving impervious surface amounts above the recorded limit if stormwater runoff from the excess impervious surface was managed on-site. Best management practices such as installing infiltration trenches, grass swales, bioretention, rain barrels, dry detention and cisterns are some of the devices used to control the runoff volume above the amount generated by the impervious surface limit. Lots in subdivisions approved from July 2001 until July 2005 are allowed to deviate.



Single Family Bioretention (Dry)



Single Family Bioretention (Wet)

The deviation policy initiated Wake County's allowance of BMPs on individual lots to satisfy stormwater ordinance requirements. Other jurisdictions, including the cities of Raleigh and Cary, allow only regional devices. Beginning in July 2005, the County required subdividers to add a note on the final subdivision plat, which prohibited deviations from the impervious surface limit in perpetuity. The County's deviation policy is one of two main policies generating BMPs; the other is current stormwater ordinance. In recent years developers have established higher ISC limits allowing them to meet demand, the result being more BMP's both structural and non-structural.



Rain Barrel

New State Legislation Likely to Increase Number of BMPs

Wake County will be required to implement the new development rules in the Jordan and Falls Lake Watersheds in 2012 as required by the State legislation creating the Falls Lake Nutrient Management Strategy (NMS) and the Jordan Lake Nutrient Management Strategy. These rules establish target export rates for nitrogen and phosphorus for new development.

The rules are in addition to Wake County's stormwater regulations and are likely to result in more BMPs. Wake County's Ordinance is based on volume control which can be achieved through site design or the use of BMPs. Implementation of the new development rules for the Jordan Lake and Falls Lake Nutrient Management Strategy in

2012 will establish different target export rates for total nitrogen and establish target export rates for total phosphorus for the first time in Wake County. The nutrient targets of the Falls Lake and Jordan rules are likely to require BMPS with higher nutrient removal efficiencies than might otherwise be required by the County's ordinance. We expect these regulations in addition to future turbidity standards to increase the number of BMPS and the percentage of projects required to install BMPs

Stormwater Wetlands

According to the NC Division of Water Quality Stormwater Best Management Practices Manual, constructed wetlands are a good choice for nutrient and sediment removal with: 1) 85% Total Suspended Solid removal efficiency; 2) 40% total nitrogen removal efficiency and; 3) 40% total Phosphorus removal efficiency.



Constructed Wetland

BMPs Generated by Volume Control Regulations Adopted in 2006

In 2006, *Article 9 Stormwater Management of the Unified Development Ordinance* replaced the stand alone *Stormwater Control Management and Watercourse Buffer Ordinance* with new stormwater regulations. The new regulations established stormwater volume controls for residential developments, in addition to the Neuse River Nutrient Management Strategy stormwater regulations. Residential stormwater runoff volume is now required to meet a target volume (curve number). Developers can meet the target curve number by employing a variety of non-structural best management practices such as disconnecting impervious surface, preservation of wooded areas, and reforestation.

If the proposed development cannot meet the target curve number with site practices alone, then structural best management practices are employed to meet the volume control requirements. Examples of structural best management practices included wet and dry detention basins, constructed wetlands, underground detention devices, infiltration devices, bioretention, etc. The current ordinance allows both regional and individual lot BMPs, which must be maintained by an owners' association. Dry and wet detention ponds (shown below) are types of BMPs frequently used to achieve the volume storage required by the UDO.



Wet Pond



Dry Detention Pond

Table 1 presents the Best Management Practices (BMPs) regulated by Wake County:

Table 1 Wake County Regulated Best Management Practices		
BMP Type	Regulatory Source	Required
Individual lot deviations	Wake County Stormwater Control Management and Watercourse Buffer Regulations	If owner of lots created between 07.02.01 and 05.19.06 want to exceed recorded impervious surface limits for lots
Regional Residential BMPs	Wake County Stormwater Control Management and Watercourse Buffer Regulations & Article 9 UDO	Under the Wake County Stormwater Control Management and Watercourse Buffer Regulations when proposed ISC exceeds 15% and under Article 9 when proposed development cannot meet target curve number without devices
Commercial BMPs	Wake County Stormwater Control Management and Watercourse Buffer Regulations & Article 9 UDO	For peak flow management and nitrogen reduction requirements of the Neuse Rules
Level spreaders	Neuse Rules	401/404 permits and/or to ensure diffuse flow into buffers
Regional Residential Retrofits	Wake County Stormwater Control Management and Watercourse Buffer Regulations & Article 9 UDO	Responsible party cannot or does not want to abide by terms of development approval which created subdivision; seeks a retrofit to allow greater ISC

NPDES Phase II Permit

In 2003, Wake County operating under the assumption that it would be subject to an NPDES Phase II General Permit and submitted a draft permit application and Stormwater Management Plan. In 2010, the State sent a revised draft permit for Wake County's

review. Upon review of the 2010 draft permit language, it became apparent that the General Permit was not applicable to Wake County as it does not operate a Municipal Separate Storm Sewer System (MS4). Upon certification in July 2010 that the County does not own or operate a Municipal Separate Storm Sewer System, the County was no longer required to obtain a General Stormwater Discharge Permit.

Nonetheless, the adoption of the new stormwater regulations in 2006 coincided with the implementation of post-construction stormwater management requirements under the National Pollution Discharge Elimination System (NPDES) Phase II rules adopted by the State. Phase II post-construction requirements include the identification of parties responsible for the long-term maintenance and operation of BMPs, development of a long-term maintenance plan including financing of operations and maintenance.

Article 9 Stormwater Management of the UDO, Section 9-32 Assurance That Improvements Will Be Maintained - requires the developer to maintain the improvements until accepted by a property owner or property owners association. The developer must disclose which party will be responsible for continued maintenance on the record plat and on the required stormwater management plan. Prior to this acceptance, the developer must provide certification to the property owner and property owners association and to the County that improvements are complete and functioning as designed. The developer must then record a maintenance plan that instructs the property owners association or lot owner about the annual maintenance tasks and associated cost for at least a 20-year period.

Wake County's Obligation to Inspect BMPs

The Unified Development Ordinance assigns responsibility for annual BMP inspections and reporting to the property owner or an owners association. In an effort to monitor the effectiveness of private sector maintenance and inspections, Wake County began its own annual inspections of private BMPs in 2009, although it is under no statutory obligation to do so. Wake County elected in 1992 to follow the low density option to comply with the State's Water Supply Watershed regulations. Under the low density option, Wake County is not required to maintain BMPs. However, if it had elected the high density option, the County would be responsible for such maintenance.

The economic recession that began in 2007 had by 2009 resulted in a decline in the number of active development projects; which allowed the reallocation of staff resources to initiate annual inspection of BMPs in 2009 and continue in 2010 and 2011. In addition to maintenance inspections, Wake County needs to inspect devices, particularly those that will be located underground, during installation to ensure proper installation and functionality. The County should also inspect BMPs upon the submittal of an as-built to verify accuracy and compliance. Additionally, periodic inspections should be



conducted to monitor the effectiveness of the private inspections and of the self-reporting system.

The initial list of permitted BMPs included known BMPs from a database created in 2006 and individual lot deviation files. A new BMP Excel database was established in October 2008 to support the tracking of all BMPs, inspections and status. This database is now being used by all Stormwater staff. Efforts to identify all existing BMP's dating back to 2001 (implementation of the Neuse Rules) will focus on three areas: 1) mainframe search of all projects; 2) review of hardcopy files to determine which ones have BMPs and 3) Identification of level spreaders. Note: Level spreaders are required by the State under the Neuse Rules for diffuse flow. In the past, level spreaders were not consistently recognized as permanent stormwater control devices. It is now the policy of Wake County to treat all level spreaders as permanent stormwater devices subject to maintenance requirements.



