Total Maximum Daily Load to Address Impaired Biological Integrity in the Little Alamance Creek Watershed, Alamance County, Cape Fear River Basin

Assessment Unit 16-19-11

DRAFT December 2010

North Carolina Department of Environment and Natural Resources
Division of Water Quality

Table of Contents

SUMMARY

The two most important factors contributing to the benthic macroinvertebrate (aquatic life) impairments in the Little Alamance Creek watershed are urban stormwater runoff and hydrologic changes due to channelization and riparian vegetation removal. These stressors to the aquatic life communities and other indicator parameters are associated with the high levels of development (impervious areas) in the Little Alamance Creek watershed.

This Total Maximum Daily Load (TMDL) must address stressors believed to be contributing to the benthic macroinvertebrate (aquatic life) impairments. Because of the stormwater-associated pollutants and the effects on aquatic life and the system's hydrology, impervious cover targets are used as surrogates to estimate stormwater pollutant load reductions needed to meet water quality standards (USEPA 2010).

The goal of this TMDL is to achieve water quality standards, in this case, a benthic macroinvertebrate community bioclassification of Good-Fair or better throughout the Little Alamance Creek watershed. Currently the bioclassification is Poor. Bioclassifications used by DWQ are Excellent, Good, Good-Fair, Fair, and Poor.

IMPLEMENTATION SUMMARY

Eliminating impervious cover (IC) is not necessary to reach the TMDL target reductions. Improved aquatic life (benthic macroinvertebrate community bioclassifications) will be the measure of TMDL success. <u>Achievement of this water quality standard may be met by implementing both structural and non-structural best management practices designed to mitigate the effects of stormwater runoff.</u>

When the TMDL is implemented, stressors to the aquatic life communities associated with stormwater runoff will be reduced. Efforts to reduce urban stormwater volume will also achieve reductions in pollutant loading, sedimentation, and stream erosion, which adversely impact surface water quality (USEPA 2010). Meeting TMDL targets to obtain bioclassifications of Good-Fair or better will be an iterative process, evaluating at each benthic monitoring site (Table 1) and recognizing incremental improvements. This process is recognized as lengthy, possibly spanning multiple permit cycles.

INTRODUCTION

Section 303(d)(1)(C) of the federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (EPA) implementing regulations direct each State to develop a Total Maximum Daily Load (TMDL) for each impaired segment on the Section 303(d) list, taking into account seasonal variations and a protective margin of safety (MOS) to account for uncertainty. Traditionally, a TMDL reflects the total pollutant loading of the impairing substance a waterbody can receive and still meet water quality standards.

The purpose of this report is to establish a TMDL to address the aquatic life impairments in the Little Alamance Creek watershed. The goal is to provide the basis for improving the watershed ecosystem through implementation of stormwater best management practices such that the beneficial uses of the waterbodies are restored. Upon approval by EPA, this TMDL becomes part of the NC Division of Water Quality (DWQ) Cape Fear River Basinwide Water Quality Plan.

In 2002, EPA provided clarifications of existing regulatory requirements for establishing wasteload allocations (WLAs) for stormwater discharges in TMDLs (USEPA Memorandum 2002 & Revisions 2010). Specific key points of the memorandums include:

- EPA expects that most Water Quality Based-Effluent Limits (WQBELs) for NPDES-regulated municipal and small construction stormwater discharges will be in the form of Best Management Practices, and that numeric limits will be used only in rare instances.

- When a non-numeric WQBEL is imposed, the permit's administrative record, including the fact sheet when one is required, needs to support that the BMPs are expected to be sufficient to implement WLA in the TMDL.

- It may be reasonable to express allocations for NPDES-regulated stormwater discharges from multiple point sources as a single categorical wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs.

- EPA expects TMDL authorities to make separate allocations to NPDES-regulated stormwater discharges (in the form of WLAs) and unregulated stormwater (in the form of load allocations). EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability in the system.

- Using Surrogate for Pollutant Parameters When Establishing Targets for TMDL Loading Capacity.

This TMDL applies to the entire Little Alamance Creek watershed based on benthic macroinvertebrate samples listed in Table 1. The DWQ benthic sampling site of Little Alamance Creek at SR 2309 has been on the NC 303(d) list of impaired waters since 2000. Benthic macroinvertebrate assessments have consistently resulted in "Poor" aquatic life conditions. Coble Brook is also considered impaired for aquatic life. This benthic site (2003) was given a Not Rated bioclassification. Until recently, the DWQ

Standard Operating Procedures (NCDWQ 2006) prohibited the assignment of bioclassifications (i.e., Excellent, Good, Good-Fair, Fair, or Poor) to streams with drainage areas less than 3.0 sq.mi. This deficiency stemmed from the fact that the bioclassification thresholds were predominately based on data obtained from streams with drainage areas greater than 3.0 sq.mi. As a result, benthic criteria limited the assignment of these bioclassifications to perennial streams with drainage areas equal to or less than 3.0 mi^2 as Not Rated or Not Impaired (NCDWQ 2006). In this case for Coble Brook, a small stream site that would not have met the criteria for a Good-Fair or better using biocriteria for larger streams was given a Not Rated bioclassification. Likewise, a small stream site that would have met the criteria for a Good-Fair or better using biocriteria for larger streams was given a Not Impaired bioclassification. In 2009 DWQ developed biocriteria for assessing small streams with drainages less than or equal to 3.0 sq.mi., allowing for bioclassification assignments of Excellent, Good, Good-Fair, Fair, or Poor (DWQ 2009). When Coble Brook is sampled again by DWQ, it will be assigned a bioclassification using the small stream criteria.

