

Appendix C10
Historical Consumptive
Use and Loss Detail By State

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1.0 Overview

This appendix presents a series of three figures showing historical consumptive use of Colorado River water for each state to facilitate understanding of the total consumptive uses by category, the relative consumptive use of Colorado River water by category, and the consumptive use of Colorado River water by category over the period 1971 to 2010. To indicate the change in consumptive use by category over time, the average use and loss for each category over the period 1971 to 1980 was used to represent the historical pattern and was then compared to the maximum value for each category in the recent period, 1999 to 2010. The maximum from 1999 to 2010 was taken to offset the potential impact on use due to the recent drought.

This appendix summarizes historical consumptive use of Colorado River water. Throughout this appendix, the term “consumptive use” refers to consumptive use of Colorado River water only, not total consumptive use (including other water sources) in the state.

2.0 Colorado

Figure C10-1 shows historical (1971 to 2010) state of Colorado consumptive use of Colorado River water by category. Colorado’s consumptive use of Colorado River water has grown from approximately 1.8 million acre-feet (maf) in 1971 to a high of 2.3 maf in 1989 (exclusive of reservoir evaporation), an increase of 29 percent. Agriculture is the largest consumptive use category in Colorado, followed by exports. Exports consist of trans-Colorado River Basin (Basin) diversions from within the hydrologic boundaries of the Basin to Front Range areas east of the Continental Divide in Colorado. The detailed information necessary to disaggregate the trans-Basin diversions into use categories was not available at the time of publication of this appendix.

Colorado has identified some concerns with the data and methodologies used in Bureau of Reclamation’s (Reclamation) Consumptive Uses and Losses Reports (Reclamation, 2005, 2012a, 2012b, 2012c) from which these data are based, including: high-altitude crop coefficients are not used in appropriate locations (i.e., grass pasture at elevations above 6,500 feet); the Crop Irrigation Water Requirement shortage estimates underestimate shortages; non-Colorado River Storage Project reservoir evaporation is underestimated; and agricultural incidental losses are overestimated. Reclamation and Colorado are continuing to work collaboratively to resolve these concerns.

Figure C10-2 displays the percent of Colorado consumptive use by category in the past (1971 to 1980 average) and recently (1999 to 2010 maximum). Although Colorado River consumptive use has increased over time, the distribution across consumptive use categories appears to have remained relatively unchanged.

Figure C10-3 displays the consumptive use for each category. It can again be seen that the largest category of consumptive use is agriculture, followed by exports. Agriculture is the most variable category year to year. The agriculture category is strongly influenced by supply, which can result in reduced requests for diversion in years with abundant precipitation and result in shortages during years of drought. The remaining categories comprise a small percentage of Colorado’s consumptive use.

FIGURE C10-1
Historical Colorado Consumptive Use of Colorado River Water by Category, 1971–2010

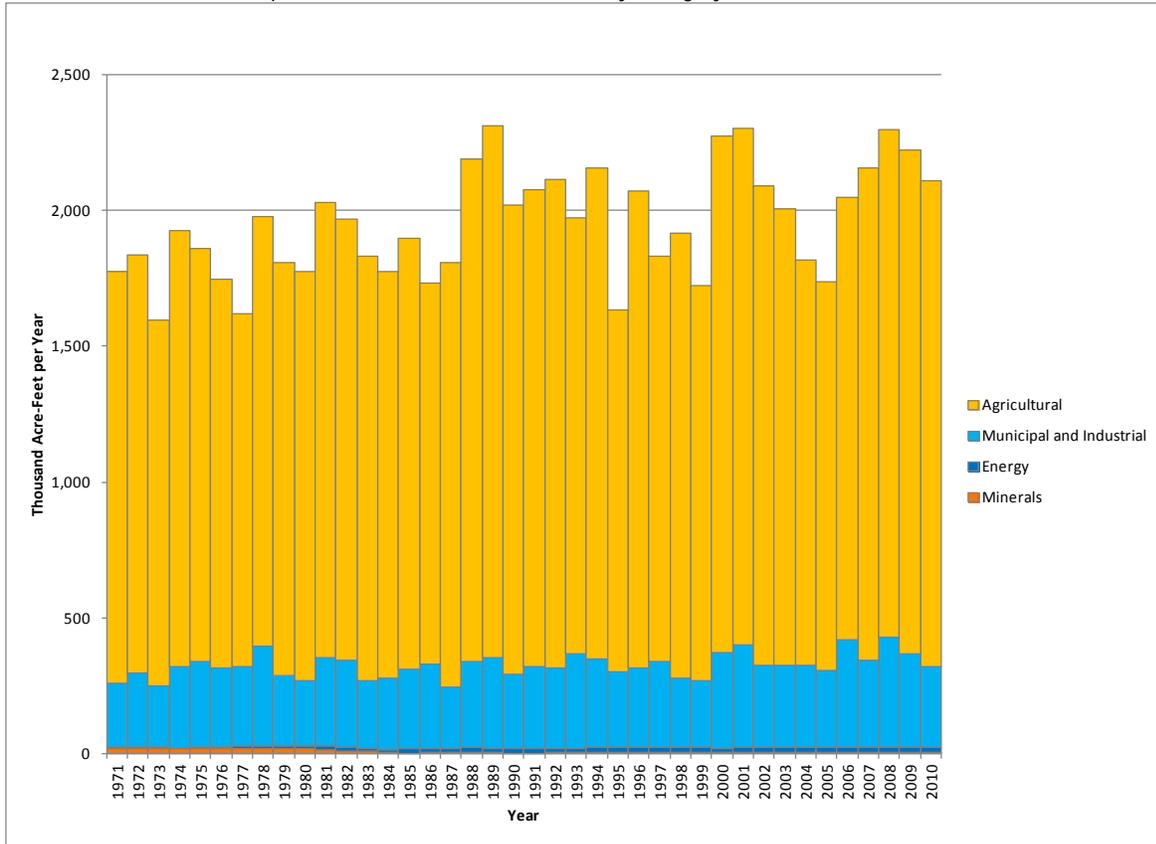


FIGURE C10-2
Historical Colorado Consumptive Use of Colorado River Water by Category, 1971–2010

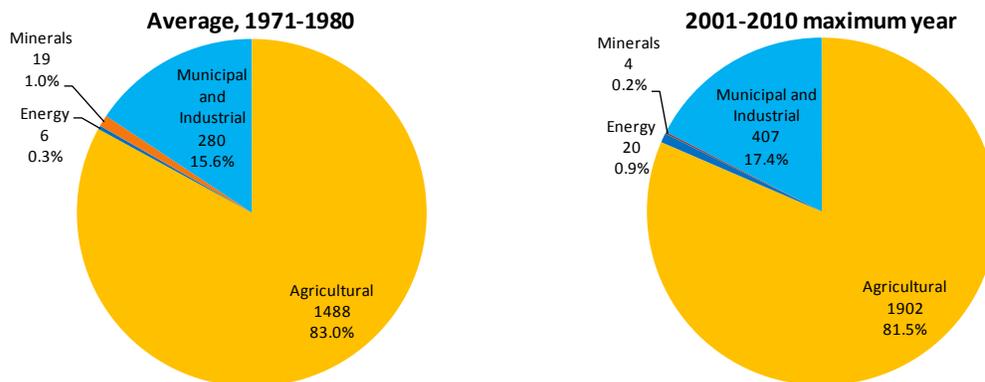
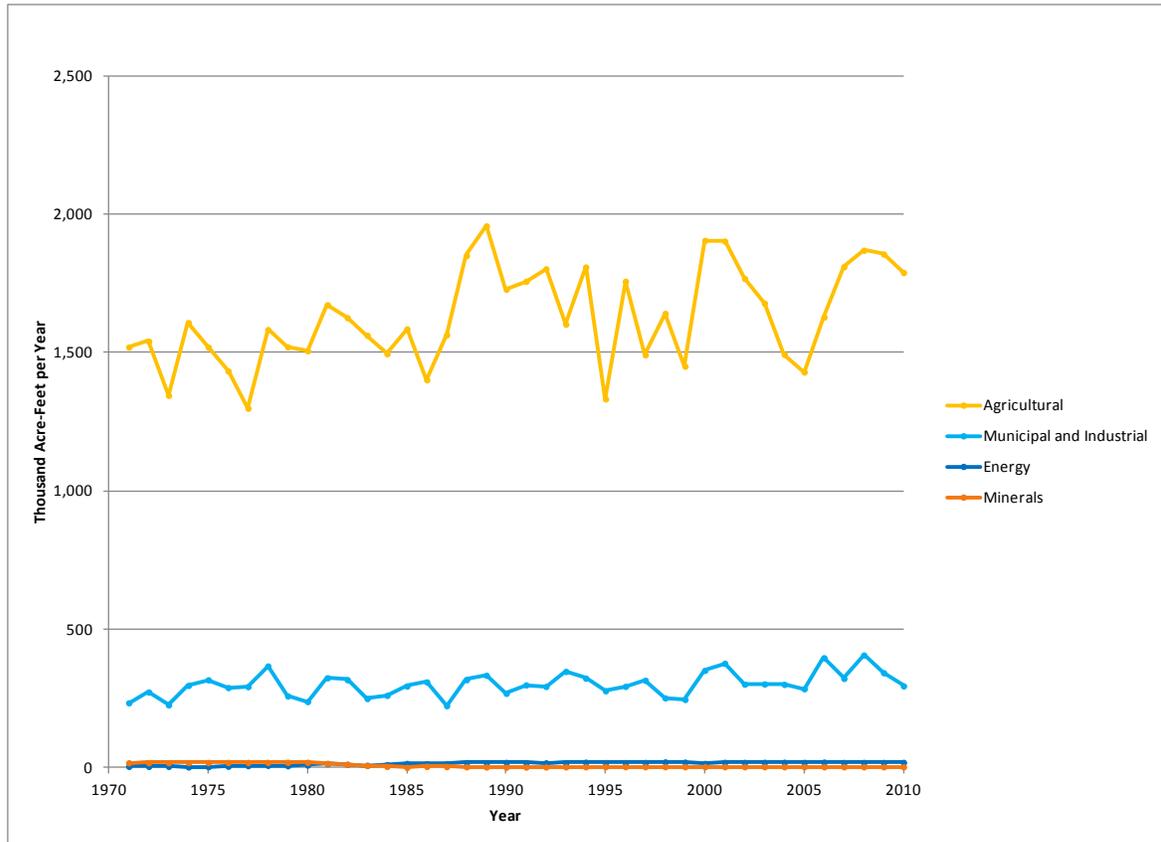


FIGURE C10-3
Historical Colorado Consumptive Use of Colorado River Water by Category, 1971–2010



3.0 New Mexico

Figure C10-4 shows historical (1971 to 2010) state of New Mexico consumptive use¹ of Colorado River water by category. New Mexico consumptive use of Colorado River water has grown from approximately 163 thousand acre-feet (kaf) in 1971 to a high of 425 kaf in 2005 (exclusive of reservoir evaporation), an increase of 122 percent. Agriculture is the largest consumptive use category in New Mexico.

