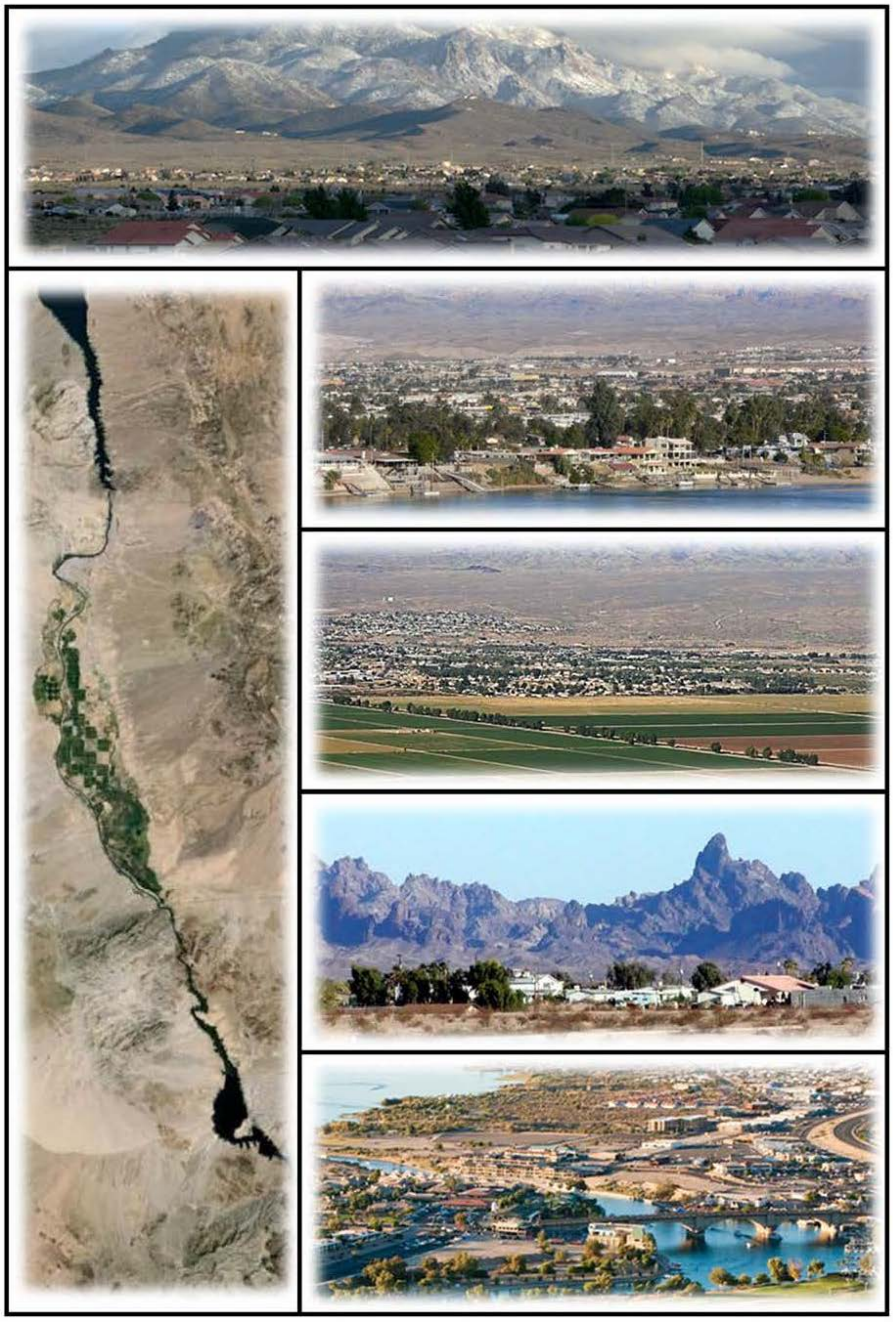
# Mohave County Water Authority
# Demand and Supply Assessment



ADWR

**Arizona Department of Water Resources**

**June, 2015**

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# List of Abbreviations and Acronyms

| | |
|---|---|
| **Act** | Boulder Canyon Project Act of 1928 |
| **ADOA** | Arizona Department of Administration |
| **ADWR** | Arizona Department of Water Resources |
| **AF** | Acre-feet |
| **AWBA** | Arizona Water Banking Authority |
| **Assessment Participants** | The entities participating in this Demand and Supply Assessments; City of Bullhead City, Golden Shores Water Conservation District, Kingman, Lake Havasu City, Mohave Valley Irrigation and Drainage District, and Mohave Water Conservation District |
| **Basin Study** | Colorado River Basin Water Supply and Demand Study |
| **CAP** | Central Arizona Project |
| **CBHC** | City of Bullhead City |
| **CDP** | Census Designated Place |
| **GIS** | Geographic Information System |
| **GPCD** | Gallons per capita per day |
| **GSWCD** | Golden Shores Water Conservation District |
| **IP** | Incorporated Place per U.S. Census |
| **ISG** | 2007 Interim Surplus Guidelines |
| **LHC** | Lake Havasu City |
| **LHIDD** | Lake Havasu Irrigation and Drainage District |
| **M&I** | Municipal and Industrial |
| **MAF** | Million acre-feet |
| **MCWA** | Mohave County Water Authority |
| **MVIDD** | Mohave Valley Irrigation and Drainage District |
| **MWCD** | Mohave Water Conservation District |
| **Panel** | Governor's Blue Ribbon Panel on Water Sustainability |
| **P4** | 4$^{th}$ Priority |
| **Reclamation** | Bureau of Reclamation |
| **Secretary** | Secretary of the Department of the Interior |
| **Strategic Vision** | Arizona's Strategic Vision for Water Supply Sustainability |
| **USGS** | United States Geological Survey |
| **WRDC** | Water Resources Development Commission |

# Chapter 1. Introduction and Purpose of Study

This report evaluates both the current and projected water demand and supplies for specific entities that are members of the Mohave County Water Authority (MCWA). The members of the MCWA considered within this report are, in alphabetical order: City of Bullhead City (CBHC), Golden Shores Water Conservation District (GSWCD), City of Kingman (Kingman), Lake Havasu City (LHC), Mohave Valley Irrigation & Drainage District (MVIDD), and the Mohave Water Conservation District (MWCD); or Assessment Participants. The City of Kingman is located off the Colorado River and is considered an off-river Assessment Participant. All other Assessment Participants are on-river water users. See Figure 1.1 for the location of each of the Assessment Participants. The goal of this assessment is to provide Assessment Participants with information that can be utilized for long term planning processes, both local and statewide.

## Background and Historical Information

### The Kingman Contract

In Arizona, the use of Colorado River water is subject to a compilation of laws, rulings, decrees, compacts and a treaty referred collectively to as the Law of the River. Part of the Law of the River is the Boulder Canyon Project Act of 1928 (Act) that authorized the Secretary of the Interior (Secretary) to function as the contracting authority for Colorado River water in the Lower Basin. The Act also requires that all Colorado River water users in the Lower Basin have a water delivery contract with the Secretary, acting through the Bureau of Reclamation (Reclamation). Because the contract requirement is in Section 5 of the Act, the contracts are often referred to as Section 5 contracts with the water rights being authorized referred to as entitlements. Entitlements may also be based on decreed rights or pursuant to a Secretarial Reservation of Mainstream Water.

In November of 1968, there were three water delivery contracts for water uses within Mohave County signed by the Secretary that represented 3 percent of Arizona's 2.8 million acre foot (MAF) allotment. The Kingman contract was for a volume not to exceed 18,500 acre-feet (AF) for municipal and industrial (M&I) use, the MVIDD contract was for a volume not to exceed 51,000 AF for irrigation and domestic use, and the Lake Havasu Irrigation and Drainage district contract was for a volume not to exceed 14,500 AF for M&I use (USDI, 1980). The Kingman contract reserved the right for the United States to terminate the contract if Kingman did not order, divert, transport and apply water by November 13, 1993.

Kingman was not diverting Colorado River water at the time the contract with the Secretary was executed. Reclamation noted that "the city of Kingman has not yet begun diversions, primarily because of the costs of pumping; i.e., the city is about 2,650 feet above the maximum water surface elevation of Lake Mohave" (USDI, 1980). In the early 1970's, Reclamation evaluated the feasibility of the Kingman Project but

concluded that development of local groundwater was economically more feasible than constructing a pipeline to deliver Colorado River water to the city (USDI, 1971).

Prior to the November 13, 1993 deadline, Kingman contracted with a consulting firm to complete a water adequacy study for the city that evaluated future water demand and alternative sources of supply (Willdan Associates, 1993). Alternatives identified in the study were: direct usage of Colorado River water; effluent reuse; storm water capture; and indirect usage of Colorado River water. The study noted that the cost estimates of constructing works necessary for direct usage of Colorado River water would cost from $53 to $84 million and this alternative was not recommended for implementation at the time. It was recommended that the city's Colorado River allocation be put to use indirectly via exchanges with other Mohave County water users.

As a result of the recommendation of the water adequacy study, Kingman solicited statements of interest from various entities that might be interested in an exchange of the city's entitlement. As a result of the solicitation process, seven entities expressed an interest in acquiring a total of more than 45,000 AF/yr of Colorado River water, well in excess of the amount available. Because the city would be unlikely to meet the November 13, 1993 deadline, Kingman worked with a variety of state interests to obtain a deadline extension from Reclamation to December 31, 1994. After the extension was granted, discussions between the Mohave County communities focused on a regional approach to utilize the Kingman contract and keep the water within Mohave County (Congressional Record Online, 1995).

Mohave County Water Authority

The decision was made that a county water authority was the solution and in April of 1994, the bill to create the county water authority became law. The successful formation of the MCWA was a result of the commitment of the Mohave County parties and their ability to compromise and reach consensus. Additionally, there was state and federal support for the MCWA. The Arizona Department of Water Resources (ADWR) supported creation of the MCWA as did Reclamation because it was their desire to have one contracting entity for the Kingman contract. During the transfer of the water entitlement to MCWA, the United States reduced the entitlement by 3,500 AF in anticipation of using the water for federal purposes related to Indian water rights settlements and the remaining 15,000 AF of the Kingman contract was transferred to the MCWA. Later, in the context of the Arizona Water Settlements Act of 2004, the ADWR and the MCWA lobbied for the transfer of 3,500 AF to the MCWA to replace the reduction and ADWR agreed to utilize other 4$^{th}$ priority water to allocate 3,500 AF of water for the exclusive purpose of facilitating Indian water rights settlements. The result is that today, MCWA holds the entire 18,500 AF of 4$^{th}$ priority water that was previously associated with the Kingman contract.

The MCWA is comprised of public entities that had a 4$^{th}$, 5$^{th}$ or 6$^{th}$ priority mainstream Colorado River contract with the Secretary for M&I use (Assessment Participants) and Mohave County which does not have a contract. The primary goal of the MCWA was to

beneficially use the Kingman contract for Colorado River water and facilitate repayment to Kingman to develop their groundwater resources.

## Purpose for the Study

Since the formation of the MCWA in 1995, its members have explored ways to address permanent and shortage supply issues. As part of those efforts, the MCWA recognized the need for a comprehensive water planning document. The MCWA made a request to ADWR to prepare a planning document that would include population estimates and associated demand projections, comparison of water demands with entitlement supplies in both normal and shortage years and a compilation of existing literature that identifies potential future water supplies.

With the exception of Kingman, the Colorado River is the Assessment Participants' primary source of water at this time, with the only additional source being effluent. Although Reclamation has not adopted accounting surface rules, the contracts that the Assessment Participants have with Reclamation identify mainstream water diverted or consumptively used by the entities to include water withdrawn from wells either within the boundary of the floodplain or within the contract service area. Consequently, information that allows the Assessment Participants to complete long-range water planning is of great importance. The desired outcome of the assessment is to enable the Assessment Participants to evaluate multiple future water supply scenarios for long-term planning purposes.

The collection of water use data in rural areas was a recommendation of the Water Resources Development Commission (WRDC) (WRDC, 2011). The participation of ADWR in the development of the water demand and supply assessment for the MCWA is supported both by the WRDC's recommendation and the agency's mission. Information obtained from this demand and supply assessment ideally can be used by the MCWA and the Assessment Participants to evaluate multiple future water scenarios to aid in long-term water resources planning.

Two key components of this assessment were development of new population projections for the Assessment Participants based on the 2010 U.S. Census information and state based regional population projections and development of new demand projections. Both of these data sets were developed in a manner that is consistent with both the WRDC report and with the Colorado River Water Supply and Demand Study (Basin Study). Additional information regarding the development of these data sets is found in Chapter 2.

## Deliverables

In addition to this report, ADWR has developed a spreadsheet that is based on ADWR modeling analyses using Reclamation's Colorado River System Simulation (CRSS) RiverWare computer model to evaluate water supply and demand scenarios for the Arizona Water Banking Authority (Appendix A). The spreadsheet can be used by the

Assessment Participants to calculate demands and further evaluate future water planning scenarios.

## References

Congressional Record Online. (1995). To direct the Secretary of the Interior to make certain modifications with respect to a water contract for the City of Kingman, Arizona. Washington, DC: U.S. Government Printing Office. Retrieved from www.gpo.gov/fdsys/pkg/CREC-1995-08-05/html/CREC-1995-08-05-pt1-PgE1678.htm.

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# Chapter 2. Methods

## Identification of Water Planning Areas

A study area was identified for each Assessment Participant to delineate the geographic area that would be analyzed in the assessment. The area is referred to as the water planning area. For the on-river Assessment Participants, the water planning area is the area contained within the contract service area associated with their Section 5 Colorado River contracts with Reclamation. For Kingman, the water planning area was determined to be the approximately 70 square mile designated water service area boundary identified on a map provided by city staff (G. Jeppson, personal communication, November 22, 2013). The city established the boundary based on where projected growth was anticipated and to facilitate the efficient delivery of water (City of Kingman, 2014) Maps of the water planning areas for Assessment Participants are found within each Assessment Participant's chapter of this report.

## Population Baseline and Projections

Baseline population and population projections through 2050 were obtained or derived from data obtained from the Arizona Department of Administration Office of Employment and Population Statistics (ADOA, 2013). The population estimates and projections prepared by ADOA must be used by all state agencies for all purposes that necessitate development of population estimates and projections.

Baseline population and population projections through 2050 were developed for each Assessment Participant's water planning area. Year 2010, or baseline population, was based on the 2010 census. Years 2011 and 2012 are estimated populations and years 2013 and beyond are projected populations. In determining the baseline population and population projections the following data sources were utilized: ESRI's Arcmap geographic information system (GIS) computer program; GIS layers for the Assessment Participant's contract service areas; GIS layers for census blocks; 2010 census population information for Arizona including 2012-2050 county population projections and 2013-2050 sub-county population projections (ADOA, 2013); and 2013 National Agricultural Imagery Program imagery. It should be noted again that the baseline population and population projections included in this assessment are for the water planning areas of this study only.

### Calculation of Baseline Population

To calculate the baseline population, census blocks were overlaid on a map of the Assessment Participant's water planning area, which is the same as the contract service area for the Participant's Colorado River entitlements. For Kingman, the water planning area was developed based on information provided by city staff, as described above. In the analysis, census blocks that were entirely located within the water

planning area had the population for that census block included in the calculation. For census blocks that intersected, or were partially within the water planning area, additional manipulation was necessary.

For intersecting or partial census blocks, the blocks were clipped into the water planning area and the proportion of the block that was included within the water planning area was calculated. Then, the corresponding proportion of the population for that block was calculated and included within the population number calculation. For example, an intersecting census block had 50 percent of the block within the water planning area and it had a population for that census block of 496 people. In determining the population of the water planning area, 50 percent of 496, or 248 people were added to the population of the water planning area for this intersecting census block.

Calculation of Population Projections Through 2050

At the county level, the ADOA (2013) projections are done for the low, medium and high range series. The ADOA (2013) also provided sub-county population projections but only for the medium range series. The sub-county level provides information for both Incorporated Places (IP) and for Census Designated Places (CDP) with a 2010 population greater than 500 people. To more accurately depict growth in their respective water planning areas, the Assessment Participants elected to utilize the sub-county data as the basis for the medium series for population projections. For additional information regarding the methodology used to develop sub-county projections for Mohave County, see ADOA (2013).

When calculating the projected population for the medium range series, a method similar to calculation of the baseline population as discussed above was utilized. The IP or CDP census information was selected based on location with respect to the water planning area. See Table 2.1 for specific information regarding sub-county unit selected as the basis for population projections for each Assessment Participant.

**Table 2.1 Information Regarding Census Data Used in Population Projections**

| Assessment Participant | Sub-County Title and Designation |
|---|---|
| City of Bullhead City | Bullhead City IP |
| Golden Shores Water Conservation District | Golden Shores CDP |
| City of Kingman | Kingman IP, New Butler CDP, portions of Mohave County |
| Lake Havasu City | Lake Havasu City IP |
| Mohave Valley Irrigation and Drainage District | Mohave Valley CDP, Willow Valley CDP, Fort Mohave CDP |
| Mohave Water Conservation District | Portions of Bullhead City IP |

In calculating the population projections, the basis described in Table 2.1 was modified as needed to include additional census block information. If the IP or CDP was smaller than the water planning area, additional census blocks were added in the same manner as previously discussed. If the IP or CDP was larger than the water planning area, the IP or CDP was reduced proportionally.

In order to provide a range of populations and demands for planning purposes, a low and a high series of population projections was also completed. Because the sub-county population projections did not include the low and high range series, the projections were derived from projections for the low and high range series for Mohave County. In each year, the medium range series projections were adjusted by the annual percentage increase derived from the Mohave County projections.

The data sets for low, medium and high series population projections are found within each Assessment Participant's chapter of this report.

## Demand Calculation

In the process of developing the work plan for this assessment, it was determined that demand would be reflected by a simple gallons per capita per day (GPCD) water use. This is consistent with the demand utilized in the analysis completed by the WRDC (2011) and the Basin Study. In the most basic calculation of GPCD, a water volume is divided by a number of people to yield GPCD. When calculating GPCD in this manner, all residential and non-residential uses plus system losses are included and this gross level of analysis may result in a larger GPCD. Additionally, drier and hotter locations may exhibit higher GPCDs than cooler wetter locations generally due to higher exterior water uses.

The WRDC (2011) report provides a good illustration of the differences between GPCDs calculated for the same area but using different methods. The WRDC GPCDs were calculated in a manner similar to this assessment and yielded a 2005 GPCD for the Phoenix AMA of 260. However, the 2005 actual residential GPCDs for cities located within the Phoenix AMA as calculated by ADWR for Active Management Area purposes ranged from 119 to 230.

For this assessment, the calculation was, for any year, the diversion volume for that year as reported to Reclamation in Article 5 Accounting reports divided by the actual or projected population for that year for the on-river Assessment Participants. The diversion volume was selected to represent demand because all of the on-river Assessment Participants have diversion contracts with Reclamation. Due to the nature of MVIDD's contract and the lack of verifiable data for municipal use for MVIDD, it was decided to utilize CBHC GPCD for MVIDD because the municipal use in the two adjacent areas is very similar.

Table 2.2 lists the GPCD utilized for each on-river Assessment Participant for the years 2000 through 2008 plus 2010 and the average GPCD for that time period. This time period was selected as being indicative of a range of both water use and climatic conditions. For Kingman, the GPCD was calculated for 2010 through 2012 based on the water withdrawals reported for the city in the Community Water System Annual Reports for those years divided by the actual or projected population. The GPCD's for Kingman were 159.7 (2010), 160.3 (2011) and 153.3 (2012) yielding an average GPCD of 158.

For each on-river Assessment Participant, the GPCD in Table 2.2 was applied to the projected population (low, medium and high range series) to derive demand. There were no adjustments to the GPCD over time; it remained static. It is believed that application of the GPCD derived from indicative years to the low, medium and high series populations provides a reasonable range of demand values to be utilized for long-range planning. Demand information can be found within each Assessment Participant's chapter of this report.

**Table 2.2. On-river Assessment Participants and Estimated GPCD Use in Gallons**

| Participant | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2010 | AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***CBHC*** | 230 | 226 | 231 | 229 | 247 | 273 | 277 | 268 | 241 | 243 | 247 |
| ***GSWCD*** | 255 | 239 | 234 | 230 | 199 | 220 | 188 | 168 | 153 | 200 | 209 |
| ***LHC*** | 311 | 304 | 304 | 296 | 309 | 213 | 237 | 256 | 273 | 221 | 272 |
| ***MVIDD*** | 230 | 226 | 231 | 229 | 247 | 273 | 277 | 268 | 241 | 243 | 247 |
| ***MWCD*** | 270 | 295 | 260 | 262 | 290 | 325 | 328 | 323 | 300 | 225 | 288 |

## Modeling for Shortage Scenarios

To provide additional information for on-river Assessment Participants for long-term planning purposes, it was determined that a comparison between projected demands and a shortage supply should be included within the assessment. This illustrates how declared shortages on the Colorado River might impact water supplies.

This assessment utilized the modeling analyses completed for the Arizona Water Banking Authority (AWBA) in April 2014. This modeling effort included an evaluation of 16 scenarios with varying assumptions that were developed to estimate the range of water volumes that might need to be stored by the AWBA. For this assessment, the modeling results were processed to determine shortage volumes for each Assessment Participant for three selected scenarios. The modeling output was processed using a shortage sharing calculation to yield a shortage volume for each scenario for each Assessment Participant. This information can be found within each Assessment Participant's chapter of this report. For more detailed information regarding modeling for shortage scenarios, see Appendix A.

*Scenario A2*

This scenario reflects a less conservative shortage scenario with the following assumptions:

1. AWBA Upper Basin Depletions – This depletion assumption was developed by ADWR and has been used by AWBA for numerous analyses. It has lower volumes than the Upper Basin Demand Schedule.
2. ADWR 2010-2011 Tribal Demand Schedule – This assumption has a lower demand volume for Arizona's Colorado River Indian Tribes than what these Tribes project.
3. The 2007 Interim Surplus Guidelines (ISG) are extended past 2026.

4. Mexico shares in all shortages.
5. The on-river users and Central Arizona Project (CAP) share shortages based on the 2006 Arizona Shortage Sharing Recommendation through the modeling period. The shortage sharing is based on their diversion entitlements.

*Scenario C2*

This scenario reflects a "middle of the road" scenario with the following assumptions:

1. AWBA Upper Basin Depletion Assumption – This depletion assumption was developed by ADWR and has been used by AWBA for numerous analyses. It has lower volumes than the Upper Basin Demand Schedule.
2. ADWR 2010-2011 Tribal Demand Schedule – This assumption has a lower demand volume for Arizona's Colorado River Indian Tribes than what these Tribes project.
3. The 2007 ISG are in effect until 2026 then shortages are determined based on an 80 percent protection of level of Lake Mead's elevation of 1,050' through the remainder of the modeling period. This is utilized because this is what had been modeled previously prior to the 2007 ISG.
4. Mexico shares in all shortages.
5. The on-river users and CAP share shortages on a pro-rata basis after 2026.

*Scenario H1*

This scenario is the most conservative scenario resulting in the greatest volume of shortages with the following assumptions:

1. Utilizes the Upper Basin Demand Schedule.
2. Utilizes the Ten Tribes Demand Schedule.
3. The 2007 ISG are in effect until 2026 then shortages are determined based on an 80 percent protection of level of Lake Mead's elevation of 1,050' through the remainder of the modeling period. This is utilized because this is what had been modeled previously prior to the 2007 ISG.
4. The on-river users and CAP share shortages on a pro-rata basis after 2026.

## References

Arizona Department of Administration (2013). Arizona Population. Retrieved in 2013 from http://population.az.gov/population-projections.

City of Kingman, Arizona. (2014). *City of Kingman General Plan Update 2030.* [City of Kingman, Arizona].The City [2014] Print.

Water Resources Development Commission. (2011). *Water Resources Development Commission – Final Report, Volume 1*.

# Chapter 3. City of Bullhead City Water Planning Area

## Water Planning Area Description

The City of Bullhead City (CBHC) is located in west central Mohave County along the Colorado River at a point where Arizona, Nevada and California meet. The CBHC is a rapidly growing community that serves as the economic hub and retail shopping center for western Mohave County and southeastern Clark County, Nevada. The CBHC is located across the Colorado River from Laughlin, Nevada, one of the nation's most popular gaming communities. More than five million people travel through Bullhead City annually (Mohave County Economic Development, 2014). The water planning area for the CBHC is shown in Figure 3.1.

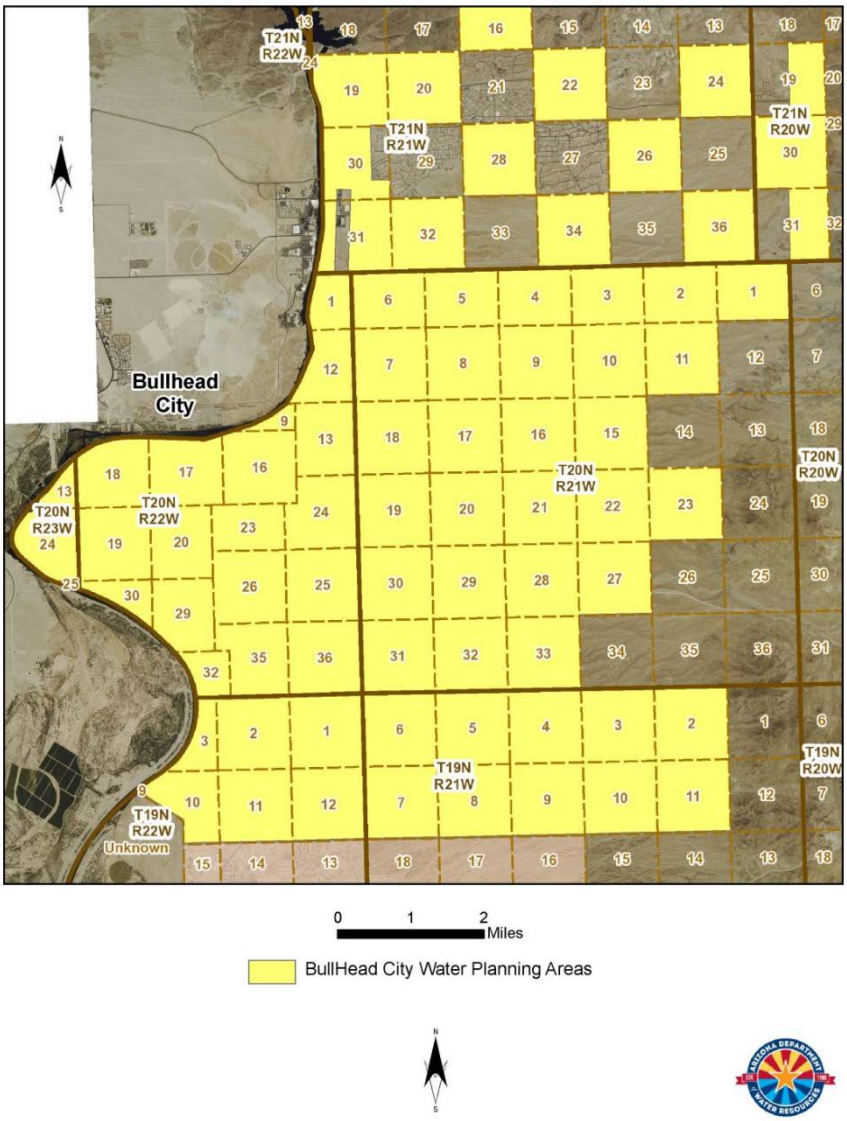


**Figure 3.1. City of Bullhead City Water Planning Area**

## Water Planning Area Background information

Although historic non-native settlement of the area dates back to the early 1800's, the CBHC, originally named "Bull's Head City" did not see major development until construction began on Davis Dam. Most recently, the CBHC's growth was stimulated by retirement housing and commercial development. Visitors are attracted year round to the recreational activities in the area and tourism is the primary economic activity.

The construction of Davis Dam was completed in 1950 and in 1951 the population of Bullhead City was less than 1,000 people. The city was incorporated in 1984 when Bullhead City and Riviera were incorporated into the CBHC. The current incorporated area covers almost 60 square miles and approximately 60 percent of the area remains undeveloped (Bullhead City, 2002). The city projects that future growth will occur in the Bullhead City Parkway area, Laughlin Ranch area, and in southern parts of the city (Bullhead City, 2013) all of which are within the water planning area. Given the environmental and physical constraints of much of the undeveloped areas, it is not anticipated that all of the remaining 60 percent of undeveloped land will be built out.

In 1982, Mohave County entered into a Section 5 Colorado River contract with Reclamation for 10,000 AF of water that was acquired from the MVIDD. There was 1,800 AF of that contract assigned to the MWCD. After the CBHC incorporated, Mohave County assigned the remaining 8,200 acre-feet of the entitlement to the city. In 1985, Bullhead City entered into its own contract with Reclamation for the remaining 8,200 AF. In 1994, the CBHC's contract was amended and increased to 15,210 AF. In 1995, the CBHC entered into a subcontract with the MCWA for an additional 6,000 AF, followed by subcontracts with MCWA in 2004 for 2,139 AF and 2009 for 1,000 AF. The total volume of Colorado River water available to the CBHC for diversion, either via contract or subcontract, is 24,349 AF.

The Colorado River water available to the CBHC for use within the water planning area is served from two separate water providers: Epcor, and Utilities Inc. These providers also supply water to entities other than the CBHC.

## Baseline and Projected Population

The 2010, or baseline, population for this assessment was 36,343 people. Tables 3.1 through 3.3 and Figure 3.2 depict the estimated and projected populations for the water planning area for the low, medium and high series.

