# SEDIMENT TRANSPORT IN STREAM CHANNEL DESIGN

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## ABSTRACT

Stream channel design has been strongly yoked to the concept of equilibrium channel geometry, building on regime theory and hydraulic geometry over the past century. Although plausible at a cursory level, equilibrium methods are unsatisfactory for a variety of reasons. They say nothing about the nature and duration of adjustment. They provide no quantitative basis for incorporating uncertainty. They generally make little or no distinction between channels with similar flow and vastly different sediment supply.

All agree that stream channel dimensions and dynamics depend on the supply of water and sediment. Here, we link water and sediment supply to specified behavior of the channel as a complete strategy for incorporating sediment transport in stream channel design. The approach builds on the classic concepts of threshold and alluvial channels. A threshold channel is one for which the bed material is immobile at a specified discharge. An alluvial channel is one whose transport capacity must be balanced against the rate of sediment supply. It is useful to define a third type of channel that combines the first two – over-capacity threshold – in which transport capacity exceeds supply but design flows do not exceed threshold limits for channel erosion. This type of channel is more common than often realized and is, in fact, unintentionally designed in many cases. Using these three channel types, we develop a basis for evaluating the significance of sediment supply to the performance of a design channel. At small sediment supply rates, channel performance is relatively insensitive to uncertainty in sediment supply and may be designed following threshold channel principles of stream competence. At large sediment supply rates, the potential for storing or evacuating channel-changing quantities of sediment is much larger. Design options include (i) active channel shifting {requiring acquisition of sufficient riparian corridor}, (ii) an over-capacity threshold channel {if sufficient slope is available}, or (iii) an alluvial channel that balances sediment supply and capacity {which may require additional investment for adequate estimates of potentially large rates of sediment transport}.

With specified values of water and sediment supply and a designated channel behavior, basic relations for hydraulics and sediment transport are solved to provide a suite of channel design choices. At this point, characteristic values of, for example, channel width can be drawn from hydraulic geometry relations or local experience in order to select among the range of possible design options. All three design strategies are placed on a common basis to allow effective and complete evaluation of design options under uncertainty. For useful application, it is not sufficient to merely characterize uncertainty. That uncertainty must be incorporated in the analysis and design of stream channels. A computational tool for estimating uncertainty will be presented within a strategy for incorporating sediment transport in channel design.