

Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 3
Water Withdrawal Forecasts

Introduction

This section of the *Nevada State Water Plan* presents the water withdrawal forecasts for the state. In addition, this section also presents the methodology used in forecasting water withdrawals by various source and use categories. Fourteen separate categories of water withdrawals were forecast for the water plan as shown below. For definitions of these source and use categories, see Section 5, Technical Supplement – Water Use Coefficient and Related Factor Development and Application.

Forecasted Categories of Water Use

The water plan includes forecasts for fourteen categories of water withdrawals which comprise either unique forecasted water use categories, i.e., irrigation water withdrawals, or an aggregation of forecasted categories, i.e., total mining water withdrawals derived from forecasts of mining processing water withdrawals and mine dewatering. Forecasts were made by the source of water, i.e., municipal and industrial (M&I) water withdrawals, or by the use of water, e.g., domestic (residential) withdrawals. The following represents a listing of the public supply and water use categories presented in this plan:

By Public Supply:

Total Municipal and Industrial (M&I) Water Withdrawals

By Water Use Type:

Total Water Withdrawals

Total Domestic (Residential) Water Withdrawals

Domestic Public Supply Withdrawals

Domestic Self-Supplied Withdrawals

Commercial and Industrial Water Withdrawals

Thermoelectric Water Withdrawals

M&I Public Use and Losses

Total Mining Water Withdrawals

Mine Processing (Consumptive) Withdrawals

Mine Dewatering (Non-Consumptive) Withdrawals

Total Agricultural Water Withdrawals

Irrigation Withdrawals

Livestock (including Fisheries and Hatcheries) Withdrawals

In addition to forecasts of water withdrawals for these categories, estimates are also presented of

consumptive water use by specific use category. The material in this section is supported by Section 5, which, in addition to providing a more detailed explanation of the methodology of the forecasts, also presents graphs of the county-specific water use coefficients and other factors used in the development of the water withdrawal. In addition, a number of appendices to the water plan lend themselves to providing greater detail for the water use forecasts and underlying socioeconomic forecasts. Specifically, Appendix 1 of the Appendices provides historical water use data for the years 1985, 1990, and 1995; Appendix 2 of the Appendices develops the population forecasts; Appendix 3 develops the employment forecasts from the population forecasts and provides detailed county forecasts for all source and use categories forecasted using these socioeconomic variables. Appendix 4 of the Appendices develops the county and state forecasts of irrigated acreage; and Appendix 5 of the Appendices presents a summary of all forecasts for the state and all counties.

The Nevada Division of Water Planning's (NDWP's) water use forecast methodology is intended to link the socioeconomic growth rate assumptions and forecasts developed in Part 2, Section 2, Nevada Socioeconomic Forecasts, for population, employment and agricultural irrigated acreage, with individual county and statewide forecasts for water withdrawals through the use of estimated "water use" factors. The water use factors were calculated from historical water withdrawal amounts divided by populations, employment, or irrigated acreage. This process of linking the socioeconomic forecasts with water withdrawal forecasts is more extensively explained in the following section, "The Forecast Methodology." [Note: For a detailed explanation of the development of the water use factors, or coefficients, and their application to specific water withdrawal forecasts, see Part 2, Section 5.] The forecast methodology represents an integrated forecasting technique which only requires forecasts of population and agricultural irrigated acreage in order to produce most of the state's water withdrawal forecasts by water use category. It should be noted that all water withdrawal forecasts presented in this section are made at the county level and then aggregated to produce the forecasts for the State of Nevada.

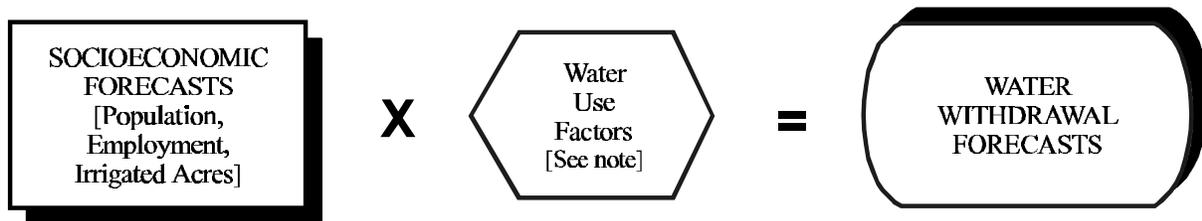
The Forecast Methodology

The forecast methodology developed for the water plan uses a forecast of key socioeconomic variables multiplied by a water use factor or coefficient to produce a water withdrawal forecast. This process is depicted in its simplest form in Flow Chart 1. Basic Forecasting Methodology. Specifically, forecasts of population, employment (which itself is derived from the population forecast), and irrigated acreage provide the means to develop a number of water withdrawal forecasts by water use category, including withdrawals for domestic (both public and self-supplied), municipal and industrial (M&I), public use and losses, commercial and industrial, irrigation and livestock water withdrawals. The only forecasted categories which use a different methodology are thermoelectric and mining water uses.

Flow Chart 2. Forecast Methodology by Use Category, expands the basic concept of Flow Chart 1 to show how the various water withdrawal forecasts by source or use category are determined. Flow Chart 2 introduces a "Units Conversion Factor" factor which merely converts the water use

coefficients, measured in either gallons per capita or per employee per day, to a total water withdrawal figure in acre-feet per year. Flow Chart 2 depicts how the fundamental socioeconomic forecasts (population, employment and irrigated acreage) are used to develop specific forecasts of water withdrawal by category. This chart also shows how mining water uses (both consumptive and

Flow Chart 1. Basic Forecast Methodology Socioeconomic Forecasts to Water Withdrawal Forecasts



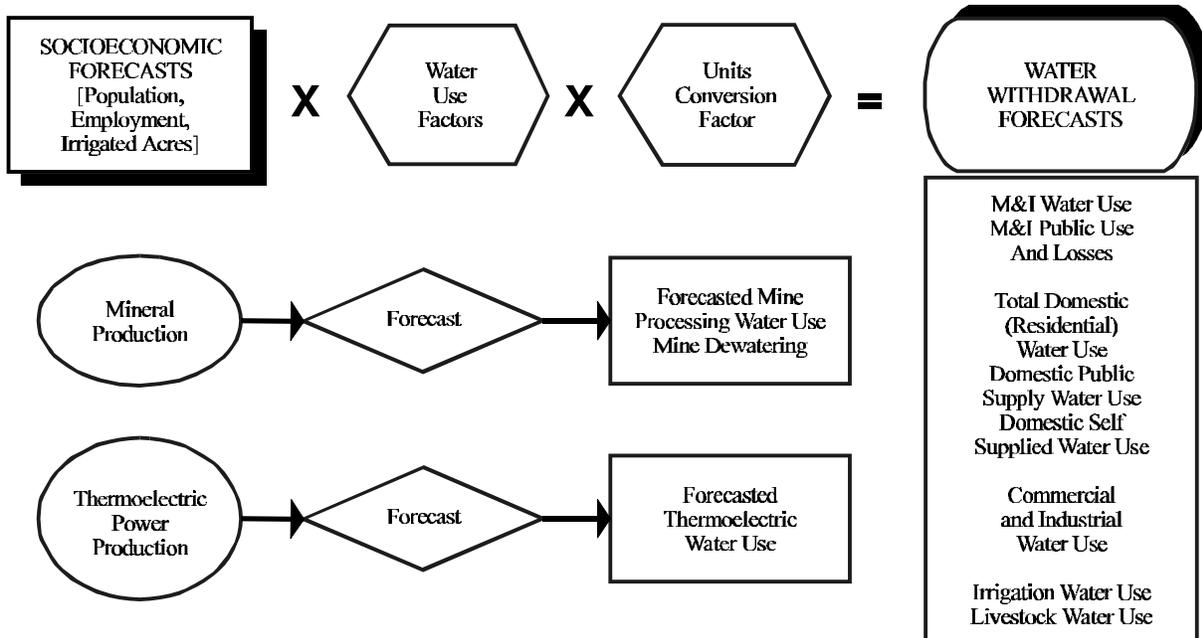
Note: Water Use Factors Measured in Gallons per Capita per Day, Gallons per Employee per Day, or Acre-Feet per Acre per Year

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Flow Chart 2. Forecast Methodology by Use Category Socioeconomic Forecasts to Water Withdrawal Forecasts

Note: Water Use Factors Measured in Gallons per Capita per Day, Gallons per Employee per Day, or Acre-Feet per Acre per Year