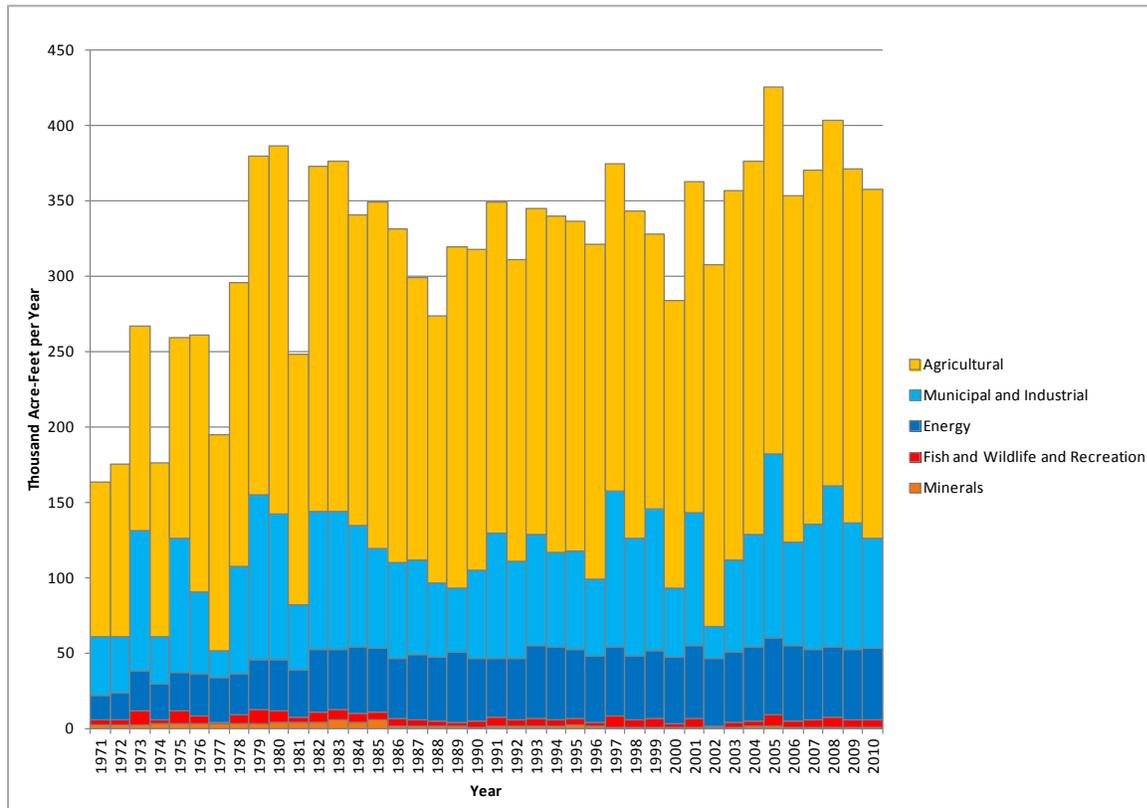
Figure C10-5 displays the percent of New Mexico consumptive use by category in the past (1971 to 1980 average) and recently (1999 to 2010 maximum). New Mexico consumptive use distribution across categories appears to have shifted slightly in the recent period, with municipal and industrial (M&I) agricultural and energy uses increasing.

Figure C10-6 displays the consumptive use for each category. It can again be seen that the largest category of consumptive use is agriculture, followed by M&I. Both agriculture and M&I (via the San Juan-Chama project) are the most variable categories year to year. The agriculture category is strongly influenced by supply, which can result in reduced requests for diversion in years with abundant precipitation and result in shortages during years of drought. Diversions for the San Juan-Chama project that serve both agricultural and M&I

¹ Excluding consumptive use in Lower Basin tributaries.

categories are determined annually based on bypass flow requirements and maximum in-year and decadal diversions. Variations from year to year are attributable to diversion limitations and not changes in demand. The next largest category is energy, with the remaining categories comprising a small percentage of New Mexico’s consumptive use.

FIGURE C10-4
 Historical New Mexico Consumptive Use of Colorado River Water by Category¹, 1971–2010



¹ San Juan-Chama project diversions are determined annually based on bypass flow requirements and maximum in-year and decadal diversions. Variations from year to year are due to flow limitations and not changes in demand.

FIGURE C10-5
Historical New Mexico Consumptive Use of Colorado River Water Percent by Category

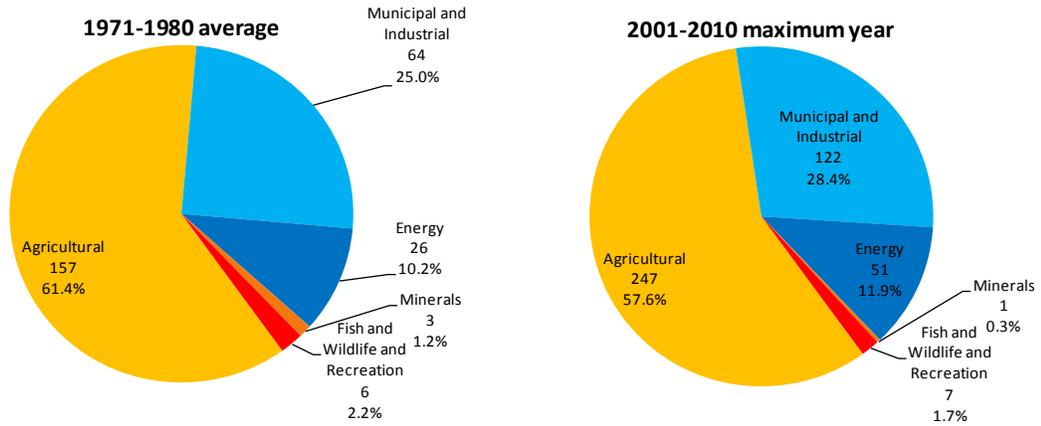
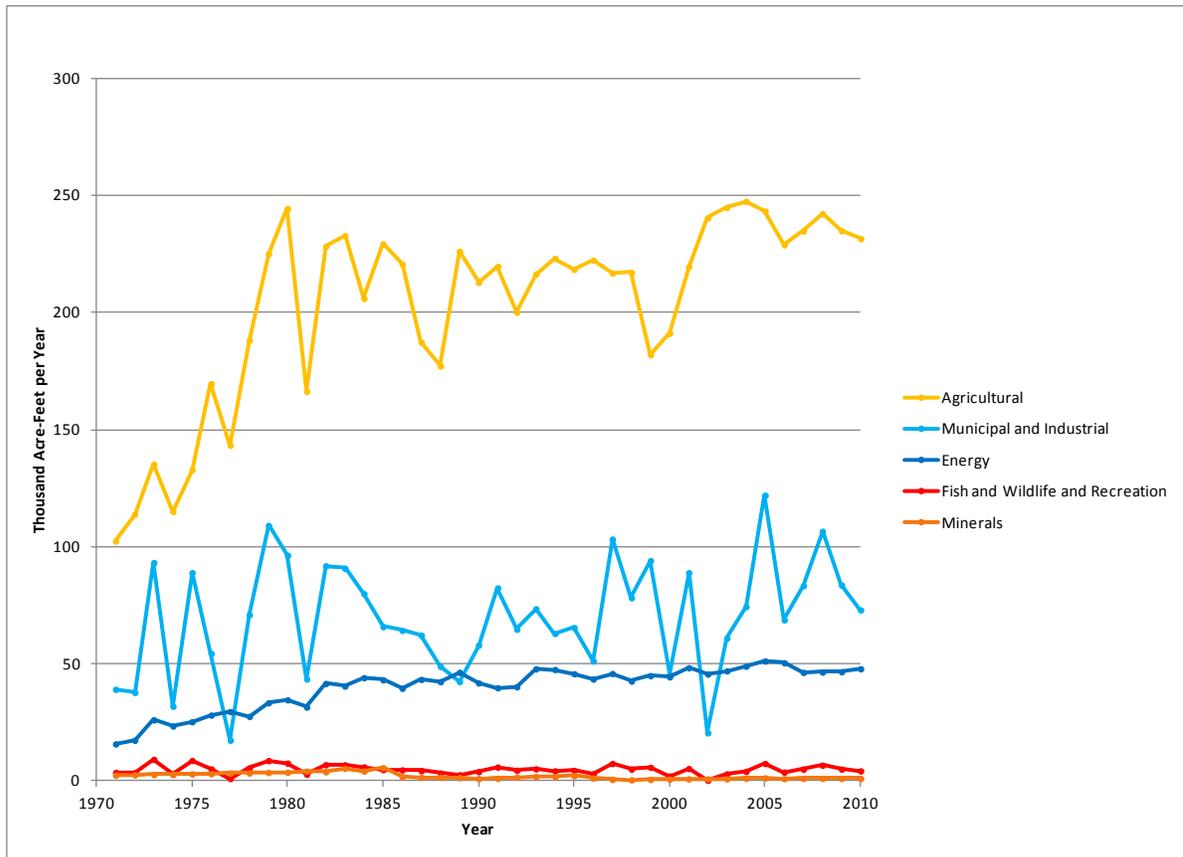


FIGURE C10-6
Historical New Mexico Consumptive Use of Colorado River Water by Category¹, 1971–2010



¹ San Juan-Chama project diversions are determined annually based on bypass flow requirements and maximum in-year and decadal diversions. Variations from year to year are due to flow limitations and not changes in demand.

