

North Carolina Nutrient Criteria Development Plan

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For Public Input – Comment period is from April 17th through May 24th 2013. Comments should be sent to Nikki Schimizzi through either one of the following:

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Executive Summary

North Carolina has established itself as a leader in site-specific, flexible nutrient control strategies through the implementation of a comprehensive nutrient management program for its surface waters. This existing program has included numeric nutrient response criteria, ambient monitoring programs, assessment methodologies, nutrient TMDLs, regulatory control of nonpoint sources, nitrogen and phosphorus permit limits, and an innovative supplemental classification of “Nutrient Sensitive Waters (NSW)” for certain waters of the State.

The State of North Carolina recognizes that additional nutrient control measures are warranted based upon the latest advances in the science of nutrient management. A careful review of current capabilities by the North Carolina Division of Water Quality (DWQ or the Division), including stakeholder input, revealed the need for additional criteria to assess, protect and restore rivers, streams and surface water supply sources including lakes and reservoirs. The Nutrient Criteria Development Plan (NCDP) has been designed to assist in addressing those needs. Additionally, the NCDP serves to meet the State’s Clean Water Act Section 106 Workplan commitment of developing a mutually agreed upon nutrient plan of action with the United States Environmental Protection Agency (EPA) by July 2013. The NCDP provides an overview of nutrient criteria related activities within the state since 2001 and describes actions that the State will take to develop additional nutrient control criteria.

The Division has identified four tasks that will need to be completed as the state moves towards criteria development. These tasks include a systematic parameter review to determine which one(s) to investigate further toward criteria development; studies to compile additional data, if necessary, based on the parameter(s) selected; analysis of the available data or study results to determine appropriate parameter(s) for criteria development; and criteria development (includes implementation considerations and fiscal analyses).

Twelve parameters were identified by DWQ for potential criteria development consideration. No new parameters were identified through the public comment process. Ten of the parameters are considered response variables as they reflect a water’s chemical and biological reaction to nutrient inputs: chlorophyll *a*, phytoplankton community, periphyton community, macrophytes, diurnal dissolved oxygen (DO) range, minimum DO, diurnal pH range, total organic carbon, algal toxins, and taste and odor phytoplankton species. The two causal variables are nitrogen and phosphorus. Parameters expected to be more representative of rivers and streams will be addressed first. The next priority will be parameters more specifically addressing surface drinking water supplies.

Execution of this plan requires collaborative work with other agencies, local governments, other stakeholders, and universities. The timeline and tasks may be adjusted based on the results of each activity and resource availability. Stakeholder involvement and updates to the North Carolina Environmental Management Commission are built into the timeline, which projects having the first potential criteria proposed by around 2020.

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Introduction

The State of North Carolina has a long history of requiring management practices to control for nutrient over-enrichment (known as eutrophication) from both point and nonpoint sources. North Carolina has established itself as a leader in the field of site specific, flexible nutrient control strategies through the implementation of a comprehensive nutrient management program for its surface waters. This existing program has included numeric water quality standards for nutrient response parameters, ambient monitoring programs, assessment methodologies, nutrient TMDLs, regulatory control of nonpoint sources, nitrogen and phosphorus permit limits, and an innovative supplemental classification of “Nutrient Sensitive Waters (NSW)” for certain waters of the State. This plan focuses specifically on strengthening the portion of North Carolina’s nutrient management program that relates to the development of water quality standards to control nutrients. The inset box below provides a description of what is included in a water quality standard.

North Carolina recognizes that additional nutrient criteria are warranted as the current criteria may not adequately address protections for all waters of the state. Accordingly, the North Carolina Division of Water Quality (DWQ) has developed this plan, the Nutrient Criteria Development Plan (NCDP), to address weaknesses in existing nutrient criteria for NC’s surface waters. The NCDP lays out a process by which criteria will be developed to address nutrient enrichment in North Carolina waterways.

The NCDP builds on existing research efforts, within and outside of the state, to determine a defensible linkage of cause to response to effect. This plan is one piece of an ongoing effort by the state to develop water quality management programs based upon the latest advances in nutrient management and the interests of many stakeholders. With this in mind, the North Carolina NCDP is a living document and is subject to change based upon the results of planned studies and emerging scientific knowledge on the subject of nutrient management.

What is a water quality standard?

Water quality standards define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from pollutants.

A water quality standard consists of four basic elements:

1. the designated uses of the state’s waters, such as public water supply, recreation, propagation of aquatic life and wildlife, or navigation;
2. the water quality criteria specifying the amounts of various pollutants, in either numeric or narrative form, that may be present in those waters without impairing the designated uses (note - criteria include any one or more of three components: magnitude, duration, and frequency);
3. antidegradation requirements to maintain and protect existing uses and high quality waters, and
4. general policies addressing implementation issues (e.g., low flows, variances, mixing zones).

Clean Water Act Obligations

North Carolina receives monetary assistance from the federal government to manage various water quality programs through Section 106 funds. Section 106 of the Clean Water Act (CWA) authorizes the US Environmental Protection Agency (EPA) to provide federal assistance to states to establish and implement ongoing water pollution control programs. Prevention and control measures supported by Section 106 funds include activities such as permitting, development of water quality standards and total maximum daily loads, ambient water quality monitoring, and enforcement. The state enters into a cooperative agreement (106 Workplan) with the EPA under this program to provide appropriate water quality management under the Clean Water Act.

Under the North Carolina Department of Environment and Natural Resources (NC DENR) current Section 106 Workplan agreement – the state is obligated to “*continue progress toward development of Numeric Nutrient Water Quality Standards*” by:

- Revising the State’s Nutrient Criteria Development Plan (NCDP), previously identified as the Nutrient Criteria Implementation Plan (NCIP) and to reflect current and proposed activities toward establishment of numeric nutrient criteria. (Due date 6/30/2013)
- Developing and meeting scheduled milestones for submitting a revised NCIP.
- Coordinating with EPA on the development of a revised NCIP and proposed nutrient criteria and provide status report on the drafts. (Due dates 12/31/2012 and 12/31/2013)
- Reporting performance milestone information on progress toward adoption of water quality standards for total nitrogen (TN) and total phosphorus (TP) for each water body type (lakes/reservoirs, rivers/streams, and estuaries). (Due date 12/31/2013)

Background on Federal and State Development of Nutrient Criteria Development Plans

The following is a brief overview of actions leading up to the drafting of this NCDP. A more detailed history is provided in Appendix A.

In 2001 the EPA, under the CWA, published ecoregional Section 304(a) criteria for total nitrogen, total phosphorus, chlorophyll *a* and Secchi depth in the Federal Register and specifically stated that the states were expected to adopt these criteria, or a revised version, into their surface water quality standards regulations. The federal register notice also indicated that the states were to develop plans by the end of 2001 for the establishment of state nutrient criteria if the state opted to not adopt federal 304(a) criteria into their regulations. The notice went on to specify that nutrient criteria should be adopted into state regulations by 2004 and that EPA may begin promulgation of nutrient criteria in those states that had not met this deadline.

North Carolina's first plan was called the NC Nutrient Criteria Implementation Plan (NCIP) and was approved by EPA in 2004¹. It included anticipated timelines for development of nutrient related actions, an overview of the State's nutrient management strategies and a data inventory summary for NC's non flowing waters (lakes, reservoirs and estuaries). The Division revised the NCIP in October 2005 to extend the milestone timelines and requested that the updated plan become the mutually agreed upon plan. This modification was approved in 2006.

In accordance with the revised NCIP timelines, the DWQ began the more formalized stakeholder process by presenting to the Environmental Management Commission (EMC) in November 2008 an information item on the NCIP, including a state-wide approach to address nutrients, planned rule revisions and proposed rules for technology-based nitrogen and phosphorus controls. The proposed rules that were drafted as a result of the stakeholder process were presented to the EMC in November 2009 and January 2010. The rules were not adopted. The EMC requested that additional information be gathered regarding eutrophication and what other states were doing with respect to nutrient control regulations.

In response to the EMC's request, the North Carolina Forum on Nutrient Over-Enrichment was conducted in May 2012. This forum provided attendees with a review of the relevant science, regulatory issues, economic considerations, and other policy issues related to nutrient over-enrichment and options for avoiding water body impairments. Recognized experts presented their ideas and experience with nutrient issues to a Forum panel (consisting of two EMC members, one representative of local government and one environmental advocacy group representative) and the Forum's attendees. The Division is maintaining a website that provides information from the Forum as well as other nutrient related activities.²

In July 2012, DWQ staff and EMC Chairman Stephen Smith presented an information item to the EMC that summarized the materials presented at the Forum. The EMC assigned the Division the task of revisiting the original NCIP, taking into consideration the information gathered at the Nutrient Forum and additional stakeholder input.

In response to this request, the DWQ formed an internal workgroup in October 2012 to assist with development of the renamed Nutrient Criteria Development Plan (NCDP). The workgroup was guided by the Section 106 commitments, US EPA memorandums and federal register publications, knowledge gained from the Nutrient Forum, public input, national activities, and directives from the EMC. The workgroup goals were to identify, prioritize, and select options for criteria development to include in a revised NCDP for North Carolina. Specifically, the workgroup was to identify research project needs with specific questions to be answered, methods to be used and timelines and milestones to be met.