Note: Units Conversion Factor from Use per Day to Water Withdrawals per Year



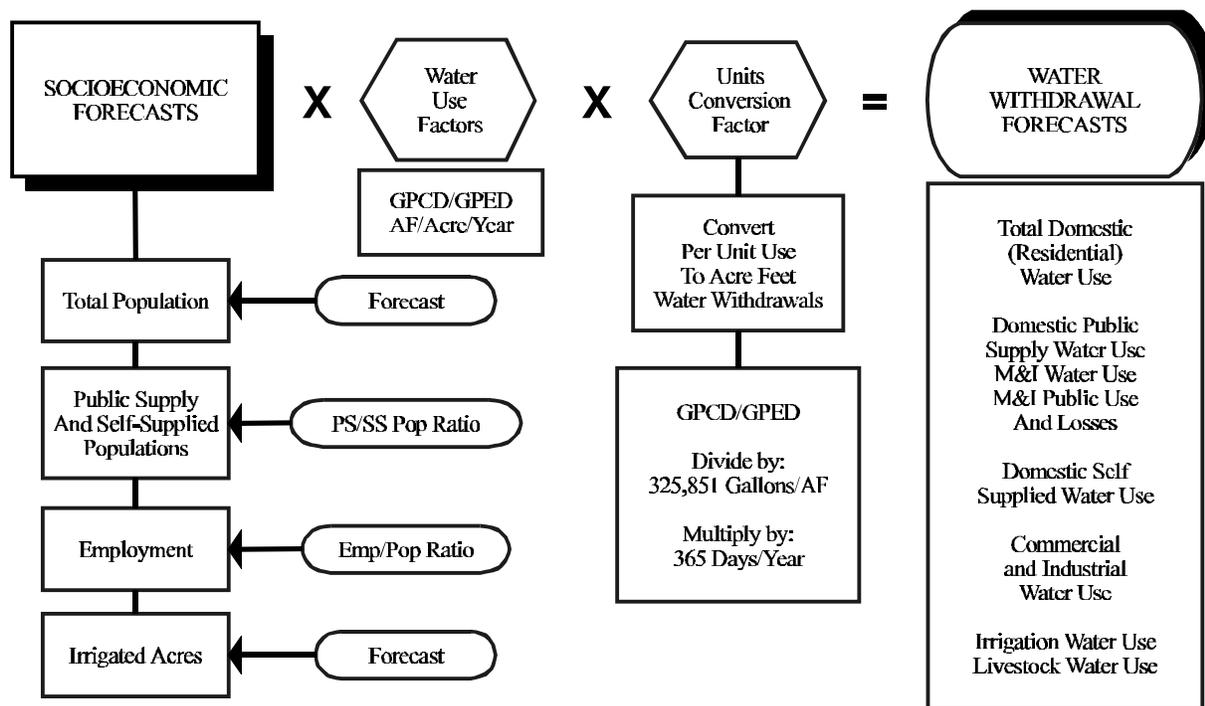
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non-consumptive) are forecast from estimates of mining activity and production levels. Also shown is the methodology for thermoelectric water withdrawal forecasts, which are estimated from general forecasts of future production levels based on such factors as population growth and regional mining activity.

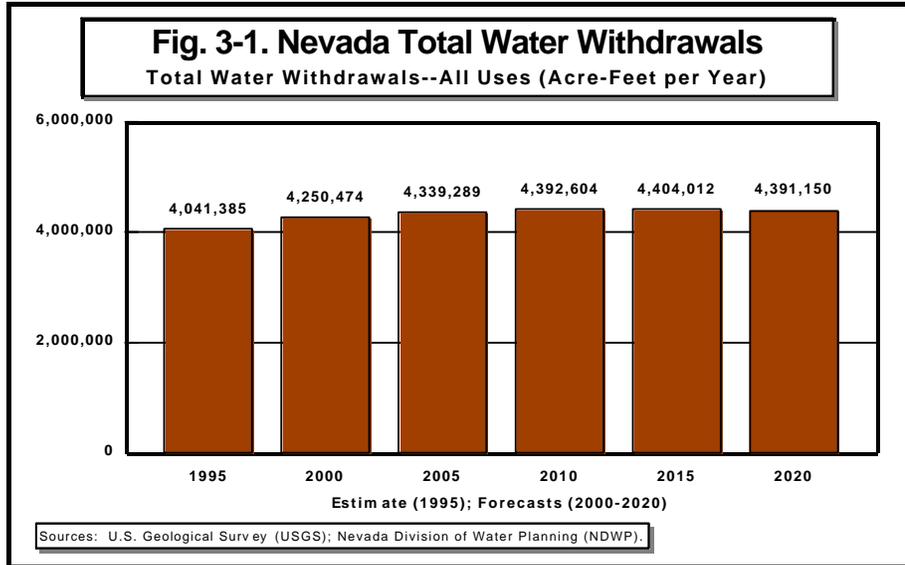
Flow Chart 3. Socioeconomic and Water Withdrawal Forecasts, shows in greater detail the interaction of the socioeconomic forecasts (population, employment and irrigated acreage), the water use factors, other forecasts assumptions (factors) and the units conversion factors, to produce the water withdrawal forecasts for the M&I, domestic, commercial and industrial and agriculture use categories. Of special note is that forecasts for all water withdrawal categories are made at the county level and then aggregated county-by-county to produce the statewide totals for all categories of water use. By this aggregation process, however, the water use coefficients reflected for the total state vary over time depending on individual county trends. This is based on the fact that the statewide water use coefficients represent, in effect, weighted averages of individual county use coefficients and therefore will vary depending on individual county trends.

Flow Chart 3 shows that the forecast of total population, multiplied by a total domestic water use factor in gallons per capita (per persons) per day (GPCD) and then multiplied by a units conversion factor, provides a forecast of total domestic (residential) water withdrawals. Similarly, the forecast of total population, multiplied by a public supply/self-supplied population factor (“PS/SS Pop Ratio”

Flow Chart 3. Socioeconomic and Water Withdrawal Forecasts
Socioeconomic Forecasts, Forecast Factors, Conversion Factors
and Forecasted Water Withdrawals by Category



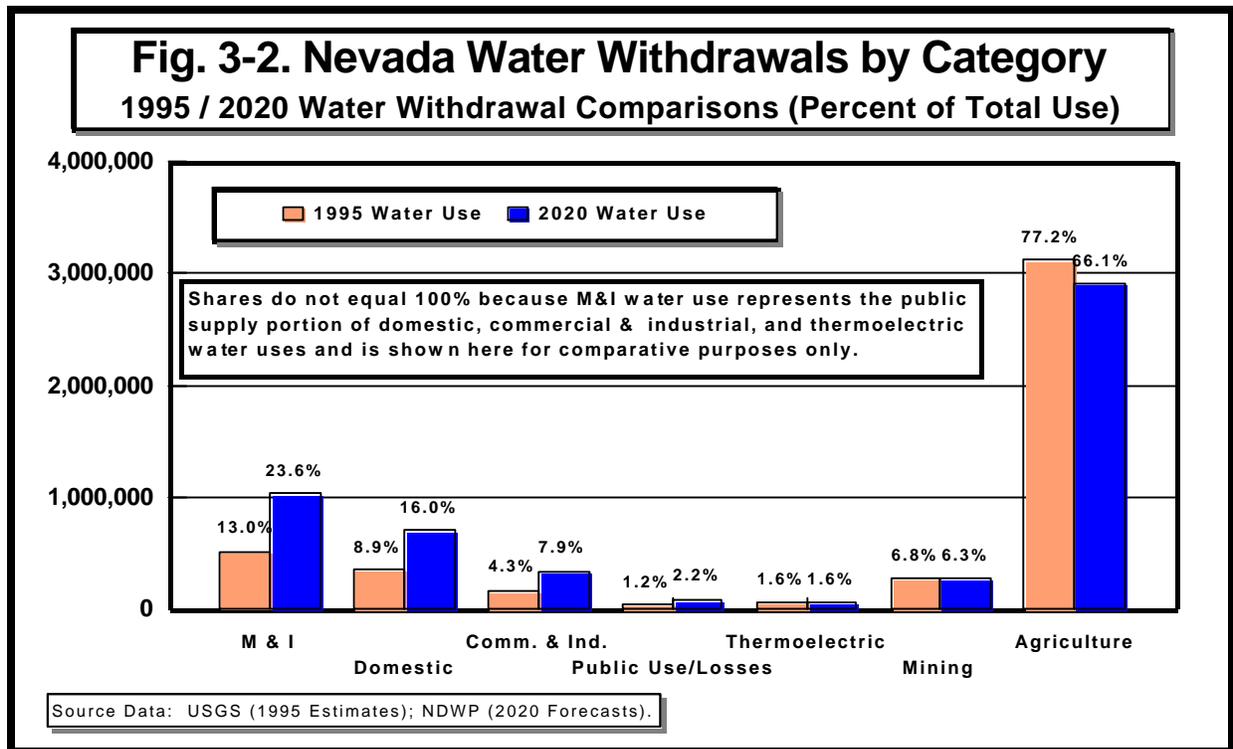
in Flow Chart 3) provides both a public supply population and a self-supplied population from which (using appropriate water use factors) domestic public supply and domestic self-supplied water withdrawal forecasts are made. The total municipal and industrial water withdrawals are projected using the estimates of the population on public supply water systems multiplied by a M&I water use factor. The M&I public use and losses are estimated (at approximately 10 percent of total M&I water withdrawals for the total state) based on historical public use and losses.



Commercial and industrial water withdrawals are based on the forecasted level of employment, which is estimated from the population forecast. Water withdrawals are then estimated using an employment-to-population ratio multiplied by a commercial water use factor. This water use factor is calculated from historical use patterns in gallons per employee per day (GPED) to yield total commercial and industrial water withdrawals. Since mining water use is forecasted using a different methodology, mining workers are subtracted from the forecasts of total employment.

Irrigation water withdrawal forecasts are made using forecasts of county irrigated acreage multiplied by an irrigated acreage water requirement factor in acre-feet per acre per year. Livestock water withdrawal forecasts are made based upon a factor (ratio) of livestock water withdrawals to irrigation water withdrawals. Total agricultural water withdrawal forecasts represent the sum of irrigation water withdrawals and livestock water withdrawals. [Note: The terms “water withdrawal” and “water use” are used interchangeably in this forecast analysis. While assumed to have the same meaning in this presentation, the term water withdrawal represents the total amount of water withdrawn for a specific use category without reference to the amount of return flow. Thus, it does not measure consumptive use, which represents water which is not returned to a source or able to be used again. Table 3–8 presents estimates and forecasts of both total water withdrawals and the estimated consumptive use.]