**Table 3.1. Estimated and Projected Population for the City of Bullhead City, Arizona by Year – Low Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 36,167 | 2021 | 43,853 | 2031 | 48,762 | 2041 | 52,312 |
| 2012 | 36,258 | 2022 | 44,403 | 2032 | 49,189 | 2042 | 52,575 |
| 2013 | 37,207 | 2023 | 44,937 | 2033 | 49,601 | 2043 | 52,826 |
| 2014 | 38,116 | 2024 | 45,456 | 2034 | 49,998 | 2044 | 53,069 |
| 2015 | 38,943 | 2025 | 45,962 | 2035 | 50,380 | 2045 | 53,303 |
| 2016 | 39,758 | 2026 | 46,456 | 2036 | 50,747 | 2046 | 53,532 |
| 2017 | 40,571 | 2027 | 46,939 | 2037 | 51,096 | 2047 | 53,759 |
| 2018 | 41,419 | 2028 | 47,409 | 2038 | 51,428 | 2048 | 53,986 |
| 2019 | 42,329 | 2029 | 47,868 | 2039 | 51,742 | 2049 | 54,215 |
| 2020 | 43,287 | 2030 | 48,319 | 2040 | 52,036 | 2050 | 54,447 |

**Table 3.2. Estimated and Projected Population for the City of Bullhead City, Arizona by Year – Medium Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 36,167 | 2021 | 46,878 | 2031 | 55,253 | 2041 | 62,159 |
| 2012 | 36,321 | 2022 | 47,777 | 2032 | 56,028 | 2042 | 62,741 |
| 2013 | 37,406 | 2023 | 48,658 | 2033 | 56,785 | 2043 | 63,309 |
| 2014 | 38,523 | 2024 | 49,523 | 2034 | 57,527 | 2044 | 63,867 |
| 2015 | 39,673 | 2025 | 50,375 | 2035 | 58,250 | 2045 | 64,417 |
| 2016 | 40,858 | 2026 | 51,215 | 2036 | 58,956 | 2046 | 64,963 |
| 2017 | 42,078 | 2027 | 52,043 | 2037 | 59,640 | 2047 | 65,508 |
| 2018 | 43,334 | 2028 | 52,859 | 2038 | 60,304 | 2048 | 66,056 |
| 2019 | 44,628 | 2029 | 53,665 | 2039 | 60,946 | 2049 | 66,607 |
| 2020 | 45,961 | 2030 | 54,462 | 2040 | 61,563 | 2050 | 67,166 |

**Table 3.3. Estimated and Projected Population for the City of Bullhead City, Arizona by Year – High Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 36,167 | 2021 | 49,363 | 2031 | 60,585 | 2041 | 70,398 |
| 2012 | 36,369 | 2022 | 50,544 | 2032 | 61,652 | 2042 | 71,267 |
| 2013 | 37,566 | 2023 | 51,707 | 2033 | 62,702 | 2043 | 72,123 |
| 2014 | 38,856 | 2024 | 52,854 | 2034 | 63,737 | 2044 | 72,971 |
| 2015 | 40,273 | 2025 | 53,987 | 2035 | 64,753 | 2045 | 73,814 |
| 2016 | 41,764 | 2026 | 55,110 | 2036 | 65,751 | 2046 | 74,654 |
| 2017 | 43,321 | 2027 | 56,222 | 2037 | 66,727 | 2047 | 75,500 |
| 2018 | 44,914 | 2028 | 57,324 | 2038 | 67,681 | 2048 | 76,352 |
| 2019 | 46,523 | 2029 | 58,417 | 2039 | 68,611 | 2049 | 77,214 |
| 2020 | 48,162 | 2030 | 59,503 | 2040 | 69,516 | 2050 | 78,090 |

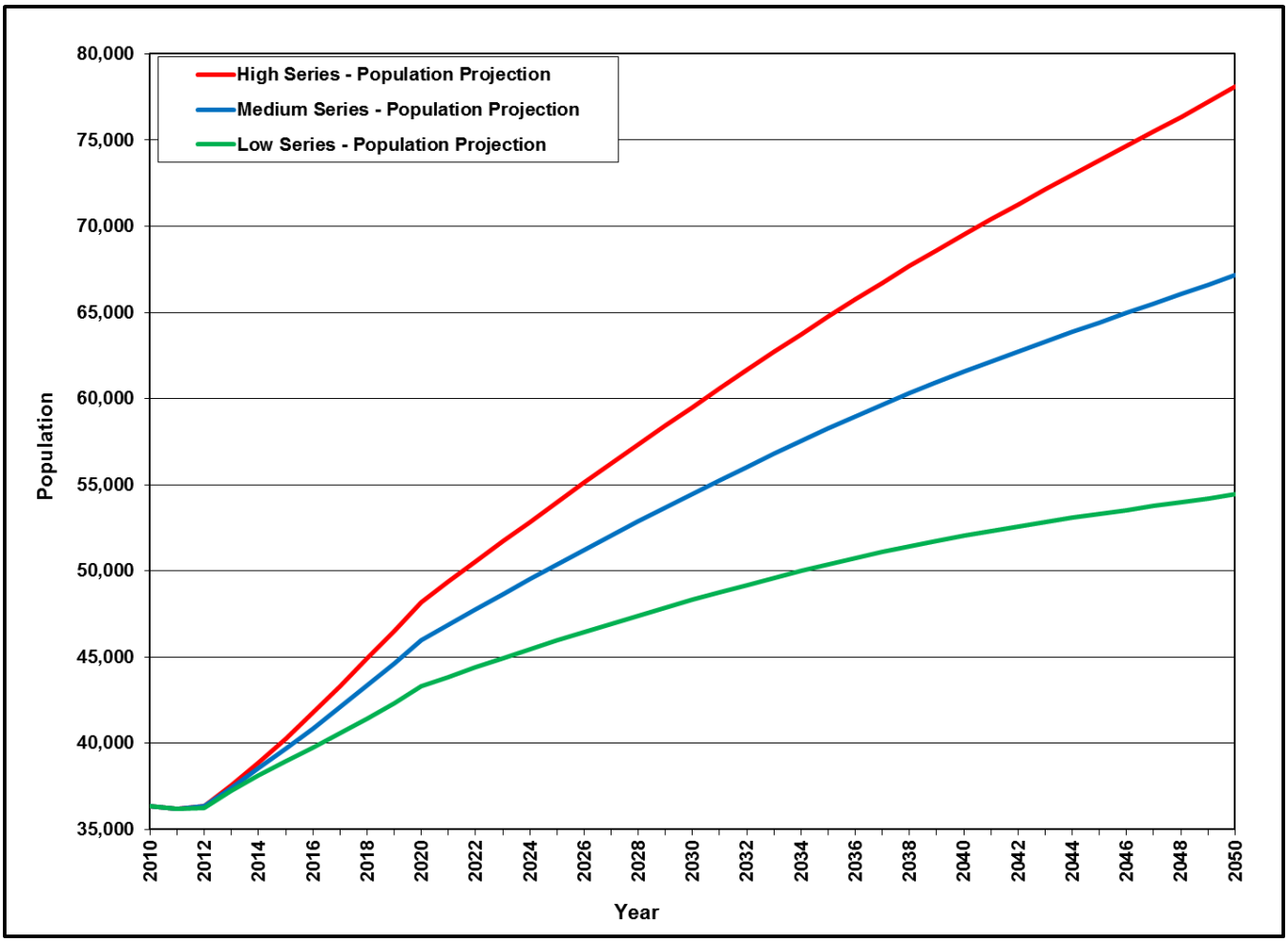


**Figure 3.2. Low, Medium and High Series Population Projections for the City of Bullhead City, Arizona from 2010 through 2050**

## Baseline and Projected Water Demand

The 2010, or baseline, demand for this assessment was 10,037 AF. Tables 3.4 through 3.6 and Figure 3.3 depict the estimated and projected water demands for the water planning area for the low, medium and high series. It should be noted that the diversion entitlement line shown in Figure 3.3 is for a normal year. The CBHC total diversion entitlement is not exceeded by water demand in any of the population projection series through 2050. Although this assessment does not show a supply and demand imbalance within the planning period, the long planning horizon for development of water projects needs to be recognized and considered.

**Table 3.4. Demand Based on Population for the City of Bullhead City, Arizona by Year – Low**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 9,988 | 2021 | 12,111 | 2031 | 13,466 | 2041 | 14,447 |
| 2012 | 10,013 | 2022 | 12,263 | 2032 | 13,584 | 2042 | 14,519 |
| 2013 | 10,275 | 2023 | 12,410 | 2033 | 13,698 | 2043 | 14,589 |
| 2014 | 10,526 | 2024 | 12,553 | 2034 | 13,808 | 2044 | 14,656 |
| 2015 | 10,755 | 2025 | 12,693 | 2035 | 13,913 | 2045 | 14,720 |
| 2016 | 10,980 | 2026 | 12,830 | 2036 | 14,014 | 2046 | 14,784 |
| 2017 | 11,204 | 2027 | 12,963 | 2037 | 14,111 | 2047 | 14,846 |
| 2018 | 11,439 | 2028 | 13,093 | 2038 | 14,203 | 2048 | 14,909 |
| 2019 | 11,690 | 2029 | 13,220 | 2039 | 14,289 | 2049 | 14,972 |
| 2020 | 11,954 | 2030 | 13,344 | 2040 | 14,370 | 2050 | 15,036 |

**Table 3.5. Demand Based on Population for the City of Bullhead City, Arizona by Year – Medium**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 9,988 | 2021 | 12,946 | 2031 | 15,259 | 2041 | 17,166 |
| 2012 | 10,031 | 2022 | 13,194 | 2032 | 15,473 | 2042 | 17,327 |
| 2013 | 10,330 | 2023 | 13,438 | 2033 | 15,682 | 2043 | 17,484 |
| 2014 | 10,639 | 2024 | 13,677 | 2034 | 15,887 | 2044 | 17,638 |
| 2015 | 10,956 | 2025 | 13,912 | 2035 | 16,086 | 2045 | 17,790 |
| 2016 | 11,283 | 2026 | 14,144 | 2036 | 16,281 | 2046 | 17,940 |
| 2017 | 11,620 | 2027 | 14,372 | 2037 | 16,471 | 2047 | 18,091 |
| 2018 | 11,967 | 2028 | 14,598 | 2038 | 16,654 | 2048 | 18,242 |
| 2019 | 12,325 | 2029 | 14,820 | 2039 | 16,831 | 2049 | 18,395 |
| 2020 | 12,693 | 2030 | 15,040 | 2040 | 17,002 | 2050 | 18,549 |

**Table 3.6. Demand Based on Population for the City of Bullhead City, Arizona by Year – High**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 9,988 | 2021 | 13,632 | 2031 | 16,731 | 2041 | 19,442 |
| 2012 | 10,044 | 2022 | 13,959 | 2032 | 17,026 | 2042 | 19,681 |
| 2013 | 10,374 | 2023 | 14,280 | 2033 | 17,316 | 2043 | 19,918 |
| 2014 | 10,731 | 2024 | 14,596 | 2034 | 17,602 | 2044 | 20,152 |
| 2015 | 11,122 | 2025 | 14,909 | 2035 | 17,882 | 2045 | 20,385 |
| 2016 | 11,534 | 2026 | 15,219 | 2036 | 18,158 | 2046 | 20,617 |
| 2017 | 11,964 | 2027 | 15,527 | 2037 | 18,428 | 2047 | 20,850 |
| 2018 | 12,404 | 2028 | 15,831 | 2038 | 18,691 | 2048 | 21,086 |
| 2019 | 12,848 | 2029 | 16,133 | 2039 | 18,948 | 2049 | 21,324 |
| 2020 | 13,301 | 2030 | 16,433 | 2040 | 19,198 | 2050 | 21,566 |

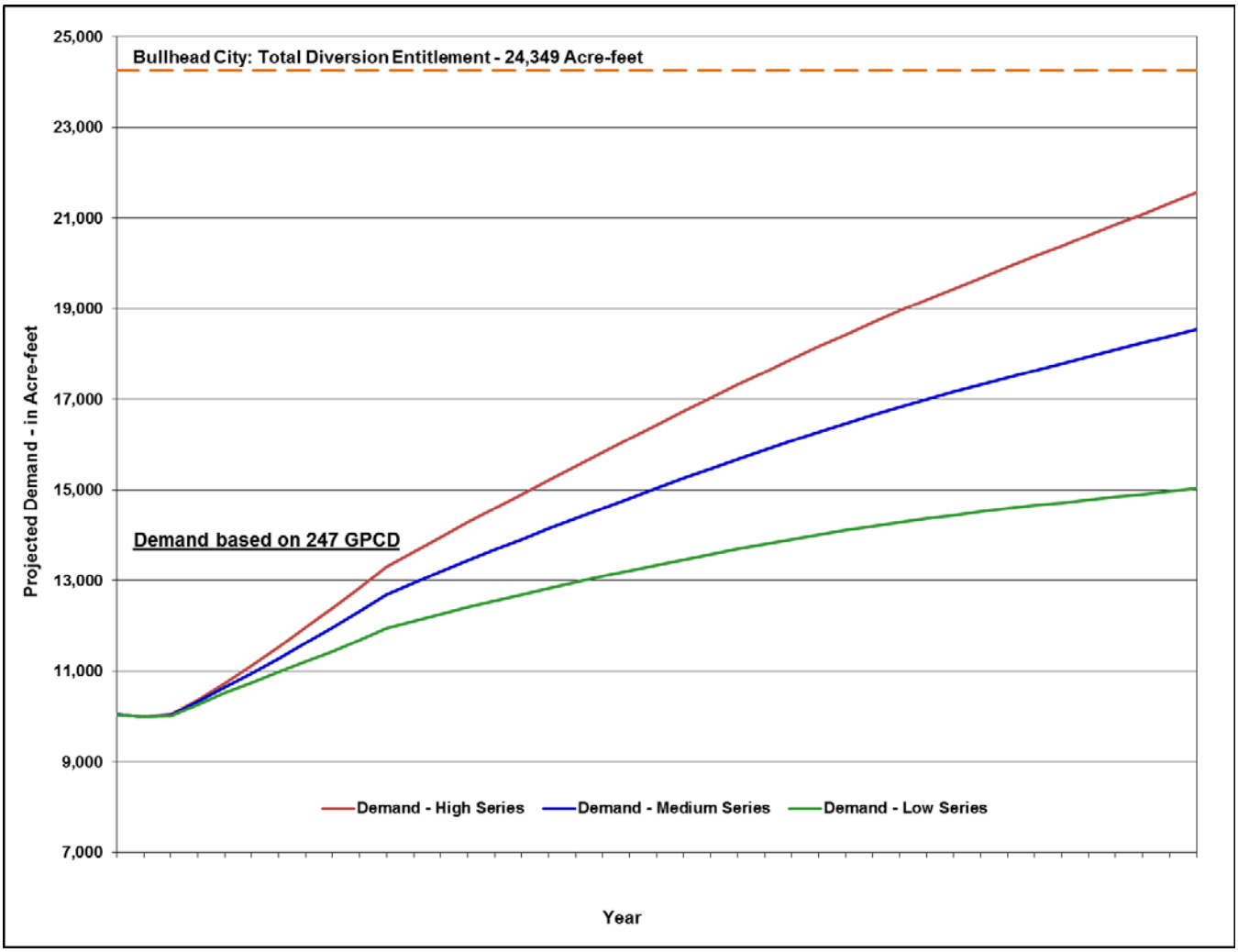


**Figure 3.3. Low, Medium and High Series Demand Projections for the City of Bullhead City, Arizona from 2010 through 2050**

## Shortage Scenarios

Tables 3.7 through 3.9 and Figure 3.4 depict the shortage volumes as a result of the three shortage scenarios analyzed. The first projected shortage that impacts the CBHC occurs in 2021 under Scenario A2.

The AWBA is required to reserve a reasonable number of long-term storage credits accrued within CAP's service area to firm on-river Fourth Priority M&I Colorado River supplies during shortage. The MCWA and the AWBA have entered into an agreement and 256,174 AF of credits have been reserved for this purpose. The CBHC has 95,247 AF of long-term storage credits reserved specifically for their use. For more information regarding the process of on-river firming, see the AWBA webpage at http://www.azwaterbank.gov/Plans_and_Reports_Documents/On-River_Firming.htm.

**Table 3.7. Years of Shortages and Shortage Volumes for Scenario A2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | CBHC Shortage Volume (AF/year) |
|---|---|---|---|
| 2021 | 3 | 480,000 | 16.3 |
| 2022 | 3 | 480,000 | 161.4 |
| 2023 | 3 | 480,000 | 308.1 |
| 2024 | 3 | 480,000 | 457.0 |
| 2027 | 3 | 480,000 | 910.5 |
| 2030 | 3 | 480,000 | 1,349.3 |
| 2031 | 3 | 480,000 | 1,445.6 |
| 2032 | 2 | 400,000 | 287.5 |
| 2033 | 2 | 400,000 | 373.7 |
| | | **Total** | **5,309.4** |

Table Notes –
2 – When Lake Mead's elevation is projected to be below elevation 1,050 feet and at or above elevation 1,025 feet, a reduction of 417,000 acre-feet (AF) is applied to the Lower Basin. Arizona's apportionment is reduced by 400,000 AF and Nevada's is reduced by 17,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 75.000 AF.

3 – When Lake Mead's elevation is projected to be below elevation 1,025 feet, a reduction of 500,000 AF is applied to the Lower Basin. Arizona's apportionment is reduced by 480,000 AF and Nevada's is reduced by 20,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 125.000 AF. Consultations with the Secretary may be required at this critical elevation.

**Table 3.8. Years of Shortages and Shortage Volumes for Scenario C2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | CBHC Shortage Volume (AF/year) |
|---|---|---|---|
| 2033 | 80P1050 | 620,000 | 7,501.1 |
| 2034 | 80P1050 | 634,000 | 7,587.9 |
| 2040 | 80P1050 | 616,000 | 8,073.1 |
| 2044 | 80P1050 | 614,000 | 8,357.6 |
| 2049 | 80P1050 | 612,000 | 8,694.3 |
| 2050 | 80P1050 | 612,000 | 8,723.1 |
| | | **Total** | **48,937.0** |

Table Notes –
80P1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called "80P1050 Abs Pro 1000)

**Table 3.9. Years of Shortages and Shortage Volumes for Scenario H1**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | CBHC Shortage Volume (AF/year) |
|---|---|---|---|
| 2035 | 80P1050 | 481,000 | 6,505.6 |
| 2036 | 80P1050 | 481,000 | 6,575.1 |
| 2037 | 80P1050 | 480,000 | 6,642.9 |
| 2038 | 80P1050 | 479,000 | 6,709.0 |
| 2039 | 80P1050 | 479,000 | 6,773.3 |
| 2040 | 80P1050 | 478,000 | 6,835.3 |
| 2041 | 80P1050 | 478,000 | 6,895.3 |
| 2042 | 80P1050 | 477,000 | 6,954.4 |
| 2043 | 80P1050 | 477,000 | 7,012.1 |
| 2044 | 80P1050 | 476,000 | 7,068.8 |
| 2045 | 80P1050 | 476,000 | 7,124.6 |
| 2046 | 80P1050 | 475,000 | 7,179.7 |
| 2047 | 80P1050 | 475,000 | 7,235.0 |
| 2048 | 80P1050 | 475,000 | 7,290.2 |
| 2049 | 80P1050 | 474,000 | 7,344.4 |
| 2050 | 80P1050 | 474,000 | 7,367.7 |
| | | **Total** | **111,513.4** |

Table Notes –

80P-1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called “80P1050 Abs Pro 1000)

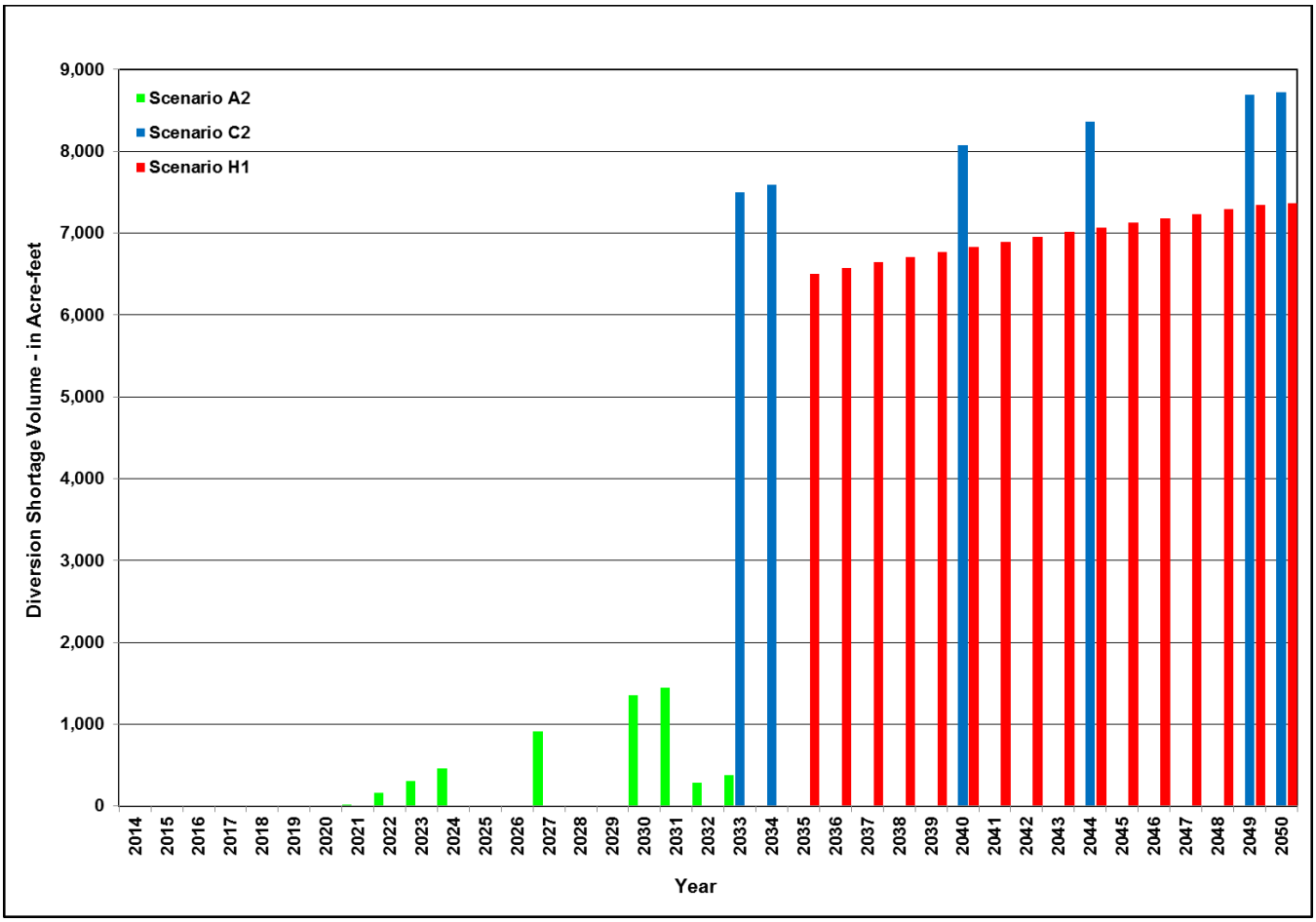


**Figure 3.4. Shortage Volumes by Year for the City of Bullhead City for the Three Scenarios Modeled**

## References

Bullhead City (Arizona). *Bullhead City General Plan*. [City of Bullhead City, Arizona, 2002]. Print.

Bullhead City (Arizona). Bullhead City draft 2014 Update to the General Plan. [City of Bullhead City, Arizona, 2013]

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# Chapter 4. City of Kingman Water Planning Area

## Water Planning Area Description

Kingman is located in northwestern Arizona in Mohave County at the intersection of Interstate 40 and U.S. 93. The city is situated in the Hualapai Valley between the Cerbat and Hualapai Mountain Ranges and is located about 35 miles east of Bullhead City and the Colorado River. Kingman is an important regional trade, service and distribution center for northwestern Arizona. Kingman's strategic location relative to Los Angeles, Las Vegas, Phoenix, Laughlin, and the Grand Canyon has made tourism, manufacturing and distribution leading industries (City of Kingman, 2010). The water planning area (WPA) for Kingman is shown in Figure 4.1.

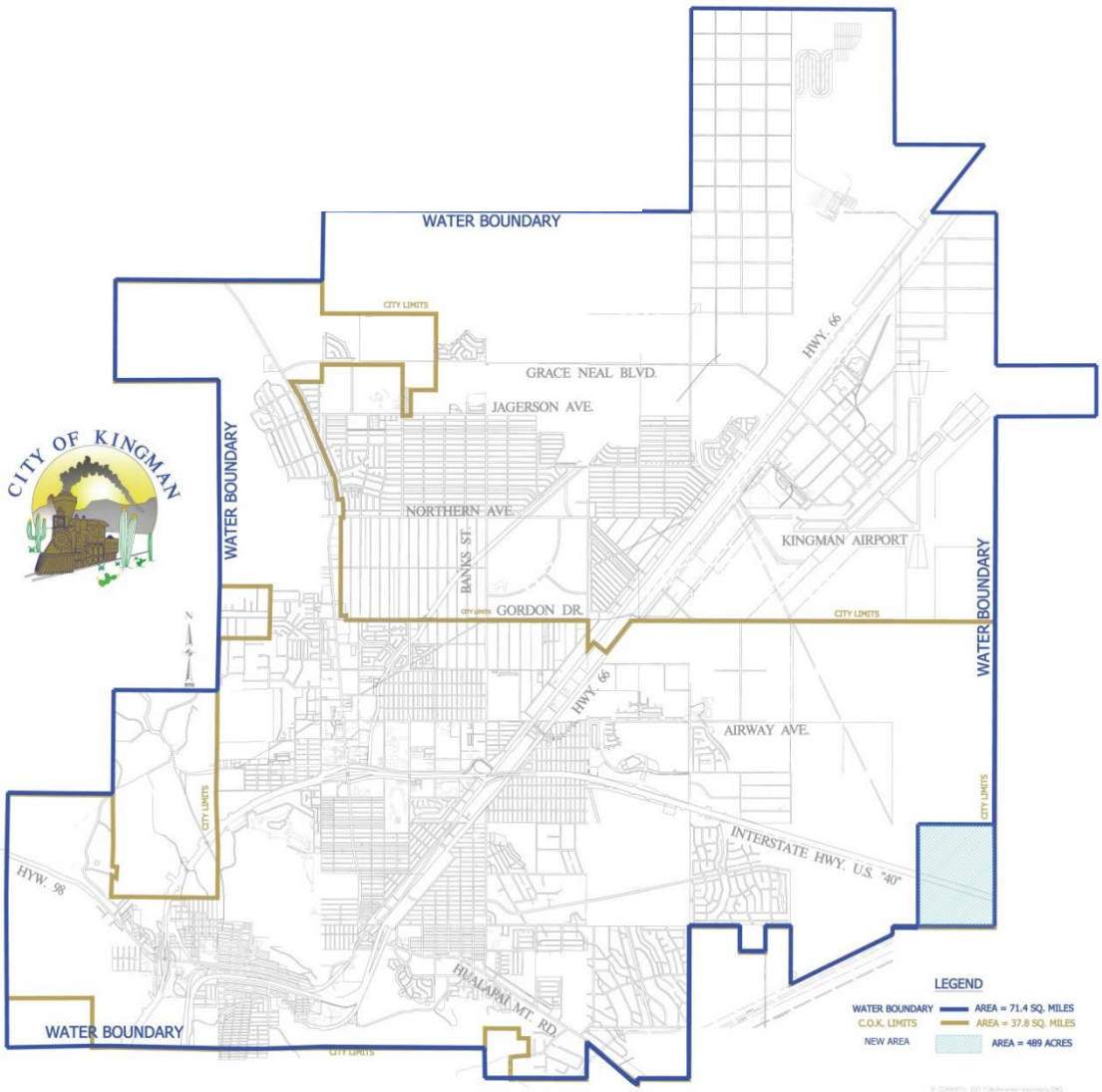



**Figure 4.1. City of Kingman Water Planning Area**

## Water Planning Area Background information

Water availability was the primary reason that engineer Lewis Kingman located the route of the Atlantic and Pacific Railroad (later Atchison Topeka & Santa Fe and now Burlington Northern & Santa Fe) through the area in 1883. Both the railroad and the availability of water have influenced the expanding ranching, mining and transportation economy in the area. Today, the Kingman area hosts an expanding industrial base and that may include wind and solar energy projects in the future.

Kingman has served as the county seat of Mohave County since 1887 and it was incorporated in 1952. The current area within the Kingman city limits is 37.97 square miles and the 2030 Kingman General Plan study area covered an area of approximately 79 square miles (City of Kingman, 2014). The area is currently comprised of various land uses, including commercial, industrial, residential, and public land uses.

The Kingman municipal water system supplies water to all areas within the Kingman water planning area, however, there are households within the planning area that are not connected to the municipal water system and utilize domestic wells. Kingman is solely reliant on groundwater and reclaimed water as there are no surface water sources available to the city.

The municipal water system includes 15 active well sites located in the Hualapai Valley and Sacramento groundwater basins. The 11 wells in the Hualapai Valley Basin have an average depth of 962 feet and an average depth to water of 640 feet. The four wells in the Sacramento Basin have an average depth of 251 feet and an average depth to water of 130 feet. The present pumping capacity for Kingman is estimated at about 18,000 to 19,500 AF per year (https://gisweb.azwater.gov/waterresourcedata/GWSI.aspx).

Previous hydrologic studies had determined that there were sufficient recoverable groundwater resources for projected demands up to 30,000 AF per year (Willdan Associates, 1993). Recent work completed by the United States Geological Survey (USGS) (Garner and Truini, 2011) identified water budgets for both the Sacramento and the Hualapai Valley Basin. Within the Hualapai Valley Basin, the change in aquifer storage is a loss of 5,600 AF each year. In the Sacramento Basin, the change in aquifer storage is a loss of 2,400 AF per year under the demands that existed at the time. The demands for pumping withdrawals were 4,500 AF for the Sacramento Valley and 9,800 AF of pumping withdrawals in the Hualapai Valley basin. Since the USGS work was completed, new agricultural development has initiated in the Hualapai Valley Basin with anticipated additional withdrawals of 10,000 to 30,000 AF per year. These additional withdrawals may impact the volume of groundwater available to Kingman.

It should be noted that according to the city, most of the Kingman municipal wells are seeing a water decline of one and a half to two feet per year (City of Kingman, 2006). Information available to ADWR confirms that each of the City's municipal supply wells

have experienced on-going water level decline rates of up to 2 feet per year through 2012 (https://gisweb.azwater.gov/waterresourcedata/GWSI.aspx).

**Population Baseline and Forecast**

The 2010, or baseline, population for this assessment was 44,186 people. Tables 4.1 through 4.3 and Figure 4.2 depict the estimated and projected populations for the water planning area for the low, medium and high series.

**Table 4.1. Estimated and Projected Population for the Kingman Water Planning Area by Year – Low Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 44,241 | 2021 | 49,243 | 2031 | 53,627 | 2041 | 57,025 |
| 2012 | 44,811 | 2022 | 49,722 | 2032 | 54,021 | 2042 | 57,295 |
| 2013 | 45,043 | 2023 | 50,189 | 2033 | 54,403 | 2043 | 57,556 |
| 2014 | 45,377 | 2024 | 50,647 | 2034 | 54,775 | 2044 | 57,810 |
| 2015 | 45,886 | 2025 | 51,096 | 2035 | 55,135 | 2045 | 58,058 |
| 2016 | 46,460 | 2026 | 51,537 | 2036 | 55,484 | 2046 | 58,303 |
| 2017 | 47,082 | 2027 | 51,970 | 2037 | 55,820 | 2047 | 58,546 |
| 2018 | 47,697 | 2028 | 52,394 | 2038 | 56,143 | 2048 | 58,790 |
| 2019 | 48,247 | 2029 | 52,811 | 2039 | 56,452 | 2049 | 59,035 |
| 2020 | 48,753 | 2030 | 53,221 | 2040 | 56,745 | 2050 | 59,284 |

**Table 4.2. Estimated and Projected Population for the Kingman Water Planning Area by Year – Medium Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 44,241 | 2021 | 52,639 | 2031 | 60,766 | 2041 | 67,760 |
| 2012 | 44,888 | 2022 | 53,499 | 2032 | 61,531 | 2042 | 68,374 |
| 2013 | 45,283 | 2023 | 54,345 | 2033 | 62,283 | 2043 | 68,977 |
| 2014 | 45,861 | 2024 | 55,179 | 2034 | 63,022 | 2044 | 69,574 |
| 2015 | 46,745 | 2025 | 56,002 | 2035 | 63,747 | 2045 | 70,164 |
| 2016 | 47,746 | 2026 | 56,816 | 2036 | 64,459 | 2046 | 70,752 |
| 2017 | 48,830 | 2027 | 57,621 | 2037 | 65,154 | 2047 | 71,341 |
| 2018 | 49,902 | 2028 | 58,417 | 2038 | 65,833 | 2048 | 71,933 |
| 2019 | 50,868 | 2029 | 59,206 | 2039 | 66,493 | 2049 | 72,529 |
| 2020 | 51,765 | 2030 | 59,988 | 2040 | 67,135 | 2050 | 73,132 |

**Table 4.3. Estimated and Projected Population for the Kingman Water Planning Area by Year – High Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 44,241 | 2021 | 55,430 | 2031 | 66,630 | 2041 | 76,742 |
| 2012 | 44,948 | 2022 | 56,598 | 2032 | 67,708 | 2042 | 77,666 |
| 2013 | 45,477 | 2023 | 57,750 | 2033 | 68,773 | 2043 | 78,581 |
| 2014 | 46,258 | 2024 | 58,889 | 2034 | 69,826 | 2044 | 79,491 |
| 2015 | 47,453 | 2025 | 60,018 | 2035 | 70,864 | 2045 | 80,399 |
| 2016 | 48,805 | 2026 | 61,137 | 2036 | 71,889 | 2046 | 81,308 |
| 2017 | 50,273 | 2027 | 62,249 | 2037 | 72,896 | 2047 | 82,222 |
| 2018 | 51,721 | 2028 | 63,352 | 2038 | 73,885 | 2048 | 83,145 |
| 2019 | 53,028 | 2029 | 64,448 | 2039 | 74,857 | 2049 | 84,078 |
| 2020 | 54,244 | 2030 | 65,541 | 2040 | 75,808 | 2050 | 85,026 |

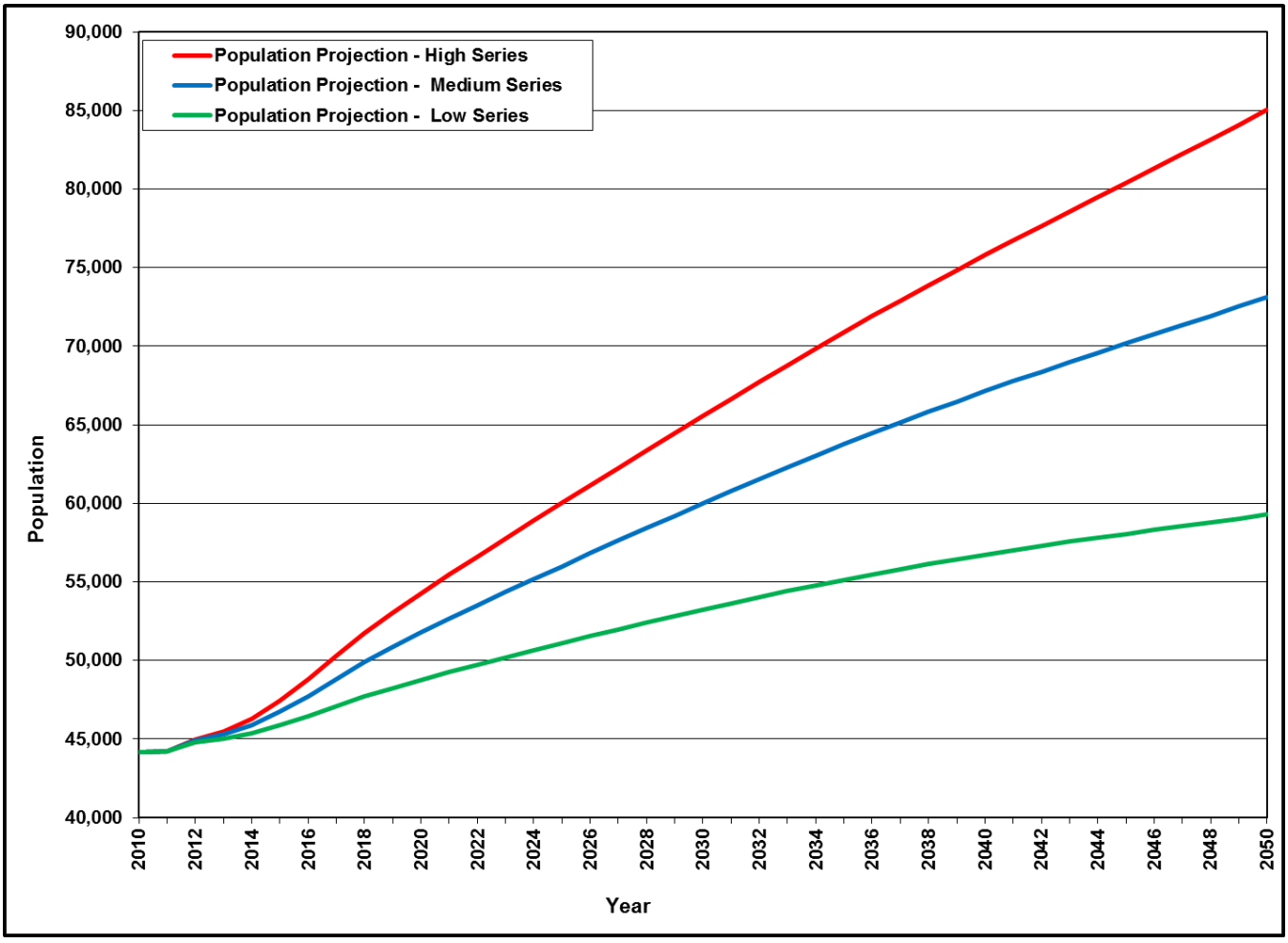



**Figure 4.2. Low, Medium and High Series Population Projections for the Kingman Water Planning Area from 2010 through 2050**

## Baseline and Projected Water Demand

In 1994, ADWR completed a staff report on the Kingman Area water supply and demand. That particular study estimated that groundwater reserves for the Sacramento Valley Basin and the Hualapai Valley Basin were approximately 50,000 AF per year. These groundwater basins are not designated as groundwater Active Management Areas, and this current assessment does not provide updated projected groundwater use by other entities for the groundwater basins that the City of Kingman relies on to meet water demands.

