NC DEQ REQUEST FOR PROPOSAL:
Development of Neuse River Basin Watershed Model

The North Carolina Department of Environmental Quality's Division of Water Resources (DWR) is seeking a qualified consultant to develop a watershed model for the Neuse River Basin to determine transport zones and delivery factors for point source discharges and nutrient offset credits, as required by SL 2020-18 Section 15.(c).

The model will support the Department's adaptive management efforts to protect and restore the Neuse River Estuary. Potential regulatory changes to be enabled by the model may include refinement of nutrient permit limits, incorporation of nonpoint source delivery factors to make nutrient trading more scientifically defensible, and evaluation of new nutrient reduction opportunities from a range of watershed sources.

Proposal Submittal Requirements

Provide an electronic copy of your submittal containing the following:

1. Letter of interest - including a synopsis of the primary and sub-consultants, the team's qualifications, the project manager and primary contact, and the project principal representing the contractual authority of the candidate.
2. Project Organization – a chart illustrating the team composition and roles. Identify key staff, their roles and expected level of commitment on the project.
3. Profile of Team – for each member of the proposed team, identify capabilities and experience, number of employees, location, years in business, and scope of services for this project.
4. Project Approach and Schedule – description of the proposed approach. Include a brief response to the preliminary scope, identifying key challenges and anticipated steps. A preliminary schedule with tasks, milestones and deliverables including meetings with the Division and stakeholders.
5. Reference Projects – Identify recent projects performed by the team with comparable scope and complexity, at least two of which should be completed. For each project, provide references, estimated and completed budgets, and years in which the project was performed.
6. Statement of Conflict of Interest – Please certify that the team does not foresee any potential conflicts of interest with any entity involved with the project. If a conflict of interest arises, it shall be disclosed immediately to DWR.

Schedule

DWR intends to select a consultant by March 1, 2021 and give approval to proceed with the modeling plan by May 1, 2021, and will seek delivery of completed products by June 1, 2023.

If interested, please submit your Proposal meeting these requirements by email no later than 5 pm on January 15, 2021 to:

Pamela Behm
DWR Modeling and Assessment Branch
Pamela.behm@ncdenr.gov

NEUSE River Basin WATERSHED MODEL – Preliminary Scope

Part I: Background

Project Goals and Objectives

Coastal nutrient pollution results in algal blooms, fish kills, and impacts to the coastal economy associated with recreation-based activities, commercial and recreational fisheries, and real estate. The Neuse Nutrient Strategy, implemented in 1997, addresses this problem by regulating major sources of nutrient pollution throughout the Neuse River Basin including wastewater, urban stormwater, and agriculture. While the strategy has succeeded in part by stemming additional nutrient loading during a time of rapid population growth, the Neuse Estuary remains impaired.

The Neuse Nutrient Strategy is not supported by a calibrated watershed model, a standard tool for the development and evaluation of more modern nutrient strategies. A watershed model informs regulatory development and management decisions in many important ways, including a refined understanding of the influence of geography or various regulatory sectors on estuarine algal blooms. This project would finance a contractor with oversight and support by DWR to develop a watershed model that meets agency standards for regulatory use and support in the Neuse River Basin. The model will be a core product relied upon by DWR staff, stakeholders, and the Environmental Management Commission in their continual refinement of the Neuse Nutrient Strategy rules.

Environmental Need and Economic Project Benefits

This project will support long overdue regulatory innovation that can drive systemic water quality improvements in the Neuse River Estuary. Recreation, property enhancement, recreational and commercial fishing, and greenways are some of the benefits of nutrient management. Excessive nutrient inputs can have many negative influences on the estuarine ecosystem and the communities that benefit from them. Conversely, these ecosystems and communities realize benefits from the management of nutrient inputs.

A watershed model is a critical scientific tool in structuring regulatory programs to achieve these broad-based environmental benefits, and several regulatory challenges or initiatives would be well-informed by the development of a watershed model. Conversely, the lack of a watershed model will continue to hamper science-based efforts to improve the efficacy of the Neuse Nutrient Strategy. The Phase II TMDL, published in 2001, identified a specific need for watershed modeling. Specific regulatory challenges that might be addressed by the watershed model are addressed herein.

