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ROBESON CREEK: A CASE STUDY IN TMDL IMPLEMENTATION PLAN DEVELOPMENT

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ABSTRACT

Robeson Creek, located in Chatham County, North Carolina, is a 303 (d) listed stream due to chlorophyll *a* violations and impaired biological communities. Pollutants associated with the chlorophyll *a* violations are nutrient inputs from point and nonpoint sources within the watershed. The North Carolina Division of Water Quality (DWQ) began monitoring water quality of Robeson Creek and its tributaries in December 2000. DWQ has developed a Total Maximum Daily Load (TMDL) for total phosphorus in this watershed. North Carolina State University (NCSU) in coordination with DWQ, the Robeson Creek Technical Advisory Committee and other stakeholders in the watershed has developed a TMDL implementation plan to address nonpoint sources of phosphorous in the Robeson Creek watershed. As part of the implementation plan, NCSU performed a watershed assessment to refine identification of pollutant types and sources as well as critical areas for implementing Best Management Practices (BMP's) at the subwatershed level.

This paper will present an overview of the development process used for the TMDL implementation plan for the Robeson Creek Watershed.

KEYWORDS. Total Maximum Daily Load, TMDL, TMDL Implementation Plan, Watershed Assessment.

INTRODUCTION

Section 303(d) of the Clean Water Act (CWA) requires that a Total Maximum Daily Load (TMDL) be developed for each of the waters appearing on Part I of the 303 (d) list. The intent of the TMDL is to establish a maximum rate at which streams can receive certain pollutants without exceeding established water quality standards. Robeson Creek, located in central North Carolina, is a 303(d) listed stream for chlorophyll *a* violations. This creek's 28.6 square mile watershed serves as a water supply source to Jordan Lake, a major water supplier to the Triangle Area of North Carolina. Although Robeson Creek is classified as a water supply watershed (WS-IV), nutrient sensitive (NSW), and a class C waterbody, the creek is rated as Partially Supporting with chlorophyll *a* violations and habitat degradation in the lower stream segment in and above its confluence with the Haw River arm of Jordan Lake, and Partially Supporting in the upper segment with impaired biological communities throughout most of the stream reach.

The TMDL target for Robeson Creek is based on the frequency of algal blooms in the Robeson Creek Cove with Total Phosphorus (TP) being the limiting nutrient. Sources of impairment include both point and nonpoint sources, including wastewater treatment plan effluent, urban development, stormwater runoff, and select agricultural practices. The NC Department of Environment and Natural Resources Division of Water Quality (DWQ) issued a draft TMDL for TP in Robeson Creek in June 2003 to address the chlorophyll *a* violations and restore designated uses to the creek. The report can be viewed online at http://h2o.enr.state.nc.us/tmdl/RobersonTMDL_PublicReviewDraft.pdf.

As part of the TMDL development process, DWQ monitored water quality of Robeson Creek and two of its tributaries, Turkey Creek and Camp Creek, from December 2000 to August 2002. Concurrently, DWQ granted EPA Section 319 funding to the North Carolina State University (NCSU) to perform a watershed assessment for Robeson Creek and develop a TMDL implementation plan to address meeting NPS load allocations for TP. In developing the implementation plan, NCSU: 1) facilitated the formation of the Robeson Creek Technical Advisory Committee; 2) continued water quality monitoring of DWQ monitoring sites and additional sites to refine potential pollutant sources; 3) performed a field-verified land use survey to assist with the TMDL as well as TMDL implementation plan; 4) performed a streambank and riparian area assessment of select sub-watersheds to refine potential pollutant sources.

ROBESON CREEK TECHNICAL ADVISORY COMMITTEE

Robeson Creek Technical Advisory Committee (RCTAC) was formed in June 2002 to assist in the development of the watershed assessment and TMDL implementation plan. Members included representatives from NCSU, DWQ, Natural Resources Conservation Service, Cooperative Extension Service, Chatham County Soil and Water Conservation District, Farm Service Agency, Town of Pittsboro, Chatham County, Townsend's Food, and Haw River Assembly. Committee meetings were held every 2 to 3 months to assess project progress and discuss relevant issues.

A major role RCTAC played during the development of the implementation plan was education. Over a period of one year, members met with business owners, farmers, and other landowners within the Robeson Creek watershed to discuss water quality issues. RCTAC also published a newsletter in April 2003 and mailed it to all the landowners within the watershed. The newsletter contained information regarding the TMDL, watershed assessment, and a stream steward campaign initiated by Haw River Assembly.

RCTAC hosted a public workshop in May 2003 for landowners and other stakeholders to introduce them to RCTAC and answer questions regarding water quality concerns within the Robeson Creek watershed. Public turnout was low for this workshop, however questions and concerns were raised and dialogue was informative. DWQ held a public workshop in July 2003 for the release of the TMDL. Turnout was slightly better and included representatives from the local governments. RCTAC will continue to facilitate public forums and educational campaigns during the implementation phase of the TMDL. The group will expand to include more stakeholders as BMP sites are located and BMP's installed.