Thermoelectric (including geothermal) water withdrawal forecasts did not lend themselves to the use of the water use factor method described above. In addition, power production across the state is generally not dependent upon the socioeconomic conditions in any one county. Consequently, these forecasts were based primarily on general population trends and increasing demands for electrical power, particularly from mining operations in some of the rural counties. Mining water withdrawal



forecasts (including both consumptive and non-consumptive withdrawals, such as mine dewatering), also presented a unique forecasting environment where employment is not directly related to water used in mineral production. These forecasts were therefore based principally on the projected state of Nevada’s gold industry, and specifically on the market price of gold, the grade of available ore bodies which influences the type of processing required and the amount of water used in processing, the level of economically-recoverable reserves, the nature of production (underground mining versus open-pit mining), and the continued need for mining dewatering in relation to future mining operations. As with all of the forecasts, the forecasted future mining water withdrawals are estimates only and actual future water use will be highly dependent on the price of gold.

Summary of Water Withdrawals by Use Category

Table 3–1. Nevada Water Withdrawal Forecast Summary, presents historical estimates (1995) and forecasts (2000–2020) of water withdrawals by major use category along with each categories’ percentage share of total statewide water withdrawals. This table represents a condensed version of Table 3–7. Nevada Estimated and Forecasted Water Withdrawals, which appears later in this section with the addition of the forecasted percentage share changes by water use category. See Fig. 3–1 for estimated and forecast water withdrawals for 1995 through 2020 and Fig. 3–2 for changes in the shares of water withdrawals between the years 1995 and 2020. In Table 3–1, the water withdrawals for domestic, commercial and industrial and thermoelectric use categories include water from both public and self-supplied sources. Public use and losses are assumed to be from public supply water sources only. It should be noted that these water withdrawal forecasts are based on the most current available level of water use and the state of water conservation. Therefore, these forecasts do not

explicitly incorporate the introduction of new technology and changes in policy and pricing actions which may tend to change the water use rates used to develop these forecasts.

**Table 3–1. Nevada Water Withdrawal Forecast Summary
Estimated (1995) and Forecasted (2000–2020) Water Use by Use Type
Acre Feet per Year and Percent of Statewide Total Water Withdrawals**

Total Nevada	1995	2000	2005	2010	2015	2020
Domestic (Residential) Withdrawals[1] Percent of Total Withdrawals	360,710 8.9%	455,464 10.7%	538,090 12.4%	607,467 13.8%	660,315 15.0%	701,338 16.0%
Commercial & Industrial Withdrawals[2] Percent of Total Withdrawals	172,407 4.3%	220,355 5.2%	261,880 6.0%	296,905 6.8%	323,811 7.4%	344,919 7.9%
Public Use and Losses[3] Percent of Total Withdrawals	48,472 1.2%	61,195 1.4%	72,313 1.7%	81,707 1.9%	88,930 2.0%	94,582 2.2%
Thermoelectric Withdrawals[4] Percent of Total Withdrawals	65,449 1.6%	67,085 1.6%	68,427 1.6%	69,522 1.6%	70,412 1.6%	71,223 1.6%
Total Mining Use[5] Percent of Total Withdrawals	274,434 6.8%	278,996 6.6%	282,708 6.5%	284,965 6.5%	283,764 6.4%	277,566 6.3%
Total Agriculture Withdrawals[6] Percent of Total Withdrawals	3,119,914 77.2%	3,167,378 74.5%	3,115,872 71.8%	3,052,038 69.5%	2,976,780 67.6%	2,901,522 66.1%
Total Water Withdrawals (Use)	4,041,385	4,250,474	4,339,289	4,392,604	4,404,012	4,391,150

Notes: "Water Withdrawal" and "Water Use" are equivalent terms, but are not the same as consumptive use; they do not account for return flows. Figures for total State of Nevada are based on an aggregation of individual county water withdrawal estimates and forecasts. Water withdrawal forecasts are based on the existing levels of conservation.

[1] Total Domestic Withdrawals includes the total residential use, both indoors and outdoors (i.e., residential landscaping).

[2] Includes both public and self-supplied withdrawals.

[3] Public Use and Losses is forecasted as a percent of total M&I water use based on historical trends.

[4] Thermoelectric Withdrawals includes water used for geothermal power plants and cooling water for conventional plants.

[5] Total Mining Withdrawals includes both consumptive and non-consumptive uses (i.e., mining dewatering).

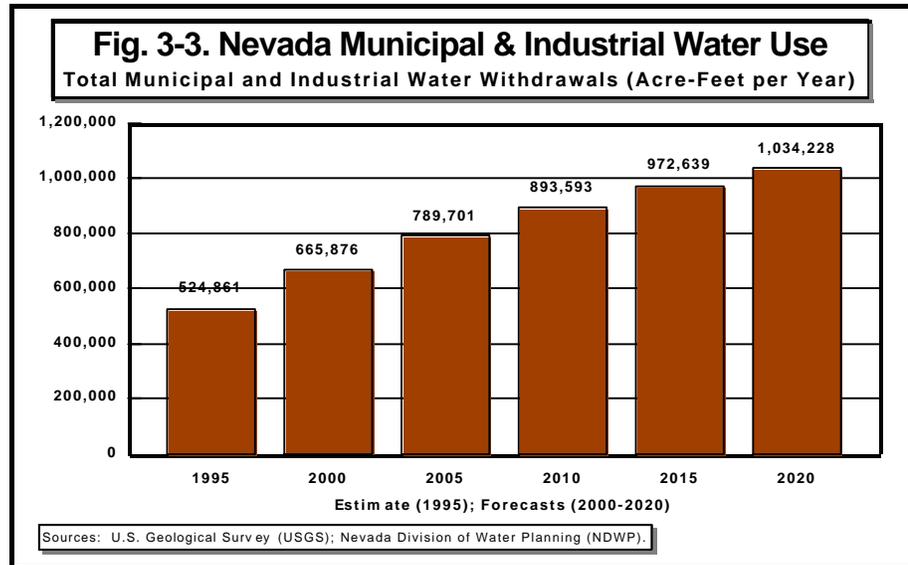
[6] Total Agriculture Withdrawals include both irrigation and livestock water use.

Source Data: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP); Irrigated acreage and 1995 irrigation water withdrawals based on USGS estimates modified by NDWP; Forecasts through 2020 based on 1995 water usage rates and NDWP forecasts of population, employment, general business conditions and estimated irrigated acreage.

Table 3–1 shows that domestic water withdrawals are expected to increase their share of statewide total water withdrawals from 8.9 percent to 16.0 percent, rising from an estimated 360,710 acre-feet in 1995 to a forecasted 701,338 acre-feet by 2020. Commercial and industrial water withdrawals are expected to rise from 4.3 percent of statewide total withdrawals in 1995 to 7.9 percent from an estimated 172,407 acre-feet in 1995 to 344,919 acre-feet by the year 2020. Public use and losses, which are forecasted by this methodology as a constant percent of total municipal and industrial withdrawals, increases from 1.2 percent of total water withdrawals in 1995 to 2.2 percent by 2020.

Thermoelectric water withdrawals, which are based primarily on continued growth in population and industry in the state, are expected to remain essentially constant at 1.6 percent of statewide total

water withdrawals. Mining water withdrawals are projected to show a slight decline in both the amount of water withdrawn between 1995 and 2020 and the share of statewide water withdrawals from 6.8 percent in 1995 to 6.4 percent by 2020. The most dramatic declines in shares of water withdrawals are expected in agriculture and



specifically, irrigation water withdrawals. Agriculture’s share of statewide total water withdrawals is expected to decline from an estimated 77.2 percent in 1995 to 66.4 percent in 2020. This decline is based on an assumption of relatively stable to modest declines in the levels of irrigated acreage in Nevada’s rural counties and the continued conversion of irrigated farmlands into urban lands and residential tracts in more urbanized counties. Fig 3-2 shows the various changes in water withdrawal shares by specific water use over the forecast horizon of 1995 to 2020.

Municipal & Industrial Water Withdrawal Forecasts

Table 3–2. Municipal & Industrial (M&I) Water Withdrawal Estimates and Forecasts, presents the statewide 1995 estimated and 2000 to 2020 forecasted municipal and industrial (M&I) water withdrawals for Nevada. M&I water use consists of withdrawals from public supply water systems for domestic, commercial and industrial and thermoelectric uses. In effect, it represents total withdrawals from public supply water systems, excluding public use and losses, which are presented separately. Table 3–2 presents the population growth assumptions and water use factors used in developing the statewide forecasts for M&I water use. The table also presents an estimate of consumptive use. These figures were developed by aggregating the individual county forecasts as presented in Appendix 3 of the Appendices. The key components to this forecast methodology are: (1) estimates and forecasts of the resident population (see Appendix 2 of the Appendices); (2) estimates and forecasts of the resident population on public supply water systems (see Appendix 3 of the Appendices); and (3) estimates of the municipal and industrial water use factor (in gallons per person per day). All water withdrawal factors used in these forecasts for each individual county are presented in Appendix 3 of the Appendices. See Fig. 3–3 for estimates and forecasts of M&I water withdrawals for the years 1995 through 2020.

