

Backwater rise due to large wood accumulations: Effect of organic fine material

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Large wood (logs with a diameter ≥ 0.1 m and a length ≥ 1.0 m) in rivers improves the diversity of morphological structures and flow conditions. It may be transported as single logs or in a bulk, forming a log jam or an accumulation at an obstruction. In a natural river, large wood (LW) accumulations create heterogeneous hydraulic gradients and increase the flow resistance. Besides various ecological benefits, LW accumulations may intensify flood hazard. During flood events, transported LW may accumulate at river infrastructures or is retained intentionally at LW retention structures. In both cases, the accumulation results in an upstream backwater rise and may lead to flooding of the nearby area. Consequently, engineering measures are necessary to mitigate LW accumulation risk.

The number of investigations on the role of LW during flood events has substantially increased within the last decades. At the Laboratory of Hydraulics, Hydrology, and Glaciology (VAW) of ETH Zurich, several studies were conducted on LW accumulation probability and rate. Formulae for backwater rise calculation already exist, but the governing parameters are still contradictory. In addition, the effect of organic fine material (e.g. branches or leaves in a LW accumulation) was neglected in all previous studies. In this present study, a series of small-scale and close-to-prototype model tests were conducted to identify the governing parameters on backwater rise due to LW accumulations. During the experiments, the approach flow conditions (inflow flow depth and Froude number) and LW accumulation characteristics (accumulation length, compactness of LW accumulations, LW characteristics, and organic fine material) were varied systematically. The experimental results show that the backwater rise depends mainly on the compactness of LW accumulations, approach flow Froude number, and organic fine material. The study confirms the hypothesis that organic fine material changes the accumulation characteristics and increases backwater rise. The findings of this study were combined in a design equation to estimate backwater rise, improving the assessment of the hazard potential of river infrastructures for flood events with high LW transport.