



**LAPORAN TEKNIKAL  
UNTUK PROJEK PENYELIDIKAN**

**“Modification of Einstein’s Bed Load Transport Formula  
for Rivers in Malaysia (Case Study of Kulim River,  
Kedah”**

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**By**

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A total of 346 sets of bed load data obtained from the Kinta River, Pari, Kerayong River and Langat River were analyzed using four common bed load equations (Einstein, Einstein-Brown, Meyer-Peter-Müller and Shields). These assessments, based on the median sediment size ( $d_{50}$ ), show that the existing equations were unable to predict the measured bed load accurately. All existing equations over-predicted the measured values, and none of the equations gave satisfactory performance when tested on local river data. Therefore, this study had developed a Modified-Einstein Equation which employs local sediment transport to yield a better equation that can accurately predict bed load transport in Malaysian rivers. Using the recommended Modified-Einstein Equation, the computed bed load transport rates were in much closer agreement with the actual measured bed load. This study also applies a new soft computing technique, i.e. an adaptive neuro fuzzy inference system (ANFIS) as an alternative to more conventional bed load predicting equations to predict measured bed load data. The results show that the recommended network can more accurately predict the measured bed load data when compared to an equation based on a regression method for application to the moderate-size and sand-bed streams in Malaysia.