The 2010, or baseline, demand for the Kingman WPA for this assessment was 7,820 AF. Tables 4.4 through 4.6 and Figure 4.3 depict the estimated and projected water demands for the water planning area for the low, medium and high series.

The amount of groundwater supply estimated to be available to the City of Kingman is not exceeded by water demand in any of the population projection series through 2050 based on a hydrologic study which determined that sufficient recoverable groundwater supplies were available to supply projected demands of up to 30,000 AF per year for 100 years (Willdan Associates, 1993). Although earlier studies indicate that there may not be a supply and demand imbalance within the planning period, the long planning horizon for development of new groundwater projects needs to be recognized and considered.

**Table 4.4. Demand Based on Population for the Kingman Water Planning Area by Year - Low**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 7,830 | 2021 | 8,715 | 2031 | 9,491 | 2041 | 10,092 |
| 2012 | 7,931 | 2022 | 8,800 | 2032 | 9,561 | 2042 | 10,140 |
| 2013 | 7,972 | 2023 | 8,883 | 2033 | 9,628 | 2043 | 10,186 |
| 2014 | 8,031 | 2024 | 8,964 | 2034 | 9,694 | 2044 | 10,231 |
| 2015 | 8,121 | 2025 | 9,043 | 2035 | 9,758 | 2045 | 10,275 |
| 2016 | 8,223 | 2026 | 9,121 | 2036 | 9,820 | 2046 | 10,319 |
| 2017 | 8,333 | 2027 | 9,198 | 2037 | 9,879 | 2047 | 10,362 |
| 2018 | 8,442 | 2028 | 9,273 | 2038 | 9,936 | 2048 | 10,405 |
| 2019 | 8,539 | 2029 | 9,347 | 2039 | 9,991 | 2049 | 10,448 |
| 2020 | 8,628 | 2030 | 9,419 | 2040 | 10,043 | 2050 | 10,492 |

**Table 4.5. Demand Based on Population for the Kingman Water Planning Area by Year – Medium**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 7,830 | 2021 | 9,316 | 2031 | 10,755 | 2041 | 11,992 |
| 2012 | 7,944 | 2022 | 9,468 | 2032 | 10,890 | 2042 | 12,101 |
| 2013 | 8,014 | 2023 | 9,618 | 2033 | 11,023 | 2043 | 12,208 |
| 2014 | 8,117 | 2024 | 9,766 | 2034 | 11,154 | 2044 | 12,313 |
| 2015 | 8,273 | 2025 | 9,911 | 2035 | 11,282 | 2045 | 12,418 |
| 2016 | 8,450 | 2026 | 10,055 | 2036 | 11,408 | 2046 | 12,522 |
| 2017 | 8,642 | 2027 | 10,198 | 2037 | 11,531 | 2047 | 12,626 |
| 2018 | 8,832 | 2028 | 10,339 | 2038 | 11,651 | 2048 | 12,731 |
| 2019 | 9,003 | 2029 | 10,478 | 2039 | 11,768 | 2049 | 12,836 |
| 2020 | 9,162 | 2030 | 10,617 | 2040 | 11,882 | 2050 | 12,943 |

**Table 4.6. Demand Based on Population for the Kingman Water Planning Area by Year – High**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 7,830 | 2021 | 9,810 | 2031 | 11,792 | 2041 | 13,582 |
| 2012 | 7,955 | 2022 | 10,017 | 2032 | 11,983 | 2042 | 13,745 |
| 2013 | 8,049 | 2023 | 10,221 | 2033 | 12,172 | 2043 | 13,907 |
| 2014 | 8,187 | 2024 | 10,422 | 2034 | 12,358 | 2044 | 14,069 |
| 2015 | 8,398 | 2025 | 10,622 | 2035 | 12,542 | 2045 | 14,229 |
| 2016 | 8,638 | 2026 | 10,820 | 2036 | 12,723 | 2046 | 14,390 |
| 2017 | 8,897 | 2027 | 11,017 | 2037 | 12,901 | 2047 | 14,552 |
| 2018 | 9,154 | 2028 | 11,212 | 2038 | 13,076 | 2048 | 14,715 |
| 2019 | 9,385 | 2029 | 11,406 | 2039 | 13,248 | 2049 | 14,880 |
| 2020 | 9,600 | 2030 | 11,600 | 2040 | 13,417 | 2050 | 15,048 |

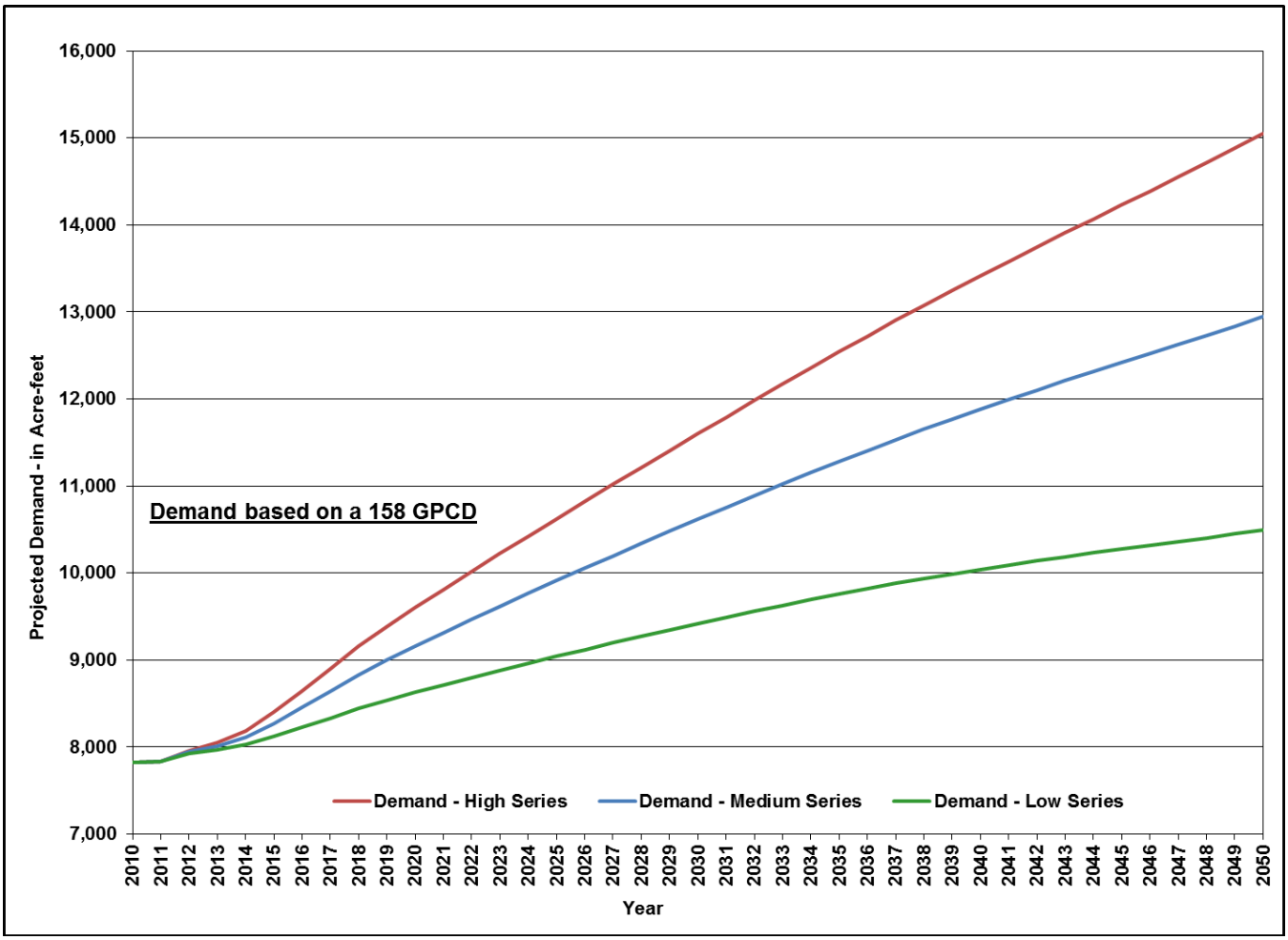



**Figure 4.3. Low, Medium and High Series Demand Projections for the Kingman Water Planning Area from 2010 through 2050**

## References

Arizona Department of Water Resources (1994). ADWR Staff Report on Kingman Area Water Supply and Demand, March 24, 1994. Obtained from Arizona Department of Water Resources.

City of Kingman (2006). City of Kingman 2007 System Water Plan, Submitted to the Arizona Department of Water Resources by the City of Kingman Water Department, December 1, 2006.

City of Kingman (2010). City of Kingman, Arizona Crossroads 2010. Retrieved from http://www.arizonacrossroads.com/

City of Kingman (2014). City of Kingman General Plan Update 2030. Retrieved from http://www.cityofkingman.gov/Portals/0/docs/cok/depts/pz/gp2030.pdf.

Garner, B.D., and Truini, Margot, 2011, Groundwater budgets for Detrital, Hualapai, and Sacramento Valleys, Mohave County, Arizona, 2007–08: U.S. Geological Survey Scientific Investigations Report 2011–5159, 34 p., available at http://pubs.usgs.gov/sir/2011/5159/.

Willdan Associates (1993). City of Kingman Water Adequacy Study Final Report. Obtained from Arizona Department of Water Resources.

# Chapter 5. Golden Shores Water Conservation District Water Planning Area

## Water Planning Area Description/Map

The Golden Shores Water Conservation District (GSWCD) water planning area is located south of Mohave Valley and approximately four miles north of Interstate 40 along the Colorado River. Topock Marsh, which separates the GSWCD from the main channel of the river, is located within the Havasu National Wildlife Refuge and is an important wildlife area along the Colorado River. The water planning area for the GSWCD is shown in Figure 5.1.

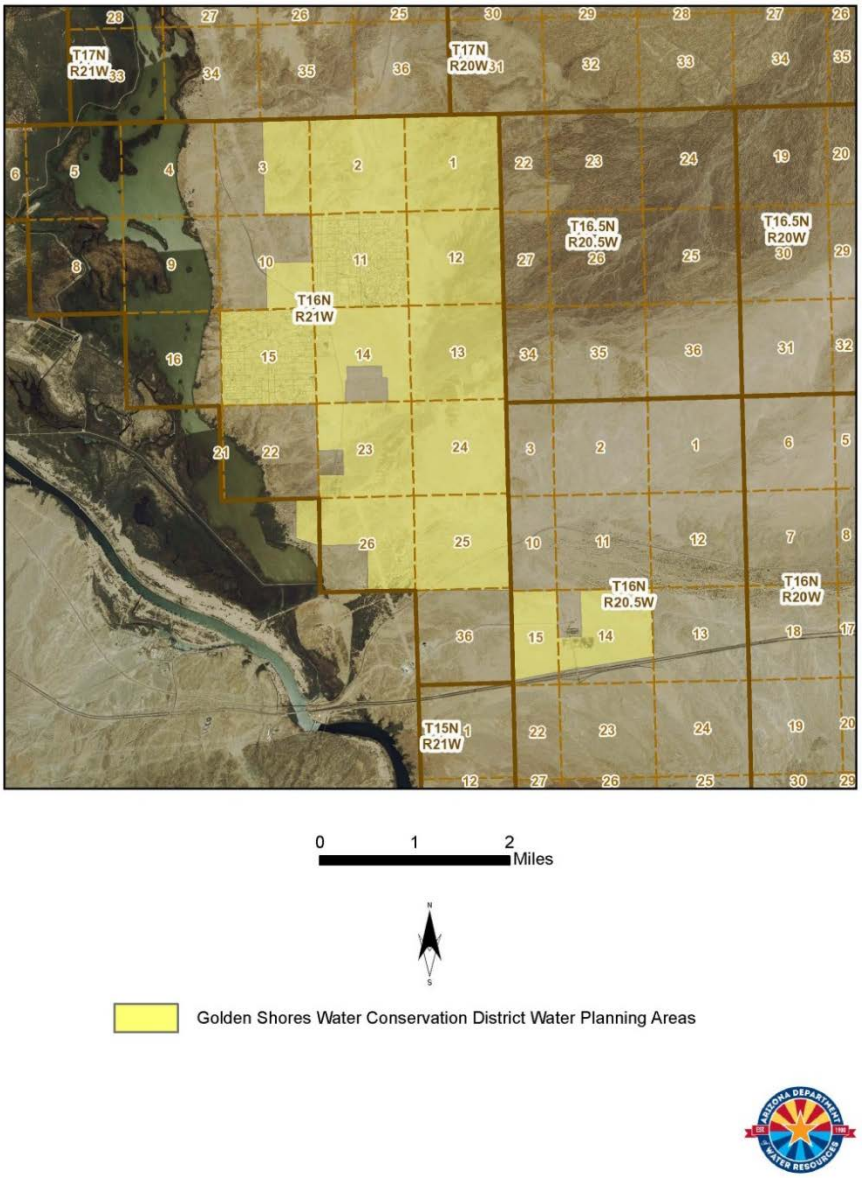



**Figure 5.1. Golden Shores Water Conservation District Water Planning Area**

## Water Planning Area Background information

The GSWCD was established in 1986 by the Mohave County Board of Supervisors for the purpose of holding a Colorado River water contract for existing and future commercial and residential development in the area. In 1989, the GSWCD entered into a contract with Reclamation for 2,000 AF of Colorado River. The total volume of Colorado River water available to the GSWCD for diversion is 2,000 AF. The GSWCD contract is a unique contract because it identifies specific water users, the locations, and volumes of water contract amounts.

Since 1989, the contract has been amended a number of times with the third, and most recent, amendment occurring in 2006. The 2006 amendment resulted in the volumes of water listed in Table 5.1 below. Legal descriptions for the lands are described in Exhibit A of the contract.

**Table 5.1. Water User and Volume of Water Use within Section 5 Contract No. 9-07-30-W0203 (Amendment No. 3)**

| Entity | Description | Volume (AF/yr) |
|---|---|---|
| GSWCD | Within the GSWCD Boundaries | 1,570 |
| Private Lands | Outside the GSWCD Boundaries | 230 |
| State Lands | Outside the GSWCD Boundaries | 200 |

Water service within the GSWCD planning area is provided by the Golden Shores Water Company, Inc. The GSWCD does not own water diversion or delivery facilities. The Golden Shores Water Company, Inc. delivers water to lands within the GSWCD boundaries, including the small community of Golden Shores, and to private lands located outside the GSWCD boundaries (Crossman and Mercer, 2009). The Golden Shores Water Company also provides water to Five Mile Landing RV Park which is within the water planning area but located on federal land. Water used by the resort does not count against the GSWCD contract volume.

## Baseline and Projected Population

The 2010, or baseline, population for this assessment was 2,026 people. Tables 5.2 through 5.4 and Figure 5.2 depict the estimated and projected populations for the water planning area for the low, medium and high series.

**Table 5.2. Estimated and Projected Population for the Golden Shores Water Conservation District by Year – Low Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 2,042 | 2021 | 2,394 | 2031 | 2,769 | 2041 | 3,066 |
| 2012 | 2,088 | 2022 | 2,435 | 2032 | 2,803 | 2042 | 3,090 |
| 2013 | 2,089 | 2023 | 2,474 | 2033 | 2,836 | 2043 | 3,113 |
| 2014 | 2,103 | 2024 | 2,513 | 2034 | 2,868 | 2044 | 3,136 |
| 2015 | 2,140 | 2025 | 2,552 | 2035 | 2,899 | 2045 | 3,158 |
| 2016 | 2,184 | 2026 | 2,589 | 2036 | 2,930 | 2046 | 3,180 |
| 2017 | 2,234 | 2027 | 2,627 | 2037 | 2,959 | 2047 | 3,202 |
| 2018 | 2,282 | 2028 | 2,663 | 2038 | 2,988 | 2048 | 3,224 |
| 2019 | 2,321 | 2029 | 2,699 | 2039 | 3,015 | 2049 | 3,245 |
| 2020 | 2,353 | 2030 | 2,734 | 2040 | 3,041 | 2050 | 3,267 |

**Table 5.3. Estimated and Projected Population for the Golden Shores Conservation District by Year – Medium Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 2,042 | 2021 | 2,559 | 2031 | 3,137 | 2041 | 3,643 |
| 2012 | 2,092 | 2022 | 2,620 | 2032 | 3,192 | 2042 | 3,687 |
| 2013 | 2,101 | 2023 | 2,679 | 2033 | 3,247 | 2043 | 3,731 |
| 2014 | 2,126 | 2024 | 2,738 | 2034 | 3,300 | 2044 | 3,774 |
| 2015 | 2,180 | 2025 | 2,797 | 2035 | 3,352 | 2045 | 3,817 |
| 2016 | 2,245 | 2026 | 2,855 | 2036 | 3,404 | 2046 | 3,859 |
| 2017 | 2,317 | 2027 | 2,912 | 2037 | 3,454 | 2047 | 3,902 |
| 2018 | 2,388 | 2028 | 2,969 | 2038 | 3,503 | 2048 | 3,944 |
| 2019 | 2,447 | 2029 | 3,025 | 2039 | 3,551 | 2049 | 3,987 |
| 2020 | 2,498 | 2030 | 3,082 | 2040 | 3,598 | 2050 | 4,030 |

**Table 5.4. Estimated and Projected Population for the Golden Shores Water Conservation District by Year – High Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 2,042 | 2021 | 2,695 | 2031 | 3,440 | 2041 | 4,126 |
| 2012 | 2,095 | 2022 | 2,771 | 2032 | 3,513 | 2042 | 4,188 |
| 2013 | 2,110 | 2023 | 2,847 | 2033 | 3,585 | 2043 | 4,251 |
| 2014 | 2,144 | 2024 | 2,923 | 2034 | 3,656 | 2044 | 4,312 |
| 2015 | 2,213 | 2025 | 2,997 | 2035 | 3,727 | 2045 | 4,374 |
| 2016 | 2,295 | 2026 | 3,072 | 2036 | 3,796 | 2046 | 4,435 |
| 2017 | 2,386 | 2027 | 3,146 | 2037 | 3,864 | 2047 | 4,497 |
| 2018 | 2,475 | 2028 | 3,220 | 2038 | 3,932 | 2048 | 4,559 |
| 2019 | 2,551 | 2029 | 3,293 | 2039 | 3,998 | 2049 | 4,622 |
| 2020 | 2,618 | 2030 | 3,367 | 2040 | 4,062 | 2050 | 4,686 |

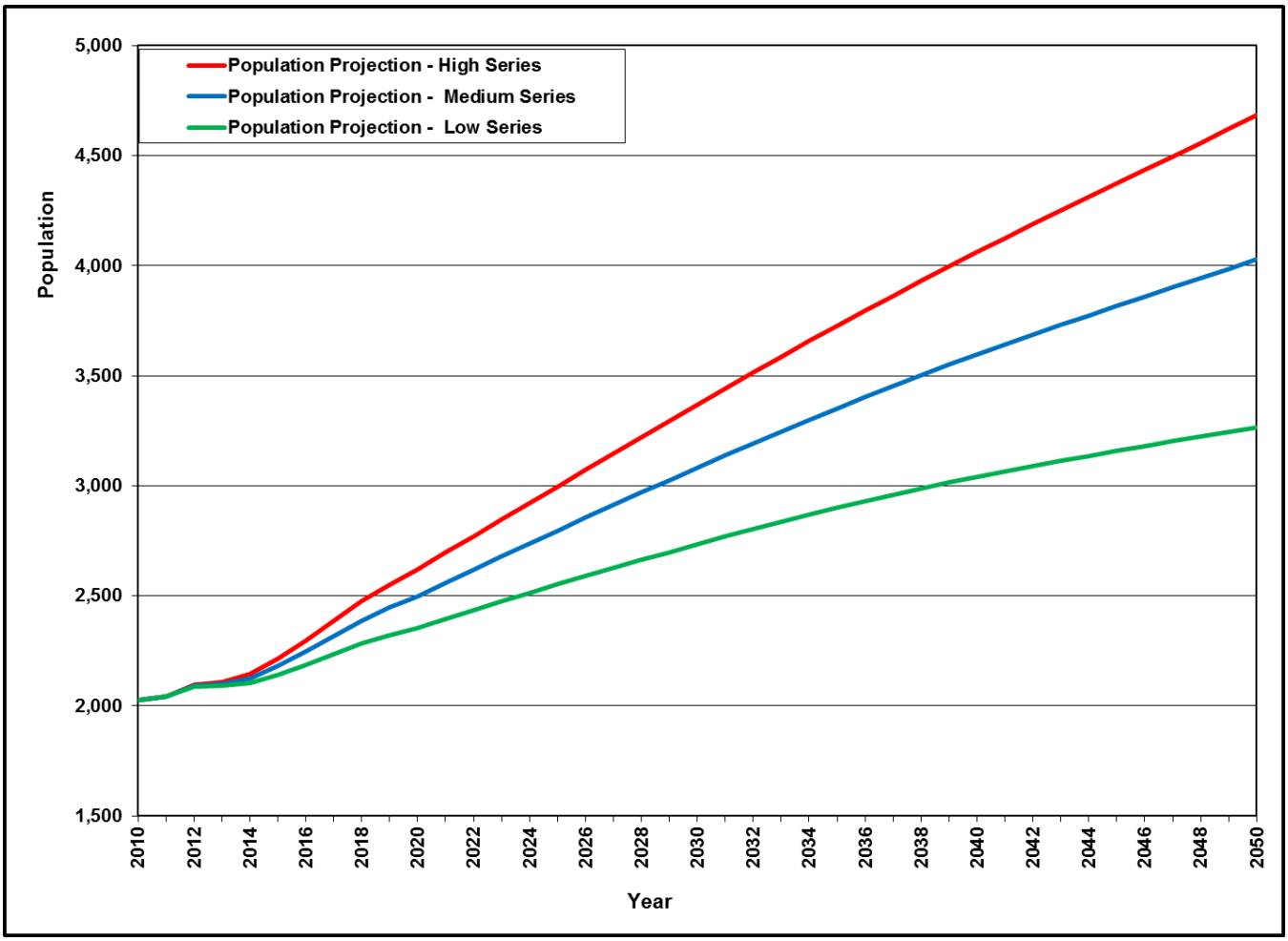



**Figure 5.2. Low, Medium and High Series Population Projections for the Golden Shores Water Conservation District from 2010 through 2050**

## Baseline and Projected Water Demand

The 2010, or baseline, demand for this assessment was 473 AF. Tables 5.5 through 5.7 and Figure 5.3 depict the estimated and projected water demands for the water planning area for the low, medium and high series. It should be noted that the diversion entitlement line shown in Figure 5.3 is for a normal year. The GSWCD total diversion entitlement is not exceeded by water demand in any of the population projection series through 2050. Although this assessment does not show a supply and demand imbalance within the planning period, the long planning horizon for development of water projects needs to be recognized and considered.

**Table 5.5. Demand Based on Population for the Golden Shores Water Conservation District by Year - Low**

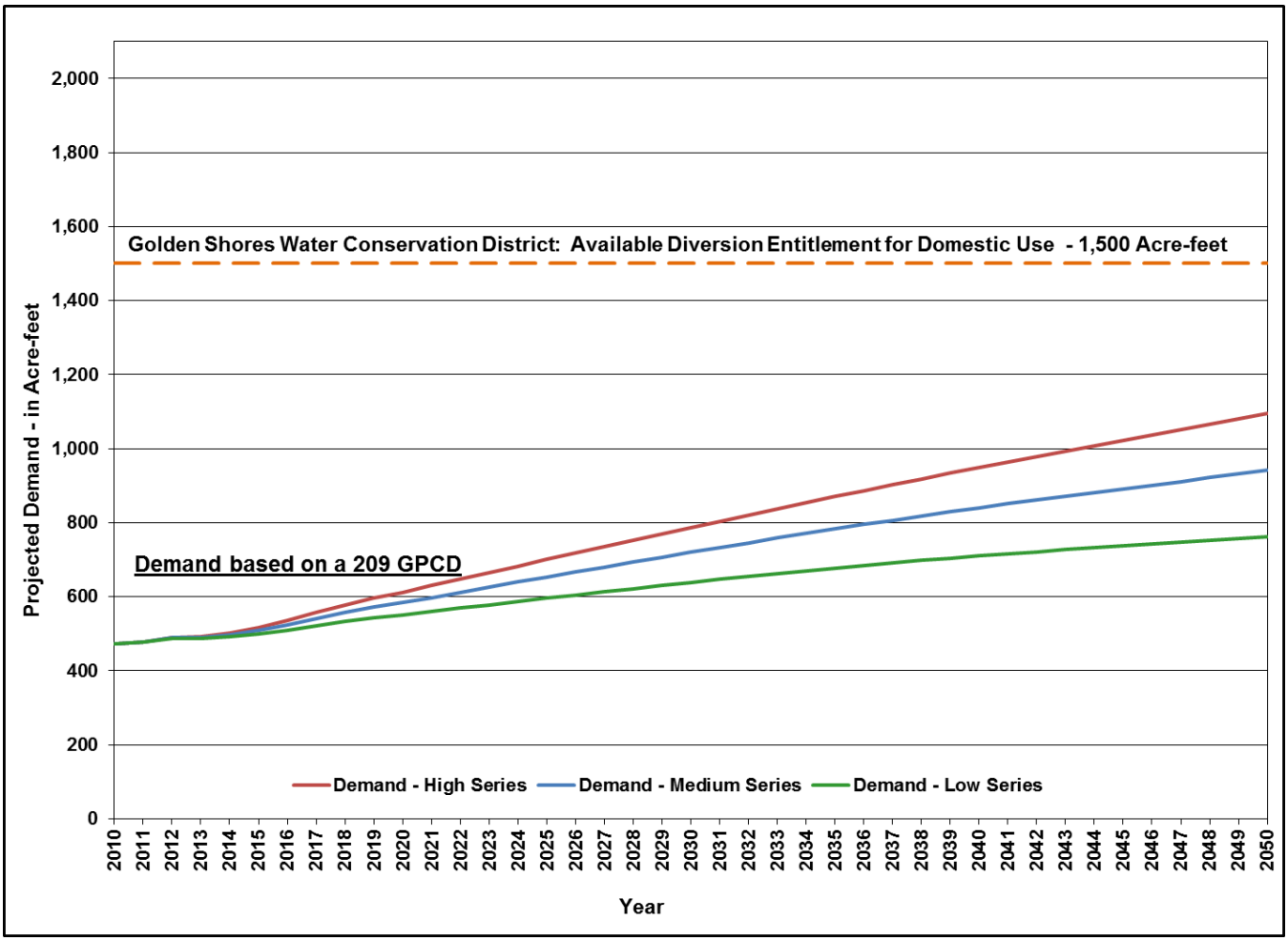
| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 477 | 2021 | 559 | 2031 | 647 | 2041 | 716 |
| 2012 | 488 | 2022 | 569 | 2032 | 655 | 2042 | 722 |
| 2013 | 488 | 2023 | 578 | 2033 | 662 | 2043 | 727 |
| 2014 | 491 | 2024 | 587 | 2034 | 670 | 2044 | 732 |
| 2015 | 500 | 2025 | 596 | 2035 | 677 | 2045 | 738 |
| 2016 | 510 | 2026 | 605 | 2036 | 684 | 2046 | 743 |
| 2017 | 522 | 2027 | 613 | 2037 | 691 | 2047 | 748 |
| 2018 | 533 | 2028 | 622 | 2038 | 698 | 2048 | 753 |
| 2019 | 542 | 2029 | 630 | 2039 | 704 | 2049 | 758 |
| 2020 | 549 | 2030 | 639 | 2040 | 710 | 2050 | 763 |

**Table 5.6. Demand Based on Population for the Golden Shores Water Conservation District by Year – Medium**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 477 | 2021 | 598 | 2031 | 733 | 2041 | 851 |
| 2012 | 489 | 2022 | 612 | 2032 | 746 | 2042 | 861 |
| 2013 | 491 | 2023 | 626 | 2033 | 758 | 2043 | 871 |
| 2014 | 496 | 2024 | 640 | 2034 | 771 | 2044 | 882 |
| 2015 | 509 | 2025 | 653 | 2035 | 783 | 2045 | 891 |
| 2016 | 524 | 2026 | 667 | 2036 | 795 | 2046 | 901 |
| 2017 | 541 | 2027 | 680 | 2037 | 807 | 2047 | 911 |
| 2018 | 558 | 2028 | 693 | 2038 | 818 | 2048 | 921 |
| 2019 | 571 | 2029 | 707 | 2039 | 829 | 2049 | 931 |
| 2020 | 583 | 2030 | 720 | 2040 | 840 | 2050 | 941 |

**Table 5.7. Demand Based on Population for the Golden Shores Water Conservation District by Year – High**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 477 | 2021 | 629 | 2031 | 804 | 2041 | 964 |
| 2012 | 489 | 2022 | 647 | 2032 | 820 | 2042 | 978 |
| 2013 | 493 | 2023 | 665 | 2033 | 837 | 2043 | 993 |
| 2014 | 501 | 2024 | 683 | 2034 | 854 | 2044 | 1,007 |
| 2015 | 517 | 2025 | 700 | 2035 | 870 | 2045 | 1,022 |
| 2016 | 536 | 2026 | 717 | 2036 | 887 | 2046 | 1,036 |
| 2017 | 557 | 2027 | 735 | 2037 | 903 | 2047 | 1,050 |
| 2018 | 578 | 2028 | 752 | 2038 | 918 | 2048 | 1,065 |
| 2019 | 596 | 2029 | 769 | 2039 | 934 | 2049 | 1,080 |
| 2020 | 611 | 2030 | 786 | 2040 | 949 | 2050 | 1,094 |




NOTE: The GSWCD entitlement is 2,000 AF but the district has a contractual obligation to provide 500 AF to Mohave Pipeline Operating Company. Due to that obligation, this assessment assumes only 1,500 AF of water is available to the GSWCD (Crossman and Mercer, 2009).