Delivery and Transport Factors

As directed by SL 2020-18, the priority of this effort is to determine transport zones and delivery factors for point source discharges and nutrient offset credits. Transport zones and delivery factors are key factors considered in the implementation of nutrient management strategies, but the transport factors used for wastewater permitting purposes are highly uncertain in the Neuse River Estuary. Current transport factors have tenuous scientific support and are based on the original 1999 Neuse Phase I TMDL, which separates nutrient delivery for wastewater sources into four coarse zones of 10, 50, 70, and 100% delivery rates. The 2001 Phase II TMDL incorporated many refinements based on estuary modeling while also refining the formula used to calculate transport factors for wastewater. A comparison of Phase I (currently used) and Phase II transport factors suggests that Phase 1 (current)

transport factors are almost uniformly too low and thus likely underestimate wastewater nutrient loading to the estuary from wastewater sources, as shown in Table 1 below. While the Phase II transport estimates were supported by additional scientific research not available in Phase I, the Phase II document also expressed clear reservations about implementing these new transport zones (Phase II TMDL at page 44). Therefore, a calibrated and validated watershed model will be necessary to rigorously estimate the proportion of end-of-pipe nutrient loading from wastewater sources that reach the Neuse River Estuary.

Table 1: Comparison of Transport Factors for Select Major Wastewater Facilities, Phase I vs. Phase II Neuse River Estuary TMDL

Permit	Permittee	Ph.I TFs	Ph. II TFs	Difference
NC0064050	APEX, TOWN-WWTP/MIDDLE CREEK	50%	56%	6%
NC0066516	FUQUAY-VARINA	50%	65%	15%
NC0065102	CARY-SOUTH WWTP, TOWN OF	50%	68%	18%
NC0025453	CLAYTON WWTP, TOWN OF	50%	72%	22%
NC0029033	RALEIGH, CITY-NEUSE RIVER WWTP	50%	88%	38%
NC0030716	CENTRAL JOHNSTON COUNTY WWTP	50%	90%	40%
NC0023906	WILSON WWTP, TOWN OF	50%	100%	50%
NC0023949	GOLDSBORO WWTP, CITY OF	70%	91%	21%
NC0024236	KINSTON-NORTHSIDE WWTP	70%	95%	25%
NC0003191	WEYERHAEUSER, NEW BERN*	100%	76%	-24%
NC0025348	NEW BERN WWTP, CITY OF	100%	100%	0%
NC0003816	US MCAS CHERRY POINT	100%	100%	0%

Having a fully calibrated watershed model will allow the Division to make permitting decisions in a timely manner and will allow newly permitted wastewater flows to be accurately accounted for in the nutrient strategy.

Transport factors also play a key role in the availability and cost of nutrient trades. Trading of nitrogen allocation between wastewater facilities is done in terms of estuary loading (end-of-pipe loading multiplied by the transport factor). When allocation is traded from downstream to upstream facilities, potential nutrient increases to the estuary will likely result due to the consistent underestimate of current transport factors. Where nutrient allocation for wastewater facilities is scarce, projected expansions potentially require the trade of allocation or nutrient offset credits valued in millions of dollars. Moreover, resulting wastewater expansions may contribute tens of thousands of additional nitrogen pounds to the estuary each year. Given the scale and cost of these potential nutrient trades and their importance to communities seeking to accommodate growth, it is critically important that transport factors be based on best available science.

Estimation of Nonpoint Source Loads

A watershed model provides a rigorous and unbiased approach to estimating relative nutrient contributions from the vast array of nonpoint nutrient sources throughout the basin. The current Neuse nutrient strategy seeks to reduce nonpoint source nutrients from cropland agriculture and new development while providing important protection through the preservation of riparian buffers. This approach has undoubtedly led to better environmental outcomes than what would have occurred without regulatory intervention. However, a watershed model is likely to identify other nonpoint nutrient sources and their relative impacts on nutrient loading to the Neuse Estuary. For example, the

Neuse nutrient strategy does not directly address nutrient runoff from existing development or transportation infrastructure.

