

Nevada State Water Plan

Nevada Division of Water Resources

Department of Conservation and Natural Resources

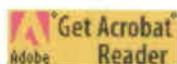
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The *Nevada State Water Plan* is published in five volumes including a summary, three parts of background information, water withdrawal forecasts and water-related issues, and a volume of supporting appendices. All contents of the water plan are presented in this Internet version essentially in the same format as the printed document. The exception to this is the appendices which are presented in their entirety, but in a more graphically interactive format. All data in the appendices is accessible electronically by an activated state map allowing direct access to individual state and county water and socioeconomic data and forecasts. The following is a listing of all volumes of the plan and a brief summary of each volume's contents. Click on each section's title to access the contents page for that volume of the water plan.

Viewing and Printing the Nevada State Water Plan

Most of the *Nevada State Water Plan* can only be viewed in "PDF" format, which requires Adobe Acrobat® Reader. If you do not already have this program on your computer, click the "Get Adobe Reader" icon below to download a free copy. The water plan's tables of contents, listings of tables and figures and introductions for each of the parts below do not require this program.



SUMMARY

Executive Summary, purpose and governing directive, water plan organization and contents, brief summary of water planning and management issues, with all of the recommendations, a glossary of terminology and a glossary of abbreviations and acronyms

PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Introduction, guidelines for the State Water Plan, the institutional framework for water planning and management in Nevada, water resources background, socioeconomic background, glossary of terminology (for Part 1), information on selected agencies and organizations, selected water-related decrees, agreements and operating criteria, and abbreviations and acronyms

PART 2 — WATER USE AND FORECASTS

Historic and current water use, socioeconomic assessment and forecasts, water use assessment and forecasts, meeting our future water supply needs, and a glossary of terminology (for Part 2)

PART 3 — WATER PLANNING AND MANAGEMENT ISSUES

Issue papers in the areas of water supply and allocation, water quality, resource conservation and recreational uses, flood management, and water planning and management, and a glossary of terminology (for Part 3)

APPENDICES

Water use data, analysis and the development of water use factors for the years 1985, 1990, 1995; population estimates, forecasts and analysis; Population and employment forecasts for municipal and industrial (M&I), domestic (residential) and commercial and industrial water withdrawals; forecasts of Nevada and county irrigated acreage; water withdrawal forecast summaries; and Nevada and county socioeconomic overviews

Should you have any questions or comments concerning the internet version of this water plan, or wish additional information in regards to the data used in this publication, or wish to order a printed copy of the water plan, please contact us at the address below.

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Nevada State Water Plan

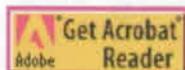
SUMMARY (with Executive Summary)

Nevada Division of Water Resources

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Nevada Division of Water Planning

Nevada State Water Plan

Executive Summary

Findings and Recommendations

Introduction

The *Nevada State Water Plan* is designed to guide the development, management and use of the state's water resources. It assesses the quantity and quality of our water resources, identifies constraints and opportunities which affect water resource decision making, and seeks to coordinate future actions to ensure that Nevadans obtain the greatest benefit from their water resources in the years to come. The first state water plan, *Water for Nevada*, was developed in the late 1960s and early 1970s. It identified a variety of issues and contained recommendations for improved water management, many which have now been implemented. Administration and management of the state's water resources has continued to evolve much to the benefit of the state's residents and the resources themselves.

Much has changed in the 25 years since that first plan was completed. Nevada's population has tripled, there is increased competition for our limited water resources, and new state and federal regulations have been enacted which impact local and state water management. An updated plan is needed to establish a comprehensive process for addressing our evolving water needs and addressing the challenges generated by growth in this, the driest of states.

Development of the *State Water Plan* is mandated by Nevada Revised Statute (NRS) 540. The *State Water Plan* was developed by the Nevada Division of Water Planning (NDWP) with the assistance of the 15-member Advisory Board for Water Resources Planning and Development (Board), the Department of Conservation and Natural Resources (DCNR) Steering Committee, local, state and federal agencies, and the public. This Executive Summary summarizes some key components of the *State Water Plan*. While the *Plan* contains a wealth of information, the following summary focuses only on water demand projections, and issues and recommendations.

Future Water Needs

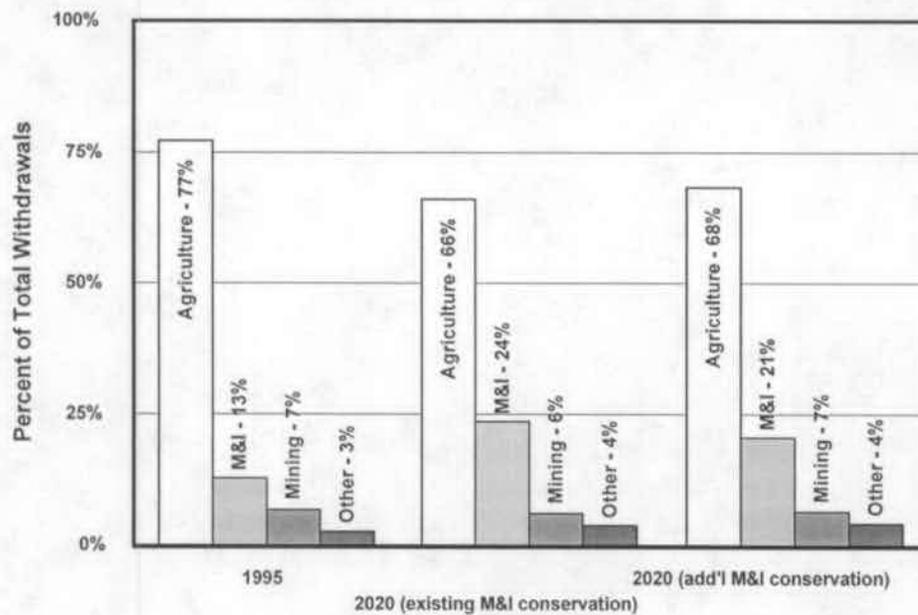
Total statewide water withdrawals are forecasted to increase about 9 percent from 4,041,000 acre-feet (af) in 1995 to 4,391,000 af in 2020, assuming current levels of conservation. Approximately one-half of these withdrawals are consumptively used. This projected increase in water use is directly attributable to Nevada's increasing population and related increases in economic endeavors. Figure ES-1 summarizes forecasted population, irrigated acres, and water withdrawals for the major use categories: agriculture, municipal and industrial (M&I), mining, and other self-supplied users (commercial, industrial, thermoelectric, domestic).

Fig. ES-1. Summary of Key Water Use Statistics

	1995	2020	Percent Increase or Decrease
Population	1,579,000	3,047,000	93%
Served by Public Supply Systems	1,488,000	2,907,000	95%
Self-Supplied	91,000	140,000	53%
Total Employment (workers)	784,000	1,512,000	93%
Irrigated Acres	715,000	666,000	-7%

	1995	2020 (existing M&I conservation)	2020 (add'l M&I conservation)
Water Withdrawals (acre-feet)			
Agriculture	3,120,000	2,902,000	2,902,000
Public Supply (M&I)	525,000	1,034,000	884,000
Mining	274,000	278,000	278,000
Other	122,000	177,000	177,000
Total	4,041,000	4,391,000	4,241,000

Distribution of Water Withdrawals by Category



The anticipated rise in total statewide water withdrawals primarily reflects expected increases in public supply for M&I water usage to meet the needs of a growing urban population, with expanding commercial and industrial activities. Nevada's population is projected to reach about 3,047,000 by the year 2020, with about 95 percent of these residents served by public water systems. It is expected that Nevada's population will become increasingly concentrated in its primary urban areas of Las Vegas (Clark County), Reno/Sparks (Washoe County) and Carson City, with varied spillover effects on neighboring counties.

M&I withdrawals currently account for about 13 percent of the water used in Nevada. Annual M&I water use is projected to increase from 525,000 af in 1995 to 1,034,000 af in 2020 (24 percent of total water withdrawals) based upon existing water use patterns and conservation measures (Figure ES-1). However, the implementation of additional conservation measures will result in M&I water withdrawals lower than the 1,034,000 af predicted. Planning groups for Southern Nevada and Washoe County have estimated that their planned additional conservation measures will result in an annual savings of about 150,000 af by the year 2020 (a 15 percent reduction in predicted withdrawals). The achievement of additional conservation is an integral part of Southern Nevada's water supply plan for the future.

About 77 percent of water withdrawals are for agricultural use. Forecasts suggest that agricultural water use could experience a 7 percent decline through 2020, with irrigated acreage possibly decreasing from about 715,000 to 666,000 acres. The historic data indicate that in some counties, irrigated acres will remain about the same, while in other counties, encroaching urbanization and the transfer of agricultural water rights to other uses will lead to reductions in irrigated acreage. Nonetheless, agriculture will continue to account for a majority of the statewide use during the next 20 years. It must be noted that statewide agricultural water use is highly variable, depending upon weather conditions and water supplies, and can vary more than 25 percent from a wet year to a dry year as a result of changing water availability.

Almost 6 to 7 percent of statewide water withdrawals occur in the mining industry. It is anticipated that mining water withdrawals will remain relatively constant at around 275,000 afy for the next 20 years. In 1995, a majority of the mining withdrawals were associated with mine dewatering with about 185,000 acre-feet per year either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. This trend is expected to continue.

Self-supplied uses for commercial, industrial, thermoelectric, and domestic purposes are projected to increase from about 122,000 acre-feet in 1995 to 177,000 acre-feet in 2020. During the planning horizon, these self-supplied uses are expected to account for 3 to 4 percent of the total statewide water withdrawals.

Interest in obtaining the necessary water supplies for wildlife and environmental needs is increasing. Additionally, the popularity of water-based outdoor recreation continues to grow. It is anticipated that these trends will continue, resulting in increased water supply demands for wildlife, environmental and recreational purposes.

Future Water Supplies

Currently, surface water supplies are virtually fully appropriated. The increase in total statewide demand, particularly M&I water use, is expected to be met via better demand management (conservation), use of alternative sources (reused water, reclaimed water and greywater), purchases, leases or other transfers from existing water users, and by new groundwater appropriations. Much of the state's unappropriated groundwater is located in basins at a distance from urban centers. Thus, increasing attention will be placed on interbasin and intercounty transfers, and implementation of underutilized water management tools such as water marketing and water banking. Water for instream flow purposes, wildlife protection, environmental purposes and recreation will likely be generated by increased conservation and the acquisition of existing water rights.

Issues and Recommendations

The *Nevada State Water Plan* presents a number of important water-related issue papers and related recommendations for future water policy development and planning. The issues presented in the *Plan* were selected after an extensive public scoping process, and were then prioritized by members of the Board, administrators within DCNR, NDWP staff and inputs from the general public. Fourteen issue discussions and recommendations were then cooperatively developed. The list of issues discussed in the *State Water Plan* is by no means exhaustive, but does represent a spectrum of the significant issues affecting Nevada's water future. Future updates of the *Water Plan* will evaluate the state's progress in addressing these issues, as well as identify and address additional issues.

The *Plan's* 14 issues were divided into five categories: water supply and allocation, water quality, resource conservation and recreational uses, flood management, and water planning and management. Of the 14 issues, two deserve special mention. Data acquisition and management represents one of the greatest challenges facing water planners and managers in the state. The State must improve its capability to collect and analyze data about its water resources and about water usage statewide. Development of the 1999 *State Water Plan* was hampered by the inaccessibility of data and concern about the reliability of the existing data. This issue affects water planning at all levels of government. The quality of future state water plans will be impaired if the State does not address the issue of data acquisition and management in the near future.

The transfer of water between basins and between counties is a significant issue statewide. Currently, Nevada has more than 15 interbasin or intercounty water transfers, and water transfers represent a significant opportunity to meet future water needs. However, water managers need to carefully identify the potential benefits and impacts water transfers may have on areas of origin and areas receiving the water. Information about water transfers must continue to be made available to the public, and the State must continue to evaluate transfer proposals to ensure that such transfers are in the public interest.

Following are summaries of the recommendations presented in the *State Water Plan*.

Water Supply and Allocation

Water Conservation. Recommendations include establishment of a state Office of Water Conservation, changes to existing conservation plan requirements, formalizing a credit for conservation program, providing assistance to agricultural users and state agencies in implementing conservation measures, establishment of a fund for water conservation demonstration projects, metering of public supply water deliveries, greater use of effluent and greywater, and initiation of a water measurement pilot program.

Integrated Water Management. Recommendations include continuation of monitoring to refine perennial yield estimates, increased development of recharge/recovery projects, increased use of a variety of water sources, and assurance that users of multiple water sources do not exceed their combined water use allocation.

Interbasin and Intercounty Transfers. Recommendations include recognition of the net value water transfers can have as long as potential impacts are addressed and public involvement is encouraged; and ensuring that water transfers are justified, environmentally sound, consistent with regional plans and do not unduly limit growth in the area of origin. Other recommendations encourage the development of mitigation plans, the provision of water planning assistance to local governments to help them respond to water transfer proposals and conducting additional research on water banking and water marketing.

Water Use Measurement and Estimation. Recommendations include development and funding of a comprehensive water use measurement and estimation program.

Domestic Wells. Recommendations include the State Engineer continuing to notify counties of potential water resource impacts due to multiple parceling activities and of appropriate water right dedication requirements; establishment of domestic well inventories; distribution of education materials to existing and potential domestic well owners; and funding support for the installation or expansion of regional water supply and/or wastewater treatment in areas where domestic well water quality has been impaired.

Water Quality

Nonpoint Source Pollution. Recommendations include the continuation of the nonpoint source program consisting of regulatory and voluntary measures.

Comprehensive Ground Water Protection and Management. Recommendations include continued support for the development and implementation of the Comprehensive State Ground Water Protection Program; development of a comprehensive groundwater monitoring network; the Division of Environmental Protection's continued evaluation of MTBE and other gasoline additives, and activities necessary to control nitrate contamination; and funding support for the installation or expansion of regional water supply systems in areas where septic tank pollution has become an issue.

Resource Conservation and Recreational Uses

Maintenance of Recreational Values. Recommendations include continued evaluation of the state's

water-based recreation resources and application of this information to recreation planning and management efforts; stronger consideration of the impacts to recreation resources resulting from proposed water-related projects, such as dams and reservoirs; continuation of water right acquisitions from willing sellers for recreational purposes; enhanced funding for the development of recreation facilities; increased research on alternative ways to meet water-based recreation needs; and increased management of watersheds to protect and enhance recreation values, among other considerations.

Water for Wildlife and Environmental Purposes. Recommendations include the development of a comprehensive and integrated management plan for prioritizing and coordinating maintenance of instream flows; adoption of a policy encouraging the purchase, lease or donation of water rights for wildlife and environmental purposes, and creation of a trust fund for acquisitions; establishment of incentive programs for the restoration of impaired aquatic and riparian resources; and the convening of a statewide working group of experts to identify alternative ways to obtain water supplies for wildlife and environmental purposes.

Flood Management

Flood Management in Nevada. Recommendations include amendment of NRS to include floodplain management as an official duty of the Division of Water Planning; development of a task force to develop a predictive model for alluvial fan flooding; development of a plan for reviewing, updating and maintaining flood maps; improved coordination with all involved agencies to improve floodplain management; creation of a flood mitigation fund; continued development of a state flood management plan; and revision of the state's model floodplain ordinance.

Water Planning and Management

Watershed Planning and Management. Recommendations include development of a Department of Conservation and Natural Resources strategy for participation in watershed planning efforts; support of watershed planning at the local level; continued development and implementation of basin plans for Nevada's hydrographic regions; funding for watershed planning groups; and participation in the review of watershed management plans.

Water Resources Data Management. Recommendations include support of agencies and local governments in the development of electronic databases and improved access to data; creation of a state GIS task force; development of a detailed water resources data inventory; development of information describing available data; development of a comprehensive water use measurement and estimation program; establishment of a groundwater quality and level monitoring network for priority basins; continued support for cooperative agreements with the U.S. Geological Survey for the funding of the stream gaging station network; and continued support of research projects such as efforts to update perennial yield estimates for priority basins.

Water Planning Assistance to Local Governments. Recommendations include enhancement of state water planning assistance to local governments through financial and/or technical means; improved water use measurement and estimation; improved data management, coordination and sharing; and enhanced watershed management and planning.

Water Education. Recommendations include expanding funding for the state's water education program; creation of a water education coordinator position in the Division of Water Planning; increased evaluation of water education programs at all levels; and increased coordination of statewide (public and private) water education activities.

Nevada Division of Water Planning

DRAFT Nevada State Water Plan**SUMMARY****Listing of Tables and Figures**

[NOTE: Certain figures within the internet version of the *Nevada State Water Plan* are not contained within the document and must be viewed from this "Listing of Tables and Figures" page. Those figures are indicated below as active links.]

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Nevada Division of Water Planning

**Nevada State Water Plan
SUMMARY**

**Section 1
Purpose, Guidelines and
the Water Planning Process**

Introduction and Purpose

Nevada is the driest state in the nation and one of the fastest growing. Water is Nevada's most precious resource, and more than any other resource, water will determine Nevada's future. The success of our economic endeavors, the sustainability of our rural communities and the protection of our environment are all dependent on the wise management of the state's water resources. Thus, comprehensive, coordinated and continuing water management planning is vital to our state's economic future and quality of life.

Development of the state water plan is required by the Nevada Revised Statutes (NRS 540.101.) In statute, the Legislature also declares that "it is the policy of the State of Nevada to continue to recognize the critical nature of the state's limited water resources" and acknowledges the increasing demands placed on these resources by growth. Further, the Nevada Legislature "recognizes the important role of water resource planning and that such planning must be based on identifying current and future needs for water" (NRS 540.011). Legislative review and consideration of the state water plan will provide additional legislative policy guidance to ongoing planning efforts.

The *Nevada State Water Plan* is designed to help guide the development, management and use of the state's water resources. The plan assesses the quantity and quality of Nevada's water resources, and identifies constraints and opportunities which affect water resource decision making. The plan looks at historical and current water use, and projects demands out to the year 2020. The most current and accepted hydrologic and socioeconomic data sets available are used to develop the plan's forecasts.

Along with providing data about water supplies and water use, the state water plan identifies pressing water management issues and recommends policy directions and actions designed to assist water managers throughout the state and all levels of government. Thus, the plan establishes a common base of knowledge and understanding which is critical if Nevadans are to reach consensus on future water management issues.

The state water plan is designed to be a policy and planning guide, not a water supply plan. Many of the decisions regarding how to meet a particular water supply objective are best determined and implemented at the local level. And in fact, many local governments have taken a close look at their own water supply needs and are now charting a course to meet those needs. Thus, while the plan summarizes local and regional water planning efforts, it focuses on a broad array of water planning

Nevada State Water Plan

issues which affect water planning, management and allocation of water resources statewide.

The key to development of the state water plan has been the establishment of a dynamic, flexible water planning process. Ongoing review and update of the plan is essential to ensure that we, as a state, successfully evaluate emerging issues and prepare ourselves to meet future challenges.

The state water plan's recommendations are addressed to a wide variety of agencies, organizations and decision makers. Thus, implementation of the plan's recommendations, subject to changing needs, will require a cooperative and coordinated effort. Prior to implementation, each of the plan's recommendations must be prioritized and evaluated for technical feasibility, and the costs and benefits of each must be identified and weighed. Implementation of the plan should assist local organizations and agencies with their own water planning, as well as help guide water management decisions at the state level. The plan's ultimate effectiveness will be judged by the extent to which it's recommendations are incorporated into other state, local and federal planning efforts and agency actions.

Public input is vital to any planning process. The state's water planning process provides Nevada's residents with a unique opportunity to help decide how the state's water resources should be managed. The state water plan has been significantly enhanced by the willingness of Nevada's residents to participate in it's development, and to share their thoughts, ideas and perspectives. At its heart, the state water plan is a valuable expression of public interest.

Statutory Authority

In 1995, the Nevada State Legislature amended Nevada Revised Statute (NRS) 540.101 and directed the Division of Water Planning to develop a state water plan. Following the 1997 legislative session, the Legislature sent the Division of Water Planning a "Letter of Intent" requesting the state water plan be submitted to the Legislature by February 15, 1999. The Division requested a 6-week time extension for plan submittal, to April 1, 1999, to allow sufficient time to complete public review of the final draft.

The authority for the preparation of the State Water Plan is found in NRS 540.101 which states in part:

1. The Division [of Water Planning] shall develop a plan for the use of water resources in the state.
2. The Division shall coordinate with local governments in developing the plan pursuant to section 1. Upon request of the Division, each local government shall cooperate with and assist the Division in the development of the plan.
3. The water plan developed pursuant to subsection 1 must include provisions designed to protect the identified needs for water for current and future development in the rural areas of the state, giving consideration to relevant factors, including but not limited to, the economy of the affected areas and the quality of life in the affected areas.
4. The Division shall submit to the Legislature for its review and consideration:
 - (a) The plan developed pursuant to subsection 1; and

Summary. Section 1 – Purpose, Guidelines and the Water Planning Process

(b) The recommendations regarding the plan provided to the Division by the advisory board on water resources planning and development pursuant to NRS 540.111.
The Division must obtain the approval of the Legislature before the plan is implemented.

Guidelines for the State Water Plan

The *Nevada State Water Plan* was developed in accordance with the legislative declaration of policy found in Nevada Revised Statutes (NRS) 540.011, and based on a series of “guiding principles” generated by the Advisory Board on Water Resources Planning and Development (Advisory Board). (See subsection below, *Participants in the Planning Process*, for a discussion of those involved in developing the state water plan.) The Advisory Board then assisted with developing the goals for the state water planning process and strategies for developing the state water plan.

Legislative Policy

NRS 540.011 establishes the basic legislative policy which has guided development of the state water plan:

NRS 540.011 Legislative declaration:

1. The legislature determines that it is the policy of the State of Nevada to continue to recognize the critical nature of the state’s limited water resources. It is acknowledged that many of the state’s surface water resources are committed to existing uses, under existing water rights, and that in many areas of the state the available groundwater supplies have been appropriated for current uses. It is the policy of the State of Nevada to recognize and provide for the protection of these existing water rights. It is also the policy of the state to encourage efficient and nonwasteful use of these limited supplies.
2. The legislature further recognizes the relationship between the critical nature of the state’s limited water resources and the increasing demands placed on these resources as the population of the state continues to grow.
3. The legislature further recognizes the relationship between the quantity of water and the quality of water, and the necessity to consider both factors simultaneously when planning the uses of water.
4. The legislature further recognizes the important role of water resource planning and that such planning must be based upon identifying current and future needs for water. The legislature determines that the purpose of the state’s water resource planning is to assist the state, its local governments and its citizens in developing effective plans for the use of water.

The legislative declaration of policy establishes the importance of protecting existing water rights, supporting water conservation, acknowledging the relationship between water supply and growth, and the role water planning plays in this, the driest state. It further establishes that water planning must focus on current and future water needs and that all levels of government must be involved in water planning.

Guiding Principles for the State Water Plan

At their January 6, 1994 meeting, the Advisory Board developed a set of 23 “guiding principles” to philosophically guide development of the State Water Plan. Some of the guiding principles reflect state law or state policy. Others reflect important water planning considerations identified during development of the state water. Later, in 1997, the Advisory Board condensed the guiding principles to these 11:

1. All water within the state, whether above or below ground, belongs to the public and its use is subject to a system of water rights administered by the State Engineer, and by state and federal court decrees and regulations.
2. Public education and public input is vital to statewide water resources planning.
3. The State Water Plan should integrate water supply, water quality, water use, and environmental issues, and should be used to guide decisions which affect water resources in the state.
4. The State Water Plan by design should be “growth neutral.” It should neither encourage nor restrict growth, and present no positions regarding the type, location or rate of growth.
5. Water right owners are entitled to buy, sell or trade their water rights to others under free market conditions. However, changes in the point of diversion, or place or manner of use must be approved prior to the change in accordance with the state water law, and state and federal court decrees and regulations.
6. The water resource needs of future generations of Nevadans should be protected by balancing economic goals with social, aesthetic, cultural and ecological values.
7. All water resource projects should be technically, environmentally and economically sound, and consistent with state law.
8. The State Water Plan should help integrate and coordinate the water planning and management activities of local, state and federal agencies.
9. The relationship between groundwater and surface water must be recognized in the State Water Plan.
10. Water conservation is an important component in the planning and management of the State’s Water Resources.
11. Watershed planning efforts should be encouraged and should include representatives of all agencies, municipalities, political subdivisions, water users and any others with an interest in the planning and management of a watershed.

Planning Goals

Following development of the guiding principles, the Advisory Board and the Department of Conservation and Natural Resources (DCNR) Steering Committee developed a number of goals and strategies for the planning process and the state water plan. As the plan evolved, so too did the goals and strategies. In general terms, the goal of the state water planning process is to make water planning and water decision making in Nevada *better*: more efficient, more effective and more inclusive. Following are results we hope to achieve through the water planning process and development of the state water plan:

1. **Water Supply:** Enough water of sufficient quality for future generations
2. **Water Rights:** Protection of existing water rights
3. **Economic Efficiency:** The preferential use of water for greatest economic gain to the state
4. **Conservation:** More conservation and less waste of water
5. **Water Quality:** Protection and enhancement of water quality
6. **Rural Water Supplies:** Protection of water supplies for current and future development in rural areas
7. **Environmental Quality :** Protection and enhancement of the environment
8. **Efficiency:** Agency actions which are coordinated and integrated to save money and time, reduce duplication in projects or services, address gaps in resource protection, and result in better decisions
9. **Decision making:** Less litigation and more cooperative decision making to resolve water resource issues
10. **Effectiveness:** More informed water resource decision making, with a greater awareness of aesthetic, cultural and ecological values
11. **Sound Science:** Water resource projects which are technically, environmentally and economically sound
12. **Public Involvement:** A better educated citizenry and more public participation in water resource decision making
13. **Quality of Life:** A higher quality of life for all Nevadans

Each update of the state water plan should bring us closer to reaching these goals. It is important to note that some of the goals may conflict, or appear to conflict, with one another. For example, economic efficiency may appear to be in direct conflict with environmental protection. However, there is growing recognition that environmental protection is actually an essential component of economic development. Economic and environmental *sustainability* is the emerging goal of many communities. Clearly, for a state that is now ranked in the top three in the country as a vacation destination, environmental quality goes hand-in-hand with economic efficiency. It is one of the roles of the water planning process to seek a balance among competing goals so that the plan's overall goal of better water management is achieved. Public involvement in the water planning process has been the key to achieving a balance which reflects the evolving interests and will of the citizenry.

Plan Components

The primary elements to be included in the State Water Plan were derived from NRS 540.051, Duties of the Division of Water Planning and NRS 540.101, Development, contents and implementation of the [state water] plan. Statutory plan components include: (1) providing arid regions with information, alternatives and recommendations including courses of planning and actions for acquiring additional water or for conserving water, (2) investigation of new sources of water such as desalinization, importation, and conservation, (3) consideration of issues of water quantity and quality simultaneously, (4) development of forecasts of future supply and demand, (5) inclusion of provisions designed to protect the need for water for current and future development in the rural areas of the state, considering the economy and quality of life in the affected areas, and (6) the development of recommendations to the Legislature to improve state water policy. Additional plan components were

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added as a result of input from the Division's Advisory Board, Department of Conservation and Natural Resources staff and the public.

The Planning Process

The 1999 *Nevada State Water Plan* was developed over a period of 4 ½ years (between late 1994 and January 1999) with the involvement of thousands of Nevada citizens. The Division of Water Planning has taken the lead, assisted by the Advisory Board on Water Resources Planning and Development, staff from the various agencies of the Department of Conservation and Natural Resources, and input from state, local and federal agencies and the public.

The steps in the water planning process were as follows:

- solicit public input to determine the scope of the plan and the issues to be addressed
- develop and update basic hydrologic and socioeconomic data sets
- analyze the water resources institutional framework
- forecast the state's population and anticipated economic trends over the next 20 years
- forecast future water needs over the next 20 years
- inventory water supplies presently available
- inventory resources already committed (permits, vested rights, etc.)
- research additional possible sources of supply
- identify alternate scenarios to meet the water needs of the state
- identify issues that affect water use, allocation and management
- develop and evaluate policy and programmatic recommendations to address the issues
- solicit public input throughout plan development to gauge the relevancy of the issues and the appropriateness of recommendations
- present comprehensive plan with recommendations to the state legislature for review and approval

Once the state Legislature approves the Plan, the Division of Water Planning will communicate plan recommendations to agencies or individuals who are in the best position to further evaluate and implement them. In some cases, the Division will establish new working groups or task forces to help determine the best approach to plan implementation. It is anticipated that the Water Planning Advisory Board will continue to advise the Division and assist in plan implementation. The Division will be responsible for tracking the progress of plan implementation and evaluating the effectiveness of plan recommendations. Subsequent updates of the Plan will include an evaluation of the state's progress in implementing the *Plan's* recommendations.

Participants in the Planning Process

Many individuals, organizations and agencies participated in development of the State Water Plan. Plan participants and their roles in plan development are briefly described below.

The Public. Extensive public involvement has been key to development of the State Water Plan. The public's opinions, thoughts, and recommendations have been solicited during every phase of the planning process. In 1992, prior to initiation of the 1999 State Water Plan, more than 800 Nevadans participated in a series of Water Policy Forums sponsored by the Nevada Cooperative Extension, the Nevada Humanities Committee and others. The results of these forums were tabulated in a report titled *Nevada's Water Future: Making Tough Choices*. This report, representing a diversity of views, was useful in the early stages of plan development and in generating options to address water issues.

In 1994 and 1995, more than 600 citizens participated in 20 public workshops sponsored by the Division of Water Planning. The purpose of these workshops was to educate the public on Nevada water law and the water planning process, and to get an early sense of the public's perception of key issues such as interbasin transfers. These scoping sessions were useful to the Division in establishing the breadth and scope of the plan.

Governor's Office. The Governor and his staff have provided executive sponsorship during plan development. Starting with the 1990 biennial report, the Governor addressed the need for development of a new state water plan as one of the most critical issues facing the state. In discussing the need for natural resource planning, the report states:

“Tantamount among these plans is the development of a statewide water management plan, especially as related to intercounty and interbasin transfers, projection of water needs, the outline of conservation methods, development of drought contingency plans and information on regulations to conserve water usage.” (page 5, *Perspectives: A Biennial Report of Nevada State Agencies – 1990*)

Subsequent biennial reports have continued to underscore the need for a state water plan and to reiterate the Governor's commitment to statewide water planning.

Division of Water Planning. Between 1993 and 1997, the Division of Water Planning compiled socioeconomic and hydrologic databases and wrote more than 25 publications (see Table 1-1) to serve as a basis for the water plan. Key documents produced during that period included the *Nevada Water Words Dictionary*, the *DRAFT State Water Policy*, reports on water usage by sector, three detailed water basin *Chronologies*, and the *County Graph and Data Books* and *Socioeconomic Overviews*.

In 1994, the Division completed the early public scoping meetings which served to help prioritize the state water plan elements. The Division went on to develop drafts of the *State Water Plan*, and then finalized the draft to be presented to the Legislature. Almost all Division staff were involved in this work effort, from plan conceptualization to final editing. The Division also provided staff support to the Advisory Board on Water Resources Planning and Development, conducted public outreach efforts and organized technical work group and steering committee meetings.

Technical Working Group. In 1994, a 20- member interagency working group composed of state

and federal agencies met over an 11- month period to frame the issues, generate ideas and develop options. The perspectives of this working group were drafted into issue papers which formed the basis of the policy recommendations contained in the *DRAFT State Water Policy*, produced in March 1995.

DCNR Steering Committee. In 1995, staff from Divisions within the Department of Conservation and Natural Resources formed a high-level departmental oversight committee to support development of the State Water Plan. This group, which included the Director and Assistant Director of the Department and staff from the Divisions of State Lands, Environmental Protection, Wildlife, Water Resources and Water Planning, and the Natural Heritage Program, provided insight into the laws, regulations and issues within their jurisdictions, recommended approaches to the planning and obtaining public input, evaluated existing state water policies and recommended changes. This steering committee was essential in setting the tone, pace and direction of the plan. Altogether, the DCNR steering committee members committed over 1700 hours to plan development.

Advisory Board on Water Resources Planning and Development. To advise the Division in matters relating to planning and development of water resources, NRS 540.111 establishes the Advisory Board on Water Resources Planning and Development (Advisory Board.) In 1995, the Legislature passed SB 101, which among other things, enlarged the Advisory Board from 13 to 15 members, and changed its composition. The Board for Financing Water Projects, formally ex-officio members of the Advisory Board, was separated to form a stand alone board, and new Advisory Board positions were opened up for representatives of mining, ranching, agriculture, conservation and the general public. The number of Washoe County representatives was also increased.

As a follow-up to the enactment of SB 101, in 1996 the Governor appointed a new set of Advisory Board members (see p viii for the list of members), only 4 of whom had served on the previous Advisory Board. The current composition of the Advisory Board on Water Resources Planning and Development is as follows:

- Six** members representing the governing bodies of the county with the largest population in the state [Clark County] and the cities in that county;
- One** member representing the largest water utility in the county with the largest population in the state [the Las Vegas Valley Water District];
- Two** members representing the county with the second largest population in the state [Washoe County] and the cities in that county;
- One** member representing the largest water utility in the county with the second largest population in the state [Sierra Pacific Power Company];
- One** member representing the general public; and
- Four** members, each representing a different one of the following interests:
 - (1) Farming;
 - (2) Mining;
 - (3) Ranching; and
 - (4) Wildlife.

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The Governor is to make the Advisory Board appointments so that at least seven members are residents of Clark County, three members are residents of Washoe County and at least three members are residents of counties which have a population less than 100,000. Altogether, the Advisory Boards held more than 25, one-to-two day meetings to participate in development of the state water plan. The Advisory Board meetings were always publicly advertised and open to public comment, and occasionally the Advisory Board held special workshops to solicit public comment in a more formal setting.

Pursuant to NRS 540.111, one of the Advisory Board's roles is to make recommendations to the Division concerning their level of concurrence with the content, findings and recommendations of the *State Water Plan*. The Division is to then submit the Advisory Board's recommendations to the Legislature with the *Plan*. The time and effort contributed by the Water Planning Advisory Board has been invaluable in bringing the Plan to fruition.

Department of Conservation and Natural Resources Advisory Board. The Department of Conservation and Natural Resources maintains its own Advisory Board. The seven Board members each represent one of the following interests: (1) general public, (2) state park users, (3) agricultural industry, (4) mining industry, (5) outdoor recreationists, (6) forestry/fire control, and (7) conservation. This DCNR Advisory Board has frequently reviewed *Nevada State Water Plan* drafts and provided advice and counsel as to the plan's content and the planning process.

Interest Groups. Many interest groups have been active in the development of the *State Water Plan*. Groups such as the Nevada Farm Bureau, Nevada Cattlemen's Association, Northern Nevada Conservation Forum, Southern Nevada Homebuilders Association, and the League of Women Voters have sponsored workshops on the plan and/or commented formally on plan work products.

Local Governments. Local government input has been critical to the planning process. The Division Administrator or staff met personally with 16 of the 17 County Commissions, and the Southern Nevada Water Authority in Clark County, to update them on plan progress, request review of key work products, and request their participation in meetings of the Water Planning Advisory Board. Nearly all county commissions sent representatives to participate in Advisory Board meetings and to provide input on local water issues.

State Legislature. The Nevada State Legislature plays a significant role in the water planning process. The Legislature initiated the water planning program and has set time frames for plan completion. The Legislature has also provided guidance for plan development via its declaration of legislative intent at the start of NRS 540, the water planning statute. Legislative committees have requested periodic briefings on plan progress, and individual Legislators have shown a special interest by participating in scoping sessions and public workshops, submitting comments on the plan or by requesting additional information. When it is finalized, the *Nevada State Water Plan* will be presented to the 1999 Legislature for their review and consideration as required by NRS 540.101.4.

Federal Agencies. Federal agencies have been involved in plan development. Federal agency staffs made presentations to the Advisory Board on regional water issues, served on technical working groups, assisted in development of some issue papers, and commented on plan drafts. Federal agencies such as the U.S. Geological Survey, Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service and Natural Resources Conservation Service made significant contributions.

Plan Formulation and Review

Division of Water Planning staff researched and produced data compilations and publications as a preliminary step in developing the state water plan. As publications were finalized and sections of the *State Water Plan* were developed, they were reviewed by the DCNR Steering Committee, the Water Planning Advisory Board and the DCNR Advisory Board. Public comment was always solicited at meetings of both Advisory Boards. Once portions of the plan were in agreed upon draft form, the drafts were sent out for public review and comment. Typically, workshops were held to explain plan sections and to elicit comment from the public.

From this intensive review, public involvement and consensus building process, the *State Water Plan* has taken shape. The plan that has emerged is directed toward the development, adoption and implementation of a variety of programs, projects and policies designed to better utilize, conserve and protect the state's most valuable natural resource. However, the planning process not only resulted in the 1999 *State Water Plan*, but also in a strong consensus regarding the need to keep the water planning process alive, funded and connected to the state's water resource decision making processes and programs.

Public Comments on the Water Plan Drafts

An interim draft of the state water plan was released during the summer of 1998. This draft included many of the background and introductory plan sections, along with the basic data which formed the foundation of the plan. The goal of this early review period was to reach consensus on the data used to develop the plan, before moving on to addressing the more complex issues and recommendations in later plan sections. Six public workshops were held during this time. The Division also made presentations to 15 of the 17 county commissions, the Southern Nevada Water Authority in Clark County and the Carson City Board of Supervisors to update them on the plan, solicit their continuing assistance in plan development and receive their preliminary thoughts and comments.

The final public review draft of the state water plan was released at the end of January 1999 and the review period extended to March 8, 1999. Over 1000 copies of the draft state water plan were distributed for public review and comment. Drafts of the plan were also made available through the Division of Water Planning's website. During this time, seven public workshops were held to review the plan's recommendations and solicit public input. Additional presentations were made before various legislative committees, interested organizations and state advisory boards, working groups and commissions. Altogether, over 50 public workshops were held and presentations made on the plan throughout the 4 ½ year planning cycle.

The Division received 39 written comments on the final public review draft of the water plan and many additional comments at public workshops. At the end of the final comment period, all of the comments received were entered into a database. The use of a database enabled the Division to more closely evaluate and analyze the comments, and to ensure that all comments on a topic were evaluated together and addressed appropriately and consistently.

Comments were provided by agricultural and rural interests, wildlife and environmental interests and

agencies. Relatively few comments were received from urban interests. Of the 39 letters received 10 were from special interest groups, 8 from individuals and one from a business (mining). The other 21 letters were from local (9), federal (8) and state (1) agencies, irrigation districts (2) and tribes(1). Comments were directed most frequently to the issues and recommendations contained in the issue papers, to the data used in the plan and in some cases, to the findings (particularly the projected decrease in agricultural water use.) While some comments focused on edits or data corrections, a large number provided policy, philosophical or analytical perspectives, especially regarding growth, interbasin transfers and the importance of water planning to the state. Many comments recognized the significant work effort that went into developing the 1999 water plan and found it to be a valuable resource.

Issues given the greatest attention by commenters, both pro and con, included:

- * conservation and credit for conservation
- * water resources data collection, management and distribution
- * integrated water management
- * water measurement and estimation
- * interbasin and intercounty transfers
- * instream flows and water for wildlife and the environment
- * local vs. state water planning

A number of the comments addressed the planning principles utilized in the plan or the plan's goals. The commenters generally noted the difficulty in developing a plan based on very general, and sometimes conflicting, goals. The water plan's goals and guiding principles were the subject of much discussion and debate early in the planning process by the Advisory Board, and were reconsidered at various points during development of the plan. Therefore, while the comments on these areas were acknowledged, the plan's goals and guiding principles were not revised.

Frequently, comments conflicted with one another. For example, some comments questioned the need for a water plan and supported the status quo. These commenters believe that the current system is working and a state water plan is not necessary. Others applauded the water plan as a critical step in proactively planning and managing the state's water resources. Another example related to the use of data in the plan. Some groups wanted the plan to include the most current data available, even if that meant that data sets weren't comparable between counties. Others wanted data sets standardized to a particular year, even if that meant that older "vintage" data was used in lieu of the latest available data. Some felt that since some of the data sets have weaknesses, no conclusions should be drawn in the plan, while others were comfortable with use of the best available data to forecast future water use.

Environmental organizations wanted to see more emphasis on managing growth and implementation of water conservation technologies, while others felt the plan should stay away from growth issues altogether and that conservation was a good idea but should not be mandated. (The plan is designed to be growth neutral, but does make strong recommendations to enhance water conservation in the state.)

Some comments expressed philosophical opposition to interbasin transfers, going so far as to suggest

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that they be banned altogether, while others felt that water transfers represented THE solution to the state's water supply problems. Some comments suggested that the water plan should express a vision of the future on a variety of topics including concepts such as sustainability, watershed planning and biodiversity. (The plan does discuss watershed planning in depth and recommend its greater usage, but only addresses issues of biodiversity or sustainability in the context of other issues.)

Concern was expressed about the role of the plan, and whether it is to be considered a mandate. However, the plan is clearly designed to be an education, planning and policy tool which makes recommendations to enhance future water management. In and of itself, the plan is not a new law, nor does it change existing water rights or reallocate water rights in any way. Projections of future water use are simply projections based on existing trends, and do not assume sweeping changes in our economy. It is anticipated that the market for water rights will drive any transfers of water rights.

A number of agricultural groups felt the plan should highlight the importance of agriculture to the state and its value in enhancing wildlife habitat, open space and rural quality of life. However, the plan does not advocate the value of any one water use or economic endeavor over another.

Comments expressed concern about the lack of water rights for maintenance of instream flows, the habitat of endangered and threatened species and the environment in general. They felt the state should assume a more active role in purchasing water rights for environmental water uses and in protecting habitats. On the other hand, a number of rural counties considered the plan's recommendations for purchase of water rights as "alarming", and a threat to their tax base. They suggested assisting irrigators in maintaining minimum pools on their own land by, for example, purchasing hay for them in dry years to prevent a reduction in stream flows at critical times.

Domestic wells were mentioned by quite a few commenters. Concerns were expressed about definition and protection of the legal rights of domestic well owners (who are not required by law to have a water right until their use exceeds 1800 gallons per day). Other comments included the view that domestic wells should be a local issue only, not a state issue, and a request for state funding support if domestic wells are required to hook up to regional water systems by the state.

A number of commenters concurred with the plan's recommendations to enhance water education, support watershed planning, develop better data, measure water use more accurately, do better flood planning and management, provide greater water planning assistance to local governments and ensure that the public remains closely involved in both state and regional water planning.

All comments were carefully reviewed and incorporated into the plan wherever possible. It is noteworthy that many of the issues raised by commenters had been discussed at length by both the Steering Committee and the Advisory Board during plan development. Thus, while these comments did not highlight new issues, they did validate the planning and public input process that was utilized. Some commenters did raise issues which were not specifically addressed in the plan. Recommendations for subjects to be addressed, or more thoroughly addressed, in future plans are listed below. It is the intent of the Division of Water Planning to include these issues in future plan updates:

- * mine dewatering

Summary. Section 1 – Purpose, Guidelines and the Water Planning Process

- * integrated management of surface and ground water
- * conflict resolution
- * better identification of environmental water needs
- * more thorough discussion of various types of water storage
- * dam safety
- * better assessment of perennial yield and restoration of over utilized aquifers

Comments received on the final public review draft of the *Nevada State Water Plan* and the comment database are available for review at the Division of Water Planning's office in Carson City.

Previous Water Planning Efforts

The state water planning program began in the 1960's. In 1967 the Nevada Legislature directed the Division of Water Resources within the Department of Conservation and Natural Resources to determine Nevada's future water needs and available water resources. The Legislative Commission was directed to study future statewide water needs and it appointed a special Legislative Subcommittee to undertake the study. The State Engineer and the Subcommittee jointly recommended the establishment of a separate section within the Division of Water Resources to carry out the necessary planning studies, and specific legislation to establish the statutory authority to implement the program.

The 1969 Legislature authorized development of a comprehensive water resource plan for Nevada through an amendment to NRS 532, and made an appropriation to the Division of Water Resources to develop a planning section. The 1973 Legislature required the State Engineer to complete the water resource plan and submit it to the 1975 legislative session. The first state water plan, *Water for Nevada*, was completed and published by November 1974. The state water planning program was active until the early 1980's, although with a dwindling staff. In 1982 the program was all but eliminated due to severe funding shortages.

The water planning program was re-instituted in 1989 through the efforts of Assembly Speaker Joe Dini and like-minded legislators who were increasingly concerned about Nevada's rapidly growing population and the lack of a current plan to identify additional water resources to satisfy demands. There was also concern regarding the lack of flood, conservation and drought planning. Thus, the present day Water Planning Division was created under NRS 540 and a small staff was hired by 1991. Since 1991, the Division of Water Planning has produced over 30 publications in support of the *State Water Plan* (as well as numerous publication updates and revisions); initiated a water education program and Internet home page; obtained grant funding to coordinate water planning activities in the Walker River Basin; assisted local governments in their water planning efforts; awarded over \$20 million in grants to small water systems; and sponsored numerous water resource conferences and workshops. In 1997 the Division received state and federal appropriations to initiate a flood planning and grant program.

The 1999 *Nevada State Water Plan* completes the latest cycle of statewide water planning. Following approval of the plan, the Division will turn its attention to developing a handbook for regional water planning and begin developing specific water management plans for the various hydrographic regions in Nevada.

Summary of Earlier Water Planning Reports and Recommendations

The first state water plan, *Water for Nevada*, was completed and published in November 1974. It consisted of a series of 16 planning documents which estimated water use, inventoried the water resources of the state, provided maps, developed forecasts for future water needs for mining, agriculture, fish and wildlife, recreation, power production and municipal use, evaluated the use of input-output economic models to analyze future water scenarios and described the water administration process in Nevada.

Many issues were identified in the 1974 State Water Plan, and a number of actions were recommended. In most cases, the plan suggested a cautious “wait and see” approach. Key plan recommendations included: (1) enacting legislation to bring geothermal resources under the purview of state water law, (2) placing time limits on subdivision approvals, (3) actively protecting state sovereignty in water allocation decisions on federal lands, (4) establishing state level floodplain zoning, (5) analyzing the state’s responsibilities for maintaining stream channels in navigable waterways, (6) continuing the data collection and water planning activities, (7) developing a new program for funding water system infrastructure improvements and water resource projects (8) protecting critical habitat and rare and endangered species when making water resource decisions and (9) where necessary, acquiring water rights for wildlife protection. Many of these recommendations were ultimately implemented in one form or another. A more detailed summary of the 1974 state water plan recommendations is provided in Volume 2 (Part 1, Section 2) of the *Nevada State Water Plan*, along with a status report on implementation of the recommendations and new developments in the last 25 years.

The *Water for Nevada* series was followed by a second series of 6 water planning reports — *Alternative Plans for Water Resource Use*. The objectives of these planning documents were environmental quality, economic efficiency and area development. The planning was focused on those regions which were having difficulty in meeting their water needs or which were expected to run out of water in the near future. Alternative plans were developed for the Walker, Humboldt, Carson-Truckee, Colorado and Snake River Basins and the Central Region of Nevada. Each report examined a series of alternate economic development scenarios for a region and projected those future scenarios which might occur *without* a plan in place.

All of the alternative plans identified water resource issues which remain issues today, 25 years later. For example, the Walker River Basin Report noted that Walker Lake was declining by 60,000 acre-feet per year, flooding was occurring throughout the basin and there were unmet water needs for agriculture and recreation. The Truckee-Carson River Basin Report noted the decline of Pyramid Lake, municipal, agricultural and industrial water shortages, lack of adequate water for wildlife areas, and flooding. These issues are perhaps even more pressing now. At this time, both lakes have declined further, municipal and industrial water shortages are more common and the New Year’s Day Flood of 1997 has moved flooding to the top of many people’s agendas.

A final *Special Summary Report* concluded the water planning series. It noted that virtually all of Nevada’s surface water resources had been committed; that in a rare year some overflow might be

available, but that in most cases storage facilities were inadequate to capture the runoff for later use. It noted that significant groundwater supplies had already been developed, and that some areas held good potential for further development. However, we had already reached the point in some basins, such as the Las Vegas Groundwater Basin and Diamond Valley, where no additional appropriations could be allowed. It was also apparent that obtaining water supplies from outside the state's boundaries was likely to be problematic, as it still is today.

The *Special Summary Report* noted that Nevada's residents viewed the lack of readily available water as a mixed blessing. While the lack of water restricted economic development in many areas of the state, it also meant that Nevada would be preserved in a fairly natural state with a relatively small population, thus enhancing the resident's "quality of life." In general, it was concluded from reaction and comment at the water planning forums, that most people of the state wanted the water resources developed and used, but not "over used." With this in mind, the state water plan conclusions and recommendations sought a middle ground.

One of the last publications produced through the early water planning program was titled *Water For Southern Nevada*. This report presented a comprehensive analysis of southern Nevada's water resources, and provided an analysis of alternatives for future water supply needs. Water supply plans were presented which describe a preferred alternative for water supply needs as well as an implementation program for water resources management.

Organization of the Nevada State Water Plan

The 1999 *Nevada State Water Plan* is being produced in six volumes:

- A *Summary* presents highlights of the State Water Plan's findings, with an emphasis on recommended legislative water policy and program initiatives.
- The main body of the *State Water Plan* includes an inventory, assessment and issue analysis of water resources in Nevada. It establishes the regulatory, historical and institutional framework affecting water planning and management within the state, provides the socioeconomic context within which water decisions are made, projects population and economic trends affecting water use, forecasts future water needs, identifies current water issues and presents recommendations to address those issues. The main body of the *State Water Plan* is divided into 3 parts as follows:
 - Part 1 – Water Resources Background and Assessment
 - Part 2 – Water Use and Forecasts
 - Part 3 – Water Planning and Management Issues
- A *Technical Data Appendix* which contains the detailed planning data and forecasts of the State's counties, cities and hydrographic basins (also available upon request in an electronic format).

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**Nevada State Water Plan
SUMMARY**

**Section 2
Institutional Framework for
Water Planning and Management**

Introduction

This section presents an overview of the institutional framework affecting water planning and management within the State. All entities involved with water planning, allocation, management and development issues must navigate their way through portions of this institutional framework in their decision-making process.

Statutory, Regulatory and Legal Considerations

This subsection provides a general summary of the major state and federal statutory, regulatory and legal constraints impacting water planning and management. Water quantity allocation and management; interstate water resource management; water quality protection and management; resource protection; flood protection and drought planning; and conservation are all important constraints to consider for a successful water plan.

Water Quantity Allocation and Management

Nevada Water Law. All waters within the boundaries of Nevada, whether above or beneath the ground surface, belong to the public and are managed on their behalf by the State. The State Engineer is responsible for the administration of Nevada Water Law, which ensures that these waters are managed so that sufficient quantities are available to preserve our quality of life and to protect existing water rights. Entities within the State can apply for the right to use that water. Like many of the western states, Nevada water law is founded on the doctrine of prior appropriation - "first in time, first in right." Under this doctrine, the first user of water from a watercourse acquires a priority right to the water and to the extent of its use under that right.

Nevada water law is set forth in Nevada Revised Statutes (NRS), Chapters 533 and 534. In addition, there are numerous court decisions which have further defined Nevada law. It is the State Engineer who determines the limit and extent of the rights of claimants to water, the use to which water may be put, the quantity of water that is reasonably required for beneficial use, and where water may be used.

As part of the duties of the office, the State Engineer reviews applications for new water rights

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appropriations. In approving or rejecting an application to appropriate water, the State Engineer follows statutory criteria:

- Is there unappropriated water in the proposed source?
- Will the proposed use impair existing rights?
- Will the proposed use prove detrimental to the public interest?
- Is the project feasible and not filed for speculative purposes?

All water rights are considered real property and can be bought, sold, traded and leased. The place of use and type of use can be changed with the State Engineer's approval. The attributes of appropriative water rights in Nevada are: 1) beneficial use is the measure and limit of the right to the use of the water; 2) rights are stated in terms of definite quantity, manner of use, and period of use; and 3) a water right can possibly be lost by abandonment or forfeiture.

Decrees. Most surface waters in Nevada are managed in accordance with civil, state or federal decrees. There are over 100 decrees governing water allocation and management in Nevada.

Tribal Water Rights. When the United States reserved land from the public domain for uses such as Native American reservations, it also implicitly reserved sufficient water to satisfy the primary purposes for which the reservation was created. This federal reserved water rights doctrine was established by the U.S. Supreme Court in 1908 in *Winters v. United States*. Federally reserved Native American water rights differ from state-issued rights in a number of ways. For instance, the Winters Doctrine asserts that federal reserved rights cannot be lost by failure to put the associated water to beneficial use. In Nevada, there are more than 20 Native American reservations and colonies.

Interstate Water Resource Management

Colorado River. In addition to Nevada, the states of California, Arizona, Wyoming, Colorado, New Mexico, and Utah, and the Republic of Mexico, all use water from the Colorado River. In 1922, these seven states entered into an interstate compact which includes a provision for the equitable division and apportionment of the waters of the Colorado River system. The U.S. Supreme Court Decree in *Arizona v. California*, 1964, established several additional dimensions to the apportionment of Colorado River water, including apportionments to the lower basin states of Nevada, California and Arizona. It was ruled that of the first 7.5 million acre-feet of mainstem water consumed in the lower basin, California was entitled to a consumptive use of 4.4 million acre-feet/year; Arizona to 2.8 million acre-feet/year; and Nevada to 0.3 million acre-feet/year.

California-Nevada Interstate Compact. The need for apportioning the water of the Truckee, Carson and Walker rivers between Nevada and California has been considered over the years. After years of negotiations, the state legislatures of California (in 1970) and Nevada (in 1971) passed legislation adopting the California-Nevada Interstate Compact. However, the U.S. Congress never ratified the Compact. Interstate allocations of the Truckee and Carson rivers were addressed in the Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990.

Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990. The latest effort to

resolve long-standing disputes over water and water rights on the Truckee River has been the enactment of congressional settlement legislation for the Truckee and Carson Rivers. This legislation, known as the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (or “Negotiated Settlement”), was approved by the 101st Congress on November 16, 1990. The main authorizations and directives included in the legislation are: an interstate allocation between Nevada and California is made of the waters of the Truckee and Carson Rivers, and Lake Tahoe; a new operating agreement is to be negotiated for the Truckee River; the Newlands Projects is reauthorized to serve additional purposes, including recreation, fish and wildlife, and as a municipal water supply for the Fallon area; a recovery program is to be developed for the endangered Pyramid Lake cui-ui fish and threatened Lahontan cutthroat trout, with a water right acquisitions program authorized; and a water rights purchase program is authorized for the Lahontan Valley wetlands.

Water Quality Protection and Management

Clean Water Act (CWA). The Water Quality Act is a 1987 amendment to the Clean Water Act of 1977, which amended the Federal Water Pollution Control Act of 1972, and is the primary legislative vehicle for federal water pollution control programs. The Water Quality Act is often referred to as the Clean Water Act (CWA). This Act was established to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters” and set goals to eliminate discharges of pollutants into navigable water, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment.

The State Environmental Commission (SEC), established by State law, has adopted regulations which define State programs to carry out the provisions of Nevada’s Water Pollution Control Laws. These laws, contained in Chapter 445A of the Nevada Revised Statutes (NRS), establish the authority to implement portions of the CWA and the Safe Drinking Water Act in addition to several non-federal water pollution control programs. In addition to adopting regulations, the SEC establishes fee schedules for permits, advises, consults and cooperates with other governmental agencies regarding water pollution matters, establishes qualifications for sewage treatment plan operators, and holds hearing regarding the actions of the Nevada Division of Environmental Protection (NDEP). The Nevada Division of Environmental Protection (NDEP) has been delegated the authority to implement aspects of the CWA in Nevada.

Other Programs (NDEP). In addition to the federal CWA and Safe Drinking Water Act programs delegated to NDEP, numerous state programs exist to protect, control and restore the quality of the waters of the State. Apart from the National Pollution Discharge Elimination System (NPDES) permits issued under the CWA, NDEP issues Water Pollution Control Permits with a zero-discharge performance standard for certain mining facilities, and State Ground Water Permits for infiltration basins, land application of treated effluent, large septic systems and industrial facilities. In addition to these permitting processes, NDEP reviews subdivision plans to ensure that wastewater is disposed of adequately. Also, NDEP regulates highly hazardous substances under the chemical accident prevention program. Remediation of polluted soil and/or groundwater falls under the State Corrective Actions Program which includes authorities under two federal acts: the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Safe Drinking Water Act. In 1974, the U.S. Congress enacted the Safe Drinking Water Act (SDWA) to enhance the safety of public drinking water in the United States through the establishment and enforcement of national drinking water standards. Congress gave the EPA the responsibility for implementation and enforcement of the SDWA. In 1978, the U.S. Environmental Protection Agency (EPA) granted primary enforcement authority (primacy) for the SDWA in Nevada to the State of Nevada (Division of Health). In 1996, additional amendments were enacted and a state revolving loan fund was authorized.

The State Health Division is responsible for implementing the program in 15 of Nevada's 17 counties. The Health Division has interlocal agreements with Clark County Health District and Washoe County District Health Department to implement various activities related to the SDWA and State Board of Health requirements in those counties.

The SDWA applies to all public drinking water systems which provide piped water for human consumption to at least 15 service connections, or regularly serve an average of at least 25 individuals daily for at least 60 days out of the year. There are currently about 700 public water systems in Nevada that are regulated under the SDWA.

Resource Protection

Endangered Species Act. The federal Endangered Species Act provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife maintains a list of endangered and threatened species. Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees, all of which are dependent upon water. The law prohibits any action, administrative or real, that results in a "taking" of a listed species, or adversely affects habitat.

In Nevada, there are 28 endangered taxa (species/subspecies) (2 are plants) and 14 threatened taxa (7 are plants). Rankings by the Nevada Natural Heritage Program place Nevada in the top ten states having the most globally imperilled species of plants and vertebrates.

State of Nevada Programs and Authority. The State of Nevada Natural Heritage Program researches, collects, and analyzes information on the existence, locations, numbers, condition, biology, and habitats of hundreds of sensitive plant and animal species throughout Nevada. These are species that could qualify for listing as a threatened or endangered in the future under current management and land-use situations. The Program continually prioritizes conservation needs throughout the State, and its easily-accessible computer database, maps, and paper files serve as a cost-effective "early warning system" designed to help prevent costly future species listings.

Nevada Revised Statute 503.589 grants the Division of Wildlife administrator the authority to enter into agreements with other entities for the conservation, protection, restoration and propagation of species of native fish, wildlife and other fauna which are threatened with extinction. Nevada Revised Statute 527.300 grants the state forester firewarden the authority to enter into agreements with other entities for the conservation, protection, restoration and propagation of species of native flora which

are threatened with extinction.

National Environmental Policy Act. The National Environmental Policy Act (NEPA) directs federal agencies to prepare an environmental impact statement (EIS) for all major federal actions which may have a significant effect on the human environment. NEPA states that it is the goal of the federal government to use all practicable means, consistent with other considerations of national policy, to protect and enhance the quality of the environment. NEPA requires all federal agencies to consider the environmental impacts of their proposed actions during the planning and decision-making processes.

Wild and Scenic Rivers Acts (Federal and California). In 1968, Congress passed the National Wild and Scenic Rivers Act to preserve in their free-flowing condition rivers which possess “outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values.” No rivers within Nevada have been designated under this federal act. In 1972, the California Legislature passed the State Wild and Scenic Rivers Act. Portions of the West Walker River and East Fork of the Carson River upstream of Nevada have been designated under the California Act. The California Act prohibits construction of any dam, reservoir, diversion or other water impoundments on a designated river.

The current U.S. Forest Service’s Humboldt and Toiyabe Land and Resource Management Plan has identified other river segments that are suitable for inclusion in the Wild and Scenic Rivers system, including segments in Jarbidge River; Little Humboldt River, North Fork; Marys River; Carson River, East Fork; East Walker River; and West Walker River.

Flood Protection and Drought Planning

Flood Control Act. The Flood Control Act authorizes the U.S. Army Corps of Engineers to perform several flood-related tasks, including the construction of small flood control projects; addressing floods and floodplain issues; snagging and clearing for flood control in channels; and emergency streambank and shoreline erosion protection for public facilities and services.

National Flood Insurance Act. The National Flood Insurance Program (NFIP) was established in 1968 by the National Flood Insurance Act. The intent of this act is to encourage communities to mitigate future flood damage by adopting and enforcing strict floodplain management ordinances in accordance with federal regulations. The Act made federally subsidized flood insurance available in communities which participate in the NFIP. In Nevada, 15 counties and 13 incorporated cities voluntarily participate in the NFIP. The Federal Emergency Management Agency (FEMA) administers the program, providing flood insurance studies and mapping for participating communities. The flood insurance studies are used for development of the Flood Insurance Rate Maps (FIRMs) that are adopted and incorporated by reference into the Flood Hazard Reduction Ordinances administered by each community. In Nevada, the Division of Water Planning has responsibility for oversight and implementation of the NFIP.

Emergency Watershed Protection. The Emergency Watershed Protection program (EWP) is administered by the Natural Resource Conservation Service (NRCS). The program provides technical and financial assistance to restore small watersheds damaged by flooding.

State Floodplain Management. Following the flooding experienced in northern Nevada in 1997, the Division of Water Planning was designated as the lead agency for floodplain management at the State level. The Division's floodplain management duties include implementation of the Community Assistance Program (CAP) and Flood Mitigation Assistance program (FMA), sponsored by FEMA. Under CAP, the Division provides technical assistance and training as needed to help communities achieve and maintain compliance with NFIP requirements. FMA grants are for mitigation projects aimed at reducing repetitive insurance losses and future damage.

The Channel Clearance program is managed by the Nevada Division of Water Resources. The program provides funding for channel clearance maintenance, restoration, surveying and monumenting. During the 1997 State Legislative Session, Senate Bill 218 was passed, establishing a state fund of \$4 million to help communities recover from damages sustained in the event of a disaster. The fund is administered by the Legislative Counsel Bureau.

Local Floodplain Management. Regulations for the development of local flood control districts are described in the Nevada Revised Statutes (NRS) 543. The Clark County Regional Flood Control District was formed under this statute in 1985. The Clark County Regional Flood Control District is a proactive regional entity with the mission of protecting life and property from flood impacts through implementation of flood control infrastructure.

State Drought Plan and the Drought Review and Reporting Committee. During the first year of the 1987-94 drought, Governor Bryan formed the Drought Review and Reporting Committee (DRRC) to monitor drought severity and recommend actions. By 1991, the Division of Water Planning, with assistance from the Governor's DRRC and the Advisory Board for Water Resource Planning and Development, developed the State Drought Plan. The Drought Plan defines drought stages (warning, severe, emergency), and establishes the roles of the DRRC, drought task forces and other agencies during the various drought stages.

Conservation

Service Connection Metering. A majority of the public water system withdrawals (in terms of volume) are metered, however not all deliveries to each service connection are metered. For example, only about 25 percent of residences in Reno/Sparks have water meters. Water meters were initially prohibited in the cities of Reno and Sparks by a 1919 statute (NRS 704.230). Since that time, gradual changes have occurred which: 1) require meters on all businesses (1977) and on all new homes built after 1988; and 2) allow meters on residences upon owner request and under certain conditions tied to the Negotiated Settlement (1990).

Low Flow Plumbing Standards. The Nevada Legislature passed Assembly Bill 359 in 1991 thereby imposing certain minimum standards for plumbing fixtures (toilets, showers, faucets and urinals) in new construction and expansions in residential, industrial, commercial and public buildings. Each

county and city was required to include these requirements in its building code or to adopt these requirements by ordinance, and to prohibit by ordinance the sale and installation of any plumbing fixture which does not meet the minimum standards.

Conservation Plans. In 1991, the Nevada Legislature passed Senate Bill 360 requiring all water purveyors (that supply water for municipal, industrial or domestic purposes) to adopt conservation plans before July 1, 1992. Public water purveyors were to submit their plans to the Division of Water Planning for review and approval before adoption (NRS 540.121 through 540.151). Private utilities were to submit their plans to the Public Service Commission (NRS 704.662 through 704.6624). However, Senate Bill 360 did not require periodic plan updates or progress reports.

U.S. Bureau of Reclamation Conservation Plans. On October 12, 1982, the Reclamation Reform Act (RRA) was signed into law. One of the provisions of the RRA requires each district, that has entered into a repayment contract or water service contract, to develop a water conservation plan. The plan is to contain definite goals, appropriate water conservation measures, and a time schedule for meeting the water conservation objectives. This provision of the RRA impacts districts such as the Truckee Carson Irrigation District and Pershing County Water Conservation District. Through their Field Services Program, Reclamation's intent is to encourage the consideration and incorporation of prudent and responsible water conservation measures in district operations.

Local and State Water Planning and Management

Many local and state entities have statutory authorities related to water use, management, protection and development. Some of the authorities are summarized in Tables 2-1 and 2-2.

Table 2-1. Local Organization Statutory Authority

Category	Agency	Program	Authority (NRS)
Water Supply	Cities	Water Facilities	266.285
	Counties	Water Facilities	244.366
	General Improvement Districts	Water Facilities	318.144
	Irrigation Districts	Irrigation	539.010 - 539.783
	Water Conservancy Districts	Water Supply	541.010 - 541.420
Water Quality	Cities	Sewer Facilities	266.285
	Counties	Sewer Facilities	244.366
	General Improvement Districts	Sewer Facilities	318.140
Environmental Uses	Conservation Districts	Conservation of Natural Resources	548.010 - 548.550
Flood Management	Flood Control Districts	Flood Control	543.170 - 543.830
	Water Conservancy Districts	Flood Control and Drainage	541.010 - 541.420
Water Planning and Management	Cities	Master Plan	278.150 - 278.230
	Counties	Regional Plan	278.0272 - 278.029
		Master Plan	278.150 - 278.230

Table 2-2. State Agency Statutory Authority

Category	Agency	Program	Authority (NRS)
Water Supply and Allocation	State Engineer's Office (Division of Water Resources)	Water Right Adjudication and Appropriation	533
		Groundwater Regulation	534
	Division of Water Planning	Small Community Grant Program	349.980 - 349.987
		Conservation Plans	540.121 - 540.151
	Public Utilities Commission	Regulation of Public Utilities	704.001 - 704.960
		Utility Environmental Protection Act (UEPA)	704.001 - 704.960
Conservation Plans		704.662 - 704.6624	
Water Quality	Division of Environmental Protection	Water Pollution Control Clean Water Act State Groundwater Permit Safe Drinking Water Act Mining Reclamation	445A.300 - 445.730 519A.010 - 519A.280
		Division of Agriculture	Control of Pesticides
	Bureau of Health Protection Services, Health Division	Safe Drinking Water Act	445A.800 - 445A.955
		Control of Septic Systems	444.650
Environmental and Recreational Uses	Division of Wildlife	Boating Safety	488, 501.243
		Wildlife Management and Propagation	504.140 - 504.490
		Protection of Threatened Species	503.584
	Natural Heritage Program	Threatened and Endangered Species Database	527.260 - 527.300
	Division of Parks	Park Facilities	407.011 - 407.250
	Division of Forestry	Protection and Preservation of Timbered Lands, Trees and Flora	527.010 - 527.330
Forest Practice and Reforestation		528.010 - 528.120	
Flood Management	Division of Water Planning	National Flood Insurance Program (Community Assistance, Flood Mitigation Assistance)	540
	Division of Water Resources	Dam Safety	535.005 - 535.110
		Channel Clearance	532.220 - 532.230
	Division of Emergency Management	Hazard Mitigation Grant	414
	Division of Forestry	Forest/Vegetative Cover for Flood Prevention	472.043
Department of Conservation and Natural Resources	Flood Control Loans	543.090 - 543.140	
Water Planning and Management	Division of Water Planning	State Water Plan	540.101
		Planning Assistance	540.011 - 540.151

Regional Plans

According to Nevada Revised Statutes 540.101(2), the Division of Water Planning is to coordinate with local governments (political subdivisions) in developing the *State Water Plan*, and upon the request of the Division, each local government shall cooperate with and assist the Division in the development of the Plan. Following is a summary of selected regional planning efforts that are underway. These planning efforts will provide valuable information for the *State Water Plan*.

Southern Nevada Water Authority Water Resource Plan

The Southern Nevada Water Authority (SNWA) was created in 1991 through a cooperative agreement among the seven regional water and wastewater agencies, including Big Bend Water District (Laughlin); City of Boulder City; Clark County Sanitation District; City of Henderson; City of Las Vegas; Las Vegas Valley Water District; and City of North Las Vegas. The purposes of SNWA are to seek new water resources for Southern Nevada, to manage existing and future water resources, to construct and manage regional water facilities, and to promote responsible conservation. The SNWA Water Resource Plan was completed January 1996, and amended February 1997.

Washoe County Comprehensive Regional Water Management Plan

In 1995, the Nevada State Legislature approved legislation which created the Regional Water Planning Commission and provided the basis and direction for the Commission and the 1995-2015 Washoe County Comprehensive Regional Water Management Plan. This legislation required that the Commission develop "...a comprehensive plan for the region covering the supply of municipal and industrial water, quality of water, sanitary sewerage, treatment of sewerage, drainage of storm waters and control of floods." The Plan was completed and approved by the 1997 State Legislature.

Clark County Regional Flood Control District Flood Control Master Plan

In response to major floods in 1983 and 1984, the Clark County Regional Flood Control District (CCRFCD) was established in 1985 to develop a regional flood control program for the Las Vegas Valley and surrounding environs. As part of the CCRFCD mandate, a comprehensive, regional Master Plan was prepared and adopted in 1986. The principal objective of the Master Plan is to provide for the long-term improvement in public safety and property damage protection from flooding events by guiding the siting, design, and installation of flood control facilities. Periodic Master Plan updates are required by law to account for changes in land use, the construction of new facilities, and for improved hydrologic and hydraulic data.

Water Quality Management Plans (Section 208 of the Clean Water Act)

Section 208 of the federal Clean Water Act was promulgated for the purpose of encouraging and facilitating the development and implementation of areawide waste treatment management plans. Section 208 plans have been developed for all areas of Nevada.

City/County Master Plans

Nevada Revised Statutes 278.150 requires each city and county to prepare and adopt a comprehensive, long-term general plan for the physical development of the city, county or region. The master plan may address a variety of matters, such as conservation, land use, population, public services and facilities, recreation, and solid waste disposal.

Water Resources Data Collection and Research

A majority of the available water resources data in Nevada is collected by a variety of state and federal entities, such as U.S. Geological Survey (USGS), Desert Research Institute (DRI), Natural Resources Conservation Service, Nevada Division of Environmental Protection, Nevada Division of Water Resources, Nevada Health Division, and the Nevada State Health Laboratory. The main types of water resources data include: streamflow data and forecasts, lake and reservoir water levels, groundwater levels, water usage, water right information, water quality data, treatment plant discharges, snowpack amounts, precipitation, and temperature. Much of the research related to Nevada's water resources is performed by USGS, DRI and University of Nevada Reno (Department of Environmental and Natural Resource Sciences; Applied Economics and Statistics).

Funding Opportunities

A variety of state and federal funding sources exist for the planning, management, protection and development of our water resources as shown in Table 2-3. These funding programs are described in more detail in Part 1, Section 1 of the *State Water Plan*.

Table 2-3. Selected Funding Programs

Agency	Program
State Agencies	
Division of Water Planning	Grants for Capital Improvements to Community Water Systems
Division of Environmental Protection	Clean Water Act Section 319 Nonpoint Source Implementation Grant Program
	Clean Water Act State Revolving Loan Fund
Division of Water Resources	Channel Clearance Program
Commission on Economic Development	Community Development Block Grant Program
Department of Business and Industry	Water Projects Financing Program
Division of Health, Bureau of Health Protection Services	Safe Drinking Water Act State Revolving Loan Fund
Legislative Counsel Bureau	Disaster Relief Fund
Federal Agencies	
Department of Agriculture, Rural Development	Rural Utilities Service Program
Environmental Protection Agency	Clean Water Act Section 104 (b)(3) Wetland Protection Development Grants
Natural Resources Conservation Service; Fish and Wildlife Service	Wetlands Reserve Program
Natural Resources Conservation Service	Environmental Quality Incentive Programs
Federal Emergency Management Agency	Flood Mitigation Assistance Grants

**Nevada State Water Plan
SUMMARY**

**Section 3
Water Resources and Use Assessment**

Introduction

An understanding of the state's water resources and its usage is a necessary component to the planning and management process. This section provides an overview of the physical characteristics of Nevada's water resources and historic water use for the last 25 years.

Water Resources Background

The following discussion provides an overview of Nevada's surface water and groundwater resources.

Topography

The topography of Nevada and the surrounding areas makes for a unique and diversified climate. Nearly all of Nevada is in the Basin and Range Province of the Intermountain Plateaus, a rugged elevated area between the Rocky Mountains and the Pacific mountain system. The topography of the Basin and Range province is characterized by isolated, long and narrow, roughly north-south trending, parallel mountain ranges and broad, intervening valleys. Internal drainage is a significant feature of the hydrology of much of Nevada with about 84 percent of the drainage flowing to low areas in enclosed basins rather than to the sea.

The topography and related geology of the State has resulted in complex surface and ground water systems, complicating the management of these resources. In the 1960s, the Nevada State Engineer's Office and the U.S. Geological Survey (USGS) recognized the need for a systematic identification of the valleys or hydrographic areas, and developed a hydrographic area map. The current hydrographic area map delineates 256 hydrographic areas within 14 major hydrographic regions and basins (Figure 3-1, Table 3-1). Of the 14 hydrographic regions and basins, only the Snake River Basin and the Colorado River Basin drain to the sea.

Figure 3-1 - Hydrographic Regions and Basins

Table 3-1. List of Hydrographic Areas

1. NORTHWEST REGION

1. Pueblo Valley
2. Continental Lake Valley
3. Gridley Lake Valley
4. Virgin Valley
5. Sage Hen Valley
6. Guano Valley
7. Swan Lake Valley
8. Massacre Lake Valley
9. Long Valley
10. Macy Flat
11. Coleman Valley
12. Mosquito Valley
13. Warner Valley
14. Surprise Valley
15. Boulder Valley
16. Duck Lake Valley

2. BLACK ROCK DESERT REGION

17. Pilgrim Flat
18. Painter Flat
19. Dry Valley
20. Sano Valley
21. Smoke Creek Desert
22. San Emidio Desert
23. Granite Basin
24. Hualapai Flat
25. High Rock Lake Valley
26. Mud Meadow
27. Summit Lake Valley
28. Black Rock Desert
29. Pine Forest Valley
30. Kings River Valley
 - (A) Rio King Subarea
 - (B) Sod House Subarea
31. Desert Valley
32. Silver State Valley
33. Quinn River Valley
 - (A) Orovada Subarea
 - (B) McDermitt Subarea

3. SNAKE RIVER BASIN

34. Little Owyhee River Area
35. South Fork Owyhee River Area
36. Independence Valley
37. Owyhee River Area
38. Bruneau River Area
39. Jarbidge River Area
40. Salmon Falls Creek Area
41. Goose Creek Area

4. HUMBOLDT RIVER BASIN

42. Marys River Area
43. Starr Valley Area
44. North Fork Area
45. Lamoille Valley
46. South Fork Area
47. Huntington Valley
48. Dixie Creek - Tenmile Creek Area
49. Elko Segment
50. Susie Creek Area
51. Maggie Creek Area
52. Marys Creek Area
53. Pine Valley
54. Crescent Valley
55. Carico Lake Valley
56. Upper Reese River Valley
57. Antelope Valley
58. Middle Reese River Valley
59. Lower Reese River Valley
60. Whirlwind Valley
61. Boulder Flat
62. Rock Creek Valley
63. Willow Creek Valley
64. Clovers Area
65. Pumpnickel Valley
66. Kelly Creek Area
67. Little Humboldt Valley
68. Hardscrabble Area
69. Paradise Valley
70. Winnemucca Segment
71. Grass Valley
72. Imlay Area
73. Lovelock Subarea
 - (A) Oreana Subarea
74. White Plains

5. WEST CENTRAL REGION

75. Bradys Hot Springs Area
76. Fernley Area
77. Fireball Valley
78. Granite Springs Valley
79. Kumiva Valley

6. TRUCKEE RIVER BASIN

80. Winnemucca Lake Valley
81. Pyramid Lake Valley
82. Dodge Flat
83. Tracy Segment
84. Warm Springs Valley
85. Spanish Springs Valley
86. Sun Valley
87. Truckee Meadows
88. Pleasant Valley
89. Washoe Valley
90. Lake Tahoe Basin
91. Truckee Canyon Segment

7. WESTERN REGION

92. Lemmon Valley
 - (A) Western Part
 - (B) Eastern Part
93. Antelope Valley
94. Bedell Flat
95. Dry Valley
96. Newcomb Lake Valley
97. Honey Lake Valley
98. Skeddadle Creek Valley
99. Red Rock Valley
100. Cold Spring Valley
 - (A) Long Valley

8. CARSON RIVER BASIN

101. Carson Desert
 - (A) Packard Valley
102. Churchill Valley
103. Dayton Valley
104. Eagle Valley
105. Carson Valley

9. WALKER RIVER BASIN

106. Antelope Valley
107. Smith Valley
108. Mason Valley
109. East Walker Area
110. Walker Lake Valley
 - (A) Schurz Subarea
 - (B) Lake Subarea
 - (C) Whisky Flat - Hawthorne Subarea

10. CENTRAL REGION

111. Alkali Valley (Mineral)
 - (A) Northern Part
 - (B) Southern Part
112. Mono Valley
113. Huntoon Valley
114. Teels Marsh Valley
115. Adobe Valley
116. Queen Valley
117. Fish Lake Valley
118. Columbus Salt Marsh Valley
119. Rhodes Salt Marsh Valley
120. Garfield Flat
121. Soda Spring Valley
 - (A) Eastern Part
 - (B) Western Part
122. Gabbs Valley
123. Rawhide Flats
124. Fairview Valley
125. Singaree Valley
126. Cowkick Valley
127. Eastgate Valley Area
128. Dixie Valley
129. Buena Vista Valley
130. Pleasant Valley
131. Buffalo Valley
132. Jersey Valley
133. Edwards Creek Valley
134. Smith Creek Valley
135. Ione Valley
136. Monte Cristo Valley
137. Big Smoky Valley
 - (A) Tonopah Flat
- (B) Northern Part
138. Grass Valley
139. Kobeh Valley
140. Monitor Valley
 - (A) Northern Part
 - (B) Southern Part
141. Ralston Valley
142. Alkali Spring Valley (Esmeralda)
143. Clayton Valley
144. Lida Valley
145. Stonewall Flat
146. Sarcobatus Flat
147. Gold Flat
148. Cactus Flat
149. Stone Cabin Flat
150. Little Fish Lake Valley
151. Antelope Valley (Eureka & Nye)
152. Stevens Basin
153. Diamond Valley
154. Newark Valley
155. Little Smoky Valley
 - (A) Northern Part
 - (B) Central Part
 - (C) Southern Part
156. Hot Creek Valley
157. Kawich Valley
158. Emigrant Valley
 - (A) Groom Lake Valley
 - (B) Papoose Lake Valley
159. Yucca Flat
160. Frenchman Flat
161. Indian Springs Valley
162. Pahrump Valley
163. Mesquite Valley (Sandy Valley)
164. Ivanpah Valley
 - (A) Northern Part
 - (B) Southern Part
165. Jean Lake Valley
166. Hidden Valley (South)
167. Eldorado Valley
168. Three Lakes Valley (Northern Part)
169. Tikapoo Valley (Tickaboo Valley)
 - (A) Northern Part
 - (B) Southern Part
170. Penoyer Valley (Sand Spring Valley)
171. Coal Valley
172. Garden Valley
173. Railroad Valley
 - (A) Southern Part
 - (B) Northern Part
174. Jakes Valley
175. Long Valley
176. Ruby Valley
177. Clover Valley
178. Butte Valley
 - (A) Northern Part (Round Valley)
 - (B) Southern Part
179. Steptoe Valley
180. Cave Valley
181. Dry Lake Valley
182. Delamar Valley
183. Lake Valley
184. Spring Valley
185. Tippet Valley
186. Antelope Valley (White Pine & Elko)
 - (A) Southern Part
 - (B) Northern Part
187. Goshute Valley
188. Independence Valley (Pequop Valley)

11. GREAT SALT LAKE BASIN

189. Thousand Springs Valley
 - (A) Herrill Siding - Brush Creek Area
 - (B) Toano - Rock Spring Area
 - (C) Montello - Crittenden Creek Area (Montello Valley)
190. Grouse Creek Valley
191. Pilot Creek Valley
192. Great Salt Lake Desert
193. Deep Creek Valley
194. Pleasant Valley
195. Snake Valley
196. Hamlin Valley

12. ESCALANTE DESERT

197. Escalante Desert

13. COLORADO RIVER BASIN

198. Dry Valley
199. Rose Valley
200. Eagle Valley
201. Spring Valley
202. Patterson Valley
203. Panaca Valley
204. Clover Valley
205. Lower Meadow Valley Wash
206. Kane Springs Valley
207. White River Valley
208. Pahroc Valley
209. Pahrnagat Valley
210. Coyote Spring Valley
211. Three Lakes Valley (Southern Part)
212. Las Vegas Valley
213. Colorado Valley
214. Piute Valley
215. Black Mountains Area
216. Garnet Valley (Dry Lake Valley)
217. Hidden Valley (North)
218. California Wash
219. Muddy River Springs Area (Upper Moapa Valley)
220. Lower Moapa Valley
221. Tule Desert
222. Virgin River Valley
223. Gold Butte Area
224. Greasewood Basin

14. DEATH VALLEY BASIN

225. Mercury Valley
226. Rock Valley
227. Fortymile Canyon
 - (A) Jackass Flats
 - (B) Buckboard Mesa
228. Oasis Valley
229. Crater Flat
230. Amargosa Desert
231. Grapevine Canyon
232. Oriental Wash

Climate

Nevada is truly a land of great climatic differences. The climate of Nevada is characterized as semi-arid to arid. Temperatures can fall below -40°F in the northeast, and rise over 120°F in the south. Precipitation can range from only three to four inches in Southern Nevada to over 40 inches (and over 300 inches of snowfall) in the Carson Range portion of the Sierra Nevada Mountains. With total precipitation averaging approximately nine inches per year, Nevada is the most arid state in the nation.

Surface Water

Surface water is a limited and precious resource in Nevada providing about 70 percent of the total water supply used in the state. Spring and summer snowmelt supplies most of the streamflow in Nevada. However, isolated summer convective storms probably cause a majority of the streamflow in southern Nevada's low altitude basins.

Major Rivers, Lakes and Reservoirs. Nevada can claim very few large rivers and streams compared to other states. With the exception of the Colorado River, Nevada's perennial rivers are small by nationwide standards. The rivers in the Snake River and Colorado River basin regions flow to the oceans, with the remaining stream systems discharging into terminal sinks and lakes. The major river systems in Nevada are the Colorado, Walker, Carson, Truckee, and Humboldt (Figure 3-2). Table 3-2 summarizes the main lakes and reservoirs within these river systems and in Nevada.

Streamflow Characteristics. Most of the streamflow in Nevada is the result of runoff from melting snow. Runoff patterns in Nevada vary seasonally and geographically, and are mainly determined by precipitation patterns (location and timing) and other climate patterns, such as temperature. Other factors such as surface geology, vegetation, land use affect the amount of runoff entering the rivers and streams. Streamflows are further affected by human-induced influences such as diversions and reservoir operations.

Table 3-3 summarizes some basic streamflow characteristics for selected USGS gaging stations throughout Nevada. As shown, average annual flows vary widely from river to river. Within a given river system, flows fluctuate year to year in response to changes in precipitation amounts. Monthly and annual flows for the Humboldt River are shown on Figures 3-3 and 3-4.

Water Yields and Committed Resources. The estimated average annual yield from Nevada's surface water systems is approximately 3.2 million acre-feet per year (Table 3-4). Generally, Nevada's surface water sources, such as lakes, streams and springs, have been fully appropriated and used for many years. In some instances, water may be available from these sources during high water years, however storage facilities would be required to capture the surplus flows for later use.

Figure 3-2 - Rivers

Table 3-2. Major Lakes and Reservoirs of Nevada and Portions of California

Hydrographic Region	Lake/Reservoir	Surface Area, acres	Active Storage Capacity, acre-feet	Total Storage Capacity, acre-feet
Carson River	Lahontan Reservoir	14,600	317,000	317,000
Colorado River	Lake Mead	158,000	26,200,000	29,700,000
	Lake Mohave	28,000	1,810,000	1,820,000
Humboldt River	Pitt-Taylor Reservoir, Lower	2,570	22,200	22,200
	Pitt-Taylor Reservoir, Upper	2,070	24,200	24,200
	Rye Patch Reservoir	12,400	194,300	194,300
	South Fork Reservoir	1,650	41,000	41,000
Snake River	Wild Horse Reservoir	2,830	73,500	73,500
Truckee River	Big and Little Washoe Lakes	5,800	14,000	38,000
	Boca Reservoir	980	40,870	41,110
	Donner Lake	800	9,500	Not reported
	Independence Lake	700	17,500	Not reported
	Lake Tahoe	124,000	744,600	125,000,000
	Martis Creek Lake	770	20,400	21,200
	Prosser Creek Reservoir	750	28,640	29,840
	Pyramid Lake ¹	111,400 (as of 9/30/96)	not applicable	21,760,000 (as of 9/30/96)
	Stampede Reservoir	3,440	221,860	226,500
Walker River	Bridgeport Reservoir	2,914	40,500	40,500
	Topaz Lake	2,410	61,000	126,000
	Walker Lake ¹	33,500 (as of 9/30/96)	not applicable	2,153,000 (as of 9/30/96)
	Weber Reservoir	950	13,000	13,000

¹Pyramid and Walker lakes are natural terminal lakes with no outlet.

Table 3-3. Summary of Streamflow Data for Selected Gaging Stations

Hydrographic Region	Gaging Station Name (Number)	Period of Record	Annual Streamflow Statistics, acre-feet		
			Average Annual	Lowest Annual	Highest Annual
Carson River	East Fork Carson River near Gardnerville, NV (10309000)	1890-1997	278,800	66,300	655,200
	West Fork Carson River at Woodfords, CA (10310000)	1901-97	81,000	18,900	210,000
	Carson River near Carson City, NV (10311000)	1940-97	298,700	42,400	826,800
	Carson River near Ft. Churchill, NV (10312000)	1911-97	272,900	26,300	804,400
Colorado River	Virgin River at Littlefield, AZ (09415000)	1930-97	175,600	72,400	504,600
	Muddy River near Glendale, NV (09419000)	1913-97	30,600	23,500	35,900
	Colorado River below Hoover Dam, AZ-NV (09421500)	1935-97	10,050,000	5,556,000	22,150,000
Humboldt River	Humboldt River at Palisade, NV (10322500)	1903-97	288,800	25,200	1,336,000
	Humboldt River near Imlay, NV (10333000)	1935-97	201,000	18,800	1,460,000
Snake River	Owyhee River above China Diversion Dam near Owyhee, NV (13176000)	1939-84	107,600	33,500	230,800
Truckee River	Truckee River at Farad, CA (10346000)	1909-97	554,500	133,200	1,769,000
	Truckee River at Reno, NV (10348000)	1907-96	492,500	76,700	1,701,000
	Truckee River below Derby Dam near Wadsworth, NV (10351600)	1918-97	289,100	4,500	1,759,000
Walker River	East Walker River near Bridgeport, CA (10293000)	1922-97	105,800	27,100	320,700
	West Walker near Coleville, CA (10296500)	1903-97	202,100	53,900	484,300
	Walker River near Wabuska, NV (10301500)	1902-97	123,300	9,300	602,300

Note: Some years of data may be missing within each period of record.

Source: U.S. Geological Survey

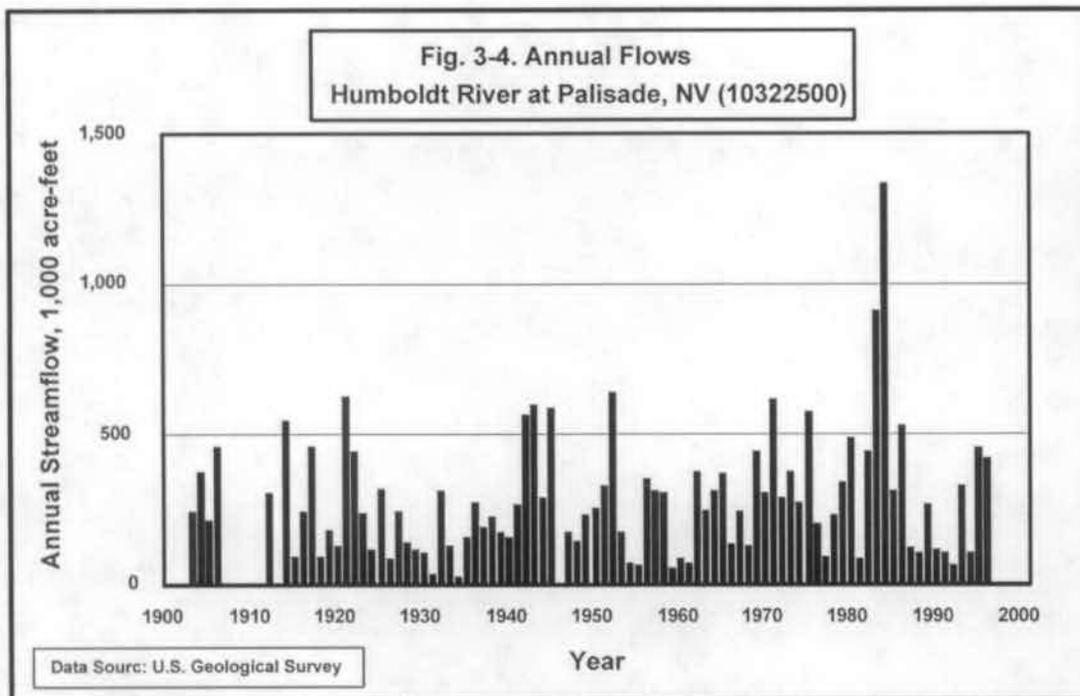
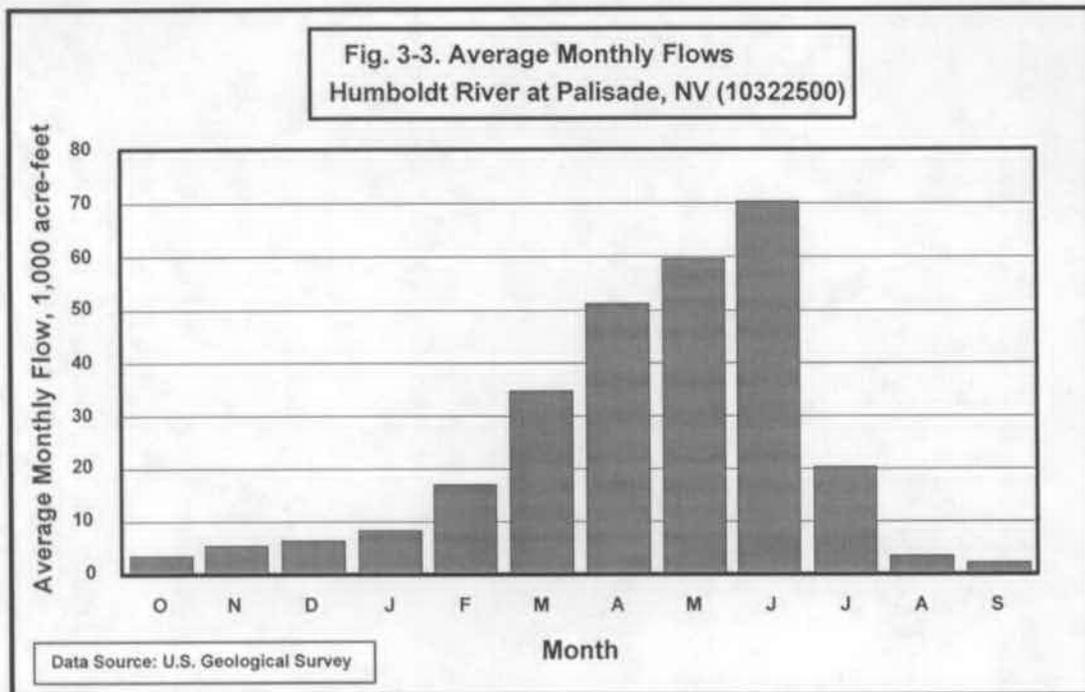


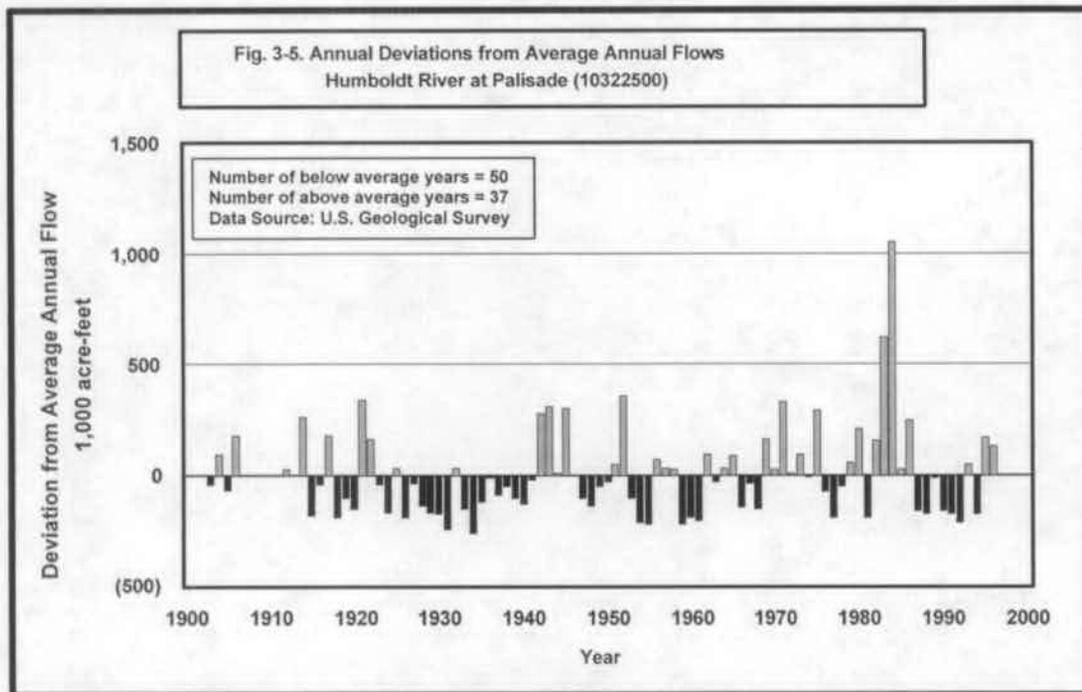
Table 3-4. Summary of Surface Water Runoff and Flows (excluding Colorado River)

Description	Acre-feet per year
Average Annual Surface Runoff	
From Watersheds within Nevada	1,900,000
Inflow from Other States	1,300,000
Total	3,200,000
Average Annual Surface Outflow to Other States	700,000

Source: "Water for Nevada, Report No. 3", State Engineer's Office, 1971

Droughts and Floods. Nevada is a land of extremes, with droughts and floods common in our highly variable climate. Years of average streamflows are rarely experienced. Periods of high flows followed by low flows are more the norm in Nevada.

Drought periods (consecutive years with streamflows much less than average) are frequent in Nevada. In many cases, Nevada's river systems experience more "below average water years" than "above average water years" (Figure 3-5).



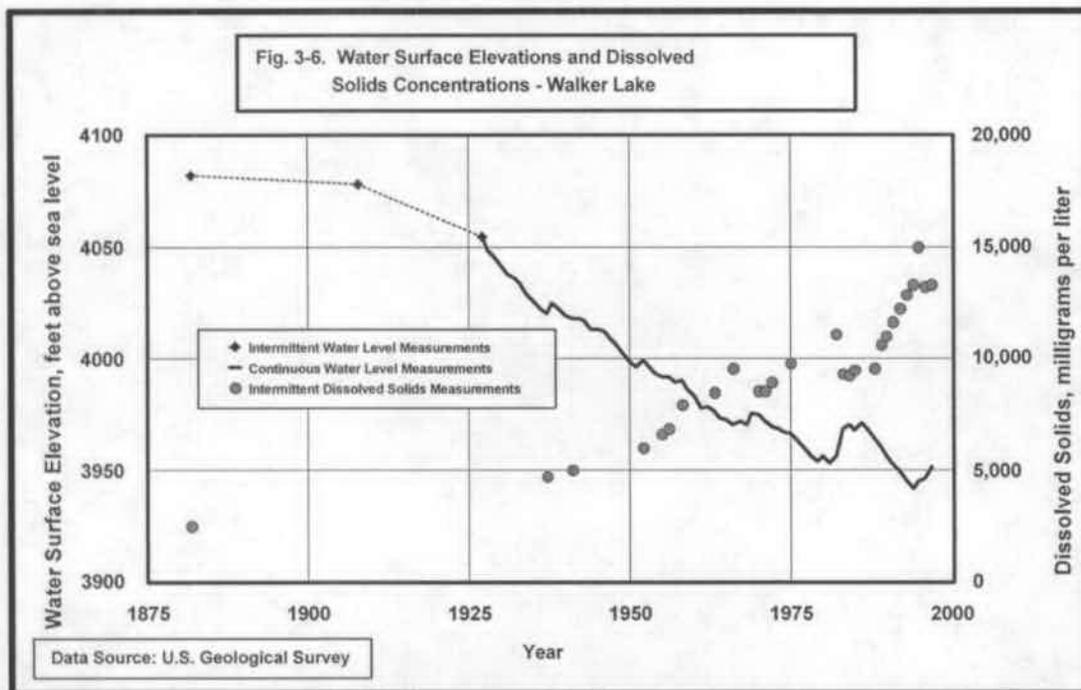
Even though Nevada is the driest state with an average annual precipitation of nine inches, floods are

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common and have occurred in all parts of the state. The effects of floods in Nevada have increased steadily as population and development have increased since the mid-1900s. Development has encroached upon natural floodplains, including alluvial fans, and thereby increased flood damage risks.

On the Truckee, Carson, and Walker rivers in west-central Nevada, the most severe floods have resulted from winter rains on snow in the Sierra Nevada Mountains. In the large drainages in southern Nevada, and small drainages and alluvial fans throughout Nevada, flash floods resulting from intense rainfall over relatively small areas are the most common.

Water Quality. Nevada's surface water quality is regulated by the Nevada Division of Environmental Protection (NDEP) and the State Environmental Commission (SEC). The quality of surface water in Nevada varies greatly from location to location and from month to month with changes in flows. In planning, both water quantity and quality need to be considered concurrently as both are interrelated. In general, constituent concentrations vary with changes in streamflow. Similarly, lake water quality has deteriorated with lowering water levels in the State's terminal lakes, such as Walker Lake (see Figure 3-6).



Groundwater

Groundwater in Nevada is an important water supply source. The surface water resources in our state have been virtually fully appropriated and future development must rely on either ground-water sources or the reallocation of surface water supplies. Groundwater provides about 40 percent of the total water supply used in Nevada and in some areas provides the entire supply. The extent to which groundwater is used may vary considerably from year to year. In many areas, groundwater is pumped to supplement surface water sources. As a result, groundwater usage in these areas increases during periods of low streamflow and decreases during high runoff periods.

Principal Ground-water Aquifers. Principal ground-water aquifers in Nevada are basin-fill aquifers, carbonate-rock aquifers, volcanic-rock aquifers, and volcanic- and sedimentary-rock aquifers. The basin-fill aquifers, composed primarily of alluvial, colluvial and lacustrine deposits, are the major aquifers in the State. Virtually all major ground-water development has been in the basin-fill aquifers with the withdrawals from the upper 500 feet of these aquifers. In eastern and southern Nevada, thick sequences of carbonate rock underlie many of the alluvial basins forming a complex regional aquifer system or systems that are largely undeveloped and not yet fully understood. The carbonate-rock aquifer supplies water to numerous springs which are used for irrigation. Volcanic-rock aquifers extend over hundreds of square miles but only one volcanic-rock aquifer in the Carson Desert (Churchill County) of west-central Nevada has been developed as a municipal water supply.

Perennial Yield and Committed Resources. Perennial yield is the amount of usable water from a ground-water aquifer which can be economically withdrawn and consumed each year for an indefinite period of time without depleting the source. Estimates of perennial yield are necessary to provide the State Engineer with a guideline by which to limit groundwater allocations (committed resources). Over the years, the USGS has developed a series of perennial yield estimates.

Under the authority granted in Nevada Revised Statutes 534, the State Engineer issues groundwater rights. The term “committed resource” represents the total volume of the permitted, certificated and vested groundwater rights which are recognized by the State Engineer and generally can be withdrawn from a basin or area in any given year. When reviewing groundwater right applications, the State Engineer considers the individual and regional perennial yield estimates, system yield estimates, and the committed resources amounts among other things in making his determination.

To assist in the tracking of the committed groundwater resources, NDWR maintains a computer database of state-issued water rights. Based upon this database, the total committed groundwater resource amount in Nevada equals about 3 million acre-feet per year (as of March/April 1998). The term “committed” refers to those water rights that are either permitted or certificated. Table 3-5 summarizes the committed resources by hydrographic region and by type of use. Committed resource values presented in the *State Water Plan* are time sensitive and subject to change from future actions on pending applications and other procedures. It must be noted that the 3 million acre-feet figure is calculated from NDWR database output and represents the estimated amount of the groundwater resources committed (permitted or certificated) to a particular beneficial use. The database is still under development and all committed resource numbers presented in the *State Water*

Table 3-5. Approximate Perennial Yield and Committed Groundwater Resources (as of March/April 1998) by Use and Hydrographic Region

Hydrographic Region	Combined Perennial Yield, acre-feet per year	Committed Groundwater Resources by Category, acre-feet per year (as of March/April 1998)					
		Irrigation & Stock	Municipal & Quasi-municipal	Mining & Milling ¹	Commercial & Industrial	Other ²	Total
1. Northwest Region	55,500	28,625	6	132	5	64	28,832
2. Black Rock Desert Region	178,825	215,658 ³	608	58,952 ⁴	920 ⁵	1,687 ⁵	277,825
3. Snake River Basin	62,100	8,091	1,145	7,813	4,877	511	22,437
4. Humboldt River Basin	463,900	492,307 ^{3,6}	53,737	141,576	63,637 ⁵	91,055 ⁷	842,312
5. West Central Region	8,200	1,678	8,743	58	28,249 ⁵	1,289	40,017
6. Truckee River Region	76,425	34,989 ³	83,902 ⁸	5,172	68,030 ⁵	19,014	211,107
7. Western Region	17,850	18,662	5,174	5,174	518	508	25,328
8. Carson River Basin	70,255	95,926 ³	62,438	4,068	12,979 ⁵	13,196 ⁵	188,607
9. Walker River Basin	57,300	205,354 ³	14,949	8,657	12,383 ⁹	6,019	247,362
10. Central Region	798,460	573,277	50,978	96,765	37,141 ⁵	9,775 ⁵	767,936
11. Great Salt Lake Basin	63,150	28,155	3,506	1,305	732	13	33,711
12. Escalante Desert Basin	1,000	2	0	0	0	0	2
13. Colorado River Basin	219,800	78,057 ³	101,362 ¹⁰	11,171	35,895	19,165 ¹¹	245,650
14. Death Valley Basin	24,550	22,325	2,154	6,086	638	333	31,536
TOTAL	2,097,315	1,803,106	388,702	342,221	266,004	162,629	2,962,662

General notes:

- A. Data on committed resources were obtained from the Nevada Division of Water Resources water rights database and represent estimated resources committed as of March/April 1998.
- B. The committed resources values include permitted and certificated amounts only.
- C. These numbers are preliminary and intended to be used for planning purposes only. Totals may include water rights that have not been adjusted for supplemental relationships with other groundwater rights. Also, totals do not include any adjustment for supplemental relationships with surface water rights. Values are subject to change due to pending water right applications, and possible cancellations and forfeitures.

Other notes:

- ¹ Mining is considered a temporary use by the State Engineer's Office and upon cessation of mining, many permits will expire. The "Mining & Milling" category includes only those rights associated with the consumptive use needs of the mines. Permits associated with dewatering operations are included in the "Other" category.
- ² "Other" includes following uses: domestic, environmental, power generation, recreation, storage, wildlife, other/decreed. Includes environmental permits issued for environmental cleanup projects. These environmental permits are temporary and expire upon cessation of cleanup activities.
- ³ Portions of rights are supplemental to surface water and are used only when surface water is not available.
- ⁴ Majority of rights held for a mine operation that is no longer pumping.
- ⁵ Portion of rights include geothermal pumpage for power generation, with majority of geothermal water reinjected into geothermal reservoir.
- ⁶ Portion of rights not exercised as mine pit dewatering discharge is being used as a substituted water source. See Footnote 7.
- ⁷ Includes rights associated with mine pit dewatering. Portion of withdrawals are used as a water source for irrigation. See Footnote 6.
- ⁸ Actual annual pumpage limited to lower value by State Engineer restrictions.
- ⁹ Portion of rights include geothermal pumpage for power generation, with some of geothermal water not reinjected.
- ¹⁰ Includes permits that will be revoked when water right holders provided water from another source (Colorado River).
- ¹¹ Includes environmental permits issued for environmental cleanup projects. These environmental permits are temporary and expire upon cessation of cleanup activities. Also includes permits granted for pumping of shallow poor quality groundwater in the Las Vegas area as needed to alleviate potential hazards resulting from rising groundwater levels caused by secondary recharge.

Plan are approximate. Actual groundwater withdrawal and consumption amounts are far less than the committed resource value of 3 million acre-feet from the NDWR database. In 1995, approximately 1.6 million acre-feet of groundwater was withdrawn with about 0.7 million acre-feet

consumed. There are a number of reasons for these differences:

- Some groundwater rights are *supplemental* to surface water rights and are only exercised during low surface water flow periods;
- In some basins, the NDWR database may be double counting a smaller portion of groundwater rights that are *supplemental* to other groundwater rights;
- Some groundwater rights may not be exercised to their fullest extent every year;
- Some groundwater rights are not currently being exercised as a water supply is being provided from another replacement source; and
- The State Engineer has placed administrative limits on pumping in some areas.

The committed resource figures derived from the NDWR database may not reflect long-term groundwater commitments for the following reasons:

- Mining is considered a temporary use by the State Engineer's Office. With some mines, existing water right permits will expire once the mining operations have ceased;
- Environmental permits issued for environmental cleanup projects are included in the committed resource figures in Table 3-5. The cleanup projects are considered temporary, and once a cleanup operation is complete the associated water rights expire; and
- The NDWR database includes committed resource amounts associated with revocable groundwater permits issued in the Las Vegas area. These rights will be revoked when the water right holders are provided water from another source, such as the Colorado River.

Designated Groundwater Basins. As the demand for groundwater has increased over the years, the State Engineer has had to increase administrative efforts in some of the groundwater basins. The State Engineer may designate a groundwater basin which is being depleted or is in need of additional administration. Basins are designated through orders issued by the State Engineer. By “designating” a basin, the State Engineer is granted additional authority in the administration of the groundwater resources within the designated basin.

Figure 3-7 displays the designation status for the 256 groundwater basins in Nevada. This map is a useful tool to generally determine where the greatest impediments to groundwater development may exist. However, the associated State Engineer's orders and rulings need to be examined for a complete understanding of the management issues and water availability within a basin. The designation status of basins as defined by the State Engineer's orders have been divided into four general categories as shown in Table 3-6.

Figure 3-7 Designated basins

Table 3-6. Designated Groundwater Basin Categories

Designation Status	General Description of Associated State Engineer's Orders
Designated	State Engineer's order(s) do not define any administrative controls.
Designated - Irrigation Denied	State Engineer's order(s) state that irrigation is <u>not</u> a preferred use in these basins and applications for new irrigation appropriations will be denied.
Designated - Preferred Uses	State Engineer's order(s) list certain types of uses as preferred in these basins, and quantity restrictions may be placed on these preferred uses.
Designated - Preferred Uses; Irrigation Denied	State Engineer's order(s) list certain types of uses as preferred in these basins. Quantity restrictions may be placed on these preferred uses. State Engineer's order(s) also state that irrigation is <u>not</u> a preferred use in these basins and applications for new irrigation appropriations will be denied. Other uses may also be listed as denied.

Whether or not a basin is designated dictates the procedures to be followed in obtaining a groundwater permit. In undesignated basins, a person can drill a well in these basins prior to filing an application for a groundwater permit. In designated basins, a groundwater permit must be obtained prior to drilling a well. Domestic wells are exempt from the permitting process, however, drillers are required to notify the State Engineer of their intent to drill a domestic well and submit a well log following completion.

Groundwater Levels. Groundwater levels fluctuate seasonally and annually in response to changes in pumpage and the climate. In some areas, groundwater levels during the late 1980s and early 1990s tended to decline due to heavier than average reliance upon groundwater during the drought of that period, but have been recovering with the return to normal and above-normal precipitation.

Groundwater Quality. The water quality in most aquifers in Nevada is suitable or marginally suitable for most uses, with constituent concentrations not exceeding State and national drinking water standards. However, there are parts of some aquifers with constituent concentrations exceeding these standards. It is important to realize that these excessive concentrations of certain constituents in groundwater may result from natural processes and/or human activities.

The quality of groundwater in the unconsolidated deposits in the Basin and Range alluvial aquifers varies from basin to basin. Dissolved-solids concentrations range from less than 500 parts per million (ppm) to more than 10,000 ppm in some areas. By comparison, ocean water has dissolved-solids concentrations of about 35,000 ppm. Locally, saline water is present near thermal springs and in areas where the basin-fill aquifers include large amounts of soluble salts. In discharge or sink areas such as the Carson and Humboldt sinks, the dissolved-solid concentrations can make the water economically unuseable. Although highly mineralized water is common in aquifers beneath playas, a deeper freshwater flow system may be present in some areas.

Historic and Current Water Use

Comprehensive water use information is critical to the success of all water planning and management functions. The following discussion provides an overview of historic and current water use estimates and discusses observed trends in Nevada's water use.

Estimating Water Use

It has been estimated that 50 to 75 percent of the total water withdrawn from groundwater and surface water sources in Nevada is actually measured, with only a portion of these data reported to any state planning agencies. Therefore in order to develop comprehensive statewide water use figures, it is necessary to generate estimates for many of the values. The most significant water use estimation program in Nevada is implemented by the U.S. Geological Survey (USGS) as part of the USGS National Water Use Information Program.

The USGS has the only program in Nevada responsible for estimating statewide water use on a routine and comprehensive basis. Staff in the USGS's National Water Use Information Program compile and disseminate water use information on local, state and national levels. In developing their estimates, the USGS staff work in cooperation with local, state, and federal agencies.

Since 1950, the USGS has estimated statewide water use at 5-year intervals and published these estimates in a national summary report. It must be stressed that the Nevada water use figures developed by USGS staff are estimates and that the water use values developed are based upon a mixture of measured and estimated water use. To the extent possible, the USGS compiles water use data collected by other agencies, water purveyors, and irrigation districts. Upon review of the USGS estimates, the Division of Water Planning identified some inconsistencies in the data. However, it is difficult to make adjustments to these data because the USGS does not produce a separate state water report documenting data sources and assumptions. Nevertheless, modifications were made by the Nevada Division of Water Planning (NDWP) as feasible to address a portion of these inconsistencies. Clearly a more comprehensive water measurement and/or estimation program is needed to improve water use quantification.

Current Water Use and Past Trends

This section presents statewide water use estimates for the period 1970-1995 at 5-year intervals (Tables 3-7 through 3-10). These estimates are divided into 8 categories of water use:

- public supply
- domestic
- commercial
- industrial
- thermoelectric
- mining
- irrigation
- livestock

Public Supply Water Use. *Public supply* refers to water withdrawn by public and private water suppliers and delivered for a variety of uses such as domestic, commercial, industrial, thermolectric, and public uses such as park landscape irrigation. Public supply-use is also referred to as Municipal and Industrial (M&I) water use. “Public supply systems” are defined as those which provide water to at least 25 people or 15 connections.

As expected, public supply water use has increased as Nevada’s population has grown. Public supply withdrawals have increased from approximately 151,000 acre-feet to 525,000 acre-feet from 1970 to 1995. For the same period, the population served by public supply systems increased from about 441,000 to about 1,488,000. From 1970 to 1990, public supply water use rates in Nevada increased from 306 to 334 gallons per capita per day (gpcd). Successful conservation programs during the 1990s have lowered statewide M&I water use down to 315 gpcd by 1995. A majority of this decrease was due to aggressive conservation in the Las Vegas area. For example, M&I use within the Las Vegas Valley Water District decreased from 358 gpcd in 1989 to 320 gpcd in 1997.

Domestic Water Use. *Domestic use* refers to water used for household purposes and includes both indoor and outdoor uses, such as drinking, food preparation, bathing, clothes and dish washing, and lawn and garden watering. Domestic water needs are met by either public supply systems or self-supplied systems (domestic wells, individual pumps, cisterns, etc.).

Domestic water use has increased over the years in response to the growing population. From 1970 to 1995, domestic water use increased from about 117,000 acre-feet to about 361,000 acre-feet. Nevada’s population increased from about 488,700 to 1,579,150 during the same period, with the percentage of people served by public supply systems increasing from about 90% to 94% of the total population.

Commercial Water Use. *Commercial use* includes water for casinos, motels, restaurants, office buildings, campgrounds, other commercial facilities, and civilian and military institutions. Commercial water needs are met by either public supply systems (community water systems) or self-supplied systems (non-community systems).

Commercial water use has increased from about 67,000 acre-feet to about 153,000 acre-feet during the period 1985 to 1995. Commercial water use trends cannot be established for previous years. Prior to 1985, the USGS had not provided water use estimates for commercial purposes as a separate category but rather commercial usage was aggregated under other uses.

Industrial Water Use. *Industrial use* includes water for manufacturing and construction. Industrial water needs are met by either public supply systems or self-supplied systems. Total industrial water use changed little during the period 1985 to 1995, ranging from about 14,000 to 19,000 acre-feet per year. Industrial water use trends cannot be established for previous years. Prior to 1985, the USGS did not separate out water use estimates for industrial purposes, rather industrial usage was aggregated with other uses.

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Thermoelectric Water Use. *Thermoelectric use* includes water used in the production of electric power generation from fossil fuel and geothermal sources. Nevada has 22 thermoelectric powerplants of which 7 are fossil fueled and 15 are geothermal. Total thermoelectric water use has more than doubled from 1985 to 1995 increasing from about 29,000 acre-feet to 65,000 acre-feet. Over the 10 year period, public supply systems provided a minor portion of the total thermoelectric water used. Usage trends cannot be presented for previous years. Prior to 1985, the USGS did not compile water use estimates for all thermoelectric purposes as a separate category.

Mining Water Use. *Mining use* refers to water used in the extraction, milling, and processing of naturally occurring minerals (including petroleum), and other activities that are part of mining, such as dust control. Minerals mined in Nevada can be divided into two categories, metals and industrial minerals. Metals mined in Nevada include gold, silver, lead, zinc, molybdenum and copper. Mined industrial minerals include aggregate, barite, cement, clay, gypsum, lime, diatomite, lithium carbonate and silica. Water use varies widely from operation to operation and is dependent upon the mineral being recovered and the recovery process employed.

Mining water withdrawals have changed significantly, increasing from about 27,000 acre-feet in 1985 to about 274,000 acre-feet in 1995. A majority of this increase is attributable to an increase in mining activities within the Humboldt River basin. Mining water use trends cannot be established for previous years. Prior to 1985, the USGS did not compile water use estimates for mining as a separate category.

Irrigation Water Use. *Irrigation use* refers to water withdrawn and applied to lands to grow crops and pasture as well as water used to irrigate golf courses and parks. Under this category, water for irrigation is self-supplied or supplied by irrigation companies or districts. Landscape watering included in the other categories, such as public supply, domestic, and commercial, is not included in the *irrigation use* category.

The main field crops grown in Nevada include alfalfa and other hay, alfalfa seed, winter and spring wheat, potatoes, garlic and onions. These crops account for about 70% of the total irrigated acreage. In addition to harvested field crops, about 30% of the irrigated acreage in Nevada is pasture.

USGS estimates (with 1995 Division of Water Planning modifications) show that irrigated acreage and water use decreased during the period 1970 to 1995. Withdrawals have decreased from about 3.4 million acre-feet in 1970 to about 3.1 million acre-feet in 1995. Due to the uncertainty with the data, it is unknown if this decrease is indicative of any statewide trend or is merely an artifact of the estimation process.

Livestock Water Use. *Livestock use* refers to water used for stock watering, feed lots, dairy operations, and other on-farm needs. Cattle are the major livestock raised in Nevada with most grazed on open range. Other livestock include sheep, horses and hogs. USGS estimates for 1970-95 shows wide fluctuations in statewide livestock water use. The variations in the data may be the result of inconsistent estimation techniques from year to year. As a result, these data may not be suitable as a basis for evaluating past water use trends. The *Nevada Agricultural Statistics* reports are an alternative data source for examining livestock trends includes. According to the *Nevada*

Agricultural Statistics, during the 1970 to 1995 period there was a general decline in the number of head of cattle, sheep and hogs from about 850,000 to about 600,000.

Water Use Summary. Statewide water use for the period 1970 to 1995 is summarized in Tables 3-7 through 3-10. Over the last 20 years, statewide water withdrawals in Nevada have been about 4 million acre-feet per year, with a little under 2 million acre-feet consumptively used. In 1995, about 60 percent of the withdrawals were from surface water sources (Tables 3-8 and 3-10). Irrigation has historically been the largest water use in Nevada varying from about 80 percent to 90 percent of the total statewide water withdrawals and consumptive use. Variations in irrigation water use are primarily the result of Nevada’s variable weather and streamflow conditions. Irrigation accounted for about 77 percent of the state withdrawals in 1995 (Figure 3-8).

The total statewide water use has changed little since 1970 but with some significant changes within certain use sectors. The most significant changes have occurred with “Public Supply” and “Mining” water uses. Public supply water use has more than tripled since 1970 in response to Nevada’s ever increasing population. Mining water use has experienced a significant increase since 1985 mostly as a result of increased mining activity in the Humboldt River basin.

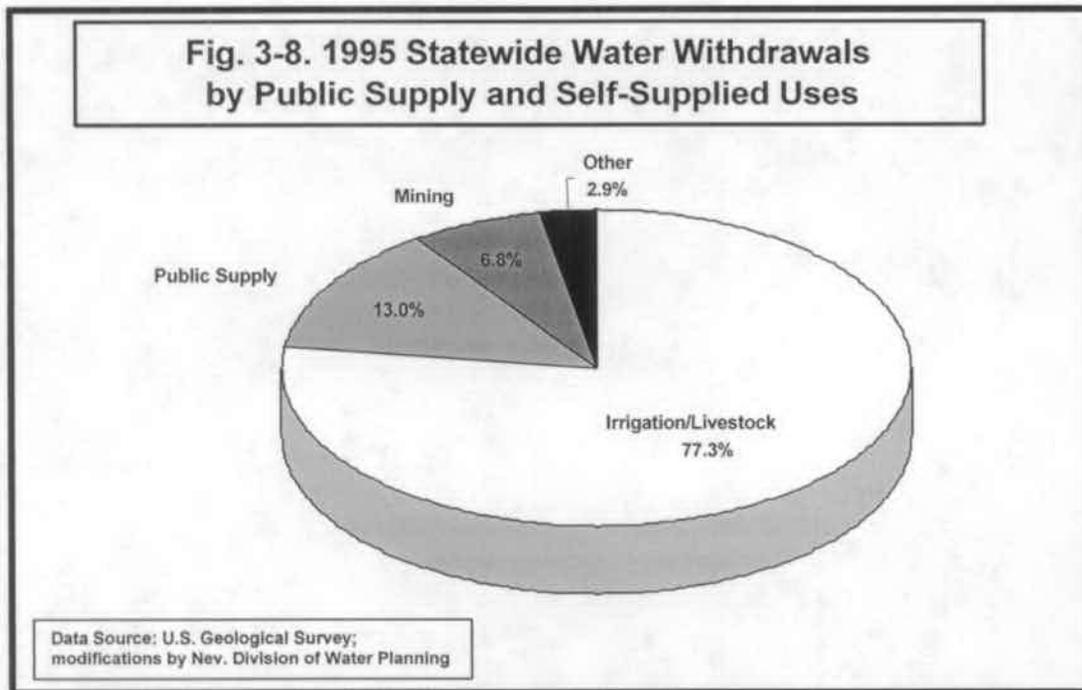


Table 3-7. Summary of Estimated Statewide Water Use (1970-95) Grouped by Public Supply and Self-Supplied Uses (in acre-feet)

Water Use Category		1970	1975	1980	1985	1990	1995
Public Supply							
Domestic	Withdrawals	106,400	134,400	168,000	211,900	266,900	342,600
	Consumptive Use	43,000	49,000	65,000	107,100	133,400	171,000
Commercial ¹	Withdrawals				60,300	100,200	129,700
	Consumptive Use				12,100	18,400	23,300
Industrial ¹	Withdrawals	44,800	58,300	93,000	7,100	2,900	2,500
	Consumptive Use	8,500	9,200	12,300	1,400	600	500
Thermoelectric ¹	Withdrawals				2,700	900	1,600
	Consumptive Use				2,700	900	1,600
Public Uses and Losses ¹	Withdrawals	Included in "Public Supply - Domestic" Category			40,100	60,400	48,500
	Consumptive Use				0	0	0
Total Public Supply	Withdrawals	151,200	192,700	261,000	322,100	431,300	524,900
	Consumptive Use	51,500	58,200	77,300	123,400	153,300	196,400
Self-Supplied							
Domestic	Withdrawals	10,200	13,400	16,500	19,700	16,700	18,100
	Consumptive Use	5,100	6,700	8,300	10,100	8,400	9,000
Commercial ¹	Withdrawals				8,300	25,400	23,500
	Consumptive Use				1,700	3,600	3,200
Industrial ¹	Withdrawals				11,400	11,400	16,800
	Consumptive Use	150,000	260,000	270,000	2,100	2,200	5,000
Thermoelectric ¹	Withdrawals	55,000	80,000	95,000	26,300	74,000	63,800
	Consumptive Use				23,700	49,300	39,400
Mining ¹	Withdrawals				27,300	120,100	274,400
	Consumptive Use				22,500	67,900	89,200
Irrigation	Withdrawals	3,400,000	3,500,000	3,500,000	3,750,000	3,160,700	3,113,600
	Consumptive Use	1,600,000	1,700,000	1,700,000	1,934,000	1,633,800	1,612,100
Livestock	Withdrawals	4,900	13,400	13,400	29,100	6,300	6,300
	Consumptive Use	2,400	9,900	10,000	7,400	2,300	2,300
Total							
	Withdrawals	3,716,300	3,979,500	4,060,900	4,194,100	3,846,000	4,041,400
	Consumptive Use	1,714,000	1,854,800	1,890,600	2,124,800	1,920,800	1,956,600

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

¹ Individual estimates were not available for 1970-80

Table 3-8. Estimated 1995 Statewide Groundwater and Surface Water Withdrawals for Public Supply and Self-Supplied Uses (in acre-feet)

Category	Source	Amount
Public Supply		
Total Public Supply	Groundwater	132,000
	Surface water	392,900
	Total	524,900
Self-Supplied		
Domestic	Groundwater	17,800
	Surface water	300
	Total	18,100
Commercial	Groundwater	7,900
	Surface water	15,600
	Total	23,500
Industrial	Groundwater	8,300
	Surface water	8,400
	Total	16,700
Thermoelectric	Groundwater	40,700
	Surface water	23,200
	Total	63,900
Mining	Groundwater	270,500
	Surface water	3,900
	Total	274,400
Irrigation	Groundwater	1,138,200
	Surface water	1,975,400
	Total	3,113,600
Livestock	Groundwater	1,100
	Surface water	5,200
	Total	6,300
Total		
Statewide Total	Groundwater	1,616,500
	Surface water	2,424,900
	Total	4,041,400

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

Nevada State Water Plan

Table 3-9. Summary of Estimated Statewide Water Use (1970-95) Grouped by Type of Use (in acre-feet)

Water Use Category		1970	1975	1980	1985	1990	1995
Domestic	Withdrawals	116,600	147,800	184,500	231,600	283,600	360,700
	Consumptive Use	48,100	55,700	73,300	117,200	141,800	180,000
Commercial ¹	Withdrawals				68,600	125,600	153,200
	Consumptive Use				13,800	22,000	26,500
Industrial ¹	Withdrawals				18,400	14,400	19,200
	Consumptive Use	194,800	318,300	363,000	3,600	2,800	5,500
Thermoelectric ¹	Withdrawals	63,500	89,200	107,300	29,000	74,900	65,400
	Consumptive Use				26,400	50,200	41,100
Mining ¹	Withdrawals				27,300	120,100	274,400
	Consumptive Use				22,500	67,900	89,200
Irrigation	Withdrawals	3,400,000	3,500,000	3,500,000	3,750,000	3,160,700	3,113,600
	Consumptive Use	1,600,000	1,700,000	1,700,000	1,934,000	1,633,800	1,612,100
Livestock	Withdrawals	4,900	13,400	13,400	29,100	6,300	6,300
	Consumptive Use	2,400	9,900	10,000	7,400	2,300	2,300
Public Supply - Public Uses and Losses	Withdrawals	Included in "Domestic" Category			40,100	60,400	48,500
	Consumptive Use				0	0	0
Total	Withdrawals	3,716,300	3,979,500	4,060,900	4,194,100	3,846,000	4,041,400
	Consumptive Use	1,714,000	1,854,800	1,890,600	2,124,800	1,920,800	1,956,600

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

¹ Individual estimates were not available for 1970-80.

Table 3-10. Estimated 1995 Statewide Groundwater and Surface Water Withdrawals for Use Types

Category	Source	Amount
Domestic (self-supplied & public supplied)	Groundwater	104,100
	Surface water	256,700
	Total	360,800
Commercial (self-supplied & public supplied)	Groundwater	40,600
	Surface water	112,600
	Total	153,200
Industrial (self-supplied & public supplied)	Groundwater	8,900
	Surface water	10,300
	Total	19,200
Thermoelectric (self-supplied & public supplied)	Groundwater	41,100
	Surface water	24,400
	Total	65,500
Mining	Groundwater	270,500
	Surface water	3,900
	Total	274,400
Irrigation	Groundwater	1,138,200
	Surface water	1,975,400
	Total	3,113,600
Livestock	Groundwater	1,100
	Surface water	5,200
	Total	6,300
Public Supply - Public Uses and Losses	Groundwater	12,200
	Surface water	36,300
	Total	48,500
Total	Groundwater	1,616,700
	Surface water	2,424,800
	Total	4,041,500

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning
 Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

Hydrographic Areas

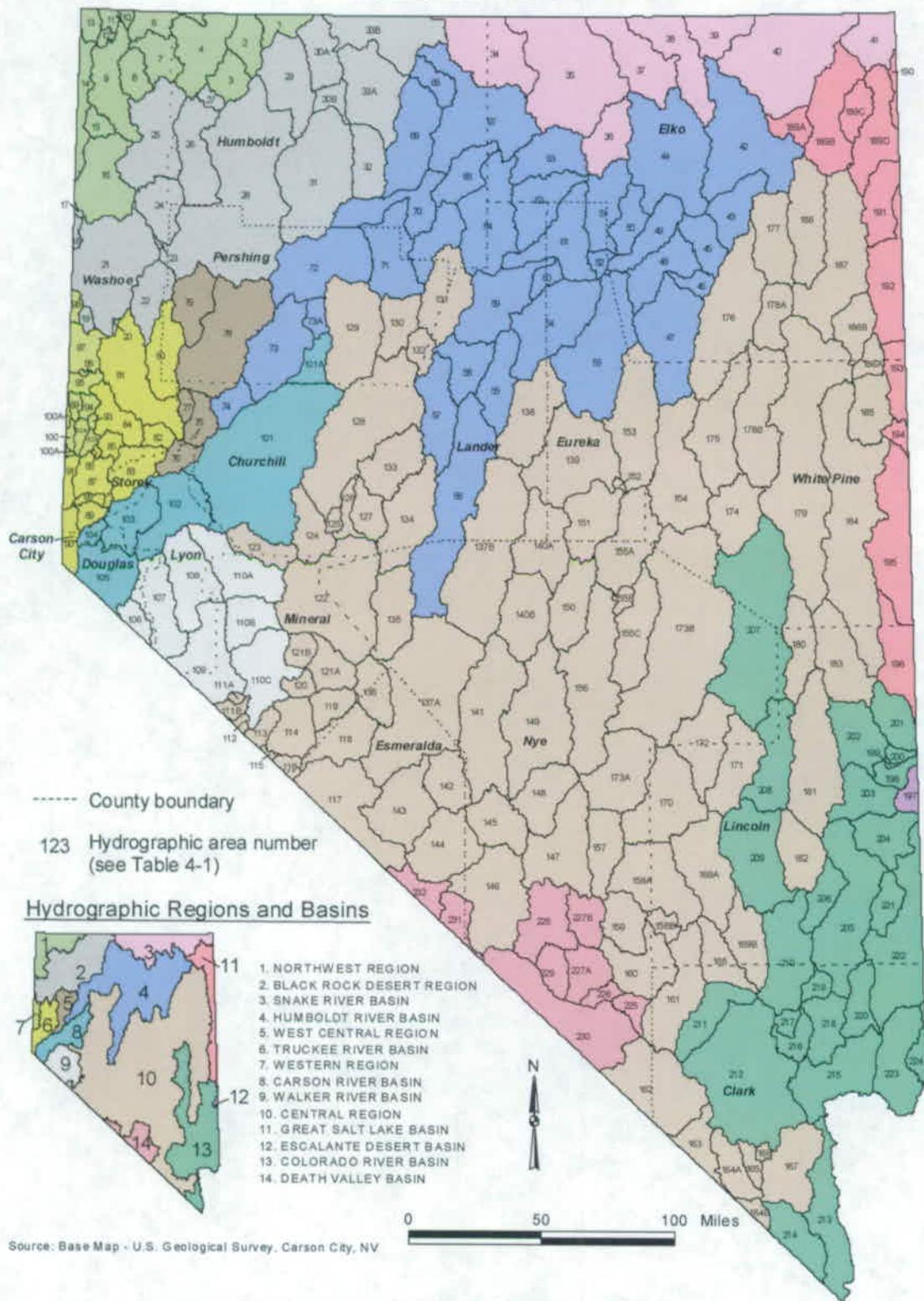


Figure 3-1. Hydrographic Regions and Basins

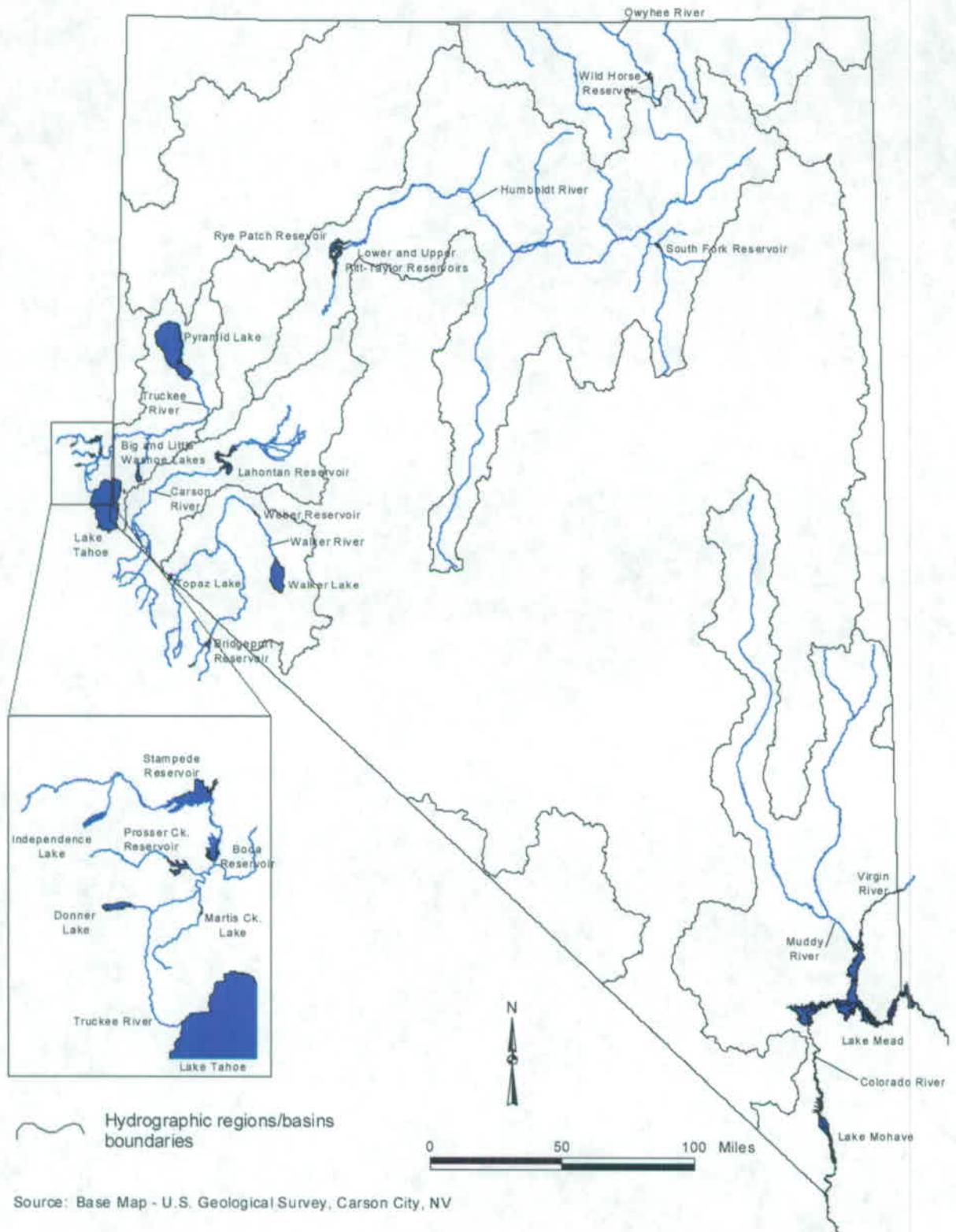


Figure 3-2. Major Rivers, Lakes and Reservoirs

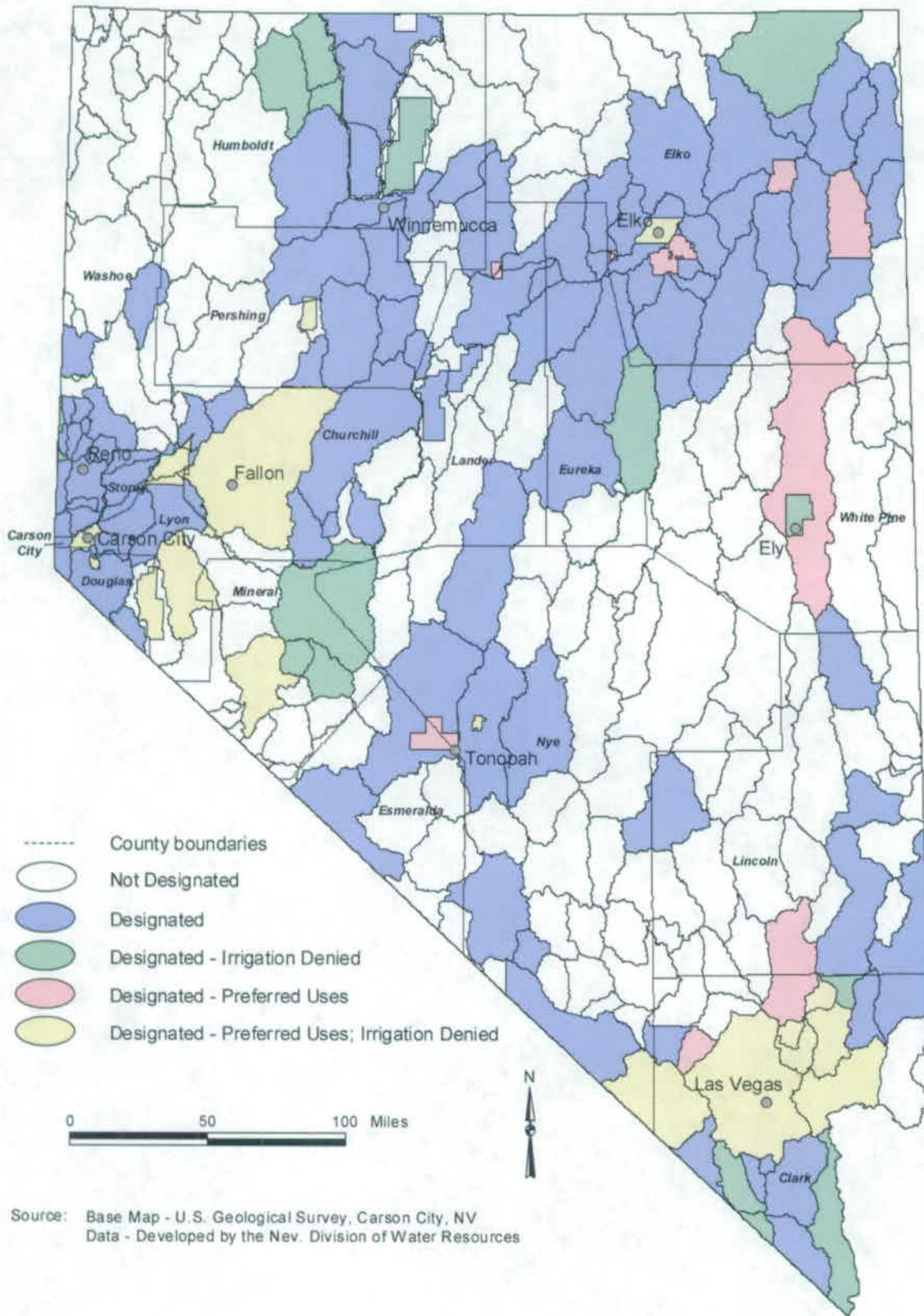


Figure 3-7. Designated Groundwater Basins of Nevada

**Nevada State Water Plan
SUMMARY**

**Section 4
Socioeconomic Assessment and Forecasts**

Introduction

This section of the Summary of the *Nevada State Water Plan* presents population and economic trends and forecasts for the Nevada economy to develop a basis for statewide water demand projections. The socioeconomic forecasts, particularly as they relate to population and employment, are used to predict state and county future water needs over a planning horizon extending through the year 2020. Population forecasts for each county and the total state are contained in Appendix 2 of the Appendices of the water plan. Appendix 3 of the Appendices presents state and county employment forecasts, which are derived from population forecasts through estimated employment-to-population ratios. Forecasts for irrigated acreage, which drive the irrigation and livestock water withdrawals, are presented in Appendix 4 of the Appendices.