**Figure 5.3. Low, Medium and High Series Demand Projections for the Golden Shores Water Conservation District from 2010 through 2050**

## Shortage Scenarios

Tables 5.8 through 5.10 and Figure 5.4 depict the shortage volumes as a result of the three shortage scenarios analyzed. The first shortage that impacts the GSWCD occurs in 2021 under Scenario A2.

**Table 5.8. Years of Shortages and Shortage Volumes for Scenario A2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | GSWCD Shortage Volume (AF/year) |
|---|---|---|---|
| 2021 | 3 | 480,000 | 1.6 |
| 2022 | 3 | 480,000 | 15.9 |
| 2023 | 3 | 480,000 | 30.5 |
| 2024 | 3 | 480,000 | 45.4 |
| 2027 | 3 | 480,000 | 92.0 |
| 2030 | 3 | 480,000 | 138.5 |
| 2031 | 3 | 480,000 | 149.1 |
| 2032 | 2 | 400,000 | 29.8 |
| 2033 | 2 | 400,000 | 38.9 |
| | | **Total** | **541.6** |

Table Notes –

2 – When Lake Mead's elevation is projected to be below elevation 1,050 feet and at or above elevation 1,025 feet, a reduction of 417,000 acre-feet (AF) is applied to the Lower Basin. Arizona's apportionment is reduced by 400,000 AF and Nevada's is reduced by 17,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 75.000 AF.

3 – When Lake Mead's elevation is projected to be below elevation 1,025 feet, a reduction of 500,000 AF is applied to the Lower Basin. Arizona's apportionment is reduced by 480,000 AF and Nevada's is reduced by 20,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 125.000 AF. Consultations with the Secretary may be required at this critical elevation.

**Table 5.8. Years of Shortages and Shortage Volumes for Scenario C2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | GSWCD Shortage Volume (AF/year) |
|---|---|---|---|
| 2033 | 80P1050 | 620,000 | 780.6 |
| 2034 | 80P1050 | 634,000 | 793.2 |
| 2040 | 80P1050 | 616,000 | 864.4 |
| 2044 | 80P1050 | 614,000 | 907.9 |
| 2049 | 80P1050 | 612,000 | 960.2 |
| 2050 | 80P1050 | 612,000 | 966.5 |
| | | **Total** | **5,272.8** |

Table Notes –

80P1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called "80P1050 Abs Pro 1000)

**Table 5.9. Years of Shortages and Shortage Volumes for Scenario H1**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | GSWCD Shortage Volume (AF/year) |
|---|---|---|---|
| 2035 | 80P1050 | 481,000 | 682.9 |
| 2036 | 80P1050 | 481,000 | 693.1 |
| 2037 | 80P1050 | 480,000 | 703.1 |
| 2038 | 80P1050 | 479,000 | 712.9 |
| 2039 | 80P1050 | 479,000 | 722.5 |
| 2040 | 80P1050 | 478,000 | 731.9 |
| 2041 | 80P1050 | 478,000 | 741.1 |
| 2042 | 80P1050 | 477,000 | 750.1 |
| 2043 | 80P1050 | 477,000 | 759.1 |
| 2044 | 80P1050 | 476,000 | 767.9 |
| 2045 | 80P1050 | 476,000 | 776.6 |
| 2046 | 80P1050 | 475,000 | 785.2 |
| 2047 | 80P1050 | 475,000 | 793.9 |
| 2048 | 80P1050 | 475,000 | 802.6 |
| 2049 | 80P1050 | 474,000 | 811.2 |
| 2050 | 80P1050 | 474,000 | 816.3 |
| **Total** | | **Total** | **12,050.4** |

Table Notes –

80P1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called “80P1050 Abs Pro 1000)

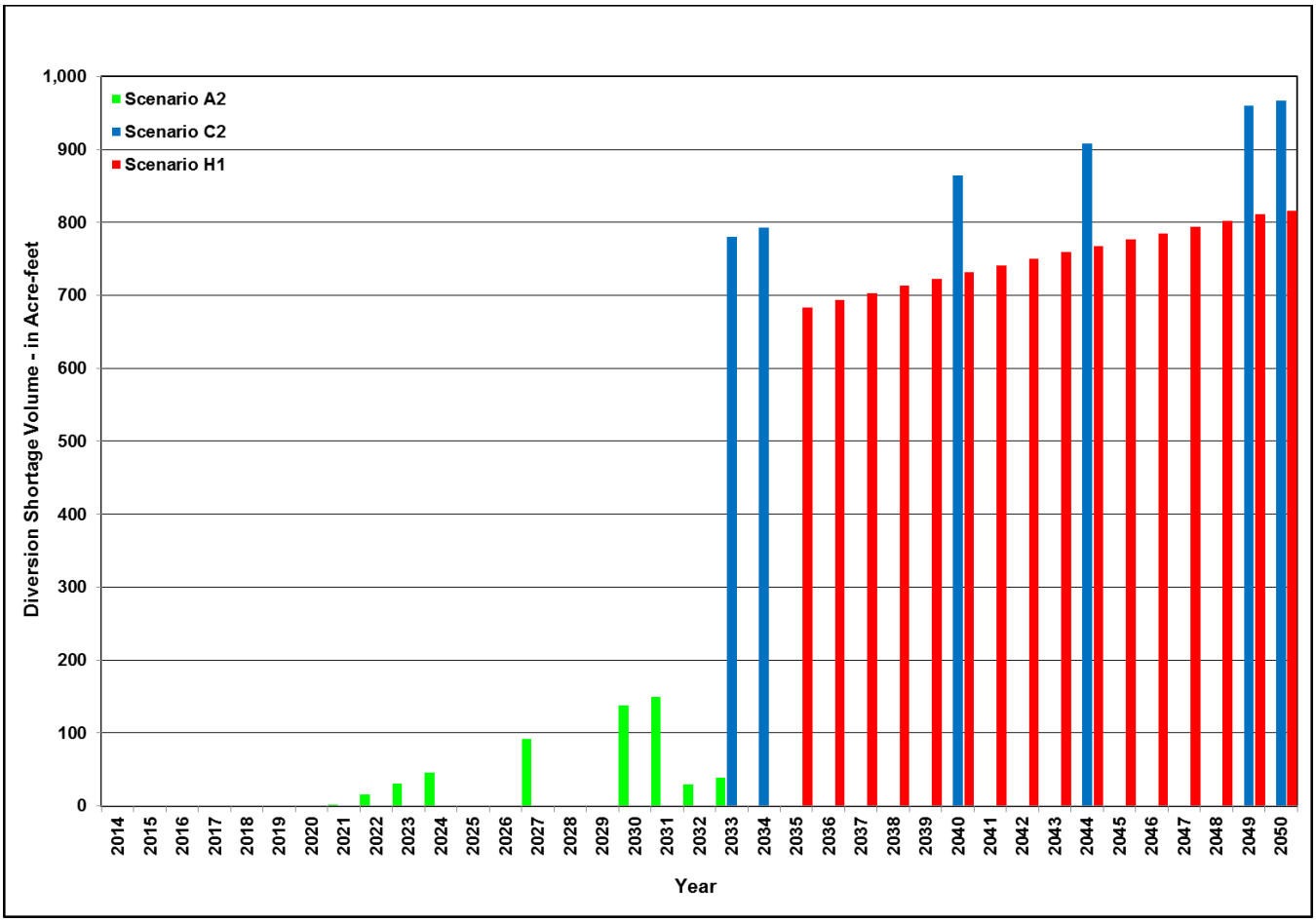



**Figure 5.4. Shortage Volumes by Year for the Golden Shores Water Conservation District for the Three Scenarios Modeled**

## References

Crossman, G.D. and J.C. Mercer, 2009. Water Resource Study for Golden Shores Water Conservation District, Golden Shores, AZ. Prepared for Golden shores Water Conservation District. Morrison Maierle, Inc., Tempe, Arizona, 32 pages plus 7 figures, 3 appendices.

# Chapter 6. Lake Havasu City Water Planning Area

## Water Planning Area Description

Lake Havasu City (LHC) is located on the eastern shore of Lake Havasu off of Highway 95 approximately 18 miles south of Interstate 40. LHC encompasses approximately 42 square miles and is the major population center of southern Mohave County (Lake Havasu City, 2013). LHC is bounded on the west by the Colorado River, and, on the other sides by either Bureau of Land Management land, State trust land or the Havasu National Wildlife Refuge. The water planning area for the LHC is shown in Figure 6.1.

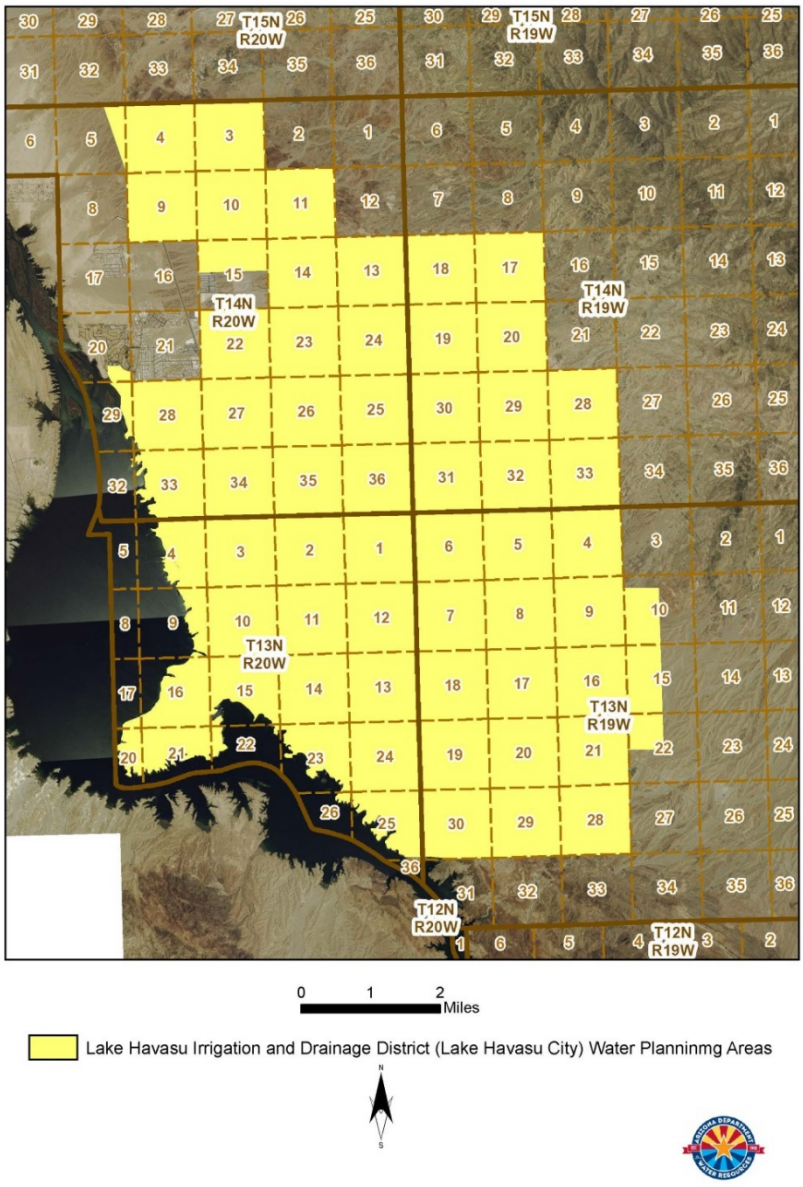



**Figure 6.1. Lake Havasu City Water Planning Area**

## Water Planning Area Background information

The community of LHC began as an Army Air Corps rest camp during World War II. Robert P. McCulloch purchased private property and federal land and initiated development of a self-sufficient, planned community in 1963 (Lake Havasu City, 2013). The Lake Havasu Irrigation and Drainage District (LHIDD) was established on September 30, 1963 by a resolution of the Mohave County Board of Supervisors. This established the irrigation district as a legal entity able to enter into a Section 5 contract for Colorado River water with Reclamation.

In 1968, the LHIDD contracted with Reclamation for 14,500 AF of Colorado River water for domestic uses. In 1983, the contract between LHIDD and Reclamation was amended and re-numbered to 3-07-30-W0039. The amendment was done to provide for deliveries of water to the Horizon Six Improvement District and the Anasazi Pueblo, Inc. bringing the total contract volume to 14,801 AF. In 1987, Contract No. 3-07-30-W0039 was amended to provide for delivery of water to Sunset Mobile Home Park bringing the total contract volume to 14,831 AF. In 1995, the LHIDD assigned the earlier contracts and amendments to Lake Havasu City. The new contract between Reclamation and LHC also included an additional 4,349 AF of water per the recommendation of ADWR resulting in a total of 19,180 AF. There was a final amendment to the contract in 2013 that added an additional 12.7 AF pursuant to a transfer bringing the total contract volume to 19,192.7 AF. Additionally, LHC has contracts with Reclamation for an unquantified volume of 5th and 6th priority water when it is available for use.

LHC has also entered into subcontracts with the MCWA for Colorado River water. The first subcontract was executed in 1995 for 6,000 AF of water. In 2009, LHC entered into a second subcontract with MCWA for 2,139 AF of water. In 2010, the 1995 contract was amended to increase the volume to 7,000 AF. The total volume of Colorado River water that LHC has pursuant to subcontracts with MCWA is 9,139 AF.

LHC provides water within the water planning area and owns multiple wells and a potable water and wastewater distribution system. The city is responsible for all water diversion and use within its contract area.

## Population Baseline and Forecast

The 2010, or baseline, population for this assessment was 52,629 people. Tables 6.1 through 6.3 and Figure 6.2 depict the estimated and projected populations for the water planning area for the low, medium and high series. Note that for the low range population series, the decrease in projected population after year 2036 is a result of applying ADOA projection assumptions and methodology which result in a decreasing rate of population increase (ADOA 2013).

**Table 6.1. Estimated and Projected Population for the Lake Havasu City, Arizona by Year – Low Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 52,508 | 2021 | 55,193 | 2031 | 56,686 | 2041 | 56,628 |
| 2012 | 52,731 | 2022 | 55,420 | 2032 | 56,757 | 2042 | 56,531 |
| 2013 | 52,499 | 2023 | 55,625 | 2033 | 56,811 | 2043 | 56,423 |
| 2014 | 52,498 | 2024 | 55,811 | 2034 | 56,849 | 2044 | 56,309 |
| 2015 | 52,828 | 2025 | 55,978 | 2035 | 56,869 | 2045 | 56,189 |
| 2016 | 53,273 | 2026 | 56,131 | 2036 | 56,875 | 2046 | 56,066 |
| 2017 | 53,795 | 2027 | 56,268 | 2037 | 56,862 | 2047 | 55,944 |
| 2018 | 54,289 | 2028 | 56,390 | 2038 | 56,832 | 2048 | 55,824 |
| 2019 | 54,658 | 2029 | 56,499 | 2039 | 56,783 | 2049 | 55,709 |
| 2020 | 54,942 | 2030 | 56,597 | 2040 | 56,714 | 2050 | 55,599 |

**Table 6.2. Estimated and Projected Population for the City of Lake Havasu City, Arizona by Year – Medium Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 52,508 | 2021 | 58,999 | 2031 | 64,232 | 2041 | 67,288 |
| 2012 | 52,822 | 2022 | 59,631 | 2032 | 64,648 | 2042 | 67,462 |
| 2013 | 52,778 | 2023 | 60,231 | 2033 | 65,039 | 2043 | 67,620 |
| 2014 | 53,058 | 2024 | 60,804 | 2034 | 65,409 | 2044 | 67,767 |
| 2015 | 53,818 | 2025 | 61,353 | 2035 | 65,753 | 2045 | 67,905 |
| 2016 | 54,747 | 2026 | 61,880 | 2036 | 66,075 | 2046 | 68,037 |
| 2017 | 55,792 | 2027 | 62,387 | 2037 | 66,371 | 2047 | 68,170 |
| 2018 | 56,800 | 2028 | 62,872 | 2038 | 66,640 | 2048 | 68,304 |
| 2019 | 57,628 | 2029 | 63,340 | 2039 | 66,883 | 2049 | 68,442 |
| 2020 | 58,336 | 2030 | 63,792 | 2040 | 67,098 | 2050 | 68,588 |

**Table 6.3. Estimated and Projected Population for the City of Lake Havasu City, Arizona by Year – High Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 52,508 | 2021 | 62,127 | 2031 | 70,431 | 2041 | 76,207 |
| 2012 | 52,893 | 2022 | 63,085 | 2032 | 71,138 | 2042 | 76,629 |
| 2013 | 53,004 | 2023 | 64,005 | 2033 | 71,816 | 2043 | 77,034 |
| 2014 | 53,517 | 2024 | 64,893 | 2034 | 72,470 | 2044 | 77,427 |
| 2015 | 54,632 | 2025 | 65,752 | 2035 | 73,094 | 2045 | 77,810 |
| 2016 | 55,962 | 2026 | 66,586 | 2036 | 73,691 | 2046 | 78,188 |
| 2017 | 57,440 | 2027 | 67,397 | 2037 | 74,257 | 2047 | 78,567 |
| 2018 | 58,870 | 2028 | 68,183 | 2038 | 74,792 | 2048 | 78,951 |
| 2019 | 60,075 | 2029 | 68,949 | 2039 | 75,295 | 2049 | 79,341 |
| 2020 | 61,130 | 2030 | 69,697 | 2040 | 75,766 | 2050 | 79,742 |

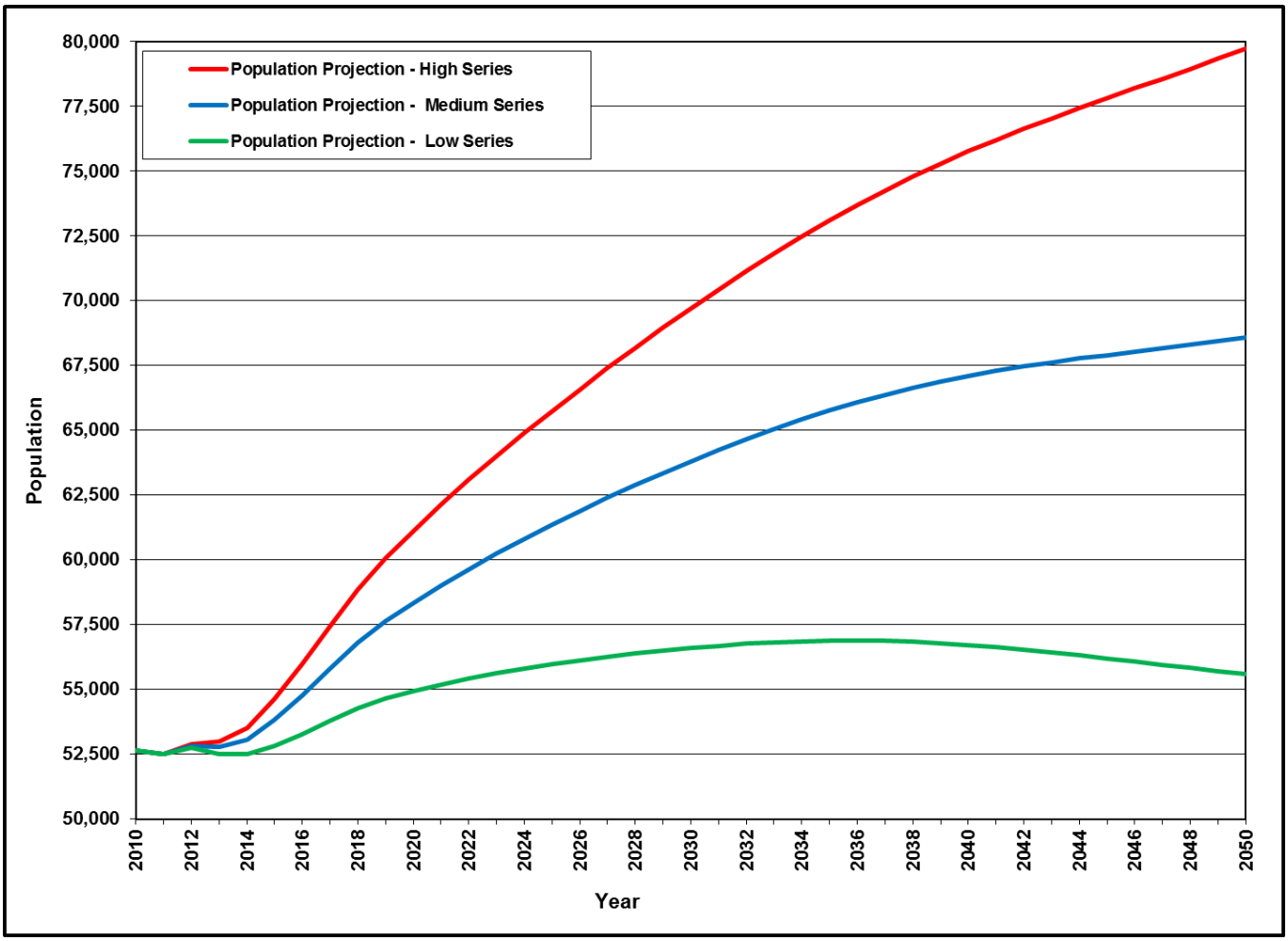



**Figure 6.2. Low, Medium and High Series Population Projections for the City of Lake Havasu City, Arizona from 2010 through 2050**

## Baseline and Projected Water Demand

The 2010, or baseline, demand for this assessment was 16,057 AF. Tables 6.4 through 6.6 and Figure 6.3 depict the estimated and projected water demands for the water planning area for the low, medium and high series. It should be noted that the diversion entitlement line shown in Figure 6.3 is for a normal year. The LHC total diversion entitlement is not exceeded by water demand in any of the population projection series through 2050. Although this assessment does not show a supply and demand imbalance within the planning period, the long planning horizon for development of water projects needs to be recognized and considered.

**Table 6.4. Demand Based on Population for the City of Lake Havasu City, Arizona by Year - Low**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 16,020 | 2021 | 16,839 | 2031 | 17,295 | 2041 | 17,536 |
| 2012 | 16,088 | 2022 | 16,909 | 2032 | 17,317 | 2042 | 17,536 |
| 2013 | 16,017 | 2023 | 16,972 | 2033 | 17,333 | 2043 | 17,536 |
| 2014 | 16,017 | 2024 | 17,028 | 2034 | 17,345 | 2044 | 17,536 |
| 2015 | 16,118 | 2025 | 17,079 | 2035 | 17,351 | 2045 | 17,536 |
| 2016 | 16,254 | 2026 | 17,126 | 2036 | 17,353 | 2046 | 17,536 |
| 2017 | 16,413 | 2027 | 17,168 | 2037 | 17,349 | 2047 | 17,536 |
| 2018 | 16,564 | 2028 | 17,205 | 2038 | 17,349 | 2048 | 17,536 |
| 2019 | 16,676 | 2029 | 17,238 | 2039 | 17,349 | 2049 | 17,536 |
| 2020 | 16,763 | 2030 | 17,268 | 2040 | 17,349 | 2050 | 17,536 |

**Table 6.5. Demand Based on Population for the City of Lake Havasu City, Arizona by Year – Medium**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 16,020 | 2021 | 18,001 | 2031 | 19,597 | 2041 | 20,530 |
| 2012 | 16,116 | 2022 | 18,194 | 2032 | 19,724 | 2042 | 20,583 |
| 2013 | 16,103 | 2023 | 18,377 | 2033 | 19,844 | 2043 | 20,631 |
| 2014 | 16,188 | 2024 | 18,552 | 2034 | 19,956 | 2044 | 20,676 |
| 2015 | 16,420 | 2025 | 18,719 | 2035 | 20,062 | 2045 | 20,718 |
| 2016 | 16,704 | 2026 | 18,880 | 2036 | 20,160 | 2046 | 20,758 |
| 2017 | 17,022 | 2027 | 19,034 | 2037 | 20,250 | 2047 | 20,799 |
| 2018 | 17,330 | 2028 | 19,182 | 2038 | 20,332 | 2048 | 20,840 |
| 2019 | 17,582 | 2029 | 19,325 | 2039 | 20,406 | 2049 | 20,882 |
| 2020 | 17,799 | 2030 | 19,463 | 2040 | 20,472 | 2050 | 20,926 |

**Table 6.6. Demand Based on Population for the City of Lake Havasu City, Arizona by Year – High**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 16,020 | 2021 | 18,955 | 2031 | 21,489 | 2041 | 23,251 |
| 2012 | 16,138 | 2022 | 19,247 | 2032 | 21,704 | 2042 | 23,380 |
| 2013 | 16,172 | 2023 | 19,528 | 2033 | 21,911 | 2043 | 23,503 |
| 2014 | 16,328 | 2024 | 19,799 | 2034 | 22,111 | 2044 | 23,623 |
| 2015 | 16,668 | 2025 | 20,061 | 2035 | 22,301 | 2045 | 23,740 |
| 2016 | 17,074 | 2026 | 20,316 | 2036 | 22,483 | 2046 | 23,855 |
| 2017 | 17,525 | 2027 | 20,563 | 2037 | 22,656 | 2047 | 23,971 |
| 2018 | 17,961 | 2028 | 20,803 | 2038 | 22,819 | 2048 | 24,088 |
| 2019 | 18,329 | 2029 | 21,036 | 2039 | 22,973 | 2049 | 24,207 |
| 2020 | 18,651 | 2030 | 21,265 | 2040 | 23,116 | 2050 | 24,330 |

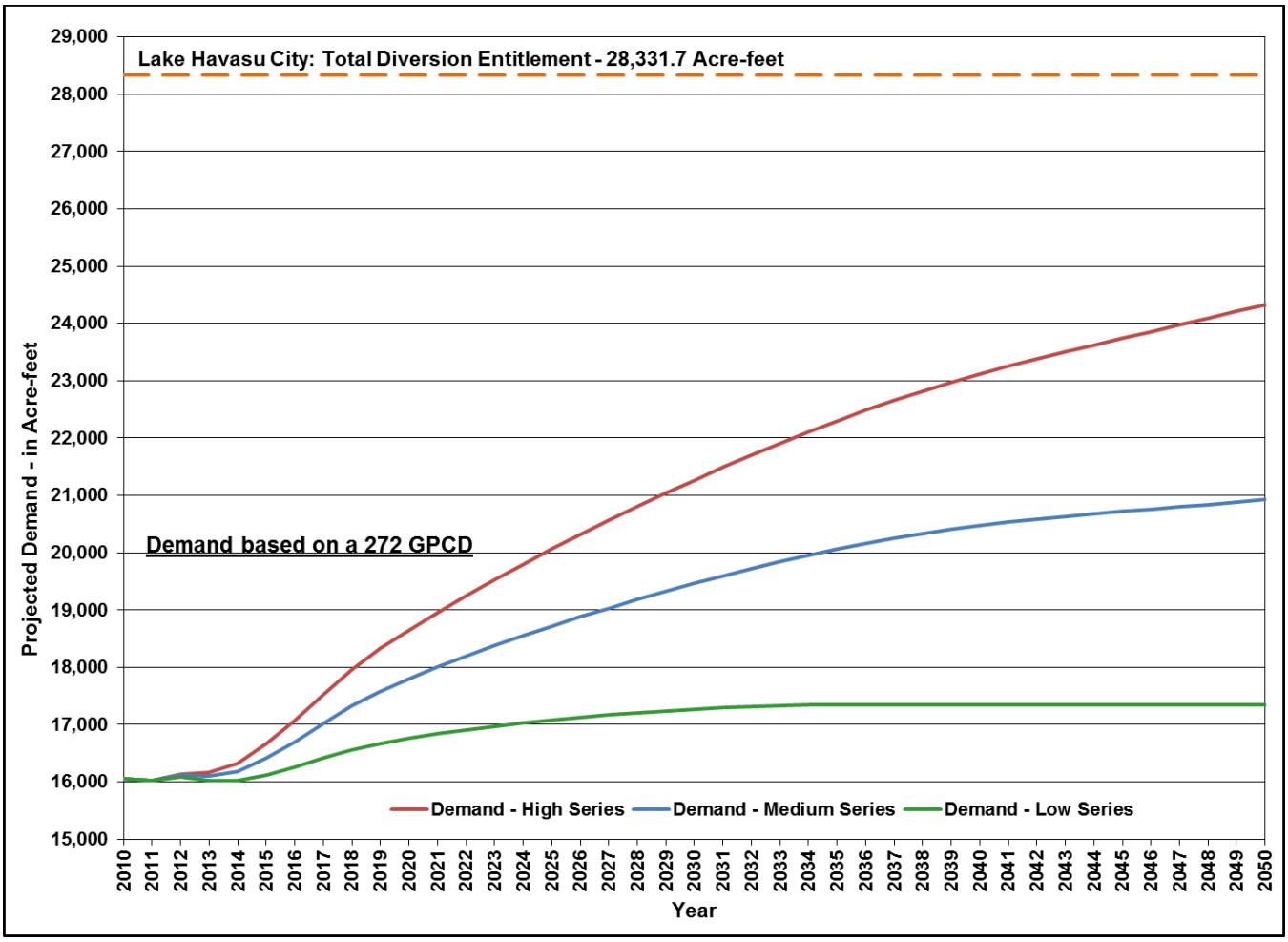



**Figure 6.3. Low, Medium and High Series Demand Projections for the City of Lake Havasu City, Arizona from 2010 through 2050**

## Shortage Scenarios

Tables 6.7 through 6.9 and Figure 6.4 depict the shortage volumes as a result of the three shortage scenarios analyzed. The first shortage that impacts LHC occurs in 2021 under Scenario A2.

The AWBA is required to reserve a reasonable number of long-term storage credits accrued within CAP's service area to firm on-river Fourth Priority M&I Colorado River supplies during shortage. The MCWA and the AWBA have entered into an agreement and 256,174 AF of credits have been reserved for this purpose. LHC has 113,074 AF of long-term storage credits reserved specifically for their use. For more information regarding the process of on-river firming, see the AWBA webpage at http://www.azwaterbank.gov/Plans_and_Reports_Documents/On-River_Firming.htm.

**Table 6.7. Years of Shortages and Shortage Volumes for Scenario A2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | LHC Shortage Volume (AF/year) |
|---|---|---|---|
| 2021 | 3 | 480,000 | 16.3 |
| 2022 | 3 | 480,000 | 159.5 |
| 2023 | 3 | 480,000 | 300.0 |
| 2024 | 3 | 480,000 | 438.5 |
| 2027 | 3 | 480,000 | 838.7 |
| 2030 | 3 | 480,000 | 1,203.6 |
| 2031 | 3 | 480,000 | 1,292.4 |
| 2032 | 2 | 400,000 | 257.5 |
| 2033 | 2 | 400,000 | 335.3 |
| | | **Total** | **4,841.7** |

Table Notes –

2 – When Lake Mead's elevation is projected to be below elevation 1,050 feet and at or above elevation 1,025 feet, a reduction of 417,000 acre-feet (AF) is applied to the Lower Basin. Arizona's apportionment is reduced by 400,000 AF and Nevada's is reduced by 17,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 75.000 AF.

3 – When Lake Mead's elevation is projected to be below elevation 1,025 feet, a reduction of 500,000 AF is applied to the Lower Basin. Arizona's apportionment is reduced by 480,000 AF and Nevada's is reduced by 20,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 125.000 AF. Consultations with the Secretary may be required at this critical elevation.