Staff presented an update on the progress of the NCDP workgroup at the November 2012 EMC meeting. The presentation informed the Commission about the state's CWA obligations related

¹ <http://portal.ncdenr.org/web/wq/ps/csu/swstandards> - scroll down to NC Nutrient Criteria Plan (1 Jun 2004).

² <http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria>

to nutrients under the FY12 and FY13 Section 106 Workplans and its proposed path forward. Additionally, staff provided a timeline for submitting the proposed plan to US EPA staff for review by June 30, 2013.

The DWQ hosted three public meetings on development of the NCDP in early December 2012. The meetings were held at various locations across the state to encourage stakeholder participation. Each meeting provided background information and allowed for questions and comments. The DWQ also accepted written comments on the NCDP development process from December 4, 2012 through February 4, 2013.

Written public comments were submitted by 20 individuals and 15 organizations. A summary of the comments organized by subject area is provided in Appendix B. All comments are provided at this website: <http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria>. Comments covered many topics including the following:

- Limitation of nutrients in discharges (19 postcards from individuals)
- Public review of the draft plan before taking to the EMC
- Establishment of a criteria development advisory group (although suggestions varied from a larger stakeholder process to an expert technical advisory group)
- Site specific approach for establishing criteria (comments for and against)
- Establishment of criteria for streams and rivers (comments for and against)
- Establishment of criteria for response variables in conjunction with nitrogen and phosphorus
- Establishment of criteria for response variables only
- Establishment of numeric criteria for nitrogen & phosphorus
- Inclusion of cost benefit analysis as part of the criteria development process
- Suggestions for specific locations/watersheds to focus on for criteria development

NCDP Priorities

To assist in prioritizing the plan of actions, the DWQ internal workgroup focused on evaluating where additional efforts could be initiated to best serve the public. The workgroup evaluated the strengths and weaknesses of current regulatory tools and developed a preliminary list of parameters for focused investigation to address the identified weaknesses.

Strengths and Weaknesses Analysis

To evaluate the state’s strengths and weaknesses with regard to nutrient control, the group examined the regulatory tools currently available through the state’s water quality standards regulations to assess, restore, and protect North Carolina’s waters. A summary of this evaluation is provided in **Table 1**.

Table 1. Evaluation of North Carolina’s Current Ability to Assess, Restore and Protect Surface Waters from Nutrient Impacts

Water Body Type	Capabilities of Current Water Quality Standards		
	Assess ¹	Restore ²	Protect ³
Reservoirs	Adequate – Chlorophyll <i>a</i> , Dissolved Oxygen, pH	Adequate – Chlorophyll <i>a</i> , Dissolved Oxygen, pH	Mountain and Upper Piedmont water bodies may not be adequately protected by current criteria. ⁴
Estuaries	Adequate – Chlorophyll <i>a</i> , Dissolved Oxygen, pH	Adequate – Chlorophyll <i>a</i> , Dissolved Oxygen, pH	Ongoing efforts are in place through the current nutrient management strategies. ⁵
Rivers & Streams	Inadequate	Where Chlorophyll <i>a</i> , Dissolved Oxygen & pH can be used	Where Chlorophyll <i>a</i> , Dissolved Oxygen & pH can be used
Drinking Water Supplies	Existing criteria may not reflect all responses to over-enrichment	Existing criteria may not reflect all responses to over-enrichment	Existing criteria may not reflect all responses to over-enrichment

¹ Assess refers to the ability to effectively use standards to determine if the water is experiencing undesired responses to nutrient enrichment.

² Restore means that there are standards that can be used as a target for cleaning up nutrient-impacted waters.

³ Protect means that there are standards that keep waters from becoming impacted by nutrients.

⁴ Chlorophyll *a* concentrations in the mountain and upper Piedmont lakes are lower than other parts of the state and there is concern that the 40 µg/L chlorophyll *a* standard is too high to prevent excessive nutrient over-enrichment and its impacts in these waters (DWQ Ambient Lakes Data 1981-2007).

⁵ Implementation of nutrient management strategies involves re-evaluation of whether the targets are achieving restoration and protection of the waters.

The workgroup determined that, using North Carolina's existing current chlorophyll *a*, dissolved oxygen, and pH standards, nutrient impacts on reservoirs and estuaries can be assessed and restoration success can be measured. In terms of protection, the current standards provide some protection for some waters and there are nutrient management strategies and rules in place that target watersheds with nutrient impacts.³

A weakness identified by the workgroup in the current regulations is the inability to effectively use the current water quality standards for chlorophyll *a*, dissolved oxygen, or pH to fully assess nutrient impacts in free-flowing waters (rivers and streams). In free-flowing waters, phytoplankton (algae that grow in the water column) may not have the time or other requirements necessary to grow excessively in the water column; therefore, phytoplankton (as measured by chlorophyll *a*, dissolved oxygen, and pH) are not one of the best indicators of nutrient enrichment in those waters. For example, excess nutrients can result in over-growths of periphyton (algae that grow on substrates) that the public find a nuisance; however, DWQ's ambient water quality sampling indicates that chlorophyll *a* in the water column is below the existing criterion.

As part of the strengths and weaknesses evaluation, the workgroup also specifically evaluated the DWQ's ability to use the state's current nutrient standards to assess, protect, and restore waters designated for use as a drinking water supply. Recognizing that a variety of factors can impact the designated use of a water supply, the workgroup determined that additional knowledge on the interactions between various causal/response, chemical and/or physical properties that affect public water supply sources should be researched.

With strengths and weaknesses outlined, the NCDP workgroup noted that limited financial and staffing resources would require prioritization of next steps. **The group determined that developing criteria that strengthens the ability to assess, protect and restore rivers, streams, and waters that are classified as a drinking water supply should be the division's priority.**

Parameters Targeted for Evaluation

Rivers and streams are flowing water bodies. As noted above, flowing waters can be difficult to assess for nutrient impacts using the state's current water quality standards. Also from a regulatory perspective, readily measurable substances like chlorophyll *a*, dissolved oxygen, and pH can be inadequate standalone tools in water supplies.

In general, nutrient enrichment can cause increased biomass production, phytoplankton species composition changes, nuisance conditions such as taste and odor or surface scums, the establishment of nuisance species such as algae that produce toxins, dissolved oxygen depletion, changes to pH, increased carbon dioxide production, and fish kills. In rivers and streams, these impacts can be episodic or manifested in downstream settings where flow slows.

³ http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=521753&name=DLEF-38782.pdf

Further, environmental factors like temperature, streambed substrate, canopy cover, precipitation, and wind can exacerbate the expression of severe nutrient responses.

In North Carolina, the terrestrial habitats, land uses, and respective aquatic systems are extremely diverse and the rates at which nutrients are available for plant uptake vary spatially and temporally. Therefore, a single criterion, benchmark or tool that is protective for all waters, including flowing waters, throughout the entire state is not appropriate.

Accordingly, multiple parameters and approaches towards the development of nutrient criteria will be explored. The causative and response parameters shown in Table 2 are DWQ's priorities for consideration in the development of nutrient criteria. Based on resources and the need for better tools for assessing streams and rivers, parameters most appropriate for those waters will be the top priority. Waters classified for drinking water supply are covered fairly well by the current standards; therefore, further refinement of criteria of those waters will be addressed following refinement of the criteria for streams and rivers.

Table 2. Priority Parameters for Investigation

Streams and Rivers	Waters Classified for Drinking Water Supply
<p><i>Response Parameters:</i></p> <ul style="list-style-type: none"> • Chlorophyll <i>a</i> • Phytoplankton community • Periphyton community • Diurnal DO range • Minimum DO • Diurnal pH range 	<p><i>Response Parameters:</i></p> <ul style="list-style-type: none"> • Total Organic Carbon • Algal Toxins • Taste and odor species
<p><i>Causal Parameters:</i></p> <ul style="list-style-type: none"> • Nitrogen • Phosphorus 	<p><i>Causal Parameters:</i></p> <ul style="list-style-type: none"> • Nitrogen • Phosphorus

Investigation Approach

The Division is proposing a process for criteria development to ensure that the criteria developed have strong scientific merit. The process consists of the following four tasks:

- Task 1 – Systematic Parameter Review
- Task 2 – Design and Implement Study Plans
- Task 3 – Determine Appropriate Parameters for Criteria Development
- Task 4 – Develop Criteria

This process also provides defined break points to allow for stakeholder participation and EMC review before proceeding to the next task. Depending on the results of each task, the plan may be modified to adjust timelines or priorities.

Each task is discussed in detail below.