Population Trends and Forecasts

Over the planning horizon, the rate of growth in Nevada's population is expected to slow, but the state's population is expected to continue to become increasingly concentrated in the primary urban areas of Las Vegas (Clark County), Reno/Sparks (Washoe County) and Carson City. The growth in population in these three principal geographic areas will have varied spillover effects on neighboring counties, such as Nye County for Clark County (Las Vegas) and Churchill, Douglas, Lyon, and Storey counties for Washoe County (Reno) and Carson City. Population forecasts incorporated into this water plan for Clark and Washoe counties were provided by the Clark County Department of Comprehensive Planning and the Washoe County Department of Community Development, respectively. The population forecasts for Washoe County were modified slightly by the Nevada Division of Water Planning (NDWP) to better smooth the intervening period forecasts, matching Washoe County's population forecast for the year 2020. Other county population forecasts developed by the NDWP were based on an extension and general moderation of recent historical growth trends. Also incorporated in the state and county population forecasts are estimates of commercial and industrial development and employment forecasts based on inputs provided by the Nevada Department of Employment, Training and Rehabilitation (DETR).

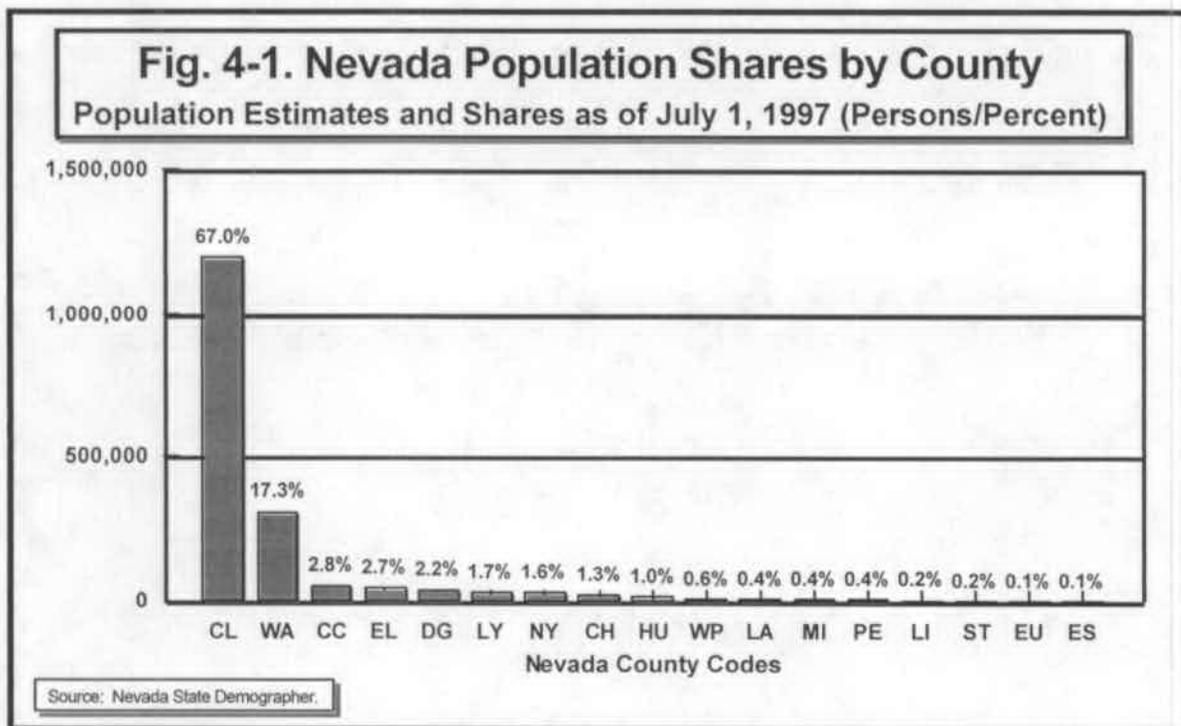
Table 4-1. Nevada Population Analysis, presents historical populations and population shares (in terms of county percent shares of the total state's population) for Nevada and its seventeen counties for selected years from 1950 to 1997. This table shows that in 1997, Nevada's total resident population was estimated to be 1,779,850 persons, up 1,618,705 persons since 1950.

Table 4-1. Nevada Population Analysis — 1950-1997
Shares Based on Percent of Total State Population (Persons/Percent of Total State)

State/County	1950	1960	1970	1980	1990	1997
NEVADA	161,145	287,660	494,990	800,508	1,236,130	1,779,850
Carson City	4,198	8,020	16,054	32,022	40,950	50,410
Statewide Share	2.61%	2.79%	3.24%	4.00%	3.31%	2.83%
Churchill County	6,188	8,505	10,650	13,917	18,100	23,860
Statewide Share	3.84%	2.96%	2.15%	1.74%	1.46%	1.34%
Clark County	48,811	128,734	277,230	463,087	770,280	1,192,200
Statewide Share	30.29%	44.75%	56.01%	57.85%	62.31%	66.98%
Douglas County	2,023	3,575	7,067	19,421	28,070	39,590
Statewide Share	1.26%	1.24%	1.43%	2.43%	2.27%	2.22%
Elko County	11,703	12,051	13,946	17,269	33,770	47,710
Statewide Share	7.26%	4.19%	2.82%	2.16%	2.73%	2.68%
Esmeralda County	611	634	623	777	1,350	1,460
Statewide Share	0.38%	0.22%	0.13%	0.10%	0.11%	0.08%
Eureka County	897	775	938	1,198	1,550	1,660
Statewide Share	0.56%	0.27%	0.19%	0.15%	0.13%	0.09%
Humboldt County	4,870	5,723	6,380	9,449	13,020	17,520
Statewide Share	3.02%	1.99%	1.29%	1.18%	1.05%	0.98%
Lander County	1,860	1,580	2,653	4,076	6,340	7,030
Statewide Share	1.15%	0.55%	0.54%	0.51%	0.51%	0.39%
Lincoln County	3,850	2,378	2,526	3,732	3,810	4,110
Statewide Share	2.39%	0.83%	0.51%	0.47%	0.31%	0.23%
Lyon County	3,703	6,245	8,437	13,594	20,590	30,370
Statewide Share	2.30%	2.17%	1.70%	1.70%	1.67%	1.71%
Mineral County	5,588	6,329	6,961	6,217	6,470	6,860
Statewide Share	3.47%	2.20%	1.41%	0.78%	0.52%	0.39%
Nye County	3,101	4,642	5,459	9,048	18,190	27,610
Statewide Share	1.92%	1.61%	1.10%	1.13%	1.47%	1.55%
Pershing County	3,122	3,178	2,656	3,408	4,550	6,600
Statewide Share	1.94%	1.10%	0.54%	0.43%	0.37%	0.37%
Storey County	657	571	696	1,503	2,560	3,520
Statewide Share	0.41%	0.20%	0.14%	0.19%	0.21%	0.20%
Washoe County	50,484	84,988	122,574	193,623	257,120	308,700
Statewide Share	31.33%	29.54%	24.76%	24.19%	20.80%	17.34%
White Pine County	9,479	9,732	10,140	8,167	9,410	10,640
Statewide Share	5.88%	3.38%	2.05%	1.02%	0.76%	0.60%

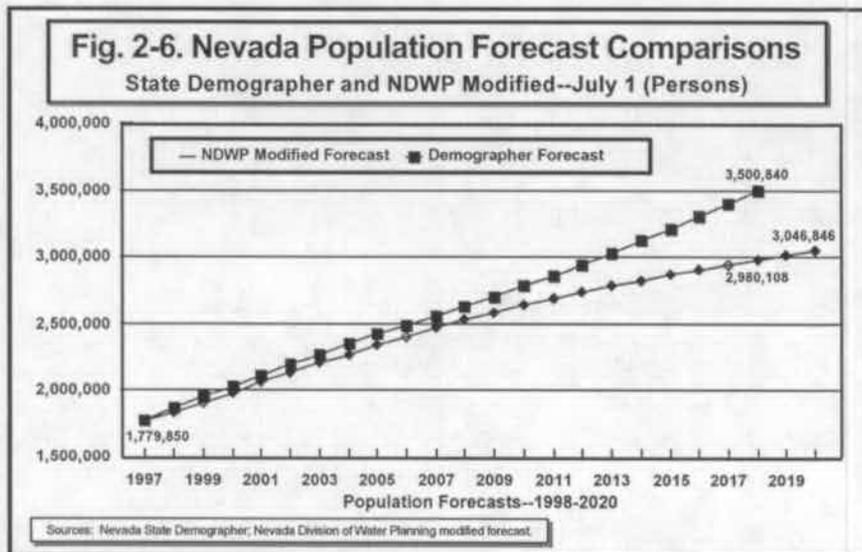
Source Data: Nevada State Demographer.

Clark County's total resident population was estimated at 1,192,200 persons in 1997 and accounted for 67.0 percent of the state's total population. This represented an increase of 36.7 percentage points in Clark County's share of the state's total population since 1950. Washoe County's population was estimated at 308,700 persons in 1997, accounting for 17.3 percent of Nevada's total population, a decline of 14.0 percentage points in its share of statewide population since 1950. Carson City's 1997 population of 50,410 persons comprised 2.8 percent of the state's total population, an increase of just over 0.2 percentage point in its population share since 1950. Together, these three Nevada urban areas accounted for 87.2 percent of the state's total population in 1997. Elko County, representing the other principal population center in Nevada, had an estimated 1997 population of 47,710 persons, accounting for 2.7 percent of the state's population and representing a decline of 4.6 percent points in state population share since 1950.



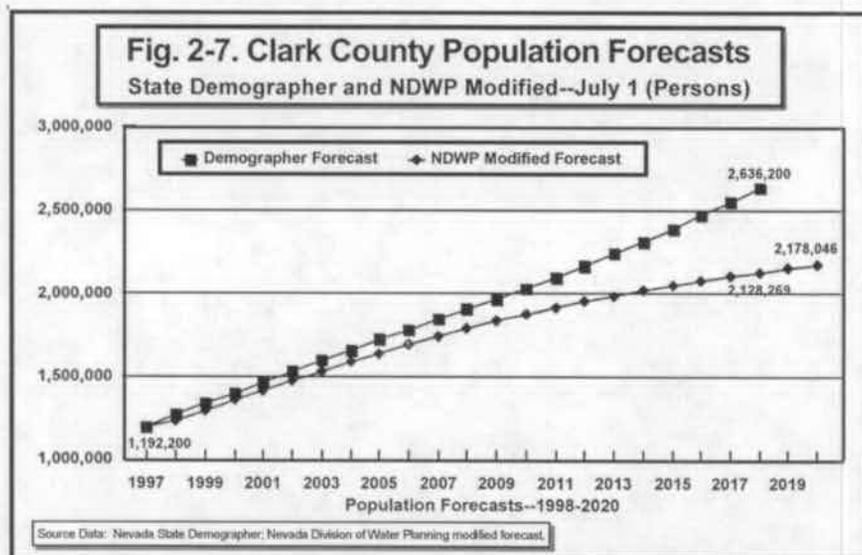
With the exception of Carson City and Clark and Douglas counties, every county in Nevada, while growing in terms of its total resident population, has actually declined in terms of its share of statewide population between 1950 and 1997. Douglas County's population trends have been strongly influenced by the county's increasing status as a "bedroom" community for neighboring Carson City, and thus Carson City and Douglas County tend to act as an integrated economic unit. These two counties have shown a slight increase in their joint population share from 3.9 percent of statewide population in 1950 to 5.1 percent in 1997. Unique population trends exist for other Nevada counties as well. For example, rapid population growth in Elko County has been due in large part to the mining industry. Between 1950 and 1970, Elko County's population grew by only 2,243 persons. However, over the next 27 years its population increased by nearly 30,000 persons.

Much of this growth was due to mining, both in Elko County and neighboring Eureka County. Lyon County represents another county where growth in neighboring Carson City, primarily, has affected its population growth. Similarly, recent rapid growth in Nye County has been primarily centered in the southern part of the county at Pahrump, which has been strongly influenced by rapid growth in nearby Las Vegas.



Two separate population forecasts are presented in the state water plan. Every year the Nevada State Demographer estimates the current population and, following this estimation process, produces a twenty-year population forecast for all counties and the total state. All state agencies are required by the Governor's Executive Order to utilize the population forecasts of the State Demographer in their budgeting and planning activities. Under an agreement with the state's population contracting agency, the Nevada Department of Taxation, the NDWP has developed an alternate set of county and state population forecasts based on inputs received from the individual counties, inputs from the Nevada Department of Employment, Training and Rehabilitation (DETR), and from the NDWP's own best forecast scenarios. These alternate forecasts are used as a basis for projecting municipal and industrial, domestic and commercial and industrial water uses.

Overall, the NDWP's statewide population forecast predicts a more moderate population growth than that of the State Demographer. The reason for this is that Nevada's total population is largely influenced by the trends in Clark County, which currently accounts for over two-thirds of the state's total population. Based on infrastructure requirements and current



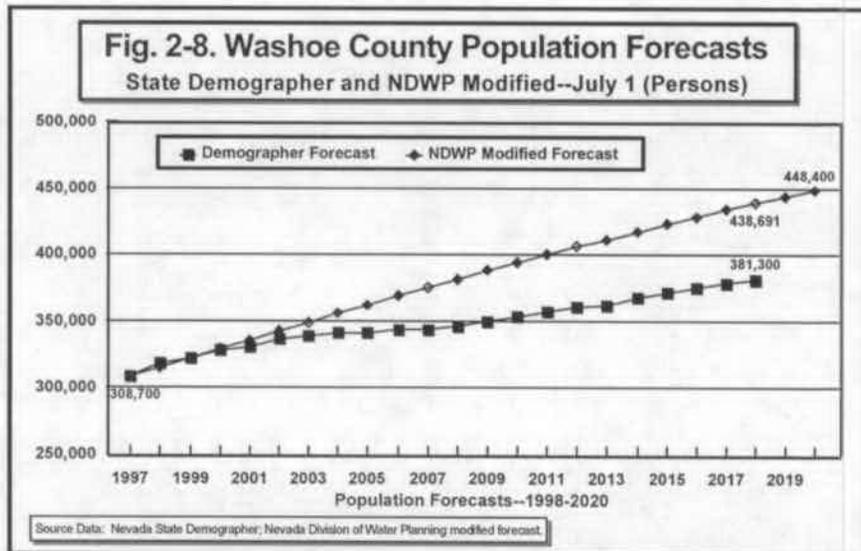
resource limitations, local planners in Clark County expect slower growth over the plan’s forecast horizon than does the State Demographer. The State Water Plan incorporates both sets of population forecasts, as shown in Table 4–2. Nevada Population Forecast Comparisons to present an anticipated “range of expected growth.” However, only the NDWP’s forecasts are incorporated into the water plan’s future water withdrawal projections. A complete set of population forecasts and related graphical analysis for each county is presented in Appendix 2 of the Appendices. This appendix also contains a comparative analysis of population forecasts for all individual counties.

Table 4–2. Nevada Population Forecast Comparisons
Nevada State Demographer and Nevada Division of Water Planning (NDWP)

Nevada Forecasts by Source	2000	2005	2010	2015	2018	2020
State Demographer						
Resident Population (persons)	2,034,020	2,421,020	2,783,700	3,313,260	3,500,840	n.a.
Nevada Division of Water Planning						
Resident Population (persons)	1,986,257	2,341,374	2,640,306	2,868,979	2,980,108	3,046,846
Difference (persons)	47,763	79,646	143,394	343,281	520,732	–
Percent Difference	2.4%	3.3%	5.2%	10.7%	14.9%	–

Note: The population forecasts of the State Demographer currently extend only through the year 2018. The “Difference” row in the table represents the difference between the forecasts of the State Demographer and NDWP. NDWP population forecasts for Clark and Washoe counties are based on population forecast inputs from those counties.
Source Data: Nevada State Demographer; Nevada Division of Water Planning (NDWP).

The Nevada State Demographer has forecast a total resident population for Nevada for the year 2018 of 3,500,840 persons, primarily based on a continuation of the more recent virtual exponential growth in Las Vegas (Clark County). The State Demographer’s forecast represents an overall increase in statewide population of 1,720,990 persons between 1997 and 2018, a near doubling of Nevada’s population over the next 20 years. The State Demographer’s forecast scenario results in an average annual rate of growth of statewide population of 3.3 percent per year for the overall forecast period of 1998 to 2018, with a sub-period average annual rate of growth of 3.6 percent between 1998 and 2008 and 2.9 percent between 2008 and 2018. The State



Demographer’s forecasted population for the year 2018 is approximately 15 percent higher than that of the NDWP.

The NDWP forecast scenario, based primarily on the expectation of slower population growth in Clark County, assumes a 2.5 percent overall annual rate of population growth for Nevada between the years 1998 and 2018, with sub-period average annual rates of 3.2 percent per year for 1998 through 2008 and 1.6 percent per year for 2008 through 2018. Based on this “range” of population forecasts developed independently by the State Demographer and the NDWP, Nevada is projected to grow at a rate of between 2.5–3.3 percent per year through 2018 at which time the population is expected to be between 3.0 and 3.5 million persons. Table 4–3. Nevada Population Forecast Summary, 1997–2020, presents a summary of the population forecasts made by the NDWP for those Nevada counties expected to equal or exceed a total resident population of 50,000 persons by the year 2020. Complete population estimates, forecasts and analysis for all Nevada’s counties may be found in the Appendices, Appendix 2.

**Table 4–3. NDWP Nevada Population Forecast Summary
Population Forecasts and Shares for Larger Nevada Counties — 1997–2020
(For counties expected to exceed 50,000 persons by the year 2020)**

State/County	1997	2000	2005	2010	2015	2020
Nevada						
Resident Population (persons)	1,779,850	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Carson City						
Resident Population (persons)	50,410	54,445	60,703	66,041	70,099	72,587
Percent of Total State	2.83%	2.74%	2.59%	2.50%	2.44%	2.38%
Clark County (Las Vegas)						
Resident Population (persons)	1,192,200	1,355,368	1,640,444	1,874,431	2,046,229	2,178,046
Percent of Total State	66.98%	68.24%	70.06%	70.99%	71.32%	71.49%
Douglas County						
Resident Population (persons)	39,590	42,834	48,180	53,272	57,900	61,854
Percent of Total State	2.22%	2.16%	2.06%	2.02%	2.02%	2.03%
Elko County						
Resident Population (persons)	47,710	51,665	57,857	63,224	67,408	70,113
Percent of Total State	2.68%	2.60%	2.47%	2.39%	2.35%	2.30%
Lyon County						
Resident Population (persons)	30,370	33,721	39,377	44,878	49,914	54,170
Percent of Total State	1.71%	1.70%	1.68%	1.70%	1.74%	1.78%
Washoe County (Reno)						
Resident Population (persons)	308,700	329,021	362,260	393,884	422,917	448,400
Percent of Total State	17.34%	16.56%	15.47%	14.92%	14.74%	14.72%

Note: Counties included are only those that are forecast to equal or exceed a resident population of 50,000 persons by the end of the forecast period (2020).

Source Data: Nevada State Demographer (1997 estimate); Nevada Division of Water Planning (2000–2020 forecasts).

Economic Trends and Forecasts

In the following analysis, principal sectors of the Nevada economy are reviewed in terms of recent trends and their probable effects on Nevada's and individual counties' future growth patterns. These primary economic sectors include gaming, which is the principal driving economic force in both Clark and Washoe counties, mining, which impacts a number of more rural counties including Elko, Eureka, Lander, Humboldt, Pershing and Nye, and agriculture, which affects a number of counties including principally Elko, Humboldt, Pershing, Douglas, Churchill and Lyon.

Gaming. Casino gaming and tourism in Nevada represents the primary "driving" economic force most affecting the state's overall population trends. While growth in tourism visitation and gaming win (revenues) has slowed over the last several years in the state's principal northern Nevada casino gaming markets of Reno-Sparks (Washoe County) and South Lake Tahoe (Douglas County), this trend has been more than off-set by high rates of growth in the southern Nevada gaming market of Las Vegas (Clark County), and specifically by trends within the Las Vegas Strip gaming sub-market. The introduction of the mega-resort complex among the Las Vegas Strip gaming properties beginning in late 1989 established a trend of rapid casino and support industry employment growth, population expansion, and gaming win growth that characterized this market throughout the 1990's. The mega-resort casino complex, with individual property employment frequently exceeding 5,000-6,000 workers (Mirage Resorts' Bellagio Resort opened in October 1998 with over 9,300 employees), had significant impacts on population growth, support service businesses, infrastructure requirements, and particularly water demands. Further, new resort complexes opening in this market through 1999 and into 2000 will extend these trends into the next century.

In contrast to the relatively strong growth expected to continue in the near term for Clark County, the Washoe County and Carson City areas, and in fact much of northern Nevada, are beginning to see significantly slower growth due to more intense competition in the gaming and tourism industry. Based on the growth in legalized gaming in other jurisdictions, especially the rise of Indian gambling on reservation lands, particularly in California and the Pacific Northwest, it is reasonable to expect a continued slowdown in the growth of gaming and tourism throughout Nevada from approximately the year 2005 onward.

The November 1998 passage of "Proposition 5", which legalized certain slot devices in Indian reservation casinos in California, is destined to have profound impacts on gaming in that state. While a constitutional challenge to this proposition has already been filed, the California voters appear to have changed their attitude towards some form of legalized casino gaming in the state and further moves in this direction may be reasonably expected. Furthermore, in January 1999, the governor of California withdrew the state's participation in any constitutional challenge to Proposition 5 and expressed the state's desire to begin negotiations on Indian gaming compacts.

While many of Nevada's tourism and gaming attractions, both man-made and natural, continue to be unrivaled in competitive markets, studies have shown that proximity has an important influence over player patronage. As a result, Nevada's casino gaming industry will have to work especially hard to compete effectively with developing gaming markets located closer to population centers throughout the U.S. The anticipated slowing in the growth in Nevada's gaming industry, however, is not expected to be uniform and will be greater in those gaming markets which do not offer features of a distinctive nature to lure consumers from more proximate gaming venues.

Mining. While gaming and tourism have had significant impacts on growth in Clark and Washoe counties, mining has had major influences on many of the rural counties' population and employment growth, demographic trends, and economic development. Since 1989, gold mining in Nevada has made a major contribution to a number of rural counties' economic growth, most especially Elko, Eureka, Humboldt, Lander, Nye, and Pershing counties. However, more recently this industry has come under growing economic and financial stress. Beginning in late 1997 and extending into 1998, due primarily to European monetary reform and Asian economic and financial problems, gold prices realized by Nevada mines have slipped dramatically. The average price of gold fell from \$387.87 per (troy) ounce in 1996 to \$331.29 per ounce in 1997, and by mid-1998 the price received by Nevada's mining interests was well below \$300 per ounce. By late 1998, gold's price had rebounded somewhat to "around" \$300 an ounce. Some of this price decline has, for the time being, been mitigated through the mining industry's use of "forward" contracts wherein the mining companies have locked in to committed prices for future gold sales.

Over the plan's forecast period, international economic and financial conditions are expected to continue to affect the nature and structure of mining operations in Nevada, thereby influencing the demographic and economic growth prospects of the rural, mining-dependent Nevada counties. Over the long-term, however, conditions within the mining industry are expected to stabilize at a price of \$280–\$350 per ounce for gold, which has become incorporated into the levels of forecast production for the industry and particularly the amount of economically recoverable reserves.

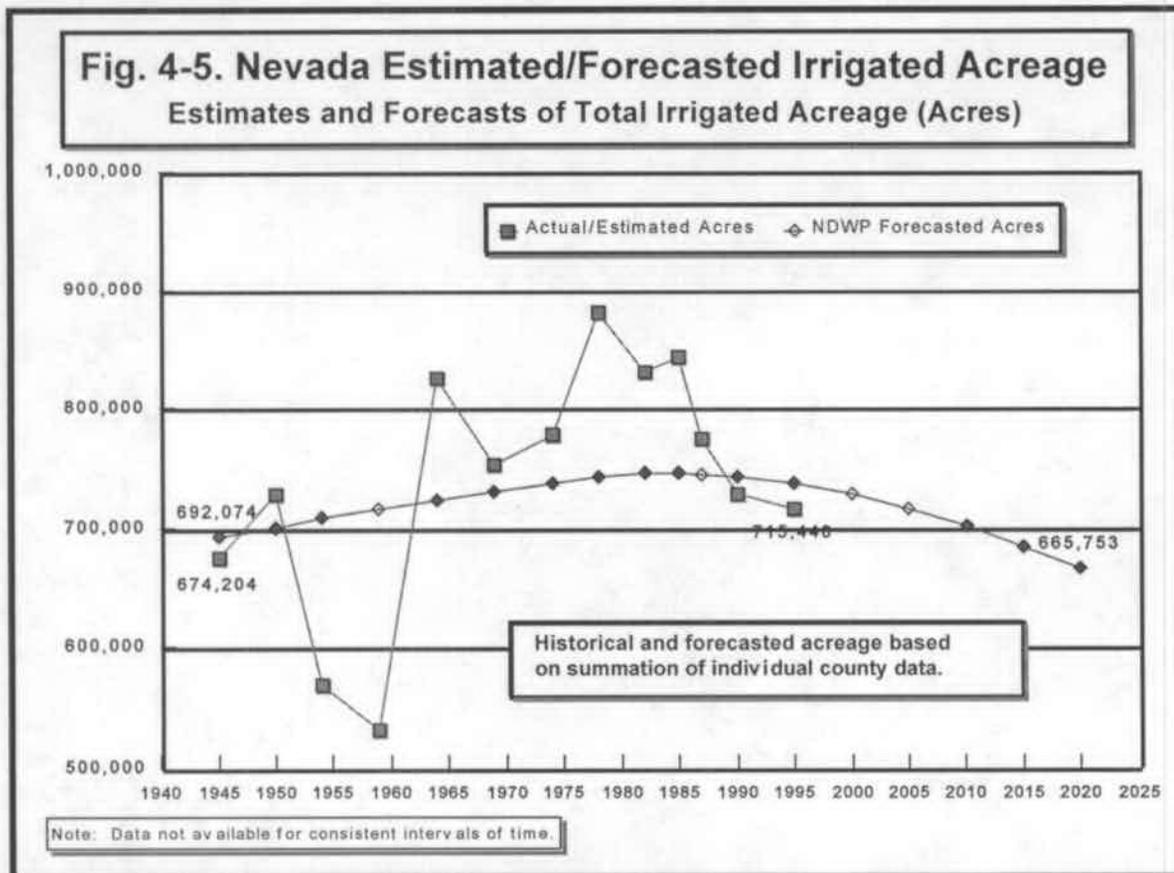
Agriculture. Agriculture represents one of Nevada's oldest and most lasting economic activities. Since the first settlements were established in the 1850's, agriculture in Nevada has continued to survive and even prosper. Today, agriculture remains a fundamental socioeconomic underpinning for a number of rural Nevada counties and, no doubt, will remain an integral part of these counties' economies irrespective of trends in other economic sectors. While on the whole agriculture may appear to have only a slight impact on Nevada's overall economic trends, the importance of agriculture for a number of rural counties cannot be overstated.

In viewing the individual county agricultural-related figures (which are presented in the Appendices, Appendix 4), particularly with respect to the amount of irrigated acreage, wide fluctuations appear typical in the estimated levels of irrigated acreage. Such fluctuations tend to indicate both highly volatile irrigation and crop production cycles based on variations in water availability and basic problems in reporting and gathering accurate data on this industry sector.

The volatility in historical measures of this industry, particularly with respect to irrigated acreage, makes forecasting irrigation and livestock water use especially difficult. However, there does appear to be a trend towards no increase in agricultural lands being brought under cultivation. In fact, some counties, Carson City, Churchill, Douglas, and Washoe in particular, it appears that encroaching urbanization and the transfer of water rights from irrigation to M&I uses is causing the level of irrigated lands to decline. Given new and growing demands for limited water resources in the state, particularly for municipal and industrial use, wildlife protection and fishery restoration, instream flows and recreation, the future amount of irrigated acreage is uncertain.

Figure 4–5. Nevada Estimated and Forecasted Irrigated Acreage, shows both estimates of historical

irrigated acreage since 1945 and the Division of Water Planning’s forecasts for Nevada’s total irrigated acreage through the year 2020 based on individual county forecasts which are aggregated to the statewide total. Detailed forecasts for all counties and the total state appear in the Appendices, Appendix 4. Forecasts were based on the approximation of a non-linear “best fit” line which tracked



individual county historical trends and then was extrapolated (extended) out to the year 2020 based upon estimates of agricultural trends and other factors such urban encroachment.

Employment Trends and Forecasts

Employment trends and forecasts constitute an important underpinning to understanding and forecasting water withdrawals by Nevada’s businesses and industry. Employment-to-population ratios, which measure the ratio of total employment to total resident population, are crucial in forecasting future employment levels from a county’s resident population. This analysis, and related statistical tests of confidence which gauge the suitability of this methodology, are presented in the Appendices for each county and aggregated for the total state (Appendix 3). Forecasts of county total employment, when combined with estimated historical commercial and industrial water use factors (gallons per worker per day), are used to forecast each county’s commercial and industrial water withdrawals and, through aggregation, these same water withdrawals for the total state.

Omitting the effects of national economic recessions, Nevada’s ratio of its total covered employment (i.e., employment covered under state and federal unemployment insurance programs) to its total resident population has tended to be relatively stable over time. For the period of 1980-1997, Nevada’s overall employment-to-population ratio has averaged 48.2 percent. Omitting recessionary periods (i.e., 1980-82 and 1990-91), the statewide average employment-to-population ratio has tended to be closer to 50 percent. Nevada’s relatively high employment-to-population ratio is typical of an economy that is being driven primarily by commercial (casino) expansion and related strong employment growth. Also evident from an analysis of these trends is that Nevada’s employment-to-population ratio has shown marked sensitivity to national business cycle fluctuations, notably the national recessionary periods of 1980-82 and 1990-91. While this point needs to be recognized, forecasts of future recessions are not explicitly incorporated in the forecasts of future employment.

Table 4-4. Nevada Population and Employment Forecasts, shows historical and forecasted population, employment and employment-to-population ratios for Nevada for selected years from 1997 through 2020. A more extensive presentation of this information for the total state and all Nevada counties for all years from 1980 through 2020 can be found in the Appendices, Appendix 3. The information and forecasts in this appendix were based on historical levels and omit possible effects of future national and local recessions.

Table 4-4. Nevada Population and Employment Forecasts
Population/Employment Estimates — 1997, NDWP Forecasts — 2000–2020
(Annual Averages — Persons and Workers)

NEVADA	1997	2000	2005	2010	2015	2020	1997-2020 Change	1997-2020 Percent Change*
Population	1,779,850	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846	1,266,996	71.2%
Employment	888,574	987,950	1,162,764	1,310,176	1,423,256	1,511,617	623,043	70.1%
Employment-to- Population Ratio	49.9%	49.9%	49.8%	49.7%	49.7%	49.7%	–	-0.20%

Note: Changes to the employment-to-population ratios over time are measured in percentage points. The Nevada figure is based on the aggregation of individual county estimates (1997) and forecasts (2000–2020) and was not forecasted independently.

Source Data: Population estimates (1997) – Nevada State Demographer; Employment estimates (1997) – Department of Employment, Training and Rehabilitation (DETR); Population and employment forecasts (2000–2020) – Nevada Division of Water Planning (NDWP). Population forecasts incorporated into the Nevada total for Clark County are from forecasts adopted by the Clark County Department of Comprehensive Planning; Population forecasts for Washoe County are from the Washoe County Department of Community Development.

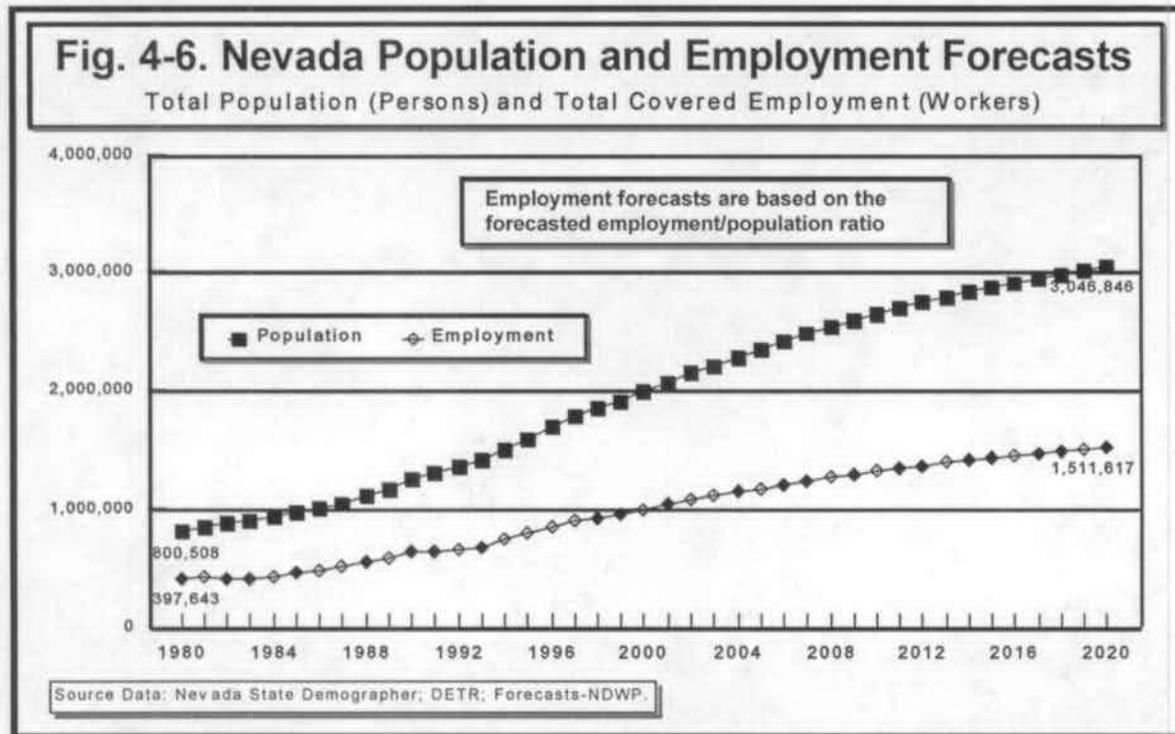
Fig. 4-6. Nevada Population and Employment Forecasts, shows the relationship between the state and county population forecasts and the employment forecasts derived through the estimates and forecasts of individual county employment-to-population ratios. The Nevada figures presented in Table 4-4 and Fig. 4-6 represent the aggregation of those county forecasts.

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**Nevada State Water Plan
SUMMARY**

**Section 5
Water Use Assessment and Forecasts**

Introduction

This section of the Summary of the *Nevada State Water Plan* is intended to summarize the Nevada Division of Water Planning's water withdrawals forecasts by public supply and type of use categories and provide an overview of the methodology by which these forecasts were made. For detailed definitions of these source and use categories and a more extensive explanation of the water use forecast methodology including all equations used, see Part 2, Water Use and Forecasts, Section 5, Technical Supplement.

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 processing water withdrawals and dewatering. Forecasts were made by the public supplied uses, i.e., municipal and industrial (M&I) withdrawals, and by the use of the water, e.g., domestic (residential) withdrawals. The following represents a listing of the water source or use categories presented in this plan:

Water Withdrawals by Public Supply Providers:

Total Municipal and Industrial (M&I) Water Withdrawals

Water Withdrawals by Type of Water Use:

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

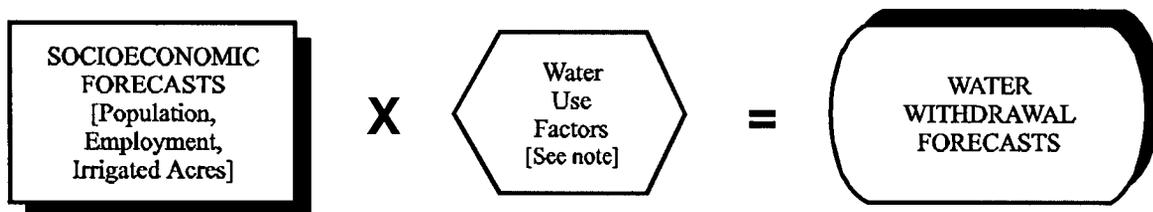
The Forecast Methodology

The forecast methodology developed for the water plan employs a relatively unique and innovative method of linking the forecasts of key socioeconomic variables, i.e., population, employment and irrigated acreage, to specific forecasts of water withdrawals through unique water use coefficients or factors. This process is depicted in its simplest form in Flow Chart 1. Basic Forecasting Methodology. Specifically, forecasts of population and employment (which were derived from the population forecasts), and irrigated acreage provide the means to develop the majority of water withdrawal forecasts for Nevada. The water use factors, which are measured from historical use patterns in terms of gallons per person or per worker per day for M&I, domestic, and commercial and industrial water uses, or in acre-feet per acre per year for irrigation water withdrawals, provide the means to more precisely link changes in the socioeconomic conditions with the resultant changes in water use. Only thermoelectric and mining water use forecasts required a different forecast methodology as explained below.

[*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 is water that is not returned to a source or able to be used again.]

Municipal and Industrial (M&I). Forecasts for M&I water withdrawals were based on forecasts

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

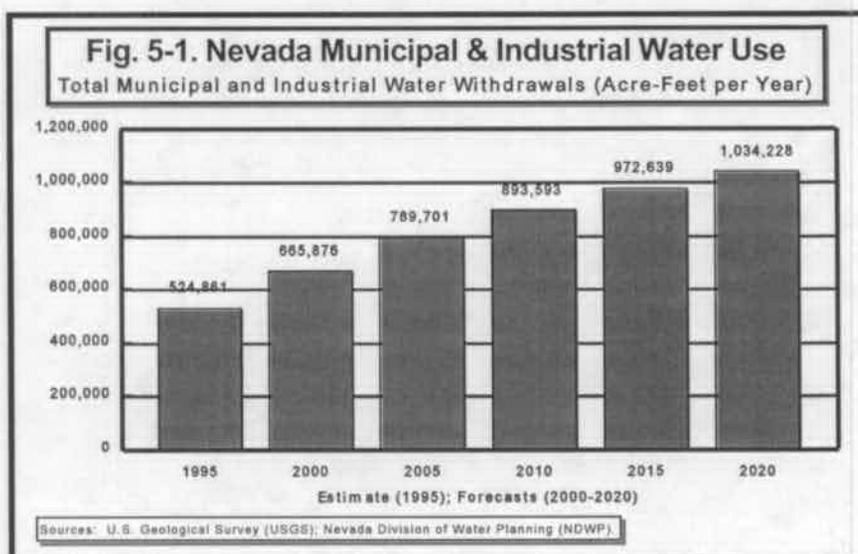


Note: Water Use Factors Measured in Gallons per Capita per Day, Gallons per Employee per Day, or Acre-Feet per Acre per Year

Nevada Division of Water Planning/Socioeconomic Analysis and Planning

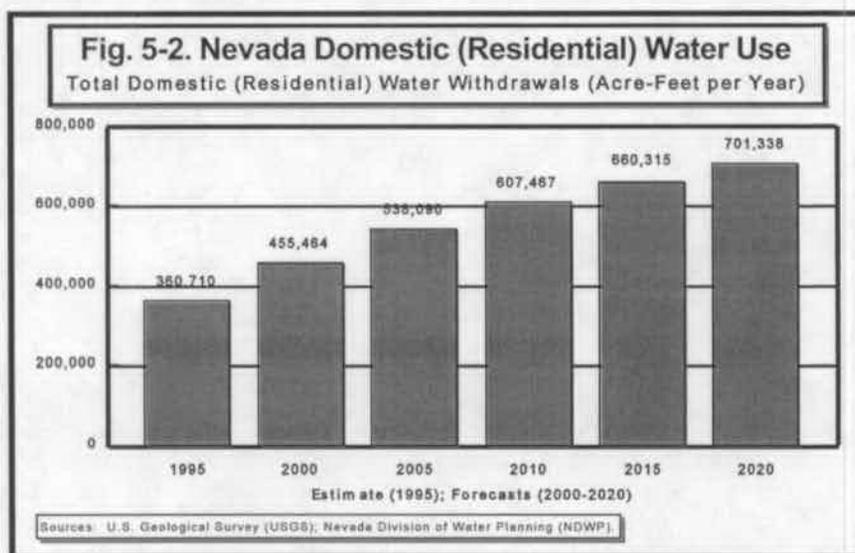
of the population being supplied water by public supply water systems. These forecasts were based on forecasts of total resident population. The estimates of the population on public supply water systems were made at the county level and were derived from 1995 water use characteristics and forecasts of the proportion of the population on public supply water systems. The population on

public supply water systems, times a county-unique M&I water use factor in gallons per capita (person) per day (GPCD), provided the forecasts for total M&I water withdrawals. Both M&I water withdrawals and domestic water withdrawals were additionally affected by the assumption of a changing proportion of the population being on public supply water systems. These forecasts were made for each county based on historical patterns.



Domestic (Residential). Total domestic or residential water withdrawals were estimated from the total resident population times a county-unique domestic water use factor measured in gallons per capita per day (GPCD). As with M&I water withdrawals, domestic water use forecasts were affected by the assumption of a changing proportion of each county’s population being on public supply water systems. In effect, total domestic water withdrawal forecasts under this assumption were based on the aggregation of (1) public supply domestic withdrawal forecasts and (2) self-supplied domestic water withdrawal forecasts using specific water use factors for each use type and a varying proportion of the population on public and self-supplied water systems.

Commercial and Industrial. Commercial and industrial water withdrawals were based on the forecasted level of employment, which was estimated for each county from that county’s population forecast and a county-unique employment-to-population ratio. The commercial and industrial water use forecast was then derived from the employment forecast multiplied by a commercial water use factor measured in gallons per employee per day (GPED). Since mining water use was forecast separately using a different methodology, county-specific forecasts



of the number of mining workers were subtracted from the forecasts of total county employment. Also, the historical commercial and industrial water use factor was calculated omitting mining workers and mining water use.

Public Use and Losses. Water withdrawals for public use and losses was assumed to be a constant percentage of each counties' M&I water withdrawal amount. Therefore, forecasts of this water use were based on forecasts of M&I water withdrawals, with the county-unique percentage factors remaining constant throughout the forecasts period.

Irrigation and Livestock. Irrigation water withdrawal forecasts were 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 were based upon a constant ratio (percentage) of livestock water withdrawals to irrigation water withdrawals. Total agricultural water withdrawal forecasts represented the sum of irrigation water withdrawals and livestock water withdrawals.

Thermoelectric. 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 due to the power plant's widespread distribution system. Consequently, these forecasts were based primarily on general population trends and increasing demands for electrical power in the diverse markets served by these power production plants, particularly from extensive mining operations in some of the rural counties.

Mining. Mining water withdrawal forecasts (including both consumptive and non-consumptive withdrawals, such as mine dewatering), also presented a unique forecasting environment and did not lend itself to the use of water use factors based on mineral production, mining employment, or other socioeconomic factors. 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 gold reserves, the nature of production (underground mining versus open-pit mining), and the continued need for mining dewatering in relation to future mining operations.

Summary of Water Withdrawals by Use Category

Table 5-1. Nevada Water Withdrawal Forecast Summary, presents historical estimates (1995) and forecasts (2000-2020) of water withdrawals by major water use categories along with each categories' percentage share of total statewide water withdrawals. Water 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 data on water use and assume current levels of water conservation. Therefore, these forecasts do not explicitly incorporate the use of new technologies or changes in policy and pricing actions, or changes in conservation practices which would alter the water use rates used to develop these forecasts.

The water use forecasts presented in Table 5–1 show that Nevada’s total water withdrawals for all sectors and use categories is expected to increase by 8.6 percent 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. The state’s total municipal and industrial water withdrawals, which as a source of water are presented separately in Table 5–2, are expected to grow by nearly 509,400 acre-feet from 524,861 acre-feet in 1995 to approximately 1,034,200 acre-feet by 2020, an increase of 97.0 percent. This trend is expected to increase M&I’s share of the state’s total water withdrawals from 13.0 percent in 1995 to 23.6 percent by the year 2020. However, on a statewide basis, it is expected that much of the increased demand in water resources for M&I, domestic, and commercial and industrial needs will be offset by declines in agricultural water withdrawals, especially from reduced irrigation water requirements.

**Table 5–1. 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 7.8%
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 Nevada are based on an aggregation of individual county water withdrawal estimates and forecasts.

[1] Total domestic withdrawals include the total residential use, both indoors and outdoors (i.e., residential landscaping).

[2] Commercial and Industrial water withdrawals include both public supply and self-supplied withdrawals.

[3] Public use and losses are forecast as a fixed percent of total municipal and industrial (M&I) water use based on historical trends.

[4] Thermoelectric withdrawals include water used for geothermal power plants and cooling water for conventional power plants.

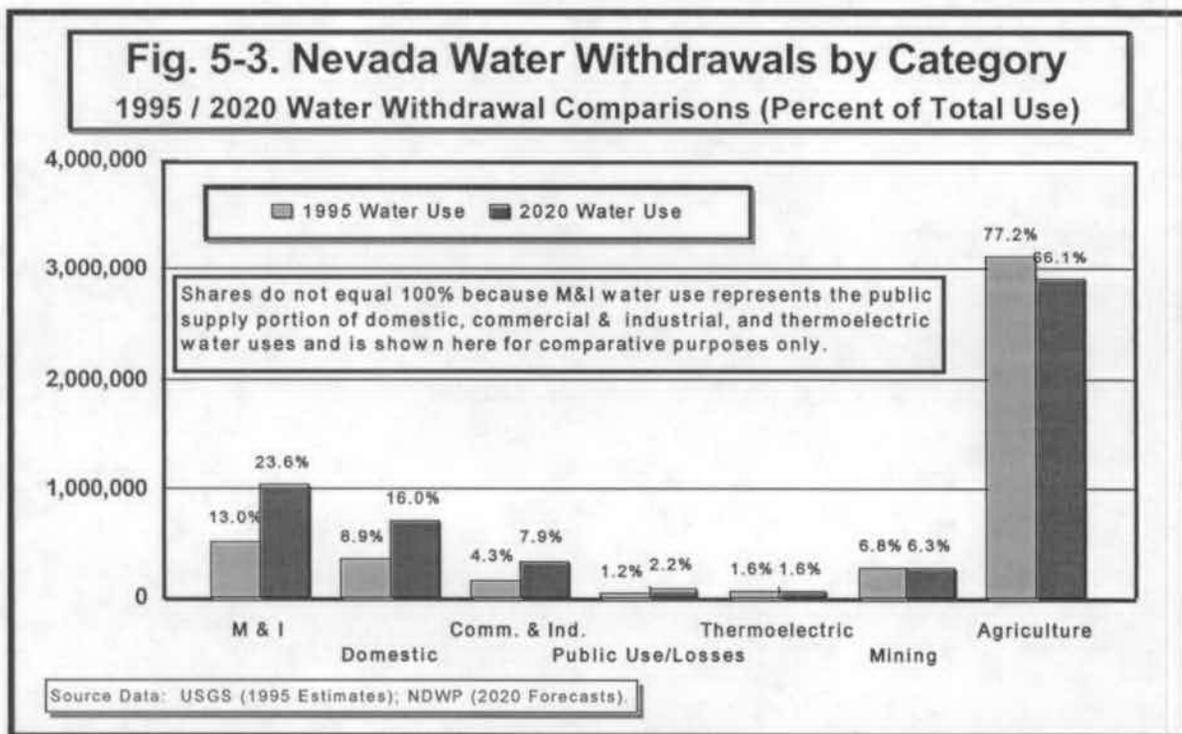
[5] Total mining withdrawals include both consumptive and non-consumptive uses (i.e., processing and mining dewatering).

[6] Total agriculture withdrawals include both irrigation water withdrawals 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 and economic conditions and estimated irrigated acreage.

Total domestic (residential) water withdrawals are expected to increase by over 340,000 acre-feet, or 94 percent over the forecast horizon, from an estimated 360,710 acre-feet of water withdrawals

in 1995 to a forecasted 701,000 acre-feet by the year 2020. This will raise the share of domestic water withdrawals from 8.9 percent of total water withdrawals in 1995 to 16.0 percent by 2020. Within total domestic, public supply domestic 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. This will increase commercial and industrial water withdrawals' share of statewide total withdrawals from 4.3 percent in 1995 to 7.9 percent by 2020. Statewide total public use and losses, which are forecasted here as a constant percent of total municipal and industrial (M&I) withdrawals, are projected to increase by 95 percent from 48,472



acre-feet in 1995 to 94,600 acre-feet by the year 2020. This will increase this category's share of total water use from 1.2 percent in 1995 to 2.2 percent by 2020. Thermoelectric water withdrawals are predicted to increase modestly 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 from 65,449 acre-feet to 71,200 acre-feet. As a share of statewide total water withdrawals, thermoelectric is expected to remain constant at 1.6 percent.

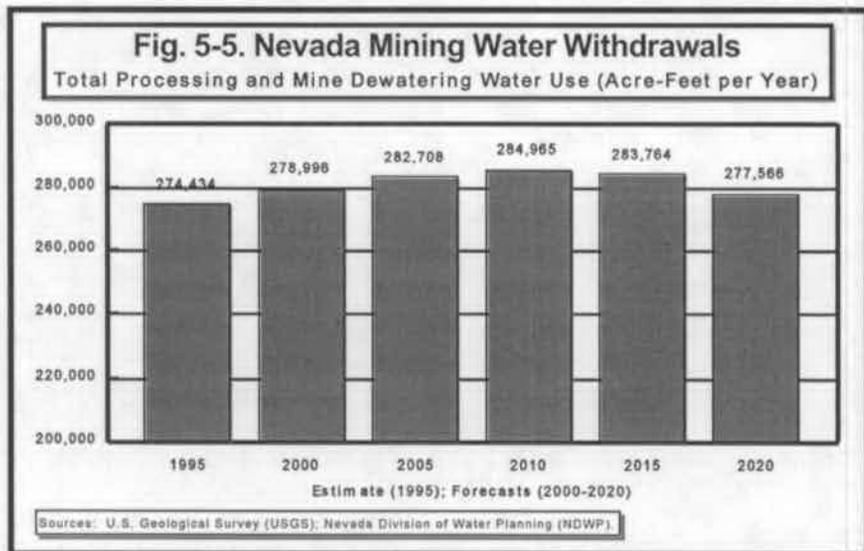
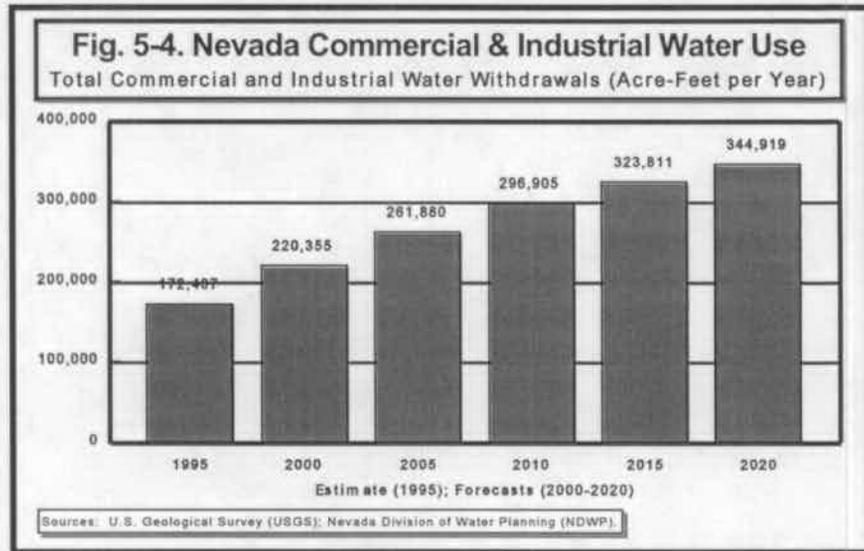
Total mining water withdrawals are expected to peak around the year 2010 at nearly 285,000 acre-feet, an increase of 10,500 acre-feet, or 3.8 percent from 1995's estimated mining water withdrawals.

As more of Nevada gold mining goes underground, total mining water withdrawals are expected to decline slightly to approximately 277,600 acre-feet by 2020, a decrease 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. Mining water withdrawals are projected to show a slight decline in both the amount and share of water withdrawn between 1995 and 2020 from 6.8 percent of statewide total water withdrawals in 1995 to 6.3 percent by 2020.

The most dramatic declines in water use patterns in the state are expected in agriculture and specifically in irrigation water withdrawals. 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 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. 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.

Agriculture's share of statewide total water withdrawals is expected to decline from an estimated 77.2 percent in 1995 to 66.1 percent by the year 2020. This decline assumes that levels of irrigated acreage will remain relatively stable or show modest declines in Nevada's rural counties. It also assumes the continued conversion of irrigated farmlands into



urban lands and residential tracts and commercial businesses in the state's more urbanized counties.

Table 5-2. Municipal & Industrial (M&I) Water Withdrawals, presents estimated (1995) and forecasted (2000 to 2020) 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. Table 5-2 also presents the population growth assumptions, the estimated population on public supply water systems, and the statewide average water use factors derived from the development of the statewide forecasts for M&I water use. All figures contained within this table represent the aggregation of trends and forecasts contained for Nevada's individual counties. The table also presents an estimate of consumptive use based on 1995 consumptive use patterns.

The socioeconomic forecast calls for a near doubling in Nevada's resident population from 1995 to the year 2020. Nevada's estimated 1995 total population of 1,579,150 persons is expected to increase by 1,467,700 persons, or 92.9 percent, to an expected 3,046,846 persons by the year 2020. In addition, based on individual county population forecasts and related socioeconomic trends, the proportion of Nevada's population on public supply water systems is expected to increase from 94.2 percent of the state's total resident population in 1995 to 95.4 percent of the state's total population by the year 2020. Based on higher usage rates typical of public supply system water users, and an increasingly larger proportion of the population coming onto public supply water systems, the statewide average M&I water use factor is expected to increase from 315.0 gallons per capita per day (GPCD) in 1995 to 317.6 GPCD by the year 2020. As a result of these changes, statewide M&I water withdrawals are expected to increase from 524,861 acre-feet in 1995 to 1,034,200 acre-feet by 2020, an increase of 509,400 acre-feet or 97.0 percent. [Note: These forecasts for M&I water withdrawals do not take into account future water conservation efforts.]

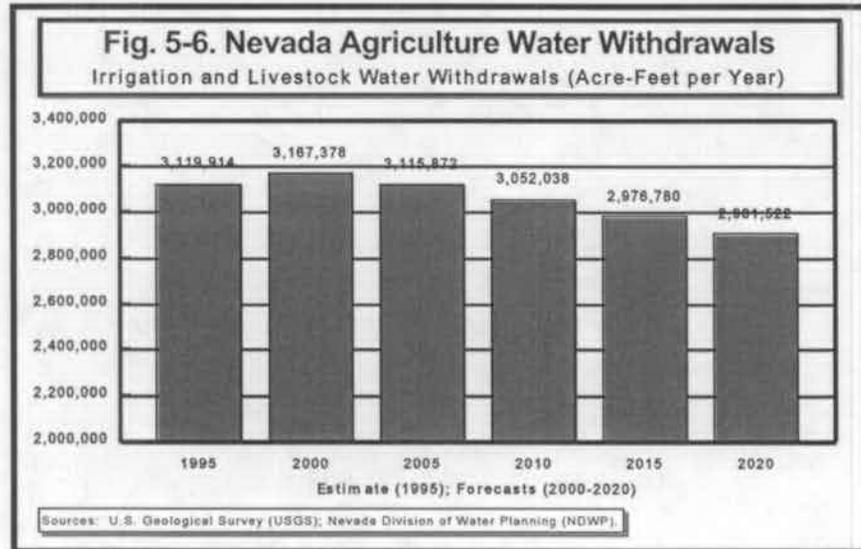


Table 5–2. Municipal & Industrial (M&I) Water Withdrawals
Estimates and Forecasts of Total Public Supply Water Withdrawals
(Water withdrawals in acre-feet per year; Use factors in gallons per person per day)

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[5]	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[6]	196,444	249,223	295,568	334,452	364,037	387,089
Public Use and Losses[7]	48,472	61,195	72,313	81,707	88,930	94,582
As a Percent of Total M&I Use[7]	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. Total 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.

[1] 1995's population estimate was developed by the Nevada State Demographer; population forecasts for the years 2000–2020 were developed by the Nevada Division of Water Planning (NDWP) along with individual county inputs.

[2] The percent of population on public supply water systems for 1995 was based on estimated made by the U.S. Geological Survey (USGS); changes to this percent over the plan's forecast horizon were estimated by NDWP.

[3] The total Nevada figure was based on aggregation of individual county estimates and forecasts.

[4] M&I water use factor was based on an aggregation of individual county trends and varies with both the proportion of the population on public supply water systems and individual county water use characteristics.

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

[6] M&I consumptive water use was 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 Fig. 5–7, Nevada Consumptive Water Use Analysis.

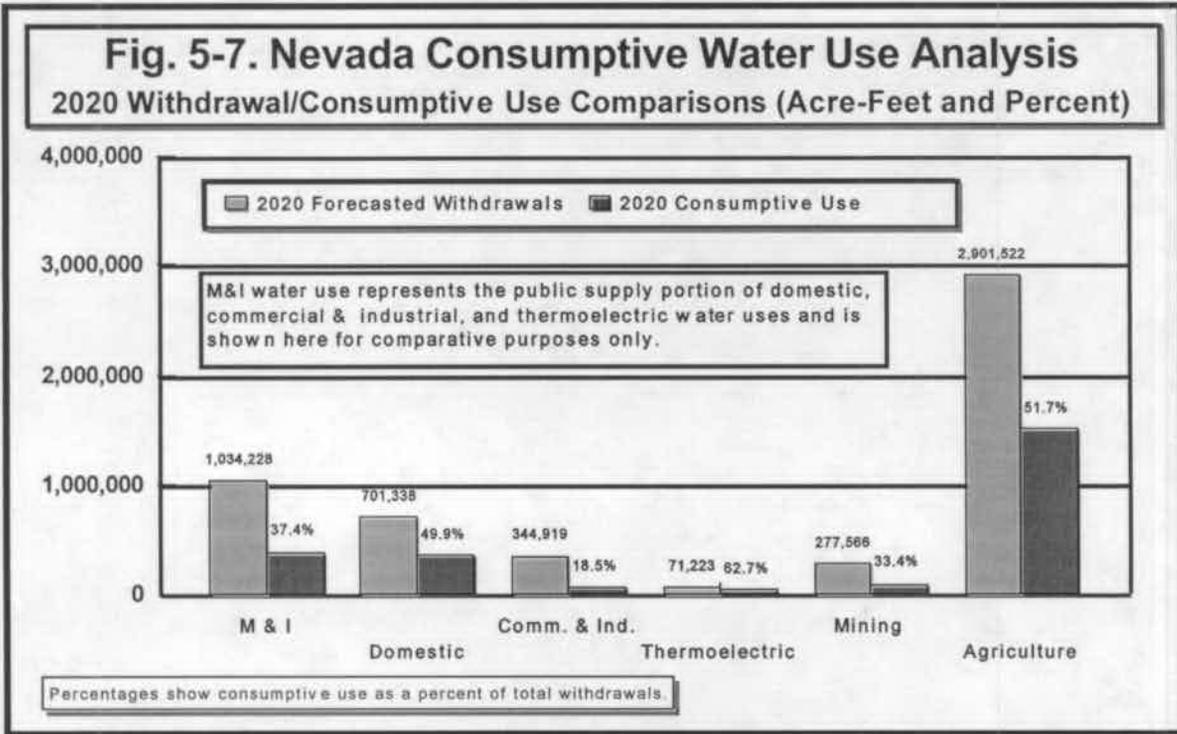
[7] Forecasts for public use and losses were based on a fixed percent of total M&I water withdrawals for each county. The Nevada figure was based on the aggregation of the county totals and while shown here as a fixed 9.2 percent of M&I withdrawals, this figure actually varies slightly over the forecast horizon based on individual county growth patterns, but does not show here due to rounding.

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

Consumptive Use Forecasts

Fig. 5–7. Nevada Consumptive Water Use Analysis, presents estimates of consumptive water use by principal source and use category based on total water withdrawals for these same categories. The data presented in this graph are based on historical relationships between water withdrawals and respective consumptive use patterns. The statewide total consumptive use figure, representing the summation of all categories of water withdrawals, is expected to decrease from 48.4 percent of total water withdrawals in 1995 to 46.8 percent by 2020 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, thereby providing nearly a 63 percent return flow from total M&I water withdrawals.



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**Nevada State Water Plan
SUMMARY**

**Section 6
Meeting Our Future Water Supply Needs**

Introduction

The future presents Nevada with many water resource challenges as a result of an ever increasing population, and competition over our limited water resources. Every effort should be made to ensure that all Nevadans have adequate and safe water supplies while protecting the quantity and quality of our water resources for current and future uses. This section provides a summary of future water demands, alternatives for meeting those needs, and water supply options identified in regional water plans.

Future Demands

As presented in the Summary, Section 5 of the *State Water Plan*, total statewide annual water withdrawals during the period 1995 to 2020 are forecasted to increase about 350,000 acre-feet (af) from 4,041,000 to 4,391,000 acre-feet per year (afy), assuming current levels of conservation. Correspondingly, annual consumptive use will increase about 96,000 af from 1,957,000 to 2,053,000 afy. This projected increase in water use is directly attributable to increasing population and related increases in economic endeavors, resulting in rising public supply (M&I), domestic, commercial, industrial and thermoelectric water usage.

The anticipated increase in total statewide water withdrawals is primarily the result of increasing public supply (M&I) water usage. Annual M&I water use is projected to increase by 509,000 af from 525,000 to 1,034,000 afy, almost doubling from 1995 to 2020. A majority of this increase in demand will be met with surface water supplies. Approximately 91 percent of this increase can be attributed to anticipated growth in Clark and Washoe counties. One of Nevada's water resource challenges will be meeting the water needs of the nearly 3 million people expected to reside in the state by 2020.

The M&I water use projections presented in the *State Water Plan* are based upon existing water use patterns and conservation measures and do not include the effects of future conservation efforts. The implementation of additional M&I conservation measures will result in lower M&I water withdrawals (in 2020) than the 1,034,000 afy predicted in the water plan. Planning groups for Southern Nevada and Washoe County have estimated that their proposed additional conservation measures will result in annual M&I withdrawals about 150,000 af less than would occur without these additional measures. The achievement of additional conservation is an integral part of Southern Nevada's water supply plan for the future.

Based upon the economic forecasts in Part 2 of the *State Water Plan*, agricultural water use could experience a 7 percent decline through 2020. Nonetheless, agriculture will continue to account for a majority of the statewide use during the next 20 years. It must be noted that statewide agricultural water use is highly variable depending upon weather conditions and water supplies, and can vary more than 25 percent from a wet year to a dry year as a result of changing water availability. While the projections in the *State Water Plan* suggest that agricultural water use will decrease in the future, planning and management efforts need to consider providing more reliable water supplies for irrigation during drought periods.

Almost 6 to 7 percent of statewide water withdrawals occur in the mining industry. It is anticipated that mining water withdrawals will remain relatively constant at around 275,000 afy with a slight increase over the next 10 years followed by a slight decline after 2010. A majority of the withdrawals are associated with mine dewatering, and about 185,000 acre-feet per year of these withdrawals are either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. The impacts of these future mine dewatering activities will continue to be monitored and evaluated.

Water Availability

Approximately 60 percent of the water withdrawn in Nevada comes from surface water sources. Available surface water supplies are highly dependent upon weather conditions with variable monthly and annual flows. With such wide fluctuations, it is difficult to provide adequate and consistent water supplies to users on the system. Utilization of above ground and below ground storage capabilities are one strategy for smoothing out some of the flow fluctuations, thereby guaranteeing more reliable supplies. Generally, Nevada's surface water sources have been fully appropriated and utilized for many years. Expanded usage of our surface water resources can only occur to a restricted extent.

With limited "excess" surface water available, those looking to surface supplies to meet future demands will need to examine a variety of options such as water right acquisitions and transfers, storage and improved management.

Groundwater supplies provide about 40 percent of our water needs. In some areas of Nevada, groundwater sources are used as a supplemental source during times of limited surface water flows. Currently, about 60 percent of Nevada's groundwater basins have varying amounts of water available for additional appropriations. However, most of these groundwater resources exist in areas distant from the anticipated water demand growth areas. Development of these sources becomes an expensive endeavor.

Options for Meeting Future Needs

Meeting our future water needs will require implementation of a combination of strategies. Possible strategies have been divided into two categories: demand management and supply development. Through demand management, water purveyors make wiser use of the available water thereby lessening the need for new source development. Supply development strategies include a variety of methods for increasing supplies and improving supply reliability.

Increasing demands and competition for our limited resources oblige water managers and suppliers to implement both demand management and supply development strategies. However, each option needs to be evaluated on a case-by-case basis for suitability, cost effectiveness and public acceptance.

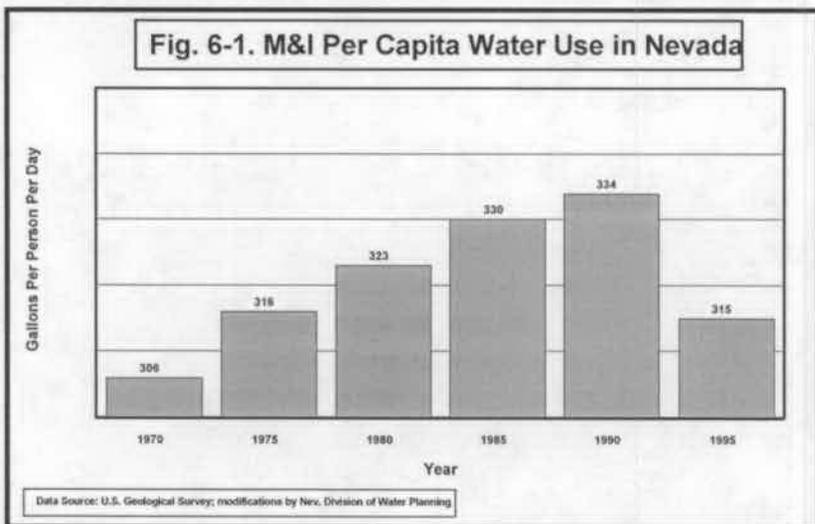
Demand Management Strategies

The time is past when water supply needs can be met simply by developing more water withdrawal, storage and delivery systems. Demand management must also be part of any long-range water supply plan. By reducing demands, new supply developments can be delayed with potential savings to the users. Demands can be managed through conservation measures and alternate strategies such as effluent reuse, greywater use and dual water systems.

Conservation. Conservation is recognized by most water suppliers and users as a cost-effective approach for extending water supplies, improving supply reliability during times of shortages, and deferring the need for new supply development. Numerous case studies have shown that a good conservation program can reduce demands significantly.

A comprehensive municipal water conservation program typically includes features such as: water system audits and leak detection, a public information and awareness program, utilization of increasing block billing, new ordinances, installation of low flow fixtures, landscape demonstration projects, use of drought tolerant plants and implementation of a xeriscape program, and installation of meters. From 1970 to 1990, Municipal & Industrial (M&I) water use rates in Nevada were on the rise (Figure 6-1). Successful conservation programs during the 1990s have lowered statewide M&I water use from 334 gallons per person per day (gpcd) in 1990 to 315 gpcd in 1995.

Agricultural conservation programs typically include: laser leveling of fields, lining of ditches, use of soil and



plant moisture monitoring devices, conversion to overhead or drip irrigation methods, and selection of low water use crops. Nevada's agricultural community has been implementing many of these conservation measures throughout the State, particularly in the Walker River and Carson River basins and the Lovelock area (Humboldt River basin).

Alternate Strategies for Reducing Potable Water Demands. Conservation reduces potable water demands by decreasing the overall water needs of the users. Other options to achieve potable water demand reductions involve the utilization of lower quality water in lieu of treated potable water, such as effluent reuse, greywater reuse and dual distribution systems.

One way to reduce demands for potable water and thus extend the higher quality supplies is through the use of treated wastewater effluent as a replacement source in Nevada. Current uses for reclaimed water include: urban landscaping such as golf courses, parks, road medians, cemeteries, etc.; agricultural irrigation; industrial uses such as cooling water and process water; wetlands applications; and construction water. Effluent reuse is increasing in Nevada with a majority of the treated wastewater being reused in Clark, Douglas, Elko, Lyon and Washoe counties and Carson City.

Another potential method for reducing potable water demands is to irrigate trees and shrubs with greywater - water that has already been used for bathing or clothes washing. Greywater can account for more than one-half of all residential indoor water use. Because greywater systems require dual piping, surge tanks and distribution piping, they can be expensive to install and may be more suitable for new construction rather than retrofit situations. Greywater is reused to a limited extent in Nevada.

The use of dual water systems is another method for reducing potable water demands. With this strategy, lower quality water (nonpotable) is used for outdoor landscape irrigation and is delivered to users via a second pipeline system separate from the potable water distribution network. As with some of the other demand management strategies, the use of dual water system may be more cost effective for new construction and limited retrofit situations.

Supply Development Strategies

Supply development strategies include alternative methods for increasing supplies and improving supply reliability, such as use of uncommitted supplies, acquisition and transfer of existing water rights, improved management of both groundwater and surface water supplies, utilization of lower quality (saline) water, and increasing natural supplies. The strategies presented in the following discussion may not be appropriate in all situations and must be examined on a case-by-case basis.

Use of Existing Committed and Uncommitted Supplies. With this strategy, water suppliers further utilize supplies under their existing water rights and/or obtain new appropriations for previously unallocated water. In general, future new allocations will be limited to groundwater as most of the surface water resources have been fully appropriated. For some areas of Nevada, this strategy may be an expensive proposition as most of the unappropriated groundwater resources exist in areas distant from the growing metropolitan areas.

Water Transfers. One tool for increasing available supplies to meet future demands is water transfers. Under this option, water rights are purchased or leased from one user for use by another. As most groundwater and surface water sources are fully appropriated, opportunities for new appropriations are typically limited to basins distant from the growing metropolitan areas. In some cases, water transfers from existing uses may be more cost effective than developing distant sources.

Groundwater Recharge and Recovery. Artificially recharging aquifers is a water resource management option available to some areas as a means of securing more reliable water supplies during periods of low surface water flows. This strategy involves recharging groundwater aquifers with available surface water for later use. Underground water storage has a number of advantages over surface reservoirs. In general, surface reservoirs may have higher construction costs and more difficult environmental permitting requirements, and higher water losses (due to evaporation). Nevada state water law provides criteria for the establishment of groundwater recharge/recovery programs.

Conjunctive use. Conjunctive use is the coordinated management of both surface water and ground water supplies. Under an active form of conjunctive use, surface water is used when available, excess surface water (if available) is stored in groundwater aquifers, and groundwater and stored surface water is then pumped to meet demands over and above those met with the surface water supplies. Benefits of conjunctive use include improved management of resources, more reliable supplies, emergency and drought relief capacity, and summer peaking options.

Desalination. Desalination is a process that removes dissolved minerals (including but not limited to salt) from seawater, saline water, or treated wastewater. Desalination for Southern Nevada has been suggested in the form of an exchange with California, i.e. Las Vegas would pay for desalination facilities in California in exchange for the use by Southern Nevada of a portion of California's Colorado River apportionment. However, high desalting costs continue to keep this option as a lower priority.

Cloud Seeding. Cloud seeding is a weather modification technique involving the injection of a substance into a cloud for the purpose of increasing precipitation amounts, thereby increasing snowpack amounts and associated streamflows. Cloud seeding first began in Nevada in the Lake Tahoe basin in the 1960s. Currently, cloud seeding activities exist in the drainage basins of Lake Tahoe, Truckee River, Carson River, Walker River, upper Humboldt River, South Fork of the Owyhee River, and Reese River. The Desert Research Institute has designed and operated the Nevada state cloud seeding program since its inception. Estimates of augmented water from seeding have varied from 35,000 to 60,000 acre-feet over each of the last ten years.

Meeting Future Municipal and Industrial (M&I) Water Needs

As already discussed, statewide M&I water use could increase from 525,000 to 1,034,000 acre-feet per year by the year 2020 if current water use patterns continue. Approximately 91 percent of this increase can be attributable to anticipated growth in Clark and Washoe counties. According to planning documents for Clark and Washoe counties, the increase in their M&I demands will be met primarily with expanded utilization of surface water supplies. Projections show that a number of other counties are also expected to experience significant M&I water use growth from 1995 to 2020: Nye (113 percent), Lyon (105 percent), Churchill (89 percent), Pershing (76 percent), Douglas (74 percent), Elko (64 percent), Storey (57 percent), Carson City (56 percent), and Humboldt (55 percent).

Many of these counties or regional entities have developed or are actively developing plans to deal with these increasing water needs. The most common solutions being considered in these plans are: conservation; expanded use of current supplies; acquisition and transfer of existing rights; reclaimed water use; groundwater recharge/recovery; and conjunctive use. Upon reviewing water supply planning efforts for Southern Nevada, and Washoe and Douglas counties, a number of observations can be made and some lessons can be learned:

- Water purveyors are utilizing demand management as a means for delaying or reducing the need for additional supplies. Conservation has become commonplace and additional conservation measures are planned for the future. For example, the achievement of additional conservation is an integral part of Southern Nevada Water Authority's water supply plan for the future.
- Effluent reuse has increased in recent years and these plans indicate that this trend will continue during the planning horizon.
- In general, these plans call for a variety of strategies and sources for meeting future demands. By not putting all their eggs in one basket, water purveyors will be able to provide reliable and safe drinking water supplies.
- Conjunctive use and recharge/recovery program are recognized as useful tools for managing both groundwater and surface water sources. The implementation of conjunctive use and recharge/recovery programs will expand in the future.
- Municipal and Industrial water supply planning is being done on a regional basis. All persons within a region can benefit when planning includes all users and interest groups, and considers both water quantity and quality within a region.
- Creative water supply solutions are being developed. With our limited water resources and growing demands, it has become necessary to look for creative solutions, such as Southern Nevada Water Authority's Arizona Banking Demonstration Project.

- The positive value of regional, consolidated M&I water systems is being acknowledged. Improved water management and “economies of scale” can be realized through water system consolidation.
- Currently, there is little reliance upon greywater and dual water systems, and desalination treatment due to the higher costs of these options. These plans suggest that this trend will probably continue.

One or all of the options presented in the Southern Nevada Water Authority, Washoe County and Douglas County plans may have possible application for M&I water system throughout Nevada. Other water purveyors and planners stand to gain valuable insight into their own water supply problems and solutions by studying other water plans.

Meeting Future Agricultural Water Needs

According to U.S. Geological Survey estimates, annual irrigation withdrawals have varied from 3.1 to 3.4 million acre-feet over the last 25 years. Irrigation withdrawals in 1995 were estimated at about 3.1 million acre-feet, with about 63 percent diverted from surface water sources. Historically, irrigated acreage and associated water usage has varied greatly from year to year in response to our fluctuating precipitation and surface water supplies. With highly variable streamflows in Nevada, those agricultural operations utilizing surface water are faced with unreliable supplies during low flow periods. As a result, many of these irrigators have developed groundwater supplies to supplement surface water sources. However, pumping groundwater is generally expensive and may not be cost effective in some cases.

Based upon past use trends, NDWP projects that statewide agricultural water withdrawals could experience a 7 percent decline through 2020. In part, encroaching urbanization and the transfer of agricultural water rights to other uses such as municipal and natural resource needs will drive future agricultural water use reductions.

While the projections in the water plan suggest that the agricultural water supply will be generally adequate to meet future usage, that should not preclude water managers, planners and users from evaluating other water supply and management issues and options such as:

- methods to improve water supply reliability for agricultural users dependent upon fluctuating surface water sources;
- implementation of water conservation methods; and
- increased utilization of treated wastewater effluent.

Meeting Future Mining Water Needs

Mining water withdrawals are anticipated to remain relatively constant at about 275,000 afy with a slight increase up to the year 2010 followed by a slight decline. Beginning in the early 1990s, a majority of the mining withdrawals have been associated with mine dewatering. These withdrawals have been significantly higher than the mines' consumptive use needs, thereby requiring the mining operations to develop alternative disposal methods for the excess water. A majority of this "excess" water has been either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. It is anticipated that this trend will continue with pit dewatering activities generating water volumes in excess of mine processing and consumptive needs.

The forecasted future mining withdrawals are estimates only and are highly dependent upon the price of gold. Actual water use may also be affected by shifts from open pit mining to underground mining. However, some degree of mine dewatering is expected to continue regardless of the type of production activity.

Meeting Future Domestic Water Needs

Statewide domestic water withdrawals are forecasted to increase from about 361,000 afy to about 701,000 afy by 2020 in response to a growing population. Public supply systems are the primary providers of water for domestic uses. As of 1995, the domestic water needs for about 94.2 percent of Nevada's population were met by public water systems. This percentage is projected to increase to 95.4 percent by 2020. Nevertheless, the number of persons on domestic wells is still expected to increase from 92,000 to 140,000 over the next 20 years.

Meeting Future Commercial, Industrial and Thermoelectric Water Needs

In 1995, commercial, industrial and thermoelectric sectors withdrew about 238,000 af of water accounting for about 6 percent of total statewide withdrawals. Public supply systems met a majority (about 85 percent) of the total commercial needs in Nevada. In the industrial and thermoelectric sectors, self-supplied systems provided most (95 percent) of the water needs.

By the year 2020, commercial, industrial and thermoelectric withdrawals are projected to increase to about 416,000 afy. It is anticipated that public supply systems will continue to satisfy a majority of future commercial water needs, while self-supplied systems will be utilized to meet most future industrial and thermoelectric demands.

Meeting Future Wildlife and Environmental Water Needs

Interest in obtaining the necessary water supplies to meet wildlife and environmental water needs is increasing. However, quantifying these water needs is a challenge. In the broadest sense, all water (with the possible exception of deep groundwater) may provide benefits to wildlife and the environment. For example, all surface water, whether in rivers, ponds, lakes or reservoirs supports a variety of flora and fauna, while also supporting other needs such as public system and irrigation uses. Additionally, shallow groundwater supports riparian vegetation and phreatophytes which provide habitat. Also, habitat may be created as a result of other activities such as irrigation. Wildlife and environmental water needs become difficult to quantify when examined in this broad manner.

The securing of water supplies for wildlife and environmental purposes is still a relatively new resource management concept. In recent years, governmental agencies and conservation organizations in Nevada have used a variety of mechanisms to obtain water for fishes, wildlife, special status species, wetlands and water quality improvement. Water has been obtained by purchasing and transferring water rights to a designated water body or portion thereof, filing for new appropriative water rights and entering into formal and informal agreements for reuse of water from agricultural irrigation systems, wastewater treatment plants, mine dewatering operations and an electric generating station. The water obtained for wildlife and environmental needs is generally used to augment stream flow, reservoir and lake levels, spring pools, wetlands and riparian areas.

Water rights have been acquired for the Lower Truckee River, Meadow Valley Wash (Condor Canyon), Upper Blue Lake (Humboldt County), Bruneau River, Carson Lake and Pasture and for a number of other aquatic and wetland resources on various federal wildlife refuges and state wildlife management areas. Many water acquisition projects have been cooperative interagency actions to meet requirements of state and federal legislation, such as the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (Public Law 101-618) Endangered Species Act, Section 404 of the Clean Water Act (wetland protections), the Migratory Bird Treaty Act and the National Environmental Policy Act.

Currently, efforts to assess and provide water supply needs are commonly retrospective, having been concentrated where ecosystem components already are deteriorating. Providing for future wildlife and environmental water supplies requires implementation of an ongoing, structured assessment process to determine where additional water supplies for wildlife and environmental needs are not being met as evidenced by deterioration in essential resource conditions. Laws and regulations have been instituted which require assessment and management actions to minimize the risk that municipal and industrial water supplies will not meet demand. A similar policy approach is needed for wildlife and environmental resources.

Meeting Future Recreation Water Needs

The popularity of water based outdoor recreation continues to grow. The number of people fishing, wildlife watching, boating, and swimming in Nevada's waters has never be higher, significantly adding to the state and local economies. In fact, tourism officials now commonly advertise the other side of Nevada, its expansive landscape and comparatively unique and rare water resources in the desert. Government agencies responsible for maintaining recreation resource values have acquired water for recreation purposes, primarily at reservoirs in the state. However, as recent experience has shown parks managers and visitors, droughts can dramatically impact water supplies at reservoirs, resulting in significant loss of available recreation resource area. Sometimes the seniority of acquired water rights does not ensure water availability during drier seasons.

As with wildlife and environmental water needs, quantification of recreational water needs may be difficult. In some instances, water for recreation is provided as the result of other water use activities. For example, reservoirs created for irrigation or municipal water supplies also provide recreation opportunities as a secondary or additional benefit. Anticipating future water needs for recreation will require implementation of a comprehensive and integrated assessment process. In fact, recreation resource needs are often intertwined with those of wildlife and the environment. Therefore, it would be practical to combine recreation and natural resource water needs assessments.

Nevada State Water Plan
SUMMARY

Section 7
Issues and Recommendations

Introduction

The following issue papers represent a summarization of those issues contained in Part 3, Water Planning and Management Issues of the *Nevada State Water Plan*. All recommendations have been retained from the original issue papers. The numbers and titles used below are the same as those used in Part 3.

1 — WATER SUPPLY AND ALLOCATION

Water Conservation

Ensuring an adequate water supply for any use is no longer only a matter of developing new sources. Conservation has become an essential part of the water supply equation. Over the last 10 years conservation has been shown to be a cost effective way to reduce demands and to extend a given water supply. Conservation measures can be pursued by all water users regardless of the type of water system, i.e. municipal, irrigation, private home, commercial or industrial, etc. Water use measurement is a key component to any conservation program. Meters and other measurement devices are needed to evaluate program effectiveness.

At this time, the State has no comprehensive program for promoting and encouraging conservation, or for assisting water use entities in developing water conservation strategies. However, in recent years the State has instituted some statutes and regulations encouraging conservation. For example in 1991, the Nevada State Legislature enacted a law requiring that each "supplier of water" for municipal, industrial or domestic purposes adopt a water conservation plan based on the climate and the living conditions in its service area by July 1, 1992. Also, the Nevada Legislature passed Assembly Bill 359 in 1991 thereby imposing certain minimum standards for plumbing fixtures (toilets, showers, faucets and urinals) in new construction and expansions in residential, industrial, commercial and public buildings. In 1992, the U.S. Congress passed the National Energy and Policy Conservation Act which set nationwide minimum flow standards for plumbing fixtures.

Issues

1. At this time, the State has no comprehensive program for promoting and encouraging conservation throughout Nevada and for assisting water users in developing water conservation strategies.
2. Currently, state law requires municipal water suppliers to submit conservation plans, but provides

little incentive for compliance. Also, there are no requirements that these plans be periodically updated or reviewed for effectiveness. Water users other than public suppliers are not required to submit conservation plans.

3. The current law of "use it or lose it" does not encourage conservation. However, existing statutes prohibit the waste of water, and provide the basis for a "credit for conservation" program.
4. State law provides few requirements and no specific incentives to conserve.
5. There have been attempts to appeal the federal minimum flow standards for plumbing fixtures. Repealing the federal standards could adversely affect Nevada's conservation efforts.

Recommendations

The following recommendations are offered as measures for improving conservation efforts in Nevada. In developing these recommendations, it was assumed that conservation would remain primarily a voluntary activity for water suppliers and users, with the State providing assistance and incentives. It is not the intent of these recommendations to advocate conservation purely for the sake of conservation. Conservation should be recognized as one of many water resource management tools that should be considered when it makes sense in terms of economics and overall resource management.

1. The State should add staff to the Division of Water Planning to provide technical, educational and financial assistance with water conservation. Duties of this staff could include:
 - review water conservation plans and provide technical assistance;
 - distribute grants;
 - prepare conservation plans for state facilities;
 - prepare and/or evaluate water audits for state facilities;
 - assemble a repository of water conservation information for distribution;
 - develop conservation education materials and provide educational seminars; and
 - compile a list of recommended best management practices for use in Nevada.
2. All municipal water suppliers are now required to implement conservation plans. It is recommended that the following steps be taken to improve this program:
 1. require municipal water systems over a certain population threshold to periodically update their conservation plans, and establish ongoing reporting requirements;
 - require municipal water systems over a certain population threshold to adopt, implement and update their water conservation plans prior to receiving any state grants or loans or State Revolving Funds (Safe Drinking Water Act);
 - require municipal water systems over a certain population threshold to adopt, implement and update their water conservation plans prior to the State Engineer's approval of a water right application or transfer request; and
 - add staff to assist municipal water systems with developing their conservation plans and encourage compliance with conservation plan requirements.
3. On a trial basis, the State should require additional groups of water users (such as irrigators, and self-supplied commercial and industrial users) above a certain water use threshold to prepare water conservation plans. A cooperative agreement with other agencies could be set up to assist in developing and reviewing the plans.
4. The Department of Conservation and Natural Resources should develop a more formal "credit for conservation" program in order to encourage more conservation throughout Nevada. This

program would be voluntary. Water use measurement and enforcement would be essential for such a program to be successful.

5. The State, in cooperation with Cooperative Extension and Natural Resources Conservation Service, should assist agricultural users in implementing conservation measures through the following mechanisms: develop an irrigation management information system with weather stations in selected basins to provide real time evapotranspiration data for irrigation scheduling; establish mobile laboratories to visit farmers to help them evaluate their water management efficiency; and establish an irrigation training and research center.
6. If state government is to promote conservation throughout Nevada, it must lead by example and assist the various state agencies in becoming more efficient. The State Legislature and the Governor should promote statewide water conservation by:
 1. incorporating water conservation policy goals into all appropriate activities and programs of state government
 2. directing agencies responsible for constructing, leasing or maintaining state facilities and property to use water conserving plumbing fixture and devices, water efficient landscape practices and other programs to maximize water conservation
 3. providing appropriate funding to affected state agencies to retrofit existing state facilities with water conserving devices.
7. The State should establish a fund to help pay for water conservation projects to demonstrate the benefits of water efficiency measures and provide an incentive for conservation/
8. The State should encourage public supply systems to meter water deliveries. Refer to the “Water Use and Estimation” issue discussion for additional information on water use measurement in Nevada.
9. The State should encourage effluent reuse and greywater use where feasible.
10. The State should initiate a water measurement program for all water users to install water measurement devices, or implement water use estimation techniques (based upon power use, etc.) for certain users over a threshold use amount and for certain basins. Funding support would be a necessary component. Refer to the “Water Use and Estimation” issue discussion for additional information on water use measurement in Nevada.
11. The State should continue to support existing state and federal minimum flow standards for plumbing fixtures.

Integrated Water Management

Groundwater and surface water supplies in Nevada are finite resources, only replenished by the nine inches of average annual precipitation. The State’s rapidly expanding population is putting increased pressures on the available water supplies, thus increasing the need for integrated water management.

Surface water is used to meet approximately 60 percent of the water needs in Nevada, with groundwater making up the other 40 percent. Surface water in the State is fully appropriated, thus future development will rely heavily on groundwater resources. In many communities groundwater currently provides 100 percent of the water supply for municipal uses. In years of low surface water supply, groundwater is pumped to supplement surface water sources.

Water quality typically varies throughout the state, dependant upon the aquifer material, location relative to thermal areas, and point and non-point sources of pollution. Concentrations of naturally occurring contaminants such as TDS, metals, fluoride and sulfates vary but typically do not exceed State and Federal drinking water standards in the majority of aquifers used for drinking water supply.

Integrated water management in Nevada consists of three components:

- **Conjunctive Use** — The goal of conjunctive use of water systems is to maximize the use of surface water supplies when they are available, and minimize the use of groundwater to conserve the total resource.
- **Water Storage** — Storage of surplus surface water in aquifers underground or in above ground reservoirs enhances groundwater supply and can be withdrawn when available supplies are not adequate to meet demand.
- **Water Reuse** — Use of previously used water or treated waste water for commercial, industrial and irrigation uses is becoming more common in Nevada. Treated effluent is currently used for irrigation at many golf courses, while commercial uses include using previously used water for cooling tower make-up water at power generating station.

Issues

1. Effective management of the total water supply in the state depends on a clear understanding of the interaction of the water resources.
2. Groundwater and surface water are managed as two separate sources in Nevada. Water allocation and management decisions need to incorporate state-of-the-art knowledge regarding the relationship between groundwater and surface water.
3. Underground storage is a viable alternative to surface water storage, eliminating evaporative losses which can be significant in Nevada. However, few communities are actively exploring the potential for underground storage.

Recommendations

1. The State should continue groundwater and surface water monitoring to refine the estimates of perennial yield of hydrographic basins, and provide an improved estimate of water availability in the state.
2. The State should support funding and development of an enhanced groundwater level and quality monitoring network to better quantify groundwater availability and use throughout the state and especially in areas of rapid growth.
3. The State should fund integrated water resource studies to assess the effects of groundwater pumping on surface water flows on critical streams and springs where impacts have been identified.
4. The State should encourage development of aquifer recharge/recovery projects where feasible throughout the state, and evaluate surface water storage options where underground storage is not feasible.
5. The State should encourage installation of dual piping in new developments to facilitate use of treated water for irrigation and other uses which are not required to meet drinking water standards.
6. The State should encourage the preferential use of reclaimed water, surface water, and stored water.

7. The State should ensure that water users who use a combination of surface water, groundwater, or alternative water sources (reclaimed water, grey water, etc.) do not use more than the total amount of water necessary to meet their needs efficiently within the limit of their water right.

Interbasin and Intercounty Transfers

Water transfers involve withdrawing either groundwater or surface water from one basin or county for beneficial use in another. Water transfers have been around for a long time and are an integral part of the settlement of Nevada. There are over 20 interbasin transfers occurring in the state today. Growing urban areas are looking to appropriate available water rights and transfer them to the place of need or purchase existing water rights and change them to municipal use, frequently in a different basin or county. Water right transfers are also being viewed as an important way to augment instream flows.

State water allocation law does not contain special criteria for evaluating interbasin or intercounty transfers. As long as unappropriated water is available, existing water rights are not impacted, and the transfer does not threaten to prove detrimental to the public interest, the State Engineer may approve the transfer. However, other sections of state law contain special requirements for water transfers, including public noticing and the establishment of a water transfer tax and mitigation plans.

Water transfers have contributed to economic development, growth and prosperity in Nevada, but there are also costs associated with such transfers. A water transfer can enable a receiving area to meet current or projected water needs, or lead to economic development or expansion. An area-of-origin can benefit from a water transfer if the area has excess water resources not otherwise needed to meet future growth or resource conservation needs. Water transfer concerns center on whether a water transfer has the potential to impact the rights of existing water users, reduce instream flows, decrease flows to wetlands or lakes downstream of the point of diversion, or decrease recharge to aquifers. Social, economic and fiscal concerns center on potential losses of taxable income, social stability or the ability to economically develop in the future. Other concerns include the impacts that population growth may bring.

Interest in water marketing, and associated water transfers, is increasing as the demand and price for water rights increases. The 1994 Nevada Legislative Committee to Study the Use, Allocation and Management of Water recommended that the water plan include general criteria for the approval of interbasin water transfer applications. The 1995 Nevada State Legislature amended the water planning statute to require that the state water plan include provisions to protect water supplies in rural areas for future development and quality of life benefits.

Issues

1. Water transfers can impact third parties. It is sometimes difficult to determine who the affected parties are and to inform them about proposed water transfers.
2. Concerns have been expressed about water transfers and their potential impacts. Regional water planning enables local officials to be prepared when water transfers are proposed for their area, and to better capitalize on any benefits and mitigate any impacts water transfers may bring.

3. Water transfers may have relatively larger impacts on rural counties. Rural counties must carefully evaluate the potential social, fiscal and economic impacts of water right transfers.
4. Nevada has many threatened and endangered species and unique ecosystems, and has lost much of its wetland environments. Protection of water quality and recreation opportunities depend in large part on water availability. Because the water needs for these beneficial uses of water have not been adequately quantified and few water rights have been obtained to support them in the past, a thorough evaluation of the potential environmental impacts must precede any large scale water transfer.
5. Water markets are developing in various ways in different parts of Nevada. There are few, if any, mechanisms to bring buyers into contact with sellers or to bring order and rationality to the process. Therefore, transaction costs are high and water rights may not be appropriately valued.

Recommendations

The following recommendations were significantly influenced by recommendations made by Nevada county commissioners and the public at more than 25 public meetings and workshops on the state water plan held in 1998. The recommendations were also influenced by the recommendations found in the 1994 *Study of the Use, Allocation and Management of Water* prepared by the Legislative Commission of the Legislative Council Bureau, State of Nevada, and in *Water Transfers in the West – Efficiency, Equity and the Environment*, 1992, prepared by the National Research Council. The recommendations below are designed to balance the positive and negative impacts interbasin and intercounty transfers may have.

1. All levels of government should recognize the potential net value of water transfers as a way to respond to changing demands for water, and encourage voluntary transfers, as long as the public interest is protected. Efforts should continue to make information available to the public concerning water transfer proposals and to provide affected interests with an opportunity to participate in any proceedings.
2. In applying the public interest test (under NRS 533.370(3)) to an interbasin or intercounty water right appropriation or change request, the State Engineer should continue to consider whether:
 - the applicant for the water transfer has justified the need to import the water and demonstrated that an effective conservation plan has been adopted for the region in need and is being effectively implemented;
 - the transfer plan conforms to or conflicts with the substance of any adopted water plans for either the area-of-origin or the area to receive the water;
 - the project is environmentally sound; and
 - the project is an appropriate long-term solution which will not unduly limit future development and growth in the area-of-origin.
3. When in the public interest, the State Engineer should continue to place conditions on water right permits to mitigate impacts of interbasin or intercounty water transfers.
4. The State should continue to provide, and accelerate where funding allows, water planning assistance to local governments to help develop regional water plans and to identify future water needs. Regional water planning will enable local governments to better plan for their economic development and protect their natural resources, and prepare them to respond to proposals to transfer water into, or out of, their areas.
5. The Division of Water Planning, with the assistance of others, should conduct additional research on the opportunities and costs associated with water banking and water marketing in Nevada, and

develop additional recommendations to improve future water transfers.

Water Use Measurement and Estimation

One of the major obstacles to improved comprehensive water planning and management is the State's lack of an overall water use and estimation program. Approximately 65 to 75 percent of the total water withdrawn from groundwater and surface water sources in Nevada is either measured with detailed diversion records maintained by various entities or estimated by the State annually in detailed pumpage and crop inventories. Only a portion of these data are maintained in an electronic database. Much of the available water use data are collected for regulatory purposes (compliance with permits, decrees, etc.) and may lack the detail needed to fully characterize water usage for planning purposes. The lack of readily available and comprehensive water use data impedes local and state planning and management efforts, including the State Water Plan. Managing and planning water resources without accurate water use information is comparable to managing a checking account without tracking the outgoing checks.

Issues

The State of Nevada lacks a comprehensive water use and estimation program. At this time, the U.S. Geological Survey (USGS) is the only agency that estimates statewide water use for Nevada. The USGS program for Nevada had been cooperatively funded by the Nevada Division of Water Resources (State Engineer's Office) until funding was cut in 1991. Since that time, the USGS has continued the program with other limited funds and the State has had little involvement in the process.

Recommendations

The following is offered as a method for improving water use measurement and estimation, and ultimately future water planning and management efforts, in Nevada:

The State should develop and fund a comprehensive water use measurement and estimation program. Some elements of this program could include the following:

- Enter water use data and estimations currently being compiled by the State Engineer into electronic databases, and link these data with the water right permits database;
 - Acquire more detailed public supply, commercial, industrial and thermoelectric usage data through one of the following mechanisms:
 - a. request that municipal water systems provide additional details of water usage data currently submitted to State Engineer's Office (for compliance with water right permit conditions) such as population served, number of connections, consumptive use estimates and breakdowns by domestic, commercial, industrial, thermoelectric deliveries, etc.;
- OR**
- b. require all of the following water users to submit detailed water use information (measured or estimated) if not currently submitted:
 - public supply systems;
 - self-supplied commercial/industrial/thermoelectric users with usage over a threshold value to be determined; and

- mining operations with water usage over a threshold value to be determined.

Information should include the following as applicable:

- number of persons served;
 - monthly/annual withdrawals by source;
 - monthly/annual deliveries by category (domestic, commercial, industrial);
 - estimated consumptive use;
 - anticipated future needs
- Expand existing program for estimating irrigated acreage and associated water use;
 - Encourage public supply systems to meter all water deliveries;
 - Initiate a water measurement program for all water users to install water measurement devices, or implement water use estimation techniques (based upon power use, etc.) for certain users over a threshold use amount and for certain basins. Funding support would be a necessary component; and
 - Provide State funding for the Division of Water Planning to match the USGS cooperative water use estimation program so that all of the water use information could be compiled in a comprehensive and integrated manner.

Domestic Wells

In Nevada, domestic wells serve approximately 6 percent of the population and withdrawal about 18,000 acre-feet per year (less than 0.5 percent of total state water use). Domestic well usage is projected to increase to about 28,000 acre-feet per year by the year 2020. Though current and projected domestic well usage accounts for a small portion of the State's total water use, some domestic well issues require consideration in the planning process.

Issues

1. For developments created through parceling, the counties have the sole responsibility for determining whether or not water rights need to be dedicated. Some counties have passed ordinances which set forth water right dedication requirements. When deemed appropriate, the State Engineer notifies county commissions of the need for water rights dedication requirements for designated basins, and encourages them to pass appropriate ordinances.
2. Under the existing system, domestic well information may be limited in some basins.
3. Domestic well owners may have limited protection from declines in water levels. Further, domestic wells may not be drilled deep enough to provide protection from drought or interference from other groundwater users.
4. The quality of domestic water supplies have been impaired by septic tank discharges and other contaminants in some areas in Nevada. Limited funding is available to mitigate these situations.

Recommendations

1. The State Engineer should continue, as necessary, to notify counties of the potential impacts on water resources due to multiple parceling activities, and recommend the implementation of water rights dedication requirements for designated basins.
2. The State Engineer, in cooperation with local governments, should establish complete domestic

- well inventories (location and number).
3. The Department of Conservation and Natural Resources should distribute educational material to existing and prospective domestic well owners regarding factors to consider when having a new well drilled or purchasing an existing well.
 4. The State should support the installation or expansion of regional water supply and/or wastewater treatment systems in areas where the quality of domestic wells supplies have been impaired. The Legislature should consider modifying the AB198 Grants to Small Water Systems program or establishing a new program to provide funding for these new installations or expansions.

2 — WATER QUALITY

Nonpoint Source Pollution

The leading cause of water quality impairment is nonpoint source (NPS) pollution. Assessments indicate all major rivers in Nevada are impacted. Urban, agricultural and grazing lands are major source areas. Flow regulation and wetland and riparian area losses are factors also. NPS pollution occurs wherever water flowing across the land or underground picks up nutrients, salts, metals, organic material, soil, or chemicals and delivers the accumulated pollutants to streams, lakes, wetlands or ground water aquifers in amounts greater than natural background levels. The excess pollutants may result in nutrient enrichment, undesirable algae growth, higher total dissolved solids, turbidity, lower dissolved oxygen, pH changes, higher temperatures and increases in pathogenic microorganisms. These conditions negatively affect water supplies by fouling water systems and increasing treatment requirements and operation and maintenance costs. Aquatic ecosystems may also be impacted by nonpoint sources.

The Nevada Division of Environmental Protection (NDEP) administers regulatory and voluntary NPS programs. Pollution control regulations and permit programs have been implemented for septic systems, storm water systems and soil grading activities. Regulation of large animal feed lots is pending. Other actions include public education, support for local Best Management Practices (BMPs), water quality monitoring and source assessments, and interagency cooperation. Potential management options include a NPS pollution credit trading program and participation in the federal Clean Water Action Plan (CWAP). The CWAP offers incentives to states undertaking an interagency watershed management process to control NPS.

Nevada's NPS management approach relies on local and federal agency cooperation. Local agency measures entail master planning to protect sensitive lands, ordinances encouraging cluster development and open space retention, wider setbacks along water courses, impervious surface limits, and ordinances requiring BMPs. Several federal agencies are involved. The Environmental Protection Agency administers Clean Water Act section 319 which promotes state NPS planning. Federal land managers address NPS pollution with land use planning and permits. The U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service protect and manage wetlands. The Natural Resources Conservation Service provides NPS project funding and technical assistance to agricultural and suburban communities through incentive programs. The USGS maintains a monitoring program for water quality, sediment quality, and aquatic biota, and conducts water quality investigations and

publishes related reports.

Issues

1. The 1998 Nevada Water Quality Assessment (305b) Report by the NDEP indicates that water quality does not meet some or all of the beneficial use standards on 775 miles of the 1,639 river miles assessed. NPS generally contributes the most to the impairment.
2. Cost is an obstacle to the implementation and acceptance of BMPs. Monitoring the effectiveness and costs of BMPs is essential to identifying least cost options. The Tahoe Bond Act of 1996 is the only state funding source for NPS projects.
3. The pollution control potential of wetlands and riparian areas has diminished. Regulations enhance agency efforts to halt wetland losses, but support for restoration is limited.
4. Expanding urban boundaries put pressure on wetlands, floodplains, and forest and range lands which adds to NPS pollution problems. Correcting NPS pollution after the fact is difficult and costly.

Recommendation

The management of nonpoint source pollution is an important water supply planning objective. To meet that objective, the following recommendation is offered.

1. The Nevada Division of Environmental Protection, in cooperation with other state agencies, should continue its nonpoint source program consisting of regulatory and voluntary measures, and coordination with federal, state, and local agencies, and the general public.

Comprehensive Ground Water Protection and Management

Aridity, complex hydrogeology, rapid population growth and diversifying public interests are factors driving a need for comprehensive ground water protection and management. Ground water provides about 40 percent of domestic, commercial, industrial, mining and agricultural water use. It also is a supply source for riparian, aquatic and certain upland ecosystems and recreational resources. Some aquifers are showing signs of water quality deterioration and increased use. Many different land uses release nitrates, pesticides, petro-chemicals and other pollutants. A pervasive contaminant from natural and human processes is dissolved solids (salinity). Naturally occurring contaminants also include metals, arsenic, boron, sulfates and radon.

Plans to increase ground water use often must address migration or contaminant concentration issues. The Nevada Division of Environmental Protection (NDEP) administers the Comprehensive State Ground Water Protection Program (CSGWPP). The program emphasizes interagency collaboration to meet objectives that complement existing regulations, address pollution control and remediation priorities, promote pollution prevention (e.g., wellhead protection program), and enhance public education. Mandatory and voluntary provisions of federal and state statutes, such as the Safe Drinking Water Act and Nevada Pesticides Act, are core elements of the CSGWPP.

The Nevada Division of Water Resources (NDWR) allocates, adjudicates, and manages ground water. Statutes emphasize protection of appropriative water rights and non-wasteful, beneficial use. The State Engineer may administer pumping limits or preferred uses where average annual recharge

does not satisfy all water rights. Aquifers are recharged by natural, incidental or artificial mechanisms. Natural replenishment occurs slowly in Nevada's arid climate. Recharge areas are limited, so protective measures are an important land use planning consideration. Incidental recharge augments shallow ground water, but in the process may result in lower quality water in the aquifer. Artificial recharge projects have been permitted by the NDWR and NDEP for storage and recovery, control of water table declines, land subsidence management and quality improvement.

Shallow ground water may influence the quantity and quality of surface water available to flora and fauna. Ecological studies of some springs have found unique, long-lived aquatic species, a number of which are vulnerable or have become extinct due to ground water changes. Acquiring a better understanding and monitoring interactions between ground water and surface water, and ecosystem resiliency is a concern of the Nevada Division of Wildlife, the Nevada Natural Heritage Program and other agencies.

Water quality protections and appropriation of ground water rights by federal or local agencies is subject to Nevada water law. Federal and local agencies protect and manage ground water individually and cooperatively through the CSGWPP. Local governments may adopt ordinances, modify land use plans, and take other actions to protect ground water. Wellhead protection program work is ongoing in many communities, although some have encountered obstacles due to limited resources, data, and expertise. The U.S. Environmental Protection Agency created the CSGWPP framework in 1992 to encourage state action. The U.S. Geological Survey (USGS) conducts investigations and monitors levels and quality in some basins. The U.S. Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service and National Park Service address state ground water objectives in natural and recreational resource management plans and permits.

Issues

1. Water quality and quantity data is collected and stored by different agencies using varying formats. This creates access and use difficulties. Agencies acknowledge that improved data management is essential, but a comprehensive effort has been difficult to muster.
2. Water management decisions increasingly require monitoring data on ambient ground water conditions, trends, and interactions. A statewide monitoring network was proposed in 1978 by USGS and NDEP. Availability of agency resources has been an obstacle.
3. Ground water use has grown. A greater understanding of technical, scientific, economic and legal aspects of recharge/recovery options and recharge zone protections is needed.
4. Pollution from nonpoint sources may cause ground water quality impairment. Use of BMPs and other preventative measures can minimize impacts and contain higher, future mitigation and remediation costs. BMP implementation costs can be an obstacle to their acceptability.
5. High densities of septic systems and stock animals have been associated with ground water nitrate enrichment, often in developments approved through a review process known as "parceling." Evaluation of water quality impacts usually is not required in this process.
6. Some evidence suggests lowering of shallow water tables can impact the ecological integrity and health of riparian and aquatic resources. Inadequate scientific understanding may lead to unanticipated natural resource degradation and losses.
7. Chemical and physical properties make MTBE a threat to drinking water supplies. Utilities with wells near fueling facilities are concerned about present and future contamination risks.

Recommendations

1. The Department of Conservation and Natural Resources (Department) should continue to fully support the development and implementation by NDEP of the Comprehensive State Ground Water Protection Program (CSGWPP).
2. The Department should support the development of and funding for a more extensive, sophisticated and comprehensive ground water monitoring network as necessary to ensure that statutory water supply protection requirements and ground water management objectives are being met, including local recharge zone protection. The monitoring network should be a coordinated effort among state agencies, as well as cooperating federal and local agencies.
3. The NDEP should continue to evaluate MTBE and other gasoline additives with respect to the positive and negative impacts to both air quality and water quality, and the overall desirability of the use of such additives in Nevada.
4. The NDEP should continue to evaluate activities necessary to control sources of nitrate contamination, such as septic system discharges, which affect ground water.
5. The NDWP should research the possibility of modifying the AB 198 Grant Program or establishing a new program to fund the creation of new or expansion of existing public water systems where septic tank pollution of the ground water has become an issue.

3 — RESOURCE CONSERVATION AND RECREATION USES

Maintenance of Recreational Values

Water recreation in Nevada is growing. Nevada Division of State Parks (NDSP) reported about 3.2 million people visited state parks in 1997, a 22 percent increase over 1987. About 70 percent of the visits were to parks with water amenities. Estimated 1996 expenditures for fishing, hunting and wildlife watching were \$211.1, \$94.9, and \$262.8 million, respectively. About 150,000 people fish in Nevada each year, according to Nevada Division of Wildlife (NDOW). Their registration data shows boating has grown 75 percent over the past decade. Recreation preferences are also changing. The number of registered personal water craft (e.g., jet skis) rose from 1,326 to 13,451 in the past decade, and wildlife watching activity is trending upward. The number of recreational water bodies with amenities are comparatively rare, so state parks are important to urban and rural communities. Thus, providing adequate supplies of suitable water for recreation resources is vital.

Recreation value has both intrinsic resource and economic components. Fish and wildlife habitat condition, water quality, number of fish caught, hunting prospects, biological diversity, aesthetics, and solitude are examples of intrinsic values. The intrinsic value people place on recreational experiences is difficult to measure precisely, yet it is an important consideration in managing natural resources for recreation. Estimations of intrinsic resource and economic values concentrate on monetary measures, such as the average dollar amount people spend traveling to and using parks (a proxy for “valuing” the enjoyment recreationists place on certain resources). A common economic measure is total expenditures for recreational goods and services.

State agencies have varied responsibilities for maintaining water recreation values. NDOW administers laws to protect, manage and conserve game, non-game and sensitive fishes, migratory waterfowl and other fauna. NDSP has taken a lead role in past statewide recreation planning. The Nevada Board of Wildlife Commissioners and NDOW recently completed a strategic planning policy analysis for wetlands at state Wildlife Management Areas (WMAs) from which updated management plans will be developed. Strategic concerns identified by these agencies include: (1) competition among multiple users of public lands and land use changes to private land have resulted in impairment and loss of wetlands and riparian areas; (2) water management is the most important issue at most WMAs; (3) water resources are vital components of Nevada's recreational base and should be protected to maintain quantity, quality and accessibility; and (4) existing levels of outdoor recreation funding are inadequate to meet recreation needs. Efforts to address these issues are ongoing.

NDOW acquires strategic conservation easements, access agreements for private land with wildlife values (e.g., agricultural fields), and water rights. The State Engineer has approved state and federal water appropriation and water right transfer applications for recreation and wildlife uses, and works with NDOW to identify applications for uses that may impact recreation resources. Since 1987, \$28 million has been spent to buy and improve state parks, some coming from the 1990 Question 5 Bond Initiative. Purchases include three ranches along the Carson River below Fort Churchill, construction of the South Fork Reservoir boat facilities and campground, Little Washoe Lake and development of day use facilities, and sewer and water systems upgrades in several parks. In addition, the Nevada Division of State Lands has acquired 8,000 acre feet of water rights for the Lahontan Valley wetlands on behalf of NDOW.

Recreation has become a major management emphasis on the 62 million acres in Nevada managed by the U.S. Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Bureau of Indian Affairs, and National Park Service. Federal land managers have become more recreation-focused in their land and resource planning. State and federal agencies manage recreation values of these resources cooperatively.

Issues

1. Satisfying growing expectations for a range of water recreation choices, settings and amenities while protecting resource values presents significant management challenges.
2. Public interest in water supplies for recreation purposes has grown. Surface waters are fully appropriated, so innovative approaches to water allocation for recreation may be needed.
3. Urban areas are expanding up to public land boundaries, resulting in loss of access. More interagency cooperation with local planners could avoid or mitigate access issues.
4. The cost of agency operations per recreation user has increased while federal funding has fallen. Awards from the federal Land and Water Conservation Fund dropped from \$3.2 million in 1979 to zero in 1995. New recreation funding strategies are needed.
5. Competition between recreation and other beneficial users for water access is growing. Recreation values should be considered in agency review of water project proposals.
6. The type and intensity of recreation uses may detrimentally affect unique, sensitive or outstanding waters. More monitoring of uses and resource values may be desirable.
7. Most water recreation occurs on public land managed by federal and state agencies. Greater

interagency coordination may enhance recreation planning and management.

Recommendations

The 1992 *State Comprehensive Outdoor Recreation Plan (SCORP)* contains discussion of specific issues, policy recommendations and suggested actions that pertain to the broader issue of maintenance of recreation values. Recreation issues applicable to the state water plan are found in Chapter IV of the 1992 *SCORP*, Issues and Actions for the Next Five Years. In 1997 NDSP produced the State Park System Plan which describes operations and resources within the park system and its future. Another source of guidance on recreation values is the policies and plans developed by the Nevada Board of Wildlife Commissioners and the NDOW presented in the *Wetland Conservation Plan Applicable to Nine State Wildlife Management Areas* (1998). This plan focuses on wetland protection at WMAs, but recommendations may have applicability to wetlands statewide.

1. The Department of Conservation and Natural Resources (Department) should continue to periodically evaluate the state's water-based recreation resources, assess public demand for this type of recreation, and apply this information to state recreation planning and management efforts to improve customer satisfaction while protecting natural resources.
2. The Department should encourage public agencies to consider impacts to recreation resources and their values relative to existing and potential recreation uses, whenever modification to existing or new public water-related projects, such as dams, weirs and reservoirs, are proposed.
3. The Department should continue to seek opportunities to acquire water rights from willing sellers for recreational purposes, including enhancements for fish habitat, wildlife habitat, flat water recreation and river-based recreation, where consistent with an agency's management plans.
4. The Department should continue to seek new and additional sources of funding to enhance opportunities and maintain resources for recreation.
5. The Department should research the feasibility of alternative mechanisms the state could use to meet public water-based recreation needs, such as purchasing land adjacent to state-owned water bodies, and obtaining development rights, conservation easements, and land use agreements.
6. The Department should encourage and support the efforts of state, federal and local agencies in managing watersheds for protection and enhancement of a full complement of recreation values, in addition to the other natural resource conservation considerations.

Water for Wildlife and Environmental Purposes

Nevada water law has recognized instream beneficial uses for many years. "Minimum" instream flow is a supply planning criterion describing the least amount of water to meet instream beneficial uses, such as habitat for aquatic flora and fauna; water quality; and recreation. A concern is whether instream flows in Nevada are adequate to sustain the quantity and quality of natural resources.

Diverting water for human use is essential, yet the public also places a high value on its natural resources. The number of extinct, threatened, endangered or sensitive fishes may indicate a deficiency in water available to some aquatic ecosystems. Of 98 native fishes in Nevada, 11 are extinct or extirpated, 23 are threatened or endangered and 43 percent are sensitive (December 1998).

Other sensitive species include amphibians, mammals, insects, gastropods and birds. The vulnerability of so many species reflects the need for instream flow protection in some areas. Inadequate supplies of suitable water for sensitive species may exacerbate their vulnerability, and may result in added regulations and costs. By considering the integrated relationships of instream flow to species vulnerability, water quality, and recreation in water allocation decisions, such outcomes may be avoided.

Methods to assess water supply requirements for biota, recreation, aesthetics, and channel maintenance have been developed and used in Nevada. Equivalent methods exist to estimate minimum water supplies for other aquatic resources and for channel maintenance purposes (e.g., revegetation, flood flow capacity). Most upper basin stream segments are free-flowing, so efforts to assess instream flow needs may focus on select portions of water bodies during low flow periods. Agencies and conservation organizations have conducted instream flow assessments on a number of water bodies. However, instream flow assessment has not yet become a commonly used tool.

Divisions within the Department of Conservation and Natural Resources have administrative authority for state laws addressing water use and allocation, water quality, and fish and wildlife, and thus have a preeminent role managing water for resource conservation. The Nevada Division of Wildlife evaluates the potential instream flow impacts on fisheries due to proposed water use projects, and has bought water rights for reservoirs, wetlands, and streams. The Nevada Division of Water Resources has approved several applications from governmental agencies to appropriate new water or convert existing water rights to instream flow purposes. Federal agencies implementing environmental and resource management statutes on public lands and waters are important cooperators in instream flow protection, as are local and tribal agencies. Policies promoting measures to increase water supplies for resource conservation may need to include incentives or compensation to water right holders. Examples of current instream flow protection efforts in Nevada include:

- U.S. Fish and Wildlife Service (FWS) and Nevada Division of State Lands are implementing a plan to acquire water for 25,000 acres for Lahontan Valley Wetlands.
- Washoe County and the cities of Reno and Sparks have begun to purchase and transfer water rights to mitigate periodic water quality impairment on segments of the Truckee River.
- The Nature Conservancy, USFWS and Federal Water Master have worked out modified river operations to aid cottonwood regeneration on the lower Truckee River.
- U.S. Bureau of Land Management has studied Walker Lake inflow rates required to raise the water level and quality for at-risk native trout and habitat for waterfowl.

Issues

1. A large share of Nevada's biological diversity is associated with comparatively rare aquatic and riparian ecosystems. Difficulties stabilizing and reversing statewide trends in resource losses signals a need for greater conservation efforts.
2. The historic and potential future losses of sensitive aquatic, riparian and wetland species indicates that additional emphasis on proactive water supply planning and management for resource conservation is a matter of urgency.
3. Wildlife Commission policies direct NDOW to secure water to maintain adequate instream flow, minimum pools, wetlands, springs and seeps for wildlife and their habitats. Difficulties acquiring water rights may be encountered due to funding or staffing levels.

4. Obtaining instream flow rights may be a cost effective and durable approach to achieving many resource conservation objectives simultaneously. Appropriate incentives may stimulate implementation of measures that make water available for resource conservation.
5. Most surface water withdrawals are for agricultural uses. Acquiring water for instream flow would likely involve the agricultural industry and communities and impact their viability. An incentive program with technical assistance may facilitate a willing agricultural water user to undertake measures that make water available for resource conservation while minimizing or avoiding impacts on existing uses.
6. Management of threatened or endangered species has proven to be complex, controversial, and costly for the private and public sector. Proactive planning and actions could enhance the survival of sensitive species, thus avoiding difficult and expensive recovery strategies.
7. Assessments often focus on “minimum” instream flow for a particular resource objective rather than an “optimum,” multi-objective approach. Comprehensive, integrated assessments should lead to greater ecosystem integrity and longer term survival of sensitive species.

Recommendations

To enhance the ongoing efforts of the state to enhance water supplies for resource conservation purposes and to encourage and facilitate public support, the following recommendations are offered.

1. The Department should seek legislative support for:
 - development of a comprehensive and integrated management plan for the purpose of prioritizing and coordinating interagency and interdisciplinary assessments of critical water needs for wildlife and environmental purposes;
 - adoption of a policy that actively encourages the purchase, lease or donation of existing water and storage rights for transfer to instream rights or to maintain lake or wetland areas;
 - establishment of a Water Rights Trust Fund to fund acquisition efforts; and
 - incentive programs for the restoration of impaired aquatic and riparian resources (e.g., “conservation for credits,” see recommendations in the Conservation issue paper, Part 3, Section 1A).
2. The Department should convene a statewide working group of experts to identify alternative mechanisms for obtaining water supplies for resource conservation and examine the existing legal, institutional, and economic aspects of identified alternatives. In addition, the working group should develop guidelines and criteria to be used by the Department in planning and evaluating water resource projects, including dam construction, significant water transfers, and modifications to reservoir storage and operation plans.

4 — FLOOD MANAGEMENT

Flood Management in Nevada

All areas of Nevada are subject to flooding, either from rivers and streams or from flash floods emerging from canyon mouths at high velocities. As more land is built upon in the watersheds and alluvial fans, the severity of flooding and cost of flood recovery is increasing. Floodplain management consists of planning and implementing programs designed to alleviate the impact of flooding on

people and communities. A key component of effective floodplain management is implementation of the National Flood Insurance Program (NFIP) at the local level. In 1998, 15 of 17 counties and numerous communities participate in the NFIP. Participation allows property owners to obtain federally subsidized flood insurance. In participating communities, the Federal Emergency Management Agency (FEMA) performs Flood Insurance Studies, and provides Flood Insurance Rate Maps (FIRMs). The FIRMs show the areas of the community subject to flooding.

Floodplain management can be achieved through both structural and non-structural measures. Structural controls include levees, detention basins, and dikes. Non-structural approaches include:

- Development of regional flood management plans;
- Mapping and study of historic flood prone areas;
- Acquisition and removal/relocation of repetitively flooded structures;
- Floodproofing;
- Flood forecasting and warning systems;
- Providing education and information to the local communities.

Issues

1. Consistent state-level assistance in implementing and enforcing floodplain management has not been available to the counties and communities in the state for several years. Lack of state assistance, combined with turnover in personnel and lack of training have made it difficult for some communities to comply with NFIP regulations.
2. Alluvial fan or flash flooding is unpredictable, and results in high velocity flows with great erosive capability. Alluvial fan flooding risks are typically either over- or under predicted due to disagreement on effective model for predicting flood flows and mapping alluvial fan flood zones among engineering and planning professionals.
3. Many of the FIRMs used for planning and permitting development are over five years old, and don't reflect current existing conditions. Rapid growth in areas of outdated flood maps may result in construction of structures in harm's way.
4. Coordination between state agencies and between state and local agencies was often inadequate in the past. Increased coordination is clearly an essential element in improving flood program effectiveness.
5. Floodplain management and mitigation must be considered an essential, on-going element in local and regional planning. In a presidentially declared disaster, FEMA sets aside a portion of the total reimbursed damages to fund mitigation work. The State has a Disaster Relief Fund, but funds for preventive mitigation are not currently available.
6. The state's model ordinance contains the minimum NFIP requirements for obtaining flood insurance which are general standards applicable nationwide. The model ordinance needs to be updated and enhanced to reflect the unique flooding conditions present in Nevada.

Recommendations

To further enhance floodplain management in Nevada, the following recommendations are proposed.

1. The State Legislature should amend NRS 540 which describes the duties of the Nevada Division of Water Planning, to include floodplain management. Formal recognition of the role assigned to the Division by the 1997 Legislature would enhance the Division's ability to administer the CAP and FMA programs.
2. The Nevada Division of Water Planning should coordinate participation of local, state, and

federal agencies to develop a procedure for quantifying alluvial fan flooding that is acceptable to engineering and planning professionals involved in floodplain management, as recommended by the Western Governors' Association. The Division should coordinate with the Nevada Bureau of Mines and Geology (NBMG) to incorporate fluvial geologic information into mapping flood-prone areas in the state.

3. The Nevada Division of Water Planning should develop a plan for reviewing, updating, and maintaining flood maps and research the potential for the state to participate in FEMA's proposed map modernization program as a Cooperating Technical Community in conjunction with the NBMG. Several communities in the state already have the capability to develop and maintain their flood maps digitally. This capability combined with the rapid growth in the state would make Nevada a good candidate for the map modernization program.
4. The Nevada Division of Water Planning should take a leadership role in improving coordination with all involved agencies (Nevada Division of Water Resources, Department of Transportation, Division of Emergency Management, Clark County Regional Flood Control District, regional water management districts, local community development agencies, community and county building departments, public works departments, etc.) to accomplish the following flood management objectives:
 - a. Encourage complete statewide participation in the NFIP;
 - b. Encourage participation in the Community Rating System;
 - c. Encourage relocation of flood prone structures and restoration of natural floodplain functions;
 - d. Encourage local communities to take advantage of the FIRM revision process; and
 - e. Emphasize education on floodplain management strategies and flood-loss reduction.
5. The State should create a state-funded Flood Mitigation Fund separate from the Disaster Relief Fund (SB 218), as recommended by the Western Governors' Association. In a presidentially declared disaster, FEMA typically sets aside 15 percent of the total FEMA-reimbursed damages to be spent specifically on flood mitigation. Similarly, 15 percent of the state's \$4 million Disaster Relief Fund (\$600,000) should be set aside for preventive flood loss strategies.
6. The Nevada Division of Water Planning should continue development of a detailed statewide Flood Management Plan which addresses the unique flooding conditions experienced in Nevada. The plan will provide a guideline for communities to use in implementing their flood ordinances. A Flood Management Plan would be particularly helpful to the communities outside of the major urban centers.
7. The Nevada Division of Water Planning should revise the state's Model Ordinance (minimum standards) to include "lessons learned" from the 1997 flood event in northern Nevada and flash flooding events throughout the state, such as higher reference floor elevations for development in flood hazard areas, and more appropriate development and construction standards in known but unmapped alluvial fan areas. Further, the state should develop a set of recommended standards. At a minimum, local governments should adopt the revised Model Floodplain Ordinance and should be encouraged to adopt the recommended standards.
8. All communities should develop flood mitigation plans which identify flood hazards and flooding risks, and evaluate options for flood mitigation. High priority should be placed on relocation of flood-prone development, restoration of natural beneficial floodplain functions and the use of zoning and conservation easements to direct growth away from floodplains.

5 — WATER PLANNING AND MANAGEMENT

Watershed Planning and Management

As the state rapidly grows, so too does the intensity and diversity of land use activities which places greater demand on the finite land and scarce water resources. To keep pace, over the past 20 years state agencies have implemented regulatory and voluntary programs to achieve significant reductions in point and non-point sources of pollution; prevent contamination from hazardous waste sites; more efficiently allocate and manage water resources; and provide assistance, information and funding to local organizations for management of watershed resources. Increasing agency support for a watershed approach stems from a recognition that water resource problems involve a multitude of land use activities that are dispersed and cross political boundaries, and that impacts on the environment can be cumulative and persistent.

A watershed is an area within a hydrographic or river basin consisting of interconnected water sources and drainages, bounded by topographic highs or water divides. In a planning context, it is an area with boundaries set by stakeholders having interests in the water resources of a watershed.

At its best, a watershed management plan is *comprehensive* in terms of basin geography, political units, and water resources; *inclusive*, created by all stakeholders and attentive to their environmental, social, regulatory and economic goals; and *integrated*, taking stock of relationships between the quantity and quality of water and other natural resources and environmental criteria. The basic steps in watershed planning include stakeholder participation and expression of interests, problem identification, strategy development and evaluation, action and monitoring plan development, and periodic progress assessments and plan reevaluation.

Advantages to implementing a watershed management approach include:

1. A watershed is a logical geographic unit for water resource planning, permitting, reporting, and problem solving.
2. Management decisions are improved as agencies collaborate more on problem resolution.
3. Data collection resources are pooled, so data is more comprehensive, integrated and available.
4. Resources are better directed to priority issues or those portions of the basin where the greatest problems exist.
5. Funding and human resources can be better leveraged. Volunteers can be involved.
6. Program efficiencies are enhanced by coordinating workloads. For example, monitoring can be done by participants closest to the sites and reporting requirements can be consolidated.
7. Public participation is encouraged and public support for management actions is enhanced.
8. A wider array of experts and citizens is involved in an integrated problem-solving process. A diversity of disciplines involved leads to expanded management choices.
9. The prospects of more stringent regulatory standards or programs may be averted.

A foundation for watershed planning is rooted in state water laws. In the 1960's, the Nevada State Engineer's Office and the U.S. Geological Survey recognized the need for a systematic identification of the hydrographic areas in Nevada in order to effectively study, develop, allocate and manage the state's surface and ground water resources. The first hydrographic map was developed in 1968, and

with minor revisions, continues to provide the basis for water planning, management and administration today. In the mid 1970's, the Nevada Division of Environmental Protection (NDWP) developed water quality management plans for the hydrographic basins under Clean Water Act (CWA), section 303. In the late 1970's and early 1980's, designated local agencies developed comprehensive wastewater management plans under CWA section 208 in Clark County, the Truckee River Basin, the Lake Tahoe Basin and the Carson River Basin using the basic principals for watershed planning.

The Department of Conservation and Natural Resources (Department) plays a leadership role in determining the extent to which watershed planning and management is instituted. Recently the Department coordinated various Divisions' involvement in watershed based actions include the Tahoe Presidential Forum and Truckee River Negotiated Settlement. Under the State Division of Conservation Districts' guidance and support, local Conservation Districts have facilitated plans and projects to conserve, protect, and enhance natural resources on a watershed basis. Examples of watershed planning include wellhead protection programs, the Truckee River Strategy Group, the Lake Mead Water Quality Forum and the Truckee River Water Quality Agreement. Another is the Nevada Ground Water Protection Task Force, a voluntary coordinating group of state, local and federal agencies which has begun efforts to define hydrographic basins with critical ground water quality concerns.

