USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

RESEARCH PROPOSAL

1. Project Title: EUTROPHICATION IN THE TAR-PAMLICO AND NEUSE RIVER

2. Focus Categories: WQL, NU, SW

3. Keywords: Water Quality, Nutrient Loading, Eutrophication, Estuarine Ecosystems, Algae, Land Use, Nitrogen, Historical Trends.

4. Duration: August 1, 1998 to July 31, 1999

5. Federal Funds: $66,492

6. Non-Federal: $132,987

7. Principal Investigator: (1) Drs. Hans W. Paerl, James L. Pinckney, and

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North Carolina - Water Resources Research Institute

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8. Congressional District: First, Second, and Sixth

9. Statement of Critical Regional Water Problem:. For several decades eutrophication has been one of the most important water quality issues for our nation's estuaries. Many citizens, elected officials, and scientists believe that many estuaries are more eutrophic now than they were several years or decades ago. However, previous studies of historical trends in nutrient concentrations, dissolved oxygen and chlorophyll *a* in some estuaries, including the Tar-Pamlico and Neuse Rivers in North Carolina, do not provide strong support for this hypothesis. Because there are significant contradictions between results

of the statistical trend analyses and our perceptions of the history of trophic status of the estuaries, it would seem prudent to continue to examine the accumulating data. Failure to understand whether or not changes are taking place will lead to two serious problems: (1) scientists will formulate and test hypotheses about eutrophication based on misinformation, and (2) legislators and regulatory agencies will have inadequate information upon which to base decisions about implementation of nutrient reduction strategies and to assess the success of those strategies.

There are many recent concerns about water quality in North Carolina estuaries (including the Tar-Pamlico River estuary and the Neuse River estuary). The combined drainage area of the Pamlico and Neuse River systems is over 25,000 square kilometers. Algal blooms, toxic algae, eutrophication, low oxygen, shellfish bed closure, decline of submerged aquatic vegetation, and fish kills are just some of the issues. Many of these problems are related, and have not been historically monitored in these systems. The history of algal communities, especially toxic algae, are of particular interest in relation to fish kills and human health concerns in these estuaries, as well as other coastal systems. The proposed research will build on previous work quantifying the degree of anthropogenic disturbance in the estuaries of the Pamlico and Neuse Rivers by providing evidence of changes in abundance and productivity of different algal groups, including toxic algae and other biological and chemical parameters back through time and in relation to specific events.

The University of North Carolina Water Resources Research Institute Advisory Committee recognized this need when they established a set of eleven priority topics for Institute-supported research for the Fiscal Year 1999. The fifth-ranked priority in the list of eleven topics is "Historical trends in nutrients, pollution control, and population growth in North Carolina since the 1950s to identify water quality trends and relationships as a tool for determining cause and effect for problems of today." The research outlined below is intended to address this priority North Carolina topic, as well as the USGS Southeastern/Island Region "Water Quality" priority area.

10. Statement of Results, Benefits and/or Information:

The proposed research will help address specific questions raised about water quality trends through time and provide insights into the effects of nitrogen loading reductions on the algal community in these estuaries. The first component will investigate the effect of a proposed 30% nitrogen reduction on the present phytoplankton community, an evaluation of the N_2 fixing potential and rates under reduced N-loading, baseline data for monitoring the effectiveness of N-loading reductions, and identification of other factors that may have to be managed to achieve the desired level of algal productivity and water quality in these estuaries. The second component will assess trophic status changes in the Tar-Pamlico and Neuse River estuaries during the period 1950-1998. The assessment will be based on three measures including: watershed nutrient production, nutrient loading to the estuaries, and riverine and estuarine water quality. The third component will characterize the environmental conditions (including anoxia), water quality, and algal communities of the Pamlico and Neuse River estuaries as they existed prior to

anthropogenic influences, and through time as land use in the watersheds of these systems has evolved with growing populations and industries.

Several groups (including these investigators and multidisciplinary teams at USGS-Raleigh Office, N.C. State Division of Water Quality, N.C. State University, and UNC-Chapel Hill) are currently developing two- and three-dimensional water quality models for the Neuse River Estuary. One of the "data gaps" for this effort is the lack of quantitative information on the relationship between historical hydrodynamic conditions, nutrient loading/concentrations, and phytoplankton community composition and responses. Additionally, the models lack sufficient data on the role of microbially mediated denitrification in N-cycling in the Neuse River Estuary. This proposed research will provide critical data necessary for model parameterization, development, and simulation.