ADEQ
Arizona Department of Environmental Quality
Janet Napolitano, Governor
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# FACT SHEET

## Ambient Groundwater Quality of the Hualapai Valley Basin: A 2000 Baseline Study – March 2007

**Figure 1 -** *Monsoon rains fill this stock tank that were diverted from Truxton Wash, below which the channel becomes braided before flowing into Red Lake, a large playa located in the center of the Hualapai Valley basin.*

### INTRODUCTION

In 2000, a baseline groundwater quality study of the Hualapai Valley basin (HUA) in Mohave County was conducted by the Arizona Department of Environmental Quality (ADEQ) Ambient Groundwater Monitoring Program, as authorized by legislative mandate in Arizona Revised Statutes §49-225. This fact sheet is a synopsis of the ADEQ Open File Report 07-05.[1]

HUA trends north-northwest and is roughly 60 miles long and varying from 15 to 25 miles wide in northwestern Arizona. The basin covers 1,820 square miles in Mohave County stretching from Hualapai Mountains just south of the City of Kingman to Lake Mead to the north.[2] The basin is composed of lands federally managed by the Bureau of Land Management, the National Park Service (as part of the Lake Mead National Recreation Area), private, State Trust and Hualapai Indian Nation lands. Land use is mainly rangeland and recreation, with private lands especially near Kingman, increasingly developed for residential housing.

### HYDROLOGY

There are no perennial streams in the HUA basin.[2] The southern portion of the basin is drained by an ephemeral watercourse, Truxton Wash, which flows north and debouches after heavy precipitation into the normally dry Red Lake Playa, underneath which exists a large salt body.[3] The other major ephemeral watercourse, Hualapai Wash, runs north of Red Lake Playa after heavy precipitation and debouches into Lake Mead.[2] Although the Colorado River, impounded in Lake Mead, forms the northern boundary of the basin, it is not a significant water supply within the HUA basin.

Groundwater is the major source of water in the HUA.[3] It occurs in both the extensive older alluvium deposits found in Hualapai Valley and, to a lesser degree, the fractured rock and thin alluvium deposits of the Hualapai, Peacock, Music, and Cerbat Mountains.[2] Historically, low-yield wells and springs located in or near mountain areas provided the main source of water for the minimal domestic, stock and mining needs of the local economy. Deep, high-yield wells located in the valley alluvium are currently the main supply source for major water users in the basin including the City of Kingman and outlying housing developments.[2]

### METHODS OF INVESTIGATION

All 26 sites were sampled for inorganic constituents. Also collected at selected sites were volatile organic compounds (VOCs)(21 samples), radiochemistry (unstable elements such as uranium, thorium or radium that release radioactivity in the form of alpha, beta and gamma radiation) (16 samples) and radon (8 samples). Groundwater sites consisted of 20 relatively shallow, domestic or stock wells and/or springs in bedrock mountain areas and 6 deep wells in the valley alluvium.

Sampling protocol followed the *ADEQ Quality Assurance Project Plan*. Based on quality control data, the effects of sampling equipment and procedures were not found to be significant based on seven quality assurance/quality control tests.

### WATER QUALITY SAMPLING RESULTS

The groundwater sample results were compared with Environmental Protection Agency (EPA) Safe Drinking Water (SDW) standards. Of the 26 sites sampled, 9 sites (35 percent) met all federal water quality standards and guidelines. (See map on next page.)

No VOCs were detected in any of the 21 samples with the exception of toluene at 4.7 micrograms per Liter in one sample. One radon sample exceeded the proposed 4,000 picocuries per liter standard.