4.0 Utah

Figure C10-7 shows historical (1971 to 2010) state of Utah consumptive use² of Colorado River water by category. Utah consumptive use of Colorado River water has grown from approximately 707 kaf in 1971 to a high of 903 kaf in 1994 (exclusive of reservoir evaporation), an increase of 29 percent. Agriculture is the largest consumptive use category in Utah.

Figure C10-8 displays the percent of Utah consumptive use by category in the past (197 to 1980 average) and recently (1999 to 2010 maximum). Utah consumptive use distribution across categories appears to have shifted in the recent period, with an increase in M&I and energy, and a decrease in agricultural use.

Figure C10-9 displays the consumptive use for each category. It can again be seen that the largest category of consumptive use is agriculture, followed by M&I. Both agriculture and M&I are the most variable categories year to year. The agriculture category is strongly influenced by supply, which can result in reduced requests for diversion in years with abundant precipitation and result in shortages during years of drought. Agricultural use in 1977 was significantly affected by reduced natural flows in the Basin, which were 36 percent below the annual long-term average at the Colorado River at Lees Ferry, Arizona. The next-largest category is energy, with the remaining categories comprising a small percentage of Utah's consumptive use.

² Excluding consumptive use in Lower Basin tributaries.

FIGURE C10-7
 Historical Utah Consumptive Use of Colorado River Water by Category, 1971–2010

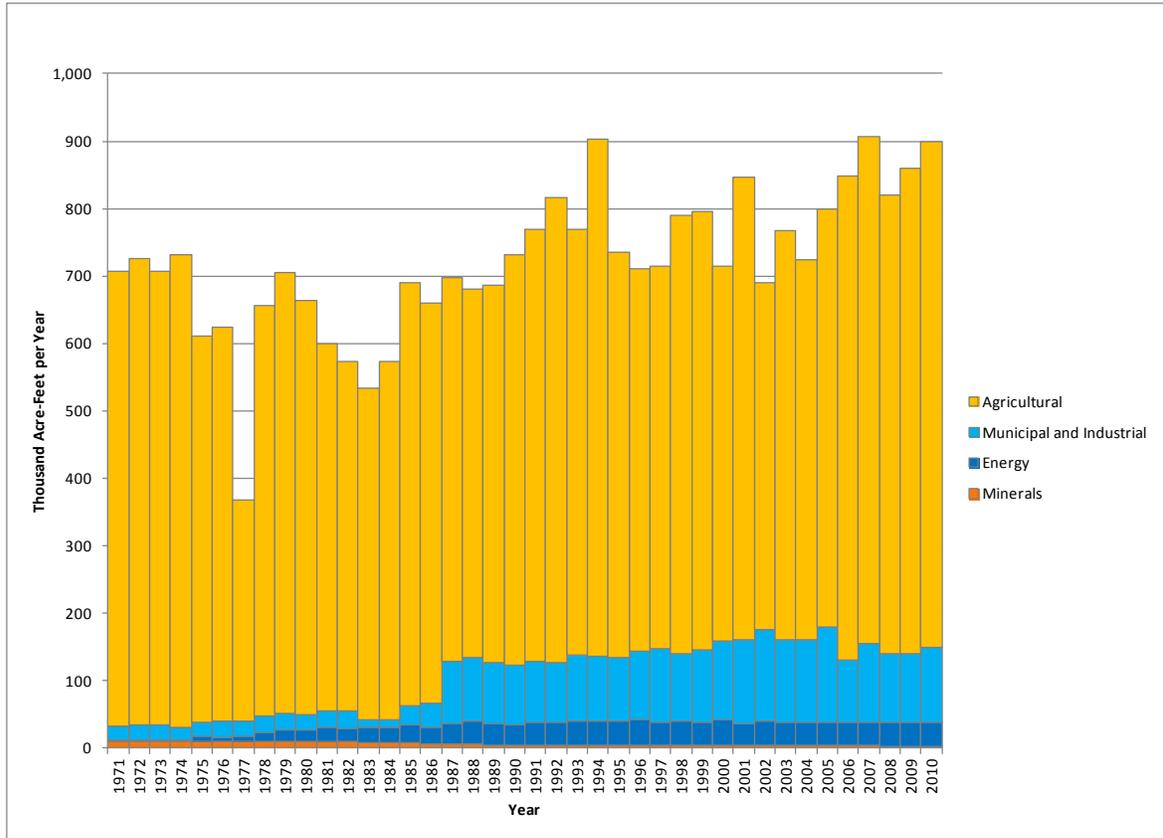


FIGURE C10-8
 Historical Utah Consumptive Use of Colorado River Water Percent by Category

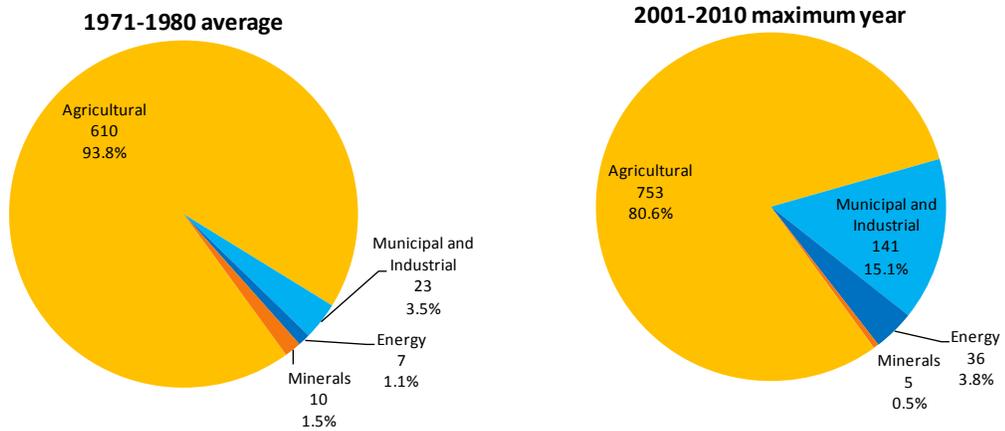
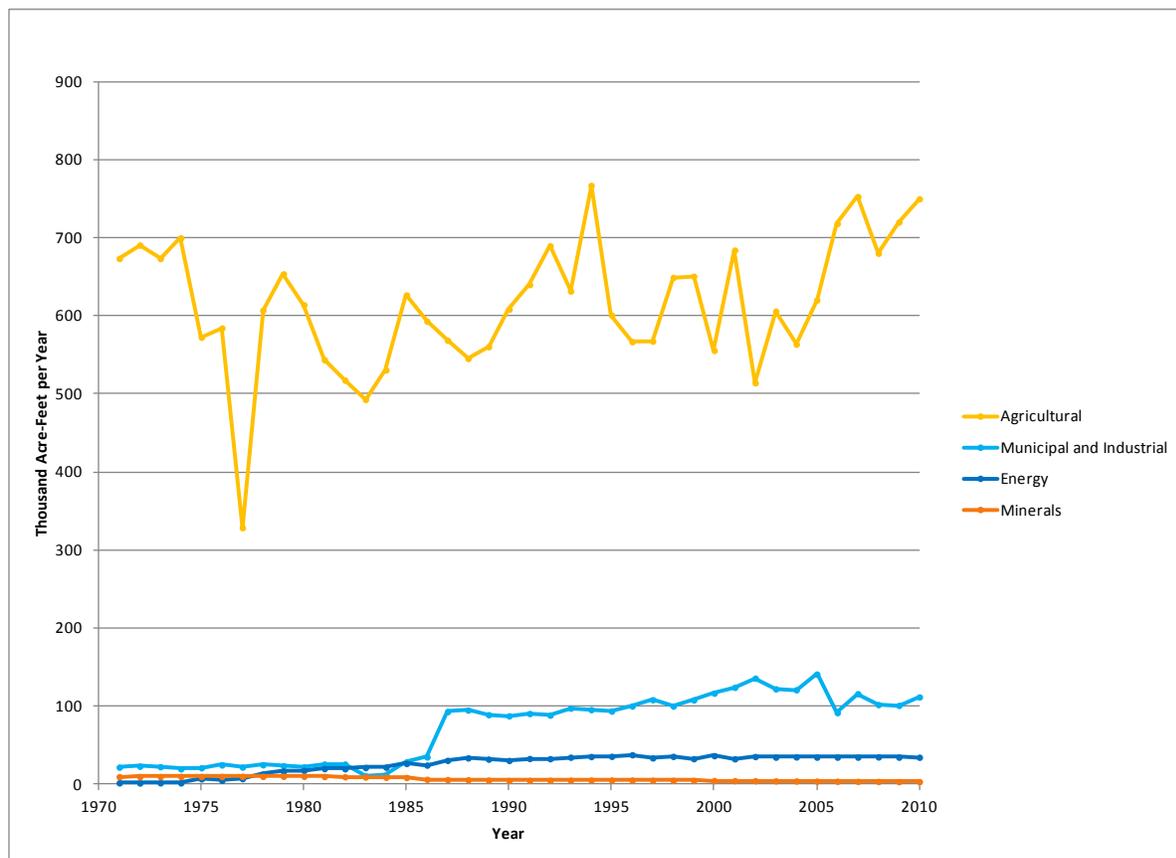


FIGURE C10-9
 Historical Utah Consumptive Use of Colorado River Water by Category, 1971–2010



5.0 Wyoming

Figure C10-10 shows historical (1971 to 2010) state of Wyoming consumptive use of Colorado River water by category. Wyoming consumptive use of Colorado River water has grown from approximately 338 kaf in 1971 to a high of 566 kaf in 1994 (exclusive of reservoir evaporation), an increase of 59 percent. Agriculture is the largest consumptive use category in Wyoming.

