Effects of the Drought on Water Quality in Lake Mead

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One of the most glaring effects of the ongoing drought on the Colorado River system is dramatically reduced reservoir levels. But lower reservoir levels mean all the constituents in the water become concentrated, affecting water quality. How have the changes in water quality in Lake Mead influenced drinking water quality and efficiency of drinking water treatment for Southern Nevada?

Lake Mead is the major reservoir on the Colorado River below Lake Powell and the Grand Canyon, formed by the construction of Hoover Dam in 1935. The lake's maximum surface area is approximately 247 square miles and the maximum surface elevation is 1,221.4 feet above mean sea level. It extends east 110 miles from Hoover Dam to the west end of the Grand Canyon and has a shoreline length of approximately 550 miles. Lake Mead contains three large basins: Boulder, Virgin, and Gregg (see map). Sources of water to Lake Mead are the Colorado River (97 percent), the Muddy and Virgin Rivers (1.5 percent) and the Las Vegas Wash (1.5 percent). At maximum capacity, Lake Mead holds approximately 28.5 million acre-feet of the 60 million acre-feet of storage on the Colorado River system. This storage declined from 24 million acre-feet in January 2000 to approximately 14 million acre-feet at the end of 2004.

Las Vegas Valley's Water Supply

Approximately 90 percent of the domestic water supply for the Las Vegas Valley is withdrawn from the Boulder Basin at Saddle Island. This supply is pumped through two intake structures to two different treatment facilities, Alfred Merritt Smith Water Treatment Facility and River Mountains Water Treatment Facility. Both facilities treat the water by predisinfection with ozone, the addition of ferric chloride, flash and rapid mixing, flocculation, direct filtration, the addition of zinc orthophosphate to inhibit corrosion, and post-chlorination. The two water treatment plants are capable of processing 750 million gallons of water per day.

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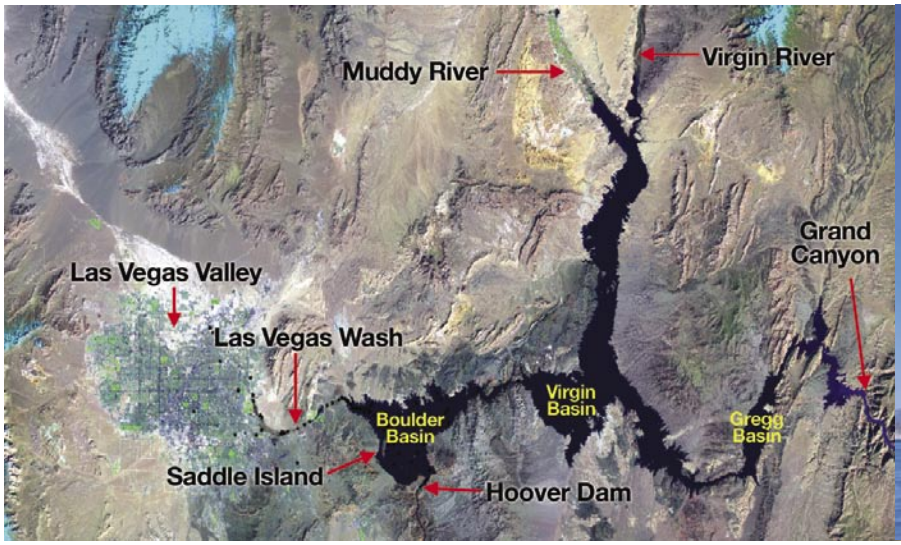
TDS, Bromide, and TOC

Three water quality parameters that have been influenced by drought in Lake Mead are total dissolved solids (TDS), bromide, and total organic carbon (TOC). The chart below shows the average concentration of each in Boulder Basin, Lake Mead. These constituents have increased primarily due to concentration from evaporation.

Because TDS affects the palatability of a drinking water source, the U.S. Environmental Protection Agency has set a secondary aesthetic standard for drinking



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water of 500 mg/L. Nevada's standard for TDS is 1,000 mg/L. TDS of water in Boulder Basin increased 11 percent from 2000 to 2004, to 1,021 mg/L. Water entering the water treatment facility is drawn from lower elevations in the lake where it is not as susceptible to the effects of evaporation, but TDS of water entering the water treatment plant increased nine percent during that period of time, to 635 mg/L. Some Las Vegas residents find the drinking water unpalatable due to high concentrations of TDS. Increasing TDS concentrations because of the drought have only intensified and spread this dissatisfaction with the taste.

