EVALUATING THE ECOSYSTEM SERVICE OF NUTRIENT REMOVAL IN A COASTAL WATERSHED: A CASE STUDY OF NEW HAMPSHIRE’S GREAT BAY

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INTRODUCTION

New Hampshire’s Great Bay Estuary (GBE), valued as one of 28 “estuaries of national significance,” provides a host of economic, social, and environmental services that are threatened by the deterioration of water quality and increased levels of nitrogen (PREP, 2013). The United States Environmental Protection Agency has issued several National Pollutant Discharge Elimination System (NPDES) permits to local wastewater treatment plants that mandate the reduction of point source pollution to the limits of technology. In order to meet the new NPDES permits’ nitrogen effluent limits of 3 mg N/L standard, the aging built infrastructure must be updated, and the combined capital costs are estimated to be about 354 million dollars (DES, 2010; Kessler, 2010). Alternatives, such as land conservation, behavior changes, and natural infrastructure, provide ways of reducing nitrogen sources from stormwater runoff or nonpoint source pollution. These alternatives represent the ecosystem service of nutrient retention and can be modeled at the watershed scale.

MODEL COMPARISON: WATERSHED PERSPECTIVE ON NITROGEN LOADING

The Natural Capital Project’s inVEST (Integrated Valuation of Environmental Services and Tradeoffs) model is a free product of the Natural Capital Project, a collaboration between Stanford University, The Nature Conservancy, World Wildlife Fund, and the University of Minnesota. inVEST’s Water Purification tool evaluates nutrient retention using several spatial data inputs. The University of New Hampshire’s Water Systems Analysis Group also has a model focused on nitrogen processing -- FrAMES (Framework for Aquatic Modeling of the Earth System).

We wanted to see how the two models compare.

AVOITED COST ANALYSIS

By comparing the outputs from the models with the NPDES permits, we can use the scenarios to calculate potential cost savings of reducing nitrogen from nonpoint sources.

We anticipate that an alternative management plan would allow the Great Bay municipalities to avoid part of the proposed cost associated with 3 mg N/L by reducing the non-point source pollution load.

PRELIMINARY RESULTS

Rogers et al. (2014) in collaboration with the Piscataqua Region Estuaries Partnership (PREP) conducted a survey to “quantify the level of citizen awareness of water quality issues” throughout New Hampshire with an oversample in Great Bay’s watershed. There were three questions directed towards understanding opinions on recent ideas to help reduce the water pollution coming from stormwater, fertilizers, and waste water treatment plants. The following results were from Piscataqua watershed residents:

- 34% claim to use a chemical fertilzer or weed killer on their lawn (n=306)
- 86% support a Water Friendly Lawn campaign that would recognize homeowners who choose low or no chemical fertilizers and that would provide coupons for home and garden products (n=317)
- 67% support a reduced water and/or sewer rate if a property owner installs measures to help stop or slow the rain runoff on their property (less pavement, porous pavement, rain barrels, or rain gardens) (n=313)

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METHODS

For this project, we wanted to know the amount of nitrogen that could be eliminated from nonpoint sources. In order to quantify this potential, we developed two scenarios of land use change for 2025: Increased Conservation and Increased Development. The modeled scenarios provide the bookend data points of land use change from the watershed.

SCENARIO DEVELOPMENT

We contacted and queried expert stakeholders to aid in the development of scenarios. Knowledgeable representatives from academia, planning organizations, state organizations, the private sector, non-profits, and the private sector filled out questionnaires regarding realistic land cover change over the next 10 years. We translated their input into various tables regarding drivers of change and relational patterns.

MODEL RUNS AND VALIDATION

We ran both models for known years and validated both models against data reported for the region and each tributary.

RESULTS

LAND COVER SCENARIOS

Twelve stakeholders aided in the development of two realistic scenarios by providing expertise on drivers of land cover change over the next 10 years. According to our stakeholders:

MODEL COMPARISON

Once the avoided cost study and the scenario maps are finalized, a future step would be to present our results to a wider stakeholder group. Ideally, we would use a facilitated workbook format to implement Multi-Criteria Decision Analysis (MCDA) in the manner of Loos et al. (unpublished). Incorporating geographic data and stakeholder values into alternative futures will provide a helpful framework for decision makers in the Piscataqua Watershed of New Hampshire and Maine.