**Table 6.8. Years of Shortages and Shortage Volumes for Scenario C2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | LHC Shortage Volume (AF/year) |
|---|---|---|---|
| 2033 | 80P1050 | 620,000 | 6,730.7 |
| 2034 | 80P1050 | 634,000 | 6,818.2 |
| 2040 | 80P1050 | 616,000 | 7,288.0 |
| 2044 | 80P1050 | 614,000 | 7,553.0 |
| 2049 | 80P1050 | 612,000 | 7,869.1 |
| 2050 | 80P1050 | 612,000 | 7,898.8 |
| | | **Total** | **44,157.7** |

Table Notes –

80P1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called "80P1050 Abs Pro 1000)

**Table 6.9. Years of Shortages and Shortage Volumes for Scenario H1**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | LHC Shortage Volume (AF/year) |
|---|---|---|---|
| 2035 | 80P1050 | 481,000 | 5,852.6 |
| 2036 | 80P1050 | 481,000 | 5,921.0 |
| 2037 | 80P1050 | 480,000 | 5,987.0 |
| 2038 | 80P1050 | 479,000 | 6,050.7 |
| 2039 | 80P1050 | 479,000 | 6,111.9 |
| 2040 | 80P1050 | 478,000 | 6,170.5 |
| 2041 | 80P1050 | 478,000 | 6,227.0 |
| 2042 | 80P1050 | 477,000 | 6,282.0 |
| 2043 | 80P1050 | 477,000 | 6,335.6 |
| 2044 | 80P1050 | 476,000 | 6,388.3 |
| 2045 | 80P1050 | 476,000 | 6,440.3 |
| 2046 | 80P1050 | 475,000 | 6,491.9 |
| 2047 | 80P1050 | 475,000 | 6,543.6 |
| 2048 | 80P1050 | 475,000 | 6,595.6 |
| 2049 | 80P1050 | 474,000 | 6,647.4 |
| 2050 | 80P1050 | 474,000 | 6,671.6 |
| | | **Total** | **100,716.9** |

Table Notes –

80P1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called “80P1050 Abs Pro 1000)

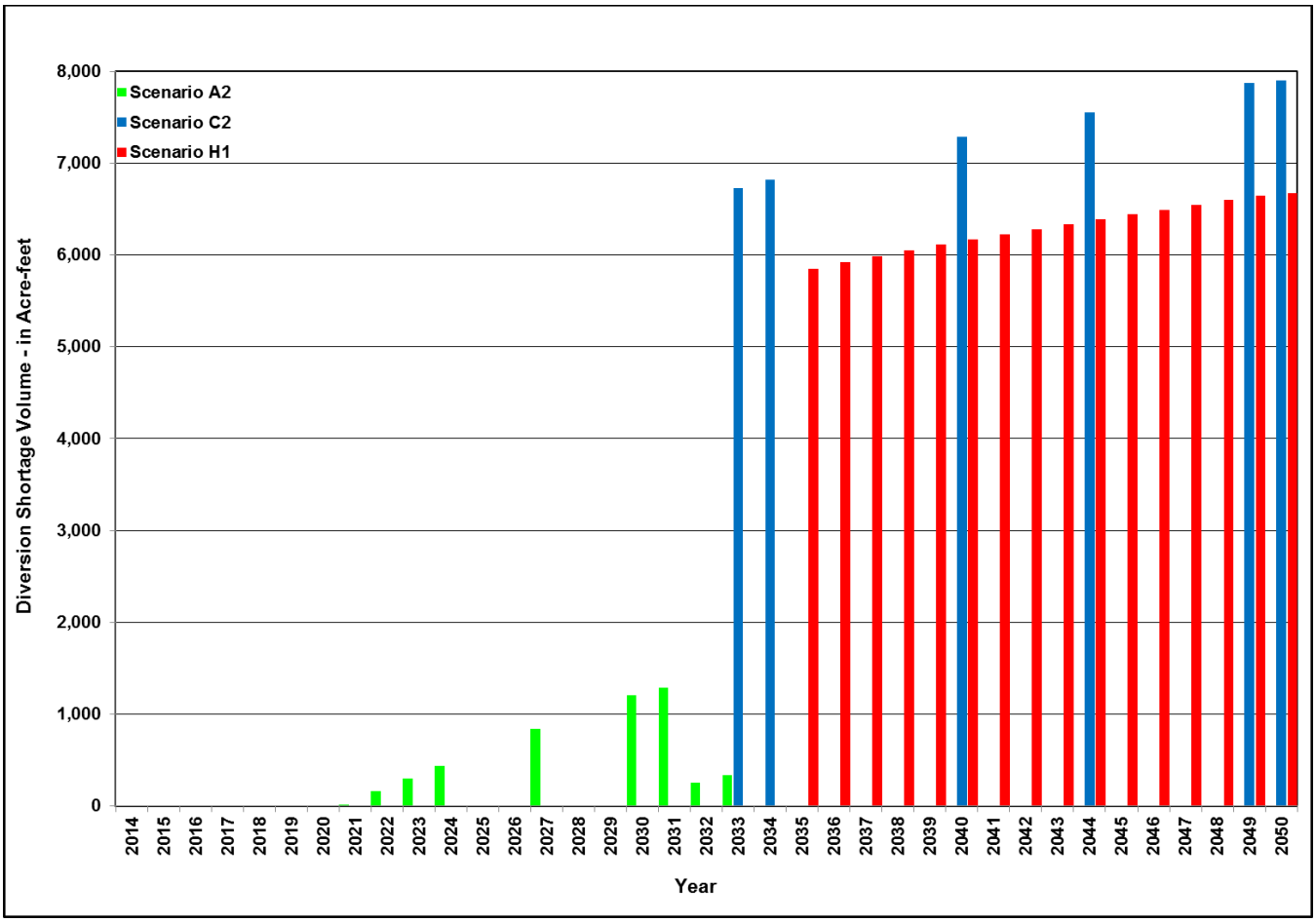



**Figure 6.4. Shortage Volumes by Year for Lake Havasu City for the Three Scenarios Modeled**

## References

Arizona Department of Administration, Employment and Population Statistics (2013). Arizona Sub-County Population Projections, 2013-2050: Methodology Report. Retrieved from https://population.az.gov/population-projections

Lake Havasu City (2013). Official Website of Lake Havasu City. Retrieved from http://www.lhcaz.gov/aboutUS.html

# Chapter 7. Mohave Valley Irrigation and Drainage District Water Planning Area

## Water Planning Area Description

The Mohave Valley Irrigation and Drainage District (MVIDD) is located in western Arizona, along the east side of the Colorado River a few miles south of the southern tip of Nevada, immediately south of Bullhead City. It is bounded on the west by the Fort Mohave Indian Reservation and the Colorado River, on the south by the Havasu National Wildlife Refuge, and on the east by primarily federal and state lands.

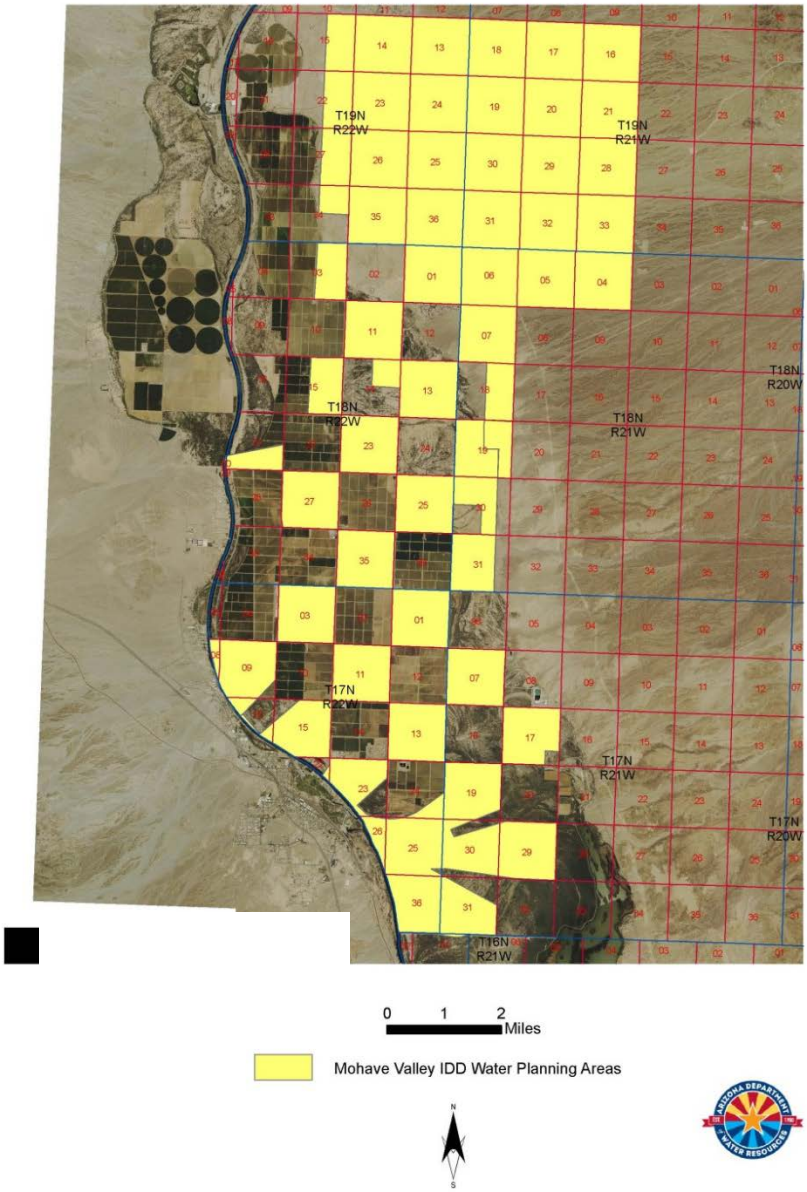



**Figure 7.1. Mohave Valley Irrigation and Drainage District Water Planning Area**

## Water Planning Area Background information

The MVIDD was formed in 1963 and entered into a Section 5 contract with Reclamation in 1968 for 51,000 AF of Colorado River water for irrigation and domestic uses. That contract was reduced to 41,000 AF when water was transferred to Bullhead City. The MVIDD is the only Assessment Participant that holds a contract for both domestic and irrigation use. There is no limitation within the Section 5 contract with respect to volumes for irrigation or domestic use; the MVIDD could utilize the entire volume for either purpose. MVIDD has also entered into a subcontract with the MCWA for 1,000 AF of 4th Priority M&I water. The total volume of Colorado River water available to the MVIDD for diversion, either via contract or subcontract, is 42,000 AF.

The MVIDD does not deliver water for domestic use. Colorado River water used for domestic purposes is served from the following water companies: Utilities, Inc., Global Water Company, Epcor, Lagoon Estates Water Company and Sunrise Vistas Water Company. The MVIDD provides water for lands located in Fort Mohave and Mohave Valley, AZ with the exception of lands that are part of the reservation of the Fort Mohave Indian Tribe. The tribe has its own water allocation for reservation lands that is completely separate from the MVIDD contract. Agricultural water use accounts for the highest volume of water use within the MVIDD. Internally, MVIDD allocates water to entities within their water planning area. The MVIDD monitors the water uses to ensure compliance with the terms of the allocations (Mohave Valley Irrigation and Drainage District, 2015).

An issue currently being faced by the MVIDD involves non-district wells being drilled within the water planning area. MVIDD is attempting to identify the actual number of wells within the water planning area to insure accurate reporting of water use to Reclamation.

## Population Baseline and Forecast

The 2010, or baseline, population for this assessment was 19,960 people. Tables 7.1 through 7.3 and Figure 7.2 depict the estimated and projected populations for the water planning area for the low, medium and high series.

**Table 7.1. Estimated and Projected Population for the Mohave Valley Irrigation and Drainage District, Arizona by Year – Low Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 20,098 | 2021 | 25,107 | 2031 | 30,541 | 2041 | 34,684 |
| 2012 | 20,550 | 2022 | 25,705 | 2032 | 31,024 | 2042 | 35,010 |
| 2013 | 20,525 | 2023 | 26,289 | 2033 | 31,493 | 2043 | 35,323 |
| 2014 | 20,710 | 2024 | 26,859 | 2034 | 31,948 | 2044 | 35,628 |
| 2015 | 21,263 | 2025 | 27,416 | 2035 | 32,388 | 2045 | 35,923 |
| 2016 | 21,944 | 2026 | 27,963 | 2036 | 32,814 | 2046 | 36,212 |
| 2017 | 22,710 | 2027 | 28,499 | 2037 | 33,224 | 2047 | 36,499 |
| 2018 | 23,441 | 2028 | 29,023 | 2038 | 33,616 | 2048 | 36,784 |
| 2019 | 24,020 | 2029 | 29,537 | 2039 | 33,990 | 2049 | 37,069 |
| 2020 | 24,494 | 2030 | 30,042 | 2040 | 34,346 | 2050 | 37,357 |

**Table 7.2. Estimated and Projected Population for the Mohave Valley Irrigation and Drainage District, Arizona by Year – Medium Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 20,098 | 2021 | 26,839 | 2031 | 34,606 | 2041 | 41,214 |
| 2012 | 20,586 | 2022 | 27,658 | 2032 | 35,337 | 2042 | 41,780 |
| 2013 | 20,635 | 2023 | 28,466 | 2033 | 36,054 | 2043 | 42,333 |
| 2014 | 20,931 | 2024 | 29,262 | 2034 | 36,759 | 2044 | 42,877 |
| 2015 | 21,662 | 2025 | 30,048 | 2035 | 37,448 | 2045 | 43,413 |
| 2016 | 22,551 | 2026 | 30,827 | 2036 | 38,123 | 2046 | 43,945 |
| 2017 | 23,554 | 2027 | 31,598 | 2037 | 38,779 | 2047 | 44,476 |
| 2018 | 24,525 | 2028 | 32,359 | 2038 | 39,418 | 2048 | 45,008 |
| 2019 | 25,325 | 2029 | 33,114 | 2039 | 40,037 | 2049 | 45,542 |
| 2020 | 26,007 | 2030 | 33,862 | 2040 | 40,635 | 2050 | 46,083 |

**Table 7.3. Estimated and Projected Population for the Mohave Valley Irrigation and Drainage District, Arizona by Year – High Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 20,098 | 2021 | 28,262 | 2031 | 37,946 | 2041 | 46,677 |
| 2012 | 20,613 | 2022 | 29,260 | 2032 | 38,885 | 2042 | 47,457 |
| 2013 | 20,723 | 2023 | 30,249 | 2033 | 39,811 | 2043 | 48,227 |
| 2014 | 21,112 | 2024 | 31,229 | 2034 | 40,727 | 2044 | 48,989 |
| 2015 | 21,989 | 2025 | 32,203 | 2035 | 41,628 | 2045 | 49,746 |
| 2016 | 23,052 | 2026 | 33,171 | 2036 | 42,516 | 2046 | 50,501 |
| 2017 | 24,249 | 2027 | 34,135 | 2037 | 43,387 | 2047 | 51,259 |
| 2018 | 25,419 | 2028 | 35,092 | 2038 | 44,239 | 2048 | 52,023 |
| 2019 | 26,401 | 2029 | 36,046 | 2039 | 45,072 | 2049 | 52,795 |
| 2020 | 27,252 | 2030 | 36,996 | 2040 | 45,884 | 2050 | 53,578 |

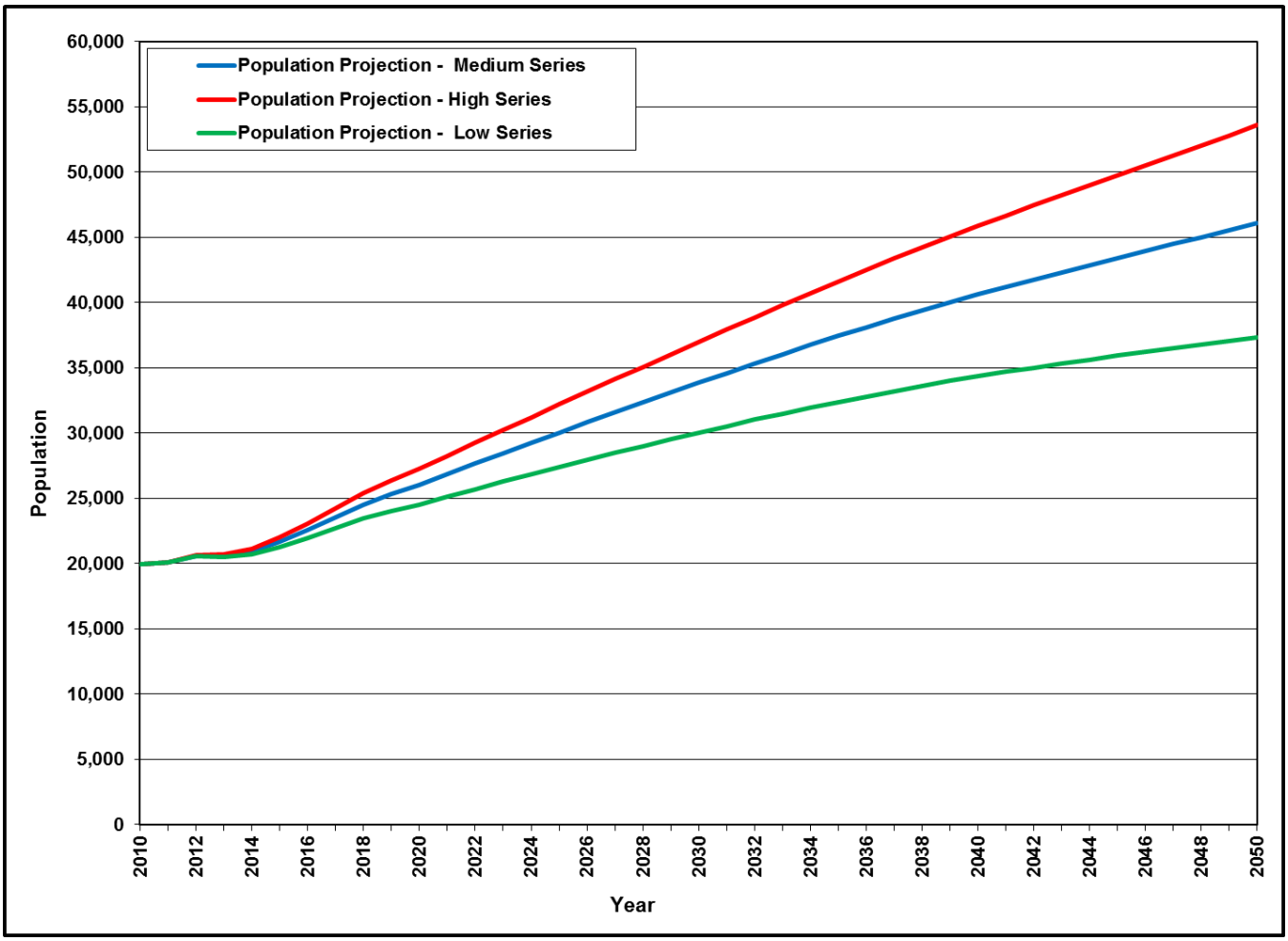



**Figure 7.2. Low, Medium and High Series Population Projections for the Mohave Valley Irrigation and Drainage District, Arizona from 2010 through 2050**

## Baseline and Projected Water Demand

The 2010, or baseline, demand for this assessment was 5,755 AF for domestic use only; agricultural irrigation use was not considered within this assessment. Tables 6.4 through 6.6 and Figure 6.3 depict the estimated and projected water demands for the water planning area for the low, medium and high series. The Basin Study assumed that 9,000 AF of the MVIDD Priority 4 entitlement would be utilized for municipal use due to MVIDD reservations of water for agricultural use of approximately 33,000 AF. This assessment utilized the same assumption used in the Basin Study, although the MVIDD entitlement is 42,000 AF for agricultural and municipal use and there is no contract limitation on municipal use. MVIDD can utilize any volume within their entitlement for municipal purposes.

On the basis of this assumption, MVIDD's municipal demand exceeded the available supply beginning in 2032 for the medium range series.

**Table 7.4. Demand Based on Population for the Mohave Valley Irrigation and Drainage District, Arizona by Year - Low**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 5,561 | 2021 | 6,947 | 2031 | 8,450 | 2041 | 9,596 |
| 2012 | 5,686 | 2022 | 7,112 | 2032 | 8,584 | 2042 | 9,686 |
| 2013 | 5,679 | 2023 | 7,273 | 2033 | 8,713 | 2043 | 9,773 |
| 2014 | 5,730 | 2024 | 7,431 | 2034 | 8,839 | 2044 | 9,857 |
| 2015 | 5,883 | 2025 | 7,585 | 2035 | 8,961 | 2045 | 9,939 |
| 2016 | 6,071 | 2026 | 7,737 | 2036 | 9,079 | 2046 | 10,019 |
| 2017 | 6,283 | 2027 | 7,885 | 2037 | 9,192 | 2047 | 10,098 |
| 2018 | 6,486 | 2028 | 8,030 | 2038 | 9,301 | 2048 | 10,177 |
| 2019 | 6,646 | 2029 | 8,172 | 2039 | 9,404 | 2049 | 10,256 |
| 2020 | 6,777 | 2030 | 8,312 | 2040 | 9,503 | 2050 | 10,336 |

**Table 7.5. Demand Based on Population for the Mohave Valley Irrigation and Drainage District, Arizona by Year – Medium**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 5,561 | 2021 | 7,426 | 2031 | 9,575 | 2041 | 11,403 |
| 2012 | 5,696 | 2022 | 7,652 | 2032 | 9,777 | 2042 | 11,559 |
| 2013 | 5,709 | 2023 | 7,876 | 2033 | 9,975 | 2043 | 11,712 |
| 2014 | 5,791 | 2024 | 8,096 | 2034 | 10,170 | 2044 | 11,863 |
| 2015 | 5,993 | 2025 | 8,314 | 2035 | 10,361 | 2045 | 12,011 |
| 2016 | 6,239 | 2026 | 8,529 | 2036 | 10,548 | 2046 | 12,158 |
| 2017 | 6,517 | 2027 | 8,742 | 2037 | 10,729 | 2047 | 12,305 |
| 2018 | 6,785 | 2028 | 8,953 | 2038 | 10,906 | 2048 | 12,452 |
| 2019 | 7,007 | 2029 | 9,162 | 2039 | 11,077 | 2049 | 12,600 |
| 2020 | 7,196 | 2030 | 9,369 | 2040 | 11,243 | 2050 | 12,750 |

**Table 7.6. Demand Based on Population for the Mohave Valley Irrigation and Drainage District, Arizona by Year – High**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 5,561 | 2021 | 7,819 | 2031 | 10,499 | 2041 | 12,914 |
| 2012 | 5,703 | 2022 | 8,096 | 2032 | 10,758 | 2042 | 13,130 |
| 2013 | 5,734 | 2023 | 8,369 | 2033 | 11,015 | 2043 | 13,343 |
| 2014 | 5,841 | 2024 | 8,640 | 2034 | 11,268 | 2044 | 13,554 |
| 2015 | 6,084 | 2025 | 8,910 | 2035 | 11,518 | 2045 | 13,763 |
| 2016 | 6,378 | 2026 | 9,178 | 2036 | 11,763 | 2046 | 13,972 |
| 2017 | 6,709 | 2027 | 9,444 | 2037 | 12,004 | 2047 | 14,182 |
| 2018 | 7,033 | 2028 | 9,709 | 2038 | 12,240 | 2048 | 14,393 |
| 2019 | 7,304 | 2029 | 9,973 | 2039 | 12,470 | 2049 | 14,607 |
| 2020 | 7,540 | 2030 | 10,236 | 2040 | 12,695 | 2050 | 14,824 |

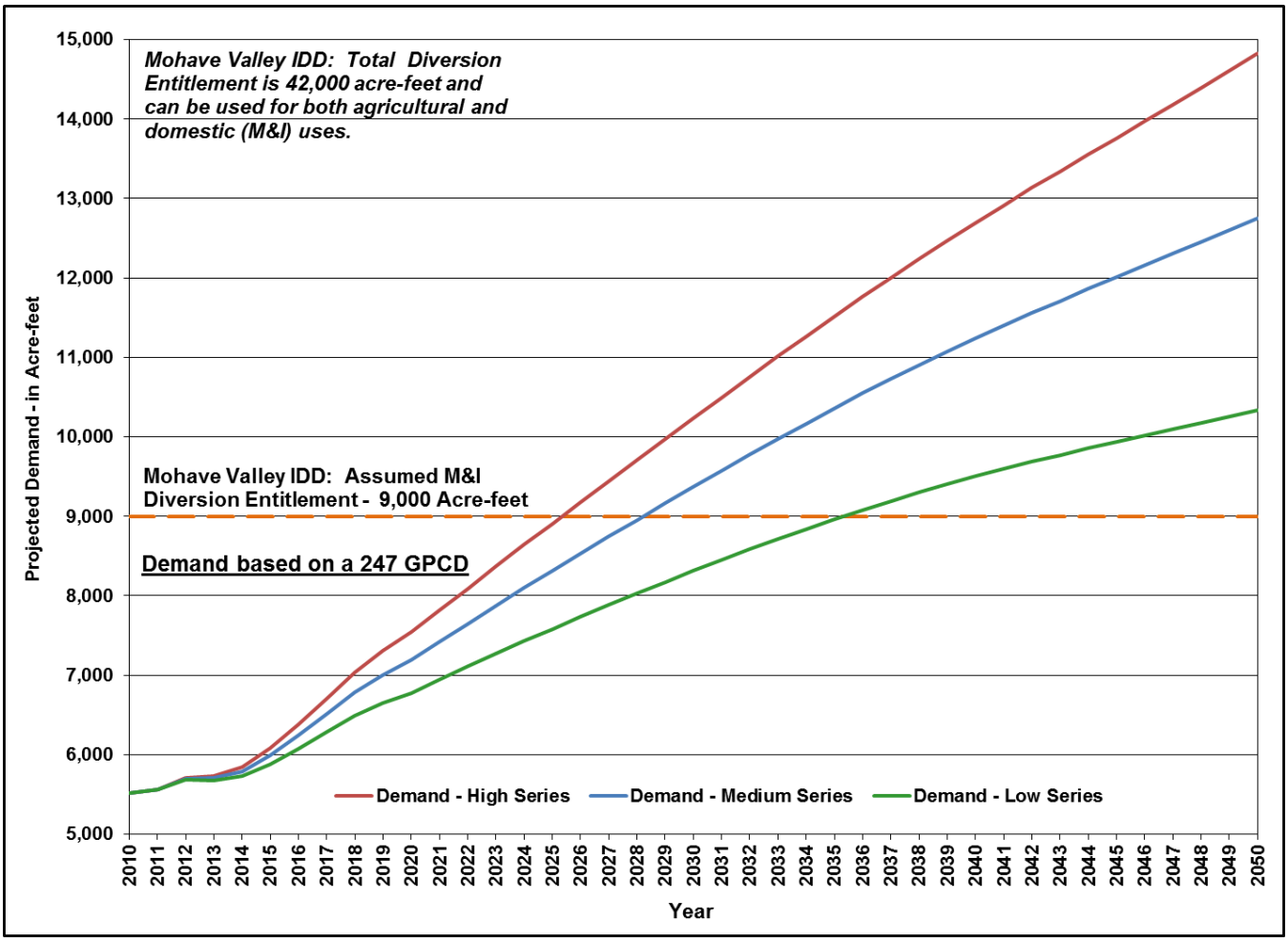



**Figure 7.3. Low, Medium and High Series Demand Projections for the Mohave Valley Irrigation and Drainage District, Arizona from 2010 through 2050**

## Shortage Scenarios

Tables 7.7 through 7.9 and Figure 7.4 depict the shortage volumes as a result of the three shortage scenarios analyzed. The first shortage that impacts MVIDD occurs in 2021 under Scenario A2.

**Table 7.7. Years of Shortages and Shortage Volumes for Scenario A2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | MVIDD Shortage Volume (AF/year) |
|---|---|---|---|
| 2021 | 3 | 480,000 | 6.6 |
| 2022 | 3 | 480,000 | 67.0 |
| 2023 | 3 | 480,000 | 131.0 |
| 2024 | 3 | 480,000 | 198.8 |
| 2027 | 3 | 480,000 | 421.7 |
| 2030 | 3 | 480,000 | 634.6 |
| 2031 | 3 | 480,000 | 676.8 |
| 2032 | 2 | 400,000 | 134.0 |
| 2033 | 2 | 400,000 | 173.4 |
| | | **Total** | **2,443.9** |

Table Notes –

2 – When Lake Mead's elevation is projected to be below elevation 1,050 feet and at or above elevation 1,025 feet, a reduction of 417,000 acre-feet (AF) is applied to the Lower Basin. Arizona's apportionment is reduced by 400,000 AF and Nevada's is reduced by 17,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 75.000 AF.

3 – When Lake Mead's elevation is projected to be below elevation 1,025 feet, a reduction of 500,000 AF is applied to the Lower Basin. Arizona's apportionment is reduced by 480,000 AF and Nevada's is reduced by 20,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 125.000 AF. Consultations with the Secretary may be required at this critical elevation.

**Table 7.8. Years of Shortages and Shortage Volumes for Scenario C2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | MVIDD Shortage Volume (AF/year) |
|---|---|---|---|
| 2033 | 80P1050 | 620,000 | 3,480.9 |
| 2044 | 80P1050 | 634,000 | 3,506.2 |
| 2040 | 80P1050 | 616,000 | 3,653.5 |
| 2044 | 80P1050 | 614,000 | 3,748.9 |
| 2049 | 80P1050 | 612,000 | 3,867.3 |
| 2050 | 80P1050 | 612,000 | 3,873.7 |
| | | **Total** | **22,130.5** |

Table Notes –

80P1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called "80P1050 Abs Pro 1000)

**Table 7.9. Years of Shortages and Shortage Volumes for Scenario H1**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | MVIDD Shortage Volume (AF/year) |
|---|---|---|---|
| 2035 | 80P1050 | 481,000 | 2,993.9 |
| 2036 | 80P1050 | 481,000 | 3,014.1 |
| 2037 | 80P1050 | 480,000 | 3,034.2 |
| 2038 | 80P1050 | 479,000 | 3,054.0 |
| 2039 | 80P1050 | 479,000 | 3,073.7 |
| 2040 | 80P1050 | 478,000 | 3,093.3 |
| 2041 | 80P1050 | 478,000 | 3,112.7 |
| 2042 | 80P1050 | 477,000 | 3,132.2 |
| 2043 | 80P1050 | 477,000 | 3,151.5 |
| 2044 | 80P1050 | 476,000 | 3,170.8 |
| 2045 | 80P1050 | 476,000 | 3,190.2 |
| 2046 | 80P1050 | 475,000 | 3,209.5 |
| 2047 | 80P1050 | 475,000 | 3,228.7 |
| 2048 | 80P1050 | 475,000 | 3,248.0 |
| 2049 | 80P1050 | 474,000 | 3,266.9 |
| 2050 | 80P1050 | 474,000 | 3,271.8 |
| | | **Total** | **50,245.6** |

Table Notes –

80P1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called “80P1050 Abs Pro 1000)

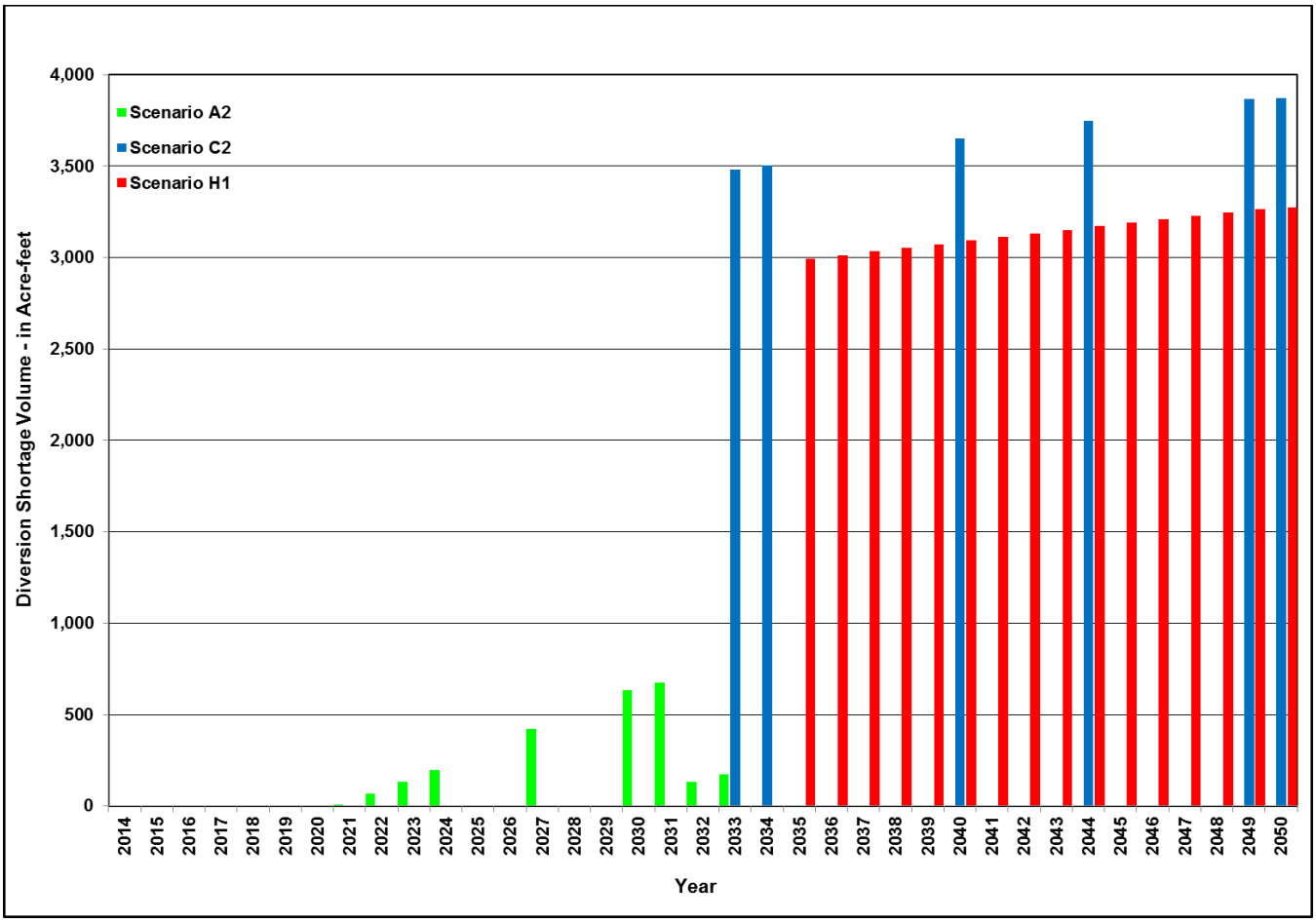



**Figure 7.4. Shortage Volumes by Year for the Mohave Valley Irrigation and Drainage District for the Three Scenarios Modeled**

## References

Mohave Valley Irrigation and Drainage District, 2015. *What does the District do?* Retrieved from http://mvidd.net/

# Chapter 8. Mohave Water Conservation District Water Planning Area

## Water Planning Area Description

The Mohave Water Conservation District (MWCD) is located in west central Mohave County just east of the Colorado River. The MWCD lies both within and outside of the city limits of the CBHC. The MWCD water planning area consists mostly of non-contiguous, checker-boarded sections of land totaling about 6,145 acres. The water planning area for the MWCD is shown in Figure 8.1.