Table 1. Little Alamance Creek Watershed Sampling Locations

Stream Name*	Assessment Unit Number (AU)	Sampling Location	Description	Current Bioclassification
Little Alamance Cr	16-19-11	Overbrook Rd.	From source to Big Alamance Creek.	Poor 2003
Little Alamance Cr	16-19-11	I-85	From source to Big Alamance Creek.	Poor 2003
Little Alamance Cr	16-19-11	NC 49	From source to Big Alamance Creek.	Poor 2003
Little Alamance Cr	16-19-11	SR 2309	From source to Big Alamance Creek.	Not Rated 2008 (drought) Poor 2006
Coble Brook	16-19-11ut3	Engleman Avenue	From source to Little Alamance Creek.	Not Rated 2003 (small stream)

* See Figure 1 for spatial reference.

APPLICABLE SURFACE WATER QUALITY STANDARDS AND RULES

TMDLs are established to achieve and maintain water quality standards. A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Examples of designated uses include aquatic life survival and propagation, swimming, drinking water supply, and shellfish harvesting. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. Criteria may differ among waters with different designated uses.

The surface water classifications for the Little Alamance Creek watershed include Classes C, Water Supply -V and Nutrient Sensitive Waters. All waters in North Carolina have the base classification of "C." Class C waters are protected for aquatic life propagation and biological integrity (including fishing and fish), wildlife, secondary recreation, agriculture and other uses suitable for Class C. There are no restrictions on watershed development or types of discharges associated with Class C (15A NCAC 02B.0211, 2007).

The Little Alamance Creek watershed is located within the Jordan Reservoir watershed of the Cape Fear River Basin. Jordan Reservoir and all waters draining to it have been supplementally classified as Nutrient Sensitive Waters (NSW) pursuant to Rules 15A NCAC 2B .0101(e)(3) and 15A NCAC 2B .0223. This supplemental classification is intended for waters needing additional nutrient management due to their experiencing or being subject to excessive growth of microscopic or macroscopic vegetation. In general, management strategies for point and nonpoint source pollution control require control of nutrients (15A NCAC 02B.0233, 2007).

NC Session Law 2005-190 directed the Environmental Management Commission to adopt permanent rules to establish and implement nutrient management strategies to protect drinking water supply reservoirs. In 2009, permanent rules for the Jordan Water Supply Nutrient Strategy were adopted http://portal.ncdenr.org/web/wq/ps/nps/jordanlake) by the General Assembly. The goal of the Jordan Nutrient Strategy is to reduce the average annual loads of nitrogen and phosphorus delivered to Jordan Reservoir from all point and nonpoint sources located within its watershed. The strategy contains a total of thirteen separate enforceable rules. Several rules require stormwater controls to reduce nutrient loads delivered from new and existing development as wells as protection of existing buffers (15A NCAC 02B .0265-.0267).

Waterbodies in the Little Alamance Creek watershed are also classified as WS-V. Per the Jordan Water Supply Nutrient Strategy, water supply waters designated WS-II, WS-III, and WS-IV within the Jordan watershed shall retain their classifications. The remaining waters in the Jordan watershed shall be classified WS-V (15A NCAC 02B .0262, 2008). Pursuant to G.S. 143-214.5(b), the entire Jordan watershed shall be designated a critical water supply watershed and through the Jordan Water Supply Nutrient Strategy given additional, more stringent requirements than the state minimum water supply watershed management requirements. The best usage of WS-V waters are protected as water supplies which are generally upstream and draining to Class WS-IV waters (15A NCAC 02B.0218, 2007). All of these administrative codes apply in Little Alamance Creek watershed and for the jurisdictions of Burlington, Graham and NCDOT are subject to the Jordan Water Supply Nutrient Strategy (15A NCAC 02B.0262).

This TMDL addresses the Little Alamance Creek watershed, which has impaired biological integrity. Impairment for biological integrity is based on a narrative standard that pertains to the aquatic life use designation. Biological integrity means “the ability of an aquatic ecosystem to support and maintain a balanced and indigenous community of organisms having species composition, diversity, population densities and functional organization similar to that of reference conditions” (15A NCAC 02B.0202, 2007).

DWQ’s criterion for assessing aquatic life as impaired is defined as a biological community at a benthic macroinvertebrate or fish sampling site with a bioclassification of Poor, Fair or Severe Stress. The criterion for assessing aquatic life as supporting is a bioclassification of Good-Fair, Good, Excellent, Not Impaired, Natural or Moderate Stress at a biological community sampling site.

Biological impairments to the Little Alamance Creek watershed were identified using bioassessment protocols outlined in the North Carolina's *Standard Operating Procedure for Benthic Macroinvertebrates* (NCDWQ 2006). Little Alamance Creek at SR 2309 has carried a benthic macroinvertebrate bioclassification of Poor or Fair since 1985. The supporting data analysis that resulted in the listing for impaired biological integrity is located in Appendix 1.

