Determination of Immediate Claystone Scour Potential

Study Title

Determination of Immediate Claystone Scour Potential

Brief Type

Final

Date

November 2025

Study Timeline

May 2023 – November 2025

Principal Investigators

Christopher T. Senseney
Associate Teaching Professor
University of Colorado Boulder
senseney@colorado.edu
Kathryn L. Stelwagon
Masters Student
University of Colorado Boulder
kathryn.stelwagon@colorado.edu

CDOT Contact Info

Study Champions

Michael Tanner, PE, CFM
State Hydraulic Engineer
Colorado Department of Transportation
michael.tanner@state.co.us

Study Manager

Thien Tran, PE
Research Engineer/Program Manager
Office of Applied Research
Colorado Department of Transportation
thien.tran@state.co.us

Interested in Finding Out More?

https://www.codot.gov/programs/research

Study Objectives

The purpose of this study was to determine the immediate scour of un-weathered claystone bedrock in bridge configurations, i.e., around piers and/or constricted flow. This study evaluated the erodibility of un-weathered claystone found in the Colorado Front Range with the SRICOS-EFA (Scour Rate in Cohesive Soils – Erosion Function Apparatus) methodology and calculations.

Background

Scour is one of the leading causes of bridge failure worldwide. It occurs when flowing water removes sediment from around bridge foundations, compromising structural stability. Multiple CDOT bridges founded on claystone and located along Clear Creek in Wheat Ridge, Colorado were recently designated as scour critical. Traditional scour prediction methods, such as those outlined in HEC-18 and implemented in HEC-RAS, were primarily developed for coarse-grained (cohesionless) soils and do not adequately account for the distinct erosion mechanisms associated with fine-grained (cohesive) materials. This study investigates the applicability of the SRICOS-EFA method for predicting scour in cohesive materials, using Colorado claystone samples collected from the Clear Creek Basin. Scour depth predictions determined from SRICOS-EFA were compared with scour predictions from HEC-18 calculations.

Methods

Claystone samples were obtained from two boring locations near four of the bridges over Clear Creek that were designated as scour critical. The claystone samples were sent to a laboratory for EFA testing. The SRICOS program was used to calculate pier scour and contraction scour at the four bridges based on the EFA test results. Concurrently, pier scour and contraction scour were calculated from HEC-18 procedures for the four bridges.

Results

Findings suggest that SRICOS-EFA may not reliably estimate scour in Colorado claystone, though this conclusion is based on a limited sample set and should be interpreted accordingly. In all cases, the SRICOS-EFA procedure significantly overpredicted both pier and contraction scour as compared to scour calculations from HEC-18.

Recommendations for Implementation (or Next Steps)

It would be beneficial to evaluate the scour critical bridges with revised scour analysis techniques currently being developed by the FHWA. The FHWA's NextScour initiative aims to combine computational fluid dynamics (CFD) modeling with shear decay functions that link the decay of hydraulic shear forces to the measured erosion resistance of the soil. Applying this shear decay framework to the Clear Creek bridges could provide valuable insight into the discrepancies between observed scour depths in the field and those predicted by existing empirical models. Such an evaluation would not only improve the reliability of scour assessments for bridges founded on claystone, but also contribute to the broader effort of calibrating and validating NextScour methods under real-world conditions.