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## **Effects of Breach Formation Parameter Uncertainty on Inundation Risk Area and Consequence Analysis**

According to the national inventory of dams (NID), there are approximately 79,500 dams in the United States, with 11,800 of these dams being classified as high hazard. It has been recommended that each high hazard dam in the United States have an emergency action plan (EAP), but it has been found that only about 60% of the high hazard dams have a complete EAP. A major aspect of these plans is inundation risk area identification and associated impacts in the event of dam failure. In order to determine the inundation risk area, an estimation of breach discharge must be completed. Most methods used to determine breach discharge, including the NWS DAMBRK model, require modelers to select size, shape, and time of breach formation. Federal agencies (e.g. Bureau of Reclamation, Federal Energy Regulatory Commission) with oversight of U.S. dams have recommended ranges of values for each of these categories based on dam type. However, variations in these parameters even within the recommended range have the potential to impose significant transformation on the discharge hydrograph relative to both timing and magnitude of the peak discharge. Therefore, it has also been recommended that sensitivity of these parameters be investigated when performing breach inundation analyses. This paper presents a sensitivity analysis of three breach parameters (average breach width, side slope, time of formation) on a series of dams in the United States. For each dam, the sensitivity analysis employed was based on the 3<sup>3</sup> factorial design, in which three levels (e.g. low, medium, and high) were selected for each of the three parameters, resulting in 27 combinations. The three levels remained within the recommended range of values for each parameter type. With each combination of input parameters, a discharge hydrograph was generated and used as a source condition for inundation analysis using a two-dimensional shallow water equation model. The resulting simulations were compared to determine parameter or combination of parameters sensitivity relative to inundation area, flood velocities, peak depths, and socio-economic impacts (e.g. population at risk, direct and indirect economic loss). Results and discussion from this sensitivity analysis will be presented in detail in the paper.