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Sediment dynamics in semi-alluvial urban streams

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Anthropogenic alterations of flow regime and sediment fluxes often occur in river catchments subject to urban development. Because of land use change, stormwater collection and channelization of low order tributaries, urban streams often have a flashy flow regime and limited, irregular sediment supply. In Southern Ontario, the response of riverine systems to urbanization is modulated by the glacial legacy. Many urban streams in the Greater Toronto Area show widespread erosion and incision and river beds are characterised by discontinuous alluvial cover and patches of exposed glacial till. Little is known about bedload transport in these semi-alluvial channels and a thorough understanding of sediment dynamics is needed for flood risk assessment and to design river restoration projects.
We used a large physical model to simulate alluvial cover evolution in a till-bed stream and to explore the role of sediment supply, channel morphology and roughness on cover stability and sediment flux. The non-erodible concrete channel comprised a straight section and a sinuous section and was fed with graded sediment. Initial conditions included fully covered and fully uncovered beds in order to assess the role of pre-existing alluvium. Bedload flux was sampled at regular intervals and cover evolution was reconstructed from high resolution images. Model runs show that the system tends to a steady state characterised by sediment input/output balance and a constant proportion of covered bed. Equilibrium cover area increases with sediment supply, but sinuosity and roughness have a major positive effect on sediment retention.