

## **Hydrologic Analysis for Stream Restoration Study on Junjung River, Penang, Malaysia**

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**Abstract.** Junjung River is located in the district of Seberang Perai Tengah, Penang, Malaysia and has a catchment area of approximately 127 km<sup>2</sup>. The length of the main channel is 21km and a study reach of 6 km has been selected. The major portion of the catchment is hilly and rugged in east part and relatively gentle and flat at the downstream. In recent years, the catchment area of Junjung River and its tributaries have been opened for housing and other development where intensive development has been taken place converting natural streams into lined channels and stream corridors into housing estates. Development has also wiped of the natural stream corridor vegetations. The Junjung river crosses several roads in the watersheds through culverts and low-lying bridges, which produce major obstructions to flow. As illustrated, the channel has been straightened and widened with native vegetation removed for the sake of hydraulic efficiency of the channel.

To meet the requirement of flood reduction and stream restoration guidelines set in the Urban Stormwater Management Manual for Malaysia (DID, 2000), three test cases of stream restoration were analysed in this study. First condition is with no restoration, second condition with cultivates shrubs and third condition cultivates with trees. HEC-HMS model was used to predict design flow for major system (ARI 50 years) and (ARI 100 years) due to 15, 30, 60 and 120 minutes design rainfall duration. Roughness coefficient due to vegetations (shrubs and trees) estimated using Fischenich's equation (2000). HEC-RAS model was used to predict the flood level for various design conditions stated above. The models were calibrated using field measurements. The introduction of scrubs caused higher burst in flood flow compared to restoration with trees. However both restorations with vegetation has higher flood level compared without condition. Restoration with trees may give less maintenance cost, provide recreational opportunities and boost habitat creation for riparian nature. Thus, restoration with trees was proposed to be adopted together with the channel improvement works such as rise up the existing bund level, widen the existing channel implementing source control oriented designs and relocation of the floodplain dwellers.

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