Habitat evaluation is not currently linked to the North Carolina Piedmont bioclassification ratings so there are no habitat thresholds or breakpoints distinguishing "condition groups" (e.g., Excellent, Good, Good-Fair, Fair, or Poor). Habitat evaluations provide an assessment of the general habitat conditions at the benthic monitoring sites. The higher overall scores simply represent better aquatic habitat than lower overall habitat scores. To reduce the subjectivity of visual interpretations of the habitat components, the DWQ assessment form provides definitions of various conditions and the associated score (NCDWQ 2006).

The DWQ methodology for evaluating instream aquatic habitat focuses on eight key components that affect the availability and suitability of habitat. The components are rated individually and the summation of the scores ranges from 0 to 100, with 100 reflecting the highest quality habitat. Habitat scores for the sites in the Little Alamance Creek watershed ranged from 43 to 75, and are provided in Appendix 1. The eight components and their relative weight to the overall score are:

- Channel modification (5)
- Instream habitat types (20)
- Bottom substrate (15)
- Pool variety (10)
- Riffle habitats (16)
- Bank stability and vegetation (14)
- Light penetration (10)
- Riparian vegetative zone width (10)

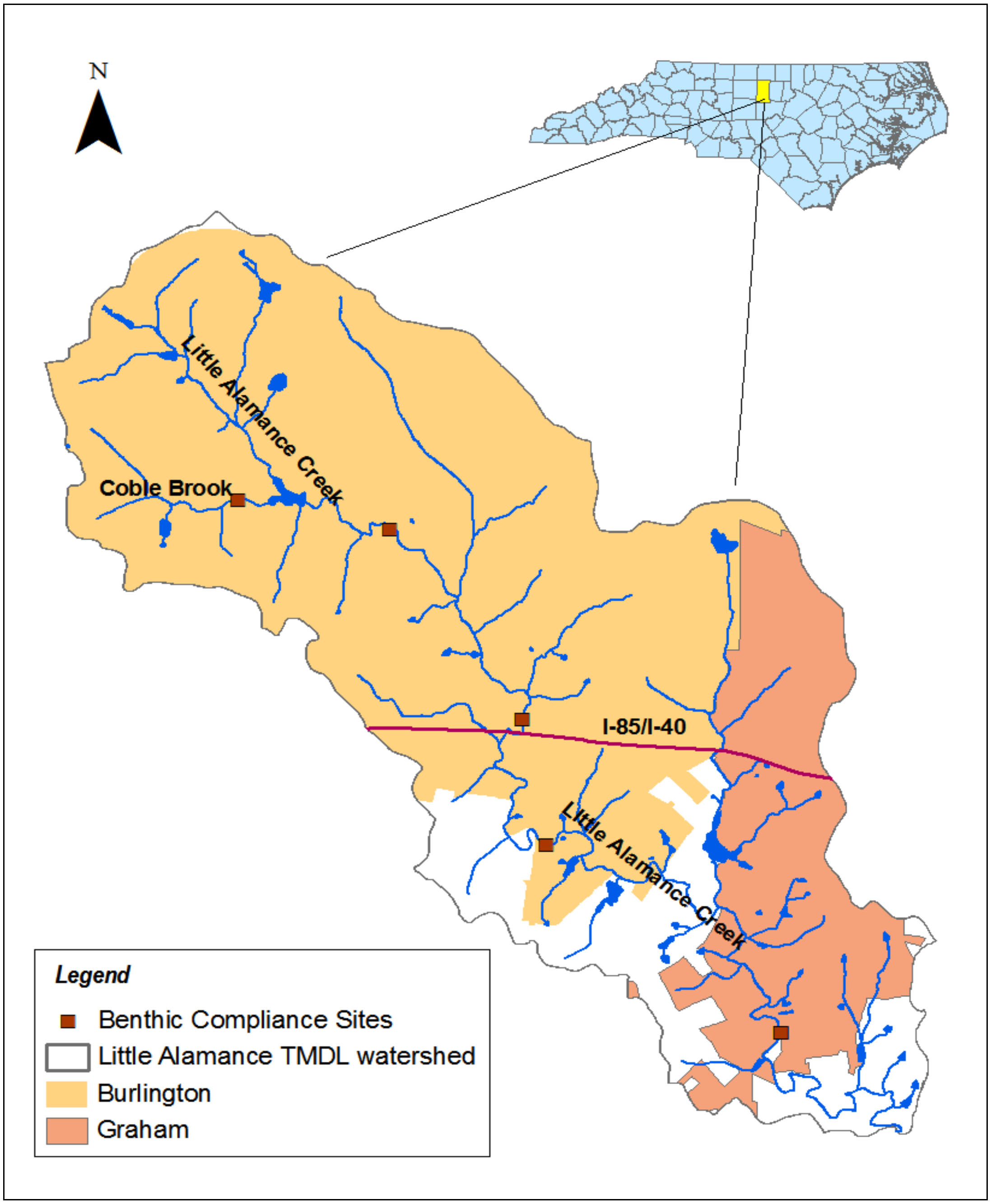
WATERSHED DESCRIPTION

The mainstem of Little Alamance Creek flows generally southeast toward its confluence with Big Alamance Creek in Alamance County, North Carolina. This watershed is within the USGS 12-digit hydrologic unit (HU) 030300020309, which is approximately 15.9 square miles in area (Figure 1). The TMDL watershed is defined as Little Alamance Creek from source to SR 2309 <u>and all tributaries</u> draining to this portion of Little Alamance Creek (Figure 1).

