Development of transition mat scour protection design methodology and comparison to the state-of-the-practice

Michael O. Turner, Amanda L. Cox, Christopher I. Thornton
Department of Civil and Environmental Engineering, Colorado State University

Abstract. Culverts are designed to convey flow through or around obstructions such as a roadway crossings, embankments and riverine infrastructure. Flow exiting a culvert experiences an abrupt flow expansion generally resulting in changes in flow regimes and substantial energy dissipation. Such flow conditions can lead to bed scour, bank erosion and local channel instability. Recent advancements in erosion control technology have resulted in the development of a class of products, termed Transition Mats, designed to provide scour protection immediately downstream of culvert outlets. Colorado State University’s Hydraulics Laboratory has conducted extensive testing of a transition mat under laboratory conditions to quantify system performance and develop a design methodology appropriate for implementing Transition Mats as scour protection. Prototype testing for both vegetated and unvegetated conditions has been coupled with Froude scale model data resulting in the development of an empirical method for determining an appropriate extent of culvert outfall protection and hydrodynamic design thresholds. Hydraulic conditions associated with flow in and around culverts have been well documented, as by Norman et al. (2001), and the Federal Highway Administration has developed numerous tools designed to quantify flow conditions and implement scour mitigation designs (Thompson and Kilgore, 2006). The purpose of this paper will be to quantify site hydraulics for three unique field conditions utilizing procedures outlined in HDS-5 (Norman et al. 2001), and then compare scour mitigation designs utilizing Transition Mats to accepted riprap design methodologies.