The increase in bromide and TOC are more of a concern from a drinking water treatment perspective. For example, when drinking water is disinfected with ozone and bromide is present, bromate is produced. Higher bromide concentrations and an elevated ozone dose results in the production of more bromate. The bromide concentration has increased 36 percent, from 0.068 mg/L to 0.106 mg/L, in Boulder Basin, while the concentration of bromide entering the water treatment plant has increased 40 percent. Bromate in drinking water is regulated by EPA under the Disinfection By-Products Rule. Water treatment processes have been modified to ensure the bromate concentration in the drinking water does not exceed the EPA standard of 0.01 mg/L. According to the 2004 Consumer Confidence Report (CCR) for the Las Vegas Valley Water District, the bromate concentration in drinking water averaged 0.006 mg/L.

TOC is a precursor in the formation of trihalomethanes (THMs), which are also regulated under EPA's Disinfection By-Products Rule. THMs are formed when TOC comes in contact with chlorine. Chlorine is used as a disinfectant in Las Vegas and many other drinking water supplies. Similar to bromate, higher TOC concentrations and elevated chlorine doses result in production of more THMs in the drinking water supply. TOC in Boulder Basin increased from 2.9 mg/L to 3.8 mg/L from 2000 to 2004 (up 24 percent), while TOC in the water entering the treatment plant increased 28 percent (3.6 mg/L). The EPA limit for THMs is 0.08 mg/L. The concentration of THMs in Las Vegas drinking water averaged 0.052 mg/L according to the 2004 CCR. An increase in either of these disinfection by-products requires additional drinking water treatment processes to prevent their formation.

Into the Future

The 2000 to 2004 drought in the Colorado River watershed significantly impacted water quality in Lake Mead and the domestic water supply for Southern Nevada. Although these issues will continue and intensify for the duration of the drought, the Southern Nevada Water Authority will make changes to water treatment processes as necessary to continue to protect the quality of Southern Nevada's domestic water supply.

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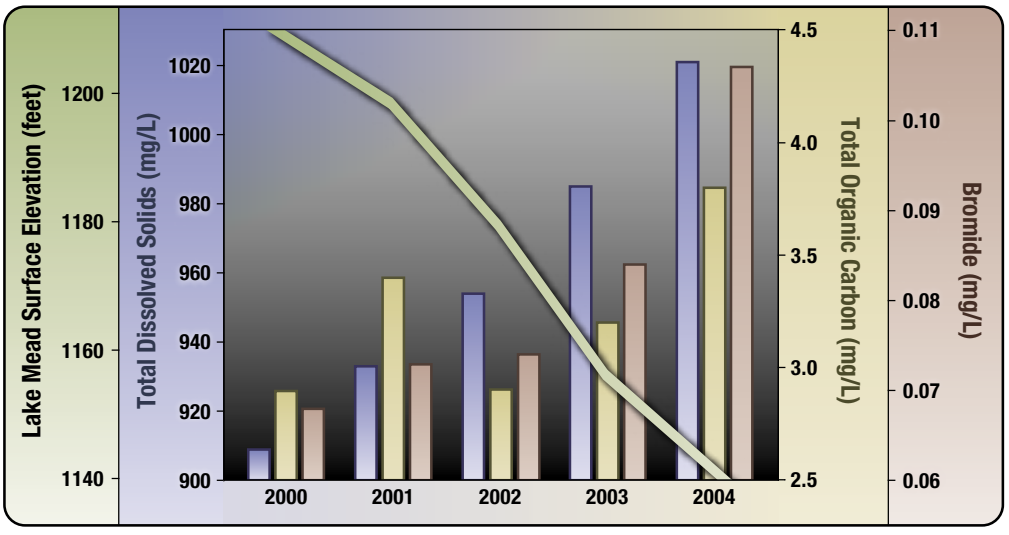

Average concentrations of bromide, total organic carbon, and total dissolved solids (calculated from specific conductance) in Boulder Basin of Lake Mead, 2000 - 2004.