

**Estimating Flood Inundation Patterns under Land Use Change Scenarios in Tullahan River Watershed by
Coupling the SWAT and RRI Models**

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Abstract

Flooding remains one of the most pressing hazards in Metro Manila, largely driven by rapid urbanization and land use changes that increase surface runoff and reduce infiltration. Hydrologic–hydrodynamic modeling provides a valuable means in understanding water movement during flood events as well as projecting inundation patterns that can assist in strategizing an effective flood risk management. This study applies an integrated Soil and Water Assessment Tool (SWAT) model and Rainfall-Runoff Inundation (RRI) modeling framework to the Tullahan River Watershed, which includes the La Mesa Watershed—Metro Manila’s primary water supply reservoir and a major contributor to downstream flood behavior. A calibrated and validated SWAT model (2000–2020) using satellite-based weather data and ground-based streamflow from a hydrologically similar Culiati River Basin will generate the runoff and discharge inputs for the RRI model. Land use and land cover (LULC) change scenarios will be applied on the baseline model where forest cover will be converted into built-up areas and forest covers are restored from other types of land cover. These SWAT model outputs will serve as inflow boundary conditions to simulate river discharge, flood depths, and inundation extent under alternative land use scenarios representing urban expansion and forest restoration trajectories. Urbanization and reforestation are expected to yield distinct hydrologic and inundation responses which will highlight the sensitivity of the watershed to land use change. By combining hydrologic and hydraulic modeling, this study will demonstrate the utility of the SWAT–RRI framework for quantifying land use–flood interactions and supporting evidence-based land use planning and flood mitigation in highly urbanized tropical watersheds.

Keywords: Rainfall–Runoff–Inundation (RRI) model, Soil and Water Assessment Tool (SWAT), Land use and land cover change, Flood risk assessment