Task 1. Systematic Parameter Review

The primary purpose of Task 1 is to assure that there are established scientific relationships between the various indicators of eutrophication and the concentrations of nitrogen and phosphorus. Task 1 will focus on gathering existing information to include literature review, review of progress in other states as they work to develop nutrient criteria, and an analysis of existing NC data for the priority parameters identified above. Information gathered at the NC Nutrient Criteria Forum will be included in this review. Task 1 will result in a detailed understanding of what research is already available, what has worked well in other states, and highlight where there are data or research gaps to be addressed in Task 2. The NCDP literature and data review efforts will consider the applicability of the research to North Carolina.

Two full time staff positions are expected to be used for this step over a one year period (Table 4). The proposed investigation approach is discussed in more detail below.

Literature Review

This phase of Task 1 is focused on identifying and reviewing current literature (scientific papers, reports, federal and state documents) which have established relationships between the parameters being investigated and the responses seen in the waters. Other state agencies will be asked to contribute to this review. The Division intends to collaborate with the local universities and academic community to further this review effort (e.g., North Carolina State University, University of North Carolina, Duke University and others).

Review of Progress in other States

Ongoing nutrient criteria development efforts of other states will be investigated in this phase of Task 1, focusing initially on states with federally approved nutrient criteria or acceptable assessment methodologies, and Southeastern states. This review aspect is anticipated to be an ongoing effort to gain a better understanding of nutrient control approaches.

Review of Available Data

The Division will conduct a review of available NC data. These efforts are intended to complement ongoing literature review efforts, data collection, and findings. Requests for existing data and the respective review may include the following sources:

- Division of Water Quality (DWQ). The Division will review existing in-house data. This includes ambient monitoring data, NPDES effluent data, NPDES upstream and downstream monitoring data, Coalition monitoring data, and DWQ lake monitoring data.
- NC Department of Environment and Natural Resources (DENR). The Division will request other divisions within DENR (Water Resources, Coastal Management, Marine Fisheries, Wildlife Resources, and Energy Mineral and Land Resources) to provide information and data that may be available for further review and analysis.
- Federal resource agencies such as the United States Geological Survey (USGS) and US Fish and Wildlife Service will be asked to participate in NCDP efforts.
- Collaboration with universities to discuss both past and ongoing research, monitoring data, models and other efforts will be pursued.
- Other. There are a variety of other sources that may have access to appropriate data (e.g., local governments, environmental groups etc.). DWQ will investigate ongoing monitoring and research efforts of other States to determine the utility and applicability of these data for North Carolina.

These efforts are anticipated to identify statistical analysis needs from data sets that are currently available and information or data gaps that remain to be addressed. Additional resources may be required to complete the statistical evaluation of the data collected. These resources may be in the form of outside research assistance to conduct data analysis, including evaluation of the relationship between the multiple causal and response parameters identified above.

A systematic investigation of the available data from permitted surface water intake locations and data in proximity to intake locations will be conducted to determine additional monitoring needs. Water treatment plants receive their source water in a variety of ways including direct river and lake intakes or intake from rivers or lakes and then storage in holding ponds; therefore, use of water quality data from these facilities requires a clear understanding of their operation and sampling protocols.

It is currently unclear if an adequate amount of “near intake” surface water data is available for analysis, especially during low flow growing season conditions. Accordingly, based on the

literature and available data review results, a study designed to address data collection needs may be initiated.

Geographic Scale

The geographic scope of Task 1 is intended to be broad as it is exploratory in nature. The applicability of parameters or combinations of parameters for investigation will be considered on the following descending (landscape size) spatial scales:

1. Regional physiographic application (e.g., Mountains, Piedmont, Coastal Plain physiographic regions),
2. River basins,
3. Differentiation of flowing stream vs. main-stem rivers by physiographic region,
4. A narrower habitat-related scale, and/or
5. Ecoregion and land use approach.

As a result of the investigation, some waters may need to be treated more site-specifically at one of the five spatial scales listed.

Results of Task 1

The information provided by the literature, state, and data review will result in refinement and focus on parameter(s) where it is possible to establish scientific linkage of cause to response and effect. Task 1 is expected to result in a more complete understanding of data gaps and should help identify other parameters that have significant utility and merit consideration. For example, these analyses may include consideration of seasonal effects, physical water quality parameters, chemical water quality parameters, severity of nuisance conditions, and morphology of the water body.

It is understood that these efforts may illuminate other functional approaches that are beyond the scope of what is presented in this current plan. If this occurs and a more suitable pathway is revealed, the DWQ intends to revisit and modify this NCDP with mutual agreement from the EMC and EPA. This modification will accommodate new information and address any new investigation priorities. This information will be communicated to the EMC and the public for consideration of application suitability.

Task 2. Design and Implement Study Plans

Task 2 will build off of the results of Task 1 by designing and implementing study plans at the appropriate geographic scale to address any identified data gaps for parameters that were deemed appropriate for continued development. Rather than evaluating parameters individually, the intent is to complete Task 1 and design studies that can evaluate multiple parameters.

If the results of Task 1 indicate the need for additional data collection to accommodate the identified data gaps in order to support the nutrient criteria investigation, resources may be sought. These funding sources may include 106 grants, 104(b) grants, 319 grant funds, and other sources that may be available for nutrient criteria development efforts.

Task 3. Determine Appropriate Parameters for Criteria Development

Based on the results of Tasks 1 and 2, parameters and the appropriate geographic region for applicability will be selected for development of criteria. Stakeholder participation and education will be conducted to ensure that environmental, regulatory and economic concerns are documented and addressed in determining the appropriate parameters for criteria development.

Task 4. Develop Criteria

This task involves development of appropriate magnitude, duration, frequency, language, implementation plans and fiscal analyses to finalize the criteria for the intended protected uses. Stakeholder, EPA and EMC input will be included.

Timeline

It is anticipated that the NCDP will require collaborative work with other agencies, local governments, and universities. Additionally, these literature review efforts, data review, analysis efforts of existing data, and implementation of investigation approaches will require staff and resource allocations. These resources are necessary to organize and manage a multidiscipline investigation / development plan of this scale (Table 4). The estimated timeline may change in future revisions of the NCDP given research or resource changes.

Conclusion

It is the goal of North Carolina to protect surface waters from eutrophication by developing additional nutrient criteria that can be used for sound evaluation of nutrient related impacts and for development of appropriate management strategies. This Plan is designed to build upon and refine the effective nutrient control that has already been achieved by the State.

Table 4. Estimated Task Duration and Full Time Employee (FTE) Needs.

Plan Components (Tasks)	Time	FTEs
EPA approval of NCDP	3 months	
Initial NCDP Organizational efforts	6 months	1
EMC update(s)	Annual	
Task 1 - Systematic Parameter Review		
Literature Review <ul style="list-style-type: none"> Review and assess literature Criteria development plan review from other states 	1 year	2
Available Data (concurrent) <ul style="list-style-type: none"> Review Statistical Analysis and assessment 		
Stakeholder & EMC Update	2 months	
Task 2 – Design and Implement Study Plans		
Study Design Development	9 months	1
Stakeholder & EMC Update	2 months	
Implementation of Study	2 years	2
Task 3 – Determine Appropriate Parameters for Criteria Development		
Analysis, assessment and write up of results	6 months	2
Stakeholder & EMC Update	2 months	
Task 4 - Develop Criteria		
Criteria Development	1 year	1
Stakeholder & EMC Update	2 months	
Total	6.7 years	

Appendix A. History of the North Carolina Nutrient Criteria Development Plan Through March 2011

2001

In January of 2001, the US Environmental Protection Agency (EPA), under the Federal Water Pollution Control Act (Clean Water Act or CWA) authority initiated efforts for states to adopt nutrient standards, specifically total nitrogen, total phosphorus, chlorophyll *a* and Secchi depth, into their state water quality standards by publishing Section 304(a) criteria in the Federal Register. These published criteria were aimed at reducing and preventing eutrophication on a national scale. The Federal Register notice specifically outlines that states are “expected to adopt or revise EPA ecoregional nutrient criteria ... into State ... water quality standards by 2004.” The notice includes directives for states to complete a plan for this adoption by the end of 2001. If states had not met this obligation by the end of 2004, EPA proposed to promulgate protective nutrient criteria in those states/tribes.

Division of Water Quality (DWQ) staff initiated meetings to determine the applicability and utility of the published federal ecoregional documents and immediately questioned the science of the recommended concentrations for chlorophyll *a*, total phosphorus and total nitrogen. These concerns were expressed by NC and other states to US EPA regional and national staff. The US EPA recognized the problems associated with the short compliance timelines and in November 2001 issued a memorandum known as the ‘Grubbs memo’⁴ that clarified the requirements for states to derive an EPA “mutually agreed upon” “plan of action” by 2004 with the intended purpose to reduce nutrients. The guidance noted that if a state had developed a plan of action or initiated its administrative process to adopt nutrient criteria by the end of 2004, EPA would conclude that a federal promulgation of rules was not appropriate.