Level Spreader (well-maintained)



Level Spreader (maintenance needed)

Watershed Management Section Inspection Certification

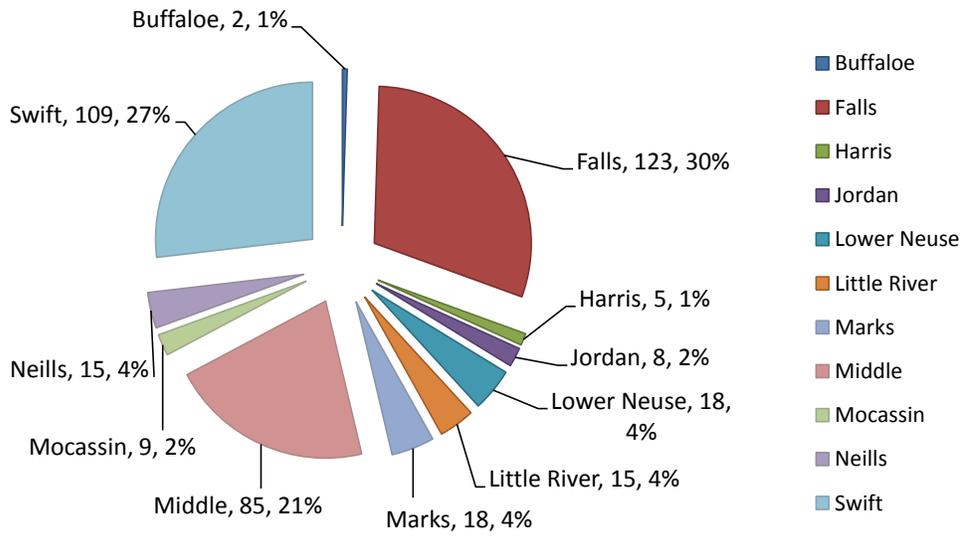
In October 2008, all eight members of the Watershed Section completed the Stormwater BMP inspection & Maintenance Certification Course offered by the NCSU, Department of Biological and Agricultural Engineering Program. The UDO requires the party responsible for maintenance of the BMP to provide annual inspections reports by a certified professional. County staff is not required to be certified, but they continue to pursue professional development on an on-going basis as it relates to stormwater plan review, approval, inspections and maintenance.

Table 2 below information summarizes annual inspections performed by Wake County staff from the 4th quarter 2010 through April 2011.

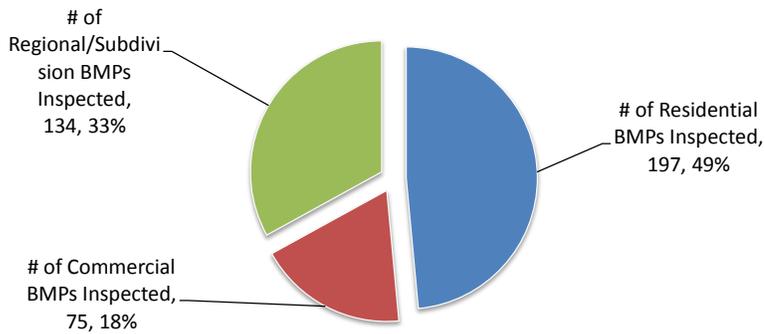
Table 2
Summary of 2011 BMP Inspections

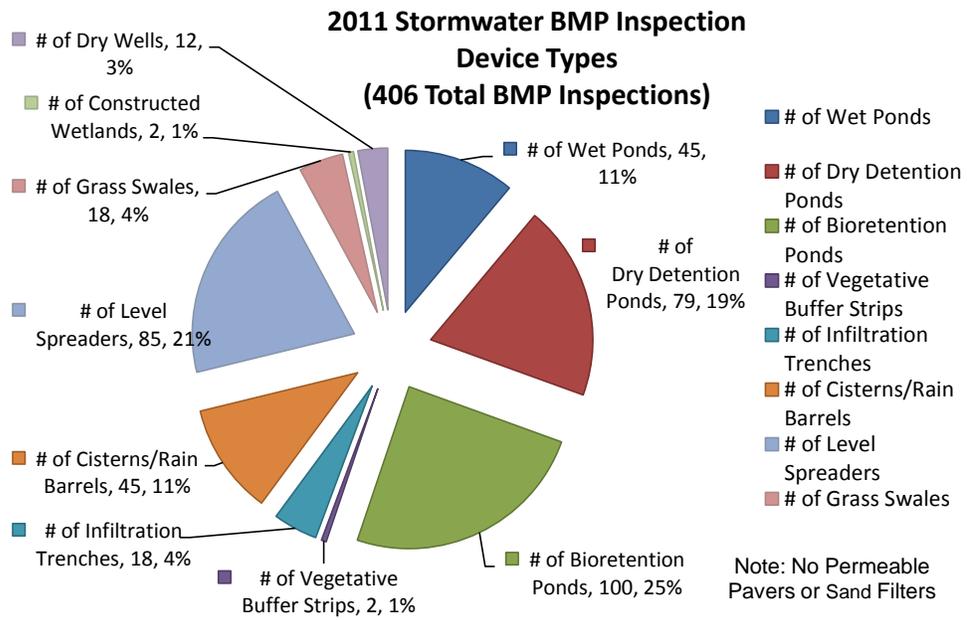
Total No. of Projects	232
Total No. of BMPs	406
No. of Residential BMPs Inspected	197
No. of Commercial BMPs Inspected	75
No. of Regional/Subdivision BMPs Inspected	134
No. of Devices Present	304
No. of Devices Not Present, 2 devices unknown	100
No. of Devices Not constructed or converted due to S&E	61
No. of Devices in Compliance	227
No. of Devices in Need of Corrective Action	123

**2011 Stormwater BMP Inspections
of BMPs per Watershed**

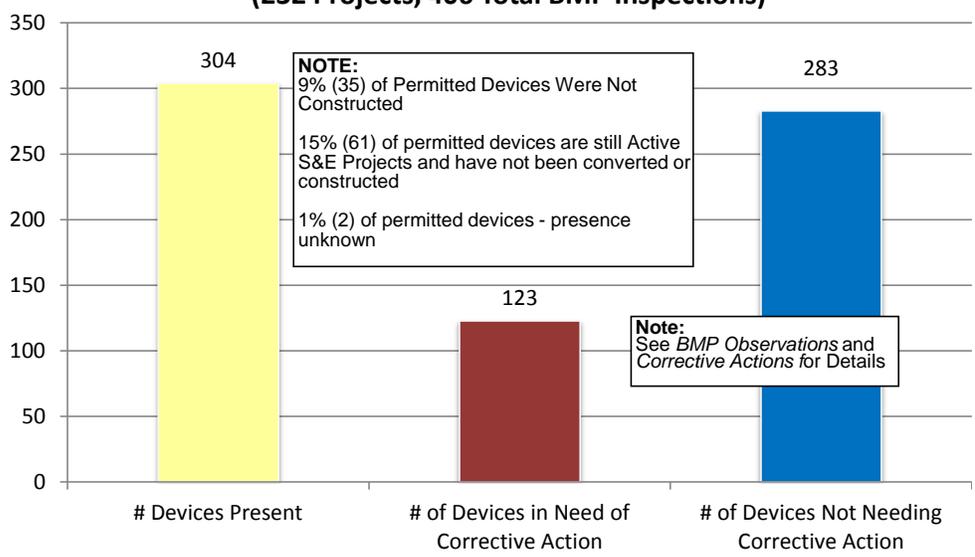


**2011 Stormwater BMP Inspections
Classifications by Residential, Commercial, and Subdivision
(406 Total BMP Inspections)**





Overall 2011 Stormwater BMP Inspection Results (232 Projects, 406 Total BMP Inspections)



Report Enhancements New in 2011

In 2010, as part of the Stormwater management mainframe enhancement project, new fields were added to the mainframe building permit screens to standardize and capture basic BMP data. The advantage is that for the first time BMP data is searchable by the interdepartmental development services staff. However, given the limitation of space on the existing mainframe permit screens, we continue to use an excel spreadsheet to document



additional BMP data and to generate ad hoc reports. Our current records are significantly more accurate and detailed than those from 2006 and are more inclusive of level spreaders than in 2009 or 2010. Watershed Management staff has reviewed the closed out files scheduled for disposal in 2010 (older than 6 years) to identify previously untracked level spreaders. These will be added to the bmp inventory. In 2011 staff will review all remaining closeout files to identify all other untracked level spreaders.

The on-going mainframe enhancement project with Information Services will result in the conversion this year of our Excel BMP database to the mainframe. Persons with mainframe access will be able to check on the status of BMPs throughout the approval, permitting, close out and life cycle maintenance. This will include a built inspections, annual staff inspections, owner inspections, complaints, enforcement action, and follow-up actions.

Municipal BMPs Tracked By Wake County

Pursuant to interlocal agreements executed in 2010, Wake County administers the new municipal stormwater ordinance for the Towns of Wendell, Rolesville and Zebulon and will maintain the same level of information on the municipal BMPs as those in the County. This information will be searchable on the mainframe and the County will generate custom reports for each municipality.

New GIS Based BMP Inventory Map

Using GIS, staff has developed a BMP inventory map that includes georeferences. Next year, we anticipate using the handheld Trimbles to enter annual inspection data and photos in the field which will automatically be uploaded into the existing BMP inventory attribute table, greatly reducing staff time devoted to data entry. Digital documents can

now be hotlink to data points on the BMP map. This will allow easy access to such documents as photos and as-built site plans. The utility of this GIS based system is limited by the fact that the Watershed Management Section has only 3 licenses. These licenses originally resided with the stormwater staff as ARCGIS has functional utility advantages over MAPS for stormwater plan review. Ideally, each staff member would have ARCGIS and a laptop capable of running it in the field. Currently, none of our laptops are capable of running the County's current version of GIS. The ARCGIS licenses are assigned as follows: Betsy Pearce, Shawn Springer and the shared PC.

