Multi-proxy sediment records from Castor Lake and Scanlon Lake, north-central Washington, provide a late Quaternary perspective on lake/catchment hydrologic and ecosystem responses to climate change and the Mazama volcanic ashfall event. Analyses of authigenic carbonate mineral oxygen and carbon isotope values, organic carbon and nitrogen content, and sedimentological facies were conducted on sediment from Castor Lake in order to reconstruct lake/catchment hydrologic balance, the source and abundance of organic matter, and variations in lake level. Sedimentary facies characterization was conducted on the Scanlon Lake sediment in order to provide supporting evidence for the lake-level shifts inferred from the Castor Lake data. Marked changes in Castor Lake proxy values occur from 12,860 to 11,440 calendar years before present (yr BP), suggesting lake/catchment responses to the Younger Dryas cold reversal including higher lake levels, substantial variability in productivity, and increased catchment erosion. High delta O-18 values at 9630 yr BP indicate that lake levels were lower than at present and that the early Holocene was dry. Sedimentological analyses and delta O-18 data demonstrate that subsequent to the Mazama climactic eruption (similar to 7600 yr BP), a transition to the lowest lake levels of the Holocene occurred over several centuries, with maximum delta O-18 values at 7290 (90% uncertainty range: 7020-7500) yr BP and low lake levels persisting until 6190 (5960-6410) yr BP. Lithological changes in the Scanlon Lake record support these inferences. The lowest delta O-18 values of the Holocene occur in sediment from similar to 5000 yr BP, indicating high lake levels at this time, after which a secular trend toward higher delta O-18 values and lower lake levels occurred. The prolonged lowstand in the centuries following the Mazama eruption suggests that catchment hydrologic characteristics were strongly impacted by the ashfall through effects on soil water retention capacity, that similar responses may have occurred in comparable settings within the Mazama ashfall zone, and that such volcanic events have the potential confound the climate signal in lake sediment records. Were a similar event to happen in the future, catchment hydrology, stream/river discharge, and lake/catchment ecosystem dynamics could be affected for centuries. (C) 2018 Elsevier Ltd. All rights reserved.