Most streams originate and ground water recharge occurs within upper and middle portions of watersheds managed by the U.S. Forest Service and U.S. Bureau of Land Management. In the past 30 years, several resource and land use laws have been enacted directing these and other federal agencies (e.g., Natural Resources Conservation Service) to make watershed management a high priority. The aim is to protect watershed values, such as riparian, wetland, and aquatic ecosystems, floodplains, water quality, water yield, soil stability, and agricultural lands. Since most water supply sources originate on watersheds managed by federal agencies, their participation in watershed planning and management is essential.

Issues

1. The watershed planning approach is already being implemented by various groups in Nevada. In order to apply these resources more effectively and efficiently, the Department of Conservation and Natural Resources is striving to improve coordination across divisions in a more integrated framework. It is anticipated that all agencies in DCNR could be involved in implementing certain recommendations listed below, as well as other agencies such as the Divisions of Health, Emergency Management, Agriculture and Minerals.
2. The application of a watershed planning approach to water resource problem solving is growing. Federal agencies and the Western Governors Association through the Western States Water Council promote and support it. Many local and regional planning efforts have been or will be initiated at a watershed level.
3. In principle, the watershed planning approach has applicability at the hydrographic basin level. Comprehensive and integrated water resource management can be accomplished by examining water resource linkages throughout a basin. The Department is well positioned to facilitate coordination across jurisdictions, land and resource management units, economic interests, and resource values. An integrated water basin plan provides a mechanism for focusing efforts,

disseminating viewpoints, summarizing actions, and articulating a set of goals and strategies with a timetable.

4. Department agencies and the Bureau of Health Protection Services are involved in federally co-funded grant and loan programs for watershed planning-related activities under the Clean Water and Safe Drinking Water Acts. In October 1997 the Clinton Administration announced the Clean Water Action Plan, which may provide federal funding to state, federal and local agencies implementing unified watershed assessments and restoration strategies. Other federal funding has been provided via direct Congressional appropriations. State agencies have supported watershed efforts through re-prioritization within programs, but few general fund appropriations have been made by the legislature to date to support these efforts. State funding could be used to train staff, and improve data gathering and dissemination, or as incentive grants to encourage local governments to participate in watershed planning.
5. Monitoring and assessment should be integral parts of all watershed management plans and can be used to determine:
 - whether planned restoration efforts have been implemented in the manner intended;
 - the effectiveness of implemented actions in achieving desired results;
 - the validity of the assumptions upon which management strategies were designed;
 - adjustments to restoration efforts that are needed due to changing conditions; and
 - the cost effectiveness of actions taken.

Recommendations

To further enhance watershed management and planning in Nevada, the following recommendations are offered:

1. The Department of Conservation and Natural Resources (Department) should develop an inter-division watershed planning and management strategy in order to more effectively play an active, participatory role in watershed planning when a water resource assessment indicates there is a need for this strategy, or when a water planning group requests Department support.
2. The Department should support watershed planning at the local level.
3. The Department should continue to work together with local, regional and federal agencies and non-governmental organizations to develop and implement integrated water basin plans for Nevada's hydrographic regions.
4. The Department should support watershed planning groups with additional funding to assist in the development of integrated, broad-based and comprehensive watershed plans.
5. The Department should assist in the review of watershed management plans, evaluate whether goals or objectives are being achieved, strategic actions implemented and results monitored, and cooperatively recommend changes where monitoring results indicate a need for improvements.

Water Resources Data Management

Accurate and comprehensive water resource data are critical to planners and decision-makers at all levels of government, researchers, developers and the business community. Now more than ever, the increasing need to manage our precious natural resources is driving the need for more detailed water and natural resources data for many areas of the state.

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At this time, state and federal agencies, counties, municipalities, universities and industries collect and maintain extensive water resource data. However, some of these data are not readily available to others, datasets may be missing information which decrease their usefulness to other agencies, or access is time consuming or cumbersome. As a result, planning and management efforts, such as development of the *State Water Plan*, become difficult. Many agencies are starting to address the data issue by providing data directories and data downloading capabilities through their Internet web sites. It is anticipated that the Internet will be the most significant tool for improving data sharing capabilities in the future.

Improved data development, collection, management, coordination and sharing offer direct and indirect benefits to all Nevadans. For example, decision-makers, planners, regulators and the public can become better informed which may lead to improved decisions, future *State Water Plan* releases can be improved, and the State's ability to assist local planning efforts can be enhanced (See "Water Planning Assistance to Local Governments" discussion in the *Summary* and Part 3 of the *State Water Plan*). Also, improved data access and sharing between agencies can result in reduced duplication of efforts, thereby saving tax dollars.

Issues

1. The State lacks a comprehensive plan to coordinate development and dissemination of temporal, textual and spatial (GIS) information.
2. Data accessibility needs to be enhanced. Some datasets are stored on paper or electronic spreadsheets which reduce their usefulness. Other datasets are managed using database systems but access may be restricted.
3. Without a comprehensive data inventory, potential users have difficulties identifying, locating and obtaining needed data.
4. Metadata (data about the data) are lacking in some instances, making it difficult for potential users to determine the appropriateness of the data for their particular purpose.
5. Data gaps exist in some areas due to the lack of a statewide groundwater quality and level monitoring network and a comprehensive statewide water use estimation program.
6. The lack of a comprehensive water use estimation program may impede state and local water planning efforts.
7. The maintenance of a viable stream gaging program is an integral part of managing our water resources.
8. Ongoing research of Nevada's water resources is needed for improved water management and planning. Current perennial yield estimates may be inaccurate for some basins and could be updated using newer technologies and methodologies.

Recommendations

The following recommendations are provided as possible means for improving water resources data management in Nevada:

1. The State should encourage and support agencies and local governments in the development of electronic databases for data currently stored on paper copies and in electronic spreadsheet files, and for future data collected. Data stored in spreadsheet files are more useful than data on paper, however the spreadsheet format does not lend itself to the types of manipulations possible with databases.

2. The State should create a new GIS task force of local, state and federal interests to evaluate in detail GIS issues and management needs. Their main task should be the development of a strategic plan which would address data coordination, collection and sharing needs, staffing and funding considerations, and provide recommendations to address these issues.
3. The State should support federal agencies, such as U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency, in their efforts to provide Internet access to data. For instance, the Department of Conservation and Natural Resources should cooperate with the USGS to provide public access to USGS water quality data.
4. The Division of Water Planning should develop and maintain a detailed inventory of water resource datasets with Internet access to the inventory and access information. State agencies should develop and provide Internet sites for data sharing to the extent possible.
5. The State should support efforts by all groups to provide GIS data information via Nevada's connection to the National Geospatial Data Clearinghouse.
6. The State should encourage the development of metadata (information about the dataset) so that potential users can more easily determine the appropriateness of the data for their particular purpose.
7. The Department of Conservation and Natural Resources should develop and implement a groundwater quality and level monitoring network for priority basins. In some basins, water level information collected more frequently than once a year would be useful.
8. The State should improve water use measurement and estimation efforts through the program defined in the "Water Use Measurement and Estimation" issue discussion.
9. The Department of Conservation and Natural Resources should continue to support the cooperative agreements with the USGS for the funding of the stream gaging station network. Future efforts to discontinue existing gaging stations must be closely scrutinized.
10. The Department of Conservation and Natural Resources should continue to support further research projects as necessary, and should support efforts to update perennial yield estimates for priority basins.

Water Planning Assistance to Local Governments

Water planning by local governments is becoming more common and more necessary in response to increasing population, increasing competition for water, and natural resource concerns. Local governments are also realizing the need to plan the future of their land and water resources in a more comprehensive manner, involving all stakeholders in the process. Without a comprehensive water planning process, decisions may be made without full consideration of potential impacts to the watershed, the water resources, and other future needs and projects. Local water plans are not only useful to guide decisions related to internal proposals, but they can also guide responses to the activities of others such as water rights transfers, proposed housing or industrial developments, federal environmental impact statements and environmental assessments, and state and federal planning efforts.

Comprehensive water planning can be time consuming and costly to local governments. Many local governments have limited personnel and funding resources for water planning. The State currently has some programs to provide local water planning assistance but more could be done to facilitate

local water planning efforts. State water planning assistance to local governments can occur in many forms. Examples of assistance include information and data sharing, financial support of local water planning efforts, review of local water planning documents, technical assistance, participation in local water planning efforts

Issues

1. Many smaller governmental entities have limited personnel and funding resources for the development of local water plans; participation in planning efforts by others, such as U.S. Bureau of Land Management and U.S. Forest Service, that may affect their region; and review and comment on federal environmental impact statements and environmental assessments for proposed projects in their area.
2. Because of limited funding and staffing at the State level, NDWP and other agencies are limited in their ability to provide a higher level of assistance to local water planning efforts.
3. Other issue discussions in the *State Water Plan* present related issues:
 - “Water Use Measurement and Estimation”: The lack of comprehensive detailed water use information for some regions may impede local planning efforts.
 - “Water Resource Data Development, Collection and Management”: Data availability and access limitations may hinder local planning.
 - “Watershed Planning and Management”: The State could further enhance watershed management and planning through additional measures.

Recommendations

The following recommendations are offered as mechanisms for improving the State’s support of local water planning activities:

1. The State should enhance local water planning assistance efforts through financial support and/or additional technical support from Division of Water Planning staff and other agencies.
2. The State should improve water use measurement and estimation efforts through the program defined in the “Water Use Measurement and Estimation” issue discussion.
3. The State should improve data management, coordination and sharing through the measures defined in the “Water Resources Data Development, Collection and Management” issue discussion.
4. The State should further enhance watershed management and planning in Nevada through the recommendation offered in the “Watershed Planning and Management” issue discussion.

Water Education

It is important that Nevada’s residents understand the fundamental science of water, how water is managed in the state, and the issues affecting water management. It is especially important that Nevada’s children learn about water so that they develop an appreciation for the unique role water plays in the development of our state and become informed citizens who can think critically and evaluate information intelligently throughout their lives. Water education must become a priority.

The state of Nevada has had a water education program in the Nevada Division of Water Planning since 1991. It includes components focusing on both children and adults, and incorporates a variety

of methods and teaching aids. Project WET (Water Education for Teachers) is a science and math education enhancement program focused on grades K-12. The program provides teachers with a foundation in the science of water and current information on water resource issues affecting Nevada, with the goal of generating teacher interest, enthusiasm and ability to teach about water. Approximately 700 of 12,000 K-12 teachers have taken the 15-hour, 1-credit Project WET course. Nevada Project WET has no dedicated staff and has been dependent on grant funding. Over the last 7 years, the Division has raised close to \$175,000 in grants, with a state contribution of about \$15,000. In 1997, the state increased its financial support to \$20,000 per year.

Other grant funded water education programs in the Division include: (1) *Nevada Riverwatch*, a student water quality monitoring program; (2) the *Water Education Calendar*, a publication of children's art work and water facts in a calendar format for distribution to elementary school classes; and (3) adult education including training seminars, conferences, events and specialty publications. Staff from other Divisions in the Department of Conservation and Natural Resources support water education as well, with seminars, conferences, grants and speaker's bureaus.

Issues

1. **Grant Funding – Administrative and Fiscal Support.** The Division of Water Planning's water education program has no staff and is dependent on grant funding. Grants require a large amount of administrative and fiscal support, both in applying for grants and tracking and accounting after a grant is awarded. State staff is necessary to coordinate and manage the water education programs, grants and contracts.
2. **Grant Funding – Match Requirements.** The limited availability of state dollars has limited the state's ability to qualify for grants because the Division cannot meet grant match requirements.
3. **Grant Funding – Start-Up.** Many federal grants are designed to provide startup funds, not long-term, continued funding. Federal granting agencies expect the state to pick-up support for the programs once they are up and rolling.
4. **Assessing the Value of Water Education.** According to a study recently published by the American Water Works Association, the cost of water education programs is quite low, ranging from 5 to 57 cents per household per year, especially as compared to the benefits provided. There is agreement that agencies must continue to look for ways to evaluate the effectiveness of their education programs, but that the long-term efficacy of such programs is probably not quantifiable.
5. **Coordination.** There are a number of groups working on water education goals throughout the state. Coordination of these groups could lead to greater effectiveness of the individual programs and increased funding opportunities.

Recommendations

1. The State should continue and enhance funding for the state water education program.
2. The State should create and fund a Water Education Coordinator position in the Division of Water Planning.
3. All organizations should continue to develop and implement methods to evaluate the effectiveness of their water education programs.
4. The Division of Water Planning should develop a water education coordination group to support water education programs, develop funding options, leverage dollars, share information, and

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coordinate activities. Participants could include the University of Nevada – Cooperative Extension, public and private water utilities, the Nevada Rural Water Association, the U.S. Bureau of Reclamation, and the Nevada Department of Education and Divisions of Environmental Protection, Wildlife and Water Resources.

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SUMMARY

Section 8
Glossary of Terminology

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in the Dictionary. Words and definitions included in this glossary which explain or summarize elements of existing water law are not intended to change that law in any way.]

Acre-Foot (AF) — A unit commonly used for measuring the volume of water; equal to the quantity of water required to cover one acre (43,560 square feet or 4,047 square meters) to a depth of 1 foot (0.30 meter) and equal to 43,560 cubic feet (1,234 cubic meters), or 325,851 gallons.

Agricultural Water Use (Withdrawals) — Includes water used for irrigation and non-irrigation purposes. Irrigation water use includes the artificial application of water on lands to promote the growth of crops and pasture, or to maintain vegetative growth in recreational lands, parks, and golf courses. Non-irrigation water use includes water used for livestock, which includes water for stock watering, feedlots, and dairy operations, and fish farming and other farm needs.

(Prior) Appropriation Doctrine — The system for allocating water to private individuals used in the western United States under which (1) the right to water was acquired by diverting water and applying it to a beneficial use and (2) a right to water acquired earlier in time is superior to a similar right acquired later in time. The doctrine of *Prior Appropriation* was in common use throughout the arid west as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of "*First in Time, First in Right*." The first person to take a quantity of water and put it to *Beneficial Use* has a higher priority of right than a subsequent user. Under drought conditions, higher priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land. Contrast with *Riparian Water Rights*.

Aquifer — (1) A geologic formation, a group of formations, or a part of a formation that is water bearing. (2) A geological formation or structure that stores or transmits water, or both, such as to wells and springs. (3) An underground layer of porous rock, sand, or gravel containing large amounts of water. Use of the term is usually restricted to those water-bearing structures capable of yielding water in sufficient quantity to constitute a usable supply.

Basin — (1) (Hydrology) A geographic area drained by a single major stream; consists of a drainage system comprised of streams and often natural or man-made lakes. Also referred to as *Drainage Basin, Watershed, or Hydrographic Region*. (2) (Irrigation) A level plot or field, surrounded by dikes, which may be flood irrigated. (3) (Erosion Control) A catchment constructed to contain and slow runoff to permit the settling and collection of soil materials transported by overland and rill runoff flows. (4) A naturally or artificially enclosed harbor for small craft, such as a yacht basin.

Beneficial Use (of Water) — (1) A use of water resulting in appreciable gain or benefit to the user, consistent with state law, which varies from one state to another. Most states recognize the following uses as beneficial:

- [1] domestic and municipal uses;
- [2] industrial uses;
- [3] irrigation;
- [4] mining;
- [5] hydroelectric power;
- [6] navigation;

- [7] recreation;
- [8] stock raising;
- [9] public parks;
- [10] wildlife and game preserves.

(2) The cardinal principle of the *(Prior) Appropriation Doctrine*. A use of water that is, in general, productive of public benefit, and which promotes the peace, health, safety and welfare of the people of the State. A certificated water right is obtained by putting water to a beneficial use. The right may be lost if beneficial use is discontinued. A beneficial use of water is a use which is of benefit to the appropriator and to society as well. The term encompasses considerations of social and economic value and efficiency of use. In the past, most reasonably efficient uses of water for economic purposes have been considered beneficial. Usually, challenges have only been raised to wasteful use or use for some non-economic purpose, such as preserving instream values. Recent statutes in some states have expressly made the use of water for recreation, fish and wildlife purposes, or preservation of the environment a beneficial use. Also see *Appropriative Water Rights*.

Best Management Practices (BMP) — Water conservation measures that generally meet one of two criteria: (1) Constitutes an established and generally accepted practice that provides for the more efficient use of existing water supplies or contributes towards the conservation of water; or (2) Practices which provide sufficient data to clearly indicate their value, are technically and economically reasonable, are environmentally and socially acceptable, are reasonably capable of being implemented by water purveyors and users, and for which significant conservation or conservation-related benefits can be achieved.

Biodiversity — Refers to the variety and variability of life, including the complex relationships among microorganisms, insects, animals, and plants that decompose waste, cycle nutrients, and create the air that we breathe. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete *Ecosystems* to the biochemical structures that are the molecular basis of heredity.

Clean Water Act (CWA) [Public Law 92–500] — More formally referred to as the *Federal Water Pollution Control Act*, the Clean Water Act constitutes the basic federal water pollution control statute for the United States. Originally based on the *Water Quality Act* of 1965 which began setting water quality standards. The 1966 amendments to this act increased federal government funding for sewage treatment plants. Additional 1972 amendments established a goal of zero toxic discharges and “fishable” and “swimmable” surface waters. Enforceable provisions of the CWA include technology-based effluent standards for point sources of pollution, a state-run control program for nonpoint pollution sources, a construction grants program to build or upgrade municipal sewage treatment plants, a regulatory system for spills of oil and other hazardous wastes, and a *Wetlands* preservation program (Section 404).

Clean Water Act (CWA), Section 319 — A federal grant program added by Congress to the CWA in 1987 and managed by the *U.S. Environmental Protection Agency (EPA)*, Section 319 is specifically designed to develop and implement state *Nonpoint Source (NPS) Pollution* management programs, and to maximize the focus of such programs on a watershed or waterbasin basis with each state. Today, all 50 states and U.S. territories receive Section 319 grant funds and are encouraged to use the funding to conduct nonpoint source assessments and revise and strengthen their nonpoint source management programs. Before a grant is provided under Section 319, states are required to: (1) complete a Nonpoint Source (NPS) Assessment Report identifying state waters that require nonpoint source control and their pollution sources; and (2) develop Nonpoint Source Management Programs that outline four-year strategies to address these identified sources.

Commercial Water Use (Withdrawals) — Water for motels, hotels, restaurants, office buildings, and other commercial facilities and institutions, both civilian and military. The water may be obtained from a public supply or may be self supplied. The terms “water use” and “water withdrawals” are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Industrial Water Use (Withdrawals)*, *Public Water Supply System* and *Self-Supplied Water*.

Conjunctive (Water) Use — (1) The operation of a groundwater basin in combination with a surface water storage and conveyance system. Water is stored in the groundwater basin for later use by intentionally recharging the basin during years of above-average water supply. (2) The combined use of surface and groundwater systems and sources to optimize resource use and prevent or minimize adverse effects of using a single source; the joining together of two sources of water, such as groundwater and surface water, to serve a particular use. (3) The integrated use and

management of hydrologically connected groundwater and surface water.

Consumptive (Water) Use — (1) A use which lessens the amount of water available for another use (e.g., water that is used for development and growth of plant tissue or consumed by humans or animals). (2) A use of water that renders it no longer available because it has been evaporated, transpired by plants, incorporated into products or crops, consumed by people or livestock, or otherwise removed from water supplies. (3) The portion of water withdrawn from a surface or groundwater source that is consumed for a particular use (e.g., irrigation, domestic needs, and industry), and does not return to its original source or another body of water. The terms *Consumptive Use* and *Nonconsumptive Use* are traditionally associated with water rights and water use studies, but they are not completely definitive. No typical consumptive use is 100 percent efficient; there is always some return flow associated with such use either in the form of a return to surface flows or as a ground water recharge. Nor are typically nonconsumptive uses of water entirely nonconsumptive. There are evaporation losses, for instance, associated with maintaining a reservoir at a specified elevation to support fish, recreation, or hydropower, and there are conveyance losses associated with maintaining a minimum streamflow in a river, diversion canal, or irrigation ditch.

Cubic Feet Per Second (CFS) — A unit expressing rate of discharge, typically used in measuring streamflow. One cubic foot per second is equal to the discharge of a stream having a cross section of 1 square foot and flowing at an average velocity of 1 foot per second. It also equals a rate of approximately 7.48 gallons per second, 448.83 gallons per minute, 1.9835 acre-feet per day, or 723.97 acre-feet per year.

Cubic Feet Per Second Day (CFS-Day) — The volume of water represented by a flow of one cubic foot per second for 24 hours. It equals 86,400 cubic feet, 1.983471 acre-feet, or 646,317 gallons.

Designated Groundwater Basin [Nevada] — In the interest of public welfare, the Nevada State Engineer, *Division of Water Resources, Department of Conservation and Natural Resources*, is authorized by statute (Nevada Revised Statute 534.120) and directed to designate a ground water basin and declare *Preferred Uses* within such designated basin. The State Engineer has additional authority in the administration of the water resources within a designated ground water basin. [A listing of Nevada's Hydrographic Regions, and designated Areas and Sub-Areas is presented in the NDWP's *Water Words Dictionary* in Appendix A-1 (hydrographic regions, areas and sub-areas), Appendix A-2 (listed sequentially by area number) Appendix A-3 (listed alphabetically by area name), and Appendix A-4 (listed alphabetically by principal Nevada county(ies) in which located).]

Dewater, and Dewatering — (1) To remove water from a waste produce or streambed, for example. (2) The extraction of a portion of the water present in sludge or slurry, producing a dewatered product which is easier to handle. (3) (Mining) The removal of ground water in conjunction with mining operations, particularly open-pit mining when the excavation has penetrated below the ground-water table. Such operations may include extensive ground-water removal and, if extensive enough and if not re-injected into the groundwater, these discharges may alter surface water (stream) flows and lead to the creation of lakes and wetland areas.

Domestic Water Use (Withdrawals) — Water used normally for residential purposes, including household use, personal hygiene, drinking, washing clothes and dishes, flushing toilets, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also referred to as *Residential Water Use*. Also see *Public Water Supply System* and *Self-Supplied Water*.

Domestic Well — A water well used solely for domestic, i.e., residential or household purposes to include both indoor and outdoor water uses. Such wells are generally not required to be permitted; however, they may have restrictions in terms of daily pumping amounts, for example, 1,800 gallons per day.

Drought — There is no universally accepted quantitative definition of drought. Generally, the term is applied to periods of less than average or normal precipitation over a certain period of time sufficiently prolonged to cause a serious hydrological imbalance resulting in biological losses (impact flora and fauna ecosystems) and/or economic losses (affecting man). In a less precise sense, it can also signify nature's failure to fulfill the water wants and needs of man.

Duty (of Water) — (1) The total volume of water per year that may be diverted under a vested water right. (2) The total volume of irrigation water required for irrigation in order to mature a particular type of crop. In stating the duty, the crop, and usually the location of the land in question, as well as the type of soil, should be specified. It also includes consumptive use, evaporation and seepage from on-farm ditches and canals, and the water that is

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eventually returned to streams by percolation and surface runoff. Also see *Alpine Decree [Nevada]*, *Orr Ditch Decree [Nevada]*, *Bench Lands [Nevada]*, and *Bottom Lands [Nevada]* for additional information and examples of specific water duties.

Ecosystem — A community of animals, plants, and bacteria, and its interrelated physical and chemical environment. An ecosystem can be as small as a rotting log or a puddle of water, but current management efforts typically focus on larger landscape units, such as a mountain range, a river basin, or a watershed. Also see *Biodiversity*.

Ecosystem Management — (Environmental) An approach to managing the nation's lands and natural resources which recognizes that plant and animal communities are interdependent and interact with their physical environment (i.e., soil, water, and air) to form distinct ecological units called *Ecosystems*. The fact that these ecosystems span jurisdictional and political boundaries necessitates a more comprehensive and unified approach to managing them. Implementing the initial stage of a government-wide approach to ecosystem management typically requires clarifying the policy goals and undertaking certain practical steps to apply the principles being considered to include:

- [1] Delineating the ecosystem;
- [2] Understanding the system(s) ecologies;
- [3] Making management choices;
- [4] Unifying disparate data and information needs and sources; and
- [5] Adapting management on the basis of new information.

Efficient Water Management Practices (EWMP)—Agricultural Water Use — The agricultural water use equivalent of *Best Management Practices (BMP)* as applied to urban water use, efficient water management practices cover the spectrum of methods to improve both the efficiency and conservation of agricultural water use by (1) enhancing irrigation management services, measurement, and accounting; (2) improving the physical system of irrigation delivery, distribution, and drainage; and (3) promoting the modification of and adjustments to the institutional system of water use by agricultural interests to include information and educational programs.

Endangered Species — Any plant or animal species threatened with extinction by man-made or natural changes throughout all or a significant area of its range; identified by the Secretary of the Interior as "endangered", in accordance with the 1973 *Endangered Species Act (ESA)*, below. [See Appendix D-1, Nevada's Endangered and Threatened Species.]

Endangered Species Act (ESA) — An act passed by Congress in 1973 intended to protect species and subspecies of plants and animals that are of "aesthetic, ecological, educational, historical, recreational and scientific value." It may also protect the listed species' "critical habitat", the geographic area occupied by, or essential to, the protected species. The *U.S. Fish and Wildlife Service (USFWS)* and the *National Marine Fisheries Service (NMFS)* share authority to list endangered species, determine critical habitat and develop recovery plans for listed species. Currently, approximately 830 animals and 270 plants are listed as endangered or threatened nationwide at Title 50, Part 17, sections 11 and 12 of the Code of Federal Regulations. Further, under a settlement with environmental groups, USFWS has agreed to propose listing another 400 species over the next few years. The 1973 Endangered Species Act superseded and strengthened the *Endangered Species Preservation Act* of 1966 and the *Endangered Species Conservation Act* of 1969. The 1973 provisions required that the act be re-authorized by Congress every five years.

Evapotranspiration (ET) — (1) The quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces. (2) The sum of *Evaporation* and *Transpiration* from a unit land area. (3) The combined processes by which water is transferred from the earth surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants. Evapotranspiration occurs through evaporation of water from the surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants (*Phreatophytes*) whose roots tap the capillary fringe of the groundwater table. The sum of evaporation plus transpiration.

"First in Time, First in Right" — A phrase indicating that older water rights have priority over more recent rights if there is not enough water to satisfy all rights. See (*Prior Appropriation Doctrine* and *Appropriative Water Rights*).

Flood, or Flood Waters — (1) An overflow of water onto lands that are used or usable by man and not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary; and the land is

adjacent to and inundated by overflow from a river, stream, lake, or ocean. (2) As defined, in part, in the *Standard Flood Insurance Policy (SFIP)*: “A general and temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters or from the unusual and rapid accumulation or runoff of surface waters from any source.”

Flood, 100-Year — A 100-year flood does not refer to a flood that occurs once every 100 years, but rather to a flood level with a 1 percent or greater chance of being equaled or exceeded in any given year. Areas below the 100 year flood level are termed special flood hazard areas. Areas between the 100-year and the 500-year flood boundaries are termed *Moderate Flood Hazard Areas*. The remaining areas are above the 500-year flood level and are termed *Minimal Flood Hazard Areas*.

Forecast (Forecasting) — (Statistics) A forecast is a quantitative estimate (or set of estimates) about the likelihood of future events based on past and current information. This “past and current information” is specifically embodied in the structure of the econometric model used to generate the forecasts. By extrapolating the model out beyond the period over which it was estimated, we can use the information contained in it to make forecasts about future events. It is useful to distinguish between two types of forecasting, *ex post* and *ex ante*. In an *ex post* forecasts all values of dependent and independent variables are known with certainty and therefore provides a means of evaluating a forecasting model. Specifically, in an *ex post* forecast, a model will be estimated using observations excluding those in the *ex post* period, and then comparisons of the forecasts will be made to these actual values. An *ex ante* forecast predicts values of the dependent variable beyond the estimation period using values for the explanatory variables which may or may not be known with certainty.

Forecast Horizon — (Statistics) The number of time periods to be forecasted; also, the time period in the future to which forecasts are to be made.

Gage, or Gauge — (1) An instrument used to measure magnitude or position; gages may be used to measure the elevation of a water surface, the velocity of flowing water, the pressure of water, the amount of intensity of precipitation, the depth of snowfall, etc. (2) The act or operation of registering or measuring magnitude or position. (3) The operation, including both field and office work, of measuring the discharge of a stream of water in a waterway.

Gallons per Capita (Person) per Day (GPCD) — An expression of the average rate of domestic and commercial water demand, usually computed for public water supply systems. Depending on the size of the system, the climate, whether the system is metered, the cost of water, and other factors, *Public Water Supply Systems (PWSS)* in the United States experience a demand rate of approximately 60 to 150 gallons per capita per day. Also see *Gallons per Employee per Day (GED)* for information on the application of this concept to commercial water use by *Standard Industrial Classification (SIC) Code*. [See Appendix C-4, Gallons Per Capita Per Day (GPCD), Water Used for Public Water Supplies by State.]

Gallons per Employee (Worker) per Day (GED, or GPED) — A measure or coefficient expressing an area’s commercial water use per worker (employee), typically for distinct industry sectors. It is based on an analytical technique for measuring and forecasting commercial water use in a service area based upon the unique, seasonal, business-related water use by specific industrial sectors. GED commercial water-use coefficients are typically developed based upon Standard Industrial Classifications (SIC) codes for which comparable commercial water use and employment data are available. For forecasting more frequently than annually, GED coefficients will incorporate seasonal patterns (monthly or quarterly) as well. By deriving forecasts of trends in industry sector employment and combining them with appropriate, industry-specific GED coefficients, relatively accurate forecasts of the corresponding commercial water use may be obtained.

Great Basin [Nevada] — An area covering most of Nevada and much of western Utah and portions of southern Oregon and southeastern California consisting primarily of arid, high elevation, desert valleys, sinks (playas), dry lake beds, and salt flats. The Great Basin is characterized by the fact that all surface waters drain *inward* to terminal lakes or sinks. Principal excluded regions within Nevada include the extreme north-central portion of the state whose waters drain northward into the Snake River Basin, thence to the Columbia River and finally to the Pacific Ocean, and the south-eastern portion of Nevada whose surface waters drain into the Colorado River Basin, thence to the Gulf of California (Mexico) and the Pacific Ocean.

Greywater (Graywater) — Wastewater from clothes washing machines, showers, bathtubs, hand washing, lavatories and sinks that are not used for disposal of chemicals or chemical-biological ingredients. Less commonly spelled *Graywater*.

Ground Water, also Groundwater — (1) Generally, all subsurface water as distinct from *Surface Water*; specifically, the part that is in the saturated zone of a defined aquifer. (2) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper level of the saturate zone is called the Water Table. (3) Water stored underground in rock crevices and in the pores of geologic materials that make up the earth's crust. Ground water lies under the surface in the ground's *Zone of Saturation*, and is also referred to as *Phreatic Water*.

Hydrographic Area [Nevada] — The 232 subdivisions (256 *Hydrographic Areas* and *Hydrographic Sub-Areas*) of the 14 Nevada *Hydrographic Regions* as defined by the State Engineer's Office, Department of Conservation and Natural Resources, Division of Water Resources. Primarily these are sub-drainage systems within the 14 major drainage basins. Hydrographic Areas (valleys) may be further subdivided into Hydrographic Sub-Areas based on unique hydrologic characteristics (e.g., differences in surface flows) within a given valley or area. [A listing of Nevada's Hydrographic Regions, Areas and Sub-Areas is presented in Appendix A-1 (hydrographic regions, areas and sub-areas), Appendix A-2 (listed sequentially by area number) Appendix A-3 (listed alphabetically by area name), and Appendix A-4 (listed alphabetically by principal Nevada county(ies) in which located).]

Hydrographic Region [Nevada] — Nevada has been divided into 14 hydrographic regions or basins, which are now used by the Nevada Division of Water Resources, Department of Conservation and Natural Resources, and the U.S. Geological Survey (USGS) to compile information pertaining to water resources and water use. These regions are also further subdivided into 232 *Hydrographic Areas* (256 Hydrographic Areas and Sub-Areas, combined) for more detailed study. See *Basins [Nevada]*, for a complete listing and description of Nevada's 14 Hydrographic Regions.

Industrial Water Use (Withdrawals) — Industrial water use includes water used for processing activities, washing, and cooling. Major water-using manufacturing industries include food processing, textile and apparel products, lumber, furniture and wood products, paper production, printing and publishing, chemicals, petroleum, rubber products, stone, clay, glass and concrete products, primary and fabricated metal industries, industrial and commercial equipment and electrical, electronic and measuring equipment and transportation equipment. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Commercial Water Use (Withdrawals)*.

Instream Flow or Instream Use — (1) The amount of water remaining in a stream, without diversions, that is required to satisfy a particular aquatic environment or water use. (2) Nonconsumptive water requirements which do not reduce the water supply; water flows for uses within a defined stream channel. Examples of instream flows include:

- [1] ***Aesthetics*** — Water required for maintaining flowing streams, lakes, and bodies of water for visual enjoyment;
- [2] ***Fish and Wildlife*** — Water required for fish and wildlife;
- [3] ***Navigation*** — Water required to maintain minimum flow for waterborne commerce;
- [4] ***Quality Dilution*** — Water required for diluting salt and pollution loading to acceptable concentrations; and
- [5] ***Recreation*** — Water required for outdoor water recreation such as fishing, boating, water skiing, and swimming.

Interbasin Transfer (of Water) — A transfer of water rights and/or a diversion of water (either groundwater or surface water) from one *Drainage* or *Hydrographic Basin* to another, typically from the basin of origin to a different hydrologic basis. Also referred to as *Water Exports* and/or *Water Imports*.

Interstate Allocation [Nevada and California] — An agreement between the states of Nevada and California over the use of the waters of Lake Tahoe and the Truckee, Carson, and Walker rivers which was ratified by California (1970) and Nevada (1971), but was never ratified by Congress. Despite this, both states have enacted legislation to enforce to the allocation of the Truckee, Carson, and Walker rivers between these two states. Subsequently, in 1990 many of the compact's provisions dealing with the waters of Lake Tahoe and the Truckee and Carson rivers became formalized under *Public Law 101-618* (the *Negotiated Settlement*).

Interstate Water Compact — (1) Broadly, an agreement between two or more states regarding competing demands for a water resource which are beyond the legal authority of one state alone to solve. (2) States administer water rights within their own political boundaries; however, the process becomes more complicated when it involves an interstate body of water (*Interstate Water*). Under these conditions there are three possible ways to achieve an interstate allocation of water: (1) A suit for equitable apportionment brought by the states in the U.S. Supreme

Court; (2) a Congressional act; and (3) an interstate compact. An interstate compact is an agreement negotiated between states, adopted by their state legislatures, and then approved by Congress. Once an allocation of interstate water is determined by such a means, the individual states may then issue water rights to its share of the water through their normal administrative process. Interstate compacts have been traditionally used in making water allocations in the western states. Also see *Interstate Allocation [Nevada and California]*.

Intrabasin Transfer (of Water) — Transfers of water within the same water basin or hydrographic area.

Irrigation Water Use (Withdrawals) — Artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth on recreational lands, such as parks and golf courses. The terms “water use” and “water withdrawals” are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Irrigation Return Flow*.

Junior (Water) Rights — A junior water rights holder is one who holds rights that are temporarily more recent than senior rights holders. All water rights are defined in relation to other users, and a water rights holder only acquires the right to use a specific quantity of water under specified conditions. Therefore, when limited water is available, junior rights are not met until all senior rights have been satisfied. See *Prior Appropriation Doctrine*.

Land Subsidence — (1) The sinking or settling of land to a lower level in response to various natural and man-caused factors. (1) With respect to ground water, subsidence most frequently results from overdrafts of the underlying water table or aquifer and its inability to fully recharge, a process termed *Aquifer Compaction*. Also see *Subsidence*.

Livestock Water Use — Water use for stock watering, feed lots, dairy operations, fish farming, and other on-farm needs. Livestock as used here includes cattle, sheep, goats, hogs, and poultry. Also included are such animal specialties as horses, rabbits, bees, pets, fur-bearing animals in captivity, and fish in captivity. Also see *Rural Water Use*.

Methyl Tertiary Butyl Ether (MTBE) — A oxygenate and gasoline additive used to improve the efficiency of combustion engines in order to enhance air quality and meet air pollution standards. MTBE is a product of petroleum refining that has been added to gasoline nationwide since the late 1970's as an octane booster. Following federal actions in the early 1990's, refiners began adding more MTBE to clean up the air. Current federal law requires some minimum amount of an oxygenate in gasoline sold in areas that do not meet air quality standards. The *U.S. Environmental Protection Agency (EPA)* considers MTBE a possible human carcinogen. In addition to being a suspected carcinogen, MTBE also pollutes waters, particularly by personal watercraft using two-stroke marine engines. More recently, leaking gasoline storage tanks containing MTBE have been found to cause contamination of nearby municipal water wells forcing their closure. MTBE has been found to mix and move more easily in water than many other fuel components, thereby making it harder to control, particularly once it has entered surface or ground waters.

Municipal and Industrial (M & I) Water Withdrawals (Use) — Water supplied for municipal and industrial uses provided through a municipal distribution system for rural domestic use, stock water, steam electric powerplants, and water used in industry and commerce.

National Environmental Policy Act (NEPA) — A 1970 Act of Congress that requires all federal agencies to incorporate environmental considerations into their decision-making processes. The act requires an *Environmental Impact Statement (EIS)* for any “major federal action significantly affecting the quality of the human environment.”

National Flood Insurance Program (NFIP) — A federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that if a community will implement and enforce measures to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHA), then the federal government will make flood insurance available to protect against flood losses that do occur. The NFIP was established by Congress through the passage of the National Flood Insurance Act of 1968. Features of the program were modified and extended with the 1973 passage of the Flood Disaster Protection Act, and other legislative measures. The NFIP is administered by the Federal Insurance Administration (FIA), which is a component part of the *Federal Emergency Management Agency*

(FEMA).

Navigable Waters [Nevada] — In Nevada bodies of water are navigable if they are used, or are susceptible of being used, in their ordinary condition as highways for commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water. In Nevada, this test of navigability (*State of Nevada v. Julius Bunkowski, et al.*, 1972) held that the Carson River was navigable, and therefore the State of Nevada owned its bed, as logs were floated down the river from about 1860 to 1895 (the commerce requirement).

Non-Point Source (NPS) Pollution — (1) Pollution discharged over a wide land area, not from one specific location. (2) Water pollution caused by diffuse sources with no discernible distinct point of source, often referred to as runoff or polluted runoff from agriculture, urban areas, mining, construction sites and other sites. These are forms of diffuse pollution caused by sediment, nutrients, organic and toxic substances originating from land use activities, which are carried to lakes and streams by surface runoff.

Perennial Yield (Ground Water) — The amount of usable water of a ground water reservoir that can be withdrawn and consumed economically each year for an indefinite period of time. It cannot exceed the sum of the *Natural Recharge*, the *Artificial (or Induced) Recharge*, and the *Incidental Recharge* without causing depletion of the groundwater reservoir. Also referred to as *Safe Yield*.

Perfected Water Right — (1) A completed or fully executed water right. A water right is said to have been perfected when all terms and conditions associated with it have been fully accomplished, e.g., the diversion has been effected and the water applied to beneficial use. (2) A water right to which the owner has applied for and obtained a permit, has complied with the conditions of the permit, and has obtained a license or certification of appropriation. (3) A water right which indicates that the uses anticipated by an applicant, and made under permit, were made for *Beneficial Use*. Usually it is irrevocable unless voluntarily canceled or forfeited due to several consecutive years of nonuse. Also referred to as a *Certified Water Right*. Also see *Appropriation Doctrine*.

Permit — (1) (Water Right) A written document which grants authority to take unused water and put it to *Beneficial Use*. If all requirements of the permit are satisfied, then the permit for water appropriation can mature into a license or *Perfected Water Right*. (2) (Discharge) A legally binding document issued by a state or federal permit agency to the owner or manager of a point source discharge. The permit document contains a schedule of compliance requiring the permit holder to achieve a specified standard or limitation (by constructing treatment facilities or modifying plant processes) by a specified date. Permit documents typically specify monitoring and reporting requirements to be conducted by the applicant as well as the maximum time period over which the permit is valid. Also see *Application, Water Right*.

Permit, Water [Nevada] — The written permission from the state engineer to appropriate public waters for a beneficial use from a surface or underground source, at a specific point of diversion, under limited circumstances. If all requirements of the permit are satisfied, then the permit for water appropriation can mature into a license or *Perfected Water Right*. Also see *Permitted Water Right [Nevada]*, and *Application, Water Right*.

Planning — A comprehensive study of present trends and of probable future developments, together with recommendations of policies to be pursued. Planning embraces such subjects as population growth and distribution; social forces; availability of land, water, minerals, and other natural resources; technological progress; and probable future revenues, expenditures, and financial policies. Planning must be responsive to rapidly changing conditions.

Planning Horizon — The overall time period considered in the planning process that spans all activities covered in or associated with the analysis or plan and all future conditions and effects or proposed actions which would influence the planning decisions.

Point Source (PS) Pollution — (1) Pollution originating from any discrete source. (2) Pollutants discharged from any distinct, identifiable point or source, including pipes, ditches, channels, sewers, tunnels, wells, containers of various types, concentrated animal-feeding operations, or floating craft. Also referred to as *Point Source of Pollution*. Also see *Non-Point Source (NPS) Pollution*.

Preferred Use [Nevada] — In the interest of public welfare, the state engineer is authorized and directed to designate preferred uses of water within the respective areas so designated by him and from which the ground water is being depleted. In acting on applications to appropriate ground water, the State Engineer may designate preferred uses in different categories: domestic, municipal, quasi-municipal, industrial, irrigation, mining and stock-watering uses and any uses for which a county, city, town, public water district or public water company furnishes the water.

Prescribed Water Rights — (1) Water rights to which legal title is acquired by long possession and use without protest of other parties. (2) Water use rights gained by trespass or unauthorized taking that ripen into a title; on

a par with rights to land gained through adverse possession. To perfect the right, the use of water must be adverse, hostile, open and continuous for five continuous years against the recognized water rights holder. Contrast with *Appropriative Water Rights*, *Riparian Water Rights*, and *Littoral Water Rights*.

Prior Appropriation Doctrine — (1) A concept in water law under which a right to a given quantity of water is determined by determining the earliest *Priority Date*. (2) The system for allocating water to private individuals used in most of the western United States. The doctrine of *Prior Appropriation* was in common use throughout the arid west as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of “*First in Time, First in Right*”. The first person to take a quantity of water and put it to *Beneficial Use* has a higher priority of right than a subsequent user. Under drought conditions, higher priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land.

Priority — The concept that the person first using water has a better right to it than those commencing their use later. An appropriator is usually assigned a “priority date”. However, the date is not significant in and of itself, but only in relation to the dates assigned other water users from the same source of water. Priority is only important when the quantity of available water is insufficient to meet the needs of all those having a right to use water. See (*Prior Appropriation Doctrine* and *Appropriative Water Rights*).

Project WET (Water Education for Teachers) [Nevada] — A statewide supplementary, interdisciplinary water education program with components for the education community (K–12) and the general public. The goal of *Nevada Project WET* is to facilitate and promote the awareness, appreciation, knowledge, and stewardship of Nevada’s water resources through the development and dissemination of classroom ready teaching aides, teacher training, learning materials, and demonstration models as well as the maintenance of a resource bureau. The program is designed to provide useful, unbiased information in a straight-forward, neutral fashion addressing a wide variety of water-related topics.

Public Interest, or Public Welfare — An interest or benefit accruing to society generally, rather than to any individuals or groups of individuals in the society. In many states, a permit to appropriate water must be denied if the appropriation would be contrary to the public interest or public welfare. These terms are sometimes vague and state engineers or others administering the water permit systems generally have viewed narrowly the authority granted under such provisions. In some cases they have restricted their consideration to matters of economic efficiency or the effects of the proposed appropriation on existing or future use for the water and have not considered such things as the environmental effects. However, recent developments, such as state environmental policy acts or legislation addressing specific public interest criteria, have placed new emphasis on this issue. Also see *Public Trust Doctrine*.

Public Scoping — The process of soliciting public comments on the issues to be examined in environmental documents such as an *Environmental Impact Statement (EIS)* or water planning documents. The process can be carried out by public meetings, soliciting written comments, or both. The identification of issues, alternatives, impacts, mitigation and/or monitoring all may be addressed during the scoping process.

Public Supply Water — (1) Water withdrawn for all users by public and private water suppliers and delivered to users that do not supply their own water. (2) Water withdrawn by and delivered to a public water system regardless of the use made of the water. Includes water supplied both by large municipal systems and by smaller quasi-municipal or privately-owned water companies. Water suppliers provide water for a variety of uses, such as *Domestic Water Use* (also referred to as *Residential Water Use*), *Commercial Water Use*, *Industrial Water Use*, *Thermoelectric Power Water Use* (domestic and cooling purposes), and *Public Water Use*.

Public Trust Doctrine — (1) A vaguely defined judicial doctrine under which the state holds its navigable waters and underlying beds in trust for the public and is required or authorized to protect the public interest in such waters. All water rights issued by the state are subject to the overriding interest of the public and the exercise of the public trust by state administrative agencies. (2) Based in Roman Law, the Public Trust Doctrine holds that certain resources belong to all the people and are therefore held in trust by the state for future generations. Since the 1970s, court rulings have expanded the concept of public trust to protect not only the traditional uses of navigation, commerce, and fishing, but also ecological preservation, open space maintenance, and scenic and wildlife habitat preservation. In a 1983 landmark ruling by the California Supreme Court (*National Audubon Society v. Superior Court of Alpine County*), the court held that water right licenses held by the City of Los Angeles and its Department of Water and Power to divert water from streams tributary to Mono Lake remain subject to ongoing State of California supervision under the public trust doctrine and could be curtailed or revoked, if necessary, to protect the

public trust. The court held that public trust uses must be considered and balanced when the rights to divert water away from *Navigable* bodies of water are to be considered. Therefore, in issuing or reconsidering any rights to appropriate or divert water, the state must balance public trust needs with the needs for other beneficial uses of water. Also see *Equal Footing Doctrine (U.S. Constitution)* and *Public Interest, or Public Welfare*.

Public Water Use — Water supplied from a *Public Water Supply System (PWSS)* and used for such purposes as fire fighting, street washing, and municipal parks, golf courses, and swimming pools. Public water use also includes system water losses (water lost to leakage) and brine water discharged from desalination facilities. Also referred to as *Utility Water Use*.

Reasonable Use — A rule with regard to percolating or riparian water restricting the landowner to a reasonable use of his own rights and property in view of and qualified by the similar rights of others, and the condition that such use not injure others in the enjoyment of their rights.

Reasonable Use Theory — A *Riparian Owner* may make reasonable use of his water for either natural or artificial wants. However, he may not so use his rights so as to affect the quantity or quality of water available to a lower riparian owner.

Reservation Doctrine, Reserved Rights Doctrine, and Winters Doctrine (or Winters Rights) — The legal rule which states that when the United States reserves public lands for a particular purpose it also reserves sufficient water to accomplish that purpose. Those who initiate water rights after the date of the reservation are subject to the reserved right. The doctrine was first announced by the United States Supreme Court in the case of *Winters v. United States*, 207 U.S. 564 (1908), involving a dispute between an Indian reservation and a rancher. For many years it was thought that the doctrine only applied to Indian reservations, but in recent years it has been extended to other types of federal reservations, such as national parks and forests. Also see *Winters Rights (Decision)* and *Practicably Irrigable Acreage (PIA)*.

Reserved Water Rights (Federal) — (1) A category of federal water rights, created by federal law and recognized by judicial decision. These rights are created when the federal government withdraws land from the public domain to establish a federal reservation such as a national park, forest, or Indian reservation. By this action, the government is held to have reserved water rights sufficient for the primary purpose for which the land was withdrawn. (2) This class of water rights is a judicial creation derived from *Winters v. United States* (207 U.S. 564, 1907) and subsequent federal case law, which collectively hold that when the federal government withdraws land from general use and reserves it for a specific purpose, the federal government by implication reserves the minimum amount of water unappropriated at the time the land was withdrawn or reserved to accomplish the primary purpose of the reservation. Federal reserved water rights may be claimed when Congress has by statute withdrawn lands from the public domain for a particular federal purpose or where the President has withdrawn lands from the public domain for a particular federal purpose pursuant to congressional authorization. The right to such water is not lost by nonuse, and its priority date is the date the land was set aside. Also see *Winters Rights (Decision)*, *Reservation Doctrine*, *Reserved Rights Doctrine*, and *Winters Doctrine (or Winters Rights)*, and *Water Law [Federal]*.

Residential Water Use — Water used normally for residential purposes, including household use, personal hygiene, and drinking, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. Also referred to as *Domestic Water Use*. Also see *Public Water Supply System* and *Self-Supplied Water*.

Riparian — Pertaining to the banks of a river, stream, waterway, or other, typically, flowing body of water as well as to plant and animal communities along such bodies of water.

Riparian Areas (Habitat) — (1) Land areas directly influenced by a body of water. Usually such areas have visible vegetation or physical characteristics showing this water influence. Stream sides, lake borders, and marshes are typical riparian areas. Generally refers to such areas along flowing bodies of water.

Riparian Doctrine — The system for allocating water used in England and the eastern United States, in which owners of lands along the banks of a stream or water body have the right to *Reasonable Use* of the waters and a *Correlative Right* protecting against unreasonable use by others that substantially diminishes the quantity or quality of water. The right is appurtenant to the land and does not depend on prior use. Under this doctrine, ownership of land along a stream or river (i.e., riparian lands) is an absolute prerequisite to a right to use water from that body of water and each such landowner has an equal right to withdraw “reasonable” amounts of water (whether or not he is presently using it or not) so long as downstream landowners are not unreasonably damaged. Contrast with *Prior Appropriation Doctrine*.

Riverine — (1) Relating to, formed by, or resembling a river including tributaries, streams, brooks, etc. (2) Pertaining to or formed by a river; situated or living along the banks of a river, for example, a “riverine ore deposit.” Also see *Riparian*.

Safe Drinking Water Act [SDWA] (Public Law 93–523) — An amendment to the *Public Health Service Act* which established primary and secondary quality standards for drinking water. The SDWA was passed in 1976 to protect public health by establishing uniform drinking water standards for the nation. In 1986 SDWA Amendments were passed that mandated the *U.S. Environmental Protection Agency (EPA)* to establish standards for 83 drinking water contaminants by 1992 and identify an additional 25 contaminants for regulation every 3 years thereafter.

Senior Rights — A senior rights holder is one who holds rights that are older (more senior) than those of junior rights holders. All water rights are defined in relation to other users, and a water rights holder only acquires the right to use a specific quantity of water under specified conditions. Thus, when limited water is available, senior rights are satisfied first in the order of their *Priority Date*.

Snowpack Telemetry (SNOTEL) — A remote, automated measurement system operated and maintained by the *Natural Resources Conservation Service (NRCS)* in the western United States to assess snowpack accumulation and potential streamflows. The concept is based upon the relationship between the water content in the snowpack and spring runoff under certain assumptions. Forecasts of runoff are made through the coordination of hydrologists with the NRCS and the *National Weather Service (NWS)*. A typical SNOTEL site consists of: (1) a precipitation measurement tube which measures the actual level of precipitation in inches of equivalent water; (2) a snow “pillow” which measures the weight of the snowpack and therefore its water content, and (3) the measurement and transmitting equipment which send the data to NRCS collection offices.

Socioeconomics — The study of the economic, demographic, and social interactions of humans.

Stream — A general term for a body of flowing water; natural water course containing water at least part of the year.

Subsidence — (1) The sinking of the land surface due to a number of factors, of which groundwater extraction is one. (2) A sinking of a large area of the earth’s crust. Typically this may result from the over-pumping of a basin’s water table and the inability of the soils to re-absorb water from natural or artificial injection. Also frequently results from overdrafts of the aquifer and its inability to fully recharge, a process termed *Aquifer Compaction*. Also see *Land Subsidence*.

Surface Water — (1) An open body of water such as a stream, lake, or reservoir. (2) Water that remains on the earth’s surface; all waters whose surface is naturally exposed to the atmosphere, for example, rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc., and all springs, wells, or other collectors directly influenced by surface water. (3) A source of drinking water that originates in rivers, lakes and run-off from melting snow. It is either drawn directly from a river or captured behind dams and stored in reservoirs. Also see *Ground Water Under the Direct Influence (UDI) of Surface Water*.

Thermoelectric (Power) Water Use — Water used in the process of the generation of *Thermoelectric Power*. The water may be obtained from a *Public Water Supply System* or may be self supplied. Also see *Self-Supplied Water*.

Total Dissolved Solids (TDS) — (Water Quality) A measure of the amount of material dissolved in water (mostly inorganic salts). Typically aggregates of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, etc. of calcium, magnesium, manganese, sodium, potassium, and other cations which form salts. The inorganic salts are measured by filtering a water sample to remove any suspended particulate material, evaporating the water, and weighing the solids that remain. An important use of the measure involves the examination of the quality of drinking water. Water that has a high content of inorganic material frequently has taste problems and/or water hardness problems. The common and synonymously used term for TDS is “salt”. Usually expressed in milligrams per liter.

Transfer (Water Right) — (1) The process of transferring a water right from one person to another. (2) A passing or conveyance of title to a water right; a permanent assignment as opposed to a temporary lease or disposal of water. Most states require that some formal notice or filing be made with an appropriate state agency so that the transaction is officially recorded and the new owner is recorded as the owner of the water right.

Turbidity — A measure of the reduced transparency of water due to suspended material which carries water quality implications. The term “turbid” is applied to waters containing suspended matter that interferes with the passage of light through the water or in which visual depth is restricted. The turbidity may be caused by a wide variety of suspended materials, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic

compounds, plankton and other microscopic organisms and similar substances.

Usufructuary (Water) Right — (1) A right to use rather than own the property of another, such as the state's water. (2) A water right holder's authority to divert and use a certain amount of water. See *Usufruct*.

Vested Water Right — (1) The water right to use either surface or ground water acquired through more or less continual beneficial use prior to the enactment of water law pertaining to the source of the water. These claims become final through *Adjudication*. (2) A fully executed or finalized appropriative right to use the waters of a state for a beneficial purpose. Also see *Certificated Water Right* and *Perfected Water Right*.

Water Administration (and Management) — A broad term referring to the collective role of defined state agencies to implement state and federal water laws, commonly through the development and implementation of appropriate statutes and regulations. This role can include oversight, approval, and enforcement responsibilities.

Water Banking — A water conservation and use optimization system whereby water is reallocated for current use or stored for later use. Water banking may be a means of handling surplus water resources and may involve aquifer recharge or similar means of storage. Typically, under such arrangements, an agency is created with the authority to purchase, sell, hold, and transfer water and water rights in addition to serving as a negotiator between buyers and sellers. Generally, participants in water banking arrangements will have their water rights protected from cancellation (non-beneficial use) for a specific period so long as their water is "deposited" in the water bank. Also see *Water Marketing*.

Water Conservation — The physical control, protection, management, and use of water resources in such a way as to maintain crop, grazing, and forest lands, vegetative cover, wildlife, and wildlife habitat for maximum sustained benefits to people, agriculture, industry, commerce, and other segments of the national economy. The extent to which these actions actually create a savings in water supply depends on how they affect new water use and depletion.

Water Duty [Nevada] — The *Alpine Decree* and *Orr Ditch Decree* provide the basis for virtually all irrigation water duties relating to water diversions from the Truckee, Carson, and Walker rivers in Northern Nevada. These decrees provide for an annual maximum irrigation duty of 4.5 acre-feet per acre for water-righted *Bench Lands* and 3.5 acre-feet per acre for water-righted *Bottom Lands* delivered to farm headgates. These duties are based on the *Crop Water Requirement* on the irrigation of alfalfa, as it is the most prominent crop and the highest water-using crop grown in the *Newlands (Irrigation) Project* in west-central Nevada. However, neither decree identifies lands as to bottom or bench lands.

Water Importation — The act or process whereby water is brought into an area or region which would not naturally receive such waters. Typically, it refers to the artificial transport of water through aqueducts, canals, or pipelines from one water basin, drainage area, county or *Hydrographic Area* to another, thereby affecting the natural surface and groundwater drainage and flow patterns in both the water exporting and importing areas.

Water Management — (1) (General) Application of practices to obtain added benefits from precipitation, water, or water flow in any of a number of areas, such as irrigation, drainage, wildlife and recreation, water supply, watershed management, and water storage in soil for crop production. Includes *Irrigation Water Management* and *Watershed Management*. (2) (Irrigation Water Management) The use and management of irrigation water where the quantity of water used for each irrigation is determined by the water-holding capacity of the soil and the need for the crop, and where the water is applied at a rate and in such a manner that the crop can use it efficiently and significant erosion does not occur. (3) (Watershed Management) The analysis, protection, development, operation, or maintenance of the land, vegetation, and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality, quantity, and timing of the water which is produced. Also see *Basin Management*.

Water Plan — A document of issues, policies, strategies and action plans intended to effectively and economically execute a *Water Planning* process.

Water Planning — Water planning is an analytical planning process developed and continually modified to address the physical, economic, and sociological dimensions of water use. As a planning process it must assess and quantify the available supply of water resources and the future demands anticipated to be levied upon those resources. Based upon this continuous supply and demand evaluation, water planning must also give direction for moving water supplies to points of use while encouraging users to be good and effective stewards of available water resources.

The water planning process requires constant re-evaluation and updating to address changing social, political, economic, and environmental parameters. While the ultimate objective of such efforts is typically the development of a comprehensive, publicly-supported *Water Plan*, it is also critical to develop and maintain a comprehensive and viable water planning process that covers various aspects of water resource development, transport, water treatment, allocation among various competing uses, conservation, waste-water treatment, re-use, and disposal.

Water Resource Plan — A planning document or process which assesses both sources and uses of water and develops strategies for their most effective and efficient use according to public needs and criteria. Also see *Water Plan*.

Water Right — (1) The legal right to use a specific quantity of water, on a specific time schedule, at a specific place, and for a specific purpose. (2) A legally-protected right, granted by law, to take possession of water occurring in a water supply and to put it to *Beneficial Use*. (3) A legal right to divert state waters for a beneficial purpose.

Water-Righted Acreage — The land base for which there are water rights.

Water Rights — (1) The legal rights to the use of water. (2) A grant, permit, decree, appropriation, or claim to the use of water for beneficial purposes, and subject to other rights of earlier date or use, called *Priority* or *Prior Appropriation*. They consist of *Riparian Water Rights*, *Appropriative Water Rights*, *Prescribed Water Rights*, and *Reserved Water Rights*. Also see *Water Law*, *Water Law [California]*, *Water Law (Federal)*, and *Water Law [Nevada]*.

Watermaster — Often an employee of a court hired to administer a court decree. Also may be an employee of a water department who distributes available water supplies at the request of water rights holders and collects hydrographic data. Also refers to a position within an irrigation project that is responsible for the internal distribution of project water.

Watershed — (1) An area that, because of topographic slope, contributes water to a specified surface water drainage system, such as a stream or river. (2) All lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream; a region or area bounded peripherally by a water parting and draining ultimately to a particular water course or body of water. Also referred to as *Water Basin* or *Drainage Basin*. (3) A ridge of relatively high land dividing two areas that are drained by different river systems. Also referred to as *Water Parting*.

Watershed Management — The analysis, protection, development, operation or maintenance of the land, vegetation and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality and timing of the water which is produced. Also referred to as *Water Management* and *Basin Management*.

Watershed Planning — The formulation of a plan, based on the concept of a *Watershed*, a *Water Basin*, a *Hydrologic Region*, or a *Hydrologic Study Area (HSA)*, with the intent to assess climatological conditions, inventory existing ground and surface water resources, determine current water uses, project future socioeconomic and environmental demands for those resources, and explore feasible water-balancing options, so as to maximize the benefits to the inhabitants of a study area while simultaneously preserving and protecting the region's wildlife, habitat, and environmental conditions.

Wellhead Protection (Program) — Programs intended to protect and preserve the quality of ground water used as a source of drinking water. A typical wellhead protection program will have a number of critical elements to include: (1) delineating the roles and responsibilities of state agencies, local governments, and water purveyors; (2) delineation of wellhead protection areas; (3) contaminant source inventories; (4) management options; (5) siting of new wells; (6) contingency and emergency planning; and (7) public participation. Typically, steps taken to protect and preserve the quality of a well are far less costly than actions necessary to restore a contaminated well.

Wetlands [Nevada] — (State Wildlife Management Areas) Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency or duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands typically include swamps, marshes, bogs, playas, springs, seeps, and similar areas. Wetlands are land transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water.

Winters Doctrine — The doctrine of (federal) reservation rights. See *Winters Rights (Decision)*.

Winters Rights (Decision) — The U.S. Supreme Court precedent decision (*Winters v. United States*, 207 U.S. 564 [1908]) in which the Court prohibited any uses by non-Indians that interfered with the Indian tribes' use of their reserved water. In *Winters*, the Court held that when reservations were established, Indian tribes and the United States implicitly reserved, along with the land, sufficient water to fulfill the purposes of the reservations. The ruling rests on the principle that Indian tribes retain all rights not explicitly relinquished. These federal reserved water

rights are commonly known as *Winters Rights* as based on the *Winters Doctrine*. The court recognized these rights as having a priority date coinciding with the date the reservation was established, thus providing a means to integrate federally reserved rights with *Appropriative Water Rights* recognized under state law. Since reserved rights are not created by state law, *Winters Rights* retain their validity and seniority regardless of whether tribes have put the water to *Beneficial Use*. On-going conflicts concerning this ruling tend to involve non-Indian water users appropriating water under state law, water that previously may have been reserved for Indian tribes, though never quantified by courts or fully used on reservations.

Water Use — The amount of water needed or used for a variety of purposes including drinking, irrigation, processing of goods, power generation, and other uses. The amount of water used may not equal the amount of water withdrawn due to water transfers or the recirculation or recycling of the same water. For example, a power plant may use the same water a multiple of times but withdraw a significantly different amount. Also see *Water Use, Types*, below.

Xeriscape™ — Landscaping with native and naturalized plant species that are adapted to survive in areas of low precipitation. [*Trademark Note:* The term “Xeriscape” is a trademark of the National Xeriscape Council, Inc., and accordingly must always be capitalized, must always be used the first time with a “™” symbol, and can only be used as an adjective, e.g., Xeriscape landscaping, a Xeriscape garden, etc.]

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Nevada State Water Plan
SUMMARY

Section 9
Abbreviations and Acronyms

[The following terms have been extracted from the Nevada Division of Water Planning's *Water Words Dictionary* and may appear within the *Nevada State Water Plan*. Definitions of these words and a more extensive listing of water-related acronyms may be found in the *Water Words Dictionary*. With respect to notation and presentation, where two acronyms have different meanings, generally the more frequently used one will be listed first.]

AF	Acre-Feet (or Acre-Foot)
AFY	Acre-Feet per Year
AMD	Acid Mine Drainage
ASC	Atmospheric Sciences Center (DRI)
ASCE	American Society of Civil Engineers
ASOS	Automated Surface Observing Systems (NWS/NOAA)
AWWA	American Water Works Association
BAC	Biological Activated Carbon [Process]
BAT	Best Available Technology [Economically Achievable]
BFE	Base Flood Elevation (FEMA)
BIA	Bureau of Indian Affairs (USDI)
BLM	Bureau of Land Management (USDI)
BMP	Best Management Practice [Urban Water Use]
BOD	Biochemical Oxygen Demand/Biological Oxygen Demand
BPI	Bureau of Plant Industry [Evaporation Pan] (USDA)
BSC	Biological Sciences Center (DRI)
CAA	Clean Air Act (EPA)
CAPA	Critical Aquifer Protection Area (SDWA)
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
CERES	California Environmental Resources Evaluation System
CFCs	Chlorofluorocarbons
CF	Cubic Feet (or Foot)
CFS	Cubic Feet per Second
CLOMR	Conditional Letter of Map Revision (FEMA)
COI	Cone of Influence
COD	Cone of Depression
CORPS	U.S. Army Corps of Engineers (also USACE)
CWA	Clean Water Act (EPA)
DCNR	Department of Conservation and Natural Resources (State of Nevada)
DEP	Division of Environmental Protection (DCNR)
DO	Dissolved Oxygen
DOF	Division of Forestry (DCNR)

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DOW	Division of Wildlife (DCNR)
DDT	Dichlorodiphenyltrichloroethane
DRI	Desert Research Institute (University of Nevada System, State of Nevada)
DWR	Division of Water Resources (DCNR)
DWR	Department of Water Resources (The Resources Agency, State of California)
DWP	Division of Water Planning (DCNR)
EA	Environmental Assessment (NEPA)
EA	Endangerment Assessment (EPA)
EDF	Environmental Defense Fund
EEEC	Energy and Environmental Engineering Center (DRI)
EIS	Environmental Impact Statement (NEPA)
EPA	[U.S.] Environmental Protection Agency
ESA	Endangered Species Act (USFWS)
ESWTR	Enhanced Surface Water Treatment Rule (EPA)
ET	Evapotranspiration
ETAW	Evapotranspiration of Applied Water
EWMP	Efficient Water Management Practice [Agricultural Water Use]
FBFM	Flood Boundary Floodway Map
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHBM	Floodway Hazard Boundary Map (FEMA)
FIRM	Flood Insurance Rate Map (FEMA)
FIS	Flood Insurance Study (FEMA)
FONSI	Finding of No Significant Impact (NEPA)
FS	Feasibility Study (EPA)
FTE	Full Time Equivalent (Employment)
GAC	Granular Activated Carbon
GD	Geologic Division (USGS)
GFD	Gallons per Square Foot [of membrane] per Day
GID	General Improvement District
GIS	Geographic Information System
GPC	Gallons per Capita (Person)
GPCD	Gallons per Capita per Day
GPD	Gallons per Day
GPED	Gallons per Employee per Day
HSA	Hydrologic Study Area (DWR, State of California)
I.E.	Irrigation Efficiency
IOWE	International Office for Water Education (Utah State University)
IRP	Integrated Resource Planning
JTU	Jackson Turbidity Unit
KGAL	Kilogallons (thousand gallons)
LOMA	Letter of Map Amendment (FEMA)
LOMR	Letter of Map Revision (FEMA)
LVEA	Lahontan Valley Environmental Alliance

Summary. Section 9 – Abbreviations and Acronyms

MAF	Million Acre-Feet
M&I	Municipal and Industrial
MBAS	Methylene Blue Active Substance
MEQ/L	Milliequivalents per Liter
MGD	Million Gallons per Day
MG/L	Milligrams per Liter
MIS	Management Indicator Species
MSL	Mean Sea Level
MTBE	Methyl Tertiary Butyl Ether
NASQAN	National Stream Quality Accounting Network (USGS)
NDEPS	National Pollutant Discharge Elimination System (EPA)
NDOW	Nevada Division of Wildlife (DCNR)
NDSP	Nevada Division of State Parks (DCNR)
NDWP	Nevada Division of Water Planning (DCNR)
NEPA	National Environmental Policy Act
NESDIS	National Environmental Satellite, Data and Information Service (NOAA)
NEXRAD	Doppler Radar Data System (NWS/NOAA)
NFIP	National Flood Insurance Program (FEMA)
NFS	National Forest Service (USDA)
NGVD	National Geodetic Vertical Datum
NHP	Natural Heritage Program (DCNR)
NIDS	NEXRAD Information Dissemination Service (NWS/NOAA)
NMD	National Mapping Division (USGS)
NMFS	National Marine Fisheries Service (NOAA)
NOAA	National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
NPDES	National Pollutant Discharge Elimination System (EPA)
NPDWR	National Primary Drinking Water Regulations (SDWA/EPA)
NPL	National Priorities List ["Superfund" List] (EPA)
NPS	Non-Point Source [Pollution]
NPS	National Park Service (USDI)
NRCS	Natural Resources Conservation Service (USDA)
NRP	National Research Program [Centers] (WRD/USGS)
NTU	Nephelometric Turbidity Unit
NWIC	National Water Information Clearinghouse (USGS)
NWPA	Newlands [Irrigation Project] Water Protective Association
NWR	National Wildlife Refuge [System] (USFWS)
NWS	National Weather Service (NOAA)
OCAP	Operating Criteria and Procedures (TCID/USBR)
OFA	Other Federal Agencies [Program] (WRD/USGS)
OSM	Office of Surface Mining Reclamation and Enforcement (Bureau of Mines/USDI)
PAHs	Polycyclic Aromatic Hydrocarbons, or Polararomatic Hydrocarbons
PAMs	Polyacrylamides
PCBs	Polychlorinated Biphenyls
PCE	Perchloroethylene
pH	Hydrogen Ion Concentration [Potential of Hydrogen]
PIA	Practicably Irrigable Acreage
P.L.	Public Law
PMF	Probable Maximum Flood (FEMA)
PPB	Parts per Billion

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PPM	Parts per Million
PPT	Parts per Thousand
PS	Point Source [Pollution]
PSA	Primary Settlement Agreement
QSC	Quaternary Sciences Center (DRI)
RCRA	Resource Conservation and Recovery Act (EPA)
RMP	Resource Management Plan (BLM)
S.A.	Seasonally Adjusted
SCS	Soil Conservation Service (now NRCS)
SDWA	Safe Drinking Water Act (EPA)
SFHA	Special Flood Hazard Area (FEMA)
SFIP	Standard Flood Insurance Policy (FEMA)
SIC	Standard Industrial Classification [Code]
SNOTEL	Snowpack Telemetry (NRCS)
SPF	Standard Project Flood (FEMA)
SWE	Snow Water Equivalent
SWRCB	State Water Resources Control Board (DWR/State of California)
SWTR	Surface Water Treatment Rule (SDWA)
TCID	Truckee–Carson Irrigation District [Nevada]
TDS	Total Dissolved Solids
THMs	Trihalomethanes
TNC	The Nature Conservancy
TROA	Truckee River Operating Agreement [California and Nevada]
TSCA	Toxic Substances Control Act (EPA)
TSS	Total Suspended Solids
TTHMs	Total Trihalomethanes
UDI	[Ground Water] Under the Direct Influence [of Surface Water]
USACE	U.S. Army Corps of Engineers (also Corps)
USBR	U.S. Bureau of Reclamation (USDI)
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service (USDA)
USFWS	U.S. Fish and Wildlife Service (USDI)
USGS	U.S. Geological Survey (USDI)
USRS	U.S. Reclamation Service (USBR)
VOCs	Volatile Organic Chemicals
WAVE	Water Alliances for Voluntary Efficiency (EPA)
WCWCD	Washoe County Water Conservation District (Nevada)
WET	Water Education for Teachers
WHPA	Wellhead Protection Area
WMA	Wildlife Management Area (NDOW/State of Nevada)
WRC	Water Resources Center (DRI)
WRD	Water Resources Division (USGS)

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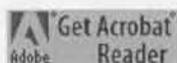
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Nevada Division of Water Resources

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Nevada Division of Water Planning

DRAFT Nevada State Water Plan**PART 1 — BACKGROUND AND RESOURCE ASSESSMENT****Introduction**

Part 1, Background and Resource Assessment, of the *Nevada State Water Plan* presents the basic underpinnings of the state's water planning effort with respect to guidelines, the state's institutional framework for water planning, water resource and socioeconomic backgrounds and glossaries of related terminology, agencies, water-related decrees and operating criteria and abbreviations and acronyms. Part 1 is divided into a number of sections to facilitate the presentation of background information. A summary of the contents of these sections is presented below.

Section 1, Introduction, is intended to introduce the reader to the water planning process and the mandates which initiated and guide this process.

Section 2, Guidelines for the State Water Plan, presents the framework under which water planning is conducted in Nevada and introduces the reader to the state's regulatory and water rights framework.

Section 3, The Institutional Framework for Water Planning and Management in Nevada, presents a discussion of the various agencies involved in water-related programs, their taskings and responsibilities, and the forums in which water planning and management is presently conducted in Nevada.

Section 4, Water Resources Background, presents a baseline assessment of Nevada's water resources in terms of climatology and hydrology and contains a number of maps showing these conditions across the state.

Section 5, Socioeconomic Background, traces Nevada's socioeconomic trends and development through the present day in terms of the population and general industry conditions that have influenced water use and demand in Nevada.

Section 6, Glossary of Terminology, provides definitions of words specifically related to the subject matter in Part 1.

Section 7, Information on Selected Federal, State and Local Agencies and Organizations, provides a detailed presentation of the various agencies involved in water planning and their organization and responsibilities.

Section 8, Selected Water-Related Decrees, Agreements and Operating Criteria, presents detailed information of some of the principal governing directives under which water is allocated in Nevada.

Section 9, Abbreviations and Acronyms, provides a comprehensive listing of the terms used in the water plan or used in other documents related to water issues and planning.

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Nevada Division of Water Planning

Nevada State Water Plan

PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 1

**Purpose, Guidelines and
the Water Planning Process**

Introduction and Purpose

Nevada is the driest state in the nation and one of the fastest growing. Water is Nevada's most precious resource, and more than any other resource, water will determine Nevada's future. The success of our economic endeavors, the sustainability of our rural communities and the protection of our environment are all dependent on the wise management of the states's water resources. Thus, comprehensive, coordinated and continuing water management planning is vital to our state's economic future and quality of life.

Development of the state water plan is required by the Nevada Revised Statutes (NRS 540.101.) In statute, the Legislature also declares that "it is the policy of the State of Nevada to continue to recognize the critical nature of the state's limited water resources" and acknowledges the increasing demands placed on these resources by growth. Further, the Nevada Legislature "recognizes the important role of water resource planning and that such planning must be based on identifying current and future needs for water" (NRS 540.011). Legislative review and consideration of the state water plan will provide additional legislative policy guidance to ongoing planning efforts.

The *Nevada State Water Plan* is designed to help guide the development, management and use of the state's water resources. The plan assesses the quantity and quality of Nevada's water resources, and identifies constraints and opportunities which affect water resource decision making. The plan looks at historical and current water use, and projects demands out to the year 2020. The most current and accepted hydrologic and socioeconomic data sets available are used to develop the plan's forecasts.

Along with providing data about water supplies and water use, the state water plan identifies pressing water management issues and recommends policy directions and actions designed to assist water managers throughout the state and all levels of government. Thus, the plan establishes a common base of knowledge and understanding which is critical if Nevadans are to reach consensus on future water management issues.

The state water plan is designed to be a policy and planning guide, not a water supply plan. Many of the decisions regarding how to meet a particular water supply objective are best determined and implemented at the local level. And in fact, many local governments have taken a close look at their own water supply needs and are now charting a course to meet those needs. Thus, while the plan

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summarizes local and regional water planning efforts, it focuses on a broad array of water planning issues which affect water planning, management and allocation of water resources statewide.

The key to development of the state water plan has been the establishment of a dynamic, flexible water planning process. Ongoing review and update of the plan is essential to ensure that we, as a state, successfully evaluate emerging issues and prepare ourselves to meet future challenges.

The state water plan's recommendations are addressed to a wide variety of agencies, organizations and decision makers. Thus, implementation of the plan's recommendations, subject to changing needs, will require a cooperative and coordinated effort. Prior to implementation, each of the plan's recommendations must be prioritized and evaluated for technical feasibility, and the costs and benefits of each must be identified and weighed. Implementation of the plan should assist local organizations and agencies with their own water planning, as well as help guide water management decisions at the state level. The plan's ultimate effectiveness will be judged by the extent to which it's recommendations are incorporated into other state, local and federal planning efforts and agency actions.

Public input is vital to any planning process. The state's water planning process provides Nevada's residents with a unique opportunity to help decide how the state's water resources should be managed. The state water plan has been significantly enhanced by the willingness of Nevada's residents to participate in its development, and to share their thoughts, ideas and perspectives. At its heart, the state water plan is a valuable expression of public interest.

Statutory Authority

In 1995, the Nevada State Legislature amended Nevada Revised Statute (NRS) 540.101 and directed the Division of Water Planning to develop a state water plan. Following the 1997 legislative session, the Legislature sent the Division of Water Planning a "Letter of Intent" requesting the state water plan be submitted to the Legislature by February 15, 1999. That date was extended to April 1, 1999 to allow sufficient time to complete public review of the final draft.

The authority for the preparation of the State Water Plan is found in NRS 540.101 which states in part:

1. The Division [of Water Planning] shall develop a plan for the use of water resources in the state.
2. The Division shall coordinate with local governments in developing the plan pursuant to section 1. Upon request of the Division, each local government shall cooperate with and assist the Division in the development of the plan.
3. The water plan developed pursuant to subsection 1 must include provisions designed to protect the identified needs for water for current and future development in the rural areas of the state, giving consideration to relevant factors, including but not limited to, the economy of the affected areas and the quality of life in the affected areas.
4. The Division shall submit to the Legislature for its review and consideration:
 - (a) The plan developed pursuant to subsection 1; and

Part 1. Section 1 – Purpose, Guidelines and the Water Planning Process

- (b) The recommendations regarding the plan provided to the Division by the advisory board on water resources planning and development pursuant to NRS 540.111.
The Division must obtain the approval of the Legislature before the plan is implemented.

The legislative declaration of policy establishes the importance of protecting existing water rights, supporting water conservation, the relationship between water supply and growth, and the role water planning plays in this, the driest state. It further establishes that water planning must focus on current and future water needs and that all levels of government must be involved in water planning.

Guidelines for the State Water Plan

The *Nevada State Water Plan* was developed in accordance with the legislative declaration of policy found in Nevada Revised Statutes (NRS) 540.011, and based on a series of “guiding principles” generated by the Advisory Board on Water Resources Planning and Development (Advisory Board). (See subsection below, *Participants in the Planning Process*, for a discussion of those involved in developing the state water plan.) The Advisory Board then assisted with developing the goals for the state water planning process and strategies for developing the state water plan.

Legislative Policy

NRS 540.011 establishes the basic legislative policy which has guided development of the state water plan:

NRS 540.011 Legislative declaration:

1. The legislature determines that it is the policy of the State of Nevada to continue to recognize the critical nature of the state’s limited water resources. It is acknowledged that many of the state’s surface water resources are committed to existing uses, under existing water rights, and that in many areas of the state the available groundwater supplies have been appropriated for current uses. It is the policy of the State of Nevada to recognize and provide for the protection of these existing water rights. It is also the policy of the state to encourage efficient and nonwasteful use of these limited supplies.
2. The legislature further recognizes the relationship between the critical nature of the state’s limited water resources and the increasing demands placed on these resources as the population of the state continues to grow.
3. The legislature further recognizes the relationship between the quantity of water and the quality of water, and the necessity to consider both factors simultaneously when planning the uses of water.
4. The legislature further recognizes the important role of water resource planning and that such planning must be based upon identifying current and future needs for water. The legislature determines that the purpose of the state’s water resource planning is to assist the state, its local governments and its citizens in developing effective plans for the use of water.

The legislative declaration of policy establishes the importance of protecting existing water rights, supporting water conservation, acknowledging the relationship between water supply and growth,

and the role water planning plays in this, the driest state. It further establishes that water planning must focus on current and future water needs and that all levels of government must be involved in water planning.

Guiding Principles for the State Water Plan

At their January 6, 1994 meeting, the Advisory Board developed a set of 23 “guiding principles” to philosophically guide development of the State Water Plan. Some of the guiding principles reflect state law or state policy. Others reflect important water planning considerations identified during development of the state water. Later, in 1997, the Advisory Board condensed the guiding principles to these 11:

1. All water within the state, whether above or below ground, belongs to the public and its use is subject to a system of water rights administered by the State Engineer, and by state and federal court decrees and regulations.
2. Public education and public input is vital to statewide water resources planning.
3. The State Water Plan should integrate water supply, water quality, water use, and environmental issues, and should be used to guide decisions which affect water resources in the state.
4. The State Water Plan by design should be “growth neutral.” It should neither encourage nor restrict growth, and present no positions regarding the type, location or rate of growth.
5. Water right owners are entitled to buy, sell or trade their water rights to others under free market conditions. However, changes in the point of diversion, or place or manner of use must be approved prior to the change in accordance with the state water law, and state and federal court decrees and regulations.
6. The water resource needs of future generations of Nevadans should be protected by balancing economic goals with social, aesthetic, cultural and ecological values.
7. All water resource projects should be technically, environmentally and economically sound, and consistent with state law.
8. The State Water Plan should help integrate and coordinate the water planning and management activities of local, state and federal agencies.
9. The relationship between groundwater and surface water must be recognized in the State Water Plan.
10. Water conservation is an important component in the planning and management of the State’s Water Resources.
11. Watershed planning efforts should be encouraged and should include representatives of all agencies, municipalities, political subdivisions, water users and any others with an interest in the planning and management of a watershed.

Planning Goals

Following development of the guiding principles, the Advisory Board and the Department of

Part 1. Section 1 – Purpose, Guidelines and the Water Planning Process

Conservation and Natural Resources (DCNR) Steering Committee developed a number of goals and strategies for the planning process and the state water plan. As the plan evolved, so too did the goals and strategies. In general terms, the goal of the state water planning process is to make water planning and water decision making in Nevada *better*: more efficient, more effective and more inclusive. Following are results we hope to achieve through the water planning process and development of the state water plan:

1. **Water Supply:** Enough water of sufficient quality for future generations
2. **Water Rights:** Protection of existing water rights
3. **Economic Efficiency:** The preferential use of water for greatest economic gain to the state
4. **Conservation:** More conservation and less waste of water
5. **Water Quality:** Protection and enhancement of water quality
6. **Rural Water Supplies:** Protection of water supplies for current and future development in rural areas
7. **Environmental Quality :** Protection and enhancement of the environment
8. **Efficiency:** Agency actions which are coordinated and integrated to save money and time, reduce duplication in projects or services, address gaps in resource protection, and result in better decisions
9. **Decision making:** Less litigation and more cooperative decision making to resolve water resource issues
10. **Effectiveness:** More informed water resource decision making, with a greater awareness of aesthetic, cultural and ecological values
11. **Sound Science:** Water resource projects which are technically, environmentally and economically sound
12. **Public Involvement:** A better educated citizenry and more public participation in water resource decision making
13. **Quality of Life:** A higher quality of life for all Nevadans

Each update of the state water plan should bring us closer to reaching these goals. It is important to note that some of the goals may conflict, or appear to conflict, with one another. For example, economic efficiency may appear to be in direct conflict with environmental protection. However, there is growing recognition that environmental protection is actually an essential component of economic development. Economic and environmental *sustainability* is the emerging goal of many communities. Clearly, for a state that is now ranked in the top three in the country as a vacation destination, environmental quality goes hand-in-hand with economic efficiency. It is one of the roles of the water planning process to seek a balance among competing goals so that the plan's overall goal of better water management is achieved. Public involvement in the water planning process has been the key to achieving a balance which reflects the evolving interests and will of the citizenry. **Plan Components**

The primary elements to be included in the State Water Plan were derived from NRS 540.051, Duties

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of the Division of Water Planning and NRS 540.101, Development, contents and implementation of the [state water] plan. Statutory plan components include: (1) providing arid regions with information, alternatives and recommendations including courses of planning and actions for acquiring additional water or for conserving water, (2) investigation of new sources of water such as desalinization, importation, and conservation, (3) consideration of issues of water quantity and quality simultaneously, (4) development of forecasts of future supply and demand, (5) inclusion of provisions designed to protect the need for water for current and future development in the rural areas of the state, considering the economy and quality of life in the affected areas, and (6) the development of recommendations to the Legislature to improve state water policy. Additional plan components were added as a result of input from the Division's Advisory Board, Department of Conservation and Natural Resources staff and the public.

Major State Statutory Policies Affecting the Water Planning Process

Following is a summary of the major legislative policies, declarations and other statements in the Nevada Revised Statutes (NRS) that affect water planning and management in Nevada. Each NRS citation has been assigned to only one of the main categories, although the statute may address issues within two or more categories.

Water Supply and Allocation

- 533.024 "The legislature declares that it is the policy of this state:
14. To encourage and promote the use of effluent, where that use is not contrary to the public health, safety and welfare, and where that use does not interfere with federal obligations to deliver water of the Colorado River."
 15. In a county whose population is less than 400,000 to recognize the importance of domestic wells as appurtenances to private homes, to create a protectible interest in such wells and to protect their supply of water from unreasonable adverse effects caused by municipal, quasi-municipal or industrial uses."
- 533.025 "The water of all sources of water supply within the boundaries of the state whether above or beneath the surface of the ground, belong to the public."
- 534.020 (1) "All underground waters within the boundaries of the state belong to the public, and, subject to all existing rights to the use thereof, are subject to appropriation for beneficial use only under the laws of this state relating to the appropriation and use of water and not otherwise."
- 540.011 (1) "...It is acknowledged that many of the state's surface water resources are committed to existing uses, under existing water rights, and that in many areas of the state the available ground water supplies have been appropriated for current uses. It is the policy of the State of Nevada to recognize and provide for the protection of these existing rights..."
- 541.030 (2)(a) "It is therefore declared to be the policy of the State of Nevada:
- (a) To control, make use of and apply to beneficial use unappropriated waters in this state to a direct and supplemental use of such waters for domestic, manufacturing, irrigation, power and other beneficial uses."

Water Quality

- 445.132 "1. The legislature finds that pollution of water in this state:
- (a) Adversely affects public health and welfare:

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- (b) Is harmful to wildlife, fish and other aquatic life; and
 - (c) Impairs domestic, agricultural, industrial, recreational and other beneficial uses of water.
2. The legislature declares that it is the policy of this state and the purpose of NRS 445.131 to 445.354, inclusive:
- (a) To maintain the quality of the waters of the state consistent with the public health and enjoyments, the propagation and protection of terrestrial and aquatic life, the operation of existing industries, the pursuit of agriculture, and the economic development of the state; and
 - (b) To encourage and promote the use of methods of waste collection and pollution control for all significant sources of water pollution (including point and diffuse sources).”

Environmental and Recreational Uses

- 501.100 “1. Wildlife in this state not domesticated and in its natural habitat is part of the natural resources belonging to the people of the State of Nevada.
2. The preservation, protection, management and restoration of wildlife within the state contribute immeasurable to the aesthetic, recreational and economic aspects of these natural resources.”

527.260 (1)(b) “The legislature finds that:

- (b) The people of the State of Nevada have an obligation to conserve and protect the various species of flora which are threatened with extinction.”

Water Use Efficiency

534.020 (2) “It is the intention of the legislature, by this chapter to prevent the waste of underground waters and pollution and contamination thereof ...”

540.011 (1) “...It is also the policy of the state to encourage efficient and nonwasteful use of these limited supplies.”

Water Planning and Management

- 540.011 “1. The legislature determines that it is the policy of the State of Nevada to continue to recognize the critical nature of the state’s limited water resources...
2. The legislature further recognizes the relationship between the critical nature of the state’s limited water resources and the increasing demands placed on these resources as the population of the state continues to grow.
3. The legislature further recognizes the relationship between the quantity of water and the quality of water, and the necessity to consider both factors simultaneously when planning the uses of water.
4. The legislature further recognizes the important role of water resource planning and that such planning must be based upon identifying current and future needs for water. The legislature determines that the purpose of the state’s water resource planning is to assist the state, its local governments and its citizens in developing effective plans for the use of water.”

541.030 (2)(b) “It is therefore declared to be the policy of the State of Nevada:

- (b) To cooperate with the United States and agencies thereof under the federal reclamation laws or other federal laws now or hereafter enacted and to construct and finance works within or without the State of Nevada as herein defined and to operate and maintain the same.”

543.020 “It is hereby declared to be the policy of the State of Nevada to cooperate with the United States and its departments and agencies, and with the counties, cities and public districts of the state, in preventing loss of life and property, disruption of commerce; interruption of transportation and communication and waste of water resulting from floods, and in furthering the conservation, development, utilization and disposal

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of water.”

548.095 “It is hereby declared, as a matter of legislative determination:

1. That the renewable natural resources of the State of Nevada are basic assets.
2. That they are being affected by the ever-increasing demands of farm and ranch operations and by changes in land use from agricultural to nonagricultural uses, such as, but not limited to, residential and commercial developments, highways and airports.
3. That conservation, protection, and controlled development of these renewable natural resources are necessary at such rate and such levels of quality as will meet the needs of the people of this state.”

548.100 “It is hereby declared, as a matter of legislative determination, that the consequences of failing to plan for and accomplish the conservation and controlled development of the renewable resources of the State of Nevada are to handicap economic development and cause degeneration of environmental conditions important to future generations.”

548.110 “It is hereby declared to be the policy of the legislature to recognize the ever-increasing demands on the renewable natural resources of the state and the need to conserve, protect and develop such resources at such levels of quality as will meet the needs of the people of the state.”

The Planning Process

The 1999 *Nevada State Water Plan* was developed over a period of 4-1/2 years (between late 1994 and January 1999) with the involvement of thousands of Nevada citizens. The Division of Water Planning has taken the lead, assisted by the Advisory Board on Water Resources Planning and Development, staff from the various agencies of the Department of Conservation and Natural Resources, and input from state, local and federal agencies and the public.

The steps in the water planning process were as follows:

- solicit public input to determine the scope of the plan and the issues to be addressed
- develop and update basic hydrologic and socioeconomic data sets
- analyze the water resources institutional framework
- forecast the state’s population and anticipated economic trends over the next 20 years
- forecast future water needs over the next 20 years
- inventory water supplies presently available
- inventory resources already committed (permits, vested rights, etc.)
- research additional possible sources of supply
- identify alternate scenarios to meet the water needs of the state
- identify issues that affect water use, allocation and management
- develop and evaluate policy and programmatic recommendations to address the issues
- solicit public input throughout plan development to gauge the relevancy of the issues and the appropriateness of recommendations
- present comprehensive plan with recommendations to the state legislature for review and approval

Once the state Legislature approves the Plan, the Division of Water Planning will communicate plan recommendations to agencies or individuals who are in the best position to further evaluate and

implement them. In some cases, the Division will establish new working groups or task forces to help determine the best approach to plan implementation. It is anticipated that the Water Planning Advisory Board will continue to advise the Division and assist in plan implementation. The Division will be responsible for tracking the progress of plan implementation and evaluating the effectiveness of plan recommendations. Subsequent updates of the Plan will include an evaluation of the state's progress in implementing the Plan's recommendations.

Participants in the Planning Process

Many individuals, organizations and agencies participated in development of the State Water Plan. Plan participants and their roles in plan development are briefly described below.

The Public. Extensive public involvement has been key to development of the State Water Plan. The public's opinions, thoughts, and recommendations have been solicited during every phase of the planning process. In 1992, prior to initiation of the 1999 State Water Plan, more than 800 Nevadans participated in a series of Water Policy Forums sponsored by the Nevada Cooperative Extension, the Nevada Humanities Committee and others. The results of these forums were tabulated in a report titled *Nevada's Water Future: Making Tough Choices*. This report, representing a diversity of views, was useful in the early stages of plan development and in generating options to address water issues.

In 1994 and 1995, more than 600 citizens participated in 20 public workshops sponsored by the Division of Water Planning. The purpose of these workshops was to educate the public on Nevada water law and the water planning process, and to get an early sense of the public's perception of key issues such as interbasin transfers. These scoping sessions were useful to the Division in establishing the breadth and scope of the plan.

Governor's Office. The Governor and his staff have provided executive sponsorship during plan development. Starting with the 1990 biennial report, the Governor addressed the need for development of a new state water plan as one of the most critical issues facing the state. In discussing the need for natural resource planning, the report states:

Tantamount among these plans is the development of a statewide water management plan, especially as related to intercounty and interbasin transfers, projection of water needs, the outline of conservation methods, development of drought contingency plans and information on regulations to conserve water usage. (p. 5, *Perspectives: A Biennial Report of Nevada State Agencies - 1990*)

Subsequent biennial reports have continued to underscore the need for a state water plan and to reiterate the Governor's commitment to statewide water planning.

Division of Water Planning. Between 1993 and 1997, the Division of Water Planning compiled socioeconomic and hydrologic databases and wrote more than 25 publications (see Table 1-1) to serve as a basis for the water plan. Key documents produced during that period included the *Nevada Water Words Dictionary*, the *DRAFT State Water Policy*, reports on water usage by sector, three detailed water basin *Chronologies*, and the *County Graph and Data Books* and *Socioeconomic Overviews*.

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In 1994, the Division completed the early public scoping meetings which served to help prioritize the state water plan elements. The Division went on to develop drafts of the *State Water Plan*, and then finalized the draft to be presented to the Legislature. Almost all Division staff were involved in this work effort, from plan conceptualization to final editing. The Division also provided staff support to the Advisory Board on Water Resources Planning and Development, conducted public outreach efforts and organized technical work group and steering committee meetings.

Technical Working Group. In 1994, a 20- member interagency working group composed of state and federal agencies met over an 11- month period to frame the issues, generate ideas and develop options. The perspectives of this working group were drafted into issue papers which formed the basis of the policy recommendations contained in the *DRAFT State Water Policy*, produced in March 1995.

DCNR Steering Committee. In 1995, staff from Divisions within the Department of Conservation and Natural Resources formed a high-level departmental oversight committee to support development of the State Water Plan. This group, which included the Director and Assistant Director of the Department and staff from the Divisions of State Lands, Environmental Protection, Wildlife, Water Resources and Water Planning, and the Natural Heritage Program, provided insight into the laws, regulations and issues within their jurisdictions, recommended approaches to the planning and obtaining public input, evaluated existing state water policies and recommended changes. This steering committee was essential in setting the tone, pace and direction of the plan. Altogether, the DCNR steering committee members committed over 1700 hours to plan development.

Advisory Board on Water Resources Planning and Development. To advise the Division in matters relating to planning and development of water resources, NRS 540.111 establishes the Advisory Board on Water Resources Planning and Development (Advisory Board.) In 1995, the Legislature passed SB 101, which among other things, enlarged the Advisory Board from 13 to 15 members, and changed its composition. The Board for Financing Water Projects, formally ex-officio members of the Advisory Board, was separated to form a stand alone board, and new Advisory Board positions were opened up for representatives of mining, ranching, agriculture, conservation and the general public. The number of Washoe County representatives was also increased.

As a follow-up to the enactment of SB 101, in 1996 the Governor appointed a new set of Advisory Board members (see p viii for the list of members), only 4 of whom had served on the previous Advisory Board. The current composition of the Advisory Board on Water Resources Planning and Development is as follows:

- Six members representing the governing bodies of the county with the largest population in the state [Clark County] and the cities in that county;
- One member representing the largest water utility in the county with the largest population in the state [the Las Vegas Valley Water District];
- Two members representing the county with the second largest population in the state [Washoe County] and the cities in that county;
- One member representing the largest water utility in the county with the second largest population in the state [Sierra Pacific Power Company];

- **One** member representing the general public; and
- Four** members, each representing a different one of the following interests:
 - (1) Farming;
 - (2) Mining;
 - (3) Ranching; and
 - (4) Wildlife.

The Governor is to make the Advisory Board appointments so that at least seven members are residents of Clark County, three members are residents of Washoe County and at least three members are residents of counties which have a population less than 100,000. Altogether, the Advisory Boards held more than 25, one-to-two day meetings to participate in development of the state water plan. The Advisory Board meetings were always publicly advertised and open to public comment, and occasionally the Advisory Board held special workshops to solicit public comment in a more formal setting.

Pursuant to NRS 540.111, one of the Advisory Board's roles is to make recommendations to the Division concerning their level of concurrence with the content, findings and recommendations of the *State Water Plan*. The Division is to then submit the Advisory Board's recommendations to the Legislature with the *Plan*. The time and effort contributed by the Water Planning Advisory Board has been invaluable in bringing the Plan to fruition.

Department of Conservation and Natural Resources Advisory Board. The Department of Conservation and Natural Resources maintains its own Advisory Board. The seven DCNR Advisory Board members each represent one of the following interests: (1) general public, (2) state park users, (3) agricultural industry, (4) mining industry, (5) outdoor recreationists, (6) forestry/fire control, and (7) conservation. This Advisory Board has frequently reviewed *State Water Plan* drafts and provided advice and counsel as to the plan's content and the planning process.

Interest Groups. Many interest groups have been active in the development of the *State Water Plan*. Groups such as the Nevada Farm Bureau, Nevada Cattlemen's Association, Northern Nevada Conservation Forum, Southern Nevada Homebuilders Association, and the League of Women Voters have sponsored workshops on the plan and/or commented formally on plan work products.

Local Governments. Local government input has been critical to the planning process. The Division Administrator or staff met personally with 16 of the 17 County Commissions, and the Southern Nevada Water Authority in Clark County, to update them on plan progress, request review of key work products, and request their participation in meetings of the Water Planning Advisory Board. Nearly all county commissions sent representatives to participate in Advisory Board meetings and to provide input on local water issues.

State Legislature. The Nevada State Legislature plays a significant role in the water planning process. The Legislature initiated the water planning program and has set time frames for plan completion. The Legislature has also provided guidance for plan development via its declaration of legislative intent at the start of NRS 540, the water planning statute. Legislative committees have requested periodic briefings on plan progress, and individual Legislators have shown a special interest by participating in scoping sessions and public workshops, submitting comments on the plan

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or by requesting additional information. When it is finalized, the *Nevada State Water Plan* will be presented to the 1999 Legislature for their review and consideration as required by NRS 540.101.4.

Federal Agencies. Federal agencies have been involved in plan development. Federal agency staffs made presentations to the Advisory Board on regional water issues, served on technical working groups, assisted in development of some issue papers, and commented on plan drafts. Federal agencies such as the U.S. Geological Survey, Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service and Natural Resources Conservation Service made significant contributions.

Plan Formulation and Review

Division of Water Planning staff researched and produced data compilations and publications as a preliminary step in developing the state water plan. As publications were finalized and sections of the *State Water Plan* were developed, they were reviewed by the DCNR Steering Committee, the Water Planning Advisory Board and the DCNR Advisory Board. Public comment was always solicited at meetings of both Advisory Boards. Once portions of the plan were in agreed upon draft form, the drafts were sent out for public review and comment. Typically, workshops were held to explain plan sections and to elicit comment from the public.

From this intensive review, public involvement and consensus building process, the *State Water Plan* has taken shape. The plan that has emerged is directed toward the development, adoption and implementation of a variety of programs, projects and policies designed to better utilize, conserve and protect the state's most valuable natural resource. However, the planning process not only resulted in the 1999 *State Water Plan*, but also in a strong consensus regarding the need to keep the water planning process alive, funded and connected to the state's water resource decision making processes and programs.

Public Comments on the Water Plan Drafts

An interim draft of the state water plan was released during the summer of 1998. This draft included many of the background and introductory plan sections, along with the basic data which formed the foundation of the plan. The goal of this early review period was to reach consensus on the data used to develop the plan, before moving on to addressing the more complex issues and recommendations in later plan sections. Six public workshops were held during this time. The Division also made presentations to 15 of the 17 county commissions, the Southern Nevada Water Authority in Clark County and the Carson City Board of Supervisors to update them on the plan, solicit their continuing assistance in plan development and receive their preliminary thoughts and comments.

The final public review draft of the state water plan was released at the end of January 1999 and the review period extended to March 8, 1999. Over 1000 copies of the draft state water plan were distributed for public review and comment. Drafts of the plan were also made available through the Division of Water Planning's website. During this time, seven public workshops were held to review the plan's recommendations and solicit public input. Additional presentations were made before various legislative committees, interested organizations and state advisory boards, working groups and commissions. Altogether, over 50 public workshops were held and presentations made on the

plan throughout the 4 ½ year planning cycle.

The Division received 39 written comments on the final public review draft of the water plan and many additional comments at public workshops. At the end of the final comment period, all of the comments received were entered into a database. The use of a database enabled the Division to more closely evaluate and analyze the comments, and to ensure that all comments on a topic were evaluated together and addressed appropriately and consistently.

Comments were provided by agricultural and rural interests, wildlife and environmental interests and agencies. Relatively few comments were received from urban interests. Of the 39 letters received 10 were from special interest groups, 8 from individuals and one from a business (mining). The other 21 letters were from local (9), federal (8) and state (1) agencies, irrigation districts (2) and tribes(1). Comments were directed most frequently to the issues and recommendations contained in the issue papers, to the data used in the plan and in some cases, to the findings (particularly the projected decrease in agricultural water use.) While some comments focused on edits or data corrections, a large number provided policy, philosophical or analytical perspectives, especially regarding growth, interbasin transfers and the importance of water planning to the state. Many comments recognized the significant work effort that went into developing the 1999 water plan and found it to be a valuable resource.

Issues given the greatest attention by commenters, both pro and con, included:

- * conservation and credit for conservation
- * water resources data collection, management and distribution
- * integrated water management
- * water measurement and estimation
- * interbasin and intercounty transfers
- * instream flows and water for wildlife and the environment
- * local vs. state water planning

A number of the comments addressed the planning principles utilized in the plan or the plan's goals. The commenters generally noted the difficulty in developing a plan based on very general, and sometimes conflicting, goals. The water plan's goals and guiding principles were the subject of much discussion and debate early in the planning process by the Advisory Board, and were reconsidered at various points during development of the plan. Therefore, while the comments on these areas were acknowledged, the plan's goals and guiding principles were not revised.

Frequently, comments conflicted with one another. For example, some comments questioned the need for a water plan and supported the status quo. These commenters believe that the current system is working and a state water plan is not necessary. Others applauded the water plan as a critical step in proactively planning and managing the state's water resources. Another example related to the use of data in the plan. Some groups wanted the plan to include the most current data available, even if that meant that data sets weren't comparable between counties. Others wanted data sets standardized to a particular year, even if that meant that older "vintage" data was used in lieu of the latest available data. Some felt that since some of the data sets have weaknesses, no conclusions should be drawn in the plan, while others were comfortable with use of the best available data to

forecast future water use.

Environmental organizations wanted to see more emphasis on managing growth and implementation of water conservation technologies, while others felt the plan should stay away from growth issues altogether and that conservation was a good idea but should not be mandated. (The plan is designed to be growth neutral, but does make strong recommendations to enhance water conservation in the state.)

Some comments expressed philosophical opposition to interbasin transfers, going so far as to suggest that they be banned altogether, while others felt that water transfers represented THE solution to the state's water supply problems. Some comments suggested that the water plan should express a vision of the future on a variety of topics including concepts such as sustainability, watershed planning and biodiversity. (The plan does discuss watershed planning in depth and recommend its greater usage, but only addresses issues of biodiversity or sustainability in the context of other issues.)

Concern was expressed about the role of the plan, and whether it is to be considered a mandate. However, the plan is clearly designed to be an education, planning and policy tool which makes recommendations to enhance future water management. In and of itself, the plan is not a new law, nor does it change existing water rights or reallocate water rights in any way. Projections of future water use are simply projections based on existing trends, and do not assume sweeping changes in our economy. It is anticipated that the market for water rights will drive any transfers of water rights.

A number of agricultural groups felt the plan should highlight the importance of agriculture to the state and its value in enhancing wildlife habitat, open space and rural quality of life. However, the plan does not advocate the value of any one water use or economic endeavor over another.

Comments expressed concern about the lack of water rights for maintenance of instream flows, the habitat of endangered and threatened species and the environment in general. They felt the state should assume a more active role in purchasing water rights for environmental water uses and in protecting habitats. On the other hand, a number of rural counties considered the plan's recommendations for purchase of water rights as "alarming", and a threat to their tax base. They suggested assisting irrigators in maintaining minimum pools on their own land by, for example, purchasing hay for them in dry years to prevent a reduction in stream flows at critical times.

Domestic wells were mentioned by quite a few commenters. Concerns were expressed about definition and protection of the legal rights of domestic well owners (who are not required by law to have a water right until their use exceeds 1800 gallons per day). Other comments included the view that domestic wells should be a local issue only, not a state issue, and a request for state funding support if domestic wells are required to hook up to regional water systems by the state.

A number of commenters concurred with the plan's recommendations to enhance water education, support watershed planning, develop better data, measure water use more accurately, do better flood planning and management, provide greater water planning assistance to local governments and ensure that the public remains closely involved in both state and regional water planning.

All comments were carefully reviewed and incorporated into the plan wherever possible. It is

noteworthy that many of the issues raised by commenters had been discussed at length by both the Steering Committee and the Advisory Board during plan development. Thus, while these comments did not highlight new issues, they did validate the planning and public input process that was utilized. Some commenters did raise issues which were not specifically addressed in the plan. Recommendations for subjects to be addressed, or more thoroughly addressed, in future plans are listed below. It is the intent of the Division of Water Planning to include these issues in future plan updates:

- * mine dewatering
- * integrated management of surface and ground water
- * conflict resolution
- * better identification of environmental water needs
- * more thorough discussion of various types of water storage
- * dam safety
- * better assessment of perennial yield and restoration of over utilized aquifers

Comments received on the final public review draft of the *Nevada State Water Plan*, as well as the comment database, are available for review at the Division of Water Planning's office in Carson City.

Previous Water Planning Efforts

The state water planning program began in the 1960's. In 1967 the Nevada Legislature directed the Division of Water Resources within the Department of Conservation and Natural Resources to determine Nevada's future water needs and available water resources. The Legislative Commission was directed to study future statewide water needs and it appointed a special Legislative Subcommittee to undertake the study. The State Engineer and the Subcommittee jointly recommended the establishment of a separate section within the Division of Water Resources to carry out the necessary planning studies, and specific legislation to establish the statutory authority to implement the program.

The 1969 Legislature authorized development of a comprehensive water resource plan for Nevada through an amendment to NRS 532, and made an appropriation to the Division of Water Resources to develop a planning section. The 1973 Legislature required the State Engineer to complete the water resource plan and submit it to the 1975 legislative session. The first state water plan, *Water for Nevada*, was completed and published by November 1974. The state water planning program was active until the early 1980's, although with a dwindling staff. In 1982 the program was all but eliminated due to severe funding shortages.

The water planning program was re-instituted in 1989 through the efforts of Assembly Speaker Joe Dini and like-minded legislators who were increasingly concerned about Nevada's rapidly growing population and the lack of a current plan to identify additional water resources to satisfy demands. There was also concern regarding the lack of flood, conservation and drought planning. Thus, the present day Water Planning Division was created under NRS 540 and a small staff was hired by 1991.

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Since 1991, the Division of Water Planning has produced over 30 publications in support of the *State Water Plan* (as well as numerous publication updates and revisions); initiated a water education program and Internet home page; obtained grant funding to coordinate water planning activities in the Walker River Basin; assisted local governments in their water planning efforts; awarded over \$20 million in grants to small water systems; and sponsored numerous water resource conferences and workshops. In 1997 the Division received state and federal appropriations to initiate a flood planning and grant program.

The 1999 *Nevada State Water Plan* completes the latest cycle of statewide water planning. Following approval of the plan, the Division will turn its attention to developing a handbook for regional water planning and begin developing specific water management plans for the various hydrographic regions in Nevada.

Organization of the Nevada State Water Plan

The 1999 *Nevada State Water Plan* is being produced in six volumes:

- A *Summary* presents highlights of the State Water Plan's findings, with an emphasis on recommended legislative water policy and program initiatives.
- The main body of the *State Water Plan* includes an inventory, assessment and issue analysis of water resources in Nevada. It establishes the regulatory, historical and institutional framework affecting water planning and management within the state, provides the socioeconomic context within which water decisions are made, projects population and economic trends affecting water use, forecasts future water needs, identifies current water issues and presents recommendations to address those issues. The main body of the *State Water Plan* is divided into 3 parts as follows:
 - Part 1 – Water Resources Background and Assessment
 - Part 2 – Water Use and Forecasts
 - Part 3 – Water Planning and Management Issues
- Two *Technical Data Appendices* which contain the detailed planning data and forecasts of the State's counties, cities and hydrographic basins (also available upon request in an electronic format).

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PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 2
Summary of 1974 State Water Plan

Introduction

The first state water plan, *Water for Nevada*, was completed and published by November 1974. It consisted of a series of 16 planning documents which estimated water use, inventoried the water resources of the state, provided maps, developed forecasts for future water needs for mining, agriculture, fish and wildlife, recreation, power production and municipal use, evaluated the use of input-output economic models to analyze future water scenarios and described the water administration process in Nevada.

The *Water for Nevada* series was followed by a second series of 6 water planning reports - *Alternative Plans for Water Resource Use*. The objectives of these planning documents were environmental quality, economic efficiency and area development. The purpose of the plans was to unite these objectives for better resource management. The planning was focused on those regions which were having difficulty in meeting their water needs or which were expected to run out of water in the near future. Alternative plans were developed for the Walker, Humboldt, Carson-Truckee, Colorado and Snake River Basins and the Central Region of Nevada. Each report examined a series of alternate economic development scenarios for a region and projected those future scenarios which might occur without a plan in place.

All of the alternative plans identified water resource issues which remain issues today, 25 years later. For example, the 1974 Water Plan noted that Walker Lake was declining by 60,000 acre-feet per year, flooding was occurring throughout the basin and there were unmet water needs for agriculture and recreation. The Truckee-Carson River Basin Report noted the decline of Pyramid Lake, municipal, agricultural and industrial water shortages, lack of adequate water for wildlife areas, and flooding. These issues remain and are perhaps even more pressing today. At this time, both lakes have declined further, municipal and industrial water shortages are more common, efforts to obtain water for wildlife and recreation are currently underway and the New Year's Day Flood of 1997 has moved flooding to the top of many people's agendas.

A final *Special Summary Report* concluded the water planning series. It noted that virtually all of Nevada's surface water resources had been committed; that in a rare year some overflow might be available, but that in most cases storage facilities were inadequate to capture the runoff for later use. It noted that significant groundwater supplies had already been developed, and that some areas held good potential for further development. However, we had already reached the point in some basins, such as the Las Vegas Groundwater Basin and Diamond Valley, where no additional appropriations

could be allowed. It was also apparent that obtaining water supplies from outside the state's boundaries was likely to be problematic, as it still is today.

The *Special Summary Report* noted that Nevada's residents viewed the lack of readily available water as a mixed blessing. While the lack of water restricted economic development in many areas of the state, it also meant that Nevada would be preserved in a fairly natural state with a relatively small population, thus enhancing the resident's "quality of life." In general, it was concluded from reaction and comment at the water planning forums, that most people of the state wanted the water resources developed and used, but not "over used." With this in mind, the state water plan conclusions and recommendations sought a middle ground.

Many issues were identified in the 1974 State Water Plan, and a number of actions were recommended. In most cases, the plan suggested a cautious "wait and see" approach. Key Plan recommendations included: 1) enacting legislation to bring geothermal resources under the purview of state water law, 2) placing time limits on subdivision approvals, 3) establishing state funding for water system infrastructure and flood management, 4) actively protecting state sovereignty in water allocation decisions on federal lands, 5) establishing state level floodplain zoning, 6) analyzing the state's responsibilities for maintaining stream channels in navigable waterways, 7) continuing the data collection and water planning activities, 8) protecting critical habitat and rare and endangered species when making water resource decisions and 9) where necessary, acquiring water rights for wildlife protection. Many of these recommendations were ultimately implemented in one form or another. The following sections summarize the conclusions and recommendations presented in the 1974 State Water Plan and the status of each today. Of note, the conclusions and recommendations presented herein are directly excerpted from the 1974 *Special Summary Report*.

General Conclusions and Recommendations of the 1974 State Water Plan

Water Law and Administrative Procedures

1974 Recommendations. "The theory inherent in the state water law involving the appropriation doctrine commonly referred to as 'first in time - first in right' and the concept that beneficial use is the measure of a right to the use of water have proven to be effective and in the State's interest. The law itself provides for changes in use as desire or demand dictate and thereby makes the law adaptable to varying conditions. Past legislative actions have provided necessary amendments all of which have been carefully evaluated for not only immediate but long term effects and ramifications. No basic changes in the theory or philosophy of the state water law are recommended. However, it should be continually scrutinized for necessary modification of specific provisions."

Status. The theory and philosophy of state water law has remained the same, however the State continues to carefully evaluate the water law and make some amendments in response to changing conditions. In fact, there have been some modifications to the state water law since 1974. One of the major statutory changes allows the State Engineer to approve temporary changes in place of diversion, manner of use or place of use of an existing water right (NRS 533.345). Another statutory change allows the State Engineer to issue environmental permits which are temporary permits to

appropriate water for the avoidance of pollution or contamination of a water source (NRS 533.437). NRS 534.250, added to the statutes in 1987, defined permitting requirements for recharge/recovery projects. In 1993, NRS 534.350 was added which allows a public water system in certain basins to receive water right credits for the addition of new customers previously served by domestic wells.

Funding of Water Resource Projects

1974 Recommendations. “It has been suggested that a fund be established to provide State participation in funding water resource development or flood control projects. Legislative consideration of funding in the past has been on a project by project basis...Establishment of a separate construction or development fund is not recommended. Individual projects should continue to be considered by the legislature for partial or total funding or financial support.”

Current Status. In 1987, the Legislature established a \$200 million loan program for financing water projects (NRS 349.935 through 349.961). Through this program, loans can be issued for financing any project for the management, control, delivery, use or distribution of water. Only two loans have been issued under this program. In recent years, this program has had no activity.

In 1991, the Legislature established the AB 198 Grant Program administered by the Division of Water Planning which provides financial assistance to water purveyors. Grant funds can be used to partially finance capital improvements made necessary by State health regulations and the federal Safe Drinking Water Act. The Board for Financing Water Projects can award up to \$40 million in grants. Thus far, over \$20 million in grant funds have been awarded for 20 projects throughout Nevada. This program remains active today.

The federal Safe Drinking Water Act (SDWA) Amendments of 1996 authorized a Drinking Water State Revolving Fund for the purpose of loaning funds to public water systems for infrastructure improvements required to achieve or maintain compliance with SDWA requirements and to protect public health objectives of the Act. In Nevada, this program is currently being developed with the Bureau of Health Protection Services acting as the lead agency.

Local Options and Discretion

1974 Recommendations. “...The concept of state administration of the water resource through application of the provisions of the water law is generally not only accepted, but endorsed with an enthusiasm for continuance...It is recommended that State authority over water resource administration be retained. Where and when possible, local options and discretion should be recognized in such matters as internal management, construction of projects affecting local interest, and financing of such projects.”

Current Status. The State has retained authority over water resource administration, however the need for local entities to be proactive in regional water resource planning is being recognized. In recent years, a number of local and watershed planning efforts have been undertaken. To ensure that counties are aware of water right application potentially affecting their region, statutory changes were made requiring the State Engineer to notify county commissioners of water right applications in their

county for use in another county (NRS 533.363).

Mining or Depletion of Ground Water

1974 Recommendations. “Withdrawal of groundwater is limited to that naturally recharged to the groundwater basin. The only exception is covered under the provisions of NRS 534.120, which allows issuance of temporary permits to appropriate groundwater which can be limited as to time and which may be revoked if and when water can be furnished by entity. This provision has been applied only in Las Vegas Valley where the alternate source of the Colorado River is available. Concepts have been advanced whereby groundwater in storage would be depleted over a given period of time...It is recommended that caution be exercised in any legislative changes to expand authorization for depletion of ground water in storage. Any authorization, in addition to that presently existing, should be on an area-by-area or case-by-case basis and should not be applicable statewide.”

Current Status. It is the policy of the State of Nevada to appropriate groundwater up to the perennial yield. In some instances, some minor applications may be approved in a fully appropriated basin if the proposed use is a preferred use and is in the public interest. Mining is considered a temporary use, and in some basins, mining withdrawals have been allowed to exceed perennial yield with the excess water being put to beneficial use where feasible.

Transbasin Diversions

1974 Recommendations. “There is presently no specific statutory reference to transbasin diversions. This has not created any problems and existing or proposed transbasin diversions can be considered, evaluated, and regulated under existing statutory provisions regarding availability of supplies and effects on existing water rights. It is recommended that no legislative amendments be initiated on this subject.”

Current Status. A number of actions have been taken since 1974. The discussion on “Interbasin and Intercounty Transfers” in Part 3 of the *State Water Plan* provides an overview of these actions and additional recommendations.

Preferred Uses

1974 Recommendations. “The only existing provision for consideration of preferred use in the appropriation of water is NRS 534.120, which relates to new appropriations of groundwater in basins being depleted. The effectiveness of the time-priority system rather than type of use-priority, coupled with provisions for changing the manner of use of water supplies as need and desire arise, lead to the conclusion that no changes are required as regards preferred uses.”

Current Status. Since 1974, no legislative changes have been made regarding preferred uses. In designated basins, the State Engineer has continued to define preferred uses for specific regions as needed. In response to the influx of Desert Land Entry requests, the 1981 State Legislature adopted NRS 533.357 which establishes priorities for various categories of irrigation water use.

Reservation of Water Quantities

1974 Recommendations. “The idea of reserving quantities of water and essentially setting them aside from appropriation for use for some specific purpose at some time in the future has been advanced. This has been specifically considered regarding future supplies for Municipal and Industrial purposes. It has been proven to be in the State and private interest to allow appropriation of available water for any beneficial use to which it can be applied at the time it can be applied. Again, as demands or requirements change, so can the manner of use of water be changed. It is recommended that this concept of reserving water be rejected.”

Current Status. Beginning prior to 1974, the State Engineer has issued orders which designate areas for preferred uses and denial of other uses. Through these orders, the State Engineer has essentially reserved an area for particular types of use. Regarding municipal water appropriations, changes to NRS 533.380 have given municipalities more flexibility in obtaining time extensions regarding the placing of water appropriations to beneficial use.

Termed Approvals of Water Appropriations

1974 Recommendations. “Water rights, when perfected, are a right in perpetuity, subject to forfeiture and abandonment. There is perhaps some authority for issuing water rights for a specific term, or time period, if it is demonstrated that the capability for beneficial use is limited to that time. There is some interest in the western states in expanding the authority for issuing termed water rights. It is not clear how this might be applied in Nevada water administration at this time. It is recommended that the concept of issuing termed water rights be further explored before any definitive action is taken.”

Current Status. In 1991, NRS 533.371 was added which allows the State Engineer to issue permits that are effective for a limited time period for a temporary use.

Water Supplies and Rights for Temporary Construction Uses

1974 Recommendations. “Generally, water supplies for temporary construction, such as highway projects, are available from existing sources and agreements can be reached for water use under some existing water right. However, time is required to obtain a water right, and this can affect obtaining water, particularly in designated groundwater basins. Limited problems created do not warrant the issuance of any type of ‘special permit.’ It is recommended that the State Highway Department consider this matter in bid notices and other material furnished potential bidders or contractors.”

Current Status. Language has been added to NRS 534.050 which allows the State Engineer to waive permit application requirements for the temporary use of water in highway construction, and other uses.

Wells for Domestic Use

1974 Recommendations. “Current statutory provisions do not apply in the matter of obtaining

permits for underground water from a well for domestic purpose where the draught does not exceed 1800 gallons per day. A 'permit system' for individual domestic wells has been considered; but it is estimated that use from such wells is about one percent of the total water use in the state. The merits and benefits to be derived do not, at this time, warrant the time, staff, and financing that would be required to administer a domestic well permit system. This is a matter that warrants continuing consideration in the future."

Current Status. The merits and benefits of a domestic well permitting system still do not warrant the time, staff and financing required. Several bills have been introduced in the Legislature attempting to create such a system, but have not been successful. For additional information, refer to the discussion on "Domestic Wells" in Part 3 of the *State Water Plan*.

Taxes on Well Production

1974 Recommendations. "In a previous session of the legislature, a bill was introduced to provide a tax on water produced from wells. There was a serious objection from all areas of the State and the bill did not pass from committee. It has since been proposed that such a tax be considered, not on a statewide basis, but in particular areas. Specifically there is interest by some local residents in taxing production from wells in Las Vegas Valley. The thought is that this would equalize the cost of well water with that served by the public utilities. It is recommended that any consideration of taxes on well production be limited to that under temporary permits which are subject to revocation within the Las Vegas Artesian Basin. It is also recommended that even this be approached only after thorough evaluation of legal ramifications and equity."

Current Status. With passage of Assembly Bill 436 in 1997, a program for the management of the groundwater in the Las Vegas Valley basin was created. As part of this program groundwater users are assessed an annual pumpage fee to fund the Las Vegas groundwater management program.

Geothermal Resources

1974 Recommendations. "Nevada's geothermal resources are administered by the state engineer pursuant to the attorney general's opinion of August 12, 1965...The implementation of the federal geothermal leasing act makes no provision for compliance with existing State water law, or for protection of existing water rights on private or public lands. Designated critical ground water basins within the State require particular regulation by the state engineer. Unregulated exploratory drilling for geothermal resources in these designated basins and other basins could adversely affect existing rights, in that the federal geothermal leasing act makes no provisions for exploration activity on private or corporate lands. It is recommended that legislation be enacted to specifically provide that geothermal resources are subject to administration under the water law and to provide for establishment of rules and regulations for such control and administration."

Current Status. NRS 534A describing geothermal resource administration was added to the statutes in 1975 with subsequent changes. Under NRS 534A, a permit is needed from the State Engineer if any of the geothermal water is consumptively used, not including reasonable system losses. Nonconsumptive geothermal permitting is administered by the Division of Minerals.

Water Supplies for Proposed Subdivisions

1974 Recommendations. “Legislation was enacted in 1971 (NRS 116 and 117) giving the State Engineer the responsibility to confirm water supplies for proposed subdivisions. This was amended in 1973 to provide that the State Engineer was to prepare and provide a review of water quantity. Authority for final approval rests with the health division of the Department of Human Resources. It is appropriate and necessary that the State Engineer be responsible for water quantity determinations in accordance with the provisions of the water law. Such provisions require that due diligence be exercised in any development of water to satisfy any proposed use. Subdivision approval does not include similar requirements. It is recommended that consideration be given to time limits on subdivision approvals [by counties]. That is, subdivisions would be approved [by counties] for development within a given period, at the conclusion of which the undeveloped portion would be subject to reconsideration. An alternative to this approach would be a requirement that water supply and sewer or disposal service be available at each lot prior to sale.”

Current Status. NRS 278.360 has since been modified which places time limits on tentative subdivision map approvals. NRS 278.377, added in 1977 with subsequent revisions, requires approval of subdivision maps by the State Engineer with regard to water quantity. A 1978 Attorney General’s opinion found that this statute grants the State Engineer has the authority to disapprove tentative subdivision maps on the basis of water quantity. Also, NRS 278.462 was added which authorizes the State Engineer to make recommendations on water quantity for parcels when requested by the county or other governing body.

State vs. Federal Jurisdiction

1974 Recommendations. “There [have] long existed questions about state and federal jurisdiction over water supplies on federally controlled lands. There have been numerous court decisions on this subject, however there remain many uncertainties which can only be resolved through federal legislation. Such legislation has been introduced in Congress in the past and will likely be introduced in the future. It is recommended that officials and citizens of the State closely scrutinize any such legislation and offer support or resistance in an effort to protect what should properly be the individual State role in administration of the resource.”

Current Status. The State continues to protect its primacy in water resources administration.

Flood Control

1974 Recommendations. “...There are extensive flood insurance programs presently available through federal agencies, and State assistance is available to local authorities for securing information about such programs. It is recommended that flood plain zoning ordinances or regulations be formulated and enforced by local government agencies. If this is not effective, flood plain zoning should be considered at the State level.”

Current Status. There have been a number of improvements to state floodplain management since issuance of the 1974 State Water Plan. For details on these changes, refer to the discussion on

“Flood Management in Nevada” in Part 3 of the *State Water Plan*.

Navigability Effects

1974 Recommendations. “There have recently been judicial determinations and legal opinions concerning navigability of some of the streams in Nevada. This has raised questions regarding State responsibilities and possible liabilities in maintaining stream channels and related issues. For example, if the course of a navigable stream is altered, either through natural processes or by design, what is the ownership status of the vacated area and resources, such as gravel aggregate within these areas. It is recommended that proper authority analyze possible ramifications, not only for the protection of the State, but so that the public may be better informed.”

Current Status. NRS 532.220 established a program to aid local governments in the clearance, maintenance, restoration, surveying and monumenting of navigable rivers. In 1980, the Attorney General issued an opinion stating that cities, counties and public districts (including irrigation districts and flood control districts) and the United States have the authority to maintain or improve the channel of a navigable river to assure its flow capacity or to avoid flood damage to adjoining property. However, no state or federal statutes require these entities to undertake such projects.

Environmental Considerations

1974 Recommendations. “There has been an increasing public awareness and understanding regarding environmentally related concerns with respect to water and other natural resources within the State. Efforts to continue and extend this public awareness through dissemination of information and through the academic system should be encouraged. Specific project or resource planning should include a consideration of environmental impacts, not only on the immediate area, but on a regional basis. Watershed management programs should include such factors as sediment retention, vegetation manipulation and management, livestock and wildlife carrying capacities, and other factors to enhance environmental quality within water availability. Critical habitat and rare and endangered species should be considered and, if necessary for their protection, appropriate water rights should be acquired. In most instances, water quality and quantity questions and issues must be jointly considered. Compatibility of administrative procedures and regulations must be retained.”

Current Status. A number of actions have been taken since 1974. NRS 533.437 was added thereby allowing the issuance of temporary permits to appropriate water needed to avoid pollution of contamination of a water source. NRS 533.367 was added which states that “[b]efore a person may obtain a right to the use of water from a spring or water which has seeped to the surface of the ground, he must ensure that wildlife which customarily uses the water will continue to have access to it.” Since 1974, Nevada Supreme Court findings have led to a broader legal interpretation of beneficial use regarding wildlife needs. In 1988, *Nevada v. Morros* concluded that providing water to wildlife is a beneficial use of water.

There are numerous examples of water rights being acquired for resource conservation purposes. The Park and Wildlife Bond Act of 1990 (Question 5) authorized the expenditure of \$47.2 million

which has been used to purchase land with special resource values. In addition, \$5 million was designated for water rights acquisitions.

The Director of the Department of Conservation and Natural Resources and the Divisions of Water Resources, Environmental Protection, and Wildlife are jointly considering water quantity, water quality and wildlife impacts when reviewing mining withdrawal applications. The Division of Water Planning has been directed to consider both water quantity and quality in its planning.

For additional information, refer to the discussions on “Nonpoint Source Pollution”, “Comprehensive Groundwater Protection and Management”, “Watershed Planning and Management”, and “Wildlife and Environmental Water Uses and Needs” in Part 3 of the *State Water Plan*.

Continuing Planning Efforts

1974 Recommendations. “The planning effort does not end here. In the 1969 report to the Legislative Commission and in testimony before the Legislative Committees, it was emphasized that water planning would be a continuing requirement. The State role and responsibility of review and evaluation of proposals by other agencies continues. Also, there is a need to provide assistance in other planning efforts, such as land planning, and water quality planning. Participation in federal, regional, and interstate investigation and negotiations is necessary to assure adequate consideration of the State of Nevada’s interest and position in water transfer or related matters. Data and information used in water resource decisions requires continuing attention to assure that it is current. It is recommended that staff and funding for the Water Planning Section in the Division of Water Resources be continued at the current rate for the next biennium and that requirements be reevaluated periodically thereafter.”

Current Status. The state water planning program was active until the early 1980's, although with a dwindling staff. In 1982, the program was eliminated due to severe funding shortages. The water planning program was re-instituted by the 1989 State Legislature, with staff hired during 1990. Since that time, the Division of Water Planning has undertaken a number of efforts. For example, the Division has produced over 50 publications including the *State Water Plan*, continues to provide

assistance to local planning efforts, compiles and distributes needed information, and administers a drinking water system grant program and a floodplain management program.

Regional Conclusions and Recommendations of the 1974 State Water Plan

Walker River Basin

1974 Recommendations. “There is not sufficient water in the Walker River system to satisfy present and projected requirements upstream and yet maintain Walker Lake as a viable fishery as it presently exists. Water levels will continue to decline and salinity will continue to increase.

Water rights confirmed both by Decree from the Federal District Court and in appropriations through State procedures must be recognized in administering water supplies of the system.

It has been suggested that extensive studies such as State-Federal Task Forces be created to further evaluate water uses and practices within the Walker River Basin. Many of the findings of the Pyramid Lake Task Force can be applied, at least in concept, to the Walker River system. It is doubtful that another Task Force effort would yield significant new data or information.

Means of maintaining the Walker Lake fishery by introducing new species that can adjust to increased salinity should be explored. Also, replacement of fishery pressures to upstream reservoirs should be considered.

The only apparent means of maintaining the existing level of Walker Lake would be to acquire existing water rights upstream for transfer to Walker Lake. No recommendation is made for a legislative determination in this matter.

It is recommended that the allocation of water set forth in the California-Nevada Interstate Water Compact be recognized and preserved.”

Current Status. Since the completion of the 1974 State Water Plan, Walker Lake water levels have continued to decline and salinity has increased.

Walker River Decree rights and state appropriative rights continue to be recognized in administering the water supplies.

The University of Nevada Reno and the Desert Research Institute have been studying the feasibility of a water bank as a mechanism for the voluntary leasing or transferring of water rights from one user to another. The Walker River Basin Advisory Committee is studying strategies for improving water conservation in the basin. Both of these studies are funded primarily with federal monies. The U.S. Army Corps of Engineers is now planning to develop various ecosystem restoration studies and projects in the basin, and is seeking local sponsorship. The Division of Water Planning created the Walker River Basin Technical Network to increase coordination among the various groups studying the basin, and improve information sharing and distribution. Using federal funds, the Division hired

a part-time watershed planner to oversee the Network and begin development of a watershed plan.

A number of efforts addressing the Walker Lake situation have been undertaken in recent years. For instance, the Division of Wildlife is now acclimating hatchery fish to high salinity water prior to their release into Walker Lake. This has greatly decreased fish mortality following planting. Over 20 studies by 10 separate agencies are currently underway or pending.

In 1983, the Division of Wildlife perfected a water right (certificate was issued) for the Walker River flood waters flowing into Walker Lake. This right is one of the most junior on the system with a priority date of September 17, 1970. A number of studies are underway which examine feasible water augmentation solutions for Walker Lake.

The California-Nevada Interstate Compact remains unratified by U.S. Congress. The Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990 (Public Law 101-618) addressed interstate allocations of the Truckee and Carson rivers, and Lake Tahoe, but not interstate allocations of the Walker River.

Carson-Truckee River Basins

1974 Recommendations. "...The State should continue to pursue and support Congressional approval of the California-Nevada Interstate Compact concerning waters of Lake Tahoe and the Truckee, Carson and Walker River Basins as ratified by the State of Nevada and California. Pending Congressional approval, the allocations of water and other provisions should be recognized and followed as State policy.

The Pyramid Lake Task Force Recommendations (both the so-called 'Government' recommendations and 'Sierra Club' recommendations) should be pressed for implementation in the areas found practical and feasible.

(Note: A summary of the main recommendations presented by these groups include:

- strict enforcement of existing decrees
- continue following suggested rules and regulations for operation of the Truckee and Carson rivers, including Lahontan Reservoir
- a variety of improvements to Truckee-Carson Irrigation District facilities to improve efficiencies while wildlife, waterfowl and recreation areas are kept viable
- initiate a cooperative pilot program to demonstrate the effects of a sprinkler system
- expedite design and construction of Marble Bluff Dam and Fishway)

The State should provide necessary funding for advancing and defending the State's position in litigation.

A firm decision should be made regarding development of water supplies within the 'Marlette-Hobart' system and intended uses of these supplies.

A reevaluation of Watasheamu Dam and Reservoir for possible recreation use and Municipal and

Industrial use in Carson Valley and Carson City should be requested of the Bureau of Reclamation.

Several alternatives for additional water supplies to serve Carson City have been identified and presented. Local interests should be encouraged to proceed with necessary legal, engineering and funding proposals for augmentation. The alternative will be a limitation on future growth and development.”

Current Status. The California-Nevada Interstate Compact remains unratified by U.S. Congress. The Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990 (Public Law 101-618) addressed interstate allocations of the Truckee and Carson rivers, and Lake Tahoe, but not interstate allocations of the Walker River.

Many of the recommendations of the Pyramid Lake Task Force were addressed in Public Law 101-618 including efficiency studies, and the purchase of water rights for wildlife. Other recommendations were addressed in OCAP (Operating Criteria and Procedures) such as storage levels, operational improvements, etc. Also, the Pyramid Lake Paiute Tribe has secured a right to the unappropriated water in the Truckee River in accordance with Nevada water law.

For about 25 years, the Department of Conservation and Natural Resources has had a fund for financing litigation in the Truckee, Carson and Walker rivers.

Since 1974, the State acquired the Marlette-Hobart system and operates it today to serve Silver City, Gold Hill, Virginia City and Carson City.

With California designating the East Fork of the Carson River as a wild and scenic river, the Watasheamu Dam and Reservoir project (which would inundate a portion of the river in California) was prohibited. Subsequent to this action, the Carson Water Subconservancy District funded a study examining the feasibility of a smaller dam and reservoir (Bodie Dam) which would not inundate lands in California. Bodie Dam was not found to be cost effective. The Subconservancy continues to examine alternative supply and management options.

Since 1974, Carson City has proceeded with the necessary steps for supply augmentation and has secured adequate water supplies for their planning horizon.

Humboldt River Basin

1974 Recommendations. “Occasionally, there are surplus waters in the Humboldt river system...Portions of this water could be salvaged for beneficial conservation and recreation uses upstream. Additionally, there is need for stabilizing flows, reducing flood damages and providing sediment detention by providing upstream storage.