Summary

Two hundred thirty-two (232) projects and four hundred (406) BMPs were inspected for this report. Three hundred and four (304) BMPs were present. Those not present included still active sedimentation or erosion control projects (61) or were never installed, not visible, or had been removed (37). One hundred twenty-three (123) required corrective action and 238 required no corrective action. Forty-eight percent (48%) of the projects inspected were individual lot deviation sites. The findings below identify problems that need to be addressed and the recommended corrective action to be taken.

Findings and Recommendations

1. Finding: The allowance of deviations was never codified and related policies and procedures were developed and modified ad hoc by staff.

Issue: Lack of consistency in policy has resulted in inconsistent administration and implementation of the deviation program.

Recommendation: Enhance deviation policies and standard operating procedures and publish on web page.

2. Finding: Deviations on single family lots account for 49% of all BMPs.

Issue: Inadequate maintenance, owners' lack of understanding regarding functional necessity of BMP, maintenance requirements and lack of adherence to annual reporting requirements are common.

Recommendation: Develop educational campaign targeting owners of individual lot BMPs regarding maintenance obligations/practices.

3. Finding: Devices deteriorate over time when not properly maintained.

Issue: Owners' defer maintenance.

Recommendation: Recommend follow-up inspection within to ensure remediation and implement targeted educational campaign.

4. Finding: Device does not function as intended.

Issue: Poor design, less than optimal choice of device, failure to construct according to plan, failure to capture runoff, lack of maintenance, etc.

Recommendation 1: Develop standard specifications for most commonly used devices and provide guidelines on selection and location of device.

Recommendation 2: Consider requiring plan prepared by a design professional for individual lot deviations.

Recommendation 3: Develop an inspection schedule for installation and post construction of all measures.

Recommendation 4: Require corrective action by responsible party.

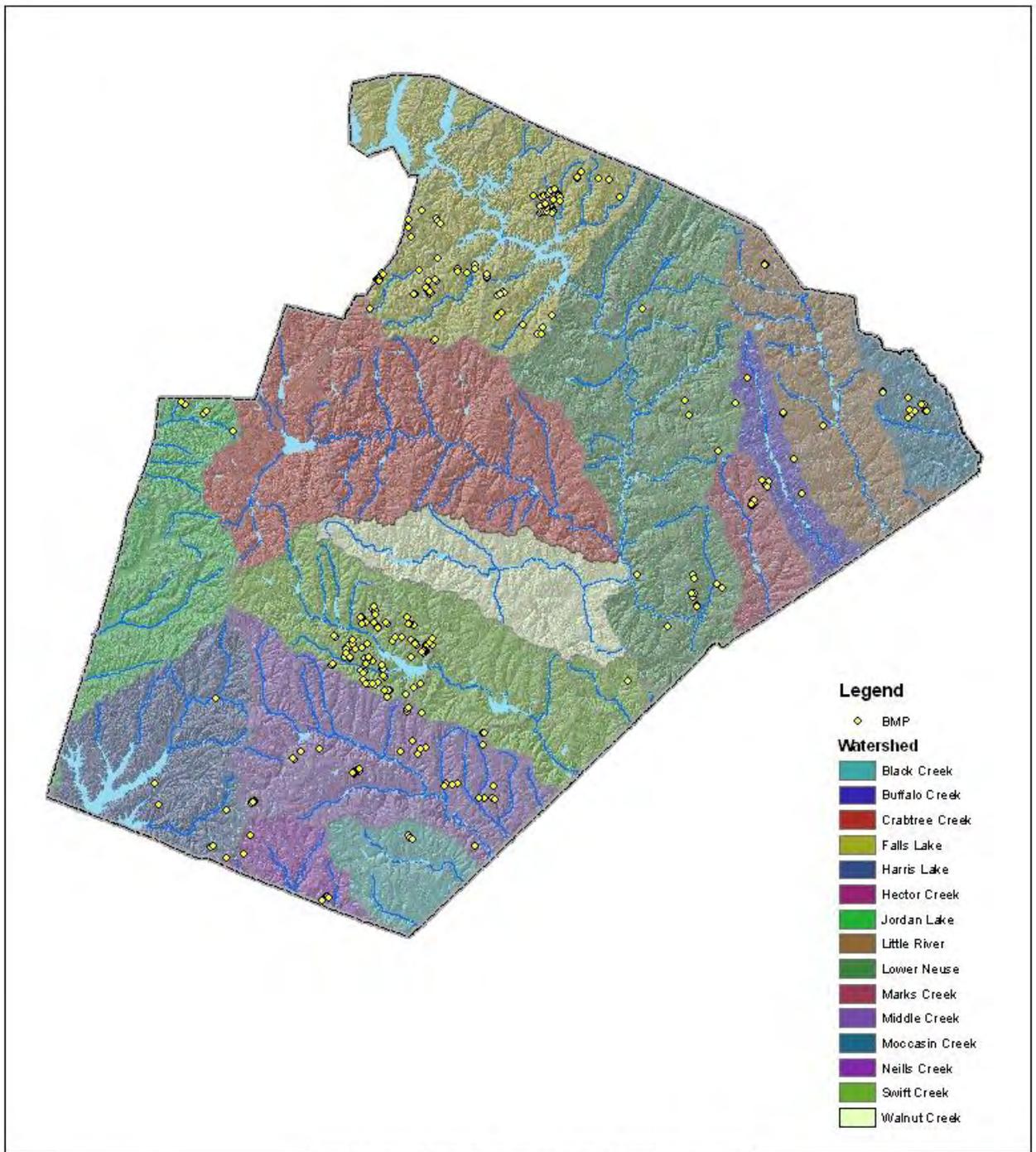
5. Finding: Coordination needed for conversion of E&SC devices into permanent stormwater devices.

Issue: Conversions may not follow standard E&SC methods/procedures such as proper dewatering, discharge, and stabilization.

Recommendation: Discuss conversion issue at the pre-construction conference; require onsite discussion of methods/procedures to be used in conversion prior to initiation.

Follow-up Action

- Continue to update the BMP database to include new projects, projects with level spreaders and legacy files
- Annual inspections of all documented BMPs
- Annual written communication with all responsible parties
- Compliance and/or enforcement
- Responsible party education and training
- Complete data management project w/IS, train staff on new mainframe functions/reporting
- Enhancement of policies and procedures
- Quarterly reporting



1 inch = 30,000 feet

**Map of Wake County showing:
BMP's by Watershed**

This document is a graphic representation only, created from the best available sources. Wake County assumes no responsibility for any errors, or misuse of this document.



- 8. Forms** – Includes a New Development Standards Checklist Wake County developed for Jordan Lake and other forms currently used by Wake County for stormwater permitting and compliance processes.

[Standards Checklist for New Development Rule Jordan Lake](#)

[Stormwater Submittal Checklist](#)

[Stormwater Permit Application](#)

[Stormwater Permit](#)

[As-built Submittal Checklist](#)

[As-built Certification](#)

[As-built Example](#)

[Access Easement](#)

[Bioretention Maintenance Agreement](#)

[Cistern Maintenance Agreement](#)

[Dry Detention Maintenance Agreement](#)

[Grass Swale Maintenance Agreement](#)

[Wet Detention Maintenance Agreement](#)

[Pond Dam Maintenance Agreement](#)

CHECKLIST OF APPLICABLE STANDARDS FOR NEW DEVELOPMENT: JORDAN LAKE NUTRIENT MANAGEMENT STRATEGY (DRAFT)		STAFF USE ONLY	
PROJECT NAME:		FILE #:	
DEV'R: √ or X	APPLICABLE STANDARD [rule reference]	STAFF: √ or X	COMMENTS/CONDITIONS
STANDARDS FOR NEW DEVELOPMENT			
1	An Approved Stormwater Management Plan –shall be required for all proposed new development disturbing 1 acre or more for single family and duplex residential development, and one-half acre or more for commercial, industrial, multifamily residential, local government property and other non-residential uses.[15A NCAC 02B.0265(3)(a)]		
2	Stormwater Permit – is required for all development and redevelopment unless exempt pursuant to the Unified Development ordinance. A permit may only be issued subsequent to a properly submitted, reviewed and approved stormwater management plan and permit application. [Wake County]		
2	Nitrogen and Phosphorus Loads- contributed by the proposed new development shall not exceed the unit area mass loading rate applicable to that subwatershed as follows for nitrogen and phosphorus, respectively, expressed in units of pounds per acre per year: 2.2 N and 0.82 P in the Upper New Hope, 4.4 N and 0.78 P in the Lower New Hope; and 3.8 and 1.43 in the Haw. [15A NCAC 02B.0265(3)(a)(i)]		
3	Compliance Other Stormwater Regulations - proposed new development subject to NPDES, water supply and other state and local mandated regulations shall comply with those regulations in addition to the other requirements of NCAC 02B.0265. [15A NCAC 02B.0265(3)(a)(iii)]		
4	Runoff Treatment –Stormwater systems shall be designed to control and treat the runoff generated from all surfaces by one inch of rainfall. Treatment volume shall be drawn pursuant to standards specific to each practice as provided the NC Stormwater Best Management Practices Manual or technically equivalent standards acceptable to NCDENR. Stormwater flows from new development shall not contribute to degradation of waters of the State. [15A NCAC 02B.0265(3)(a)(iv)]		
-	Peak Flow – new development shall not result in a net increase in peak flow leaving the site from the predevelopment conditions for the 1 yr-24hr storm. [15A NCAC 02B.0265(3)(a)(iv)]		
6	Replacement or Expansion w/No Net Increase in BUA – proposed development that would replace or expand structures or improvements that existed as of December 2001, the end of the baseline period, <i>and that would not result in a net increase in built-upon area</i> shall not be required to meet nutrient loading targets or high-density requirements except to the extent that it shall provide stormwater control at least equal to the previous development. [15A NCAC 02B.0265(3)(a)(v)]		