The Little Alamance Creek watershed lies within the municipalities of Burlington and Graham. According to 2000 US Census data, the Little Alamance watershed had a population of 27,581. In 2005, the Piedmont Triad Council of Governments (PTCOG) estimated a population amount of 29,512 from data utilized from its Regional Data Center (NCEEP 2007). One major highway (I-85/I-40) transects the TMDL watershed (Figure 1). This watershed is mostly urbanized with 59.7% of the area developed as single family residential (NCEEP 2007). Industrial uses make up 12.4% of the area. Industrial and commercial uses are clustered mainly around Interstate 85/40 and other major thoroughfares. Impervious surfaces (areas such as roof tops, roads and parking lots that prevent infiltration of precipitation into the soil) cover approximately 26% of this watershed. Significant impacts to stream biota can generally be expected with this degree of unmitigated impervious cover (Schueler 1994).

The watershed is located mostly in the Carolina Slate Belt 45c ecoregion. (Griffith et al. 2002) and is composed mainly of three geological types, Metamorphosed Gabbro and Diorite, Mafic Metavolcanic Rock, and Quartzite. The predominant soil series is the Mecklenburg- Elon – Cecil series, comprising almost the entire watershed south of Route 70. The Vance -Appling – Enon-Cecil series can be found north of Route 70 and encompasses the majority of the hydric soils found in the watershed.

Figure 1 - Little Alamance Creek TMDL watershed



POLLUTANT SOURCE ASSESSMENT

This TMDL report largely draws its information from a 2003 stressor study conducted by DWQ in the Little Alamance Creek watershed. Stressor studies are specialized studies that attempt to identify specific factors leading to degraded water quality conditions, including impairments of biological integrity. These efforts analyze the causes of impairment by measuring various water quality parameters. DWQ's Biological Assessment unit conducted the stressor study in June 2003. This effort assessed benthic macroinvertebrates, habitat characteristics, and chemical and physical data to analyze specific stressors to the aquatic community. Major watershed activities and sources of pollution contributing to those causes such as hydrologic changes due to channelization/riparian removal and stormwater runoff from urban areas were identified

(NCDWQ 2003). The supporting data analysis that resulted in the listing for impaired biological integrity is located in Appendix 1.

In addition, the North Carolina Ecosystem Enhancement Program (EEP) initiated a multi-phase project in 2006 to develop a Local Watershed Plan (LWP) for the Little Alamance and Travis/Tickle Creek watersheds. Although this effort included the Travis/Tickle Creek watershed, only the information regarding the Little Alamance Creek watershed will be utilized in this TMDL development. In March 2007, EEP partnered with Piedmont Triad Council of Government (PTCOG) and completed the first phase of the LWP, the *Watershed Characterization*. This effort coordinated stakeholder/landowner involvement, technical/watershed assessment teams and recommendations for field assessments. A total of six goals were indentified: increase local government awareness of the impacts of urban growth, strengthen watershed protection standards, improve water quality through stormwater management, identify/rank land parcels for retrofits, stream repair, preservation/conservation, assess aquatic health to identify stressors and meet requirements of outside funding sources for implementation.

In June 2008, EEP completed a *Detailed Assessment Report* (Phase II) which summarizes field work and methods used to identify impairments, and stormwater as a key stressor. In November 2008, a *Final Restoration Plan* (Phase III) was completed which used data to prioritize projects for restoration and conservation as well as recommended policy measures. This final phase included management strategies for watershed-scale restoration activities. This TMDL for the Little Alamance Creek watershed and its subsequent implementation plan will focus on the LWP identified areas of greatest need and risk.

Conclusions of the DWQ stressor study and the EEP LWP show aquatic organisms in the Little Alamance Creek watershed are heavily impacted by multiple stressors. The EEP LWP for the Little Alamance Creek watershed included a rigorous source assessment methodology and stressor identification process. The assessment analyzed the causes of impairment by measuring various water quality chemical, physical and biological parameters. Major watershed activities and sources of pollution contributing to those causes (such as stream bank erosion from urbanized stormwater runoff) were identified.

The relative contribution of these stressors cannot be clearly differentiated based on the available data. However, candidate causes of impairment such as channelization and exceptionally high (flashy) storm flows associated with high levels of urbanized areas (impervious areas) were determined as likely contributors to the biological impairment. Specific toxics of concern to the benthic community were not identified. The findings from the source assessment and stressor identification process are discussed in the next section of this report, and demonstrate that no single pollutant or group of specific pollutants have been identified as the cause of impairment in the watershed.

Significant contributors to impairment of the Little Alamance Creek watershed include NPDES Stormwater Phase II permit holders City of Burlington (NCS000428) and City of Graham (NCS000408), as well the NPDES Stormwater Phase I permit holder NC Department of Transportation (NCDOT) (NCS000250).