Figure C10-11 displays the percent of Wyoming consumptive use by category in the past (1971 to 1980 average) and recently (1999 to 2010 maximum). Wyoming consumptive use distribution across categories appears to have shifted slightly in the recent period, with an increase in energy, M&I, and agriculture uses, as well as a decrease in minerals use.

Figure C10-12 displays the consumptive use for each category. It can again be seen that the largest category of consumptive use is agriculture. The agriculture category is strongly influenced by supply, which can result in reduced requests for diversion in years with abundant precipitation and result in shortages during years of drought. Agricultural use in 1977 was significantly affected by reduced natural flows in the Basin, which were 36 percent below the annual long-term average at the Colorado River at Lees Ferry, Arizona. The next largest category is energy, followed by M&I, with the remaining categories comprising a small percentage of Wyoming’s consumptive use.

FIGURE C10-10
 Historical Wyoming Consumptive Use of Colorado River Water by Category, 1971–2010

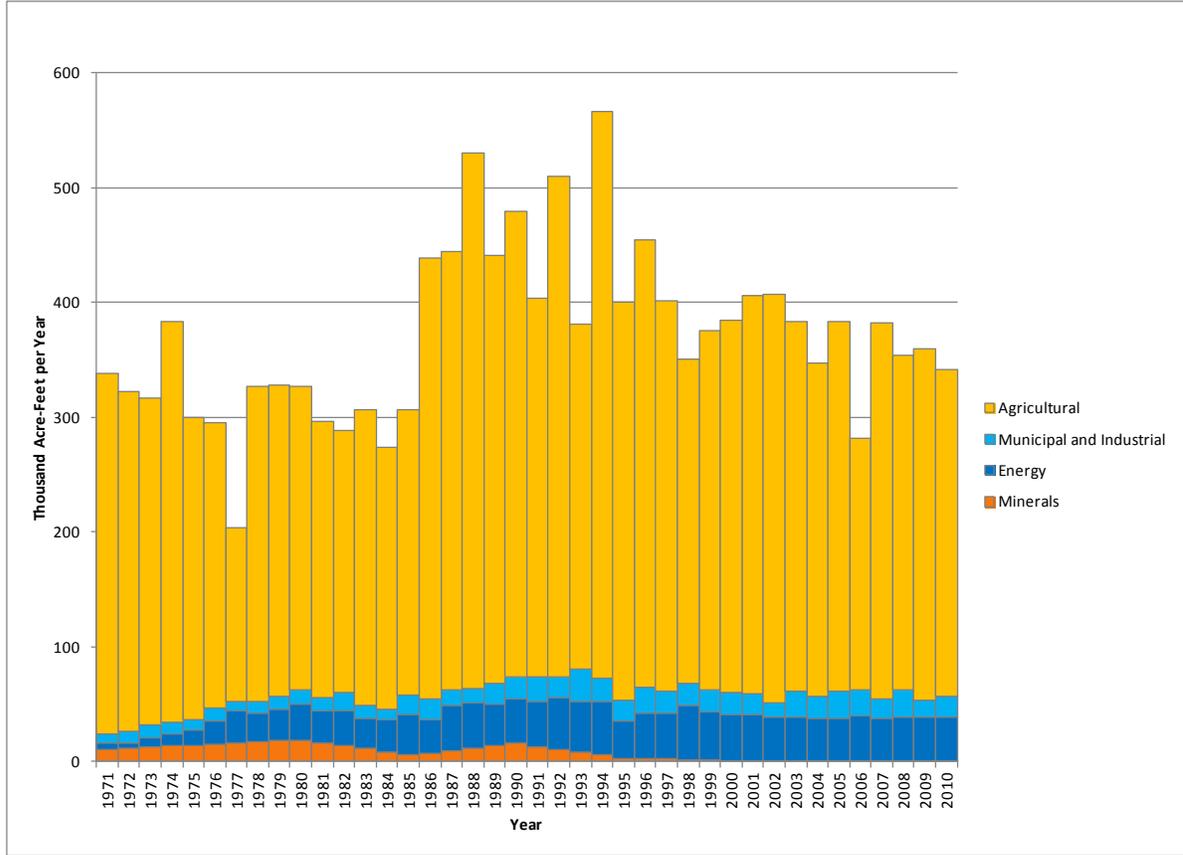


FIGURE C10-11
 Historical Wyoming Consumptive Use of Colorado River Water Percent by Category

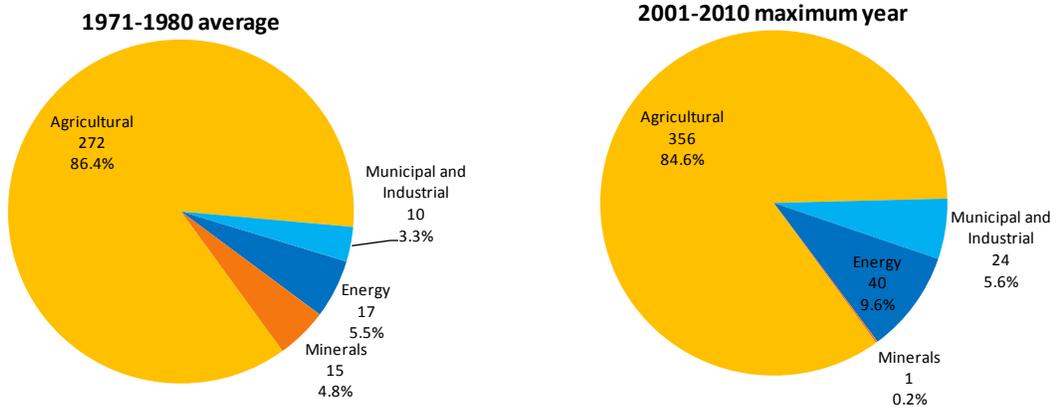
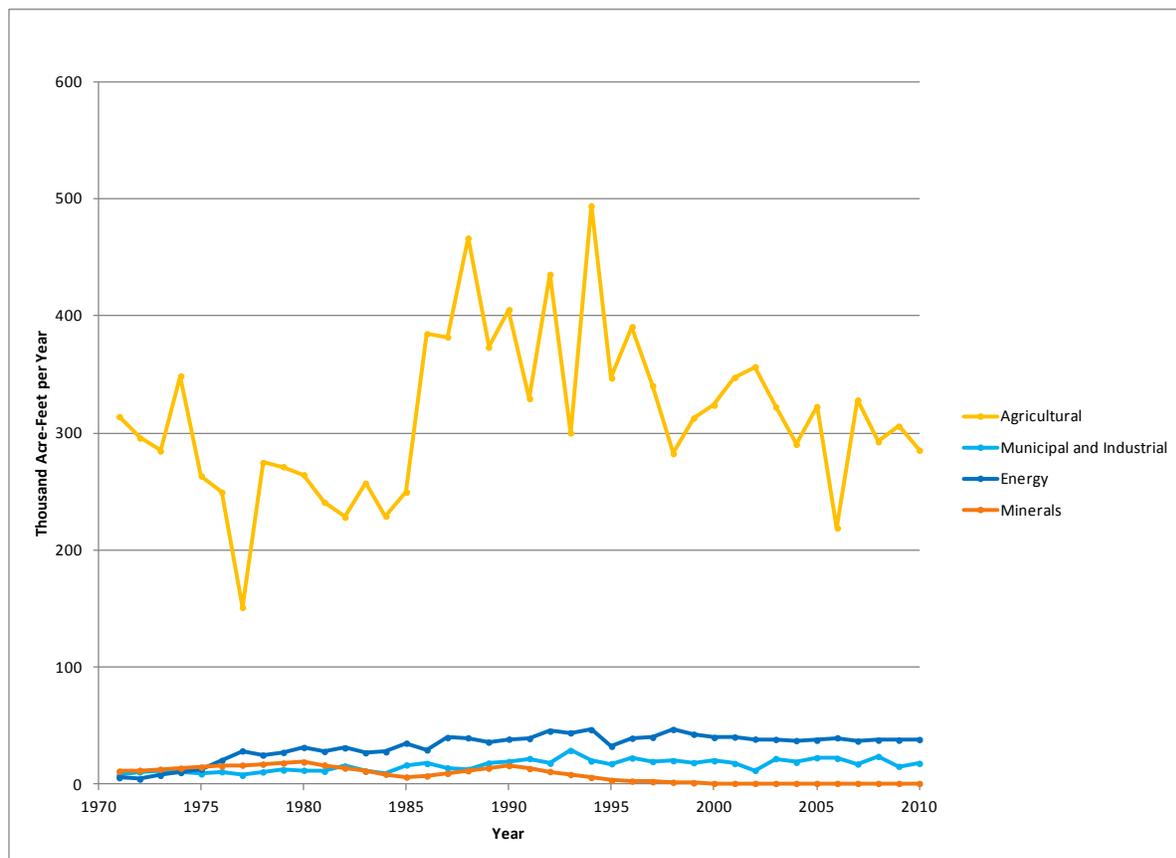


FIGURE C10-12
 Historical Wyoming Consumptive Use of Colorado River Water by Category, 1971–2010



6.0 Arizona

Upper Basin. Figure C10-13 shows historical (1971 to 2010) state of Arizona Upper Basin consumptive use of Colorado River water by category. Arizona Upper Basin consumptive use of Colorado River water has grown from approximately 5 kaf in 1971 to a high of 40 kaf in 1985 (exclusive of reservoir evaporation), an increase of 318 percent. Energy is the largest consumptive use category for Arizona’s Upper Basin use and accounts for most of the increase.