The proposed Humboldt River Storage Project includes...[a number of storage reservoirs]. The 1973 Legislature passed a Resolution supporting the Humboldt Project, contingent upon a favorable environmental and fish and wildlife impact assessment and other beneficial aspects. A sum was also appropriated for an analysis of the impacts. The results will be furnished in separate reports, and

specific recommendations will depend upon these results.

However, it can be recommended that in any event, existing water rights be protected and in no way jeopardized.

Also, water rights for the Humboldt-Toulon Wildlife area are being considered and will be considered further.”

Current Status. In 1974, an environmental investigation of proposed Humboldt River Storage Project plus the proposed Rock Creek dam was completed. Of the proposed projects, only the South Fork Dam and Reservoir has been constructed at a smaller scale than originally envisioned. South Fork Reservoir is operated solely for recreation purposes.

Existing water rights continue to be protected.

Water rights have been acquired for the Humboldt-Toulon Wildlife area.

Central Region

1974 Recommendations. “This area encompasses the large portion of Central Nevada where there are no large stream systems or surface water sources...[Local people] were concerned about being ‘lumped’ in such a large area. Some Pahrump Valley residents felt that population projections were low.

Consideration should be given to a Compact concerning water of the Pahrump Valley Ground Water Basin between Nevada and California.

It is recommended that growth trends be carefully monitored to assess the potential water requirements.

This region also holds potential for the area development concept, but this should not be imposed on the local people without their opportunity to be heard.”

Current Status. No action has been taken on a compact between Nevada and California regarding Pahrump Valley groundwater. In 1991, NRS 532.175 was added to the statutes thereby authorizing the State Engineer to enter into agreements with neighboring states concerning the cooperative management of shared groundwater basins. Currently, no such agreement exists for Pahrump Valley.

Some of the counties within the Central Region are developing water plans that examine growth trends and assess their future water needs.

Colorado River Basin

1974 Recommendations. “Presently available sources of water for the Las Vegas Valley including groundwater, Colorado River supplies, and return flows from use of these sources are projected to

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be adequate until sometime between 1990 and 2000. There may be a period of time before 1980 (prior to implementation of the second stage of the Southern Nevada Water Supply Project) when shortages could be expected. These times and dates will depend on growth of the area and resulting increases in water requirements.

Recommendations for this area are: The second stage of the Southern Nevada Water Supply Project should be expedited and completed at the earliest possible time.

Local water service entities should continue and, in fact, increase their efforts to maximize use of the Colorado River supplies and thus reduce withdrawals from the ground water basin.

Population growth and resulting increases in water requirements should be monitored closely.

The alternatives presented in the special Water Planning Report, 'Water Supply for the Future in Southern Nevada' [1971] should be considered in establishing goals and procedures for possible means of meeting future water requirements. This responsibility should be assumed by Clark County with necessary assistance provided by the State.

(Note: The basic alternatives presented in the above-referenced report included:

- water from sources within Nevada - Pahrump Valley, Amargosa Desert, Railroad Valley, Pahrangat Valley, Virgin River Valley
- water from sources outside Nevada - Snake River basin, Columbia River basin, desalination of Pacific Ocean water in exchange for additional Colorado River water
- conservation to reduce demands
- population redistribution - providing economic incentives to future growth to occur outside of the Las Vegas metropolitan in other areas of excess water
- limiting population growth)

Return flow should be carefully administered and managed for optimum use.

The State and local roles in matters such as Colorado River salinity and water quality controls should continue to be vigorously pursued.

The State representation should continue active participation in efforts such as the Committee of '14' and the Colorado River Salinity Forum to assure that Nevada's interests in the Colorado River are protected.

Discussions should be initiated with representatives of Utah and Arizona directed to formulating a Compact to allocate the waters of the Virgin River."

Current Status. Construction of the second stage of the Southern Nevada Water Supply Project started in 1977 and was completed by 1983. Rapid growth has continued in the Las Vegas Valley and in 1993 the first phase of a multiyear capital improvement plan to supply the needed water was initiated. Phase I was completed in 1997 and Phase II will be completed in 1999.

In 1991, the Southern Nevada Water Authority (SNWA) was created through a cooperative agreement among the seven regional water and wastewater agencies in Clark County. The purposes of SNWA are to seek new water resources for Southern Nevada, to manage existing and future water resources, to construct and manage regional water facilities, and to promote responsible conservation. In 1994, SNWA began an integrated resource planning process to aid in the selection of appropriate combinations of resources, facilities and conservation program to meet future demands in Southern Nevada. The SNWA Water Resource Plan was completed January 1996 and amended February 1997. SNWA continues to monitor population and water use growth, and examine alternatives which optimize all supplies, including the Colorado River, other surface water, groundwater, and reclaimed water.

Some of the alternatives presented in “Water Supply for the Future in Southern Nevada” are being implemented, fully or partially, or are still being considered as potential future solutions:

- Conservation measures are successfully reducing water demands in the Las Vegas Valley. The implementation of additional conservation measures is an integral part of SNWA’s Water Resource Plan for the future.
- The SNWA Water Resource Plan includes the Cooperative Water Project (CWP) as a potential future water supply alternative to meet demands beyond the year 2025. The CWP involves the collection and transmission of groundwater from sixteen hydrologic basins in Clark, Lincoln, Nye and White Pine counties.

Return flows to the Colorado River from Las Vegas Valley are calculated by a methodology developed by the U.S. Bureau of Reclamation in consultation with the Colorado River Commission, and was approved by the lower Colorado River basin states in 1984.

The Nevada Division of Environmental Protection established the Lake Mead Water Quality Coordination Forum with the objective to protect public health and preserve the water quality of the Las Vegas Valley Wash and Bay and Lake Mead. The Forum coordinates the many efforts of the interested parties and stakeholders regarding the water quality concerns.

The State continues to be active in the Colorado River Basin Salinity Control Forum and support those projects beneficial to Nevada.

The State Engineer has initiated discussions with Utah and Arizona representatives regarding the allocation of Virgin River water. Also, the State Engineer has issued a water right permit to Southern Nevada Water Authority for an average of 190,000 acre-feet per year from the Virgin River.

Snake River Basin

1974 Recommendations. “The Nevada Legislature previously ratified a Columbia River Compact which includes the water supplies within this region. The Compact was not ratified by some other participating states and is therefore not effective. There has been a renewed interest throughout the Northwestern states in pursuing Compact negotiations.

It is recommended that Nevada representatives actively participate in such negotiations to protect our share of this resource.

The State is currently a party in a suit involving development and use of groundwater in Nevada and the possible effects on surface streams in Nevada which flow into Idaho. It is recommended that the State's position in this suit be aggressively pursued and defended."

Current Status. The Columbia River Compact remains unratified by some states, however the Compact Commission is still in existence. The suit referred to the 1974 Recommendations (Bellbrand) has been settled. The surface waters in the Salmon Falls Creek and Goose Creek areas were adjudicated. The remainder of the tributaries are presently being adjudicated.

1974 State Water Plan Conclusions and Recommendations on Projected Water Requirements

Municipal and Industrial

1974 Recommendations. "In most communities and cities throughout the State, there will be sufficient water available in the immediate area to meet projected municipal and industrial requirements, through the planning period or until 2020. In some cases, water quality problems may develop and treatment will be necessary. Also, in many instances, it may be necessary to acquire existing water rights and change the manner of use.

It is recommended that water service entities in the various cities and communities assess their water supply and treatment needs and immediately initiate programs to assure a sufficient water supply for their anticipated needs. Necessary data and assistance is available from State Water Planning information."

Current Status. The larger municipal water suppliers have been actively planning for future water supply and treatment needs, and developing capital improvement programs. The Division of Water Planning continues to provide data and assistance to water service entities and others. Through the AB 198 grant program, the Division of Water Planning has provided funding assistance to the smaller communities for infrastructure improvements.

Electric Energy Generation

1974 Recommendations. "More electric energy facilities will be required in the future to supply Nevada's demand, and possibly to supply a portion of demand in the remaining ten Western States.

Private, state, and federal studies should continue for conventional fossil fueled plants, as well as nuclear plants, geothermal plants, and pumped storage facilities. New dams and reservoirs should be analyzed to see if electric power generation would be feasible. Utilities should consider purchasing

existing water rights to provide the additional necessary water supplies required for steam-electric generation of electric energy.

Caution should be exercised not to overcommit water supplies for generation of power to be exported. If export is necessary for a period of time, a 'recapture' condition should be imposed to assure that demands and requirements within Nevada can be met."

Current Status. In 1981, NRS 533.372 was added to the statutes authorizing the State Engineer to approve or disapprove any water right application for the purpose of generating energy to be exported out of Nevada.

Mining

1974 Recommendations. "Mining has been an industry in Nevada for over 100 years and is expected to continue to be economically vital. Many of the mining processes require large amounts of water, some of which result in a degradation of water quality.

Discharge water should be adequately treated before returning to the stream or river system or to a ground water basin.

In water-short areas, or where the projected mining water demands exceed the available supply, plans to augment present supplies should be initiated. These might include interbasin transfers, purchasing existing water rights, and possibly reusing discharge waters."

Current Status. Mining water use has changed significantly since the release of the 1974 State Water Plan. Since that time, withdrawals have increased over 10 times due primarily to increased pit dewatering activities. Of the estimated 274,000 acre-feet withdrawn in 1995 at mines, only about 32 percent was consumptively used by mine operations. The remaining volume was reinjected, infiltrated, evaporated, discharged to surface water bodies, or reused for irrigation purposes. Disposal of these excess waters has been regulated by the Division of Environmental Protection to ensure that the waters are adequately treated prior to discharge. While some mines are utilizing excess pit water, other mines have had to rely on interbasin transfers or the purchase of water rights for their needed supplies.

Recreation

1974 Recommendations. "There is a general need for more water-based recreation in Nevada... In construction of new reservoirs, consideration should be given to minimum flows and maintenance of minimum pools. Diversions should be screened and fish ladders built at new and existing dams. As the demand increases for water-based recreation, new areas should be developed and new facilities should be established at existing lakes and reservoirs.

Requirements for minimum pools and minimum flows should not be imposed on existing facilities or

projects unless water rights are acquired for these purposes, either through new appropriation or acquisition of existing rights.”

Current Status. NRS 535.020 requires that new dams or the alteration of existing dams have fishways installed over or around dams, and for the protection and preservation of fish in streams obstructed by dams. In 1986, the South Fork Reservoir near Elko was constructed solely for recreational purposes. The operation of this reservoir provides for minimum downstream flows. There are numerous examples of water rights being acquired for recreation, environmental and wildlife purposes as presented in the “Environmental Considerations” discussion in this section of the *State Water Plan*. For additional information, refer to the discussion on “Maintaining Recreational Values” in Part 3 of the *State Water Plan*.

Agriculture

1974 Recommendations. “Potential agricultural development is severely limited in many areas of the State because of inadequate water supplies. It has been necessary to deny issuance of permits to appropriate water for agricultural use in some areas. Existing agriculture is inhibited also in some cases by variations of flows, sedimentation, salinity, floods, and outmoded structures and facilities.

Consideration should be given by ranchers, farmers, irrigation districts and water companies to improved efficiencies, regulatory storage facilities, management and operation practices and to other conservation measures.

The state should continue to enforce water right conditions for maximum utilization of the limited supplies.”

Current Status. Nevada’s agricultural community has been implementing a variety of conservation measures throughout the State, particularly in the Walker and Carson River basins and the Lovelock area (Humboldt River basin). For more information, refer to the discussion on “Water Conservation” in Part 3 of the *State Water Plan*.

Fish and Wildlife

1974 Recommendations. “As the development and use of water in the State has increased, in some cases, natural sources of water have been restricted or become completely inaccessible to wildlife. Other factors affecting wildlife watering include the continued physical presence of domestic livestock or human activity at or near water sources.

One possible solution would be for the Fish and Game Department to acquire water rights for wildlife purposes at the various natural water sources. This procedure would be time consuming and expensive.

An alternative would be legislation to provide that in new appropriations of water, that the applicant allow a sufficient quantity of water to remain at the source for wildlife needs. This requirement should not be imposed on existing facilities and should not impair or adversely affect existing water rights.

Current Status. A number of actions have been taken to provide water supplies for fish and wildlife. For more information, refer to the discussions on “Environmental Considerations” and “Recreation” presented earlier in this section of the *State Water Plan*.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 3
The Institutional Framework for
Water Planning and Management

Introduction

This section presents an overview of the institutional framework affecting water planning and management within the State. All entities involved with water planning, allocation, management and development issues must navigate their way through portions of this institutional framework in their decision-making process.

Statutory, Regulatory and Legal Considerations

This subsection provides a general summary of the major state and federal statutory, regulatory and legal constraints impacting water planning and management. Water quantity allocation and management; interstate water resource management; water quality protection and management; resource protection; flood protection and drought planning; and conservation are all important constraints to consider for a successful water plan.

Water Quantity Allocation and Management

Nevada Water Law. All waters within the boundaries of Nevada, whether above or beneath the ground surface, belong to the public and are managed on their behalf by the State. The State Engineer is responsible for the administration of Nevada Water Law, which ensures that these waters are managed so that sufficient quantities are available to preserve our quality of life and to protect existing water rights. Entities within the State can apply for the right to use that water. Like many of the western states, Nevada water law is founded on the doctrine of prior appropriation - “first in time, first in right.” Under this doctrine, the first user of water from a watercourse acquires a priority right to the water and to the extent of its use under that right.

Nevada water law is set forth in Nevada Revised Statutes (NRS), Chapters 533 and 534. In addition, there are numerous court decisions which have further defined Nevada law. It is the State Engineer who determines the limit and extent of the rights of claimants to water, the use to which water may be put, the quantity of water that is reasonably required for beneficial use, and where water may be used.

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As part of the duties of the office, the State Engineer reviews applications for new water rights appropriations. In approving or rejecting an application to appropriate water, the State Engineer follows statutory criteria:

- Is there unappropriated water in the proposed source?
- Will the proposed use impair existing rights?
- Will the proposed use prove detrimental to the public interest?
- Is the project feasible and not filed for speculative purposes?

All water rights are considered real property and can be bought, sold, traded and leased. The place of use and type of use can be changed with the State Engineer's approval. The attributes of appropriative water rights in Nevada are: 1) beneficial use is the measure and limit of the right to the use of the water; 2) rights are stated in terms of definite quantity, manner of use, and period of use; and 3) a water right can possibly be lost by abandonment or forfeiture.

The State Engineer has primary responsibility for the distribution of all surface water in Nevada except on civil decreed streams systems unless so granted by the civil court; and except on federally decreed stream systems. Stream systems which have been adjudicated are distributed in accordance with the associated decree by water commissioners. The water commissioners are recommended by the State Engineer and confirmed by the state district court. In areas where an irrigation district has been formed, the water is distributed by irrigation district personnel.

Decrees. Most surface waters in Nevada are managed in accordance with civil, state or federal decrees. There are over 100 decrees governing water allocation and management in Nevada. Following is a brief summary of the major decrees affecting water allocation and management in specified basins:

- **Alpine Decree (federal).** The waters of the Carson River are distributed in accordance with the Alpine Decree issued in *United States v. Alpine Land and Reservoir Co., et al.* by the federal district court on October 28, 1980. Although the Alpine Decree encompasses water rights in both Nevada and California, it is not an interstate allocation as neither state was a party to the decree.
- **Bartlett Decree, Edwards Decree (state).** The waters of the Humboldt River are distributed in accordance with the Bartlett Decree issued by state district court in 1931 and the Edwards Decree issued by state district court in 1935. The Edwards Decree corrected errors and omissions in the Bartlett Decree.
- **Orr Ditch Decree (federal).** The waters of the Truckee River and its tributaries are distributed in accordance with the Orr Ditch Decree issued in *United States v. Orr Ditch Water Company, et al.* by federal district court on September 8, 1944. No rights to the use of Truckee River water in California were included in this decree. The Orr Ditch Decree also incorporated the provisions of the earlier Truckee River Agreement. In 1935, the United States, Truckee-Carson Irrigation District, Sierra Pacific Power Company, and the Washoe County Water Conservation District entered into the Truckee River Agreement which set out the operational rules of the river system.

- **Walker River Decree (federal).** The waters of the Walker River and its tributaries are distributed in accordance with the federal decree issued in *United States v. Walker River Irrigation District, et al.* by federal district court on April 14, 1936 and amended on April 24, 1940. Although the Walker River Decree encompasses water rights in both Nevada and California, it is not an interstate allocation as neither state was a party to the decree.

Tribal Water Rights. When the United States reserved land from the public domain for uses such as Native American reservations, it also implicitly reserved sufficient water to satisfy the purposes for which the reservation was created. This federal reserved water rights doctrine was established by the U.S. Supreme Court in 1908 in *Winters v. United States*. Federally reserved Indian water rights differ from state-issued rights in a number of ways. For instance, the Winters Doctrine asserts that federal reserved rights cannot be lost by failure to put the associated water to beneficial use.

In Nevada, the more than 20 Native American reservations and colonies occupy approximately 1.6% of the land area (about 1 million acres). About 90% of these reserved lands are within five reservations: 1) Pyramid Lake Indian Reservation (southern Washoe County); 2) Walker River Indian Reservation (predominately northern Mineral County); 3) Duck Valley Indian Reservation (northern Elko County); 4) Goshute Indian Reservation (northeastern White Pine County); and 5) Moapa River Indian Reservation (northern Clark County).

Interstate Water Resource Management

Colorado River. In addition to Nevada, the states of California, Arizona, Wyoming, Colorado, New Mexico, and Utah, and the Republic of Mexico, all use water from the Colorado River. In 1922, these seven states entered into an interstate compact which includes a provision for the equitable division and apportionment of the waters of the Colorado River system. The Boulder Canyon Act of 1928 provided, among other things, for the construction of works to protect and develop the Colorado River Basin by the U.S. Bureau of Reclamation. The U.S. Supreme Court Decree in *Arizona v. California*, 1964, established several additional dimensions to the apportionment of Colorado River water, including apportionments to the lower basin states of Nevada, California and Arizona. It was ruled that of the first 7.5 million acre-feet of mainstem water consumed in the lower basin, California was entitled to a consumptive use of 4.4 million acre-feet/year; Arizona to 2.8 million acre-feet/year; and Nevada to 0.3 million acre-feet/year. In 1968, the Colorado River Basin Project Act authorized the Central Arizona Project and it provided for allocations to the lower basin states in years of insufficient mainstream water to satisfy the specified consumptive use of 7.5 million acre-feet per year.

The Nevada State Legislature recognized the value of this resource in 1935 when it created the Nevada Colorado River Commission to serve as the State's watchdog over the Colorado River. Among its other statutory responsibilities, the commission is required to "receive, protect and safeguard and hold in trust for the State of Nevada" all the water and associated water rights in the Colorado River to which the State is entitled under federal law, interstate compacts and treaties. The Commission is also responsible in various ways for the distribution of this water, and thus is authorized to contract for the use of the water.

California-Nevada Interstate Compact. The need for apportioning the water of the Truckee, Carson and Walker rivers between Nevada and California has been considered over the years. After years of negotiations, the state legislatures of California (in 1970) and Nevada (in 1971) passed legislation adopting the California-Nevada Interstate Compact. However, the U.S. Congress never ratified the Compact. Interstate allocations of the Truckee and Carson rivers were addressed in the Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990.

Truckee-Carson-Pyramid Lake Water Rights Settlement Act of 1990. The latest effort to resolve long-standing disputes over water and water rights on the Truckee River has been the enactment of congressional settlement legislation for the Truckee and Carson Rivers. This legislation, known as the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (or “Negotiated Settlement”), was approved by the 101st Congress on November 16, 1990. The main authorizations and directives included in the legislation are:

- an interstate allocation between Nevada and California is made of the waters of the Truckee and Carson Rivers, and Lake Tahoe;
- a new operating agreement is to be negotiated for the Truckee River;
- the Newlands Projects is reauthorized to serve additional purposes, including recreation, fish and wildlife, and as a municipal water supply for the Fallon area;
- a recovery program is to be developed for the endangered Pyramid Lake cui-ui fish and threatened Lahontan cutthroat trout, with a water right acquisitions program authorized; and
- a water rights purchase program is authorized for the Lahontan Valley wetlands.

Many of the Negotiated Settlement’s provisions, including the interstate apportionment, will not become effective until a number of conditions are met, including dismissal of certain lawsuits and the negotiation of an operating agreement for the Truckee River among the United States, Nevada, California, the Pyramid Lake Paiute Indian Tribe, the Sierra Pacific Power Company, and other parties. The involved parties hope to complete the operating agreement negotiations by 1999.

Water Quality Protection and Management

Clean Water Act (CWA). The Water Quality Act is a 1987 amendment to the Clean Water Act of 1977, which amended the Federal Water Pollution Control Act of 1972, and is the primary legislative vehicle for federal water pollution control programs. The Water Quality Act is often referred to as the Clean Water Act (CWA). This Act was established to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters” and set goals to eliminate discharges of pollutants into navigable water, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment.

The State Environmental Commission (SEC), established by State law, has adopted regulations which define State programs to carry out the provisions of Nevada’s Water Pollution Control Laws. These laws, contained in Chapter 445A of the Nevada Revised Statutes (NRS), establish the authority to implement portions of the CWA and the Safe Drinking Water Act in addition to several non-federal water pollution control programs. In addition to adopting regulations, the SEC establishes fee schedules for permits, advises, consults and cooperates with other governmental agencies regarding

water pollution matters, establishes qualifications for sewage treatment plant operators, and holds hearings regarding the actions of the Nevada Division of Environmental Protection (NDEP). The powers and duties of the SEC are listed primarily in NRS 445A.425, and also in NRS 445A.135, 445A.160, 445A.180, 445A.428, 445A.430, 445A.605, and 445A.610.

NDEP has been delegated the authority to implement aspects of the CWA in Nevada. Following is a summary of major sections of the CWA and their application to water quality management in Nevada.

- **Section 106(e) - Water Quality Monitoring.** With assistance from federal grants, NDEP operates a surface water quality monitoring network with water quality parameters monitored at about 100 sites throughout the State. In addition, NDEP has access to water quality data collected by other agencies. Data collected under these monitoring programs are used to establish water quality standards, assess compliance with water quality standards, conduct trend analyses, validate water quality models, set discharge limitations, conduct nonpoint source assessments, compile the Section 303(d) List, develop Section 208 Plan amendments, and develop the Section 305(b) Report.
- **Section 208 - Water Quality Management Plans.** Section 208 of the CWA was promulgated for the purpose of encouraging and facilitating the development and implementation of areawide wastewater treatment management plans. If an area(s) within the State is identified as having substantial water quality control problems as a result of urban-industrial concentrations or other factors, the Governor of the State may designate the boundaries of each such area and appoint a single representative organization, including elected officials from local governments or their designees, capable and responsible for developing effective areawide water treatment management plans. Absent action by the Governor, NDEP is the responsible agency for developing 208 Plans. Following are the five areas for which 208 plans have been developed and the agencies responsible for plan development:

Carson River Basin - NDEP

Clark County - Clark County Board of County Commissioners

Lake Tahoe Basin - Tahoe Regional Planning Agency

Washoe County - Truckee Meadows Regional Planning Agency

Remainder of the State (non-designated area) - NDEP

Section 208 Plans are used in the review of permit and funding applications. Proposed activities which are inconsistent with the 208 Plan cannot go forward until a plan amendment is approved.

- **Section 303 - Water Quality Standards.** Federal requirements for water quality standards and antidegradation are contained in Section 303 of the CWA. State requirements are contained in NRS 445A.520 and NRS 445A.425 states the powers and duties of the SEC, including the adoption of water quality standards. Water quality standards define water quality goals of a waterbody by designated uses and by setting criteria necessary to protect the uses. Antidegradation requirements are contained in NRS 445A.565 which requires that waters of higher quality be protected. Water quality standards serve as the regulatory basis for establishing

water quality based treatment controls. In Nevada, the SEC is required to establish water quality standards at a level to protect and ensure a continuation of the designated beneficial use or uses within a stream or other waterbody (NRS 445A.425).

- **Section 303(d) List.** Section 303(d) of the CWA requires states to identify waters that do not or are not expected to meet applicable water quality standards with existing controls alone. This Section 303(d) List, developed by the NDEP provides a comprehensive inventory of waterbodies impaired by all sources of pollution, including point sources, nonpoint sources, or a combination of both. This inventory is the basis for targeting waterbodies for watershed solutions.

Once these waters are identified, the State is required to develop total maximum daily loads (TMDLs) for these waters. A TMDL quantifies allowable pollutant loads that a given water body can assimilate to the level needed to meet the water quality standards. TMDLs are then used to set effluent limits for permitted discharges.

- **Section 305(b) - Water Quality Assessment.** Section 305(b) of the CWA requires states to produce biennial "Water Quality Assessments" that assess progress in achieving the objectives of the CWA. NDEP is responsible for producing Nevada's 305(b) Reports.
- **Section 314 - Clean Lakes.** Pursuant to Section 314 of the CWA, the Clean Lakes Program was established in 1972 to define the causes and extent of water pollution problems in the lakes of each State and for developing and implementing effective techniques to restore them. Through the Clean Lakes Program, NDEP State has received Federal funding for numerous studies and implementation projects. Federal funding is no longer available under Section 314.
- **Section 319 - Nonpoint Source Pollution.** Section 319 of the CWA authorizes the Nonpoint Source Pollution Management Program and provides funding to states to implement nonpoint source program. Nevada began the Nonpoint Source (NPS) Management Program in 1987 using Federal funds. The primary goal of the program is to identify, control and abate the impacts of NPS pollution on the quality of the State's surface and ground waters. The State's current approach in controlling nonpoint sources is to seek voluntary compliance through regulatory and non-regulatory programs including technical and financial assistance, training, technology transfer, demonstration projects and education.
- **Section 401 Certification Program.** Under provisions of the CWA, any applicant for a Federal license or permit (e.g. 404 permit) to conduct any activity that may result in a discharge to navigable waters must provide the Federal agency with a Section 401 certification. The 401 certification, made by the state in which the discharge originates, declares that the discharge will comply with applicable provisions of the CWA, including water quality standards. Section 401 provides states with two distinct powers: 1) the power indirectly to deny Federal permits or licenses by withholding certification; and 2) the power to impose conditions upon Federal permits by placing limitations on certification.

In Nevada, NDEP has the responsibility to review and comment on proposed projects under the 401 Certification Program. NDEP may grant, waive or deny certification for a federally permitted

activity that may result in a discharge to the waters of the state or adversely impact downstream water quality. If the applicant can demonstrate that the proposed project will not impact existing water quality nor cause a violation of a water quality standard, or water quality improvements are expected, 401 certification is given. If the project is expected to negatively impact water quality, NDEP will require conditions in the permit to offset project impacts or deny certification.

- **Section 402 - National Pollutant Discharge Elimination System.** Section 402 of the CWA established a permit system known as the National Pollutant Discharge Elimination System (NPDES) to regulate point sources of discharges (wastewater treatment plants, etc.) into surface waters of the United States. In 1987, Section 402 was amended to require the regulation of stormwater runoff under the NPDES. The U.S. Environmental Protection Agency (EPA) has delegated this program to NDEP. NPDES permits cannot be issued if the proposed discharge is inconsistent with the 208 Water Quality Management Plan for the area (NRS 445A.490).
- **Section 404 - Dredge and Fill Permits.** Section 404 regulates the discharge of dredged and fill materials into navigable rivers, and protects wetlands from encroachment. None of these regulated activities may occur unless a permit is obtained from the U.S. Army Corps of Engineers. Generally, the project proponent must agree to mitigate or have plans to mitigate environmental impacts caused by the project before a permit is issued.

Under amendments in the CWA, the State is responsible for certifying a Section 404 project proposal's compliance with applicable water quality standards. NDEP has the responsibility to review and comment on proposed projects under the 401 Certification Program and has the right to deny certification of a 404 permit which would prevent the Corps of Engineers from using the permit.

- **Section 603 - State Revolving Fund Program.** Section 603 of the CWA provides for the establishment of State Revolving Fund (SRF) programs. Through the SRF, NDEP provides loans at or below market rates and other forms of financial assistance to municipalities and other entities to assist in financing the construction of waste water treatment works or projects to control nonpoint sources of water pollution. Only those facilities addressed in the Section 208 Plan are eligible for funding under this program.

Other State Programs (NDEP). In addition to the federal CWA and Safe Drinking Water Act programs delegated to NDEP, numerous state programs exist to protect, control and restore the quality of the waters of the State. Apart from the NPDES permits issued under the CWA, NDEP issues Water Pollution Control Permits with a zero-discharge performance standard for certain mining facilities, and State Ground Water Permits for infiltration basins, land application of treated effluent, large septic systems and industrial facilities. In addition to these permitting processes, NDEP reviews subdivision plans to ensure that wastewater is disposed of adequately. Also, NDEP regulates highly hazardous substances under the chemical accident prevention program. Remediation of polluted soil and/or groundwater falls under the State Corrective Actions Program which includes authorities under two federal acts: the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Other Federal Programs (NDEP). Management of solid waste, hazardous waste and underground storage tanks are covered by the Resource Conservation and Recovery Act (RCRA) programs delegated to NDEP. Nevada also has a program under the Comprehensive Environmental Response Compensation, and Liability Act (CERCLA) to perform spill reporting and tracking, assessments, investigations and remedial activities as necessary.

Safe Drinking Water Act. In 1974, the U.S. Congress enacted the Safe Drinking Water Act (SDWA) to enhance the safety of public drinking water in the United States through the establishment and enforcement of national drinking water standards. Congress gave the EPA the responsibility for implementation and enforcement of the SDWA. In 1978, EPA granted primary enforcement authority (primacy) for the SDWA in Nevada to the State of Nevada (Division of Health). The State Health Division is responsible for implementing the program in 15 of Nevada's 17 counties. The Health Division has interlocal agreements with Clark County Health District and Washoe County District Health Department to implement various activities related to the SDWA and State Board of Health requirements in those counties.

The SDWA applies to all public drinking water systems which provide piped water for human consumption to at least 15 service connections, or regularly serve an average of at least 25 individuals daily for at least 60 days out of the year. There are currently about 700 public water systems in Nevada that are regulated under the SDWA.

In 1996, additional amendments were enacted and a state revolving loan fund was authorized. The amendments included a "right to know" provision which will require water authorities to disclose chemicals and bacteria found in drinking water and required EPA to establish more stringent standards against cryptosporidium and other drinking water contaminants that pose significant health risks. The new law goes beyond a regulatory approach to add the concept of prevention. The law seeks to prevent problems by increasing public water systems' capacity to provide safe drinking water, and by protecting the source waters. EPA is currently developing additional rules which will address radon, uranium and arsenic concentrations, disinfection byproducts, groundwater disinfection, and enhancement of the Surface Water Treatment Rule. Following are descriptions of the main highlights of the current SDWA.

- **Public Water Supply Supervision Program.** Primary enforcement authority of the SDWA is the responsibility of the Nevada Health Division. Through the State Public Water Supply Supervision Programs (PWSS), the Nevada Health Division enforces the drinking water quality standards of the water provided by the 700 public water systems in the State. The Health Division has interlocal agreements with Clark County Health District and Washoe County District Health Department to implement various activities related to the SDWA and State Board of Health requirements.
- **Underground Injection Control Program.** Authorized under the Safe Drinking Water Act, the Underground Injection Control (UIC) Program is delegated to the State. NRS 445 provides the authority which allows the NDEP, Bureau of Water Pollution Control, through the SEC, to regulate the UIC Program and issue permits. The purpose of the UIC permit is to regulate

underground injection and to prevent pollution of groundwater and protect the environment. A UIC permit must be obtained prior to drilling an injection well or injecting fluid into a well.

- **Wellhead Protection Program.** The 1986 Amendments to the SDWA established a new Wellhead Protection Program (WHPP) to protect groundwater supplies for public water supply systems, and mandated that each state develop a WHPP. The authority to implement Nevada's WHPP was delegated to NDEP by the Governor during the same year. At a minimum, each State's WHPP must: 1) specify roles and duties of state and local entities, and public water suppliers, with respect to the development and implementation of WHPPs; 2) delineate the wellhead protection area (WHPA) for each well; 3) identify sources of contamination within each WHPA; 4) develop management options to protect the water supply within the WHPA from such contaminants; 5) develop contingency plans in the event of contamination; 6) site new wells as needed to maximize yield and minimize potential contamination; and 7) ensure public participation.

In 1994, Nevada's WHPP was approved by EPA and has been successfully implementing wellhead protection at the local level. Presently there are seventeen Nevada communities developing or implementing WHPPs with the assistance of NDEP, and interest has been expressed by several more communities. The voluntary nature of Nevada's WHPP coupled with both financial and technical assistance from the State and EPA have been the keys to its success.

- **Comprehensive State Ground Water Protection Program.** EPA initiated the Comprehensive State Ground Water Protection Program (CSGWPP) guidance to provide states with a framework for developing comprehensive, integrated groundwater protection programs. EPA is encouraging states to develop and implement CSGWPPs that meet the needs of the state. CSGWPPs are voluntary and encourage groundwater resource management through a cooperative, multi-agency approach.

While the State of Nevada has the primary role in protecting and managing its groundwater resources, the CSGWPP process provides the opportunity to review, evaluate, and revise groundwater protection efforts so as to improve their effectiveness. The goal of a Fully-Integrated CSGWPP is to ensure that groundwater protection and management efforts are consistent and coordinated across all federal, State and local programs. The Nevada Division of Environmental Protection is the lead agency for the CSGWPP development and received EPA endorsement of its core CSGWPP in November 1997.

- **Drinking Water State Revolving Fund.** The SDWA Amendments of 1996 authorized a Drinking Water State Revolving Fund (DWSRF) to assist public water systems to finance the costs of infrastructure needed to achieve or maintain compliance with SDWA requirements and to protect public health objectives of the Act. The administrator of EPA is authorized to award capitalization grants to States, which in turn can provide low cost loans and other types of assistance to eligible systems (community and non-profit non-community water systems). To be eligible to receive capitalization grants, a state must establish a drinking water treatment revolving loan fund.

Under this program, Nevada will receive an annual allotment from the federal government, but must contribute an amount equal to 20 percent of the total federal contribution. The DWSRF funds can then be loaned to public water systems to facilitate compliance with national primary drinking water regulations and further the health protection objectives of the SDWA. Disadvantaged systems may receive loan subsidies, including forgiveness of the principal. Portions of the DWSRF funds may also be used for fund administration, small system technical assistance, Public Water Supply Supervision activities, state capacity development strategies, operator certification programs, and source water protection programs. The Bureau of Health Protection Services is the lead agency for the DWSRF.

- **Capacity Development.** Under the 1996 SDWA Amendments, states are given until October 1, 1999 to obtain the authority to ensure that new community water systems and non-transient non-community water systems have the technical, financial, and managerial capacity to meet National Primary Drinking Water Regulations. A state will receive only 80 percent of its Drinking Water State Revolving Fund allotment unless the state has such authority. As part of this program, states are required to prepare and submit to EPA a list of community water systems and non-transient, non-community water systems that have a history of significant noncompliance and the reasons for their noncompliance. States are also required to establish strategies for assisting systems in developing and maintaining technical, financial and management capacity. Periodic reports on the efficacy of their development strategies and water system capacity improvements are required.
- **Vulnerability Assessment Program.** The SDWA regulations set forth monitoring requirements (e.g. sampling frequency, etc.) for various potential contaminants. The costs associated with some of the related laboratory analyses can place a significant financial burden on water systems. Sensitive to these potential high costs, the SDWA allows states some flexibility in establishing water chemistry monitoring requirements. In response, the Nevada State Health Division, Bureau of Health Protection Services, has voluntarily developed a monitoring waiver program. Certain water quality monitoring requirements may be waived for a given water system if the vulnerability assessment shows the system to be at low risk to contamination.

The waiver program focuses on performing vulnerability assessments including an evaluation of the source water site, an evaluation of the components of the water system, previous monitoring results, prior historical/environmental/land usage in the source water area, contaminant persistence and transport potential, hydrogeology of the area, well construction, known well abandonment history and a review of the initial water quality monitoring results.

As a direct result of the vulnerability assessment program, water systems throughout Nevada have saved about \$3.5 million to date in monitoring costs. It is anticipated that a total of \$5.5 million to \$6 million could be saved if vulnerability assessments are performed for all water sources.

- **Source Water Assessment Program.** Reauthorization of the SDWA in 1996 added new requirements for States to develop and implement a Source Water Assessment Program (SWAP). The purpose of a SWAP is to identify existing sources of drinking water and determine what potential contamination problems may arise that need to be addressed. In part, the final SWAP

is to address: delineations of land area contributing to public water systems' sources (Source Water Protection Areas - SWPA); inventory of known and significant contaminants within the SWPAs; analysis of source susceptibility to contamination; and plans for protection of source waters. The Bureau of Health Protection Services is responsible for development and implementation of SWAP.

Insecticide, Fungicide, and Rodenticide Act (Pesticide Management Plan). The Nevada Division of Agriculture (DOA) has primacy to administer the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in the State. With regard to pesticides, the primary responsibility is to regulate the registration, use, storage, sale, and disposal of unwanted, canceled and suspended pesticides in Nevada. The DOA has been involved in groundwater protection activities since 1988 as a direct result of a nationwide EPA study which discovered that at least 46 different pesticides had contaminated groundwater in 26 states. In most cases, sources of contamination were traced to legal, prescribed use of the particular pesticide. However, some contamination was attributed to direct sources such as pesticide mixing and loading, accidents, and improper well design.

Although the EPA study did not detect pesticide contamination in Nevada, the DOA decided to take a pro-active approach to this problem and designed a program that would prevent further degradation of groundwater quality. Based on the experience of other states and EPA, DOA has developed a program to address this issue. The program began with the development of a Generic State Management Plan that contains a description of essential elements designed to accomplish the goal of designing a protective program that would prevent further degradation of groundwater quality. This has led to the development of Pesticide Management Plans (PMPs). These PMPs as well as the Generic State Management Plan contain many elements. The major elements discussed in the plans will include: 1) protective and preventative actions; 2) monitoring; 3) resources available; 4) other state and federal agencies' roles and responsibilities; and the DOA's legal authority to administer the groundwater protection program. The Generic State Management Plan has been developed which addresses most of these elements. A regulatory framework will be part of the PMPs, which may require setback restrictions, restricted use classification, time of year restrictions, and outright cancellation of pesticides where the water resources may be vulnerable to groundwater contamination.

Resource Protection

Endangered Species Act. The federal Endangered Species Act provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife maintains a list of endangered and threatened species. Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees, all of which are dependent upon water. The law prohibits any action, administrative or real, that results in a "taking" of a listed species, or adversely affects habitat.

In Nevada, there are 28 endangered taxa (species/subspecies) (2 are plants) and 14 threatened taxa (7 are plants). Approximately another 250 taxa are considered as potential candidates for listing. More information is needed before these taxa can be removed from the candidate list or moved to the threatened/endangered list. Nevada leads the nation and North America in having the most fishes

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listed as endangered, threatened, or of special concern (43 taxa according to the American Fisheries Society). Rankings by the Nevada Natural Heritage Program place Nevada in the top ten states having the most globally imperilled species of plants and vertebrates.

Nevada Natural Heritage Program. The State of Nevada Natural Heritage Program researches, collects, and analyzes information on the existence, locations, numbers, condition, biology, and habitats of hundreds of sensitive plant and animal species throughout Nevada. These are species that could qualify for listing as a threatened or endangered in the future under current management and land-use situations. The Program continually prioritizes conservation needs throughout the State, and its easily-accessible computer database, maps, and paper files serve as a cost-effective “early warning system” designed to help prevent costly future species listings.

Wildlife Commission Statutory Authority. NRS 503.589 grants the Division of Wildlife administrator the authority to enter into agreements with other entities for the conservation, protection, restoration and propagation of species of native fish, wildlife and other fauna which are threatened with extinction.

Division of Forestry Statutory Authority. NRS 527.300 grants the state forester firewarden the authority to enter into agreements with other entities for the conservation, protection, restoration and propagation of species of native flora which are threatened with extinction.

National Environmental Policy Act. The National Environmental Policy Act (NEPA) directs federal agencies to prepare an environmental impact statement (EIS) for all major federal actions which may have a significant effect on the human environment. NEPA states that it is the goal of the federal government to use all practicable means, consistent with other considerations of national policy, to protect and enhance the quality of the environment. NEPA requires all federal agencies to consider the environmental impacts of their proposed actions during the planning and decision-making processes.

Wild and Scenic Rivers Acts (Federal and California). In 1968, Congress passed the National Wild and Scenic Rivers Act to preserve in their free-flowing condition rivers which possess “outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values.” No rivers within Nevada have been designated under this federal act. In 1972, the California Legislature passed the State Wild and Scenic Rivers Act. Portions of the West Walker River and East Fork of the Carson River upstream of Nevada have been designated under the California Act. The California Act prohibits construction of any dam, reservoir, diversion or other water impoundments on a designated river.

The current U.S. Forest Service’s Humboldt and Toiyabe Land and Resource Management Plan has identified other river segments that are suitable for inclusion in the Wild and Scenic Rivers system. These river segments are:

- Jarbidge River - from Idaho-Nevada border to source;
- Little Humboldt River, North Fork - from reservoir at Little Humboldt River confluence to

source;

- Marys River - from west boundary of Section 13, T42N, R59E to source;
- Carson River, East Fork - from last diversion dam approximately one mile above Lahontan Fish Hatchery to source;
- East Walker River - from Bridgeport Reservoir to bridge crossing near Flying M Ranch headquarters; and
- West Walker River - from source at Tower Lake to confluence with Rock Creek.

Flood Protection and Drought Planning

Flood Control Act. The Flood Control Act authorizes the U.S. Army Corps of Engineers to perform several flood-related tasks. Section 205 of the Act authorizes the construction of small flood control projects; Section 206 authorizes the Corps Flood Plain Management Services Program to deal with floods and floodplain issues; Section 208 provides for snagging and clearing for flood control in channels; and Section 14 authorizes emergency streambank and shoreline erosion protection for public facilities and services. Activities performed under the Flood Plain Management Services program include technical assistance, planning guidance, pamphlets and supporting studies.

National Flood Insurance Act. The National Flood Insurance Program (NFIP) was established in 1968 by the National Flood Insurance Act. The intent of this act is to encourage communities to mitigate future flood damage by adopting and enforcing strict floodplain management ordinances in accordance with federal regulations. The Act made federally subsidized flood insurance available in communities which participate in the NFIP. In Nevada, 15 counties and 13 incorporated cities voluntarily participate in the NFIP. The Federal Emergency Management Agency (FEMA) administers the program, providing flood insurance studies and mapping for participating communities. The flood insurance studies are used for development of the Flood Insurance Rate Maps (FIRMs) that are adopted and incorporated by reference into the Flood Hazard Reduction Ordinances administered by each community. In Nevada, the Division of Water Planning (NDWP) has responsibility for oversight and implementation of the NFIP.

Emergency Watershed Protection. The Emergency Watershed Protection program (EWP) is administered by the Natural Resource Conservation Service (NRCS). The program provides technical and financial assistance to restore small watersheds damaged by flooding. The type of assistance provided by the program includes clearing debris from clogged water sheds, restoring vegetation and stabilizing river banks. In addition, NRCS is authorized under the 1996 Farm Bill, to offer a floodplain easement option to agricultural landowners. This option allows land which has been damaged by flooding to be permanently restored to natural floodplain hydrology.

State Floodplain Management. Following the flooding experienced in northern Nevada in 1997, NDWP was designated as the lead agency for floodplain management at the State level. The Division's floodplain management duties include implementation of the Community Assistance Program (CAP) and Flood Mitigation Assistance program (FMA), sponsored by FEMA. Under CAP, NDWP provides technical assistance and training as needed to help communities achieve and maintain compliance with NFIP requirements. FMA grants are for mitigation projects aimed at reducing repetitive insurance losses and future damage.

- **Hazard Mitigation Program.** The Nevada Division of Emergency Management is responsible for implementing a comprehensive hazard mitigation program which includes flooding mitigation. The State Hazard Mitigation Officer manages the Hazard Mitigation Grant Program (HMGP), sponsored by FEMA.
- **Statewide All-Hazard Mitigation Committee.** This committee was established in 1998 to help coordinate mitigation activities and funding needs associated with all hazards including flooding. The 21 members come from a wide array of public and private organizations.
- **Channel Clearance Program.** The Channel Clearance program is managed by the Nevada Division of Water Resources (NDWR). The program provides funding for channel clearance maintenance, restoration, surveying and monumenting. Local communities, including counties, cities, irrigation districts, and flood control districts can apply for matching funds to maintain channels of navigable rivers within their jurisdictional boundaries.
- **Disaster Relief Bill.** During the 1997 State Legislative Session, Senate Bill 218 was passed, establishing a state fund of \$4 million to help communities recover from damages sustained in the event of a disaster. The fund is administered by the Legislative Counsel Bureau.

Local Floodplain Management. Regulations for the development of local flood control districts are described in NRS 543. The Clark County Regional Flood Control District was formed under this statute in 1985. The Clark County Regional Flood Control District is a proactive regional entity with the mission of protecting life and property from flood impacts through implementation of flood control infrastructure. Flood control projects are funded by a one quarter of one percent sales tax. The District has also implemented a comprehensive floodplain management program which includes flood hazard mitigation, community outreach, and mapping.

State Drought Plan and the Drought Review and Reporting Committee. During the first year of the 1987-94 drought, Governor Bryan formed the Drought Review and Reporting Committee (DRRC) to monitor drought severity and recommend actions. By 1991, NDWP, with assistance from the Governor's DRRC and the Advisory Board for Water Resource Planning and Development, developed the State Drought Plan. The State Drought Plan defines the State's response in the event of a drought. More specifically, the Drought Plan defines drought stages (warning, severe, emergency), and establishes the roles of the DRRC, drought task forces and other agencies during the various drought stages.

Conservation

Service Connection Metering. A majority of the public water system withdrawals (in terms of volume) are metered, however not all deliveries to each service connection are metered. For example, only about 25 percent of residences in Reno/Sparks have water meters. Water meters were initially prohibited in the cities of Reno and Sparks by a 1919 statute (NRS 704.230). Since that time, gradual changes have occurred which: 1) require meters on all businesses (1977) and on all new homes built after 1988; and 2) allow meters on residences upon owner request and under certain

conditions tied to the Negotiated Settlement (1990).

Low Flow Plumbing Standards. The Nevada Legislature passed Assembly Bill 359 in 1991 thereby imposing certain minimum standards for plumbing fixtures (toilets, showers, faucets and urinals) in new construction and expansions in residential, industrial, commercial and public buildings. Each county and city was required to include these requirements in its building code or to adopt these requirements by ordinance, and to prohibit by ordinance the sale and installation of any plumbing fixture which does not meet the minimum standards.

Conservation Plans. In 1991, the Nevada Legislature passed Senate Bill 360 requiring all water purveyors (that supply water for municipal, industrial or domestic purposes) to adopt conservation plans before July 1, 1992. These plans were to include provisions relating to:

- Public education to increase public awareness for the need to conserve water;
- Specific conservation measures suitable for the service area;
- Water management, including leak detection, effluent reuse;
- Contingency plan for drought;
- Implementation schedule; and
- Measures to evaluate plan effectiveness.

Public water purveyors were to submit their plans to NDWP for review and approval before adoption (NRS 540.121 through 540.151). Private utilities were to submit their plans to the Public Service Commission (NRS 704.662 through 704.6624). However, Senate Bill 360 did not require periodic plan updates or progress reports.

U.S. Bureau of Reclamation Conservation Plans. On October 12, 1982, the Reclamation Reform Act (RRA) was signed into law. One of the provisions of the RRA requires each district, that has entered into a repayment contract or water service contract, to develop a water conservation plan. The plan is to contain definite goals, appropriate water conservation measures, and a time schedule for meeting the water conservation objectives. This provision of the RRA impacts districts such as the Truckee Carson Irrigation District and Pershing County Water Conservation District. Through their Field Services Program, Reclamation's intent is to encourage the consideration and incorporation of prudent and responsible water conservation measures in district operations. This is to be achieved by:

- Providing technical and financial assistance to districts and entities developing and implementing water conservation plans;
- Establishing collaborative efforts with districts and other entities to improve the management of water and to assist in meeting their water conservation goals;
- Encouraging joint efforts toward the coordinated planning, preparation and implementation of water conservation plans by districts with mutual or complementary needs;
- Ensuring that Reclamation assistance programs support and complement State water conservation efforts;
- Providing districts with education materials to assist with water plan development and implementation; and

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- Providing water management and conservation planning workshops and training opportunities for districts and other entities.

Local and State Water Planning and Management

Many local and state entities have statutory authorities related to water use, management, protection and development. Some of the authorities are summarized in the following tables.

Table 3-1. Local Organization Statutory Authority

Category	Agency	Program	Authority (NRS)
Water Supply	Cities	Water Facilities	266.285
	Counties	Water Facilities	244.366
	General Improvement Districts	Water Facilities	318.144
	Irrigation Districts	Irrigation	539.010 - 539.783
	Water Conservancy Districts	Water Supply	541.010 - 541.420
Water Quality	Cities	Sewer Facilities	266.285
	Counties	Sewer Facilities	244.366
	General Improvement Districts	Sewer Facilities	318.140
Environmental Uses	Conservation Districts	Conservation of Natural Resources	548.010 - 548.550
Flood Management	Flood Control Districts	Flood Control	543.170 - 543.830
	Water Conservancy Districts	Flood Control and Drainage	541.010 - 541.420
Water Planning and Management	Cities	Master Plan	278.150 - 278.230
	Counties	Regional Plan	278.0272 - 278.029
		Master Plan	278.150 - 278.230

Table 3-2. State Agency Statutory Authority

Category	Agency	Program	Authority (NRS)
Water Supply and Allocation	State Engineer's Office (Division of Water Resources)	Water Right Adjudication and Appropriation	533
		Groundwater Regulation	534
	Division of Water Planning	Small Community Grant Program	349.980 - 349.987
		Conservation Plans	540.121 - 540.151
	Public Utilities Commission	Regulation of Public Utilities	704.001 - 704.960
		Utility Environmental Protection Act (UEPA)	704.001 - 704.960
Conservation Plans		704.662 - 704.6624	
Water Quality	Division of Environmental Protection	Water Pollution Control Clean Water Act State Groundwater Permit Safe Drinking Water Act Mining Reclamation	445A.300 - 445A.730 519A.010 - 519A.280
		Division of Agriculture	Control of Pesticides
	Bureau of Health Protection Services, Health Division	Safe Drinking Water Act	445A.800 - 445A.955
		Control of Septic Systems	444.650
Environmental and Recreational Uses	Division of Wildlife	Boating Safety	488, 501.243
		Wildlife Management and Propagation	504.140 - 504.490
		Protection of Threatened Species	503.584
	Natural Heritage Program	Threatened and Endangered Species Database	527.260 - 527.300
	Division of Parks	Park Facilities	407.011 - 407.250
	Division of Forestry	Protection and Preservation of Timbered Lands, Trees and Flora	527.010 - 527.330
Forest Practice and Reforestation		528.010 - 528.120	
Flood Management	Division of Water Planning	National Flood Insurance Program (Community Assistance, Flood Mitigation Assistance)	540
	Division of Water Resources	Dam Safety	535.005 - 535.110
		Channel Clearance	532.220 - 532.230
	Division of Emergency Management	Hazard Mitigation Grant	414
	Division of Forestry	Forest/Vegetative Cover for Flood Prevention	472.043
Department of Conservation and Natural Resources	Flood Control Loans	543.090 - 543.140	
Water Planning and Management	Division of Water Planning	State Water Plan	540.101
		Planning Assistance	540.011 - 540.151

Regional Plans

According to NRS 540.101(2), NDWP is to coordinate with local governments (political subdivisions) in developing the *State Water Plan*, and upon the request of the Division, each local government shall cooperate with and assist the Division in the development of the Plan. Following is a summary of selected regional planning efforts that are underway. These planning efforts will provide valuable information for the *State Water Plan*.

Southern Nevada Water Authority Water Resource Plan

The Southern Nevada Water Authority (SNWA) was created in 1991 through a cooperative agreement among the following seven regional water and wastewater agencies:

- Big Bend Water District (Laughlin);
- City of Boulder City;
- Clark County Sanitation District;
- City of Henderson;
- City of Las Vegas;
- Las Vegas Valley Water District; and
- City of North Las Vegas.

The purposes of SNWA are to seek new water resources for Southern Nevada, to manage existing and future water resources, to construct and manage regional water facilities, and to promote responsible conservation. The SNWA Water Resource Plan was completed January 1996, and amended February 1997.

Washoe County Comprehensive Regional Water Management Plan

In 1995, the Nevada State Legislature approved legislation which created the Regional Water Planning Commission and provided the basis and direction for the Commission and the 1995-2015 Washoe County Comprehensive Regional Water Management Plan. This legislation required that the Commission develop "...a comprehensive plan for the region covering the supply of municipal and industrial water, quality of water, sanitary sewerage, treatment of sewerage, drainage of storm waters and control of floods." The Plan was completed and approved by the 1997 State Legislature.

Clark County Regional Flood Control District Flood Control Master Plan

In response to major floods in 1983 and 1984, the Clark County Regional Flood Control District (CCRFCDD) was established in 1985 to develop a regional flood control program for the Las Vegas Valley and surrounding environs. As part of the CCRFCDD mandate, a comprehensive, regional Master Plan was prepared and adopted in 1986. The principal objective of the Master Plan is to provide for the long-term improvement in public safety and property damage protection from flooding events by guiding the siting, design, and installation of flood control facilities. Periodic Master Plan updates are required by law to account for changes in land use, the construction of new facilities, and for improved hydrologic and hydraulic data.

Water Quality Management Plans (Section 208 of the Clean Water Act)

Section 208 of the federal Clean Water Act was promulgated for the purpose of encouraging and facilitating the development and implementation of areawide waste treatment management plans. Following are the five areas for which 208 plans have been developed and the agencies responsible for plan development:

Carson River Basin - NDEP
Clark County - Board of County Commissioners
Lake Tahoe Basin - Tahoe Regional Planning Agency
Washoe County - Truckee Meadows Regional Planning Agency
Remainder of the State (non-designated area) - NDEP

City/County Master Plans

Nevada Revised Statutes 278.150 requires each city and county to prepare and adopt a comprehensive, long-term general plan for the physical development of the city, county or region. The master plan may address a variety of matters, such as:

- Conservation;

This element of the plan may address a variety of topics including development and utilization of natural resources, including water, underground water, water supply, forests, soils, rivers and other waters, harbors, fisheries, wildlife, minerals and other natural resources. The reclamation of land and waters, flood control, prevention and control of the pollution of streams and other waters may also be included

- Land use;
- Population;
- Public services and facilities;
- Recreation; and
- Solid waste disposal.

Water Resources Data Collection and Research

The following section provides a brief discussion of the main entities collecting water resources data and performing water resources research in Nevada.

U.S. Geological Survey - Water Resources Division

The mission of the Water Resources Division (WRD) of the U.S. Geological Survey (USGS) is to provide the hydrologic information and understanding needed to manage the Nation's water resources to benefit the people of the United States. To accomplish this mission, WRD in cooperation with federal, state and local agencies, uses a variety of investigative and interpretive techniques to collect

and transfer hydrologic information to interested parties. Programs sponsored by WRD in Nevada include:

- Data collection to aid in evaluating the quantity, quality, distribution, and use of water resources in Nevada. WRD routinely collects water discharge data for gaging stations on streams, canals and drains; peak flow data at miscellaneous sites and springs; water elevation and contents for lakes and reservoirs; water levels in wells; and water quality for stream, canal and drain sites, and wells.
- Analytical and interpretive water-resources appraisals to describe the occurrence, quality, and availability of surface and ground water in Nevada.
- Basic and problem-oriented research in hydraulics, hydrology, and related fields of science and engineering
- Scientific and technical assistance in hydrology to other federal, state and local agencies
- Development and maintenance of national computer databases and associated Geographic Information System (GIS) databases for hydrologic data - streamflow, water quality and biology, groundwater characteristics and water use.
- Public distribution of water resources data and results of water resources investigations through reports, maps, computerized information services, and other forms of release

The USGS cooperates with more than 40 local, State, and Federal agencies and Indian Tribes in Nevada. Partnerships with local and State agencies typically are financed on a matching-funds basis.

Desert Research Institute

A nonprofit, statewide division of the University and Community College System of Nevada, Desert Research Institute (DRI) pursues a full-time program of basic and applied environmental research on a local, national, and international scale. The five centers within DRI research such diverse areas as: the natural and human factors influencing the availability and quality of water resources, issues and concerns common to arid and developing regions worldwide, improving society's fundamental knowledge and understanding of hydrologic systems, and encouraging more effective and efficient management of water resources (Water Resources Center); improving the fundamental understanding of the nature of the Earth's dynamic surface from approximately 2 million years ago to the present day, and applying this knowledge toward enhancing effective management of the environment and cultural resources (Quaternary Sciences Center); understanding atmospheric chemistry, climate dynamics, large-scale dynamic meteorology, mesoscale dynamic meteorology, and physical meteorology, and developing instrumentation and techniques for atmospheric measurements (Atmospheric Sciences Center); researching how natural and agricultural ecosystems function and respond to natural and human impacts on the environment, especially air quality, and the technology that can be applied to mitigate these impacts (Energy and Environmental Engineering Center). Additionally, the Western Regional Climate Center, within the Atmospheric Sciences Center, is one of six regional centers funded by the National Oceanic and Atmospheric Administration. The Climate Center provides data and products tailored to the needs of federal agencies, regional organizations, state and local entities, and the private sector.

University of Nevada Reno (UNR)

Within UNR's College of Agriculture, two departments perform a variety of research projects pertaining to Nevada's water resources. The Department of Environmental and Natural Resource Sciences provides interdisciplinary research in physical, biological and ecological sciences. The Department of Applied Economic and Statistics with the College of Agriculture provides research which emphasizes the application of economic principles and statistical analysis to issues involving growth, infrastructure, agriculture, natural resources and the environment.

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) within U.S. Department of Agriculture works in three primary areas: soil and water conservation; resource inventories; and rural community development. Under one NRCS program, staff perform snow surveys and develop water supply forecasts. The purpose of the program is to provide western states and Alaska with information on future water supplies. NRCS field staff collect and analyze data on depth and water equivalent of the snowpack at more than 1,200 mountain sites and estimate annual water availability, spring runoff, and summer streamflows. Individuals, organizations, and state and Federal agencies use these forecasts for decisions relating to agricultural production, fish and wildlife management, municipal and industrial water supply, urban development, flood control, recreation power generation, and water quality management. The National Weather Service includes the forecasts in their river forecasting function.

Nevada Division of Environmental Protection

NDEP operates a surface water quality monitoring network. Under this program, water quality parameters are monitored by NDEP at about 100 sites throughout Nevada. A variety of other data are compiled under other NDEP programs. NDEP's UIC (Underground Injection Control) program requires groundwater quality characterization data in the permit application. The Solid Waste program, hazardous waste facilities oversight, mining-related permitting and state groundwater permitting programs all require some amount of groundwater monitoring in the absence of any contaminant release. Facilities such as wastewater treatment plants and industrial operations with permitted discharges to surface water are required to monitor effluent quality and to submit discharge monitoring reports to NDEP.

Nevada Division of Water Resources

NDWR maintains an electronic database of water rights within the State, including information on place of use, point of diversion, allowable diversion rates and volumes, and other ancillary data. NDWR also collects well log data and pumpage data, and develops crop and pumpage inventories.

Nevada Health Division and State Health Laboratory

As required by state and federal drinking water regulations, public supply systems routinely submit

water samples to laboratories for analysis. The laboratory results are then sent as paper copies to the Nevada Health Division which has primary enforcement authority for drinking water regulations. Depending upon the public supply system, analyses are performed by either the State Health Laboratory or by private laboratories. The State Health Laboratory maintains analytical results in an electronic database.

Funding Opportunities

A variety of state and federal funding sources exist for the planning, management, protection and development of our water resources. The following discussion provides a brief introduction to the main funding programs available in Nevada.

State Agencies

Grants for Capital Improvements to Community Water Systems (Nevada Division of Water Planning). The Assembly Bill (AB) 198 Grant program provides assistance to water purveyors in partially funding capital improvements made necessary by the State health regulations and the federal Safe Drinking Water Act. Preference is given to water systems serving less than 6,000 people. Grants are limited to publicly owned water systems. Eligible projects include pipe and tank replacements, looping lines, improvement of springs, and drilling of new wells. Expansion of existing systems to meet growth needs is not eligible.

Clean Water Act Section 319 Nonpoint Source Implementation Grant Program (Nevada Division of Environmental Protection, Nonpoint Source Program). These grants are made available through federal funds passed through NDEP's Nonpoint Source Program, and are awarded annually on a competitive basis. Eligible activities include: best management practices which reduce, eliminate and/or prevent nonpoint source pollution; technology transfer, innovative methods or practices, ground water protection, pollution prevention, technical assistance and public education. This program is a matching grant program where at least 50 percent of the project cost is a local expense.

Community Development Block Grant Program (Nevada Commission on Economic Development). Under this program, grants are awarded for community infrastructure studies and construction. Eligible projects include construction of new wells and water distribution lines.

Water Projects Financing Program (Nevada Department of Business and Industry). Through this programs, loans are issued for financing any project for the management, control, delivery, use or distribution of water. To be eligible, any proposed project must satisfy one or more of the following: resolve or abate an emergency situation; provide for the best utilization of surface and ground waters; promote reclamation; provide storage; facilitate offstream storage; accomplish aquifer recharge; acquire site for a reservoir; generate benefits from the rehabilitation or modernization of existing facilities; and obtain significant economic, environmental and water conservation benefits.

State Petroleum Fund (Nevada Division of Environmental Protection, UST/LUST/Claims

Branch). The Nevada Petroleum Fund can reimburse underground and above-ground storage tank owners for a substantial percentage of costs incurred in clean-up activities. Home heating oil tanks are automatically enrolled in the Fund and are eligible for funding.

State Revolving Fund (Clean Water Act) (Nevada Division of Environmental Protection, Bureau of Water Pollution Control). The Nevada State Revolving Fund provides loans at or below market rate and other forms of financial assistance to municipalities and other entities to assist in financing the construction of waste water treatment works or projects to control nonpoint sources of water pollution.

Drinking Water State Revolving Fund (Safe Drinking Water Act) (Nevada Division of Health, Bureau of Health Protection Services). The SDWA Amendments of 1996 authorized a Drinking Water State Revolving Fund (DWSRF) to assist public water systems to finance the costs of infrastructure needed to achieve or maintain compliance with SDWA requirements and to protect public health objectives of the Act.

Channel Clearance Program (Nevada Division of Water Resources). This program provides funding for channel clearance maintenance, restoration, surveying and monumenting. Local communities, including counties, cities, irrigation districts, and flood control districts can apply for matching funds to maintain channels of navigable rivers within their jurisdictional boundaries.

Disaster Relief Fund (Legislative Counsel Bureau). In 1997, the Legislature established a state fund of \$4 million to help communities recover from damages sustained in the event of a disaster.

Federal Agencies

Rural Utilities Service Program (U.S. Dept. Of Agriculture, Rural Development). This program provides a variety of funding opportunities for rural areas and towns with populations under 10,000. Rural Development offers loans for the development of water and waste disposal systems (including solid waste disposal and storm drainage). Also, Rural Development offers grants for:

- development of water and waste disposal systems;
- technical assistance and training on a wide range of issues related to water delivery and waste disposal;
- technical assistance and training for improved solid waste management; and
- emergency improvements to drinking water systems.

Clean Water Act Section 104 (b)(3) Wetland Protection Development Grants (U.S. Environmental Protection Agency). This grant program was designed to assist state, tribal and local governments in developing wetlands protection programs. Grants are provided to state agencies for priority wetlands planning activities such as wetland watershed protection approach demonstration projects; state wetlands conservation plan development, refinement or implementation; state/tribal section 404 assumption assistance; streamlining state/tribal regulatory programs; and assessing and monitoring the ecological integrity of wetlands.

Wetlands Reserve Program (Natural Resources Conservation Service & U.S. Fish & Wildlife Service). The Wetlands Reserve Program is a conservation easement and habitat restoration program that focuses primarily on wetlands in agricultural production. The purposes of the program are: to restore the hydrology and vegetation of converted wetlands (wetlands brought into agricultural production prior to December 23, 1985) or wetlands formed under natural conditions; to protect the functions and values of wetlands for wildlife habitat; and to improve water quality, floodwater retention, and ground water recharge capacity of wetlands. The program offers cash payment to landowners for placing permanent conservation easements on their wetland property, as well as cost-share assistance for restoration work.

Environmental Quality Incentives Program (Natural Resources Conservation Service, USDA). The 1996 Federal Agricultural Improvement and Reform Act of 1996 (1996 Farm Bill) created the Environmental Quality Incentives Program (EQIP) to combine the functions of most existing U.S. Department of Agriculture conservation cost-share programs. Its purpose is to provide flexible technical, financial and educational assistance to farmers and ranchers to address a broad range of conservation issues. EQIP provides cost-share assistance for up to 75 percent depending on the conservation practices used.

Flood Mitigation Assistance Grants (Federal Emergency Management Agency and Nevada Division of Water Planning). The Federal Emergency Management Agency provides grants to communities for mitigation projects aimed at reducing repetitive insurance losses and future damage. The Nevada Division of Water Planning is the point of contact for this grant program.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 4
Water Resources Background

Introduction

An understanding of the state's water resources is a necessary component to the planning and management process. It is the intent of this section to provide the reader with an overview of Nevada's surface water and groundwater resources.

Topography

The topography of Nevada and the surrounding areas makes for a unique and diversified climate. Nearly all of Nevada is in the Basin and Range Province of the Intermountain Plateaus, a rugged elevated area between the Rocky Mountains and the Pacific mountain system. The topography of the Basin and Range province is characterized by isolated, long and narrow, roughly north-south trending, parallel mountain ranges and broad, intervening valleys as shown in Figure 4-1.

Internal drainage is a significant feature of the hydrology of much of Nevada. About 84 percent of the State is within the Great Basin in which drainage is to low areas in enclosed basins rather than to the sea.

Hydrographic Areas

The topography and related geology of the State has resulted in complex surface and ground water systems, complicating the management of these resources. In the 1960s, the Nevada State Engineer's Office and the U.S. Geological Survey (USGS) recognized the need for a systematic identification of the valleys or hydrographic areas throughout Nevada. Such a system was needed in the study, research, development, management and administration of the water resources, both ground-water and surface water. A hydrographic areas map was subsequently developed in 1968 by the USGS and the State Engineer's Office. This was the first known effort to identify completely and systematically the hydrographic regions and areas of the Nevada. While the 1968 map has undergone some minor revisions, it continues to provide the basis for water planning, management and administration. The current hydrographic area map delineates 256 hydrographic areas within 14 major hydrographic regions and basins (Figure 4-2, Table 4-1). Of the 14 hydrographic regions and basins, only the Snake River Basin and the Colorado River Basin drain to the sea.

Figure 4-1 - shaded relief map

Figure 4-2 - Hydrographic Regions and Basins

Table 4-1. List of Hydrographic Areas

1. NORTHWEST REGION

1. Pueblo Valley
2. Continental Lake Valley
3. Gridley Lake Valley
4. Virgin Valley
5. Sage Hen Valley
6. Guano Valley
7. Swan Lake Valley
8. Massacre Lake Valley
9. Long Valley
10. Macy Flat
11. Coleman Valley
12. Mosquito Valley
13. Warner Valley
14. Surprise Valley
15. Boulder Valley
16. Duck Lake Valley

2. BLACK ROCK DESERT REGION

17. Pilgrim Flat
18. Painter Flat
19. Dry Valley
20. Sano Valley
21. Smoke Creek Desert
22. San Emidio Desert
23. Granite Basin
24. Hualapai Flat
25. High Rock Lake Valley
26. Mud Meadow
27. Summit Lake Valley
28. Black Rock Desert
29. Pine Forest Valley
30. Kings River Valley
 - (A) Rio King Subarea
 - (B) Sod House Subarea
31. Desert Valley
32. Silver State Valley
33. Quinn River Valley
 - (A) Orovada Subarea
 - (B) McDermitt Subarea

3. SNAKE RIVER BASIN

34. Little Owyhee River Area
35. South Fork Owyhee River Area
36. Independence Valley
37. Owyhee River Area
38. Bruneau River Area
39. Jarbidge River Area
40. Salmon Falls Creek Area
41. Goose Creek Area

4. HUMBOLDT RIVER BASIN

42. Marys River Area
43. Starr Valley Area
44. North Fork Area
45. Lamoille Valley
46. South Fork Area
47. Huntington Valley
48. Dixie Creek - Tenmile Creek Area
49. Elko Segment
50. Susie Creek Area
51. Maggie Creek Area
52. Marys Creek Area
53. Pine Valley
54. Crescent Valley
55. Carico Lake Valley
56. Upper Reese River Valley
57. Antelope Valley
58. Middle Reese River Valley
59. Lower Reese River Valley
60. Whirlwind Valley
61. Boulder Flat
62. Rock Creek Valley
63. Willow Creek Valley
64. Clovers Area
65. Pumpernickel Valley
66. Kelly Creek Area
67. Little Humboldt Valley
68. Hardscrabble Area
69. Paradise Valley
70. Winnemucca Segment
71. Grass Valley
72. Imlay Area
73. Lovelock Valley
 - (A) Oreana Subarea
74. White Plains

5. WEST CENTRAL REGION

75. Bradys Hot Springs Area
76. Fernley Area
77. Fireball Valley
78. Granite Springs Valley
79. Kumiva Valley

6. TRUCKEE RIVER BASIN

80. Winnemucca Lake Valley
81. Pyramid Lake Valley
82. Dodge Flat
83. Tracy Segment
84. Warm Springs Valley
85. Spanish Springs Valley
86. Sun Valley
87. Truckee Meadows
88. Pleasant Valley
89. Washoe Valley
90. Lake Tahoe Basin
91. Truckee Canyon Segment

7. WESTERN REGION

92. Lemmon Valley
 - (A) Western Part
 - (B) Eastern Part
93. Antelope Valley
94. Bedell Flat
95. Dry Valley
96. Newcomb Lake Valley
97. Honey Lake Valley
98. Skedaddle Creek Valley
99. Red Rock Valley
100. Cold Spring Valley
 - (A) Long Valley

8. CARSON RIVER BASIN

101. Carson Desert
 - (A) Packard Valley
102. Churchill Valley
103. Dayton Valley
104. Eagle Valley
105. Carson Valley

9. WALKER RIVER BASIN

106. Antelope Valley
107. Smith Valley
108. Mason Valley
109. East Walker Area
110. Walker Lake Valley
 - (A) Schurz Subarea
 - (B) Lake Subarea
 - (C) Whisky Flat - Hawthorne Subarea

10. CENTRAL REGION

111. Alkali Valley (Mineral)
 - (A) Northern Part
 - (B) Southern Part
112. Mono Valley
113. Huntoon Valley
114. Teals Marsh Valley
115. Adobe Valley
116. Queen Valley
117. Fish Lake Valley
118. Columbus Salt Marsh Valley
119. Rhodes Salt Marsh Valley
120. Garfield Flat
121. Soda Spring Valley
 - (A) Eastern Part
 - (B) Western Part
122. Gabbs Valley
123. Rawhide Flats
124. Fairview Valley
125. Stingaree Valley
126. Cowkick Valley
127. Eastgate Valley Area
128. Dixie Valley
129. Buena Vista Valley
130. Pleasant Valley
131. Buffalo Valley
132. Jersey Valley
133. Edwards Creek Valley
134. Smith Creek Valley
135. Lone Valley
136. Monte Cristo Valley
137. Big Smoky Valley
 - (A) Tonopah Flat

- (B) Northern Part
138. Grass Valley
139. Kobeh Valley
140. Monitor Valley
 - (A) Northern Part
 - (B) Southern Part
141. Ralston Valley
142. Alkali Spring Valley (Esmeralda)
143. Clayton Valley
144. Lida Valley
145. Stonewall Flat
146. Sarcobatus Flat
147. Gold Flat
148. Cactus Flat
149. Stone Cabin Flat
150. Little Fish Lake Valley
151. Antelope Valley (Eureka & Nye)
152. Stevens Basin
153. Diamond Valley
154. Newark Valley
155. Little Smoky Valley
 - (A) Northern Part
 - (B) Central Part
 - (C) Southern Part
156. Hot Creek Valley
157. Kawich Valley
158. Emigrant Valley
 - (A) Groom Lake Valley
 - (B) Papoose Lake Valley
159. Yucca Flat
160. Frenchman Flat
161. Indian Springs Valley
162. Pahump Valley
163. Mesquite Valley (Sandy Valley)
164. Ivanpah Valley
 - (A) Northern Part
 - (B) Southern Part
165. Jean Lake Valley
166. Hidden Valley (South)
167. Eldorado Valley
168. Three Lakes Valley (Northern Part)
169. Tikapoo Valley (Tickaboo Valley)
 - (A) Northern Part
 - (B) Southern Part
170. Penoyer Valley (Sand Spring Valley)
171. Coal Valley
172. Garden Valley
173. Railroad Valley
 - (A) Southern Part
 - (B) Northern Part
174. Jakes Valley
175. Long Valley
176. Ruby Valley
177. Clover Valley
178. Butte Valley
 - (A) Northern Part (Round Valley)
 - (B) Southern Part
179. Steptoe Valley
180. Cave Valley
181. Dry Lake Valley
182. Delamar Valley
183. Lake Valley
184. Spring Valley
185. Tippet Valley
186. Antelope Valley (White Pine & Elko)
 - (A) Southern Part
 - (B) Northern Part
187. Goshute Valley
188. Independence Valley (Pequop Valley)

11. GREAT SALT LAKE BASIN

189. Thousand Springs Valley
 - (A) Hermill Siding - Brush Creek Area
 - (B) Toano - Rock Spring Area
 - (C) Montello - Crittenden Creek Area (Montello Valley)
190. Grouse Creek Valley
191. Pilot Creek Valley
192. Great Salt Lake Desert
193. Deep Creek Valley
194. Pleasant Valley
195. Snake Valley
196. Hamlin Valley

12. ESCALANTE DESERT

197. Escalante Desert

13. COLORADO RIVER BASIN

198. Dry Valley
199. Rose Valley
200. Eagle Valley
201. Spring Valley
202. Patterson Valley
203. Panaca Valley
204. Clover Valley
205. Lower Meadow Valley Wash
206. Kane Springs Valley
207. White River Valley
208. Pahroc Valley
209. Pahrnagat Valley
210. Coyote Spring Valley
211. Three Lakes Valley (Southern Part)
212. Las Vegas Valley
213. Colorado Valley
214. Piute Valley
215. Black Mountains Area
216. Garnet Valley (Dry Lake Valley)
217. Hidden Valley (North)
218. California Wash
219. Muddy River Springs Area (Upper Moapa Valley)
220. Lower Moapa Valley
221. Tule Desert
222. Virgin River Valley
223. Gold Butte Area
224. Greasewood Basin

14. DEATH VALLEY BASIN

225. Mercury Valley
226. Rock Valley
227. Fortymile Canyon
 - (A) Jackass Flats
 - (B) Buckboard Mesa
228. Oasis Valley
229. Crater Flat
230. Amargosa Desert
231. Grapevine Canyon
232. Oriental Wash

Climate

The climate of Nevada is characterized as semi-arid to arid with precipitation and climate varying widely throughout the State. With temperatures that fall below -40°F in the northeast, and rise over 120°F in the south, and precipitation that ranges from only three to four inches in Southern Nevada to over 40 inches (and over 300 inches of snowfall) in the Carson Range portion of the Sierra Nevada Mountains, Nevada is truly a land of contrasts. Three basic geographical characteristics are responsible for Nevada's unusual and diverse climate:

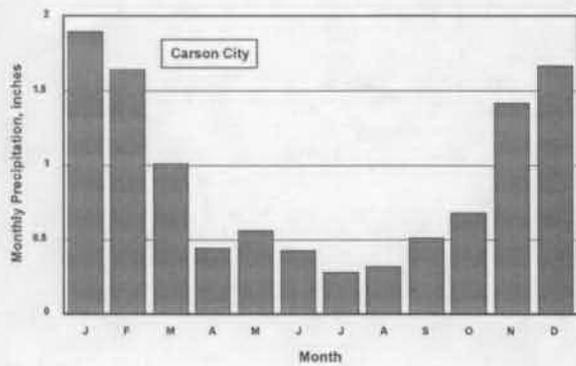
Latitude: Nevada spans approximately seven degrees of latitude, or about 500 miles, from the north boundary to the southern tip of the State. As a result, average temperatures are 15° to 20°F cooler in the north than the south.

Elevation: The Basin and Range Province, with its wide elevation fluctuations from the valley floors to the mountain tops, is another factor responsible for our diverse climate. Elevations vary from under 1,000 feet to over 13,000 feet above sea level, with the higher elevations generally experiencing lower temperatures and more precipitation.

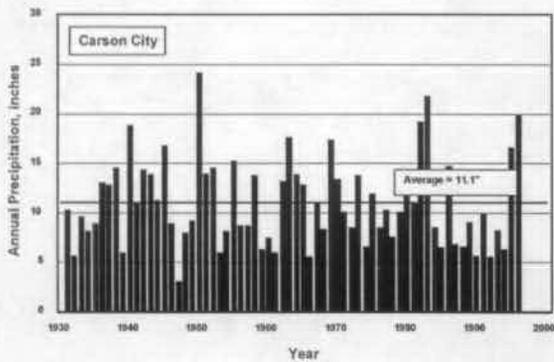
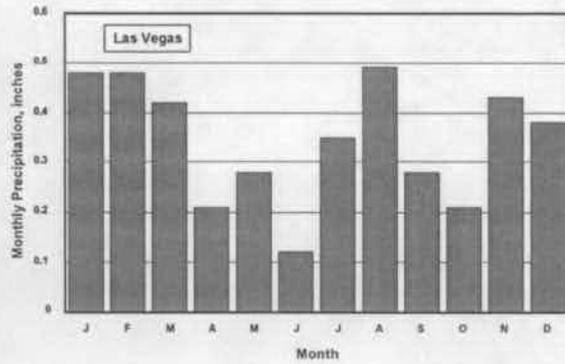
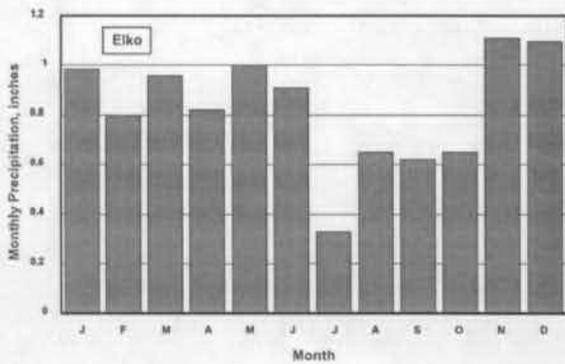
Continentality: Continentality is the most important factor affecting Nevada's climate. The continental effect results from the continuous barrier of the Pacific mountain system to the west. Moisture laden winds traveling east from the Pacific Ocean are forced to rise, cool and drop precipitation as the Pacific mountain system is encountered. The resulting winds entering Nevada are much drier and provide reduced precipitation. This rainshadow effect is the primary reason for Nevada's dry climate.

Figure 4-3 shows the spatial variability of precipitation in Nevada. With total precipitation averaging approximately nine inches per year, Nevada is the most arid state in the nation. Monthly and annual fluctuations in precipitation can be significant. Figure 4-4 displays monthly and annual precipitation variations for three selected precipitation measurement sites in Nevada. Of the total annual precipitation falling in Nevada, approximately 10 percent results in stream runoff and groundwater recharge (*Water for Nevada, Nevada's Water Resources - Report No. 3*, State Engineer's Office, October 1971). The remaining 90 percent is lost through evaporation and transpiration. Like precipitation, evaporation is also widely variable. Average lake surface evaporation rates range from less than 36 inches per year in the west to over 80 inches per year in the south (Figure 4-5).

Figure 4-3 Precipitation



Monthly Variations: Precipitation in Nevada varies from month to month with most moisture falling in the winter. During the warmer and drier summer periods, the precipitation that does occur is the result of convective summer thunderstorms which can produce brief, but intense rainfall.



Annual Variations: The average of annual precipitation is commonly used as an indicator of the amount of precipitation that could be expected in a given year. However, annual variations in precipitation are significant and “average” years are rarely experienced.

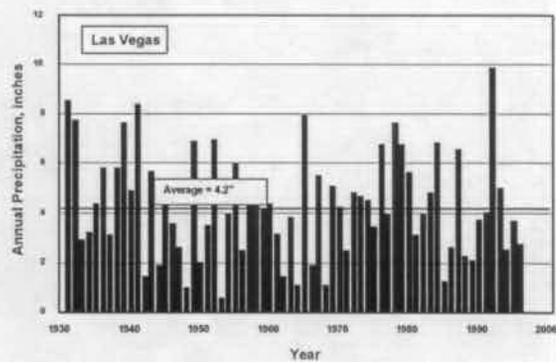
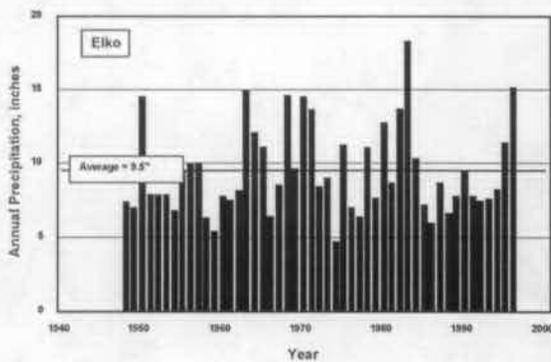


Fig. 4-4. Precipitation Variability for 3 Selected Sites

Figure 4-5 Evaporation

Surface Water

Surface water is a limited and precious resource in Nevada providing about 70 percent of the total water supply used in the state. Spring and summer snowmelt supplies most of the streamflow in Nevada. However, isolated summer convective storms probably cause a majority of the streamflow in southern Nevada's low altitude basins.

Throughout the State, surface water flows can vary widely from year to year and from month to month, with maximum discharges generally in May and June as a result of snowmelt in the mountains. With the exception of the Humboldt Basin, most of the surface waters in Nevada's rivers are the result of snowmelt occurring in other states such as California, Wyoming, Colorado, and Utah.

Flows in the upper reaches of the larger rivers (Carson, Humboldt, Truckee, Walker) typically increase as one moves downstream. The larger rivers typically follow the flow pattern of a gaining stream in the well-watered mountain reaches and a losing stream in the lower-altitude reaches. Reductions in flow occur due to irrigation, public use, infiltration, and evapotranspiration.

Major Rivers, Lakes and Reservoirs

Nevada can claim very few large rivers and streams compared to other states. With the exception of the Colorado River, Nevada's perennial rivers are small by nationwide standards. Rivers in the Snake River Basin and Colorado River Basin regions flow into the ocean, with the remaining streams systems discharging into terminal sinks and lakes with no outflow to the sea. The major river systems in Nevada are the Colorado, Walker, Carson, Truckee, and Humboldt (Figure 4-6). Table 4-2 summarizes the main lakes and reservoirs within these river systems and in Nevada.

The **Carson River** flows from the eastern slopes of the Sierra Nevada in California and terminates in the Carson Sink. Waters of the Carson River are used predominately for agriculture from Carson Valley down to the Fallon area. Only a few regulating storage reservoirs exist in the basin, with Lahontan Reservoir being the largest. Lahontan Reservoir is used to store water from the Carson River, and water diverted from the Truckee River by Derby Dam and conveyed to Lahontan Reservoir via the Truckee Canal. Water released from Lahontan Reservoir is used predominately for agriculture, and wildlife purposes.

The **Colorado River** is the largest river in Nevada, flowing through Wyoming, Colorado, Utah, New Mexico, Arizona, California and Nevada. Along its 1,400 mile course to the Gulf of Mexico, the Colorado River Basin drains an area of about 240,000 square miles or about one-twelfth the area of the contiguous United States. The Colorado River and tributaries in Nevada provide a majority of the drinking water supply to the Las Vegas area, hydroelectric power and recreation opportunities at Lake Mead and Lake Mohave, and water for agricultural purposes.

Figure 4-6 Major rivers, lakes, reservoirs

Table 4-2. Major Lakes and Reservoirs of Nevada and Portions of California

Hydrographic Region	Lake/Reservoir	Surface Area, acres	Active Storage Capacity, acre-feet	Total Storage Capacity, acre-feet
Carson River	Lahontan Reservoir	14,600	317,000	317,000
Colorado River	Lake Mead	158,000	26,200,000	29,700,000
	Lake Mohave	28,000	1,810,000	1,820,000
Humboldt River	Pitt-Taylor Reservoir, Lower	2,570	22,200	22,200
	Pitt-Taylor Reservoir, Upper	2,070	24,200	24,200
	Rye Patch Reservoir	12,400	194,300	194,300
	South Fork Reservoir	1,650	41,000	41,000
Snake River	Wild Horse Reservoir	2,830	73,500	73,500
Truckee River	Big and Little Washoe Lakes	5,800	14,000	38,000
	Boca Reservoir	980	40,870	41,110
	Donner Lake	800	9,500	Not reported
	Independence Lake	700	17,500	Not reported
	Lake Tahoe	124,000	744,600	125,000,000
	Martis Creek Lake	770	20,400	21,200
	Prosser Creek Reservoir	750	28,640	29,840
	Pyramid Lake ¹	111,400 (as of 9/30/96)	not applicable	21,760,000 (as of 9/30/96)
	Stampede Reservoir	3,440	221,860	226,500
Walker River	Bridgeport Reservoir	2,914	40,500	40,500
	Topaz Lake	2,410	61,000	126,000
	Walker Lake ¹	33,500 (as of 9/30/96)	not applicable	2,153,000 (as of 9/30/96)
	Weber Reservoir	950	13,000	13,000

¹Pyramid and Walker lakes are natural terminal lakes with no outlet.

The **Humboldt River** is the longest river contained wholly within the State. The Humboldt River originates in the Ruby, East Humboldt, Independence and Jarbidge Mountains and flows westward to terminate in the Humboldt Sink. A majority of the Humboldt River system water is used for agriculture. There are only a few flow regulating reservoirs in the basin, the largest (Rye Patch Reservoir) being near the end of the system. As a result, late season irrigation water shortages are commonplace throughout much of the area above Rye Patch Reservoir.

The **Truckee River** originates at the northern end of Lake Tahoe in California and terminates at Pyramid Lake. Along its course, water is utilized to meet a variety of needs, such as municipal and industrial, agriculture, hydroelectric power, and wildlife. A portion of the Truckee River flow is diverted at Derby Dam and is conveyed via the Truckee Canal to Lahontan Reservoir in the Carson River Basin. With numerous upstream reservoirs, mostly in California, the Truckee River is one of the most regulated river systems in Nevada.

The **Walker River**, with its headwaters in California, flows into Nevada and terminates at Walker Lake. Most of the flow of the Walker River system originates in California and is used predominately for agricultural purposes in Nevada and California. The two largest reservoirs on the system (Topaz Lake located in Nevada and California, Bridgeport Reservoir located wholly in California) are owned and operated by the Walker River Irrigation District and are predominately used to supply irrigation water to district members.

Streamflow Forecasts and Data Collection

The collection and analysis of snowpack and streamflow data are essential for proper management and planning of our surface water resources. A better understanding of each basin's surface water system is made possible through snow depth and streamflow measurements.

Snowpack Measurements and Streamflow Forecasts. Natural Resources Conservation Service (NRCS) operates a series of snow depth measurement stations through the western United States, including Nevada. Utilizing the data collected at these stations, NRCS and National Weather Service hydrologists develop streamflow and water supply forecasts for the major surface water systems. These forecasts are used to guide water management and emergency management decisions.

Gaging Stations. The USGS is the principal Federal agency which collects surface water data in Nevada. The USGS began collecting streamflow data in 1889 with the establishment of a gaging station on the Truckee River near the Nevada-California state line. During the next six years, additional gaging stations were established in the Humboldt, Carson, Walker and Truckee basins. As of 1996, the USGS surface water quantity monitoring network consists of water discharge measurements for 170 gaging stations on streams, canals and drains, 99 peak flow stations and miscellaneous sites, and five springs; and water levels and contents for 22 lakes and reservoirs. The general objective of the stream-gaging program is to provide information on, or to develop estimates of, flow characteristics at any point on any stream.

Other entities collect streamflow data for regional purposes. For example, the Clark County Regional Flood Control District operates a network of meteorologic and water depth monitoring stations as

part of the District's Flood Threat Recognition Program..

Streamflow Characteristics. Most of the streamflow in Nevada is the result of runoff from melting snow. Runoff patterns in Nevada vary greatly both seasonally and geographically, and are mainly determined by precipitation patterns (location and timing) and other climate patterns, such as temperature. Other factors such as surface geology, vegetation, and land use affect the amount of runoff entering the rivers and streams. Streamflows are further affected by human-induced influences such as diversions and reservoir operations.

Table 4-3 summarizes some basic streamflow characteristics for selected USGS gaging stations throughout Nevada (see Figure 4-7 for station locations). As shown, average annual flows vary widely from river to river. Within a given river system, flows fluctuate year to year in response to changes in precipitation amounts. Some of these annual variations can be dramatic. For instance, at the "Walker River near Wabuska, NV" gaging station, the highest flows for a year exceeded the lowest annual flows by over 50 times. Figure 4-8 depict monthly and annual streamflow variations for the Colorado, Humboldt and Truckee rivers.

Water Yields and Committed Resources

The estimated average annual yield from Nevada's surface water systems is approximately 3.2 million acre-feet per year (Table 4-4). Generally, Nevada's surface water sources, such as lakes, streams and springs, have been fully appropriated and used for many years. In some instances, water may be available from these sources during high water years, however storage facilities would be required to capture the surplus flows for later use.

Most priority rights for surface water in Nevada were established in the 1800s. Rights to use water for irrigation date back to the 1850s in streams draining the Sierra Nevada Mountains and to the 1870s and 1880s in the Humboldt River Basin.

Droughts and Floods

Nevada is a land of extremes, with droughts and floods common in our highly variable climate. Years of average streamflows are rarely experienced. Periods of high flows followed by low flows are more the norm in Nevada.

Droughts. Years of below average flows in rivers are not uncommon and many water users are prepared to cope with one year of low streamflows by resorting to supplemental sources such as reservoirs and groundwater. For most of Nevada's water users, who depend mostly upon surface water, problems can begin to occur when below average flows are experienced for two or more consecutive years. Over time, reservoir and groundwater levels tend to decline due to increased uses and these supplemental sources may become depleted. Droughts can also create quality problems for both surface water and groundwater sources. The decreased flows experienced during a drought tend to result in diminished quality for the remaining water.

Table 4-3. Summary of Streamflow Data for Selected Gaging Stations

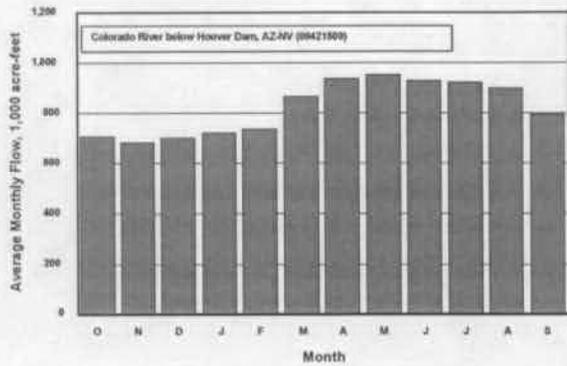
Part 1. Section 4 – Water Resources Background

Hydrographic Region	Gaging Station Name (Number)	Period of Record	Annual Streamflow Statistics, acre-feet		
			Average Annual	Lowest Annual	Highest Annual
Carson River	East Fork Carson River near Gardnerville, NV (10309000)	1890-1997	278,800	66,300	655,200
	West Fork Carson River at Woodfords, CA (10310000)	1901-97	81,000	18,900	210,000
	Carson River near Carson City, NV (10311000)	1940-97	298,700	42,400	826,800
	Carson River near Ft. Churchill, NV (10312000)	1911-97	272,900	26,300	804,400
Colorado River	Virgin River at Littlefield, AZ (09415000)	1930-97	175,600	72,400	504,600
	Muddy River near Glendale, NV (09419000)	1913-97	30,600	23,500	35,900
	Colorado River below Hoover Dam, AZ-NV (09421500)	1935-97	10,050,000	5,556,000	22,150,000
Humboldt River	Humboldt River at Palisade, NV (10322500)	1903-97	288,800	25,200	1,336,000
	Humboldt River near Imlay, NV (10333000)	1935-97	201,000	18,800	1,460,000
Snake River	Owyhee River above China Diversion Dam near Owyhee, NV (13176000)	1939-84	107,600	33,500	230,800
Truckee River	Truckee River at Farad, CA (10346000)	1909-97	554,500	133,200	1,769,000
	Truckee River at Reno, NV (10348000)	1907-96	492,500	76,700	1,701,000
	Truckee River below Derby Dam near Wadsworth, NV (10351600)	1918-97	289,100	4,500	1,759,000
Walker River	East Walker River near Bridgeport, CA (10293000)	1922-97	105,800	27,100	320,700
	West Walker near Coleville, CA (10296500)	1903-97	202,100	53,900	484,300
	Walker River near Wabuska, NV (10301500)	1902-97	123,300	9,300	602,300

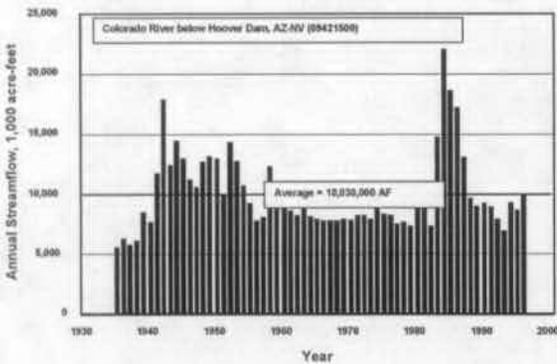
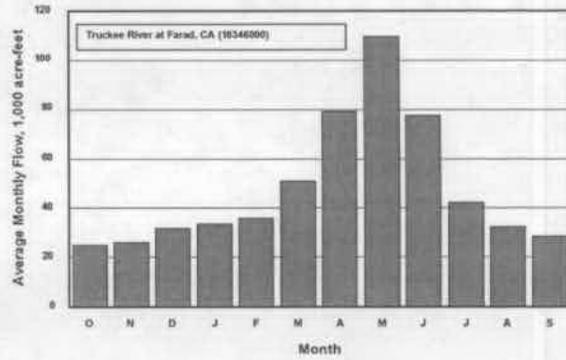
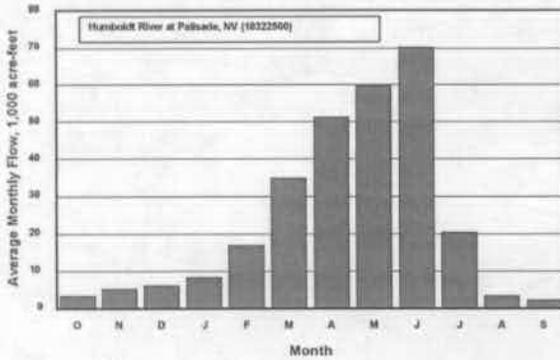
Note: Some years of data may be missing within each period of record.

Source: U.S. Geological Survey

Figure 4-7 selected gaging stations



Monthly Variations: Streamflows in Nevada vary from month to month with most flow occurring from March through June as a result of snowmelt. Colorado River flows fluctuate much less from one month to the next due to the regulating effect of reservoirs on the system.



Annual Variations: Streamflows vary from year to year in response to annual variations in precipitation amounts upstream of the gaging stations

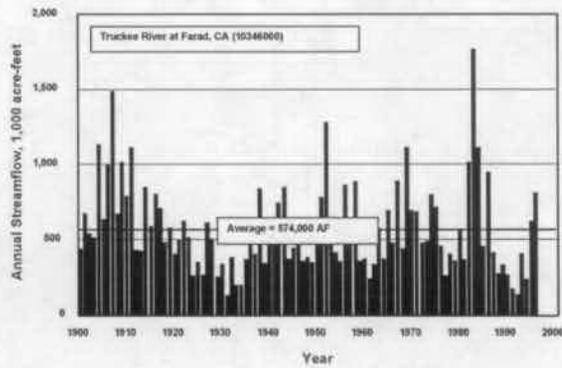
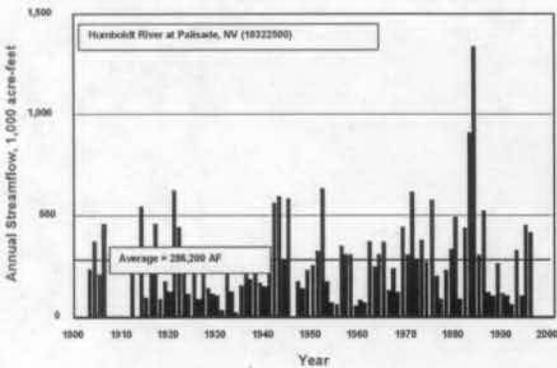


Fig. 4-8. Streamflow Variability for 3 Selected Sites

Table 4-4.

Summary of Surface Water Runoff and Flows (excluding Colorado River)

Description	Acre-feet per year
Average Annual Surface Runoff	
From Watersheds within Nevada	1,900,000
Inflow from Other States	1,300,000
Total	3,200,000
Average Annual Surface Outflow to Other States	700,000

Source: "Water for Nevada, Report No. 3", State Engineer's Office, 1971

Drought periods (consecutive years with streamflows much less than average) are frequent in Nevada. In many cases, Nevada's river systems experience more "below average water years" than "above average water years" (Figure 4-9). The most significant documented droughts of the 20th century were during 1928-37, 1953-55, 1959-62, 1976-77 and 1987-94, with the 1928-37 period possibly the most severe and longest of this century in northern Nevada.

Floods. Even though Nevada is the driest state with an average annual precipitation of nine inches, floods are common and have occurred in all parts of the state. The effects of floods in Nevada have increased steadily as population and development have increase since the mid-1900s. Development has encroached upon natural floodplains, including alluvial fans, and thereby increasing flood damage risks.

On the Truckee, Carson, and Walker rivers in west-central Nevada, the most severe floods have resulted from winter rains on snow in the Sierra Nevada Mountains. In the large drainages in southern Nevada, and small drainages and alluvial fans throughout Nevada, flash floods resulting from intense rainfall over relatively small areas are the most common. Flooding from these intense rainstorms is typically sudden and life threatening. Flooding along the Humboldt, Truckee, Carson, and Walker rivers in northern Nevada is generally not as sudden and more time is available to prepare for the flooding. However, these floods are usually longer with longer periods of flood inundation. Table 4-5 summarizes the major flood events that have occurred this century in Nevada.

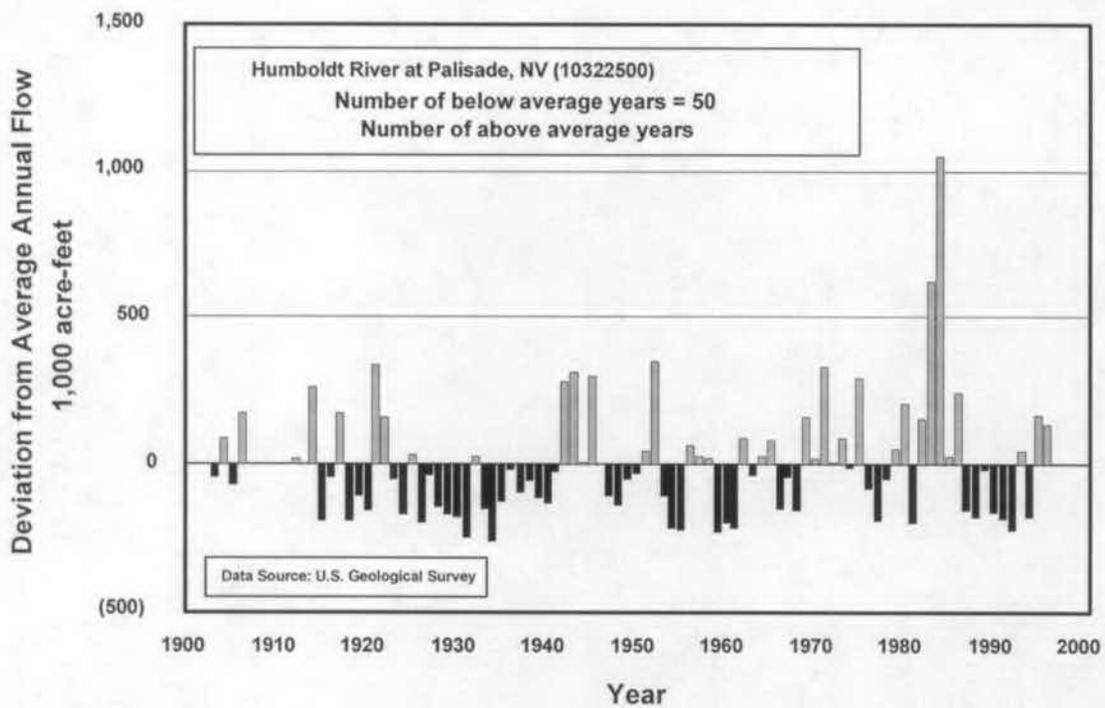
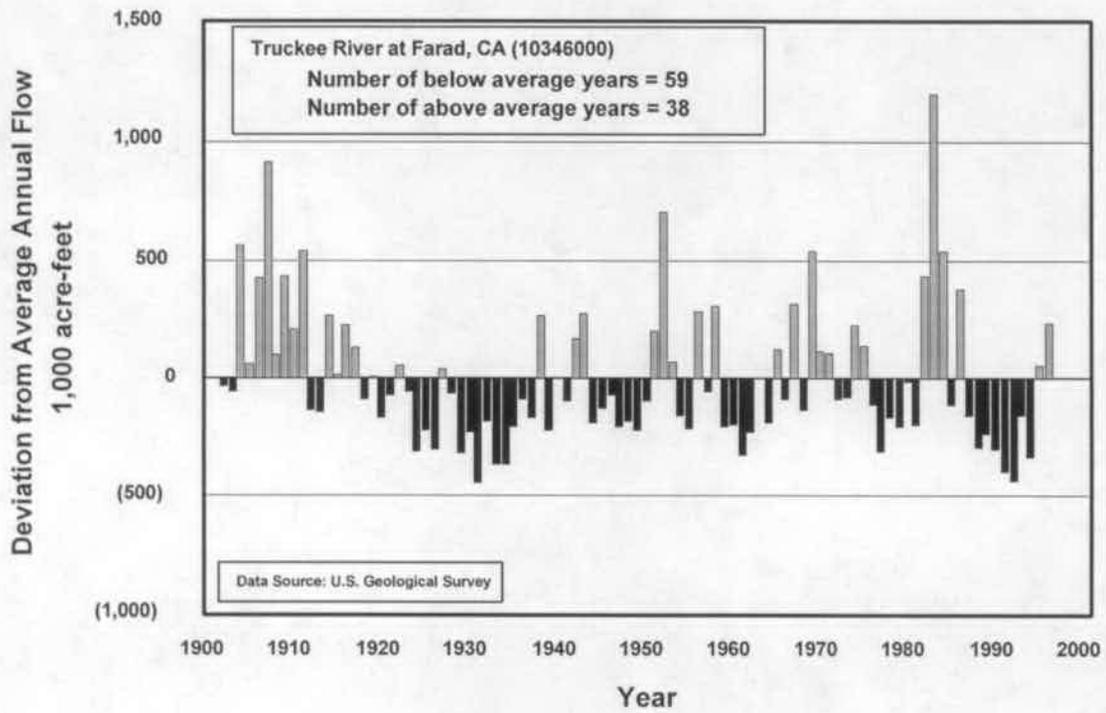


Fig. 4-9. Examples of Annual Deviations from Average Annual Flows

Table 4-5. Summary of Major Floods in Nevada, 1907-97

Date	Area Affected	Recurrence Interval (years)	Remarks
Mar. 1907	Sierra Nevada drainages	Unknown	May rank with 1950 and 1955 floods in Carson Valley and along Truckee River
Feb. 1910	Upper Humboldt River basin	>100	Similar to hydrologic conditions during Feb. 1962 flood.
Nov.-Dec. 1950	Sierra Nevada drainages	50	Not as severe as Dec. 1955 flood in Carson River drainage.
Dec. 1955	Sierra Nevada drainages	40 to 100	Most severe flood from upper Carson River drainage downstream to Carson City
Feb. 1962	Humboldt River drainage	>50 in upper Humboldt	Rapid thawing and light rain on snowpack
Feb. 1963	Sierra Nevada drainages	50	Severe in Carson and Truckee River drainages
Dec. 1964	Sierra Nevada drainages	20	
Sept. 14, 1974	Eldorado Canyon (dry tributary to the Colorado River, 50 miles southeast of Las Vegas)	>100	9 lives lost
July 1975	Las Vegas Valley	Unknown	2 lives lost
Aug. 1981	Moapa Valley and vicinity	Unknown	Severe damage to agriculture and highways.
Mar.-June 1983	Statewide except south	<10 to 50	Greatest snowmelt floods known (except in Humboldt River basin - see Apr.-June 1984).
July 1983	Las Vegas Valley, Muddy River	Unknown	
Apr.-June 1984	Centered in Humboldt River drainage	>100 along middle and lower Humboldt River	Greatest snowmelt floods known in Humboldt River basin.
July-Sept. 1984	Las Vegas Valley	Unknown	5 lives lost
Feb. 1986	Sierra Nevada drainages	10 to 50	Greatest discharge in main rivers since 1963
Jan. 1997	Sierra Nevada drainages	50 to >100	Heavy rainfall on snowpack

Source: National Water Summary 1988-89 - Floods and Droughts: Nevada, U.S. Geological Survey, Carson City, Nevada.; January 1997 Flooding in Northern Nevada - Was This a "100-Year Flood"?, U.S.G.S. Fact Sheet FS-077-97, U.S. Geological Survey, Carson City, Nevada, May 1997.

Water Quality

Nevada's surface water quality is regulated by the Nevada Division of Environmental Protection (NDEP) and the State Environmental Commission (SEC). The quality of surface water in Nevada varies greatly from location to location and from month to month with changes in flows. Tables 4-6 and 4-7 shows average total dissolved solids concentrations at a number of surface water monitoring sites throughout Nevada. In planning, both water quantity and quality need to be considered concurrently as both are interrelated. In general, constituent concentrations vary with changes in streamflow. Similarly, lake water quality is impacted by water levels in the State's terminal lakes. Figure 4-10 shows how total dissolved solids concentrations have increased in Walker and Pyramid lakes as the volume of water has decreased

Table 4-6. Comparison of Streamflow and Dissolved-Solids Concentrations at Selected USGS Water-Quality Sites

U.S.G.S. Water Quality Station	Mean Concentration of Dissolved Solids, milligrams per liter	Mean Discharge, cubic feet per second
Virgin River at Littlefield, AZ (09415000)	1,990	243
Colorado River below Hoover Dam, AZ-NV (09521500)	697	13,840
Steptoe Creek near Ely, NV (10244950)	180	7.0
South Twin River near Round Mountain, NV (10249300)	86	6.6
Carson River near Carson City, NV (10311000)	199	405
Humboldt River near Carlin, NV (10321000)	301	375

Source: Water Resources Data, Nevada, Water Year 1996, U.S. Geological Survey Water Data Report NV-96-1

Table 4-7. Comparison of Streamflow and Dissolved-Solids Concentrations at Selected NDEP Water-Quality Sites

NDEP Water Quality Station	Mean Concentration of Dissolved Solids, milligrams per liter	Mean Discharge, cubic feet per second
Truckee River at Tracy, NV	160	780
Walker River at Snyder Lane	200	180

Source: Nevada Division of Environmental Protection files, U.S. Geological Survey data, and Nevada Division of Water Planning files

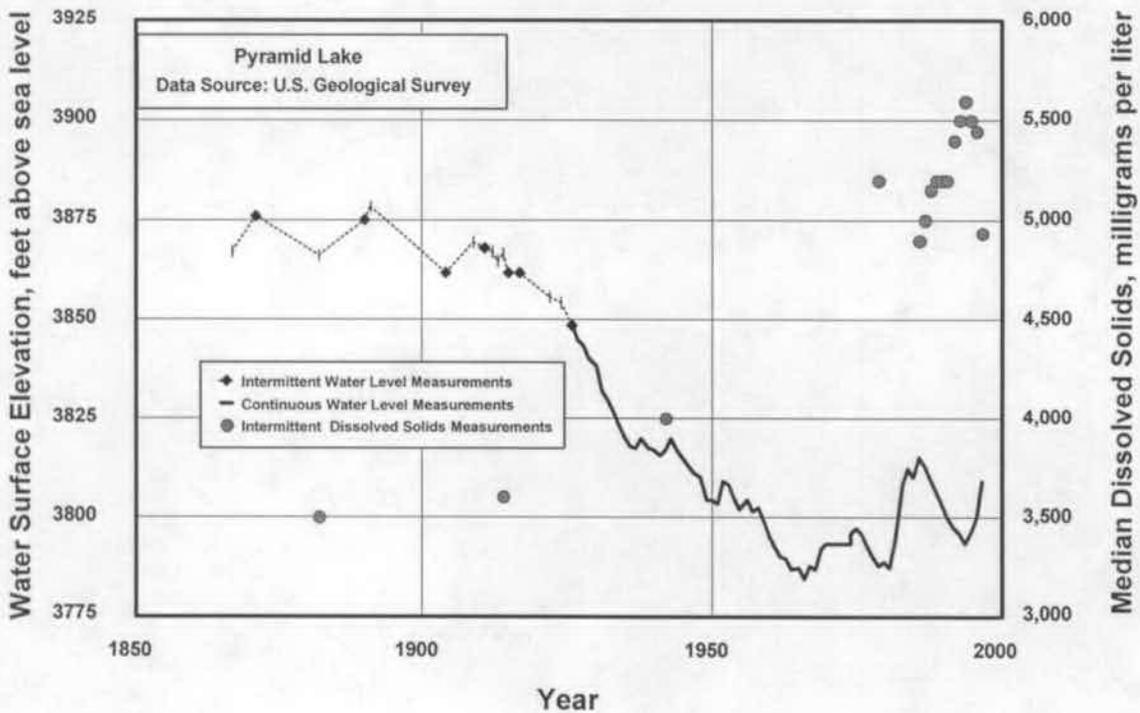
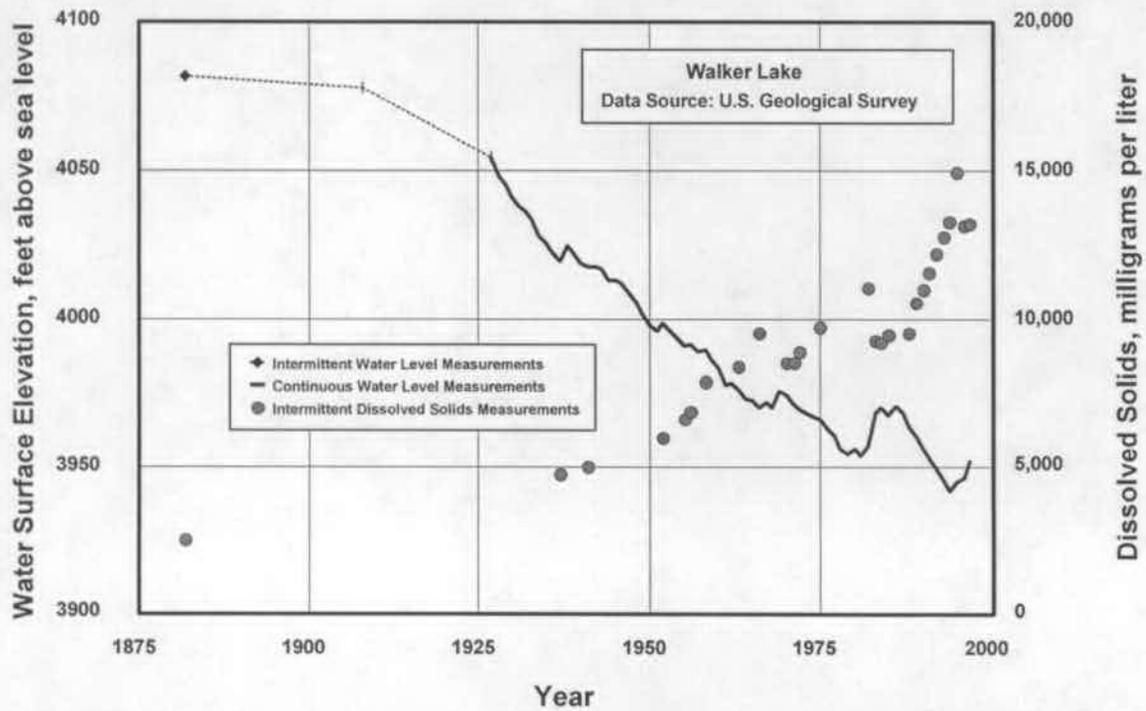


Fig. 4-10. Water Surface Elevations and Dissolved Solids Concentrations at Walker and Pyramid Lakes

The impacts on water quality from the municipal and industrial discharges have been greatly reduced over the last few years, with most point source pollutants eliminated from direct discharges or stringently controlled. Nonpoint source pollution due mainly to agriculture, urban runoff and hydrologic modifications impacts various waters of Nevada. Water quality parameters of concern include nutrients, suspended solids, turbidity and bacteria which are being targeted in the State's Nonpoint Source Program administered by NDEP. Water quality has been improving due to the removal of point sources and the implementation of more stringent standards. The Nonpoint Source Program helps to further improve water quality by promoting public awareness, improved grazing and irrigation practices, erosion control measures and the implementation of best management practices.

Surface Water Quality Management and Data Collection. Nevada's surface water quality is regulated by NDEP and the SEC. Certain aspects of the Federal Clean Water Act are implemented by NDEP for programs within Nevada. With assistance from federal grants, NDEP operates a surface water quality monitoring program of water bodies in Nevada, regularly monitoring over 100 sampling points in the 14 hydrographic regions. Section 303(d) of the Clean Water Act requires the State to develop a list of water bodies that need additional measures beyond existing controls to achieve or maintain water quality standards. The Section 303(d) list, developed by NDEP, provides a comprehensive inventory of water bodies impaired by all pollution sources, including point sources and nonpoint sources. This inventory is the basis for targeting water bodies for watershed-based solutions. Nevada's first priority in targeting water bodies is impairment of the beneficial use standards. In general, a water body is included on the 303(d) list if the beneficial use standards were exceeded more than 25% of the time. The current 303(d) list is available from NDEP upon request. For a more complete description of NDEP water quality programs, refer to Part 1, Section 3 of the *State Water Plan*.

As of 1996, the USGS collected water quality data for 96 stream, canal, spring and drain sites throughout Nevada as part of their systematic data-collection program. In addition to routine monitoring, USGS is also conducting the National Water Quality Assessment Program (NAWQA) in Nevada and throughout the United States in response to the lack of long-term, consistent information on water quality nationwide. NAWQA Program goals are to describe the status and trends in the quality of the Nation's water resources and to provide scientific understanding of the major factors which affect surface and ground water quality. The Nevada NAWQA Project began in 1991 and includes the Las Vegas Valley area and the Carson and the Truckee River Basins. Project scientists are using multi-disciplinary approaches to compare and contrast the effects of urban and agricultural activities on water quality.

Groundwater

Groundwater in Nevada is an important water supply source. The surface water resources in our state have been virtually fully appropriated and future development must rely on either ground-water sources or the reallocation of surface water supplies. Groundwater provides about 40 percent of the total water supply used in Nevada and in some areas provides the entire supply. The extent to which groundwater is used may vary considerably from year to year. In many areas, groundwater is pumped to supplement surface water sources. As a result, groundwater usage in these areas increases during periods of low streamflow and decreases during high runoff periods.

Proper planning and management of our ground-water resources cannot occur without knowledge about aquifer location, perennial yield, recharge, storage volume, committed resources (water righted amounts), actual water usage, water levels, water quality, and projected trends. The following sections provide available background information on Nevada's groundwater resources.

Principal Ground-water Aquifers

Principal ground-water aquifers in Nevada are basin-fill aquifers, carbonate-rock aquifers, volcanic-rock aquifers, and volcanic- and sedimentary-rock aquifers (Figure 4-11). The basin-fill aquifers, composed primarily of alluvial, colluvial and lacustrine deposits, are the major aquifers in the State. Virtually all major ground-water development has been in the basin-fill aquifers with the withdrawals from the upper 500 feet of these aquifers. In eastern and southern Nevada, thick sequences of carbonate rock underlie many of the alluvial basins forming a complex regional aquifer system or systems that are largely undeveloped and not yet fully understood. The carbonate-rock aquifer supplies water to numerous springs which are used for irrigation. Volcanic-rock aquifers extend over hundreds of square miles but only one volcanic-rock aquifer in the Carson Desert (Churchill County) of west-central Nevada has been developed as a municipal water supply.

Within the Basin and Range Province, aquifers are generally not continuous, or regional, because of the complex faulting in the region. Of the aquifer types discussed above, any or all may be in, or underlie, a particular basin and constitute separate sources of water. However in some instance, interconnection between the aquifers may exist.

Groundwater and Surface Water Interaction

Groundwater and surface water cannot be viewed as independent and separate sources in water management decisions. In some areas, groundwater may discharge into streams and contribute significantly to surface water flows. Groundwater usage may lessen surface flows in these instances. Conversely, surface water infiltrates into the groundwater systems through natural causes and/or human activities (such as irrigation). As a result, changes in surface water flows and usage may impact groundwater levels.

Figure 4-11 Aquifers

Perennial Yield and Committed Resources

Perennial yield is the amount of usable water from a ground-water aquifer which can be economically withdrawn and consumed each year for an indefinite period of time without depleting the source. Estimates of perennial yield are necessary to provide the State Engineer with a guideline by which to limit groundwater allocations (committed resources).

Recognizing the need for more detailed groundwater information, such as perennial yield estimates, the State Engineer and the U.S. Geological Survey (USGS) began a cooperative groundwater study program in 1945 with funding from the State Legislature. A number of water resource bulletins have been produced from this program. However, the most statewide comprehensive groundwater study efforts did not begin until the State Legislature in 1960 authorized a series of ground-water reconnaissance studies be performed under the cooperative supervision of the Nevada Division of Water Resources (NDWR) and the USGS. This program, which extended until 1974, resulted in 60 reconnaissance reports covering the hydrology of 219 hydrographic areas. Based upon these reports, the water resources bulletins, and other more recent studies, estimates of perennial yield have been developed for the 256 hydrographic areas. The total combined perennial yield of the basin-fill aquifers statewide is approximately 2.1 million acre-feet per year. The perennial yield figures currently available are estimates only and provide guidelines for water planning and management. In developing these estimates, the USGS utilized the Maxey-Eakin method which was developed between 1947 and 1951. While some of the perennial yield estimates have been updated with more current methodologies, many of the yield estimates in use today were developed over 25 years ago.

In basins with significant groundwater discharge to streams, the USGS developed system yield estimates in addition to the groundwater perennial yield estimates. System yield is the amount of usable groundwater and surface water that can be economically withdrawn and consumed each year for an indefinite period of time without depleting the source. For these basins, the perennial yield estimates may include groundwater discharges to surface streams. Development of these groundwater aquifers could potentially reduce surface flows and impact downstream surface water users.

Under the authority granted in Nevada Revised Statutes 534, the State Engineer issues groundwater rights. The term “committed resource” represents the total volume of the permitted, certificated and vested groundwater rights which are recognized by the State Engineer and generally can be withdrawn from a basin or area in any given year. When reviewing groundwater right applications, the State Engineer considers the individual and regional perennial yield estimates, system yield estimates, and the committed resources amounts among other things in making determinations.

Nevada State Water Plan

To assist in the tracking of the committed groundwater resources, NDWR maintains a computer database of state-issued water rights. Based upon this database, the total committed groundwater resource amount in Nevada equals about 3 million acre-feet per year (as of March/April 1998). The term "committed" refers to those water rights that are either permitted or certificated. Table 4-8 and Figure 4-12 summarizes the committed resources by hydrographic region and by type of use. Committed resource values presented in the *State Water Plan* are time sensitive and subject to change from future actions on pending applications and other procedures. It must be noted that the 3 million acre-feet figure is calculated from NDWR database output and represents the estimated amount of the groundwater resources committed (permitted or certificated) to a particular beneficial use. The database is still under development and all committed resource numbers presented in the *State Water Plan* are approximate. Actual groundwater withdrawal and consumption amounts are far less than the committed resource value of 3 million acre-feet. In 1995, approximately 1.6 million acre-feet of groundwater was withdrawn with about 0.7 million acre-feet consumed. There are a number of reasons for these differences:

- Some groundwater rights are *supplemental* to surface water rights. Supplemental groundwater is generally pumped only as needed to augment low surface water supplies. As a result, supplemental groundwater rights are not usually exercised to their fullest extent every year.
- Some groundwater rights are *supplemental* to other groundwater rights with one well pumped to augment the supply from another well. When this supplemental relationship exists between rights, the State Engineer assigns a combined annual pumpage duty for both wells which is less than the sum of each well's individual duty. The NDWR database does not automatically account for these supplemental situations. NDWR staff must first make adjustments to the database numbers to avoid double counting of these supplemental commitments. These adjustments have been made to the database for about 35% of basins. In the other basins, committed resources values as taken from the NDWR may be overestimated due to double counting of the supplemental water rights.
- Some groundwater rights may not be exercised to their fullest extent every year. For example, municipalities are allowed to hold water rights in reserve as needed for future growth.
- Some groundwater rights are not currently being exercised as a water supply is being provided from another source. For example, groundwater being pumped as part of the mine dewatering operations at Barrick's Post/Betze-Meikle Mine is utilized for irrigation in Boulder Flat Valley (Humboldt River Basin). Both the irrigation and mine dewatering are separately permitted with their permitted pumpage amounts included in Table 4-8. However under this situation, the irrigation operation is using the pit water rather than pumping the irrigation wells and exercising their groundwater rights. The NDWR database is not capable of adjusting for this type of substitution, and database printouts obtained for the *State Water Plan* include both the irrigation rights and the dewatering rights in the committed resource values.

Table 4-8. Approximate Perennial Yield and Committed Groundwater Resources (as of March/April 1998) by Use and Hydrographic Region

Hydrographic Region	Combined Perennial Yield, acre-feet per year	Committed Groundwater Resources by Category, acre-feet per year (as of March/April 1998)					Total
		Irrigation & Stock	Municipal & Quasi-municipal	Mining & Milling ¹	Commercial & Industrial	Other ²	
1. Northwest Region	55,500	28,625	6	132	5	64	28,832
2. Black Rock Desert Region	178,825	215,658 ³	608	58,952 ⁴	920 ⁵	1,687 ⁵	277,825
3. Snake River Basin	62,100	8,091	1,145	7,813	4,877	511	22,437
4. Humboldt River Basin	463,900	492,307 ^{3,6}	53,737	141,576	63,637 ⁵	91,055 ⁷	842,312
5. West Central Region	8,200	1,678	8,743	58	28,249 ⁵	1,289	40,017
6. Truckee River Region	76,425	34,989 ³	83,902 ⁸	5,172	68,030 ⁵	19,014	211,107
7. Western Region	17,850	18,662	5,174	5,174	518	508	25,328
8. Carson River Basin	70,255	95,926 ³	62,438	4,068	12,979 ⁵	13,196 ⁵	188,607
9. Walker River Basin	57,300	205,354 ³	14,949	8,657	12,383 ⁹	6,019	247,362
10. Central Region	798,460	573,277	50,978	96,765	37,141 ⁵	9,775 ⁵	767,936
11. Great Salt Lake Basin	63,150	28,155	3,506	1,305	732	13	33,711
12. Escalante Desert Basin	1,000	2	0	0	0	0	2
13. Colorado River Basin	219,800	78,057 ³	101,362 ¹⁰	11,171	35,895	19,165 ¹¹	245,650
14. Death Valley Basin	24,550	22,325	2,154	6,086	638	333	31,536
TOTAL	2,097,315	1,803,106	388,702	342,221	266,004	162,629	2,962,662

General notes:

- A. Data on committed resources were obtained from the Nevada Division of Water Resources water rights database and represent estimated resources committed as of March/April 1998.
- B. The committed resources values include permitted and certificated amounts only.
- C. These numbers are preliminary and intended to be used for planning purposes only. Totals may include water rights that have not been adjusted for supplemental relationships with other groundwater rights. Also, totals do not include any adjustment for supplemental relationships with surface water rights. Values are subject to change due to pending water right applications, and possible cancellations and forfeitures.

Other notes:

- ¹ Mining is considered a temporary use by the State Engineer's Office and upon cessation of mining, many permits will expire. The "Mining & Milling" category includes only those rights associated with the consumptive use needs of the mines. Permits associated with dewatering operations are included in the "Other" category.
- ² "Other" includes following uses: domestic, environmental, power generation, recreation, storage, wildlife, other/decreed. Includes environmental permits issued for environmental cleanup projects. These environmental permits are temporary and expire upon cessation of cleanup activities.
- ³ Portions of rights are supplemental to surface water and are used only when surface water is not available.
- ⁴ Majority of rights held for a mine operation that is no longer pumping.
- ⁵ Portion of rights include geothermal pumpage for power generation, with majority of geothermal water reinjected into geothermal reservoir.
- ⁶ Portion of rights not exercised as mine pit dewatering discharge is being used as a substituted water source. See Footnote 7.
- ⁷ Includes rights associated with mine pit dewatering. Portion of withdrawals are used as a water source for irrigation. See Footnote 6.
- ⁸ Actual annual pumpage limited to lower value by State Engineer restrictions.
- ⁹ Portion of rights include geothermal pumpage for power generation, with some of geothermal water not reinjected.
- ¹⁰ Includes permits that will be revoked when water right holders provided water from another source (Colorado River).
- ¹¹ Includes environmental permits issued for environmental cleanup projects. These environmental permits are temporary and expire upon cessation of cleanup activities. Also includes permits granted for pumping of shallow poor quality groundwater in the Las Vegas area as needed to alleviate potential hazards resulting from rising groundwater levels caused by secondary recharge.

Figure 4-12. Estimated Committed Groundwater Resources by Type of Use and Hydrographic Region.

- The State Engineer has placed administrative limits on pumping in some areas. For example, the State Engineer has limited pumpage by Sierra Pacific Power Company from the Truckee Meadows Basin to an amount less than Sierra's water right duty. The NDWR database is not capable of reflecting this pumpage limit in any calculation of committed resource amounts. Any committed resource values taken from the NDWR database reflect only the permitted/certificated pumpage amounts, not any pumpage limits.

The committed resource figures derived from the NDWR database may not reflect long-term groundwater commitments for the following reasons:

- Mining is considered a temporary use by the State Engineer's Office. With some mines, existing water right permits will expire once the mining operations have ceased.
- Environmental permits issued for environmental cleanup projects are included in the committed resource figures in Table 4-7. The cleanup projects are considered temporary, and once a cleanup operation is complete the associated water rights expire.
- The NDWR database includes committed resource amounts associated with revocable groundwater permits issued in the Las Vegas area. These rights will be revoked when the water right holders are provided water from another source, such as the Colorado River.

Management of Groundwater Rights Information

The total committed groundwater resource values presented in Table 4-8 and Figure 4-12 were derived directly from the NDWR database as of March and April 1998. At that time (March/April 1998), approximately 85 percent of all state-issued water rights in Nevada had been entered into this database. However, the groundwater rights for 88 of the 256 basins have been completely entered into the database and adjusted for supplemental rights (Figure 4-13). As a result, the committed resource figures from the NDWR database for these 88 basins are more accurate than for the other 168 basins, and the committed resource totals derived from the NDWR database maybe slightly lower than the actual amount. Committed resource values for the 168 basins should be considered preliminary estimates. Also, the committed resource values in some basins change daily. Current estimates should be obtained from the Nevada Division of Water Resources.

Groundwater Availability

As the demand for groundwater has increased over the years, the State Engineer has had to increase administrative efforts in some of the groundwater basins. The State Engineer may designate a groundwater basin which is being depleted or is in need of additional administration. Basins are designated through orders issued by the State Engineer. By "designating" a basin, the State Engineer is granted additional authority in the administration of the groundwater resources within the designated basin. For example, the State Engineer may issue orders which define preferred uses, deny certain water uses, or curtail pumpage. Preferred uses may include domestic, municipal, quasi-municipal, industrial, irrigation, mining and stock-watering uses or any other beneficial use. Each basin is managed as a separate unit with the State Engineer issuing orders and rulings as needed for

Figure 4-13 Basins with GW rights on NDWR database

the management of the groundwater resources. Figure 4-14 displays the designation status for the 256 groundwater basins in Nevada. This map is a useful tool to generally determine where the greatest impediments to groundwater development may exist. However, the associated State Engineer's orders and rulings need to be examined for a complete understanding of the management issues and water availability within a basin. The designation status of basins as defined by the State Engineer's orders have been divided into four general categories as shown in Table 4-9.

Table 4-9. Designated Groundwater Basin Categories

Designation Status	General Description of Associated State Engineer's Orders
Designated	State Engineer's order(s) do not define any administrative controls.
Designated - Irrigation Denied	State Engineer's order(s) state that irrigation is <u>not</u> a preferred use in these basins and applications for new irrigation appropriations will be denied.
Designated - Preferred Uses	State Engineer's order(s) list certain types of uses as preferred in these basins, and quantity restrictions may be placed on these preferred uses.
Designated - Preferred Uses; Irrigation Denied	State Engineer's order(s) list certain types of uses as preferred in these basins. Quantity restrictions may be placed on these preferred uses. State Engineer's order(s) also state that irrigation is <u>not</u> a preferred use in these basins and applications for new irrigation appropriations will be denied. Other uses may also be listed as denied.

Whether or not a basin is designated dictates the procedures to be followed in obtaining a groundwater permit. In undesignated basins, a person can drill a well in these basins prior to filing an application for a groundwater permit. In designated basins, a groundwater permit must be obtained prior to drilling a well. Domestic wells are exempt from the permitting process, however, drillers are required to notify the State Engineer of their intent to drill a domestic well and submit a well log following completion.

In general for basins with preferred uses defined, applications for preferred uses are considered by the State Engineer prior to applications for non-preferred uses. However, the State Engineer has the authority to deny applications for non-preferred uses even though the designation orders do not explicitly prohibit these uses. Regardless of the basin designation status, the State Engineer has the authority to deny a water application if: 1) there is not unappropriated water; 2) the proposed use will impair existing rights; 3) the proposed use will be detrimental to the public interest; and 4) the project is not feasible and is filed for speculative purposes.

Figure 4-15 presents a general picture of the uncommitted groundwater resources in Nevada. "Uncommitted groundwater resources" are assumed equal to perennial yield estimates less permitted and certificated water right amounts as extracted from the NDWR water rights database as shown on Table 4-7. Approximately 60% of the 256 basins have committed resource volumes below the perennial yield estimates. The following qualifiers apply to the data upon which this map is based:

Figure 4-14 - Designated basins

Figure 4-15.uncommitted gw

- The perennial yield figures are estimates only and are subject to change following future studies.
- In some basins, groundwater aquifers discharge to streams thereby providing a portion of the supply for downstream surface water users. In these basins, development of the entire perennial yield amount could potentially impact surface water uses.
- The committed resource numbers upon which this map is based are subject to change on a daily basis as a result of new actions, such as approval of pending applications or forfeitures. About 1/3 of the groundwater basins have pending applications. The most current information can be obtained from NDWR.

Groundwater Data Collection

NDWR and USGS collect a majority of the groundwater usage and level data in Nevada as described in the following discussion.

Pumpage and Crop Inventories. As part of their groundwater management duties, NDWR performs annual estimates of pumpage or “pumpage inventories” for some of the groundwater basins. Generally, these pumpage inventories are based upon a mixture of both actual measurements and estimates. In other basins, NDWR performs crop inventories in which irrigated crop acreages and associated water use are estimated. Figure 4-16 shows the basin locations for these inventories and their status. Some pumpage data are submitted to NDWR by the permit holders as a requirement of water right permit conditions, however these data do not represent all of the groundwater use within these basins. Figure 4-17 shows the basin for which groundwater pumpage data are submitted to NDWR as required by water right conditions.

Groundwater Level Data. The USGS and NDWR are the primary agencies collecting groundwater level data on a statewide basis. In the report entitled “Water Resources Data, Nevada, Water Year 1996” which is part of an annual series, the USGS presents water level data for 145 primary observation wells (measured monthly or more frequently) and 1041 secondary observation wells (measured one to four times per year) within 98 hydrographic basins. These water level data are maintained in electronic databases. Some of the groundwater level data presented in USGS’s annual report have been collected by other agencies and then compiled by the USGS. NDWR currently collects groundwater level data in 73 basins. Figure 4-18 shows the basins where the USGS and NDWR collect groundwater level data. Most of the NDWR data is collected once a year, typically in the spring. Only a portion of the NDWR data are maintained in the USGS database with the remaining data stored in paper files.

