Lessons learned from a screening study of bedrock erodibility at spillway foundations

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The potential for bedrock scour is an important consideration for spillway design and performance. The 2017 Oroville incident underscored the importance of bedrock scour and spillway reliability to the overall safety of dams in general, and since then many dam owners have initiated studies to systematically evaluate spillway erodibility for every dam in their portfolio. These studies can be costly and time consuming for dam owners with large inventories, highlighting the need for screening studies to help dam owners focus their efforts where they are needed most. This presentation will illustrate lessons learned from a screening study of spillway erodibility at five dams in central Idaho. This study used the Erodibility Index method (Annandale, 1995, 2006) to assess the potential erodibility of spillway foundation materials under scenario hydrologic loads to evaluate which sites may require additional study, and which sites do not. We relied extensively on existing data supplemented by limited field mapping to characterize the erosion resistance of foundation materials. To evaluate stream power at the toes of the spillways, we developed simplified computational flow dynamics (CFD) slice models of a 1-ft-wide section of each spillway using FLOW-3D and adopted other parameters from project data, when possible. When compared to historic records of erosion at the dam sites, we found that the predictions of erosion developed from strict application of the Erodibility Index Method worked well at sites with abundant geologic data directly downstream of the spillway. However, one dam illustrated a mismatch between erosion predictions and historic performance records. This dam had no geologic data from the spillway toe, and was primarily characterized from borings drilled for the dam foundation and from limited outcrops elsewhere onsite. Moreover, the stream power at the toe of this spillway is highly sensitive to the tailwater elevation, and the maximum stream power occurs during the lowest floods considered. This is particularly important for dam safety, because smaller floods occur more frequently than larger floods, and therefore represent a greater risk. Although the Erodibility Index Method provides a useful numerical approach to rapidly assess the potential for erosion at damsites using data that are typically readily available, our study is an important reminder to incorporate professional judgement in both site characterization and hydraulic modeling.