Figure C10-14 displays the percent of Arizona consumptive use of Colorado River water by category in the past (1971 to 1980 average) and recently (1999 to 2010 maximum). Arizona Upper Basin consumptive use of Colorado River water distribution across categories appears to have shifted in the recent period, with an increase in energy use and a decrease in agricultural use.

Figure C10-15 displays the consumptive use for each category. It can again be seen that the largest category of consumptive use is energy. Water used within the energy category serves the Navajo Generating Station, which began operation in 1974. The remaining categories comprise a small percentage of Arizona’s Upper Basin consumptive use.

FIGURE C10-13
 Historical Arizona Upper Basin Consumptive Use of Colorado River Water by Category, 1971–2010

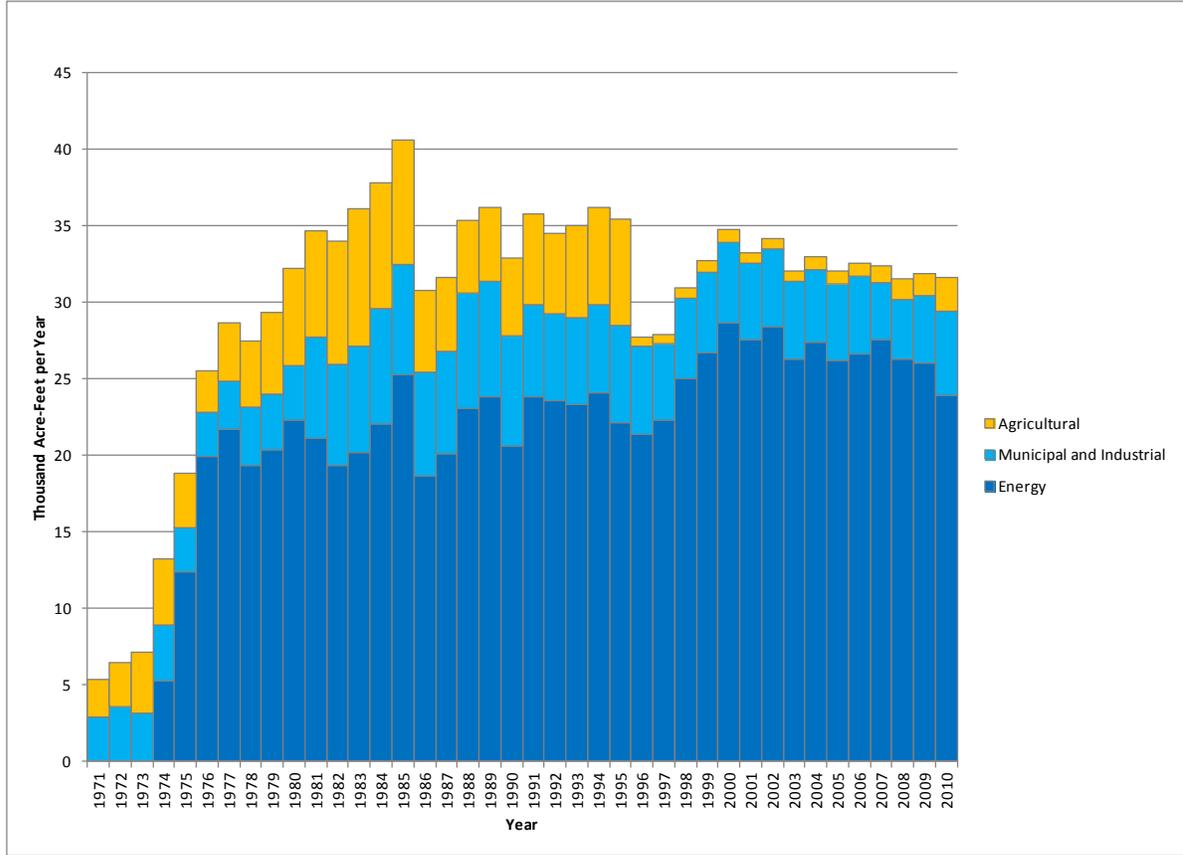


FIGURE C10-14
 Historical Arizona Upper Basin Consumptive Use of Colorado River Water Percent by Category

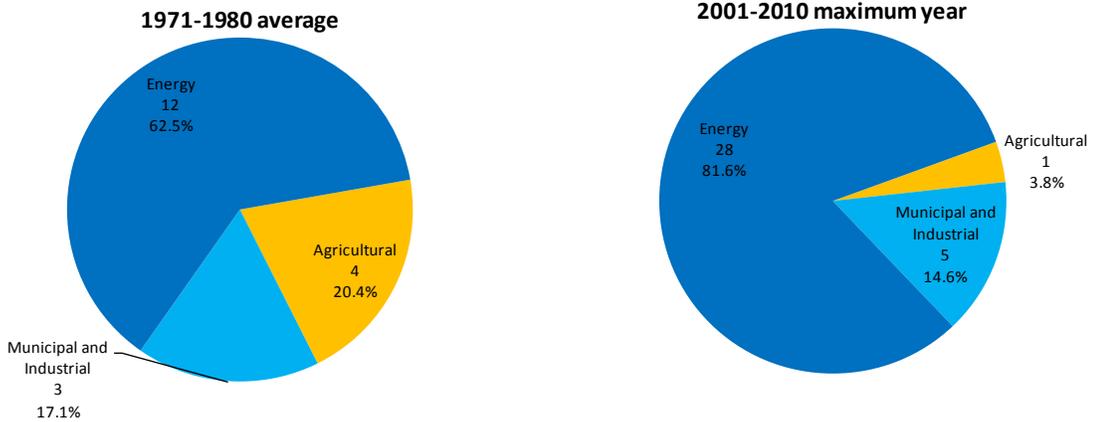
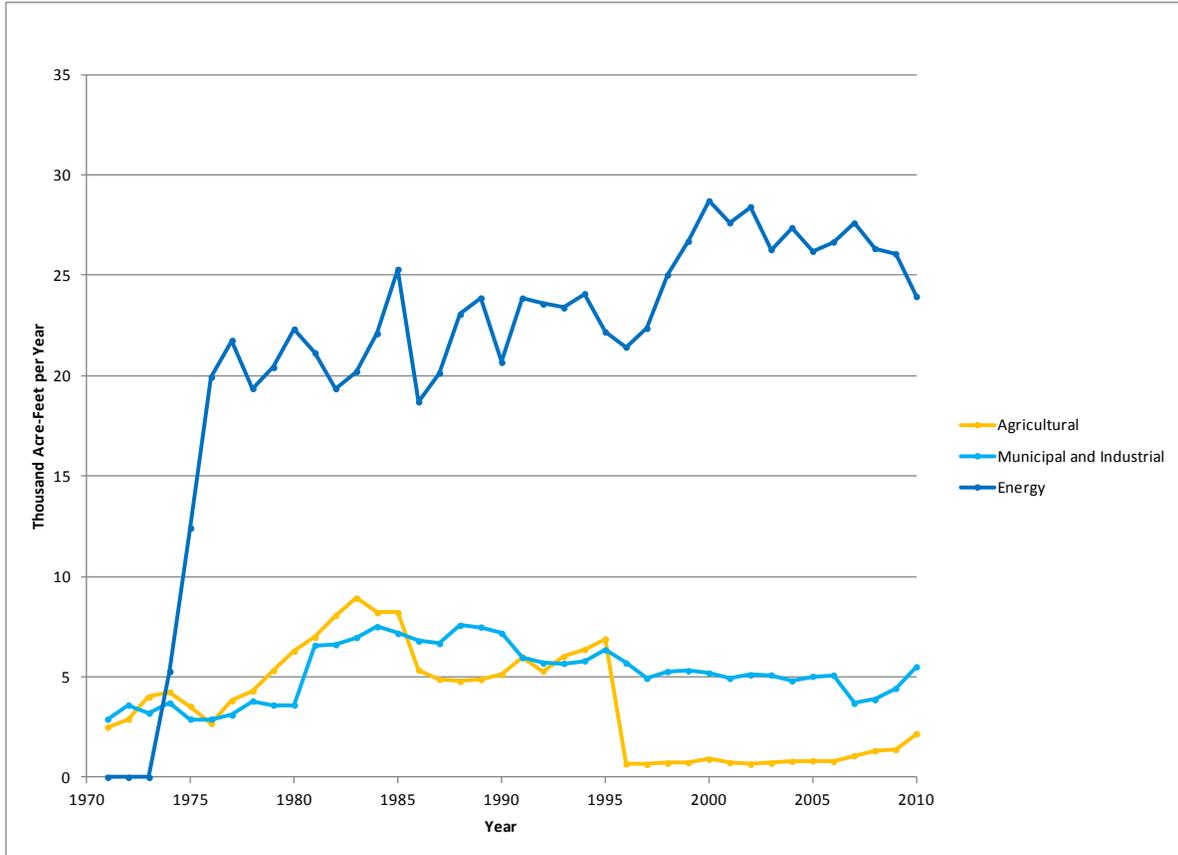


FIGURE C10-15
 Historical Arizona Upper Basin Consumptive Use of Colorado River Water by Category¹, 1971–2010



¹ Water used within the energy category serves the Navajo Generating Station, which began operation in 1974.

