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Designing ecological flows to gravely braided rivers in alpine environments

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Designing ecological flows in gravelly braided streams requires estimating the channel forming discharge in order to maintain the braided reach physical (allocation of flow and bed load) and ecological (maintaining the habitat diversity) functions. At present, compared to single meander streams, there are fewer guiding principles for river practitioners that can be used to manage braided streams. Insight into braiding morphodynamics using braiding intensity indices allows estimation of channel forming discharge. We assess variation in braiding intensity by mapping the total number of channels (BIT) and the number of active (transporting bed load) channels (BIA) at different stages of typical diurnal melt-water hydrographs in a pro-glacial braided river, Sunwapta River, Canada. Results show that both BIA and BIT vary with flow stage but over a limited range of values. Furthermore, maximum BIT occurs below peak discharge. At this stage there is a balance between channel merging from inundation and occupation of new channels as the stage rises. This stage is the channel forming discharge because above this stage the existing braided pattern cannot discharge the volume of water without causing morphological changes (e.g., destruction of bifurcations, channel avulsion).
Estimation of the channel forming discharge requires a set of braiding intensity measurements over a range of flow stages. The design of ecological flows must take into consideration flow regime characteristics rather than just the channel forming discharge magnitude.