To support Levee Ready Columbia's effort to re-certify levees along the Columbia and Willamette Rivers and remain accredited, two 2-dimensional hydraulic models, Adaptive Hydraulics and Delft3D-Flexible Mesh, were used to simulate the effects of plausible extreme high water during the 2030 to 2059 period. The Columbia River was simulated from Bonneville Dam to the mouth of Columbia River, and the Willamette River was simulated from Willamette Falls to the Columbia River confluence. Inputs to the models included lidar and bathymetric mapping data to determine bed level, and boundary conditions in the form of daily inflow hydrographs and water levels in the ocean offshore of the mouth of the Columbia River. Future conditions streamflow and coastal ocean water levels were based on climate science data developed by the U.S. Army Corps of Engineers and others. The hypothetical, extreme but plausible, upstream model boundary was based on scaling up the hydrographs from the 1996 flood. Scaling factors were determined by comparing the peak flow rankings determined from flood frequency analyses of historical unregulated periods and 2040s simulated unregulated winter streamflow. The comparison resulted in scaling up the Columbia River hydrograph by 40-percent and scaling up the Willamette River and Lower Columbia River tributaries hydrographs by 20-percent. The downstream ocean boundary was based on a combination of sea-level change, high tide, and storm surge.

The models were calibrated for the 1996 winter and 1997 spring periods. The two models compared well to the measured water-surface elevation over the historical periods and had good performance statistics, with root-mean square error ranging from 0.085 to 0.32 meters, Nash-Sutcliffe values greater than 0.96, and bias ranging from -0.03 to 0.28 meters. The simulated peak stage in the Columbia River at Vancouver, Washington, for 1996 was 9.60 and 9.98 meters compared to the measured peak of 9.89 meters. Future peak stage then was simulated with boundary conditions representing extreme but plausible future conditions at the inflow sites and the ocean boundary.

The two calibrated models compared well in their simulations of extreme but plausible future conditions. For the 0-meter sea-level change scenario, the simulated peak stage in the Columbia River at Vancouver was 11.15 and 11.39 meters; and for the 1-meter sea-level change scenario, the simulated peak stage in the Columbia River was 11.25 and 11.54 meters. The total increase in stage as compared to the 1996 measured peak stage ranged from 1.26 to 1.65 meters.