# EVALUATION OF RUNOFF ESTIMATION USING SCS METHOD FOR INFRASTRUCTURE DESIGN - A CASE STUDY OF ATTANAGALU OYA BASIN-KARASNAGALA, SRI LANKA

Sonam Tobgay

138658N



Degree of Master of Engineering in

Water Resources Engineering and Management

Department of Civil Engineering

University of Moratuwa

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Thesis submitted in partial fulfillment of the requirements for the Degree of Master of Engineering in Civil Engineering



Supervised by

Professor N.T.S.Wijesekera

UNESCO Madanjeet Singh Centre for
South Asia Water Management (UMCSAWM)
Department of Civil Engineering

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## DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in text.

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Sonam Tobgay Date

The above candidate has carried out research for the Masters thesis under my supervision

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Professor N.T.S.Wijesekera Date

# ABSTRACT

Runoff estimation information on streamflow is a central component for water resource engineering and management. Generally, majority of catchments that demand for water engineering interventions are ungauged. Lack of runoff is a hindrance for optimum infrastructure development. Soil Conservation Service Curve Number method commonly known as the SCS CN method is a popular model elsewhere and in Sri Lanka for runoff estimation in ungauged catchments. One key factor in the use of this model is the determination of Curve Number for the concerned area. Though there are applications SCS model had been carried out for Sri Lanka, the CN estimations had been based on literature recommended values and methods. However the uses of such values require verifications with modeled and observed streamflows. The present study carried out an evaluation of runoff estimation using SCS-CN method developing an event based rainfall runoff model for Attanagalu Oya River Basin at Karasnagala. This study first evaluated the use of literature reported methods for base flow separation and effective rainfall computations to determine the appropriate models for computing direct runoff from the observed streamflows. The SCS CN model developed for the Karasnagala was then tested with a comparison of computed and observed hydrographs. Daily rainfall and runoff data of ten years (1971-1981), 1:50,000 topographic maps, land use and soil data were used for the model development. 60 events were separated after an evaluation of available streamflow and rainfall data. 30 events were used for model calibration and 30 were used for verification. Model evaluation was carried out in several ways. Initially the watershed curve number was determined using standard SCS tables. Then each individual event was calibrated by optimising CN numbers. Average CN from the calibration dataset was then verified using 30 events. Parameter optimisations were done with the Mean Ratio of Absolute Error (MRAE) as the objective function while the Ratio of Absolute Error to Mean (RAEM), ratio of absolute errors corresponding to peak flow, the time to peak and the time base of the hydrographs were computed to reflect the goodness of fit between the observed and modeled streamflows. The present work used the concave method for baseflow separation while the constant loss method was incorporated for the determination of effective rainfall.

The weighted catchment average CN for Karasnagala was 85.18. Calibration of the model produced an average MRAE of 0.59. Results of graphical outputs and the errors computed for peak flow magnitude and occurrence revealed that in case of very good model outputs, the MRAE values were well below 0.20. Average optimised catchment CN value during calibration was 70.11. Verification with the average CN value resulted in a MRAE of 0.40 and the outputs demonstrated that the modeled peak flow magnitudes may be considered as reasonable. The entire set of 60 events showed a MRAE of 0.59 for weighted average CN. The average optimised CN for the same set was 70.11 with a MRAE of 0.40.

The present work revealed that the estimate of stream flows with CN estimations based on standard tables were of lesser quality when compared with those with the use of average CN value from individual observed event calibrations. It was also identified that the SCS CN model estimations with average optimised CN values for Karasnagala watershed do not produce satisfactorily representative results and hence should be used with caution. While showing a wide disparity in the hydrograph reproduction, the SCS CN model outputs indicated the possibility of using the SCS CN model for computation of peak flow magnitude

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