2002 - 2004

From early 2002 through June 1, 2004, DWQ staff drafted the ‘North Carolina Nutrient Criteria Implementation Plan’ (NCIP) to accomplish the federal mandate of developing a “plan of action” for submission to the EPA Region IV. The US EPA Region IV provided a “mutual agreement” letter approving North Carolina’s initial plan on September 4, 2004. This submittal included anticipated timelines for development of nutrient related actions, an overview of the State’s nutrient management strategies and a data inventory summary for NC lakes and reservoirs. The first NCIP for NC was finalized in September 2004.

2005 - 2006

⁴ http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/nutrient_2001_Grubbs_Memo.pdf

In October 2005 the DWQ staff informed the EMC about the Triennial Review of water quality standards and the relationship of the proposed chlorophyll *a* standards and the NCIP.

On October 25, 2005, the passage of NC General Assembly Session Law 2005-190 pertaining to the protection of drinking water supply reservoirs created significant demands on staff resources. The Division revised the NCIP in October 2005 to extend the milestone timelines and requested that the updated plan become the mutually agreed upon plan. This request was made in accordance with the Grubbs memo and timelines were adjusted to meet both the needs of SL 2005-190 and the Federal Register 2001 requirements. The US EPA Region IV agreed with the request in July 2006.

2007

The US EPA continued to stress the importance of taking appropriate actions and on May 25, 2007, Benjamin Grumbles, Assistant Administrator, US EPA issued a 'Memorandum on Nutrients'⁵, which further encouraged states to "accelerate" adoption of nitrogen and phosphorus (as causal variables), and chlorophyll *a* and transparency (as response variables) into states' water quality standards. North Carolina responded to this memo by submitting clarifying information to explain our proactive nutrient management approach.

2008 - 2009

In accordance with the proposed NCIP timelines, the DWQ began the more formalized stakeholder process by presenting to the Environmental Management Commission (EMC) in November 2008 an information item on the NCIP, including a state-wide approach to address nutrients, planned rule revisions and proposed rules for technology based nitrogen and phosphorus controls.

Beginning in January 2009, stakeholder groups and EMC information items provided the public and the EMC with:

1. Proposals to change water quality standards, including chlorophyll *a*,
2. Overviews of the proactive nutrient management approach which included chlorophyll *a* thresholds levels derived from the NCIP,
3. Water bodies identified through the NCIP investigations that would likely be affected by any proposed changes to water quality standards or to regulations pertaining to point and nonpoint source control.

The proposed thresholds and proactive strategies were not water quality standards and were not subject to EPA approval. They were, however, a result of the mutual agreement with the EPA for actions to be undertaken to achieve stronger controls on nutrients as directed by the

⁵ (http://portal.ncdenr.org/c/document_library/get_file?folderId=521753&name=DLFE-13932.pdf)

January 2001 Federal Register notice and subsequent memorandums. The review of the chlorophyll *a* standards was required under the CWA Triennial Review process and the NCIP mutual agreement.

In November 2009, DWQ submitted a request to EPA Region IV staff to further extend NCIP timelines for adopting revised chlorophyll *a* standards and the establishment of chlorophyll *a* threshold rules with their associated management strategies. These revisions to the timelines provide additional time for the administrative rule making process. Approval of this timeline modification has not been granted, so 'mutual agreement' has not been re-established.

The Division continued to pursue proposed changes to the chlorophyll *a* water quality standards (15A NCAC 2B .0200) in conjunction with proposed chlorophyll *a* threshold rules (15A NCAC 2B.0600) and presented these proposals in November 2009 to the EMC. Commission members requested that additional stakeholder meetings occur on the proposed chlorophyll *a* threshold regulations before moving forward.

2010

Planning staff requested and obtained permission to proceed with changes to water quality standards in 15A NCAC 2B .0200, which included the modifications to the existing chlorophyll *a* standards. In accordance with the NCIP proposals, these draft rules included a regionally specific chlorophyll *a* standard for the mountains and upper Piedmont. Permission was granted by the EMC in March 2010 to take the rule package to public hearing. This package did not include the proposed nutrient chlorophyll *a* threshold rules. As part of the rule-making process, the state began to document the potential fiscal impacts of the proposals. That process is still underway.

Separately, the EMC requested that additional meetings be held regarding the proposed nutrient chlorophyll *a* threshold rules. Two meetings were held in October 2010 to gain insight from a number of interested parties, including representatives of the League of Municipalities, Home Builders Association, Association of County Commissioners, North Carolina Conservation Network and agricultural interest groups. As a result of these meetings, staff presented additional revisions and modifications of the nutrient chlorophyll *a* threshold regulations to the EMC. The EMC did not approve the proposals to move forward and directed staff to address six specific areas of concern in greater detail:

1. Review alternatives to threshold rules and indicators/criteria for determining eutrophication
2. Develop a clearer statement of the underlying science in the form of a white paper or other form
3. Provide more detailed review of costs and cost savings
4. Consider basing the threshold on something other than chlorophyll *a*
5. Consider other indicators of trending or change
6. Increase education on nutrient over-enrichment

2011

To more closely consider the EMC's concerns, the DWQ proposed holding a public scientific nutrient forum to obtain relevant knowledge as to the environmental and economical impact of implementation of proactive management of nutrients. The EMC agreed with the plan and subsequently, the DWQ and the EMC hosted 'The North Carolina Forum on Nutrient Over-Enrichment' (Forum)⁶ in May 2012.

In March 2011, the US EPA issued an additional memorandum to states "Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions", (Nancy Stoner, Acting Assistant Administrator). The memorandum reaffirmed EPA's commitment to make greater progress in accelerating the reduction of nitrogen and phosphorus loadings to the nation's waters. The memorandum indicated eight principals that are guiding and that have guided the US EPA in working with states to achieve near-term reductions in nutrient loadings. The Division concurred with several elements of the memorandum particularly that states need to provide leadership in addressing nutrients and that there must be room to innovate and respond to local situations.

2012 to Present

The North Carolina Forum on Nutrient Over-Enrichment' was conducted in May 2012. This forum provided attendees with a review of the relevant science, regulatory issues, economic considerations, and other policy issues related to nutrient over-enrichment and options for avoiding water body impairments.

Recognized experts presented their ideas and experience with nutrient issues to a Forum panel (consisting of two EMC members, one representative of local government and one environmental advocacy group representative) and the Forum's attendees. The Division is maintaining a website that provides information from the Forum as well as other nutrient related activities.⁷

In July 2012, DWQ staff and EMC Chairman Stephen Smith presented an information item to the EMC that summarized the materials presented at the Forum. The Division was assigned the task of revisiting the original NCIP, taking into consideration the Nutrient Forum and additional stakeholder input.

The DWQ formed an internal workgroup in October 2012 to assist with development of the NCDP. The workgroup was guided by the Section 106 commitments, US EPA memorandums and federal register publications, knowledge gained from the Nutrient Forum, public input,

⁶ <http://www.ncsu.edu/mckimmon/cpe/opd/NCFONOE/index.html>

⁷ <http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria>

national activities, and directives from the EMC. The workgroup goals were to identify, prioritize, and select the options that may work best for North Carolina. Specifically, identify research project needs with specific questions to be answered, methods to be used and timelines and milestones to be met.

Staff presented an update on the progress of the NCDP workgroup at the November 2012 EMC meeting. The presentation informed the Commission about the state's federal water pollution control act obligations related to nutrients under the FY12 and FY13 Section 106 Workplans and its proposed path forward. Additionally, staff provided a timeline for submitting the proposed plan to US EPA staff for review by June 30, 2013.

The DWQ hosted three public meetings on development of the NCDP in early December 2012. The meetings were held at various locations across the state to encourage stakeholder participation. Each meeting provided background information and allowed for questions and comments. DWQ also accepted written comments from December 4, 2012 through February 4, 2013.

Written public comments were submitted by 20 individuals and 15 organizations. All comments can be reviewed on the DWQ website: <http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria>. A summary of the comments organized by subject area is provided in Appendix B of the NCDP. Comments covered many topics including the following:

- Nineteen (19) of the individuals sent a postcard urging action to limit nutrients in discharges
- Public review of the draft plan before taking to the EMC
- Establishment of a criteria development advisory group (although suggestions varied from a larger stakeholder process to an expert technical advisory group)
- Site specific approach for establishing criteria (comments for and against)
- Establishment of criteria for streams and rivers (comments for and against)
- Establishment of criteria for response variables in conjunction with nitrogen and phosphorus
- Establishment of criteria for response variables only
- Establishment of numeric criteria for nitrogen & phosphorus
- Inclusion of cost benefit analysis as part of the criteria development process
- Suggestions for specific locations/watersheds to focus on for criteria development

Appendix B. Summary of Public Comments Received Between December 4, 2012 and February 4, 2013

Comments received from:

Individuals:

1. 19 postcards
2. Tim Spruill, Hydrologist, USGS-Retired

Organizations:

1. Albemarle-Pamlico National Estuary Partnership (APNEP)
2. Cardno ENTRIX
3. Catawba Riverkeeper
4. City of Charlotte
5. City of Salisbury
6. Division of Marine Fisheries
7. Division of Soil and Water Conservation (DSWC)
8. Mecklenburg County
9. Neuse River Compliance Association (NRCA)
10. North Carolina American Water Works Association – Water Environment Association (NCAWWA)
11. North Carolina Farm Bureau Federation, Inc. (Farm Bureau)
12. North Carolina League of Municipalities (NCLM)
13. North Carolina Water Quality Association (NCWQA)
14. UNC Wilmington Center for Marine Sciences (2)
15. Waterkeepers Alliance/Waterkeepers Carolina

DRAFT

Comments in specific support for limiting discharges of nutrients

19 postcards

Comments in support of reviewing the draft plan prior to taking to WQC/EMC

AWWA

City of Charlotte

DSWC

Mecklenburg County

NCLM

NCWQA

NRCA

Waterkeepers Alliance/Waterkeepers Carolina

Comments in support of an advisory group/active stakeholder process

APNEP

Cardno ENTRIX

DSWC

Farm Bureau

Tim Spruill (expert technical advisory group proposed, not necessarily stakeholders)

Comments regarding implementation of original NCIP

Waterkeepers Alliance/Waterkeepers Carolina – The Waterkeepers expressed concern that NC has unreasonably delayed development of numeric nutrient criteria for the past eight years. State that NC has not met its obligations contained in the June 2004 agreement and has requested timeline extensions twice, first in October 2005, and again in November, 2009.