A watershed model provides a rigorous and unbiased approach to estimating nutrient loads and the relative nutrient contributions from the vast array of nonpoint nutrient sources throughout the basin. A watershed model will potentially also provide insights about sources of increased organic nitrogen being delivered to the Neuse estuary. While the Neuse nutrient strategy has successfully reduced inorganic nitrogen contributions to the estuary, the amount of total nitrogen remains similar due in large part to offsetting organic nitrogen increases. The source, or more likely multiples sources, of that increasing organic nitrogen trend is uncertain and has led to many hypotheses from agency personnel and stakeholders alike.

Part 2: Project Description and Technical Specifications

Project Narrative

Project proposals to complete a Neuse River Basin watershed model will need to include the following four major sequential tasks and associated subtasks. All tasks will require meetings and public engagement support.

Task 1: Compile and pre-process data and information to support model development

Subtask 1.1: Quality Assurance Program Plan (QAPP)

With DWR oversight and guidance, the contractor will develop a Quality Assurance Program Plan (QAPP) to guide model development. The QAPP will be developed in accordance with existing DWR guidance. Examples of information contained in a complete QAPP include (but are not limited to): modeling team roles and responsibilities, principal study questions, approaches for supporting data acquisition and management, a description of the model selection procedure and resulting model selected for this project, a depiction of how the selected model represents nutrient sources, fate and transport, time periods to be used for calibration and validation, model performance criteria and targets, description of methods to be used for delivery factor determination by source, and a description of model uncertainty evaluation.

Subtask 1.2: Data Assembly

With DWR oversight and assistance, the contractor will compile all data necessary for model development in coordination with the Neuse River Basin Association, the United States Geological Survey, the NC Department of Transportation, and other organizations maintaining relevant watershed data.

The spatial scale for this effort is the Neuse River Basin beginning below the Falls Lake dam and extending down to the estuary. The Falls Lake watershed is excluded from explicit modeling in this effort to avoid unnecessary duplication of existing efforts by the Upper Neuse River Basin Association to model this watershed. [Note this does not mean that dischargers to the Falls Lake watershed will not be excluded from the development of estuary delivery factors, but that delivery will be inferred based on the modeling efforts by the UNRBA as well as this watershed model.] The timeframe for the modeling should be selected based on the purposes of the project, incorporate a wide range of meteorological conditions, and consider the availability of data and resources. DWR's preferred modeling timeframe is 2002-2019.

Data inputs will include physical characteristics of the watershed like land use, land cover, topography, soils, hydraulic characteristic of streams/rivers, and hydrology. Also necessary are data sets associated with flow, water quality, atmospheric deposition, and weather. Nutrient source inputs will need to be characterized using best available information including point source discharges, stormwater, septic tank distributions, and agricultural operations. Data will be compiled in a consistent format. As necessary, readily available information will be used to develop assumptions about nutrient sources and features.

The involvement of stakeholders from the Neuse River Basin to include the Neuse River Basin Association, the United States Geological Survey, NC Department of Agriculture, NC Department of Transportation, and other organizations will be key to successful model development. Stakeholders will have the opportunity to provide data and provide confirmation that individual sources are represented in the model correctly.

Task 1 Deliverables:

1. Quality Assurance Project Plan
2. Database containing the collective data set and initial data analysis for model parameterization to include GIS datasets, flow and water quality input datasets, and nutrient source input datasets (Point sources and nonpoint sources)
3. Technical memoranda documenting development of input datasets, including justification for final composition of land cover dataset, and summarizing QA/QC approaches
4. Up to two public meetings with DWR and stakeholders

Task 2: Develop a watershed model of the Neuse River Basin

Subtask 2.1: Model establishment and calibration

The selected watershed model will be constructed to account for all sources of nutrients in the basin to the extent practicable. The selected model should have the ability to run at least in a daily time step and represent different forms of nutrients including nitrate + nitrite (NO2/3), ammonia (NH4), organic nitrogen (ON), orthophosphate (PO4) and organic phosphate (OP), and should represent time varying dynamic systems.