7	<p>Replacement or Expansion with Net Increase in BUA proposed new development that would replace or expand existing structures or improvements and that would result in a net increase in built-upon area shall have the option either to achieve at least the percentage loading reduction objectives stated in 15A NCAC 02B.0262 as applied to nitrogen (35% UNH, 0% LNH and 8% Haw) and phosphorous (5% UNH, 0% LNH and 8% Haw) loading from the previous development for the entire project site, or to meet the loading rate targets expressed in lbs/ac/yr of nitrogen (2.2 UNH, 4.4 LNH, and 3.8 Haw) and phosphorous (0.82 UNH, 0.78 LNH, and 1.43 Haw) [15A NCAC 02B.0265(3)(a)(v)]. <i>Note: There is no reduction goal for redevelopment in the LNH for N or P; therefore the loading rate targets are not applicable only for replacements or expansions that result in a net increase in BUA.</i></p>		
8	<p>Riparian Buffers – new development shall comply with the riparian buffer protection requirements of 15A NCAC 02B.0267 and .0286 [15A NCAC 02B.0265(3)(a)(vi)]</p>		
9	<p>Nutrient Offset Option- Developers shall have the option of offsetting part of their nitrogen and phosphorus loads by implementing or funding offset management measures as follows: Before using the offset options, a development shall attain a maximum nitrogen loading rate onsite of 4lbs/ac/yr for single-family detached and duplex residential development and eight lbs/ac/yr for other development including multi-family residential, commercial and industrial and other non-residential property and shall meet any requirements for engineered stormwater controls described in NCAC 02B.0265(3)(a)(iii).</p>		
10	<p>Offsite offsetting measures – shall achieve at least equivalent reductions in nitrogen and phosphorus loading to the remaining reduction needed onsite to comply with the loading target rates. [NCAC 02B.0265 (3) (a) (vii)].</p>		
11	<p>Offset Payments - A developer may make offset payments to the NC Ecosystem enhancement Program contingent upon acceptance of payments by that program or may propose the use other offsite offset measures to the local government or utilize a private seller. All offset measures shall meet the requirements of 15A 02B .0273(2) through (4). [NCAC 02B.0265 (3) (a) (vii)].</p>		
11	<p>Maintenance Plan – A plan to ensure maintenance, enforcement and compliance of BMPs for the life of the development [NCAC 02B.0265 (3) (b) and (c)].</p>		

END

9/9/2011 2:47:12 PM



WAKE COUNTY STORMWATER CHECKLIST

Under County ordinance, most new development is required to obtain a stormwater permit. A stormwater management plan is designed to protect downstream water resources and property owners from water pollution, flooding and other damage caused by urban runoff after a development is complete. This checklist shows what information needs to be provided and what issues need to be addressed when preparing a stormwater management plan. All items listed may not be applicable to each site, nor is the list all-inclusive. It is meant to serve as a guide for the stormwater planner. County policy suggests a **Pre-Submittal Conference** prior to Preliminary Plan Submission.

Note: Curve number worksheets are not required for non-residential projects.

_____ **Stormwater Plan Review Fee**
 _____ **Flood Study Fee**
 _____ **Stormwater Permit Fee**

Preliminary Plan Submittal.

Delineate and Label On Map (1"=equals no more than 100') & Drawings

	North arrow, graphic scale, drafting version/date and designation of source documents for all map features
	Existing and proposed watershed, sub-watershed, and land use boundaries. (<i>contributing watersheds that extend beyond the site boundaries may be delineated on a separate map.</i>)
	Delineate any required Neuse Riparian Buffers and/or provide documentation of buffer reductions.
	Delineation of all proposed impervious surfaces, roads, well lots, recreation sites, including single family residences.
	Clearly delineate flood hazard boundaries, including FEMA series J maps and flood hazard soils. Differentiate between floodplain and open space. Indicate lots which will require flood permits.
	Delineate all flood hazard soils and/or provide documentation of soils redelineations.
	Stormwater Design Tool Worksheets: Summary, Target CN, Preliminary Plan, Post development CN (residential only)
	Proposed stormwater discharge points (<i>where water leaves site by surface or subsurface flows</i>).
	Proposed drainage easements and widths (<i>in Feet</i>).
	Type, size location and cross-section of all proposed stormwater management conveyance systems (<i>grass swale, lined channel, storm culvert, etc.</i>).
	Location and type of all proposed stormwater management structures (<i>wet/dry detention basin, filtering/infiltration basin, bioretention, etc.</i>).
	Proposed access lanes and sediment disposal areas for future maintenance of stormwater management facilities.
	Indicate whether 401/404 permits are required and applied for.

Construction Plan Submittal (in addition to preliminary list)

	Joint application for plan approval
	Plan narrative describing site drainage, stormwater management objectives, and how the proposed stormwater management plan will meet the objectives and be implemented.
	Complete set of Stormwater Design Worksheets (residential only)
	Pre/post development peak flows for the 1-yr, 2-yr, 10-yr., and 100-yr./24 hour storm events for all proposed stormwater discharge points from the site.
	Support data for all stormwater practice designs, such as drainage area boundaries, Tc/Tt values, inflow/outflow rates, stage/storage data, hydrographs, outlet designs, infiltration rates, water elevations, design output, summary, etc.
	Show compliance with required setbacks from on-site systems and well sites
	Soil profile investigation data (<i>color, texture, groundwater/bedrock depth, structure, etc.</i>) extended at least 3 feet below the planned bottom elevation of any structure/component.
	Nitrogen Export Load Calculations
	Required flood study approvals
	Backwater easements
	Draft Stormwater Agreement
	Draft Maintenance Agreement
	Draft Deed Restrictions / Protective Covenants Proposal
	Draft As Built Plan or performance guarantee paperwork.
	Other hydraulic and hydrologic computations critical to the plan/designs.
	401/404 approvals
	Impact assessment for discharges to wetlands.
	Planting and landscaping plans critical to the stormwater designs.
	Signature, Date And Professional Seal: for all Stormwater design management proposals, i.e. calculations, BMP designs, operations/maintenance/budget/as-built/inspections/manuals.

Final Plat Submittal

	Table with impervious calculations
	Perpetuity statement (residential)
	Show impervious limit on each lot rounded to nearest whole number
	Asterisk lots requiring flood permits (residential)
	Show finished floor elevations as required
	Show required buffers, flood hazard areas, drainage easements, ...
	Show specific locations of permanent stormwater devices with maintenance easements; label as permanent stormwater detention and maintenance easement.
	Show required statements in support of design calculations such as tree preservation areas and disconnected impervious.
	Receipt for required NC EEP offset fee.
	Completed Stormwater Agreement
	Completed Maintenance Agreement
	Deed Restrictions / Protective Covenants Proposal
	As Built plans for stormwater devices (see as built checklist)
	Performance guarantee in lieu of as-built plans



Construction Plan Application for Stormwater, Floodplain Management, Sedimentation & Erosion Control

I. PROPERTY INFORMATION

- 1. Project Name: 2. Address: 3. Wake County Pin #: 4. Jurisdictional Area: (List municipality if applicable for S&EC) 5. Zoning District 6. River Basin: (Neuse/Cape Fear) 7. County Watershed: (Falls Lake, Smith Creek, Little River, Swift Creek, Jordan) 8. If in the Swift Creek Water Supply Watershed, indicate applicable land use type per the Swift Creek Land Management Plan: 9. Total area in acres: 10. Total property area to be disturbed in acres: 11. Present Land Use (Check): Commercial Residential Agricultural Vacant Forest 12. Proposed Land Use/Project Type (Check): Commercial Residential Redevelopment 13. Recorded: Book of Maps No. Page No. 14. Property W/In FEMA Flood Zone: (yes/no) 15. Zone: (A, AE, X) 16. FIRM Panel No.: 17. FIRM Effective Date: 18. Exiting Impervious (sq.ft) 19. New or Proposed Impervious (sq.ft) 20. Impervious Surface of Well Lot and Access Road (sq.ft)