NCDWQ draft revisions to water quality standards (January 2010) contain inadequate progress toward reaching the goals for non-flowing waters laid out in the NCIP. Makes note that EPA issued statements that the chlorophyll *a* standards are mostly unchanged from the values in place before the NCIP, and that no supporting data to justify such values was provided to them.

Citing NCDENR and the EMC duty to “design water quality standards that are adequate to protect human health, to prevent injury to plant and animal life..... and to secure for the people of North Carolina, now and in the future, the beneficial uses of these great natural resources.” (Ref. N.C.G.S. §§ 143-211(c); 143-214.1, N.C.G.S. § 143B-282(a) (2)(b)) Commenter articulates that after eight years of planning, assessment and scientific evaluation, North Carolina still has not developed numeric criteria adequate to protect the designated uses of the state’s waters and is still relying on the chlorophyll *a* criterion developed in the 1970s. Waterkeepers Alliance/Waterkeepers Carolina notes NCDENR acknowledgement (2009) that the chlorophyll *a* criterion was inadequate as evidenced by the continued eutrophication of the state’s waters. Despite the state’s unreasonable delay in reaching the goals stated in its NCIP, EPA has continued to give North Carolina more time to come up with adequate numeric nutrient criteria,

justified by adequate data. Further, the commenter speaks to the EMC's duty to adopt nutrient criteria pursuant to Section 303(c) of the CWA. 33 U.S.C. §1313(c)(2)(A) and 40 C.F.R. § 131.2 and to its duty to base the nutrient criteria on sound scientific rationale." 40 C.F.R. § 131.11(a)(1). Because NCDWQ has been evaluating its criteria for eight years and it is not disputed by EPA or NCDWQ that the existing criteria is inadequate to protect the designated uses of North Carolina's waters, if the EMC does not propose a reasonable plan designed to quickly establish appropriate numeric criteria based on sound science, the EPA also has a duty to step in and promulgate nutrient criteria for North Carolina to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a); 33 U.S.C. § 1313(c)(4).

Waterkeepers Alliance/Waterkeepers Carolina further states that North Carolina's waters are experiencing increased nutrient pollution and associated degradation of drinking water, fisheries and recreational resources exacerbated by North Carolina's undue delay in adopting and enforcing appropriate nutrient criteria necessary to protect designated uses for the state's waterbodies. Comments note that EPA and numerous organizations have advocated that North Carolina adopt numeric nitrogen and phosphorus standards and states that North Carolina is the only southeast state that refuses to move toward adoption of numeric criteria. The Waterkeepers Alliance states a concern with the statewide chlorophyll *a* criterion, and states the EPA opinion that it is in need of revision and is now weaker than the standards in most other states. They stress that in requesting an extension of the deadlines for development of nutrient criteria from EPA in 2009, NCDWQ acknowledged that its chlorophyll *a* criterion needed to be revised and that "additional proactive nutrient control measures are warranted based on the latest advances in the science of nutrient management and the continued eutrophication of waters."

Comments on strengths of existing programs

Farm Bureau – Comments question whether the case has been made that NC needs to adopt an extensive new set of nutrient criteria. Stressing that NC has an excellent record of addressing nutrient issues through nutrient strategy development and, in many cases, subsequent rule adoption. The NC NCDP should not be designed to "reinvent the wheel." The plan should foremost address and stress the first goal stated on the NCDP website, "The plan will: [h]ighlight and enhance NC's current approaches to nutrient management."

The Farm Bureau requests that DWQ extensively describe the current approach and its implementation in order for better recognition of efforts underway. An extensive review of the current approach is needed for DWQ to justify efforts to "enhance" the State's current approaches. Proof of the need for "enhancements" should be provided.

The website states that the plan will "[p]rovide for exploration of built-in protection and prevention." Before "exploring" such, the State should consider the many mechanisms already in place. NC already has nutrient strategies for a large part of the State, nutrient regulations for

much of the State, and also has the nutrient sensitive waters classification capability when waters are determined to be nutrient sensitive.

The Farm Bureau encourages that the plan should focus on other programs already in place (water supply watershed regulations, state and federal stormwater regulations, sedimentation and erosion control regulations), indicating that they provide built-in protection and prevention and reduce nutrient contributions to waters, even if nutrient delivery reduction is not the primary purpose of these programs or regulations.

NCLM – The League recognizes that while DWQ undertakes the necessary research to fill data gaps in the current plan, the NCDP must demonstrate a commitment to further nutrient controls now. Current activities to control nutrient impairments of lakes and estuaries – an area DWQ has determined is sufficiently addressed through its long-standing chlorophyll *achlorophyll a* approach – will no doubt continue throughout the time needed to complete NCDP research projects. The NCDP can identify such planned activities to show the state’s continued commitment to addressing nutrient impairment.

NCWQA – (Referring to the March 2011, US EPA document: “Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions”) North Carolina can point to existing programs for all eight of EPA’s recommended elements for a state nutrient management framework. Although there are opportunities to enhance these elements, NCWQA recommends that the NCDP emphasize the effective leveraging, coordination, and refinement of existing programs, and adopt major new elements only as necessary to address any major regulatory gaps.

Comments expressing concern about impact in areas with existing nutrient management strategies/controls

Farm Bureau – The Farm Bureau encouraged extensive review of the economic impact on farmers and other citizens related to any proposed changes and discouraged any DWQ changes to the criteria that could affect rules and programs already in place.

NRCA – The NRCA endorses the Division’s position that any revisions to the nutrient criteria will not impact water bodies that have implemented a TMDL stating that the Neuse Management Strategy has been in place for 10 years and any revisions should be implemented through the TMDL process.

Comments regarding developing criteria for flowing waters

Do not support developing criteria for flowing waters>>

AWWA - Development of a separate category for flowing waters is not needed – AWWA states that control of nutrient impairment should be focused on non-flowing waters indicating that development of flowing water biological indicators, such as periphyton, would impact the schedule as the usefulness of this biological parameter for controlling nutrient impairment is

not proven. AWWA also stated concern that NC has never utilized periphyton as a biological indicator and has few resources and expertise for the efforts needed to develop such criteria. AWWA indicated that as nutrient issues are presented in non-flowing waters, control strategies, and protection measures can be extended as far upstream in flowing waters as necessary to mitigate any responding condition.

Support developing criteria for flowing waters>>

Catawba Riverkeeper – Consider monitoring of TN and TP (causal variables), rather than simply the response variables (chlorophyll *a*), in the rivers and streams that deliver N and P to the lakes, where they tend to create problems.

Tim Spruill - Not all streams and reservoirs respond biologically to over-fertilization with nutrients. Consequently, streams that are not detected using biological monitoring techniques (i.e., response variables such as chlorophyll *a*) can transport excessive amounts of nitrogen and phosphorus to downstream bodies of water, including estuaries and sounds, the ultimate receivers of all pollution in the basin draining to the ocean from each river basin.

Recommendation - Numeric chemical standards should be established for all streams to protect the ultimate receiver of all nutrient loading, the estuary:

1. to prevent catchments which do not locally exhibit effects of eutrophication from contributing excessive quantities of nutrients to the receiving estuary through uncontrolled point and nonpoint source discharges to the State's waters.
2. to prevent unfair (to those watersheds and stakeholders who are not discharging excessive amounts—i.e. the mass/unit area that is proportional to the relative amount from upstream areas of the watershed delivered to the receiving estuary) portion of the cost of preventing eutrophication to the State's waters.

Comments regarding the list of parameters under consideration

Catawba Riverkeeper – Consider Nitrogen and Phosphorus in their entireties. Citing literature concerns expressed with bioavailability, form of N and P, and transport. They stressed that without considering the total N and P, there will likely still be eutrophication problems even when testing of only the dissolved phase revealed relatively little N and P in transport. Encouraged monitoring of TN and TP (causal variables), rather than simply the response variables (chlorophyll *a*), in the rivers and streams that deliver N and P to the lakes, where they tend to create problems.

