Spillway Debris Physical Model Study: Morning-glory Spillway Structure

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Physical hydraulic model tests have been performed on two different configurations of a morning-glory spillway (with and without piers) to determine the impacts of reservoir woody debris on the water surface elevation (WSE) behind a dam and the discharge capacity of the spillway structure. Debris jams were formed by steadily introducing woody debris into a reservoir and allowing the jam to form with natural physical processes as the flow approached and passed the spillway structure. Piers would prevent major blockages from occurring within the morning-glory spillway for at least one iteration at every flow rate tested. Without piers, a vortex formed that was able to pass nearly all debris from the reservoir through the transition into the downstream conduit, even if the debris length exceeded the geometric length of the opening. Occasionally, this would cause major jams within the transition and result in the WSE rising to a level that would exceed the model test capacity. For both configurations, debris impacts were greatest during weir flow, specifically discharge capacity reduction. Once the flow regime progressed to orifice or pipe control, debris impacts were reduced because buoyancy kept the debris pieces at the surface of the reservoir. In addition to the natural jam, the debris was manually compacted to form an artificial cluster to formulate an upper limit to debris impacts. Many tests were found to break apart approaching debris clusters by either the piers or the vortex, depending on which was present. Debris presents a significant risk to morning-glory spillways regardless of pier configuration by significantly reducing the discharge capacity, especially when under weir control.