

## GEOLOGICAL ASSESSMENT AND POTENTIAL DEBRIS FLOW VOLUME ESTIMATION AT BUKIT CHENDERING, KUALA TERENGGANU, TERENGGANU, MAL

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Debris flow geohazard is not uncommon in hilly tropical terrain of Malaysia but received little attention from geoscientists and engineers mainly because their occurrences are difficult to predict. The development of the new Terengganu Palace in the northern flank of the Chendering Hill has been considered to be facing with threat of debris flow geohazards because the palace compound is partly surrounded by steep and rugged hill slopes which are dissected by narrow and steep hanging valleys. The potential for debris flow geohazards in this area has been identified from aerial photographs studies and field mapping, where some of the hanging valley flows are converging towards the site of the Public Ceremonial Building. Evidences for past debris flows have been identified in five hanging valleys. Geological assessments have been carried out in these valleys to search for evidence of past debris flow incidents and to characterise the nature of the past debris flows deposits. From the five hanging valleys, only two (i.e. Valley 2 and Valley 3) are considered very high risk and ought to be installed with suitable mitigating structures. Flexible debris flow barriers rather than rigid concrete structures have been opted for Valley 2 and Valley 3 because of site accessibility and construction feasibility. To facilitate the engineering design of the flexible debris flow barriers, potential debris flow volume for both valleys have to be estimated on the first place. The estimation of the potential debris flow is done empirically by estimating the area of the source and the thickness of the potential source (i.e. the combined thickness of loose sediments, colluvial deposits, and overburden soils). The estimate is done by subdividing the map of the potential source area into equal cells using a grid, estimate the proportion of each cell that is covered by the deposits, and then sum. Thickness ( $T_m$ ) of the loose sediments at source were measured and estimated directly in the field from the exposed outcrops along the stream channel. With the given area and thickness, volume of the bulk debris flow source can be calculated by multiplying the total area with the measured source thickness ( $T_m$ ). This formula gives dry volume of debris sources in the valley catchment. Under extreme rainfall event, it is very unlikely that the entire volume of the debris in the catchment will turn into debris flow. Past experiences indicate that the likely situation is that only 20 percent to 30 percent of the debris sources will be sliding down entering the valley channel and mixed up with water to form the likely debris flow volume. In most wet debris flow events of tropical country, the amount of water made up about 40percent of the entire flow volume. Therefore, by taking these factors into consideration, the predicted debris flow volumes for both Valleys 2 and 3 can be reliably estimated to facilitate the engineering design of the debris flow barriers.

Keywords: Debris Flow, Geohazard, Geological Assessment, Volume Estimation, Hilly Tropical Terrain