A PCSWMM / GIS Based Water Balance Model for the Reesor Creek Watershed

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Abstract

One of the driving pressures of land-use changes is urban development. In the Greater Toronto Area (GTA), there have been drastic changes to local watersheds as urban areas sprawl over surrounding rural areas. Natural watersheds maintain a balance between precipitation, runoff, infiltration, evaporation, and evapotranspiration. It is necessary to understand the water balance of a watershed in order to develop and implement watershed procedures that are addressed in a watershed plan. In an urbanized watershed, the runoff rate and volume will increase. This is because paved surfaces, rooftops, altered drainage systems, and sewer systems convey runoff at greater rates because of their imperviousness and minimal friction coefficients. While Duffins Creek may be one of the healthiest watersheds in the GTA, it is also one that is producing the most concern for the Toronto and Region Conservation Authority (TRCA) where findings suggested that proposed urbanization will impact the water quality and quantity.

There are three objectives for this research. The first is to develop a new modelling approach that integrates GIS and hydrologic models (e.g. SWMM) in a water balance analysis on a watershed basis for the Reesor Creek subwatershed. The second objective is to calibrate the model by observing how differing techniques, in this case, lumped, clustered, grid, and kriging analyses can discretize both the landscape and incoming precipitation. And lastly, to observe the effects of spatially distributed rainfall measurements and their affects on the three modelling approaches.

Results show that as the watershed is divided into smaller segments, not only does the discretion and database increase, so to did the percent difference. Also, kriging rainfall does accurately predict rainfall at ungauged (virtual) sites only under certain conditions and that a strong correlation between measured rainfall values does not confirm a strong relationship with generated runoff.

Recommendations included the use of a longer time series of rainfall, streamflow, and predicted rainfall to observe temporal variations, as well as to use climate data such as evaporation and temperature in the models. It was also recommended that a larger number of sample points to be used in the kriging with various surface interpolation techniques to observe model differences.