Farm Bureau – Indicated that the DWQ website states that the plan will “[i]nclude review of a variety of possible criteria including response variables like benthic macroinvertebrates, periphyton, continuous dissolved oxygen, total organic carbon, algal densities and causal variables like nitrogen and phosphorus. They state that the possibility of any proposed numeric nutrient standards is a concern. Requested information on potential other variables under consideration and requested potential parameters to include chlorophyll *achlorophyll a*.

DSWC - The Division of Soil and Water encourages the continued use of chlorophyll *achlorophyll a* as a response variable where appropriate and applicable. The chlorophyll *achlorophyll a* criterion in standards should only be adjusted when science justifies new number(s), and when it is cost effective and achievable to implement.

Comments regarding designated uses

City of Charlotte – Indicated that designated uses of a water body should be prioritized. Stating that designated uses can sometimes be in conflict with regards to nutrients where higher nutrients may increase the biomass and sustain a healthy ecosystem (aquatic life usage) while at the same time the conditions may not be appealing for primary recreational usage (swimming).

NCWQA – Stated that any new response criteria should have a demonstrated cause and effect relationship with designated use attainment. The existing NCIP indicates that North Carolina will explore the utility of alternative response criteria such as periphyton measures in streams. NCWQA supports the investigation of alternative response variables, but with the strong encouragement that such variables only be adopted as criteria if they can be defensibly linked to impacts on aquatic life, recreation, drinking water, or other designated uses. Such linkages should go beyond mere statistical correlations to include mechanistic, cause-and effect relations which are demonstrated by scientific investigation. This is not to advocate that all scientific uncertainty in criteria-use linkages can or must be eliminated.

For example, North Carolina's existing NCIP indicates that the state will explore various algal measures in streams such as periphytic *chlorophyll a*, percent coverage, and diatom indices of biotic integrity (IBI). Diatom IBIs are an example of an indicator that may or may not have direct meaning for designated use attainment. In contrast, high accumulations of nuisance or toxic algal taxa may directly impact high trophic levels or other uses.

North Carolina should consider refinement of designated uses in concert with criteria development. In order to achieve the most defensible links between criteria and designated uses, it may be necessary to refine designated use categories. This could take the form of a tiered aquatic life use (TALU) framework that acknowledges variation in the biological potential of different water bodies. Several states (e.g., MN, ME, NJ) have developed TALUs which provide higher levels of protection for higher quality or value streams. Similarly, USEPA led the Chesapeake Bay states in a process to refine the designated uses of Bay waters into ecologically-based categories (migratory & spawning waters, shallow water, open water, deep water, etc.). We encourage DWQ to consider and implement similar TALU and spatial concepts to further tailor use designations in conjunction with criteria development.

Comments with approach suggestions

APNEP – (Comments were Specific to Albemarle-Pamlico estuarine system.) Suggested that a dedicated independent contractor manage the development and consideration of numeric nutrient criteria approaches specifically related to North Carolina's estuarine waters. To

develop protective criteria for these estuarine waters, approaches should include (1) reference condition approaches, (2) stressor-response relationships, (3) and water quality simulation models. If sufficient data exists, APNEP suggests that an ideal scenario might entail developing numeric criteria using each methodology, then comparing the results and adopting criteria accordingly.

APNEP suggests work might be undertaken in concert with the APNEP Science and Technical Advisory Committee, with scientific input from state and federal agency representatives and researchers in relevant fields. APNEP offered to administer the contract, or otherwise provide support should it be administered elsewhere. APNEP noted that criteria may be more easily accepted by EPA, the state and responsible parties if an outside contractor is employed.

NCWQA – (Timeline) Requested that the NCDP include a realistic, staged schedule that makes near-term progress while providing ample time for research, refinement of the State's existing programs and development of cost-effective policies and regulations for a longer-term implementation. They suggest that underestimation of the time required to identify and adopt scientifically defensible criteria has been a major reason for repeated revisions to nutrient plans in other states.

Tim Spruill – (Scientific Advisory Group) For North Carolina to make progress in protecting water quality from over-fertilization and resulting eutrophication, Mr Spruill advises that the State should seriously seek and consider new opinions, both inside and outside the state, from a variety of individuals and academic institutions who possess knowledge on establishment of water quality standards and criteria.

(Literature Review/Suggested Criteria Concentrations) Mr. Spruill recommends that DWQ should consider information supportive of numeric nutrient standards and include opinions, evidence from published papers, and arguments by scientists supportive of this view. He concurs with studies on estuarine over-fertilization conducted in North Carolina and other areas of the U.S. that reduction of both nitrogen and phosphorus are necessary to prevent eutrophication incidents in freshwater and estuaries. He indicates that critical concentrations, above which concentrations are associated with summertime algal blooms, approximate between 0.05 and 0.1 mg/L as an upper limit for total phosphorus and approximately 7- 10 times those concentrations (0.35-1 mg/L) for total nitrogen. He requests that these concentrations should be considered for establishment of chemical nutrient standards in all lakes, reservoirs, estuaries and streams, and at least in the Piedmont and Coastal Plain regions, with more restrictive standards for the Blue Ridge. The upper part of these ranges might be most appropriate for stream standards, with the lower part more suitable for quiescent water bodies.

(Adoption of Criteria plus Control of Nutrient Loading) – Suggests that in addition to water quality standards, it may be reasonable, effective, and consistent within the context of the TMDL program, to consider nutrient controls in terms of watershed loading by using annual yields (tons per square mile per year). Based on runoff coefficients for selected land uses estimated by previous researchers, 1 tpsm of total nitrogen and 0.1 tpsm total phosphorus

would be reasonable annual average targets for yields to estuaries and lakes. These yields allow for some contamination by urban and agricultural practices, but would avoid extreme rates of nutrient loading (i.e., above 0.15 tpsm for total P and 1.4 tpsm for total N).

Recommendation- Include the possibility of using annual nutrient yields as a way to protect water quality of lakes and estuaries. Mr Spruill suggests that there is information on yields typical of various land uses that could be used to develop workable protective nutrient loading standards for streams draining into lakes, reservoirs, and estuaries.

Waterkeepers Alliance/Waterkeepers Carolina (Timelines/targeted areas/types of criteria) –

The Waterkeepers recommend that the NCDP include specific actions/deadlines/interim milestones including time for data collection, data analysis, criteria proposal, and criteria adoption that prioritize promulgation of criteria in impacted waters where adequate scientific justification for criteria exists. They indicate that this information is available for NC's Coastal Plain and in other areas of the state. Request that numeric criteria address causal (nitrogen and phosphorus) and response variables for all waters that contribute nutrient loadings to NC waterways. Suggest that criteria should be informed by scientific understanding of the relationship between nutrient loadings and water quality impairment and that where scientific information is lacking, the plan should set forth specific actions for collecting necessary scientific information.

Comments with location specific study plan suggestions

APNEP – APNEP indicates that ambient monitoring provides poor coverage in the Albemarle-Pamlico estuary (no stations in Bogue, Back, Core, Croatan, Roanoke, or Currituck Sounds). They explain further that some ambient stations are found in the river mouths of the Neuse and Pamlico Rivers, but otherwise no ambient monitoring data exists for the vast expanse of Pamlico Sound. Albemarle Sound currently has the best monitoring coverage, with ambient stations at most river mouths and through the center of the sound. Noting significant, and important, ambient monitoring stations in inland waters, they request that the DWQ/EPA partner with APNEP to consider options through which consistent and statistically rigorous water quality information might be obtained for North Carolina's major sounds.

DMF - Due to the detrimental effect of eutrophication on coastal habitat and fish, DMF recommends that a focus of the plan include:

- The Cape Fear River. Noting that this coastal river basin is showing signs of eutrophication, which could negatively impact several federally listed and depleted anadromous fish species. Request/suggest that monitoring of cause and response variables in targeted areas is needed to determine source and effect of nutrient loading and effective control strategies (IMOVEED this to a different section) More intense monitoring and assessment of the estuarine rivers, creeks and sounds where Submerged Aquatic Vegetation (SAV) is or has historically occurred. Bogue Sound was noted as a critically important fish habitat that should be protected. Existing research indicates that

current nutrient and sediment criteria are insufficient to maintain adequate water quality for this habitat.

- The lower Neuse River. Although nutrient management strategies are already in place, more monitoring and action may be needed.

NRCA – Noting that the current research on the health and improvement of the Neuse estuary is not being financially supported by the Division and that programs that once were supported by the Division (ModMon and FerryMon) no longer receive state funding, NRCA suggests that the strategy selected by the Division must provide for and support monitoring to verify the criteria are succeeding in the goal of reducing nutrients in the effected water bodies.