Model configuration will consist of developing model segments, model reaches, and hydrologic response units. Model parameters like land use, soil, and slope will be assigned to each hydrologic response unit. Model calibration will proceed through maximization of model fit as defined in the QAPP across multiple monitoring locations. Model calibration involves the adjustment of model parameters to achieve a best fit between model predictions and field observations. After construction of the selected model is complete, a model configuration memorandum will be drafted.

Subtask 2.2: Evaluation of model performance

An evaluation of model performance in relation to management objectives will be conducted to ensure suitability for intended management uses. Model fit will be expressed in qualitative terms like “very good,” “good,” “fair,” or “poor” in relation to model performance for comparable projects. Some of the specific parameters upon which this evaluation will be conducted include percent difference between simulated and recorded flow and water quality parameters, relative absolute and root mean square error, and the coefficient of determination (R^2) between simulated and observed data.

Subtask 2.3: Interpretation of modeling results

Modeling results will be interpreted by the contractor to support key management questions identified in the QAPP. Interpretation of results will be subject to model and data limitations as well as the assumptions underlying the model. Key topics for interpretation include delivery and transport of nutrients to the Neuse River estuary, loading from existing developed jurisdictions in the Neuse River Basin, and recommendations for future monitoring adjustments.

Task 2 Deliverables:

1. Model configuration memorandum
2. Model calibration report
3. Electronic version of the model, model input/output, as well as model pre-processors and model post-processors
4. Model training sessions for DWR staff and model support after the contract is completed
5. A minimum of two meetings with DWR and stakeholders during Task 2
6. Training for staff and interested parties about the model

Task 3: Apply Model to Establish Load Estimates

To the extent supported by available data, apply the Neuse watershed model to conduct loading scenario analyses for the modeled time period. Loading estimates shall be partitioned by transport zones, by subwatershed, by regulatory sector, and by political jurisdictions, to the extent practicable. Delivery factors will also be provided for the smallest feasible hydrologic units, at modeled subwatershed scale, for use in permitting and trading. Delivery zones may be consolidated in response to agency or stakeholder input to facilitate implementation.

Task 3 Deliverables:

1. Summary table of source and delivered annual mass loads for different land covers broken out by subwatershed, jurisdiction, and sources (point and nonpoint sources in the watershed)
2. Up to two meetings with DWR and stakeholders during task 3

Task 4: Deliver Model and Documentation for Peer Review

Technical memorandums and results from prior tasks will be combined into a preliminary draft report for DWR review. Following DWR review, a subsequent draft report that incorporates DWR comments will be required. The report will include the model description, inputs and outputs; model assessment and interpretation, model assumption and uncertainty, discussion of future model uses including appropriate uses, users, and adaptation; and the relationship of the model to load reduction accounting methods. Note that contractor support following model completion to include peer review and contractor response is not included in this scope of work, however DWR expects to seek follow-on funding upon completion to provide for these components.

Task 4 Deliverables:

1. Preliminary draft model report for DWR review
2. Draft model report and modeling files, including all electronic model input files necessary to run model and confirm outputs

Part 3: Available Funding and DWR Roles

DWR announces the availability of $300,000 in funding to support this project. As noted above, the DWR will seek follow-on funding to support a peer review process and post modeling technical support.

The DWR's Modeling and Assessment Branch will serve as the contract managers and provide technical support for this project. As mentioned above, this will include gathering relevant data, and providing feedback and review throughout the process.

DWR's Nonpoint Source Planning Branch will provide primary stakeholder engagement support. This will include hosting or attending public meetings to inform the regulated community about the purposes of this modeling effort, to coordinate the collection of relevant data, and to seek and apply input regarding the development of the model and application of the model's results.

Other DWR sections and programs will provide consultations in their areas of expertise in areas as broad ranging as contract administration, water quality data extraction, and NPDES permitting.