



## Lessons Learned from North Carolina Nutrient Regulation Experiences

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### Motivation for Nutrient Regulations

Incidents of impaired surface water quality like the formation of algae blooms and the occurrence of fish kills highlighted the need for the North Carolina Department of Environment and Natural Resources (NCDENR) to develop nutrient regulations. NCDENR developed load based regulations specific to each watershed with the management concept that all sources share responsibility for reducing nutrient contributions. This means that all contributors, point and non-point, were required to meet the same percent reduction for mass contributions of nitrogen (N) and phosphorus (P).



*In-stream algae growth (left) and 2012 fish kill incident (right). (Photo credit: www.ncdenr.gov)*

### Development of Nutrient Regulations

A combination of baseline studies, watershed modeling, and in some cases dilution studies were used to determine watershed nutrient reduction goals for each impaired river basin or watershed. The baseline study determined the unregulated nutrient loads discharged to a watershed. Next, the watershed was modeled or empirical data was used to establish acceptable total nitrogen (TN) and/or total phosphorous (TP) loads to a watershed based on Chlorophyll A formation. The resulting information was used to calculate the necessary percent reduction for each watershed based on the baseline load and the determined acceptable load.

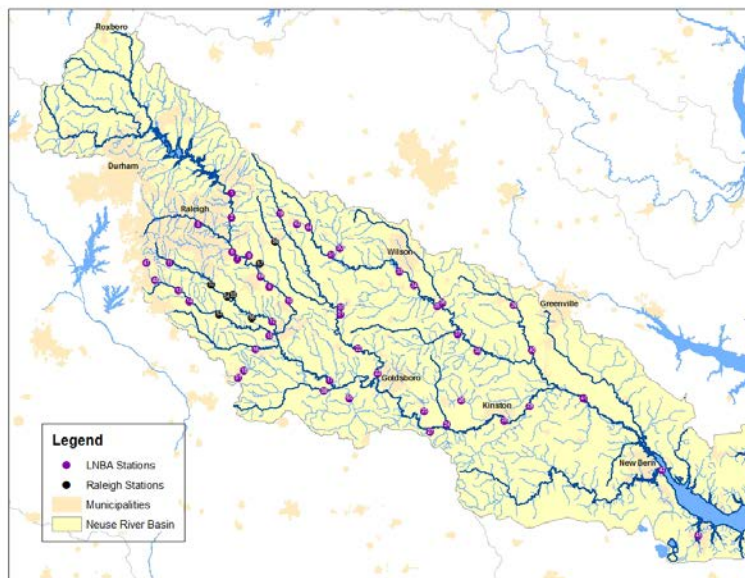
Permits were issued to WWTFs (Wastewater Treatment Facilities) for TN and/or TP based on the maximum permitted discharge volume at the time of the baseline study. For most watersheds, modeling indicated that a TN reduction of approximately 30% was necessary. In the Neuse River Basin limited benefit was projected for reduction of TP, but other river basins and watersheds had a range of necessary TP reduction. Non-point sources are required to meet the same percent reduction as determined for point sources, but do not have the same sampling or reporting requirements. Point source sampling requirements are permitted specifically for each discharge permit. TN and TP concentrations are not regulated except in the Neuse River Estuary where maximum TP concentration of 2 mg/L is permitted. Many point sources frequently operate below the maximum permitted flow and therefore can have higher concentrations of TN and/or TP when operating below permitted capacity. For example, a facility may be permitted for equivalent of 4 mg/L TN at 4 MGD but if operating at 2MGD the actual discharge could be 8 mg/L TN. A summary of the regulated TN and TP levels is provided in the table below.

