

Use of the Manning Equation for Estimating the Discharge of High-Gradient Canals and Natural Streams

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Abstract. The Manning Equation is an empirical equation for the estimation of stream or canal discharge based on the water depth, channel geometry, slope of the water surface, and an empirically-derived Manning roughness coefficient. A commonly-used formula for estimating the Manning roughness coefficient for high-gradient ($S > 0.002$) streams uses only the slope and the hydraulic radius. The objective of this study has been to determine whether the same formula applies in high-gradient canals and in high-gradient natural streams that incise other rock types. The objective has been addressed by measuring the Manning roughness coefficient at 15 sites in high-gradient canals and 15 sites in high-gradient streams that incise carbonate bedrock in Utah County, Utah, and at 12 sites in high-gradient streams that incise volcanic bedrock in Haiti. For the high-gradient canals, the Manning roughness coefficient is normally about twice as high as would be chosen based upon the materials that line the canal. The preliminary interpretation is that many of the high-gradient canals are flowing in the supercritical regime, which has eroded the canal walls, for example, to expose the aggregate beneath the trowel finish of a canal wall. Streams incising the three bedrock types have statistically significantly different relationships among the Manning roughness coefficient, slope and hydraulic radius, most likely because the sediment size that results from a particular slope and hydraulic radius depends upon the rock type. A unified formula for high-gradient streams that includes bedrock properties is being developed. Further results will be reported at the meeting.