STRESSOR IDENTIFICATION
The stressor study conducted by DWQ in the Little Alamance Creek watershed in 2003 included a detailed evaluation of the causes of impairment. The following paragraphs summarize the findings of that analysis. These studies included the following primary tasks:

- Identification of potential "candidate" causes of impairment in the watershed
- Collection of additional data
- Characterization of the causes of impairment using a "strength of evidence" approach

The strength of evidence evaluation included analysis of whether candidate stressors were primary causes of impairment, secondary causes of impairment, part of the cumulative cause of impairment, a contributing stressor, a potential cause or contributor, or an unlikely cause or contributor. Other sources of evidence evaluated included benthic macroinvertebrate community data, habitat and riparian area assessment, chemistry, toxicity data, current watershed activities, land uses, and pollutant sources.

The following candidate causes <u>were</u> <u>not</u> determined to be significant or primary causes of impairment in Little Alamance Creek and therefore are not addressed by this TMDL:

<u>Toxicity (resulting from residential and commercial development).</u> Water chemistry data, watershed characteristics, and benthic community data were utilized in the evaluation of toxicity as a cause of impairment. Although toxic impacts are typically very episodic and difficult to identify, data from the benthic macroinvertebrate fauna showed no indication of toxic conditions.

<u>Low Dissolved Oxygen.</u>
Although there are areas with poor habitat (including deep uniform stream channels, little habitat diversity, rip-rap, minimal stream bottom diversity, and very low or no flow velocities), dissolved oxygen levels are not viewed as a primary limiting factor for benthos. The watershed is not impaired for dissolved oxygen.

<u>Organic and nutrient enrichment</u>**.** Benthic community data were utilized to evaluate organic and nutrient enrichment as a potential cause of stress on the biological community. The benthic macroinvertebrate fauna showed no indication of excessive nutrient conditions. The newly adopted nutrient rules for the Jordan Lake watershed are applied in the Little Alamance Creek watershed.

The following candidate causes <u>were</u> determined to be significant causes of impairment in Little Alamance Creek:

<u>Stormwater runoff due to high levels of impervious surfaces and lack of stormwater control.</u> High conductivity measurements across the watershed are indicative of a mixture of pollutants from urban runoff. The benthic macroinvertebrate data lacked specific indicator taxa but rather exhibited highly pollution tolerant benthic communities, suggesting considerable impacts from urban/suburban pressures. The stream bank erosion and sedimentation associated with these events contribute to habitat degradation associated with biological impairment. The lack of stormwater treatment and control was found to be the most pervasive stressor in the watershed.

Hydromodification (resulting from riparian vegetation removal).
Many of the benthic community sites noted significant lack of riparian vegetation areas. Hydrologic changes, due to channelization and large amounts of impervious surface, have degraded instream habitat. This was identified as a secondary stressor.

Hydromodification (resulting from channelization).
Many of the benthic community sites evidenced previous or historical channelization of the stream. Hydrologic changes, due to channelization and large amounts of impervious surface, degrade instream habitat. This was also identified as a secondary stressor.

Based on a weight of evidence analysis, the three most important factors are stormwater runoff from large impervious areas and hydromodification from channelization and riparian vegetation removal. Although toxicity was not viewed as a primary cause of impairment, combined with other causes of impairment, it may contribute to the cumulative effect. All of the stressors and indicator parameters discussed above are associated with the high levels of development in the Little Alamance Creek watershed. The control of untreated stormwater runoff to this watershed should provide benefits to the aquatic community.

WATER QUALITY TARGET

According to 'Estimating and Projecting Impervious Cover (IC) in the Southeastern United States' (USEPA 2005), degraded benthic community sites are evident as impervious area increases. Specifically, among sites in North Carolina with a total impervious area greater than 10%, 62% were degraded. In contrast, 90% of sites with less than 10% IC were not degraded.

Research conducted by The Center for Watershed Protection (CWP) indicated that variability in stream quality indicator data is usually dampened when impervious cover (IC) exceeds 10%, which presumably reflects the stronger influence of stormwater runoff on stream quality indicators. In particular, the chance that a stream quality indicator will attain a high quality score is sharply diminished at higher IC levels. This trend becomes pronounced within the 10 to 25% IC range and almost inevitable when watershed IC exceeds 25%. This pattern suggests that IC is a more robust and reliable indicator of overall stream quality beyond the 10% IC threshold (CWP 2003).

A TMDL must address stressors believed to be contributing to the aquatic life impairments. Stormwater runoff from impervious surfaces carries a complex array of potential pollutants that can impact the aquatic community. Because of the uncertainty in identifying specific pollutants in urbanized stormwater runoff, difficulties arise in quantifying the real target (biological integrity) in a TMDL. In the 2009 report *Urban Stormwater Management in the United States*, the National Research Council suggests that a more straightforward way to regulate stormwater contributions to waterbody impairment would be to use a surrogate (e.g. impervious cover), as a measure of stormwater loading (USEPA 2010). Because of stormwater-associated pollutants and the effects on hydrology in the Little Alamance Creek watershed, impervious cover is used as the surrogate target to estimate stormwater pollutant load reductions needed to meet water quality standards.
Based on the above findings, the surrogate TMDL target for Little Alamance Creek is 9% IC. This target incorporates a 1% IC margin of safety. The Little Alamance Creek