Comments with specific study plan/research/sampling suggestions

NCLM - To make the final nutrient criteria as scientifically sound as possible, the League recommends several NCDP research projects:

- a. First, building off research presented at the nutrient forum, the NCDP should include a project to examine the effect of legacy groundwater contributions to a water body's nutrient load.
- b. The plan should include projects to examine the appropriate variables (including inorganic and organic nitrogen), or nitrogen to- phosphorus ratio, to measure for each water body type. NCDP projects should examine these various effects of nutrient levels when deciding the appropriate parameter to use in a regulatory scheme.
- c. Identification of water body types needing further monitoring to support valid criteria, noted a deficiency in data for streams and other flowing waters.

NCWQA – Request that any developed criteria should contain an examination of criteria frequency and duration (or averaging periods). Noting that the response of many water bodies to nutrient loading can vary a great deal based upon hydrologic, seasonal, and inter-annual variability, NCWQA recommends that criteria frequency and averaging periods should be set to avoid assessment being largely influenced by uncontrollable short-term peaks or unusual hydrologic years. NCWQA notes that his approach de-emphasizes outliers and unusual loading events (e.g., hurricanes) and emphasizes the long-term status of the water body.

UNCW – UNCW suggests that, when blooms are visible, monitoring should include, as standard protocol, surface film sampling to enable quantification of *Microcystis* blooms to assess the chlorophyll *a* biomass.

Comments seeking reductions from non-point source contributors

Catawba Riverkeeper – The Catawba Riverkeepers urged the plan to consider areas of agriculture and dry litter spreading. They note swine concentrated animal feeding operations

("CAFOs") and their waste ponds as plaguing waterways, especially during heavy rain events. They express concern that poultry CAFOs have increased due to lack of legislative oversight. Noting that with ~600 poultry houses in the Catawba basin, an increase in resources to inspect and monitor dry litter application and storage is warranted. They express that the primary concern with the impact of these CAFO operations on the environment is with regard to nutrient overloading, so targeted monitoring around (upstream and downstream of) areas densely populated with poultry CAFOs would target a likely key source. They suggest that increased investigations may identify responsible parties for over-application relative to the appropriate agronomic rate or application when rain is imminent. They express concern regarding the impact of the CAFOs in sub-basins draining to Lake Hickory, Lake Rhodhiss, and the South Fork River.

Sludge spreading must be considered. The Catawba Riverkeeper urged that sludge application processes be better monitored. Again noting that DENR lacks the resources to have someone monitoring and inspecting sludge spreading with any regularity. They also note that the impacts of N and P in applied sludge must be better understood relative to the surrounding waterways and overall environment. With such waterway monitoring for impacts upstream and downstream of sludge spreading sites, more appropriate agronomic rates and N and P limits can be established.

Fertilizer education. The Catawba Riverkeepers indicate that while the CWA addressed point source pollution very well, problems with non-point source pollution were poorly addressed and have grown in recent years. They suggest that regulations addressing "fertilizer blackouts", adopted in other states could be one part of the solution. They acknowledge that enforcement is likely to be an issue, so revised regulations combined with education programs are offered as the best solution.

DMF - Due to the detrimental effect of eutrophication on coastal habitat and fish, DMF recommends that a focus of the plan include:

Nutrient management strategies that provide for consideration of point and nonpoint pollutant sources from all land uses, as well as hydromodifications that could be contributing to nutrient response variables.

NCLM - The nutrient forum demonstrated the scientific uncertainty that still exists when designing effective nutrient management strategies. And closer to home, N.C. researchers continue to investigate the effectiveness of various strategies, particularly non-point source controls such as urban stormwater management techniques. Whether in the NCDP or beyond, the League recommends that DWQ devise research projects to measure the effectiveness of a wide variety of non-point source control techniques, tailoring the projects to each of the different water body types in the state. The non-point sources to consider should include, at a minimum, urban stormwater, crop and animal agriculture, septic, groundwater, and atmospheric contributors. This research would ideally result in management strategies that more effectively target nutrient inputs.

NRCA –Noting that members of the NRCA have invested over \$300 million in facility improvements to reduce nitrogen delivered to the Neuse Estuary, they acknowledge no “net gain” has been realized in nitrogen load reductions delivered to the Neuse estuary. Extrapolation of these results indicates that benefits will be greater if greater focus is placed on non-point source reductions.

Comments in support of setting numeric nutrient criteria at protection level

Tim Spruill – Recognizing that if the nutrient or chlorophyll *a* standards are set to indicate degraded water quality, then unfortunately, the damage is already done by the time violations are detected. Mr Spruill recommends a proactive stance that includes adoption of enforceable nutrient and *chlorophyll a* standards set to levels that prevent degraded water quality and an implementation of preventative procedures and land-use practices before reaching degraded status. He states that unless a standard is enforceable by the State, there is little incentive from stakeholders to enact remedial procedures until the standard is reached, at which time it is too late for cost-effective remediation. Mr Spruill recommends that by establishing and adopting numeric chemical standards that are preventative and broadly applied (broadly across regions such as the Inner and Outer Coastal Plain, Piedmont, and Blue Ridge) water quality can be protected against future increases in nutrient concentrations and loads. He suggests that these preventative standards should be the critical “warning” link to initiating nutrient control practices in such watersheds before reaching concentration or load standards that indicate loss of use. Use of response variables alone, such as *chlorophyll a*, does not ensure that excessive loading and/or concentrations will be detected in all streams and water bodies.

Comments in support of site specific approach

AWWA
City of Charlotte
DSWC
Farm Bureau
NCLM
NCWQA
NRCA

Comments in support of consideration of criteria for response variables in conjunction with/in lieu of N&P (matrix type approach)

AWWA (support response variables only)
City of Charlotte
DSWC
Farm Bureau
NCLM
NCWQA
Waterkeepers Alliance/Waterkeepers Carolina

Comments in support of numeric nutrient criteria

APNEP

Catawba Riverkeeper

Tim Spruill

Waterkeepers Alliance/Waterkeepers Carolina

Comments in support of trend analysis for any potential proactive approaches

NCLM - As with the threshold rules proposal advanced by DWQ in 2010, League members continue to strenuously object to any regulatory approach which imposes permit limits and other nutrient control strategies upon the occurrence of exceedances of a numerical value that is not the water quality standard. The threshold approach and any other similar approaches remain flawed because they do not adequately reflect trends in water bodies. The League therefore recommends that the NCDP contain projects to explore methods that would accurately determine a particular water body was headed toward impairment.

NCWQA – NCWQA recommends that proactive/preventative strategies should retain flexible implementation mechanisms and not default to limit-of-technology treatment requirements. NCWQA further recommends that the revised NCDP retain and reemphasize the need for basin specific planning approaches and non-regulatory agreements among dischargers over stringent, one-size-fits-all treatment requirements for regulated sources. Additionally, proactive/preventative strategies should include the confirmation of increasing trends in response variables. The diagnosis of nutrient enrichment and the need for preventative management should be based not only on the magnitude of response variables, but also on trends. For example, if a water body historically exceeded *chlorophyll a* thresholds but showed no signs of degradation, it may not require as aggressive management as a water body with increasing trends. The planning response should include an investigation of why response variables are changing (nutrient loads, streamflow/climatic trends, natural cycles) before jumping to the imposition of aggressive nutrient control requirements.

Comments in support of cost-benefit analyses during criteria development

APNEP – Noting current NC regulations requiring development of a fiscal note, APNEP encourages that the analysis should attempt to quantify the economic benefits arising from numeric nutrient criteria. To that end, APNEP requests support for an examination of the ecosystem services provided by North Carolina's sounds and associated habitats, and the extent to which these services might be reduced by excessive nutrient inputs.

NCLM – NCLM recommends DENR incorporate cost-benefit analysis. The League recommends that the NCDP include projects aimed at setting the appropriate levels of any selected nutrient criteria, including incorporating a cost-benefit analysis into any decision-making. A cost-benefit analysis would also form a solid basis for NCDP projects that might examine different water

body classification categories, especially when needing to weigh competing designated uses of various water bodies.

NRCA – NRCA supports the inclusion of a cost benefit analysis in selecting the appropriate levels in the nutrient criteria. Noting that members of the NRCA have invested over \$300 million in facility improvements to reduce nitrogen delivered to the Neuse Estuary, they acknowledge no “net gain” has been realized in nitrogen load reductions delivered to the Neuse estuary. Extrapolation of these results indicates that benefits will be greater if greater focus is placed on non-point source reductions.

Comments in support of integrating flexibility into criteria

City of Charlotte – Charlotte requests that DENR not use only numeric criteria; suggest that DENR include a narrative assessment of water body health including algal or aquatic species as indicator of impairment or lack thereof. When verifying the condition of a water body, algal samples and other aquatic species should be used to support the findings from numeric criteria. Some species prefer high nitrogen while others prefer high phosphorus. Algal and other aquatic samples should be used to help make the connection between parameters analyzed for water quality and the aquatic health of the water body. These samples should not be used as a basis for impairment but rather to support the conclusions developed from other criteria.