WATER QUALITY MONITORING

In September, 2002, the NCSU Water Quality Group began a monitoring program in Robeson Creek. This program included establishing 8 stream monitoring sites in the watershed. Two of the sites are on Robeson Creek and serve to document water quality conditions upstream and downstream of most pollutant sources. Monitoring sites on 3 of the major tributaries (Turkey Creek, Camp Creek, and Little Creek) were also established. Monthly grab sampling has been conducted at all 8 sites since the start of monitoring. Samples were analyzed for total Kjeldahl nitrogen (TKN), nitrate nitrogen (NO₃-N), ammonia nitrogen (NH₃-N), total phosphorus (TP), dissolved phosphorus (OP), and total suspended solids (TSS) using standard methods. To date, continuous monitoring using automated samplers has only been established at 6 sites due to difficulties in obtaining landowners' permission and a delay for equipment procurement. Analyses of pollutant sources computed from only grab samples are often a poor approximation of total loading for some pollutants (Line et al., 1998), especially where nonpoint sources are present as in Robeson Creek. Therefore, a combination of monthly grab samples and storm samples were used along with nearly continuous discharge measurements to compute total loading from three of the sites with automated samplers.

Whereas DWQ only collected grab samples, the additional information collected from storm samples by NCSU is allowing for a better estimation of pollutant loading. As more data are collected and analyzed, the pollutant sources will be further refined. This will be of great importance in determining BMP locations throughout the watershed. With the assistance of a second grant, NCSU will continue monitoring this watershed in order to determine if BMP's are working to reduce TP inputs.

LAND USE SURVEY

During the fall and winter of 2002, NCSU performed a land use reconnaissance of the Robeson Creek watershed. Using 1997 orthophotos provided by Chatham County as base maps, NCSU personnel visually examined most of the land uses in the area either through a windshield survey or by walking into parcels. Areas that were not accessible by vehicle or foot were verified either by land owner contacts or conversations with NRCS and Cooperative Extension personnel. Land uses were demarcated on the base maps and then translated into Geographic Information System (GIS) format. From the GIS data, analysis was performed on various land uses throughout the watershed. The data collected were used to assist in the development of the TMDL as well as the implementation plan.

NCSU concluded that this is a mostly rural and forested watershed with a small urban component. Approximately 73 percent of the land is forested, with the rest of the land divided between agricultural and urban uses. During this survey, several tracts of land were actively being logged. It was noted that many of the forestry logging operations could be improved, especially where runoff and sedimentation problems occurred. Although this is not a major agricultural watershed, some small farms with livestock were recorded. Opportunities for BMP's exist within these areas, especially where livestock are currently not fenced out of creeks. The Town of Pittsboro lies wholly within the center of this watershed. In town, the majority of roads are bounded by curb and gutter which allows stormwater to flow directly to the creeks. Further noted were residential lawns that abutted creeks with little or no buffers.

Townsend's Foods, Inc. owns and operates a poultry processing facility within the watershed. A 16-acre waste lagoon provides an irrigation source that is sprayed onto approximately 150 acres of spray fields. Water quality violations have occurred in the past as runoff from these fields has contaminated surface waters. Although DWQ monitors these operations closely, field reconnaissance from the land use survey revealed areas for improvement and possible installation of BMP's. Another documented pollutant source is the Town of Pittsboro Waste Water Treatment Plant. Effluent is piped directly to Robeson Creek. DWQ has found this to be a major source of TP and will be working with the town to remedy the problem.

STREAMBANK AND RIPARIAN AREA ASSESSMENT

As part of the watershed assessment conducted by NCSU to support development of the TMDL implementation plan, a streambank and riparian area assessment was performed for two subwatersheds of Robeson Creek. Little Creek was chosen to represent an urban subwatershed and Camp Creek was selected as a rural subwatershed. The streambank assessment portion of the study included determination of the bank erodibility hazard index (BEHI) and Bank Height Ratio (BHR) to assess the impacts of streambank erosion on the watershed (Rosgen, 1996). Eroding streambanks are a major contributor of sediment to waterbodies across the state. This sediment may carry attached phosphorous as well. For this reason, determining areas to target for streambank restoration and/or channel stabilization may help to meet various goals within the Robeson Creek watershed. Other components of this study included assessing the riparian condition of the stream reaches in terms of buffer density, width, composition, and maturity. A healthy riparian buffer is a vital component of a stable stream. The presence of in-stream habitat was also assessed, as well as any notable alterations that have occurred historically. The reaches were approximately 500 feet in length, and a cross section survey was performed at each one to verify bankfull estimations. The information gathered in this study was analyzed to highlight

tributaries and reaches that are in need of restoration and/or stabilization. GIS was used to graphically depict the condition of the reaches. The goal of the assessment was to more effectively target locations for future restoration, which will reduce sediment due to streambank erosion and improve habitat.

CONCLUSION

Robeson Creek watershed is a relatively small impaired watershed within central North Carolina, yet represents a diversity of water quality issues. During the development of the TMDL implementation plan, NCSU with assistance from other stakeholders was able to locate and quantify many of the problems pertaining to water quality throughout the watershed. The formation of RCTAC allowed technical expertise of local agencies to assist in identifying pollutant sources and develop educational programs to help improve these issues. Water quality monitoring continues to pinpoint areas of pollutant loading and will help to determine whether or not implementation of BMP's is working. A land use survey allowed NCSU to investigate the watershed and quantify land uses for use in the TMDL and implementation plan. Finally, the streambank and riparian area assessment has helped to locate more areas for BMP installation and water quality improvement. All of these processes aided in the formation of the TMDL implementation plan for Robeson Creek. The future challenge is implementing this plan and working with stakeholders to remove this creek from the impaired waters list.

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