TMDL target is expected to protect all waters, because the measure of TMDL success is based upon water quality standards for benthic macroinvertebrate data and not upon a quantified actual reduction in IC. Specifically, the goal of this target is to achieve a benthic macroinvertebrate community bioclassification of Good-Fair, Not Impaired or better. Achievement of this water quality standard may be met by implementing management practices designed to mitigate the effects of stormwater runoff. Because IC is a surrogate measure, eliminating IC is not necessary in reaching the TMDL target reductions. Measuring the aquatic life (biological community) directly will be the method for assessing attainment of the TMDL goal. “TMDLs may be established using a pollutant-by-pollutant or biomonitoring approach.” (40 CFR 130.7(c)(1)(i)) This approach was first used in North Carolina for the Swift Creek TMDL (NCDWQ 2009), approved by USEPA in 2009.

SEASONAL VARIATION AND CRITICAL CONDITIONS

Regulations require that a TMDL be established with consideration of seasonal variations. Stormwater flows occur throughout the year, with different environmental effects at both low and high flows. Critical conditions for aquatic life protection are not limited to flow conditions or time of year. Benefits realized from impervious cover mitigation occur in all seasons because stormwater management will be implemented to meet the IC target and will reduce adverse impacts (pollutant loading and damaging flows) for the full spectrum of storms throughout the year.

MARGIN OF SAFETY

A Margin of Safety (MOS) is required as part of a TMDL in recognition of many uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection.

A 1% IC Margin of Safety (MOS) was subtracted from the surrogate TMDL target to account for uncertainty in the analysis, resulting in a combined WLA and LA target of 9%. The goal of the TMDL is to reduce impacts from stormwater on the aquatic life in the Little Alamance Creek watershed.

WASTELOAD ALLOCATION (WLA) AND LOAD ALLOCATION (LA)

In the Little Alamance Creek watershed there are no continuous NPDES wastewater discharges, individual industrial stormwater discharges, or permitted animal operations. There are three intermittent NPDES permitted dischargers in the Little Alamance Creek watershed. The City of Burlington (NCS000428) and the City of Graham (NCS000408) are regulated under the NPDES Phase II Stormwater permits. The NC Department of Transportation (NCS000250) is regulated under the Phase I NPDES Stormwater permit. The WLA portion of this TMDL applies to these NPDES stormwater permits. This TMDL applies to designated and future MS4 permits that are subject to the NPDES program (EPA Memorandum 2010).

Stormwater discharges are highly variable in frequency and duration. It is reasonable to express allocations for NPDES-regulated stormwater discharges from multiple point sources as a single categorical wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs (EPA Memorandum 2002). This TMDL applies the surrogate 9% IC target to the stormwater drainage area affecting both regulated and non-regulated sources in this watershed.

To calculate the equivalent of % IC reductions required to achieve the TMDL target:

Equivalent of percent IC reduction = [(IC Current Condition – surrogate IC Target)/IC Current Condition)] x 100
where surrogate IC Target = 9%

The equivalent of percent IC reduction (Table 2) was calculated for the Little Alamance Creek TMDL watershed (Figure 1). The equivalent IC reduction is 62% for the TMDL watershed (Table 2). This TMDL watershed is delineated as the USGS 12-digit hydrologic unit (HU) 030300020309 and is approximately 15.9 square miles in area. The current condition (Table 2) was calculated from analysis of existing percent imperviousness using the National Land Cover Dataset (2001), supplemented by the *Watershed Assessment Model for North Carolina* (Pate 2009). The current condition for the Little Alamance Creek TMDL watershed is 26% impervious.

Achieving the equivalent %IC reduction will require mitigation of the adverse impacts of stormwater, including but not limited to reducing pollutant loading and reducing the volume of storm runoff. Such actions could include disconnecting IC, installing infiltration basins, eliminating illicit discharges, etc. The TMDL target bioclassification of Good-Fair or better will be measured at the benthic compliance points (Figure 1).

Table 2. TMDL Targets, Surrogate Targets, and Equivalent Percent Reductions for Little Alamance Creek TMDL Watershed

TMDL Target Bioclassification	Percent Impervious Cover				Equivalent % Reduction *
	TMDL Surrogate Target	WLA and LA	MOS	Current Condition	
Good-Fair or better	10%	9%	1%	26%	62% Equivalent of % IC reduction accomplished by improved stormwater management.

* Equivalent of %IC reduction means actions that mitigate the adverse impacts of stormwater, including but not limited to reducing pollutant loading and reducing the volume of storm runoff. Such actions could include disconnecting IC, installing infiltration basins, eliminating illicit discharges, etc.

TMDL IMPLEMENTATION

EPA is not required to, and does not, approve TMDL implementation plans. This section is intended to provide some initial assistance for implementing this TMDL.

