GEOLOGY & HYDROLOGY EXPERTS REVIEW 2018 BONANZA SPRING ASSESSMENT

(1-30-18) Scientists and investigators have long maintained that the 11-mile distance and 1,100-foot elevation difference between the Cadiz Water Project and the closest spring – Bonanza Spring – make it improbable that drawing water from the "alluvial" aquifer in the Cadiz Valley would impact springs, which support desert flora and fauna. This scientific determination was validated through the Project's California Environmental Quality Act environmental review process in 2012 and then upheld in court in 2014 and by the CA Court of Appeal in 2016. San Bernardino County, which is charged with regulating groundwater in the area, established a management plan for the Cadiz Water Project that includes regular monitoring of Bonanza and two additional springs in the watershed to ensure the scientific conclusions remain constant.

Despite formal government review and approvals, project opponents have continued to express concerns about potential impacts of the project. To resolve all questions and address any lingering concerns about the project, Cadiz asked structural geologist and Mojave Desert expert Miles Kenney Ph.D. to conduct a focused study of Bonanza Spring in the western Clipper Mountains. His work involved several months of study in late 2017 and early 2018, including six days field mapping in the area of Bonanza Spring and detailed aerial image mapping. Dr. Kenney's findings indicate that two important geologic features led to the development of Bonanza Spring. These include the intersection of two impermeable fault zones at the Bonanza Spring and extensive exposures of volcanic bedrock north of the spring in the Clipper Mountains. According to hydrologist Terry Foreman and subsequent peer review, the fractured bedrock allows locally derived groundwater to feed the spring from precipitation seeping down from higher elevations, not groundwater in the alluvial aquifer below, which is separated by unsaturated soils and faulting.

Peer Review: In December 2017, 10 professional hydrologists and geologists visited Bonanza Spring with Dr. Kenney and Mr. Foreman to review and observe the Spring. In January, after Dr. Kenney and Mr. Foreman completed their written report (Kenney and Foreman, 2018), five of the professionals who visited Bonanza in December peer-reviewed the report and concurred with its conclusions that Bonanza Spring would not be impacted by the regulated conservation of groundwater at Cadiz. A selection of comments from the field visit and subsequent peer review can be found below.

Miles Kenney, PhD
Professional Geologist

"I believe that I was able to provide very strong Geologic Evidence regarding why the Bonanza Spring occurs where it does.

"The most compelling finding is that we found two relatively robust fault zones that show evidence of being impermeable to groundwater that intersect essentially exactly at Bonanza Spring. I have found fault zones that intersect right where the spring is. Fault zones are well known to be groundwater barriers, and we found that to be the case here.

"Additionally, and importantly, I identified an abundant exposure of volcanic rock, faults, and dikes upslope from Bonanza Spring and the two most prominent fault zones that locally intersect exactly where the spring is. It's the first time we have an explanation for why the

spring is here and we also found evidence that the spring has been here for hundreds of thousands of years."

Terry Foreman, CHG
Professional Hydrogeologist

"Dr. Kenney's field work and analysis demonstrate that two distinct faults have separated the Spring from the alluvial aquifer in the Fenner Gap. They have created a catchment area that provides a perennial recharge and source of water to Bonanza from above and are independent of the alluvial aquifer water table in the Valley miles below.

"From this data I was able to determine that there is sufficient groundwater production from precipitation and groundwater migration to perennially maintain Bonanza.

"This means Bonanza Spring is hydraulically disconnected from the groundwater system supplying Cadiz."

John Sharp Jr., Ph.D.
Professor of Geology – University of Texas at Austin

"Dr. Kenney knows more about the geology of that area than anyone else… he's the expert.

"Dr. Kenney mapped a fault where the spring occurs that acts as a dam. When you get rainfall coming down, it gets into the cracks in the rocks at higher elevations and flows downhill until it hits the fault and backs up. The water exits right at the spring, where there are fractures in the rock."

"Bonanza Spring and Cadiz are not connected. If it was a connected system, the spring wouldn't be there, it would be flowing farther downhill.

"Having reviewed Dr. Kenney's mapping and explanation of the geology in the area, I am convinced that the projected pumping for Cadiz is not going to have any measurable effect on Bonanza Spring at all. The threat to Bonanza Spring comes from a change in rainfall patterns and drought caused by climate change."

Mark Wildermuth
President, Principal Engineer – Wildermuth Environmental Inc.

"Miles prepared a wonderful geologic assessment of the area that makes a lot of sense hydrologically and geologically.

"This study disproves an earlier speculation that contends groundwater was going to flow 30 miles across the valley by some undefined means and show up at the Bonanza Spring. Miles' assessment shows there is no connection between the regional aquifer system and the spring, making such a groundwater flow impossible.

"There is plenty of evidence to show there is a catchment area, or drainage basin, on the surface upstream of the spring where rainwater can collect and support spring discharge. This is a local hydrologic feature, not part of the regional system."

Timothy K. Parker, PG, CEG, CHG
Principal, Parker Groundwater

"Overall the report is well written and technically sound and I concur with the conclusions."

Dennis Williams, Ph.D.
President, GEOSCIENCE

"The report is compelling and consistent with historical conclusions that the Bonanza Spring exists separately from the alluvial aquifer and is recharged from above not below. The geology is only understood when standing at the site. The site visit put these conclusions into perspective – the distance, elevation and landscape all contribute to the validity of the report."

Anthony Brown
CEO, Principal Hydrologist – Aquilogic

"The existence of qanats above Bonanza Spring makes it clear that the spring was historically at a higher elevation. Qanats are part of an ancient system used in arid climates to move water from an elevated source through underground tunnels. These qanats at Bonanza Spring were dug into the existing bedrock to intercept water.

"They went to a lot of effort to dig a tunnel here at elevation 30 feet above the elevation of the current spring, which would suggest to me that historically the spring was at a much higher elevation. At this location is where they felt they would capture the most water. So what we're seeing is essentially 30 feet of fluctuation just from natural recharge changes over the past 100 years.

"The natural changes in recharge effects over the last century have had a much more dramatic effect on the location of the spring than any projected pumping the Cadiz project would likely have."

To view the entire study and supporting material, visit
http://www.cadizwaterproject.com/2018-bonanza-spring-study/

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