Watershed Nutrient Reduction Goals (Table credit: [www.lnba.net](http://www.lnba.net))

Nutrient Strategy	Nutrient Reduction Goal (Nitrogen (N), Phosphorus (P))	Baseline Year
Neuse Basin	30% N	1991-1995
Tar-Pamlico Basin	30% N No increase in P	1991
Jordan Lake Watershed -Upper New Hope -Lower New Hope -Haw	35%, N, 5% P No Increase N & P 8% N, 5% P	1997-2001
Falls Lake Watershed	40% N 77% P	2006

**Basin Associations and a Shared Approach to Compliance**

The implementation of load based regulations has resulted in the formation of basin associations that share responsibility for monitoring and compliance. NCDENR allows the members of a watershed association to submit compliance reports as a group showing that the TN/TP load of the group meets the combined groups permitted value. One example of this is in the Neuse River Basin where the Lower Neuse Basin Association (LNBA) and the Neuse River Compliance Association (NRCA) have formed. LNBA is a monitoring program to handle the required sampling for participating members. NRCA is responsible for group permit compliance and submits the combined annual load levels for the participating members as a group. If the association is compliant, then all participating members are deemed in compliance. An individual facility can be out of compliance as long as the association is in compliance. Most permitted point sources participate in these associations but it is not operated by the state and a permitted facility is not required to participate in an association.



Lower Neuse Basin Association Monitoring Locations. (Photo credit: [www.lnba.net](http://www.lnba.net))



## **Potential for Nutrient Management Strategies**

Load based regulations require that the total permitted load to a river basin or watershed will not increase for any reason including: WWTF expansion or new discharge sources as a result of population growth or development. This means implementation of alternative approaches including improved nutrient removal technologies or nutrient trading must be utilized to adapt to population growth or development. Basin associations provide a way to identify and incentivize implementation of nutrient removal technologies that would most efficiently benefit the group or can facilitate nutrient trading or leasing between point sources. For example, in 2013 the NRCA leased 1000 pounds of nitrogen to a point source requiring increased nutrient discharge capacity. The revenue can be used to fund things like sampling, reporting or treatment improvements for the participating members.

Additionally, load based regulations incentivizes other nutrient load reduction strategies by providing a load reduction credit for implementation. WWTFs can gain credit by implementation of non-point source BMP's therefore increasing the allowable point source nutrient load at the facility; however, when WWTFs have reviewed this option, it is found to be expensive and uncertain and it has not been used. Similarly, water reuse of WWTF effluent receives a nutrient load reduction credit based on volume of water utilized. Some facilities, like North Cary Water Reclamation Facility, developed a water reuse program as a water conservation effort and also receive credit for nutrient load reduction; however, there are additional operational considerations and costs associated with implementation of WWTF effluent water reuse.



*North Cary Water Reclamation Facility achieves nutrient removal with a Kreuger Bio-Denitro Process (oxidation ditch w/BNR) and receives nutrient credit for effluent water reuse. (Photo credit: www.lnba.net)*

## **Results from Nutrient Regulation**

The development of nutrient regulations has effectively reduced nutrient loads from point sources by more than 50% of baseline values in the Neuse and Tar-Pamlico River Basins. Additionally, some associations like the Neuse River Basin are discharging half of the permitted nutrient load. There has been a notable decrease in stream nitrate concentrations, indicating reduction from point source (i.e. WWTF) contributions. However, there has not been a notable change in the trend for total nitrogen (primarily organic) in the river basins or watersheds and incidents like algae blooms and fish kill are still a potential concern.

## **Summary of Lessons Learned**

There are some potential lessons that could be incorporated into the concentration based nutrient regulations implemented in Colorado. North Carolina has shown that load based regulations have significantly reduced discharge of nutrients from point sources, incentivizes alternative strategies like water reuse and nutrient leasing/trading, and has resulted in a collaborative approach with the formation of associations that collaborate on management efforts and group compliance. This approach can help to reduce the burden on the smaller facilities and optimize the implementation of nutrient management practices. This would require river basin and watershed specific modeling to determine the baseline and acceptable load levels. This effort may be difficult in Colorado depending on the sensitivity of the watershed. The potential benefits are that a shared responsibility encourages collaboration and incentivizes the implementation of improved nutrient removal strategies. This approach has proven to be very effective in North Carolina.