Municipal and industrial water withdrawal forecasts are based on the resident population utilizing a public supply water system multiplied by a water use factor which is determined from historical conditions and trends. The water use factor for M&I water use for 1995 was based on the trends for

that year and therefore represents the level of M&I water use conservation at that time. Further, throughout the forecast, the M&I water use factor is not fixed, but rather varies over time as the proportion of the resident population on public supply water systems changes (see Table 3–2, line “Percent Population on Public Supply”). Table 3–2 shows the variation in the M&I water use factor over time (“Municipal & Industrial Use Factor”), that is, from 315.0 gallons per person per day in 1995 to 317.6 gallons per person per day by 2020, reflecting the assumption that an increasing proportion of Nevada’s total population will be provided water by a public supply water system.

Table 3–2. Municipal & Industrial (M&I) Water Withdrawals
Estimates and Forecasts of Total Public Supply Water Withdrawals
(Water withdrawals in acre-feet per year; Use factors in gallons per person per day)

Total Nevada	1995	2000	2005	2010	2015	2020
Resident Population (persons)[1]	1,579,150	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Percent Population on Public Supply[2]	94.2%	94.6%	94.8%	95.0%	95.2%	95.4%
Population on Public Supply[3]	1,487,636	1,878,477	2,221,592	2,510,991	2,733,001	2,906,882
Population Self Supplied	91,514	107,780	119,783	129,315	135,978	139,964
Municipal & Industrial (M&I) Factor[4]	315.0	316.5	317.3	317.7	317.7	317.6
Municipal & Industrial Withdrawals[4]	524,861	665,876	789,701	893,593	972,639	1,034,228
Percent of Total Water Withdrawals	13.0%	15.7%	18.2%	20.3%	22.1%	23.6%
M&I Consumptive Use[5]	196,444	249,223	295,568	334,452	364,037	387,089
Public Use and Losses[6]	48,472	61,195	72,313	81,707	88,930	94,582
As a Percent of Total M&I Use[6]	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%
Percent of Total Water Withdrawals	1.2%	1.4%	1.7%	1.9%	2.0%	2.2%

Notes: One acre-foot equals approximately 325,851 gallons. Water withdrawals and water use are equivalent terms, but are not the same as consumptive use as they do not account for return flows. Nevada figures represent an aggregation of individual county estimates and forecasts. As aggregated into the total Nevada figures, population forecasts for Clark County are based on population forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County are based on population forecasts adopted by the Washoe County Department of Community Development. Water withdrawal forecasts are based on the existing levels of conservation.

[1] 1995 population estimate developed by the Nevada State Demographer; population forecasts for 2000–2020 were developed by the Nevada Division of Water Planning (NDWP).

[2] Percent of population on public supply water systems for 1995 is based on USGS estimates; changes to this percent over the forecast horizon are estimated by NDWP.

[3] Total Nevada figure based on aggregation of individual county totals.

[4] Total M&I water use includes all public supplied water for domestic, commercial, industrial and thermoelectric uses; includes effects of a variable population on public supply water systems.

[5] M&I consumptive water use estimated from a fixed 37.4 percent of total M&I estimated and forecasted water withdrawals. The consumptive use factors are presented for all water use categories in Table 3.8.

[6] Public Use and Losses based on a fixed percent of total M&I water withdrawals for each county. The Nevada figure is based on the aggregation of the county totals and while shown here as a fixed 9.2 percent of M&I withdrawals, this figure actually varies slightly over the forecast horizon based on individual county growth patterns.

Source Data: Nevada State Demographer; U.S. Geological Survey (USGS); Nevada Division of Water Planning (NDWP).

The public supply domestic water use factor was assumed to be higher than the usage rate for self supplied domestic water users. As a result, as the proportion of the population receiving its waters from public supply water systems increases the water usage rate will tend to raise as well. This

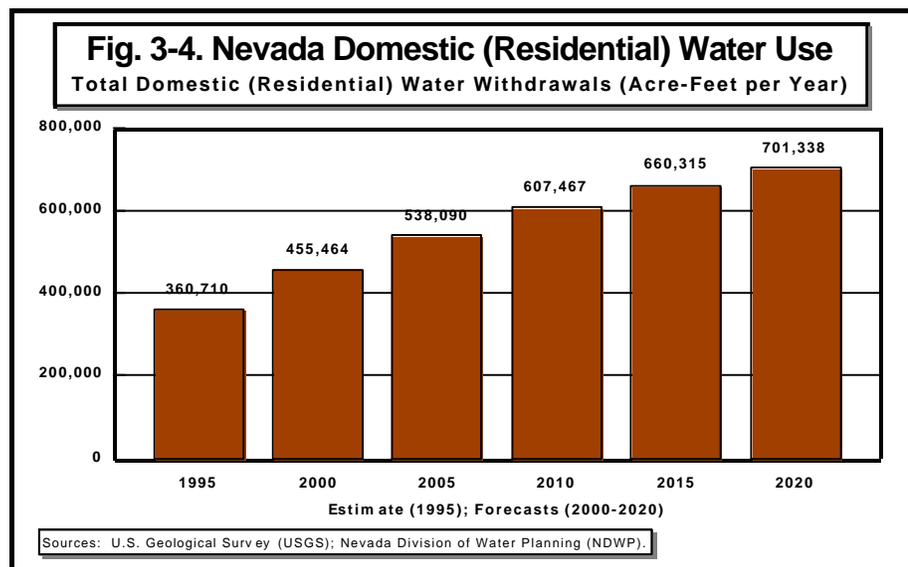
approach also assumes that other principal M&I uses, i.e., commercial and industrial, have constant usage rates in gallons per worker per day. Based on both increasing population and commercial development, water use forecasts call for total M&I water withdrawals to increase from an estimated 524,861 acre-feet in 1995 to 1,034,228 acre-feet by the year 2020, a total increase of over 97 percent. This corresponds to an average annual increase of 2.8 percent per year over the state water plan’s forecast horizon.

Domestic (Residential) Water Withdrawal Forecasts

Domestic water withdrawal forecasts were based on both population and usage rates as determined from historical trends. Table 3–3. Domestic Water Withdrawal Forecasts, presents domestic (residential) water withdrawal forecasts for both domestic public supply and self-supplied water withdrawals. The key components to the domestic water forecast methodology are: (1) estimates and forecasts of the total resident populations (see Appendix 2 of the Appendices); (2) estimates and forecasts of the resident population on public supply water systems (see Appendix 3 of the Appendices); (3) estimates and forecasts of the population on self-supplied water systems; and (4) estimates of specific water use factors for total domestic water use (using the entire population), public supplied domestic water use (using public supply population only), and self-supplied domestic water use (using only the self-supplied population).

The forecasts for domestic water withdrawals presented in Table 3–3 and in Fig. 3–4 assume that a varying proportion of the total population is on public supply water systems. Varying the percent of the population on public water systems over time is believed to represent a more realistic estimate of future water use conditions. This assumption is also supported by historic trends, which have more typically shown such variations. These changes to the proportion of the population on public supply systems were estimated individually for each county based on NDWP estimates of future growth characteristics. All forecast changes are presented in Appendix 3 of the Appendices.

Based on the forecasts presented in Table 3–3, total domestic water withdrawals are forecasted to rise from an estimated 360,710 acre-feet in 1995 to an estimated 701,338 acre-feet by the year 2020. This represents a total increase of 94 percent and an average annual increase of 2.7 percent per year. It is also estimated that the



percent of the population on public supply water systems would increase over this forecast period. This results in the total domestic water use factor rising slightly over time (from 203.9 gallons per person per day in 1995 to 205.5 gallons per person per day by 2020).

Table 3–3. Domestic (Residential) Water Withdrawal Forecasts
Based on Variable Percent of Population on Public Supply Water Systems
(Water withdrawals in acre-feet per year; Use factors in gallons per person per day)

Total Nevada	1995	2000	2005	2010	2015	2020
Resident Population (persons)[1]	1,579,150	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Percent Population on Public Supply[2]	94.2%	94.6%	94.8%	95.0%	95.2%	95.4%
Population on Public Supply[3]	1,487,636	1,878,477	2,221,592	2,510,991	2,733,001	2,906,882
Population being Self Supplied	91,514	107,780	119,783	129,315	135,978	139,964
Variable Domestic Use Factor[4]	203.9	204.7	205.2	205.4	205.5	205.5
Public Supply Use Factor	205.6	206.3	206.7	206.8	206.9	206.9
Self-Supplied Use Factor	176.6	177.3	177.5	177.5	177.4	177.2
Total Domestic Water Withdrawals[4]	360,710	455,464	538,090	607,467	660,315	701,338
Percent of Total Water Withdrawals	8.9%	10.7%	12.4%	13.8%	15.0%	16.0%
Public Supply Domestic Water Use	342,605	434,063	514,277	581,756	633,300	673,563
Self-Supplied Domestic Water Use	18,105	21,401	23,813	25,711	27,016	27,775
Total Domestic Consumptive Use[5]	180,037	227,331	268,571	303,198	329,575	350,051

Notes: One acre-foot equals approximately 325,851 gallons. Water withdrawals and water use are equivalent terms, but are not the same as consumptive use as they do not account for return flows. Nevada figures represent an aggregation of individual county estimates and forecasts. As aggregated into the total Nevada figures, population forecasts for Clark County are based on population forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County are based on population forecasts adopted by the Washoe County Department of Community Development. Water withdrawal forecasts are based on the existing levels of conservation.

[1] 1995 population estimate developed by the Nevada State Demographer; population forecasts for 2000–2020 were developed by the NDWP in conjunction with Clark and Washoe counties.

[2] Percent of population on public supply water systems for 1995 is based on USGS estimates; changes to this percent over the forecast horizon are estimated by NDWP.

[3] Total Nevada figure based on aggregation of individual county totals.

