AN ABSTRACT OF A DISSERTATION

MONITORING AND MODELING THE HYDROLOGY OF A FORESTED SINKHOLE WETLAND ON THE TENNESSEE HIGHLAND RIM

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This dissertation provides a comprehensive hydrologic study of a forested sinkhole wetland located on the eastern portion of the Tennessee Highland Rim. The wetland is located in a developing watershed with 13 % impervious surfaces. Measured diurnal surface water cycles are used to estimate daily evapotranspiration (ET) and seepage. Historically, this technique has been applied to groundwater systems with considerable uncertainty due to the estimation of specific yield. Surface water systems were found to exhibit a wider range of diurnal cycles. For application to surface water systems, the method is typically applied with an assumed specific yield of 1.0. This assumption was found to be invalid for application to surface water systems with a non-cylindrical pond geometry. The potential adverse impacts of continued watershed development on the wetland plant community were examined by simulating long-term hydrology for different future land management scenarios with the SPAW (Soil-Plant-Atmosphere-Water) hydrologic model. The results indicate that development with impervious surfaces in the range of 20-25 % is unlikely to appreciably influence the existing plant community. Maintenance of a forested buffer was found to be the most important aspect of future land management. A water budget model for depression wetlands, called DEPMOD, was developed. A conceptual model of the wetland system consisting of three storage zones (canopy, surface water, and soil profile) formed the basis for DEPMOD. Water budget equations were written for each storage zone and solved by DEPMOD using a daily time step. For the Algood wetland, DEPMOD predicted the wetland hydroperiod within 2.8 % during the calibration period and 4.0 % during the validation period. Annual water budgets were constructed for two years (2004 and 2005). Subsurface explorations revealed a shallow soil profile of ~2 m in thickness over limestone residuum. A distinguishing feature of the soil profile was a fragipan horizon that occurred at a depth of ~1 m from the ground surface throughout the wetland and extended into the adjacent upland. Soil morphological features of reduction indicate a perched water table exists above the fragipan horizon for portions of the year. The results of a modeling study with the physically based and fully distributed MIKE-SHE model were used to characterize the error in ET and seepage estimates computed from diurnal surface water cycles. Neglecting nightime ET is found to contribute significantly to the total error.