Groundwater levels fluctuate seasonally and annually in response to changes in pumpage and the climate. Figure 4-19 shows long-term groundwater levels for six selected wells throughout Nevada. In some areas, groundwater levels during the late 1980s and early 1990s tended to decline due to heavier than average reliance upon groundwater during the drought of that period, but have been recovering with the return to normal and above-normal precipitation.

Figure 4-16. Crop inventory

Figure 4-17. Pumpage data

Figure 4-18. Level collection

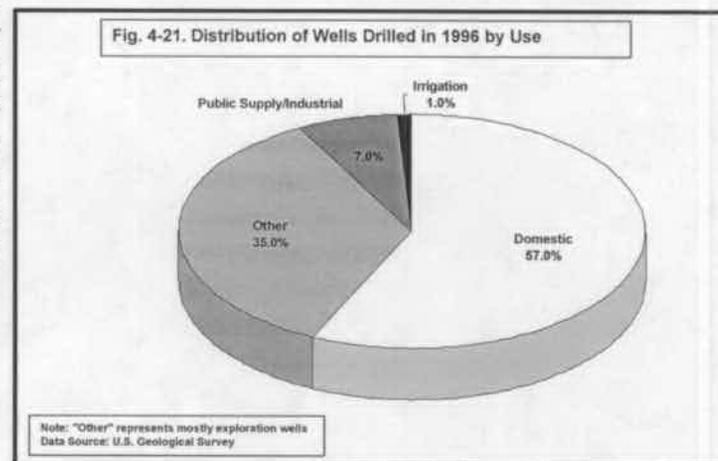
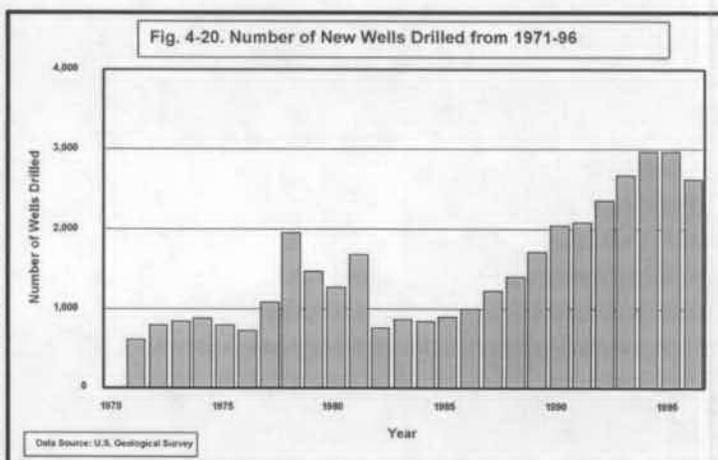
Figure 4-19. Water levels

Nevada State Water Plan

As shown on Figure 4-19, significant groundwater level declines have occurred in Diamond Valley. In response, the State Engineer has designated the basin and has taken actions to reduce total pumpage in the basin. Las Vegas Valley has also experienced significant groundwater level declines (Figure 4-19) due to overpumpage. Another result of overpumping groundwater is the reduction of artesian pressures in the aquifer, which leads to the compaction of aquifer materials and to land surface subsidence. Subsidence in the Las Vegas Valley has been monitored since 1935. Since that time, the land surface has subsided over five feet in many areas of the valley. A number of actions have been taken to address the basin overdraft and subsidence problems. Starting in 1987, the Las Vegas Valley Water District began an artificial recharge program to temporarily store Colorado River water in the principal aquifer during times of lower water use. The State Engineer has designated the basin and has taken actions to reduce pumpage in the basin. In 1997 the Nevada State Legislature created a Las Vegas Valley Groundwater Management Program for the oversight, protection and stabilization of the basin's groundwater supply.

Well Logs. Since the 1940s, well logs have been submitted to the State Engineer's Office. These well logs include a variety of information such as: well location, drilling method, proposed use, well depth, and depth to water. Examination of these logs indicates that groundwater development in Nevada has continued to expand over the years. Figure 4-20 displays the increase experienced in the number of wells drilled annually from 1971 to 1996. In 1996, there were approximately 2,632 new wells drilled in Nevada. Of this total, about 1,500 wells were for domestic uses and about 900 were exploration wells (Figure 4-21). In 1996 the well drilling was concentrated in the north-central, northwestern, and southern parts of the State.

In 1994, NDWR and USGS cooperatively developed a computer database for managing the well log information. Currently, the database contains information on approximately 50,000 wells in Nevada. The database does not contain any detailed information on the subsurface geology.



Groundwater Quality

The quality of water from most aquifers in Nevada is suitable or marginally suitable for most uses. Most aquifers contain water with a majority of the constituent concentrations not exceeding State and national drinking water standards. However, there are parts of some aquifers with constituent concentrations exceeding these standards. It is important to realize that these excessive concentrations of certain constituents in groundwater may result from both natural processes and/or human activities.

The quality of groundwater in the unconsolidated deposits in the Basin and Range alluvial aquifers varies from basin to basin. Dissolved-solids concentrations range from less than 500 parts per millions (ppm) to more than 10,000 ppm in some areas (Figure 4-22). By comparison, ocean water has dissolved-solids concentrations of about 35,000 ppm. Locally, saline water is present near thermal springs and in areas where the basin-fill aquifers include large amounts of soluble salts. In discharge or sink areas such as the Carson and Humboldt sinks, the dissolved-solid concentrations can make the water economically unuseable. Although highly mineralized water is common in aquifers beneath playas, a deeper freshwater flow system may be present in some areas.

Groundwater Quality Management and Data Collection. Groundwater quality is regulated by NDEP and the SEC. Certain aspects of the Federal Clean Water Act and the Safe Drinking Water Act are implemented by NDEP within Nevada. Groundwater quality is monitored by NDEP, and other State and Federal agencies. However, there is no ambient groundwater quality monitoring network in Nevada as there is with the surface water resources. Most of the available groundwater quality data are the result of special studies in specific areas, monitoring required by State permitting programs and by drinking water regulations. For instance, NDEP may require groundwater monitoring for groundwater discharge permits issued for industrial plants, land applications of treated sewage effluent, and geothermal injection wells. Groundwater monitoring also may be required in response to suspected contamination, such as mining sites or leaking fuel tanks.

Other NDEP activities include the development of the Comprehensive State Ground Water Protection Program (CSGWPP) and the Wellhead Protection Program (WHPP). NDEP initiated the CSGWPP to protect groundwater resources throughout Nevada and has received EPA endorsement on the program. The WHPP is intended to protect existing and future municipal groundwater resources. For a more complete description of NDEP water quality programs, refer to Part 1, Section 3 of the *State Water Plan*.

All community water systems are required to monitor water quality under the Federal Safe Drinking Water Act and State law for both groundwater and surface water systems. The State Health Division, Bureau of Health Protection Services, uses these data to check for compliance with the drinking water standards.

Figure 22 - tds

Another significant source of groundwater quality data is the USGS. The USGS undertakes a wide range of special studies in specific basins which results in the collection and compilation of groundwater quality data. As of 1996, the USGS is collecting water quality data for 111 wells within 11 of the 256 hydrographic basins. As stated above, most groundwater monitoring is short-term and site specific in response to a particular problem. This lack of continuous, long-term groundwater quality data makes any trend assessments a difficult proposition. In response to the lack of long-term, consistent information on water quality nationwide, the USGS developed the National Water-quality Assessment (NAWQA) Program. NAWQA Program goals are to describe the status and trends in the quality of the Nation's water resources and to provide scientific understanding of the major factors that affect surface and ground water quality. The Nevada NAWQA Project began in 1991 and includes the Las Vegas Valley area and the Carson and the Truckee River Basins. Project scientists are using multi-disciplinary approaches to compare and contrast the effects of urban and agricultural activities on water quality.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 5
Socioeconomic Background

Introduction

This section of the *Nevada State Water Plan* provides an overview of demographic and economic characteristics and trends within the State of Nevada. Nevada's seventeen counties have shown considerable variation in their population s growth rates and other economic conditions. To facilitate a better understanding of these county-specific conditions and trends, individual county socioeconomic overviews have been compiled as stand-alone publications in support of the state water plan.

Nevada's present and future water needs can only be determined in concert with a thorough understanding of the trends in the state's population growth and economic prospects. This overview of Nevada's socioeconomic characteristics is intended to provide the baseline information upon which future water demands can be determined. By analyzing and combining economic conditions and water usage patterns with forecasts of future socioeconomic trends, a more accurate picture of Nevada's future water use needs can be derived.

Early Settlement Patterns, Economic Pursuits and Population Trends

Nevada's earliest European settlements served the needs of the first emigrant wagon trains traveling to Oregon and California. In the 1850's, in the northern part of the state, water diversions for irrigation originated along the Humboldt, Carson, Truckee and Walker rivers to facilitate increased agriculture production, making this the state's first and longest lasting industry. In the southern part of the state, the city of Las Vegas and the valley in which it lies were named for the lush meadows supported by natural artesian springs. The first organized water diversion and irrigation efforts in the state was recorded in the Las Vegas Valley, where early Mormon colonists began diverting the flow of Las Vegas Creek for agricultural purposes.

Later, in the 1860's, the early discoveries of Nevada's vast mineral wealth, particularly with the Comstock Lode (Storey County), Aurora (Mineral County) and Bodie (California), led to an expansion of agriculture and ranching endeavors in Smith and Mason valleys (Lyon County). Carson Valley (Douglas County) and Stillwater (Churchill County) also became important agricultural centers for the early influx of miners. A virtual explosion in population took place in Nevada's various mining districts. Water, and particularly its availability and use, soon influenced Nevada's growth patterns. Early in Nevada's development, water-rights conflicts arose among the mines and ore-

processing mills, the loggers and lumbermen, and the state's agricultural interests.

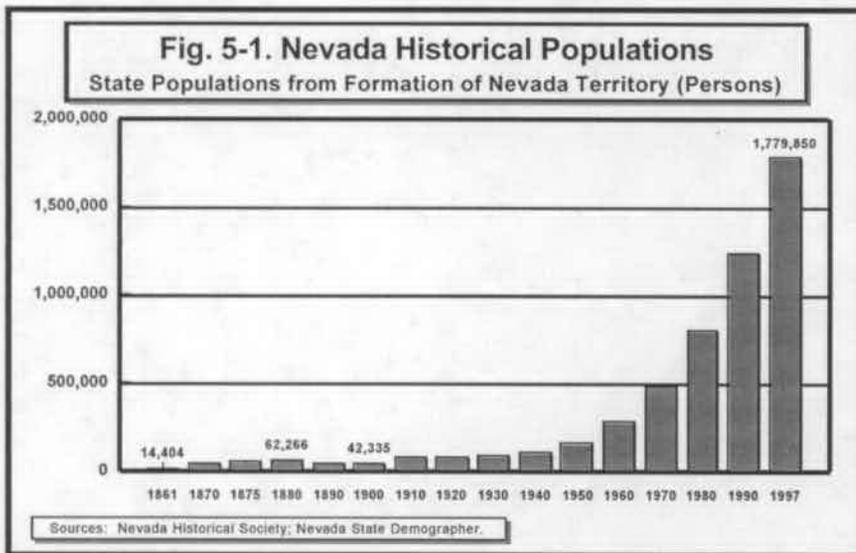
On November 25, 1861, the Nevada Territory was separated from the Utah Territory and the first Nevada Territorial Legislature met in Carson City and carved nine counties out of the newly created territory — Churchill, Douglas, Esmeralda, Humboldt, Lyon, Ormsby (later Carson City), Storey, Washoe and Lake counties. Just over a year later Lake County, which comprised the northern portion of present-day Washoe County, was renamed Rook County, and finally, in 1883, it became incorporated into Washoe County. At its inception, Esmeralda County comprised virtually four-fifths of the area of the new Territory of Nevada, with the remaining eight counties clustered in the northwestern portion of the state. Eventually, Esmeralda County was whittled down, ultimately resulting in the creation of an additional eight counties for Nevada.

While Nevada was still a territory, both Lander County (1862) and Nye County (1864) were created out of Esmeralda County. After statehood was obtained on October 31, 1864, Lincoln County, named after the President who supported Nevada's entry into the Union, was formed in 1866 out of Nye County. Then, in 1869, Elko and White Pine counties were created out of Lander County, as was Eureka County in 1873. Later, in 1908, Clark County was formed out of the southern portion of Lincoln County, Mineral County was formed in 1911 out of Esmeralda County, and finally, rounding out Nevada's present 17 counties, Pershing County was formed in 1919 out of the southern portion of Humboldt County. (See the Nevada and county map on the inside of the front cover.)

Based on a special territorial census conducted in 1861, Nevada's population was recorded at 14,404 persons, with the greatest portion, or 4,581 persons, residing in and around Virginia City (Storey County). By the 1870 census, Nevada's population had risen dramatically to 42,491 persons, of which 11,359 inhabitants, or 27 percent of the state's total, were located in Virginia City and its environs, and 7,189 persons, or another 17 percent of the state's total population, were located in and around Ely in White Pine County. These constituted the two principal mining centers in the state at that time. Meanwhile, Reno's (Washoe County's) population of only 3,224 persons comprised less than eight percent of the state's total population, while Las Vegas (Clark County) was still part of

Lincoln County (1870 population of 2,985) and would not come into its own until 1908.

By 1875 the state's population had grown to 52,630 persons and that of Virginia City, mirroring the fortunes of the Comstock Lode silver mining boom, had peaked at 19,528 residents, comprising over 37 percent of the state's total population.

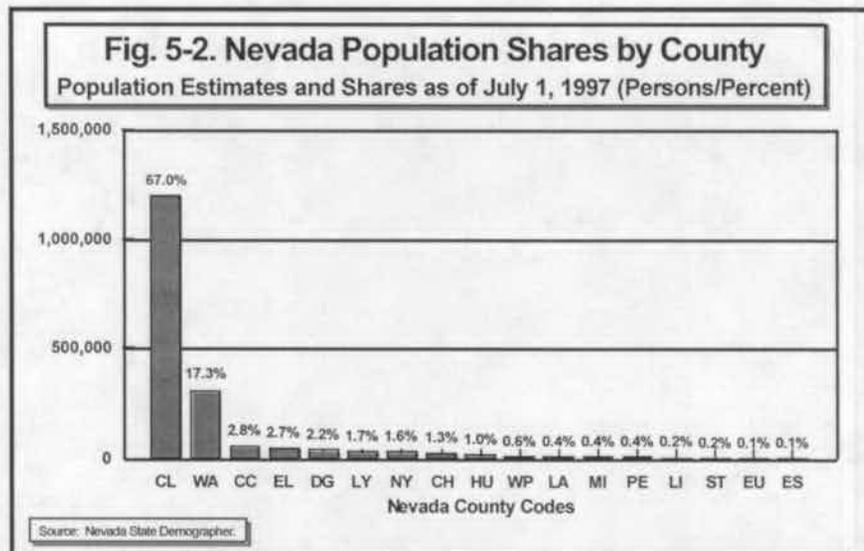


By 1877, however, the era of the Comstock mines was beginning to wane. While mining efforts in this area continued at a far reduced scale for another 20 years, the last of the great bonanzas, uncovered in 1875, steadily and gradually played out after 1880. By the time of the 1880 census, the state's population had risen to 62,266 persons, although with the decline of the Comstock, Virginia City's population, at 16,155 persons, had begun its inevitable decline.

By the turn of the century, the collapse of the mining industry produced the state's Great Depression of 1880–1900, reducing Nevada's population to 42,335 persons in 1890, down nearly 20,000 persons and 32 percent from that recorded in 1880 (see Figure 5–1). The temporary demise of Nevada's mining industry led to profound population contractions throughout the state with almost 16,000 persons abandoning the Comstock mining area alone. As a result, by 1900 only 3,673 persons remained in Virginia City to work the mine tailings and eke out an existence as best they could. This exodus from the Comstock continued virtually unabated and by 1930 less than 700 persons remained in the town that had, quite literally, secured a place for Nevada in the Union.

Nevada's 1900 census of population showed that Reno, located along the Truckee River, had become the dominant socioeconomic center of the state, a distinction it would not relinquish until late in 1950 to Las Vegas. Reno's 9,141 residents recorded in the 1900 census accounted for almost 22 percent of Nevada's total population. The other two large communities were Winnemucca, located along the Humboldt River and the path of the Central Pacific Railroad, which accounted for 4,463 of the state's population, and Elko, with 5,688 residents. Together, these three large agriculture-based economies — Reno, Winnemucca, and Elko — strategically located along both river systems and rail routes, accounted for over 45 percent of Nevada's 42,335 total residents in 1900. Interestingly, some 30 years before this time, the two major mining areas of the state — Virginia City and Ely — had comprised an identical 45 percent of the state's total population. By 1890, however, their share of Nevada's total resident population had fallen to only 13 percent, and would eventually fall to less than one percent by 1997. It was not the last time that mining in Nevada so abruptly altered the socioeconomic patterns and fortunes of a region.

New mineral discoveries and massive infusions of capital and labor brought Nevada back to its feet and effectively ended the state's 1880–1900 Great Depression. On May 19, 1900, an erstwhile miner named Jim Butler discovered a promising outcrop of ore in the desert of southwestern Nevada. Initial assays revealed over 640 ounces of silver and \$200 of gold per ton. The rush



was on to the Goldfield Mining District and the cycle of prosperity, so reminiscent of the Comstock era, provided an unexpected boon to the state. During the 1900 census, Goldfield's (Esmeralda County) population was recorded at only 1,972 persons. Within five years, this isolated mining community had swelled to between 25,000 and 30,000 persons and was by far the largest community in Nevada. Nearly just as quickly, however, the Goldfield mining boom began its inevitable downward spiral. Goldfield's population fell to 9,369 persons by 1910 and then to only 2,410 persons by the time of the 1920 census, fewer than had been recorded during the 1880 population census of Esmeralda County. Such extreme variations in population would come to characterize early mining in Nevada. Thirty miles to the north of Goldfield, the town of Tonopah (Nye County) also boomed from local gold discoveries, with its population exploding from just 1,140 persons in 1900 to 7,513 persons by 1910.

As further evidence of Nevada's extensive mineral wealth, promising gold deposits were discovered north of Carlin in Eureka and Elko counties in 1907. However, many decades would pass before precious metal prices and advancements in mining extraction and milling technology allowed for the extensive development and cost-effective mining of this vast, but relatively low-grade region of ore, later to be called the "Carlin Trend".

The Development of Modern Nevada

After the last of the great gold rushes in central Nevada, events began to take place that were destined to dramatically shape Nevada's future and lay the foundations for solid economic growth and prosperity. After an absence of 21 years, gambling again became legal in the State of Nevada on March 19, 1931. At that time, probably few could foresee the far-reaching impacts that the legalization of gaming would have on the state's future socioeconomic development, the fiscal structure of the state, water-use patterns and consumption rates, and the economic prosperity of its citizens. While showing modest growth through the Great Depression era and World War II, after the war the industry began to expand rapidly based largely on improved transportation infrastructure and a more mobile and affluent population.

The development of Nevada's gaming industry since WWII has been complemented by a diversification into other business endeavors as well, most notably warehousing, transportation, manufacturing and distribution. Early railway development was enhanced by Nevada's strategic location and access to the large urban markets of California, Oregon, and Washington, and public warehousing gained a natural foothold in Nevada. Legislative support for these industry pursuits came in the form of a 1949 law granting tax-exempt status to stored personal property awaiting interstate or international transshipment. In 1969, the "Freeport Law" was enhanced further by including "manufacturing" in the list of freeport-allowable processes and interpreting "processing" to include the feeding, watering, and slaughter of livestock. This law has proven to be instrumental in the continued growth and diversification of Nevada's economy.

Based upon Nevada's growing emphasis on gaming, tourism, warehousing and manufacturing, by 1960 nearly 75 percent of Nevada's population of 285,278 inhabitants lived in either Las Vegas with 127,016 persons (45 percent of the total population), or Reno with 84,743 persons (30 percent of

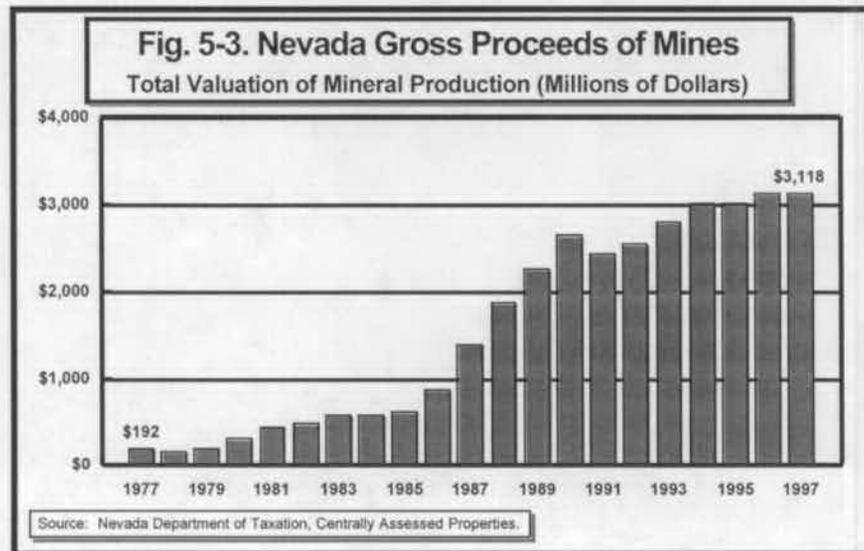
the total population). By the 1970 census, Nevada's population stood at 488,738 persons, of which 56 percent resided in Las Vegas and 25 percent were located in Reno. These two metropolitan areas now accounted for almost 81 percent of Nevada's total population.

By the late 1970's and early 1980's, the

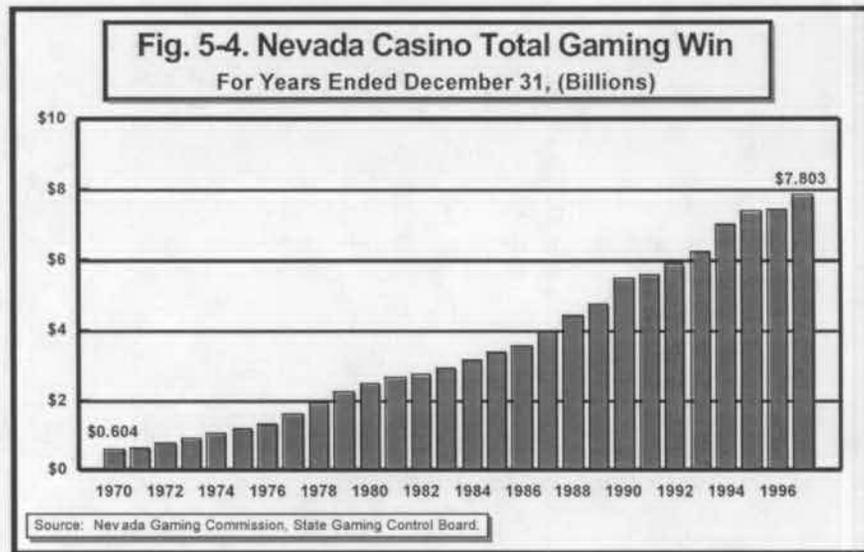
combination of national inflation, recession, and economic uncertainty had significantly elevated the price of gold and fostered a new resurgence in Nevada mining activities. Although gold had first been discovered along the "Carlin Trend" in 1907, it took the combination of high prices and advanced technology in the extraction and milling processes to promote the extensive development of these new mining operations. Today, the Carlin Trend constitutes Nevada's richest gold deposit and covers a vast area of north-central Nevada, running in approximately a northwesterly direction from Carlin, in Elko County, through the northeast corner of Eureka County, and back into Elko County (see Figure 5-3).

Major expansions in the state's gaming and tourism industry continued through the 1970's, 1980's and especially in the 1990's, when a new paradigm of Nevada casino, the mega-resort hotel and entertainment complex, became evident along the Las Vegas Strip. These full-featured casino, resort, and entertainment complexes firmly established the Las Vegas market as the premier destination resort location in the world, enticing over 30 million visitors in 1997 to the many-varied features (see Figure 5-4). After the severe national recession of 1980-82, which had noticeable effects on the state's gaming industry, the state's political leaders reinforced Nevada's commitment to economic diversification through the creation of a Commission of Economic Development and financial support of regional economic development authorities. With the state's economy and fiscal sources of revenues critically dependent on the health of the casino gaming industry, the state's diversification efforts ably served to present "the other side of Nevada."

During the late 1990's, effective marketing of the state's tourism and gaming attractions, combined with the continued promotion of diversified business interests, made Nevada the fastest growing state in the nation. By 1997, Nevada's resident population was estimated to have reached nearly 1.8 million persons, a considerable expansion from the 14,404 persons recorded in the first special territorial census taken in 1861. This overall growth equated to an average increase of nearly 13,000 persons per year over each of these 136 years. Furthermore, since 1950, Nevada's population has increased by an average of approximately 34,500 persons per year during the last 47 years. Of the total 1997 estimated population of 1,779,850 persons, 1,192,200 persons, or 67.0 percent, were



estimated to be living in Las Vegas, and 308,7000 persons, or 17.3 percent, were living in Reno. Together, these two areas now account for over 80 percent of Nevada's total population. Adding the other principal urban areas of Carson City (50,410 residents) and City of Elko (19,670 residents), produces an urban population concentration in Nevada of over 88 percent (see Figure 5-2).



But growth in Nevada and in particular the high rate of growth, has put severe strains on the state's resource requirements, particularly water. The state's infrastructure needs, social service requirements, police and fire protection, environmental conditions, and overall quality of life have also been affected. While some of the problems related to this rapid growth may be overcome or mitigated with judicious and timely legislation and more effective planning, others may become long-term situations that Nevada's residents in these rapidly growing areas will just have to accept. Despite the issues that growth raises, many believe that growth, appropriately planned and managed, must continue if the state, and its fundamental economic sectors, are to remain competitive and viable.

Geography, Land Ownership, and County Relationships to Hydrographic Regions

Nevada is situated in the western United States and is bordered by the State of California to the west and south; the states of Oregon and Idaho to the north, and the states of Utah and Arizona to the east. The Colorado River serves as Nevada's southeastern border with part of Arizona.

Nevada is divided into sixteen counties and one incorporated city, Carson City, the state's capital and the former Ormsby County. Nevada has a total surface area of 110,540 square miles and is the seventh largest state in the nation. Figure 5-5 shows county shares of Nevada's total area. From this graph we may see that just two counties — Nye and Elko — account for nearly one-third of Nevada's total area. The relationship between county populations and areas can be seen in Figure 5-9, which shows the population densities in persons per square mile using 1997 population figures. Nevada's overall topography is characterized by basins and ranges consisting of isolated mountain ranges with intervening long and relatively narrow valleys. Most of Nevada, totaling approximately 93,000 square miles, lies within what is called the Great Basin, in which all surface waters drain inward to terminal lakes, sinks, or playas. The highest point in the state is Boundary Peak (13,140

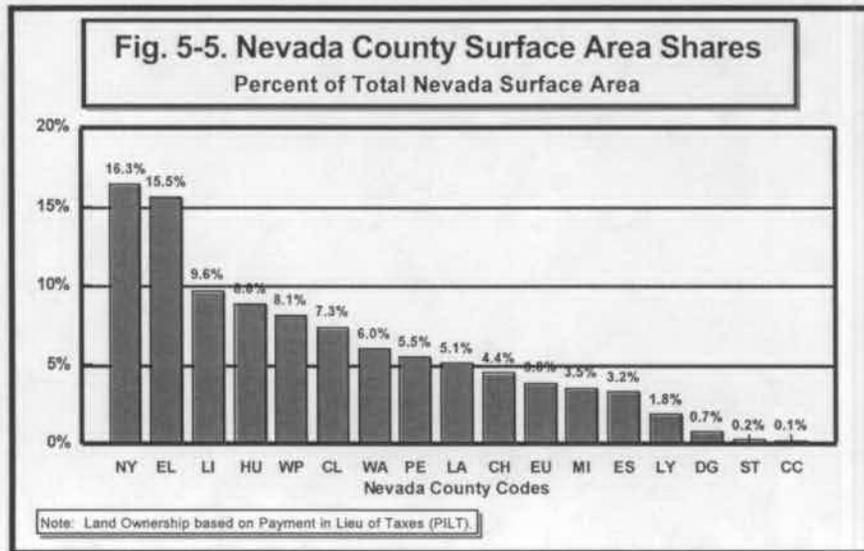
feet above mean sea level, or MSL), located in the Sierra Nevada Mountains in Esmeralda County and along the border with California. The lowest elevation in the state is 490 feet (MSL) and is located in the southernmost tip of the state along the Colorado River.

Nevada is the driest state in the nation in terms of its average annual rainfall. While the state

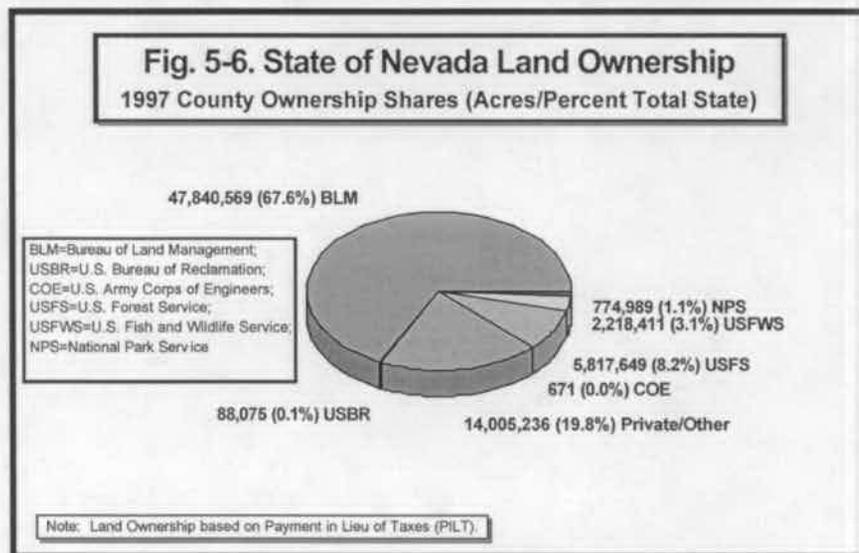
is characterized by a number of high mountain ranges, much of the precipitation driven by the jet stream and coming off the Pacific Coast is blocked by the rain shadow effect of the Sierra Nevada Mountains which lies along Nevada’s western border. Other precipitation entering the state typically comes in from the north and east, affecting the Ruby, Jarbidge, Independence, and East Humboldt mountains in Elko County in northeastern Nevada, and from wet tropical storm systems driven up from the south into Clark County and the Las Vegas area. The seasonal nature of the state’s precipitation, combined with its highly uneven nature, has required the extensive use of dams, reservoirs, lakes and diversion structures to trap the from the mountains in the spring and supply water for irrigation during the growing season and livestock and municipal purposes throughout the year. Groundwater pumping has also proven an increasingly important source of water, particularly for domestic purposes.

Of Nevada’s 70,745,600 acres of surface area, 56,740,364 acres, or over 87 percent of the state’s total area are managed and controlled by the federal government. Of these federally-managed public lands, approximately 47,840,569 acres are managed by the U.S. Bureau of Land Management (BLM); 5,817,649 acres are managed by the U.S. Forest Service (USFS); 2,218,411 acres are managed by the U.S. Fish and Wildlife Service (USFWS); 774,989 acres are managed by the National Park Service (NPS); 88,075 acres are managed by the U.S. Bureau of Reclamation (USBR); and 671 acres in Lincoln County are controlled by the U.S. Army Corps of Engineers (COE). Another 1,114,521 acres of the state lie within Indian Reservations and are held in trust by the Bureau of Indian Affairs (BIA). The state owns 264,166 acres. Relative to other states in the nation, Nevada has the highest percentage of federally-managed public lands. Figure 5–6 presents the areas and shares of the state’s total area that is owned or managed by various entities. This graph is based on the “Payment in Lieu of Tax System (PILT)” and includes only those lands specifically withdrawn for public use for which the federal government pays taxes to the state.

The U.S. Geological Survey (USGS) and the Nevada Division of Water Resources (DWR), Department of Conservation and Natural Resources, have divided the State of Nevada into discrete hydrologic units for water planning and surface and groundwater management purposes. These



have been identified as 232 hydrographic areas (256 hydrographic areas and sub-areas, combined) within 14 major hydrographic regions or basins. These fourteen hydrographic regions (basins) and their 256 hydrographic areas and sub-areas, and their relationship to Nevada's seventeen counties are presented below and in the map which follows.



- [1] **Northwest Region** — Covers 3,052 square miles (7,905 square kilometers or 1,953,280 acres) of northern Washoe and Humboldt counties and encompasses 16 hydrographic areas; extends into the State of California to the west and the State of Oregon to the north;
- [2] **Black Rock Desert Region** — Covers 8,632 square miles (22,357 square kilometers or 5,524,480 acres) of parts of Washoe, Humboldt, and Pershing counties and includes 17 hydrographic areas, two of which are divided into separate hydrographic sub-areas; extends into the State of California to the west and the State of Oregon to the north;
- [3] **Snake River Basin** — Covers 5,230 square miles (13,546 square kilometers or 3,347,200 acres) in parts of Elko and Humboldt counties and includes eight hydrographic areas; extends into the states of Oregon and Idaho to the north and the State of Utah to the east;
- [4] **Humboldt River Basin** — Covers 16,843 square miles (43,623 square kilometers or 10,779,520 acres) in parts of eight counties — Elko, White Pine, Eureka, Humboldt, Lander, Nye, Pershing, and Churchill — and the largest river (Humboldt River) wholly contained within Nevada. This basin contains 34 hydrographic areas and one hydrographic sub-area and is one of only two that are wholly contained within the State of Nevada. It originates in the Ruby, Jarbidge, Independence, and East Humboldt Mountain ranges (Elko County) and terminates in the Humboldt Lake and Sink (Pershing and Churchill counties). During particularly wet years, the Humboldt Sink may drain into the Carson Sink by means of the Humboldt Slough;
- [5] **West Central Region** — Covers 1,656 square miles (4,289 square kilometers or 1,059,840 acres) and includes parts of Pershing, Lyon, and Churchill counties and comprises five hydrographic areas. This basin is one of only two waterbasins that are wholly contained within the State of Nevada;
- [6] **Truckee River Basin** — Encompasses 2,300 square miles (5,957 square kilometers or 1,472,000 acres) containing parts of Washoe, Pershing, Churchill, Lyon, Douglas,

- Carson City, and Storey counties comprising 12 hydrographic areas; originates in the Sierra Nevada Mountains, the State of California and the Lake Tahoe Basin and terminates in Pyramid Lake (Washoe County);
- [7] **Western Region** — Covers 602 square miles (1,559 square kilometers or 385,280 acres) and is contained only in Washoe County in Nevada; contains nine hydrographic areas, one of which is divided into two sub-areas and another into one hydrographic sub-area; extends to the west into the State of California;
- [8] **Carson River Basin** — Covers 3,519 square miles (9,114 square kilometers or 2,252,160 acres) and includes parts of six counties—Douglas, Carson City, Lyon, Storey, Churchill, and Pershing; contains five hydrographic areas and one sub-area; has its origin to the west in the Sierra Nevada Mountains and the State of California and its terminus in the Carson Sink and Desert (Churchill and Pershing counties);
- [9] **Walker River Basin** — Covers 3,046 square miles (7,889 square kilometers or 1,949,440 acres) of Mineral, Lyon, and Douglas counties (and a very small portion of Churchill County) and includes five hydrographic areas, one of which has been divided into three hydrographic sub-areas; has its origin to the west in the Sierra Nevada Mountains and the State of California and its terminus in Walker Lake (Mineral County);
- [10] **Central Region** — By far the largest hydrographic region in Nevada covering 46,783 square miles (121,167 square kilometers or 29,941,120 acres) in thirteen Nevada counties—Nye, Elko, White Pine, Lincoln, Clark, Humboldt, Pershing, Churchill, Lander, Eureka, Lyon, Mineral, and Esmeralda. This region includes 78 hydrographic areas, ten of which are divided into two sub-areas and one into three sub-areas; extends to the south and west into the State of California;
- [11] **Great Salt Lake Basin** — Covers 3,807 square miles (9,860 square kilometers or 2,436,480 acres) of the easternmost portions of Elko, White Pine, and Lincoln counties; includes eight hydrographic areas, one of which is divided into four hydrographic sub-areas; extends to the east into the State of Utah;
- [12] **Escalante Desert Basin** — Covers a large area in Utah but only a very small part of it is in Lincoln County, Nevada—106 square miles (275 square kilometers or 67,480 acres). It is made up of only one hydrographic area; extends to the east into the State of Utah;
- [13] **Colorado River Basin** — Covers 12,376 square miles (32,054 square kilometers or 7,920,640 acres) including parts of Clark, Lincoln, Nye, and White Pine counties and is divided into 27 hydrographic areas; extends to the south into California, borders the Colorado River to the south and east, and extends into the states of Arizona and Utah to the east;
- [14] **Death Valley Basin** — Covers 2,593 square miles (6,716 square kilometers or 1,659,520 acres) of Nye and Esmeralda counties including eight hydrographic areas, one of which has been divided into two hydrographic sub-areas; also extends into the State of California to the south and west.

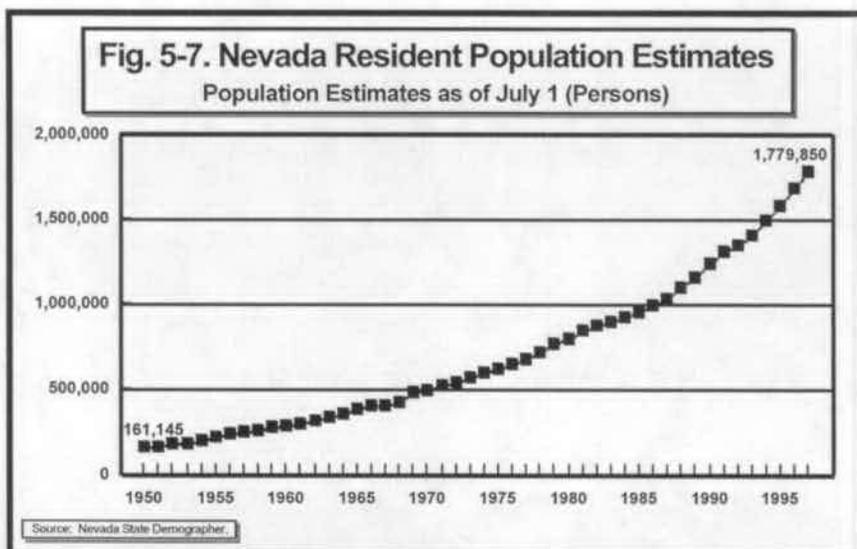
The figure, Nevada Hydrographic Regions/Basins and County Boundaries, shows the relationship between Nevada's political borders, i.e., counties, and its water basins. This information, and the relationship between the political (county) designations and the watershed boundaries becomes important as water planning shifts from a county basis, as largely presented in this water plan, to a more watershed-oriented basis.

[Placement of Figure 1.5 – 1. Nevada Hydrographic Regions/Basins and County Boundaries]

Socioeconomic Characteristics

Population. Nevada's resident population was estimated at 1,779,850 persons on July 1, 1997, representing a population increase of 5.7 percent over the prior year and corresponding to an increase of 95,280 persons. During the years of 1990 through 1997, Nevada's population growth averaged 5.2 percent per year. By decade, Nevada's population has grown at an annual average rate as follows: 1950's — 6.0 percent per year; 1960's — 5.6 percent per year; 1970's — 4.9 percent per year; and during the 1980's — 4.4 percent per year (see Table 5-1). During the entire 1950-1997 time period, Nevada's population growth has averaged a rate of growth of 5.4 percent per year. Figure 5-7 presents the trend in the state's population estimates for 1950 through 1997. This graphs shows the more recent rapid rise in population since 1990, which corresponded to trends in Las Vegas (Clark County) and the completion of the first mega-resort casino properties — The Mirage and Excalibur.

Nevada's total population has grown by 72.0 percent over the most recent ten-period of 1987-1997. Over this same 10-year period, the fastest growing counties in terms of population have been Elko (96.3 percent), Clark (93.3 percent), and Nye County (81.6 percent). The slowest growing counties with respect to resident population since 1987 include Eureka (11.4 percent), Mineral



(11.4 percent), Mineral (9.4 percent), Lincoln (8.4 percent) and Esmeralda County (down 5.2 percent). Other counties' 10-year population growth rates, ranked by rate of growth, include Lyon (65.6 percent), Storey (65.3 percent), Pershing (60.6 percent), Douglas (57.9 percent), Lander (52.8 percent), Humboldt (52.5 percent), Churchill (42.8 percent), Carson City (36.3 percent), White Pine (33.0 percent), and Washoe County (29.5 percent). Figure 5-8 shows annual population growth rates for 1950 through 1997.

Table 5-1. Nevada Population Estimates — 1950-1997, shows total state and individual county decennial population estimates for the years 1950 through 1990, the latest population estimate for 1997, and annual average rates of growth for each decennial estimation period and for the period of 1990 through 1997. Population growth rates declined for the three decades after the 1950's when growth averaged nearly 6.0 percent per year. However, by the 1990's, with rapid growth in the state's basic industry of gaming and tourism and the construction of mega-resort casino complexes in Las Vegas (Clark County), population growth accelerated to nearly 5.4 percent per year, a trend

that is likely to carry into the early 21st century as new mega-resort complexes continue to be constructed into the year 2000 (see Figure 5–8).

Table 5–1. Nevada Population Estimates — 1950–1997

Population Estimates by County and Period Annual Average Growth (Persons)

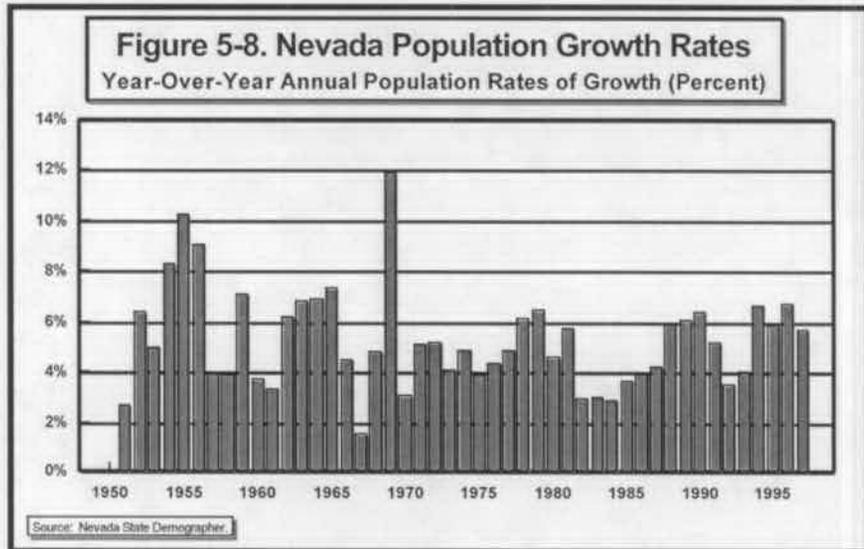
State/County	1950	1960	1970	1980	1990	1997
NEVADA	161,145	287,660	494,990	800,508	1,236,130	1,779,850
Annual Average Growth	—	5.97%	5.58%	4.92%	4.44%	5.35%
Carson City	4,198	8,020	16,054	32,022	40,950	50,410
Annual Average Growth	—	6.69%	7.19%	7.15%	2.49%	3.01%
Churchill County	6,188	8,505	10,650	13,917	18,100	23,860
Annual Average Growth	—	3.23%	2.27%	2.71%	2.66%	4.03%
Clark County	48,811	128,734	277,230	463,087	770,280	1,192,200
Annual Average Growth	—	10.18%	7.97%	5.26%	5.22%	6.44%
Douglas County	2,023	3,575	7,067	19,421	28,070	39,590
Annual Average Growth	—	5.86%	7.05%	10.64%	3.75%	5.04%
Elko County	11,703	12,051	13,946	17,269	33,770	47,710
Annual Average Growth	—	0.29%	1.47%	2.16%	6.94%	5.06%
Esmeralda County	611	634	623	777	1,350	1,460
Annual Average Growth	—	0.37%	-0.17%	2.23%	5.68%	1.13%
Eureka County	897	775	938	1,198	1,550	1,660
Annual Average Growth	—	-1.45%	1.93%	2.48%	2.61%	0.98%
Humboldt County	4,870	5,723	6,380	9,449	13,020	17,520
Annual Average Growth	—	1.63%	1.09%	4.01%	3.26%	4.33%
Lander County	1,860	1,580	2,653	4,076	6,340	7,030
Annual Average Growth	—	-1.62%	5.32%	4.39%	4.52%	1.49%
Lincoln County	3,850	2,378	2,526	3,732	3,810	4,110
Annual Average Growth	—	-4.70%	0.61%	3.98%	0.21%	1.09%
Lyon County	3,703	6,245	8,437	13,594	20,590	30,370
Annual Average Growth	—	5.37%	3.05%	4.89%	4.24%	5.71%
Mineral County	5,588	6,329	6,961	6,217	6,470	6,860
Annual Average Growth	—	1.25%	0.96%	-1.12%	0.40%	0.84%
Nye County	3,101	4,642	5,459	9,048	18,190	27,610
Annual Average Growth	—	4.12%	1.63%	5.18%	7.23%	6.14%
Pershing County	3,122	3,178	2,656	3,408	4,550	6,600
Annual Average Growth	—	0.18%	-1.78%	2.52%	2.93%	5.46%
Storey County	657	571	696	1,503	2,560	3,520
Annual Average Growth	—	-1.39%	2.00%	8.00%	5.47%	4.65%
Washoe County	50,484	84,988	122,574	193,623	257,120	308,700
Annual Average Growth	—	5.35%	3.73%	4.68%	2.88%	2.65%
White Pine County	9,479	9,732	10,140	8,167	9,410	10,640
Annual Average Growth	—	0.26%	0.41%	-2.14%	1.43%	1.77%

Note: Annual Average Growth Rates are measured from the preceding decennial population estimate.

Source Data: Nevada State Demographer.

Nevada shows extreme variation in its population density among its seventeen counties. Based on

1997 populations, Nevada's average population density across all counties was approximately 16.1 persons per square mile. By county, Nevada's most populous counties in 1997 were Carson City (329 persons per square mile), Clark County (147 persons per square mile), Douglas County (53 persons per square mile), and Washoe County (47 persons per square mile).



At the opposite extreme, Nevada's least populous counties were Esmeralda, Eureka, and Lincoln, all with a population density of approximately 0.4 person per square mile.

Labor Force and Employment. Table 5-2. Nevada Labor Force and Employment Information, presents populations, labor force information, total employment and unemployment for the years 1970 through 1997. The labor force and employment information in Table 5-2 is based on Nevada's resident population and shows only those workers residing within the state. The labor force to population ratios provide information on Nevada's labor force participation rate, an important measure in assessing that portion of the total population either employed or actively seeking employment.

Figure 5-10 presents trends in Nevada's labor force and employment over the period of 1970 through 1997 while Figure 5-11 shows the level and percent (of the labor force) of the state's unemployment for these same years.

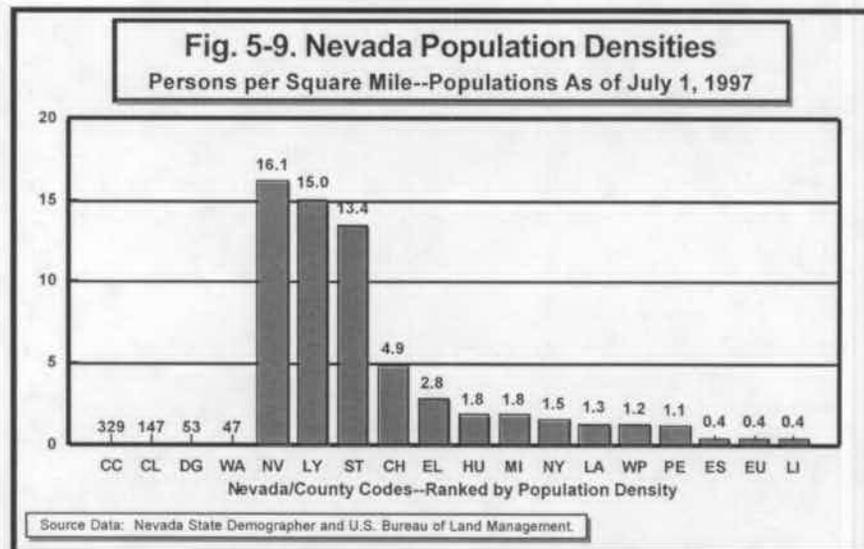


Table 5-2.
Nevada Labor Force and Employment Information

1970-1997 Populations, Labor Force, Employment and Unemployment

Part 1. Section 5 – Socioeconomic Background

Year	Population (Persons)	Total Labor Force (Persons)	Labor Force to Population Ratio	Total Employment (Persons)	Persons Unemployed	Unemploy. Rate (S.A.)
1970	494,990	217,850	44.0%	204,600	13,250	5.9%
1971	520,000	227,950	43.8%	211,900	16,050	7.0%
1972	546,800	241,300	44.1%	224,075	17,225	7.0%
1973	569,200	260,175	45.7%	244,125	16,050	6.1%
1974	596,700	276,125	46.3%	253,900	22,225	7.8%
1975	620,000	288,300	46.5%	260,325	27,975	9.7%
1976	646,800	304,875	47.1%	277,750	27,125	8.9%
1977	678,100	333,875	49.2%	318,725	15,150	4.5%
1978	719,300	336,875	46.8%	321,775	15,100	4.4%
1979	765,300	400,000	52.3%	379,800	20,200	5.0%
1980	800,508	429,975	53.7%	402,575	27,400	6.3%
1981	846,220	463,025	54.7%	429,875	33,150	7.1%
1982	870,970	483,000	55.5%	433,975	49,025	10.2%
1983	897,160	486,000	54.2%	437,225	48,775	9.9%
1984	922,580	500,000	54.2%	457,775	42,225	7.8%
1985	955,810	521,000	54.5%	478,450	42,550	8.1%
1986	993,220	532,025	53.6%	500,000	32,025	6.0%
1987	1,035,040	557,025	53.8%	521,475	35,550	6.3%
1988	1,096,130	583,975	53.3%	554,000	29,975	5.1%
1989	1,162,340	602,000	51.8%	571,875	30,125	5.0%
1990	1,236,130	667,000	54.0%	633,125	33,875	5.0%
1991	1,299,360	693,000	53.3%	654,850	38,150	5.5%
1992	1,345,035	715,000	53.2%	667,400	47,600	6.6%
1993	1,398,840	745,975	53.3%	691,300	54,675	7.2%
1994	1,491,490	777,525	52.1%	729,700	47,825	6.1%
1995	1,579,150	804,350	50.9%	760,950	43,400	5.4%
1996	1,684,570	844,050	50.1%	798,400	45,650	5.4%
1997	1,779,850	883,225	49.6%	846,975	36,250	4.4%

Notes: Population estimates are as of July 1st; labor force and employment are measures of the number of persons by place of residence and are based on census relationships.

Source Data: Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation (DETR), Research and Analysis Bureau.

Covered Employment and Payrolls. Table 5-3. Nevada Covered Employment and Payrolls — 1997, presents Nevada's employment characteristics based on Nevada's 1997 total covered

employment (i.e., workers covered under state and federal unemployment insurance programs). This table shows that of Nevada's 888,574 workers (excluding agriculture) in 1997, the 371,753 workers in the state's service industry accounted for the greatest portion of total employment at 41.8 percent. Nevada's 216,491 gaming industry jobs alone accounted for 24.4 percent of the state's total jobs in 1997. The state's service industries also accounted for the greatest percentage of total state payrolls at 38.9 percent, with gaming alone accounting for 20.4 percent of Nevada's 1997 payrolls. (See Figure 5-12 for trends in Nevada's total covered employment for 1980 through 1997.)

The highest average annual salary in Nevada in 1997 was in the mining industry which, at \$49,905 per worker per year, was 74.1 percent greater than the state's average all-industry annual salary of \$28,671 per worker. The lowest average annual salary was in the state's wholesale and retail trade industries, which, at \$21,704 per worker per year, was only 75.7 percent of Nevada's overall average annual wage. Based on U.S. Department of Commerce, Bureau of Economic Analysis (BEA) full and part-time job classifications, the combined classification of agriculture, forestry, and fishing-related employment was estimated to comprise only approximately 1.4 percent of all jobs within Nevada in 1996 as compared to 2.1 percent of all jobs in 1970.

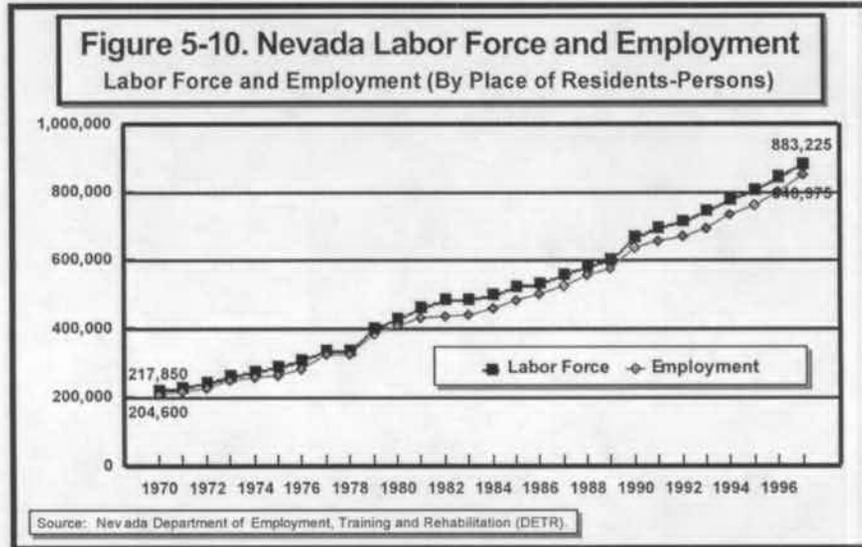
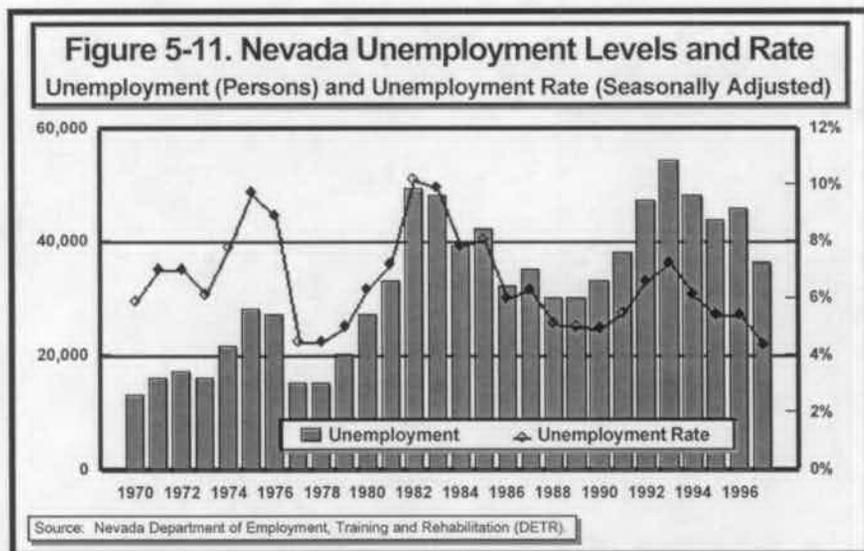


Table 5-3.
Nevada Covered Employment and Payrolls — 1997
 Covered Employment, Payrolls, and Average Annual Salaries

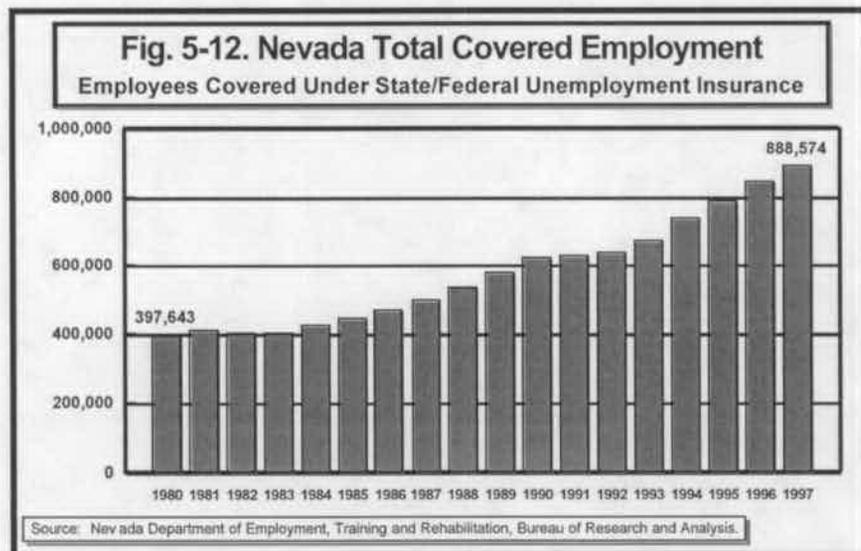


Industry Category	Employment (Persons)	Percent of Total Employment	Payrolls (Millions of Dollars)	Percent of Total Payrolls	Annual Average Salaries (Dollars)	Salary as a Percent of the County Average
TOTAL STATE	888,574	n.a.	\$25,476.73	n.a.	\$28,671	100.0%
Mining	14,663	1.7%	731.75	2.9%	49,905	174.1%
Construction	81,953	9.2%	2,907.04	11.4%	35,472	123.7%
Total Manufacturing	40,604	4.6%	1,342.50	5.3%	33,063	115.3%
Trans., Public Utilities	44,877	5.1%	1,459.20	5.7%	32,516	113.4%
Total Trade	180,425	20.3%	3,915.94	15.4%	21,704	75.7%
Finance, Insurance and Real Estate	40,338	4.5%	1,371.24	5.4%	33,994	118.6%
Service Industries	371,753	41.8%	9,906.98	38.9%	26,649	92.9%
Gaming-Related	216,491	24.4%	5,202.57	20.4%	24,031	83.8%
Total Government	104,255	11.7%	3,638.94	14.3%	34,904	121.7%
Federal Government	13,519	1.5%	572.76	2.2%	42,367	147.8%
State Government	24,974	2.8%	838.29	3.3%	33,566	117.1%
Local Government	65,762	7.4%	2,227.89	8.7%	33,878	118.2%

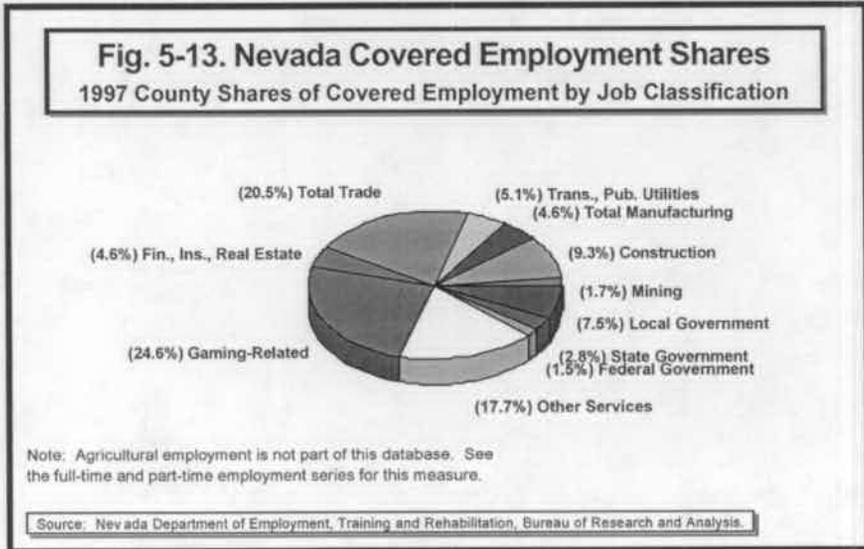
Note: Includes employees covered under state and federal unemployment insurance programs. Agricultural employment is not part of this employment series.

Source Data: Nevada Department of Employment, Training and Rehabilitation (DETR), Research and Analysis Bureau.

Of Nevada's principal industry sectors, the state's service industry dominates labor market and employment trends. With nearly 42 percent of all jobs in various service industries, primarily gaming related, medical and health care, and business and personal services, this industry tends to both drive and



respond to employment trends in many other sectors, particularly trade, transportation and communication, finance and real estate, and state and local government sectors. Furthermore, with the services sector, one quarter of all jobs in Nevada are employed directly in gaming and related industry sectors of amusement and recreation.



Casino Gaming. The

Nevada casino gaming industry represents a fundamental underpinning of the state’s economy both in terms of economic output and in terms of its fiscal effects on state and local government revenues. In addition, gaming also represents the state’s major “export” industry, bringing new capital (i.e., money) into the state in terms of tourism expenditures for Nevada’s gaming and tourism-related products and services. Nevada’s total casino gaming win, that is, the casinos’ “take” after payment of all winnings to players, was \$7.803 billion in 1997 and has grown at an average annual rate of approximately 9.5 percent since 1970.

Table 5-4. Nevada Casino Gaming Win — 1970-1997, shows gaming win trends for Nevada and its principal gaming markets and sub-markets. The Nevada casino gaming industry is characterized by a number of principal gaming markets, typically delineated by county or city boundaries. Figure 5-14 presents Nevada’s principal gaming markets and sub-markets and their 1997 levels of total gaming win and shares of statewide total gaming win. On a principal gaming market basis, Clark County accounted for 78.9 percent of Nevada’s total gaming win in 1997, Washoe County accounted for 12.7 percent of statewide total gaming win, and the South Lake Tahoe portion of Douglas County accounted for 3.8 percent of 1997’s total gaming win. Other



principal gaming markets in Nevada included Elko County, which accounted for 2.5 percent of the state's total gaming win in 1997, and Carson Valley, which includes Carson City and that portion of Douglas County outside the South Lake Tahoe area and accounted for slightly less than 1.0 percent of the state's total gaming win in 1997.

Table 5–4. Nevada Casino Gaming Win — 1970–1997
Total Casino Gaming Win† by Principal Gaming Market (Millions of Dollars)

Principal Gaming Market or Sub-Market	1970	1980	1990	1997	1990-97 Change in Gaming Win and Share	1990-97 Percent Change in Gaming Win
TOTAL STATE	604.35	2,478.45	5,480.25	7,802.70	2,322.45	42.38%
Clark County[1]	394.24	1,697.41	4,103.39	6,152.42	2,049.03	49.94%
Percent of Total	65.23%	68.49%	74.88%	78.85%	3.97%	
Las Vegas Strip	290.90	1,231.98	2,604.98	3,809.40	1,204.41	46.23%
Percent of Total	48.13%	49.71%	47.53%	48.82%	1.29%	
Las Vegas Downtown	91.50	348.63	676.91	679.05	2.15	0.32%
Percent of Total	15.14%	14.07%	12.35%	8.70%	-3.65%	
Laughlin	n.a.	n.a.	398.64	482.26	83.62	20.98%
Percent of Total			7.27%	6.18%	-1.09%	
Boulder Strip	n.a.	n.a.	142.14	411.79	269.64	189.70%
Percent of Total			2.59%	5.28%	2.68%	
Rest of Clark County[2]	11.84	116.80	280.72	769.93	489.21	174.27%
Percent of Total	1.96%	4.71%	5.12%	9.87%	4.75%	
Washoe County[3]	119.52	462.28	814.14	995.23	181.09	22.24%
Percent of Total	19.78%	18.65%	14.86%	12.75%	-2.10%	
City of Reno	91.72	362.12	628.02	751.21	123.19	19.62%
Percent of Total	15.18%	14.61%	11.46%	9.63%	-1.83%	
City of Sparks	n.a.	n.a.	104.04	150.64	46.61	44.80%
Percent of Total			1.90%	1.93%	0.03%	
South Lake Tahoe[4]	72.21	221.09	339.16	294.97	(44.19)	-13.03%
Percent of Total	11.95%	8.92%	6.19%	3.78%	-2.41%	
Carson Valley[5]	3.88	34.63	57.26	73.75	16.49	28.80%
Percent of Total	0.64%	1.40%	1.04%	0.95%	-0.10%	
Elko County	7.48	37.87	111.67	198.31	86.64	77.58%
Percent of Total	1.24%	1.53%	2.04%	2.54%	0.50%	
City of Wendover	n.a.	n.a.	53.39	99.83	46.44	86.99%
Percent of Total			0.97%	1.28%	0.31%	

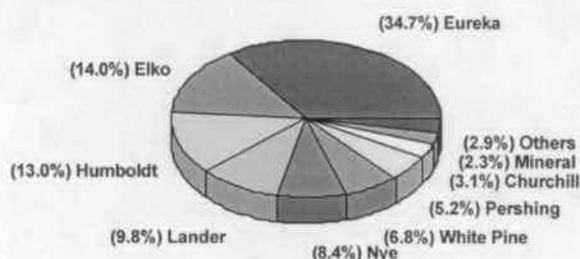
Notes: Casino gaming win is equal to the “house hold,” or the amount retained by the casino after all payouts as winnings to customers. “Percent of Total” measures each gaming market’s share of Nevada’s total gaming win. Principal gaming markets are presented in bold face type; gaming “sub-markets” appear in regular type. The Clark County (Las Vegas) casino gaming market consists of a number of sub-markets, the most important being the Las Vegas Strip. Others sub-markets include Las Vegas Downtown, Laughlin, Boulder Strip and the “Rest of Clark County,” consisting of off-Strip properties and casinos in North Las Vegas. Carson Valley casinos include those in Carson City and Douglas County, excluding the South Lake Tahoe properties. n.a. = Gaming win data not available for these time periods.

Source Data: Nevada Gaming Commission, State Gaming Control Board.

Nevada's gaming markets are further subdivided into distinct gaming areas or sub-markets, typically based on a city or defined geographic area basis. These principal sub-markets include the Las Vegas Strip (comprising 48.8 percent of Nevada's total gaming win in 1997), Las Vegas Downtown (comprising

8.7 percent of the state's total gaming win), Laughlin (comprising 6.2 percent of statewide gaming win), Boulder Strip (comprising 5.3 percent of statewide gaming win), the city of Reno (comprising 9.6 percent of total gaming win), the city of Sparks (comprising 1.9 percent of total gaming win), and the city of Wendover in Elko County (comprising 1.3 percent of statewide total gaming win).

Fig. 5-15. Nevada Gross Proceeds of Mines Shares
1997 Shares of Nevada Mineral Valuation (Percent of Total)



Source: Nevada Department of Taxation, Centrally Assessed Properties.

Mining. Table 5-5. Nevada Mining Industry Analysis — 1985-1997, presents information and trends with respect to the total valuation of minerals produced, the number of mining workers, and the productivity of mining workers for Nevada's counties principally involved in mining activities. With the exception of White Pine County, which produces gold, silver and copper, the principal output of these counties' mines is gold, with silver being a by-product. The rapid and relatively recent growth in gold mining in Nevada is clearly reflected by the trends between 1985 and 1990 (see Figure 5-3). Since that time, production has typically shown more modest gains and in some cases actually shown retrenchment in total production (e.g., Eureka and Humboldt counties).

Since the state became a territory in 1861, mining has and continues to play a crucial role in terms of the socioeconomic characteristics and trends of Nevada's more rural counties. Today, Nevada represents the largest gold producer in the United States with \$2.671 billion in total gold production in 1997. The total value of all mining activity in the state in 1997 came to \$3.118 billion, up slightly over 1996's total mineral production of \$3.110 billion. Five Nevada counties — Eureka County (accounting for 34.7 percent of total mineral production in 1997), Elko County (14.0 percent of total production), Humboldt County (13.0 percent of total production), Lander County (9.8 percent of total production), and Nye County (8.4 percent of total production) — accounted for 79.9 percent of the state's 1997 total proceeds of mines (see Figure 5-15 for shares of mining proceeds for Nevada's major producing counties).

Table 5-5. Nevada Mining Industry Analysis — 1985-1997

Gross Mineral Proceeds, Workers, Productivity of Nevada's Principal Mining Counties
(Proceeds in Millions of Dollars; Productivity in Dollars per Worker per Year)

Mining County	1985	1990	1995	1997	1990-97 Volume Change	1990-97 Percent Change
NEVADA						
Gross Mining Proceeds[1]	\$623.63	\$2,635.47	\$2,991.62	\$3,118.09	\$482.61	18.31%
Number Mining Workers	6,081	14,321	13,187	14,663	342	2.39%
Mining Worker Productivity[3]	\$102,554	\$184,029	\$226,862	\$212,650	\$28,621	15.55%
Elko County						
Gross Mining Proceeds	\$102.35	\$238.43	\$183.47	\$436.31	\$197.88	82.99%
Number Mining Workers	774	1,289	1,295	1,427	138	10.71%
Mining Worker Productivity	\$132,235	\$184,970	\$141,674	\$305,751	\$120,780	65.30%
Eureka County						
Gross Mining Proceeds	\$114.88	\$789.73	\$1,412.68	\$1,081.39	\$291.66	36.93%
Number Mining Workers	636	3,599	3,927	4,270	671	18.64%
Mining Worker Productivity	\$180,633	\$219,432	\$359,735	\$253,254	\$33,822	15.41%
Humboldt County						
Gross Mining Proceeds	\$31.94	\$356.96	\$441.82	\$405.24	\$48.28	13.52%
Number Mining Workers	393	1,527	2,305	2,451	924	60.51%
Mining Worker Productivity	\$81,272	\$233,768	\$191,681	\$165,338	(\$68,431)	-29.27%
Lander County						
Gross Mining Proceeds	\$96.22	\$276.03	\$279.94	\$304.58	\$28.55	10.34%
Number Mining Workers	845	1,360	1,082	1,290	(70)	-5.15%
Mining Worker Productivity	\$113,869	\$202,961	\$258,726	\$236,110	\$33,149	16.33%
Nye County						
Gross Mining Proceeds	\$140.04	\$500.41	\$229.55	\$260.90	(\$239.52)	-47.86%
Number Mining Workers	884	1,949	1,296	1,363	(586)	-30.07%
Mining Worker Productivity	\$158,420	\$256,754	\$177,120	\$191,413	(\$65,341)	-25.45%
Pershing County						
Gross Mining Proceeds	\$16.12	\$96.90	\$111.60	\$163.04	\$66.15	68.27%
Number Mining Workers	195	683	682	861	178	26.06%
Mining Worker Productivity	82,688	141,869	163,639	189,367	47,498	33.48%
White Pine County						
Gross Mining Proceeds	\$22.16	\$98.04	\$60.87	\$210.65	\$112.61	114.86%
Number Mining Workers	412	886	615	767	(119)	-13.43%
Mining Worker Productivity	\$53,783	\$110,653	\$98,980	\$274,636	\$163,982	148.19%

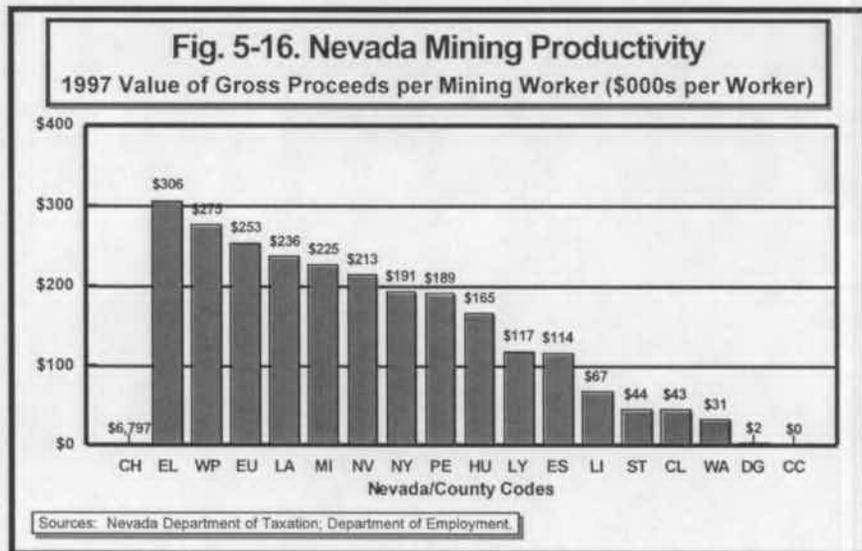
[1] Gross mining proceeds measures the market valuation of mineral sales made by the Nevada mining industry.

[2] Mining worker productivity measures the total state or county gross mining proceeds divided by the respective mining employment; measured in dollars per mining worker per year.

Source Data: Nevada Department of Taxation, Centrally Assessed Properties, Division of Assessment Standards.

In 1997 Nevada mines employed 14,663 workers, accounting for 1.7 percent of the state's total employment. The Nevada mining industry paid \$731.75 million in total payrolls, accounting for 2.9 percent of the state's total payrolls. Mining jobs averaged \$49,905 in annual wages per worker, 74.1 percent greater than the state's all-industry average payroll of \$28,671 per worker. On average, the mining worker in Nevada produced \$212,650 in gross proceeds in 1997, effectively covering the average mining wage by 4.26 times. In Eureka County's gold mines, the average worker produced

\$253,254 in gross proceeds in 1997, covering the average mining wage in that county by 4.80 times. Figures of mining productivity provide good measures of the viability of future mining operations with higher productivity measures also providing higher returns to producers (see Figure 5-16 for relative levels of mining worker productivity measures).



While mining's impact to the major population centers is slight, a number of rural counties are critically dependent on the health of this industry sector and it will continue to be a primary driving force for those counties' socioeconomic conditions and trends.

Agriculture. Agriculture represents one of Nevada's oldest and longest-lasting economic activities. While mining may have been responsible for the early influx of emigrants through and into Nevada between 1850-1880, as well as bringing the State of Nevada into the Union in 1864, it was agriculture that remained after the original Comstock Lode's demise in the 1870's and 1880's. It was also agriculture that persevered during Nevada's depression of 1880-1900 when the state lost nearly one-third of its population. Agriculture in Nevada continued to survive and even prosper when later mining efforts in the state went through boom and bust cycles during the early 1990's. Today, agriculture remains a fundamental socioeconomic underpinning for a number of rural Nevada counties and, no doubt, will remain an integral part of these counties' economies irrespective of current or future mining trends.

Figure 5-17 shows the county shares of the state's total irrigated acreage, which was estimated at 715,439 acres in 1995.

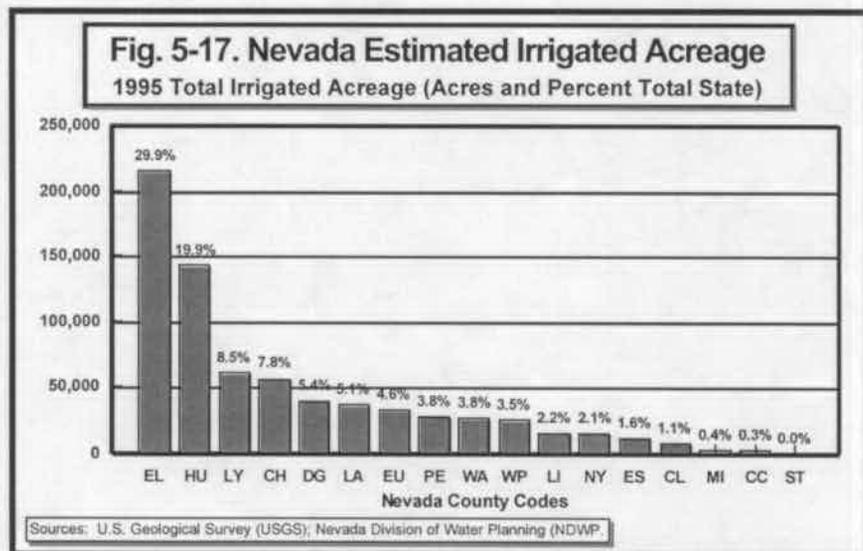


Table 5-6. Nevada Agricultural Statistics — 1974-1995, shows key agriculture statistics for all Nevada's counties. It appears that agriculture, in terms of total irrigated

acreage, peaked in the state during the late 1970's or early 1980's. There has also been a more recent trend towards a strong statewide decline in on-farm workers and stronger growth to employment in related agricultural areas, primarily agricultural service workers, most typically representing the landscaping and lawn care service industries in the more urbanized areas of the state. On a statewide basis, workers involved in farm activities declined from 4,570 workers in 1974 to 3,962 workers by 1995 while workers in agricultural-related activities increased from 1,325 workers in 1974 to 9,180 workers by 1995.

Table 5–6. Nevada Agricultural Statistics — 1974–1995
Irrigated Acreage, Farm Marketings and Farm-Related Employment

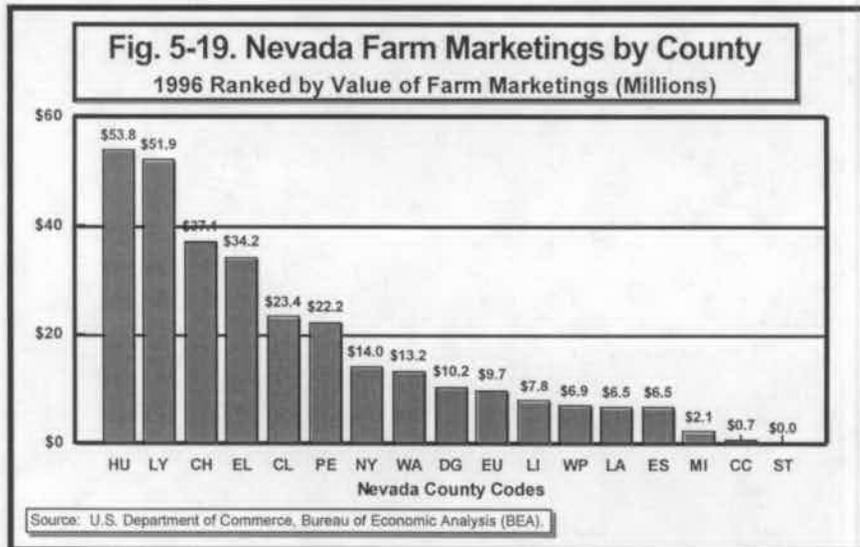
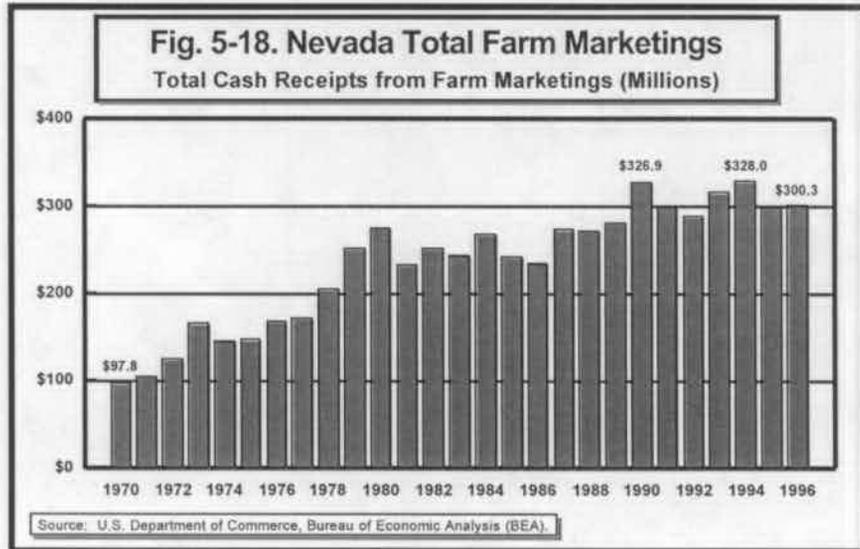
NEVADA	1974	1978	1982	1987	1990	1995
Irrigated Acres	777,510	881,151	829,761	773,588	728,350	715,439
Farm Marketings (\$000s)	\$145,458	\$204,047	\$250,610	\$271,904	\$326,889	\$298,085
Farm Workers	4,570	5,639	5,140	5,628	5,260	3,962
Agric. Services Workers	1,325	2,089	2,723	4,405	6,227	9,180

Source Data: Irrigated acreage figures for 1974, 1978, 1982 and 1987 are from the Bureau of the Census, Agriculture Division; irrigated acreage figures for 1990 are estimates from the U.S. Geological Survey (USGS); irrigated acreage for 1995 are derived from estimates made by the Nevada Division of Water Planning (NDWP). Farm marketings, number of farm and agricultural service workers are from U.S. Department of Commerce, Bureau of Economic Analysis (BEA), Regional Economic Information Service (REIS). Agricultural Services Workers include workers in agricultural services, which is primarily landscaping and lawn care, as well as jobs in the forestry and fisheries areas.

With rising prices for agricultural produce, it appears that the value of Nevada's farm marketings peaked in the early 1990's, considerably later than the peak in reported acreage under irrigation (see Table 5–6 and Figure 5–18). Figure 5–19 shows the value of farm marketings ranked by county. In comparing these figures with the ranking of county irrigated acreage in Figure 5–17, we may see that while Elko County accounted for nearly 30 percent of the state's total irrigated acreage in 1996, it accounts for \$34.2 million, or 11.4 percent, of the state's total farm marketings. On the other hand, Lyon County, which accounted for only 8.5 percent of statewide irrigated acreage in 1996, made up \$51.9 million, or 17.3 percent of total farm marketings. The differences between shares of irrigated acreage and shares of farm marketings are best explained by the nature of the crops, with lower producing counties emphasizing forage crops like alfalfa, and other counties producing higher-valued crops (potatoes, onions, garlic, etc.).

In viewing the individual county figures, which are presented in Appendix 4 of the Appendices, particularly with respect to the amount of irrigated acreage, there also appears wide fluctuations in these levels of irrigated acreage indicating either highly volatile irrigation and crop production cycles based on water available for irrigation or, also very likely, fundamental problems in reporting and gathering accurate data on this industry sector.

The volatility in historical measures of this industry, particularly with respect to irrigated acreage, related water usage rates and livestock figures, makes forecasting irrigation and livestock water use especially difficult. However, there does appear to be a trend towards no new agricultural lands being brought under cultivation and in some counties, e.g., Carson City, Churchill, and Washoe in particular, it appears that encroaching urbanization and the transfer of water rights to other uses, i.e., municipal and industrial, is causing the level of irrigated lands to actually decline. Given new and growing demands for limited water resources in the state, particularly for municipal use, wildlife protection and fishery restoration, instream flows and recreation, the future of agriculture in Nevada becomes especially uncertain.



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PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 6

Glossary of Terminology

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in that source. Words and definitions included in this glossary which explain or summarize elements of existing water law are not intended to change that law in any way.]

(Prior) Appropriation Doctrine — The system for allocating water to private individuals used in the western United States under which (1) the right to water was acquired by diverting water and applying it to a beneficial use and (2) a right to water acquired earlier in time is superior to a similar right acquired later in time. In most states water rights are not now acquired by diverting water and applying it to a beneficial use. Such a system is referred to as the constitutional method of appropriation. Water rights are acquired by application, permit, and license, which may not require diversion and application to a beneficial use. Superiority of right is based on earliest in time and has no reference to whether two rights are for a similar use. The doctrine of *Prior Appropriation* was in common use throughout the arid west as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of "*First in Time, First in Right*." The first person to take a quantity of water and put it to *Beneficial Use* has a higher priority of right than a subsequent user. Under drought conditions, higher priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land. Contrast with *Riparian Water Rights*.

Appropriative Water Right [Nevada] — Nevada's water law is based on statutes enacted in 1903 and 1905 and are founded on the principal of *Prior Appropriation*. Unlike some other states, Nevada has a statewide system for the administration of both ground water and surface water. Appropriative water rights are based on the concept of applying water to *Beneficial Use* and "*First in Time, First in Right*." Appropriative water rights can be lost through nonuse and they may be sold or transferred apart from the land. Due in large part to the relative scarcity of water in Nevada and numerous competing uses, Nevada has had a thriving market for water transfers for a number of years. A person in Nevada who desires to place water to beneficial use must file an application with the State Engineer to initiate the process of acquiring an appropriative water right. Also see *Riparian Water Rights*, *Prescribed Water Rights*, and *Reserved Water Rights (Federal)*.

Beneficial Use (of Water) — (1) The amount of water necessary when reasonable intelligence and diligence are used for a stated purpose. (2) A use of water resulting in appreciable gain or benefit to the user, consistent with state law, which varies from one state to another. Most states recognize the following uses as beneficial:

- [1] domestic and municipal uses;
- [2] industrial uses;
- [3] irrigation;
- [4] mining;
- [5] hydroelectric power;
- [6] navigation;
- [7] recreation;
- [8] stock raising;
- [9] public parks;
- [10] wildlife and game preserves.

(2) The cardinal principle of the *(Prior) Appropriation Doctrine*. A use of water that is, in general, productive of public benefit, and which promotes the peace, health, safety and welfare of the people of the State. A certificated

water right is obtained by putting water to a beneficial use. The right may be lost if beneficial use is discontinued. A beneficial use of water is a use which is of benefit to the appropriator and to society as well. The term encompasses considerations of social and economic value and efficiency of use. In the past, most reasonably efficient uses of water for economic purposes have been considered beneficial. Usually, challenges have only been raised to wasteful use or use for some non-economic purpose, such as preserving instream values. Recent statutes in some states have expressly made the use of water for recreation, fish and wildlife purposes, or preservation of the environment a beneficial use. Also see *Appropriative Water Rights*.

Biodiversity — Refers to the variety and variability of life, including the complex relationships among microorganisms, insects, animals, and plants that decompose waste, cycle nutrients, and create the air that we breathe. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete *Ecosystems* to the biochemical structures that are the molecular basis of heredity.

Clean Water Act (CWA) [Public Law 92-500] — More formally referred to as the *Federal Water Pollution Control Act*, the Clean Water Act constitutes the basic federal water pollution control statute for the United States. Originally based on the *Water Quality Act* of 1965 which began setting water quality standards. The 1966 amendments to this act increased federal government funding for sewage treatment plants. Additional 1972 amendments established a goal of zero toxic discharges and “fishable” and “swimmable” surface waters. Enforceable provisions of the CWA include technology-based effluent standards for point sources of pollution, a state-run control program for nonpoint pollution sources, a construction grants program to build or upgrade municipal sewage treatment plants, a regulatory system for spills of oil and other hazardous wastes, and a *Wetlands* preservation program (Section 404).

Clean Water Act (CWA), Section 319 — A federal grant program added by Congress to the CWA in 1987 and managed by the *U.S. Environmental Protection Agency (EPA)*, Section 319 is specifically designed to develop and implement state *Nonpoint Source (NPS) Pollution* management programs, and to maximize the focus of such programs on a watershed or waterbasin basis with each state. Today, all 50 states and U.S. territories receive Section 319 grant funds and are encouraged to use the funding to conduct nonpoint source assessments and revise and strengthen their nonpoint source management programs. Before a grant is provided under Section 319, states are required to: (1) complete a Nonpoint Source (NPS) Assessment Report identifying state waters that require nonpoint source control and their pollution sources; and (2) develop Nonpoint Source Management Programs that outline four-year strategies to address these identified sources.

Clean Water Standards (EPA) — Generally refers to any enforceable limitation, control, condition, prohibition, standard, or other requirement which is promulgated pursuant to the *Federal Water Pollution Control Act (Clean Water Act) [Public Law 92-500]* or contained in a permit issued to a discharger by the *U.S. Environmental Protection Agency (EPA)* or by a state under an approved program, as authorized by Section 402 of the Clean Water Act, or by local governments to ensure compliance with pretreatment regulations as required by Section 307 of the Clean Water Act.

Designated Groundwater Basin [Nevada] — In the interest of public welfare, the Nevada State Engineer, *Division of Water Resources, Department of Conservation and Natural Resources*, is authorized by statute (Nevada Revised Statute 534.120) and directed to designate a ground water basin and declare *Preferred Uses* within such designated basin. The State Engineer has additional authority in the administration of the water resources within a designated ground water basin. [A listing of Nevada’s Hydrographic Regions, and designated Areas and Sub-Areas is presented in the NDWP’s *Water Words Dictionary* in Appendix A-1 (hydrographic regions, areas and sub-areas), Appendix A-2 (listed sequentially by area number) Appendix A-3 (listed alphabetically by area name), and Appendix A-4 (listed alphabetically by principal Nevada county(ies) in which located).]

Drought — There is no universally accepted quantitative definition of drought. Generally, the term is applied to periods of less than average or normal precipitation over a certain period of time sufficiently prolonged to cause a serious hydrological imbalance resulting in biological losses (impact flora and fauna ecosystems) and/or economic losses (affecting man). In a less precise sense, it can also signify nature’s failure to fulfill the water wants and needs of man.

Ecosystem — A community of animals, plants, and bacteria, and its interrelated physical and chemical environment.

An ecosystem can be as small as a rotting log or a puddle of water, but current management efforts typically focus on larger landscape units, such as a mountain range, a river basin, or a watershed. Also see *Biodiversity*.

Ecosystem Management — (Environmental) An approach to managing the nation's lands and natural resources which recognizes that plant and animal communities are interdependent and interact with their physical environment (i.e., soil, water, and air) to form distinct ecological units called *Ecosystems*. The fact that these ecosystems span jurisdictional and political boundaries necessitates a more comprehensive and unified approach to managing them. Implementing the initial stage of a government-wide approach to ecosystem management typically requires clarifying the policy goals and undertaking certain practical steps to apply the principles being considered to include:

- [1] Delineating the ecosystem;
- [2] Understanding the system(s) ecologies;
- [3] Making management choices;
- [4] Unifying disparate data and information needs and sources; and
- [5] Adapting management on the basis of new information.

Endangered Species — Any plant or animal species threatened with extinction by man-made or natural changes throughout all or a significant area of its range; identified by the Secretary of the Interior as “endangered”, in accordance with the 1973 *Endangered Species Act (ESA)*, below. [See Appendix D-1, Nevada's Endangered and Threatened Species.]

Endangered Species Act (ESA) — An act passed by Congress in 1973 intended to protect species and subspecies of plants and animals that are of “aesthetic, ecological, educational, historical, recreational and scientific value.” It may also protect the listed species’ “critical habitat”, the geographic area occupied by, or essential to, the protected species. The *U.S. Fish and Wildlife Service (USFWS)* and the *National Marine Fisheries Service (NMFS)* share authority to list endangered species, determine critical habitat and develop recovery plans for listed species. Currently, approximately 830 animals and 270 plants are listed as endangered or threatened nationwide at Title 50, Part 17, sections 11 and 12 of the Code of Federal Regulations. Further, under a settlement with environmental groups, USFWS has agreed to propose listing another 400 species over the next few years. The 1973 Endangered Species Act superseded and strengthened the *Endangered Species Preservation Act* of 1966 and the *Endangered Species Conservation Act* of 1969. The 1973 provisions required that the act be re-authorized by Congress every five years.

“First in Time, First in Right” — A phrase indicating that older water rights have priority over more recent rights if there is not enough water to satisfy all rights. See (*Prior Appropriation Doctrine* and *Appropriative Water Rights*).

Gage, or Gauge — (1) An instrument used to measure magnitude or position; gages may be used to measure the elevation of a water surface, the velocity of flowing water, the pressure of water, the amount of intensity of precipitation, the depth of snowfall, etc. (2) The act or operation of registering or measuring magnitude or position. (3) The operation, including both field and office work, of measuring the discharge of a stream of water in a waterway.

Great Basin [Nevada] — An area covering most of Nevada and much of western Utah and portions of southern Oregon and southeastern California consisting primarily of arid, high elevation, desert valleys, sinks (playas), dry lake beds, and salt flats. The Great Basin is characterized by the fact that all surface waters drain *inward* to terminal lakes or sinks. Principal excluded regions within Nevada include the extreme north-central portion of the state whose waters drain northward into the Snake River Basin, thence to the Columbia River and finally to the Pacific Ocean, and the south-eastern portion of Nevada whose surface waters drain into the Colorado River Basin, thence to the Gulf of California (Mexico) and the Pacific Ocean. Within this area referred to as the Great Basin, major river drainage areas include:

- [1] **Truckee River**, whose source is Lake Tahoe (Basin) and whose terminus is Pyramid Lake in western Nevada;
- [2] **Carson River**, whose west and east forks originate along the eastern slopes of the Sierra Nevada Mountains and whose terminus is the Carson Sink (Playa) in west-central Nevada;
- [3] **Walker River**, whose west and east fork tributaries also originate along the eastern slopes of the Sierra Nevada Mountains and whose terminus is Walker Lake in western Nevada; and

[4] **Humboldt River**, the only major river wholly contained in Nevada, whose principal source is the Ruby Mountains in eastern Nevada and whose terminus is the Carson Sink (Playa) in west-central Nevada. Pyramid Lake and Walker Lake in western Nevada represent the remnants of the ancient *Lake Lahontan*, an *Ice Age* lake that covered a considerable portion of northwestern Nevada during the Pluvial Period of some 75,000–10,000 years ago. The Great Salt Lake in western Utah, the last major remnant of the ancient Ice Age Lake Bonneville, which covered a large portion of what is now the Utah portion of the Great Basin, is also contained within this area and acts as the terminus for surface water drainage from the western slopes of the Wasatch Range in north-central Utah.

Ground Water, also Groundwater — (1) Generally, all subsurface water as distinct from *Surface Water*; specifically, the part that is in the saturated zone of a defined aquifer. (2) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper level of the saturate zone is called the Water Table. (3) Water stored underground in rock crevices and in the pores of geologic materials that make up the earth's crust. Ground water lies under the surface in the ground's *Zone of Saturation*, and is also referred to as *Phreatic Water*.

Integrated (Water) Resource Planning (IRP) — A comprehensive, interdisciplinary approach to water resource planning that encompasses water resource assessment, demand considerations, analysis of alternatives, risk management, resource diversity, environmental considerations, least-cost analysis, multidimensional modeling, and participatory decision making and public input, among other factors. Integrated Resource Planning begins with specific policy objectives that are applied to extensive lists of options for water supply sources, distribution systems, or other operational requirements. The options are then narrowed after evaluating demand requirements, environmental impacts, conservation options, costs, risks, and other aspects of a project. IRP involves a dynamic process of assessing demand and supply conditions and creatively integrating alternatives and new technologies. While the concepts of IRP are relatively new to the process of water planning, it has been used extensively in the energy industry. As a planning process it helps decision makers select the best mix of water resources, facilities, and conservation measures to meet water demands. In addition to traditional planning techniques, IRP also

- [1] Includes extensive public involvement;
- [2] Considers both supply-side (resources and facilities) and demand-side (conservation) alternatives as ways of meeting demands;
- [3] Considers goals and objectives in addition to dollar costs (e.g., environmental concerns, public acceptability, etc.);
- [4] Considers uncertainty in demand forecasts, regulations, etc.; and
- [5] Considers the effect of water rates on water demands.

Interbasin Transfer (of Water) — A transfer of water rights and/or a diversion of water (either groundwater or surface water) from one *Drainage* or *Hydrographic Basin* to another, typically from the basin of origin to a different hydrologic basis. Also referred to as *Water Exports* and/or *Water Imports*.

Interstate Allocation [Nevada and California] — An agreement between the states of Nevada and California over the use of the waters of Lake Tahoe and the Truckee, Carson, and Walker rivers which was ratified by California (1970) and Nevada (1971), but was never ratified by Congress. Despite this, both states have enacted legislation to enforce to the allocation of the Truckee, Carson, and Walker rivers between these two states. Subsequently, in 1990 many of the compact's provisions dealing with the waters of Lake Tahoe and the Truckee and Carson rivers became formalized under *Public Law 101-618* (the *Negotiated Settlement*).

Interstate Water Compact — (1) Broadly, an agreement between two or more states regarding competing demands for a water resource which are beyond the legal authority of one state alone to solve. (2) States administer water rights within their own political boundaries; however, the process becomes more complicated when involving an interstate body of water (*Interstate Water*). Under these conditions there are three possible ways to achieve an interstate allocation of water: (1) A suit for equitable apportionment brought by the states in the U.S. Supreme Court; (2) a Congressional act; and (3) an interstate compact. An interstate compact is an agreement negotiated between states, adopted by their state legislatures, and then approved by Congress. Once an allocation of interstate water is determined by such a means, the individual states may then issue water rights to its share of the water through their normal administrative process. Interstate compacts have been traditionally used in making water allocations in the western states. Also see *Interstate Allocation [Nevada and California]*.

Interstate Waters — According to law, interstate waters are defined as: (1) rivers, lakes and other waters that flow across or form a part of state or international boundaries; (2) waters of the Great Lakes; and (3) coastal waters

whose scope has been defined to include ocean waters seaward to the territorial limits and waters along the coastline (including inland streams) influenced by the tide.

Intrabasin Transfer (of Water) — Transfers of water within the same water basin or hydrographic area.

Junior (Water) Rights — A junior water rights holder is one who holds rights that are temporarily more recent than senior rights holders. All water rights are defined in relation to other users, and a water rights holder only acquires the right to use a specific quantity of water under specified conditions. Therefore, when limited water is available, junior rights are not met until all senior rights have been satisfied. See *Prior Appropriation Doctrine*.

National Economic Development — One of the two main objectives of planning for water and related land resources by governmental agencies whose activities involve planning and development of water resources. Such activities are reflected in the increase in the nation's productive output, an output which is partly reflected in a national product and income accounting framework to measure the continuing flow of goods and services into direct consumption or investment.

National Environmental Policy Act (NEPA) — A 1970 Act of Congress that requires all federal agencies to incorporate environmental considerations into their decision-making processes. The act requires an *Environmental Impact Statement (EIS)* for any "major federal action significantly affecting the quality of the human environment."

National Flood Insurance Program (NFIP) — A federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that if a community will implement and enforce measures to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHA), then the federal government will make flood insurance available to protect against flood losses that do occur. The NFIP was established by Congress through the passage of the National Flood Insurance Act of 1968. Features of the program were modified and extended with the 1973 passage of the Flood Disaster Protection Act, and other legislative measures. The NFIP is administered by the Federal Insurance Administration (FIA), which is a component part of the *Federal Emergency Management Agency (FEMA)*.

Navigable Waters [Nevada] — In Nevada bodies of water are navigable if they are used, or are susceptible of being used, in their ordinary condition as highways for commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water. In Nevada, this test of navigability (*State of Nevada v. Julius Bunkowski, et al.*, 1972) held that the Carson River was navigable, and therefore the State of Nevada owned its bed, as logs were floated down the river from about 1860 to 1895 (the commerce requirement).

Perennial Yield (Ground Water) — The amount of usable water of a ground water reservoir that can be withdrawn and consumed economically each year for an indefinite period of time. It cannot exceed the sum of the *Natural Recharge*, the *Artificial (or Induced) Recharge*, and the *Incidental Recharge* without causing depletion of the groundwater reservoir. Also referred to as *Safe Yield*.

Perfected Water Right — (1) A completed or fully executed water right. A water right is said to have been perfected when all terms and conditions associated with it have been fully accomplished, e.g., the diversion has been effected and the water applied to beneficial use. (2) A water right to which the owner has applied for and obtained a permit, has complied with the conditions of the permit, and has obtained a license or certification of appropriation. (3) A water right which indicates that the uses anticipated by an applicant, and made under permit, were made for *Beneficial Use*. Usually it is irrevocable unless voluntarily canceled or forfeited due to several consecutive years of nonuse. Also referred to as a *Certified Water Right*. Also see *Appropriation Doctrine*.

Permit — (1) (Water Right) A written document which grants authority to take unused water and put it to *Beneficial Use*. If all requirements of the permit are satisfied, then the permit for water appropriation can mature into a license or *Perfected Water Right*. (2) (Discharge) A legally binding document issued by a state or federal permit agency to the owner or manager of a point source discharge. The permit document contains a schedule of compliance requiring the permit holder to achieve a specified standard or limitation (by constructing treatment facilities or modifying plant processes) by a specified date. Permit documents typically specify monitoring and reporting requirements to be conducted by the applicant as well as the maximum time period over which the permit is valid. Also see *Application, Water Right*.

Permit, Water [Nevada] — The written permission from the state engineer to appropriate public waters for a beneficial use from a surface or underground source, at a specific point of diversion, under limited circumstances. If all requirements of the permit are satisfied, then the permit for water appropriation can mature into a license or *Perfected Water Right*. Also see *Permitted Water Right [Nevada]*, and *Application, Water Right*.

Planning — A comprehensive study of present trends and of probable future developments, together with recommendations of policies to be pursued. Planning embraces such subjects as population growth and distribution; social forces; availability of land, water, minerals, and other natural resources; technological progress; and probable future revenues, expenditures, and financial policies. Planning must be responsive to rapidly changing conditions.

Planning Horizon — The overall time period considered in the planning process that spans all activities covered in or associated with the analysis or plan and all future conditions and effects or proposed actions which would influence the planning decisions.

Policy — (Water Planning) A statement of governmental intent against which individual actions and decisions are evaluated. The wording of policies conveys the level of commitment to action, for example, policies which use the word “shall” are mandatory directives, while those using the word “should” are statements of direction to be followed unless there are compelling reasons to do otherwise.

Preferred Use — A use given some sort of preference not given other uses. Preference can take many forms, depending on state law. One type of use, such as domestic use, may be preferred over others when there are competing applications to appropriate the same water. Persons having water rights for preferred use may be entitled to take water before those having rights for other uses, regardless of their relative priorities. A person needing water for a preferred use may be authorized to condemn (i.e., to buy in a forced judicial sale) water being used for non-preferred purposes. Also see *Designated Ground Water Basin* and *Designated Ground Water Basin [Nevada]*.

Preferred Use [Nevada] — In the interest of public welfare, the state engineer is authorized and directed to designate preferred uses of water within the respective areas so designated by him and from which the ground water is being depleted. In acting on applications to appropriate ground water, he may designate such preferred uses in different categories with respect to the particular areas involved within the following limits: domestic, municipal, quasi-municipal, industrial, irrigation, mining and stock-watering uses and any uses for which a county, city, town, public water district or public water company furnishes the water.

Prescribed Water Rights — (1) Water rights to which legal title is acquired by long possession and use without protest of other parties. (2) Water use rights gained by trespass or unauthorized taking that ripen into a title; on a par with rights to land gained through adverse possession. To perfect the right, the use of water must be adverse, hostile, open and continuous for five continuous years against the recognized water rights holder. Contrast with *Appropriative Water Rights*, *Riparian Water Rights*, and *Littoral Water Rights*.

Prior Appropriation Doctrine — (1) A concept in water law under which a right to a given quantity of water is determined by such a procedure as having the earliest *Priority Date*. (2) The system for allocating water to private individuals used in most of the western United States. The doctrine of *Prior Appropriation* was in common use throughout the arid west as early settlers and miners began to develop the land. The prior appropriation doctrine is based on the concept of “*First in Time, First in Right*”. The first person to take a quantity of water and put it to *Beneficial Use* has a higher priority of right than a subsequent user. Under drought conditions, higher priority users are satisfied before junior users receive water. Appropriative rights can be lost through nonuse; they can also be sold or transferred apart from the land. Contrasts with *Riparian Doctrine* and *Riparian Water Rights*. Also see *Littoral Water Rights* and *Prescribed Water Rights*.

Priority — The concept that the person first using water has a better right to it than those commencing their use later. An appropriator is usually assigned a “priority date”. However, the date is not significant in and of itself, but only in relation to the dates assigned other water users from the same source of water. Priority is only important when the quantity of available water is insufficient to meet the needs of all those having a right to use water. See (*Prior Appropriation Doctrine* and *Appropriative Water Rights*).

Priority Date — The date of establishment of a water right; the officially recognized date associated with a water right. The rights established by application have the application date as the date of priority. Relative to other water rights, the priority date may make a water right senior (predating other rights) or junior (subordinate to other rights). See (*Prior Appropriation Doctrine* and *Appropriative Water Rights*).

Public Interest, or Public Welfare — An interest or benefit accruing to society generally, rather than to any individuals or groups of individuals in the society. In many states, a permit to appropriate water must be denied if the appropriation would be contrary to the public interest or public welfare. These terms are sometimes vague

and state engineers or others administering the water permit systems generally have viewed narrowly the authority granted under such provisions. In some cases they have restricted their consideration to matters of economic efficiency or the effects of the proposed appropriation on existing or future use for the water and have not considered such things as the environmental effects. However, recent developments, such as state environmental policy acts or legislation addressing specific public interest criteria, have placed new emphasis on this issue. Also see *Public Trust Doctrine*.

Public Scoping — The process of soliciting public comments on the issues to be examined in environmental documents such as an *Environmental Impact Statement (EIS)* or water planning documents. The process can be carried out by public meetings, soliciting written comments, or both. The identification of issues, alternatives, impacts, mitigation and/or monitoring all may be addressed during the scoping process.

Public Trust Doctrine — (1) A vaguely defined judicial doctrine under which the state holds its navigable waters and underlying beds in trust for the public and is required or authorized to protect the public interest in such waters. All water rights issued by the state are subject to the overriding interest of the public and the exercise of the public trust by state administrative agencies. (2) Based in Roman Law, the Public Trust Doctrine holds that certain resources belong to all the people and are therefore held in trust by the state for future generations. Since the 1970s, court rulings have expanded the concept of public trust to protect not only the traditional uses of navigation, commerce, and fishing, but also ecological preservation, open space maintenance, and scenic and wildlife habitat preservation. In a 1983 landmark ruling by the California Supreme Court (*National Audubon Society v. Superior Court of Alpine County*), the court held that water right licenses held by the City of Los Angeles and its Department of Water and Power to divert water from streams tributary to Mono Lake remain subject to ongoing State of California supervision under the public trust doctrine and could be curtailed or revoked, if necessary, to protect the public trust. The court held that public trust uses must be considered and balanced when the rights to divert water away from *Navigable* bodies of water are to be considered. Therefore, in issuing or reconsidering any rights to appropriate or divert water, the state must balance public trust needs with the needs for other beneficial uses of water. Also see *Equal Footing Doctrine (U.S. Constitution)* and *Public Interest, or Public Welfare*.

Reasonable Use — A rule with regard to percolating or riparian water restricting the landowner to a reasonable use of his own rights and property in view of and qualified by the similar rights of others, and the condition that such use not injure others in the enjoyment of their rights.

Reasonable Use Theory — A *Riparian Owner* may make reasonable use of his water for either natural or artificial wants. However, he may not so use his rights so as to affect the quantity or quality of water available to a lower riparian owner.

Reservation Doctrine, Reserved Rights Doctrine, and Winters Doctrine (or Winters Rights) — The legal rule which states that when the United States reserves public lands for a particular purpose it also reserves sufficient water to accomplish that purpose. Those who initiate water rights after the date of the reservation are subject to the reserved right. The doctrine was first announced by the United States Supreme Court in the case of *Winters v. United States*, 207 U.S. 564 (1908), involving a dispute between an Indian reservation and a rancher. For many years it was thought that the doctrine only applied to Indian reservations, but in recent years it has been extended to other types of federal reservations, such as national parks and forests. Also see *Winters Rights (Decision)* and *Practically Irrigable Acreage (PIA)*.

Reserved Water Rights (Federal) — (1) A category of federal water rights, created by federal law and recognized by judicial decision. These rights are created when the federal government withdraws land from the public domain to establish a federal reservation such as a national park, forest, or Indian reservation. By this action, the government is held to have reserved water rights sufficient for the primary purpose for which the land was withdrawn. (2) This class of water rights is a judicial creation derived from *Winters v. United States* (207 U.S. 564, 1907) and subsequent federal case law, which collectively hold that when the federal government withdraws land from general use and reserves it for a specific purpose, the federal government by implication reserves the minimum amount of water unappropriated at the time the land was withdrawn or reserved to accomplish the primary purpose of the reservation. Federal reserved water rights may be claimed when Congress has by statute withdrawn lands from the public domain for a particular federal purpose or where the President has withdrawn lands from the public domain for a particular federal purpose pursuant to congressional authorization. The right to such water is not lost by nonuse, and its priority date is the date the land was set aside. Also see *Winters Rights (Decision)*, *Reservation Doctrine*, *Reserved Rights Doctrine*, and *Winters Doctrine (or Winters Rights)*, and *Water Law [Federal]*.

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Riparian Doctrine — The system for allocating water used in England and the eastern United States, in which owners of lands along the banks of a stream or water body have the right to *Reasonable Use* of the waters and a *Correlative Right* protecting against unreasonable use by others that substantially diminishes the quantity or quality of water. The right is appurtenant to the land and does not depend on prior use. Under this doctrine, ownership of land along a stream or river (i.e., riparian lands) is an absolute prerequisite to a right to use water from that body of water and each such landowner has an equal right to withdraw “reasonable” amounts of water (whether or not he is presently using it or not) so long as downstream landowners are not unreasonably damaged. Contrast with *Prior Appropriation Doctrine*.

Safe Drinking Water Act [SDWA] (Public Law 93–523) — An amendment to the *Public Health Service Act* which established primary and secondary quality standards for drinking water. The SDWA was passed in 1976 to protect public health by establishing uniform drinking water standards for the nation. In 1986 SDWA Amendments were passed that mandated the *U.S. Environmental Protection Agency (EPA)* to establish standards for 83 drinking water contaminants by 1992 and identify an additional 25 contaminants for regulation every 3 years thereafter. See *Drinking Water Standards, Drinking Water Standards [Nevada], Primary Drinking Water Standards, and Secondary Drinking Water Standards*. [Also see Appendix B–3, Nevada Drinking Water Standards of the *Water Words Dictionary*.]

Senior Rights — A senior rights holder is one who holds rights that are older (more senior) than those of junior rights holders. All water rights are defined in relation to other users, and a water rights holder only acquires the right to use a specific quantity of water under specified conditions. Thus, when limited water is available, senior rights are satisfied first in the order of their *Priority Date*.

Snowpack Telemetry (SNOTEL) — A remote, automated measurement system operated and maintained by the *Natural Resources Conservation Service (NRCS)* in the western United States to assess snowpack accumulation and potential streamflows. The concept is based upon the relationship between the water content in the snowpack and spring runoff under certain assumptions. Forecasts of runoff are made through the coordination of hydrologists with the NRCS and the *National Weather Service (NWS)*. A typical SNOTEL site consists of: (1) a precipitation measurement tube which measures the actual level of precipitation in inches of equivalent water; (2) a snow “pillow” which measures the weight of the snowpack and therefore its water content, and (3) the measurement and transmitting equipment which send the data to NRCS collection offices.

Socioeconomics — The study of the economic, demographic, and social interactions of humans.

Stream — A general term for a body of flowing water; natural water course containing water at least part of the year. In *Hydrology*, the term is generally applied to the water flowing in a natural channel as distinct from a canal. More generally, as in the term *Stream Gaging*, it is applied to the water flowing in any channel, natural or artificial. Some classifications of streams include, *in relation to time*:

- [1] **Ephemeral Streams** — Streams which flow only in direct response to precipitation and whose channel is at all times above the water table.
- [2] **Intermittent or Seasonal Streams** — Streams which flow only at certain times of the year when it receives water from springs, rainfall, or from surface sources such as melting snow.
- [3] **Perennial Streams** — Streams which flow continuously.

And, *in relation to ground water*:

- [4] **Gaining Streams** — Streams or a reach of a stream that receive water from the zone of saturation. Also referred to as an *Effluent Stream*.
- [5] **Insulated Streams** — Streams or a reach of a stream that neither contribute water to the zone of saturation nor receive water from it. Such streams are separated from the zones of saturation by an impermeable bed.
- [6] **Losing Streams** — Streams or a reach of a stream that contribute water to the zone of saturation. Also referred to as an *Influent Stream*.
- [7] **Perched Streams** — Perched streams are either losing streams or insulated streams that are separated from the underlying ground water by a zone of aeration.

Surface Water — (1) An open body of water such as a stream, lake, or reservoir. (2) Water that remains on the earth’s surface; all waters whose surface is naturally exposed to the atmosphere, for example, rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc., and all springs, wells, or other collectors directly influenced by surface water. (3) A source of drinking water that originates in rivers, lakes and run-off from melting

snow. It is either drawn directly from a river or captured behind dams and stored in reservoirs. Also see *Ground Water Under the Direct Influence (UDI) of Surface Water*.

Transfer (Water Right) — (1) The process of transferring a water right from one person to another. (2) A passing or conveyance of title to a water right; a permanent assignment as opposed to a temporary lease or disposal of water. Most states require that some formal notice or filing be made with an appropriate state agency so that the transaction is officially recorded and the new owner is recorded as the owner of the water right.

Truckee–Carson–Pyramid Lake Water Rights Settlement Act of 1990 — See *Negotiated Settlement*.

Underground Injection Control (UIC) — A program required in each state by a provision of the *Safe Drinking Water Act (SDWA)* for the regulation of *Injection Wells*, including a permit system. An applicant must demonstrate that the well has no reasonable chance of adversely affecting the quality of an underground source of drinking water before a permit is issued.

Usufruct, also Usufructuary — (Legal–Civil Law) The right of enjoying a thing, the property of which is vested in another, and to draw from the same all the profit, utility, and advantage which it may produce, provided it be without altering the substance of the thing. For example, in Nevada, the state’s water belongs to the people, but is permitted, through the water rights permitting process, to be used beneficially by other individuals or entities.

Usufructuary (Water) Right — (1) A right to use rather than own the property of another, such as the state’s water. (2) A water right holder’s authority to divert and use a certain amount of water. See *Usufruct*.

Vested Water Right — (1) The water right to use either surface or ground water acquired through more or less continual beneficial use prior to the enactment of water law pertaining to the source of the water. These claims become final through *Adjudication*. (2) A fully executed or finalized appropriative right to use the waters of a state for a beneficial purpose. Also see *Certificated Water Right* and *Perfected Water Right*.

Water Administration (and Management) — A broad term referring to the collective role of defined state agencies to implement state and federal water laws, commonly through the development and implementation of appropriate statutes and regulations. This role can include oversight, approval, and enforcement responsibilities.

Water Duty [Nevada] — The *Alpine Decree* and *Orr Ditch Decree* provide the basis for virtually all irrigation water duties relating to water diversions from the Truckee, Carson, and Walker rivers in Northern Nevada. These decrees provide for an annual maximum irrigation duty of 4.5 acre-feet per acre for water-righted *Bench Lands* and 3.5 acre-feet per acre for water-righted *Bottom Lands* delivered to farm headgates. These duties are based on the *Crop Water Requirement* on the irrigation of alfalfa, as it is the most prominent crop and the highest water-using crop grown in the *Newlands (Irrigation) Project* in west-central Nevada. However, neither decree identifies lands as to bottom or bench. This has created considerable controversy, particularly within the Newlands Project, which constitutes a principal water user of both Carson River waters and Truckee River (diverted) waters. Also see *Alpine Decree [California and Nevada]*, *Orr Ditch Decree [Nevada and California]*, *Bench Lands [Nevada]*, and *Bottom Lands [Nevada]*.

Water Law — A law that has been instigated to control the right to the use of water. See *(Prior) Appropriation Doctrine* and *Riparian Doctrine*.

Water Law [Federal] — Except when provided by federal law, e.g., *Federal Reserved (Water) Rights*, federal water rights must satisfy the administration and permitting process of the state in which the federal project is located. An important 1978 U.S. Supreme Court case (*California v. United States*) held that unless state law conflicted with clear Congressional directives, the federal government must obtain water rights under state law for reclamation purposes. Under the federal reserved rights concept, the federal government reserves sufficient water rights when it withdraws land from the public domain to establish a federal reservation such as a national park or Indian reservation. Also see *Reservation Doctrine*, *Reserved Rights Doctrine*, and *Winters Doctrine* and *Winters Rights (Decision)*.

Water Law [Nevada] — Nevada’s water law is based on the *Prior Appropriation Doctrine*. Furthermore, unlike some other states, Nevada has a statewide system for the administration of both ground water and surface water. *Appropriative Water Rights* are based on the concept of applying water to *Beneficial Use* and “*First in Time, First in Right*”. Appropriative water rights can be lost through nonuse and they may be sold or transferred apart from the land. Due in large part to the relative scarcity of water in Nevada and numerous competing uses, Nevada has

had a thriving market for water transfers for a number of years. Water rights in Nevada are administered by the State Engineer. Also see *Application, Water Right, Riparian Doctrine, Riparian Water Rights, Littoral Water Rights, Prescribed Water Rights, and Reserved Water Rights*.

Water Management — (1) (General) Application of practices to obtain added benefits from precipitation, water, or water flow in any of a number of areas, such as irrigation, drainage, wildlife and recreation, water supply, watershed management, and water storage in soil for crop production. Includes *Irrigation Water Management* and *Watershed Management*. (2) (Irrigation Water Management) The use and management of irrigation water where the quantity of water used for each irrigation is determined by the water-holding capacity of the soil and the need for the crop, and where the water is applied at a rate and in such a manner that the crop can use it efficiently and significant erosion does not occur. (3) (Watershed Management) The analysis, protection, development, operation, or maintenance of the land, vegetation, and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality, quantity, and timing of the water which is produced. Also see *Basin Management*.

Water Plan — A document of issues, policies, strategies and action plans intended to effectively and economically execute a *Water Planning* process. Also see *Water Policy*.

Water Planning — Water planning is an analytical planning process developed and continually modified to address the physical, economic, and sociological dimensions of water use. As a planning process it must assess and quantify the available supply of water resources and the future demands anticipated to be levied upon those resources. Based upon this continuous supply and demand evaluation, water planning must also give direction for moving water supplies to points of use while encouraging users to be good and effective stewards of available water resources. The water planning process requires constant re-evaluation and updating to address changing social, political, economic, and environmental parameters. While the ultimate objective of such efforts is typically the development of a comprehensive, publicly-supported *Water Plan*, it is also critical to develop and maintain a comprehensive and viable water planning process that covers various aspects of water resource development, transport, water treatment, allocation among various competing uses, conservation, waste-water treatment, re-use, and disposal. Also see *Water Policy*.

Water Resource Plan — A planning document or process which assesses both sources and uses of water and develops strategies for their most effective and efficient use according to public needs and criteria. Also see *Water Plan, Water Planning, and Water Policy*.

Water Right — (1) The legal right to use a specific quantity of water, on a specific time schedule, at a specific place, and for a specific purpose. (2) A legally-protected right, granted by law, to take possession of water occurring in a water supply and to put it to *Beneficial Use*. (3) A legal right to divert state waters for a beneficial purpose.

Water-Righted Acreage — The land base for which there are water rights.

Water Rights — (1) The legal rights to the use of water. (2) A grant, permit, decree, appropriation, or claim to the use of water for beneficial purposes, and subject to other rights of earlier date or use, called *Priority* or *Prior Appropriation*. They consist of *Riparian Water Rights, Appropriative Water Rights, Prescribed Water Rights, and Reserved Water Rights*. Also see *Water Law, Water Law [California], Water Law (Federal), and Water Law [Nevada]*.

Water Rights, Correlative Doctrine — When a source of water does not provide enough for all users, the water is reapportioned proportionately on the basis of prior water rights held by each user.

Water Use — The amount of water needed or used for a variety of purposes including drinking, irrigation, processing of goods, power generation, and other uses. The amount of water used may not equal the amount of water withdrawn due to water transfers or the recirculation or recycling of the same water. For example, a power plant may use the same water a multiple of times but withdraw a significantly different amount. Also see *Water Use, Types*, below.

Water Use Practices — Direct, indirect, consumptive, and nonconsumptive uses of water. These include domestic practices (e.g., washing, bathing, cooking, drinking), navigation, wildlife habitat management, irrigation practices, recreation activities, industrial uses, and hydroelectric power generation.

Water Use, Types — The use of water may be classified by specific types according to distinctive uses, such as the following:

- [1] Commercial Water Use
- [2] Domestic Water Use
- [3] Hydroelectric Power Water Use

- [4] Irrigation Water Use
- [5] Livestock Water Use
- [6] Mining Water Use
- [7] Navigational Water Use
- [8] Other Water Use
- [9] Public Water Use (same as *Utility Water Use*)
- [10] Residential Water Use (same as *Domestic Water Use*)
- [11] Rural Water Use
- [12] Thermoelectric Power Water Use

Watermaster — Often an employee of a court hired to administer a court decree. Also may be an employee of a water department who distributes available water supplies at the request of water rights holders and collects hydrographic data. Also refers to a position within an irrigation project that is responsible for the internal distribution of project water.

Watershed — (1) An area that, because of topographic slope, contributes water to a specified surface water drainage system, such as a stream or river. (2) All lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream; a region or area bounded peripherally by a water parting and draining ultimately to a particular water course or body of water. Also referred to as *Water Basin* or *Drainage Basin*. (3) A ridge of relatively high land dividing two areas that are drained by different river systems. Also referred to as *Water Parting*.

Watershed Management — The analysis, protection, development, operation or maintenance of the land, vegetation and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality and timing of the water which is produced. Also referred to as *Water Management* and *Basin Management*.

Watershed Planning — The formulation of a plan, based on the concept of a *Watershed*, a *Water Basin*, a *Hydrologic Region*, or a *Hydrologic Study Area (HSA)*, with the intent to assess climatological conditions, inventory existing ground and surface water resources, determine current water uses, project future socioeconomic and environmental demands for those resources, and explore feasible water-balancing options, so as to maximize the benefits to the inhabitants of a study area while simultaneously preserving and protecting the region's wildlife, habitat, and environmental conditions.

Wellhead Protection (Program) — Programs intended to protect and preserve the quality of ground water used as a source of drinking water. A typical wellhead protection program will have a number of critical elements to include: (1) delineating the roles and responsibilities of state agencies, local governments, and water purveyors; (2) delineation of wellhead protection areas; (3) contaminant source inventories; (4) management options; (5) siting of new wells; (6) contingency and emergency planning; and (7) public participation. Typically, steps taken to protect and preserve the quality of a well are far less costly than actions necessary to restore a contaminated well.

Wetlands [Nevada] — (State Wildlife Management Areas) Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency or duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands typically include swamps, marshes, bogs, playas, springs, seeps, and similar areas. Wetlands are land transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water.

Winters Doctrine — The doctrine of (federal) reservation rights. See *Winters Rights (Decision)*.

Winters Rights (Decision) — The U.S. Supreme Court precedent decision (*Winters v. United States*, 207 U.S. 564 [1908]) in which the Court prohibited any uses by non-Indians that interfered with the Indian tribes' use of their reserved water. In *Winters*, the Court held that when reservations were established, Indian tribes and the United States implicitly reserved, along with the land, sufficient water to fulfill the purposes of the reservations. The ruling rests on the principle that Indian tribes retain all rights not explicitly relinquished. These federal reserved water rights are commonly known as *Winters Rights* as based on the *Winters Doctrine*. The court recognized these rights as having a priority date coinciding with the date the reservation was established, thus providing a means to integrate federally reserved rights with *Appropriative Water Rights* recognized under state law. Since reserved rights are not created by state law, *Winters Rights* retain their validity and seniority regardless of whether tribes have put the water to *Beneficial Use*. On-going conflicts concerning this ruling tend to involve non-Indian water users appropriating water under state law, water that previously may have been reserved for Indian tribes, though never quantified by courts or fully used on reservations. Also see *Reservation Doctrine*, *Reserved Rights Doctrine*,

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and Winters Doctrine, Practicably Irrigable Acreage (PIA), (Prior) Appropriation Doctrine, and Water Law [Federal].

Yield, Firm — The maximum annual supply of a given water development that is expected to be available on demand, with the understanding that lower yields will occur in accordance with a predetermined schedule or probability. Sometimes referred to as *Dependable Yield*.

Yield, Perennial — The amount of usable water of a ground-water reservoir that can be economically withdrawn and consumed each year for an indefinite period of time. It cannot exceed the sum of the *Natural Recharge*, the *Artificial (or Induced) Recharge*, and the *Incidental Recharge* without causing depletion of the groundwater reservoir. Also referred to as *Safe Yield*.

Yield, Safe — With reference to either a surface- or ground-water supply, the rate of diversion or extraction for *Consumptive Use* which can be maintained indefinitely, within the limits of economic feasibility, under specified conditions of water-supply development. Also see *Perennial Yield*.

Nevada Division of Water Planning

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PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 7

Glossary on Selected Federal, State, and Local Agencies and Organizations

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in that source.]

(United States) Army Corps of Engineers (Corps or COE) — Originally formed in 1775 during the Revolutionary War by General George Washington as the engineering and construction arm of the Continental Army. Initially, the Corps of Engineers built fortifications and coastal batteries to strengthen the country's defenses and went on to found the Military Academy at West Point, help open the West, and to develop the nation's water resources. In its military role, the COE plans, designs, and supervises the construction of facilities to insure the combat readiness of the U.S. Army and Air Forces. In its civilian role, the COE has planned and executed national programs for navigation and commerce, flood control, water supply, hydroelectric power generation, recreation, conservation, and preservation of the environment. In a very general sense, the U.S. Army Corps of Engineers has a primary responsibility for water projects which protect property from potential flood damage, whereas the (U.S. Department of the Interior) *Bureau of Reclamation (USBR)* is responsible for primarily western water projects with respect to developing water sources for agriculture and commerce. In reality, however, quite often these federal agencies' project goals overlap with USBR's dams and reservoirs providing important flood protection and the COE's water projects — dams, locks, and canals — providing important water transportation linkages and benefits to commerce. The following are the COE's primary missions and objectives. [See Appendix E-2 of the *Water Words Dictionary* for a more complete description of the U.S. Army Corps of Engineers' organizational structure and primary missions and objectives.]

- [1] ***Navigation Improvements***—to assist in the development, safety, and conduct of waterborne commerce;
- [2] ***Flood Control***—to prevent or reduce flood damages and disruptions by accommodating flood flows in problem areas;
- [3] ***Hurricane and Storm Damage Reduction***—preventing or reducing tidal and storm-related damage by building protective structures, such as dams or barriers, in estuaries; by raising the heights of dunes and natural beaches; and by building groins, dikes, seawalls or breakwaters;
- [4] ***Coastal and Shoreline Erosion***—protect against ocean and lake shoreline erosion by providing seawalls, groins or other structures that reduce waves' destructive effects; by filling an nourishing beaches and dunes to replace and maintain lost areas; and by planting vegetation that will hold and stabilize erodible materials; by preventing streambank erosion through the use of gabions, riprap and vegetative plantings;
- [5] ***Water Supply***—at the request of local interests, include water supply storage in new projects, and modify existing projects for new or additional water supply storage, and in limited emergency circumstances, provide emergency supplies of clean water to a locality confronted by a source of contaminated water likely to cause a substantial threat to public health;
- [6] ***Hydroelectric Power***—facilities for hydroelectric power are recognized as primarily the responsibility of non-federal interests; however, the Corps may include hydroelectric power development in multipurpose projects when it complements the major objectives of flood control or navigation;
- [7] ***Outdoor Recreation***—facilitate the development of outdoor recreation facilities at Corps projects thereby providing a variety of opportunities for picnicking, camping, swimming, boating, hunting, fishing, hiking, and other pursuits;
- [8] ***Environment***—per various federal requirements (*Fish and Wildlife Coordination Act, Endangered Species Act, National Historic Preservation Act*), a recognition that Corps projects must include not only facilities

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to mitigate unavoidable environmental damages, but also considerations of environmental restoration through opportunities created by the projects;

- [9] **Water Quality Control**—per *Federal Water Pollution Control Act (Clean Water Act)* requirements, the Corps is required to consider including water storage for regulation of stream flow and quality improvements in its reservoir and lake projects;
- [10] **Aquatic Plant Control**—per the *River and Harbor Act*, the Corps is authorized to conduct research and control or eradicate undesirable aquatic plants through research and application on the use of chemicals, mechanical harvesters, and natural enemies (insects, pathogens, and fish).

(United States) Bureau of Indian Affairs (BIA) — An agency of the U.S. Department of the Interior which has the primary responsibility for exercising the federal government's trust relationship with Indian tribes. The BIA was first established in 1824 in the War Department, then transferred to the Department of the Interior in 1849. The BIA has prime responsibility to provide services to Indian tribes and plays a central role in the settlement process of Indian water rights disputes. The BIA exercises prime trust responsibility in providing federal government protection for Indian resources and federal assistance in resource development and management. Quite often this responsibility complicates the Department of the Interior's other broad responsibilities to manage the use of lands and natural resources on public lands through its *Bureau of Land Management (BLM)* land use programs, its *Bureau of Reclamation (USBR)* water-related projects, and its *U.S. Fish and Wildlife Service (USFWS)* wildlife and habitat restoration programs, which may frequently come in conflict with the Bureau of Indian Affairs Indian water rights issues. [For example, in *Nevada v. United States* (463 U.S. 129{1983}), the United States Supreme Court held that the United States [Department of the Interior] could adequately represent more than one interest simultaneously, and so it is not subject to the same standards as a private trustee. In this case, the Court found that claims made by the United States on behalf of the Pyramid Lake Paiute Indian Tribe to protect fisheries should have been asserted in prior litigation. Nevertheless, the Court found the failure to do so was not a breach of its trust obligations to the tribe, even though the United States also had protected the competing interests of non-Indian irrigators.] Also see *Negotiated Settlement and Truckee River Operating Agreement (TROA)*.

(United States) Bureau of Land Management (BLM) — An agency of the U.S. Department of the Interior responsible for the stewardship of the nation's public lands. The Bureau of Land Management is committed to the sustained management, protection, and improvement of these lands in a manner consistent with the needs of the American people. The BLM's management philosophy is based on the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. The resources under the BLM's oversight include recreation, rangelands, timber, minerals, watersheds, fish and wildlife, wilderness, air, and scenic, scientific and cultural values. The BLM oversees the largest natural resource base in the federal government. This base includes 270 million acres of public lands ranging from old growth forests in the Pacific Northwest to sun drenched desert ecosystems in the Southwest to Arctic tundra in Alaska. The BLM also supervises mineral leasing and operations on an additional 300 million acres of federal mineral estate that underlie other surface ownerships. BLM managed public lands provide habitat for thousands of wildlife and plant species, including some 220 federally-listed threatened and endangered species and 1,200 species considered candidates for listing. The BLM manages over 169,000 miles of fish bearing streams and more than 50 million acres of forested lands. In addition, the BLM is caretaker of an estimated 4 million cultural properties, including 400 listed in the *National Register of Historic Places*. The BLM also manages more than 1.6 million acres of designated wilderness and 22.8 million acres of wilderness study areas. More than 46,500 wild horses and burros roam BLM land in the West. The BLM permits and manages various uses of the public lands, including grazing, mining, recreation, and timber operations. These activities traditionally have been managed on an individual basis. However, more recently the BLM's management efforts have shifted to a more comprehensive ecosystem basis of managing such lands to insure sustained benefits for future generations of Americans. The Bureau of Land Management has its headquarters office in Washington, D.C. There are an additional eleven state offices for managing resources in the western states of Alaska, Arizona, California, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Wyoming. BLM resources for the Eastern United States are managed out of Springfield, Virginia. The BLM also supports a National Interagency Fire Center (NIFC) in Boise, Idaho as well as a public information service center (SC) in Denver, Colorado and a centralized employee training center in Phoenix, Arizona. In Nevada alone, the BLM manages some 48 million acres of public lands

or approximately 67 percent of all lands in Nevada.

(United States) Bureau of Reclamation (USBR) — An agency of the U.S. Department of the Interior responsible for many of the dam, reservoir, and irrigation projects in the Western United States. The USBR reclamation program was authorized by the Reclamation Act of 1902 which was initially intended to reclaim the arid and semiarid lands of the Western United States by conserving and supplying irrigation water to make them productive. Since that beginning, the USBR's mission has expanded considerably to include multipurpose water development by providing water for irrigation, hydroelectric power, water for homes, businesses and factories, outdoor recreation, flood control, fish and wildlife enhancement, improved water quality, river regulation and control, and other related uses of water. Currently the USBR administers some 322 storage dams, 14,490 miles of canals, 174 pumping plants, and 50 hydroelectric plants. USBR water irrigates 146,000 farms in the West, provides part or all the water needs on nearly 10 million acres, yielding enough food for 33 million people, and also provides 620 billion gallons of water a year of municipal and industrial use in western towns and cities. In terms of its original intent and broad governing guidelines, the U.S. Bureau of Reclamation is primarily responsible for water projects with respect to developing water sources for agriculture and commerce, while the *U.S. Army Corps of Engineers (COE)* has had primary responsibility for water projects which protect property from potential flood damage. In reality, however, quite often these federal agencies' project goals overlap with USBR's dams and reservoirs providing important flood protection and the COE's water projects—dams, locks, and canals—providing important water transportation linkages and benefits to commerce.

Colorado River Commission [Nevada] — An agency of the State of Nevada consisting of seven members, to include four members appointed by the Governor and three members from the *Southern Nevada Water Authority* Board of Directors. The Colorado River Commission has broad statutory authority to establish policies for the management of Nevada's allocation of power and water resources from the Colorado River and for the development of designated land in Southern Nevada.