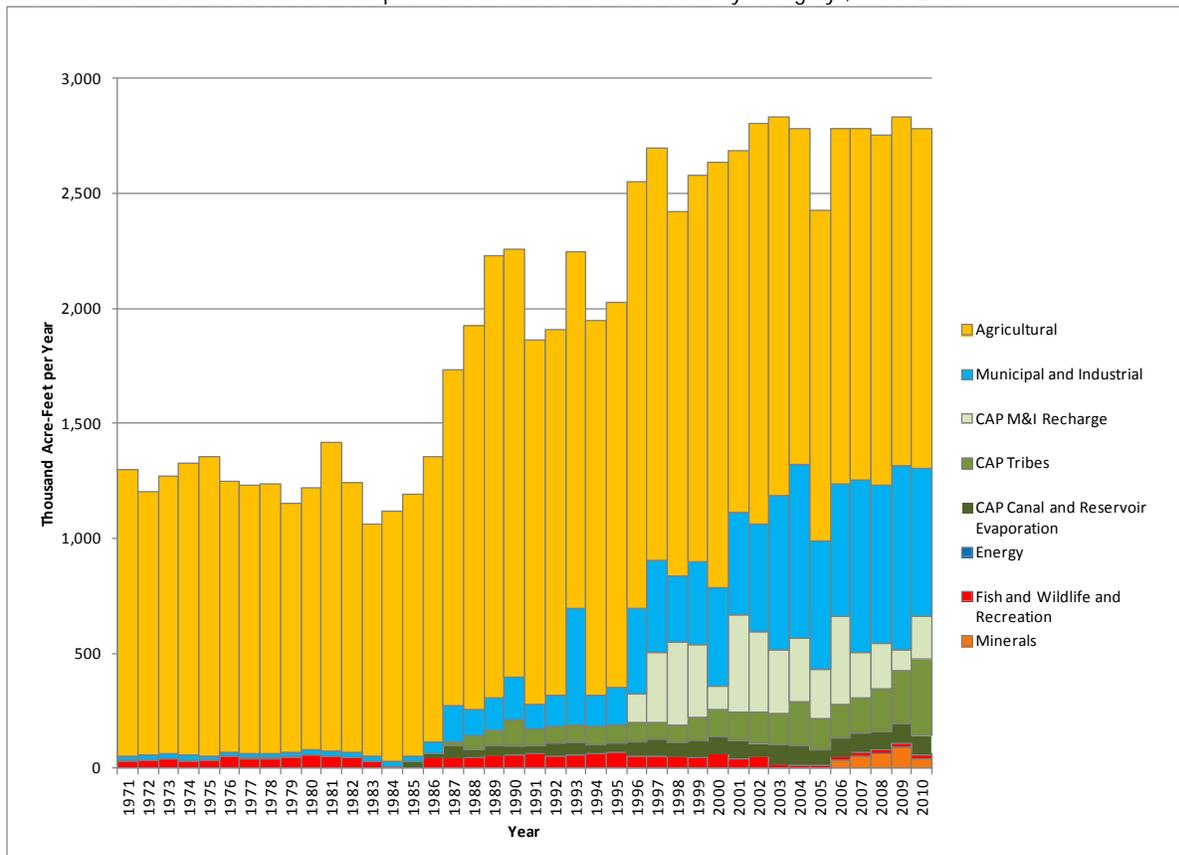
Lower Basin. Figure C10-16 shows historical (1971 to 2010) state of Arizona Lower Basin consumptive use of Colorado River water by category. Arizona's Lower Basin consumptive use of Colorado River water has grown from approximately 1.3 maf in 1971 to a high of 2.8 maf in 2003 (exclusive of reservoir evaporation), an increase of 115 percent. Agriculture is the largest use category. The agriculture and M&I consumptive use categories show an increase beginning in the late 1980s, largely due to the construction of the Central Arizona Project (CAP).

Arizona also provided a breakdown by use category of CAP deliveries from the mainstem to the Gila River Basin, with three additional use categories. These are CAP M&I Recharge, representing the activities of the Central Arizona Groundwater Replenishment District, Arizona Water Banking Authority, and interstate banking; CAP tribes, representing the CAP water delivered to meet tribal use; and CAP Canal and Reservoir Evaporation, representing losses within the CAP delivery system. Tribal use in Arizona except for CAP deliveries is included as a component of the agriculture and/or M&I demand categories. The CAP data by use category, however, should be considered preliminary and may be updated in the future.

Figure C10-17 displays the percent of Arizona Lower Basin consumptive use by category in the past (1971 to 1980 average) and recently (1999 to 2010 maximum). Arizona's use distribution across categories appears to have shifted in the recent period, with a significant increase in M&I portion of total use and a significant decrease in the agriculture portion of total use.

Figure C10-18 displays the consumptive use for each category. It can again be seen that the largest category of consumptive use is agriculture, while M&I sharply increases after deliveries from the CAP begin in 1985. Agriculture, M&I, and M&I Recharge are the most variable categories year to year. The remaining categories comprise a small percentage of Arizona's consumptive use.

FIGURE C10-16
 Historical Arizona Lower Basin Consumptive Use of Colorado River Water by Category¹, 1971–2010



¹ CAP began deliveries in 1985.

FIGURE C10-17
 Historical Arizona Lower Basin Consumptive Use of Colorado River Water Percent by Category

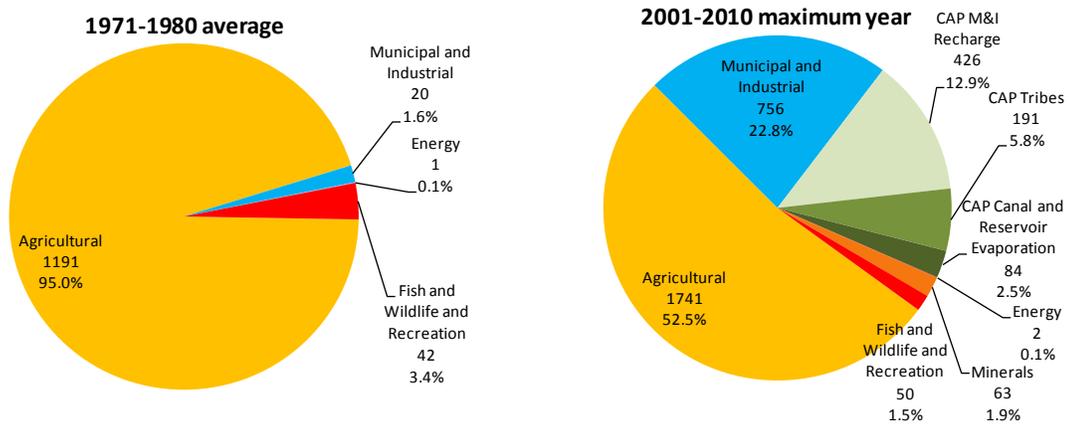
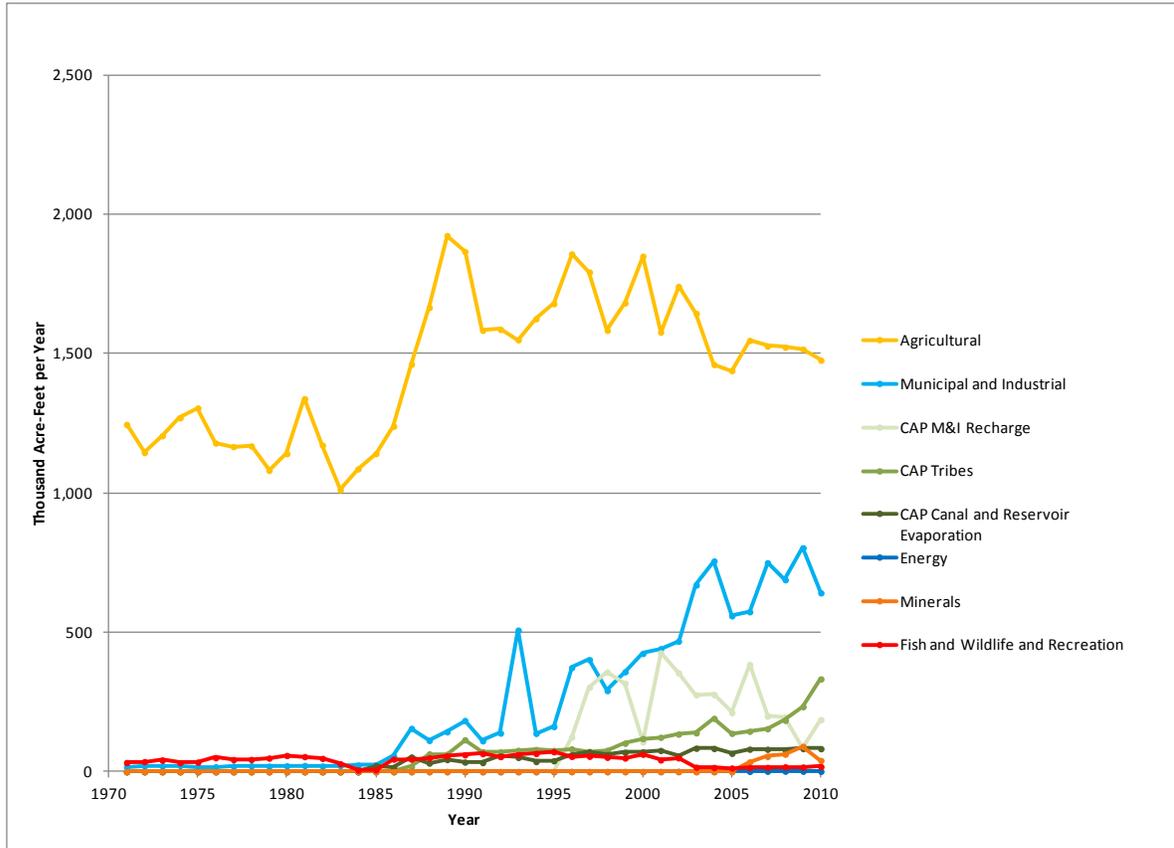


FIGURE C10-18
 Historical Arizona Lower Basin Consumptive Use of Colorado River Water by Category, 1971–2010



