Water Supply Planning for the Morongo Basin Area

Overview

The Morongo Basin is located in California's High Desert, east of the San Bernardino Mountains. The study area includes the Town of Yucca Valley and the communities of Joshua Tree and Landers. Population has grown significantly over the last 10 years and is projected to continue to grow for at least the next 25 years. The basin has a limited available water supply, but as population increases, water demands will also increase. In order to meet future water demands, either additional water supply will have to be imported to the area, significant water conservation will have to occur, or a combination of the two.

(Fig 1: Morongo Map "Study Area")

Background

The study area is part of a larger closed groundwater basin. A groundwater basin is a sub-surface basin in which groundwater collects or is retained, or from which groundwater may flow. Natural water supply to the study area comes from storm water flows and is estimated to average 731 acre-feet per year (AFY). This estimate is derived by taking the average amount of water that flows into the basin (inflow) minus the average amount of water that flows out of the basin (outflow). The study area is made up of four smaller groundwater basins; the natural water supply to each basin is indicated in Table 1, below.

Table 1. STUDY AREA ESTIMATES OF NATURAL SUPPL	LY (AFY)
Joshua Tree/Copper Mountain Valley Basin	104 -
Ames/Means Valley Basin	523 3
Johnson Valley	0 3
Warren Valley	<u>104</u> ²
Total Average Natural Supply	731

Net Natural Supply to the groundwater basin is equal to the "Safe Yield" – this is the amount of water that can be consumptively used each year from the basin without causing eventual depletion or contamination the supply.\(^1\) Consumptive use is water removed from available supplies without direct return to the groundwater basin for uses such as manufacturing, agriculture, and food preparation.\(^1\) It is important to distinguish consumptive use from the amount of water pumped from the basin, or "gross water use.\(^1\) The consumptive use is about 50\% of the gross use because only half leaves the basin and

¹ Oeste Hydrologic Atlas. California State University Fullerton and Mojave Water Agency. July, 2009.

² USGS Scientific Investigations Report 2004-5267. "Evaluation of Geohydrologic Framework, Recharge Estimates, and Ground-Water Flow of the Joshua Tree Area," 1994. Represents 1/2 of 207 acre-feet of recharge total for both the Copper Mountain and Warren Valley basins combined.

³ "Basin Conceptual Model and Assessment of Water Supply and Demand for the Ames Valley, Johnson Valley, and Means Valley Groundwater Basins", April 2007, Kennedy/Jenks/Todd LLC. Ames = 523 AFY; Means = 0 AFY.

the other half returns to the groundwater (for example, most of the water used inside a house [showers, sinks, etc.] flows down the drain, enters a septic tank/sewer system, and after some amount of time returns to the water table). Therefore, when looking at water supply amounts, a supply can actually provide for double the gross amount of water pumped (i.e. 731 AFY of natural supply effectively provides for 1,462 AFY of gross pumping because only 731 AF is consumptively used).

In the Morongo Basin, the safe yield is less than the consumptive use. In order to make up the difference in water demand, the area receives water from the State Water Project (SWP) to supplement natural supply. The California State Water Project is a water storage and delivery system of reservoirs, aqueducts, and pumping plants that delivers water from the Sacramento-San Joaquin Delta to urban and agricultural water users in Northern, Central and Southern California.⁴ SWP water is imported to the Morongo Basin through a pipeline that delivers water from the aqueduct in Hesperia to groundwater recharge locations in Landers, Yucca Valley, and in the future to Joshua Tree. The maximum supply available from the SWP is 7,257 AFY,⁵ with an average annual supply of 3,628 AFY. Total supply to the basin, including natural and SWP supply, is 4,359 AFY (731 AFY average natural inflow + 3,628 AFY average annual imports). Remember: 4,359 AFY of supply is enough to meet 8,718 AFY of gross water production.

Beneficial water use in the study area is entirely for municipal purposes (residential, commercial, and public; there are currently no major agricultural or industrial water users). A majority of the water use is residential, with the remainder being used for commercial, office, schools, parks, etc ("Other Municipal"). Water demand has increased as population has increased, but has remained relatively flat on a per-person basis. Table 2, below, depicts water use and population for the study area from 2000 to 2008. Water is supplied to retail customers (businesses, homeowners) by four separate water districts; however, for the purpose of simplification only the totals for the study area are indicated below.