II. DOCUMENT SUBMITTED WITH THIS REQUEST:

Copies of this application () Sets of Construction Plans (5) Fees: (See attached fee schedule) Subdivision Preliminary Approval Document

A. Stormwater Review:

Stormwater Narrative Stormwater Checklist: SW Calculations () Nitrogen Export Load Calculations Deed Restrictions and Protective Covenants Application Form Operations, Maintenance, Inspection and Budget Manuel *Residential Maximum Curve No. Post-development Curve No. Soil Scientist Soils Evaluation

B. Flood Study Review:

Floodstudy Narrative Flood Study Checklist Floodstudy Calculations ()

C. For Sedimentation & Erosion Control Review:

Erosion Control Narrative Sedimentation & Erosion Checklist Financial Responsibility/Ownership Form: S&E Calculations () DWQ, 404 and/or 401 approval document NC DOT Driveway Encroachment Agreement:

Other Documents Submitted with this request: *See Article 9-20 of the UDO

III. GENERAL INFORMATION

1. **Property Owner** (s) (specify the name of the corporation, individual, etc., who owns the property):

Name: _____
 Street Address: _____
 Mailing Address: _____
 E-Mail Address: _____
 Phone#:(____) _____ Cell#:(____) _____ Fax#: (____) _____

2. **Applicant/Engineer/Architect/Surveyor** * (Person to whom all correspondence will be sent):

Name: _____
 Firm/other: _____
 Street Address: _____
 Mailing Address: _____
 E-Mail Address: _____
 Phone#: (____) _____ Cell#: (____) _____ Fax#: (____) _____
 Relationship to Owner: _____

**If not a resident of North Carolina, a North Carolina agent must be designated for the purpose of receiving correspondences.*

IV. APPLICANT'S CERTIFICATION:

PRINT NAME _____

SIGNATURE _____ **DATE** _____

OWNER/PERSON FINANCIALLY RESPONSIBLE

V. Residential Construction Plan Review Fees:

S&E _____ x \$250.00 = _____
 Exact disturbed acres(No Cap) round to nearest dollar

*SW _____ x \$250.00 = _____
 Exact disturbed acres round to nearest dollar
 (10-Acre Cap or minimum of \$250.00)

Subdivision Review Fee = \$275.00

*Minor Flood Study please add \$500.00/ each crossing _____ x 500.00 = _____

*Major Flood Study please add \$1,000.00/ each crossing _____ x 1,000.00 = _____

Total Fees Due

--

VI. Non-Residential Construction Plan Review Fees:

S&E _____ x \$250.00 = _____
 Exact disturbed acres (No Cap) round to nearest dollar

*SW _____ x _____ = _____
 Exact disturbed acres (50 Acre Cap) _____
 \$250 (0-9 acres)
 \$375 (10-19 acres)
 \$435 (20-29 acres)
 \$470 (30-39 acres)
 \$485 (40-50 acres)
 round to nearest dollar

*Minor Flood Study please add \$500.00/ each crossing _____ x 500.00 = _____

*Major Flood Study please add \$1,000.00/ each crossing _____ x 1,000.00 = _____

Total Fees Due

--

**Applies only to Wake County Jurisdictional Projects*

(form created April 2007)

OFFICIAL USE ONLY				
Date Received	S&E	Stormwater	Subdivision	Flood Major____, Minor____
S permit #	S	S	S	S

08/08/2011 16:57:47

EROSION/FLOOD/STORMWATER PERMIT

WIS039

ASSGND TO:

LAST UPDATED BY: J. SJAARDEMA

856-6195

PERMIT#: S000362 STS: A APP DATE: 11/10/2003

COMP DATE:

PROJECT: THE RECREATION CTR @ STONEMOOR

DAY PHONE: (919) 469 - 3340

ADDRESS: 111 MACKENAN DRIVE

FAX#: (919) 467 - 8008

CITY: CARY

STATE: NC ZIP: 27511

OWNER: CREEDMOOR PARTNERS LLC

DAY PHONE: (919) 571 - 8263

ADDRESS: 5623 DURLEIGH RD STE 151

FAX#: (919) 571 - 1521

CITY: RALEIGH

STATE: NC ZIP: 27612

HD USE: 601 STORMWATER PERMIT

BLDG PRMT:

WW PRMT:

EXIST USE:

ORIG PERMIT#:

REC?: Y

WATER: I WASTEWTR: I BK/PG: 9999 9999

TAX MAP#: 0239 0006

TOWNSHIP: 02 BARTON'S CREEK JURIS: WC ZON: R40W

PIN: 0799.01 08 6349 000

SUBD#: 000 000 00 SUBD NAME:

LOT-SEC:

ACRE: 4.35

%IMPERV: 17.40 LIMIT: 15.00 TYPE USE: C NEW?: Y

DISTURB ACRE: 2.20

WATERSHED: N FLOOD STUDY REQ?: N COMP DATE:

RECEIPT#: 0006220 FEE: 550.00

ST#: MI: DIR: NAME: OLD CREEDMOOR

DIR: TYP: RD

DIRECTIONS: INTERSECTION OF NORWOOD RD & OLD CREEDMOOR RD
STORMWATER PLAN APPROVED BY JMC ON 2/26/04

RCPT DAT: 03/04/2004

F1=PRMT F2=INSP F3=NOTES F6=FEE F8=MULTI-ADD F9=EMAIL F12=BLDG PRMT F13=WW PRMT



Wake County As-Built Checklist

Under county ordinance, projects requiring stormwater management devices require Assurance that Improvements will be Completed and Maintained per Article 9, Stormwater Management, of the Unified Development Ordinance (UDO). Upon completion of required improvements, the developer must submit as-built plans of required stormwater improvements to the Wake County Department of Environmental Services. These plans must indicate whether stormwater improvements were constructed in accordance with the county approved stormwater plan. This checklist shows what information needs to be provided and what issues need to be addressed when preparing an as-built plan. All items listed may not be applicable to each site, nor is the list all-inclusive. It is meant to serve as a guide for the engineer preparing an as-built plan.

As-Built Certification. Two copies of as-built, field-verified plans must be signed and sealed by a registered Professional Engineer and/or a Registered Land Surveyor, both licensed to practice in the State of North Carolina, showing contours, elevations, grades, locations, drainage and hydraulic structures, and detention basin volumes.

	Vicinity map on plan sheet.
	Profile along the centerline of the embankment.
	Profiles and/or cross sections of the stormwater management facilities with associated details.
	Elevations of the “water quality”, 10, and 100 year storms as appropriate.
	Profile along the centerline of the principal spillway/outfall pipe extending below the protected outfall or to the downstream manhole structure
	As-Built topography and/or dimensions of the stormwater management facility with computations to verify conformance with the approved plan.
	Establishment of a benchmark on the riser/control structure or inlet headwall to the nearest 0.1-foot.
	Profile along the centerline of the emergency spillway.
	Design and As-Built stage-storage table on the plan view sheet.
	Storage deviation verification (i.e. TR-20 computer run to show adequate storage if the available storage does not agree with the original design storage.
	The dimensions and type of material for the riser/control structure.
	The diameter, length, and type of material for the principal spillway, underdrains, and observation/cleanout wells.
	The size, location and type of trash rack device(s).
	The number, size and location of the anti-seep collars, precast collars, and cradles as appropriate.
	Invert, size and length of any low stage orifices and high stage weir crests.
	Flow splitter diversion pipe/weir invert, size, and location.
	Incoming and outgoing storm drain sizes, inverts, and outfall dimensions.
	Thickness and type of coarse/fine aggregates and planting soil.
	Filter fabric/geotextile type and location.
	Landscape/wetland plantings number and location. Include landscape plan with as-built plan set.
	Certification statement and seal by a Professional Engineer indicating, “This record drawing is accurate and complete, the stormwater management facilities are constructed per the approved stormwater management plan or subsequent approved revisions, and stormwater management is provided per the approved design computations”.
	Verify easements, covenants, and any other legal agreements are recorded and in the file.
	Verify that the stormwater management facility was constructed within the recorded easement area.
	Provide proof of recordation of stormwater agreement / provide copy
	Provide signed maintenance agreement

PROFESSIONAL ENGINEER'S
CERTIFICATION

PROJECT NAME Stonemoor Recreation Center Stormwater Management Basin

Wake Co Project No. S-36-02 DATE ISSUED May 10, 2005

I, Dale Werenko, PE, as a duly registered Professional Engineer in the State of North Carolina, having been authorized to observe (periodically, weekly, full time) the construction of Stonemoor Recreation Center the project, Stormwater Management Basin, Wake County, NC for the
Project Name *Location*

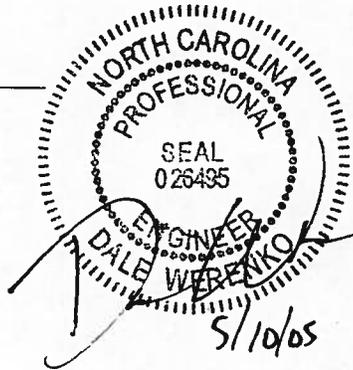
Permittee hereby state that, to the best of my abilities, due care and diligence was used in the observation of the construction such that the construction was observed to be built within substantial compliance and intent of this permit, the approved plans and specifications, and other supporting materials.