NCLM - The League supports a flexible approach to criteria development. The nutrient forum prompted several possibilities:

- a. Develop a range in values for both causal and response variables, indicating where specific water body types should fall within those ranges;
- b. Set criteria for each classification of waters, possibly using different methods to set this criteria depending on the pertinent characteristics of that water body type;
- c. Follow Maine’s example, setting criteria based on both causal and response variables but including an option in the criteria for site-specific nutrient values.

Comments regarding implementation after criteria have been developed (beyond the scope of the NCDP)

AWWA

Demonstrate use impairment – use “use assessment methodology,” when describing how to make impairment designations for instances of nutrient criteria exceedances; require further study and confirmation of actual impacts to designated uses *before* declaring a water body as impaired for nutrients. Once nutrient criteria have been exceeded, but before an impairment determination is made, the DWQ should conduct thorough site-specific analysis into whether a water body’s designated uses are impaired as well. Such an analysis would likely include measurements of the water body’s biological characteristics to verify whether the nutrient inputs are actually harming the aquatic life of the particular water body.

Assign responsibility proportionate to the source of impairment - Upon detection and validation of a water body’s trend toward impairment, the members suggest that DWQ consider non-regulatory approaches to work with proven nutrient contributors to that water body and the public. Communication of the trend with contributors and the public may assume a primary tactic in this approach. The communications should contain solid evidence of a trend toward degradation, accompanied by suggested control strategies and information on the consequences of violating a water quality standard.

Include measures to equitably hold accountable all contributors to the impairment - The principle of flexibility is a central tenet to effective nutrient management in the state’s waters. Without flexibility to tailor management solutions to the specific needs of various water bodies, significant public and private resources may be spent in an inadequate pursuit of improving water quality. Likewise, without the flexibility to conduct further studies on whether a water body meets its designated uses upon detection of elevated nutrient levels, impairment determinations would not accurately reflect conditions in the water body.

Cost-benefit analysis should overlay all nutrient management strategy decisions - One basic tenet of these management strategies should hold that the cost of implementing a particular nutrient control must be in proportion to the expected reduction in nutrient loads to the water body. Implementation strategies should also explore innovations such as nutrient trading to stimulate effective reductions of nutrient loads at the most reasonable cost. Other opportunities could include the development of a nutrient credit system that would reward nutrient contributing entities for reducing nutrient discharges to a greater extent than required.

Nutrient Sensitive Waters (NSW) classification needs to be revised – NSW classification could very well be a method of proactively addressing increasing eutrophication in water bodies. Proactively using this definition of NSW would seem to accomplish what the NCDP is trying to achieve. However in its current state, the NSW classification only impacts NPDES discharges. Specifically, GS 143-215.1 (c1)-(c6) currently prescribes automatic 5.5 mg/l and 2 mg/l limits for TN and TP, respectively, for any waters designated as NSW by the EMC. The NSW classification

would need to be improved to include an entire toolbox of methods that could be used to administer an appropriate nutrient management plan based on identification of significant sources of nutrients and the cause and effect impacts to a waterbody.

Refine the use of the word “criteria” as it can sometimes be problematic - Many equate criteria to a standard. Clarification is needed to present criteria as an “Action Level” or target level that when exceeded over some frequency and duration requires additional actions. Actions are then put in place such as elevation of monitoring activity and/or land use evaluations to further refine the issue and causative factors that are the contributors of N&P to allow site specific plans to be formulated.

Public education is important to promote basin-wide nutrient control understanding, development, and implementation of control approaches – Public education and involvement is a key to success in implementing nutrient management programs. In this, point source controls should not be imposed in the absence of a basinwide planning methodology that addresses all major sources. Basin planning efforts should evaluate the cumulative impact of sources such as treatment plants, cropland, animal operations, stormwater, forests, septic tanks (groundwater sources of nutrients) and atmospheric deposition. It is important to keep the public informed as the NCDP considers the long-term impacts of sources that discharge directly to surface water and those that load nutrients to groundwater that subsequently enter surface waters.

Utilize statistically significant sampling methods and analysis prior to designating a water body as impaired – Non-flowing waters are impacted by detention time, seasonal changes in water density (stratification), stormwater flows, and water body use. A sufficient number of samples must be performed that address each of the natural impacts to a water body to provide a statistically significant conclusion that a water body is suffering from degradation due to nutrient loading or that the water body is impaired. The NCDP should develop guidelines and procedures to develop statistically significant sampling protocols.

City of Salisbury

Where impairment occurs in impounded stream segments rather than throughout a basin, in-lake protection and remediation methods will be evaluated as alternatives to basin-wide methods for addressing impairment.

When impairment occurs in an impoundment or in a portion of an impoundment, operation and management of the impoundment must be considered in the development of methods for water quality protection and enhancement. These methods can include, for example, headwater elevation management, impoundment retention time management, water release scheduling, aeration/oxygenation, dredging, sediment capping, and other methods.

NCLM

The League suggests that the state’s “use assessment methodology,” when describing how to make impairment designations for instances of nutrient criteria exceedances, require further

study and confirmation of actual impacts to designated uses before declaring a water body as impaired for nutrients. In the case of nutrient impairments, the dedication of resources to address the impairment is simply too great not to take additional measures to confirm the impairment.

In tandem with considering the broader range of water body characteristics for criteria development, the League recommends a similar reconsideration of the designated uses of each water body type. Under the CWA, designated uses are evaluated along with criteria, or standards, when determining the impairment status of a water body. Ecological and recreational designated uses may differ between water body classifications, and they can often be in conflict. The League recommends that DWQ design an NCDP project to support a reconsideration of designated uses, including the possibility that for some water systems, competing uses may need to be prioritized to achieve an optimal water quality result.

The League recommends that DWQ extend this principle of site-specific analysis beyond criteria development to making impairment determinations. Once nutrient criteria have been exceeded, but before an impairment determination is made, the League expects DWQ to conduct thorough site-specific analysis into whether a water body's designated uses are impaired as well. Such an analysis would likely include measurements of the water body's biological characteristics to verify whether the nutrient inputs are actually harming the aquatic life of the particular water body.

While the NCDP primarily addresses water body standards and classifications, the impacts of these regulations are mostly felt from implementation plans that result from exceedances of those standards and classifications. Therefore, in this area, League members firmly believe cost-benefit analysis should overlay all nutrient management strategy decisions. One basic tenet of these management strategies should hold that the cost of implementing a particular nutrient control must be in proportion to the expected reduction in nutrient loads to the water body. Implementation strategies should also explore innovations such as nutrient trading to stimulate effective reductions of nutrient loads at the most reasonable cost.

Upon detection and validation of a water body's trend toward impairment, the League suggests that DWQ consider non-regulatory approaches to work with proven nutrient contributors to that water body and the public. Communication of the trend with contributors and the public may assume a primary tactic in this approach. The communications should contain solid evidence of a trend toward degradation, accompanied by suggested control strategies and information on the consequences of violating a water quality standard.

NCWQA

Implementation approaches should include nutrient trading and offsets. North Carolina has been a national leader in nutrient trading, which has been shown to facilitate implementation and lower overall costs (Houtven and others, 2012). As North Carolina revises the NCDP, DWQ must retain and expand options for nutrient trading and offsets. Given the high costs of nutrient controls, it is important that localities receive credit for all effective nutrient reduction

practices that can be documented. Septic system hook-ups are an example of an effective nutrient reduction practice for which North Carolina currently lacks a clear mechanism for crediting, although other states (e.g., VA, MD) in the mid-Atlantic region do provide credits for this practice. It is recommended that the NCDP identify the need for a statewide review of nutrient reduction practices and how they can be credited so that we provide incentives (rather than disincentives) for ongoing cost-effective nutrient reductions.

Implementation mechanisms should include cost-benefit analyses. As discussed at the Nutrient Forum, nutrient controls practices vary over several orders of magnitude regarding the cost-per-pound of nutrients removed. Similarly, nutrient reduction practices vary a great deal regarding ancillary benefits (stream protection, wildlife habitat, flooding reduction, aesthetics) and detriments (energy use, waste production, greenhouse gas emissions, etc.). In order to achieve the greatest environmental benefit with limited resources, holistic cost benefit analyses should be a mandatory element of basin-specific implementation mechanisms.

NRCA

Adaptive management strategies are necessary in designing nutrient management programs that achieve nutrient reductions. Ten years of implementing the Neuse Management Strategy illustrated the need to allow point and non-point source trading to meet nutrient management goals. As discussed at the May, 2012 N.C. Forum on Nutrient Over-Enrichment there are many mechanisms that can be implemented at a very low cost as opposed to major improvements at wastewater treatment facilities. Many utilities would invest in other best management practices if allowed nutrient credit for those investments and greater nutrient reductions would be achieved at a lower cost.

The plan selected by DWQ must be sustainable in terms of overall impact to the environment. Nutrient reductions at wastewater treatment facilities are not only capital intensive but have a significant impact on greenhouse emissions (energy demands), increased biosolids productions, and additional chemical costs. Non-point source reduction practices can be accomplished with less environmental cost as noted in the Nutrient Forum.