“Understanding the source of water for selected springs within Mojave Trails National Monument, California” – Study Highlights

About the Study

This investigation (“Understanding the source of water for selected springs within Mojave Trails National Monument, California”), was conducted by **Andy Zdon, Technical Director of Water Resources at Partner Engineering and Science;** M. Lee Davisson, PG, of ML Davisson & Associates; and Adam H. Love, Ph.D., of Roux Associates, with funding provided by Mojave Desert Land Trust.

This analysis was performed with the intent to **better understand the water source that sustains Bonanza Spring**, neighboring Lower Bonanza Spring, and the desert ecosystem that is dependent on those resources. Due to the **striking differences in physical character** between Bonanza Spring and other springs in the Clipper Mountains, this study sought a greater understanding of Bonanza Spring and the causes for its physical differences.

[S]ubstantial groundwater development is proposed for export out of the region. Proposed groundwater development is anticipated to be **in excess of the groundwater recharge to the basin**, resulting in basin aquifer drawdown from pumping upgradient, and impacts to elevations above Bonanza Spring.

About Bonanza Spring

Bonanza Spring [is] the largest spring in the southeastern Mojave Desert… and has generally been assumed to be a **perched spring disconnected from the basin-fill aquifer system**.

Generally, most of the springs in the Mojave Desert are “local” or “perched” springs that are the result of precipitation in their local watershed that percolates into the ground, only to reach the surface where bedrock restrictions to underflow force water to the surface.

Bonanza Spring has exhibited a relatively **steady flow** that has been noted back to that reported by Thompson in 1929, which **contrasts with other area springs** with more seasonal flow. A spring flow system that is more regional in nature would leave Bonanza Spring potentially **more susceptible to regional pumping impacts** than springs such as Hummingbird.

Study Conclusions and Implications for Bonanza Spring

Whereas other springs in the area, Hummingbird, Chuckwalla, and Teresa Springs, each appear to be locally sourced as “perched” springs… water within Bonanza Spring is **from a basin-fill water source**, deriving its water from recharge north of the Clipper Mountains, such as the Providence and New York Mountains, and **could be impacted if groundwater levels decrease at, or near, the spring**.

Future groundwater development in the region, should it occur, should be cognizant of **the likelihood of a hydraulic connection** between the recharge area for Fenner Valley, and Fenner Valley itself with Bonanza Spring. Based on the existing source characterization of Bonanza Spring, **a reduction in**

groundwater level could result in an uncertain, but potentially substantial decrease in free-flowing water from the spring source.

[E]xpansion of a cone of depression in areas of substantial pumping, and limited recharge, can occur for periods long after pumping ceases (100 years or more). This is due to the continued drawing in of more distant groundwater to infill the recovering cone of depression.

Additional monitoring wells between a proposed well field in Fenner Valley and the spring would provide a means to identify early changes to the groundwater system indicative of future impacts on Bonanza Spring. Additionally, **reliance on observable changes at the spring as a trigger for changes in groundwater management or usage will not be an effective protective measure** due to the delays in groundwater changes described above.

Supporting Data

[T]he **water directly at the source location is 6.5_C warmer than the average annual temperature**. This indicates that the water issuing from Bonanza Spring has been at a depth of at least 750 feet below ground surface.

Bonanza Spring **flow has been consistent for more than 100 years** despite multi-year wet periods and longer periods of drought (as indicated by the literature).

Isotopic signatures [are] consistent with past studies (e.g., Davisson (2000)) of waters in Fenner Valley and Mojave National Preserve indicating waters derived from sources north of the Clipper Mountains such as the New York Mountains or Providence Mountains.

[I]sotopic signatures of precipitation collected in the Clipper Mountains are much higher than those at Bonanza Spring.

[Water samples indicate] that the **spring water has a composite age greater than 65 years old** despite the limited size of the watershed.

[S]ite field conditions related to large size of the spring and associated small watershed size indicate that the spring flow observed is not compatible with its watershed and the low volume of precipitation anticipated in that watershed.

Research Methods Used in the Study

The source of spring flow at Bonanza Spring was evaluated through an integration of **published geologic maps, measured groundwater levels, water quality chemistry, and isotope data** compiled from both published sources and new samples collected for water chemistry and isotopic composition.

During site visits, field water quality parameters of temperature, pH, electrical conductivity, and dissolved oxygen were measured at the sources of the springs. Field instruments were checked for calibration daily, if not at higher frequencies.