Dale Werenko
Signature

5/10/05
Date

P.E. REGISTRATION NO. 26495

WR Project No. 201280.11



"THIS MAP IS NOT A CERTIFIED SURVEY AND HAS NOT BEN REVIEWED BY A LOCAL GOVERNMENT AGENCY FOR COMPLIANCE WITH ANY APPLICABLE LAND DEVELOPMENT REGULATIONS.



NORWOOD ROAD

LOBLEY HILL LANE PUBLIC R/W

10233

STONEMOOR / LINVILLE RECREATION CENTER
BOM 2003 PG 1271

LOT 67
BOM 2003
PG 1271

ACCESS ESMT.
5856 SQ FT
0.13± AC

STORMWATER CONTROL ESMT.
11174 SQ FT
0.26± AC

20' PRIVATE DRAINAGE ESMT.

492.14'

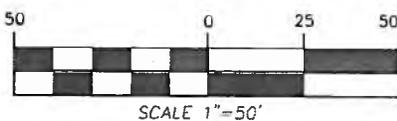
20' DRAINAGE ESMT.

30' WAKE COUNTY DRAINAGEWAY BUFFER

20' BUILDING SETBACK

LINE TABLE		
LINE	BEARING	LENGTH
L1	S78°27'41"W	2.82
L2	S86°47'16"W	74.27
L3	N74°11'00"W	10.05
L4	S08°15'24"W	36.24
L5	S81°44'36"E	23.29
L6	N12°07'09"E	13.96
L7	S77°01'41"E	0.00
L8	S74°11'00"E	10.05
L9	N86°47'16"E	75.01
L10	N12°27'57"W	19.24
L11	S79°36'49"E	28.85
L12	S04°22'45"W	42.53
L13	S79°12'00"W	100.49
L14	N71°18'18"W	106.37
L15	N50°21'09"E	77.03
L16	S82°14'34"E	71.26
L17	N12°27'57"W	13.99

CURVE TABLE					
CURVE	LENGTH	RADIUS	DELTA	BEARING	CHORD
C1	92.19'	1037.50'	5°05'29"	S03°14'10"W	92.16
C2	68.89'	300.00'	13°09'23"	S05°53'16"E	68.73
C3	57.09'	209.00'	15°39'04"	S80°25'24"W	56.91
C4	58.93'	101.64'	33°13'08"	N89°12'26"E	58.10
C5	70.68'	359.00'	11°16'49"	N79°49'24"W	70.56
C6	21.71'	322.00'	3°51'45"	N79°48'44"W	21.70
C7	7.93'	5.00'	90°51'10"	S57°32'44"W	7.12
C8	16.93'	341.00'	2°50'41"	N75°36'20"W	16.93
C9	69.36'	119.64'	33°13'08"	N89°12'26"E	68.40
C10	52.40'	191.00'	15°43'06"	S80°27'25"W	52.23
C11	5.42'	25.00'	12°25'24"	N87°00'02"W	5.41
C15	29.50'	300.00'	5°38'03"	N09°38'55"W	29.49



EASEMENT EXHIBIT
STONEMOOR / LINVILLE RECREATION CENTER
ACCESS & STORMWATER CONTROL EASEMENT
Withers & Ravenel
ENGINEERING & SURVEYING, INC.
111 MacKENAN DRIVE, CARY, N.C. 27511 (919) 469-3340

**STORMWATER CONTROL STRUCTURE
BIORETENTION MAINTENANCE AGREEMENT**

PROJECT: _____

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS: _____

I. Monthly or after every runoff producing rainfall, whichever comes first:

- a. Remove debris from bioretention area.
- b. Inspect for ponding, washed-out areas, and soil conditions.
- c. Check for eroded areas of bioretention area and repair before next rainfall.
- d. Check vegetation conditions within the bioretention area and replace if necessary any damaged plant materials.

II. Quarterly

- a. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
- b. Check bioretention inlet pipes for undercutting. Repair if necessary.
- c. Repair any broken pipes.
- d. Remulch any void areas by hand whenever needed.
- e. Replace rip rap at out let pipe that is choked with sediment.

III. Semi-Annually

- a. Reseed grass swale or border twice yearly.
- b. Apply new mulch twice yearly.

IV. General

- a. All components of bioretention area to be kept in working order.
- b. This property and bioretention area is also subject to the Stormwater Agreement filed in relation to this project.
- c. In case the ownership of the bioretention transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 2007 and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

**STORMWATER CONTROL STRUCTURE
CISTERN MAINTENANCE AGREEMENT**

PROJECT: _____

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS: _____

- I. Monthly** *or after every runoff producing rainfall, whichever comes first:*
 - a. Make sure downspouts are draining into cistern.
 - b. Check and clear inlet, gutters, or downspouts of any obstructions.
 - c. Check tank for water, tank should be empty in 5 days after rainfall event. Fix as needed.

- II. Semi-Annually**
 - a. Inspect drawdown lines. Repair/replace as necessary.
 - b. Repair any broken pipes.
 - c. Inspect tank for accumulated sediment-debris clean as necessary.

- III. General**
 - a. All components of stormwater cistern are to be kept in working order.
 - b. In case the ownership of the Property/Cistern Transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 20__ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

**STORMWATER CONTROL STRUCTURE
DRY DETENTION MAINTENANCE AGREEMENT**

PROJECT: _____

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS: _____

- I. Monthly** *or after every runoff producing rainfall, whichever comes first.*
- a. Remove debris from trash rack.
 - b. Check and clear orifice of any obstructions.
 - c. Check pond side slopes; remove trash, repair eroded areas before next rainfall.
- II. Quarterly**
- a. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning.
 - b. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
 - c. Check impoundment inlet pipes for undercutting. Repair if necessary.
 - d. Repair any broken pipes.
 - e. Replace rip rap that is choked with sediment.
- III. Semi-Annually**
- a. Remove accumulated sediment from bottom of outlet structure.
 - b. Check pond depth at various locations. If depth is reduced to 75% of original design depth, remove sediment to original design depth.
 - c. Reseed grassed swales twice yearly. Repair eroded areas immediately.
- IV. General**
- a. Mow side slopes according to the season. Maximum grass height to be six (6) inches.
 - b. All components of impoundment system to be kept in good working order.
 - c. In case the ownership of the Impoundment Transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.
 - d. This property and impoundment is also subject to the Operation and Maintenance Manual filed with the register of deeds.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 2008 and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

Permit Name: _____

(to be provided by DWQ)

Drainage Area Number: _____

Grassed Swale Operation and Maintenance Agreement

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

Important maintenance procedures:

- The drainage area of the grassed swale will be carefully managed to reduce the sediment load to the grassed swale.
- After the first-time fertilization to establish the grass in the swale, fertilizer will not be applied to the grassed swale.

The grassed swale will be inspected **once a quarter**. Records of operation and maintenance will be kept in a known set location and will be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
The entire length of the swale	Trash/debris is present.	Remove the trash/debris.
	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then re-sod (or plant with other appropriate species) and water until established. Provide lime and a one-time fertilizer application.
	Sediment covers the grass at the bottom of the swale.	Remove sediment and dispose in an area that will not impact streams or BMPs. Re-sod if necessary.
	Vegetation is too short or too long.	Maintain vegetation at a height of approximately six inches.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the NC Division of Water Quality 401 Oversight Unit at 919-733-1786.

Permit Number: _____
(to be provided by DWQ)

I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed above. I agree to notify DWQ of any problems with the system or prior to any changes to the system or responsible party.

Project name: _____

BMP drainage area number: _____

Print name: _____

Title: _____

Address: _____

Phone: _____

Signature: _____

Date: _____

Note: The legally responsible party should not be a homeowners association unless more than 50% of the lots have been sold and a resident of the subdivision has been named the president.

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, _____, and acknowledge the due execution of the forgoing grassed swale maintenance requirements. Witness my hand and official seal,



SEAL

My commission expires _____

**STORMWATER CONTROL STRUCTURE
WET DETENTION MAINTENANCE AGREEMENT**

PROJECT: _____

RESPONSIBLE PARTY: _____ **PHONE #:** _____

ADDRESS: _____

- I. Monthly or after every runoff producing rainfall, whichever comes first.**
 - a. Remove debris from trash rack.
 - b. Check and clear orifice of any obstructions.
 - c. Check pond side slopes; remove trash, repair eroded areas before next rainfall.

