Flow Modeling of the Maha Oya at Peradeniya

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Introduction

The Maha Oya, which is a water way through the University of Peradeniya, originates from the Hanthana mountain range and discharges to the Mahaweli River near the university gymnasium. The catchment of Maha Oya covers about 5.2 km^2. Understanding the flows in the Maha Oya is important as it supplies water to the Peradeniya Botanical Gardens and to many cultivations including nurseries and contributes to the pleasing environment of the main campus, and also, to plan mitigatory measures against possible damages to university infrastructure due to seasonal floods and poor water quality in it during seasonal low flows.

This study is focuses on the setting up of a rainfall- runoff model to estimate the discharge of the Maha Oya. It includes the calibration and verification of the HEC-HMS (Hydrologic Engineering Centre of US Army Corps Engineers Hydrological Modeling System) for the catchment.

The HEC-HMS hydrological modeling software has been used for the study of hydropower optimization in Sri Lanka. As an example, for the flood-rainfall analysis of Broadlands hydropower project the software has been utilized. For the flood analysis, the unit hydrograph technique (Snyder's unit hydrograph) in the HEC-HMS has been used since it is simple and only a few unknown parameters had to be figured out.

Methodology

Modeling of the Maha Oya Catchment using HEC-HMS mainly includes two steps: the catchment's model calibration and the verification of the results. To set up the model, catchment topographic, geologic and land use details were collected. Since the catchment is ungauged a stream flow gauge was set up. The stage of the stream was measured on a daily basis and converted to discharge using the rating curve established. Daily rainfall data were obtained from the Gannoruwa rainfall recording station. Daily flows in the Maha Oya and daily rainfall were obtained from 01/11/2006 to 15/06/2007.

The set of data from 01/11/2006 to 30/04/2007 was used for the model calibration and the data from 30/04/2007 to 15/06/2007 for model verification. The model parameters were optimized so that the simulated hydrograph matched the observed hydrograph during the calibration. The optimized parameters so obtained were used for model verification.

Results and discussion

Calibration of the model was done by running the HEC-HMS model employing the constant monthly base flow method and the Clark unit hydrograph method with an initial loss of 20.32 mm, a constant loss rate of 25 mm/h, a storage coefficient of 0.8 h, and with a catchment imperviousness of 20% and time of concentration of 2.3 h. Figures 1 and 2 compare the simulated and observed stream flows of the Maha Oya close to the University mosque.

The model can be used for the simulation of Maha Oya flow for rainfall data after the month of June, since the calibration has been done for the relatively rainy months such as November and December.

Concluding remarks

A rainfall-runoff model for estimating stream flow of the Maha Oya at Peradeniya University premises was developed. This calibrated model can be used as a tool for estimating discharge characteristics of the Maha Oya necessary for the planning constructions on the banks of the stream and for the estimation of potential withdrawals from it.

References

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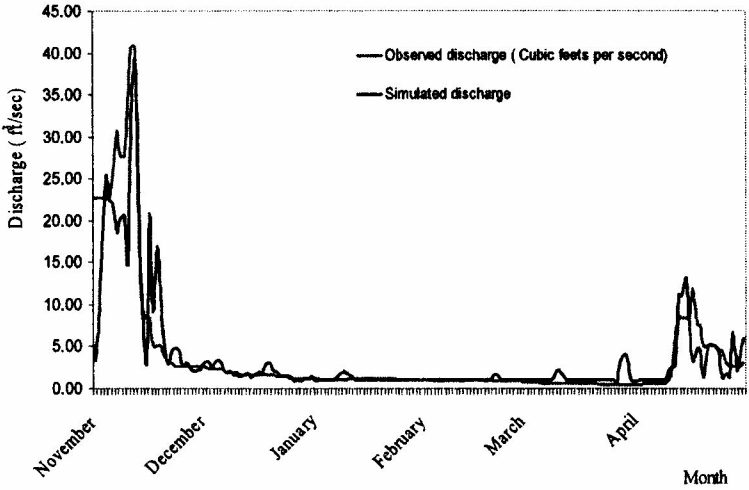

Figure 1. Simulated and observed stream flow of the Maha Oya for the calibration period

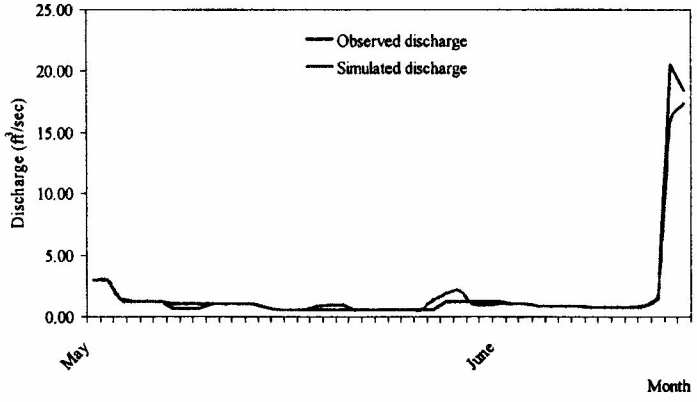

Figure 2. Simulated and observed stream flow of the Maha Oya for the verification period