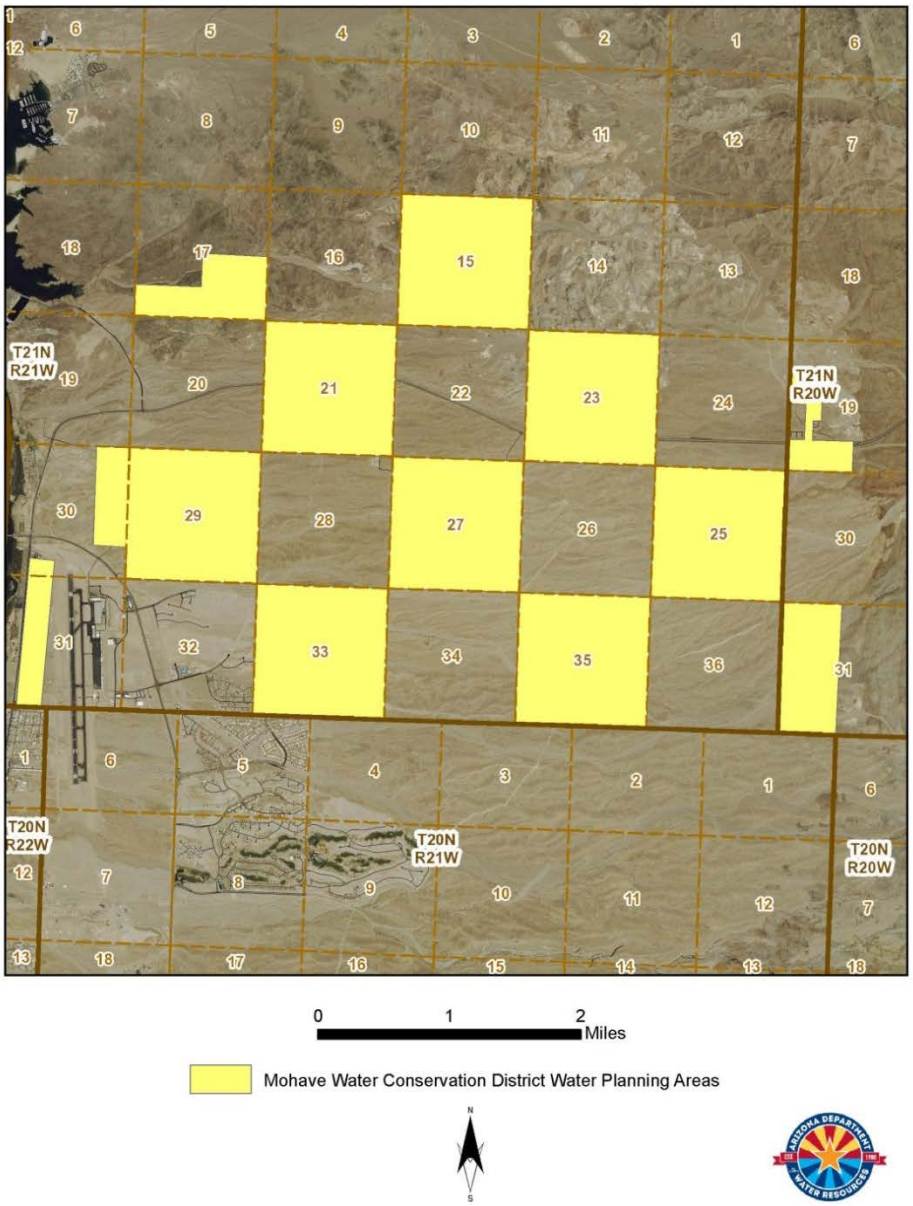



**Figure 8.1. Mohave Water Conservation District Water Planning Area**

## Water Planning Area Background information

The MWCD was established by land owners in 1975 for the purpose of contracting with Reclamation for the diversion and use of Colorado River water. In 1979, the MWCD entered into a contract with Reclamation for 1,800 AF of water for domestic use to supply the rapidly growing area. The MWCD currently has an additional entitlement to 3,000 AF of Colorado River water through subcontracting with the MCWA. It is anticipated by the MWCD that all remaining water will go to residential use (personal communication, February 2014).

In 1999, CBHC initiated a process to dissolve the MWCD but it was not successful at that time. The MWCD is obligated to serve water to the incorporated areas of CBHC from the MWCD's allocation. CBHC considered taking over service to those areas of the MWCD's contract area and include them as part of the city's application for designation of water adequacy from the ADWR but this did not occur. Although more than half of the MWCD's contract area is within the CBHC limits, the contracts and contract areas remain separate.

The MWCD delivers no water and does not own any diversion or distribution facilities. The domestic distribution system in the area is owned by a private water company. There have been a number of water providers over the years, but from 2010 until December 2013 only Epcor (formerly Arizona-American Water Company) and North Mohave Valley Water Corporation were diverting and delivering water to customers in the MWCD contract area. As of December 31, 2013, the North Mohave Valley Water Corporation assets were acquired by Epcor. Water use within the contract area is primarily residential plus one airport.

## Baseline and Projected Population

The 2010, or baseline, population for this assessment was 3,429 people. Tables 8.1 through 8.3 and Figure 8.2 depict the estimated and projected populations for the water planning area for the low, medium and high series.

**Table 8.1. Estimated and Projected Population for the Mohave Water Conservation District, Arizona by Year – Low Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 3,412 | 2021 | 4,138 | 2031 | 4,601 | 2041 | 4,936 |
| 2012 | 3,421 | 2022 | 4,190 | 2032 | 4,641 | 2042 | 4,961 |
| 2013 | 3,511 | 2023 | 4,240 | 2033 | 4,680 | 2043 | 4,984 |
| 2014 | 3,596 | 2024 | 4,289 | 2034 | 4,717 | 2044 | 5,007 |
| 2015 | 3,674 | 2025 | 4,337 | 2035 | 4,753 | 2045 | 5,029 |
| 2016 | 3,751 | 2026 | 4,383 | 2036 | 4,788 | 2046 | 5,051 |
| 2017 | 3,828 | 2027 | 4,429 | 2037 | 4,821 | 2047 | 5,072 |
| 2018 | 3,908 | 2028 | 4,473 | 2038 | 4,852 | 2048 | 5,094 |
| 2019 | 3,994 | 2029 | 4,516 | 2039 | 4,882 | 2049 | 5,115 |
| 2020 | 4,084 | 2030 | 4,559 | 2040 | 4,910 | 2050 | 5,137 |

**Table 8.2. Estimated and Projected Population for the Mohave Water Conservation District, Arizona by Year – Medium Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 3,412 | 2021 | 4,423 | 2031 | 5,213 | 2041 | 5,865 |
| 2012 | 3,427 | 2022 | 4,508 | 2032 | 5,286 | 2042 | 5,920 |
| 2013 | 3,529 | 2023 | 4,591 | 2033 | 5,358 | 2043 | 5,973 |
| 2014 | 3,635 | 2024 | 4,673 | 2034 | 5,428 | 2044 | 6,026 |
| 2015 | 3,743 | 2025 | 4,753 | 2035 | 5,496 | 2045 | 6,078 |
| 2016 | 3,855 | 2026 | 4,832 | 2036 | 5,563 | 2046 | 6,129 |
| 2017 | 3,970 | 2027 | 4,910 | 2037 | 5,627 | 2047 | 6,181 |
| 2018 | 4,089 | 2028 | 4,987 | 2038 | 5,690 | 2048 | 6,232 |
| 2019 | 4,211 | 2029 | 5,063 | 2039 | 5,750 | 2049 | 6,284 |
| 2020 | 4,336 | 2030 | 5,139 | 2040 | 5,809 | 2050 | 6,337 |

**Table 8.3. Estimated and Projected Population for the Mohave Water Conservation District, Arizona by Year – High Range Series**

| 2011-2020 | People | 2021-2030 | People | 2031-2040 | People | 2041-2050 | People |
|---|---|---|---|---|---|---|---|
| 2011 | 3,412 | 2021 | 4,657 | 2031 | 5,716 | 2041 | 6,642 |
| 2012 | 3,431 | 2022 | 4,769 | 2032 | 5,817 | 2042 | 6,724 |
| 2013 | 3,544 | 2023 | 4,879 | 2033 | 5,916 | 2043 | 6,805 |
| 2014 | 3,666 | 2024 | 4,987 | 2034 | 6,014 | 2044 | 6,885 |
| 2015 | 3,800 | 2025 | 5,094 | 2035 | 6,109 | 2045 | 6,964 |
| 2016 | 3,941 | 2026 | 5,200 | 2036 | 6,204 | 2046 | 7,044 |
| 2017 | 4,087 | 2027 | 5,305 | 2037 | 6,296 | 2047 | 7,123 |
| 2018 | 4,238 | 2028 | 5,409 | 2038 | 6,386 | 2048 | 7,204 |
| 2019 | 4,390 | 2029 | 5,512 | 2039 | 6,474 | 2049 | 7,285 |
| 2020 | 4,544 | 2030 | 5,614 | 2040 | 6,559 | 2050 | 7,368 |

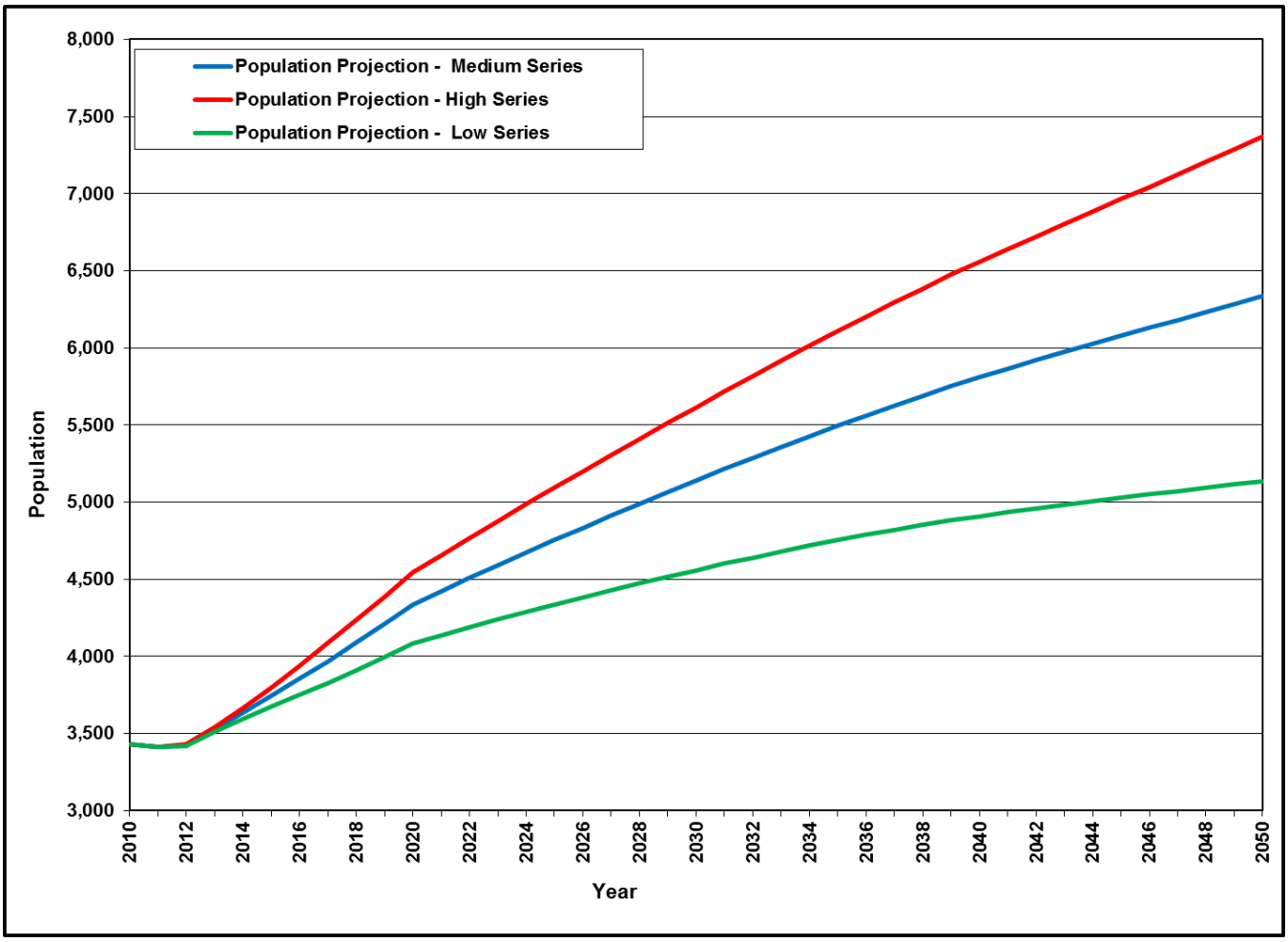



**Figure 8.2. Low, Medium and High Series Population Projections for the Mohave Water Conservation District, Arizona from 2010 through 2050**

## Baseline and Projected Water Demand

The 2010, or baseline, demand for this assessment was 1,106 AF. Tables 8.4 through 8.6 and Figure 8.3 depict the estimated and projected water demands for the water planning area for the low, medium and high range series. It should be noted that the diversion entitlement line shown in Figure 8.3 is for a normal year. The MWCD total diversion entitlement is not exceeded by water demand in any of the population projection series through 2050. Although this assessment does not show a supply and demand imbalance within the planning period, the long planning horizon for development of water projects needs to be recognized and considered.

**Table 8.4. Demand Based on Population for the Mohave Water Conservation District, Arizona by Year - Low**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 1,101 | 2021 | 1,335 | 2031 | 1,484 | 2041 | 1,592 |
| 2012 | 1,103 | 2022 | 1,351 | 2032 | 1,497 | 2042 | 1,600 |
| 2013 | 1,132 | 2023 | 1,368 | 2033 | 1,509 | 2043 | 1,608 |
| 2014 | 1,160 | 2024 | 1,383 | 2034 | 1,522 | 2044 | 1,615 |
| 2015 | 1,185 | 2025 | 1,399 | 2035 | 1,533 | 2045 | 1,622 |
| 2016 | 1,210 | 2026 | 1,414 | 2036 | 1,544 | 2046 | 1,629 |
| 2017 | 1,235 | 2027 | 1,428 | 2037 | 1,555 | 2047 | 1,636 |
| 2018 | 1,260 | 2028 | 1,443 | 2038 | 1,565 | 2048 | 1,643 |
| 2019 | 1,288 | 2029 | 1,457 | 2039 | 1,575 | 2049 | 1,650 |
| 2020 | 1,317 | 2030 | 1,470 | 2040 | 1,584 | 2050 | 1,657 |

**Table 8.5. Demand Based on Population for the Mohave Water Conservation District, Arizona by Year – Medium**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 1,101 | 2021 | 1,427 | 2031 | 1,681 | 2041 | 1,892 |
| 2012 | 1,105 | 2022 | 1,454 | 2032 | 1,705 | 2042 | 1,909 |
| 2013 | 1,138 | 2023 | 1,481 | 2033 | 1,728 | 2043 | 1,927 |
| 2014 | 1,172 | 2024 | 1,507 | 2034 | 1,751 | 2044 | 1,944 |
| 2015 | 1,207 | 2025 | 1,533 | 2035 | 1,773 | 2045 | 1,960 |
| 2016 | 1,243 | 2026 | 1,559 | 2036 | 1,794 | 2046 | 1,977 |
| 2017 | 1,280 | 2027 | 1,584 | 2037 | 1,815 | 2047 | 1,994 |
| 2018 | 1,319 | 2028 | 1,609 | 2038 | 1,835 | 2048 | 2,010 |
| 2019 | 1,358 | 2029 | 1,633 | 2039 | 1,855 | 2049 | 2,027 |
| 2020 | 1,399 | 2030 | 1,657 | 2040 | 1,873 | 2050 | 2,044 |

**Table 8.6. Demand Based on Population for the Mohave Water Conservation District, Arizona by Year – High**

| Year 2011-2020 | Demand (AF/year) | Year 2021-2030 | Demand (AF/year) | Year 2031-2040 | Demand (AF/year) | Year 2041-2050 | Demand (AF/year) |
|---|---|---|---|---|---|---|---|
| 2011 | 1,101 | 2021 | 1,502 | 2031 | 1,844 | 2041 | 2,142 |
| 2012 | 1,107 | 2022 | 1,538 | 2032 | 1,876 | 2042 | 2,169 |
| 2013 | 1,143 | 2023 | 1,574 | 2033 | 1,908 | 2043 | 2,195 |
| 2014 | 1,182 | 2024 | 1,608 | 2034 | 1,940 | 2044 | 2,221 |
| 2015 | 1,226 | 2025 | 1,643 | 2035 | 1,971 | 2045 | 2,246 |
| 2016 | 1,271 | 2026 | 1,677 | 2036 | 2,001 | 2046 | 2,272 |
| 2017 | 1,318 | 2027 | 1,711 | 2037 | 2,031 | 2047 | 2,298 |
| 2018 | 1,367 | 2028 | 1,744 | 2038 | 2,060 | 2048 | 2,324 |
| 2019 | 1,416 | 2029 | 1,778 | 2039 | 2,088 | 2049 | 2,350 |
| 2020 | 1,466 | 2030 | 1,811 | 2040 | 2,115 | 2050 | 2,376 |

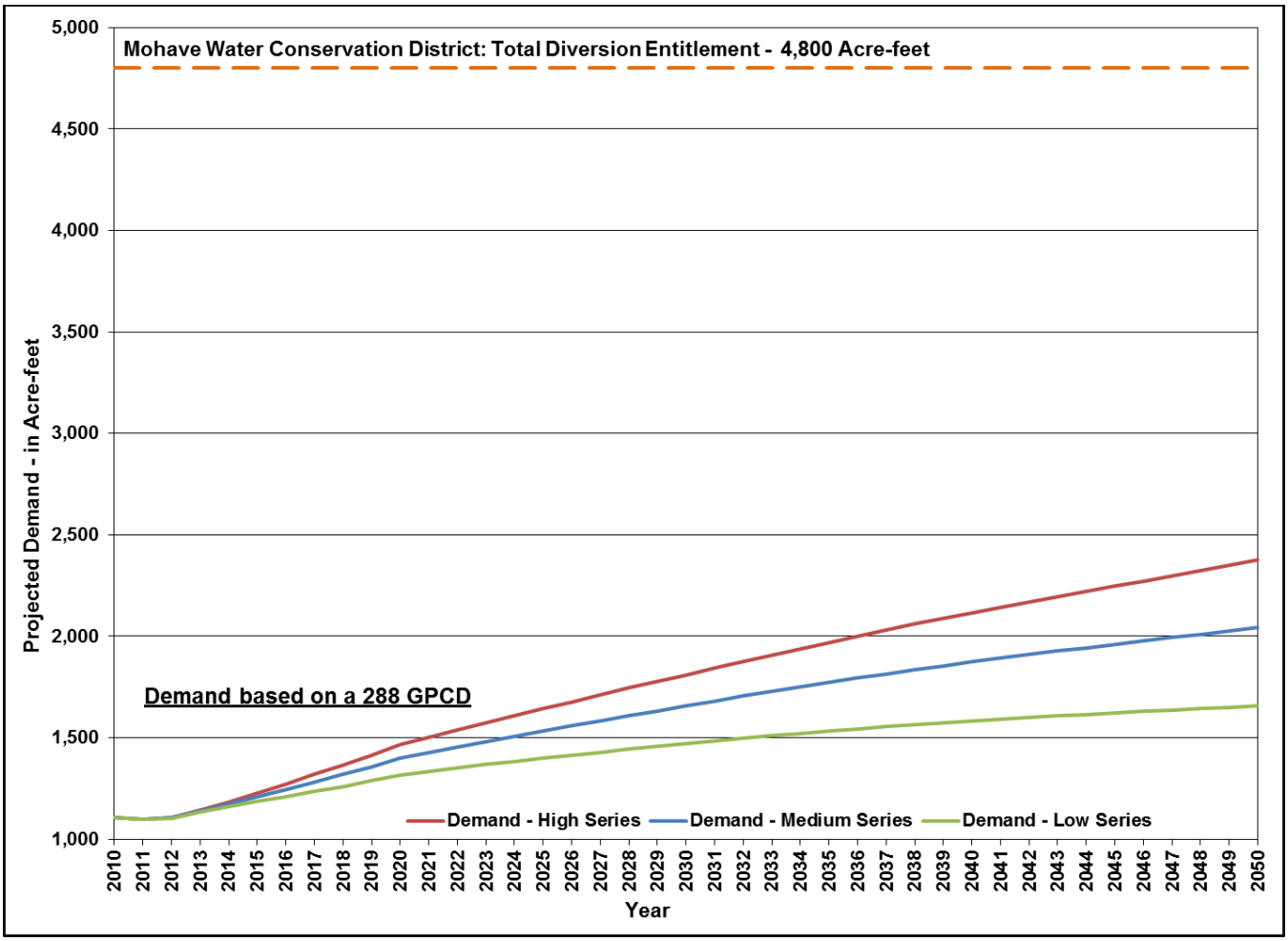



**Figure 8.3. Low, Medium and High Series Demand Projections for the Mohave Water Conservation District, Arizona from 2010 through 2050**

## Shortage Scenarios

Tables 8.7 through 8.9 and Figure 8.4 depict the shortage volumes as a result of the three shortage scenarios analyzed. The first shortage that impacts MWCD occurs in 2021 under Scenario A2.

The AWBA is required to reserve a reasonable number of long-term storage credits accrued within CAP's service area to firm on-river Fourth Priority M&I Colorado River supplies during shortage. The MCWA and the AWBA have entered into an agreement and 256,174 AF of credits have been reserved for this purpose. The MWCD has 21,555 AF of long-term storage credits reserved specifically for their use. For more information regarding the process of on-river firming, see the AWBA webpage at http://www.azwaterbank.gov/Plans_and_Reports_Documents/On-River_Firming.htm.

**Table 8.7. Years of Shortages and Shortage Volumes for Scenario A2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | MWCD Shortage Volume (AF/year) |
|---|---|---|---|
| 2021 | 3 | 480,000 | 4.2 |
| 2022 | 3 | 480,000 | 42.1 |
| 2023 | 3 | 480,000 | 80.1 |
| 2024 | 3 | 480,000 | 118.6 |
| 2027 | 3 | 480,000 | 234.9 |
| 2030 | 3 | 480,000 | 346.2 |
| 2031 | 3 | 480,000 | 370.3 |
| 2032 | 2 | 400,000 | 73.5 |
| 2033 | 2 | 400,000 | 95.4 |
| **Total** | | | **1,365.2** |

Table Notes –

2 – When Lake Mead's elevation is projected to be below elevation 1,050 feet and at or above elevation 1,025 feet, a reduction of 417,000 acre-feet (AF) is applied to the Lower Basin. Arizona's apportionment is reduced by 400,000 AF and Nevada's is reduced by 17,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 75.000 AF.

3 – When Lake Mead's elevation is projected to be below elevation 1,025 feet, a reduction of 500,000 AF is applied to the Lower Basin. Arizona's apportionment is reduced by 480,000 AF and Nevada's is reduced by 20,000 AF. Per Minute No. 319, Mexico's deliveries are reduced by 125.000 AF. Consultations with the Secretary may be required at this critical elevation.

**Table 8.8. Years of Shortages and Shortage Volumes for Scenario C2**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | MWCD Shortage Volume (AF/year) |
|---|---|---|---|
| 2033 | 80P1050 | 620,000 | 1,915.4 |
| 2034 | 80P1050 | 634,000 | 1,934.8 |
| 2040 | 80P1050 | 616,000 | 2,044.9 |
| 2044 | 80P1050 | 614,000 | 2,111.7 |
| 2049 | 80P1050 | 612,000 | 2,194.3 |
| 2050 | 80P1050 | 612,000 | 2,201.5 |
| **Total** | | | **12,402.6** |

Table Notes –
80P1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called "80P1050 Abs Pro 1000)

**Table 8.9. Years of Shortages and Shortage Volumes for Scenario H1**

| Year | Lake Mead Shortage Operation | Arizona Shortage Volume (AF/year) | MWCD Shortage Volume (AF/year) |
|---|---|---|---|
| 2035 | 80P1050 | 481,000 | 1,656.5 |
| 2036 | 80P1050 | 481,000 | 1,672.1 |
| 2037 | 80P1050 | 480,000 | 1,687.4 |
| 2038 | 80P1050 | 479,000 | 1,702.4 |
| 2039 | 80P1050 | 479,000 | 1,717.1 |
| 2040 | 80P1050 | 478,000 | 1,731.3 |
| 2041 | 80P1050 | 478,000 | 1,745.3 |
| 2042 | 80P1050 | 477,000 | 1,759.0 |
| 2043 | 80P1050 | 477,000 | 1,772.6 |
| 2044 | 80P1050 | 476,000 | 1,786.1 |
| 2045 | 80P1050 | 476,000 | 1,799.5 |
| 2046 | 80P1050 | 475,000 | 1,813.0 |
| 2047 | 80P1050 | 475,000 | 1,826.5 |
| 2048 | 80P1050 | 475,000 | 1,840.1 |
| 2049 | 80P1050 | 474,000 | 1,853.7 |
| 2050 | 80P1050 | 474,000 | 1,859.4 |
| **Total** | | | **28,222.0** |

Table Notes –

80P1050 - Shortage strategy of 80% protection of Lake Mead elevation 1,050 feet and absolute protection of elevation of 1,000 feet (also called “80P1050 Abs Pro 1000)

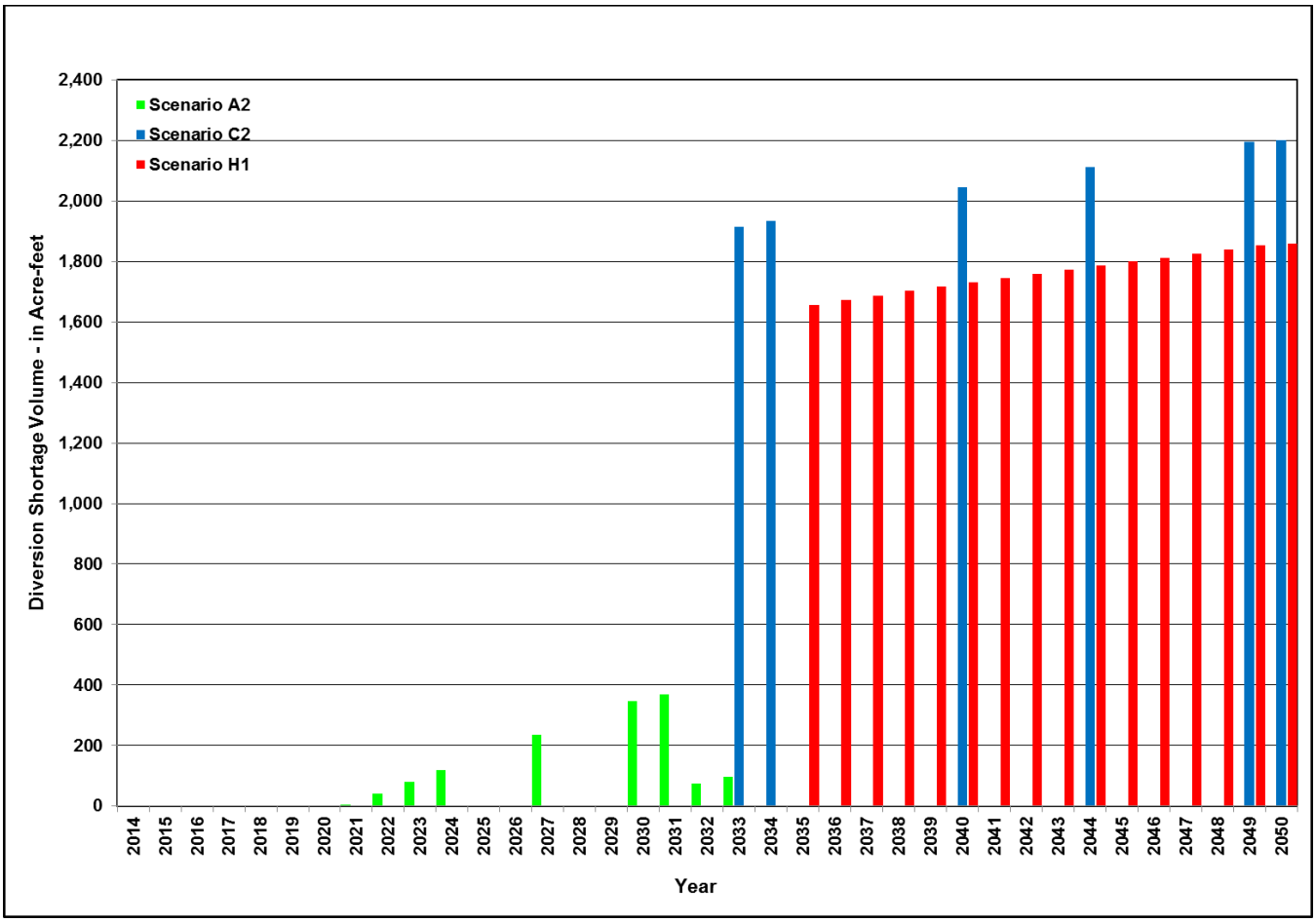



**Figure 8.4. Shortage Volumes by Year for the Mohave Water Conservation District for the Three Scenarios Modeled**

# Chapter 9. Potential Water Supplies Available to Assessment Participants

## Background

Colorado River water is the primary water supply for the Assessment Participants, with the exception of Kingman. Consequently, identification of additional supplies that may be obtained by Assessment Participants is a component of long term water management planning. The investigation of supplementary long-term water supplies has been completed by a number of entities within the state due to the recognition of the importance and need for these resources. A key component of all of the investigations is that development of alternative supplies can take a significant amount of time and require a significant amount of money.

> *…it is now clear that water supply acquisition and/or importation will be required for some areas of the State to realize their growth potential.*
> **Executive Summary**
> **Arizona's Next Century: A Strategic Vision for Water Supply Sustainability**
>
> *The Study confirms that the Colorado River Basin faces a range of potential future imbalances between supply and demand. The Study indicates that targeted investments in water conservation, reuse, and augmentation projects can improve the reliability and sustainability of the Colorado River system to meet current and future water needs.*
> **Executive Summary**
> **Colorado River Basin Water Supply and Demand Study**
>
> *It is now known… areas within the state will require development of additional supplies for the future. Absent development of supply acquisition and transportation projects, some portions of this arid state may struggle to meet projected water demands with locally available supplies. Reclaimed water is used to meet non-potable demands and augment aquifers in many areas. These supplies are anticipated to increase with growth and can be used to stretch available groundwater and surface water supplies.*
> **Executive Summary**
> **Water Resources Development Commission Final Report Volume I**

In this assessment, water resources literature was reviewed and general information regarding water supplies is included within this section. It should be noted that water supplies identified in other literature may not be accessible to Assessment Participants.

## Arizona's Next Century: A Strategic Vision for Water Supply Sustainability (Strategic Vision)

The Strategic Vision focused on regional strategies and identified 22 planning areas with possible solutions and strategies for individual areas. The on-river Assessment Participants members are located within the Colorado Main Stem North Planning Area

and Kingman is located within the Northwest Basins Planning Area (http://www.azwater.gov/AzDWR/Arizonas_Strategic_Vision/).