- II. Quarterly**
 - a. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning.
 - b. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
 - c. Check impoundment dam and inlet pipes for undercutting / critter holes. Repair if necessary.
 - d. Repair any broken pipes.
 - e. Replace rip rap that is choked with sediment.

- III. Semi-Annually**
 - a. Remove accumulated sediment from bottom of outlet structure.
 - b. Check pond depth at various locations. If depth is reduced to 75% of original design depth, remove sediment to original design depth.
 - c. Reseed grassed swales twice yearly. Repair eroded areas immediately.

- IV. General**
 - a. Mow side slopes according to the season. Once per year sufficient to discourage woody vegetation. Avoid "lawn" type maintenance to reduce geese populations.
 - b. Wetland plants are encouraged along pond perimeter. Invasive species such as cattails shall be removed.
 - c. All components of impoundment system to be kept in good working order.
 - d. In case the ownership of the Impoundment Transfers, the current owner shall, within thirty (30) days of transfer of ownership, notify the Wake County Environmental Services, Flood and Stormwater Section of such ownership transfer.
 - e. This property and impoundment is also subject to the Operation and Maintenance Manual filed with the register of deeds.

I, _____, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device. I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature: _____ Date: _____

I, _____, a Notary Public for the State of _____, County of _____, do hereby certify that _____ personally appeared before me this _____ day of _____, 20__ and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,

Seal _____

My commission expires: _____

Pond and Dam Maintenance Agreement

NORTH CAROLINA

WAKE COUNTY

Property of:

KNOWN ALL MEN BY THESE PRESENTS that,
being the owners of all properties surrounding that pond as well as the pond itself, located in Wake County, North Carolina designated as Stonemoor subdivision and particularly described on plat in Book of Maps pending Page pending Wake County Registry,

DO HEREBY AGREE AND COVENANT with all persons, firms or corporations, now owning or hereafter acquiring and ownership and or riparian right to the pond as referenced above, that all are hereby subjected to the following Pond and Dam Maintenance Agreement, running with said properties by whomever owned, to wit:

1. The parties acknowledge that the dam is located within the subdivision of, Stonemoor described in Book of Maps pending Page pending Wake County Registry. The parties further acknowledge that the spillway for said dam is located on the property of Creedmoor Partners, LLC Pin Number pending with emergency spillway being on the property of Creedmoor Partners, LLC.
2. As Creedmoor Partners, LLC is planning to develop the tract or parcel of land upon which the dam and pond are located, Creedmoor Partners, LLC does agree to perform any and all maintenance and repair required by the appropriate governmental authorities to bring the pond, dam and spillways into compliance with current applicable governmental regulations.
3. Whereas Creedmoor Partners, LLC will be deeding the open space upon which the dam and spillway and emergency spillway sit upon to the Stonemoor Homeowners Association, both Creedmoor Partners, LLC and Stonemoor Homeowners Association, give, grant, and convey unto Wake County, the right and easement to come upon their property for the purpose of cleaning, improving and repairing any portion of the pond, dam and spillway which may be required by the appropriate governmental authorities to bring the pond, dam and spillways into compliance with current governmental requirements.
4. Upon completion of the initial improvements (whether or not the same are actually required by the appropriate governmental authorities), the parties of this Agreement, for themselves as well as their successors in interest, agree that thereafter all maintenance, improvements, upkeep and maintenance of the pond, dam and spillways shall be the responsibility of the Stonemoor Homeowners Association, their heirs, successors, and assigns, regardless of whether the required work is to the dam, pond or spillways. To accomplish such upkeep and maintenance, the parties to this agreement hereby grant to the other party reciprocal easements for the purpose of going upon the property of the other, for construction and maintenance of the required improvements and or repairs.

5. While Creedmoor Partners, LLC is in the process of developing the parcel, and to insure that the pond, dam and spillways are at all times operable, Creedmoor Partners, LLC and Stonemoor Homeowners Association will obtain periodic maintenance services on the pond, dam and spillways. The cost of said maintenance shall be the responsibility of the Stonemoor Homeowners Association.

Maintenance services should include but are not limited to:

- Removal of all trees with four inch diameter or greater from the dam.
- Inspection of riser and spillway to insure proper functionality.
- Debris and sediment removal from riser and barrel.
- Maintain proper pond depth.
- Repair any eroded areas.
- Repair any broken pipes.
- Mow side slopes according to season.

6. Upon completion of development by Creedmoor Partners, LLC, then the homeowners association as established by Creedmoor Partners, LLC shall select a person or firm to undertake the responsibility of periodic pond, dam and spillway maintenance. In the event that said association or its successors to the task of maintenance do not perform the necessary maintenance, then Creedmoor Partners, LLC or their successors in title, as applicable, may have the pond, dam and or spillways maintained as needed and apportion the cost to the Stonemoor Homeowners Association.

IN TESTIMONY WHEREOF, _____
has caused this instrument to be executed, by its Manager, and
have hereunto set their hand and seals, this the ___ day of _____.

for Creedmoor Partners, LLC

_____(SEAL)

_____(SEAL)
for Stonemoor Homeowners Assoc.

_____(SEAL)

NORTH CAROLINA

WAKE COUNTY

I, the undersigned, a Notary Public in and of the State and County aforementioned do hereby certify that _____, personally appeared before me this day and acknowledged the execution of the forgoing instrument, for and in behalf of said Company.

WITNESSED my hand and notarial seal, this the _____ day of _____.

Notary Public
My Commission Expires _____

NORTH CAROLINA

WAKE COUNTY

I, the undersigned a Notary Public in the State and County aforesaid, do hereby certify that _____ personally appeared before me this day and acknowledged the execution of the forgoing instrument.

WITNESSED my hand and notarial seal, this the _____ day of _____.

Notary Public
My Commission Expires _____

OPERATIONS AND MAINTENANCE MANUAL

Project: Stonemoor Rec Center

EARTHEN DAM STRUCTURE

Wake County, North Carolina

Owners: **Creedmoor Partners, LLC**

Prepared By: Withers & Ravenel, Inc.

Date: 5-12-05

Project: Stonemoor Rec Center

Date Constructed: March-April 2005

Location: In the southeast quadrant of the intersection of Norwood Rd. and Old Creedmoor Road

Receiving Water Course: Tributary of Lower Barton Creek

Contractor: (List below)

Impoundment & Dam	Percy Johnson, Inc. (Raleigh, NC) (919) 772-2987
Spillway	Percy Johnson, Inc. (Raleigh, NC) (919) 772-2987

Material Supplies:

Riser Structure	4'x4' Precast Concrete Box Riser
Bottom Drain	12" orifice into riser
Drain Gate Valve	N/A – Dry Pond
Outlet Pipe	18" Reinforced Concrete Pipe, 40' long
Trash Rack	No trash rack, slab top riser box

OPERATIONS & MAINTENANCE MANUAL

Stonemoor Rec Center: Earthen Dam Structure

This manual established procedures for maintenance and operation of the development known as **Stonemoor Rec Center: Earthen Dam Structure**.

I. Maintenance of Embankments

A. Vegetation

The embankment has a ground cover of fescue, which if properly maintained will prevent erosion of the embankment and provide an easy surface for inspection. Grass should be fertilized every October and April.

- ◆ Re-Seeding – periodically re-seeding may be required to establish grass on areas where seed did not take or has been destroyed. Before seeding, fertilizer (12-12-12) should be applied at a minimum rate of 12 to 15 pounds per 1,000 SF. The seed should be evenly sown at a rate of three pounds per 1,000 SF. The seed should be covered with soil to the depth of approximately $\frac{1}{4}$ ". Immediately following the planting, the area should be mulched with straw.
- ◆ Trees & Shrubs – trees, shrubs, and other landscape vegetation should be permitted only as shown on the approved planting plan.
- ◆ Mowing – grass mowing, brush cutting and removal of weed vegetation will be necessary for the proper maintenance of the embankment. All embankment slopes and vegetation of spillways should be mowed when the grass exceeds 8" in height. Acceptable methods include the use of weed whips or power brush cutters and mowers.

B. Erosion

Erosion occurs when the water concentrates causing failure of the vegetation or when vegetation dies and sets up the environment for rill erosion and eventually gullies from the stormwater runoff. The dam should be inspected for these areas. Proper care of vegetative areas that develop erosion is required to prevent more serious damage to the embankment. Rills and gullies should be filled with suitable soil compacted and then seeded. Methods described in Section I-A, on vegetation, should be used to properly establish the grass surface. Where eroded areas are detected, the cause of the erosion should be addressed to prevent a continued maintenance problem. Frequently problems result from the concentration of runoff to one point of the embankment crest instead of a uniform distribution of runoff. This can be corrected by reshaping the crest to more evenly distribute the runoff to areas, which are not experiencing erosion problems.