[4] Variable Total Domestic Use Factor represents change in population on public supply water systems for each county and was developed from the aggregation of individual county forecasts.

[5] Domestic consumptive water use based on a fixed 49.9 percent of total domestic estimated and forecasted water withdrawals. The consumptive use factors are presented for all water use categories in Table 3–8.

Source Data: Nevada State Demographer; Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP).

Domestic water withdrawals for public supply water users are expected to increase from 342,605 acre-feet per year in 1995 to 673,563 acre-feet by 2020, an overall increase of 97 percent or 2.7 percent per year. Water withdrawals made by self-supplied domestic water users are expected to increase from 18,105 acre-feet in 1995 to 27,775 acre-feet by 2020, an overall increase of 53 percent or 1.7 percent per year.

Commercial and Industrial Water Withdrawal Forecasts

Commercial and industrial water use forecasts are presented in Table 3–4. Commercial and Industrial Water Withdrawal Forecasts. These forecasts are based on the forecasted number of employees multiplied by a water use factor measured in gallons per worker per day for each county and then aggregated to a statewide total. However, the employment figures used for each county were adjusted to remove mining workers, as water use by these workers (and the mining industry) are presented separately.

Table 3–4. Commercial and Industrial Water Withdrawal Forecasts Based on Total Employment less the Estimated and Forecasted Number of Mining Workers (Water withdrawal in acre-feet per year; Use factor in gallons per employee per day)

Total Nevada	1995	2000	2005	2010	2015	2020
Resident Population (persons)[1]	1,579,150	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Employment-Population Ratio	49.7%	49.7%	49.7%	49.6%	49.6%	49.6%
Total Employment (workers)	784,486	987,950	1,162,764	1,310,176	1,423,256	1,511,617
Employment less Mining Workers	771,299	973,251	1,148,331	1,295,999	1,409,685	1,499,030
Commercial/Industrial Use Factor[2]	199.6	202.1	203.6	204.5	205.1	205.4
Commercial/Industrial Withdrawals[2]	172,407	220,355	261,880	296,905	323,811	344,919
Percent of Total Water Withdrawals	4.3%	5.2%	6.0%	6.8%	7.4%	7.9%
Comm./Industrial Consumptive Use[3]	31,950	40,836	48,531	55,022	60,008	63,920

Notes: One acre-foot equals approximately 325,851 gallons. Water use and water withdrawals are equivalent terms, but are not the same as consumptive use as they do not account for return flows. As aggregated into the total Nevada figures, population forecasts for Clark County are based on population forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County are based on population forecasts adopted by the Department of Community Development. Water withdrawal forecasts are based on the existing levels of conservation.

[1] 1995 population estimate developed by the Nevada State Demographer; population forecasts for 2000–2020 developed by the Nevada Division of Water Planning (NDWP) in conjunction with Clark and Washoe counties.

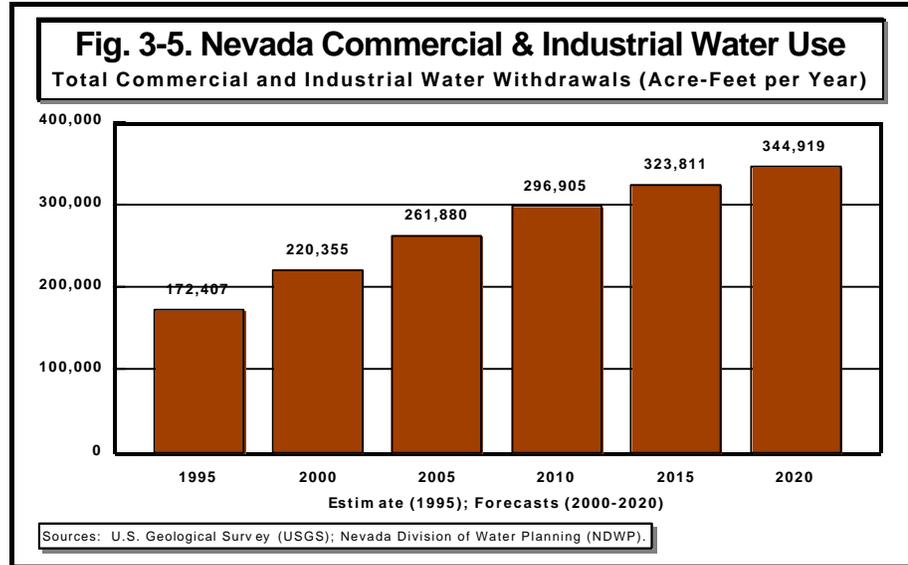
[2] Excludes water used in mining operations and by mining workers; mining water use is calculated separately.

[3] Commercial and Industrial consumptive water use is based on fixed 18.5 percent of commercial and industrial estimated and forecasted water withdrawals. The consumptive use factors are presented for all water use categories in Table 3.8.

Source Data: Nevada State Demographer; Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP).

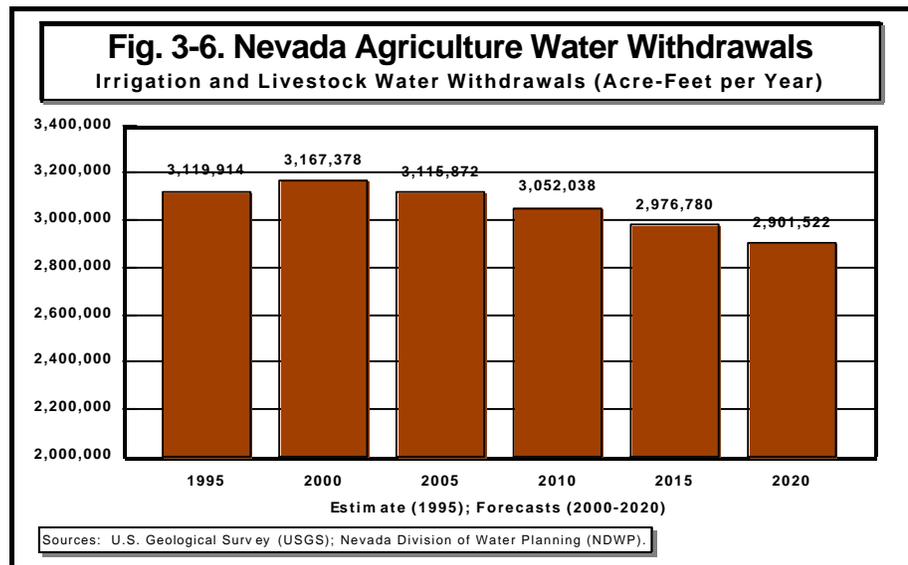
The employment forecasts for each county were determined from historical trends in that county’s employment-to-population ratio. Individual county information showing population forecasts, forecasts of each county’s employment-to-population ratio, total employment and mining employment

forecasts are presented in Appendix 3 of the Appendices. Based on these individual county forecasts, statewide total commercial and industrial water use is expected to increase from an estimated 172,407 acre-feet in 1995 to 338,881 acre-feet by 2020 (see Fig. 3-5), corresponding to an overall increase of 96.6 percent and an average annual increase of 2.7 percent per year.



Agricultural Water Withdrawal Forecasts

Agricultural water withdrawal forecasts for Nevada were developed using forecasts of county irrigated acreage multiplied by a county-unique irrigated acreage water use factor, measured in acre-feet per acre per year. The forecasts for irrigated acreage were presented in Part 2, Section 2, Socioeconomic Assessment and Forecasts and are also presented for each county in Appendix 4 of the Appendices. The forecasts of irrigated acreage were made for each county using a non-linear “curve-fitting” estimation process and extrapolation out to the year 2020. The water use factor represents an average water requirement derived from 1995 data which is unique to each county and which is assumed to be applicable to all irrigated lands in that county. The individual irrigation water use factors were not varied over the forecast period. Using a constant irrigation factor is reasonable given that each irrigator’s water use permit or certificate specifies a fixed application quantity or rate. It also implies that there will be no significant changes in the nature of the crops being grown or the number of croppings per year. Forecasted figures of



irrigated acreage were multiplied by the county-unique irrigated acreage water use factor.

Livestock water withdrawals were estimated from forecasted irrigation water withdrawals based on the historical trends of the ratio of livestock water use to total irrigation water use. Table 3–5. Nevada Agricultural Water Withdrawal Forecasts, presents forecasts of Nevada’s irrigated acreage, irrigation water withdrawals, the irrigated acreage water use factor, livestock water withdrawals, livestock/irrigation water use factor, and total agricultural water withdrawals (irrigation and livestock combined) for 5-year intervals between 1995 through 2020. These figures represent an aggregation of individual county forecasts which are presented in Appendix 4 of the Appendices along with a statewide average irrigation water requirement.

