Illinois-Indiana Sea Grant Annual Report: FY 2008

Project Title: Integrated Modeling for the Ecosystem Restoration of Marshes in the Lake Calumet Area

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Abstract

This project was officially started in July of 2008. We have coupled SWMM and MODFLOW models to better simulated overland and subsurface flow in the Calumet area. We have reviewed all the reports on water quality study and collected available surface water and groundwater quality data. We have also developed a simple groundwater MODFLOW model for the Cluster Site and a preliminary WASP water quality model for the Indian Ridge Marsh surface water body.

Introduction

The goal of this project is to develop effective modeling tools to assess ecosystem restoration plans and develop benchmarks for the ecological restoration in the Lake Calumet area.

Specific objectives are:

1) To develop water quality simulation component of the SWMM model for watershed and stream that can be used as a basis for determining the best water quality management strategies for the Lake Calumet Cluster Site and the adjacent open spaces it affects: Indian Ridge Marsh, Big Marsh, Heron Pond, and Dead Stick Pond

2) To develop a flow and solute transport model for groundwater system in the area, particularly the Cluster Site, and couple it to SWMM to simulate the surface and groundwater interactions

3) To evaluate the water quality and ecological impacts of different remedial options proposed for the Cluster Site as well as other upland properties in the marsh watersheds, using the modeling tools

4) To develop benchmark plans which will include a combination of various measures in achieving water quality targets Plans to accomplish project goal(s)

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From Aug. when we received the project funding to Dec. of 2008, we have completed the following major tasks:

1. Coupling of SWMM and MODFLOW

The U.S. Environmental Protection Agency's SWMM model has been used to simulate the surface runoffs in the Calumet area for a project completed in 2008 for the City of Chicago Department of Environment. This current project will develop a groundwater model using U.S. Geological Survey's MODFLOW to simulate subsurface flow and its associated water quality, particular pollutants from landfills in the area to estimate the impact of groundwater discharge to water quality in the Indian Ridge Marsh. In order to improve modeling accuracy, we coupled SWMM and MODFLOW for better simulation of infiltration rate and groundwater recharge rate. SWMM and MODFLOW models were coupled through modifying the sources codes.

2. MODFLOW model for the Cluster Site

A simple MODFLOW model was developed for the Cluster site by using the geological cross sections reported for the area. This MODFLOW model needs to be expanded to include the contributing watershed or overland areas to Indian Ridge Marsh, Big Marsh, Dead Stick Pond and Heron Pond. Better aquifer information and groundwater piezometric head need to be sought to improve the model.

3. Collection of Water Quality Data

We have reviewed all the reports on water quality studies in the Calumet area and gathered the water quality data for surface water and groundwater.

Groundwater (91, 92, and 93):
Temperature, pH, DO, Ammonia, Nitrate (NO3), and Phosphate
Surface Water (ISWS, 1997):
Temperature, pH, DO, Conductivity, Nitrite & nitrite-N, Ammonia-N, total phosphate, dissolved phosphate.
Surface Water (V3, 2003-2004)
Temperature, pH, DO, Conductivity, DO Saturation (?), Oxidation reduction potential (ORP)

4. Development of WASP model for the Indian Ridge Marsh

A preliminary water quality model was developed to simulate nutrients in the Indian Ridge Marsh surface water body. The USEPA surface water quality model – WASP was used and ISWS 1997 water quality data was used for model calibration. The preliminary model only considers the overland flow from

surrounding contributing watersheds to the Indian Ridge Marsh and direct rainfall into the water body. Groundwater discharge will be added into the model.

Challenges and Plans

The greatest challenge for this modeling effort has been available data and the quality of data. We plan to collect and analyze systematic water quality samples twice this year if we can allocate our budget to cover the cost. It is crucial for more reliable modeling results.