- ◆ Abutment Areas -- the abutment is the line formed where the embankment fill comes into contact with the existing slope. Runoff from rainfall concentrates in these gutter areas and can reach erosive velocities because of the steep slopes. If a normal stand of grass cannot be maintained on the abutments, additional measures may be needed such as jute matting to provide for the establishment of a good ground cover.
- ◆ Upstream Embankment Slope -- Erosion problems can develop on the upstream face of the dam due to the fluctuation of water level in the pond. This is a result of a combination of wave actions and ground saturation, which occurs from the elevated water levels. The erosion generally occurs as the water level falls and the saturated ground becomes subjected to the wave action. If erosion becomes a problem, it may necessitate the installation of a stone armoring along the zone subject to fluctuating water level. This would consist of 18" of NCDOT Class B stone for erosion control underlain with Mirifi 140 geotextile fabric. It should be centered at the point of the erosion problem and covering an area 2' above and below the approximate center of the eroded area.

C. Seepage

- ◆ Seepage may vary in appearance from a soft wet area to a flowing spring. It may show up first as only an area where the vegetation is more lush and darker green. Cattails, reeds, mosses and other marsh vegetation often become established in a seepage area. The downstream abutment areas where the embankment fill and natural ground interface are very common locations for seepage. Also the contact between the embankment and the spillway conduit is a very common location which is generally attributed to poor compaction around the conduit. Due to the way in which conduits are put in, this is generally most evident on the underside of the conduit. Slides may result from excessively saturated embankment slopes. The natural foundation area immediately downstream of the dam abutment should also be inspected to ensure that "piping" is not occurring underneath the embankment. "Piping" may appear as a "boil" evident as spring carries soil. The soil usually deposits around the boil area and is evident by the sedimentary deposits accompanying it. Seepage can also occur into the spillway conduit through cracks in the pipe or improperly sealed joints. These can be seen by observing the conduit when the water level is high. The movement of the water itself is not dangerous, but if soil particles are being carried with it, then it can create a shortcut for the piping of soil. This might show up on the upstream face of the embankment roughly along the line of the conduit itself.

D. Cracks, Slides, Sloughing, and Settlement

- ◆ Cracks – the entire embankment should be inspected for cracks. Short, isolated cracks are usually not significant, but larger cracks (wider than $\frac{1}{4}$ "), well defined cracks indicate a serious problem. There are two types of cracks: transverse and longitudinal.
 - Transverse cracks appear crossing the embankment and indicated difference of settlement within the embankment. these cracks provide avenues for seepage and piping could develop.
 - Longitudinal cracks run parallel to the embankment and may signal the early stages of a slide. In recently built structures, these cracks may be indicative of poor compaction or poor foundation preparation resulting in consolidation after construction.
- ◆ Slides – Slides and slumps are serious threats to the safety of an embankment. Slides can be detected easily unless obscured by vegetation. Arch shaped cracks are indications that slides are slipping or beginning to slip. These cracks soon develop into large scarps in the slope at the top of the slide.
- ◆ Settlement – settlement occurs both during construction and after the embankment has been completed and places in service. To a certain degree this is normal and should be experienced. It is usually the most pronounced at the location of maximum foundation depth or embankment height. Excessive settlement will reduce the free board (difference in elevation between the water surface and the top of the dam). Any area of excessive settlement should be restored to original elevation and condition to reduce the risk of overtopping. A relatively large amount of settlement (more than 6") within a small area could indicate serious problems in the foundation or perhaps the lower part of the embankment. Settlement accompanied by cracking often precedes failure.
- ◆ What to do if seepage, cracks, slides or settlement are detected: If any of the above items are detected there may be signs of significant problems, which could lead, to the failure of the structure. A geotechnical or civil engineer should be consulted regarding the origin of these problems and for the assessment of the appropriate solutions for correcting them. If the professional is not immediately able to inspect the dam, then the bottom drain should be opened and the water level lowered to remove the risk of failure until a professional can observe these problems.

E. Rodent Control

Rodents such as ground hogs, muskrats, and beavers are attracted to dams and reservoirs and can be quite dangerous to structural integrity and proper performance of the embankment and spillway. Groundhog and muskrats thrive on burrowing in the manmade earth embankments, which become

pathways for seepage. In the event that burrows are detected within the dam, then the rodents should be dealt with by removal.

II. MAINTENANCE OF SPILLWAYS & CONTROL STRUCTURES

A. Inspection of Spillway Conduits

Conduits should be inspected thoroughly once a year. Conduits should be visually inspected by actually entering the conduit a sufficient distance between the riser structure and the outlet to check all the joints. Conduit should be inspected for proper alignment (sagging), elongation and displacement at joints, cracks, leaks, surface water, surface wear, loss of protective coating, corrosion and blocking. Problems with conduits most often occurs at joints and special attention should be given to them during inspection. Joints should be checked for gaps caused by elongation or settlement and loss of joint filler material. Open joints can permit erosion of the embankment material and possibly the piping of soil material through the joints. A depression in the soil surface over the pipe may be signs that soil is being removed from around the pipe.

- ◆ What to do if problems are detected with the spillway: Retain the assistance of a civil engineer or geotechnical engineer qualified in the design of embankments to perform an inspection of the dam. If in doubt, lower the water surface elevation of the pond until such time as an inspection can be performed by a qualified professional.

B. Trashracks on Pipe Spillways

There is no trashrack located on the principal spillway structure; therefore no maintenance is necessary.

III. OPERATION

A. Pond Drains

The 12-inch opening at the bottom the principal spillway will serve to drain the pond completely. Period inspections should occur to ensure that there are no obstructions blocking the flow of water through the opening. Remove any material from the opening to provide a clear path for the water to flow.

B. Record Keeping

Operation of a dam should include recording of the following:

- ◆ Annual Inspection Reports – a collection of written inspection report should be kept on record in Section IV of this manual. Inspection should be conducted annually.
- ◆ Observations – all observations should be recorded. Where periodic inspections are performed following significant rainfall events, these inspections should be logged into the Periodic Inspection, Operation & Maintenance Form in Section IV of this manual.
- ◆ Maintenance – written records of maintenance and/or repairs should be recorded on the Periodic Inspection, Operation & Maintenance Form in Section IV of this manual.
- ◆ Other Operation Procedures – the owner should maintain a complete and up-to-date set of plans (as-built drawings) and all changes made to the dam over time should be recorded on the as-builts.

C. Sedimentation & Dredging

Sedimentation from establishing areas tributary to the pond will eventually result in the reduction of the retention pool and eventually will have to be removed. The frequency of this sediment removal can be reduced by ensuring that the site areas around the building be stabilized with a vegetative ground cover such that it restrains erosion. This would include a periodic application of fertilizer and other treatments necessary to promote a stable groundcover and minimize sedimentation to the pond. For aesthetic purposes it may be desirable to maintain it prior to this point. Generally, the dredging process begins with the removal of as much water as possible from the deposited silt and so the material can be excavated with conventional equipment for trucking offsite. The removed material should be hauled offsite to a suitable landfill site or mounded somewhere on site and stabilized with a groundcover sufficient to restrain erosion.

IV. INSPECTION, OPERATION & MAINTENANCE CHECKLISTS

V. SPECIAL CONSIDERATIONS

POND INSPECTION CHECKLIST

Date: _____
Time: _____

Project: Earthen Dam / Drop Spillway Structure

SPILLWAYS – DRAINS – OUTLETS

Check/Circle Noted	Condition	Observations	Action Repair --	Action Monitor --	Action Investigative --
Principal/Emergency Spillway		Type:			
	Cracks/Deterioration				
	Joint Deterioration				
	Improper Alignment				
	Cracks/Deterioration				
	Joint Deterioration				
	Seepage/Piping				
	Undercutting				
	Erosion				
	Debris				

General Comments, Sketches & Field Measurements

POND INSPECTION CHECKLIST

Date: _____
 Time: _____

Project: Earthen Dam / Drop Spillway Structure

EMBANKMENT -- POOL

Check/Circle Condition Noted	Observations	Action Repair -	Action Monitor -	Action Investigative --
U/S Slope	Type:			
Vegetation/Riprap				
Beaching/slides/cracks				
Undermining/erosion				
Rodent burrows				
Crest	Type:			
Ruts/erosion				
Cracks/settlement				
Poor alignment				
D/S Slope	Type:			
Vegetation/erosion				
Rodent burrows				
Sloughs/slides/cracks				
Seepage/wetness				
Pool	Type:			
Erosion/ground cover				
Sedimentation				
Water quality				
Abutment	Type:			
Vegetation/erosion				
Slough/slides/cracks				
Seepage/wetness				

General Comments, Sketches & Field Measurements