This TMDL applies to designated and future MS4 permits that are subject to the NPDES program. The linkage of the TMDL with the NPDES Stormwater Phase I and II permits will constitute a significant portion of the implementation. The goal of this TMDL is to reduce the effects of stormwater impacts to the receiving streams so that water quality standards for biological integrity are met. Attainment of such a standard is achieved when a benthic macroinvertebrate community sample receives a bioclassification of Not Impaired, Good-Fair or better. Compliance will be measured at the benthic sampling sites on Little Alamance Cr at Overbrook Road, I-85, NC 49, SR 2309 and on Coble Brook at Engleman Avenue. DWQ will continue monitoring the biological communities in this watershed to track TMDL implementation and attainment of water quality standards. This will be an iterative process to meet TMDL targets for attaining a bioclassification of Good-Fair or better at the monitoring compliance points. This process is recognized as lengthy, possibly spanning multiple permit cycles.

Implementation for this TMDL will best be accomplished through incorporating an adaptive management strategy for stormwater runoff. Such a strategy should include one or more of the following for new and existing development:

- Installing engineering BMPs to reduce the impacts of stormwater runoff from impervious areas.
- Reducing impervious cover.
- Restoration of riparian buffers.
- Eliminate the application of noxious chemicals to stream buffer areas.
- Minimizing additional disturbance to maintain existing natural buffering capacity
- Disconnecting impervious cover from the surface waterbodies to reduce peak flows and volumes of stormwater runoff.
- Reclamation of paved or piped streams through stream enhancement and daylighting projects.
- Adopting land use ordinances that require or allow Low Impact Development (LID) techniques or other non-structural best management practices.
- Detecting and eliminating illicit discharges.
- Developing an educational component and outreach program.
- Stream restoration.

Affected entities may propose alternative measures that meet the intent of the TMDL.

Stormwater impacts include erosion and damage to instream aquatic habitat, a complex mix of pollutant loading, and lack of infiltration to provide stable base flow to streams. When the TMDL is implemented, stressors from urban stormwater runoff affecting aquatic life will be reduced or not delivered to the waterbody.

The waterbodies draining this watershed are located in urbanized areas that are subject to the requirements of North Carolina's NPDES Phase I and II Stormwater permits. Several efforts for addressing stormwater runoff are currently in place for Burlington and Graham under their permit. The municipalities must develop, implement and enforce a Stormwater Management Plan and ordinances approved by the NC Department of Environment and Natural Resources (NCDENR). The plan includes educational and regulatory initiatives to ensure sound development. Ordinances approved by NCDENR and adopted by Burlington and Graham address requirements for new and/or existing development, illicit discharges detection and elimination, watershed protection, and sediment and erosion control. The cities of Burlington and Graham were issued a NPDES Stormwater Permit, effective June 1, 2005. Under the NPDES permit, stormwater runoff from new development that disturbs greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, must be controlled and treated in accordance with the conditions of the permit and the Stormwater Management Plan. The permit and Stormwater Management Plan mandate:

1. A public education and outreach program on the impacts of stormwater discharges and how to reduce pollutants in stormwater runoff.
2. A public involvement and participation program.
3. A program to detect and eliminate illicit discharges within the jurisdictional area.
4. A program to reduce pollutants in any stormwater runoff from construction activities resulting from a land disturbance of greater than or equal to one acre.
5. A program to address post-construction stormwater runoff from new development that cumulatively disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale; and
6. A pollution prevention/good housekeeping program for municipal operations that addresses operation and maintenance, including a training component, to prevent or reduce pollutant runoff from those operations.

Burlington, Graham and NCDOT are subject to the Jordan Lake –Water Supply Nutrient Strategy (15A NCAC 02B.0262). These requirements strictly limit runoff from new and existing development, lower runoff amount from agriculture, and protect riparian buffers and wetlands. In addition, jurisdictions are required to meet the WS-V classification requirements that pertain to point/nonpoint sources and stormwater pollution control criteria for this watershed (15A NCAC 02B.0218) and protect its classified uses as a drinking water supply.

IMPLEMENTATION RESOURCES

Resources are available to assist in the implementation of this TMDL.

The NC Ecosystems Enhancement Program partnered with the Piedmont Triad Council of Governments to determine sources of impairment to the biological community on a subwatershed scale in Little Alamance Creek watershed. This analysis determined a list of priority projects, programs, and policies that can help restore, improve hydrologic function, and provide sustainable stewardship solutions for growing jurisdictions. The document can be found here:
http://www.nceep.net/services/lwps/Little_Alamance/LATT_FinalWatershedPlan.pdf

The Center for Watershed Protection has produced a series of Urban Subwatershed Restoration Manuals. The manuals provide comprehensive information on watershed restoration techniques by introducing an integrated framework for restoration and techniques for assessing urban watersheds. The manual series can be located here:
http://www.cwp.org/PublicationStore/USRM.htm

A report prepared for The United States Environmental Protection Agency, *Stormwater TMDL Implementation Support Manual, March 2006 (Project No: 10598-001-500)* shows the impervious cover method used in developing TMDL targets. The report can be located here: http://www.epa.gov/ne/eco/tmdl/assets/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

The *North Carolina Division of Water Quality 2007 Stormwater BMP Manual* provides guidance for meeting stormwater regulations and designing stormwater BMPs that meet water quality objectives. The manual can be located here: *http://h2o.enr.state.nc.us/su/bmp_updates.htm*

The North Carolina State University developed a NC Low Impact Development Technique document. The project documented changes in runoff and pollutant export resulting from the construction of a low impact development residential subdivision. This is located here: *http://www.bae.ncsu.edu/programs/extension/wqg/*.