Department of Conservation And Natural Resources [Nevada] — The mission of the Department is to conserve, protect, manage, and enhance the Nevada's natural resources in order to provide the highest quality of life for Nevada's citizens and visitors. The Department consists of nine divisions and/or agencies which include:

- [1] **Division of Conservation Districts** — Regulates the activities of the state's locally elected conservation districts which work for the conservation and proper development of the state's renewable natural resources by providing services to individual landowners and coordination with other public and private agencies.
- [2] **Division of Environmental Protection (DEP)** — Responsible for the administration and enforcement of all environmental statutes and regulations; issues permits, monitors for air and water pollution and inspects solid and hazardous waste management. The Division consists of the *Bureau of Air Quality*, the *Bureau of Water Pollution Control*, *Bureau of Mining Regulation and Reclamation*, *Bureau of Water Quality Planning*, *Bureau of Corrective Actions*, *Bureau of Waste Management*, and the *Bureau of Federal Facilities*. The *State Environmental Commission* is also part of the Division and is responsible for adopting necessary environmental rules, regulations and plans authorized by statute. [See Appendix E-4 for a more complete description of DEP's functional responsibilities.]
- [3] **Division of Forestry** — Manages and coordinates all forestry, nursery, endangered plant species and watershed resource activities on certain public and private lands; responsible for protecting structural and natural resources through fire protection, prevention and suppression. The Division also conducts the Forestry Conservation Camps Program which coordinates and supervises the outside work performed by inmates residing in Department of Prison conservation camps.
- [4] **Division of State Lands** — Acquires, holds, and disposes of all state lands and interests in lands; provides technical land-use planning assistance, training, and information to local units of government or other agencies; develops policies and plans for the use of lands under federal management and represents the state in its dealings with the federal land management agencies.
- [5] **Division of State Parks** — Plans, develops, and maintains a system of parks and recreational areas for the use and enjoyment of residents and visitors. The Division also preserves areas of scenic, historic, and scientific significance in Nevada.

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- [6] **Division of Water Planning** — Provides technical, financial and economic assistance to government agencies and individual citizens concerning regional and local water supplies; develops and implements a statewide water resource management plan and policy initiatives on a watershed basis; conducts hydrologic, climatologic, and socioeconomic data collection, research, modeling, forecasting and data analysis; develops and implements water resource public information and education programs; provides technical and financial assistance and outreach programs to assist local governments, watershed planning groups, and other agencies with respect to water resource matters; and develops and implements a statewide water conservation program.
- [7] **Division of Water Resources** — Responsible for protecting the health and safety of Nevada citizens through the appropriation of public waters. Other responsibilities include the adjudication of claims of vested water rights; distribution of water in accordance with court decrees; review of water availability for new major construction and housing projects; review of the construction and operation of dams; appropriation of geothermal resources; licensing of well drillers and water right surveyors; review of flood control projects; maintenance of water resource data and records; and providing technical assistance to government boards, offices, and agencies.
- [8] **Division of Wildlife** — Preserves, protects, manages and restores wildlife and its habitat within the state for aesthetic, scientific, recreational and economic benefits; tasked with promoting safety for persons and property in the operation of equipment and boating vessels
- [9] **Natural Heritage Program** — Serves as a centralized repository containing detailed information on sensitive (threatened and endangered) species of animals, plants, and communities; provides information on biology, habitats, locations, population and conservation status, and management needs.

(United States) Department of the Interior (USDI) — Originally established by Congress in 1849 as the executive department of the United States government, the USDI's function has changed from that of performing housekeeping duties for the federal government to its present role as custodian of the nation's natural resources. As the nation's principal conservation agency, the USDI has the responsibility of protecting and conserving the country's land, water, minerals, fish, and wildlife; of promoting the wise use of all these natural resources; of maintaining national parks and recreation areas; and of preserving historic places. It also provides for the welfare of American Indian reservation communities and of inhabitants of island territories under U.S. administration. As of 1988 the USDI managed more than 220 million hectares (550 million acres, or 850,000 square miles) of federal resource lands; about 340 units of the national park system; 70 fish hatcheries, and 442 *National Wildlife Refuges (NWF)*; and numerous reclamation dams that provide water, electricity, and recreation. The USDI also constructs irrigation works, enforces mine safety laws, makes geological surveys and prepares maps, conducts mineral research, and administers wild and scenic rivers as well as national and regional trails. The USDI is currently in charge of the *Bureau of Indian Affairs (BIA)*, the *U.S. Fish and Wildlife Service (USFWS)*, the *National Park Service (NPS)*, and the *U.S. Geological Survey (USGS)*. It also oversees the Bureau of Mines, which is responsible for ensuring that the nation has adequate mineral supplies and for overseeing and evaluating all aspects of minerals research; the *U.S. Bureau of Land Management (BLM)*, which manages public lands and their resources; the *U.S. Bureau of Reclamation (USBR)*, which assists local governments in reclaiming arid lands in western states and provides programs for hydro-electric power generation, flood control, and river regulation; the Minerals Management Service, which deals with leasable minerals on the Outer Continental Shelf and ensures efficient recovery of mineral resources; and the Office of Surface Mining Reclamation and Enforcement, which helps to protect the environment from adverse effects of mining operations. Other agencies under the USDI's jurisdiction include the Office of Small and Disadvantaged Business Utilization and the Office of Territorial and International Affairs.

Department of Water Resources (DWR) [California] — The California state agency within *The Resources Agency* that is responsible for long-term water planning, operation of the *State Water Project*, and state water conservation programs. The basic goal of the DWR is to ensure that California's needs for water supplies, water-related recreation, fish and wildlife, hydroelectric power, prevention of damage and loss of life from floods and dam failure, and water-related environmental enhancements are met; and to ensure that the manner in which these needs are fulfilled is consistent with public desires and attitudes concerning environmental and social

considerations. The *California Water Commission*, also within The Resources Agency, serves as a policy advisory body to the Director of the DWR on matters within the department's jurisdiction and coordinates state and local views on federal appropriations for water projects in California. The commission also conducts public hearings and investigations statewide for the department and provides an open forum for interested citizens to voice on water development issues. The *California State Water Resources Control Board (SWRCB)*, located within the California Environmental Protection Agency, is assigned the responsibility to protect water quality and allocate water rights.

Desert Research Institute (DRI) [Nevada] — The Desert Research Institute was created in 1959 by an act of the Nevada Legislature as a unit of the University of Nevada. When the University of Nevada System was formed in 1968, DRI became an autonomous, nonprofit division of this system. Since that time DRI has grown to be one of the world's largest multi-disciplinary environmental research organizations focusing on arid lands. The DRI operates from statewide facilities in Las Vegas, Reno, Stead, Laughlin, and Boulder City. The DRI's activities are directed from five research centers representing the *Geosphere* (Quaternary Sciences Center), *Hydrosphere* (Water Resources Center), *Biosphere* (Biological Sciences Center), and *Atmosphere* (Atmospheric Sciences Center and Energy and Environmental Engineering Center). Multi-disciplinary teams drawn from these centers are assembled to address basic and applied research problems on a project-by-project basis. Listed below are the DRI's five research centers and their primary mission statement. [See Appendix E-3 of the *Water Words Dictionary* for a more complete listing of the DRI's major laboratories operated and the principal skills and activities supported.]

- [1] ***Atmospheric Sciences Center (ASC)*** — The ASC is a nationally recognized leader in the field of atmospheric sciences. The ASC's mission is to improve the fundamental understanding of the earth's atmosphere, particularly as it relates to the weather and to the climate of arid regions. The ASC is the home of the strongest atmospheric modification research program in the United States.
- [2] ***Biological Sciences Center (BSC)*** — The BSC focuses on plant and soil biology from an ecological perspective. The BSC's mission is to improve the fundamental understanding of the earth's biosphere, thereby providing the knowledge needed to effectively manage biological resources important to the future use and habitation of the earth.
- [3] ***Energy and Environmental Engineering Center (EEEC)*** — The EEEEC largely conducts air resources research. The EEEEC's mission is to conduct high-quality research to understand current and future human impacts on the environment, especially air quality, and the technology that can be applied to mitigate these impacts.
- [4] ***Quaternary Sciences Center (QSC)*** — The QSC is one of approximately 15 Quaternary research programs worldwide. The QSC's mission is to improve the fundamental understanding of past climates and associated environmental responses and human adaptations to climate change during the Quaternary Period (covering the last 1.8 million years).
- [5] ***Water Resources Center (WRC)*** — The WRC is the largest water research group focused on arid lands in the United States. The WRC's mission to improve the fundamental understanding and knowledge of hydrologic systems, with special emphasis on arid lands, for more effective management of hydrologic resources.

(State) Division of Health [Nevada] — An agency within the Department of Human Resources, State of Nevada, whose primary water-related mandate (Nevada Revised Statutes 445.361) is "to provide water which is safe for drinking and other domestic purposes and thereby promote the public health and welfare." The Division serves as the primacy agency for the *Public Water System Supervision Program (PWSSP)* as authorized under the federal *Safe Drinking Water Act (SDWA) [Public Law 93-523]* and its amendments. The Division implements State Board of Health regulations which address drinking water monitoring and quality, public water system construction, and public water system operator certification. To accomplish its tasks, the Division consists of a number of Boards and Bureaus, to include:

- [1] ***State Board of Health*** — Advises the Health Division Administrator on matters relating to public health and welfare.
- [2] ***State Health Officer*** — Primary state adviser on matters pertaining to medical health; oversees the activities of the Bureau of Laboratory Services, Bureau of Community Health Services, Bureau of

Family Health Services, Bureau of Disease Control and Intervention Services, and the Bureau of Health Planning.

- [3] **Bureau of Health Protection Services** — Provides for safe drinking water, health engineering, sanitation (food, dairy, drugs and cosmetics), and radiological health matters.
- [4] **Bureau of Laboratory Services** — Microbiology lab, chemistry lab, research and testing on community water systems.
- [5] **Bureau of Community Health Services** — Family planning, community health nursing, and clinic services.
- [6] **Bureau of Family Health Services** — Genetics, special children's clinic, children's dental services, newborn screening, and health promotion and education.
- [7] **Bureau of Health Planning** — State health plan, primary care development center, state center for health statistics, tobacco control initiative.
- [8] **Bureau of Disease Control and Intervention Services** — Programs dealing with surveillance, immunization, TB control.
- [9] **Bureau of Licensure and Certification** — Programs dealing with health facilities, laboratory personnel certification, emergency medical services and trauma.
- [10] **Bureau of Administrative Services** — Fiscal management, personnel, affirmative action, legal services, vital records, and cancer registry.

(United States) Environmental Protection Agency (EPA) — The U.S. Environmental Protection Agency (EPA) is responsible for implementing the federal laws designed to protect the environment. EPA endeavors to accomplish its mission systematically by proper integration of a variety of research, monitoring, standard-setting, and enforcement activities. As a complement to its other activities, EPA coordinates and supports research and anti-pollution activities of state and local governments, private and public groups, individuals, and educational institutions. EPA also monitors the operations of other Federal agencies with respect to their impact on the environment. EPA was created through Reorganization Plan #3 of 1970, which was devised to consolidate the federal government's environmental regulatory activities into a single agency. The plan was sent by the President to Congress on July 9, 1970, and the agency began operation on December 2, 1970. EPA was formed by bringing together 15 components from 5 executive departments and independent agencies. Air pollution control, solid waste management, radiation control, and the drinking water program were transferred from the Department of Health, Education, and Welfare (now the Department of Health and Human Services). The federal water pollution control program was taken from the Department of the Interior, as was part of a pesticide research program. From the Department of Agriculture, EPA acquired authority to register pesticides and to regulate their use, and from the Food and Drug Administration, EPA inherited the responsibility to set tolerance levels of pesticides in food. EPA was assigned some responsibility from the Atomic Energy Commission, and absorbed the duties of the Federal Radiation Council. The enactment of major new environmental laws and important amendments to older laws in the 1970s and 1980s greatly expanded EPA's responsibilities. The agency now administers ten comprehensive environmental protection laws:

- [1] Clean Air Act (CAA)
- [2] Clean Water Act (CWA)
- [3] Safe Drinking Water Act (SDWA)
- [4] Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or "Superfund")
- [5] Resource Conservation and Recovery Act (RCRA)
- [6] Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- [7] Toxic Substances Control Act (TSCA)
- [8] Marine Protection, Research, and Sanctuaries Act (MPRSA)
- [9] Uranium Mill Tailings Radiation Control Act (UMTRCA)
- [10] Pollution Prevention Act

The primary mandates for the water-related programs administered through the EPA Water Management Division are the *Federal Water Pollution Control Act (Public Law 92-500)*, as amended, commonly referred to as the *Clean Water Act (CWA)*, and the *Safe Drinking Water Act (SDWA — Public Law 93-523)*. The CWA addresses the discharge of pollutants from point and nonpoint sources into waters of the United States (as defined). The goal

Part 1. Section 7 – Selected Agencies and Organizations

of the SDWA is to protect public health over lifetime exposure to drinking water by ensuring that the source water as well as the system storage distribution and service lines are free and protected from contamination. EPA water-related programs establish national and regional objectives, promote delegation of programs to states (primacy), and support that delegation in a manner that ensures achievement of required objectives. Also see *Science Advisory Board (SAB)*. The following constitute the principal offices of the EPA. [See Appendix E-1 of the *Water Words Dictionary* for a more complete description of the organizational structure of the U.S. Environmental Protection Agency and a description of each office's functions.]

- [1] Office of the Administrator (OA)
- [2] Office of Administration and Resources Management (OARM)
- [3] Office of Enforcement (OE)
- [4] Office of General Counsel (OGC)
- [5] Office of Policy, Planning, and Evaluation (OPPE)
- [6] Office of International Activities (OIA)
- [7] Office of Inspector General (OIG)
- [8] Office of Water (OW)
- [9] Office of Solid Waste and Emergency Response (OSWER)
- [10] Office of Air and Radiation (OAR)
- [11] Office of Prevention, Pesticides and Toxic Substances (OPPTS)
- [12] Office of Research and Development (ORD)

Federal Emergency Management Agency (FEMA) — An independent agency of the federal government founded in 1979 and reporting to the President of the United States and headquartered in Washington D.C. FEMA's mission is to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery. Primary support functions of FEMA include; (1) advising on building codes and flood plain management; (2) teaching people how to get through a disaster; (3) helping equip local and state emergency preparedness; (4) coordinating the federal response to a disaster; (5) making disaster assistance available to states, communities, businesses and individuals; (6) training emergency managers; (7) supporting the nation's fire service; and (8) administering the national flood and crime insurance programs (*National Flood Insurance Program*). FEMA's operating directorates consist of: (1) Mitigation Directorate; (2) Information Technology Directorate; (3) Federal Insurance Administration (Program); (4) Operations Support Directorate; (5) Preparedness Directorate; (6) Response and Recovery Directorate; (7) United States Fire Administration; and (8) ten Regional Offices. FEMA's ten regions, Federal Regional Centers, and states included in each region are:

- [1] Region I (Boston, Massachusetts) — Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont;
- [2] Region II (New York, N.Y., Caribbean Division – San Juan, Puerto Rico) — New York, New Jersey, the Commonwealth of Puerto Rico and the Territory of the U.S. Virgin Islands;
- [3] Region III (Philadelphia, Pennsylvania) — District of Columbia, Delaware, Maryland, Pennsylvania, Virginia, West Virginia;
- [4] Region IV (Atlanta, Georgia) — Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee;
- [5] Region V (Chicago, Illinois) — Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin;
- [6] Region VI (Denton, Texas) — Arkansas, Louisiana, New Mexico, Oklahoma and Texas;
- [7] Region VII (Kansas City, Missouri) — Iowa, Kansas, Missouri, Nebraska;
- [8] Region VIII (Denver, Colorado) — Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming;
- [9] Region IX (San Francisco, California) — Arizona, California, Hawaii and Nevada; and the Territory of American Samoa, the Territory of Guam, the Commonwealth of the Northern Mariana Islands, the Republic of the Marshall Islands, the Federated States of Micronesia, and the Republic of Palau;
- [10] Region X (Bothell, Washington) — Alaska, Idaho, Oregon and Washington.

(United States) Fish and Wildlife Service (USFWS) — Part of the U.S. Department of the Interior, the early beginnings of the Fish and Wildlife Service go back to 1871 when the federal government established the Commissioner of Fisheries. In 1896, the Division of Biological Survey was established within the Department

of Agriculture. In 1939, these functions were transferred to the Department of the Interior. Then in 1940, these functions were formally consolidated and redesignated as the Fish and Wildlife Service. Further reorganization came in 1956 when the Fish and Wildlife Act created the Bureau of Sport Fisheries and Wildlife. An amendment to this act in 1974 designated the Bureau as the U.S. Fish and Wildlife Service. Today the USFWS consists of a headquarters in Washington, D.C., eight regional offices, and over 700 field units and installations. Included are more than 470 National Wildlife Refuges, comprising more than 90 million acres, 57 fish and wildlife research laboratories and field units, 43 cooperative research units at universities across the country, nearly 135 national fish hatcheries and fishery assistance stations, and a nationwide network of law enforcement agents and biologists. The functions of the USFWS primarily includes the following:

- [1] Acquires, protects and manages unique ecosystems necessary to sustain fish and wildlife, such as migratory birds and endangered species;
- [2] As specified in the *Endangered Species Act (ESA)* (1973), as amended, and in conjunction with the *National Marine Fisheries Service (NMFS)*, determines critical habitat and develops recovery plans for protected endangered and threatened species of plants and animals;
- [3] Operates fish hatcheries to support research, develop new techniques and fulfill the public demand for recreational fishing;
- [4] Operates wildlife refuges to provide, restore, and manage a national network of lands and waters sufficient in size, diversity and location to meet society's needs for areas where the widest possible spectrum of benefits associated with wildlife and wildlands is enhanced and made available;
- [5] Conducts fundamental research on fish, wildlife and their habitats to provide better management and produce healthier and more vigorous animals; also protects fish and wildlife from dislocation or destruction of their habitats;
- [6] Renders financial and professional assistance to states, through federal aid programs, for the enhancement and restoration of fish and wildlife resources;
- [7] Establishes and enforces regulations for the protection of migratory birds, marine mammals, fish and other non-endangered wildlife from illegal taking, transportation or sale within the United States or from foreign countries; and
- [8] Communicates information essential for public awareness and understanding of the importance of fish and wildlife resources, and changes reflecting environmental degradation that ultimately will affect the welfare of human beings.

Also see *National Wildlife Refuge System, Endangered Species Act (ESA), Endangered Species, Threaten Species, and National Oceanic and Atmospheric Administration (NOAA)*.

(United States) Forest Service (USFS) — The largest and most diverse agency of the U.S. Department of Agriculture, the Forest Service provides leadership in the management, protection, and use of the nation's forests and rangelands, which comprise almost two-thirds of the nation's federally owned lands. The creation of the Forest Service go back to 1891 when the President was authorized to establish Forest Reserves from forest and range lands in the *Public Domain*. In 1905 the responsibilities for the management and protection of these Forest Reserves was transferred from the Department of the Interior to the Department of Agriculture and the Forest Service was formally established. The Forest Reserves were then renamed National Forests. Today the Forest Services manages 156 National Forests, 19 National Grasslands, and 16 Land Utilization Projects that make up the National Forest System located in 44 states, Puerto Rico, and the Virgin Islands. Much of the nation's fresh water supply flows from National Forest System lands and insuring adequate yields of high quality water and continuing soil productivity are primary aims of the Forest Service's watershed management programs. The Forest Service manages more than 14 percent of the nation's 1.2 billion acres of forest range. This National Forest System (NFS) rangeland is managed to conserve the land and its vegetation while providing food for both domestic livestock and wildlife. The Forest Service manages fish and wildlife habitat on the National Forests and National Grasslands in cooperation with the individual states' fish and game departments. Of the 191 million acres of National Forests, 86.5 million acres are classified as commercial forests, available for, and capable of, producing crops of industrial wood. National Forest timber reserves are managed on a sustained-yield basis to produce a continuous supply of wood products to meet the nation's economic demands while maintaining the productive capacity of these lands. In 1924 the Forest Service pioneered the establishment of wilderness areas on National Forest lands. National Forest lands are a major source of mineral and energy supplies with regulatory and

management responsibilities for mineral activities shared with the Department of the Interior, Bureau of Mines. The Forest Service, with one of the world's largest wildland firefighting forces, provides direct fire protection and control for National Forest System lands as well as cooperative fire control on several million additional acres. The Forest Service is responsible for the forest management aspects of the Watershed Protection and Flood Prevention Program administered by the *Natural Resources Conservation Service (NRCS)*. The Forest Service also participates in the forestry aspects of the River Basin Program, which guides and coordinates water and related land resource planning among several federal departments. The Forest Service operates an extensive forestry research program consisting of eight Forest and Range Experiment Stations, a Forest Products Laboratory, and 75 research labs located throughout the U.S., Puerto Rico, and the Pacific Trust Territories. The Forest Service is organized into nine (9) regions as listed below (regional headquarters are in parentheses):

- [1] **Eastern Region** (Milwaukee, Wisconsin) — Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, West Virginia, Ohio, Indiana, Michigan, Illinois, Missouri, Iowa, Wisconsin, Minnesota;
- [2] **Southern Region** (Atlanta, Georgia) — Virginia, North Carolina, South Carolina, Kentucky, Tennessee, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas;
- [3] **Rocky Mountain Region** (Denver, Colorado) — South Dakota, Nebraska, Kansas, Wyoming, Colorado;
- [4] **Northern Region** (Missoula, Montana) — North Dakota, Montana, Idaho (northern part only), South Dakota (northwest corner only), Wyoming (northwest corner only);
- [5] **Intermountain Region** (Ogden, Utah) — Nevada, Utah, Idaho (except northern portion), Wyoming (western portion only);
- [6] **Southwest Region** (Albuquerque, New Mexico) — Arizona, New Mexico;
- [7] **Pacific Northwest Region** (Portland, Oregon) — Washington, Oregon;
- [8] **Pacific Southwest Region** (San Francisco, California) — California, Hawaii;
- [9] **Alaska Region** (Juneau, Alaska) — Alaska.

(United States) Geological Survey (USGS) — An agency of the U.S. Department of Interior responsible for providing extensive earth-science studies of the Nation's land, water, and mineral resources. The USGS was established by an act of Congress on March 3, 1879, to provide a permanent federal agency to conduct the systematic and scientific "classification of the public lands, and examination of the geological structure, mineral resources, and products of national domain." An integral part of that original mission is to publish and distribute the earth-science information needed to understand, plan the use of, and manage the nation's energy, land, mineral, and water resources. Since 1879, the research and fact-finding role of the USGS has grown and been modified to meet the changing needs of the nation it serves. As part of that evolution, the USGS has become the map-making agency for the federal government, the primary source of data on surface- and ground-water resources of the nation, and the employer of the largest number of professional earth scientists. The USGS is organized into three operational Divisions: the National Mapping Division (NMD), charged with development and application of mapping and *Geographic Information System (GIS)* technology; the Geologic Division (GD), which conducts geologic mapping and research; and the Water Resources Division (WRD). The mission of the Water Resources Division of the USGS is to provide the hydrologic information and understanding needed to manage the nation's water resources to benefit its residents. Typical water resource programs sponsored by the WRD include:

- [1] Data collection to aid in evaluating the quantity, quality, distribution, and use of the nation's water resources;
- [2] Analytical and interpretive water-resources appraisals to describe the occurrence, quality, and availability of surface and ground water throughout the nation;
- [3] Basic and problem-oriented research in hydraulics, hydrology, and related fields of science and engineering;
- [4] Scientific and technical assistance in hydrology to other federal, state, and local agencies;
- [5] Development and maintenance of national computer data bases and associated Geographic Information Systems (GIS) of hydrologic data — streamflow, water quality and biology, groundwater characteristics, and water use; and
- [6] Public distribution of water-resources data and results of water-resources investigations through reports, maps, computerized information services, and other forms of release.

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Programs of the Water Resources Division are funded under three types of arrangements:

- [1] *Federal Program* — funding is appropriated directly to USGS by the U.S. Congress for projects of national interest;
- [2] *Cooperative Program* — funding is shared by USGS and interested state and local agencies; and
- [3] *Other Federal Agencies (OFA) Program* — funding is supplied by federal agencies requesting technical assistance from the USGS.

The Water Resources Division's headquarters is at the USGS National Center in Reston, Virginia. Regional offices are maintained in Reston; Atlanta, Georgia; Denver, Colorado; and Menlo Park, California. With the exception of the National Research Program (NRP) centers at Reston, Denver, and Menlo Park, most of the WRD program is distributed to 51 USGS District Offices organized by state boundaries.

National Oceanic and Atmospheric Administration (NOAA) — An agency of the U.S. Department of Commerce, the National Oceanic and Atmospheric Administration was formed in 1970, but its origins may actually be traced as far back as 1807 when President Thomas Jefferson ordered a survey of the new nation's coastline. Today, NOAA has translated the United States' geographic, atmospheric, oceanic, and meteorological informational needs into an organization concentrating in the following principal areas:

- [1] *Research and Analysis* — NOAA researchers and scientists in the areas of oceanography, meteorology, biology, and physics explore the sea and air for new clues aimed at understanding or reversing environmental damage such as ozone depletion, the greenhouse effect, and possible global warming;
- [2] *Satellite Imaging and Mapping* — NOAA's satellites provide essential information for accurate weather forecasts, monitor winter snowpack conditions across the country, and gauge the health of coastal estuaries;
- [3] *Data Compilation and Dissemination* — The results of NOAA's data collection, satellite mapping, and research and analysis affords vast stores of information in NOAA's global data centers available for climate, oceanographic and geophysical reports vital to the public and industry;
- [4] *Forecasting and Weather Warning* — Through the National Weather Service (NWS), NOAA provides extensive information and warnings when severe weather threatens life and property.

The National Oceanic and Atmospheric Administration consists of a number of separate agencies to effect these research, analysis, monitoring, informational, and forecasting requirements.

- [1] *National Weather Service (NWS)* — The National Weather Service operates a vast network of automated weather stations around the nation equipped with sophisticated doppler radar systems on the ground as well as sophisticated satellites providing detailed imaging which provide meteorologists and citizens early warnings of severe weather conditions. In cooperation with the Federal Aviation Administration (FAA), the NWS is proceeding with establishing some 1,000 fully automated weather data collection sites, termed *Automated Surface Observing Systems (ASOS)*.
- [2] *National Ocean Service (NOS)* — The National Ocean Service charts and surveys America's coastal waterways, providing safe passage for commerce and recreation interests. The NOS also plays a major role in managing America's coastlines and NOAA's *Coastal Zone Management Program* strives to protect wetlands, water quality, beaches, wildlife, and other important resources and uses of our coasts. As part of the NOS, NOAA's *National Marine Sanctuaries*, the nation's underwater national parks, provide unique undersea preserves to protect important coastal resources. The NOS monitors the health of the coast and probes how our use of the nation's nearshore waters affects the environment.
- [3] *National Environmental Satellite, Data and Information Service (NESDIS)* — The NESDIS operates the world's largest environmental data storage and distribution facility providing extensive and highly detailed data on weather, the oceans and geophysics. The NESDIS is also responsible for NOAA's polar orbiting and geostationary satellites which provide important information on the oceans and atmosphere. Other NESDIS satellites collect images of cloud and storm patterns which are then relayed to NOAA's National Weather Service and are extensively used by the nation's meteorologists for local weather reporting and forecasting.
- [4] *National Marine Fisheries Service (NMFS)* — The NMFS serves as steward for America's living marine resources, conducting research necessary to manage these valuable resources and enforces

fishery regulations, maintains the wholesomeness of U.S. seafood products, and protects coastal fishery habitats and nurseries. The NMFS manages the 32 federal fishery resource plans, covering more than 230 species, and plays a key role in protecting coastal habitats, marine mammals and endangered and threatened species per the *Endangered Species Act (ESA)*.

- [5] **Office of Oceanic and Atmospheric Research** — NOAA's scientists conduct leading edge research on weather, climate, air quality, the oceans and the Great Lakes through a network of environmental laboratories and monitoring stations as well as through university researchers supported by NOAA through the *National Sea Grant College Program* and the *National Undersea Research Program*.
- [6] **NOAA Corps** — NOAA also operates the nation's smallest uniformed service consisting of some 400 officers commanding NOAA's fleet of hurricane hunter aircraft and environmental research ships providing in a variety of scientific and research operations.

National Weather Service (NWS) — An agency of the (U.S. Department of Commerce) *National Oceanic and Atmospheric Administration (NOAA)*, the primary mission of the National Weather Service is to protect life and property and enhance the nation's economy by providing warnings and forecasts of hazardous weather, including thunderstorms, flooding, hurricanes, tornadoes, winter weather, and tsunamis. The primary customer of the NWS is the private weather industry whose meteorologists receive data and information directly from the NWS and incorporate it into local news reports. The NWS also operates its own radio network; the *NOAA Weather Radio* is the sole government radio system providing direct warnings of hazardous weather conditions and natural disasters to private citizens through a network of 390 transmitters across the nation. The NWS provides short and long-range forecasts, severe weather warnings, and atmospheric data continually to private weather vendors for a fee using a telephone data transmittal system called *Family of Services*. NWS Doppler radar data is provided through the *NWS NEXRAD Information Dissemination Service (NIDS)* and is available from commercial weather vendors under an agreement with the NWS. The *NOAA Weather Wire Service* is the primary NWS telecommunications network for NWS forecasts, warnings, and other products to the mass media (TV, radio, newspaper) and emergency management agencies. It consists of a satellite communications system operated under contract by GTE/Contel. In a joint effort with the Federal Aviation Administration (FAA), some 250 NWS manual data collection field offices will be replaced with approximately 1,000 automated data collections sites, termed *Automated Surface Observing Systems (ASOS)*, thereby greatly enhancing both the timeliness and frequency of the NWS weather reporting capabilities.

(United States) Natural Resources Conservation Service (NRCS) — Formerly known as the *Soil Conservation Service (SCS)*, an agency of the U.S. Department of Agriculture, the Natural Resources Conservation Service (NRCS) had its beginnings with a 1929 emergency act of Congress in response to the famous Dust Bowl when land practices, primarily in the Midwest Farm Belt, caused extensive soil erosion and threatened the food production of the United States. Initially, ten experiment stations were established to work with Land Grant Universities to study soil erosion and ways to prevent it. As a result of these initial efforts, the Soil Erosion Service was established in 1933 to show American farmers new ways of preventing and recovering from soil erosion. In 1935 Congress changed the Soil Erosion Service into the Soil Conservation Service and made it a permanent agency of the U.S. Department of Agriculture. In 1994 the name was change to Natural Resources Conservation Service to denote a broader role of responsibility in natural resource conservation. Presently, the NRCS works in three primary areas: (1) soil and water conservation; (2) resource inventories; and (3) rural community development. These activities are covered under a number of direct NRCS programs, involving only NRCS resources, and NRCS assisted programs, involving the NRCS and at least one other government agency.

Direct NRCS Programs:

- [1] Technical Assistance
- [2] Great Plains Conservation Program
- [3] Watershed Protection, Long-Term Contracts (Public Law 566)
- [4] USDA Compliance Plans

NRCS Assisted Programs:

- [1] Agriculture Conservation Program
- [2] Water Bank Program
- [3] Colorado River Salinity Control Program

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- [4] Conservation Reserve Program
- [5] Water Quality Incentive Program
- [6] Emergency Conservation Program
- [7] Wetlands Reserve Program

Newlands (Irrigation) Project [Nevada] — One of the first Department of the Interior, *U.S. Bureau of Reclamation (USBR)* (U.S. Reclamation Service at that time) irrigation projects completed in the United States. The project was authorized originally as the *Truckee–Carson Irrigation Project* on March 14, 1903 by the Secretary of the Interior and was renamed the Newlands Project in 1919 in honor of Nevada Senator Francis G. Newlands, who originally sponsored the 1902 Reclamation Act. Derby Dam, located on the lower Truckee River, was completed in June 1905 to divert waters from the Truckee River Basin to the Carson River. In August 1906 the Truckee Canal was completed between the Truckee and Carson rivers. Waters began flowing through this canal in 1906 while 1907 proved to be the first full year of irrigation. Lahontan Reservoir was completed in 1915 on the Carson River to receive Truckee River waters through the Truckee Canal and provided a more stable supply of water for irrigation needs to a defined service area in the Town of Fernley and the lower Carson River Basin near the City of Fallon, Churchill County, in western Nevada. The project originally (1902) called for the possible irrigation of up to 450,000 acres; however, this figure was continually reduced, finally to approximately 73,000 acres when it was found, after much legal controversy, that the full use of the waters of Lake Tahoe would not be available. Soon after the project was authorized, this figure of irrigable acreage was reduced to 210,000 acres in 1904, to 172,000 acres in 1910, and to 97,400 acres in 1925, of which 73,301 acres were determined to be irrigable in 1926. The project's service area currently consists of approximately 73,800 acres of land that are entitled to receive irrigation water, of which only approximately 58,000–60,000 acres are actually irrigated. Water for these lands is supplied from the Truckee and Carson rivers. Water from the Truckee River is diverted to the Carson River Basin at Derby Dam via the 32.5-mile long Truckee Canal. Since its completion, the Newlands Project has been embroiled in controversy resulting from intense competition for the limited water from these two rivers. Controversy has centered on the actual number of acres with legal water rights, the classification of irrigation lands as *Bench Land* or *Bottom Land* (which determines the applicable water duty — 4.5 AF/year or 3.5 AF/year, respectively), the maximum allowable water duty, the efficiency of project operations, and the volume of water diverted from the Truckee River's terminus, Pyramid Lake. In 1967, *Operating Criteria and Procedures (OCAP)* were first instituted in order to maximize the use of Carson River flows to satisfy project requirements and to minimize water diversions from the Truckee River at Derby Dam. Even so, controversy continued and in 1973, the Federal District Court in Washington, D.C. ordered the implementation of a new OCAP for this project. Amid continued controversy, in 1985 the Bureau of Reclamation published an *Environmental Assessment (EA)* which examined an alternative OCAP. Based on comments to this 1985 EA, the Bureau of Reclamation made the decision to initiate an *Environmental Impact Statement (EIS)*. A final OCAP was approved in 1988. *Public Law 101-618*, enacted on November 16, 1990, (also referred to as the *Negotiated Settlement*), requires the current OCAP to remain in effect at least through December 31, 1997, and is intended to allow all principal parties to develop a new *Truckee River Operating Agreement (TROA)*. A major issue has been to secure an adequate water supply (both as to quantity and quality) to preserve Pyramid Lake and protect its environmentally sensitive fish species, the endangered cui-ui (*Chasmistes cujus*) and the threatened Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*).

(The) Resources Agency [California] — The mission of the California Resources Agency is to oversee the state's activities relating to the conservation, management, and enhancement of California's natural and cultural resources; including land, wildlife, water, and minerals. The administrative head of The Resources Agency, the Secretary for Resources, is a member of the Governor's Cabinet, serves as the Governor's representative on the Agency's boards and commissions, and oversees administration of the *California Environmental Quality Act (CEQA)*. The California Resources Agency is comprised of the following entities:

- California Coastal Commission
- Department of Boating and Waterways
- Department of Conservation
- California Conservation Corps
- Department of Fish and Game

- Department of Forestry and Fire Protection
- Department of Parks and Recreation
- Department of Water Resources
- California Energy Commission
- California State Lands Commission
- San Francisco Bay Conservation and Development Commission
- California Tahoe Conservancy
- Colorado River Board of California
- Coachella Valley Conservancy
- Santa Monica Mountains Conservancy
- State Coastal Conservancy
- State Reclamation Board

Other special programs administered by The Resources Agency include:

- CERES, the California Environmental Resources Evaluation System
- California Biodiversity Council
- California Rivers Assessment
- CAL–FED Bay–Delta Program
- Natural Community Conservation Program
- California Ocean Resources Management Program

Southern Nevada Water Authority (SNWA) [Nevada] — An agency created in 1991 through a cooperative agreement among the seven regional water and wastewater agencies in southern Nevada. The purpose of the SNWA was to address water resource management and water conservation on a regional basis through *Integrated Resource Planning (IRP)* techniques and, through such efforts, plan, manage, and develop additional supplies of water for southern Nevada. The seven regional agencies comprising the SNWA include:

- [1] Big Bend Water District (Laughlin)
- [2] City of Boulder City
- [3] City of Henderson
- [4] City of Las Vegas
- [5] City of North Las Vegas (serving portions of unincorporated Clark County and the City of Las Vegas)
- [6] Clark County Sanitation District
- [7] Las Vegas Valley Water District (LVVWD, serving the City of Las Vegas and portions of unincorporated Clark County)

Potable water in the Las Vegas region is provided by five different water purveyors: Big Bend Water District, Boulder City, City of Henderson, Las Vegas Valley Water District (LVVWD), and the City of North Las Vegas. Wastewater service is provided by four different agencies: Boulder City, City of Henderson, the City of Las Vegas and Clark County Sanitation District. Also see *Southern Nevada Water System (SNWS)*.

Southern Nevada Water System (SNWS) [Nevada] — On October 22, 1965, President Lyndon B. Johnson signed legislation authorizing construction of the Alfred Merritt Smith Water Treatment Facility and the Robert B. Griffith Water Project. These two projects form the Southern Nevada Water System, which supplies municipal and industrial water to the Las Vegas Valley Water District, Nellis Air Force Base and the cities of Boulder City, Henderson, and North Las Vegas. The Southern Nevada Water System refers to the system of treatment and transmission facilities that diverts raw Colorado River water from Lake Mead, and delivers potable water to three major retail water purveyors in the Las Vegas Valley, as well as Nellis Air Force Base and Boulder City. The treatment facility, located on the shores of Lake Mead, is known as the Alfred Merritt Smith Water Treatment Facility (AMSWTF). The transmission facilities, which divert water from Lake Mead to the treatment plant and then deliver treated water to Boulder City through the River Mountains tunnel and throughout the Las Vegas Valley, are referred to as the Robert B. Griffith Water Project. Treatment facilities were constructed in two stages by the State of Nevada acting through its Colorado River Commission. Transmission facilities were also constructed in two stages by the federal government through the U.S. Bureau of Reclamation. The state and federal facilities work together to form the Southern Nevada Water System which, as of January 1, 1996, is controlled by the *Southern Nevada Water Authority (SNWA)*. SNWA in turn employs the Las Vegas Valley Water

District (LVVWD) as its operating agent. The principal facilities of the SNWS are detailed below:

Treatment Facilities – Treatment facilities currently have the capacity to treat 600 million gallons per day (MGD). Until completion of the SNWS Phase II Improvements in 1999, delivery capability is 480 MGD. During 1997 the treatment plant produced an average of 314.8 MGD. The maximum day production was 469.5 MGD. The treatment process involves disinfection, aeration, flocculation, filtration and post-treatment. Disinfection is accomplished primarily by the application of chlorine; however, new facilities will employ ozonation for disinfection as well. Aeration is done primarily to improve aesthetic qualities of the water. Flocculation is a chemical process that causes minute particles in the water to coagulate into larger particles that can be filtered out. Filtration is provided by 26 filters, each with 2800 square feet of surface area; the filter media is composed of anthracite coal, silica sand, and aggregate. Filter performance is monitored and, when it declines below acceptable limits, the filter is backwashed. All backwash water is reclaimed and recycled to the head of the facility; no backwash water is returned to Lake Mead. Sludge captured in the backwash process is dried and disposed of in a landfill. Post-treatment is the addition of a small amount of chemicals to retard corrosion, and additional chlorine if necessary, to prevent bacteriological regrowth in the distribution systems. Water quality is assured by testing samples taken from over 260 different locations throughout the system. Samples are tested for chemical, microbiological, and other contaminants. Lake Mead has proven to be a very high quality water source which, along with effective design and operation of the treatment facilities, allows SNWS to provide water that exceeds all applicable standards to the over one million people in the Las Vegas Valley.

Transmission Facilities – Transmission facilities begin with the 13-foot diameter intake tunnel, which diverts Lake Mead water from 150 feet below its surface and conveys it through Saddle Island to Pumping Plant #1. The pumping plant lifts the water up to the raw water aqueduct, which conveys it to the AMSWTF. Treated water is lifted 708 feet to the River Mountains Tunnel, where it flows 4 miles by gravity to the Las Vegas Valley. After emerging from the tunnel, water is diverted to various points throughout the valley, where it is handed off to the facilities of retail purveyors at 17 rate-of-flow control stations. Pumping plants are used to move the water uphill, and rate-of-flow control stations are used to regulate and measure the flow into customers' storage facilities. Water from the AMSWTF is also conveyed to Boulder City by five pumping plants and eight miles of pipelines. Once it enters the system, treated water is never exposed to open air until the consumer uses it. SNWS consumes approximately 10 percent of the power generated by Nevada Power Company, making it the largest single customer.

Major Components of the Transmission Facilities – (1) Intake Tunnel: 1400 feet long, 13 feet in diameter; (2) 6 miles of raw and treated water aqueducts, 10 feet in diameter, and associated surge tanks; (3) River Mountains Tunnel: 4 miles long, 12 feet in diameter; (4) 14 major pumping plants and associated electrical equipment; (5) 18 major lateral systems totaling over 80 miles of pipeline as large as 12 feet in diameter; (6) 17 rate-of-flow control stations and associated regulating tanks.

State Water Resources Control Board (SWRCB) [California] — The water rights and water permitting agency of the State of California. The SWRCB consists of five members (to include a Chairman and Vice Chairman) whose responsibility it is to “protect water quality and allocate water rights” within the State of California. To assist in these functions, the SWRCB is served by a staff to include an Executive Director, a Chief Deputy and nine (9) Regional Board Executive Officers serving the regions of:

- [1] North Coast Region;
- [2] San Francisco Bay Region;
- [3] Central Coast Region;
- [4] Los Angeles Region;
- [5] Central Valley Region;
- [6] Lahontan Region;
- [7] Colorado River Basin Region;
- [8] Santa Ana Region; and
- [9] San Diego Region.

Tahoe Regional Planning Agency (TRPA) [California and Nevada] — A bi-state regulatory agency created in July 1968 as part of a provisional California–Nevada Interstate Compact developed by the joint California–Nevada

Part 1. Section 7 – Selected Agencies and Organizations

Interstate Compact Commission which was formed in 1995. The TRPA was the first bi-state regional environmental planning agency in the United States. The TRPA was intended to oversee land-use planning and environmental issues within the Lake Tahoe Basin and is dedicated to preserving the beauty of the region. Today, the TRPA leads the cooperative effort within the basin to preserve, restore, and enhance the unique natural and human environment of the region and is a leading partner in a comprehensive program which monitors water quality, air quality, and other threshold standard indicators. The TRPA's Environmental Thresholds Carrying Capacities (ETCC) programs are designed to address the following thresholds:

- Water Quality
- Air Quality
- Soil Conservation
- Vegetation
- Fisheries
- Wildlife
- Scenic Resources/Community Design
- Recreation
- Noise

The structure of the TRPA consists of a 15-member Governing Board which sets TRPA policy, oversees administration of the agency, approves all amendments to the Lake Tahoe Basin Regional Plan and reviews major project applications. The Governing Board is advised by a 19-member Advisory Planning Commission made up of area planning and natural resource management professionals, and lay persons. The Executive Director directs approximately 50 staff members in the following principal functional areas: (1) Environmental Education; (2) Environmental Improvement Program (EIP) Facilitation; (3) Environmental Compliance Division; (4) Project Review Division; and (5) Long Range Planning Division. Representation on the TRPA's Governing Board is as follows:

- [1] Governor of California Appointee (California);
- [2] Governor of California Appointee (California);
- [3] California Assembly Speaker Appointee (California);
- [4] California Senate Rules Committee Appointee (California);
- [5] El Dorado County Appointee (California);
- [6] Placer County Appointee (California);
- [7] City of South Lake Tahoe Appointee (California);
- [8] Governor of Nevada Appointee (Nevada);
- [9] Nevada Government Appointee (Nevada);
- [10] Nevada Department of Conservation & Natural Resources Appointee (Nevada);
- [11] Washoe County Appointee (Nevada);
- [12] Douglas County Appointee (Nevada);
- [13] Carson City Appointee (Nevada);
- [14] Nevada at-Large Appointee (Nevada);
- [15] Presidential Appointee (United States)

In late 1995 the TRPA created the Shorezone Partnership Committee of 20 organizations and entities to lessen the problems among those interested in the future development of Lake Tahoe. Those represented included: California and Nevada state lands; California and Nevada state parks, California Department of Fish and Game, California Tahoe Conservancy, Lahontan Regional Water Quality Control Board; League to Save Lake Tahoe; Nevada Division of Wildlife; Tahoe Lakefront Owners Association; TRPA; Tahoe Research Group; Tahoe-Sierra Preservation Council; U.S. Army Corps of Engineers; U.S. Forest Service; commercial property owners; Lake Tahoe marinas; Lake Tahoe tour-boat operators; other private property owners; and Lake Tahoe Basin recreation concessionaires.

Truckee-Carson Irrigation District (TCID) [Nevada] — The agent of the U.S. Department of the Interior *Bureau of Reclamation (USBR)* which serves the interests of the water-righted agricultural water users in the *Newlands (Irrigation) Project*, located in Churchill County, Nevada. The Newlands Project, originally named the Truckee-Carson Irrigation Project, was America's first federal reclamation project completed under the Reclamation Act of 1902. The Truckee-Carson Irrigation District has operated the Newlands Project since 1926

and is responsible for dispersing some 320,000 acre-feet of water from the Carson and Truckee rivers during normal water years. TCID is responsible for the operation of the Lake Tahoe Dam at the outlet to Lake Tahoe at Tahoe City in Placer County, California, Derby Dam on the lower Truckee River in Washoe County, Nevada, Lahontan Dam on the lower Carson River in Churchill County, Nevada, and, some six miles below Lahontan Dam, the Carson Diversion Dam which distributes the releases from Lahontan Reservoir into the project's principal "T" (T-Line) and "V" (V-Line) primary distribution canals. Within the Newlands Projects, there are 102 miles of main canals, 312 miles of irrigation laterals, an extensive system of private ditches, 345 miles of drainage ditches, and numerous diversion dams and regulating reservoirs. TCID offices are located in Fallon, Nevada (Churchill County), and its operations are managed by a Project Manager, a board of seven members, and approximately 50 full-time employees. In 1978 the USBR canceled the contract under which TCID had operated the project since 1926. The cancellation was in response to a refusal of the farmer-dominated organization to follow federal water conservation guidelines, or *Operating Criteria and Procedures (OCAP)*. TCID has been operating under a temporary contract since 1984.

Walker River Irrigation District (WRID) [Nevada] — The litigation of *Pacific Live Stock Company v. Antelope Valley Land and Cattle Company* and the issuance of *Decree 731* caused a number of farmers in Smith and Mason valleys to band together in April 1919 and form the Walker River Irrigation District (WRID). WRID included all irrigated areas in Nevada on the East Walker River, the West Walker River, and the main Walker River, except those areas within the Walker River Indian Reservation. WRID moved to obtain the financing and rights to both Bridgeport and Topaz reservoir sites, sites which had earlier been selected and surveyed by the U.S. Reclamation Service (USRS, currently the U.S. Bureau of Reclamation, USBR). The water rights for Topaz Reservoir were obtained from the liquidation of the Antelope Valley Land and Cattle Company. Although WRID was established as a Nevada agency serving lands entirely within Nevada, its reservoirs would be located either entirely in California (Bridgeport Reservoir) or partially in California and Nevada (Topaz Reservoir). Funding for dam and reservoir construction and operation was obtained privately with water recipients obligated to pay off the debt. Initial funding was held down as WRID assumed no responsibility for the construction or maintenance of irrigation canals, ditches, or laterals.

Water Alliances For Voluntary Efficiency (WAVE) — A water conservation program conceived by the U.S. *Environmental Protection Agency (EPA)* in December 1992 and designed to help increase water efficiency in U.S. lodging facilities. The program encourages participating hotels to install water efficient technologies for bathroom fixtures, dish washing and laundry facilities, cooling towers, and landscaping. The program's goal is to reduce water use and associated energy consumption, help inform hotel guests and employees about the importance of water conservation, and help hotels realize a monetary savings for their efforts. Program components consist of technical assistance, research material availability, computer software programs to survey water use and evaluate options, and public recognition of participation.

Nevada State Water Plan
PART 1 — BACKGROUND AND RESOURCE ASSESSMENT

Section 8
Glossary on Selected Water-Related Decrees,
Agreements and Operating Criteria

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in that source. Words and definitions included in this glossary which explain or summarize elements of existing water law are not intended to change that law in any way.]

Alpine Decree [California and Nevada] — The Federal Court adjudication of the relative water rights on the Carson River which is the primary regulatory control of Carson River operations today. The decree is administered in the field by a *Watermaster* appointed by the federal district court. The decree, initiated by the U.S. Department of the Interior on May 1, 1925 through *United States of America v. Alpine Land and Reservoir Company, et al.*, Civ. No. D-183 BRT, to adjudicate water rights along the Carson River. The decree was finally entered 55 years later on October 28, 1980, making it the longest lawsuit undertaken by the federal government against private parties over water rights. The decree established the respective water rights (to surface water only) of the parties to the original lawsuit, both in California and Nevada to Carson River water. The decree did not make an interstate allocation of the Carson River between California and Nevada; it only quantified individual water rights. Neither state was a party to the decree. In addition to Carson River surface water rights, it also established the rights to reservoir storage in the high alpine reservoirs and confirmed the historical practice of operating the river on rotation, so that irrigators with more junior priorities could be served as long as possible. These upper alpine reservoirs were permitted to fill out of priority order, in accordance with historical practice. The decree also specifically recognized *Riparian Water Rights* in California (as distinguished from the quantified *Appropriative Water Rights* used in Nevada). For purposes of water distribution, the Carson River and its east and west forks, were divided into eight (8) segments and when the river went into regulation (i.e., there was not enough water in the Upper Carson River to serve the most junior priority) each segment of the river was to be administered autonomously. Duties of water were set forth for various locations according to *Bench Land* and *Bottom Land* designations. For lands in the *Newlands Irrigation Project* (i.e., below Lahontan Dam) in Churchill County near Fallon, the Alpine decree provided for an annual net consumptive use of surface water for irrigation of 2.99 acre-feet per acre and a maximum water duty of 4.5 acre-feet per acre for water-righted bench lands and 3.5 acre-feet per acre for water-righted bottom lands *delivered to the land*. For lands above the Newlands Project (i.e., above Lahontan Reservoir), the net consumptive water use was set at 2.5 acre-feet per acre with water duties of 4.5 acre-feet per acre *diverted to the canal* for bottom lands, 6.0 acre-feet per acre diverted to the canal for the alluvial fan lands and 9.0 acre-feet per acre diverted to the canal for the bench lands. This annual net consumptive use, or *Crop Water Requirement*, was based on the water duty of alfalfa as it is a dominant and the highest water-using crop grown in Nevada. While the Alpine Decree established water duties for bench and bottom lands throughout the Carson River Basin, it made no identification of those lands. The decree also granted landowners on the Newlands Project an *Appurtenant Water Right* for the patented lands, effectively transferring water rights to these land holders individually.

Bartlett Decree [Nevada] — The Bartlett Decree was issued on January 2, 1931 by Judge George A. Bartlett and adjudicated water rights along the Humboldt River and its tributaries. In addition to adjudicating the river system's water rights, this decree also recognized that the surface waters within the Humboldt River system were already fully appropriated, leaving no surplus water for irrigation during an average, or normal water year. Another important finding of the Bartlett Decree recognized the differences in growing seasons between the Humboldt River's upper basin and its lower basin and therefore divided the river system into two districts, District

No. 1 below Palisade (USGS gaging station 10322500) and District No. 2 above Palisade. The Bartlett Decree also recognized the seasonal and ephemeral nature of many streams within the Humboldt River Basin through the concept of "flash streams" and the special need to accommodate water appropriators along such stream systems. These water courses were defined as streams "that have a sudden or flash flow or flush flow for a comparatively brief period of time, while such stream is draining the particular basin or source of supply fed by melting snows... These flash streams in varying degrees are typical of the necessity of cumulating the flow during the flush for the particular rights to be served. Where lands are entitled to irrigation from such flash streams, they must be served at the times when the water is available." The Bartlett Decree established three classes of lands with different irrigation requirements (water duties) and irrigation periods (both with respect to the number of days of allowable irrigation and the specific periods of irrigation). These irrigable land classes included: (1) Harvest crop lands (Class A) – all lands devoted to cultivated crops, including irrigated native or other grass lands which normally receive sufficient water to produce a crop which will justify cutting for hay, although it may sometimes be pastured and not cut; (2) Meadow pasture lands (Class B) – all grass lands free from brush which receive sufficient water to produce what may be classed as good pasture, but not sufficient to warrant cutting for hay; and (3) Diversified pasture lands (Class C) – all lands from which the brush has not been cleared but which are artificially irrigated to some extent for the production of grasses for pasturage. Further, the irrigation periods within the Humboldt River system varied by both the class of the land and whether it was in District No. 1 (below Palisade) or District No. 2 (above Palisade). Due to extensive review and corrections of the written findings by Judge Bartlett, the final Bartlett Decree would not be entered until October 20, 1931. The Bartlett Decree was subsequently modified by the *Edwards Decree*. With respect to adjudication of the Humboldt River, also see *Carville Decree*.

California–Nevada Interstate Compact [California and Nevada] — After thirteen years of negotiations between the two states (began in 1955), the joint California–Nevada Interstate Compact Commission approved a provisional Interstate Compact in July 1968 for the division of the waters of Lake Tahoe, and the Truckee, Carson, and Walker rivers. This provisional compact, with some modification, was eventually ratified by both states (California in September 1970 and Nevada in March 1971). The compact created the Tahoe Regional Planning Agency (TRPA) to oversee land-use planning and environmental issues within the Lake Tahoe Basin. However, the compact was never ratified by Congress which would have made it law. A major issue of contention was a phrase in the compact which stated that the use of waters by the federal government, its agencies, instrumentalities, or wards was to be against the use by the state in which it is made. This limitation, combined with new court interpretations of the federal *reserved water rights (Winters Doctrine)*, waters required for Pyramid Lake fish species under the *Endangered Species Act (ESA)*, and *public trust doctrine* issues combined to derail Congressional approval. Even so, both states chose to implement its terms under individual state legislation. With respect to the Lake Tahoe Basin, the compact provided for a maximum annual gross diversion from all sources of 34,000 acre-feet, of which California was allocated 23,000 acre-feet per year and Nevada 11,000 acre-feet per year.

Carville Decree [Nevada] — The Carville Decree was issued on January 24, 1935 by Judge E.P. Carville and adjudicated water rights for the Little Humboldt River. As with the 1931 *Bartlett Decree* (and the 1935 *Edwards Decree* modifying the Bartlette Decree), the Carville Decree determined water rights for three classes of lands: (1) Class A – harvest crops; (2) Class B – meadow pasture; and (3) Class C – diversified pasture. In general, the decree provided for a flow of 1.0 cfs per 100 acres of decreed land, or at rates proportional to this. When water was available, Class A water rights are for the delivery of water at this rate of flow for a period of 180 days from March 15 to September 15, or a total water diversion during the season of 3.6 acre-feet per acre. Class B rights are for 90 days from March 15 to June 13, for a total of 1.8 acre-feet per acre. Class C rights are for 45 days from March 15 to April 28, for a total of 0.9 acre-feet per acre. With respect to adjudication of the Humboldt River, also see *Bartlett Decree* and *Edwards Decree*.

Colorado River Compact — An agreement entered into on November 24, 1922 and ratified by the legislatures of the seven states within the Colorado River Basin — Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming — agreeing to the general allocation of the waters of the Colorado River. The compact divided the Colorado River Basin into an *Upper Basin* and a *Lower Basin*, with the division point established at Lees Ferry, a point in the mainstream of the Colorado River approximately 30 river miles south of the Utah-Arizona boundary. The Upper Basin was defined to include those parts of the states of Arizona, Colorado, New Mexico, Utah, and

Wyoming within and from which waters naturally drain into the Colorado River system above Lees Ferry, and all parts of these states that are not part of the river's drainage system but may benefit from water diverted from the system above Lees Ferry. The Lower Basin was defined to include those parts of the states of Arizona, California, Nevada, New Mexico, and Utah within and from which waters naturally drain into the Colorado River system below Lees Ferry, and all parts of these states that are not part of the river's drainage system but may benefit from water diverted from the system below Lees Ferry. The compact did not apportion water to any state; however, it did apportion to each upper and lower basin the exclusive, beneficial consumptive use of 7,500,000 acre-feet of water per year from the Colorado River system in perpetuity. Further, the compact gave to the Lower Basin the right to increase its annual beneficial consumptive use of such water by 1,000,000 acre-feet. This compact cleared the way for federal legislation for the construction of Hoover Dam. Subsequently, the Upper Basin states entered into the *Upper Colorado River Basin Compact* on October 11, 1948 which provided Arizona to use 50,000 acre-feet of water per year from the upper Colorado River system and apportioned the remaining water to the Upper Basin states according to the following percentages: Colorado, 51.75 percent; New Mexico, 11.25 percent; Utah, 23 percent; and Wyoming, 14 percent. The Lower Basin states could not come to an agreement on apportionment on their own, and in October 1962, the U.S. Supreme Court ruled that of the first 7,500,000 acre-feet of mainstream water in the Lower Basin, California is entitled to 4,400,000 acre-feet (58.67 percent), Arizona to 2,800,000 acre-feet (37.33 percent), and Nevada to 300,000 acre-feet (4.00 percent).

Decree 731 (Interim Walker River Decree) [Nevada] — In response to the suit filed in 1902 (*Miller et Lux v. Rickey*), subsequently renamed to the *Pacific Livestock Company v. Antelope Valley Land and Cattle Company*, water rights adjudication in the Federal District Court for Nevada resulted in the issuance of Decree 731 on March 24, 1919. [During the Nevada gold mining boom of the early 1900's, Thomas B. Rickey was actively involved in both mining and banking as well as ranching. So much so, in fact, that he suffered failure in the panic of 1907 and his ranching properties were sold to the Antelope Valley Land and Cattle Company. Also, the agricultural holdings of Muller and Lux were taken over by the Pacific Livestock Company.] The Decree addressed the amount of water to which each party was entitled, the source of the water, the area to which it was to be applied, and the priority date for each use. The Decree also encompassed many, but not all, of the other water users on the river, particularly the water rights of the smaller agricultural water users as well as the irrigation rights of the Walker River Indian Reservation. Five separate water rights for the reservation were quantified with priority dates ranging from 1868 to 1886 (the reservation was established on November 29, 1859) and the government was permitted to purchase additional rights from the proposed Topaz Reservoir to supply the reservation. [These five water rights included: (1) 1868 priority date – 4.70 cfs, 385.95 acres irrigated; (2) 1872 priority date – 3.55 cfs, 295.80 acres irrigated; (3) 1875 priority date – 6.15 cfs, 512.80 acres irrigated; (4) 1883 priority date – 7.50 cfs, 625.20 acres irrigated; and (5) 1886 priority date – 1.03 cfs, 85.80 acres irrigated.] In effect, the Decree addressed essentially only direct diversions from the river and its tributaries. Except for some general provisions pertaining to the Antelope Valley Land and Cattle Company's storage rights, particularly those relating to the prospective development of Alkali Lake (Topaz) Reservoir, no other storage rights were quantified. As an interim measure, Decree 731 did assign priorities and amounts of water for irrigating specified lands of the parties and allowed incidental domestic and stock-watering uses to be served under the irrigation rights.

Decree C-125 (Final Walker River Decree) [Nevada] — In adjudication of the 1924 filing of *United States v. Walker River Irrigation District, et al.*, Decree C-125 for waters of the Walker River was issued on April 14, 1936 by the Federal District Court for Nevada. In addition to recognizing the water rights defined in Decree 731 (March 24, 1919) as to priority date, amount and place of use, and defined other storage and diversion rights, the Walker River Indian Reservation's attempt to acquire a right to divert 150 cfs for the irrigation of reservation lands was rejected. While Decree C-125 adjudicated most of the irrigation rights of the Walker River system, the court did not define domestic rights, irrigation uses on natural forest land, some private riparian lands, and any storage rights for Weber Reservoir, which had recently been constructed on the Walker River Indian Reservation. Also, no rights were included for Walker Lake itself. A federal *Watermaster* would be responsible for its enforcement. The District Court refused the Tribe's claim (for right to a rate of flow of 150 cfs), stating that even if an implied tribal water right was included with reservation lands, the white pioneers were in "an inexpugnable position" and the "court was not about to take fifty years of beneficial farming use away from these settlers for the sake of supplying the tribe with guaranteed water." In June 1939 Decree C-125 was modified on appeal to the U.S. Circuit Court of Appeals, Ninth Circuit (104 Fed 2d 334 [1939]). The Walker River Indian Reservation was

granted a right to divert 26.25 cfs (they had asked for 150 cfs) for 180 days (amounting to 9,450 acre-feet from natural flows) to be measured at the Parker Gage (currently the Wabuska gage) at the north (outlet) end of Mason Valley approximately where the reservation boundary begins. This diversion period is in contrast to upstream users who have an irrigation season of up to 245 days as reaffirmed in the "Rules and Regulations for the Walker River System" under Decree C-125. All defendants agreed to the stipulation which granted the Walker River Indian Reservation a November 29, 1859 priority date for its water rights for the irrigation of 2,100 acres of reservation land. The original priority dates established in Decree 731 in 1919 had assigned priority dates (5) ranging from 1868 to 1886. [These five water rights included: (1) 1868 priority date – 4.70 cfs, 385.95 acres irrigated; (2) 1872 priority date – 3.55 cfs, 295.80 acres irrigated; (3) 1875 priority date – 6.15 cfs, 512.80 acres irrigated; (4) 1883 priority date – 7.50 cfs, 625.20 acres irrigated; and (5) 1886 priority date – 1.03 cfs, 85.80 acres irrigated.

Edwards Decree [Nevada] — The Edwards Decree was issued on October 8, 1935 and represented a modification of adjudicated water rights for the Humboldt River based on the October 20, 1931 *Bartlett Decree*. Due to subsequent protests to the issuance of the Bartlett Decree, on December 16, 1931, the first of a number of rulings for the modification, correction and amendment of the Bartlett Decree was made by Judge H.W. Edwards. This was followed by additional changes and amendments entered on April 27, 1933, February 8, 1934, June 8, 1934, October 1, 1934, November 19, 1934, February 11, 1935, and finally on March 11, 1935. Collectively, this compilation of modifications and changes to the 1931 Bartlett Decree became known as the Edwards Decree. One particular change of some importance removed the Bartlett Decree's language pertaining to the formal division of the Humboldt River system into a District No. 1 below Palisade and a District No. 2 above Palisade. In its place, the Edwards Decree merely established specific irrigation seasons and reaffirmed the three classes of land for specific water rights, the water duty for each land class, and the period over which water was to be received by these lands. As most of the corrected water-rights contained within the Edwards Decree applied to lands above Palisade (i.e., the upper Humboldt River Basin), the Edwards Decree was applied to and used for distribution of the Humboldt River system's waters above Palisade, while the Bartlett Decree continued to apply to and be used in the distribution of water below Palisade. In general, the Edwards Decree provided for a flow of 1.23 cfs per 100 acres of decreed land or at proportional rates. Three land classes were established (the same as for the Bartlett Decree) with different dates of use and number of days of allowed irrigation. Each sub-basin within the overall Humboldt River Basin had its unique amount of decreed land and decreed water within the three land classes (A, B and C). Diverted water for irrigation purposes was to be measured where the main ditch enters or becomes adjacent to the land to be irrigated. With respect to adjudication of the Humboldt River, also see *Carville Decree*.

Floriston Rates [California and Nevada] — Currently represents the primary operational criteria of the Truckee River between its source (Lake Tahoe) and its terminus (Pyramid Lake). The rates originated in a 1915 decree (*Truckee River General Electric Decree*) in which the *U.S. Bureau of Reclamation (USBR)* gained an easement to operate the Lake Tahoe outlet dam in return for providing year-round flow rates for run-of-the-river users — hydropower and a pulp and paper mill. Along with the *Orr Ditch Decree* (1944) and the *Truckee River Agreement* (1935), which has been incorporated into the Orr Ditch Decree, these requirements govern the Truckee River flows. The Floriston rates essentially constitute a minimum instream flow in the river, as long as water is physically available in Lake Tahoe and Boca Reservoir to support the rates. Water may only be stored in Lake Tahoe and Boca Reservoir when rates are being met. The precise definition contained in the Truckee River Agreement is as follows:

- [1] **Floriston Rates** means the rate of flow in the Truckee River at the head of the diversion penstock at Floriston, California (to be measured at the Iceland gage, but currently measured at the Farad gage) consisting of an average flow of 500 cubic feet of water per second each day during the period commencing March 1 and ending September 30 of any year, and an average flow of 400 cubic feet per second each day during the period commencing October 1 and ending the last day of the next following February of any year.
- [2] **Reduced Floriston Rates** means rates of flow in the Truckee River, measured at the Iceland gage (currently the Farad gage), effective and in force during the period commencing November 1 and ending the next following March 31 of each year, determined as follows:
 - (a) 350 cubic feet per second whenever the elevation of the water surface of Lake Tahoe

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- is below 6226.0 feet above sea level and not below 6225.25 feet above sea level; and
(b) 300 cubic feet per second whenever the water surface elevation of Lake Tahoe is below 6225.25 feet above sea level.

Also see *Truckee River Agreement [Nevada and California]*.

(Truckee River) General Electric Decree [California] — Represented the resolution, through a 1915 federal court consent decree, of a lengthy series of conflicts, litigation, and negotiations between the U.S. Bureau of Reclamation (USBR, then the U.S. Reclamation Service, USRS) and the Truckee River General Electric Company (predecessor to the present-day Sierra Pacific Power Company), which, in 1902, through a complicated series of real estate transactions had obtained title to the Lake Tahoe Dam, surrounding lands, and the hydropower plants on the Truckee River. The Bureau of Reclamation was in desperate need of Lake Tahoe water for its Newlands Project, then nearing completion near Fallon in Churchill County. This decree granted the Bureau of Reclamation an easement to operate the Lake Tahoe Dam and to use surrounding property owned by the power company. On its part, the Bureau of Reclamation was required to provide certain year-round flow rates (the *Floriston Rates*), measured at a stream gage near the state line, to support hydropower generation. These rates, in fact, dated back to a 1908 river flow agreement among the Truckee River General Electric Company, the Floriston Land and Power Company, and the Floriston Pulp and Paper Company and required that “...there shall be maintained a flow of water in the said Truckee River at Floriston [California] of not less than 500 cubic feet per second from the First day of March to the 30th day of September inclusive, in each year, and of not less than 400 cubic feet per second from the 1st day of October to the last day of February, inclusive, in each year.” While this decree did dictate how the Lake Tahoe Dam would be operated, it did little to solve the concerns of residents of the lake and lessen California’s concerns over the apportionment of Lake Tahoe waters.

OCAP (Operating Criteria and Procedures) [Nevada] — Operating criteria originally instituted in 1967 for water diversions and irrigation of the *Newlands (Irrigation) Project [Nevada]* in the Carson River Basin and designed to maximize use of Carson River flows to satisfy project requirements and minimize diversions from the Truckee River. Current OCAP requirements for this project were set in 1988 and according to *Public Law 101–618 (the Negotiated Settlement)* are to remain in effect at least through December 31, 1997 at which time a new *Truckee River Operating Agreement (TROA) [Nevada and California]* will be implemented.

Orr Ditch Decree [Nevada and California] — A tabulation or adjudication of Nevada (only) water rights for the Truckee River and its tributaries regulated through a series of reservoirs and irrigation canals, administered by the U.S. District Court Federal Water Master in Reno, Nevada. In combination with the *Truckee River Agreement [Nevada and California]* and the *Floriston Rates [California and Nevada]*, the Orr Ditch Decree currently represents the basis for operation of the Truckee River between its source (Lake Tahoe) and its terminus (Pyramid Lake). The Orr Ditch Decree (1944) incorporates the provisions of the Truckee River Agreement (1935), which provides for operation of storage facilities, especially Lake Tahoe, to satisfy Truckee River water rights. The Floriston rates constitute the chief operation objective on the Truckee River today and originated as a turn-of-the-century flow requirement for run-of-the-river users — hydropower and a pulp and paper mill. While the Orr Ditch Decree establishes water rights for entities within Nevada using the Truckee River’s waters, the Truckee River Agreement, as part of that Decree, determines the operational mechanisms to satisfy those rights. Also see *Truckee River General Electric Decree [California]*.

Preliminary Settlement Agreement (PSA) [Nevada] — An agreement reached between the Pyramid Lake Paiute Tribe of Indians and Sierra Pacific Power Company (SPPCo) on May 23, 1989. The PSA provides SPPCo the ability to store its water rights in federally operated reservoirs along the Truckee River in California at times when it is not needed for municipal and industrial (M&I) water supply in the Reno–Sparks Metropolitan Area. In exchange, excess water in storage is used for fishery purposes when drought conditions are not in effect. Also, SPPCo forgoes its right to single-use hydroelectric flows in the Truckee River under the *Orr Ditch Decree [Nevada and California]*, thereby enabling the United States and the Tribe to store water for fishery benefit at certain times of the year. The PSA is incorporated into *Public Law 101–618 (the Negotiated Settlement)* by reference.

Public Law 101–618 (PL 101–618) [Nevada and California] — Omnibus legislation passed by the 101st Congress at the end of its 1990 session intended to settle a number of outstanding disputes concerning the Truckee and

Carson Rivers. The legislation authorized an ambitious environmental restoration program to benefit the *Lahontan Valley Wetland System [Nevada]* and Pyramid Lake and the lower Truckee River. It also established a framework for resolving separate by closely-related water-resource conflicts involving the Pyramid Lake Paiute and Fallon Paiute-Shoshone Tribes, the cities of Reno and Sparks (Nevada), the states of Nevada and California, and (pending the resolution of several as-yet unsatisfied controversies) the *Newlands (Irrigation) Project [Nevada]*. The legislation contains two primary titles: *TITLE I — The Fallon Paiute-Shoshone Indian Tribal Settlement Act*; and *TITLE II — The Truckee-Carson-Pyramid Lake Water Rights Settlement Act*. Collectively, the legislation can be referred to as the *Negotiated Settlement*. The seven (7) main elements covered by the legislation include:

- [1] ***Promote the Enhancement and Recovery of Endangered and Threatened Fish Species*** — A recovery program is to be developed for the Pyramid Lake endangered fish species cui-ui (*Chasmistes cujus*) and the threatened fish species Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) in compliance with the *Endangered Species Act (ESA)* and the *Truckee-Carson-Pyramid Lake Water Rights Settlement Act*. Water rights acquisitions are authorized for this purpose.
- [2] ***Protect Wetlands from Further Degradation*** — A water rights purchase program is authorized for *Lahontan Valley Wetlands*, with the intent of sustaining an average of 25,000 acres of wetlands (*Stillwater National Wildlife Refuge*: 14,000 acres; *Carson Lake and Pasture*: 10,200 acres; and *Fallon Reservation and Indian Lakes*: 800 acres) to both prevent further degradation and improve the habitat of the fish and wildlife which depend on those wetlands. The *U.S. Fish and Wildlife Service (USFWS)* has estimated that this will require up to 125,000 acre-feet (AF) of water per year.
- [3] ***Encourage the Development of Solutions for Demands on Truckee River Waters*** — An operating agreement is to be negotiated for the Truckee River — *The Truckee River Operating Agreement (TROA)* — covering procedures for using storage capacity in upstream reservoirs in California consistent with recovery objectives for listed Pyramid Lake fishes. This includes the implementation of the terms and conditions of the *Primary Settlement Agreement (PSA)* between SPPCo and the Pyramid Lake Paiute Tribe.
- [4] ***Improve Management and Efficiency of the Newlands Project*** — The Secretary of the Interior is authorized to operate and maintain the *Newlands Project* to serve additional purposes, including recreation, improved water quality flowing to the wetlands, improved fish and wildlife habitat, and municipal water supply for Lyon and Churchill counties. A project efficiency study is required. The 1973 Gesell Decision is recognized and the 1988 *Operating Criteria and Procedures (OCAP)* is to remain in effect at least through 1997.
- [5] ***Fallon Paiute-Shoshone Water Issues Settlement*** — Establishment of a settlement fund for the Fallon Paiute-Shoshone Tribe totaling \$43 million. The Tribe is authorized to purchase land and water rights to consolidate tribal holdings within the reservation. Specific litigation filed by the Tribe is to be dismissed.
- [6] ***Pyramid Lake Paiute Tribe Issues Settlement*** — A tribal economic development fund of \$40 million was established for the Pyramid Lake Paiute Indian Tribe to provide for the settlement of water, fish, and other issues. Another fund of \$25 million was established for the Pyramid Lake fishery.
- [7] ***Interstate Water Apportionment Settlement*** — Facilitate an interstate allocation of the waters of the Truckee River, Carson River, and Lake Tahoe between the states of California and Nevada.

Also see *Truckee River Agreement [Nevada and California]*.

Sierra Valley Decree [California-Nevada] — Adjudication (1958) allowing the Sierra Valley Water Company to divert a portion of the Little Truckee River in California into Webber Creek for irrigation purposes in the Sierra Valley in the Feather River Basin. The maximum allowable diversion is 60 cubic feet per second (cfs), averaging approximately 5,700 acre-feet (AF) per year (although as a supplemental water source, diversions typically vary between 1,500 AF and 10,000 AF per year). Waters may be diverted only between March 15th and September 30th of each year. The *Priority Date* of this water right was set at 1870.

Tahoe-Prosser Exchange Agreement (California-Nevada) — Also referred to as the “Agreement for Water Exchange Operations of Lake Tahoe and Prosser Creek Reservoir,” this agreement was finalized in June 1959 and designated certain waters in Prosser Reservoir in the Truckee River Basin as “Tahoe Exchange Water.” By this

agreement, when waters were to be released from Lake Tahoe for a minimum instream flow (50 cfs winter; 70 cfs summer) and when such releases from Lake Tahoe were not necessary for *Floriston Rates* due to normal flows elsewhere in the river, then an equal amount of water (exchange water) could be stored in Prosser Reservoir and used for releases at other times. Also see *Truckee River Agreement [Nevada and California]*.

Tri-Partite Agreement [Lahontan Valley, Nevada] — The 50-year agreement among Truckee-Carson Irrigation District (TCID), Nevada State Board of Fish and Game Commissioners (currently the Nevada Board of Wildlife Commissioners as part of the Nevada Division of Wildlife, NDOW), and U.S. Fish and Wildlife Service (USFWS) regarding the establishment, development, operation, and maintenance of *Stillwater National Wildlife Management Area*, dated November 26, 1948. In 1960 the management of this area was changed to a two-party agreement between USFWS and NDOW.

Truckee River Agreement [Nevada and California] — The Truckee River Agreement (1935) represents the current basis for the operation of the Truckee River, including its tributaries and diversions, between its source (Lake Tahoe) and its terminus (Pyramid Lake). Parties to this agreement include the *Truckee-Carson Irrigation District (TCID)*, serving the irrigation rights of agricultural water users of the *Newlands (Irrigation) Project [Nevada]* in Churchill County, Nevada, Sierra Pacific Power Company (SPPCo), serving primarily the municipal and industrial water needs of the cities of Reno and Sparks, Nevada, and the Washoe County Water Conservation District (WCWCD), serving the agricultural water users in the Truckee Meadows. Operation of upstream reservoirs is under the supervision of the Federal Water Master, who administers court-imposed requirements under the *Orr Ditch Decree [Nevada and California]* to supply water to achieve *Floriston Rates [California]* (mandated river flow rates) at the California-Nevada border. The 1944 Orr Ditch Decree, which incorporates the Truckee River Agreement, affirmed numerous individual water rights (both municipal and industrial and agricultural), including Truckee River diversion rights earlier than 1939. The Truckee River Agreement provides for operation of storage facilities, especially Lake Tahoe, to satisfy these rights and required the building of Boca Dam and Reservoir. The agreement further contains language intended to settle the disputes over pumping Lake Tahoe by:

- [1] Establishing the natural conditions in the bed and banks of Lake Tahoe and of the Truckee River near Tahoe City, Placer County, California, and prohibiting any alteration of such natural conditions without the approval of the Attorney General of the State of California, and, in fact, allowing parties to the agreement the right to restore these areas to their natural condition, as necessary;
- [2] Prohibiting the creation of any other outlet of Lake Tahoe in addition to the present and natural outlet at the head of the Truckee River;
- [3] Prohibiting the removal of water from Lake Tahoe for irrigation or power uses by any means other than gravity except upon the declaration of the U.S. Secretary of the Interior; and
- [4] Prohibiting the removal of water from Lake Tahoe for sanitary or domestic uses by any means other than gravity, except upon the condition that the Departments of Health of the States of Nevada and California, or other officers exercising similar authority, shall first have made and filed with the Attorney General of the State of Nevada and the Attorney General of the State of California certificates showing that a necessity for such pumping of Lake Tahoe exists.

The prescribed Floriston rates constitute the chief operational objective on the Truckee River today and originated as a turn-of-the-century flow requirement for run-of-the-river users — hydropower and a pulp and paper mill. Stored water in Lake Tahoe and Boca Reservoir is used to “make rates,” as specified in the Truckee River Agreement, when the river’s natural flow alone does not suffice. The following is a listing of the dams and reservoirs that are operated along the Truckee River and their ownership, uses, and operational criteria. Not all these reservoirs are operated as part of the Truckee River Agreement.

- [1] **Lake Tahoe** — The first dam at Lake Tahoe’s exit into the Truckee River, located at Tahoe City in Placer County, California, was constructed in the early 1870s and the existing Lake Tahoe Dam was constructed in 1913. The Lake Tahoe drainage area covers approximately 506 square miles. Water is stored only in the top 6.1 feet, from an elevation of 6,223.0 feet (the lake’s assumed natural rim above mean sea level — MSL) to an elevation of 6,229.1 feet (MSL). Total storage capacity equals approximately 744,600 acre-feet and is used to supplement Floriston rates in conjunction with natural runoff of other tributaries and Boca Dam releases. The Lake Tahoe Dam is owned by the USBR and operated under agreement by the TCID for the Newlands Project in Churchill County, Nevada. Lake Tahoe storage capacity is not considered part of the U.S. Army Corps of Engineers (COE) flood control system. Lake Tahoe waters may be exchanged for water from Prosser Creek Reservoir (the

Tahoe-Prosser Exchange Agreement) in order to maintain a live stream below the Lake Tahoe Dam without adversely affecting Nevada water users' storage. Whenever possible, Lake Tahoe releases are to maintain a minimum instream flow of 50–70 cubic feet per second (cfs) downstream from the dam (varies with season).

- [2] **Donner Lake** — The first dam on Donner Lake was built in 1877, while the current dam was constructed in the 1930s. Donner Lake drains an area of only approximately 14 square miles. Water in Donner Lake is privately owned by Sierra Pacific Power Company (SPPCo) of Reno, Nevada and TCID and is not required to be used to meet Floriston rates. The dam is jointly owned and operated by SPPCo and TCID. Lake storage levels range between 5,924 feet MSL and 5,935.8 feet MSL (providing for 9,500 acre-feet of storage capacity). The SPPCo portion of the stored water is used to supplement Reno–Sparks municipal and industrial water use; the TCID portion is used to supplement Newlands Project irrigation water requirements. After the lake fills, lake inflows are passed through to supplement Floriston rates. Lake storage is not part of COE flood control system. The State of California requires a minimum flow of 2–3 cfs downstream from the dam for maintaining fish habitat.
- [3] **Independence Lake** — The original Independence Lake dam was constructed in 1879 and created a storage capacity of 3,000 acre-feet. After SPPCo acquired ownership of the lake and dam in 1937, the dam was enlarged in 1939 to its present size with a total storage capacity of 17,500 acre-feet. Independence Lake drains an area of only eight square miles. Like Donner Lake water, this water is privately owned and not required to be used to meet Floriston rates; the stored waters are owned by SPPCo and supplement the SPPCo water supply for the Reno–Sparks municipal and industrial water use during droughts. The lake's first storage priority is for 3,000 acre-feet of (original) storage; an additional 14,500 acre-feet of storage is permitted after Boca Reservoir is full and the Floriston rates and Truckee River diversion rights (Orr Ditch Decree) are satisfied. The State of California requires a minimum flow of 2 cfs downstream from the dam for maintaining fish habitat.
- [4] **Martis Creek Reservoir** — The Martis Creek Dam was constructed by the COE in 1971 and was intended to store waters from a 40 square mile drainage area to include not only Martis Creek, by the East, West, and Central Martis Creeks as well. In accordance with COE requirements, this reservoir, with a total storage capacity of 20,400 acre-feet, serves only flood control purposes. While legislation allows for other uses, only temporary storage is currently permitted due to an unsafe, leaking dam. Except during flood storage, reservoir outflows equal inflows.
- [5] **Prosser Creek Reservoir** — The Prosser Creek Reservoir was constructed by the USBR in 1962 to store waters from a 50 square mile drainage area beginning 11 miles to the west at Warren Lake. The reservoir, with a total capacity of 29,800 acre-feet, is owned and operated by the USBR for three purposes: (a) as part of the COE Truckee River flood control program; (b) the storage of water under the terms of the Tahoe–Prosser Exchange Agreement (which provides that a portion of this water, when available, may be used to meet Floriston rates in lieu of making such releases from Lake Tahoe); and (c) to meet the spawning flow needs of Pyramid Lake's endangered cui-ui fish species and its threatened Lahontan cutthroat trout, or for other federal purposes. The State of California generally requires a minimum flow of natural flow or 5 cfs, whichever is less, downstream from the dam for maintaining fish habitat.
- [6] **Stampede Reservoir** — The dam and reservoir, constructed by the USBR in 1970, drains an area of some 136 square miles and has a total capacity of 226,000 acre-feet. Water must be used primarily for spawning flows for the endangered cui-ui fish species and the threatened Lahontan cutthroat trout of Pyramid Lake. Storage space is also part of COE flood control plan. Stampede Reservoir water may be stored only after: (1) Floriston rates and Truckee River diversion rights have been satisfied; (2) Boca Reservoir is full; and (3) Independence Lake is full. Due to its relatively junior water rights, this reservoir seldom fills and therefore has been targeted as a prime storage location for Reno–Sparks municipal water as part of the Negotiated Settlement (Public Law 101–618) and the implementation of a new Truckee River Operating Agreement (TROA). The State of California requires a minimum flow of 30 cfs downstream from the dam for maintaining fish habitat (although this agreement has expired, the rates of flow have been maintained).
- [7] **Boca Reservoir** — The original Boca dam was built around 1868 for ice harvesting. The present, much larger dam, was constructed in 1937 and created a reservoir with a total capacity of 40,800 acre-

feet and a drainage area, to include the entire Little Truckee River Basin (including both Independence Lake and Stampede Reservoir) of some 172 square miles. Title to stored water is held by the USBR and operated by the Washoe County Water Conservation District (WCWCD). The reservoir's water is used in conjunction with Lake Tahoe water to maintain Floriston rates and to provide part of the required COE flood control capacity. Up to 25,000 acre-feet of water may be stored in Boca Reservoir only after Floriston rates are satisfied and Independence Lake's first storage priority of 3,000 acre-feet is satisfied. The balance may not be filled unless the Newlands Project diversion right at Derby Dam (on the lower Truckee River) has been satisfied. SPPCo stores a small portion (800 acre-feet) of its privately owned stored water (POSW) rights here. There are no minimum downstream flow requirement associated with Boca Reservoir.

- [8] **Derby Dam/Truckee Canal/Lahontan Reservoir** — Although Lahontan Reservoir is not a storage facility of the Truckee River Basin, it does store Truckee River waters diverted at Derby Dam on the lower Truckee River. Derby Dam, which is located approximately 11 miles upstream from Wadsworth, Nevada, is the regulating device by which Truckee River waters are diverted into the Truckee Canal for use within the Truckee Division of the Newlands Project and for storage in Lahontan Reservoir in the Carson River Basin for use within the Carson Division of the Newlands Project. The dam, originally named the Truckee River Diversion Dam, was completed by the USBR in June 1905, whereas the Truckee Canal was not completed through to the Carson River until August 1906. Lahontan Reservoir was not completed until 1915, at which time the Truckee Canal's outlet was re-routed slightly upstream so as to enter Lahontan Reservoir instead of flowing directly into the Carson River below the dam. Diversions and releases are conducted in accordance with the Truckee River Agreement, the Orr Ditch Decree, and Newlands Project OCAPs, which allow for a maximum diversion of up to 1,500 cfs (Orr Ditch Decree right, although current canal capacity is only 900 cfs) from: (a) remainder of Floriston rates and return flows from upstream diversions; (b) right to Truckee River tributary water; and (c) any water bypassed or released to obtain space to store flood waters in reservoirs if water right holder did not identify a use for the release. Under the more recent project OCAPs, the quantity of water which may be diverted from the Truckee River at Derby Dam varies with the determination of irrigation entitlement each year (water-righted acreage to be irrigated and the appropriate water duty for bench and bottom lands) and the predicted runoff from the Carson River and water in storage in Lahontan Reservoir.

Also see *Operational Criteria and Procedures (OCAP) [Nevada]*, *Public Law 101-618 [Nevada and California]*, and *Truckee River Operating Agreement (TROA) [Nevada and California]*.

Truckee River General Electric Decree [California] — Represented the resolution, through a 1915 federal court consent decree, of a lengthy series of conflicts, litigation, and negotiations between the *U.S. Bureau of Reclamation (USBR)* and the Truckee River General Electric Company (predecessor to the present-day Sierra Pacific Power Company), which, in 1902, through a complicated series of real estate transactions had obtained title to the Lake Tahoe Dam, surrounding lands, and the hydropower plants on the Truckee River. The USBR was in desperate need of Lake Tahoe water for its Newlands Project, then nearing completion near Fallon in Churchill County. This decree granted the USBR an easement to operate the Lake Tahoe Dam and to use surrounding property owned by the power company. On its part, the USBR was required to provide certain year-round flow rates (the *Floriston Rates*), measured at a stream gage near the state line, to support hydropower generation. These rates, in fact, dated back to a 1908 river flow agreement among the Truckee River General Electric Company, the Floriston Land and Power Company, and the Floriston Pulp and Paper Company and required that "...there shall be maintained a flow of water in the said Truckee River at Floriston [California] of not less than 500 cubic feet per second from the First day of March to the 30th day of September inclusive, in each year, and of not less than 400 cubic feet per second from the 1st day of October to the last day of February, inclusive, in each year." While this decree did dictate how the Lake Tahoe Dam would be operated, it did little to solve the concerns of residents of the lake and lessen California's concerns over the apportionment of Lake Tahoe waters.

Truckee River Operating Agreement (TROA) [Nevada and California] — The Truckee River Operating Agreement is incorporated in Section 205 of *Public Law 101-618 (the Negotiated Settlement)* and requires that the U.S. Secretary of the Interior negotiate an operating agreement for the Truckee River with the States of Nevada and California, and other parties. The intent of the TROA is to supplant the current *Truckee River Agreement* and provide for the comprehensive management of the Truckee River waters in California and Nevada, as well

as to provide important long-term drought protection for the Reno–Sparks (Nevada) Metropolitan Area. The primary purpose of the TROA is to improve management of Truckee River reservoirs located in California by expanding existing operations for the benefit of municipal and industrial water use, increase drought storage, aid in the recovery of endangered and threatened fish species, and, in general, improve fish and wildlife habitat within the Truckee River Basin. This would be accomplished by “networking” reservoir releases and storage (i.e., unify reservoir operations for a common objective and into a single schedule) in a manner that would not infringe on existing water storage, release, and use rights or flood control requirements. The TROA would also allow for the exchange, transfer, and release of waters from the upstream reservoirs to improve the likelihood of maintaining instream flows for fish and wildlife. The TROA is intended to provide a number of substantive benefits to users of Truckee River waters. These benefits may be listed in four fundamental areas:

- [1] **Reservoir Management** — Improve river flow and river management by improving flexibility, coordinate reservoir storage and release, allow transfers and exchanges among various reservoirs to reduce spills, provide for recreational pools, etc., create a water credit system, promote more efficient use of existing water supplies, allow for the storage of “other waters”, centralize Truckee River water management, improve water accounting (budgeting) and forecasting, eliminate releases solely for power generation, permit storage of water savings from conservation in the Reno–Sparks Metropolitan Area, and provide for greater water marketing among private water rights holders;
- [2] **Fish and Wildlife** — Enhance spawning potential of the Pyramid Lake endangered cui-ui (*Chasmistes cujus*) and threatened Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) fish species through improved overall river operations, commitment of specified waters, increased water availability, and mitigation of significant adverse environmental impacts;
- [3] **Municipal and Industrial Use** — Provide additional M&I drought relief storage for the Reno–Sparks Metropolitan Area through an M&I Water Credit System;
- [4] **Conservation** — Promote water conservation in the Reno–Sparks Metropolitan Area through water metering and various conservation programs.

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Section 9

Abbreviations and Acronyms

[The following terms have been extracted from the Nevada Division of Water Planning's *Water Words Dictionary* and may appear within the *Nevada State Water Plan*. Definitions of these words and a more extensive listing of water-related acronyms may be found in the *Water Words Dictionary*. With respect to notation and presentation, where two acronyms have different meanings, generally the more frequently used one will be listed first.]

AF	Acre-Feet (or Acre-Foot)
AFY	Acre-Feet per Year
ASC	Atmospheric Sciences Center (DRI)
ASCE	American Society of Civil Engineers
ASOS	Automated Surface Observing Systems (NWS/NOAA)
AWWA	American Water Works Association
BAC	Biological Activated Carbon [Process]
BADT	Best Available Demonstrated Technology
BAT	Best Available Technology [Economically Achievable]
BCF	Bioconcentration Factor
BCP	Bioconcentration Potential
BCT	Best [Conventional] Control Technology
BFE	Base Flood Elevation (FEMA)
BIA	Bureau of Indian Affairs (USDI)
BLM	Bureau of Land Management (USDI)
BMP	Best Management Practice [Urban Water Use]
BOD	Biochemical Oxygen Demand/Biological Oxygen Demand
BPI	Bureau of Plant Industry [Evaporation Pan] (USDA)
BPT	Best Practicable Control Technology
BSC	Biological Sciences Center (DRI)
CAA	Clean Air Act (EPA)
CAPA	Critical Aquifer Protection Area (SDWA)
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
CERES	California Environmental Resources Evaluation System
CFCs	Chlorofluorocarbons
CF	Cubic Feet (or Foot)
CFS	Cubic Feet per Second
CIR	Consumptive Irrigation Requirement/Crop Irrigation Requirement
CLOMR	Conditional Letter of Map Revision (FEMA)
COI	Cone of Influence
COD	Chemical Oxygen Demand
COD	Cone of Depression
CORPS	U.S. Army Corps of Engineers (also USACE)
CSS	Combined Sewer System

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CWA	Clean Water Act (EPA)
DBPs	Disinfection By-Products
DCNR	Department of Conservation and Natural Resources (State of Nevada)
D/DBP	Disinfectant and Disinfection By-Product Rule (EPA)
DEP	Division of Environmental Protection (DCNR)
DNAPLs	Denser (than water) Non-Aqueous-Phase Liquids
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DOF	Division of Forestry (DCNR)
DOW	Division of Wildlife (DCNR)
DDT	Dichlorodiphenyltrichloroethane
DRI	Desert Research Institute (University of Nevada System, State of Nevada)
DWR	Division of Water Resources (DCNR)
DWR	Department of Water Resources (The Resources Agency, State of California)
DWP	Division of Water Planning (DCNR)
EA	Environmental Assessment (NEPA)
EA	Endangerment Assessment (EPA)
EDF	Environmental Defense Fund
EEEC	Energy and Environmental Engineering Center (DRI)
EIS	Environmental Impact Statement (NEPA)
EPA	[U.S.] Environmental Protection Agency
ESA	Endangered Species Act (USFWS)
ESWTR	Enhanced Surface Water Treatment Rule (EPA)
ET	Evapotranspiration
ETAW	Evapotranspiration of Applied Water
EWMP	Efficient Water Management Practice [Agricultural Water Use]
FBFM	Flood Boundary Floodway Map (FEMA)
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHBM	Floodway Hazard Boundary Map (FEMA)
FIRM	Flood Insurance Rate Map (FEMA)
FIS	Flood Insurance Study (FEMA)
FONSI	Finding of No Significant Impact (NEPA)
FS	Feasibility Study (EPA)
FTE	Full Time Equivalent (Employment)
GAC	Granular Activated Carbon
GACT	Granular Activated Carbon Treatment
GD	Geologic Division (USGS)
GFD	Gallons per Square Foot [of membrane] per Day
GID	General Improvement District
GIS	Geographic Information System
GPC	Gallons per Capita (Person)
GPCD	Gallons per Capita per Day
GPD	Gallons per Day
GPED	Gallons per Employee per Day
HCP	Habitat Conservation Plan (EPA)
HSA	Hydrologic Study Area (DWR, State of California)

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ICR	Information Collection Rule (EPA)
I.E.	Irrigation Efficiency
IOWE	International Office for Water Education (Utah State University)
IRP	Integrated Resource Planning
JTU	Jackson Turbidity Unit
KGAL	Kilogallons (thousand gallons)
KGRA	Known Geothermal Resource Area
LOMA	Letter of Map Amendment (FEMA)
LOMR	Letter of Map Revision (FEMA)
LR	Leaching Requirement
LTAR	Long Term Acceptance Rate [of Soils]
LVEA	Lahontan Valley Environmental Alliance
MAF	Million Acre-Feet
M&I	Municipal and Industrial
MBAS	Methylene Blue Active Substance
MCL	Maximum Contaminant Level (EPA)
MCLG	Maximum Contaminant Level Goal (EPA)
MEQ/L	Milliequivalents per Liter
MGD	Million Gallons per Day
MG/L	Milligrams per Liter
MIS	Management Indicator Species
MSL	Mean Sea Level
MTBE	Methyl Tertiary Butyl Ether
NAPLs	Non-Aqueous-Phase Liquids
NASQAN	National Stream Quality Accounting Network (USGS)
NDEPS	National Pollutant Discharge Elimination System (EPA)
NDOW	Nevada Division of Wildlife (DCNR)
NDSP	Nevada Division of State Parks (DCNR)
NDWP	Nevada Division of Water Planning (DCNR)
NEPA	National Environmental Policy Act
NESDIS	National Environmental Satellite, Data and Information Service (NOAA)
NEXRAD	Doppler Radar Data System (NWS/NOAA)
NFIP	National Flood Insurance Program (FEMA)
NFS	National Forest Service (USDA)
NGVD	National Geodetic Vertical Datum
NHP	Natural Heritage Program (DCNR)
NIDS	NEXRAD Information Dissemination Service (NWS/NOAA)
NIFC	National Interagency Fire Center (BLM)
NIPDWR	National Interim Primary Drinking Water Regulations
NMD	National Mapping Division (USGS)
NMFS	National Marine Fisheries Service (NOAA)
NOAA	National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
NO_x	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System (EPA)
NPDWR	National Primary Drinking Water Regulations (SDWA/EPA)
NPL	National Priorities List [“Superfund” List] (EPA)

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NPS	Non-Point Source [Pollution]
NPS	National Park Service (USDI)
NRCS	Natural Resources Conservation Service (USDA)
NRDC	Natural Resources Defense Council (private environmental organization)
NRP	National Research Program [Centers] (WRD/USGS)
NSDWR	National Secondary Drinking Water Regulations
NTU	Nephelometric Turbidity Unit
NVS	Non-Volatile Solids
NVSS	Non-Volatile Suspended Solids
NWIC	National Water Information Clearinghouse (USGS)
NWPA	Newlands [Irrigation Project] Water Protective Association
NWR	National Wildlife Refuge [System] (USFWS)
NWS	National Weather Service (NOAA)
OCAP	Operating Criteria and Procedures (TCID/USBR)
OFA	Other Federal Agencies [Program] (WRD/USGS)
OSM	Office of Surface Mining Reclamation and Enforcement (Bureau of Mines/USDI)
PAHs	Polycyclic Aromatic Hydrocarbons, or Polararomatic Hydrocarbons
PAMs	Polyacrylamides
PCBs	Polychlorinated Biphenyls
PCE	Perchloroethylene
PDC	Project Dependable Capacity
pH	Hydrogen Ion Concentration [Potential of Hydrogen]
PIA	Practicably Irrigable Acreage
P.L.	Public Law
PLSS	Public Land Survey System
PMF	Probable Maximum Flood (FEMA)
PNAAs	Polynuclear Aromatic Hydrocarbons
PPB	Parts per Billion
PPM	Parts per Million
PPT	Parts per Thousand
PS	Point Source [Pollution]
PSA	Primary Settlement Agreement
PWS	Public Water System/Public Water Supply
PWSS	Public Water Supply System
QPF	Quantitative Precipitation Forecast
QSC	Quaternary Sciences Center (DRI)
RCRA	Resource Conservation and Recovery Act (EPA)
RI	Remedial Investigation (EPA)
RI/FS	Remedial Investigation/Feasibility Study (EPA)
RMCL	Recommended Maximum Containment Level
RMP	Resource Management Plan (BLM)
S.A.	Seasonally Adjusted
SAB	Science Advisory Board (EPA)
SAE	Seasonal Application Efficiency
SCS	Soil Conservation Service (now NRCS)
SDWA	Safe Drinking Water Act (EPA)
SFHA	Special Flood Hazard Area (FEMA)

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SFIP	Standard Flood Insurance Policy (FEMA)
SIC	Standard Industrial Classification [Code]
SMCL	Secondary Maximum Contaminant Level (EPA)
SNOTEL	Snowpack Telemetry (NRCS)
SPCCP	Spill Prevention Control and Countermeasures Plan (CWA)
SPF	Standard Project Flood (FEMA)
SWAP	Source Water Protection Program (EPA)
SWCS	Soil and Water Conservation Society
SWE	Snow Water Equivalent
SWPP	Source Water Protection Program (EPA)
SWRCB	State Water Resources Control Board (DWR/State of California)
SWTR	Surface Water Treatment Rule (SDWA)
TC	Total Carbon
TCID	Truckee–Carson Irrigation District [Nevada]
TDS	Total Dissolved Solids
THMs	Trihalomethanes
TMDL	Total Maximum Daily Load (EPA)
TNC	The Nature Conservancy
TROA	Truckee River Operating Agreement [California and Nevada]
TS	Total Solids
TSCA	Toxic Substances Control Act (EPA)
TSS	Total Suspended Solids
TTHMs	Total Trihalomethanes
UDI	[Ground Water] Under the Direct Influence [of Surface Water]
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers (also Corps)
USBR	U.S. Bureau of Reclamation (USDI)
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USDW	Underground Source of Drinking Water
USFS	U.S. Forest Service (USDA)
USFWS	U.S. Fish and Wildlife Service (USDI)
USGS	U.S. Geological Survey (USDI)
USRS	U.S. Reclamation Service (USBR)
UV	Ultraviolet Radiation
VOC	Volatile Organic Carbon
VOCs	Volatile Organic Chemicals
WAVE	Water Alliances for Voluntary Efficiency (EPA)
WCWCD	Washoe County Water Conservation District (Nevada)
WET	Water Education for Teachers
WHPA	Wellhead Protection Area
WMA	Wildlife Management Area (NDOW/State of Nevada)
WPA	Watershed Protection Approach (EPA)
WRC	Water Resources Center (DRI)
WRD	Water Resources Division (USGS)
ZOC	Zone of Contribution
ZOI	Zone of Influence

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Section 10
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Section 11

Indexes to Part 1

[Note: Index entries are presented separately for each section.]

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Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 1
Historic and Current Water Use

Introduction

Comprehensive water use information is critical to the success of all water planning and management functions. This section of the *State Water Plan* provides an overview of historic and current water use estimates and discusses observed trends in Nevada's water use.

Estimating Water Use

Approximately 65 to 75 percent of the total water withdrawn annually from groundwater and surface water sources in Nevada is either measured with detailed diversion records maintained by various entities or estimated by the State annually in detailed pumpage and crop inventories. According to the State Engineer's Office, water use data submitted to the Office and calculated by staff in the pumpage and crop inventories accounts for about 90 percent of the total groundwater usage. The balance of the groundwater and surface water usage must be estimated. The most significant water use estimation program in Nevada is implemented by the U.S. Geological Survey (USGS) as part of the USGS National Water Use Information Program.

USGS National Water Use Information Program

The USGS has the only program in Nevada responsible for estimating statewide water use on a routine and comprehensive basis. Staff in the USGS's National Water Use Information Program compile and disseminate water use information on local, state and national levels. In developing their estimates, the USGS staff work in cooperation with local, state, and federal agencies.

Since 1950, the USGS has estimated statewide water use at 5-year intervals and published these estimates in a national summary report. USGS water use estimates for Nevada and other states are included in the national summary report, but a separate detailed Nevada water use report with individual county breakdowns is not published. The national summary report includes water use information for each of the 50 states, plus the District of Columbia, Puerto Rico and the Virgin Islands, and for each of the 21 major water resources regions in the United States. The USGS water use estimates for Nevada have been maintained in an electronic database since 1985.

It is important to note that the Nevada water use figures developed by USGS staff are estimates and that the water use values developed are based upon a mixture of *measured* and *estimated* water use. To the extent possible, the USGS compiles water use data collected by other agencies. Much of the

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information is obtained from the State Engineer's Office (Nevada Division of Water Resources). As discussed in Part 1, Section 4 of the *State Water Plan*, the State Engineer's Office develops crop and pumpage inventories for about 40% of the basins. Pumpage data from about 30% of the 256 hydrographic areas are submitted by water right holders to the State Engineer's Office as a requirement of permit conditions. However, the pumpage data that are submitted may not represent all water usage within a particular basin. The USGS obtains additional information through personal communications with various irrigation districts, federal water masters, water purveyors and from any recent USGS studies for a particular region. Federal law does not allow the USGS to mail out surveys to collect additional data.

Much of the water use data presented in this section has been developed by the USGS as part of the National Water Use Information Program. Upon review of the USGS estimates, the Division of Water Planning identified some inconsistencies in the data. However, it is difficult to make adjustments to these data because the USGS does not produce a separate Nevada water use report documenting data sources and assumptions. Nevertheless, as feasible, modifications were made to the USGS estimates by the Nevada Division of Water Planning (NDWP) to address a portion of these inconsistencies. Clearly, a more comprehensive water measurement and/or estimation program is needed to improve water use quantification. Both the original source data obtained from the USGS and the NDWP modifications are presented in the appendix. The "Water Use Measurement and Estimation" issue discussion in Part 3 of the *State Water Plan* provides additional information on available data and needs.

Current Water Use and Past Trends

This section presents statewide water use estimates for the period 1970-1995 at 5-year intervals. These estimates are divided into 8 categories of water use:

- public supply
- domestic
- commercial
- industrial
- thermoelectric
- mining
- irrigation
- livestock

For the public supply category (municipal water systems), this section provides estimated withdrawals by source and deliveries to domestic, commercial, industrial, and thermoelectric power users. The other categories represent both public supplied and self-supplied uses. Self-supplied withdrawals by source, deliveries from public suppliers (where applicable), and consumptive use estimates are given for these categories. Detailed county estimates are presented in the appendices.

Public Supply Water Use

Public supply refers to water withdrawn by public and private water suppliers and delivered for a variety of uses such as domestic, commercial, industrial, thermoelectric, and public uses such as park landscape irrigation. Public supply use is also referred to as Municipal and Industrial (M&I) water use. "Public supply systems" are defined as those which provide water to at least 25 people or 15 connections.

Background on Data Sources. Water use information submitted to the State Engineer for water right permit compliance was the primary source of data utilized by the USGS in their public supply water use estimations. Currently, about 20% of the approximately 300 public supply systems in Nevada are required to submit water withdrawal information to the State Engineer’s Office for permit compliance. These systems include over 95% of the total population served by public supply systems. However, the data submitted to the State Engineer do not include details needed to develop a comprehensive picture of public supply water use. Such details include:

- number of persons served by the system;
- deliveries by categories, i.e. domestic, commercial, industrial, thermoelectric;
- consumptive use amounts; and
- estimation of public uses and losses.

In developing their water use figures, the USGS relied on other data sources or estimations for these types of information. Upon review of the USGS estimates, the Division of Water Planning identified some inconsistencies in the data and modified the estimates as appropriate. Both the original USGS estimates and the Division of Water Planning modifications are presented in the appendix.

1995 Public Supply Water Use. More than 90 percent of Nevada’s population is currently served by about 300 public supply systems. The percentage of the population that is served by public supply systems varies from county to county (Table 1-1).

Table 1-1. Percentage of Population on Public Supply Systems

County	1970	1980	1990
Carson City	86.1	92.2	92.9
Churchill	42.0	48.4	49.1
Clark	94.8	97.1	97.5
Douglas	78.5	81.6	77.1
Elko	80.0	85.2	84.8
Esmeralda	54.2	65.8	68.1
Eureka	60.4	67.3	58.1
Humboldt	71.6	72.0	63.9
Lander	81.5	82.4	77.6
Lincoln	83.7	85.2	77.1
Lyon	58.0	61.4	64.4
Mineral	87.5	90.6	92.5
Nye	72.4	59.0	51.3
Pershing	89.8	72.2	76.7
Storey	99.4	70.9	57.7
Washoe	91.9	93.1	92.5
White Pine	89.8	84.8	75.8
Average	90.7	92.4	92.5

According to the U.S. Census Bureau, about 92.5% of Nevada’s population were served by public supply systems in 1990 with the remaining 7.5% served by domestic wells or other individual water systems. For 1995, the USGS estimated that about 94.2% of the population was supplied by public supply systems.

Table 1-2 provides a summary of public supply water use estimates for 1995 (see appendix for more detailed water information). Public supply systems withdrew approximately 525,000 acre-feet (af) in 1995, which is about 13% of the total statewide water withdrawals. Approximately 37% (196,000 af) of the withdrawals were consumptively used by the various users.

While only about 10% of the public supply systems utilize surface water, over 70% of the people on public supply systems receive surface water as some portion of their drinking water supply. As of 1995, about 75% of public supply system withdrawals were surface water. Most of the surface water use is in the Las Vegas area (Colorado River) and the Reno-Sparks and Lake Tahoe areas (Lake Tahoe/Truckee River system).

Table 1-2. Estimated Public Supply Water Use for 1995

Category	Value
Population	
Population served	1,487,640
Percentage of total population	94.2%
Withdrawals (acre-feet)	
Groundwater	131,958
Surface Water	392,903
Total	524,861
Deliveries & public uses/losses (acre-feet)	
Domestic	342,605
Commercial	129,707
Industrial	2,454
Thermoelectric	1,624
Total deliveries	476,388
Public uses and losses	48,473
Total deliveries and public uses and losses	524,861
Consumptive use (acre-feet)	
	196,444
Water use per person (gallons per person per day)	
Withdrawals per person	315
Domestic deliveries per person	206

Note: Data are estimates only and subject to revision.

Source: U.S. Geological Survey with modifications by Nevada Division of Water Planning

In 1995, public supply systems delivered approximately 65% (343,000 af) to domestic users, 25% (130,000 af) to commercial users, and 1% (4,000 af) to industrial and thermoelectric users. The remaining 9% (48,000 af) was estimated for public uses (firefighting, street washing, etc.) and losses from the distribution system (Figure 1-1).

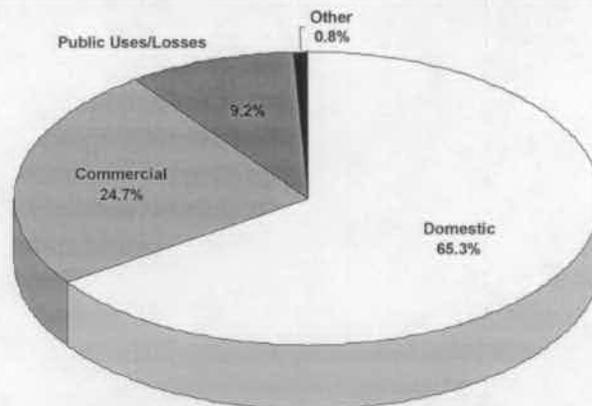
Often public supply water use is presented in terms of gallons per person (capita) per day (gpcd). In 1995, Nevada's public supply systems withdrew an average of about 315 gallons each day for each person on these systems. This factor includes all water used for all purposes such as domestic, commercial, industrial, and thermoelectric, and also includes public uses and system losses. Domestic deliveries accounted for about 65% of all water used within the public supply

systems, resulting in a residential use factor of 206 gpcd (Table 1-2). Per capita water use tends to vary from county to county and region to region. Nevada's average per capita water use is greatly impacted by Clark County usage rates. Public supply water use in Clark County accounts for over 70% of all public supply usage in Nevada.

Per capita public supply water use varies from state to state with higher per person water use in the western United States compared to the eastern states. According to USGS estimates for the period 1970-90, Nevada has typically had one of the highest per capita water use rates in the country. Figure 1-2 presents 1995 per capita water use for each of the western states and the remaining states as a whole.

In 1995, Nevada had the highest per capita water use (315 gpcd) for all public supply uses and the highest per capita use (206 gpcd) for domestic public supply uses.

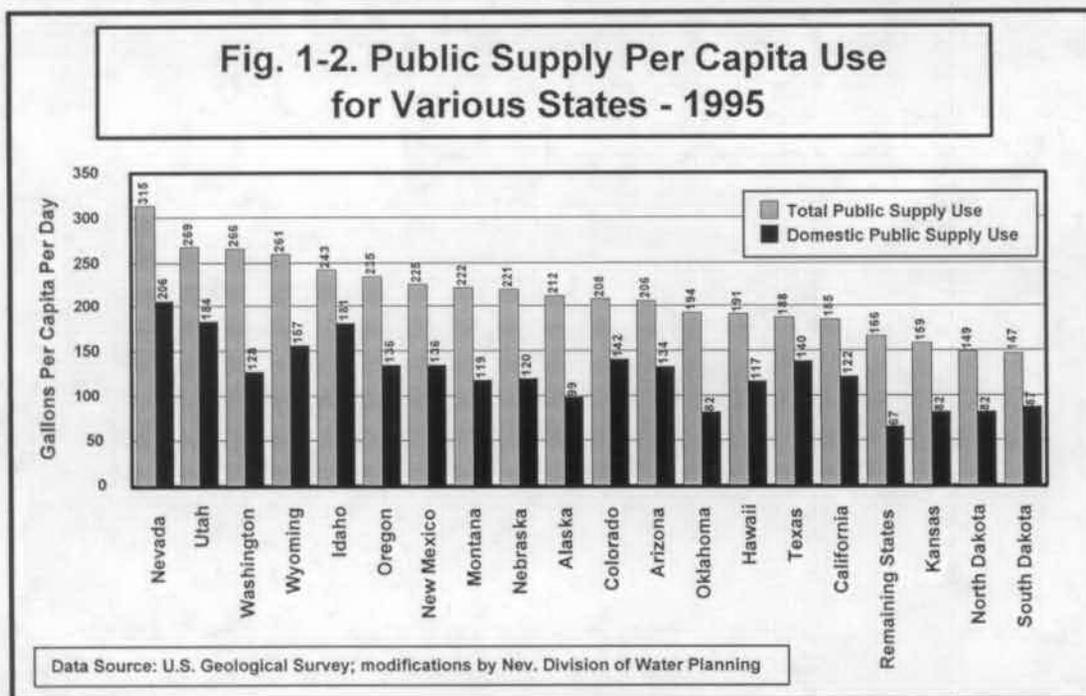
Fig. 1-1. 1995 Public Supply Water Uses by Category



Data Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

There are a few possible explanations for Nevada’s high per capita water use. For instance, about 1/3 of the water withdrawn by Nevada public supply systems is used for landscape watering. As Nevada is the driest state in the U.S., more landscape watering is generally required than in other states thereby increasing our increasing our per capita water usage. Another possible explanation is that the public withdrawal amounts estimated by USGS include water used by hotels and casinos, and other tourism-dependent operations. However only the resident population is included in the per capita estimates. The large number of visitors to Nevada result in higher public supply water use and per capita rates.

Public Supply Water Use Trends. As expected, public supply water use has increased as Nevada’s population has grown. Public supply withdrawals have increased from approximately



151,000 acre-feet to 525,000 acre-feet from 1970 to 1995 (Table 1-3, Figure 1-3). For the same period, the population served by public supply systems increased from about 441,000 to about 1,488,000. From 1970 to 1990, public supply water use rates in Nevada increased from 306 to 334 gallons per capita per day (gpcd). Successful conservation programs during the 1990s have lowered statewide M&I water use down to 315 gpcd by 1995. A majority of this decrease was due to aggressive conservation in the Las Vegas area. For example, M&I use within the Las Vegas Valley Water District decreased from 358 gpcd in 1989 to 320 gpcd in 1997. Detailed county water use data for 1985-95 are included in the appendices.

Table 1-3. Estimated Public Supply Withdrawals and Consumptive Use, 1970-95

Category	1970	1975	1980	1985	1990	1995
Withdrawals (acre-feet)	151,219	192,664	260,993	322,143	431,322	524,861
Consumptive Use (acre-feet)	51,526	58,247	77,290	123,358	153,321	196,444

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Population Served	441,000	545,000	721,000	871,140	1,152,770	1,487,640
% of State Population	90.2%	90.1%	90.1%	91.1%	93.3%	94.2%
Withdrawals Per Person (gpcd)	306	316	323	330	334	315

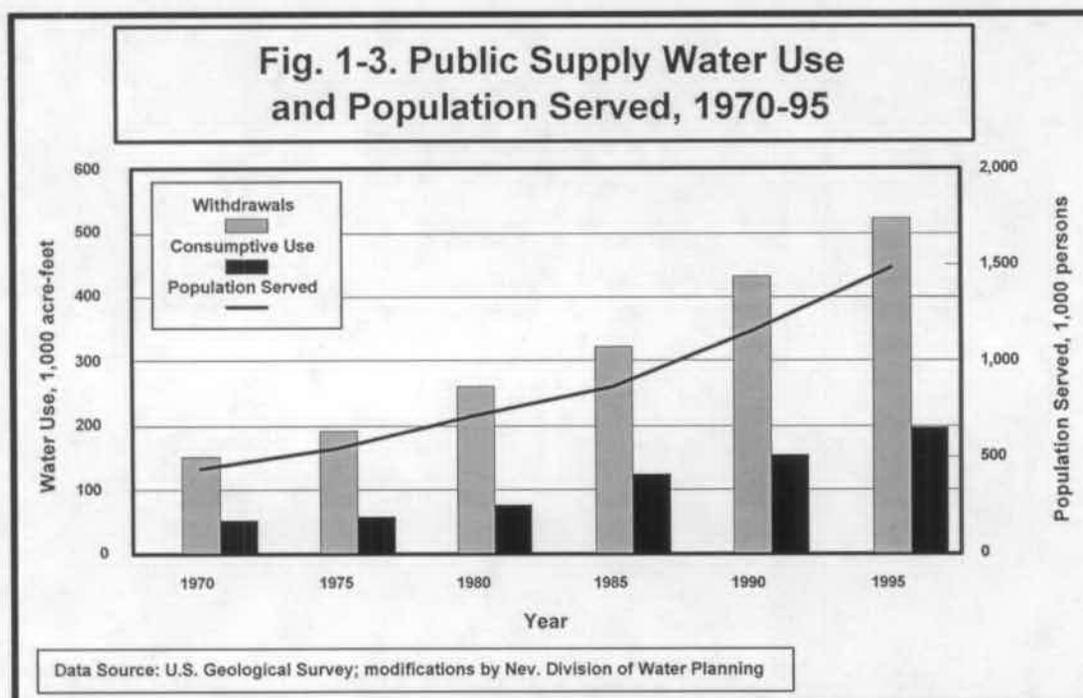
gpcd = gallons per capita (person) per day

Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Note: Data are estimates only and subject to revision

Domestic Water Use

Domestic use refers to water used for household purposes and includes both indoor and outdoor uses, such as drinking, food preparation, bathing, clothes and dish washing, and lawn and garden watering. Domestic water needs are met by either public supply systems or self-supplied systems



(domestic wells, individual pumps, cisterns, etc.).

Background on Data Sources. As described earlier, the major public supply systems submit water withdrawal information to the State Engineer's Office. However, these data are not divided into categories such as domestic, commercial, industrial, and thermoelectric, nor do they include information on the number of persons served. Fortunately, the larger water systems produce planning documents that provide these types of details. The USGS relies primarily on these planning documents and other available reports to analyze the domestic use portion of the total public supply use. For those smaller public supply systems lacking detailed water use reports, the USGS estimates the domestic use portion based upon factors developed for larger systems in the same region. Populations served by public supply systems are estimated based upon the available water planning documents.

Measurements of self-supplied domestic use are limited and, thus estimation is required for most values. As part of the National Water Use Information Program, the USGS estimates self-supplied domestic use by assuming a water use rate of approximately 120 gallons per person per day. A higher value is deemed to be more appropriate. For the *State Water Plan*, self-supplied domestic use for each county is assumed at 90 percent of county public-supplied domestic use. By multiplying these per person water use rates and the number of persons on private domestic systems, total self-supplied domestic water usages are estimated. The number of person on private domestic systems are estimated by subtracting the population served by public systems from total county populations.

1995 Domestic Water Use. Table 1-4 presents a summary of domestic water use estimates for 1995 as developed by the USGS and modified by the Division of Water Planning (see the appendices for more detailed estimates). In 1995, domestic use withdrawals were approximately 361,000 acre-feet with 50% (180,000 acre-feet) of this amount consumed. Domestic water withdrawals accounts for about 9% of the 1995 state total water withdrawals.

In 1995, the domestic water needs of 94.2% of Nevada's population (1,488,000) were met with public supply systems. Self-supplied systems provided domestic water for the other 5.8% (92,000). Over 96% (343,000 acre-feet) of the water needed for domestic purposes was delivered by public supply systems. Domestic self-supplied systems withdrew about 18,000 acre-feet in 1995, with groundwater being the primary source.

Table 1-4. Estimated Domestic Water Use for 1995

	Self-Supplied Domestic	Public-Supplied Domestic	All Domestic Combined
Population served	91,510	1,487,640	1,579,150
% of total population	5.8%	94.2%	100.0%
Withdrawals or deliveries, acre-feet			
Groundwater	17,783	86,303 *	104,086 *
Surface water	321	256,302 *	256,623 *
Total	18,105	342,605	360,710
Consumptive Use, acre-feet	9,022	171,015	180,037
Water use per person (gallons per person per day)	177	206	204

* Estimated by Nevada Division of Water Planning

Source: U.S. Geological Survey with modifications by Nevada Division of Water Planning

Note: Data are estimates only and subject to revision.

Domestic Water Use Trends. Domestic water use has increased over the years in response to the growing population. From 1970 to 1995, domestic water use increased from about 117,000 acre-feet to about 361,000 acre-feet (Table 1-5, Figure 1-4). Nevada's population increased from about 489,000 to about 1,579,000 during the same period, with the percentage of people served by public supply systems increasing from about 90% to 94% of the total population. Refer to the appendices

for detailed county water use data for 1985-95.

Table 1-5. Estimated Domestic Withdrawals and Consumptive Use, 1970-95

Category	1970	1975	1980	1985	1990	1995
Self-Supplied Domestic						
Withdrawals, acre-feet	10,200	13,400	16,500	19,673	16,668	18,105
Consumptive Use, acre-feet	5,100	6,700	8,250	10,092	8,385	9,022
Population Served	47,700 *	60,000 *	79,500 *	84,670	83,360	91,510
% of Total Population	9.8%	9.9%	9.9%	8.9%	6.7%	5.8%
Withdrawals Per Person, gpcd	190 *	200 *	185 *	207	179	177
Public-Supplied Domestic						
Deliveries, acre-feet	106,400 **	134,400 **	168,000 **	211,896	266,906	342,605
Consumptive Use, acre-feet	43,000 *	49,000 *	65,000 *	107,129	133,442	171,015
Population Served	441,000	545,000	721,000	871,140	1,152,770	1,487,640
% of Total Population	90.2%	90.1%	90.1%	91.1%	93.3%	94.2%
Withdrawals Per Person, gpcd	215	220	208	217	207	206
All Domestic Combined						
Withdrawals/deliveries, acre-feet	116,600 **	147,800 **	184,500 **	231,569	283,574	360,710
Consumptive Use, acre-feet	48,100 *	55,700 *	73,250 *	117,221	141,827	180,037
Population Served	488,700 *	605,000 *	800,500 *	955,810	1,236,130	1,579,150
Withdrawals Per Person, gpcd	213 *	218 *	206 *	216	205	204

* Data not available from USGS. Estimated by NDWP.

** Includes public uses & losses.

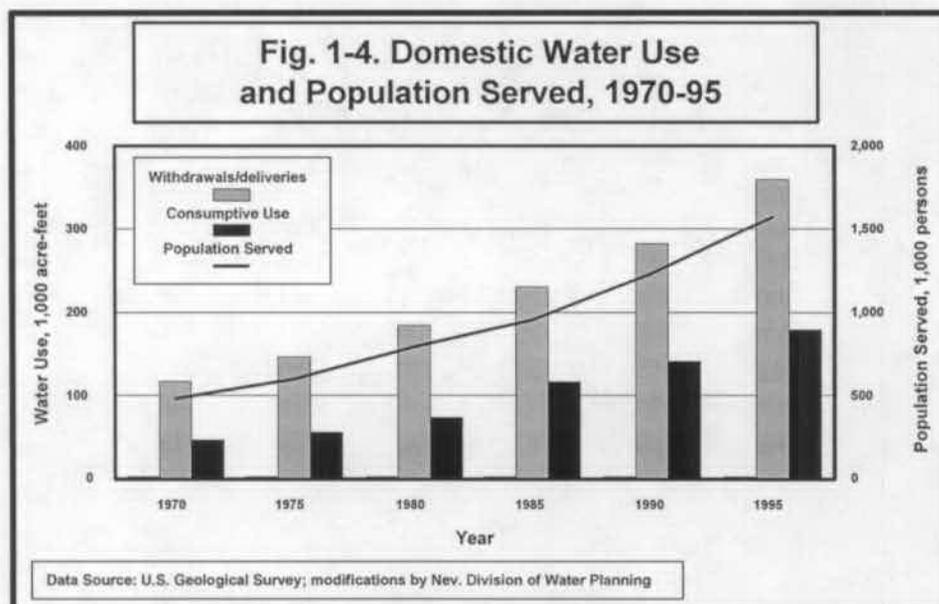
gpcd = gallons per capita (person) per day

Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Note: Data are estimates only and subject to revision.

Commercial Water Use

Commercial use includes water for casinos, motels, restaurants, office buildings, campgrounds, other commercial facilities, and civilian and military institutions. Commercial water needs are met by



either public supply systems (community water systems) or self-supplied systems (non-community systems).

Background on Data Sources. In quantifying a portion of the public-supplied commercial water use, the USGS has relied upon reports produced by the larger public supply systems. For those smaller systems lacking detailed water use reports, the USGS estimated public-supplied commercial water use with factors developed for the larger public supply systems and other factors (such as water use per employee estimates).

There are about 400 self-supplied water systems in Nevada which provide water for casinos, motels, campgrounds and other commercial facilities. In general, the USGS applies various use factors to estimate water use by these systems thereby quantifying self-supplied commercial usage. The USGS also uses available water use information collected by the State Engineer's Office. None of the USGS estimates were modified by the Nevada Division of Water Planning.

1995 Commercial Water Use. Table 1-6 provides a summary of 1995 commercial water use estimates as developed by the USGS (see appendix for more detailed estimates). In 1995, about 153,000 acre-feet was used for commercial purposes, with about 17% (26,000 acre-feet) of these withdrawals being consumed. Commercial water use accounts for 4% of the state total. About 85% (130,000 acre-feet) of the water needed for commercial operations in 1995 was delivered by public supply systems. The remaining 15% (23,000 acre-feet) was provided by self-supplied systems. Surface water was the principal source for self-supplied water furnishing about 66% (16,000 acre-feet) of the self-supplied withdrawals.

Table 1-6. Estimated Commercial Water Use for 1995

	Self-Supplied Commercial	Public-Supplied Commercial	All Commercial Combined
Withdrawals or deliveries, acre-feet			
Groundwater	7,919	32,674 *	40,593 *
Surface water	15,559	97,033 *	112,592 *
Total	23,477	129,707	153,184
Consumptive Use, acre-feet	3,193	23,268	26,461

* Estimated by the Nevada Division of Water Planning

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision.

Commercial Water Use Trends. Commercial water use has increased from about 69,000 acre-feet to about 153,000 acre-feet during the period 1985 to 1995 (Table 1-7). Commercial water use trends cannot be established for previous years. Prior to 1985, the USGS had not provided water use estimates for commercial purposes as a separate category but rather commercial usage was aggregated under other uses. Refer to the appendices for detailed county water use data for 1985-95.

Table 1-7. Estimated Commercial Withdrawals and Consumptive Use, 1985-95

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Category	1985	1990	1995
Self-Supplied Commercial			
Withdrawals (acre-feet)	8,287	25,426	23,477
Consumptive Use (acre-feet)	1,669	3,583	3,193
Public-Supplied Commercial			
Deliveries (acre-feet)	60,340	100,218	129,707
Consumptive Use (acre-feet)	12,096	18,401	23,268
All Commercial Combined			
Withdrawals/deliveries (acre-feet)	68,627	125,644	153,184
Consumptive Use (acre-feet)	13,765	21,984	26,461

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision.

Industrial Water Use

Industrial use includes water for manufacturing and construction. Industrial water needs are met by either public supply systems or self-supplied systems.

Background on Data Sources. To estimate industrial water usage, the USGS utilizes data obtained from water-supply companies, and Nevada Division of Water Resources pumpage records. However, these data generally cover only a portion of the industrial water use. Also, few public supply systems record industrial and commercial use as two separate categories. Due to the lack of data, the USGS estimates much of the industrial usage in Nevada. None of the USGS estimates were modified by the Nevada Division of Water Planning.

1995 Industrial Water Use. Industrial water use estimates for 1995 are shown in Table 1-8 (see the appendices for more detailed estimates). In 1995, approximately 19,000 acre-feet were used for industrial purposes with about 29% (5,000 acre-feet) being consumed. Industrial water withdrawals account for 0.5% of the state total. About 87% (17,000 acre-feet) of the water used for industrial purposes was furnished by self-supplied systems, with the other 13% provided by public supply systems. The self-supplied systems withdrew almost equal amounts of surface water and groundwater during 1995.

Table 1-8. Estimated Industrial Water Use for 1995

	Self-Supplied Industrial	Public-Supplied Industrial	All Industrial Combined
Withdrawals or deliveries, acre-feet			
Groundwater	8,322	618 *	8,940 *
Surface water	8,446	1,836 *	10,282 *
Total	16,768	2,454	19,222
Consumptive Use, acre-feet	4,952	537	5,489

* Estimated by the Nevada Division of Water Planning

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision.

Industrial Water Use Trends. Total industrial water use changed little during the period 1985 to 1995 (Table 1-9). Industrial water use trends cannot be established for previous years. Prior to 1985, the USGS did not separate out water use estimates for industrial purposes, rather industrial usage was aggregated with other uses. Refer to the appendices for detailed county water use data for 1985-95.

Table 1-9. Estimated Industrial Withdrawals and Consumptive Use, 1985-95

Category	1985	1990	1995
Self-Supplied Industrial			
Withdrawals (acre-feet)	11,369	11,437	16,768
Consumptive Use (acre-feet)	2,139	2,228	4,952
Public-Supplied Industrial			
Deliveries (acre-feet)	7,057	2,946	2,454
Consumptive Use (acre-feet)	1,411	582	537
All Industrial Combined			
Withdrawals/deliveries (acre-feet)	18,426	14,383	19,222
Consumptive Use (acre-feet)	3,550	2,810	5,489

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision.

Thermoelectric Water Use

Thermoelectric use includes water used in the production of electric power generation from fossil fuel and geothermal sources. Nevada has 22 thermoelectric powerplants, seven of which are fossil fueled and 15 are geothermal.

Background on Data Sources. Thermoelectric water use data, as compiled by the USGS, were obtained directly from the power plants, State Engineer's records and/or estimated. No modifications were performed by the Nevada Division of Water Planning.

1995 Thermoelectric Water Use. Thermoelectric water use estimates for 1995 are shown in

Table 1-10 (see the appendices for detailed county estimates). In 1995 approximately 65,000 acre-feet were used for thermoelectric power generation with about 63% (41,000 acre-feet) being consumed. Thermoelectric water withdrawals accounts for 2% of the state total. The USGS estimated that Nevada's thermoelectric plants generated about 19 billion kilowatt-hours in 1995.

Table 1-10. Estimated Thermoelectric Water Use for 1995

	Self-Supplied Thermoelectric	Public-Supplied Thermoelectric	All Thermoelectric Combined
Withdrawals or deliveries, acre-feet			
Groundwater	40,650	409 *	41,059 *
Surface water	23,176	1,215 *	24,391 *
Total	63,825	1,624	65,449
Consumptive Use, acre-feet	39,429	1,624	41,053

* Estimated by the Nevada Division of Water Planning

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision.

Over 97% (about 64,000 acre-feet) of the water needed for thermoelectric operations in 1995 was furnished by self-supplied systems. The remaining 2,000 acre-feet was provided by public supply water systems. Groundwater was the primary source for self-supplied water furnishing about 64% (41,000 acre-feet) of the self-supplied withdrawals.

Thermoelectric Water Use Trends. Total thermoelectric water withdrawals have more than doubled from 1985 to 1995 increasing from about 29,000 acre-feet to 65,000 acre-feet (Table 1-11). Over the 10 year period, public supply systems provided a minor portion of the total thermoelectric water used. Usage trends cannot be presented for previous years. Prior to 1985, the USGS did not compile water use estimates for all thermoelectric purposes as a separate category.

Table 1-11. Estimated Thermoelectric Withdrawals and Consumptive Use, 1985-95

Category	1985	1990	1995
Self-Supplied Thermoelectric			
Withdrawals (acre-feet)	26,278	74,019	63,825
Consumptive Use (acre-feet)	23,668	49,298	39,429
Public-Supplied Thermoelectric			
Deliveries (acre-feet)	2,722	896	1,624
Consumptive Use (acre-feet)	2,744	896	1,624
All Thermoelectric Combined			
Withdrawals/deliveries (acre-feet)	29,022	74,915	65,449
Consumptive Use (acre-feet)	26,390	50,194	41,053

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision.

Mining Water Use

Mining use refers to water used in the extraction, milling, and processing of naturally occurring minerals (including petroleum), and other activities that are part of mining, such as dust control. Minerals mined in Nevada can be divided into two categories: metals and industrial minerals. Metals mined in Nevada include gold, silver, lead, zinc, molybdenum and copper. Mined industrial minerals include aggregate, barite, clay, gypsum, lime, diatomite, lithium carbonate, magnesite and silica. Water use varies widely from operation to operation and is dependent upon the mineral being recovered and the recovery process employed.

Background on Data Sources. In developing mining water use estimates for Nevada, the USGS relies upon pumpage data available from the Nevada Division of Water Resources and prepares estimates where data gaps exist. Prior to 1985, the USGS did not have a separate estimate for mining water use.

Many mines operate dewatering systems to maintain dry conditions as ore and other materials are removed. Under the USGS National Water Use Information Program, any water removed for mine dewatering that is not consumptively used in the mine operations is not included in the withdrawal figures. However in Nevada, mine dewatering represents a significant share of total water withdrawals and may impact the amount of water available for other uses. Therefore, mine dewatering needs to be considered in any planning effort. For this reason, the Division of Water Planning modified the USGS water use estimates to include all dewatering withdrawals. Utilizing the State Engineer's pumpage records for 1990 and 1995, the Division calculated the nonconsumptive use portion of the withdrawals. The mine dewatering figures include water that is reinjected into the groundwater, utilized for another use such as irrigation, or discharged. The nonconsumptive use dewatering values were added to the USGS consumptive use figures to arrive at total mining water withdrawals. Adjustments were not made to the USGS estimates for 1985 as no pumpage data are available from the State Engineer's Office for that year.

1995 Mining Water Use. Mining water use estimates for 1995 are shown on Table 1-12 (see the appendices for more detailed estimates). Of the estimated 274,000 acre-feet per year withdrawn in 1995, approximately 89,000 acre-feet per year (about 32%) was consumptively used by mining operations. The remaining 68% (185,000) was reinjected, infiltrated, evaporated, discharged to surface water bodies, or used for irrigation purposes. In some areas, mine dewatering discharges are being used for irrigation as a substitute for pumped water from irrigation wells. In these instances, the irrigation operation is temporarily using the mine dewatering discharge rather than pumping its own permitted groundwater wells.

Mine water withdrawals accounted for about 7% of the total state water withdrawals. A majority of statewide mine water withdrawals occur in the Humboldt River basin. In 1995, mine water withdrawals in the Humboldt River basin accounted for about 70% of the state total mine water withdrawals.

Table 1-12. Estimated Mining Water Use for 1995

Use Category	Use, acre-feet
Withdrawals	
Groundwater	270,524
Surface water	3,909
Total	274,433
Consumptive Use	89,163
Nonconsumptive Use	185,270

Source: U.S. Geological Survey with modifications by Nev. Division of Water Planning

Note: Data are estimates only and subject to revision.

