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Soil and Water Science
Research Brief

University of Florida Institute of Food and Agricultural Sciences

# Large-Scale Modeling of Phosphorus Transport in the Northern Everglades

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A solute transport model was used to predict phosphorous (P) mobility in the northern Everglades. Over the past several decades, a parcel of the northern Everglades, now called Water Conservation Area (WCA) 2A, has received agricultural drainage waters that are P-enriched relative to the historic rainfall-driven hydrologic inputs.

Phosphorus enrichment has occurred in WCA 2A soils (Figure 1), and open water sloughs have become colonized by invasive cattails, *Typha domingensis*. Methods of reducing drainage water P concentrations have been actively pursued, but the possible effects of low P water moving over the enriched soils have not been fully addressed.

The target total P concentration for water discharged into WCA 2A is 10 µg/L because species shifts have been observed above that level. In this study, transport model results suggest that if the target is met, P in the soils will be mobilized such that the nutrient-impacted region will expand spatially.

Water movement through WCA-2A was modeled for steady-state flow (Figure 2), though seasonality will be included in future scenarios. The P-cycling was modeled as a two-site, non-equilibrium process, including biological uptake ($k_1 = 36\ day^{-1}$), diffusive flux ($k_2 = 0.36\ day^{-1}$), and abiotic sorption-exchange (Figure 3). Phosphorus movement through the marsh has slowed by biological sequestration, yet eventually all of the stored soil-P may become mobilized into a low-P water column though diffusive flux.

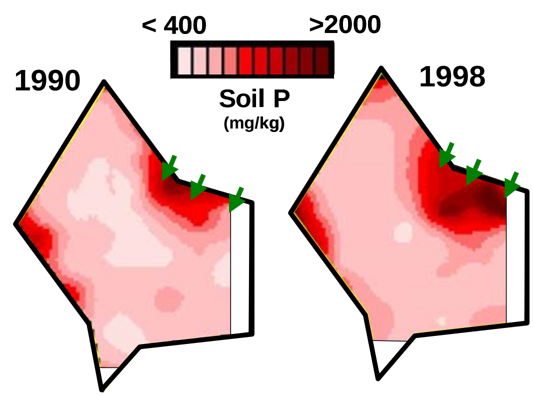


Figure 1. Soil phosphorus content in Water Conservation Area 2A in the Northern Everglades. Arrows denote major surface water inputs to the marsh (From DeBusk et al., 2001).

Empirical relationships between surface water P concentrations, porewater-P, and soil-P content were used to calibrate P cycling processes and model output (Figure 4) to existing spatial and temporal soils data (e.g., DeBusk et al., 2001).

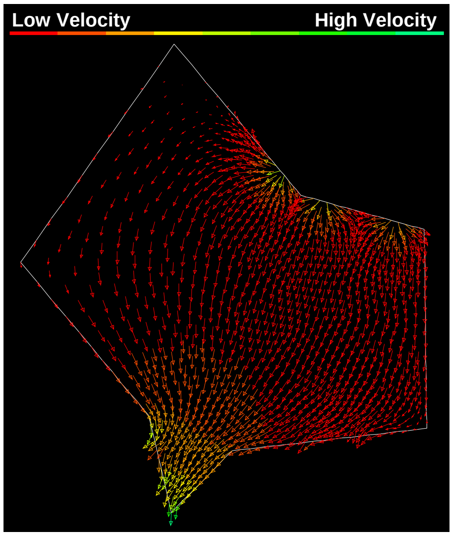


Figure 2. Velocity vector field developed for WCA-2A from surface water discharges into and out of the marsh. Slow flows are predicted through the interior marsh, while high velocities occur primarily near water control structures.

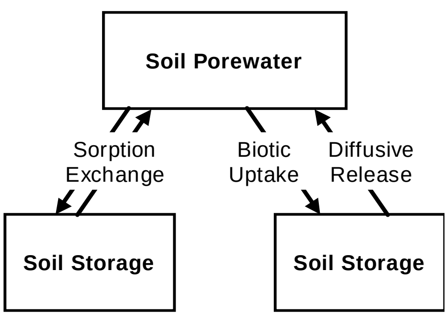


Figure 3. Two-site model structure for phosphorus exchange between soil porewater and soil storages.

Several model scenarios predicted that water column TP concentrations within WCA-2A may exceed 10 µg/L for over 100 years after inflow targets are met. These results have implications for resource managers who, in considering restoration alternatives, may choose hydrologic isolation of the P-impacted region to retain phosphorus accrued in the soils.

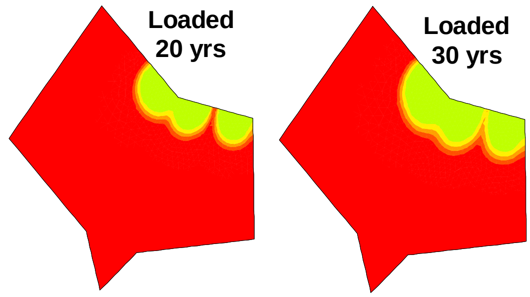


Figure 4. Predicted soil-P contents after 20 and 30 years of discharge along the northeastern levee. Enriched areas shown in green above background (red)

Reference:

DeBusk et al. 2001. J. Env. Qual. 30:1438-46

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