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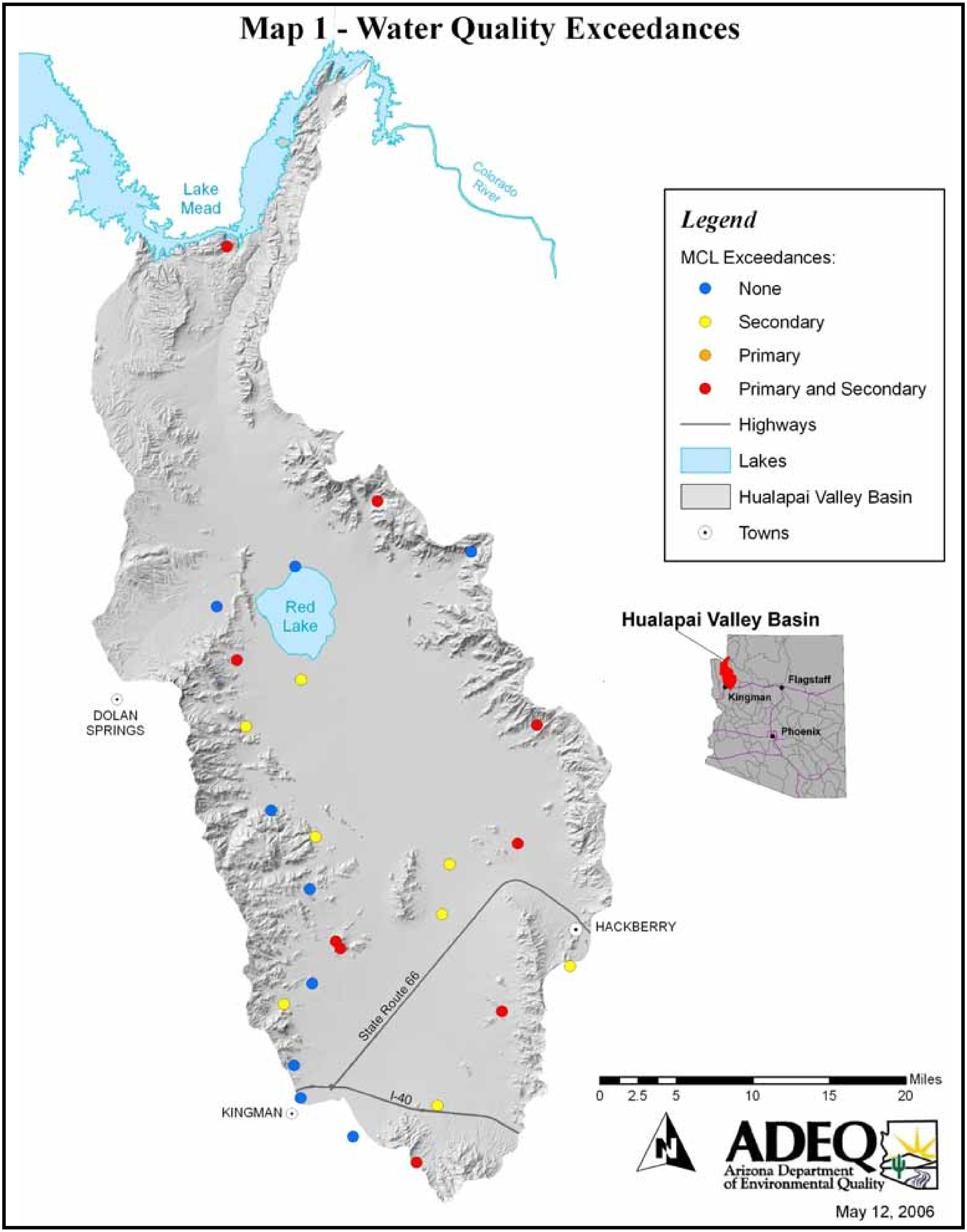



**Map 1 -** *Sample sites in Hualapai Valley are color-coded according to their water quality standard status.*

**Figure 2 -** *The Hualapai Basin ends at Lake Mead, created in 1936 with the impoundment of the Colorado River by Hoover Dam.*

EPA SDW Primary Maximum Contaminant Levels (MCLs) are enforceable, health-based water quality standards that public water systems must meet when supplying water to their customers. Primary MCLs are based on a daily lifetime consumption of two liters of water. Of the 26 sites sampled, 9 sites (35 percent) had concentrations of at least one constituent that exceeded a Primary MCL. Health-based exceedances included arsenic (3 sites), fluoride (2 sites), gross alpha (3 sites), nitrate (3 sites), radium 226/228 (1 site), and uranium (2 sites).