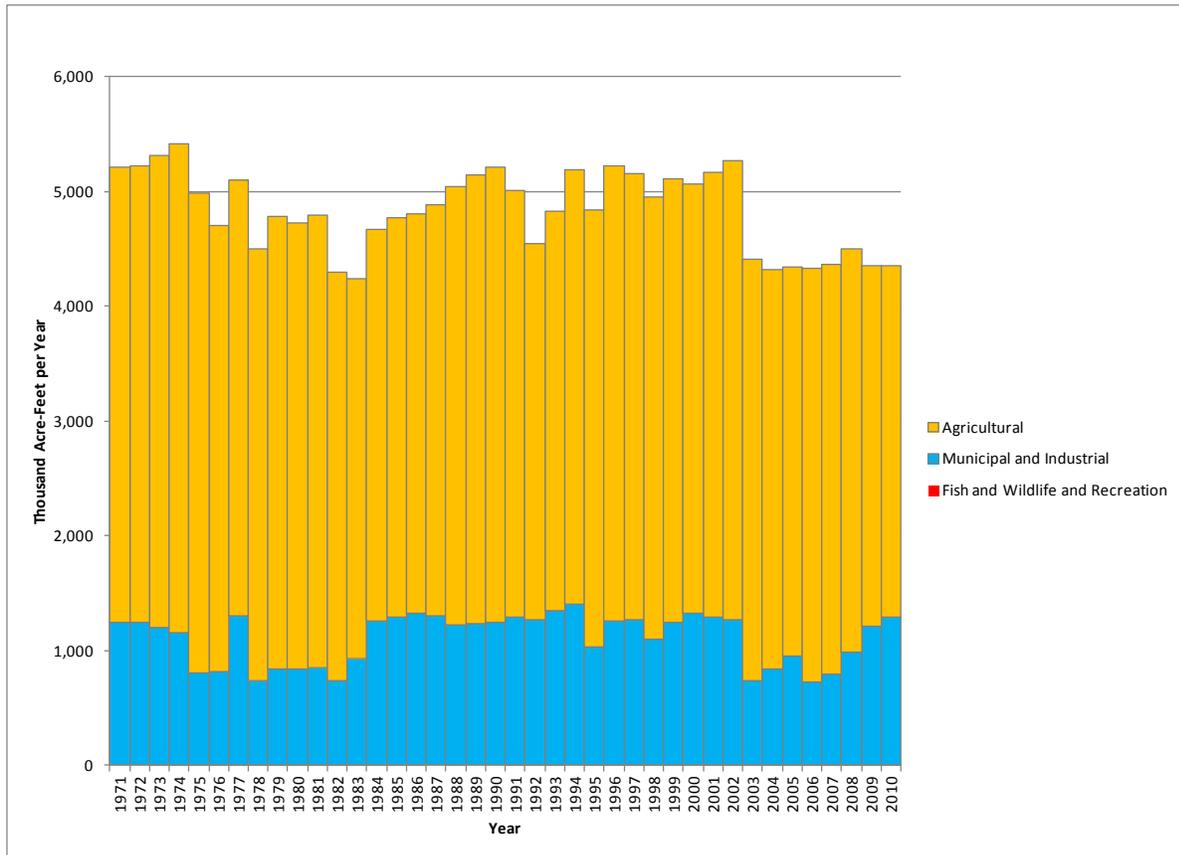
7.0 California

Figure C10-19 shows historical (1971 to 2010) state of California consumptive use of Colorado River water by category. California consumptive use of Colorado River water increased from approximately 5.2 maf in 1971 to a high of 5.4 maf in 1974, then decreased to approximately 4.4 maf over the period 2003 to 2010, a decrease of 19 percent. California’s use above its apportionment of 4.4 maf per year was attributable to available unused apportionment in the Lower Basin and surplus water supply conditions for the Lower Division states.

Figure C10-20 displays the percent of California consumptive use by category in the past (1971 to 1980 average) and recently (2003 to 2010 maximum). A period from 2003 to 2010 was used instead of 1999 to 2010 to represent recent use because the Colorado River Water Delivery Agreement (Federal Quantification Settlement Agreement), an integral part of implementing California’s “4.4 Plan,” was signed in 2003. Although California consumptive use has decreased over time, the distribution across categories remains relatively unchanged.

Figure C10-21 displays the consumptive use for each category. It can again be seen that the largest category of consumptive use is agriculture followed by M&I.³ The M&I and agriculture categories show significant variability from year to year. Delivery losses incurred by the irrigation districts have been included in the agriculture category. The remaining categories comprise a small percentage of California’s consumptive use.

FIGURE C10-19
Historical California Consumptive Use of Colorado River Water by Category¹, 1971–2010



¹ California’s use above its normal apportionment of 4.4 million acre-feet per year (maf) was attributable to available unused apportionment in the Lower Basin and surplus water supply conditions for the Lower Division states.

³ M&I includes entities served by the Metropolitan Water District of Southern California, Imperial Irrigation District, and Coachella Valley Water District.

FIGURE C10-20
 Historical California Consumptive Use of Colorado River Water Percent by Category

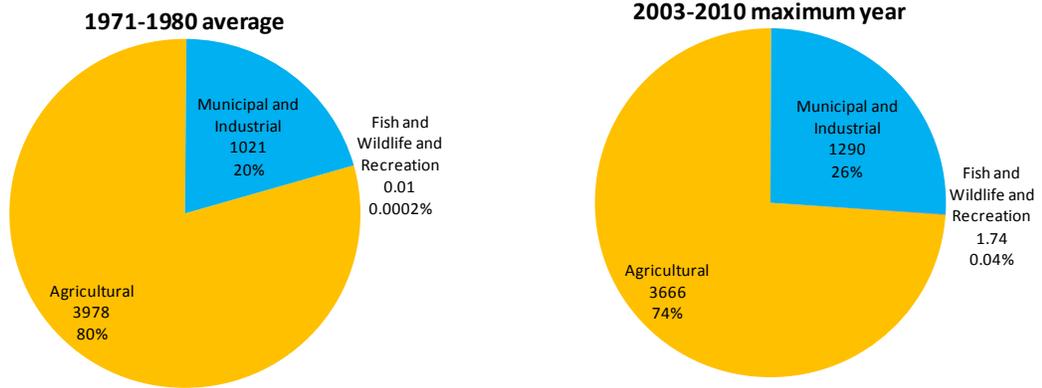
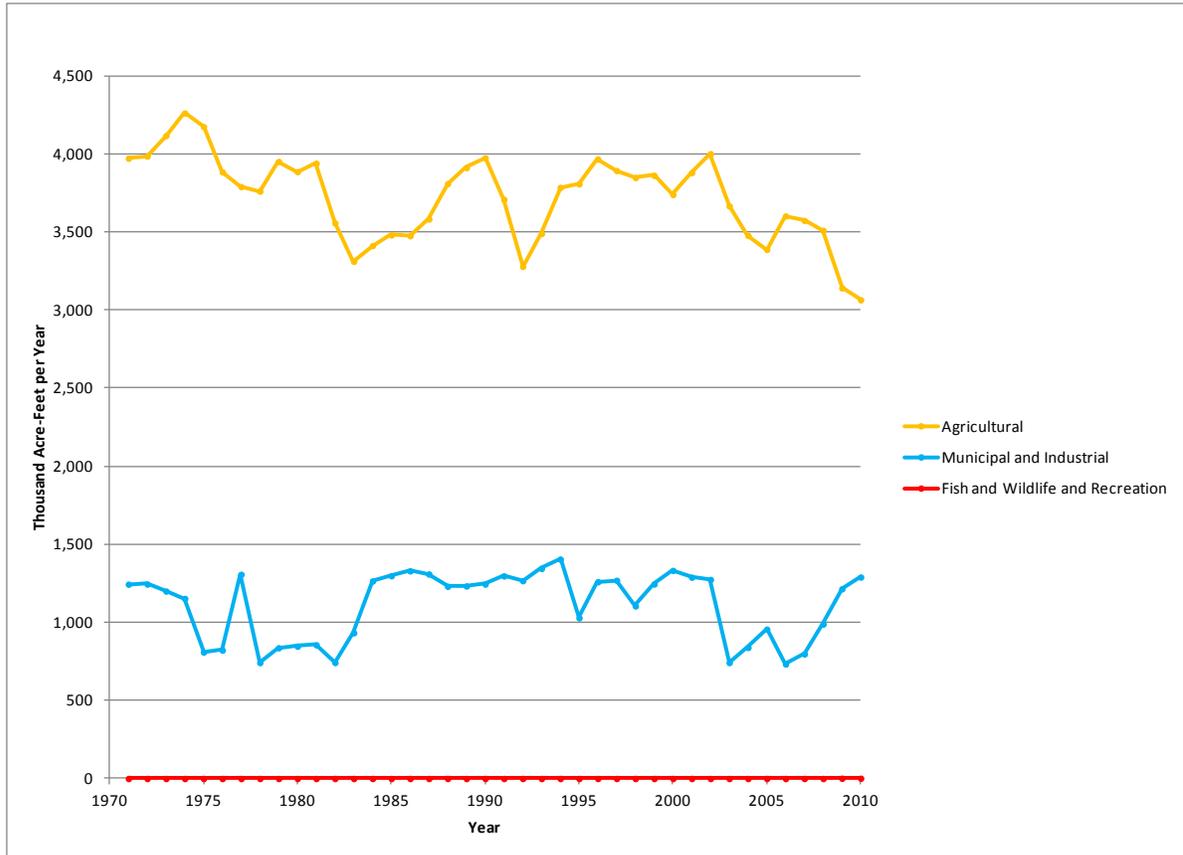


FIGURE C10-21
 Historical California Consumptive Use¹ of Colorado River Water by Category, 1971–2010



¹ California's use above its normal apportionment of 4.4 mafy was attributable to available unused apportionment in the Lower Basin and surplus water supply conditions for the Lower Division states.