The Strategic Vision stated that over the next 25 to 100 years, an additional 900,000 AF to 3.2 MAF will need to be developed to meet projected water demands. The following are the potential supplies identified:

- Non-Indian Agricultural Priority CAP water;
- Reclaimed water/water reuse;
- Groundwater in storage (both potable and brackish supplies);
- Water supplies developed from revised watershed management practices;
- Water supplies developed through weather modification;
- Water supplies developed from large-scale or macro rainwater harvesting/stormwater capture; and
- Importation or exchange of new water supplies developed outside of Arizona (e.g., ocean desalination)

The Strategic Vision defined strategies to help achieve a long-term balance between supply and demand. The strategies that were identified for the two planning areas associated with this Assessment are:

- Reclaimed water reuse
- Conservation
- Expanded monitoring and reporting of water use
- Increased access to locally available groundwater (potable and brackish) and enhanced recharge
- Local water supply study – groundwater system analysis and modeling
- Firming of low priority Colorado River supplies
- Importation or exchange of new water supplies developed outside of Arizona (e.g., ocean desalination)

The Strategic Vision proposes desalination as a statewide strategic priority. A suggested alternative is partnership with other Colorado River water users in exchange for water from Lake Mead. The Strategic Vision identifies potential partners for seawater desalination including higher priority Colorado River entitlement holders in Arizona and California, the State of California, or Mexico. Because of the expense and the need to identify partners and develop agreements, such projects will require a significant investment of time – up to 20 years to bring to fruition.

## 2012 Colorado River Basin Water Supply and Demand Study

The Basin Study assessed the current and future imbalances in water supply and demand for the period 2010 to 2060 with the intent to develop and evaluate opportunities and strategies for resolving imbalances. The Basin Study concluded that there will be a 2060 Colorado River Basin-wide average imbalance of 3.2 MAF. The 2060 Arizona imbalance is approximately 242,900 AF to over 1.27 MAF (http://www.usbr.gov/lc/region/programs/crbstudy.html).

The Basin Study identified a broad range of potential options to resolve water supply and demand imbalances. The options were categorized as those types that would increase supply, reduce demand, and modify operations. Several of the types and categories of options that may be more directly applicable to the Assessment Participants are listed in Table 9.1. This table includes only information that was considered by Reclamation for inclusion in the *Options and Strategies to Resolve Supply and Demand Imbalances* as part of the Basin Study.

**Table 9.1 Summary of Representative Options Including Cost and Timing**

| Option Type | Option Category | Representative Option | Estimated Cost $/AFyear | Years before Available |
|---|---|---|---|---|
| Increase Supply | Desalination | Gulf of California | 2,100 | 20 - 30 |
| | | Groundwater in the area near Yuma, Arizona | 600 | 10 |
| | Reuse | Municipal Wastewater | 1,500 – 1,800 | 10 - 35 |
| | | Grey Water | 4,200 | 10 |
| | | Industrial Wastewater | 2,000 | 10 |
| Reduce Demand | M&I Water Conservation | M&I Water Conservation | 500 - 900 | 5 - 40 |
| | Agricultural Water Conservation | Agricultural Water Conservation | 150 - 750 | 10 - 15 |
| | | Agricultural Water Conservation with Transfers | 250 -750 | 5 - 15 |
| Modify Operations | Water Transfers, Exchanges, and Banking | Water Transfers and Exchanges (same as Agricultural Water Conservation with Transfers) | 250 - 750 | 5 - 15 |

## 2012 Water Resources Development Commission (WRDC)

The WRDC was established by the Legislature in 2010 and was tasked with assessing Arizona's water demand and the supplies available to meet demand for the 2035, 2060, and 2110. The WRDC determined that the total statewide demand will range from a low of 8.1 MAF in 2035 to a high of 10.6 MAF in 2110 with current demands of 6.9 MAF. The estimated total statewide difference between supply and demand varies between 900,000 AF and 3.2 MAF (http://www.azwater.gov/AzDWR/PermitsFormsApplications/Publications.htm).

WRDC concluded that without proactive and localized water management strategies, future water supply and demand imbalances may exist throughout the state, and recognized the need to acquire additional supplies and develop infrastructure to access new and existing unused water supplies. The water supplies evaluated as potential future water supplies included: groundwater; surface water (both in-state rivers and the Colorado River); reclaimed water; and other. The other category included the following water supplies: currently undevelopable or underutilized sources of water such as brackish or poor quality groundwater, mine drainage, and agricultural drainage; desalinated water; and water made available through weather modification.

The WRDC did not specifically identify the potential future water supplies available to meet the projected demands of the Assessment Participants. Table 9.2 summarizes the information from the WRDC report for the Lake Havasu and Mohave Basins. This information was included in the evaluation of basins that may require development of additional water supplies and potential future availability.

**Table 9.2 Basins that May Require Development of Additional Water Supplies and Potential Future Water Supplies Available to that Basin**

| Basin | County | Potential Future Water Supplies Available |
|---|---|---|
| Lake Havasu | Mohave | In-basin Groundwater unlikely, Colorado River – Unlikely, Reclaimed Water, Development of Other Supplies - Unknown |
| Lake Mohave | Mohave | In-basin Groundwater unlikely, Colorado River – Unlikely, Reclaimed Water, Development of Other Supplies - Unknown |

**2010 Blue Ribbon Panel on Water Supply Sustainability Final Report**

The Governor's Blue Ribbon Panel on Water Sustainability (Panel) was formed to identify and overcome obstacles to increased water sustainability. The ADWR, the Arizona Department of Environmental Quality, and the Arizona Corporation Commission jointly chaired the Panel to promote water conservation and recycling of reclaimed water, gray water, storm water, and other waters (http://www.azwater.gov/AzDWR/PermitsFormsApplications/Publications.htm).

Recognizing that finding new untapped water supplies is a challenge, the Panel defined its purpose as follows:

> *To advance water sustainability statewide by increasing reuse, recycling, and conservation to protect Arizona's water supplies and natural environment while supporting continued economic development and to do so in an effective, efficient and equitable manner.*

The Panel provided the following recommendations on statute, rule, and policy changes:

- Increase the volume of reclaimed water reused for beneficial purposes in place of raw or potable water
- Advance water conservation, increase the efficiency of water use by existing users, and increase the use of recycled water for beneficial purposes in place of raw or potable water
- Reduce the amount of energy needed to produce, deliver, treat, and reclaim and recycle water by the municipal, industrial, and agricultural sectors
- Reduce the amount of water required to produce and provide energy by Arizona power generators
- Increase public awareness and acceptance of reclaimed and recycled water uses and the need to work toward water sustainability.

# APPENDIX A: Shortage Analysis

June 2015

## Background

For the Mohave County Water Authority Demand and Supply Assessment, ADWR utilized the information developed for the 2014 Arizona Water Banking Authority (AWBA) firming update to estimate shortage impacts to the Assessment Participants (except Kingman). The 2014 AWBA firming update evaluated 16 different scenarios to account for uncertainties related to:

- Upper Colorado River Basin depletions
    - The AWBA assumes an Upper Colorado River basin depletion of 4.8 million acre-feet (MAF) by 2031 and stays constant thereafter.
    - The Upper Colorado River Commission has projected an Upper Colorado River Basin depletion of 5.57 MAF by 2060.
- Arizona Colorado River Tribes' depletions
    - ADWR assumes a more moderate increase in mainstream Tribal water use.
    - The Ten Tribes Partnership projects an Arizona mainstream Tribal demand that is about 130,000 AF greater than ADWR's assumption.
- Lower Colorado River Basin shortage criteria after 2026
    - The 2007 Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (Interim Guidelines) are scheduled to end in 2026
    - The other method for determining shortages in the Lower Colorado River Basin is based on protecting Lake Mead's elevation of 1,050 feet 80 percent of the time and protecting elevation 1,000 feet 100 percent of the time. These two elevations are critical for the Southern Nevada Water Authority's ability to pump water out of Lake Mead and what was modeled prior to the 2007 Interim Guidelines.
- Shortage sharing between Priority 4 (P4) municipal and industrial (M&I) on-river users and the Central Arizona Project
    - The 2006 shortage sharing agreement is scheduled to end in 2026. The agreement is that P4 M&I on-river users share the shortages with CAP based on their entitlements.
    - The other method of shortage sharing is based on pro rata distribution of shortages between P4 M&I on-river users and CAP.

All of the modeling assumptions are shown in Attachment 1. Attachment 2 shows the 16 scenarios.

## Analyses

The following is provided as a brief overview of the modeling and calculations performed to provide the numerical results for the Assessment. The results are consistent with other ADWR analyses performed for the AWBA.

To determine the shortages that may impact the availability of supplies for the P4 M&I on-river users, ADWR used the United States Bureau of Reclamation's (Reclamation) Colorado River System Simulation (CRSS) RiverWare computer model. The model was used to provide projections for a one-hundred year period from 2014 to 2113, with the results focused on the study period of 2014-2050.

One hundred and five (105) different hydrologic sequences (or traces) were analyzed by the model utilizing the natural flow hydrology developed by Reclamation, based on the historic flow on the Colorado River from 1906-2010. The natural flow hydrology can be considered the flow that would have occurred without cultural (or man-made) depletions. By evaluating all 105 traces, the recorded historical variability of Colorado River flows is represented. The model then simulates the operation of the Colorado system using each trace, projecting surplus, normal, or shortage conditions for the Lower Colorado River Basin.

One of the outputs from the CRSS model is the projected available water supply for Arizona P4 contractors, which is a combination of on-river and CAP users. These outputs then undergo further calculations to provide projections of the water delivery and shortage quantities for each year in the future for each trace specific to P4 on-river users (as a group).

In times of surplus or normal Colorado River supplies, all P4 contractors' demands are met. In times of shortages, the shortage supply is distributed between the P4 on-river users and CAP. A user is "shorted" when the supply is less than the user's scheduled demand. For each year in the future assessed in the analysis, the shortage quantities are averaged over the one hundred and five traces to give the annual average shortage amount. The annual average shortage amounts can be summed over the years of the study period (2014-2050) to give the total average annual shortage.

ADWR met with the Mohave County Water Authority (MCWA) to discuss various ways to illustrate the impact of shortages to the Assessment Participants. ADWR provided MCWA with several examples of how to display these impacts. It was decided by MCWA to use the AWBA scenarios "A2", "C2", and "H1" as examples of the possible range and magnitude of shortages that could occur during the study period of 2014 to 2050. The selected scenarios are highlighted in Attachment #2.

Attachment #3 shows the total average annual amount of AWBA firming for P4 M&I on-river P4 users for the 16 scenarios, which is an indicator of the severity of the shortages. A review of Attachment #3 shows that the scenarios selected by MCWA cover the range of these possible scenarios.

MCWA also chose to look closer at the hydrologic trace that produced the median volume of shortages for each scenario. By looking at specific traces, an example can be seen on how much shortage may be projected for each year based on the sequences of input hydrology represented by that trace. These sequences are shown in Attachment #4. Attachment #4 also shows the Lake Mead shortage tiers or operation, the associated Arizona shortage volume, and the P4 On-river municipal and industrial contractors' shortage volume for the 3 selected traces.

For each on-river Assessment Participant, ADWR calculated the shortage volume for scenarios "A2", "C2", and "H1". Attachments #5 through #9 show the detailed shortage volume calculations for the Study Participants, except for the Kingman Water Planning Area, which is not affected by shortages since Colorado River water is not used as a supply The shortage volumes determined by the model for the total P4 M&I on-river group applies to the consumptive uses and is shown in the left-most columns of each scenario grouping and is titled Median Consumptive Use Shortage.

The next step is to calculate each participant's pro rata share of the total P4 M&I on-river entitlement, which is 65,248 acre-feet. The total P4 M&I on-river shortage amount was multiplied by the proportional share for each participant based on their entitlement to calculate each participant's shortage amount. For example, Bullhead City's total entitlement is 24,349 acre-feet. Its proportional share of the total P4 M&I on-river entitlement is 0.286 (24,349/85,248). The pro rata amount of shortage is shown in the "Proportional Share" box.

A complicating factor for these calculations was that the population projections used for the AWBA firming update were based on Arizona's 2006 projections. The MWCA Assessment used the latest 2010 United States Census data and the Arizona's official 2013 population projections to estimate the demand for each Assessment Participant. ADWR adjusted the shortage volumes based on whether a participant's demand increased or decreased. The shortage amount adjusted for this demand change is shown in the Adjusted Consumptive Use Shortage column.

Because the shortage volumes were based on consumptive use, for ease in determining shortages to deliveries, ADWR converted them to diversion amounts based on the diversion to consumptive use ratio derived from Reclamation's Colorado River Accounting and Water Use Reports. Using Bullhead City as an example, its diversion to consumptive use ratio is 1.49. Thus, if the "Adjusted Consumptive Use Shortage" volume is 100 acre-feet, then its shortage diversion amount is 149 acre-feet (100 x 1.49). The "Adjusted Diversion Shortage" column then represents the overall diversion shortage volumes for each year based on those model traces. The results are also shown graphically in Chapters 3 and 5 through 8 of the Assessment.

## ATTACHMENT #1: Colorado River Simulation System (CRSS) Model Assumptions, Arizona Water Banking Authority 2014 Firming Update

### Upper Colorado River Basin (Upper Basin) Depletion Schedules

- AWBA Upper Basin Depletion Schedule – the Upper Colorado River Basin States (Colorado, New Mexico, Utah, Wyoming, and Arizona's Upper Basin portion) depletion is limited to 4.8 million acre-feet, which occurs in 2031.
- 2007 Upper Colorado River Commission Depletion schedule – this is the most current Upper Basin depletion schedule, which is currently being used in Reclamation's official CRSS modeling. The Upper Basin depletions total 5.4 million acre-feet by 2060.

### Arizona Non-Indian Mainstream Depletion Schedule

- Arizona Department of Water Resources (ADWR) 2010/2011 Depletion Schedules –ADWR updated its 2007 consumptive use/depletion analysis of all mainstream non-Indian contractors/entitlement holders in 2010/2011. For many of the municipal contractors, ADWR used the 2006 Arizona population projections through 2055 and extrapolated to 2113.

### Arizona Tribal Mainstream Depletion Schedules

- ADWR 2010/2011 Depletion Schedules – ADWR updated its 2007 consumptive use/depletion analysis of the mainstream tribal communities in 2010/2011. ADWR utilized the average 2005 to 2009 consumptive use for estimating mainstream tribal consumptive use.
- Ten Tribes Schedules - for Reclamation's 2001 Interim Surplus Criteria Environmental Impact Statement (EIS), the "Ten Tribes" of the Colorado Basin developed a set of depletion schedules that were used for CRSS modeling. These schedules were also used in Reclamation's 2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations of Lakes Powell and Mead EIS (Interim Guidelines). These schedules show a greater depletion than projected by ADWR's mainstream 2010/2011 tribal depletion schedules.

### California and Nevada Depletion Schedules

- 2007 Interim Guidelines California and Nevada Schedules – the CRSS model uses the depletion schedules provided by Reclamation in the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations of Lakes Powell and Mead EIS

### Number of Years to Run the Model

- 100 Years – the CRSS model is run for a 100-year period starting in 2014 (2014-2113).

**Hydrology**

- Natural Flow Hydrology – the CRSS model uses Reclamation's 1906 to 2010 natural flow hydrology or 105 years of record.
- Hydrologic Re-sampling – the CRSS model utilizes the "Indexed Sequential" method for the hydrologic re-sampling. For example, the first year of hydrology starts at 1906 for the first model "trace", the second trace starts with 1907, the third trace starts in 1908, and so on.

**Shortage Protection Strategy**

- Interim Guidelines Extended - shortage protection strategy for the period 2008 to 2026 uses specified elevations of 1,075 feet , 1,050 feet, and 1,025 feet for Lower Basin shortages of 333,000 (320,000 acre-feet shortage to Arizona), 417,000 (400,000 acre-feet shortage to Arizona), and 500,000 acre-feet (480,000 acre-feet shortage to Arizona), respectively. The shortage protection strategy has been extended past 2026.
- Interim Guidelines end in 2026 - this Lake Mead shortage protection strategy uses a theoretical methodology to calculate the amount of Lower Basin reductions required to protect Lake Mead elevation 1,050 feet 80% of the time and absolutely protect elevation 1,000 feet (this strategy has also been called "80P1050 1000").
- Mexico Shortages – shortages to Mexico per Minute No. 319. The Mexico shortages follow the same elevation tiers as for the United States Lower Basin States. Mexico shortages are 50,000 acre-feet, 70,000 acre-feet, and 125,000 acre-feet, respectively. It has been assumed that the Mexico's shortage would extend past the 5 year period specified in Minute No.319,

**Surplus Strategy**:

- Three surplus strategies are used in the analysis.
    - Flood Control Surplus – if flood control releases are made from Lake Mead, then the Secretary of the Interior can allocate surplus water to the Lower Basin States and Mexico.
    - "70R" (or "Quantified') Surplus - is a model algorithm which looks at the Lake Mead reservoir elevation at the beginning of a year. It then assumes that a 70$^{th}$ percentile runoff, less normal demand uses and losses, is the net inflow. The 70$^{th}$ percentile runoff is 17.333 million acre-feet and is the runoff that is greater than 70% of the historical runoff values. Normal demand is 7.5 million acre-feet for the Lower Basin States and 1.5 million acre-feet for Mexico. The model then determines if this inflow causes the system to exceed the January 1 system space flood control requirement in the next year. If the projected Lake Mead volume exceeds system flood control space at the end of the year, then surplus water demand schedules are used for that year.

- Domestic Surplus – the model uses the domestic surplus procedures as described in the Interim Shortage Guideline. The domestic surplus is declared when Lake Mead elevation is between elevation 1,145 feet and elevation the estimated "Quantified Surplus" elevation, The Domestic Surplus is in effect through calendar year 2016.
- Intentionally Created Surplus (ICS) – the model uses the ICS procedures as described in the Interim Shortage Guidelines. The Secretary of the Interior can declare ICS condition when the Lake Mead's elevation is between elevation 1,145 and elevation 1,075 feet.

**Initial Reservoir Elevations**

- CRSS Reservoir Starting Reservoir Elevations – the actual January 1st, 2014 reservoir elevations based on Reclamation's January 2014 24-month study are used. These elevations are shown below.

| Reservoir | 2014 Initial Reservoir Conditions January 2014 24-Month Study |
|---|---|
| Fontenelle | 6,485.02 |
| Flaming Gorge | 6,015.78 |
| Starvation | 5,734.92 |
| Taylor Park | 9,310.93 |
| Blue Mesa | 7,461.56 |
| Morrow Point | 7,147.65 |
| Crystal | 6,749.68 |
| Navajo | 6,025.59 |
| Powell | 3,584.43 |
| Mead | 1,106.73 |
| Mohave | 639.57 |
| Havasu | 445.37 |

**Operation of Yuma Desalination Plant (YDP)**

- YDP Operation – the YDP is assumed not be operational during the 100 year analysis period.

**Shortage Sharing between Priority 4 (P4) Mainstream Entitlement Holders and the Central Arizona Project (CAP)**

- 2006 Shortage Sharing Agreement – in this agreement, shortages to P4 mainstream entitlement holders are based on their entitlements.
- Pro Rata Shortage Sharing – shortages to P4 mainstream entitlement holders and to CAP are allocated on proportional basis.

## CAP Priority 4 Demands

- Two CAP demand build-out schedules are used: one for build-out occurring by 2035 and one for build-out occurring by 2045. The CAP build-out schedules were developed for Indian, municipal and industrial, and non-Indian agricultural priority pools.

# ATTACHMENT #2: Modeling Scenarios Summary for the Arizona Water Banking Authority

**2014 Firming Goals Update**

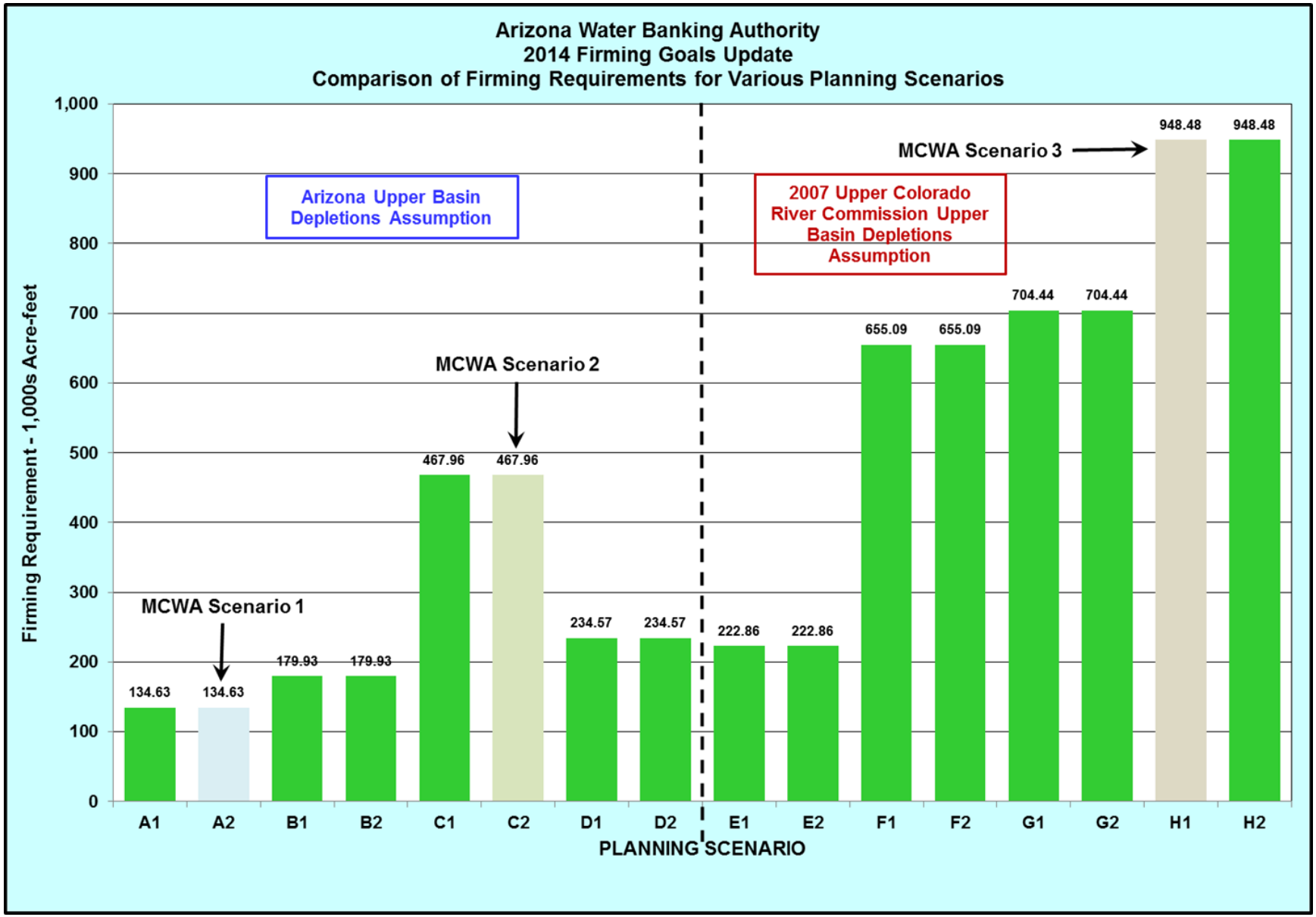
**Assumptions Common to All Runs:**

Initial Reservoir Elevation - Actual January 2014 from Reclamation's January 24-Month Study
2007 Interim Guidelines Surplus Strategy
Arizona 2010-2011 On-River Depletion Schedules
Yuma Desalination Plant Not Operational

(Numerical Values in 1,000's Acre-feet)

| Model Scenario | Upper Basin Depletion Schedule | On-River Tribal Schedule | Lake Mead Shortage Criteria | Mexico Shares in Shortage | On-River and CAP Shortage Sharing *Arizona Shortage Sharing Recommendation Extended after 2026* | On-River and CAP Shortage Sharing *Pro Rata Shortages After 2026* | CAP 2035 Demand Build-Up Schedule | CAP 2045 Demand Build-Up Schedule | On-River M&I Priority 4 Annual Average AWBA Firming Obligation |
|---|---|---|---|---|---|---|---|---|---|
| A1 | AWBA Upper Basin Assumption | ADWR 2010-2011 Update | Interim Guidelines Extended | Yes | Yes | No | Yes | No | 134.63 |
| **A2 (MCWA Scenario 1)** | AWBA Upper Basin Assumption | ADWR 2010-2011 Update | Interim Guidelines Extended | Yes | Yes | No | No | Yes | 134.63 |
| B1 | AWBA Upper Basin Assumption | Ten Tribes | Interim Guidelines Extended | Yes | Yes | No | Yes | No | 179.93 |
| B2 | AWBA Upper Basin Assumption | Ten Tribes | Interim Guidelines Extended | Yes | Yes | No | No | Yes | 179.93 |
| C1 | AWBA Upper Basin Assumption | ADWR 2010-2011 Update | Interim Guidelines Until 2026, 80P1050 Thereafter | Yes | No | Yes | Yes | No | 467.96 |
| **C2 (MCWA Scenario 2)** | AWBA Upper Basin Assumption | ADWR 2010-2011 Update | Interim Guidelines Until 2026, 80P1050 Thereafter | Yes | No | Yes | No | Yes | 467.96 |
| D1 | AWBA Upper Basin Assumption | Ten Tribes | Interim Guidelines Until 2026, 80P1050 Thereafter | Yes | No | Yes | Yes | No | 234.57 |
| D2 | AWBA Upper Basin Assumption | Ten Tribes | Interim Guidelines Until 2026, 80P1050 Thereafter | Yes | No | Yes | No | Yes | 234.57 |
| E1 | Upper Basin Schedule | ADWR 2010-2011 Update | Interim Guidelines Extended | Yes | Yes | No | Yes | No | 222.86 |
| E2 | Upper Basin Schedule | ADWR 2010-2011 Update | Interim Guidelines Extended | Yes | Yes | No | No | Yes | 222.86 |
| F1 | Upper Basin Schedule | Ten Tribes | Interim Guidelines Extended | Yes | Yes | No | Yes | No | 655.09 |
| F2 | Upper Basin Schedule | Ten Tribes | Interim Guidelines Extended | Yes | Yes | No | No | Yes | 655.09 |
| G1 | Upper Basin Schedule | ADWR 2010-2011 Update | Interim Guidelines Until 2026, 80P1050 Thereafter | Yes | No | Yes | Yes | No | 704.44 |
| G2 | Upper Basin Schedule | ADWR 2010-2011 Update | Interim Guidelines Until 2026, 80P1050 Thereafter | Yes | No | Yes | No | Yes | 704.44 |
| **H1 (MCWA Scenario 3)** | Upper Basin Schedule | Ten Tribes | Interim Guidelines Until 2026, 80P1050 Thereafter | Yes | No | Yes | Yes | No | 948.48 |
| H2 | Upper Basin Schedule | Ten Tribes | Interim Guidelines Until 2026, 80P1050 Thereafter | Yes | No | Yes | No | Yes | 948.48 |

**ATTACHMENT #3: Arizona Water Banking Authority – Comparison of Firming Requirements**



## ATTACHMENT #4: Priority 4 Municipal and Industrial On-river Shortages Median Cumulative Hydrologic Traces

(Values in Acre-feet)

| Year | Scenario A2 - Trace 58 | | | Scenario C2 - Trace 17 | | | Scenario H1 - Trace 76 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lake Mead Shortage Tier/Operation | Arizona Shortage Volume | P4 On-River M&I Shortage | Lake Mead Shortage Tier/Operation | Arizona Shortage Vlolume | P4 On-River M&I Shortage | Lake Mead Shortage Tier/Operation | Arizona Shortage Volume | P4 On-River M&I Shortage |
| **2014** | None | 0 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2015** | None | 0 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2016** | 1 | 320,000 | 0 | None | 0 | 0 | 1 | 320,000 | 0 |
| **2017** | 1 | 320,000 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2018** | 1 | 320,000 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2019** | 2 | 400,000 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2020** | 2 | 400,000 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2021** | 3 | 480,000 | 41 | None | 0 | 0 | None | 0 | 0 |
| **2022** | 3 | 480,000 | 406 | None | 0 | 0 | None | 0 | 0 |
| **2023** | 3 | 480,000 | 771 | None | 0 | 0 | None | 0 | 0 |
| **2024** | 3 | 480,000 | 1,137 | None | 0 | 0 | None | 0 | 0 |
| **2025** | 2 | 400,000 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2026** | 2 | 400,000 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2027** | 3 | 480,000 | 2,235 | None | 0 | 0 | None | 0 | 0 |
| **2028** | 2 | 400,000 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2029** | 2 | 400,000 | 0 | None | 0 | 0 | None | 0 | 0 |
| **2030** | 3 | 480,000 | 3,267 | None | 0 | 0 | None | 0 | 0 |
| **2031** | 3 | 480,000 | 3,484 | None | 0 | 0 | None | 0 | 0 |
| **2032** | 2 | 400,000 | 690 | None | 0 | 0 | None | 0 | 0 |
| **2033** | 2 | 400,000 | 893 | 80P1050 | 619,807 | 17,919 | None | 0 | 0 |
| **2034** | 1 | 320,000 | 0 | 80P1050 | 619,249 | 18,049 | None | 0 | 0 |
| **2035** | 1 | 320,000 | 0 | None | 0 | 0 | 80P1050 | 481,226 | 15,412 |
| **2036** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 480,671 | 15,516 |
| **2037** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 480,129 | 15,619 |
| **2038** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 479,596 | 15,721 |
| **2039** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 479,075 | 15,823 |
| **2040** | None | 0 | 0 | 80P1050 | 616,167 | 18,807 | 80P1050 | 478,566 | 15,923 |
| **2041** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 478,062 | 16,023 |
| **2042** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 477,570 | 16,124 |
| **2043** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 477,082 | 16,223 |
| **2044** | None | 0 | 0 | 80P1050 | 614,300 | 19,298 | 80P1050 | 476,602 | 16,322 |
| **2045** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 476,126 | 16,422 |
| **2046** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 475,651 | 16,521 |
| **2047** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 475,182 | 16,620 |
| **2048** | None | 0 | 0 | None | 0 | 0 | 80P1050 | 474,713 | 16,720 |
| **2049** | None | 0 | 0 | 80P1050 | 612,066 | 19,908 | 80P1050 | 474,248 | 16,817 |
| **2050** | None | 0 | 0 | 80P1050 | 611,786 | 19,941 | 80P1050 | 473,960 | 16,842 |

## ATTACHMENT #5: Bullhead City – Shortage Estimates for Selected Scenarios

(All Values are in Acre-feet)

**Bullhead City Proportion of Total Priority 4 (P4) Municipal and Industrial Entitlements**

| Total P4 M&I Entitlements | Bullhead City Entitlements [1] | Proportional Share | Diversion to Consumptive Use Ratio |
|---|---|---|---|
| 85,248 | 24,349 | 0.286 | 1.4925 |

| Year | Bullhead City 2010 Consumptive Use [2] | Bullhead City 2014 Consumptive Use [3] | Percentage Increase / Decrease | Scenario A2 Lake Mead Shortage Tier/Operation | Scenario A2 Arizona Shortage Volume | Scenario A2 Median P4 M&I On-River Consumptive Use Shortage [4] | Bullhead City Proportional Share | Bullhead City Scenario A2 Adjusted Consumptive Use Shortage | Bullhead City Scenario A2 Adjusted Diversion Shortage | Scenario C2 Lake Mead Shortage Tier/Operation | Scenario C2 Arizona Shortage Volume | Scenario C2 Median P4 M&I On-River Consumptive Use Shortage [4] | Bullhead City Proportional Share | Bullhead City Scenario C2 Adjusted Consumptive Use Shortage | Bullhead City Scenario C2 Adjusted Diversion Shortage | Scenario H1 Lake Mead Shortage Tier/Operation | Scenario H1 Arizona Shortage Volume | Scenario H1 Median P4 M&I On-River Consumptive Use Shortage [4] | Bullhead City Proportional Share | Bullhead City Scenario H1 Adjusted Consumptive Use Shortage | Bullhead City Scenario H1 Adjusted Diversion Shortage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | 8,354 | 7,128 | 0.8533 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2015 | 8,502 | 7,341 | 0.8634 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2016 | 8,648 | 7,560 | 0.8742 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 1 | 320,000 | 0 | 0 | 0 | 0 |
| 2017 | 8,792 | 7,786 | 0.8855 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2018 | 8,933 | 8,018 | 0.8976 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2019 | 9,072 | 8,258 | 0.9102 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2020 | 9,208 | 8,504 | 0.9235 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2021 | 9,341 | 8,674 | 0.9285 | 3 | 480,000 | 41 | 12 | 11 | 16 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2022 | 9,471 | 8,840 | 0.9334 | 3 | 480,000 | 406 | 116 | 108 | 161 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2023 | 9,598 | 9,003 | 0.9380 | 3 | 480,000 | 771 | 220 | 206 | 308 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2024 | 9,722 | 9,163 | 0.9425 | 3 | 480,000 | 1,137 | 325 | 306 | 457 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2025 | 9,843 | 9,321 | 0.9469 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2026 | 9,961 | 9,476 | 0.9513 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2027 | 10,076 | 9,630 | 0.9557 | 3 | 480,000 | 2,235 | 638 | 610 | 911 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2028 | 10,187 | 9,780 | 0.9601 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2029 | 10,296 | 9,930 | 0.9644 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2030 | 10,401 | 10,077 | 0.9689 | 3 | 480,000 | 3,267 | 933 | 904 | 1,349 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2031 | 10,503 | 10,223 | 0.9734 | 3 | 480,000 | 3,484 | 995 | 969 | 1,446 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2032 | 10,603 | 10,367 | 0.9778 | 2 | 400,000 | 690 | 197 | 193 | 288 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2033 | 10,700 | 10,507 | 0.9820 | 2 | 400,000 | 893 | 255 | 250 | 374 | 80P1050 | 619,807 | 17,919 | 5,118 | 5,026 | 7,501 | None | 0 | 0 | 0 | 0 | 0 |
| 2034 | 10,793 | 10,644 | 0.9862 | 1 | 320,000 | 0 | 0 | 0 | 0 | 80P1050 | 619,249 | 18,049 | 5,155 | 5,084 | 7,588 | None | 0 | 0 | 0 | 0 | 0 |
| 2035 | 10,885 | 10,778 | 0.9902 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 481,226 | 15,412 | 4,402 | 4,359 | 6,506 |
| 2036 | 10,974 | 10,909 | 0.9941 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,671 | 15,516 | 4,432 | 4,405 | 6,575 |
| 2037 | 11,061 | 11,035 | 0.9977 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,129 | 15,619 | 4,461 | 4,451 | 6,643 |
| 2038 | 11,146 | 11,158 | 1.0011 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,596 | 15,721 | 4,490 | 4,495 | 6,709 |
| 2039 | 11,230 | 11,277 | 1.0042 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,075 | 15,823 | 4,519 | 4,538 | 6,773 |
| 2040 | 11,312 | 11,391 | 1.0070 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 616,167 | 18,807 | 5,372 | 5,409 | 8,073 | 80P1050 | 478,566 | 15,923 | 4,548 | 4,580 | 6,835 |
| 2041 | 11,394 | 11,501 | 1.0095 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 478,062 | 16,023 | 4,577 | 4,620 | 6,895 |
| 2042 | 11,474 | 11,609 | 1.0118 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,570 | 16,124 | 4,605 | 4,660 | 6,954 |
| 2043 | 11,553 | 11,714 | 1.0139 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,082 | 16,223 | 4,634 | 4,698 | 7,012 |
| 2044 | 11,632 | 11,817 | 1.0159 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 614,300 | 19,298 | 5,512 | 5,600 | 8,358 | 80P1050 | 476,602 | 16,322 | 4,662 | 4,736 | 7,069 |
| 2045 | 11,712 | 11,919 | 1.0177 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 476,126 | 16,422 | 4,691 | 4,774 | 7,125 |
| 2046 | 11,791 | 12,020 | 1.0194 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,651 | 16,521 | 4,719 | 4,811 | 7,180 |
| 2047 | 11,870 | 12,121 | 1.0211 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,182 | 16,620 | 4,747 | 4,848 | 7,235 |
| 2048 | 11,949 | 12,222 | 1.0228 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 474,713 | 16,720 | 4,776 | 4,885 | 7,290 |
| 2049 | 12,030 | 12,324 | 1.0245 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 612,066 | 19,908 | 5,686 | 5,825 | 8,694 | 80P1050 | 474,248 | 16,817 | 4,803 | 4,921 | 7,344 |
| 2050 | 12,111 | 12,428 | 1.0262 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 611,786 | 19,941 | 5,696 | 5,845 | 8,723 | 80P1050 | 473,960 | 16,842 | 4,811 | 4,937 | 7,368 |
| | | | | | | | Total | 3,557 | 5,309 | | | | Total | 32,789 | 48,937 | | | | Total | 74,716 | 111,513 |

**ENDNOTES**

[1] Bullhead City's Colorado River *diversion* entitlements are comprised of its original contract amount of 15,120 acre-feet, plus two subcontracts with the Mohave County Water Authority totaling 9,139 acre-feet..