**Table 3–5. Nevada Agricultural Water Withdrawal Forecasts
Irrigated Acreage (Acres), Water Requirement (Acre-Feet per Acre per Year), and Irrigation
and Livestock Water Use (Acre-Feet) — 1995–2020 (Acres and Acre-Feet per Year)**

Total Nevada	1995	2000	2005	2010	2015	2020
Total Irrigated Acreage	715,439	727,500	715,563	700,742	683,247	665,753
Irrigation Water Withdrawals	3,113,585	3,160,754	3,109,348	3,045,636	2,970,521	2,895,406
Percent of Agricultural Withdrawals	99.8%	99.8%	99.8%	99.8%	99.8%	99.8%
Irrigation Water Requirement	4.4	4.3	4.3	4.3	4.3	4.3
Irrigation Consumptive Use†	1,612,079	1,636,501	1,609,885	1,576,898	1,538,007	1,499,115
Livestock Water Withdrawals	6,329	6,624	6,524	6,402	6,259	6,116
Percent of Agricultural Withdrawals	0.20%	0.21%	0.21%	0.21%	0.21%	0.21%
As a Percent of Irrigation Use	0.203%	0.210%	0.210%	0.210%	0.211%	0.211%
Livestock Consumptive Use†	2,319	2,427	2,390	2,346	2,293	2,241
Total Agricultural Water Use	3,119,914	3,167,378	3,115,872	3,052,038	2,976,780	2,901,522
Percent of Total Water Withdrawals	77.2%	74.5%	72.0%	70.0%	67.9%	66.4%
Agricultural Consumptive Use	1,614,398	1,638,928	1,612,275	1,579,244	1,540,300	1,501,356

Notes: One acre-foot equals approximately 325,851 gallons. Water use and water withdrawals are equivalent terms, but are not the same as consumptive use as they do not account for return flows. 1995 irrigation figures based on U.S. Geological Survey (USGS) estimates, modified by the Nevada Division of Water Planning (NDWP). Forecasts through 2020 are based on 1995 usage rates and relationships and NDWP forecasted irrigated acreage amounts. Livestock water use as a percent of irrigation water use based on 1990 USGS studies. Nevada totals based on aggregation of individual county estimates and forecasts. Water withdrawal forecasts are based on the existing levels of conservation.

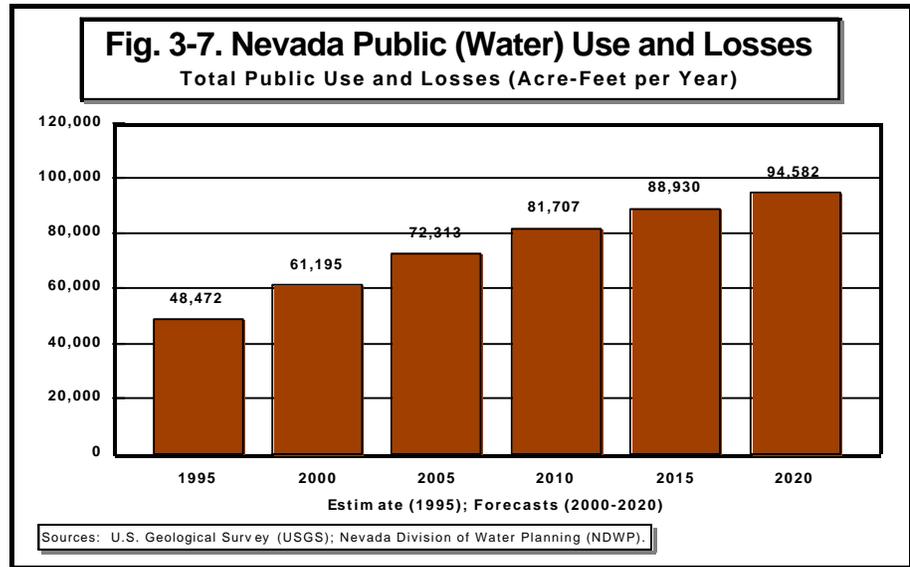
† Consumptive uses for both irrigation and livestock are estimated from a fixed percent of respective water withdrawals.

Source Data: 1995 irrigated acreage – USGS and NDWP; Irrigated acreage forecasts – NDWP; Irrigation water use factor (water duty) – USGS and NDWP; Livestock water use rates – USGS and NDWP.

Table 3–5 shows that Nevada’s total irrigated acreage is forecast to increase slightly from an estimated 715,440 acres in 1995 to 727,500 acres by the year 2000. Subsequently, irrigated acreage is forecast to decline through the year 2020 to 665,753 acres, representing a total period decline of 6.9 percent, or an average annual decline of 0.3 percent per year.

Based on an average water use coefficient of 4.3–4.4 acre-feet per acre per year (based on an aggregation of the individual county irrigation water use requirements), statewide total irrigation water withdrawals are expected to go from an estimated 3,113,585 acre-feet in 1995 to 2,895,406 acre-feet by the year 2020, representing a total

decline of 7.0 percent and an average annual decline of 0.3 percent per year. Livestock water withdrawals are expected to decline from 6,313 acre-feet in 1995 to 6,116 acre-feet in the year 2020. Thus, total agricultural water withdrawals are expected to decline from 3,119,914 acre-feet in 1995 to 2,901,522 acre-feet by the year 2020, representing a total decline in this sector’s water use of 218,392 acre-feet or 7.0 percent over the next 20 years.



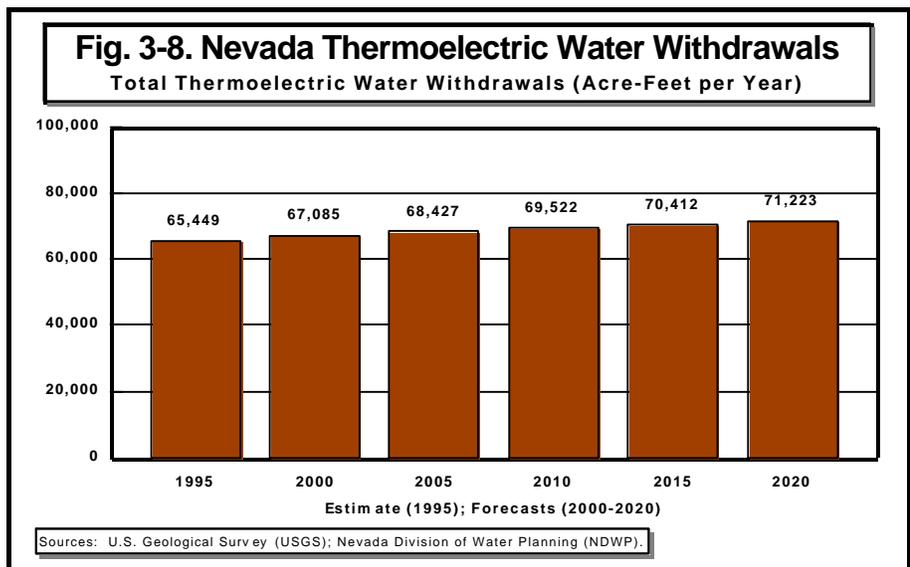
Public Use and Losses

Forecasts of public use and losses (see Fig. 3–7) were developed using the assumption that this water use category constituted essentially a fixed percent of total municipal and industrial (M&I) forecasted water withdrawals and are presented in Table 3–2 along with the M&I water withdrawal forecasts. The statewide total for this water use category was based on an aggregation of individual county estimates and forecasts.

The percentage figures for each individual county’s public use and loss water use ratio to total M&I water withdrawals were based on 1995 relationships.

Thermoelectric Water Withdrawals

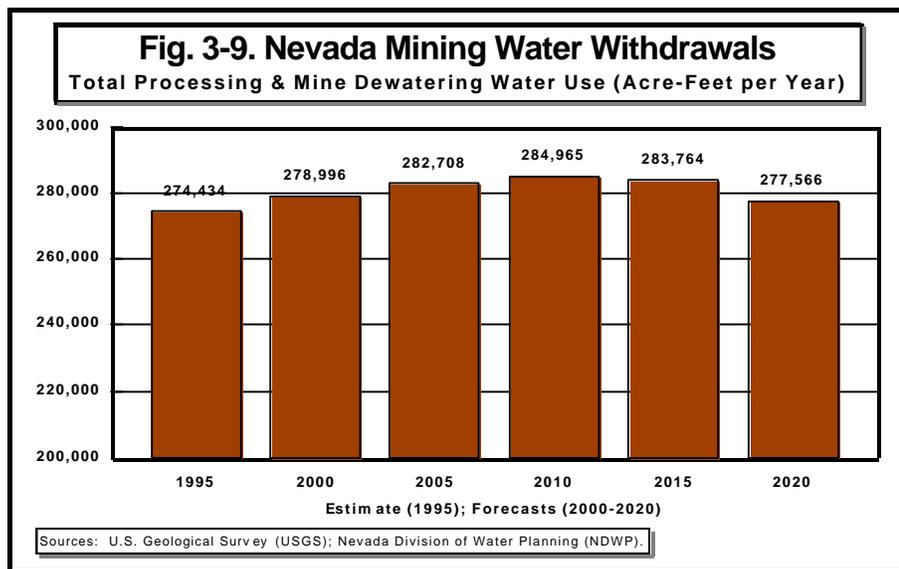
Forecasts for the statewide total thermoelectric water



withdrawals (see Fig. 3–8) were based on an aggregation of individual county estimates and forecasts. County forecasts were made based on historical trends in this water withdrawal category and general forecasts of populations and commercial and industrial activities, particularly including anticipated future mining production served by these electrical power systems.

