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River safe yield with the constraint of a contracted rectangular weir for surface water supply

Jing Teck Lau*, Darrien Yau Seng Mah and Alsidqi Hasan

Department of Civil Engineering, Universiti Malaysia Sarawak (UNIMAS), Kota Samarahan 94300, Sarawak, Malaysia

* Corresponding author. E-mail: dante.lau91@hotmail.com

Abstract

Aydin *et al.* introduced the weir velocity concept in 2011 for discharge measurement in contracted rectangular sharp-crested weirs. Gharahjeh *et al.* further reinforced this formula in 2015 to allow discharge to be computed using only weir velocity and crest width. These newly introduced expressions are tested and demonstrated to determine surface water yield of Tapah River in Sarawak. Aydin and Gharahjeh's formula is found to perform similarly to the improved discharge coefficient developed by French in 1986, but is simpler and easier to use. Exploring Aydin and Gharahjeh's formula through theoretical, experimental, and field approaches, it has been found that the formula performs well in a controlled environment. Discharge computations based on field data were determined to have been formerly underestimated, with the reason as yet undetermined.

Key words: crest width, discharge measurement, head, regulated river, velocity, water treatment plant

INTRODUCTION

River safe yield

Generally, raw water is obtained from rivers and treated through a conventional water treatment plant (WTP) to produce clean water. There are concerns about water availability in rivers. Rapid modernization, population growth, and commercial, housing, and industrial development in rural areas of Sarawak has led to an increased demand for clean water from many communities. This is especially true for the Tapah/Beratok/Siburan areas along the Kuching-Serian Highway (The Borneo Post 2015). The Tapah/Beratok WTP (Figure 1) must produce more treated water than its design capacity in order to meet high demand at the locality. In addition, rising water demand will soon increase about the natural equilibrium of supplies during the dry and hot seasons, leading to severe water crises. The mounting demands and the increasing areas of conflict strengthen the call for an analysis of the river's safe water yield.

Safe yield, in the context of water storage, is a term generally used to describe the utmost quantity of water which can be guaranteed during a critical dry period (Linsley & Franzini 1979). The New Jersey (USA) Water Supply Authority (2000) defines safe yield from surface sources as the maintainable yield of a water system continuously throughout a repetition of the most severe drought of record. Safe yield estimates may be either simple or complex. The Commonwealth of Virginia USA (2016) divides the safe yield of a source into two systems: (i) simple intake (free flowing stream); or (ii) complex intake (impoundments in conjunction with streams). For the purposes of this study, Tapah/Beratok WTP has adopted complex intake with impoundment by a weir at the point of water supply intake in the Tapah River.