Mining Water Use Trends. Mining water use has changed significantly since 1985. According to Table 1-13, total mining withdrawals have increased by a factor of 10 from 1985 to 1995 with consumptive uses increasing by a factor of 4. A majority of this increase is attributable to an increase in mining activities within the Humboldt River basin. Mining water use trends cannot be established for previous years. Prior to 1985, the USGS did not compile water use estimates for mining as a separate category. Refer to the appendix for detailed county water use data for 1985-95.

Table 1-13. Estimated Mining Withdrawals and Consumptive Use, 1985-95

Category	1985	1990	1995
Withdrawals (acre-feet)	27,309	120,124	274,433
Consumptive Use (acre-feet)	22,469	67,858	89,163
Nonconsumptive Use (acre-feet)	4,840	52,266	185,270

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Data are estimates only and subject to revision.

Irrigation Water Use

Irrigation use, as classified by the USGS for the National Water Use Information Program, refers to water withdrawn and applied to lands to grow crops and pasture as well as self-supplied water used to irrigate golf courses and parks. Under this category, water for irrigation is self-supplied or supplied by irrigation companies or districts. The amount of self-supplied water used for golf course and park irrigation is minor compared to the agricultural irrigation use and could not be presented as a separate category due to data limitations. Landscape watering from a public supply water system is not included in the *irrigation use* category, but rather in the public supply category. The main field crops grown in Nevada include alfalfa and other hay, alfalfa seed, winter and spring wheat, potatoes, garlic and onions. These crops account for about 70% of the total irrigated acreage. In addition to harvested field crops, about 30% of the irrigated acreage in Nevada is pasture.

Background on Data Sources. Although irrigation is the largest use of water in Nevada, only limited irrigation measurements are available. The measured data that do exist must be obtained from a variety of sources which sometimes contain conflicting information.

For those areas of Nevada lacking measured water use data, the USGS typically estimates irrigation water use as follows:

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- compile estimates of irrigated land by crop type and irrigation method (flood, sprinkler);

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- develop consumptive use factors (acre-feet used per acre) and irrigation efficiency coefficients (ranging from 0.0 [least efficient] to 1.0 [most efficient]); and
- develop consumptive use and withdrawal estimates by applying the above factors to the irrigated acreage values.

The USGS staff has used a variety of data sources to develop irrigation water use estimates. Irrigated acreage estimates were generally derived from Nevada Division of Water Resources crop and pumpage inventories, data obtained from irrigation districts, other USGS project reports, some satellite imagery, the *Census of Agriculture* developed by the U.S. Census Bureau every 4 to 5 years, (however periods do not necessarily coincide with the USGS estimates), and the *Nevada Agricultural Statistics* published annually by the Nevada Agricultural Statistics Service (reports harvested crops only which accounts for about 70% of irrigated land). Consumptive use rates for different areas of the State and various crops were obtained from the U.S. Natural Resources Conservation Service; and irrigation efficiency factors were developed from available information and literature. The following general equations were utilized by the USGS to estimate consumptive use and withdrawals:

consumptive use (acre-feet) = irrigated acreage (acres) x consumptive use factor (acre-feet/acre)

withdrawals (acre-feet) = consumptive use (acre-feet) / irrigation efficiency coefficient

With the exception of the 1995 data, the USGS irrigation water use estimates for the previous years were utilized for the *State Water Plan*. The original 1995 data showed a significant drop in irrigated acreage and water use from 1985/90 to 1995 which was not consistent with data presented in the *Nevada Agricultural Statistics* reports. Therefore, the Division of Water Planning modified the 1995 estimates for inclusion in the *Plan*.

According to the USGS, the 1995 acreage estimates were based upon the 1992 U.S. Agriculture Census which indicated a sharp decline in irrigated land as a result of the drought. Also, the consumptive use factors utilized for the 1995 estimates were generally lower than those used for the previous 1985/90 estimates. For the *State Water Plan*, the Division of Water Planning developed new 1995 irrigated acreage estimates based upon *Nevada Agricultural Statistics* data. As the *Nevada Agricultural Statistics* reports only harvested hay acreages by county (which accounts for only about 70% of the total irrigated acreage), these data were adjusted as needed to include all irrigated lands. Consumptive use and withdrawal amounts were then developed by utilizing use consumptive use factors and efficiency coefficients more consistent with the 1985 and 1990 estimates. A detailed explanation of this methodology is presented in the appendix.

Irrigation water use in Nevada can be extremely variable from year to year in response to water availability. During periods of drought, irrigated acreage and water use typically decline or groundwater use may increase to augment reduced surface supplies. It must be emphasized that the USGS water use estimates are developed only every 5 years and as such these estimates do not accurately reflect the annual variations in irrigation water use.

1995 Irrigation Water Use. Table 1-14 provides a summary of 1995 irrigation water use estimates (see appendix for more detailed estimates). In 1995 about 3.1 million acre-feet were withdrawn for irrigation purposes, of which about 1.6 million acre-feet were consumed. Irrigation water withdrawals accounted for 77% of the 1995 total state withdrawals.

Table 1-14. Estimated Irrigation Water Use for 1995

Category	Value
Withdrawals, acre-feet	
Groundwater	1,138,184
Surface water	1,975,401
Total	3,113,585
Consumptive use, acre-feet	1,612,079
Irrigated Land, acres	
Sprinkler	175,284
Flood	540,156
Total	715,440

Source: U.S. Geological Survey with modifications by Nevada Division of Water Planning

Note: Data are estimates only and subject to revision.

It is estimated that about 63% of the total water withdrawn in 1995 was diverted from surface water sources with the remaining 37% produced from groundwater sources. Flood irrigation was used for about 75% of the approximate 715,000 acres irrigated, with sprinklers used for the other 25%. The average amount of water withdrawn for irrigation was about 4.4 acre-feet per irrigated acre (which includes conveyance losses). Consumptive use averages about 1/2 that amount, or 2.3 acre-feet per irrigated acre.

Irrigation Water Use Trends. USGS estimates (with 1995 Division of Water Planning modifications) show that irrigated acreage and water use decreased during the period 1970 to 1995 (Table 1-15, Figure 1-5). Due to the uncertainty with the data, it is unknown if this decrease is indicative of any statewide trend or is merely an artifact of the estimation process.

Table 1-15. Estimated Irrigation Withdrawals and Consumptive Use, 1970-95

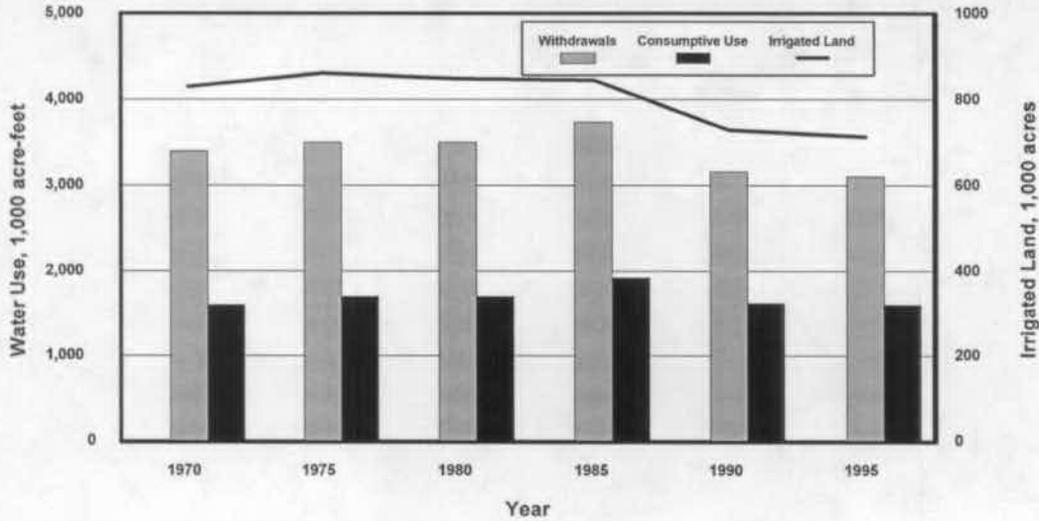
Category	1970	1975	1980	1985	1990	1995
Withdrawals (acre-feet)	3,400,000	3,500,000	3,500,000	3,750,000	3,161,000	3,114,000
Consumptive Use (acre-feet)	1,600,000	1,700,000	1,700,000	1,934,000	1,634,000	1,613,000
Irrigated Land (acres)	830,000	860,000	850,000	844,000	729,000	715,000

Source: U.S. Geological Survey; 1995 USGS estimates modified by Nevada Division of Water Planning

Note: Data are estimates only and subject to revision.

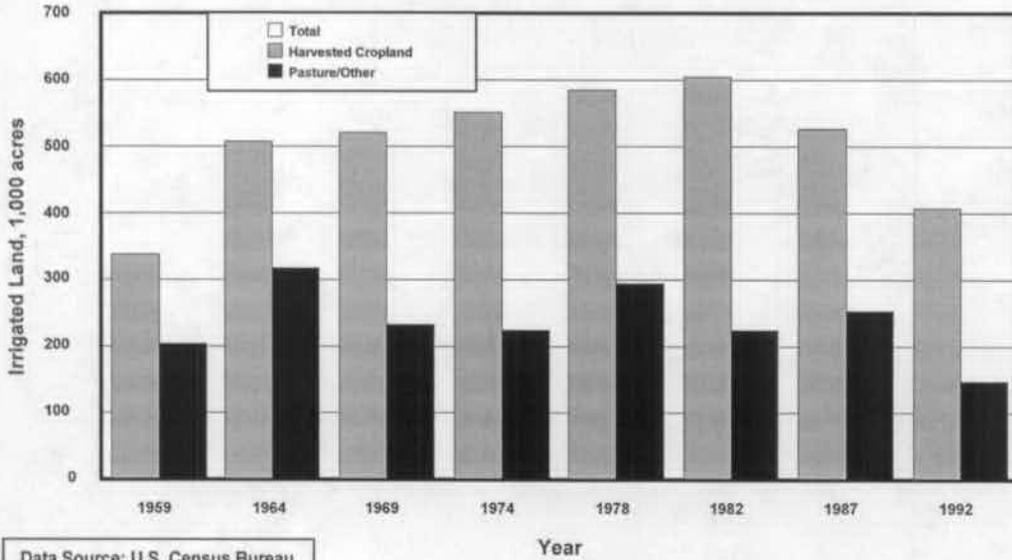
Other data sources for the amount of historically irrigated lands include the U.S. Census and the *Nevada Agricultural Statistics*. U.S. Census data show that irrigated acreage fluctuated during the period 1959 to 1992 (Figure 1-6) varying from lows of about 550,000 acres in 1959 and 1992 (both dry years) to a high of 881,000 acres in 1978. Data published in *Nevada Agricultural Statistics* reports indicates that the amount of harvested cropland has fluctuated widely during the 1960 to 1995 period (Figure 1-7). The amount of harvested cropland peaked at just over 600,000 acres during the early 1980s. According to the U.S. Census data, harvested cropland accounts for about 70% of the total irrigated land in Nevada.

Fig. 1-5. Irrigation Water Use and Irrigated Land, 1970-95

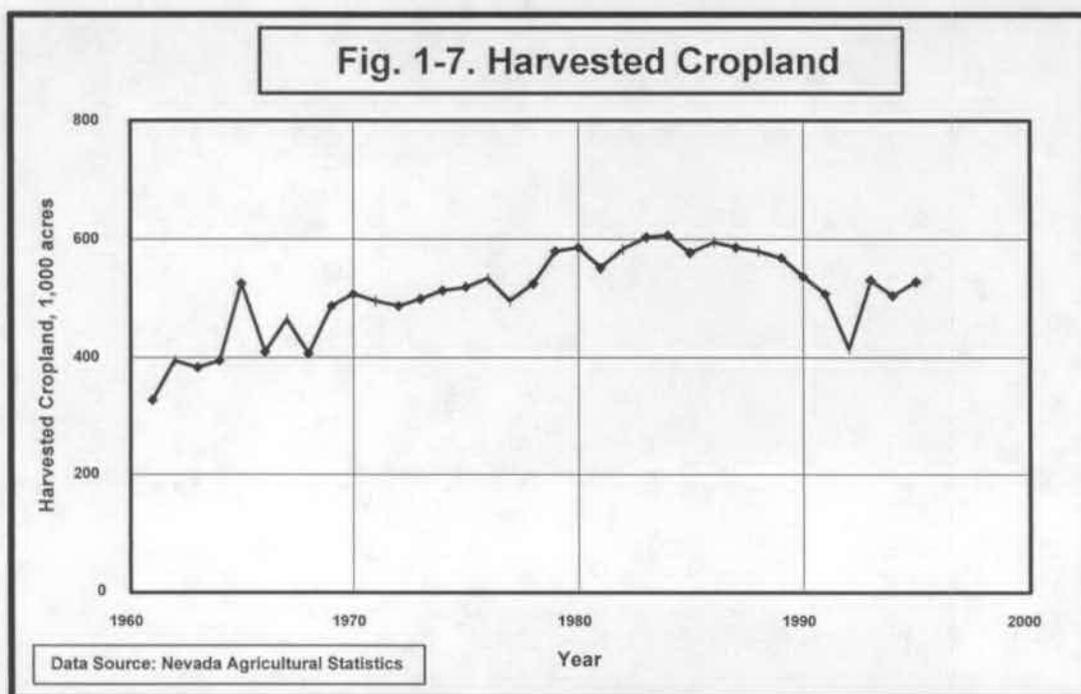


Data Source: U.S. Geological Survey; modifications by Nev. Division of Water Planning

Fig. 1-6. Irrigated Land



Data Source: U.S. Census Bureau



Livestock Water Use

Livestock use refers to water used for stock watering, feed lots, dairy operations, and other on-farm needs. Cattle are the major livestock raised in Nevada with most grazed on open range. Other livestock include sheep, horses and hogs.

Background on Data Sources. Several sources are used by the USGS in deriving livestock water use estimates. Livestock population estimates are compiled from a number of agencies such as the Nevada Department of Agriculture, U.S. Bureau of Census, and U.S. Bureau of Land Management. Assumed water use rates per animal are applied to the population counts to estimate water use. None of the USGS estimates were modified by the Division of Water Planning.

Table 1-16. Estimated Livestock Water Use for 1995

Category	Value
Withdrawals, acre-feet	
Groundwater	1,119
Surface water	5,210
Total	6,329
Consumptive Use, acre-feet	2,319

Source: U.S. Geological Survey

Note: Data are estimates only and subject to revision

1995 Livestock Water Use. Table 1-16 provides a summary of 1995 livestock water use estimates (see appendix for more detailed estimates). In 1995 about 6,000 acre-feet was withdrawn for livestock purposes, of which about 2,000 acre-feet was consumed. About 80% of the total water withdrawn in 1995 was diverted from surface water sources. Livestock water withdrawals accounted for about 0.2% of the 1995 total state use.

Livestock Water Use Trends. U S G S estimates for 1970-95 shows wide fluctuations in

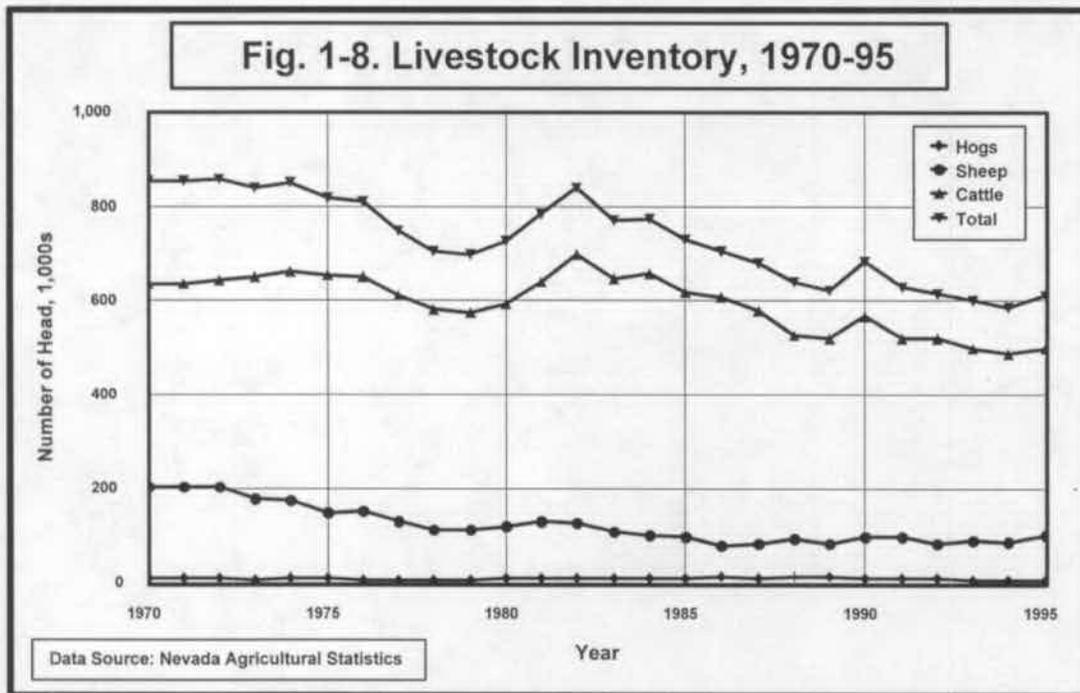
statewide livestock water use (Table 1-17). The variations in the data may be the result of inconsistent estimation techniques from year to year. As a result, these data may not be suitable as a basis for evaluating past water use trends. The *Nevada Agricultural Statistics* reports are an alternative data source for examining livestock trends. According to the *Nevada Agricultural Statistics*, during the 1970 to 1995 period there was a general decline in the number of head of cattle, sheep and hogs from about 850,000 to about 600,000 (Figure 1-8).

Table 1-17. Estimated Livestock Withdrawals and Consumptive Use, 1970-95

Category	1970	1975	1980	1985	1990	1995
Withdrawals (acre-feet)	4,900	13,400	13,400	29,100	6,300	6,300
Consumptive Use (acre-feet)	2,400	9,900	10,000	7,400	2,300	2,300

Source: U.S. Geological Survey

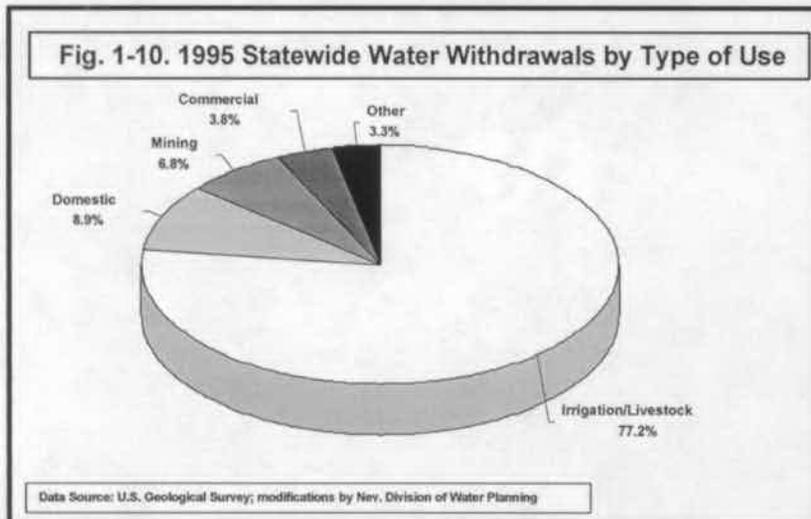
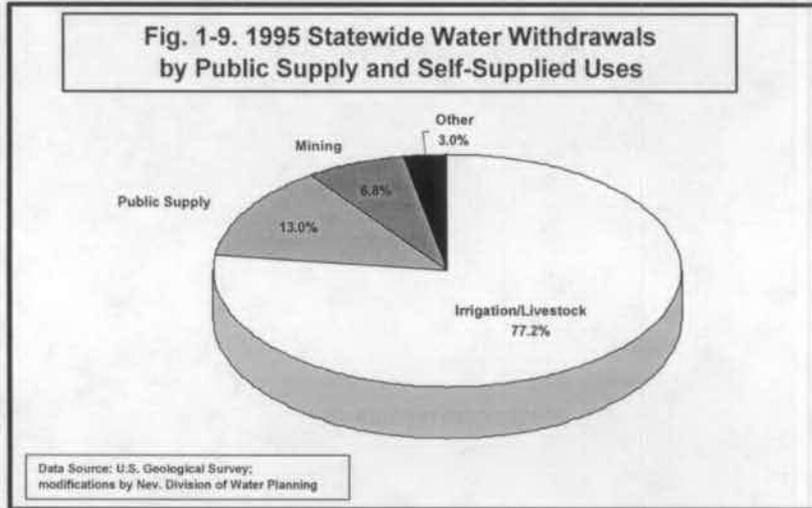
Note: Data are estimates only and subject to revision



Water Use Summary

Statewide water use for the period 1970 to 1995 is summarized in two different forms in the following tables and figures. Tables 1-18 and 1-19, and Figure 1-9 presents water use divided into two major categories - public supply uses and self-supplied uses. Table 1-20 and 1-21, and Figure 1-10 provides a water use breakdown by type of use regardless of water supplier.

Over the last 20 years, statewide water withdrawals in Nevada have been about 4 million acre-feet per year, with a little under 2 million acre-feet consumptively used. In 1995, about 60 percent of the withdrawals were from surface water sources. Irrigation has historically been the largest water use in Nevada varying from about 80 percent to 90 percent of the total statewide water withdrawals and



consumptive use. In 1995, irrigation use accounted for about 77 percent of the total state withdrawals. Variations in irrigation water use are primarily the result of Nevada’s variable weather and streamflow conditions.

Overall, the total statewide water use has changed little since 1970, however, there have been some significant changes within certain use sectors. The most

significant changes have occurred with “Public Supply” and “Mining” water uses. Public supply water use has more than tripled since 1970 in response to Nevada’s ever increasing population. Mining water use has experienced a significant increase since 1985 mostly as a result of increased mining activity in the Humboldt River basin.

Table 1-18. Summary of Estimated Statewide Water Use (1970-95) Grouped by Public Supply and Self-Supplied Uses (in acre-feet)

Water Use Category		1970	1975	1980	1985	1990	1995
Public Supply							
Domestic	Withdrawals	106,400	134,400	168,000	211,900	266,900	342,600
	Consumptive Use	43,000	49,000	65,000	107,100	133,400	171,000
Commercial ¹	Withdrawals				60,300	100,200	129,700
	Consumptive Use				12,100	18,400	23,300
Industrial ¹	Withdrawals	44,800	58,300	93,000	7,100	2,900	2,500
	Consumptive Use	8,500	9,200	12,300	1,400	600	500
Thermoelectric ¹	Withdrawals				2,700	900	1,600
	Consumptive Use				2,700	900	1,600
Public Uses and Losses ¹	Withdrawals	Included in "Public Supply - Domestic" Category			40,100	60,400	48,500
	Consumptive Use				0	0	0
Total Public Supply	Withdrawals	151,200	192,700	261,000	322,100	431,300	524,900
	Consumptive Use	51,500	58,200	77,300	123,400	153,300	196,400
Self-Supplied							
Domestic	Withdrawals	10,200	13,400	16,500	19,700	16,700	18,100
	Consumptive Use	5,100	6,700	8,300	10,100	8,400	9,000
Commercial ¹	Withdrawals				8,300	25,400	23,500
	Consumptive Use				1,700	3,600	3,200
Industrial ¹	Withdrawals				11,400	11,400	16,800
	Consumptive Use	150,000	260,000	270,000	2,100	2,200	5,000
Thermoelectric ¹	Withdrawals	55,000	80,000	95,000	26,300	74,000	63,800
	Consumptive Use				23,700	49,300	39,400
Mining ¹	Withdrawals				27,300	120,100	274,400
	Consumptive Use				22,500	67,900	89,200
Irrigation	Withdrawals	3,400,000	3,500,000	3,500,000	3,750,000	3,160,700	3,113,600
	Consumptive Use	1,600,000	1,700,000	1,700,000	1,934,000	1,633,800	1,612,100
Livestock	Withdrawals	4,900	13,400	13,400	29,100	6,300	6,300
	Consumptive Use	2,400	9,900	10,000	7,400	2,300	2,300
Total							
	Withdrawals	3,716,300	3,979,500	4,060,900	4,194,100	3,846,000	4,041,400
	Consumptive Use	1,714,000	1,854,800	1,890,600	2,124,800	1,920,800	1,956,600

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

¹ Individual estimates were not available for 1970-80

Table 1-19. Estimated 1995 Statewide Groundwater and Surface Water Withdrawals for Public Supply and Self-Supplied Uses (in acre-feet)

Category	Source	Amount
Public Supply		
Total Public Supply	Groundwater	132,000
	Surface water	392,900
	Total	524,900
Self-Supplied		
Domestic	Groundwater	17,800
	Surface water	300
	Total	18,100
Commercial	Groundwater	7,900
	Surface water	15,600
	Total	23,500
Industrial	Groundwater	8,300
	Surface water	8,400
	Total	16,700
Thermoelectric	Groundwater	40,700
	Surface water	23,200
	Total	63,900
Mining	Groundwater	270,500
	Surface water	3,900
	Total	274,400
Irrigation	Groundwater	1,138,200
	Surface water	1,975,400
	Total	3,113,600
Livestock	Groundwater	1,100
	Surface water	5,200
	Total	6,300
Total		
Statewide Total	Groundwater	1,616,500
	Surface water	2,424,900
	Total	4,041,400

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

Nevada State Water Plan

Table 1-20. Summary of Estimated Statewide Water Use (1970-95) Grouped by Type of Use (in acre-feet)

Water Use Category		1970	1975	1980	1985	1990	1995
Domestic (self-supplied & public supplied)	Withdrawals	116,600	147,800	184,500	231,600	283,600	360,700
	Consumptive Use	48,100	55,700	73,300	117,200	141,800	180,000
Commercial ¹ (self-supplied & public supplied)	Withdrawals				68,600	125,600	153,200
	Consumptive Use				13,800	22,000	26,500
Industrial ¹ (self-supplied & public supplied)	Withdrawals				18,400	14,400	19,200
	Consumptive Use	194,800	318,300	363,000	3,600	2,800	5,500
Thermoelectric ¹ (self-supplied & public supplied)	Withdrawals	63,500	89,200	107,300	29,000	74,900	65,400
	Consumptive Use				26,400	50,200	41,100
Mining ¹	Withdrawals				27,300	120,100	274,400
	Consumptive Use				22,500	67,900	89,200
Irrigation	Withdrawals	3,400,000	3,500,000	3,500,000	3,750,000	3,160,700	3,113,600
	Consumptive Use	1,600,000	1,700,000	1,700,000	1,934,000	1,633,800	1,612,100
Livestock	Withdrawals	4,900	13,400	13,400	29,100	6,300	6,300
	Consumptive Use	2,400	9,900	10,000	7,400	2,300	2,300
Public Supply - Public Uses and Losses	Withdrawals	Included in "Domestic" Category			40,100	60,400	48,500
	Consumptive Use				0	0	0
Total	Withdrawals	3,716,300	3,979,500	4,060,900	4,194,100	3,846,000	4,041,400
	Consumptive Use	1,714,000	1,854,800	1,890,600	2,124,800	1,920,800	1,956,600

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

¹ Individual estimates were not available for 1970-80.

Table 1-21. Estimated 1995 Statewide Groundwater and Surface Water Withdrawals for Use Types

Category	Source	Amount
Domestic (self-supplied & public supplied)	Groundwater	104,100
	Surface water	256,700
	Total	360,800
Commercial (self-supplied & public supplied)	Groundwater	40,600
	Surface water	112,600
	Total	153,200
Industrial (self-supplied & public supplied)	Groundwater	8,900
	Surface water	10,300
	Total	19,200
Thermoelectric (self-supplied & public supplied)	Groundwater	41,100
	Surface water	24,400
	Total	65,500
Mining	Groundwater	270,500
	Surface water	3,900
	Total	274,400
Irrigation	Groundwater	1,138,200
	Surface water	1,975,400
	Total	3,113,600
Livestock	Groundwater	1,100
	Surface water	5,200
	Total	6,300
Public Supply - Public Uses and Losses	Groundwater	12,200
	Surface water	36,300
	Total	48,500
Total	Groundwater	1,616,700
	Surface water	2,424,800
	Total	4,041,500

Source: U.S. Geological Survey; modifications by Nevada Division of Water Planning

Note: Figures may not add to totals because of independent rounding. Data are estimates only and subject to revision.

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Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 2
Socioeconomic Assessment and Forecasts

Introduction

This section of the *Nevada State Water Plan* presents population, demographic and economic conditions and trends for the Nevada economy and provides individual county and statewide population and socioeconomic forecasts. In Part 2, Section 3 of the water plan, these demographic forecasts, particularly as they related to population and employment, are used to predict future water needs over a planning horizon extending through the year 2020. More specifically, population forecasts and their relationship to total employment comprise the foundation of the forecasts for municipal and industrial (M&I), domestic (residential), and commercial and industrial water withdrawals as well as M&I public use and losses.

Population forecasts for each Nevada county and the total state are contained in Appendix 2 of the Appendices of the water plan. Appendix 3 of the Appendices presents the employment forecasts, which are derived from population forecasts, and also contains specific water use coefficients in either gallons per person or per worker per day to forecast each county's M&I, domestic (residential) and commercial and industrial water use. County forecasts for these measures are aggregated for the statewide total. Tables showing individual county population, employment and water withdrawal estimates and projects are contained in this appendix. Other categories of water withdrawals, namely thermoelectric (including geothermal), mining (including both consumptive and non-consumptive uses, such as mine dewatering), irrigation and livestock (total agriculture), are forecast using methods unique to each of these sectors as explained in Part 2, Section 3, Water Use Assessment and Forecasts.

Population and Demographic Trends

Nevada's population is expected to continue to become increasingly concentrated in its primary urban areas of Las Vegas (Clark County), Reno-Sparks (Washoe County) and Carson City. This increasing level of urbanization will have varied spillover effects on neighboring counties, e.g., Nye County for Clark County, and Churchill, Douglas, Lyon, and Storey counties for Washoe County and Carson City. Population forecasts incorporated into this plan for Clark and Washoe counties were provided by the Clark County Department of Comprehensive Planning and the Washoe County Department of Community Development, respectively. The population forecasts for Washoe County were slightly modified by the Nevada Division of Water Planning (NDWP) to smooth the intervening period forecasts, matching Washoe County's population forecast for the year 2020. Other county

population forecasts were developed by the NDWP in conjunction with county inputs and were based on an extension and moderation of recent historical growth trends and the incorporation of estimated industrial development and employment forecasts based on inputs provided by the Nevada Department of Employment, Training and Rehabilitation (DETR).

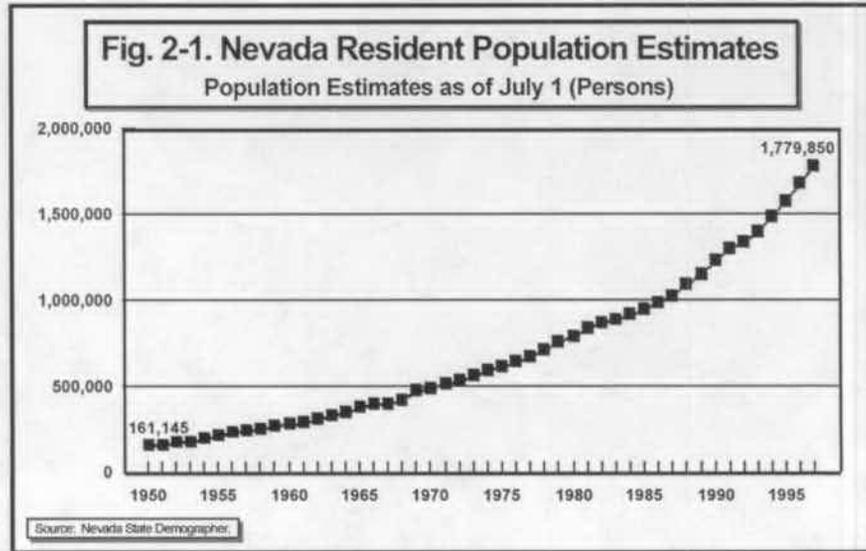


Fig. 2-1. Nevada Population Estimates, and Fig. 2-2. Nevada Population Growth Rates show annual population trends from 1950 through 1997. From Fig. 2-1, one can see the more recent acceleration of growth occurring since 1990 with the arrival of the first mega-resort casino in the Las Vegas gaming market. Table 2-1. Nevada Population Share Analysis — 1950-1997, presents historical and forecasted populations and population shares (in terms of county shares of the state's total population) for Nevada and its seventeen counties at ten-year intervals from 1950 to 1997. This table shows that in 1997, Clark County's total resident population was estimated at 1,192,200 persons and accounted for nearly 67.0 percent of the state's total population. This represented an increase of 36.7 percentage points in Clark County's share of the state's total population since 1950.

Also from Table 2-1, Washoe County's population was estimated at 308,700 persons in 1997, accounting for 17.3 percent of Nevada's total population, a decline of 14.0 percentage points in its share of statewide population since 1950. Carson City's population of 50,410 persons in 1997 comprised 2.8 percent of the state's total population, an increase of just over 0.2 percentage point in its population share since 1950. Together, these three Nevada urban areas accounted for 87.2 percent of the state's total population in 1997. Elko County, representing the other principal population center in Nevada, had an estimated population of 47,710 persons in 1997, accounting for 2.7 percent of the state's population and representing a decline of 4.6 percent points in state population share since 1950.

Table 2-1 also shows that the combined population share of the state's principal urban areas of Clark County, Washoe County and Carson City increased from 64.2 percent in 1950 to 87.2 percent of the state's total population in 1997. This represents an increase of 23.0 percentage points in these area's share of statewide total population from 1950 to 1997. The gain in population share from 1950 to 1997 was due entirely to the rapid growth in Clark County as Carson City showed virtually no change in its population share over the 1950-1997 time period and Washoe County actually lost 14.0 percentage points in its share of the state's total population from 1950 to 1997.

Table 2–1. Nevada Population Share Analysis — 1950–1997
Shares Based on Percent of Total State Population (Persons/Percent of Total State)

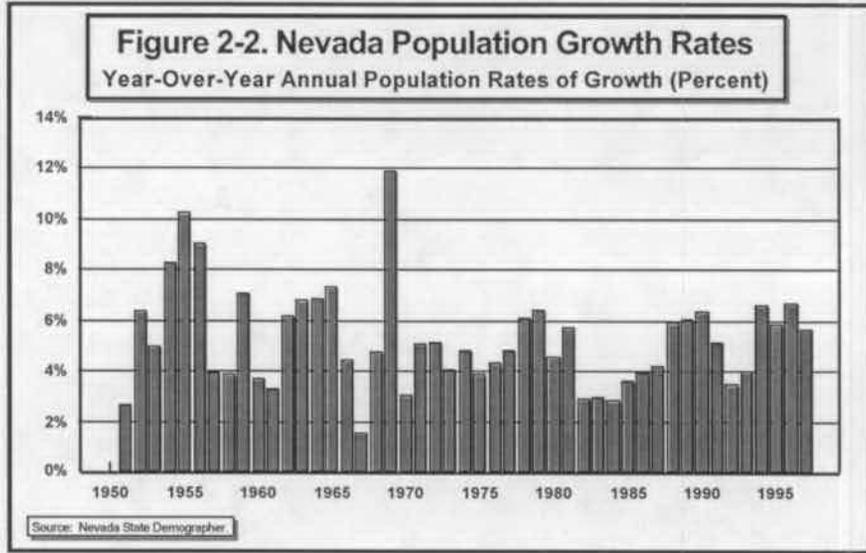
State/County	1950	1960	1970	1980	1990	1997
NEVADA	161,145	287,660	494,990	800,508	1,236,130	1,779,850
Carson City	4,198	8,020	16,054	32,022	40,950	50,410
Statewide Share	2.61%	2.79%	3.24%	4.00%	3.31%	2.83%
Churchill County	6,188	8,505	10,650	13,917	18,100	23,860
Statewide Share	3.84%	2.96%	2.15%	1.74%	1.46%	1.34%
Clark County	48,811	128,734	277,230	463,087	770,280	1,192,200
Statewide Share	30.29%	44.75%	56.01%	57.85%	62.31%	66.98%
Douglas County	2,023	3,575	7,067	19,421	28,070	39,590
Statewide Share	1.26%	1.24%	1.43%	2.43%	2.27%	2.22%
Elko County	11,703	12,051	13,946	17,269	33,770	47,710
Statewide Share	7.26%	4.19%	2.82%	2.16%	2.73%	2.68%
Esmeralda County	611	634	623	777	1,350	1,460
Statewide Share	0.38%	0.22%	0.13%	0.10%	0.11%	0.08%
Eureka County	897	775	938	1,198	1,550	1,660
Statewide Share	0.56%	0.27%	0.19%	0.15%	0.13%	0.09%
Humboldt County	4,870	5,723	6,380	9,449	13,020	17,520
Statewide Share	3.02%	1.99%	1.29%	1.18%	1.05%	0.98%
Lander County	1,860	1,580	2,653	4,076	6,340	7,030
Statewide Share	1.15%	0.55%	0.54%	0.51%	0.51%	0.39%
Lincoln County	3,850	2,378	2,526	3,732	3,810	4,110
Statewide Share	2.39%	0.83%	0.51%	0.47%	0.31%	0.23%
Lyon County	3,703	6,245	8,437	13,594	20,590	30,370
Statewide Share	2.30%	2.17%	1.70%	1.70%	1.67%	1.71%
Mineral County	5,588	6,329	6,961	6,217	6,470	6,860
Statewide Share	3.47%	2.20%	1.41%	0.78%	0.52%	0.39%
Nye County	3,101	4,642	5,459	9,048	18,190	27,610
Statewide Share	1.92%	1.61%	1.10%	1.13%	1.47%	1.55%
Pershing County	3,122	3,178	2,656	3,408	4,550	6,600
Statewide Share	1.94%	1.10%	0.54%	0.43%	0.37%	0.37%
Storey County	657	571	696	1,503	2,560	3,520
Statewide Share	0.41%	0.20%	0.14%	0.19%	0.21%	0.20%
Washoe County	50,484	84,988	122,574	193,623	257,120	308,700
Statewide Share	31.33%	29.54%	24.76%	24.19%	20.80%	17.34%
White Pine County	9,479	9,732	10,140	8,167	9,410	10,640
Statewide Share	5.88%	3.38%	2.05%	1.02%	0.76%	0.60%

Note: County population shares are based on a percentage of the statewide total population.

Source Data: Nevada State Demographer.

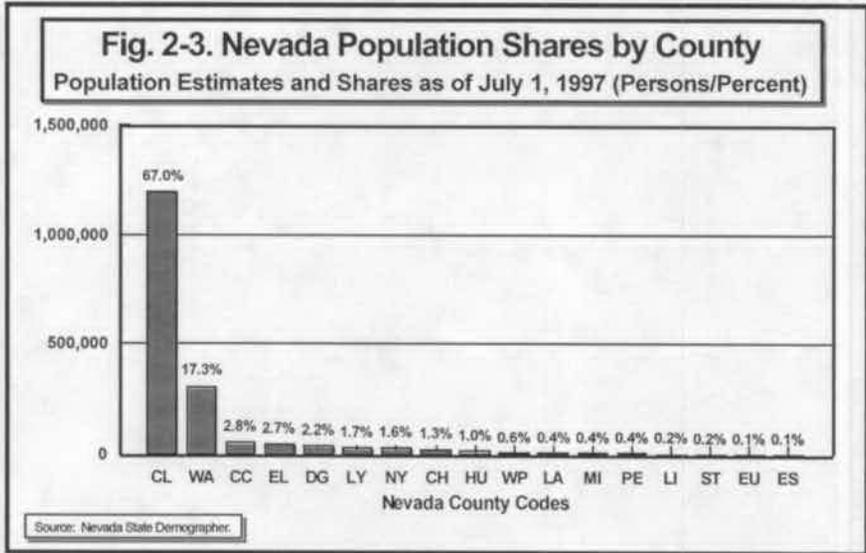
The population share trends presented in Table 2–1 indicate that while virtually every rural county in Nevada (i.e., all counties excluding Clark, Washoe and Carson City), has grown in its total resident population, they have declined in terms of their shares of statewide population between 1950

and 1997. The only exception to this has been Douglas County, where population trends have been strongly influenced by the county's increasing status as a "bedroom" community for neighboring Carson City. Unique population trends exist for other Nevada counties as well. For example, rapid population growth in Elko County has been

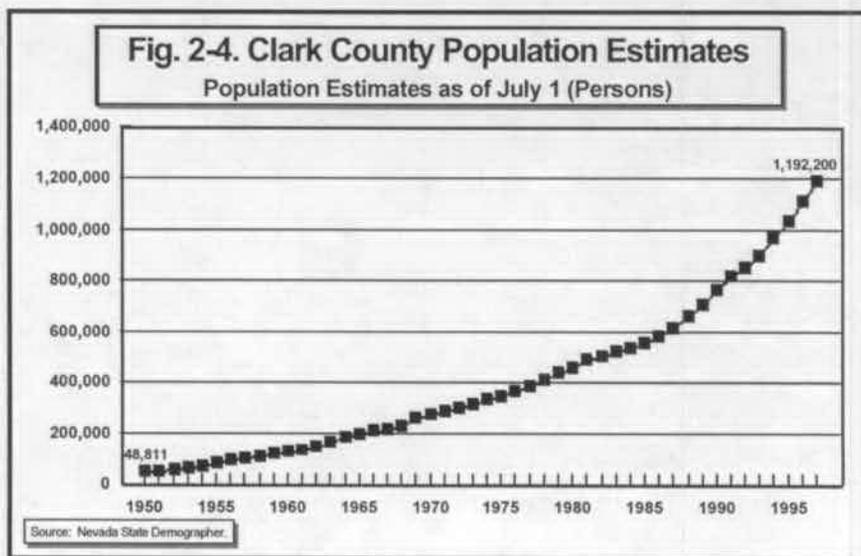


due in large part to trends in the mining industry, especially since the late 1980's. Between 1950 and 1970, Elko County's population grew by only 2,243 persons. However, over the next 27 years its population grew by nearly 30,000 persons. Much of this growth was due to mining, both in Elko County and neighboring Eureka County. Lyon County represents another county where growth in neighboring Carson City, primarily, has affected its population growth. Similarly, recent rapid growth in Nye County has been primarily centered in the southern part of the county at Pahrump, which has been influenced by rapid growth in nearby Las Vegas.

Gaming and Tourism. Casino gaming and tourism in Nevada represent the primary "driving" economic force most affecting the state's overall population trends. While growth in tourism and gaming win (revenues) has more recently slowed in the state's principal northern Nevada casino gaming markets of Reno-Sparks (Washoe County) and South Lake Tahoe (Douglas County), this trend has been more than off-set by high rates of growth in the southern Nevada gaming market of Las Vegas (Clark County), and specifically by trends within the Las Vegas Strip gaming sub-market, which alone accounts for nearly 50 percent of the state's total gaming win. The introduction of the mega-resort complex to the Las Vegas Strip gaming market beginning in late 1989 established a trend of rapid employment growth, population expansion,



and gaming win growth that has characterized this market throughout the 1990's. The mega-resort casino complex, with employment requirements for each new facility frequently exceeding 5,000-6,000 workers (the Bellagio, which opened in late 1998, employs over 9,000 workers), has produced significant impacts on population growth, the expansion of

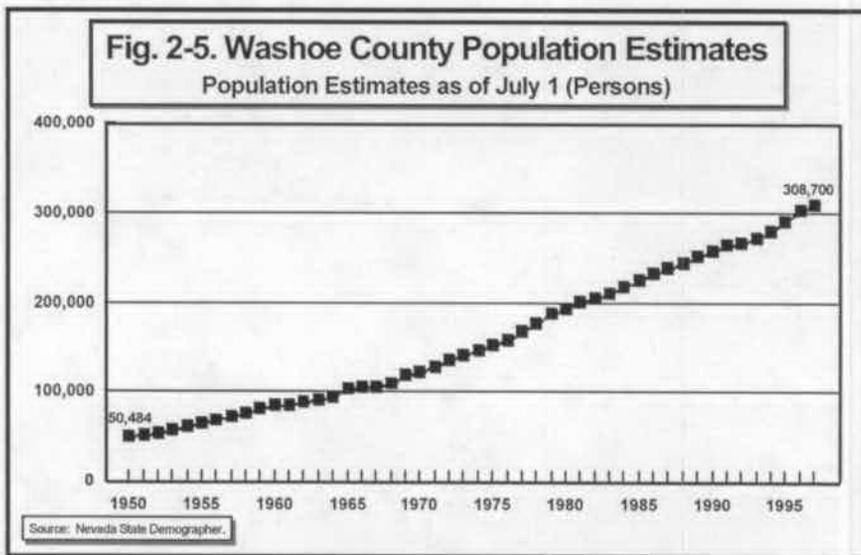


support service businesses, infrastructure requirements, and water demands. Furthermore, new resort complexes opening in this gaming market through 1999 and into 2000 will extend these growth trends into the next century.

Mining. While gaming and tourism have had significant impacts on growth in Clark and Washoe counties, mining has had major influences on many of the rural counties' population and employment growth, demographic trends, and economic development. Since 1989, gold mining in Nevada has made a major contribution to a number of rural counties' economic growth, most especially Elko, Eureka, Humboldt, Lander, Nye, and Pershing counties.

More recently, however, this industry has come under growing economic stress. Beginning in late 1997 and extending into 1999, due primarily to European monetary reform (the creation of the European Monetary Union, or EMU) and Asian economic and financial problems, gold prices realized by Nevada mines have slipped dramatically.

The average price of gold fell from \$387.87 per (troy) ounce in 1996 to \$331.29 per ounce in 1997, and by mid-1998 the price received by Nevada's mining interests was well below \$300 per ounce. By late 1998, gold's price had rebounded somewhat to "around" \$300 an ounce. Some of this price decline has, for the time



being, been mitigated through the mining industry's use of "forward" contracts wherein the mining companies have locked in to committed prices for future gold sales.

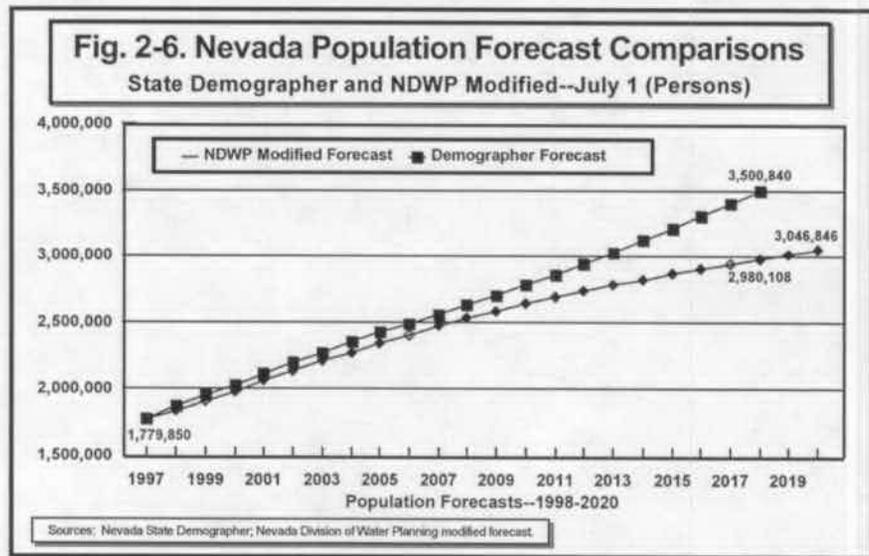
Over the plan's forecast period, international economic and financial conditions are expected to continue to affect the nature and structure of mining operations in Nevada, and, in the process, the demographic and economic growth prospects of the rural, mining-dependent Nevada counties. Long-term conditions within the mining industry are expected to stabilize gold's price at approximately \$280-\$350 per ounce, which has become incorporated into the levels of forecast production for the industry and particularly the amount of economically recoverable reserves.

Nevada Population Analysis and Forecasts

Two separate population forecasts are presented in the water plan. Every year the Nevada State Demographer estimates the current population and, following this, produces a twenty-year population forecast for all counties and the total state. All state agencies are required by the Governor's Executive Order to utilize the population forecasts of the State Demographer in their budgeting and planning activities. Per agreement with the state's population contracting agency, the Nevada Department of Taxation, the NDWP has developed an alternate set of county and state population forecasts based on inputs received from the individual counties, inputs from the Nevada Department of Employment, Training and Rehabilitation (DETR), and from the NDWP's own best estimates.

Overall, the NDWP's statewide population forecast predicts a more moderate population growth than that of the State Demographer. The reason for this is that Nevada's total population is largely influenced by the trends in Clark County's population, which in 1997 accounted for nearly 67 percent of the state's resident population. Based on infrastructure requirements and current resource limitations, local planners in Clark County expect slower growth over the plan's forecast horizon than does the Nevada State Demographer. The water plan incorporates both sets of population forecasts, as shown in Table 2-2.

Nevada Population Forecast Comparisons, to present an anticipated "range of expected growth." However, only the NDWP's forecasts are incorporated into the water plan's future water withdrawal projections. The complete set of population forecasts and related graphical analysis for each county is presented in Appendix 2 of the Appendices. This



appendix also contains the comparative analysis of the two sets of forecasts for all individual counties.

The Nevada State Demographer has forecast a population for Nevada for the year 2018 of 3,500,840 persons, primarily based on the continued virtual exponential growth in Clark County. This forecast represents an overall increase in statewide population of 1,720,990 persons between 1997 and 2018, a near doubling of Nevada’s population over the next 20 years. The State Demographer’s forecast scenario results in an average annual rate of growth of statewide population of 3.3 percent per year for the overall forecast period of 1998 to 2018, with a sub-period average annual rate of growth of 3.6 percent between 1998 and 2008 slowing to 2.9 percent between 2008 and 2018. The State Demographer’s forecasted population for 2018 is approximately 15 percent higher than that of the NDWP.

Table 2–2. Nevada Population Forecast Comparisons
Nevada State Demographer and Nevada Division of Water Planning (NDWP)

Nevada Forecasts by Source	2000	2005	2010	2015	2018	2020
State Demographer						
Resident Population (persons)	2,034,020	2,421,020	2,783,700	3,313,260	3,500,840	n.a.
Nevada Division of Water Planning						
Resident Population (persons)	1,986,257	2,341,374	2,640,306	2,868,979	2,980,108	3,046,846
Difference (persons)	47,763	79,646	143,394	343,281	520,732	–
Percent Difference	2.4%	3.3%	5.2%	10.7%	14.9%	–

Note: The population forecasts of the State Demographer currently extend only through the year 2018. The difference amount represents the difference between the forecasts of the State Demographer and NDWP. NDWP population forecasts for Clark and Washoe counties are based on population forecast inputs from those counties.

Source Data: Nevada State Demographer; Nevada Division of Water Planning (NDWP).

The NDWP forecast scenario, based primarily on slower population growth in Clark County, assumes a more modest 2.5 percent overall annual rate of population growth for Nevada between the years 1998 and 2018, with sub-period average annual rates of 3.2 percent per year for 1998 to 2008 falling to an average annual rate of growth of 1.6 percent for the years 2008 through 2018.

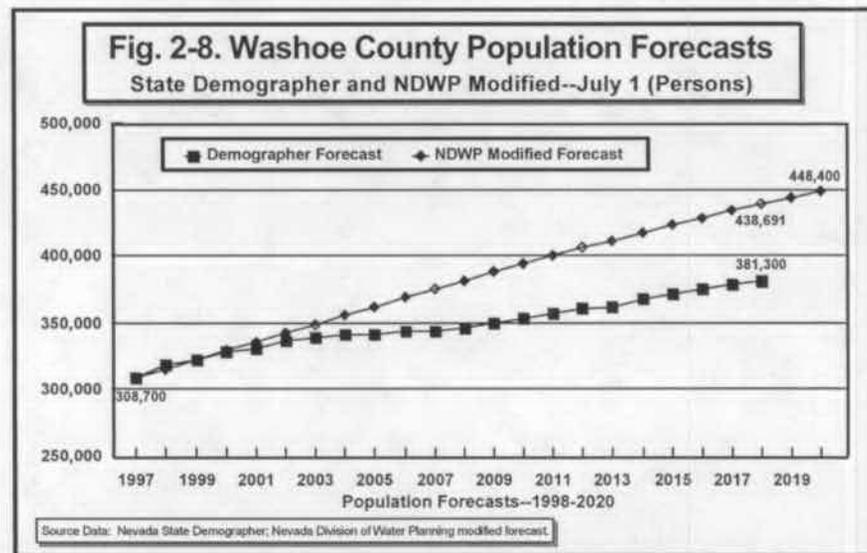
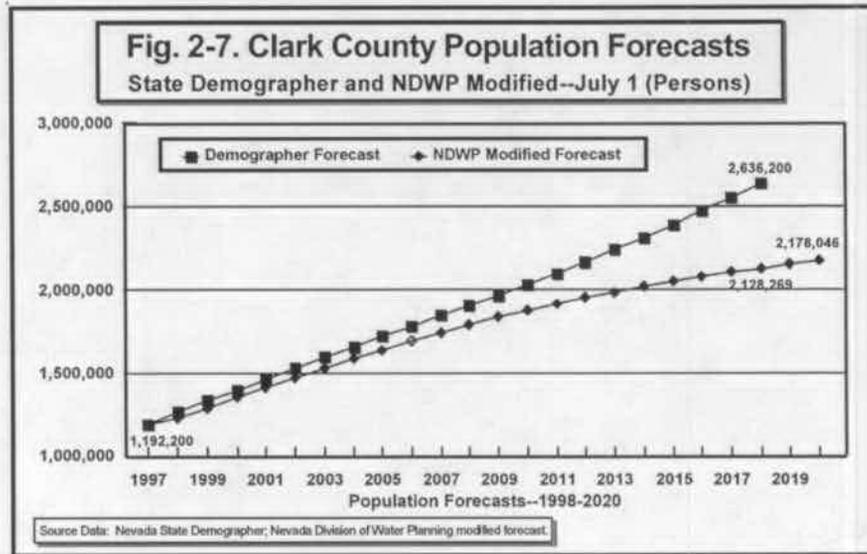
Based on the “range” of population forecasts developed independently by the State Demographer and the NDWP, Nevada is projected to grow at a rate of between 2.5–3.3 percent per year through 2018. Growth rates are expected to average between 3.2–3.6 percent per year between 1998 and 2008 and then moderate to between 1.6–2.9 percent per year between 2008 and 2018. This overall rate of

growth represents an increase in Nevada's total population of between 1,200,258 persons (NDWP) and 1,720,990 persons (State Demographer) between 1997 and 2018, resulting in a total forecasted population range of 2,980,108–3,500,840 persons by July 1, 2018. In the near term, the increase in the state's population will continue

to be fueled in large part by strong growth in the Las Vegas economy, particularly from its casino gaming and tourism industry. The gaming sector, at least for the next several years, will continue to see new major resort-casino construction, continuing to make southern Nevada the premier destination resort location in the world.

By contrast, the Washoe County and Carson City areas, and in fact much of northern Nevada, are beginning to see slower growth due to more intense competition in the gaming and tourism industry. Based on the growth in legalized gaming in other jurisdictions, and particularly the rise of Indian gambling on reservation lands, especially in California and the Pacific Northwest, it is reasonable to expect a continued slowdown in the growth of gaming and tourism throughout Nevada from approximately the year 2005 onward. The November 1998 passage of "Proposition 5", which legalized slot devices in Indian reservation casinos in California, is destined to have profound impacts on gaming in that state.

While at least two constitutional challenges to Proposition 5 have been filed, California voters appear to have changed their attitude towards legalized casino gaming within their state and further moves in this direction may be reasonably expected. Also, in early January 1999, California's Governor and Attorney General withdrew their support for any



challenge to Proposition 5.

While many of Nevada’s tourism and gaming attractions, both man-made and natural, continue to be unrivaled with respect to featured offerings in competitive markets, studies have shown that proximity has an important influence over player patronage. As a result, Nevada’s casino gaming industry will have to work hard to compete with developing gaming markets located closer to population centers throughout the U.S. The anticipated slowing in the growth in Nevada’s gaming industry, however, is not expected to be uniform and will be stronger in those markets which do not offer features of a distinctive nature to lure consumers from more proximate gaming opportunities.

Table 2–3. Nevada Population Forecast Summary, 1995–2020, presents a summary of the population forecasts for those larger Nevada counties expected to equal or exceed a total resident population of 50,000 persons by the year 2020. Complete population forecasts and analysis for all Nevada’s counties may be found in Appendix 2 of the Appendices. These population forecasts and county shares of total state population are based on the modified forecasts made by the NDWP and specifically incorporate the population forecasts provided by the Clark County Department of Comprehensive Planning and the Washoe County Department of Community Development.

**Table 2–3. NDWP Nevada Population Forecast Summary
Population Forecasts and Shares for Larger Nevada Counties — 1997–2020
(For counties expected to exceed 50,000 persons by the year 2020)**

State/County	1997	2000	2005	2010	2015	2020
Nevada						
Resident Population (persons)	1,779,850	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846
Carson City						
Resident Population (persons)	50,410	54,445	60,703	66,041	70,099	72,587
Percent of Total State	2.83%	2.74%	2.59%	2.50%	2.44%	2.38%
Clark County (Las Vegas)						
Resident Population (persons)	1,192,200	1,355,368	1,640,444	1,874,431	2,046,229	2,178,046
Percent of Total State	66.98%	68.24%	70.06%	70.99%	71.32%	71.49%
Douglas County						
Resident Population (persons)	39,590	42,834	48,180	53,272	57,900	61,854
Percent of Total State	2.22%	2.16%	2.06%	2.02%	2.02%	2.03%
Elko County						
Resident Population (persons)	47,710	51,665	57,857	63,224	67,408	70,113
Percent of Total State	2.68%	2.60%	2.47%	2.39%	2.35%	2.30%
Lyon County						
Resident Population (persons)	30,370	33,721	39,377	44,878	49,914	54,170
Percent of Total State	1.71%	1.70%	1.68%	1.70%	1.74%	1.78%
Washoe County (Reno)						
Resident Population (persons)	308,700	329,021	362,260	393,884	422,917	448,400
Percent of Total State	17.34%	16.56%	15.47%	14.92%	14.74%	14.72%

Note: Counties included are only those that are forecast to equal or exceed a resident population of 50,000 persons by the end of

the forecast horizon (2020).

Source Data: Nevada State Demographer (1997 estimate); Nevada Division of Water Planning (2000–2020 forecasts).

Nevada’s Employment Composition and Industry Trends

Table 2–4. Nevada Covered Employment — 1980–1997, shows trends in Nevada’s total “covered employment” (a definition of employment which includes those employees covered under state and federal unemployment insurance programs) as well as trends in the shares of total employment by principal industry sector. Employment trends and industry composition are

important considerations in forecasting commercial and industrial water withdrawals as each industry sector tends to use water at different rates in terms of gallons per employee per day. To forecast commercial and industrial water withdrawals for the water plan, an average commercial and industrial “water use coefficient” for all industry sectors is used in conjunction with forecasted total employment. It is therefore important to assess anticipated changes in future employment composition by specific industry sectors to insure that no dramatic changes are expected which might significantly alter the average usage factor and thereby jeopardize the reasonableness and usefulness of this forecast methodology.

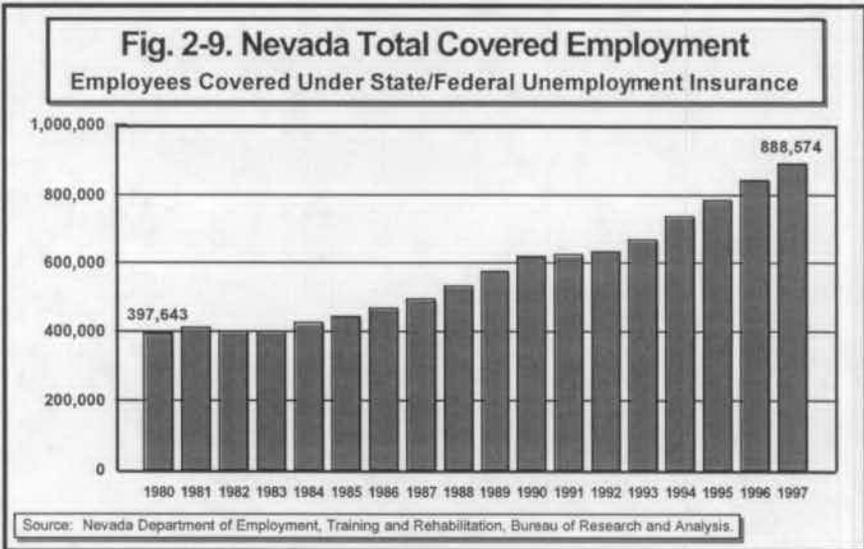
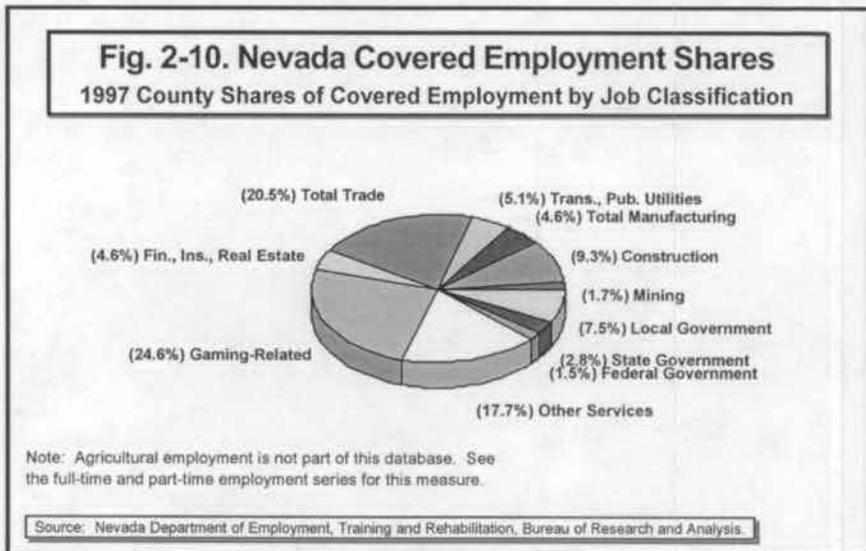


Fig. 2–9. Nevada Total Covered Employment shows the trend in statewide total employment from 1980 to 1997. This graph shows the slowdown in employment growth in Nevada during the national recessionary periods of 1980-82 and 1990-91, clearly indicating Nevada’s linkages to national business cycles. The state’s covered employment data,



compiled by the Nevada Department of Employment, Training and Rehabilitation (DETR), represents the most accurate and detailed measure of commercial and industrial employment in the State of Nevada.

Table 2–4. Nevada Covered Employment Trends — 1980–1997
Trends in Covered Employment and Shares by Principal Industry Sector (Workers)

Industry Category	1980	1985	1990	1997	1980-97 Change in Workers	1980-97 Percent Change
Total State	397,643	443,527	619,638	888,574	490,931	123.5%
Mining Percent of Total	6,219 1.56%	6,081 1.37%	14,321 2.31%	14,663 1.65%	8,444	135.8%
Construction Percent of Total	26,434 6.65%	24,121 5.44%	46,903 7.57%	81,953 9.22%	55,519	210.0%
Total Manufacturing Percent of Total	19,200 4.83%	21,958 4.95%	26,245 4.24%	40,604 4.57%	21,404	111.5%
Trans., Public Utilities Percent of Total	22,403 5.63%	23,908 5.39%	31,445 5.07%	44,877 5.05%	22,474	100.3%
Total Trade Percent of Total	80,330 20.20%	90,874 20.49%	124,260 20.05%	180,425 20.31%	100,095	124.6%
Fin., Ins., Real Estate Percent of Total	17,777 4.47%	21,287 4.80%	28,245 4.56%	40,338 4.54%	22,561	126.9%
Service Industries Percent of Total	165,516 41.62%	192,289 43.35%	267,067 43.10%	371,753 41.84%	206,237	124.6%
Gaming-Related Percent of Total	114,950 28.91%	125,483 28.29%	165,384 26.69%	216,491 24.36%	101,541	88.3%
Total Government Percent of Total	56,830 14.29%	59,788 13.48%	75,962 12.26%	104,254 11.73%	47,424	83.4%
Federal Government Percent of Total	10,369 2.61%	10,462 2.36%	12,341 1.99%	13,519 1.52%	3,150	30.4%
State & Local Gov't Percent of Total	46,462 11.68%	49,325 11.12%	63,621 10.27%	90,736 10.21%	44,274	95.3%
State Government Percent of Total†	15,300 32.93%	15,621 31.67%	19,354 30.42%	24,974 27.52%	9,674	63.2%
Local Government Percent of Total†	31,162 67.07%	33,704 68.33%	44,267 69.58%	65,762 72.48%	34,600	111.0%

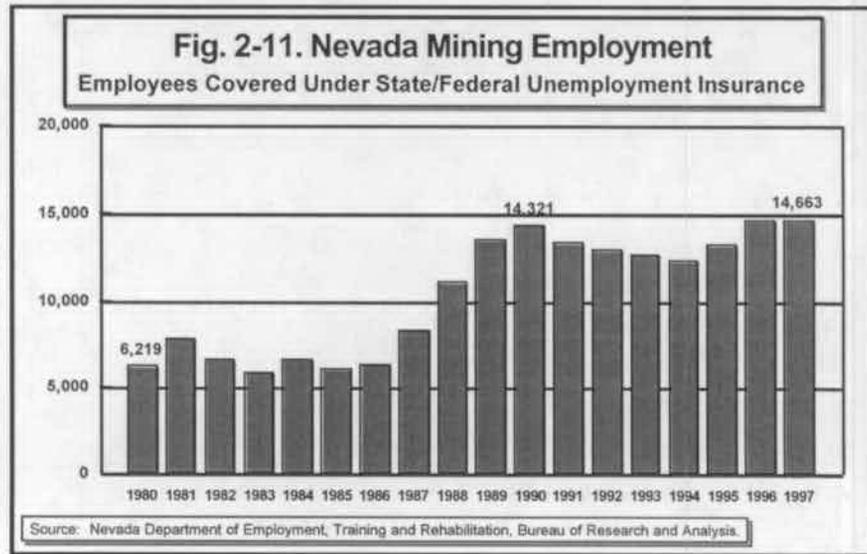
Notes: Includes employment covered under state and federal unemployment insurance programs. State and local government employment shares for the years 1980, 1985, and 1990 are estimated based on trends of 1993 through 1997. Agriculture and related employment categories (i.e., agricultural services, forestry and fisheries) are not part of this database).

† Percent of total for state government and local government are based on a percent of total state and local government only.

Source Data: Nevada Department of Employment, Training and Rehabilitation (DETR), Research and Analysis Bureau.

Fig. 2–10. Nevada Covered Employment Shares, shows the distribution of total covered employment across Nevada's principal industry sectors for 1997. However, this database does not include workers in the sectors of farming, agricultural services, forestry or fisheries. Therefore, employment

in these sectors was analyzed using another employment measure, termed "full and part-time employment," which is compiled by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA). Fig. 2-15. Nevada Full/Part-Time Employment Shares, presents this alternative employment measure and, while not as recent as the covered



employment data, it does incorporate agricultural and related employment for the State of Nevada. Fig 2-15 shows a wide range in employment shares for 1996 in various sectors from a high of 42.7 percent in total services to 1.5 percent in farming and related agricultural service industry jobs.

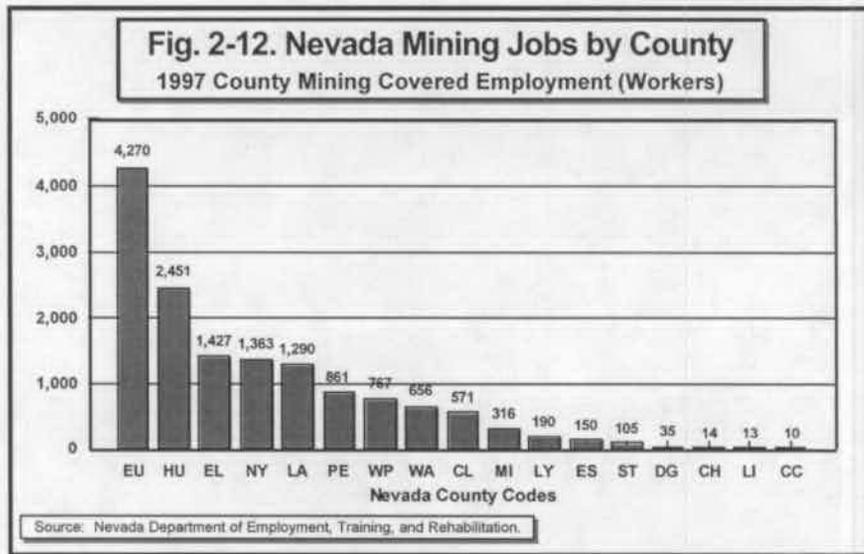
Table 2-4 shows that since 1980, covered employment in Nevada's construction industry has shown the most rapid growth, which is not surprising in a rapidly growing state like Nevada. This construction industry growth has been driven by construction needed for commercial development (primarily major casino complexes in the Las Vegas economy) as well as growth in associated retail trade businesses, residential housing units and various infrastructure requirements such as airport facilities, roads and highways, public utilities, schools, etc. Since 1989, statewide construction jobs in support of Nevada's mining industry also contributed to these totals. In the following section each principal industry sector is analyzed in terms of its historical trends and future prospects for growth.

Employment Analysis by Industry Sector

Construction. In addition to its rapid growth, construction employment has proven to be the most volatile employment sector in the state. Nevada's construction employment declined by 25.0 percent, or 6,594 workers from 1980 to 1983, reflecting the 1980-82 national recessionary period. Then, reflecting the 1990-91 national recession, Nevada's construction employment declined again by 16.4 percent or 7,690 workers between 1990 and 1993. The construction industry increased its share of statewide total covered employment from 6.6 percent in 1980 to 9.2 percent by 1997. Continued strong, albeit more moderate, growth trends in this sector are expected into the next century, with some slowdown occurring in the later part of the plan's forecasting horizon (1998-2020).

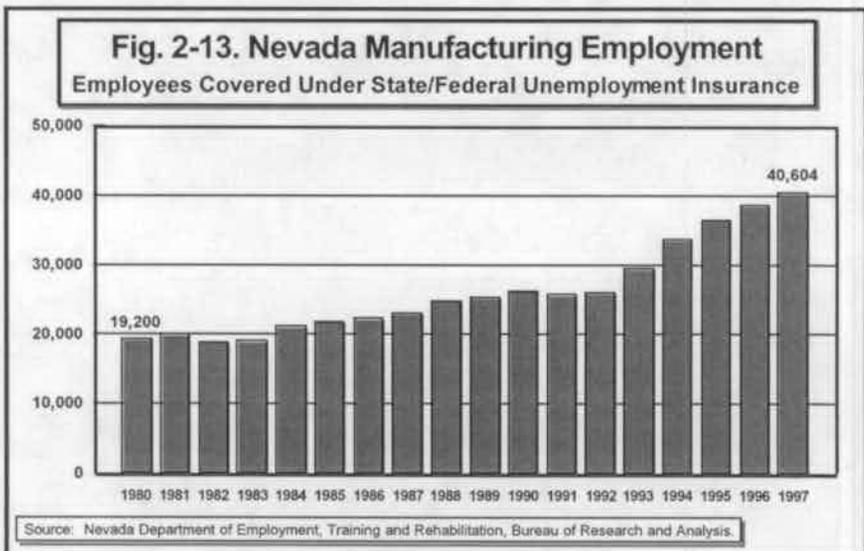
Mining. Mining jobs in Nevada rose by 8,444 workers, an increase of nearly 136 percent between 1980 and 1997 (see Fig. 2-11). More recent trends have indicated a marked slowdown in this industry sector due to price pressures on Nevada's primary mineral, gold, and resultant cost restraints on mining operators. Due to the take-off of Nevada's gold mining industry in the late 1980's, this

industry's share of statewide total covered employment rose from 1.6 percent in 1980 to 2.3 percent by 1990. By 1997, due to significant declines in the price of gold, Nevada's mining industry's share of total covered employment slipped back to 1.6 percent, the same share of statewide total employment it held in 1980. Over the near term, mining employment



in Nevada is expected to decline, eventually falling and then remaining at about 12,000-13,000 workers over most of the water plan's forecast period. Impacts on the mining industry due to price swings and continued uncertainty in world gold markets will affect both employment and population growth in Nevada's rural and mining-dependent counties. Fig. 2-12 shows the number of 1997 mining jobs ranked by county.

Manufacturing. Manufacturing has shown relatively good growth in terms of employment. Between 1980 and 1997, employment in this industry sector has risen by 21,404 workers, or 111.5 percent (see Fig. 2-13). As a primary industry targeted for the state's economic diversification efforts, continued growth in the state's manufacturing sector is expected. Although manufacturing's share of statewide total covered employment has actually declined slightly from 1980 (4.8 percent to 4.6 percent), its relative stability in terms of employment share is counter to national trends in which manufacturing employment slid significantly from over 20 percent of total employment in the early 1960's to only 14 percent in the 1990's.



Transportation and Public Utilities.

Nevada's transportation and public utility jobs, as well as jobs in finance, insurance and real estate, represent two industry sectors in which only modest

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gains to employment are anticipated over the forecast horizon. These industries are being particularly impacted by mergers (finance and especially banking) and deregulation (public utilities, particularly electrical power, gas and water), with the net effect of only modest increases expected to employment over the forecast horizon. Since 1980, transportation and public utility jobs have grown by 100.3 percent, or 22,474 workers. This industry's share of statewide total covered employment has fallen, however, from 5.6 percent in 1980 to 5.0 percent by 1997.

Recent trends in the mandated deregulation of the electrical power industry are destined to result in mergers and, initially, reduced levels of employment. However, there also has been a tendency for these newly deregulated businesses to expand into new businesses more or less related to their primary business of power generation or distribution. Consequently, later in the forecast horizon, more rapid employment growth in the public utility sector may be expected.

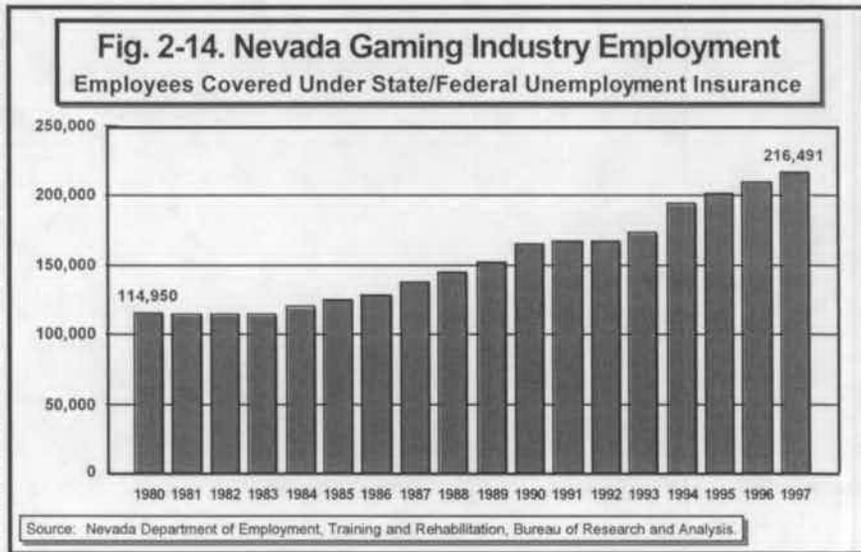
Finance, Insurance and Real Estate (F.I.R.E.). Finance-related jobs in Nevada have shown an increase of 126.9 percent since 1980, representing an addition of 22,561 workers to total state employment. Much of this increased employment has come in the real estate area, whereas employment trends in the state's financial institutions, and banking in particular, have been and will continue to be adversely impacted by out-of-state ownership and continued mergers and acquisitions. Financial-related employment in the state showed virtually the same share of total jobs in 1997 as it did in 1980, 4.5 percent.

Wholesale and Retail Trade. Total wholesale and retail trade employment growth from 1980 to 1997 has shown gains slightly above those of the state average (124.6 percent versus 133.5 percent). From 1980 to 1997, employment in this industry sector has grown by 124.6 percent, representing an addition of 100,095 workers since 1980. The majority of this growth has occurred in the state's retail trade businesses and has been closely linked to growth in Nevada's tourism and gaming industries, as well as the rapid growth in resident population. This industry's share of statewide total employment has changed only slightly since 1980, rising from 20.2 percent to 20.3 percent of statewide employment by 1997. More modest increases in the state's gaming and tourism industry sectors are destined to also moderate future growth rates in total trade employment.

Total Services. Employment in all of Nevada's service industries (i.e., gaming-related, medical and health care services, personal services, business services, etc.), which represents the dominant industry sector in the state, has advanced by 124.6 percent since 1980, resulting in an addition of 206,237 new workers. Particularly strong employment growth has been shown in business services and medical and health care services industry sectors. Due primarily to more modest gains in gaming-related employment, which accounted for over 58 percent of total service industry employment in 1997, jobs in total services have only increased slightly since 1980, rising from a 41.6 percent share of statewide total employment to 41.8 percent by 1997.

Services – Gaming and Tourism. Relative to other principal industry sectors, gaming-related

employment in Nevada has shown more modest employment growth since 1980 (see Fig. 2-14). This trend primarily reflects the effects of a more competitive gaming industry, both interstate and intra-state, and a maturing Nevada economy in which gaming continues to represent the dominant basic industry, but one of diminishing importance as support industries expand



their employment levels. Gaming's share of statewide total employment has fallen from 28.9 percent in 1980 to 24.4 percent by 1997 as Nevada's support industries have, in effect, played "catch-up" to the lead that the gaming and tourism industry showed beginning in the early 1980's. Gaming, however, will continue as the primary industry sector, although its dominance is destined to slowly decline as the market for tourists becomes increasingly saturated and Nevada finds itself competing with the growing number of legalized gaming locations throughout the U.S. and the world.

Government. Statewide total government employment (federal, state, and local governments) has reflected the effects of rapid population growth and the need to provide public services by local (county and city) governments. As a result, the greatest growth in the overall government sector has occurred at the local government level, where employment has risen 111.0 percent since 1980, reflecting a statewide increase of 34,600 jobs. Local government's share of total government employment has risen from approximately 67 percent in 1980 to over 72 percent by 1997. State government has also been influenced by population demands, but not to the extent shown by Nevada's local governmental entities. Total state government employment rose from 15,300 workers in 1980 to nearly 25,000 workers by 1997, an increase of 63.2 percent or 9,674 workers. By comparison, total employment in Nevada has risen by nearly twice this amount, or nearly 124 percent since 1980.

Characteristically, federal government employment has risen more in response to program requirements and federal budgetary restrictions than local population effects. On this basis, Nevada's federal government employment rose by only 30.4 percent since 1980, representing an increase of 3,150 workers over 17 years. Over the planning horizon covered by the State Water Plan, federal government employment growth is expected to remain relatively stable and state government employment to slow from prior periods. Local government employment will also moderate somewhat as statewide overall economic activity begins to slow and state and local government budgets become more strained.

Agriculture and Related Industries. Using BEA's full time and part-time employment data,

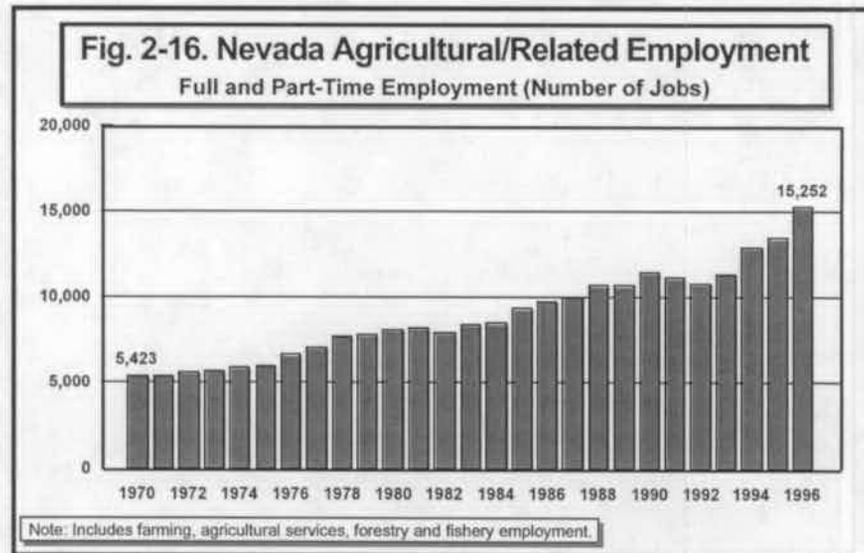
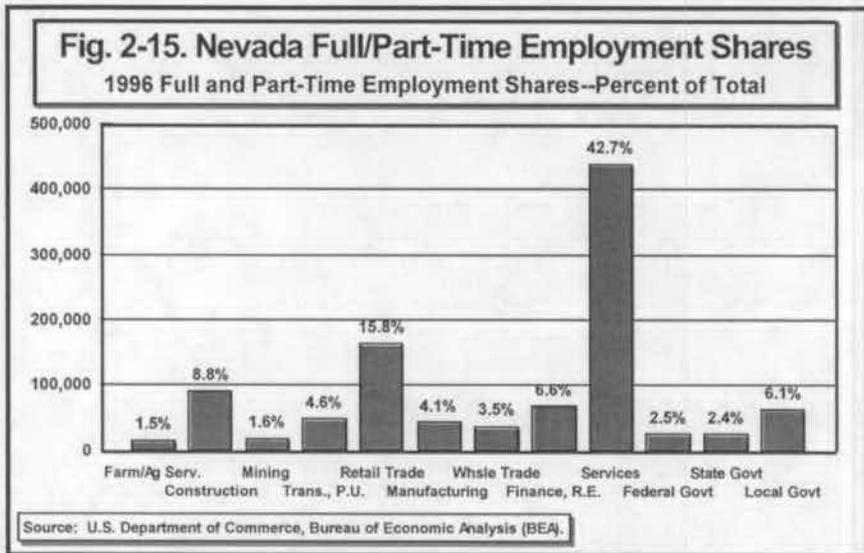
Nevada's agriculture (farming) industry accounted for only 1.5 percent of Nevada's total employment in 1996 and has shown virtually no growth since 1970. On the other hand, employment in agricultural services, forestry and fisheries has expanded more dramatically. While it appears that total agricultural-related employment has increased since 1970

(see Fig. 2-16. Nevada Agricultural/Related Employment), on-farm jobs have actually declined slightly from 1970 to 1996. Fig. 2-17. Nevada Agricultural Employment Composition shows that agricultural service and related jobs have grown from 820 workers in 1970 to 10,963 workers in 1996. The majority of

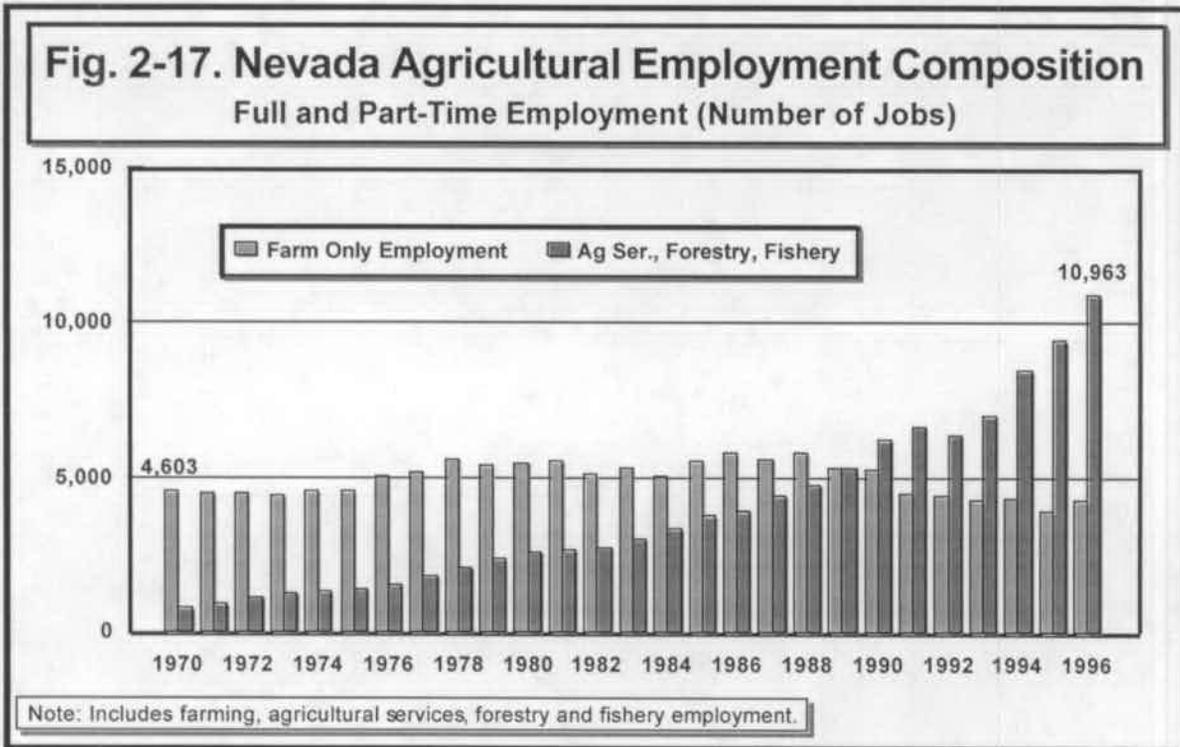
these jobs are in lawn services and landscaping and are primarily located in the more urban areas of the state. For example, of this total amount, 9,432 agricultural and related service jobs, or 86.0 percent, were located in either Carson City, Clark or Washoe counties. Employment growth in the farm sector is expected to continue to decline moderately while the agricultural and related employment sectors are expected to continue to show strong growth along with population and commercial and industrial expansion.

While some changes are expected in the overall composition and share of industry sectors within individual counties and for the total state, it is not expected that these changes in job mix will be significant enough to preclude the use of an average commercial and industry water use factor

(i.e., gallons per worker per day) to estimate future commercial and industrial water use patterns based on total employment trends. Both state and county economic and employment data sets and the related water use coefficients will be updated as new



information becomes available.



Nevada's Casino Gaming Industry

Casino gaming represents Nevada's primary industry sector in terms of persons employed, payrolls, "exports" (of gaming-related products and services) and impacts on other industry sectors both in terms of employment and productive output. Table 2-5. Nevada Casino Gaming Win — 1970-1997 presents basic revenue trends in Nevada's gaming industry for its principal gaming markets (Clark, Washoe and Elko counties, South Lake Tahoe, and Carson Valley in Table 2-5) and the various gaming sub-markets within these principal gaming markets. The gaming win measures the dollar volume of casino patrons' wagered amounts that are retained by the casino after all payouts as winnings. This amount is also referred to as the "house hold". As a primary revenue source, the gaming win represents the most fundamental measure of the economic and financial health of this industry and the effects of tourists' patronage of Nevada casinos.

Table 2-5 shows the effects that increasing intra-state competition has had on Nevada's various casino gaming markets. Rapid casino expansion, primarily in the Las Vegas (Clark County) gaming sub-markets of the Las Vegas Strip and the Boulder Strip, has adversely affected gaming revenue trends of other sub-markets within Clark County, i.e., the Las Vegas Downtown and Laughlin casinos. Laughlin's revenue growth has also been adversely affected by Indian casinos around Phoenix, Arizona, a principal "feeder" market for this gaming location. Even so, the Clark County

gaming market has shown impressive gaming win growth and now accounts for nearly 80 percent of the state's total gaming win (see Fig. 2-18).

Table 2-5. Nevada Casino Gaming Win — 1970-1997

Total Casino Gaming Win† by Principal Gaming Market (Millions of Dollars)

Principal Gaming Market or Sub-Market	1970	1980	1990	1997	1990-97 Change in Gaming Win and Share	1990-97 Percent Change in Gaming Win
TOTAL STATE	\$604.35	\$2,478.45	\$5,480.25	\$7,802.70	\$2,322.45	42.38%
Clark County[1]	\$394.24	\$1,697.41	\$4,103.39	\$6,152.42	\$2,049.03	49.94%
Percent of Total	65.23%	68.49%	74.88%	78.85%	3.97%	
Las Vegas Strip	\$290.90	\$1,231.98	\$2,604.98	\$3,809.40	\$1,204.41	46.23%
Percent of Total	48.13%	49.71%	47.53%	48.82%	1.29%	
Las Vegas Downtown	\$91.50	\$348.63	\$676.91	\$679.05	\$2.15	0.32%
Percent of Total	15.14%	14.07%	12.35%	8.70%	-3.65%	
Laughlin	n.a.	n.a.	\$398.64	\$482.26	\$83.62	20.98%
Percent of Total			7.27%	6.18%	-1.09%	
Boulder Strip	n.a.	n.a.	\$142.14	\$411.79	\$269.64	189.70%
Percent of Total			2.59%	5.28%	2.68%	
Rest of Clark County[2]	\$11.84	\$116.80	\$280.72	\$769.93	\$489.21	174.27%
Percent of Total	1.96%	4.71%	5.12%	9.87%	4.75%	
Washoe County[3]	\$119.52	\$462.28	\$814.14	\$995.23	\$181.09	22.24%
Percent of Total	19.78%	18.65%	14.86%	12.75%	-2.10%	
City of Reno	\$91.72	\$362.12	\$628.02	\$751.21	\$123.19	19.62%
Percent of Total	15.18%	14.61%	11.46%	9.63%	-1.83%	
City of Sparks	n.a.	n.a.	\$104.04	\$150.64	\$46.61	44.80%
Percent of Total			1.90%	1.93%	0.03%	
South Lake Tahoe[4]	\$72.21	\$221.09	\$339.16	\$294.97	(\$44.19)	-13.03%
Percent of Total	11.95%	8.92%	6.19%	3.78%	-2.41%	
Carson Valley[5]	\$3.88	\$34.63	\$57.26	\$73.75	\$16.49	28.80%
Percent of Total	0.64%	1.40%	1.04%	0.95%	-0.10%	
Elko County	\$7.48	\$37.87	\$111.67	\$198.31	\$86.64	77.58%
Percent of Total	1.24%	1.53%	2.04%	2.54%	0.50%	
City of Wendover	n.a.	n.a.	\$53.39	\$99.83	\$46.44	86.99%
Percent of Total			0.97%	1.28%	0.31%	

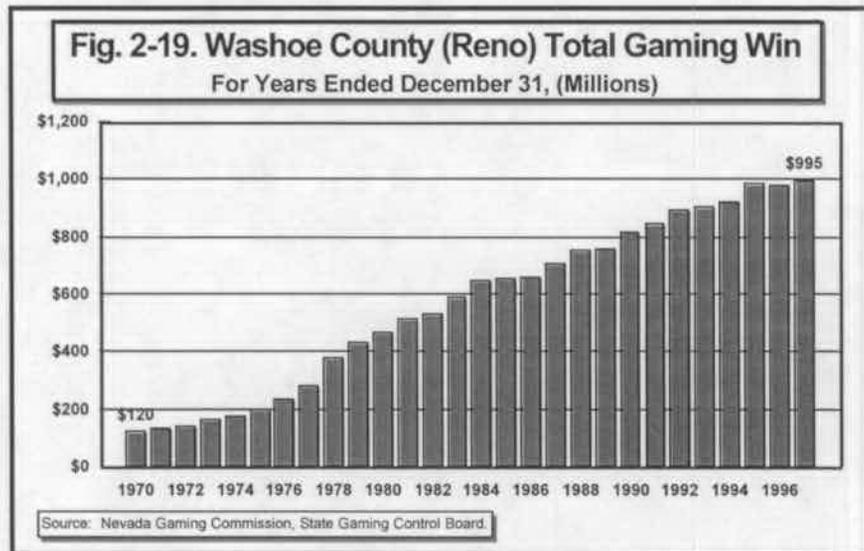
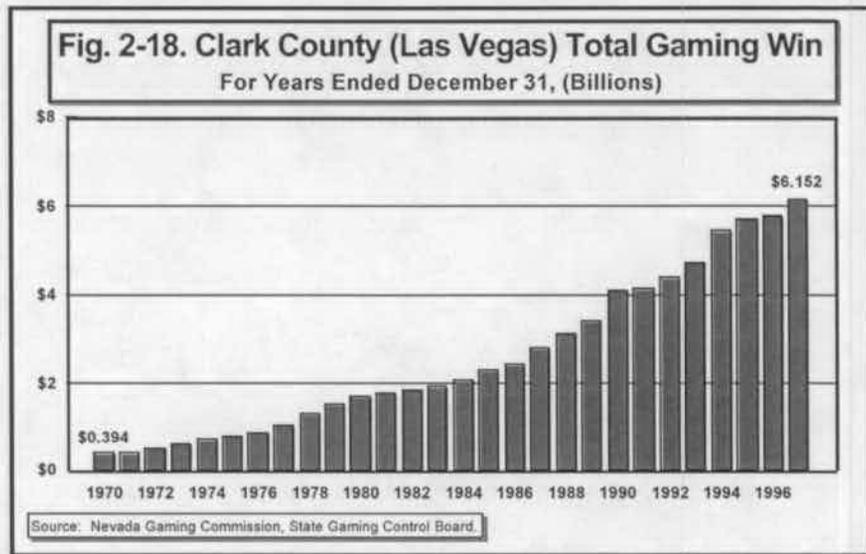
Notes: "Percent of Total" measures each gaming market's share of Nevada's total gaming win. Average annual growth rates (Ave. Ann.) are the average annual rate of growth between 1990 and 1997. Principal gaming markets are presented in bold face type; gaming "sub-markets" appear in regular type. Carson Valley casinos include those in Carson City and Douglas County, excluding the South Lake Tahoe properties.

† Casino gaming win is equal to the "house hold," or the amount retained by the casino after all payouts as winnings to customers. n.a. = Gaming win data not available for these time periods.

Source Data: Nevada Gaming Commission, State Gaming Control Board.

The expansion of mega-resort casino complexes along and just off the Las Vegas Strip has also had

an adverse impact on the northern Nevada gaming markets of Washoe County (Reno-Sparks) and South Lake Tahoe (Douglas County) as can be seen by a marked slowing of growth in these markets in the 1990's (see Fig. 2-19). These trends, combined with near-term openings of major casino resort complexes along the Las Vegas Strip (Bellagio, Mandalay Bay, Venetian, Paris, etc.) in late 1998 and into 1999 portend a continuation of intensifying competition for a limited supply of tourists and casino patrons. Consequently, based on both interstate and intra-state competition, the forecast for this industry is for more modest overall growth over the entire forecast horizon and even slower growth in those gaming markets which do not make sufficient investments to maintain a competitive advantage in this industry. Due to the relatively greater importance of gaming to the Las Vegas economy, this assessment constitutes the primary reason for lower rates of growth in forecasts for both employment and population in southern Nevada.



Nevada's Mining Industry

Table 2-6. Nevada Mineral, Petroleum, Geothermal Production, shows the relative concentration of Nevada's mineral industry in gold and silver production, especially gold. This is particularly true with respect to mining's effects on employment in a number of rural counties. Also shown in this table are the relatively wide price fluctuations which have typified the market behavior of these precious metals. In 1997, gold prices had averaged \$331 for Nevada's mining operations and by early 1998

they had moved below \$300 per ounce, creating severe pressures on the state's gold producers. Based on both economic fundamentals and financial market conditions, it is expected that some recovery to the price of gold will be experienced over the forecast horizon, but it is doubtful that prices will recover to levels shown in the early 1990's. Consequently, mining employment in Nevada is expected to decline slightly over the next 20 years as producers attempt to cut costs, especially salaries, and improve operating efficiencies. (See Fig. 2-20 for trends in the gross proceeds of Nevada's mines from 1977 through 1997, and Fig. 2-21 for county shares of 1997's gross proceeds of mines.)

Table 2-6. Nevada Mineral, Petroleum, Geothermal Production
Statewide Production of Principal Minerals for Years 1978-1997 (Units of Production)

Mineral	1978	1980	1985	1990	1995	1997
Barite (thousands of short tons)	1,788	2,268	590	405	514	586
Copper (thousand lbs)	20,543	—	—	11,067	13,000	148,600
Geothermal Power (thousands of mega-water hours)	—	—	—	884	1,360	1,348
Gold (troy ounces)	260,895	250,618	1,276,114	5,813,000	6,764,000	7,828,000
Mercury (76-pound flasks)	24,163	3,300	16,530	—	—	—
Petroleum (thousands of 42-gallon barrels)	1,269	893	3,060	4,012	1,342	1,000
Sand and Gravel (thousands of short tons)	10,040	7,000	9,979	26,000	28,000	28,000
Silver (troy ounces)	804,000	167,000	4,947,000	21,529,000	24,602,000	24,645,000
Gold—Average Price per Ounce (dollars)	\$193.55	\$613.28	\$317.66	\$380.02	\$384.09	\$324.99
Silver—Average Price per Ounce (dollars)	\$5.40	\$21.54	\$6.14	\$5.00	\$5.19	\$4.62

Note: In 1997, gold and silver comprised nearly 86 percent of total mineral valuation in Nevada.

Source Data: Nevada Bureau of Mines and Geology, *The Nevada Mineral Industry*, various issues.

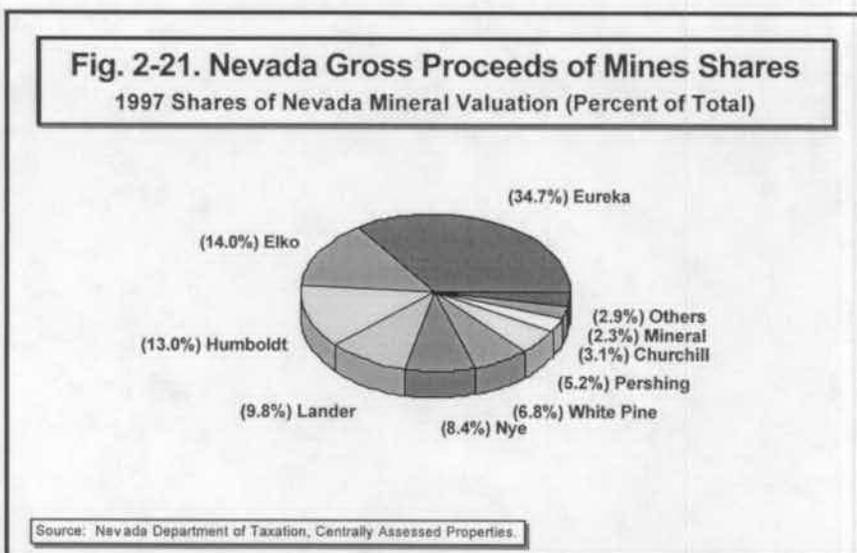
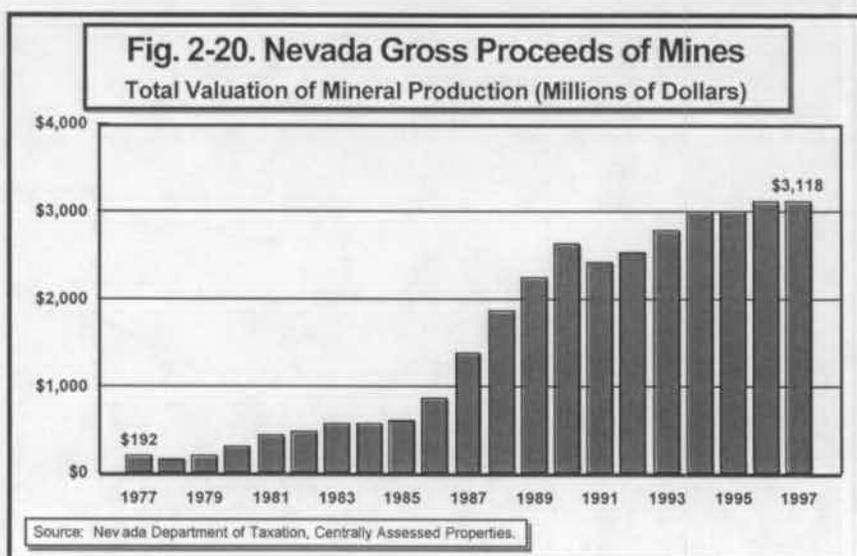
Table 2-6 shows the historical relative market prices received for Nevada's precious metals. This information shows that market prices for both gold and silver have varied greatly over the entire period of presentation, and most especially during times of economic uncertainty and inflation, i.e., the 1980-82 recessionary period. This high price variability reflects the more historic use of these precious metals, and particularly gold, as a "store of value" and inflation hedge. From these trends, which show the price of gold varying from a low of \$194 per ounce in 1978 to a high of \$613 per ounce in 1980 (an inflationary and recessionary year), and the price of silver ranging between \$5.00 and \$21.54 per ounce, it becomes more obvious why Nevada's production of these minerals has shown such extreme variation over recent years. In fact, gold production in Nevada has been

relatively stable during the more recent period of economic stability during the 1990's when gold's price has remained within a relatively narrow range well above \$300 per ounce.

The declining price of gold has resulted in significant declines in mining-dependent taxable sales (a major source of county tax

revenues) as mining companies have curtailed major investment projects and reduced local spending. To offset declining market prices and revenues, Nevada's gold mines have been able to reduce their weighted average cash production costs from an average of \$229 per ounce in 1996 to \$214 per ounce in 1997. Much of this cost constraint has come from the unique relationship between the market price of gold and production costs. As market prices decline, gold producers quickly switch to higher grade deposits (higher concentrations of gold per ton of earth removed), thereby automatically lowering production costs. More recently, mines have been able to effect this change very rapidly, thereby virtually "locking in" production costs to market prices.

Based on continuing international financial changes (European monetary reform and the backing levels in gold of the European Monetary Union) and economic turmoil (Asia), some further moderation to the price of gold is expected in 1998 and into 1999. Mining and construction-related employment have begun to reflect the impacts of these gold price declines and production cost restraints. Even though Nevada currently remains one of the most efficient (i.e., least-cost) gold producers in the world (e.g., in 1997 South Africa showed an average production cost of \$301 per ounce and Australia showed \$261 per ounce), the extent of the worldwide decline in the price of gold has nonetheless forced severe cost-cutting measures and altered the



Nevada State Water Plan

Nevada gold industry's development and production efforts, shifting emphasis to higher grade ore bodies and more productive underground gold mining versus surface (open pit) mining. Uncertainty about the price of gold is destined to affect future employment and population growth in the rural Nevada counties

So long as gold has been priced at a "premium" based on its extensive use as an effective hedge against inflation and economic uncertainty, and not priced solely on its intrinsic (i.e., industrial or commercial usage) value, such price fluctuations will likely continue. More recent trends, however, show gold's diminished role as an inflation hedge as well as a less important role as a monetary reserve held by central banks in support of national currencies. In particular, the formation of the European Monetary Union, with its requirement for significantly lower holdings of gold reserves, has resulted in large bullion sales, consequently depressing gold prices below \$300 per ounce in early 1998. Once these transitory effects have settled down, however, some recovery to gold's longer-term price is expected, although it is uncertain as to the extent of that recovery. Forecasts for Nevada's mining industry will depend primarily on the market price of gold, as this price "drives" economically-recoverable reserves upon which industry production and exploration depend. Forecast assumptions incorporated into this plan for mineral production and mining water withdrawals are based on an industry-accepted long-term price of gold at \$280–\$350 per ounce.

The resurgence of copper mining in Nevada, principally in White Pine County, is also a recent trend as reflected in Table 2–6. As with precious metals, falling copper prices have affected this industry and it is not certain if recent cost-cutting efforts will insure the long-term survivability of copper mining in Nevada. The fluctuating world-wide prices of both industrial and precious minerals has characterized Nevada's mining industry since the late 1800's and makes forecasting this industry (e.g., production, employment, water withdrawals, etc.) especially difficult in the face of numerous economic, financial, political and environmental related influences and uncertainties.

Nevada's Agricultural Industry

Agriculture represents one of Nevada's oldest and most lasting economic activities. Since the first settlements were established in the 1850's, agriculture in Nevada has continued to survive and even prosper. Today, agriculture remains a fundamental socioeconomic underpinning for a number of rural Nevada counties and, no doubt, will remain an integral part of these counties' economies irrespective of current or future mining trends. While on the whole agriculture may appear to have relatively little impact on Nevada's overall economic trends, the importance of agriculture for a number of rural counties cannot be overstated. See Fig. 2–22 for trends in Nevada's total farm marketings since 1970 and Fig. 2–23 for 1996 shares of total farm marketings by county.

Table 2–7. Nevada Agricultural Statistics — 1974–1995, summarizes key agriculture statistics for Nevada in terms of irrigated acreage, total farm marketings (monies received from farm marketing sales), farm worker employment and employment in agricultural services, forestry and fisheries. From the information in this table, it appears that agriculture, in terms of total irrigated acreage, peaked in the state during the late 1970's or early 1980's. (Precise determination is difficult and some important agricultural data, for example irrigated acreage, is only obtained by the Census Bureau

every four or five years.) Based on rising agricultural prices, farm marketings, however, continued to increase through at least 1990 despite fewer acres being irrigated. Livestock and related sales constituted over 70 percent of total farm marketings from 1974 through at least 1987, falling to 60 percent by 1995.

Table 2–7. Nevada Agricultural Statistics — 1974–1995
Irrigated Acreage, Farm Marketings and Farm-Related Employment

NEVADA	1974	1978	1982	1987	1990	1995
Irrigated Acres	777,510	881,151	829,761	773,588	728,350	715,439
Farm Marketings (\$000s)	\$145,458	\$204,047	\$250,610	\$271,904	\$326,889	\$298,085
Livestock and Products	\$115,979	\$154,820	\$181,373	\$203,774	\$211,486	\$179,589
Percent of Marketings	79.7%	75.9%	72.4%	74.9%	64.7%	60.2%
Total Crops	\$29,479	\$49,227	\$69,237	\$68,130	\$115,403	\$118,496
Percent of Marketings	20.3%	24.1%	27.6%	25.1%	35.3%	39.8%
Total Agric. Employment	5,895	7,728	7,863	10,033	11,487	13,142
Farm Workers	4,570	5,639	5,140	5,628	5,260	3,962
Percent Total Employment	77.5%	73.0%	65.4%	56.1%	45.8%	30.2%
Agric. Services Workers	1,325	2,089	2,723	4,405	6,227	9,180
Percent Total Employment	22.5%	27.0%	34.6%	43.9%	54.2%	69.8%

Source Data: Irrigated acreage figures for 1974, 1978, 1982 and 1987 are from the U.S. Bureau of the Census, Agriculture Division; irrigated acreage figures for 1990 are estimates from the USGS data; irrigated acreage for 1995 are derived from estimates made by the NDWP. Farm marketings, number of farm and agricultural service workers are from U.S. Department of Commerce, Bureau of Economic Analysis (BEA). Agricultural Services Workers include workers in agricultural services, which is primarily landscaping and lawn care occupations, as well as jobs in the forestry and fisheries employment areas.

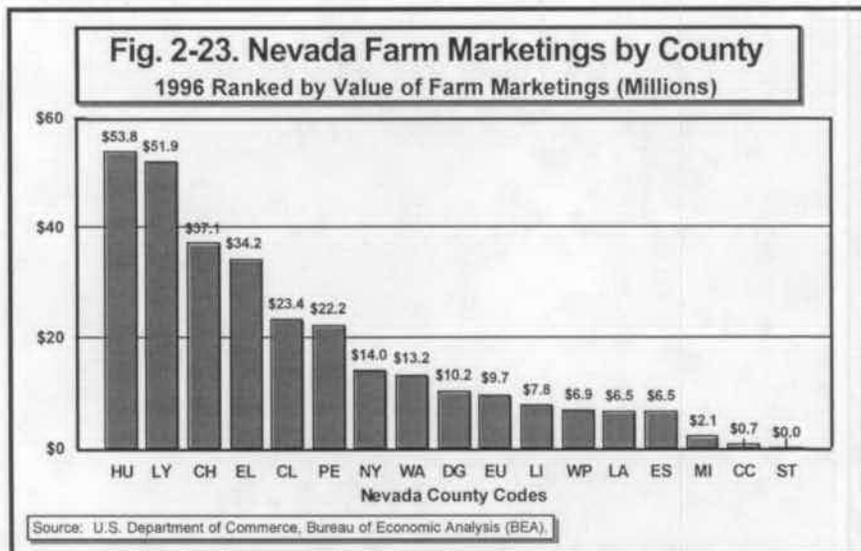
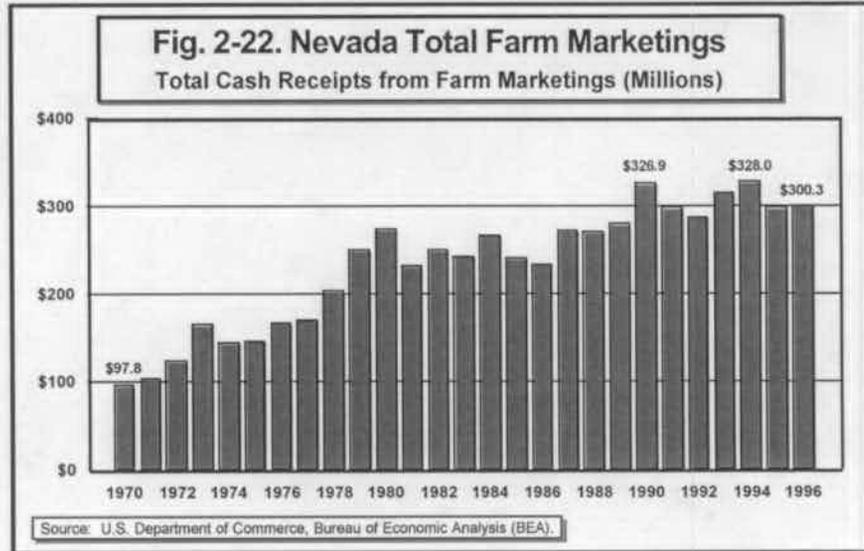
There has also been a more recent trend towards a strong statewide decline in on-farm workers and a growing importance of employment in related agricultural-related fields, primarily consisting of agricultural service workers, most typically representing the landscaping and lawn care service industries. From Table 2–7, workers involved in on-farm activities declined from 4,570 workers in 1974, comprising 77.5 percent of total agriculture and related employment, to 3,962 workers, or 30.2 percent of employment, by 1995. Meanwhile, workers in agricultural-related activities increased from 1,325 workers in 1974 (22.5 percent of employment in these fields) to 9,180 workers by 1995 (nearly 70 percent of total agricultural-related employment). In viewing the individual county agricultural-related figures (which are presented in Appendix 4 of the Appendices), particularly with respect to the amount of irrigated acreage, there appears wide fluctuations in estimated levels of irrigated acreage. Such fluctuations tend to indicate either highly volatile irrigation and crop production cycles or, more than likely, fundamental problems in reporting and gathering accurate data on this industry sector.

The volatility in historical measures of this industry, particularly with respect to irrigated acreage, related water usage rates and livestock figures, makes forecasting irrigation and livestock water use especially difficult. However, there does appear to be a trend towards no increase in agricultural lands being brought under cultivation and in some

counties, e.g., Carson City, Churchill, Douglas, and Washoe in particular, it appears that encroaching urbanization and the transfer of water rights to other uses, i.e., municipal and industrial, is causing the level of irrigated lands to actually decline. Given new and growing demands for limited water resources in the state, particularly for municipal use, wildlife protection and fishery restoration, instream flows and recreation, the future of agriculture in Nevada is somewhat uncertain.

Table 2-8. Nevada Forecasted Irrigated Acreage presents the Nevada Division of Water Planning's forecasts for total irrigated acreage Nevada and the state's principal agricultural counties. Nevada's total irrigated acreage figures are based on individual county forecasts which were then aggregated to produce the statewide total. Forecasts of irrigated acreage are expected to show declines in all counties, with accelerated declines in the more urbanized counties, i.e., Washoe County in Table 2-8.

Table 2-8.
Nevada
Forecasted
Irrigated
Acreage
Selected Counties -
Estimated (1995) and
Forecasted (2000-2020)
Irrigated Acreage
(Acres)



Nevada/Selected Counties	1995	2000	2005	2010	2015	2020
Nevada Total Irrigated Acreage	715,440	727,500	715,563	700,742	683,247	665,753
Churchill County Irrigated Acreage	56,094	54,523	54,130	53,685	53,191	52,696
Douglas County Irrigated Acreage	38,640	37,877	37,266	36,554	35,746	34,937
Elko County Irrigated Acreage	213,903	214,007	211,077	207,396	203,001	198,606
Humboldt County Irrigated Acreage	142,558	144,936	141,487	136,988	131,536	126,084
Lyon County Irrigated Acreage	60,975	61,317	60,643	59,884	59,045	58,207
Pershing County Irrigated Acreage	27,368	29,079	28,441	27,688	26,831	25,974
Washoe County Irrigated Acreage	27,048	25,716	24,671	23,483	22,176	20,869

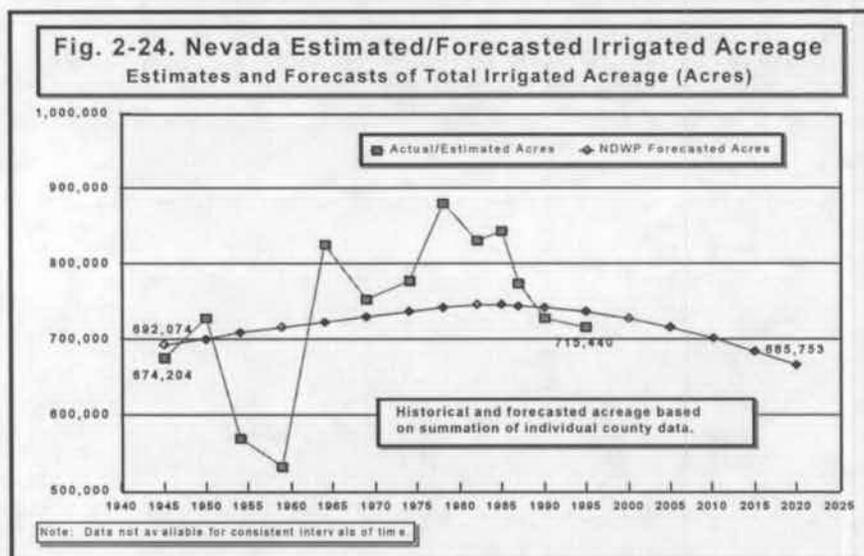
Notes: The selected counties presented above accounted for nearly 80 percent of Nevada’s total estimated irrigated acreage in 1995. Nevada totals are based on an aggregation of individual county estimates and forecasts of total irrigated acreage. Estimates of irrigated acreage for 1995 are based on U.S. Geological Survey (USGS) estimates, modified by the Nevada Division of Water Planning (NDWP) with modifications based on other source information (U.S. Department of Agriculture, Nevada Agricultural Statistics Service, and U.S. Department of Commerce, Bureau of Economic Analysis). County forecasts of irrigated acreage for 2000–2020 were based on NDWP forecasts derived from a non-linear “best fit” line for each county’s 1945–1995 data and then extrapolated out to the year 2000.

Source Data: 1995 irrigated acreage – USGS and NDWP; irrigated acreage forecasts – NDWP.

Fig. 2-24. Nevada Irrigated Acreage, shows both estimates of historical irrigated acreage since 1945 and the Division of Water Planning’s forecasts for Nevada’s total irrigated acreage through the year 2020 based on individual county forecasts which are aggregated to the statewide total. Detailed forecasts for all counties and the total state appear in Appendix 4 of the Appendices. Forecasts were based on the approximation of a non-linear “best fit” line which tracked historical trends and then was extrapolated (extended) out to the year 2020 based upon estimates of agricultural trends and other factors, for example urban encroachment.

Nevada’s Population and Employment Forecasts

Forecasted employment-to-population ratios for each county are crucial in forecasting employment levels from



the respective county's population forecasts. This analysis and related statistical tests are presented in Appendix 3 of the Appendices for each county and aggregated for the total state. The resultant forecasts of county total employment, combined with estimated historical and commercial and industrial water use factors (gallons per worker per day), are then used to forecast each county's commercial and industrial water withdrawals and, through aggregation, commercial and industrial water withdrawals for the total state.

Omitting the effects of national economic recessions, Nevada's ratio of its total covered employment to its resident population have tended to be relatively stable over time. For the period of 1980-1997, Nevada's ratio of its employment to population has averaged 48.2 percent. The average employment-to-population ratio, omitting recessionary periods, has tended to be closer to 50 percent. Nevada's relatively high employment-to-population ratio is typical of an economy that is being driven primarily by commercial expansion and related strong employment growth. Also evident from an analysis of these trends is that Nevada's employment-to-population ratio has shown marked sensitivity to national business cycle fluctuations, notably the U.S. recessionary periods of 1980-82 and 1990-91. While this point needs to be recognized, future recessions do not constitute any part of the forecasts for water withdrawals.

Another factor which would tend to affect the employment-to-population ratio is that as an economy "matures" and employment growth moderates relative to population growth, the trend towards household formation and a larger retired population component begins to affect this relationship, typically lowering the employment-to-population ratio over time. Changes in this relationship may also be influenced by changes in certain demographic factors, for example, changing birth rates (fertility rates) which would tend to alter the relationship between population growth and employment growth. Also, a change in the status of an area, for example, its appeal as a major retirement community, would tend to change the ratio of an area's employment to population over time.

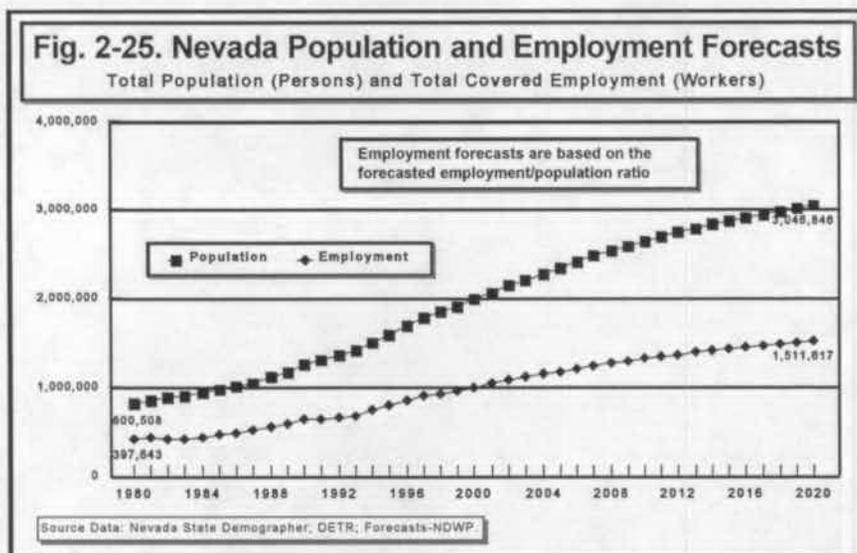


Table 2-9. Nevada Population and Employment Forecasts shows historical and forecasted population, employment and employment-to-population ratios for Nevada for selected years from 1997 through 2020. Unlike the forecast output tables which begin with the last estimated year of water withdrawal measures, i.e., 1995, this table uses 1997 to show the last year of population and employment estimates and hence the last actual measure of the employment-to-population ratio. A more extensive

presentation of this information for the total state and all counties for all years from 1980 through 2020 can be found in Appendix 3 of the Appendices. The information and forecasts in this appendix were based on historical levels and omit possible effects of future national and local recessions. Inputs on demographic trends and industrial development were also provided by the Nevada Department of Employment, Training and Rehabilitation (DETR).

Table 2–9. Nevada Population and Employment Forecasts
Population/Employment Estimates — 1997, NDWP Forecasts — 2000–2020
(Annual Averages — Persons and Workers)

NEVADA	1997	2000	2005	2010	2015	2020	1997-2020 Change	1997-2020 Percent Change*
Population	1,779,850	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846	1,266,996	71.2%
Employment	888,574	987,950	1,162,764	1,310,176	1,423,256	1,511,617	623,043	70.1%
Employment-to- Population Ratio	49.9%	49.9%	49.8%	49.7%	49.7%	49.7%	–	-0.20%

Note: Changes in the employment-to-population ratios are measured in percentage points. The Nevada employment-to-population figure is based on the aggregation of individual county estimates (1997) and forecasts (2000–2020).

Source Data: Population estimates (1997) – Nevada State Demographer; employment estimates (1997) – Nevada Department of Employment, Training and Rehabilitation (DETR); population and employment forecasts (2000–2020) – Nevada Division of Water Planning (NDWP). Population forecasts for Clark County were provided by the Clark County Department of Comprehensive Planning; population forecasts for Washoe County were derived from forecasts adopted by the Washoe County Department of Community Development.

Fig. 2-25. Nevada Population and Employment Forecasts presents forecasts of Nevada’s population and employment through the planning horizon. Population forecasts are more fully presented in the Appendix 2 of the Appendices while the employment forecasts are presented in Appendix 3 of the Appendices and are derived from the forecasts of employment-to-population ratios developed for each county. The total state figures are obtained from an aggregation of the individual county estimates and forecasts.

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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.

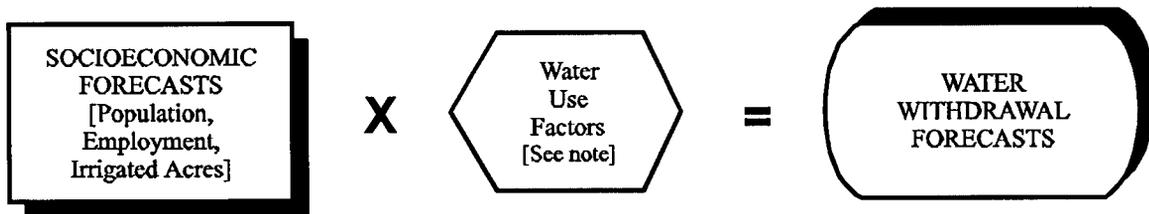
The Forecast Methodology

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



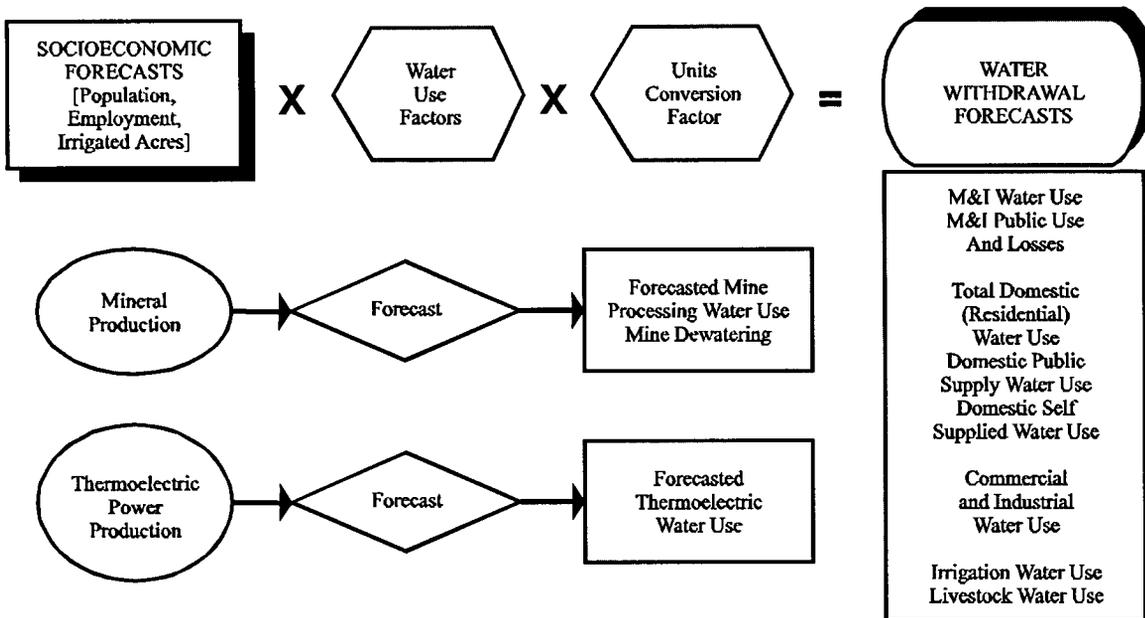
Note: Water Use Factors Measured in Gallons per Capita per Day, Gallons per Employee per Day, or Acre-Feet per Acre per Year

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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



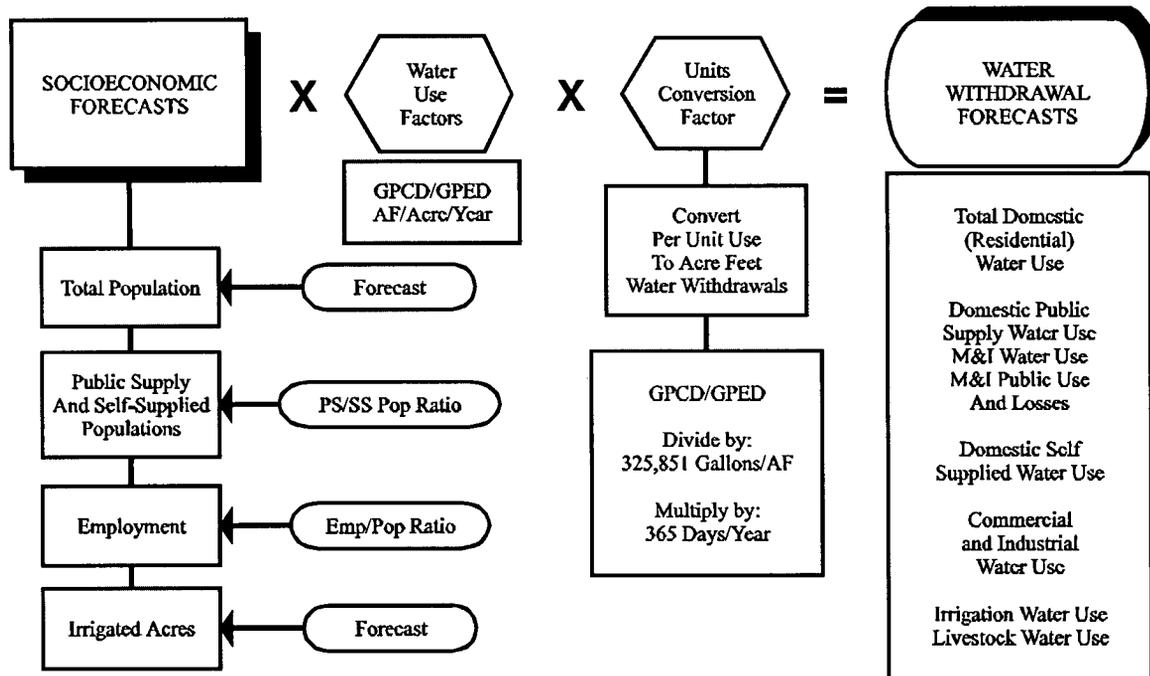
Nevada Division of Water Planning/Socioeconomic Analysis and Planning

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



Nevada Division of Water Planning/Socioeconomic Analysis and Planning

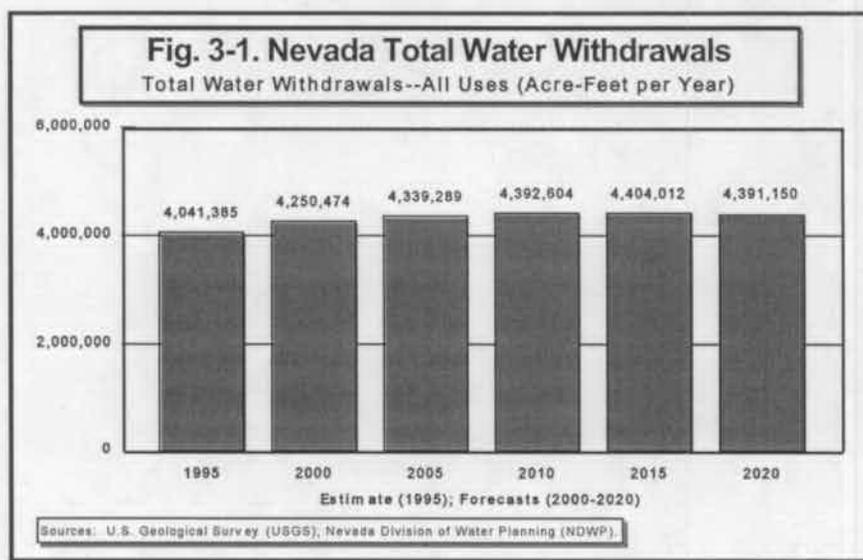
in Flow Chart 3) provides both a public supply population and a self-supplied population from which (using appropriate water use factors) domestic public supply and domestic self-supplied water withdrawal forecasts are made. The total municipal and industrial water withdrawals are projected using the estimates of the population on public

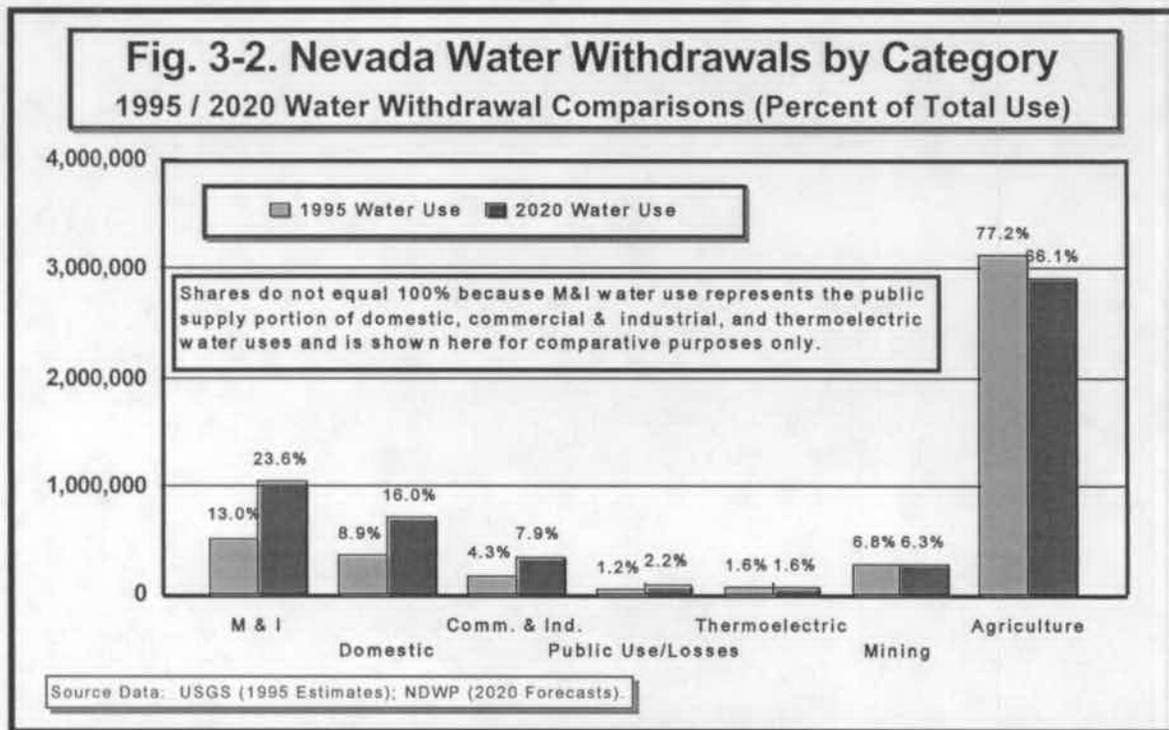
supply water systems multiplied by a M&I water use factor. The M&I public use and losses are estimated (at approximately 10 percent of total M&I water withdrawals for the total state) based on historical public use and losses.

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

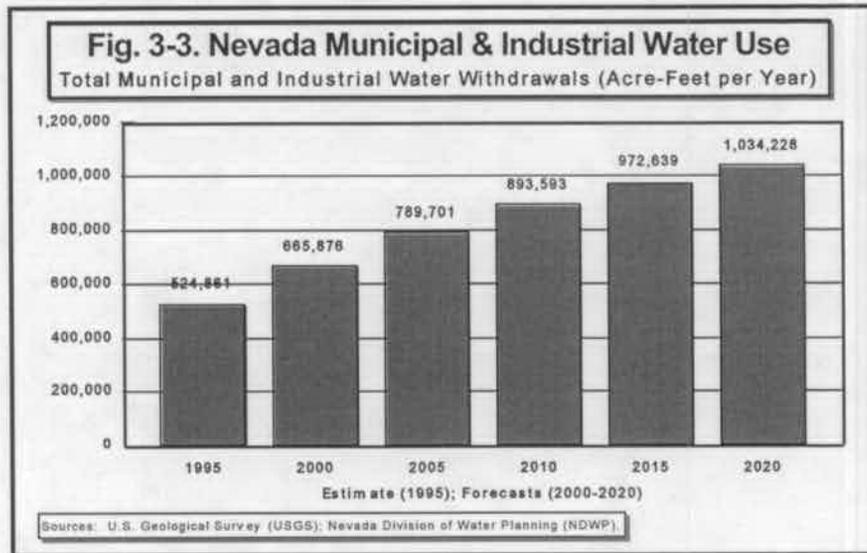
[6] Total Agriculture Withdrawals include both irrigation and livestock water use.