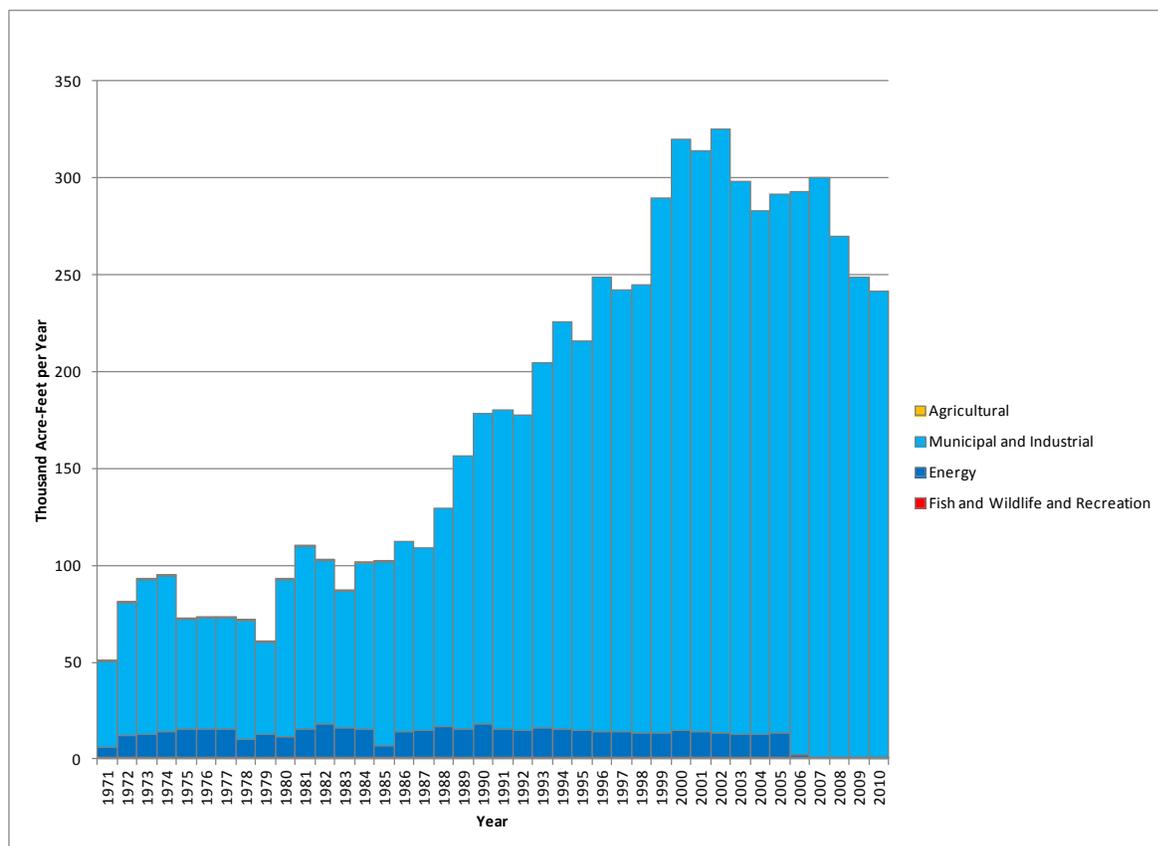
8.0 Nevada

Figure C10-22 shows historical (1971 to 2010) state of Nevada consumptive use of Colorado River water by category. Nevada consumptive use of Colorado River water has grown from approximately 51 kaf in 1971 to a high of 325 kaf in 2002, an increase of 537 percent. Nevada’s use above its apportionment of 300 thousand acre-feet per year (kafy) is attributable to surplus water supply conditions for the Lower Division States. M&I is essentially the only consumptive use category in Nevada. Although there is a small amount of agricultural use by the Fort Mohave Indian Reservation, all of that use has been categorized as M&I.

Figure C10-23 displays the percent of Nevada consumptive use by category in the past (1971 to 1980 average) and recently (1999 to 2010 maximum). Beginning in 2006, water use by the Southern California Edison Company declined to approximately 500 acre-feet per year (afy), accounting for the decrease in the energy category. Figure C2-24 displays the consumptive use for each category.

FIGURE C10-22

Historical Nevada Consumptive Use of Colorado River Water by Category^{1,2}, 1971–2010



¹ Nevada’s use above its 300 kafy apportionment was attributable to surplus water supply conditions for the Lower Division states.

² Beginning in 2006, water use by the Southern California Edison Company (energy category) declined to approximately 500 afy.

FIGURE C10-23
 Historical Nevada Consumptive Use of Colorado River Water Percent by Category

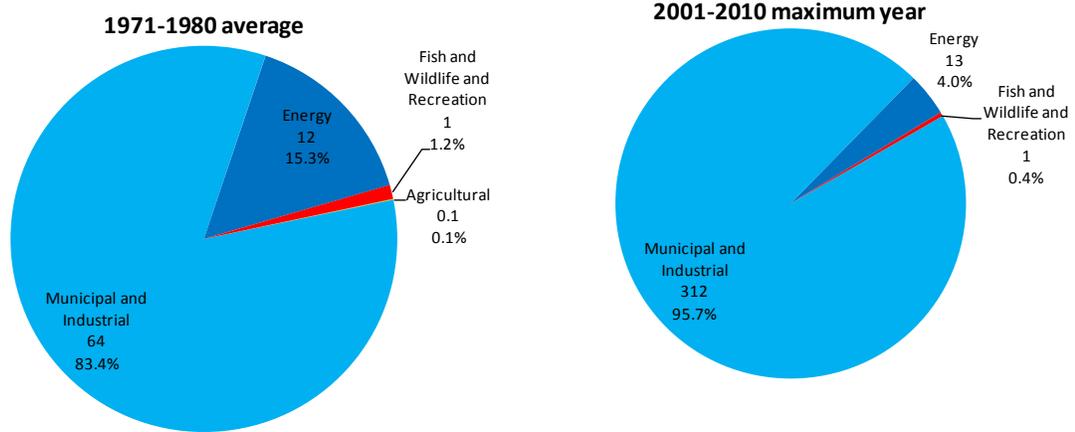
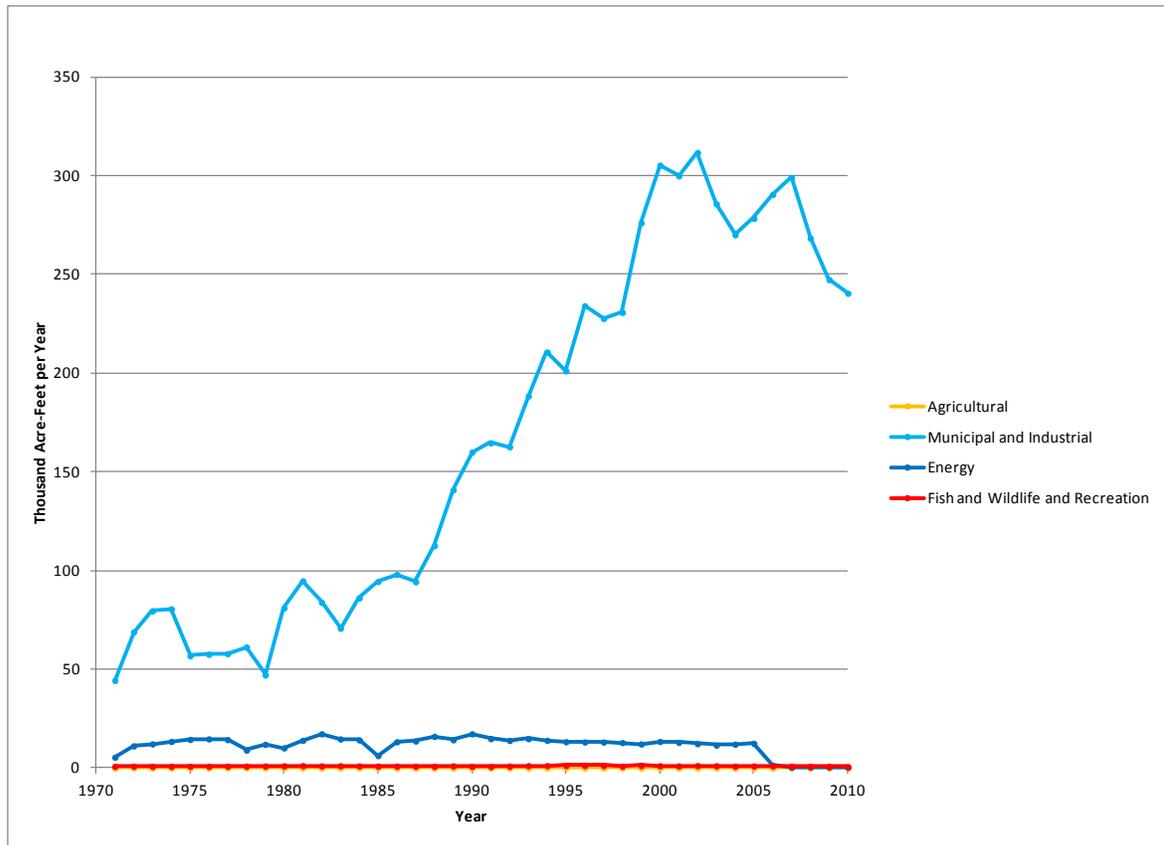


FIGURE C10-24
 Historical Nevada Consumptive Use of Colorado River Water by Category^{1,2}, 1971–2010



¹ Nevada’s use above its 300 kafy apportionment was attributable to surplus water supply conditions for the Lower Division states.

² Beginning in 2006, water use by the Southern California Edison Company (energy category) declined to approximately 500 afy.

9.0 References

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- Bureau of Reclamation (Reclamation). 2012a. *Colorado River Basin Consumptive Uses and Losses Report 1996–2000*. Retrieved from <http://www.usbr.gov/uc/library/envdocs/reports/crs/crsul.html>.
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