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An Integrated Assessment of Impacts of Altered Flow regimes on Hydrologic, Ecologic, and Economic Conditions within the Walker River Basin

Tracy

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An Integrated Assessment of Impacts of Altered Flow Regimes on Hydrologic, Ecologic and Economic Conditions within the Walker River Basin

Dr. John C. Tracy, Executive Director, Center for Watersheds and Environmental Sustainability, Desert Research Institute, 2215 Raggio Parkway, Reno, NV, 775-673-7385, tracy@dri.edu

Dr. Tom Harris, Professor of Resource Economics, 227A Fleischman Agricultural Building, University of Nevada, Reno, 775-784-16499, harris@cabnr.unr.edu

Walker Lake is a terminal desert lake located in west-central Nevada, whose watershed is 11,110 square km, with its headwaters in the eastern Sierra Nevada range. The headwater flows are primarily comprised of snowmelt that typically peak in the late spring and early summer and total approximately 403 million m^3/yr. At the current time, about 400 million m^3/yr are diverted from the Walker River and its tributaries. Diversions from the Walker River were started in the mid 1800s and are primarily used for irrigated agriculture and are not completely consumptive. Thus, some return flows do migrate back to the main river channels, resulting in an average yearly flow to Walker Lake of approximately 135 million m^3/yr. Due to the hydrologic imbalance created by the diversion of water from the Walker River, Walker Lake's volume has decreased from 11 billion m^3 in the 1880s, to its current level of 1.67 billion m^3. During this time its salt concentration (expressed in TDS) has risen from 2,560 mg/l in the late 1880s, to its current level of over 14,000 mg/l. Under current hydrologic conditions the volume of water in Walker Lake will eventually stabilize at 924 million m^3, and have a corresponding TDS concentration of 35,200 mg/l. Walker Lake serves as a critical resource for a number of aquatic and avian species, most notably the Lahontan Cutthroat Trout (LCT), which is listed as a threatened species. LCT are the only trout native to the Lahontan sub-basin in Nevada. LCT were historically found in the Carson, Humboldt, Truckee, and Walker rivers, as well as associated tributary lakes and streams. Historical distribution of LCT in the Walker Basin includes Walker Lake and its tributaries to the headwaters of the West and East Walker River watersheds. The LCT in Walker Lake today do not reproduce due to a lack of access to spawning habitat in the Walker River and unsuitable lake conditions. The LCT in Walker Lake are raised in hatcheries and stocked in the lake. High water temperatures and unsuitable alkalinity, salinity, and other geochemical conditions at present in the lake preclude growth of individuals to large size. LCT can tolerate high amounts of dissolved solids (>10,000 mg/l) because acute alkaline exposure is part of the LCT "natural" life cycle. However at TDS concentrations above 13,000 mg/l LCT exhibit an increased mortality rate, with complete mortality at TDS concentrations above 16,000 mg/l. To prevent the TDS concentration in Walker Lake from reaching 16,000 mg/l, inflows to Walker Lake will have to balance evaporation from the lake, which will require an additional inflow to Walker Lake of approximately 64 million m^3/yr. A potential plan that has been put forth to provide for this increased inflow to Walker Lake is the purchase and transfer of water rights from willing sellers in agricultural regions to Walker Lake. However, there is concern that this plan could damage Walker Basin's agricultural economy. Analyses are performed to determine how water rights purchase strategies affect water quality conditions in Walker Lake, agricultural lands under production, agricultural economic output and the overall economic output from the basin. These analyses demonstrate that to increase flow to Walker Lake by the required amount that approximately 30% of water rights within the watershed would have to be retired. This purchase of water rights would translate into a 25% reduction in agricultural lands, decreases in employment and economic output in the agricultural sectors in the watershed, but extremely small changes in the overall employment and economic output for all economic sectors within the Walker River watershed.