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Backwater development by woody debris

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Placement of woody debris is a common method for increasing ecological values in river and stream restoration, and is thus widely used in natural environments. Water managers, however, are afraid to introduce wood in channels draining agricultural and urban areas. Upstream, it may create backwater, depending on hydrodynamic characteristics including the obstruction ratio, the Froude number and the surface level gradient. Patches of wood may trigger or counter morphological activity, both laterally, through bank erosion and protection, and vertically, with pool and riffle formation. Also, a permeable construction composed of wood will weather over time. Both morphodynamic activity and weathering cause backwater effects to change in time. The purpose of this study is to quantify the time development of backwater effects caused by woody debris. Hourly water levels gauged upstream and downstream of patches and discharge are collected for five streams in the Netherlands. The water level drop over the woody debris patch relates to discharge in the streams. This relation is characterized by an increasing water level difference for an increasing discharge, up to a maximum. If the discharge increases beyond this level, the water level difference reduces to the value that may represent the situation without woody debris. This reduction depends primarily on the obstruction ratio of the woody debris in the channel cross-section. Morphologic adjustments in the stream and reorientation of the woody material reduce the water level drop over the patches in time. Our results demonstrate that backwater effects can be reduced by optimizing the location where woody debris is placed and manipulating the obstruction ratio. Current efforts are focussed on representing woody debris in a one-dimensional numerical model, aiming to obtain a generic tool to achieve a stream design with woody debris that minimizes backwater.