

## **Estimation of Flood Zones along Ungauged Gravel-Bed Braided Rivers**

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**Abstract.** With regard to river engineering projects along a gravel-bed river in an ungauged watershed, experience-based engineering and engineering judgment is shown to be important part of the procedure needed for determining flood-hazard zones. This paper presents a case study of a flood-hazard delineation project along a reach of the Dehbakri River in Kerman province, Iran. After following the usual routine procedure involving a widely used one-dimensional numerical model to estimate the 100-year recurrence for defining the flood hazard area, it was found that the estimated flood levels along a gravel-bed channel did not match well-delineated watermarks formed during earlier flood flows. Because there was no substantial data or observations regarding the flood's peak discharge or stage, it was found that experience and judgment had to be used. The observations use the limited observational data available (water-level marks) and insight from studies at similar channels, to reach a reasonable estimation that match observed water levels. This paper describes the experience and judgement used to estimate flood levels and a flood zone for the reach along the Dehbakri River. In particular, this paper points out that, for steep, braided gravel-bed rivers, critical depth of flow acts as a form of constraint causing the channel-bed characteristics to change, switching from sub- to super-critical flow; and, relatedly altering bed forms and flow resistance. The typical fixed-bed numerical models sometimes (e.g. this study) inaccurately estimate the flow characteristics in steep loose-bed channels. Indeed, there is no alternative at present other than to make use of observed water-levels associated with earlier floods. Therefore, experience and engineering judgment emphasize the importance of determining water levels associated with the loose, deformable beds of ungauged gravel-bed rivers.