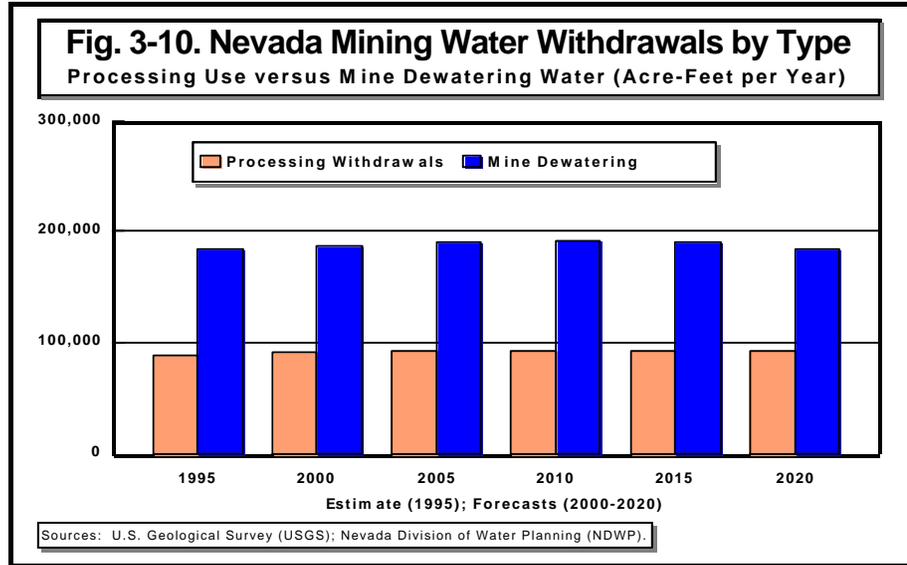
Mining Water Withdrawal Assumptions and Forecasts

Water withdrawal forecasts for Nevada’s mining industry are based on the expected trends in the state’s gold mining industry, which constitutes the majority of this economic sector’s production, employment and water withdrawals. Water withdrawal estimates for the mining industry for 1995 showed a total of 274,434 acre-feet of water withdrawals, of which mine dewatering activities, mostly in support of open-pit gold mining, accounted for over two-thirds. In addition, gold mining processing operations, consisting primarily of washing, scrubbing and leaching, accounted for a significant portion of the mines’ processing (consumptive) water withdrawals. Based on conditions and assumptions presented below, the forecasts for mining water withdrawals are presented in Table 3–6. Nevada Forecasted Mining Water Withdrawals. Fig. 3–9 shows total forecasted mining withdrawals, to include both consumptive (processing) use and non-consumptive (mining dewatering) withdrawals.



With respect to the state of the gold mining industry, several key factors and critical assumptions come into play. First, future gold mining activity in Nevada, and thus future water use, are critically dependent on the price of gold which determines the level of economically-recoverable gold reserves. As gold’s market price declines, irrespective of the use of futures contracts to “lock in” on an economically viable price, available reserves which are economically feasible for recovery also decline. Conversely, as the price of gold increases, more marginal ore bodies now become economically attractive based on production costs of recovery. Also, the gold industry has become far more

resilient in its ability to adjust its cost structure to current gold prices. Therefore, falling prices do not necessarily spell an end to gold mining, as the industry rapidly adjusts to the mining of available higher grade ore, thereby lowering the mines’ overall cost structure. Consequently, while exploration and future investment may wane with falling gold prices, reasonable production levels are likely to be maintained.



In 1997, Nevada’s gold mining industry produced over 7 million ounces of gold at an average market price of around \$330 per ounce. At an estimated “recovery” price of between \$280 and \$350 per (troy) ounce, which is the long-term market price anticipated by the industry for gold once the economic and financial fundamentals become better stabilized, there currently exists estimated recoverable reserves in Nevada of just over 95 million ounces. This indicates an estimated economic life of this industry of 12–15 years at current production levels. However, historically, estimated recoverable reserves have been periodically bolstered by new discoveries as existing ore bodies and proven reserves near depletion. Therefore, as an over-riding assumption in mining water use forecasts, it is assumed that with continued exploration some level of economically profitable gold mining in Nevada will continue throughout the forecast horizon.

Table 3–6. Nevada Forecasted Mining Water Withdrawals
Estimated (1995) and Forecasted (2000–2020) Water Use (Acre-Feet/Year)

Total Nevada	1995	2000	2005	2010	2015	2020
Total Mining Water Withdrawals[1]	274,434	278,996	282,708	284,965	283,764	277,566
Percent of Total Water Withdrawals	6.8%	6.6%	6.5%	6.5%	6.4%	6.3%
Mine Processing (consumptive use)	89,164	90,947	92,402	93,289	93,469	92,751
Percent of Total Mining Water Use	32.5%	32.6%	32.7%	32.7%	32.9%	33.4%
Mine Dewatering (non-consumptive)	185,270	188,049	190,306	191,676	190,296	184,815
Percent of Total Mining Water Use	67.5%	67.4%	67.3%	67.3%	67.1%	66.6%

Notes: "Water Use" and "Water Withdrawals" are equivalent terms, but are not the same as consumptive use; do not account for return flows. Water withdrawal forecasts are based on the existing levels of conservation.

[1] Total Mining Use includes both consumptive (processing) and non-consumptive uses (i.e., mining dewatering).

Source Data: U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP); Forecasts through 2020 based on 1995 mining processing and dewatering usage rates and NDWP assumptions of mineral (gold) prices, economically-recoverable

reserves, type of production activities and general market conditions.

Other important mining issues are the nature of production and how changes in production techniques will modify both consumptive water use and mining dewatering. Whether the industry follows current production trends towards more underground mining of higher-grade ore, or continues its present emphasis on open-pit mining of lower-grade ore is, to a degree, dependent on gold's market price and will affect the amount of water use. Currently, the industry does not expect a significant alteration in dewatering levels even if more mining operations move below ground; dewatering of adjacent or nearby open pits is usually sufficient to also dewater mine shafts in the near vicinity of the pit. In addition, there is a general belief within the industry that underground mining may not necessitate the same level of either processing water use (due to higher grade ores and difference processing needs), or require mining dewatering as in the past. However, some degree of mine dewatering is expected to continue irrespective of the type of production activity. Based on these assumptions, in general agreement with mining association production estimates, forecasts for both mine productive water use and mining dewatering are anticipated to grow only slightly over the near-term and then begin to decline moderately after the year 2010 (see Fig. 3–10).

Total Water Use Forecasts

Table 3–7. Nevada Estimated and Forecasted Water Use by Sector, presents the entire set of water withdrawal forecasts by category for Nevada. The table shows water withdrawal estimates for 1995 and forecasts at five-year intervals out to 2020. These forecasts for the total state are based on the aggregation of county figures as presented in Appendix 5 of the Appendices. All forecasts are based on existing conservation measures and do not account for significant changes in water use patterns. From these projections, statewide total water withdrawals are expected to begin to level off between 2010 and 2015 and then begin to decline. While M&I, domestic and commercial and industrial water withdrawals are expected to continue to grow based on increasing population, employment, commercial and industrial expansion, the sectors of irrigation and mine dewatering are expected to show a decline in water withdrawals.

Based on these projections, Nevada's total water withdrawals for all sectors and categories is expected to increase from 1995's estimated 4,041,385 acre-feet of total water withdrawals to approximately 4,391,000 acre-feet of annual water withdrawals by the year 2020, an increase of nearly 350,000 acre-feet, or 8.6 percent. The state's total municipal and industrial water withdrawals are expected to grow by 509,000 acre-feet from 524,861 acre-feet in 1995 to approximately 1,034,000 acre-feet by 2020, an increase of 97 percent. However, it is expected that much of this increase will be offset by decreased agricultural water withdrawals, especially irrigation water withdrawals. Annual water use for irrigation is expected to decline by 218,179 acre-feet, or 7.0 percent, from an estimated 3,113,585 acre-feet in 1995 to a forecasted 2,895,000 acre-feet by 2020.

Total domestic (residential) water withdrawals are expected to increase by over 340,000 acre-feet, or 94 percent by 2020, from an estimated 360,710 acre-feet of water withdrawals in 1995 to a forecasted 701,000 acre-feet by the year 2020. Domestic public supply water withdrawals are

expected to increase by 331,000 acre-feet, or nearly 97 percent, from an estimated 342,605 acre-feet in 1995 to a forecasted 674,000 acre-feet by 2020. Self-supplied domestic water withdrawals are forecasted to increase by 9,700 acre-feet, or 53 percent from an estimated 18,105 acre-feet in 1995 to nearly 28,000 acre-feet by 2020. Commercial and industrial water withdrawals are expected to increase by 172,500 acre-feet, or 100 percent by 2020, from an estimated 172,407 acre-feet in 1995 to a forecasted 345,000 acre-feet of water withdrawals by the year 2020.

**Table 3–7. Nevada Estimated and Forecasted Water Withdrawals
Estimated (1995) and Forecasted (2000–2020) Water Use by Use Type (Acre-Foot/Year)**

Total Nevada	1995	2000	2005	2010	2015	2020
Total Domestic (Residential) Use[1]	360,710	455,464	538,090	607,467	660,315	701,338
Domestic–Public Supplied[2]	342,605	434,063	514,277	581,756	633,300	673,563
Domestic–Self Supplied	18,105	21,401	23,813	25,711	27,016	27,775
Commercial and Industrial Use	172,407	220,355	261,880	296,905	323,811	344,919
Public Use and Losses[3]	48,472	61,195	72,313	81,707	88,930	94,582
Thermoelectric Use[4]	65,449	67,085	68,427	69,522	70,412	71,223
Total Mining Use[5]	274,434	278,996	282,708	284,965	283,764	277,566
Mine Processing (consumptive)	89,164	90,947	92,402	93,289	93,469	92,751
Mine Dewatering (non-consumptive)	185,270	188,049	190,306	191,676	190,296	184,815
Total Agriculture Withdrawals[6]	3,119,914	3,167,378	3,115,872	3,052,038	2,976,780	2,901,522
Irrigation Water Withdrawals	3,113,585	3,160,754	3,109,348	3,045,636	2,970,521	2,895,406
Livestock Water Use	6,329	6,624	6,524	6,402	6,259	6,116
Total Water Withdrawals (Use)	4,041,385	4,250,474	4,339,289	4,392,604	4,404,012	4,391,150

Notes: One acre-foot equals approximately 325,851 gallons. Water withdrawals and water use are equivalent terms, but are not the same as consumptive use as they do not account for return flows. Water withdrawal forecasts are based on the existing levels of conservation.