Table 2. STUDY AREA WATER DEMAND (ACRE-FEET) AND POPULATION									
Residential ⁶	4,268	4,201	4,798	4,109	4,819	4,612	4,762	5,201	4,639
Other Municipal ⁶	1,172	1,322	1,033	1,237	1,047	1,263	1,557	1,245	1,225
Gross Water Use ⁶	5,440	5,524	5,831	5,346	5,866	5,875	6,319	6,446	5,864
Population ⁷	32,218	32,404	32,669	33,092	33,989	35,017	36,068	36,777	36,996

In order to normalize data, water use is often discussed in Gallons Per Capita per Day (GPCD), allowing for comparison from one year to the next or one group of people to the next, regardless of differences in population. GPCD is also often used to project future water demand, because it is the correlation between population and water use (i.e. population multiplied by GPCD yields the total water use for the population). Table 3, below, indicates the GPCD water demand in the study area.

⁴ CA Department of Water Resources State Water Project Website. http://www.water.ca.gov/swp/.

⁵ Agreement for Construction, Operating and Financing of the Morongo Basin Pipeline Project, March 15, 1991.

⁶ Water use data source: Mojave Water Agency

⁷ Population estimates were derived from ESRI data, accessed in 2009 at http://www.primarydatasource.com.

Table 3.										
STUDY AREA WATER DEMAND (GALLONS PER CAPITA PER DAY)										
	2000	2001	2002	2003	2004	2005	2006	2007	2008	
Residential ⁶	118	116	131	111	127	118	118	126	112	
Other Municipal ⁶	32	36	28	33	27	32	39	30	30	
Gross GPCD ⁶	151	152	159	144	154	150	156	156	141	
Average Residential: 120 GPCD Average Other: 32 GPCD Average Overall: 152 GPCD										

In the study area, the GPCD is low compared to other areas (it is over 200 in most of Mojave Water Agency's service area). This means some water conservation has already occurred. Residential water use nationwide is estimated at 172 GPCD; with 71 GPCD used indoors and 101 GPCD on landscape irrigation. With the study area at 120 GPCD for residential use, it is unknown how much of the conservation occurred indoors versus outdoors; however, the area is known for having desert landscaping and little turf or high-water-use plants. The California Department of Water Resources has estimated homes with water-efficient indoor fixtures use an average of 34 GPCD, both half of what a typical household in the United States uses indoors. Additionally, outdoor use can be reduced to nearly zero with desert landscaping and native plants. All non-residential water use currently averages 32 GPCD (gross use at 152 GPCD minus residential use at 120 GPCD); but again it is not known how much water is used for landscaping versus indoors or what level of conservation has already occurred for indoor use in the non-residential sectors. It is probably safe to assume non-residential water use has the potential to conserve at least 10%.

An acre-foot equals 325,851 gallons; so in the study area where the average residential water use is 120 GPCD, a household of three would use 0.40 acre-feet per year (120 gal x 3 persons x 365 days \div 325,851 gals). For gross water use, at 152 GPCD, the average in the study is 0.17 AFY. This means that the current effective supply to the region of 8,718 AFY is enough water to serve 51,282 people (8,718 \div 0.17). Population in the study area is projected to increase from 36,996 in 2008 to 70,956 in 2035. ¹⁰ If per-capita use remains the same as it is today (i.e. no water conservation occurs), water demand will increase to over 12,000 AFY by 2035.

Table 4.							
PROJECTED PO	PULATION						
	2008	2010	2015	2020	2025	2030	2035
Population	36,996	39,512	45,800	52,089	58,378	64,667	70,956
Gross GPCD	152	152	152	152	152	152	152
Water Demand	6,299	6,727	7,798	8,869	9,940	11,010	12,081
Water Supply	8,718	8,718	8,718	8,718	8,718	8,718	8,718

Future water supply is a very important issue for every community. Water providers use information similar to what has been described so far to plan ahead and make decisions about future water supply. Adding new water supplies is very expensive; cost is one of the primary factors in making those types of decisions. The Mojave Water Agency recently purchased additional State Water Project water rights

⁸ Residential Water Use Summary, American Water Works Association and Aquacraft. 1999. http://www.aquacraft.com/Publications/resident.htm.