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.



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

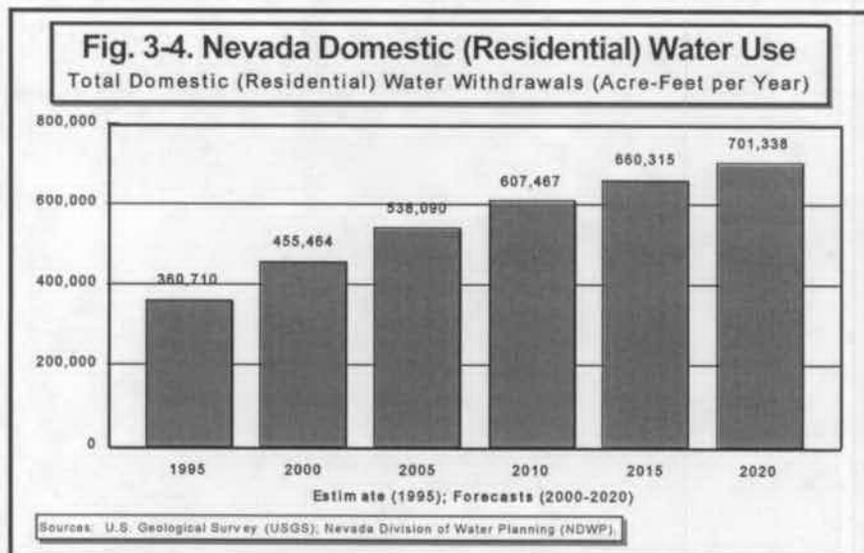
approach also assumes that other principal M&I uses, i.e., commercial and industrial, have constant usage rates in gallons per worker per day. Based on both increasing population and commercial development, water use forecasts call for total M&I water withdrawals to increase from an estimated 524,861 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).

Nevada State Water Plan

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.

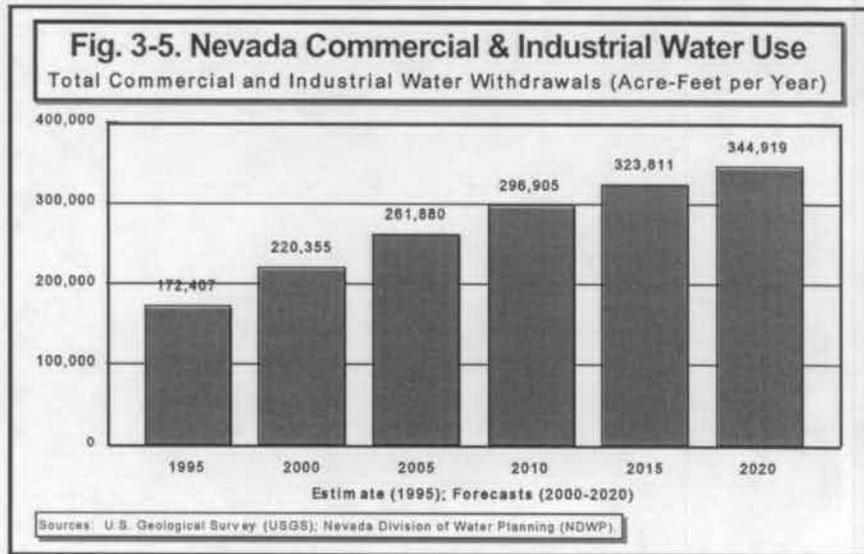
[2] Excludes water used in mining operations and by mining workers; mining water use is calculated separately.

[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).

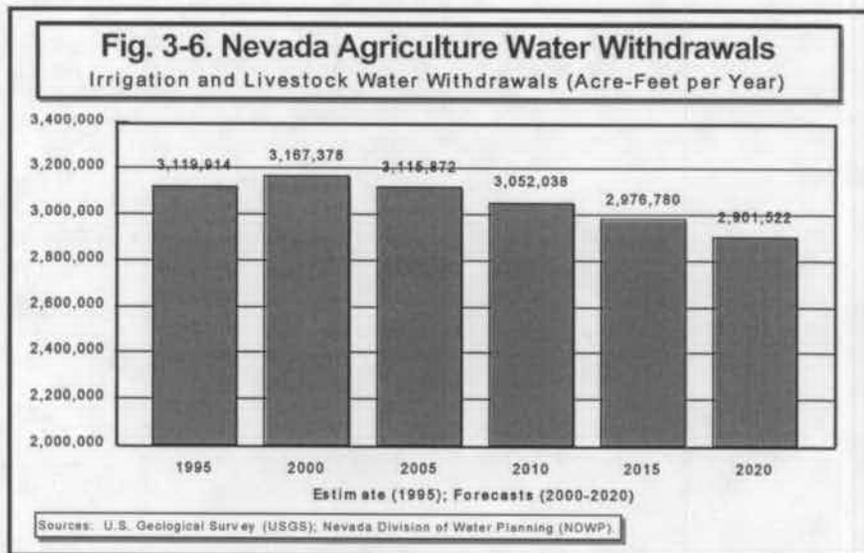
The employment forecasts for each county were determined from historical trends in that county’s employment-to-population ratio. Individual county information showing population forecasts, forecasts of each county’s employment-to-population ratio, total employment and mining employment

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.

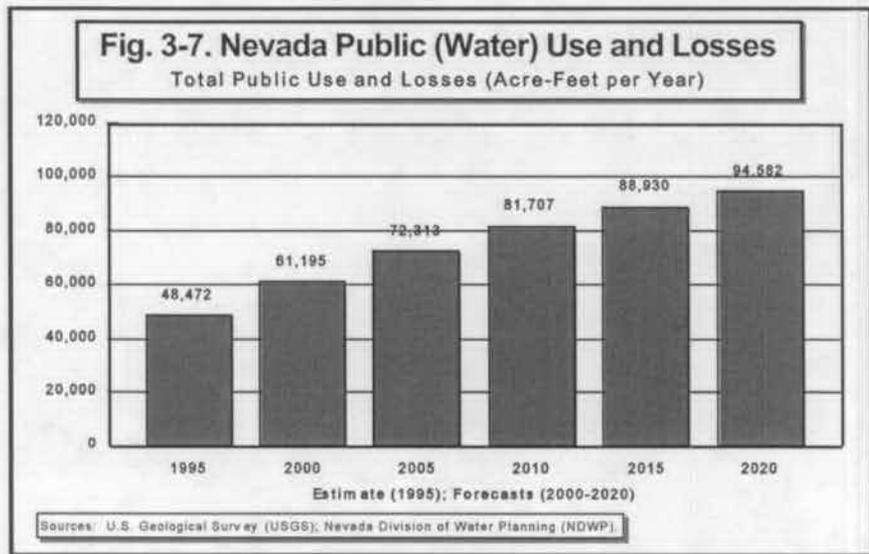
† Consumptive uses for both irrigation and livestock are estimated from a fixed percent of respective water withdrawals.

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.



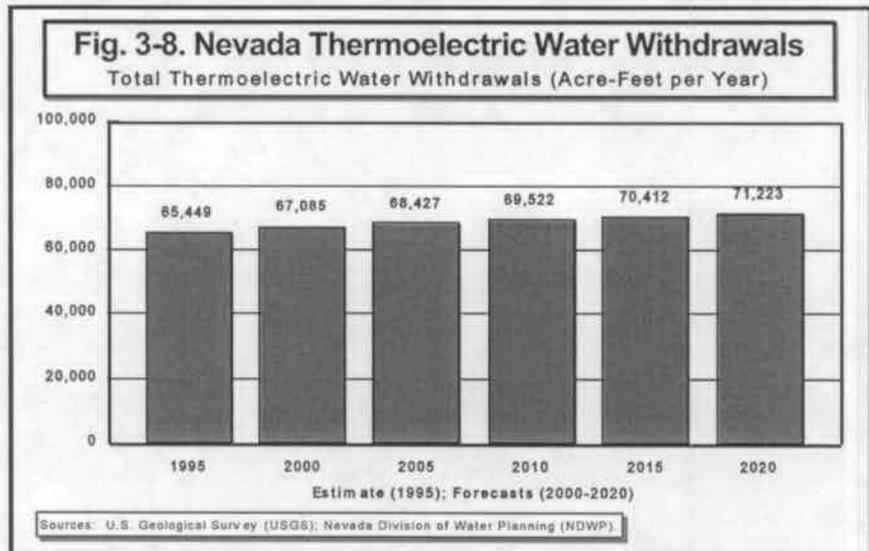
Public Use and Losses

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

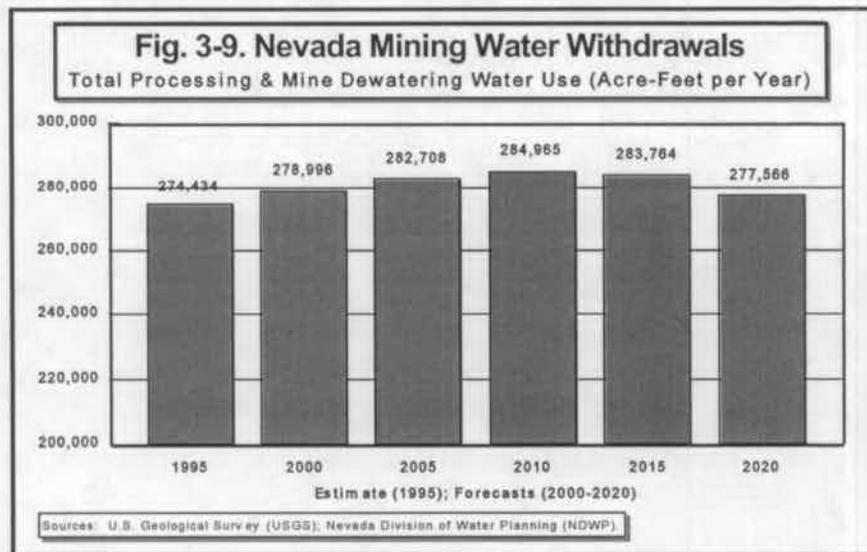
Forecasts for the statewide total thermoelectric water



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.

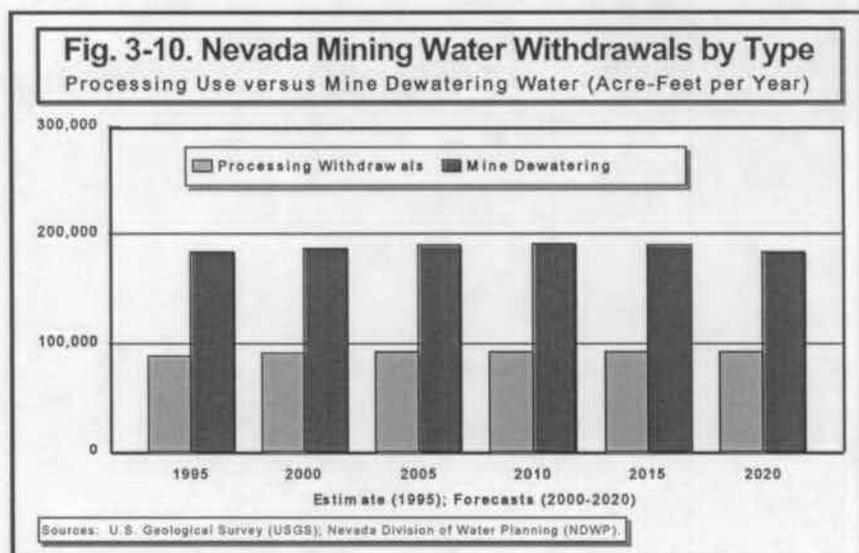
Mining Water Withdrawal Assumptions and Forecasts

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).

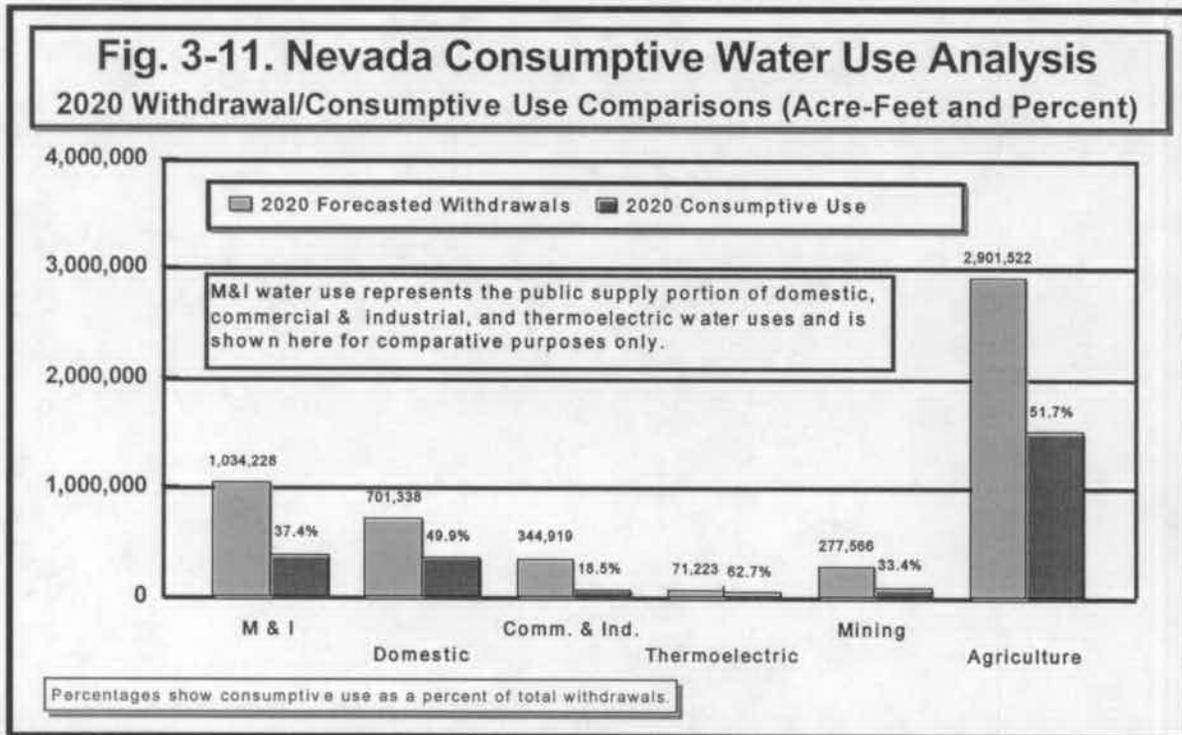
[6] Total Agriculture Withdrawals includes both irrigation and livestock water withdrawals.

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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Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 4
Meeting Our Future Water Supply Needs

Introduction

The future presents Nevada with many water resource challenges as a result of an ever increasing population, and competition over our limited water resources. Every effort should be made to ensure that all Nevadans have adequate and safe water supplies while protecting the quantity and quality of our water resources for current and future uses. This section of the *State Water Plan* is intended as an overview of future water demands, alternatives for meeting those needs, and water supply options identified in regional water plans.

Future Demands

As presented in Part 2, Section 3 of the *State Water Plan*, total statewide annual water withdrawals during the period 1995 to 2020 are forecasted to increase about 350,000 acre-feet (af) from 4,041,000 to 4,391,000 acre-feet per year (afy), assuming current levels of conservation. Correspondingly, annual consumptive use will increase about 96,000 af from 1,957,000 to 2,053,000 afy. This projected increase in water use is directly attributable to increasing population and related increases in economic endeavors, resulting in rising public supply (M&I), domestic, commercial, industrial and thermoelectric water usage.

The anticipated increase in total statewide water withdrawals is primarily the result of increasing public supply (M&I) water usage. Annual M&I water use is projected to increase by 509,000 af from 525,000 to 1,034,000 afy, almost doubling from 1995 to 2020. A majority of this increase in demand will be met with surface water supplies. Approximately 91 percent of this increase can be attributed to anticipated growth in Clark and Washoe counties. It is expected that M&I usage will account for almost one-quarter of the total statewide usage by 2020. One of Nevada's water resource challenges will be meeting the water needs of the nearly 3 million people expected to reside in the state by 2020.

The M&I water use projections presented in Part 2 of the *State Water Plan* are based upon existing water use patterns and conservation measures and do not include the effects of future conservation efforts. The implementation of additional M&I conservation measures will result in lower M&I water withdrawals (in 2020) than the 1,034,000 afy predicted in the water plan. Planning groups for Southern Nevada and Washoe County have estimated that their proposed additional conservation measures will result in annual M&I withdrawals about 150,000 af less than would occur without these additional measures. The achievement of additional conservation is an integral part of Southern Nevada's water supply plan for the future.

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Based upon the economic forecasts in Part 2 of the *State Water Plan*, agricultural water use could experience a 7 percent decline through 2020. Nonetheless, agriculture will continue to account for a majority of the statewide use during the next 20 years. It must be noted that statewide agricultural water use is highly variable depending upon weather conditions and water supplies, and can vary more than 25 percent from a wet year to a dry year as a result of changing water availability. While the projections in the *State Water Plan* suggest that agricultural water use will decrease in the future, planning and management efforts need to consider providing more reliable water supplies for irrigation during drought periods.

Almost 6 to 7 percent of statewide water withdrawals occur in the mining industry. It is anticipated that mining water withdrawals will remain relatively constant at around 275,000 afy with a slight increase over the next 10 years followed by a slight decline after 2010. A majority of the withdrawals are associated with mine dewatering, and about 185,000 acre-feet per year of these withdrawals are either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. The impacts of these future mine dewatering activities will continue to be monitored and evaluated.

Water Availability

Approximately 60 percent of the water withdrawn in Nevada comes from surface water sources. Most of Nevada's surface water is the result of runoff from melting snow, with peak flows generally occurring in May and June. Available surface water supplies are highly dependent upon weather conditions with variable monthly and annual flows. For example, the Humboldt River at Palisade (midway down the river) has experienced flows of 1,336,000 acre-feet during one year and only 25,000 acre-feet during another year. With such wide fluctuations, it is difficult to provide adequate and consistent water supplies to users on the system. Utilization of above ground and below ground storage capabilities are one strategy for smoothing out some of the flow fluctuations, thereby guaranteeing more reliable supplies.

Generally, Nevada's surface water sources have been fully appropriated and utilized for many years. Expanded usage of our surface water resources can only occur to a restricted extent. With limited "excess" surface water available, those looking to surface supplies to meet future demands will need to examine a variety of options such as water right acquisitions and transfers, storage and improved management.

Groundwater supplies provide about 40 percent of our water needs. In some areas, groundwater is used as a sole source. In other areas, groundwater is used as a supplemental source during times of limited surface water flows. Currently, about 60 percent of Nevada's groundwater basins have varying amounts of water available for additional appropriations for agriculture, urban and other uses. However, most of these groundwater resources exist in areas distant from the anticipated water demand growth areas. Development of these sources can become an expensive endeavor if interbasin transfers are involved.

Options for Meeting Future Water Needs

Meeting our future water needs will require implementation of a combination of strategies. Possible strategies have been divided into two categories: demand management and supply development. Through demand management, water purveyors make wiser use of the available water thereby lessening the need for new source development. Supply development strategies include a variety of methods for increasing supplies and improving supply reliability.

Increasing demands and competition for our limited resources oblige water managers and suppliers to implement both demand management and supply development strategies. However, each option needs to be evaluated on a case-by-case basis for suitability, cost effectiveness and public acceptance.

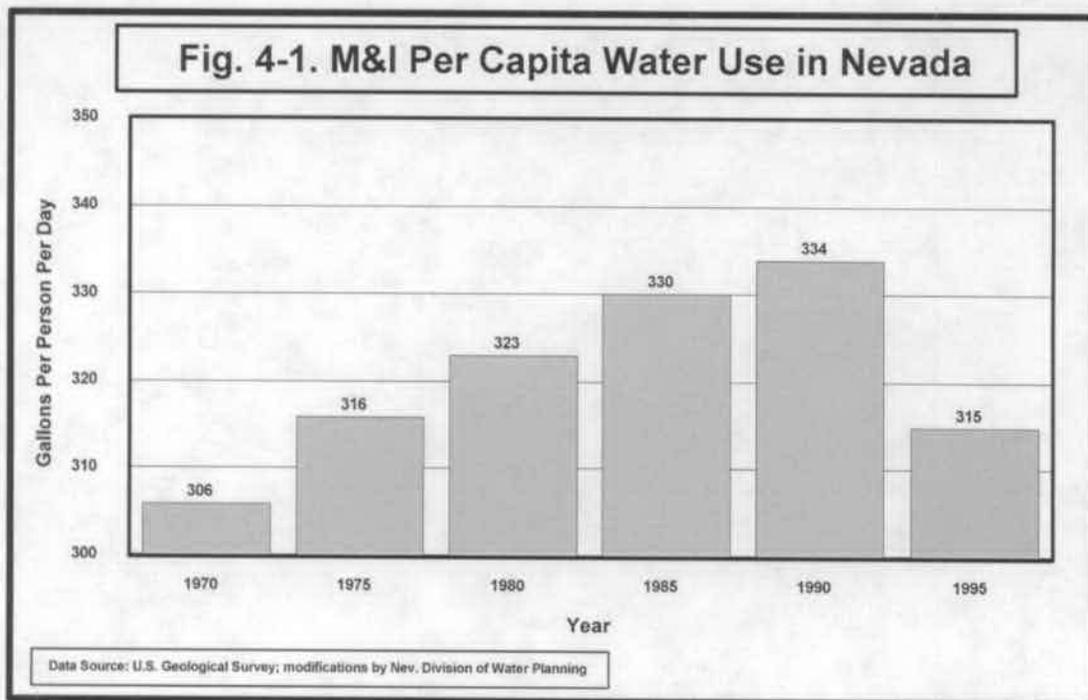
Demand Management Strategies

The time is past when water supply needs can be met simply by developing more water withdrawal, storage and delivery systems. Demand management must also be part of any long-range water supply plan. By reducing demands, new supply developments can be delayed with potential savings to the users. Demands can be managed through conservation measures and alternate strategies such as effluent reuse, greywater use and dual water systems.

Conservation. Conservation is recognized by most water suppliers and users as a cost-effective approach for extending water supplies, improving supply reliability during times of shortages, and deferring the need for new supply development. Numerous case studies have shown that a good conservation program can reduce demands significantly.

A comprehensive municipal water conservation program typically includes features such as: water system audits and leak detection, a public information and awareness program, utilization of increasing block billing, new ordinances, installation of low flow fixtures, landscape demonstration projects, use of drought tolerant plants and implementation of a xeriscape program, and installation of meters.

From 1970 to 1990, Municipal & Industrial (M&I) water use rates in Nevada were on the rise (Figure 4-1). Successful conservation programs during the 1990s have lowered statewide M&I water use from 334 gallons per person per day (gpcd) in 1990 to 315 gpcd in 1995. In the Las Vegas area, the critical impact of conservation to the region's water planning efforts has been recognized by the Southern Nevada Water Authority and participating water purveyors. The local governments and water suppliers have implemented a variety of conservation measures, such as: banning the creation of artificial lakes, adopting water waste ordinances, restricting lawn watering, establishing increasing block rates for billing purposes, establishing an active public education and outreach



program, and pursuing the use of lower quality water in lieu of potable supplies where feasible. As a result of these conservation efforts, Municipal & Industrial (M&I) water use in the Las Vegas Valley Water District has decreased from 358 gpcd (gallons per capita per day) in 1989 to 320 gpcd in 1997. Residential use has decreased from 213 gpcd to 197 gpcd during the same period.

Agricultural conservation programs typically include: laser leveling of fields, lining of ditches, use of soil and plant moisture monitoring devices, conversion to overhead or drip irrigation methods, and selection of low water use crops. Nevada's agricultural community has been implementing many of these conservation measures throughout the State, particularly in the Walker River and Carson River basins and the Lovelock area (Humboldt River basin).

For additional information on conservation, refer to Part 3 of the *State Water Plan*.

Alternate Strategies for Reducing Potable Water Demands. Conservation reduces potable water demands by decreasing the overall water needs of the users. Other options to achieve potable water demand reductions involve the utilization of lower quality water in lieu of treated potable water. The main options in this category include: effluent reuse, greywater reuse and dual distribution systems. These alternate strategies may not reduce overall water usage, but rather shift some of the demand from one water source (potable) to another (nonpotable). These approaches may not be appropriate in all situations and must be examined on a case-by-case basis.

- **Effluent reuse.** One way to reduce demands for potable water and thus extend the higher quality supplies is through the use of treated wastewater effluent as a replacement source in Nevada.

Current uses for reclaimed water include: urban landscaping such as golf courses, parks, road medians, cemeteries, etc.; agricultural irrigation; industrial uses such as cooling water and process water; wetlands applications; and construction water.

Effluent reuse is not only a tool for managing and reducing potable water demands, but also a tool for managing treated wastewater. Increasingly stringent wastewater discharge requirements have induced some municipalities and industries to seek alternative methods to dispose of treated wastewater effluent. Effluent reuse decreases potable water demands only if it is used as a replacement source.

Effluent reuse is increasing in Nevada. In Clark County, approximately 11,000 acre-feet of treated wastewater was reused for landscape and golf course irrigation, and power plant purposes during 1997. The Southern Nevada Water Authority has projected wastewater reuse to reach approximately 25,000 acre-feet per year by the year 2000. Approximately 4,000 acre-feet of the wastewater generated in Washoe County (about 2,000 acre-feet from Lake Tahoe basin for reuse in Douglas County, about 2,000 acre-feet from Truckee Meadows area) was reused during 1997 for landscape, golf course and agricultural irrigation, and environmental uses, such as wetlands. According to the "1995-2015 Washoe County Comprehensive Regional Water Management Plan," effluent reuse is expected to increase as treated wastewater is substituted for fresh water used for irrigation. The City of Carson City reuses all of its treated wastewater (approximately 6,000 acre-feet in 1997) for landscape and agricultural irrigation, and will continue to do so as the community population and the associated wastewater volumes increase. Also, all wastewater generated (about 4,000 acre-feet in 1997) in Nevada's portion of the Lake Tahoe basin is exported for reuse in Douglas County.

Treated wastewater is also used in other counties, primarily Elko, and Lyon. Generally, effluent reuse has served both as a replacement for potable water and as an alternative disposal method.

- **Greywater Use.** Another potential method for reducing potable water demands is to irrigate trees and shrubs with greywater - water that has already been used for bathing or clothes washing. Greywater can account for more than one-half of all residential indoor water use. However, some household water, such as wastewater from toilets, kitchen sinks, dishwashers, or laundry water from soiled diapers, is not suitable for reuse because it may contain bacterial contaminants, grease or residues of detergents that are harmful to plants. Because greywater systems require dual piping, surge tanks and distribution piping, they can be expensive to install and may be more suitable for new construction rather than retrofit situations.

In the early 1990s, California developed standards for household use of greywater for irrigation. The standards set specifications for plumbing design and equipment to ensure that greywater is safe for intended uses. The California Urban Water Conservation Council considers greywater use to be a potential Best Management Practice (BMP), but has taken no action to elevate it to a mandatory BMP. At this time, greywater is reused to a limited extent in Nevada.

- **Dual Water Systems.** The use of dual water systems is another method for reducing potable water demands. With this strategy, lower quality water (nonpotable) is used for outdoor landscape irrigation and is delivered to users via a second pipeline system separate from the potable water distribution network.

Approximately one-third of our treated drinking water is used for landscape irrigation. Utilizing untreated water for landscape purposes has the potential to significantly decrease potable water needs. Dual water systems allow public water systems to extend their high quality water sources and reduce water treatment costs. However the requirement for an additional distribution system can cause dual water systems to be cost prohibitive. As with some of the other demand management strategies, the use of dual water systems may be more cost effective for new construction and limited retrofit situations.

Dual water systems are common along the Wasatch Front in Utah. Most communities in that area utilize dual systems to pipe untreated water for landscape water purposes.

Supply Development Strategies

Supply development strategies include alternative methods for increasing supplies and improving supply reliability, such as use of uncommitted supplies, acquisition and transfer of existing water rights, improved management of both groundwater and surface water supplies, utilization of lower quality (saline) water, and increasing natural supplies. The strategies presented in the following discussion may not be appropriate in all situations and must be examined on a case-by-case basis.

Use of Existing Committed and Uncommitted Supplies. With this strategy, water suppliers further utilize supplies under their existing water rights and/or obtain new appropriations for previously unallocated water. In general, future new allocations will be limited to groundwater as most of the surface water resources have been fully appropriated. For some areas of Nevada, this strategy may be an expensive proposition as most of the unappropriated groundwater resources exist in areas distant from the growing metropolitan areas.

Water Transfers. One tool for increasing available supplies to meet future demands is water transfers. Under this option, water rights are purchased or leased from one user for use by another. As most groundwater and surface water sources are fully appropriated, opportunities for new appropriations are typically limited to basins distant from the growing metropolitan areas. In some cases, water transfers from existing uses may be more cost effective than developing distant sources.

Additional information on transfers is provided in the "Interbasin Transfer" discussion in Part 3 of the *State Water Plan*.

Groundwater Recharge and Recovery. Artificially recharging aquifers is a water resource management option available to some areas as a means of securing more reliable water supplies during periods of low surface water flows. This strategy involves recharging groundwater aquifers with available surface water for later use. In effect, it makes use of an underground reservoir to store water in much the same way that surface water reservoirs are used. The stored water is then removed

when needed to augment other supplies. It must be noted that groundwater recharge/recovery is only feasible in certain areas as dictated in part by aquifer conditions.

Underground water storage has a number of advantages over surface reservoirs. In general, surface reservoirs may have higher construction costs and more difficult environmental permitting requirements, and higher water losses (due to evaporation). Nevada state water law provides criteria for the establishment of groundwater recharge/recovery programs.

Additional information on groundwater recharge and recovery is provided in the “Integrated Groundwater and Surface Water Management” discussion in Part 3 of the *State Water Plan*.

Conjunctive use. Conjunctive use is the coordinated management of both surface water and ground water supplies. Under an active form of conjunctive use, surface water is used when available, excess surface water (if available) is stored in groundwater aquifers, and groundwater and stored surface water is then pumped to meet demands over and above those met with the surface water supplies. (Note: With the groundwater recharge/recovery strategy, only the stored surface water is removed to augment existing surface water supplies.) A passive form of conjunctive use is to simply rely on surface water in wet years and use groundwater in dry years with no institutional groundwater recharge program. Benefits of conjunctive use include improved management of resources, more reliable supplies, emergency and drought relief capacity, and summer peaking options.

Additional information on conjunctive use is provided in the “Integrated Groundwater and Surface Water Management” discussion in Part 3 of the *State Water Plan*.

Desalination. Desalination is a process that removes dissolved minerals (including but not limited to salt) from seawater, saline water, or treated wastewater. A number of technologies have been developed for desalination, examples being reverse osmosis (RO) and distillation. Of the more than 7,500 desalination plants in operation worldwide, 60 percent are located in the Middle East. In contrast, 12 percent of the world’s desalination capacity is in the Americas, with most of the plants located in the Caribbean and Florida. According to the California Water Plan, California has more than 150 desalting plants (combined capacity of 66,000 acre-feet per year) providing freshwater for municipal, industrial, power, and other uses. In California, the main applications, in order of treatment capacities, are groundwater recovery, wastewater desalination and seawater desalting.

The desalination of saline waters is proven technology but has little application in Nevada. While Nevada does have areas of high salinity groundwater, the cost of developing other freshwater supply options has been more cost effective. Desalination may become more cost effective in the future as available freshwater sources become fully utilized and/or more expensive to develop. As long as cheaper freshwater sources are available, future use of desalination plants in Nevada will be limited.

Desalination for Southern Nevada has been suggested in the form of an exchange with California, i.e. Las Vegas would pay for desalination facilities in California in exchange for the use by Southern Nevada of a portion of California’s Colorado River apportionment. However, high desalting costs continue to keep this option as a lower priority.

Cloud Seeding. Cloud seeding is a weather modification technique involving the injection of a substance into a cloud for the purpose of increasing precipitation amounts, thereby increasing snowpack amounts and associated streamflows. In northern Nevada where the primary water source is snowmelt from the Sierra Nevada and other mountain ranges, the appropriate cloud seeding option is one which augments the winter snowpack over these mountain ranges.

Operational cloud seeding over mountain ranges in the western United States has been conducted for over 40 years. Currently, most of the watersheds on the western slopes of the Sierra Nevada have wintertime cloud seeding projects associated with them, with sponsorship primarily by farming organizations and power companies. The value of water to these groups has made cloud seeding a viable alternative for additional water for many years. Cloud seeding first began in Nevada in the Lake Tahoe basin in the 1960s. Currently, cloud seeding activities exist in the drainage basins of Lake Tahoe, Truckee River, Carson River, Walker River, upper Humboldt River, South Fork of the Owyhee River, and Reese River. The Desert Research Institute has designed and operated the Nevada state cloud seeding program since its inception. Estimates of augmented water from seeding have varied from 35,000 to 60,000 acre-feet over each of the last ten years.

Meeting Future Municipal and Industrial (M&I) Water Needs

As already discussed, statewide M&I water use could increase from 525,000 to 1,034,000 acre-feet per year by the year 2020 if current water use patterns continue. Approximately 91 percent of this increase can be attributable to anticipated growth in Clark and Washoe counties. According to planning documents for Clark and Washoe counties, the increase in their M&I demands will be met primarily with expanded utilization of surface water supplies. Projections show that a number of other counties are also expected to experience significant M&I water use growth from 1995 to 2020: Nye (113 percent), Lyon (105 percent), Churchill (89 percent), Pershing (76 percent), Douglas (74 percent), Elko (64 percent), Storey (57 percent), Carson City (56 percent), and Humboldt (55 percent).

Many of these counties have developed or are actively developing plans to deal with these increasing water needs. The most common solutions being considered in these plans are: conservation; expanded use of current supplies; acquisition and transfer of existing rights; reclaimed water use; groundwater recharge/recovery; and conjunctive use. Following is a discussion of some regional water planning efforts that have been undertaken around the State. This is not intended to be an exhaustive presentation of all water supply planning activities in Nevada, but rather an overview of some of the major M&I supply challenges facing different regions and associated potential solutions. Each region has its own unique set of challenges and solutions must be evaluated on a case-by-case basis.

Southern Nevada Water Authority

The Southern Nevada Water Authority (SNWA) was created in 1991 through a cooperative agreement among the seven regional water and wastewater agencies in Clark County. SNWA membership includes:

- Big Bend Water District (Laughlin)
- City of Boulder City
- Clark County Sanitation District
- City of Henderson
- City of Las Vegas
- Las Vegas Valley Water District
- City of North Las Vegas

It should be noted that water use by entities within the Authority accounts for a majority of the Municipal & Industrial (M&I) use in Clark County. The purposes of SNWA are to seek new water resources for Southern Nevada, to manage existing and future water resources, to construct and manage regional water facilities, and to promote responsible conservation. In 1994, the Authority began an integrated resource planning process to aid in the selection of appropriate combinations of resources, facilities and conservation programs to meet future water demands in Southern Nevada. The SNWA Water Resource Plan was completed January 1996 and amended February 1997.

Water Use Forecasts. M&I water withdrawals in Clark County have been forecasted by the Division of Water Planning to increase from about 380,000 acre-feet in 1995 to 784,000 acre-feet in 2020 (Table 4-1). This value corresponds favorably with SNWA's Year 2020 forecasts ("With Existing Conservation" Scenario) for Authority water purveyors. Conservation measures are being successfully implemented by SNWA purveyors. For example, Las Vegas Valley Water District has reduced their total M&I usage from 358 gallons per capita per day (gpcd) in 1989 to 320 gpcd in 1997, a decline of about 11 percent. Domestic usage decreased from 213 gpcd to 197 gpcd during that same period.

The achievement of additional conservation is an integral part of SNWA's Water Resource Plan and needed to meet demands to the Year 2025. Based upon planned additional conservation in the future, SNWA estimated M&I water withdrawals to be approximately 642,000 acre-feet in the Year 2020 and 714,700 acre-feet in 2030 (Table 4-1). The SNWA Water Resource Plan presents options for meeting these demands.

Table 4-1. Comparison of M&I Water Withdrawal Projections for Southern Nevada

Agency	Scenario	Applicable Region	1995 (acre-feet)	2020 (acre-feet)	2030 (acre-feet)
USGS	Estimated historic use	Clark County	380,000	not applicable	not applicable
NDWP	Based upon 1995 water use and conservation patterns	Clark County	See USGS data	784,000	not applicable
SNWA (per SNWA Water Resource Plan)	Based upon existing conservation measures	SNWA water purveyors (Note: Includes about 96% of Clark County's M&I usage; includes both potable and nonpotable water usage)	364,400	777,500	865,400
	With planned additional conservation greater than 1995 patterns			642,000	714,700

Data Sources: U.S. Geological Survey, SNWA Water Resource Plan (1997), Nev. Division of Water Planning

Supply Options. According to the SNWA Water Resource Plan, water demands can be met from now until approximately 2007 by fully utilizing the Authority's existing long-term water supplies, unused Nevada (non-SNWA) Colorado River water, the Las Vegas Valley aquifer, and continuing conservation efforts. The existing long-term water supplies include:

- reclaimed water;
- current groundwater rights;
- pre-1992 Colorado River water rights;
- Colorado River water acquired from Southern California Edison and Basic Management Inc.; and
- SNWA's 1992 contract with the Secretary of the Interior for additional Colorado River water.

To meet increased water demands from 2007 until 2025, the Authority intends to utilize Colorado River surpluses (if available), the Southern Nevada Groundwater Bank, the Arizona Banking Demonstration Project, and the future Arizona groundwater bank (if necessary). The Authority also intends to exercise the 1992 contractual rights it has with the Secretary of the Interior (right similar to those relied upon by California). These rights provide for an annual distribution by the Secretary of the Interior of unused apportionments and surplus flows within the lower Colorado River. Banked water, unused apportionments and surplus flows are all critical resources for the Authority. Since unused apportionments and surplus flows are uncertain, however, the Authority will continue to aggressively pursue other future resources.

Under the Southern Nevada Groundwater Bank, the Las Vegas Valley Water District is recharging available Colorado River water into the regional groundwater system for later use. Under the Arizona Banking Demonstration Project, the Authority paid the Central Arizona Water Conservation District to store a portion of Arizona's Colorado River apportionment in Arizona aquifers for use by Nevada. Under certain conditions, Nevada will be able to divert additional Colorado River water in exchange for the water stored in the Arizona aquifers.

To meet water demands beyond 2025, future resource possibilities for SNWA include: utilization of surface water from the Virgin and/or Muddy rivers, Colorado River water banked in the Southern Nevada Groundwater Bank or the Arizona Groundwater Bank, managed surpluses of Colorado River water, Colorado River transfers and marketing, or construction of the Cooperative Water Project to import groundwater from sixteen hydrologic basins in southern and eastern Nevada via a pipeline network.

Washoe County

In 1995, the Nevada State Legislature approved legislation which created the Washoe County Regional Water Planning Commission and provided the basis and direction for the Commission and the 1995-2015 Washoe County Comprehensive Regional Water Management Plan. This legislation required that the Commission develop "...a comprehensive plan for the region covering the supply of municipal and industrial [public supply] water, quality of water, sanitary sewerage, treatment of sewerage, drainage of storm waters and control of floods." The plan was completed and approved by the 1997 State Legislature. All areas of Washoe County are included in the plan except for the Tahoe Basin, the Pyramid Lake Paiute Reservation, and generally the area north of Pyramid Lake. Water use by the public water systems within the Washoe County Plan area accounts for a majority of the potable water use in Washoe County.

Water Use Forecasts. The Washoe County Plan includes potable water withdrawal projections up to the year 2015 and discusses options for meeting these future needs. Because of uncertainty in future water use patterns, the Washoe County Plan provides a range of potential water use figures.

The Division of Water Planning projected Washoe County public supply withdrawals at 115,800 acre-feet per year for the year 2015 and 123,000 acre-feet for 2020 (Table 4-2). These forecasts were developed using factors representative of 1995 water use patterns and conservation efforts. NDWP's 2015 forecast of 115,800 acre-feet per year is just slightly higher than Washoe County's forecast of 111,500 (with 1996 typical conservation). One reason for the difference is that the NDWP projections include Lake Tahoe, Pyramid Lake Paiute Reservation, and northern Washoe County public supply water usage.

At the direction of the Washoe County Regional Water Planning Commission, the Washoe County Plan identifies the scenario "with Negotiated Settlement" (94,000 acre-feet in the year 2015) as the most probable potable water demand projection. The Washoe County Plan also provides non-potable water demand forecasts. According to the Plan, "[T]he outlook [for non-potable water usage] is for a broad decline in freshwater use to irrigate large public areas (e.g. parks, golf courses) and remaining agricultural lands."

Table 4-2. Comparison of M&I Water Withdrawal Projections for Washoe County

Nevada State Water Plan

Agency	Scenario	Applicable Region	1995 (acre-feet)	2015 (acre-feet)	2020 (acre-feet)
USGS	Estimated historic use	Washoe County	79,400	not applicable	not applicable
NDWP	Based upon 1995 water use and conservation patterns	Washoe County	See USGS data	115,800	123,000
Washoe County (per Washoe County Water Plan)	With 1996 typical conservation	Washoe County excluding Lake Tahoe basin, Pyramid Lake Paiute Reservation, and northern regions (Note: includes about 95% of Washoe County's M&I usage)	83,300 ¹	111,500 ¹	not available
	With Negotiated Settlement conservation and metering			94,000 ¹	
	With aggressive conservation			86,600 ¹	

¹Values include water withdrawals for domestic wells, however the Washoe County Plan does not provide a detailed breakdown to represent estimated domestic well usage. According to NDWP estimates, 1995 domestic water use was approximately 5,000 acre-feet.

Data Sources: U.S. Geological Survey, 1995-2015 Washoe County Comprehensive Regional Water Management Plan (1997), Nev. Division of Water Planning

Supply Options. Current primary water sources for public supply systems within the Washoe County Plan study area include Truckee River water (about 75 percent) and/or groundwater (about 25 percent). Both of these sources are utilized to meet potable water needs in the Central Truckee Meadows and some outlying areas. For most of the basins outside the Central Truckee Meadows, groundwater is the primary water resource. Conjunctive use of Truckee River water and groundwater is implemented to optimize the yield of the region's water resources, thus reducing the risk that some outlying basins in Washoe County will experience groundwater overdrafts in the near future. Of the current potable water withdrawal of approximately 83,000 acre-feet/year, about 60,000 to 70,000 acre-feet is diverted from the Truckee River with the remainder withdrawn from groundwater sources. The primary water purveyor in Washoe County is Sierra Pacific Power Company (SPPCo) which has produced its own plan entitled "1995-2015 Water Resource Plan." Since issuance of its plan, SPPCo has entered into a service territory agreement with Washoe County making its Truckee River water supplies available regionwide through wholesale agreements. The Washoe County Regional Water Plan recommends that the SPPCo plan serve as the basis for water resource planning in the Central Truckee Meadows and adjoining systems which are interconnected to SPPCo.

The Washoe County Water Plan is based upon the assumption that the Negotiated Settlement (Public Law 101-618) will be fully implemented. The Negotiated Settlement not only provides sufficient water resources for the next 50 years or more, it also secures the community's existing Truckee River supply. The Settlement quiets bi-state claims to Truckee River water, resolves many years of litigation, provides environmental and Tribal benefits, and more than triples available drought storage. Upon full implementation, the Negotiated Settlement will provide a water supply from the Truckee River of 119,000 acre-feet/year (current usage is 60,000 to 70,000 acre-feet/year), sufficient to meet regional water needs well past the Year 2020. Incremental yield of the Negotiated Settlement has been estimated at 39,000 acre-feet per year which reflects the conversion of 42,900 acre-feet of

Truckee River irrigation rights to municipal uses.

Since the Negotiated Settlement is not yet in effect, SPPCo has studied and evaluated alternate resource options. In the event the Settlement is not completed, subsequent Washoe County Plan revisions will need to include alternate water supplies, including regional conjunctive use of resources, artificial recharge and contract(s) for storage in Federal reservoirs.

The Washoe County Water Plan also identifies water supply alternatives for meeting future M&I needs in the valleys north of the Central Truckee Meadows area. These options include: delivery of Truckee River water, and importation of surface water and groundwater from neighboring hydrographic basins.

Douglas County

In 1994, the “Carson Valley Comprehensive Water Plan” was prepared to provide a comprehensive review of municipal water resource supply and provisions of water service to the various communities within the Carson Valley. The plan elements and recommendations were updated and included in the Douglas County Master Plan adopted in 1996. This element of the Water Plan addresses the water needs of those public supply systems in the Carson Valley and Topaz Lake regions of the county. There are a number of public supply systems in the Lake Tahoe basin portion of Douglas County which are not included in the master plan element. Subsequent to the adoption of the 1996 Master Plan, Douglas County has developed updated water use projections for Carson Valley (Douglas County only).

Water Use Forecasts. NDWP has forecasted Douglas County M&I water withdrawals at approximately 18,000 acre-feet for the year 2015 and 19,200 acre-feet for 2020 (Table 4-3). Utilizing higher population estimates, the County has projected annual M&I use (excluding Lake Tahoe basin and the Topaz Lake area) at about 19,500 acre-feet by 2017.

Supply Options. The water element of the Douglas County Master Plan recommends that the future M&I demands (Year 2015) be met by consolidating some of the water systems and further utilizing existing M&I water rights. There are approximately 14 public water supply systems in the Carson Valley and Topaz Lake regions of Douglas County. When considered as a whole, these public supply systems possess sufficient cumulative M&I groundwater rights to meet future M&I water system demands beyond the year 2015. However some of the public supply systems have excess rights, while others have insufficient rights to meet these future demands. The Douglas Master Plan water and wastewater element recommends the physical interconnection of a number of these systems to benefit the systems with inadequate water rights and to improve overall water supply reliability.

Table 4-3. Comparison of M&I Water Withdrawal Projections for Douglas County

Agency	Scenario	Applicable Region	1995 (acre-feet)	2015 (acre-feet)	2020 (acre-feet)
USGS	Estimated historic use	Douglas County	11,100	not applicable	not applicable
NDWP	Based upon 1995 water use and conservation patterns	Douglas County	See USGS data	18,000	19,200
Douglas County Master Plan	With 1996 typical conservation	Douglas County - excluding Lake Tahoe basin and Topaz Lake area (Note: includes about 75% of Douglas County's M&I usage)	9,531 (1996)	19,500 (2017)	not applicable
	With 10% conservation			17,531 (2017)	

Data Sources: U.S. Geological Survey, Douglas County Master Plan (1996), correspondence from Douglas County, Nev. Division of Water Planning

Summary

The previous discussion presented a brief summary of current M&I water supply planning efforts undertaken by SNWA, Washoe County, and Douglas County. Each planning effort has identified strategies that may be useful for other planning efforts.

Upon reviewing these regional plans, a number of observations can be made and some lessons can be learned:

- Water purveyors are utilizing demand management as a means for delaying or reducing the need for additional supplies. Conservation has become commonplace and additional conservation measures are planned for the future. For example, the achievement of additional conservation is an integral part of Southern Nevada Water Authority's water supply plan for the future.
- Effluent reuse has increased in recent years and these plans indicate that this trend will continue during the planning horizon.
- In general, these plans call for a variety of strategies and sources for meeting future demands. By not putting all their eggs in one basket, water purveyors will be able to provide reliable and safe drinking water supplies.
- Conjunctive use and recharge/recovery program are recognized as useful tools for managing both groundwater and surface water sources. The implementation of conjunctive use and recharge/recovery programs will expand in the future.

- Municipal and Industrial water supply planning is being done on a regional basis. All persons within a region can benefit when planning includes all users and interest groups, and considers both water quantity and quality within a region.
- Creative water supply solutions are being developed. With our limited water resources and growing demands, it has become necessary to look for creative solutions, such as SNWA's Arizona Banking Demonstration Project.
- The positive value of regional, consolidated M&I water systems is being acknowledged. Improved water management and "economies of scale" can be realized through water system consolidation.
- Currently, there is little reliance upon greywater and dual water systems, and desalination treatment due to the higher costs of these options. These plans suggest that this trend will probably continue.

One or all of the options presented in the SNWA, Washoe County and Douglas County plans may have possible application for M&I water systems throughout Nevada. Other water purveyors and planners stand to gain valuable insight into their own water supply problems and solutions by studying other water plans.

Meeting Future Agricultural Water Needs

According to U.S. Geological Survey estimates, annual irrigation withdrawals have varied from 3.1 to 3.4 million acre-feet over the last 25 years. Irrigation withdrawals in 1995 were estimated at about 3.1 million acre-feet, with about 63 percent diverted from surface water sources. Historically, irrigated acreage and associated water usage has varied greatly from year to year in response to our fluctuating precipitation and surface water supplies. With highly variable streamflows in Nevada, those agricultural operations utilizing surface water are faced with unreliable supplies during low flow periods. As a result, many of these irrigators have developed groundwater supplies to supplement surface water sources. However, pumping groundwater is generally expensive and may not be cost effective in some cases.

Based upon past use trends, NDWP projects that statewide agricultural water withdrawals could experience a 7 percent decline through 2020. In part, encroaching urbanization and the transfer of agricultural water rights to other uses such as municipal and natural resource needs will drive future agricultural water use reductions.

While the projections in the water plan suggest that the agricultural water supply will be generally adequate to meet future usage, that should not preclude water managers, planners and users from evaluating other water supply and management issues and options such as:

- methods to improve water supply reliability for agricultural users dependent upon fluctuating surface water sources, including storage;
- implementation of water conservation methods;
- increased utilization of treated wastewater effluent; and
- development of available groundwater resources.

Meeting Future Mining Water Needs

Mining water withdrawals are anticipated to remain relatively constant at about 275,000 afy with a slight increase up to the year 2010 followed by a slight decline. Beginning in the early 1990s, a majority of the mining withdrawals have been associated with mine dewatering. These withdrawals have been significantly higher than the mines' consumptive use needs, thereby requiring the mining operations to develop alternative disposal methods for the excess water. A majority of this "excess" water has been either discharged to surface water systems, reinjected into aquifers or used by other sectors such as irrigation. It is anticipated that this trend will continue with pit dewatering activities generating water volumes in excess of mine processing and consumptive needs.

The forecasted future mining withdrawals are estimates only and are highly dependent upon the price of gold. Actual water use may also be affected by shifts from open pit mining to underground mining. However, some degree of mine dewatering is expected to continue regardless of the type of production activity.

Meeting Future Domestic Water Needs

Statewide domestic water withdrawals are forecasted to increase from about 361,000 afy to about 701,000 afy by 2020 in response to a growing population. Public supply systems are the primary providers of water for domestic uses. As of 1995, the domestic water needs for about 94.2 percent of Nevada's population were met by public water systems. This percentage is projected to increase to 95.4 percent by 2020. Nevertheless, the number of persons on domestic wells is still expected to increase from 92,000 to 140,000 over the next 20 years.

Meeting Future Commercial, Industrial and Thermoelectric Water Needs

In 1995, commercial, industrial and thermoelectric sectors withdrew about 238,000 af of water accounting for about 6 percent of total statewide withdrawals. Public supply systems met a majority (about 85 percent) of the total commercial needs in Nevada. In the industrial and thermoelectric sectors, self-supplied systems provided most (95 percent) of the water needs (Table 4-3).

Table 4-3. 1995 Commercial, Industrial and Thermoelectric Water Use

Sector	Self-Supplied Withdrawals (acre-feet per year)	Public Supplied Deliveries (acre-feet per year)	Total Water Use (acre-feet per year)
Commercial	23,500 [15% of total commercial]	129,700 [85% of total commercial]	153,200
Industrial	16,800 [87% of total industrial]	2,500 [13% of total industrial]	19,300
Thermoelectric	63,800 [98% of total thermoelectric]	1,600 [2% of total thermoelectric]	65,400
Total	104,100 [44% of total commercial, industrial, thermoelectric]	133,800 [56% of total commercial, industrial, thermoelectric]	237,900

Source: U.S. Geological Survey

By the year 2020, commercial, industrial and thermoelectric withdrawals are projected to increase to about 416,000 afy. It is anticipated that public supply systems will continue to satisfy a majority of future commercial water needs, while self-supplied systems will be utilized to meet most future industrial and thermoelectric demands.

Meeting Future Wildlife and Environmental Water Needs

Interest in obtaining the necessary water supplies to meet wildlife and environmental water needs is increasing. However, quantifying these water needs is a challenge. In the broadest sense, all water (with the possible exception of deep groundwater) may provide benefits to wildlife and the environment. For example, all surface water whether in rivers, ponds, lakes or reservoirs supports a variety of flora and fauna, while also supporting other needs such as public system and irrigation uses. Additionally, shallow groundwater supports riparian vegetation and phreatophytes which provide habitat. Also, habitat may be created as a result of other activities such as irrigation. Wildlife and environmental water needs become difficult to quantify when examined in this broad manner.

The securing of water supplies for wildlife and environmental purposes is still a relatively new resource management concept. In recent years, governmental agencies and conservation organizations in Nevada have used a variety of mechanisms to obtain water for fishes, wildlife, special status species, wetlands and water quality improvement. Water has been obtained by purchasing and transferring water rights to a designated water body or portion thereof, filing for new appropriative water rights and entering into formal and informal agreements for reuse of water from agricultural irrigation systems, wastewater treatment plants, mine dewatering operations and an electric generating station. The water obtained for wildlife and environmental needs is generally used to augment stream flow, reservoir and lake levels, spring pools, wetlands and riparian areas.

Water rights have been acquired for the Lower Truckee River, Meadow Valley Wash (Condor Canyon), Upper Blue Lake (Humboldt County), Bruneau River, Carson Lake and Pasture and for a

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number of other aquatic and wetland resources on various federal wildlife refuges and state wildlife management areas. Many water acquisition projects have been cooperative interagency actions to meet requirements of state and federal legislation, such as the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (Public Law 101-618) Endangered Species Act, Section 404 of the Clean Water Act (wetland protections), the Migratory Bird Treaty Act and the National Environmental Policy Act.

Currently, efforts to assess and provide water supply needs are commonly retrospective, having been concentrated where ecosystem components already are deteriorating. Providing for future wildlife and environmental water supplies requires implementation of an ongoing, structured assessment process to determine where additional water supplies for wildlife and environmental needs are not being met as evidenced by deterioration in essential resource conditions. Laws and regulations have been instituted which require assessment and management actions to minimize the risk that municipal and industrial water supplies will not meet demand. A similar policy approach is needed for wildlife and environmental resources.

Meeting Future Recreation Water Needs

The popularity of water based outdoor recreation continues to grow. The number of people fishing, wildlife watching, boating, and swimming in Nevada's waters has never be higher, significantly adding to the state and local economies. In fact, tourism officials now commonly advertise the other side of Nevada, its expansive landscape and comparatively unique and rare water resources in the desert. Government agencies responsible for maintaining recreation resource values have acquired water for recreation purposes, primarily at reservoirs in the state. However, as recent experience has shown parks managers and visitors, droughts can dramatically impact water supplies at reservoirs, resulting in significant loss of available recreation resource area. Sometimes the seniority of acquired water rights does not ensure water availability during drier seasons.

As with wildlife and environmental water needs, quantification of recreational water needs may be difficult. In some instances, water for recreation is provided as the result of other water use activities. For example, reservoirs created for irrigation or municipal water supplies also provide recreation opportunities as a secondary or additional benefit. Anticipating future water needs for recreation will require implementation of a comprehensive and integrated assessment process. In fact, recreation resource needs are often intertwined with those of wildlife and the environment. Therefore, it would be practical to combine recreation and natural resource water needs assessments.

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Nevada State Water Plan
PART 2 — WATER USE AND FORECASTS

Section 5
Technical Supplement
Water Use Coefficient and Related Forecast Factor
Development and Application

Introduction

This technical supplement to the water withdrawal (use) forecasts presented in Section 3, Part 2 of the *Nevada State Water Plan* provides more detailed information as to the methodology behind the forecasts. Specifically, this section provides (1) a description of the water withdrawal categories analyzed and forecasted in this water plan and (2) the process by which specific water use coefficients and related forecast factors were estimated and the methodology used in the forecast development process. Graphs are also provided which present county-specific water use coefficients and other, related forecasts factors. The water use coefficients or factors, presented in gallons per person per day for municipal and industrial (M&I) water use and domestic water use, gallons per worker per day for commercial and industrial water use, or acre-feet per acre per year for irrigation water use, allow for the direct incorporation of socioeconomic forecasts (population, employment, irrigated acreage) into the water planning and forecasting process. This methodology provides the means by which forecasts of water withdrawals for certain economic sectors can be determined directly from changes in related socioeconomic factors.

Water Withdrawal (Use) Forecast Categories (Sectors)

The following water withdrawal categories were analyzed and forecast in this plan.

Total Water Withdrawals — Includes water withdrawals from both public and self-supplied sources for the categories of domestic, commercial and industrial, thermoelectric, public use and losses, mining and agricultural water uses.

Domestic (Residential) Water Withdrawals — Water withdrawn normally for residential purposes, including household use, personal hygiene, drinking, washing clothes and dishes, flushing toilets, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply water system or may be self-supplied. The State Water Plan presents forecasts for total domestic, public supply domestic and self-supplied domestic water withdrawals.

Commercial and Industrial Water Withdrawals — Water withdrawals for motels, hotels, restaurants, office

buildings, and other commercial facilities and institutions, both civilian and military. The water may be obtained from a public supply or may be self supplied. As used in this plan, commercial and industrial water withdrawal forecasts include all water withdrawals by businesses and industry, excluding thermoelectric and mining.

Public Use and Losses — Water supplied from a public water supply system (PWSS) and used for such purposes as fire fighting, street washing, and municipal parks, golf courses, and swimming pools. Also includes system water losses (water lost to leakage). Also referred to as public water use or utility water use.

Thermoelectric Water Withdrawals — Water withdrawals used for thermoelectric power generation and for cooling purposes in electric power plants. The water may be obtained from a public water supply system or may be self supplied. Only total thermoelectric water withdrawals are forecast within this water plan.

Mining Water Withdrawals — Consists of water withdrawals for mining processing functions (presumed to be consumptive uses) and for mine dewatering purposes (assumed to be a non-consumptive use). In actuality, all processing uses are not necessarily consumptive in nature and, similarly, all mine dewatering is not necessarily non-consumptive. For purposes of this water plan, forecasts are presented for total mining water withdrawals as well as those withdrawals for mine processing use and mine dewatering.

Total Agricultural Water Withdrawals — All water withdrawals for agricultural purposes consisting of water withdrawals for both irrigation applications (crops and irrigated pasture lands) and livestock watering purposes. Forecasts are presented for total agricultural water withdrawals and its component parts of irrigation water withdrawals and livestock (to include fishery, i.e., hatchery) water withdrawals.

Municipal and Industrial (M&I) Water Withdrawals — All water withdrawals supplied by public supply water systems. For the purposes of this planning and forecasting effort, these withdrawals are assumed to consist of water withdrawals for domestic (residential), commercial, industrial and thermoelectric purposes. Unlike the water “use” categories listed above which comprise total water withdrawals, M&I water withdrawals are not so much a water use as it is a measure of the withdrawals from a water “source”.

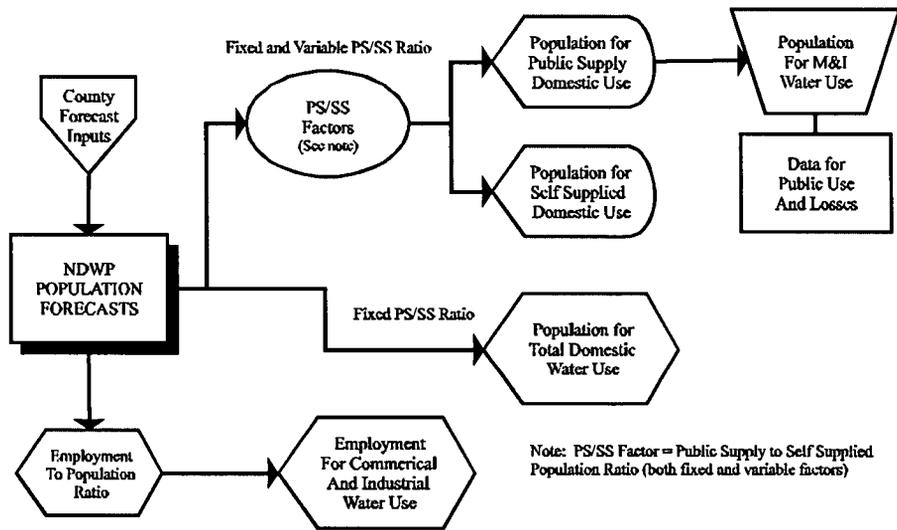
Water Use Coefficient Development and Application in the Water Withdrawal Forecasts

The presentation on water use coefficients (or water use factors) and related factor terms and their application to forecasting water withdrawals for the State of Nevada and its counties is presented in the following sections. These sections pertain specifically to the development of specific and county-unique water use coefficients and their use in forecasting municipal and industrial (M&I) water withdrawals, domestic (residential) water withdrawals (both public supply and self supplied withdrawals), commercial and industrial water withdrawals and total agricultural water withdrawals (consisting of both irrigation and livestock water withdrawals). [Note: The terms “water withdrawal” and “water use” are used interchangeably in this presentation. While assumed to have the same in meaning, the term water withdrawal is a more descriptive term as it is intended to represent the total water withdrawn for a specific use category and makes no inference as to degree of consumptive use and return flows from that particular use.]

Flow Chart 1. Population Forecasts and Water Withdrawals shows the basic relationship between the county population forecasts and various water withdrawals by sector. Water withdrawals may be considered as by the source of water, i.e., M&I water from public supply water systems, or by use, i.e., domestic, commercial,

industrial, thermoelectric, etc. Population forecasts constitute a crucial part of the forecasts for municipal and industrial (M&I) water withdrawals, public use and losses (from M&I water withdrawals), domestic water withdrawals (both public supply and self supplied), and commercial and industrial water withdrawals (from employment which was based on employment-to-population ratios). The remaining flow charts in this technical supplement reflect the method by which water withdrawal forecasts were determined and are described in greater detail by the equations which follow.

Flow Chart 1. Population and Water Withdrawal Forecasts



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Municipal and Industrial (M&I) Water Withdrawals

The technique to develop M&I water withdrawals is presented in Flow Chart 2. Municipal & Industrial (M&I) Water Withdrawals and the equations which follow. The forecasts for (M&I) Public Use and Losses were based on a county-specific fixed relationship (factor) between the M&I water withdrawal forecast and historical use patterns and then aggregated for the total state. These factors averaged between 9 and 10 percent on a statewide based and are presented for each county in Appendix 3 of the Appendices.

This section on M&I water withdrawals is presented in two parts. Part (A) describes the development of M&I water withdrawals forecasts based on a fixed proportion of the total resident population remaining on public supply water systems whereas Part (B) incorporates a specific variation in this proportion which is unique to each county and uses, as a starting value, the proportion figures for each county for the year 1995. The basic assumption under Part (B) was that there will exist a change in the proportion of the population on public supply water systems, which tends to agree with historical experience. The specific M&I water withdrawal forecasts incorporated in the water plan use the assumption of a variable proportion of the population on public supply water systems.

M&I Fixed Water Withdrawals. (Assumption: A fixed proportion of the population remains on public supply water systems resulting in the use of a fixed total M&I water use coefficient). This population assumption is shown in Equation [1]:

$$\begin{aligned}
 &[\text{Population on Public Supply Water Systems}]_{\text{Fixed Proportion}} \\
 &= [\text{Total Resident Population Forecast}] \times [\text{Constant PS/SS Percentage Factor}] \qquad [1]
 \end{aligned}$$

The term [Total Resident Population Forecast] in Equation [1] represent the county population forecasts based on NDWP's population growth assumptions (see Appendix 2 of the Appendices for each county's forecasts and aggregated forecasts for the total state). Also in Equation [1], the term

$$[\text{Constant PS/SS Percentage Factor}] \tag{2}$$

represents a constant proportion (PS/SS = public supply population to self supplied population) of the resident population for 1995 assumed to remain on public supply water systems (and therefore a constant proportion continues to be self supplied). These county-unique fixed proportions are presented in the summary table of water use coefficients and related forecasting factors in Appendix 3 of the Appendices. From this information, total M&I water withdrawals, measured in acre-feet per year and based on a fixed proportion of the population on public supply water systems was determined from

$$[\text{Total M\&I Water Withdrawals}]_{\text{Fixed}} = [\text{Population on Public Supply}]_{\text{Fixed Proportion}} \times [\text{M\&I Water Use Factor}]_{\text{Fixed}} \tag{3}$$

where the M&I water use coefficient (factor) was determined from 1995 historical data by

$$[\text{M\&I Water Use Factor}]_{\text{Fixed}} = [\text{M\&I Water Use}]_{1995} / [\text{Population on Public Supply}]_{1995} \tag{4}$$

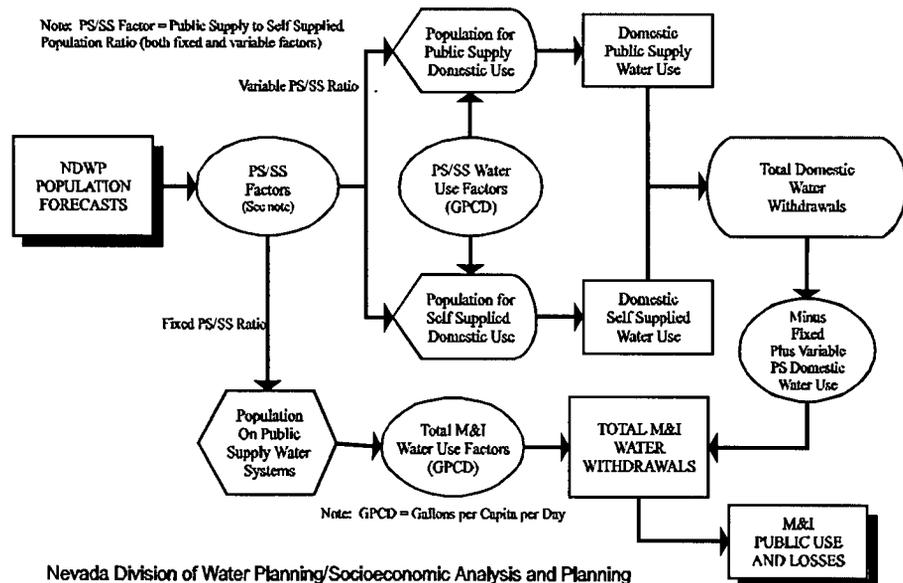
and is measured in gallons per capita (per person) per day (GPCD).

M&I Variable Water Withdrawals. (Assumption: A variable proportion of the population was on public supply water systems resulting in a variable total M&I water use coefficient; variation in total M&I water use coefficient was based on the difference in total domestic water use based on a varying percent of the population on public supply water systems and the differences in the water use coefficients for domestic public supply usage and domestic self supplied usage).

Conceptually, total M&I water withdrawals based on the assumption of a varying proportion of the population on public supply water systems could be calculated using a relationship similar to that presented in Equation [3] above, or,

$$[\text{Total M\&I Water Withdrawals}]_{\text{Variable}} = [\text{Population on Public Supply}]_{\text{Variable Proportion}} \times [\text{M\&I Water Use Factor}]_{\text{Variable}} \tag{5}$$

Flow Chart 2. Municipal & Industrial (M&I) Water Withdrawals



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where the population on public supply water systems in Equation [5] was determined from Equation [6] presented below:

$$[\text{Population on Public Supply}]_{\text{Variable Proportion}} = [\text{Total Resident Population Forecast}] \times [\text{Variable PS/SS Percentage Factor}] \quad [6]$$

In Equation [6], the term [Variable PS/SS Percentage Factor] represents a variable proportional term unique for each county based on the historical (1995) proportion of the population on public supply water systems and forecasts of changes in this proportion through the year 2020. This information for each county is presented in Appendix 3 of the Appendices. However, the water use coefficient term, [M&I Water Use Factor]_{Variable}, presented in Equation [5] is unknown in this situation as it will vary by population proportions (public and self supplied) and specific water use coefficients for these types of uses. Furthermore, it cannot be readily calculated and will therefore have to be calculated indirectly.

The change in total M&I water withdrawals based on the forecast assumption of a varying proportion of the population on public supply water systems, however, can be determined from the change in total domestic water withdrawals based on changes in the proportion of the population on public supply water systems. Therefore, the following equation will be used in lieu of Equation [5] to calculate the total M&I water withdrawals based on variations in the population on public supply water systems:

$$[\text{Total M\&I Water Withdrawals}]_{\text{Variable}} = [\text{Total M\&I Water Withdrawals}]_{\text{Fixed}} - [\text{Public Supply Domestic Water Withdrawals}]_{\text{Fixed}} + [\text{Public Supply Domestic Water Withdrawals}]_{\text{Variable}} \quad [7]$$

In Equation [7] the term [Total M&I Water Withdrawals]_{Fixed} was calculated in Equation [3], above, and both the terms [Public Supply Domestic Water Withdrawals]_{Fixed} and [Public Supply Domestic Water Withdrawals]_{Variable} can be determined directly from population forecasts, estimated proportions of the population on public supply water systems, and appropriate domestic public and self supplied water use coefficients. These calculations and equations are presented in the next section on forecasting domestic water withdrawals.

The term [Public Supply Domestic Water Withdrawals]_{Variable} in Equation [7], unlike the term [Public Supply Domestic Water Withdrawals]_{Fixed}, will therefore incorporate the effects of a varying proportion of the population on public supply water systems. Inherent in this methodology is that the water use factors for other components of M&I water use, i.e., commercial and industrial, will not change over time. From Equation [7], the variable M&I water use coefficient term, [M&I Water Use Factor]_{Variable}, measured in gallons per capita (person) per day (GPCD), can then be determined from Equation [8]:

$$[\text{M\&I Water Use Factor}]_{\text{Variable}} = [\text{Total M\&I Water Withdrawals}]_{\text{Variable}} / [\text{Population on Public Supply}]_{\text{Variable Proportion}} \quad [8]$$

As the calculation of this M&I water use coefficient (factor) in Equation [8] is made “after the fact,” that is, after the (variable population) total M&I water withdrawals have already been calculated, the coefficient itself serves no useful function in the forecast development and only shows the resultant variation in the M&I water use coefficient based on the assumption of a varying proportion of the population being served by public supply

water systems. Also, since the coefficient incorporates specific assumptions about population forecasts and forecasts of the proportion of that population on public supply water systems, its usefulness in future forecasts and planning is restricted to retaining these exact assumptions.

The final water use forecast described in this section deals with public use and losses. As shown in Flow Chart 2, forecasts of this type of water withdrawal are based directly on the level of M&I water withdrawals. The relationship between each county's historical public use and losses and its total M&I water withdrawals resulted in a county-specific public use and loss factor as presented in Appendix 3 of the Appendices. These factors were then used to forecast public use and losses as follows:

$$\begin{aligned} & \text{[Public Use and Losses]} \\ & = \text{[Total M\&I Water Withdrawals]}_{\text{variable}} \times \text{[Public Use and Losses Factor]}_{\text{Fixed}} \end{aligned} \quad [9]$$

from which the fixed term $\text{[Public Use and Losses Factor]}_{\text{Fixed}}$ in Equation [9] is based on historical 1995 data as calculated from

$$\begin{aligned} & \text{Public Use and Losses Factor}_{\text{Fixed}} \\ & = \text{[Public Use and Losses]}_{1995} / \text{[Total M\&I Water Withdrawals]}_{1995} \end{aligned} \quad [10]$$

No changes in these factor terms for all counties were made over the forecast horizon.

Total Domestic (Residential), Public Supply Domestic, and Self-Supplied Domestic Water Withdrawals

The technique to develop the domestic water withdrawal forecasts are presented in Flow Chart 3. Total Domestic (Residential) Water Withdrawals. This flow chart, and the equations below, describe the method used to develop water use forecasts on both a fixed and variable basis, that is, (1) the assumption that a fixed proportion of the population remains on public supply systems (Part A) and (2) that this proportion varies over the forecast horizon (Part B). This distinction becomes important as it is the variable Total Domestic Water Withdrawal forecasts that are incorporated in this plan and are also used for the development of the Total M&I Water Withdrawal forecasts presented in the previous section.

Total Domestic, Public Supply and Self-Supplied Fixed Water Withdrawals. (Assumption: A fixed proportion of the resident population remains on public supply water systems resulting in a fixed total domestic water use coefficient). Total domestic water withdrawals, in acre-feet per year, can be calculated from the relationship in Equation [11]:

$$\begin{aligned} & \text{[Total Domestic Water Withdrawals]}_{\text{Fixed}} \\ & = \text{[Total Resident Population Forecast]} \times \text{[Total Domestic Water Use Factor]}_{\text{Fixed}} \end{aligned} \quad [11]$$

where the water use factor, in gallons per capita (person) per day (GPCD), was determined from historical information on water withdrawals and populations such that

$$\text{[Total Domestic Water Use Factor]}_{\text{Fixed}}$$

$$= [\text{Total Domestic Water Use}]_{1995} / [\text{Total Resident Population}]_{1995} \quad [12]$$

Similarly, for the domestic public supply water withdrawals, in acre-feet per year, we can use

$$\begin{aligned} & [\text{Domestic Public Supply Water Withdrawals}]_{\text{Fixed}} \\ & = [\text{Resident Population}]_{\text{Public Supply-Fixed}} \times [\text{Domestic Public Supply Use Factor}]_{\text{Fixed}} \end{aligned} \quad [13]$$

where the domestic public supply water use factor, measured in gallons per capita (person) per day (GPCD), was calculated using historical relationships such that

$$\begin{aligned} & [\text{Domestic Public Supply Water Use Factor}]_{\text{Fixed}} \\ & = [\text{Domestic Public Supply Water Use}]_{1995} / [\text{Population on Public Supply}]_{1995} \end{aligned} \quad [14]$$

Likewise, for the domestic self-supplied water withdrawals, also measured in acre-feet per year, we can use

$$\begin{aligned} & [\text{Domestic Self-Supplied Water Withdrawals}]_{\text{Fixed}} \\ & = [\text{Resident Population}]_{\text{Self Supplied-Fixed}} \times [\text{Domestic Self-Supplied Use Factor}]_{\text{Fixed}} \end{aligned} \quad [15]$$

where the domestic self-supplied water use factor, measured in gallons per capita (person) per day (GPCD), was calculated using historical data such that

$$\begin{aligned} & [\text{Domestic Self-Supplied Water Use Factor}]_{\text{Fixed}} \\ & = [\text{Domestic Self-Supplied Water Use}]_{1995} / [\text{Population being Self Supplied}]_{1995} \end{aligned} \quad [16]$$

Total Domestic, Public Supply and Self-Supplied Variable Water Withdrawals. (Assumption: A variable proportion of the population is on public supply water systems resulting in a variable total domestic water use coefficient; variation in the total domestic water use coefficient is based on the differences in the domestic public supply usage rate and the domestic self supplied usage rate). Here, the total domestic water withdrawals cannot be calculated directly due to the variations that will occur in the total domestic water use factor from the changing proportion of the population on public supply water systems. Therefore, total domestic water withdrawals are calculated from its separate components, as shown in Equation [17] below:

$$\begin{aligned} & [\text{Total Domestic Water Withdrawals}]_{\text{Variable}} = [\text{Domestic Public Supply Water Withdrawals}]_{\text{Variable}} \\ & + [\text{Domestic Self-Supplied Water Withdrawals}]_{\text{Variable}} \end{aligned} \quad [17]$$

where domestic public supply water withdrawals, measured in acre-feet per year and assuming a variable proportion of population on public supply water systems, can be calculated from Equation [18] below:

$$\begin{aligned} & [\text{Domestic Public Supply Water Withdrawals}]_{\text{Variable}} \\ & = [\text{Population on Public Supply}]_{\text{Variable Proportion}} \times [\text{Domestic Public Supply Use Factor}]_{\text{Fixed}} \end{aligned} \quad [18]$$

Similarly, the domestic self supplied water withdrawals in acre-feet per year can be calculated from

$$[\text{Domestic Self-Supplied Water Withdrawals}]_{\text{Variable}}$$

$$= [\text{Population being Self Supplied}]_{\text{Variable Proportion}} \times [\text{Domestic Self-Supplied Use Factor}]_{\text{Fixed}} \quad [19]$$

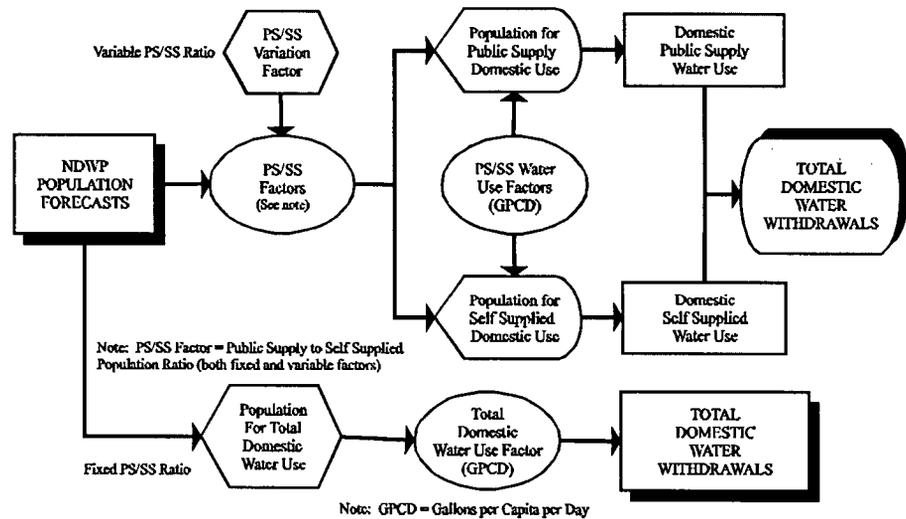
In order to determine the proportion of the resident population being self supplied, we can use the relationship shown in Equation [6] for the determination of the variations in the population on public supply water systems (and therefore the population being self supplied). Based on this relationship, we have the relationship shown in Equation [20]:

$$\begin{aligned} & [\text{Population on Public Supply}]_{\text{Variable Proportion}} \\ &= [\text{Total Resident Population Forecast}] \times \\ & [\text{Variable PS/SS Percentage Factor}] \end{aligned} \quad [20]$$

with the requirement that

$$\begin{aligned} & [\text{Total Resident Population Forecast}] \\ &= [\text{Population on Public Supply}]_{\text{Variable Proportion}} + \\ & [\text{Population being Self Supplied}]_{\text{Variable Proportion}} \end{aligned} \quad [21]$$

Flow Chart 3. Domestic (Residential) Water Withdrawals



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Calculations of total domestic, public supply domestic and self-supplied domestic water withdrawal forecasts, along with all assumptions, water use factors and population proportions on public supply water systems, are presented in Appendix 3 of the Appendices for all counties and aggregated for the total state.

Commercial and Industrial Water Withdrawals

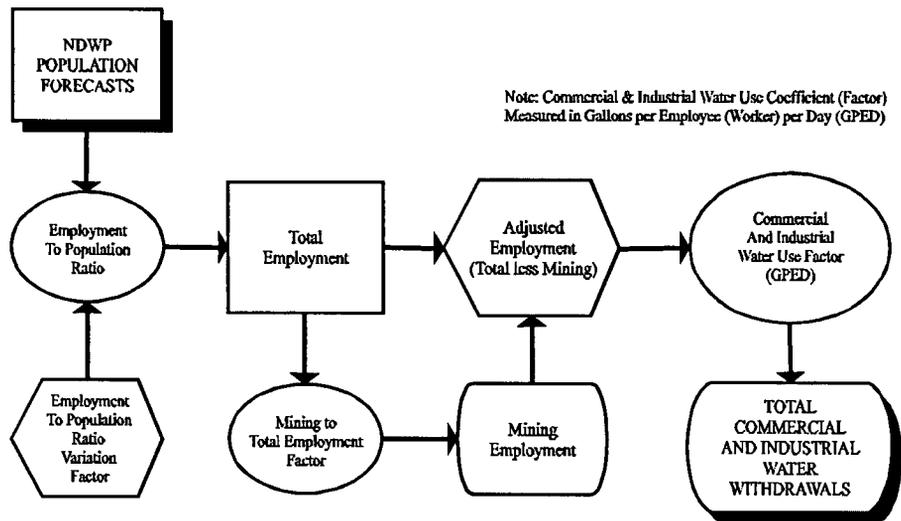
The water withdrawal forecasts for commercial and industrial water use are presented in Flow Chart 4. Commercial and Industrial Water Withdrawals and presented in more detail in the equations below. Flow Chart 4 shows that this forecast methodology incorporates three forecast factors. First, total employment was estimated for each county based on a unique forecast of that county's employment-to-population ratio. This ratio was based on the county's 1997 figure and assumed to vary over the forecast horizon. The ratio variation rate constituted the second forecast factor. The third forecast factor was the county-specific commercial and industrial water use coefficient, in gallons per employee (per worker) per day (GPED), and was based on each

individual county’s commercial structure and historical water use patterns. This coefficient was kept constant over the forecast horizon as its value was based more on the nature of production and the state of technology.

Total commercial and industrial water withdrawals were therefore forecast using forecasts of a socioeconomic measure (i.e., employment) and a water use factor. The water use factor, in gallons per employee per day, represented an average water usage rate for all employment classifications. While it is known that various industry sectors use water at different rates (i.e., at varying gallons per employee per day, or GPED’s) based on unique processing and business conditions, so long as the overall composition of employment and production does not show significant changes over the forecast horizon, this fixed commercial water use coefficient represents a reasonable assumption of average water use rate for all industry sectors.

One important alteration in this methodology was the exclusion of mining employment from the total employment figures and from the determination of the commercial and industrial

Flow Chart 4. Commercial & Industrial Water Withdrawals



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water use coefficient calculation. This was necessary as mining water withdrawals were determined from direct forecasts of mining output. Using this methodology, total commercial and industrial water withdrawals, measured in acre-feet per year, were calculated from Equation [22]:

$$[\text{Commercial \& Industrial Water Withdrawals}] = [\text{Total Employment}]_{\text{Adjusted}} \times [\text{Commercial \& Industrial Use Factor}]_{\text{Fixed}} \quad [22]$$

where the adjusted total employment term in Equation [22] was derived from

$$[\text{Total Employment}]_{\text{Adjusted}} = [\text{Total Employment}] - [\text{Mining Employment}] \quad [23]$$

Equation [23] reflects the removal of the forecasted mining employment from the forecasts of each county’s total employment. These forecasts of total employment and mining employment are presented In Appendix 3 of the Appendices for each county and the total state, with the statewide total being an aggregation of the individual counties. The commercial and industrial water use coefficient, measured in gallons per worker per day, was calculated from historical data on water use and employment using the following equation:

$$[\text{Commercial \& Industrial Use Factor}]_{\text{Fixed}}$$

$$= [\text{Commercial \& Industrial Water Use}]_{1995} / [\text{Total Employment} - \text{Mining Employment}]_{1995} \quad [24]$$

As can be seen from Equation [24], above, the development of the commercial and industrial water use factor also incorporated the removal of mining employment. Total employment for each county was determined uniquely from historical relationships between the total employment and the total resident population and presented in the form of a county-unique employment-to-population ratio.

Historical employment-to-population ratios for 1997 for Nevada and all counties are presented in Fig. 5–9. Employment to Population Ratios. These ratio, which varied uniquely for each county over the forecast horizon, were then used to forecast each county’s total employment (and the total state from an aggregation of the county forecasts) as shown in the following equation:

$$\begin{aligned} &[\text{Total Employment}] \\ &= [\text{Total Resident Population Forecast}] \times [\text{Employment-to-Population Ratio}]_{\text{variable}} \end{aligned} \quad [25]$$

where forecasts of the term $[\text{Employment-to-Population Ratio}]_{\text{variable}}$ in Equation [25] were estimated uniquely for each county based on forecasts of future industrial development and related employment trends versus population forecasts. Each county’s mining employment (aggregated to a statewide total) was also determined uniquely based on current mining conditions and trends and forecasts of future mining activity. These forecasts of mining employment are presented in detail for each county in Appendix 3 of the Appendices and were based on the following calculation:

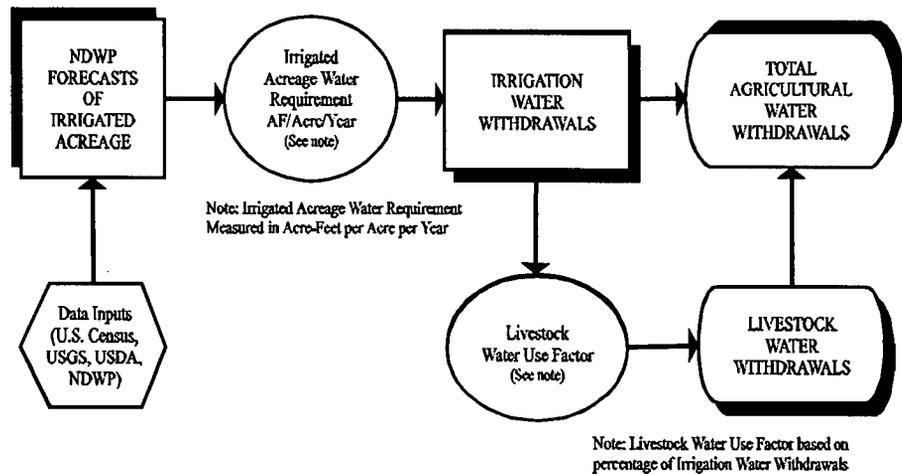
$$[\text{Mining Employment}] = [\text{Total Employment}] \times [\text{Mining Employment Factor}]_{\text{variable}} \quad [26]$$

where $[\text{Mining Employment Factor}]_{\text{variable}}$ represented the assumption of a variable percent of mining employment to total county employment.

Agricultural Water Withdrawals

The methodology for total agricultural, irrigation and livestock water withdrawals is presented in Flow Chart 5. Total Agricultural, Irrigation and Livestock Water Withdrawals and is presented greater detail in the equations below. Agricultural water withdrawals were driven from forecasts of (1) irrigated acreage, (2) county-unique irrigated acreage water use requirements, and (3) county-specific relationships of irrigation water withdrawals and livestock water withdrawals. This assumption of a consistent link (i.e., fixed factor) between livestock water needs and irrigation water withdrawals represented a simplifying assumption and precluded the need to make county-specific livestock forecasts independently of forecasts of irrigated acreage and pasture lands, which itself may be subject to errors and inconsistencies. All historical trends, irrigation and livestock forecast assumptions, and forecasts for both irrigation and livestock water withdrawals are presented in Appendix 4 of the Appendices for each county and aggregated for the statewide total.

Flow Chart 5. Total Agriculture, Irrigation and Livestock Water Withdrawals



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The basic calculation for forecasting each county’s total agricultural water withdrawals, measured in acre-feet per year, was based on the relationship shown in Equation [27]:

$$\begin{aligned}
 & \text{[Total Agricultural Water Withdrawals]} \\
 & = \text{[Irrigation Water Withdrawals]} + \text{[Livestock Water Withdrawals]} \qquad [27]
 \end{aligned}$$

where forecasted irrigation water withdrawals in Equation [27] are based on forecasts of total irrigated acreage (including irrigated pasture lands) times a fixed irrigated acreage water use requirement, measured in acre-feet per acre per year, such that

$$\begin{aligned}
 & \text{[Irrigation Water Withdrawals]} \\
 & = \text{[Irrigated Acreage]} \times \text{[Irrigated Acreage Water Use Requirement]}_{\text{Fixed}} \qquad [28]
 \end{aligned}$$

Livestock water withdrawals in Equation [27] are based on the level of irrigation water withdrawals times a “livestock water use factor” which is based on historical conditions, or

$$[\text{Livestock Water Withdrawals}] = [\text{Irrigation Water Use}] \times [\text{Livestock Water Use Factor}]_{\text{Fixed}} \quad [29]$$

Forecasts of each county's irrigated acreage were based on historical trends and a "best fit" non-linear line (curve fit) of these trends extrapolated out to the year 2020. Graphs and tables of historical data and forecasts for each county's irrigated acreage are presented in detail in Appendix 4 of the Appendices. The irrigated acreage water use requirement coefficient term was determined from historical water use patterns by the equation

$$\begin{aligned} & [\text{Irrigated Acreage Water Use Requirement}]_{\text{Fixed}} \\ & = [\text{Irrigation Water Withdrawals}]_{1995} / [\text{Total Irrigated Acreage}]_{1995} \end{aligned} \quad [30]$$

The livestock water withdrawals were assumed to be based on the level of irrigation water withdrawals and a fixed factor term, $[\text{Livestock Water Use Factor}]_{\text{Fixed}}$, in Equation [29] representing the historical relationships between livestock water withdrawals and irrigation water withdrawals, such that

$$\begin{aligned} & [\text{Livestock Water Use Factor}]_{\text{Fixed}} \\ & = [\text{Livestock Water Withdrawals}]_{1995} / [\text{Irrigation Water Withdrawals}]_{1995} \end{aligned} \quad [31]$$

Both the irrigated acreage water use requirement (as shown in Fig. 5-11. Irrigated Acreage Water Requirement) and the livestock use coefficient (as shown in Fig. 5-12. Livestock to Irrigation Water Withdrawals), while unique to each county, are assumed to be fixed over the forecast horizon. State of Nevada totals for both irrigation water withdrawals and livestock water withdrawals were based on the aggregation of individual county forecasts of these measures.

Graphs: Water Use Coefficients and Related Forecast Factors

The graphs on the following pages present the county-specific water use coefficients and related forecast factors used in the forecast model equations just described.

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PART 2 — WATER USE AND FORECASTS

Section 6
Glossary of Terminology

[Source: Nevada Division of Water Planning's *Water Words Dictionary*. Words presented in italics and the referenced appendices may be found in the Dictionary. Words and definitions included in this glossary which explain or summarize elements of existing water law are not intended to change that law in any way.]

Acre-Feet (AF) — A unit commonly used for measuring the volume of water. See *Acre-Foot*.

Acre-Foot (AF) — A unit commonly used for measuring the volume of water; equal to the quantity of water required to cover one acre (43,560 square feet or 4,047 square meters) to a depth of 1 foot (0.30 meter) and equal to 43,560 cubic feet (1,234 cubic meters), or 325,851 gallons.

Agricultural Use — The use of any tract of land for the production of animal or vegetable life; uses include, but are not limited to, the pasturing, grazing, and watering of livestock and the cropping, cultivation, and harvesting of plants.

Agricultural Water Use (Withdrawals) — Includes water used for irrigation and non-irrigation purposes. Irrigation water use includes the artificial application of water on lands to promote the growth of crops and pasture, or to maintain vegetative growth in recreational lands, parks, and golf courses. Non-irrigation water use includes water used for livestock, which includes water for stock watering, feedlots, and dairy operations, and fish farming and other farm needs.

Average Water Year — A term denoting the average annual hydrologic conditions based upon an extended or existing period of record. Because precipitation, runoff, and other hydrologic variables vary from year to year, planners typically project future scenarios based on hydrologic conditions that generally include average, wet (high-water), and drought (low-water) years.

Basin — (1) (Hydrology) A geographic area drained by a single major stream; consists of a drainage system comprised of streams and often natural or man-made lakes. Also referred to as *Drainage Basin*, *Watershed*, or *Hydrographic Region*. (2) (Irrigation) A level plot or field, surrounded by dikes, which may be flood irrigated. (3) (Erosion Control) A catchment constructed to contain and slow runoff to permit the settling and collection of soil materials transported by overland and rill runoff flows. (4) A naturally or artificially enclosed harbor for small craft, such as a yacht basin.

Blackwater — Water that contains animal, human, or food wastes; wastewater from toilet, latrine, and aqua privy flushing and sinks used for food preparation or disposal of chemical or chemical-biological ingredients. Compare to *Greywater*.

CFS (Cubic Foot per Second) — A unit of discharge for measurement of flowing liquid equal to a flow of one cubic foot per second past a given section. A rate of flow equivalent to 448.83 gallons per minute. Also called *Second-Foot*.

CFS-Day — The volume of water represented by a flow of 1 cubic foot per second for 24 hours. It equals 86,400 cubic feet, 1.983471 acre-feet, or 646,317 gallons.

Cloud Seeding — A *Weather Modification* technique involving the injection of a substance into a cloud for the purpose of influencing the cloud's subsequent development. Ordinarily, this refers to the injection of a nucleating agent, which creates a nucleus around which precipitation will form. In common practice, cloud seeding involves the aerial release of silver iodide particles into convective clouds to create thunderstorms.

Commercial Water Use (Withdrawals) — Water for motels, hotels, restaurants, office buildings, and other commercial facilities and institutions, both civilian and military. The water may be obtained from a public supply

or may be self supplied. The terms “water use” and “water withdrawals” are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Industrial Water Use (Withdrawals)*, *Public Water Supply System* and *Self-Supplied Water*.

Community Water System — A public water system with 15 or more connections and serving 25 or more year-round residents and thus is subject to the *U.S. Environmental Protection Agency (EPA)* regulations enforcing the *Safe Drinking Water Act (SDWA)*.

Conjunctive Management — The integrated management and use of two or more water resources, such as a (groundwater) aquifer and a surface water body.

Conjunctive (Water) Use — (1) The combined use of surface and groundwater systems and sources to optimize resource use and prevent or minimize adverse effects of using a single source; the joining together of two sources of water, such as groundwater and surface water, to serve a particular use. (2) The integrated use and management of hydrologically connected groundwater and surface water.

Conservation — (1) Increasing the efficiency of energy use, water use, production, or distribution. (2) The careful and organized management and use of natural resource, for example, the controlled use and systematic protection of natural resources, such as forests, soil, and water systems in accordance with principles that assure their optimum long-term economic and social benefits. Also, preservation of such resources from loss, damage, or neglect.

Consumption, Domestic — The quantity or quantity per capita (person) of water consumed in a municipality or district for domestic uses during a given period, usually one day. Domestic consumption is generally considered to include all uses included in “municipal use of water,” in addition to the quantity of water wasted, lost, or otherwise unaccounted for. Also see *Consumption, Municipal; Municipal Use of Water*.

Consumption, Industrial — The quantity of water consumed in a municipality or district for mechanical, trade, and manufacturing uses during a given period, usually one day.

Consumption, Municipal — The quantity of water consumed through use in developed urban areas. Also see *Consumption, Domestic; Consumptive Use*.

Consumptive (Water) Use — (1) A use which lessens the amount of water available for another use (e.g., water that is used for development and growth of plant tissue or consumed by humans or animals). (2) A use of water that renders it no longer available because it has been evaporated, transpired by plants, incorporated into products or corps, consumed by people or livestock, or otherwise removed from water supplies. (3) The portion of water withdrawn from a surface or groundwater source that is consumed for a particular use (e.g., irrigation, domestic needs, and industry), and does not return to its original source or another body of water. No typical use is 100 percent efficient; there is always some return flow associated with a use either in the form of a return to surface flows or as a ground water recharge. Nor are typically nonconsumptive uses of water entirely nonconsumptive. There are evaporation losses, for instance, associated with maintaining a reservoir at a specified elevation to support fish, recreation, or hydropower, and there are conveyance losses associated with maintaining a minimum streamflow in a river, diversion canal, or irrigation ditch.

Consumptive Water Use, Irrigation — The quantity of water that is absorbed by the crop and transpired or used directly in the building of plant tissue, together with that evaporated from the cropped area. Does not include runoff or deep percolation in support of the *Crop Leaching Requirement*.

Crop Irrigation Requirement — The amount of irrigation water in acre-feet per acre required by the crop; it is the difference between *Crop Consumptive Use*, or *Crop Requirement*, and the effective precipitation for plant growth. To this amount the following items, as applicable, are added: (1) irrigation applied prior to crop growth; (2) water required for leaching; (3) miscellaneous requirements of germination, frost protection, plant cooling, etc.; and (4) the decrease in soil moisture should be subtracted.

Cropland — Land currently tilled, including cropland harvested, land on which crops have failed, summer fallowed land, idle cropland, cropland planted in cover crops or soil improvement crops not harvested or pastured, rotation pasture, and cropland being prepared for crops, or newly seeded cropland. Cropland also includes land planted in vegetables and fruits, including those grown on farms for home use. All cultivated (tame) hay is included as cropland. Wild hay is excluded from cropland and included in pasture and range.

Cross-Sectional Analysis — (Statistics) Observations or characteristics of a variable analyzed without respect to variations due to time. Cross-sectional econometric models provide information on the behavior of a variable due to external factors. Contrast with *Time-Series Analysis*.

Cubic Feet Per Second (CFS) — A unit expressing rate of discharge, typically used in measuring streamflow. One cubic foot per second is equal to the discharge of a stream having a cross section of 1 square foot and flowing at

an average velocity of 1 foot per second. It also equals a rate of approximately 7.48 gallons per second, 448.83 gallons per minute, 1.9835 acre-feet per day, or 723.97 acre-feet per year.

Cubic Feet Per Second Day (CFS-Day) — The volume of water represented by a flow of one cubic foot per second for 24 hours. It equals 86,400 cubic feet, 1.983471 acre-feet, or 646,317 gallons.

Demand Management Alternatives — Water management programs that reduce the demand for water, such as water conservation, drought rationing, rate incentive programs, public awareness and education, drought landscaping, etc.

Dependable Supply — That water which can be expected to be available at a time and place with the quality demanded; sometimes the amount of water available is at a stated percentage of time.

Dependable Yield — The maximum annual supply of a given water development that is expected to be available on demand, with the understanding that lower yields will occur in accordance with a predetermined schedule or probability. More frequently referred to as *Firm Yield*.

Desalination, or Desalinization — (1) To remove salts and other chemicals, as from sea water or soil, for example. Usually used with respect to the salt contained in water. (2) Specific treatment processes to demineralize sea water or brackish (saline) water for reuse. Also referred to as *Desalting*.

Designated Groundwater Basin — A basin where permitted ground water rights approach or exceed the estimated average annual recharge and the water resources are being depleted or require additional administration. Under such conditions, a state's water officials will so designate a groundwater basin and, in the interest of public welfare, declare *Preferred Uses* (e.g., municipal and industrial, domestic, agriculture, etc.). Also referred to as *Administered Groundwater Basin*.

Designated Groundwater Basin [Nevada] — In the interest of public welfare, the Nevada State Engineer, *Division of Water Resources, Department of Conservation and Natural Resources*, is authorized by statute (Nevada Revised Statute 534.120) and directed to designate a ground water basin and declare *Preferred Uses* within such designated basin. The State Engineer has additional authority in the administration of the water resources within a designated ground water basin.

Dewater, and Dewatering — (1) To remove water from a waste produce or streambed, for example. (2) The extraction of a portion of the water present in sludge or slurry, producing a dewatered product which is easier to handle. (3) (Mining) The removal of ground water in conjunction with mining operations, particularly open-pit mining when the excavation has penetrated below the ground-water table. Such operations may include extensive ground-water removal and, if extensive enough and if not re-injected into the groundwater, these discharges may alter surface water (stream) flows and lead to the creation of lakes and wetland areas. As such water removals only last so long as the mine is in operation, eventually surface water impacts, if present, will be eliminated, consequently jeopardizing surface water uses, such as irrigation, livestock, wildlife, or riparian habitat that may have become dependent upon the continuation of these temporary flows. Also, when the mine dewatering operations cease, the remaining open pit will eventually begin to fill up with ground water, resulting in significantly increased evaporation from ground water reservoirs.

Domestic Water — Water supplied to individual dwellings and other land uses which is suitable for drinking.

Domestic Water Use (Withdrawals) — Water used normally for residential purposes, including household use, personal hygiene, drinking, washing clothes and dishes, flushing toilets, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. The terms "water use" and "water withdrawals" are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also referred to as *Residential Water Use*. Also see *Public Water Supply System* and *Self-Supplied Water*.

Evapotranspiration (ET) — (1) The quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces. (2) The sum of *Evaporation* and *Transpiration* from a unit land area. (3) The combined processes by which water is transferred from the earth surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants. Evapotranspiration occurs through evaporation of water from the surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants (*Phreatophytes*) whose roots tap the capillary fringe of the groundwater table. The sum of evaporation plus transpiration.

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Forecast (Forecasting) — (Statistics) A forecast is a quantitative estimate (or set of estimates) about the likelihood of future events based on past and current information. This “past and current information” is specifically embodied in the structure of the econometric model used to generate the forecasts. By extrapolating the model out beyond the period over which it was estimated, we can use the information contained in it to make forecasts about future events. It is useful to distinguish between two types of forecasting, *ex post* and *ex ante*. In an *ex post* forecasts all values of dependent and independent variables are known with certainty and therefore provides a means of evaluating a forecasting model. Specifically, in an *ex post* forecast, a model will be estimated using observations excluding those in the *ex post* period, and then comparisons of the forecasts will be made to these actual values. An *ex ante* forecast predicts values of the dependent variable beyond the estimation period using values for the explanatory variables which may or may not be known with certainty.

Forecast Horizon — (Statistics) The number of time periods to be forecasted; also, the time period in the future to which forecasts are to be made.

Gallon [U.S.] — A unit of capacity, containing four quarts, used in the United States primarily for liquid measure. One U.S. gallon contains 231 cubic inches, 0.133 cubic feet, or 3.7853 liters. It takes approximately 325,851 gallons to make up 1 acre-foot (AF). [*Historical Note:* The U.S. gallon is the same as the old English *wine gallon* which was originally intended in England to be equivalent to a cylinder of seven inches in diameter and six inches in height.]

Gallons per Capita (GPC) — A term used relative to water use per person per specified time, usually a day.

Gallons per Capita (Person) per Day (GPCD) — An expression of the average rate of domestic and commercial water demand, usually computed for public water supply systems. Depending on the size of the system, the climate, whether the system is metered, the cost of water, and other factors, *Public Water Supply Systems (PWSS)* in the United States experience a demand rate of approximately 60 to 150 gallons per capita per day. Also see *Gallons per Employee per Day (GED)* for information on the application of this concept to commercial water use by *Standard Industrial Classification (SIC) Code*. [See Appendix C-4, Gallons Per Capita Per Day (GPCD), Water Used for Public Water Supplies by State.]

Gallons per Employee (Worker) per Day (GED, or GPED) — A measure or coefficient expressing an area’s commercial water use per worker (employee), typically for distinct industry sectors. It is based on an analytical technique for measuring and forecasting commercial water use in a service area based upon the unique, seasonal, business-related water use by specific industrial sectors. GED commercial water-use coefficients are typically developed based upon Standard Industrial Classifications (SIC) codes for which comparable commercial water use and employment data are available. For forecasting more frequently than annually, GED coefficients will incorporate seasonal patterns (monthly or quarterly) as well. By deriving forecasts of trends in industry sector employment and combining them with appropriate, industry-specific GED coefficients, relatively accurate forecasts of the corresponding commercial water use may be obtained.

Gallons per Minute — A unit expressing rate of discharge, used in measuring well capacity. Typically used for rates of flow less than a few cubic feet per second (cfs).

GPCD — Gallons per capita (per person) per day — a measure of water use in municipalities. [See Appendix C-4, Gallons Per Capita Per Day (GPCD), Water Used for Public Water Supplies by State.]

GPD — Gallons per day, a measure of the rate of flow or the rate of water withdrawal from a well. Typically used when the rate of flow in cubic feet per second (cfs) is too low to be useful.

Greywater (Graywater) — Wastewater from clothes washing machines, showers, bathtubs, hand washing, lavatories and sinks that are not used for disposal of chemicals or chemical-biological ingredients.

Hydrographic Area [Nevada] — The 232 subdivisions (256 *Hydrographic Areas* and *Hydrographic Sub-Areas*) of the 14 Nevada *Hydrographic Regions* as defined by the State Engineer’s Office, Department of Conservation and Natural Resources, Division of Water Resources. Primarily these are sub-drainage systems within the 14 major drainage basins. Hydrographic Areas (valleys) may be further subdivided into Hydrographic Sub-Areas based on unique hydrologic characteristics (e.g., differences in surface flows) within a given valley or area. [A listing of Nevada’s Hydrographic Regions, Areas and Sub-Areas is presented in Appendix A-1 (hydrographic regions, areas and sub-areas), Appendix A-2 (listed sequentially by area number) Appendix A-3 (listed alphabetically by area name), and Appendix A-4 (listed alphabetically by principal Nevada county(ies) in which located).]

Hydrographic Region [Nevada] — Nevada has been divided into 14 hydrographic regions or basins, which are now

used by the Nevada Division of Water Resources, Department of Conservation and Natural Resources, and the U.S. Geological Survey (USGS) to compile information pertaining to water resources and water use. These regions are also further subdivided into 232 *Hydrographic Areas* (256 Hydrographic Areas and Sub-Areas, combined) for more detailed study. See *Basins [Nevada]*, for a complete listing and description of Nevada's 14 Hydrographic Regions.

Impound — To accumulate and store water as in a reservoir.

Indirect Water Uses — Uses of water that are not immediately apparent to the consumer. For example, a person indirectly uses water when driving a car because water was used in the production process of steel and other automotive components.

Industrial, Self-supplied Water — Water withdrawn from privately developed sources and delivered through water systems established entirely or primarily for commercial and industrial use. Includes water used by mining, manufacturing, military establishments, educational and penal institutions, golf courses, hotels, motels, restaurants, casinos and other small businesses.

Industrial Water Use (Withdrawals) — Industrial water use includes water used for processing activities, washing, and cooling. Major water-using manufacturing industries include food processing, textile and apparel products, lumber, furniture and wood products, paper production, printing and publishing, chemicals, petroleum, rubber products, stone, clay, glass and concrete products, primary and fabricated metal industries, industrial and commercial equipment and electrical, electronic and measuring equipment and transportation equipment. The terms “water use” and “water withdrawals” are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Commercial Water Use (Withdrawals)*.

Injection Well — Refers to a well constructed for the purpose of injection treated wastewater directly into the ground. Wastewater is generally forced (pumped) into the well for dispersal or storage into a designated aquifer. Injection wells are generally drilled into nonpotable aquifers, unused aquifers, or below freshwater levels.

Irrigate — (1) To supply (dry land) with water by means of ditches, pipes, or streams; to water artificially. (2) To wash out (a body cavity or wound) with water or a medicated fluid. (3) To make fertile or vital as if by watering.

Irrigation — (1) The controlled application of water for agricultural purposes through man-made systems to supply water requirements not satisfied by rainfall. (2) The application of water to soil for crop production or for turf, shrubbery, or wildlife food and habitat.

Irrigation Water Use (Withdrawals) — Artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth on recreational lands, such as parks and golf courses. The terms “water use” and “water withdrawals” are equivalent, but not the same as *Consumptive Use* as they do not account for return flows. Also see *Irrigation Return Flow*.

Livestock Water Use — Water use for stock watering, feed lots, dairy operations, fish farming, and other on-farm needs. Livestock as used here includes cattle, sheep, goats, hogs, and poultry. Also included are such animal specialties as horses, rabbits, bees, pets, fur-bearing animals in captivity, and fish in captivity. Also see *Rural Water Use*.

M&I (Municipal and Industrial) Water Withdrawals (Use) — Water supplied for municipal and industrial uses provided through a municipal distribution system.

Mining Water Use — Water use for the extraction of minerals occurring naturally including solids, such as coal and ores; liquids, such as crude petroleum; and gases, such as natural gas. Also includes uses associated with quarrying, well operations (*Dewatering*), milling (crushing, screening, washing, flotation, and so forth), and other preparations customarily done at the mine site or as part of a mining activity, such as dust control, maintenance, and wetland restoration. Generally, most of the water used at a mining operation is self-supplied. Also see *Self-Supplied Water*.

Model — (Statistics) A simulation, by descriptive, conceptual, statistical, or other means, of a process or thing that is difficult or impossible to observe directly, as in an *Economic Consumption Model* or a *River Flow Model*.

Modeling (Forecasting and Simulation Analysis) — The application of a mathematical process or simulation framework, for example a mathematical or *Econometric Model*, to describe various phenomenon and analyze the effects of changes in independent (i.e., explanatory) variables on dependent variables.

Municipal and Industrial (M & I) Water Withdrawals (Use) — Water supplied for municipal and industrial uses provided through a municipal distribution system for rural domestic use, stock water, steam electric powerplants, and water used in industry and commerce.

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Municipal Water System — A water system which has at least five service connections or which regularly serves 25 individuals for 60 days. See *Public Water System (PWS)*.

Non-Community Water System (NCWS) — A public water system that is not a community water system, e.g., the water supply at a camp site or national park.

Non-Consumptive Water Use — Non-consumptive water use includes a water use that is not consumed, for example, water withdrawn for purposes such as hydropower generation. This also includes uses such as boating or fishing where the water is still available for other uses at the same site. No typical consumptive use is 100 percent efficient; there is always some return flow associated with such use either in the form of a return to surface flows or as a ground water recharge. Nor are typically non-consumptive uses of water entirely non-consumptive. There are evaporation losses, for instance, associated with maintaining a reservoir at a specified elevation to support fish, recreation, or hydro-power, and there are conveyance losses associated with maintaining a minimum streamflow in a river, canal, or ditch.

Non-Transient Non-Community Water System — (1) A public water system that regularly serves at least 25 of the same non-resident persons per day for more than six months per year. (2) A public water system that is not a community water system and that regularly serves at least 25 of the same people over six months per year. Common types of such water systems are those serving schools, daycare centers, factories, restaurants, nursing homes, and hospitals.

Open-Pit Mining — The process of removing mineral deposits that are found close enough to the surface so that the construction of tunnels (underground mining) is not necessary. The soil and strata that cover the deposit are removed to gain access to the mineral deposit.

Population — (Statistics) The total number of potential observations in a specific category, for example, the human population of a particular city, or the number of animals of a particular species within a defined area. Typically, measurements of the behavior and characteristics of the population are not possible and therefore a *Sample* is selected which, if an *Unbiased Sample*, will, even in its limited numbers, be representative of the characteristics of the total population.

Population Density — (1) The number per unit area of individuals of any given species at a given time. (2) (Water Planning) The number of people in a given area. The number may be obtained by multiplying the number of dwelling units per unit area (e.g., square mile, square kilometer, acre, etc.) by the number of residents per dwelling unit.

Potable Water — Water that is drinkable. Specifically, freshwater that generally meets the standards in quality as established in the U.S. Environmental Protection Agency (EPA) *Drinking Water Standards* for drinking water throughout the United States. Potable water is considered safe for human consumption and is often referred to as *Drinking Water*. Freshwater that exceeds established chloride and dissolved solids limits is often referred to as slightly saline, brackish, or nonpotable water and is either diluted with fresher water or treated through a desalination process to meet potable-water standards for public supply.

Price Elasticity (of Water) — Defined as the ratio of the percent change in the quantity demanded of water (or any other economic good) and the percent change in price, or

$$n_{\text{water}} = \text{Percent Change in } Q_{\text{water}} / \text{Percent Change in } P_{\text{water}}$$

An elastic demand results when the ratio of n_{water} is greater than unity (>1), implying that a given change in price will result in a greater (percentage) change in the quantity demanded. Under such conditions of “elastic demand” for water, consumers tend to be responsive to changes in the price for water. Conversely, an inelastic demand results when the ratio of n_{water} is less than unity (<1), implying that a given change in price will result in a smaller (percentage) change in the quantity demanded. Under such conditions of “inelastic demand,” consumers are relatively unresponsive to changes in the price for water. Along any given (downward sloping) demand curve, the elasticity will vary from inelastic, to unity, to elastic as the price rises further.

Public Supply Water — (1) Water withdrawn for all users by public and private water suppliers and delivered to users that do not supply their own water. (2) Water withdrawn by and delivered to a public water system regardless of the use made of the water. Includes water supplied both by large municipal systems and by smaller quasi-municipal

or privately-owned water companies. Water suppliers provide water for a variety of uses, such as *Domestic Water Use* (also referred to as *Residential Water Use*), *Commercial Water Use*, *Industrial Water Use*, *Thermoelectric Power Water Use* (domestic and cooling purposes), and *Public Water Use*.

Public Utility — A private business organization, subject to government regulation, that provides an essential commodity or service, such as water, electricity, transportation, or communications, to the public.

Public Water Use — Water supplied from a *Public Water Supply System (PWSS)* and used for such purposes as fire fighting, street washing, and municipal parks, golf courses, and swimming pools. Public water use also includes system water losses (water lost to leakage) and brine water discharged from desalination facilities. Also referred to as *Utility Water Use*.

Reclaimed Water — Waste water that becomes suitable for a specific beneficial use as a result of treatment or brackish water demineralized for use. General types of reclaimed waste water include:

- [1] **Primary Effluent** — reclaimed water that only has had sewage solids removed and is typically used only for surface irrigation of tree, fodder, and fiber crops;
- [2] **Secondary Effluent** — reclaimed water that has had sewage solids removed and has been oxidized and disinfected and is used to irrigate golf courses and cemeteries and provide water for pasture and food crops; and
- [3] **Tertiary Recycled Water** — water produced by conventional sewage treatment followed by more advanced procedures including filtration and disinfection, providing it with the broadest range of uses.

Residential Water Use — Water used normally for residential purposes, including household use, personal hygiene, and drinking, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. Also referred to as *Domestic Water Use*. Also see *Public Water Supply System* and *Self-Supplied Water*.

Resident Population — The number of persons who live within a state or other political subdivision (county, city, etc.) who consider it their permanent place of residence. College students, military personnel, and inmates of penal institutions are counted as permanent residents. According to this definition, tourist and seasonal or part-time residents are considered nonresident population.

Return Flow — (1) The amount of water that reaches a ground or surface water source after release from the point of use and thus becomes available for further use. (2) That part of a diverted flow which is not consumptively used and returns to its original source or another body of water. (3) (Irrigation) Drainage water from irrigated farmlands that re-enters the water system to be used further downstream. Such waters may contain dissolved salts or other materials that have been leached out of the upper layers of the soil.

Reuse (of Water) — (1) Water that is discharged by one user and is used by other users. (2) Repeated use of the same water by subsequent users in sequential systems. Sometimes, it also means water discharged by one unit and used by other units in the same plant. Also referred to as *Recycled Water*.

Reuse Systems — Refers to the deliberate application of reclaimed water for a beneficial purpose. Reuse may encompass landscape irrigation (such as golf courses, cemeteries, highway medians, parks, playgrounds, school yards, nurseries, and residential properties), agricultural irrigation (such as food and fruit crops, wholesale nurseries, sod farms and pasture grass), aesthetic uses, ground-water recharge, environmental enhancement of surface water and wetland restoration, fire protection, and other useful purposes.

Reverse Osmosis — (1) (Desalination) Refers to the process of removing salts from water using a membrane. With reverse osmosis, the product water passes through a fine membrane that the salts are unable to pass through, while the salt waste (brine) is removed and disposed. This process differs from electrodialysis, where the salts are extracted from the feedwater by using a membrane with an electrical current to separate the ions. The positive ions go through one membrane, while the negative ions flow through a different membrane, leaving the end product of freshwater. (2) (Water Quality) An advanced method of water or wastewater treatment that relies on a *Semi-permeable Membrane* to separate waters from pollutants. An external force is used to reverse the normal osmotic process resulting in the solvent moving from a solution of higher concentration to one of lower concentration.

Self-Supplied Water — Water withdrawn from a surface or ground-water source directly by a user rather than being obtained from a *Public Water Supply System (PWSS)*.

Self-Supplied Water (Industrial) — Water for industrial use, supplied from sources other than municipal distribution systems.

Sigmoid Growth — (Data Analysis) A growth rate trend characterized by an elongated S-shaped, or sigmoid curve. Typical of population growth rate trends which begin rapidly at an exponential rate but slow as limiting factors are encountered until a limit is approached asymptotically.

Significant (Statistical) — A term applied to differences, correlations, cause-and-effect relationships, etc., to indicate that they are probably not due to chance alone. Significant ordinarily indicates a probability of not less than 95 percent, while highly significant indicates a probability of not less than 99 percent.

Thermoelectric Power — Electrical power generated using fossil-fuel (coal, oil, or natural gas), geothermal, or nuclear energy.

Thermoelectric (Power) Water Use — Water used in the process of the generation of *Thermoelectric Power*. The water may be obtained from a *Public Water Supply System* or may be self supplied. Also see *Self-Supplied Water*.

Time-Series Analysis — (Statistics) Techniques that attempt to predict the future by using historical data rather than by building cause-and-effect models. Typically, such techniques are most appropriate when the historical data is relatively well behaved and when forecasts, primarily, are sought and not precise cause-and-effect relationships. Contrast with *Cross-Sectional Analysis*.

Variable — (Statistics) A series of comparable observations or characteristics of a phenomenon taken as a single set of data; a listing of specific characteristics of a population or a number of observations taken over a specific period of time which may reasonably be expected to vary from observation to observation.

Water Conservation — The physical control, protection, management, and use of water resources in such a way as to obtain maximum sustained benefits while reducing water use. Water conservation results in a reduction in applied water due to more efficient water use such as through the implementation of *Best Management Practices (BMP)* — *Urban Water Use*, or *Efficient Water Management Practices (EWMP)* — *Agricultural Water Use*.

Water Demand — The water requirements for a particular purpose, such as irrigation, power production, municipal supply, plant transpiration, or storage.

Water Supply System — Includes the works and auxiliaries for collection, treatment, storage, and distribution of the water from the sources of supply to the free-flowing outlet of the ultimate consumer. Also see *Public Water System (PWS)*.

Water Use — The amount of water used for a variety of purposes including drinking, irrigation, processing of goods, power generation, and other uses. The amount of water used is typically less than the amount of water withdrawn for a particular use due to water transfers, the recirculation or recycling of the same water, return flows, etc. For example, a power plant may use the same water multiple times, but withdraw a significantly different amount. Also see *Water Use, Types*, below.

Water Use, Types — The use of water may be classified by specific types according to distinctive uses, such as the following:

- [1] Commercial Water Use
- [2] Domestic Water Use
- [3] Hydroelectric Power Water Use
- [4] Irrigation Water Use
- [5] Livestock Water Use
- [6] Mining Water Use
- [7] Navigational Water Use
- [8] Other Water Use
- [9] Public Water Use (same as *Utility Water Use*)
- [10] Residential Water Use (same as *Domestic Water Use*)
- [11] Rural Water Use
- [12] Thermoelectric Power Water Use

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Section 7
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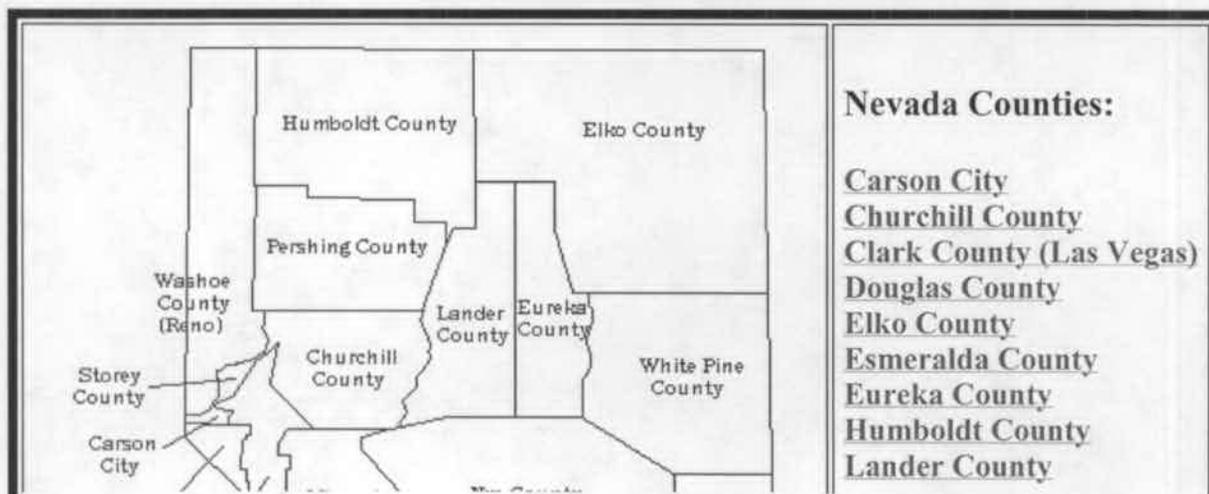
The *Nevada State Water Plan Appendices* are presented in six appendices as shown below. All appendices relating to the statewide total or a particular county are attainable from the individual state or county appendix contents pages which are accessible from the map or table listing below. The following appendices are presented:

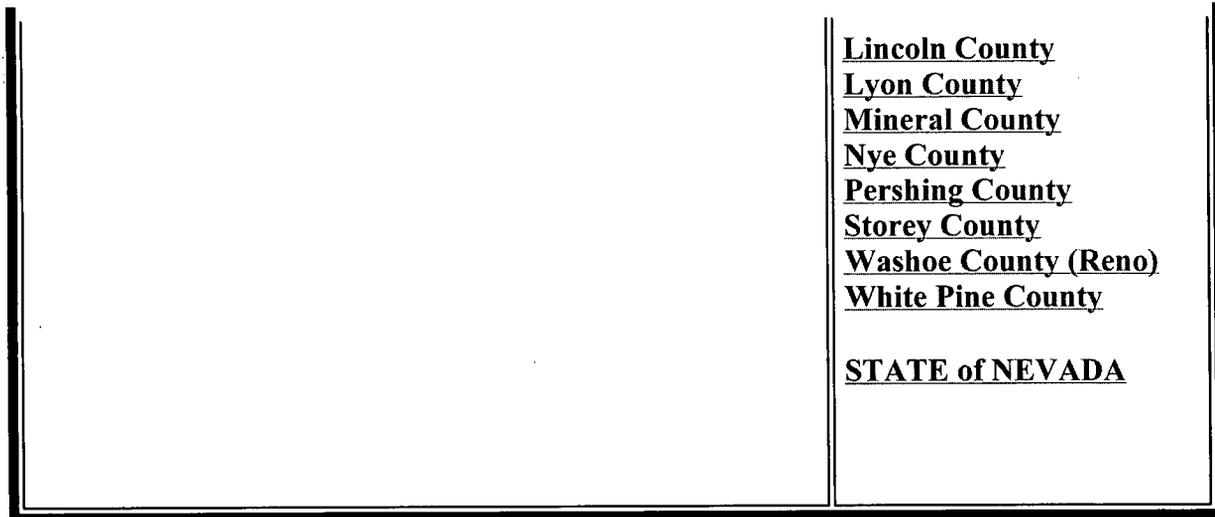
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Appendix 6 – Nevada and County Socioeconomic Overviews of the State Water Plan are incorporated into the water plan by reference only. For these documents, we invite you to view the NDWR's Socioeconomic Overviews Internet presentation:

[Nevada Socioeconomic Overviews](#)

Click on individual counties within the Nevada county map below to view that county's appendix contents page. County appendices may also be selected from the county listing to the right of the map. The Nevada appendix contents page is accessible either under the map title "Nevada" or from "State of Nevada."





📍 [See Chart of Formation of Nevada's Counties](#)

📍 [See County/Hydrographic Basin \(Regions\) Map](#)

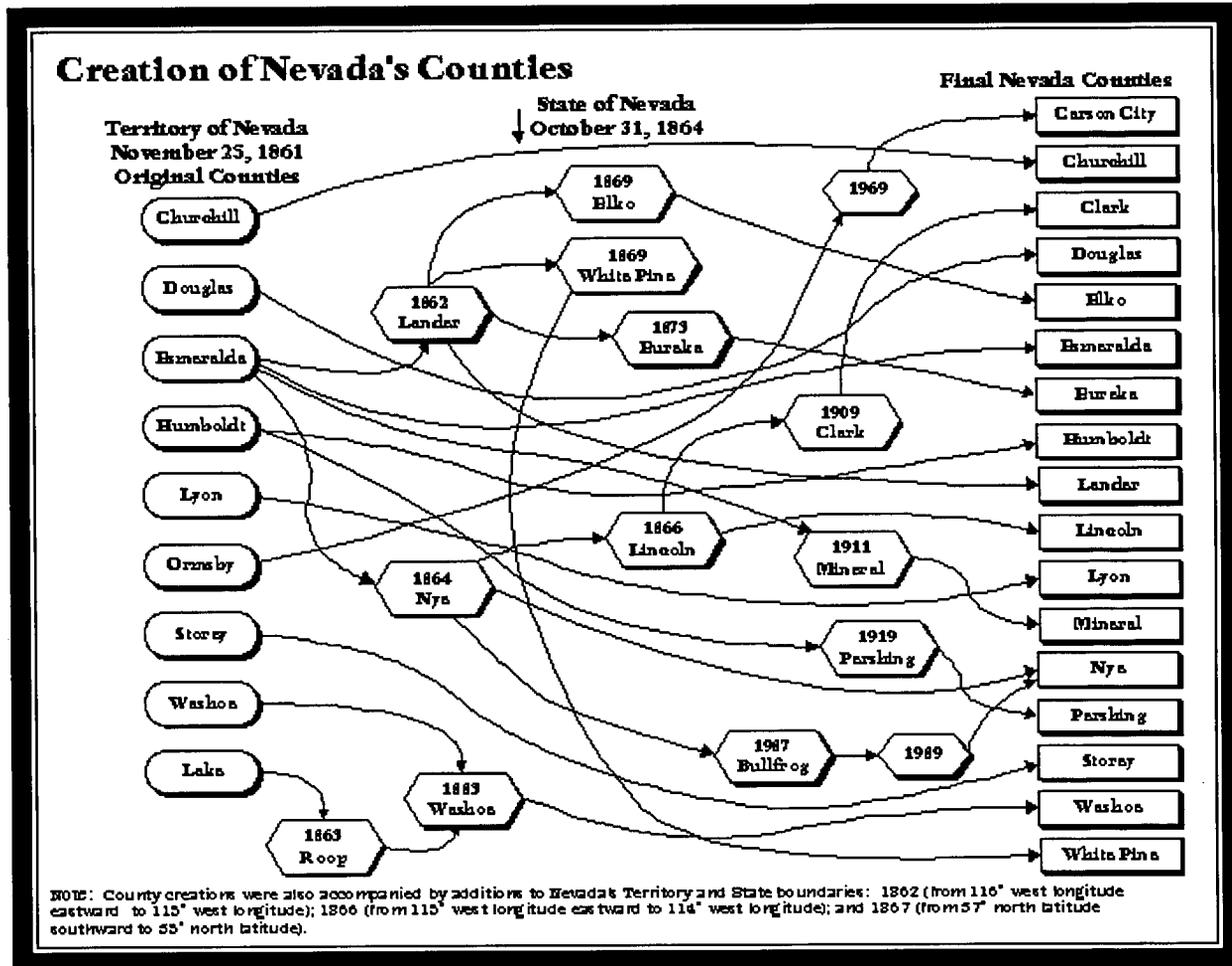


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Nevada Hydrographic Basin Index Map

The map below shows Nevada's 14 Hydrographic Basins (Regions) and their relationship to Nevada's 17 counties.

[Click on the basins or their names for more information.]



Information on Nevada's Hydrographic Basins or Regions

For hydrologic analysis and water planning and management purposes, the U.S. Geological Survey (USGS) and the Nevada Division of Water Resources, Department of Conservation and Natural Resources, have divided the State of Nevada into fourteen (14) distinct and discrete hydrologic units called *Hydrographic Regions or Basins*. A hydrographic region (or waterbasin or watershed) is broadly defined as a geographic area drained by a single major stream or an area consisting of a drainage system comprised of streams and often natural or man-made lakes. These principal hydrographic regions have been further disaggregated into 232 distinct *Hydrographic Areas* and 256 *Hydrographic Areas and Sub-Areas*. These smaller hydrologic units typically comprise a valley, a portion of a valley, or terminal basin. Information on these hydrographic

areas and sub-areas may be accessed from the listing of hydrographic regions above. The 14 Nevada hydrographic regions (basins) are:

- [1] **Northwest Region** — Covers 3,052 square miles (7,905 square kilometers or 1,953,280 acres) of northern Washoe and Humboldt counties and encompasses 16 hydrographic areas; extends into the State of California to the west and the State of Oregon to the north;
- [2] **Black Rock Desert Region** — Covers 8,632 square miles (22,357 square kilometers or 5,524,480 acres) of parts of Washoe, Humboldt, and Pershing counties and includes 17 hydrographic areas, two of which are divided into separate hydrographic sub-areas; extends into the State of California to the west and the State of Oregon to the north;
- [3] **Snake River Basin** — Covers 5,230 square miles (13,546 square kilometers or 3,347,200 acres) in parts of Elko and Humboldt counties and includes eight hydrographic areas; extends into the states of Oregon and Idaho to the north and the State of Utah to the east;
- [4] **Humboldt River Basin** — Covers 16,843 square miles (43,623 square kilometers or 10,779,520 acres) in parts of eight counties — Elko, White Pine, Eureka, Humboldt, Lander, Nye, Pershing, and Churchill — and the largest river (Humboldt River) wholly contained within Nevada. This basin contains 34 hydrographic areas and one hydrographic sub-area and is one of only two that are wholly contained within the State of Nevada. It originates in the Ruby, Jarbidge, Independence, and East Humboldt Mountain ranges (Elko County) and terminates in the Humboldt Lake and Sink (Pershing and Churchill counties). During particularly wet years, the Humboldt Sink may drain into the Carson Sink by means of the Humboldt Slough;
- [5] **West Central Region** — Covers 1,656 square miles (4,289 square kilometers or 1,059,840 acres) and includes parts of Pershing, Lyon, and Churchill counties and comprises five hydrographic areas. This basin is one of only two waterbasins that are wholly contained within the State of Nevada;
- [6] **Truckee River Basin** — Encompasses 2,300 square miles (5,957 square kilometers or 1,472,000 acres) containing parts of Washoe, Pershing, Churchill, Lyon, Douglas, Carson City, and Storey counties comprising 12 hydrographic areas; originates in the Sierra Nevada Mountains, the State of California and the Lake Tahoe Basin and terminates in Pyramid Lake (Washoe County);
- [7] **Western Region** — Covers 602 square miles (1,559 square kilometers or 385,280 acres) and is contained only in Washoe County in Nevada; contains nine hydrographic areas, one of which is divided into two sub-areas and another into one hydrographic sub-area; extends to the west into the State of California;
- [8] **Carson River Basin** — Covers 3,519 square miles (9,114 square kilometers or 2,252,160 acres) and includes parts of six counties—Douglas, Carson City, Lyon, Storey, Churchill, and Pershing; contains five hydrographic areas and one sub-area; has its origin to the west in the Sierra Nevada Mountains and the State of California and its terminus in the Carson Sink and Desert (Churchill and Pershing counties);
- [9] **Walker River Basin** — Covers 3,046 square miles (7,889 square kilometers or 1,949,440 acres) of Mineral, Lyon, and Douglas counties (and a very small portion of Churchill County) and includes five hydrographic areas, one of which has been divided into three hydrographic sub-areas; has its origin to the west in the Sierra Nevada Mountains and the State of California and its terminus in Walker Lake (Mineral County);
- [10] **Central Region** — By far the largest hydrographic region in Nevada covering 46,783 square miles (121,167 square kilometers or 29,941,120 acres) in thirteen Nevada counties—Nye, Elko, White Pine, Lincoln, Clark, Humboldt, Pershing, Churchill, Lander, Eureka, Lyon, Mineral, and Esmeralda. This region includes 78 hydrographic areas, ten of which are divided into two sub-areas and one into three sub-areas; extends to the south and west into the State of California;

[11] **Great Salt Lake Basin** — Covers 3,807 square miles (9,860 square kilometers or 2,436,480 acres) of the easternmost portions of Elko, White Pine, and Lincoln counties; includes eight hydrographic areas, one of which is divided into four hydrographic sub-areas; extends to the east into the State of Utah;

[12] **Escalante Desert Basin** — Covers a large area in Utah but only a very small part of it is in Lincoln County, Nevada — 106 square miles (275 square kilometers or 67,480 acres). It is made up of only one hydrographic area; extends to the east into the State of Utah;

[13] **Colorado River Basin** — Covers 12,376 square miles (32,054 square kilometers or 7,920,640 acres) including parts of Clark, Lincoln, Nye, and White Pine counties and is divided into 27 hydrographic areas; extends to the south into California, borders the Colorado River to the south and east, and extends into the states of Arizona and Utah to the east;

[14] **Death Valley Basin** — Covers 2,593 square miles (6,716 square kilometers or 1,659,520 acres) of Nye and Esmeralda counties including eight hydrographic areas, one of which has been divided into two hydrographic sub-areas; also extends into the State of California to the south and west.

NOTE: A complete listing of Nevada's 14 Hydrographic Regions, and 256 Hydrographic Areas and Sub-Areas is presented in the Nevada Division of Water Planning's *Water Words Dictionary*. This publication is available from the Nevada Division of Water Planning and is also available in electronic format on the Internet accessible from the NDWR's Home Page.

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