**Figure 3 -** *Wells in the Hualapai Valley basin are capable of producing upwards of 1,000 gallons per minute, including this 1,059 feet deep irrigation well off Route 66 between Kingman and Hackberry. The sample from this well met all health-based water quality standards.*

EPA SDW Secondary MCLs are unenforceable, aesthetics-based water quality guidelines for public water systems. Water with Secondary MCLs may be unpleasant to drink and/or create unwanted cosmetic or laundry effects but is not considered a health concern. At 17 sites, concentrations of at least one constituent exceeded a Secondary MCL. Aesthetics-based exceedances included chloride (2 sites), fluoride (11 sites), iron (2 sites), manganese (3 sites), pH-field (2 sites), sulfate (2 sites), and total dissolved solids or TDS (11 sites).

## GROUNDWATER COMPOSITION

Analytical results indicate that groundwater in the HUA is generally *slightly alkaline, fresh, and hard to very hard* based on pH values, TDS and hardness concentrations. Groundwater sample chemistry varied widely with mixed-mixed (no dominant cation or anion) and mixed-bicarbonate the most common compositions (Figure 4). Among trace elements, only boron, fluoride, selenium and zinc were detected at more than 20 percent of sample sites. Nitrate concentrations were sometimes elevated, with 11 sites (42 percent) having concentrations (>3 milligram per liter as nitrogen) that may be from human activities.

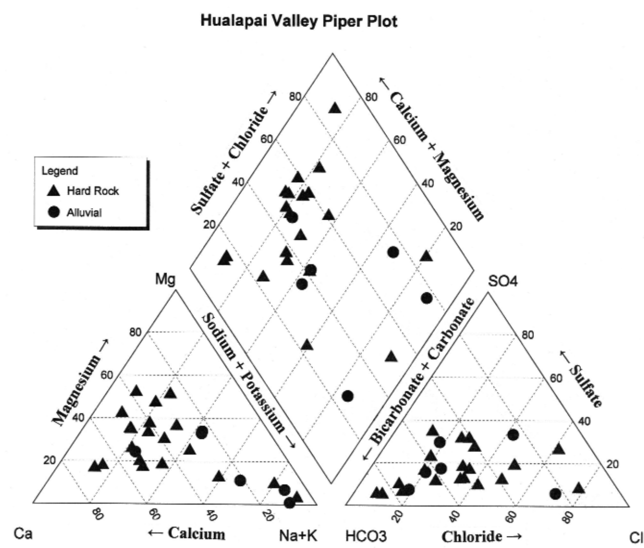



**Figure 4 -** *This diagram shows sample sites in the Hualapai Valley basin vary widely in water chemistry. In most samples, calcium/magnesium is a larger cation component of the water than sodium/potassium while bicarbonate/carbonate and sulfate/chloride are evenly split as to which is the larger anion component.*

Statistically-significant patterns were found among groundwater water sources (ANOVA test, $p \leq 0.05$). Temperature (field-measured), pH (field-measured), and fluoride (Figure 6) were significantly higher at sites in the alluvium than at sites in hardrock. In contrast, calcium, magnesium and hardness were significantly higher at sites in hardrock than in alluvium. TDS and bicarbonate were also higher at sites in hardrock than in alluvium but just missed the statistical confidence level.