[1] Total Domestic Withdrawals equals the total residential use, both indoors and outdoors (i.e., residential landscaping).

[2] Domestic Public Supplied Water Withdrawals is residential use of water supplied by public supply water systems.

[3] Public Use and Losses are estimated at a fixed percent of total M&I based on historical trends.

[4] Thermoelectric Withdrawals includes water used for geothermal power plants and cooling water for conventional plants.

[5] Total Mining Withdrawals includes both consumptive and non-consumptive uses (i.e., mining dewatering).

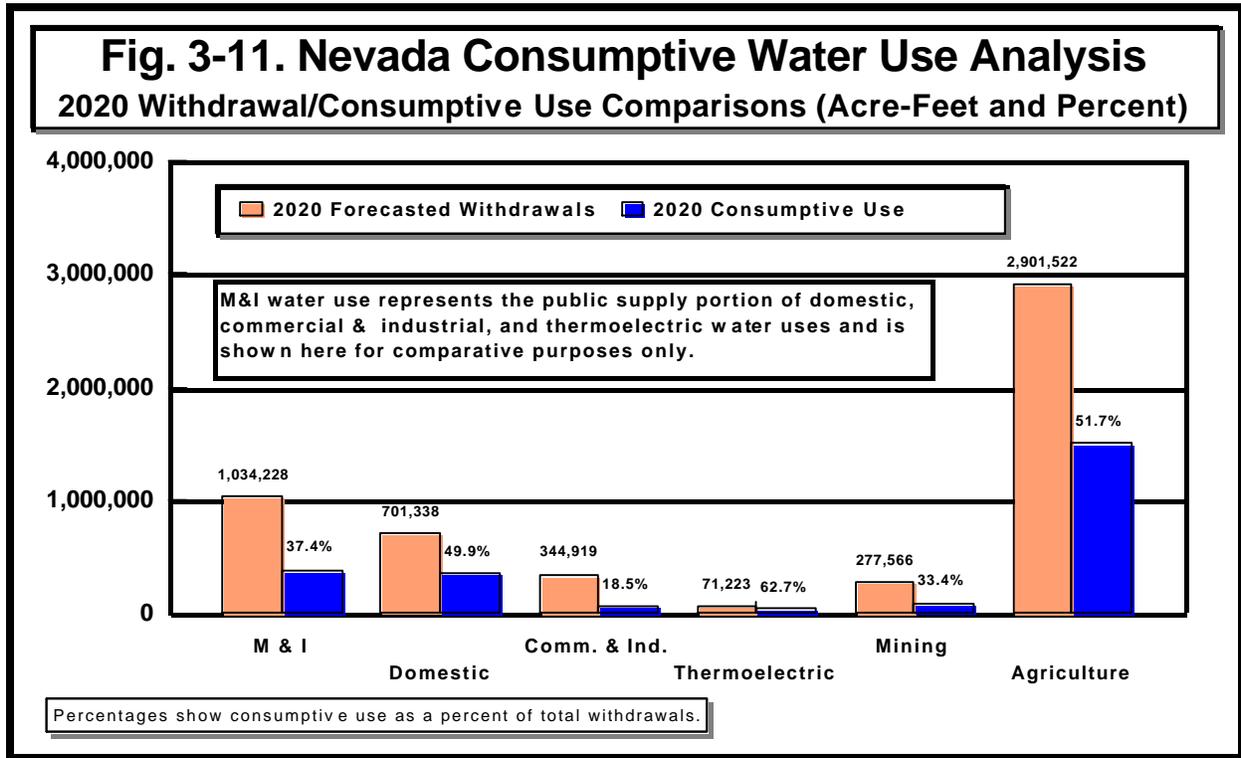
[6] Total Agriculture Withdrawals includes both irrigation and livestock water withdrawals.

Source Data: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP).

Based on patterns in forecasted total irrigated acreage determined from individual county forecasts, total agricultural water withdrawals, including both irrigation and livestock water withdrawals, are forecasted to peak around the year 2000 at approximately at 3.167 million acre-feet and then decline by some 266,000 acre-feet, or 8.4 percent, to 2.902 million acre-feet by the year 2020. This decline is based solely on forecasted trends in irrigated acreage. Total mining water withdrawals are expected to peak around the year 2010 at nearly 285,000 acre-feet, an increase of 10,500 acre-feet, or 3.8 percent from 1995's estimated mining water withdrawals.

As more of Nevada gold mining goes underground, total mining water withdrawals are expected to

decline to approximately 277,600 acre-feet by 2020, a decline of 7,400 acre-feet, or 2.6 percent from water withdrawals forecasted for 2010. Most of this decline occurs in mine dewatering as mining operations and mine processing water withdrawals are expected to decline only modestly after the year 2010. Thermoelectric water withdrawals continue to increase throughout the forecast period based on rising population, continued mining activity, and other electrical energy demands. Total thermoelectric water withdrawals are expected to increase by 5,800 acre-feet, or 8.8 percent between



1995 and 2020.

Consumptive Use Forecasts

Table 3–8. Nevada Consumptive Use Forecast Summary presents estimates of consumptive water use by principal use category based on total water withdrawals for these same categories. The forecasts in this table were based on historical relationships between water withdrawals and respective consumptive use patterns. The total consumptive use figure, representing the summation of all categories, is expected to decrease from 48.4 percent of total water withdrawals to 46.8 percent as water use patterns change across the various water use categories primarily from agriculture (with a consumptive use estimated at 51.7 percent including both irrigation and livestock consumptive uses) to municipal and industrial which has an average consumptive use estimated at 37.4 percent, i.e., a 63 percent return flow. Fig. 3–11 shows the statewide total forecasted water withdrawals by use category for the year 2020 and that portion of each water withdrawal which is expected to be consumptively used.

Table 3–8. Nevada Consumptive Use Forecast Summary
Estimated (1995) and Forecasted (2000–2020) Consumptive Use by Use Type (Acre-Foot/Year)

Total Nevada	1995	2000	2005	2010	2015	2020
Domestic (Residential) Withdrawals[1]	360,710	455,464	538,090	607,467	660,315	701,338
Total Consumptive Use	180,037	227,331	268,571	303,198	329,575	350,051
Percent Consumptive Use	49.9%	49.9%	49.9%	49.9%	49.9%	49.9%
Commercial & Industrial Withdrawals	172,407	220,355	261,880	296,905	323,811	344,919
Total Consumptive Use	31,950	40,836	48,531	55,022	60,008	63,920
Percent Consumptive Use	18.5%	18.5%	18.5%	18.5%	18.5%	18.5%
Thermoelectric Withdrawals[2]	65,449	67,085	68,427	69,522	70,412	71,223
Total Consumptive Use	41,053	42,079	42,921	43,608	44,166	44,675
Percent Consumptive Use	62.7%	62.7%	62.7%	62.7%	62.7%	62.7%
Total Mining Use[3]	274,434	278,996	282,708	284,965	283,764	277,566
Total Consumptive Use	89,164	90,947	92,402	93,289	93,469	92,751
Percent Consumptive Use	32.5%	32.6%	32.7%	32.7%	32.9%	33.4%
Total Agriculture Withdrawals[4]	3,119,914	3,167,378	3,115,872	3,052,038	2,976,780	2,901,522
Total Consumptive Use	1,614,398	1,638,928	1,612,275	1,579,244	1,540,300	1,501,356
Percent Consumptive Use	51.7%	51.7%	51.7%	51.7%	51.7%	51.7%
Irrigation Water Withdrawals	3,113,585	3,160,754	3,109,348	3,045,636	2,970,521	2,895,406
Irrigation Consumptive Use	1,612,079	1,636,501	1,609,885	1,576,898	1,538,007	1,499,115
Percent Consumptive Use	51.8%	51.8%	51.8%	51.8%	51.8%	51.8%
Livestock Water Withdrawals	6,329	6,624	6,524	6,402	6,259	6,116
Livestock Consumptive Use	2,319	2,427	2,390	2,346	2,293	2,241
Percent Consumptive Use	36.6%	36.6%	36.6%	36.6%	36.6%	36.6%
Total Water Withdrawals (Use)	4,041,385	4,250,474	4,339,289	4,392,604	4,404,012	4,391,150
Total Consumptive Use	1,956,602	2,040,121	2,064,701	2,074,361	2,067,518	2,052,752
Percent Consumptive Use	48.4%	48.0%	47.6%	47.2%	46.9%	46.7%

Notes: "Water Withdrawal" and "Water Use" are equivalent terms, but are not the same as consumptive use; do not account for return flows. Estimates of consumptive use are based on estimates provided by the U.S. Geological Survey (USGS). Figures for the total State of Nevada are based on an aggregation of individual county estimates and forecasts of water withdrawals and consumptive use. Water withdrawal forecasts are based on the existing levels of conservation.

[1] Total Domestic Use equals the total residential use, both indoors and outdoors (i.e., residential landscaping).

[2] Thermoelectric Use includes water used for geothermal power plants and cooling water for conventional plants.

[3] Total Mining Use includes both consumptive and non consumptive uses (i.e., mining dewatering).

[4] Total Agriculture Withdrawals includes both irrigation and livestock water use.

Source Data: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR); U.S. Geological Survey (USGS); and Nevada Division of Water Planning (NDWP).

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