REFERENCES

Center for Watershed Protection. 2003. *Impacts of Impervious Cover on Aquatic Systems.*

Griffith, G.E., Omernik, J.M., Comstock, J.A., Schafale, M.P., McNab, W.H., Lenat, D.R., and MacPherson, T.F., 2002, *Ecoregions of North Carolina*, U.S. Environmental Protection Agency, Corvallis, OR

North Carolina Division of Water Quality. 2006. *Standard Operating Procedures for Benthic Macroinvertebrates.*

North Carolina Division of Water Quality. 2007. *Fresh Surface Water Quality Standards for Class C Waters, 15A NCAC 02B.0211*.

North Carolina Division of Water Quality. 2007. *Fresh Surface Water Quality Standards for Class WS-V Waters, 15A NCAC 02B.0218*.

North Carolina Division of Water Quality. 2008. *Jordan Water Supply Nutrient Strategy, 15A NCAC 02B.0262*.

North Carolina Division of Water Quality. 2009. *Total Maximum Daily Load for Addressing Impaired Biological Integrity in the Headwaters of Swift Creek Watershed, Neuse River Basin.*

North Carolina Division of Water Quality, 2009. *Small Streams Biocriteria Development*. 29 May

North Carolina Division of Water Quality, 2003. TMDL Stressor Study Memorandum. 3 November

North Carolina Ecosystems Enhancement Program. 2007. *Little Alamance, Travis, & Tickle Creek Watershed Characterization, Phase I.* March

North Carolina Ecosystems Enhancement Program. 2008. *Little Alamance, Travis, & Tickle Creek Watersheds Assessment, Phase II.* June

North Carolina Ecosystems Enhancement Program. 2008. *Little Alamance, Travis, & Tickle Creek Watersheds Report & Project Atlas, Phase III.* November

Pate, Travis. 2009. *Watershed Assessment Model for North Carolina.* Master's Project-University of North Carolina-Chapel Hill.

Schueler, T.R. 1994. *The Importance of Imperviousness.* Watershed Protection Techniques1, 100-111.

United States Environmental Protection Agency. 2005. *Estimating and Projecting Impervious Cover in the Southeastern United States.* EPA/600/R-05/061.

United States Environmental Protection Agency, Memorandum. 2002. *Establishing TMDL Wasteload Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs*.

United States Environmental Protection Agency, Memorandum. 2010. *Revisions to the November 22, 2002 Memorandum "Establishing TMDL Wasteload Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs*."

Appendix 1 - Summary data for benthos sites in the Little Alamance Creek Watershed, from the DWQ 2003 Stressor Study.

Stream	**Coble Brook**	**L Alamance Cr**	**L Alamance Cr**	**L Alamance Cr**	**L Alamance Cr**	**Reedy Fork**
Location	Engleman Ave.	Overbrook Rd.	I- 85	NC 49	SR 2309	SR 2269
Sample Method	Qual 4	Qual 4	Full Scale	Full Scale	Full Scale	EPT
Date	6/24/03	6/24/03	6/24/03	6/23/03	6/23/03	6/19/03
COMMUNITY						
Ephemeroptera	2	3	2	2	3	4
Plecoptera	0	0	0	0	0	4
Trichoptera	2	2	2	2	2	6
Coleoptera	1	1	0	1	2	
Odonata	1	0	2	2	5	
Megaloptera	0	0	0	0	0	
Chironomidae	17	16	16	20	22	
Misc. Diptera	1	2	2	2	1	
Oligochaeta	0	0	1	1	0	
Crustacea	1	2	2	3	3	
Mollusca	2	1	3	0	2	
Other	0	2	2	0	1	
Total Taxa Richness	27	30	33	33	41	14
EPT Abundance	40	34	13	22	50	52
Biotic Index	6.96	7.25	7.60	6.85	6.69	4.43
EPT Biotic Index	7.00	6.84	6.47	6.67	6.70	4.43
Bioclassification	Not Rated	Poor	Poor	Poor	Fair	Good-Fair
PHYSICAL CHARACTERISTICS						
Drainage Area (sq. miles)	0.6	4.4	7.4	9.0	14.4	14
Width (in meters)	3	5	5	5	7	5
Average Depth	0.1	0.2	0.3	0.2	0.5	0.3
Canopy (% coverage)	90	40	90	90	60	85
Bank Erosion						
Substrate (%)						
Boulder	20	20	0	20	30	0
Rubble	10	20	10	10	10	0
Gravel	10	10	20	10	20	0
Sand	60	40	70	60	40	100
Silt	0	10	0	0	0	0
Habitat Score	56	64	57	75	73	43
CHEMISTRY						
Temperature (^{o}C)	20	25	21	20	19	21
Conductivity (μmhos/cm)	90	185	214	208	181	91
Dissolved Oxygen (mg/l)	5.8	6.9	6.1	7.0	6.8	7.4
LOCATION/COMMENTS						
County	Alamance	Alamance	Alamance	Alamance	Alamance	Guilford
Latitude	360510	360500	360354	360310	360204	360928
Longitude	792811	792710	792616	792606	792434	795006