Modeling of Potential Dam Removal Impacts to Habitat, Flooding and Channel Stability on the Carmel River, California

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Abstract: The California Department of Water Resources, Division of Safety of Dams (DWR-DSD), has determined that San Clemente Dam in Monterey County, California, does not meet seismic safety standards. The concrete arch dam, which has a 300-foot wide crest and maximum structural height of 106 feet, was completed in 1921. At the present time, the reservoir behind the dam is nearly filled with sediment, with less than 150 acre-feet of the original 1,425 acre-foot storage capacity of the reservoir remaining sediment-free. Several alternatives are being considered to bring the dam to a safe condition, including lowering the crest of the dam by 19 feet and complete removal the dam. Both of these alternatives will result in the release of part or all of the stored sediment into the downstream reaches of the Carmel River at rates that exceed the historical sediment supply.

A sediment-routing study of the approximately 19-mile reach of the Carmel River between the dam and the Pacific Coast was performed to assess the potential impacts to flooding and fish habitat of various alternatives for releasing the stored sediments. The analysis was performed using the HEC-6T, Sedimentation in Stream Networks, computer code. Typical of most streams that drain from the Southern Coastal Ranges physiographic province, the study reach transitions from a canyon-bound, cobble- and boulder-bed with significant bedrock outcrop control at the upstream end to a sand bed in the downstream 3 to 4 miles of the reach. These characteristics, as well as the highly variable hydrology, presented significant challenges in formulating and applying HEC-6T model. In cooperation with the model's developer, several modifications were made to the computer code to improve its applicability to the problem. These modifications included addition of a routine to vary the Manning's roughness coefficient based on the depth of sedimentation to better reflect hydraulic changes associated with deposition of sand over a cobble and boulder bed, and decoupling of the routines that limit the zones across the cross sections in which aggradation and degradation can occur.

In completing the study, the model was run for several different sediment release scenarios with different hydrologic sequences. Results obtained from the model are believed to realistically describe the magnitude, and temporal and spatial distribution, of those sediment deposits as the elevated sediment loads pass through the reach. This information provided a basis for evaluating changes in flood potential, channel stability, and impacts to instream habitat associated with the deposits.