[2] In 2010, ADWR used the 2006 State of Arizona population projection for Bullhead City, which was based on the United States 2000 Census data.

[3] In 2014, ADWR used the 2013 State of Arizona population projection for Bullhead City, which was based on the United States 2010 Census data.

[4] The median shortage values are based on ADWR's 2010 demand projections for Priority 4 mainstem municipal entitlement holders. Bullhead City's share of the shortage has to be adjusted to account for an either increase or decrease in Bullhead City's demands based on the ADWR's 2014 estimates.

## ATTACHMENT #6: Golden Shores Water Conservation District – Shortage Estimates for Selected Scenarios

(All Values are in Acre-feet)

**Golden Shores Water Conservation District Proportion of Total Priority 4 (P4) Municipal and Industrial Entitlements**

| Total P4 M&I Entitlements | Golden Shores Water Conservation District Entitlements [1] | Proportional Share | Diversion to Consumptive Use Ratio |
|---|---|---|---|
| 85,248 | 2,000 | 0.023 | 1.4925 |

| Year | Golden Shores Water Conservation District 2010 Consumptive Use [2] | Golden Shores Water Conservation District 2014 Consumptive Use [3] | Percentage Increase / Decrease | Scenario A2 Lake Mead Shortage Tier/Operation | Scenario A2 Arizona Shortage Volume | Scenario A2 Median P4 M&I On-River Consumptive Use Shortage [4] | Golden Shores Water Conservation District Proportional Share | Golden Shores Water Conservation District Scenario A2 Adjusted Consumptive Use Shortage | Golden Shores Water Conservation District Scenario A2 Adjusted Diversion Shortage | Scenario C2 Lake Mead Shortage Tier/Operation | Scenario C2 Arizona Shortage Volume | Scenario C2 Median P4 M&I On-River Consumptive Use Shortage [4] | Golden Shores Water Conservation District Proportional Share | Golden Shores Water Conservation District Scenario C2 Adjusted Consumptive Use Shortage | Golden Shores Water Conservation District Scenario C2 Adjusted Diversion Shortage | Scenario H1 Lake Mead Shortage Tier/Operation | Scenario H1 Arizona Shortage Volume | Scenario H1 Median P4 M&I On-River Consumptive Use Shortage [4] | Golden Shores Water Conservation District Proportional Share | Golden Shores Water Conservation District Scenario H1 Adjusted Consumptive Use Shortage | Golden Shores Water Conservation District Scenario H1 Adjusted Diversion Shortage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | 330 | 333 | 1.0089 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2015 | 335 | 341 | 1.0193 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2016 | 340 | 351 | 1.0345 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 1 | 320,000 | 0 | 0 | 0 | 0 |
| 2017 | 344 | 363 | 1.0529 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2018 | 349 | 374 | 1.0702 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2019 | 354 | 383 | 1.0823 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2020 | 358 | 391 | 1.0909 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2021 | 363 | 400 | 1.1038 | 3 | 480,000 | 41 | 1 | 1 | 2 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2022 | 367 | 410 | 1.1165 | 3 | 480,000 | 406 | 10 | 11 | 16 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2023 | 371 | 419 | 1.1289 | 3 | 480,000 | 771 | 18 | 20 | 30 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2024 | 376 | 429 | 1.1410 | 3 | 480,000 | 1,137 | 27 | 30 | 45 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2025 | 380 | 438 | 1.1529 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2026 | 384 | 447 | 1.1646 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2027 | 387 | 456 | 1.1763 | 3 | 480,000 | 2,235 | 52 | 62 | 92 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2028 | 391 | 465 | 1.1878 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2029 | 395 | 473 | 1.1992 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2030 | 398 | 482 | 1.2106 | 3 | 480,000 | 3,267 | 77 | 93 | 138 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2031 | 402 | 491 | 1.2220 | 3 | 480,000 | 3,484 | 82 | 100 | 149 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2032 | 405 | 500 | 1.2333 | 2 | 400,000 | 690 | 16 | 20 | 30 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2033 | 408 | 508 | 1.2442 | 2 | 400,000 | 893 | 21 | 26 | 39 | 80P1050 | 619,807 | 17,919 | 420 | 523 | 781 | None | 0 | 0 | 0 | 0 | 0 |
| 2034 | 411 | 516 | 1.2550 | 1 | 320,000 | 0 | 0 | 0 | 0 | 80P1050 | 619,249 | 18,049 | 423 | 531 | 793 | None | 0 | 0 | 0 | 0 | 0 |
| 2035 | 415 | 525 | 1.2655 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 481,226 | 15,412 | 362 | 458 | 683 |
| 2036 | 418 | 533 | 1.2757 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,671 | 15,516 | 364 | 464 | 693 |
| 2037 | 420 | 541 | 1.2856 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,129 | 15,619 | 366 | 471 | 703 |
| 2038 | 423 | 548 | 1.2950 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,596 | 15,721 | 369 | 478 | 713 |
| 2039 | 426 | 556 | 1.3041 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,075 | 15,823 | 371 | 484 | 723 |
| 2040 | 429 | 563 | 1.3127 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 616,167 | 18,807 | 441 | 579 | 864 | 80P1050 | 478,566 | 15,923 | 374 | 490 | 732 |
| 2041 | 432 | 570 | 1.3208 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 478,062 | 16,023 | 376 | 497 | 741 |
| 2042 | 434 | 577 | 1.3287 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,570 | 16,124 | 378 | 503 | 750 |
| 2043 | 437 | 584 | 1.3362 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,082 | 16,223 | 381 | 509 | 759 |
| 2044 | 440 | 591 | 1.3435 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 614,300 | 19,298 | 453 | 608 | 908 | 80P1050 | 476,602 | 16,322 | 383 | 514 | 768 |
| 2045 | 442 | 597 | 1.3505 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 476,126 | 16,422 | 385 | 520 | 777 |
| 2046 | 445 | 604 | 1.3574 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,651 | 16,521 | 388 | 526 | 785 |
| 2047 | 448 | 611 | 1.3642 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,182 | 16,620 | 390 | 532 | 794 |
| 2048 | 450 | 617 | 1.3709 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 474,713 | 16,720 | 392 | 538 | 803 |
| 2049 | 453 | 624 | 1.3775 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 612,066 | 19,908 | 467 | 643 | 960 | 80P1050 | 474,248 | 16,817 | 395 | 543 | 811 |
| 2050 | 456 | 631 | 1.3842 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 611,786 | 19,941 | 468 | 648 | 966 | 80P1050 | 473,960 | 16,842 | 395 | 547 | 816 |
| | | | | | | | Total | 363 | 542 | | | | Total | 3,533 | 5,273 | | | | Total | 8,074 | 12,050 |

**ENDNOTES**

[1] Golden Shores Water Conservation District's Colorado River diversion entitlement is for its original contract amount of 2,000 acre-feet.

[2] In 2010, ADWR used the 2006 State of Arizona population projection for Golden Shores Water Conservation District, which was based on the United States 2000 Census data.

[3] In 2014, ADWR used the 2013 State of Arizona population projection for Golden Shores Water Conservation District, which was based on the United States 2010 Census data.

[4] The median shortage values are based on ADWR's 2010 demand projections for Priority 4 mainstem municipal entitlement holders. Golden Shores Water Conservation District's share of the shortage has to be adjusted to account for an either increase or decrease in Golden Shores Water Conservation District's demands based on the ADWR's 2014 estimates.

## ATTACHMENT #7: Lake Havasu City – Shortage Estimates for Selected Scenarios

(All Values are in Acre-feet)

**Lake Havasu City Proportion of Total Priority 4 (P4) Municipal and Industrial Entitlements**

| Total P4 M&I Entitlements | Lake Havasu City Entitlements [1] | Proportional Share | Diversion to Consumptive Use Ratio |
|---|---|---|---|
| 85,248 | 28,332 | 0.332 | 1.6130 |

| Year | Lake Havasu City 2010 Consumptive Use [2] | Lake Havasu City 2014 Consumptive Use [3] | Percentage Increase / Decrease | Scenario A2 Lake Mead Shortage Tier/Operation | Scenario A2 Arizona Shortage Volume | Scenario A2 Median P4 M&I On-River Consumptive Use Shortage [4] | Lake Havasu City Proportional Share | Lake Havasu City Scenario A2 Adjusted Consumptive Use Shortage | Lake Havasu City Scenario A2 Adjusted Diversion Shortage | Scenario C2 Lake Mead Shortage Tier/Operation | Scenario C2 Arizona Shortage Volume | Scenario C2 Median P4 M&I On-River Consumptive Use Shortage [4] | Lake Havasu City Proportional Share | Lake Havasu City Scenario C2 Adjusted Consumptive Use Shortage | Lake Havasu City Scenario C2 Adjusted Diversion Shortage | Scenario H1 Lake Mead Shortage Tier/Operation | Scenario H1 Arizona Shortage Volume | Scenario H1 Median P4 M&I On-River Consumptive Use Shortage [4] | Lake Havasu City Proportional Share | Lake Havasu City Scenario H1 Adjusted Consumptive Use Shortage | Lake Havasu City Scenario H1 Adjusted Diversion Shortage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | 12,646 | 10,037 | 0.7937 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2015 | 13,008 | 10,180 | 0.7826 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2016 | 13,366 | 10,356 | 0.7748 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 1 | 320,000 | 0 | 0 | 0 | 0 |
| 2017 | 13,718 | 10,554 | 0.7694 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2018 | 14,064 | 10,744 | 0.7640 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2019 | 14,403 | 10,901 | 0.7569 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2020 | 14,736 | 11,035 | 0.7489 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2021 | 15,062 | 11,161 | 0.7410 | 3 | 480,000 | 41 | 14 | 10 | 16 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2022 | 15,380 | 11,280 | 0.7334 | 3 | 480,000 | 406 | 135 | 99 | 160 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2023 | 15,690 | 11,394 | 0.7262 | 3 | 480,000 | 771 | 256 | 186 | 300 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2024 | 15,994 | 11,502 | 0.7191 | 3 | 480,000 | 1,137 | 378 | 272 | 438 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2025 | 16,289 | 11,606 | 0.7125 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2026 | 16,578 | 11,705 | 0.7061 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2027 | 16,858 | 11,801 | 0.7000 | 3 | 480,000 | 2,235 | 743 | 520 | 839 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2028 | 17,131 | 11,893 | 0.6942 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2029 | 17,396 | 11,982 | 0.6887 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2030 | 17,558 | 12,067 | 0.6873 | 3 | 480,000 | 3,267 | 1,086 | 746 | 1,204 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2031 | 17,558 | 12,150 | 0.6920 | 3 | 480,000 | 3,484 | 1,158 | 801 | 1,292 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2032 | 17,558 | 12,229 | 0.6965 | 2 | 400,000 | 690 | 229 | 160 | 258 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2033 | 17,558 | 12,303 | 0.7007 | 2 | 400,000 | 893 | 297 | 208 | 335 | 80P1050 | 619,807 | 17,919 | 5,955 | 4,173 | 6,731 | None | 0 | 0 | 0 | 0 | 0 |
| 2034 | 17,558 | 12,373 | 0.7047 | 1 | 320,000 | 0 | 0 | 0 | 0 | 80P1050 | 619,249 | 18,049 | 5,998 | 4,227 | 6,818 | None | 0 | 0 | 0 | 0 | 0 |
| 2035 | 17,558 | 12,438 | 0.7084 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 481,226 | 15,412 | 5,122 | 3,629 | 5,853 |
| 2036 | 17,558 | 12,499 | 0.7119 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,671 | 15,516 | 5,157 | 3,671 | 5,921 |
| 2037 | 17,558 | 12,555 | 0.7151 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,129 | 15,619 | 5,191 | 3,712 | 5,987 |
| 2038 | 17,558 | 12,606 | 0.7180 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,596 | 15,721 | 5,225 | 3,751 | 6,051 |
| 2039 | 17,558 | 12,652 | 0.7206 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,075 | 15,823 | 5,259 | 3,789 | 6,112 |
| 2040 | 17,558 | 12,692 | 0.7229 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 616,167 | 18,807 | 6,250 | 4,518 | 7,288 | 80P1050 | 478,566 | 15,923 | 5,292 | 3,826 | 6,171 |
| 2041 | 17,558 | 12,729 | 0.7249 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 478,062 | 16,023 | 5,325 | 3,861 | 6,227 |
| 2042 | 17,558 | 12,761 | 0.7268 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,570 | 16,124 | 5,359 | 3,895 | 6,282 |
| 2043 | 17,558 | 12,791 | 0.7285 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,082 | 16,223 | 5,392 | 3,928 | 6,336 |
| 2044 | 17,558 | 12,819 | 0.7301 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 614,300 | 19,298 | 6,414 | 4,683 | 7,553 | 80P1050 | 476,602 | 16,322 | 5,425 | 3,961 | 6,388 |
| 2045 | 17,558 | 12,845 | 0.7316 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 476,126 | 16,422 | 5,458 | 3,993 | 6,440 |
| 2046 | 17,558 | 12,870 | 0.7330 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,651 | 16,521 | 5,491 | 4,025 | 6,492 |
| 2047 | 17,558 | 12,895 | 0.7345 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,182 | 16,620 | 5,524 | 4,057 | 6,544 |
| 2048 | 17,558 | 12,921 | 0.7359 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 474,713 | 16,720 | 5,557 | 4,089 | 6,596 |
| 2049 | 17,558 | 12,947 | 0.7374 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 612,066 | 19,908 | 6,616 | 4,879 | 7,869 | 80P1050 | 474,248 | 16,817 | 5,589 | 4,121 | 6,647 |
| 2050 | 17,558 | 12,974 | 0.7389 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 611,786 | 19,941 | 6,627 | 4,897 | 7,899 | 80P1050 | 473,960 | 16,842 | 5,597 | 4,136 | 6,672 |
| | | | | | | | Total | 3,002 | 4,842 | | | | Total | 27,377 | 44,158 | | | | Total | 62,442 | 100,717 |

**ENDNOTES**

[1] Lake Havasu City's Colorado River *diversion* entitlements are comprised of its original contract amount of 19,180 acre-feet and a transfer of 12.7 acre-feet, plus two subcontracts with the Mohave County Water Authority totaling 9,139 acre-feet.

[2] In 2010, ADWR used the 2006 State of Arizona population projection for Lake Havasu City, which was based on the United States 2000 Census data.

[3] In 2014, ADWR used the 2013 State of Arizona population projection for Lake Havasu City, which was based on the United States 2010 Census data.

[4] The median shortage values are based on ADWR's 2010 demand projections for Priority 4 mainstem municipal entitlement holders. Lake Havasu City's share of the shortage has to be adjusted to account for an either increase or decrease in Lake Havasu City's demands based on the ADWR's 2014 estimates.

## ATTACHMENT #8: Mohave Valley Irrigation and Drainage District – Shortage Estimates for Selected Scenarios

(All Values are in Acre-feet)

**Mohave Valley IDD Proportion of Total Priority 4 (P4) Municipal and Industrial Entitlements**

| Total P4 M&I Entitlements | Mohave Valley IDD Entitlements [1] | Proportional Share | Diversion to Consumptive Use Ratio |
|---|---|---|---|
| 85,248 | 9,000 | 0.106 | 1.4480 |

| Year | Mohave Valley IDD 2010 Consumptive Use [2] | Mohave Valley IDD 2014 Consumptive Use [3] | Percentage Increase / Decrease | Scenario A2 Lake Mead Shortage Tier/Operation | Scenario A2 Arizona Shortage Volume | Scenario A2 Median P4 M&I On-River Consumptive Use Shortage [4] | Mohave Valley IDD Proportional Share | Mohave Valley IDD Scenario A2 Adjusted Consumptive Use Shortage | Mohave Valley IDD Scenario A2 Adjusted Diversion Shortage | Scenario C2 Lake Mead Shortage Tier/Operation | Scenario C2 Arizona Shortage Volume | Scenario C2 Median P4 M&I On-River Consumptive Use Shortage [4] | Mohave Valley IDD Proportional Share | Mohave Valley IDD Scenario C2 Adjusted Consumptive Use Shortage | Mohave Valley IDD Scenario C2 Adjusted Diversion Shortage | Scenario H1 Lake Mead Shortage Tier/Operation | Scenario H1 Arizona Shortage Volume | Scenario H1 Median P4 M&I On-River Consumptive Use Shortage [4] | Mohave Valley IDD Proportional Share | Mohave Valley IDD Scenario H1 Adjusted Consumptive Use Shortage | Mohave Valley IDD Scenario H1 Adjusted Diversion Shortage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | 5,064 | 4,141 | 0.8177 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2015 | 5,064 | 4,285 | 0.8462 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2016 | 5,064 | 4,461 | 0.8810 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 1 | 320,000 | 0 | 0 | 0 | 0 |
| 2017 | 5,064 | 4,659 | 0.9201 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2018 | 5,064 | 4,852 | 0.9581 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2019 | 5,064 | 5,010 | 0.9893 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2020 | 5,064 | 5,145 | 1.0160 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2021 | 5,064 | 5,309 | 1.0484 | 3 | 480,000 | 41 | 4 | 5 | 7 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2022 | 5,064 | 5,471 | 1.0805 | 3 | 480,000 | 406 | 43 | 46 | 67 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2023 | 5,064 | 5,631 | 1.1120 | 3 | 480,000 | 771 | 81 | 90 | 131 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2024 | 5,064 | 5,789 | 1.1431 | 3 | 480,000 | 1,137 | 120 | 137 | 199 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2025 | 5,064 | 5,944 | 1.1738 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2026 | 5,064 | 6,098 | 1.2042 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2027 | 5,064 | 6,251 | 1.2343 | 3 | 480,000 | 2,235 | 236 | 291 | 422 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2028 | 5,064 | 6,401 | 1.2641 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2029 | 5,064 | 6,435 | 1.2707 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2030 | 5,064 | 6,435 | 1.2707 | 3 | 480,000 | 3,267 | 345 | 438 | 635 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2031 | 5,064 | 6,435 | 1.2707 | 3 | 480,000 | 3,484 | 368 | 467 | 677 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2032 | 5,064 | 6,435 | 1.2707 | 2 | 400,000 | 690 | 73 | 93 | 134 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2033 | 5,064 | 6,435 | 1.2707 | 2 | 400,000 | 893 | 94 | 120 | 173 | 80P1050 | 619,807 | 17,919 | 1,892 | 2,404 | 3,481 | None | 0 | 0 | 0 | 0 | 0 |
| 2034 | 5,064 | 6,435 | 1.2707 | 1 | 320,000 | 0 | 0 | 0 | 0 | 80P1050 | 619,249 | 18,049 | 1,906 | 2,421 | 3,506 | None | 0 | 0 | 0 | 0 | 0 |
| 2035 | 5,064 | 6,435 | 1.2707 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 481,226 | 15,412 | 1,627 | 2,068 | 2,994 |
| 2036 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,671 | 15,516 | 1,638 | 2,082 | 3,014 |
| 2037 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,129 | 15,619 | 1,649 | 2,095 | 3,034 |
| 2038 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,596 | 15,721 | 1,660 | 2,109 | 3,054 |
| 2039 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,075 | 15,823 | 1,670 | 2,123 | 3,074 |
| 2040 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 616,167 | 18,807 | 1,986 | 2,523 | 3,653 | 80P1050 | 478,566 | 15,923 | 1,681 | 2,136 | 3,093 |
| 2041 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 478,062 | 16,023 | 1,692 | 2,150 | 3,113 |
| 2042 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,570 | 16,124 | 1,702 | 2,163 | 3,132 |
| 2043 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,082 | 16,223 | 1,713 | 2,176 | 3,152 |
| 2044 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 614,300 | 19,298 | 2,037 | 2,589 | 3,749 | 80P1050 | 476,602 | 16,322 | 1,723 | 2,190 | 3,171 |
| 2045 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 476,126 | 16,422 | 1,734 | 2,203 | 3,190 |
| 2046 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,651 | 16,521 | 1,744 | 2,216 | 3,209 |
| 2047 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,182 | 16,620 | 1,755 | 2,230 | 3,229 |
| 2048 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 474,713 | 16,720 | 1,765 | 2,243 | 3,248 |
| 2049 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 612,066 | 19,908 | 2,102 | 2,671 | 3,867 | 80P1050 | 474,248 | 16,817 | 1,775 | 2,256 | 3,267 |
| 2050 | 5,064 | 6,435 | 1.2707 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 611,786 | 19,941 | 2,105 | 2,675 | 3,874 | 80P1050 | 473,960 | 16,842 | 1,778 | 2,260 | 3,272 |
| | | | | | | | Total | 1,688 | 2,444 | | | | Total | 15,283 | 22,130 | | | | Total | 34,700 | 50,246 |

ENDNOTES

[1] Mohave Valley IDD's Colorado River *diversion* entitlements total 42,000 acre-feet, which consists of 5,940 acre-feet of Priority 1, 35,060 acre-feet of Priority 4 entitlement, and 1,000 acre-feet subcontract with the Mohave County Water Authority.
ADWR has assumed that 9,000 acre-feet of the Priority 4 entitlement is for municipal use. It should be noted that starting in 2032, Mohave Valley IDD's assumed municipal entitlement was exceeded.

[2] In 2010, ADWR used the 2006 State of Arizona population projection for Mohave Valley IDD, which was based on the United States 2000 Census data.

[3] In 2014, ADWR used the 2013 State of Arizona population projection for Mohave Valley IDD, which was based on the United States 2010 Census data.

[4] The median shortage values are based on ADWR's 2010 demand projections for Priority 4 mainstem municipal entitlement holders. Mohave Valley IDD's share of the shortage has to be adjusted to account for an either increase or decrease in Mohave Valley IDD's demands based on the ADWR's 2014 estimates.

## ATTACHMENT #9: Mohave Water Conservation District – Shortage Estimates for Selected Scenarios

(All Values are in Acre-feet)

**Mohave Water Conservation District Proportion of Total Priority 4 (P4) Municipal and Industrial Entitlements**

| Total P4 M&I Entitlements | Mohave Water Conservation District Entitlements [1] | Proportional Share | Diversion to Consumptive Use Ratio |
|---|---|---|---|
| 85,248 | 4,800 | 0.056 | 1.4925 |

| Year | Mohave Water Conservation District 2010 Consumptive Use [2] | Mohave Water Conservation District 2014 Consumptive Use [3] | Percentage Increase / Decrease | Scenario A2 Lake Mead Shortage Tier/Operation | Scenario A2 Arizona Shortage Volume | Scenario A2 Median P4 M&I On-River Consumptive Use Shortage [4] | Mohave Water Conservation District Proportional Share | Mohave Water Conservation District Scenario A2 Adjusted Shortage | Mohave Water Conservation District Scenario A2 Adjusted Diversion Shortage | Scenario C2 Lake Mead Shortage Tier/Operation | Scenario C2 Arizona Shortage Volume | Scenario C2 Median P4 M&I On-River Consumptive Use Shortage [4] | Mohave Water Conservation District Proportional Share | Mohave Water Conservation District Scenario C2 Adjusted Shortage | Mohave Water Conservation District Scenario C2 Adjusted Diversion Shortage | Scenario H1 Lake Mead Shortage Tier/Operation | Scenario H1 Arizona Shortage Volume | Scenario H1 Median P4 M&I On-River Consumptive Use Shortage [4] | Mohave Water Conservation District Proportional Share | Mohave Water Conservation District Scenario H1 Adjusted Shortage | Mohave Water Conservation District Scenario H1 Adjusted Diversion Shortage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | 684 | 785 | 1.1479 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2015 | 698 | 809 | 1.1588 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2016 | 712 | 833 | 1.1705 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 1 | 320,000 | 0 | 0 | 0 | 0 |
| 2017 | 725 | 858 | 1.1830 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2018 | 739 | 884 | 1.1964 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2019 | 752 | 910 | 1.2106 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2020 | 765 | 937 | 1.2257 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2021 | 777 | 956 | 1.2297 | 3 | 480,000 | 41 | 2 | 3 | 4 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2022 | 790 | 974 | 1.2334 | 3 | 480,000 | 406 | 23 | 28 | 42 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2023 | 802 | 992 | 1.2370 | 3 | 480,000 | 771 | 43 | 54 | 80 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2024 | 814 | 1,010 | 1.2404 | 3 | 480,000 | 1,137 | 64 | 79 | 119 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2025 | 826 | 1,027 | 1.2437 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2026 | 837 | 1,044 | 1.2471 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2027 | 849 | 1,061 | 1.2505 | 3 | 480,000 | 2,235 | 126 | 157 | 235 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2028 | 860 | 1,078 | 1.2539 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2029 | 870 | 1,094 | 1.2574 | 2 | 400,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2030 | 881 | 1,110 | 1.2610 | 3 | 480,000 | 3,267 | 184 | 232 | 346 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2031 | 891 | 1,127 | 1.2647 | 3 | 480,000 | 3,484 | 196 | 248 | 370 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2032 | 901 | 1,142 | 1.2684 | 2 | 400,000 | 690 | 39 | 49 | 74 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 |
| 2033 | 910 | 1,158 | 1.2720 | 2 | 400,000 | 893 | 50 | 64 | 95 | 80P1050 | 619,807 | 17,919 | 1,009 | 1,283 | 1,915 | None | 0 | 0 | 0 | 0 | 0 |
| 2034 | 920 | 1,173 | 1.2756 | 1 | 320,000 | 0 | 0 | 0 | 0 | 80P1050 | 619,249 | 18,049 | 1,016 | 1,296 | 1,935 | None | 0 | 0 | 0 | 0 | 0 |
| 2035 | 929 | 1,188 | 1.2790 | 1 | 320,000 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 481,226 | 15,412 | 868 | 1,110 | 1,657 |
| 2036 | 937 | 1,202 | 1.2824 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,671 | 15,516 | 874 | 1,120 | 1,672 |
| 2037 | 946 | 1,216 | 1.2855 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 480,129 | 15,619 | 879 | 1,131 | 1,687 |
| 2038 | 954 | 1,230 | 1.2886 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,596 | 15,721 | 885 | 1,141 | 1,702 |
| 2039 | 962 | 1,243 | 1.2913 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 479,075 | 15,823 | 891 | 1,150 | 1,717 |
| 2040 | 970 | 1,255 | 1.2938 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 616,167 | 18,807 | 1,059 | 1,370 | 2,045 | 80P1050 | 478,566 | 15,923 | 897 | 1,160 | 1,731 |
| 2041 | 978 | 1,267 | 1.2961 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 478,062 | 16,023 | 902 | 1,169 | 1,745 |
| 2042 | 985 | 1,279 | 1.2982 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,570 | 16,124 | 908 | 1,179 | 1,759 |
| 2043 | 993 | 1,291 | 1.3002 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 477,082 | 16,223 | 913 | 1,188 | 1,773 |
| 2044 | 1,000 | 1,302 | 1.3021 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 614,300 | 19,298 | 1,087 | 1,415 | 2,112 | 80P1050 | 476,602 | 16,322 | 919 | 1,197 | 1,786 |
| 2045 | 1,007 | 1,313 | 1.3039 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 476,126 | 16,422 | 925 | 1,206 | 1,799 |
| 2046 | 1,014 | 1,325 | 1.3058 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,651 | 16,521 | 930 | 1,215 | 1,813 |
| 2047 | 1,021 | 1,336 | 1.3077 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 475,182 | 16,620 | 936 | 1,224 | 1,826 |
| 2048 | 1,028 | 1,347 | 1.3096 | None | 0 | 0 | 0 | 0 | 0 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 474,713 | 16,720 | 941 | 1,233 | 1,840 |
| 2049 | 1,035 | 1,358 | 1.3116 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 612,066 | 19,908 | 1,121 | 1,470 | 2,194 | 80P1050 | 474,248 | 16,817 | 947 | 1,242 | 1,854 |
| 2050 | 1,042 | 1,369 | 1.3137 | None | 0 | 0 | 0 | 0 | 0 | 80P1050 | 611,786 | 19,941 | 1,123 | 1,475 | 2,201 | 80P1050 | 473,960 | 16,842 | 948 | 1,246 | 1,859 |
| | | | | | | | Total | 915 | 1,365 | | | | Total | 8,310 | 12,403 | | | | Total | 18,909 | 28,222 |

**ENDNOTES**

[1] Mohave Water Conservation District's Colorado River diversion entitlements are comprised of its original contract amount of 1,800 acre-feet, plus a subcontract with the Mohave County Water Authority for 3,000 acre-feet.

[2] In 2010, ADWR used the 2006 State of Arizona population projection for Mohave Water Conservation District, which was based on the United States 2000 Census data.

[3] In 2014, ADWR used the 2013 State of Arizona population projection for Mohave Water Conservation District, which was based on the United States 2010 Census data.

[4] The median shortage values are based on ADWR's 2010 demand projections for Priority 4 mainstem municipal entitlement holders. Mohave Water Conservation District's share of the shortage has to be adjusted to account for an either increase or decrease in Mohave Water Conservation District's demands based on the ADWR's 2014 estimates.