⁹ CA Department of Water Resources Urban Drought Guidebook 2008 Update

¹⁰ Projected population in Morongo derived from data from the San Bernardino Associated Governments (SANBAG).

(known as "Table A") for about \$5,000 per acre-foot. Water conservation is also an option to add more supply – by reducing the amount of water currently used and thereby making that water available for future use. Incentive programs – in which water providers such as MWA pay people to conserve water (for example, to replace grass with desert landscaping, or to replace old toilets with water-conserving ones) – are one way for a water provider to implement water conservation. The cost of conservation varies depending on the specific program. Removing grass may only cost \$3,000 per acre-foot conserved; whereas incentives to replace indoor plumbing fixtures can cost more than \$10,000 per acre-foot. A detailed list of conservation "Best Management Practices" has been developed by the California Urban Water Conservation Council and can be found in their MOU Regarding Urban Water Conservation in California. 12

Scenario

Let us assume the scenario is very similar to what was described above. However, we will use slightly different numbers. The problem is as follows: the Morongo Basin area has a population that is projected to double in 20 years. They currently have a fixed average annual water supply and if water use continues at its current per-capita rate, demand will exceed supply far ahead of the 20-year population projection. Population is 40,000 in 2010 and projected to increase at a flat rate of 2,000 persons per year to 80,000 by the year 2030. Gross water use is currently 150 GPCD, or 6,720 AF in 2010. If GPCD remains flat at 150, by 2030 water use is projected to increase to 13,440 AF. Current supply from both natural and imported sources is only 9,000 AFY; resulting in a net deficit of 4,440 AFY by 2030 (in this scenario we will ignore the consumptive use variable and assume an acre-foot of water supply provides for an acre-foot of gross water use).

<u>Part 1.</u> Using the information above, assuming gross water use remains at 150 GPCD, what year does the demand surpass available supply? Hint: to convert GPCD to Acre-feet per Year, use the following equation: (GPCD x Population x $365 \div 325,851$).

Part 2. In this scenario, the Morongo Basin needs to increase water supplies and/or conserve water in order to meet future demands. As indicated above, a deficit of 4,440 AFY is projected in 2030. Using the scenario described above, recommend a water supply "portfolio" for the Morongo Basin to implement by 2030 in order to meet the demands. Let's assume the Morongo Basin has \$20 million to spend over the next 20 years on creating additional water supplies (ignoring inflation). This money can be spent on conservation, Additional imported water rights, or a combination of both. The portfolio you recommend will need to include a figure indicating specific items (e.g. 500 AFY of new imported water rights purchased); the cost of each; the gross GPCD after implementation; and the total water use and total water supply in 2030 for the Morongo basin. Along with the figure, include a short written description of why you chose the arrangement of options that you did. Use the following assumptions when developing the portfolio:

- 1. Table A water rights cost \$5,000 per acre-foot; a maximum of 2,000 AF is available for purchase.
- 2. Grass removal incentive program costs \$3,000 per AF conserved. The maximum potential for this program is an overall reduction of 25 GPCD for the entire population (i.e. 80,000 people

¹² Memorandum of Understanding Regarding Urban Water Conservation in California. September 16, 2009.

¹¹ Mojave Water Agency Water Conservation Incentive Program analysis

- with an initial GPCD of 150 reduced to 125 GPCD results in a gross water use reduction of 2,240 AFY).
- 3. Indoor fixture replacement incentive program costs of \$10,000 per acre-foot conserved. The maximum potential for this program is an additional 25 GPCD for the entire population.
- 4. Conservation incentive programs are a one-time investment that result in a permanent reduction in water use for each year afterward (Similar to the purchase of new imported water rights as a one-time investment with a permanent gain in water supply for each following year).