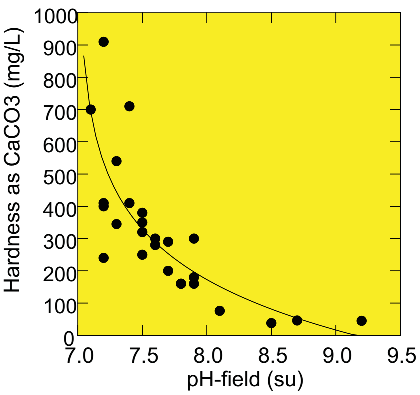
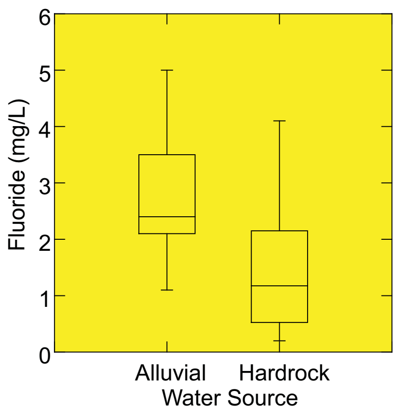



**Figure 5 -** *As pH-field values increase, hardness concentrations tend to decrease in this negative correlation that is statistically significant ($p \leq 0.05$). The pH – hardness relationship has been found in other Arizona groundwater basins and is likely related to precipitation of calcite in response to increases in pH.*[4]

**Figure 6 -** *Fluoride concentrations are significantly higher in the alluvium than in hardrock (ANOVA test, $p \leq 0.05$). Although calcium can be an important control on this constituent, fluoride's relatively low concentrations ($\leq$ 5 mg/L) in the study area suggest hydroxyl ion exchange or sorption/de-sorption reactions are the important fluoride controls in Hualapai Valley.*[4]




The limited sampling conducted in wells situated in the older alluvium—the aquifer that stores the majority of water reserves in the HUA—revealed generally acceptable groundwater quality with fluoride the only constituent of concern. Fluoride exceeded health based standards in one well and aesthetics based standards in four other wells; otherwise pH-field and TDS were the only aesthetic standards exceeded in one well apiece. The elevated fluoride concentrations are believed to occur naturally and are controlled by pH values that also increase downgradient through silicate hydrolysis reactions.[4]

## CONCLUSIONS

Of the 26 samples collected in the HUA, roughly one-third met all health and aesthetic water quality standards. Constituents exceeding health-based standards were arsenic, nitrate, gross alpha, fluoride, uranium and radium-226/228. TDS and fluoride most commonly exceeded the aesthetics-based standards. These water quality exceedances appear, with the possible exception of nitrate, to be the result of naturally occurring geochemical processes. This conclusion is based on the relatively remote and undeveloped nature of the basin as well as other nearby, lightly developed, groundwater basins in Mohave County having similar constituent exceedances.

Most importantly, the limited sampling of wells tapping the valley's older alluvium—the most important aquifer in the HUA—revealed mostly acceptable groundwater quality in contrast to the more variable water quality found in—and adjacent to—hardrock mountains. This pattern largely supports earlier studies that indicated groundwater generally meets water quality standards but in some areas, usually near the edge of the older alluvium or within the fractured or weathered crystalline rocks or the thin patches of alluvium in the mountains, the water can be highly mineralized.[3, 5]

Several factors may contribute to this water quality difference. The main source of recharge to the older alluvium is from streambed infiltration near the apexes of dissected alluvial fans which extend into the mountain canyons.[3] This recharge should be relatively dilute, high quality water since it travels only a short distance percolating from the stream channels to the underlying aquifer—and therefore, has little opportunity to dissolve and transport minerals.[5] Recharge moving through fractured bedrock aquifers in the mountains is likely to have higher concentrations of dissolved minerals because of the greater distance traveled through weathered, mineralized zones—especially where mining areas expose ores to oxidation and subsequent contact with percolating groundwater.[5] The older alluvium near the peripheries of Hualapai Valley may also receive significant quantities of water recharged via this pathway.

## FOR MORE INFORMATION

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Maps by Lisa Rowe

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