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 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 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 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

(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

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.

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

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* 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).

Index to Summary, Part 1:

Walker River Basin report (1 – 15)
Water For Southern Nevada (1 – 15)
Water Planning Division (1 – 13)

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

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 availible 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), sponsered 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	586.010 - 586.520
	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.

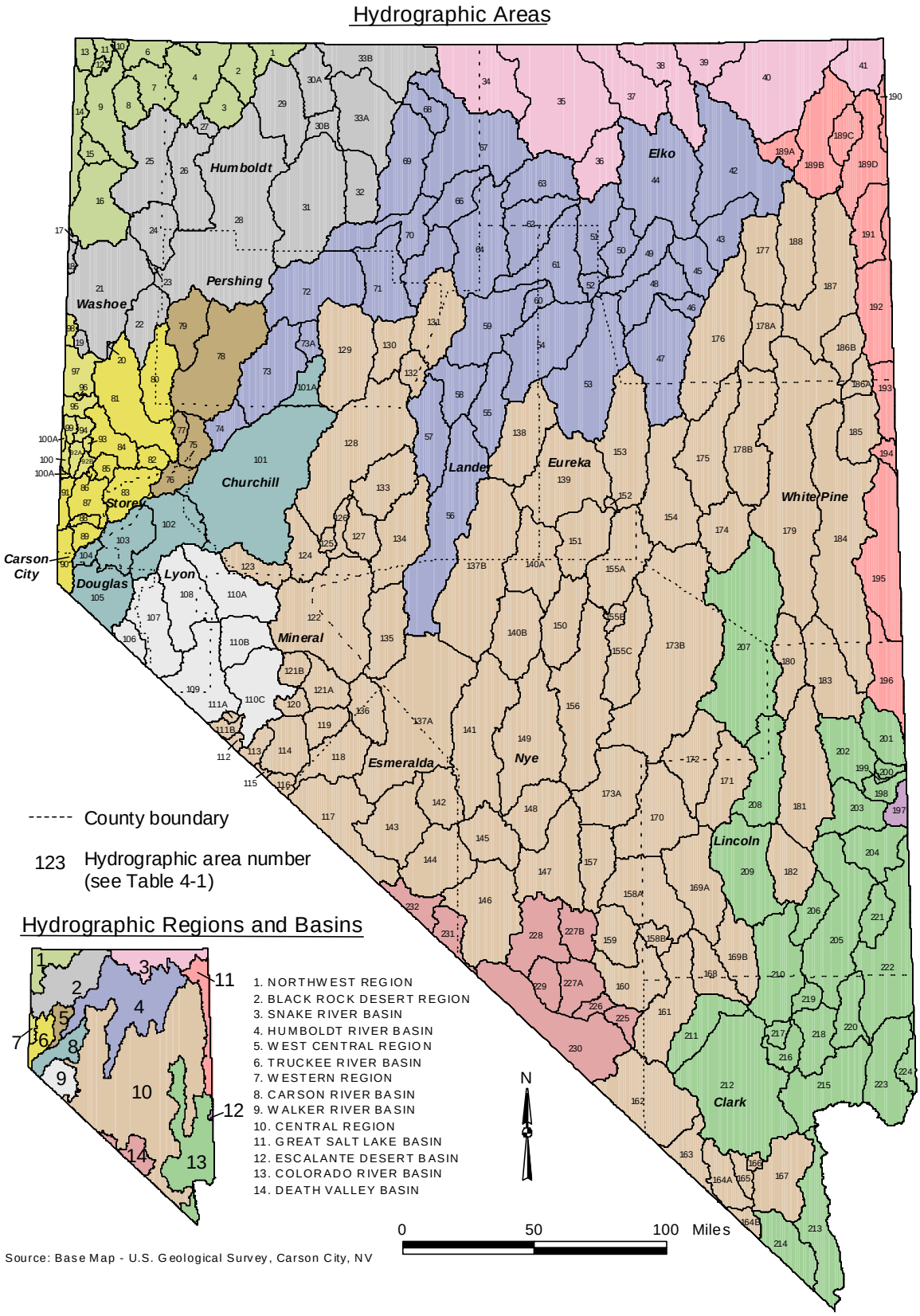


Figure 3-1. Hydrographic Regions and Basins

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. 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. 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. 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. 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. Tippett 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. Pahranagat 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

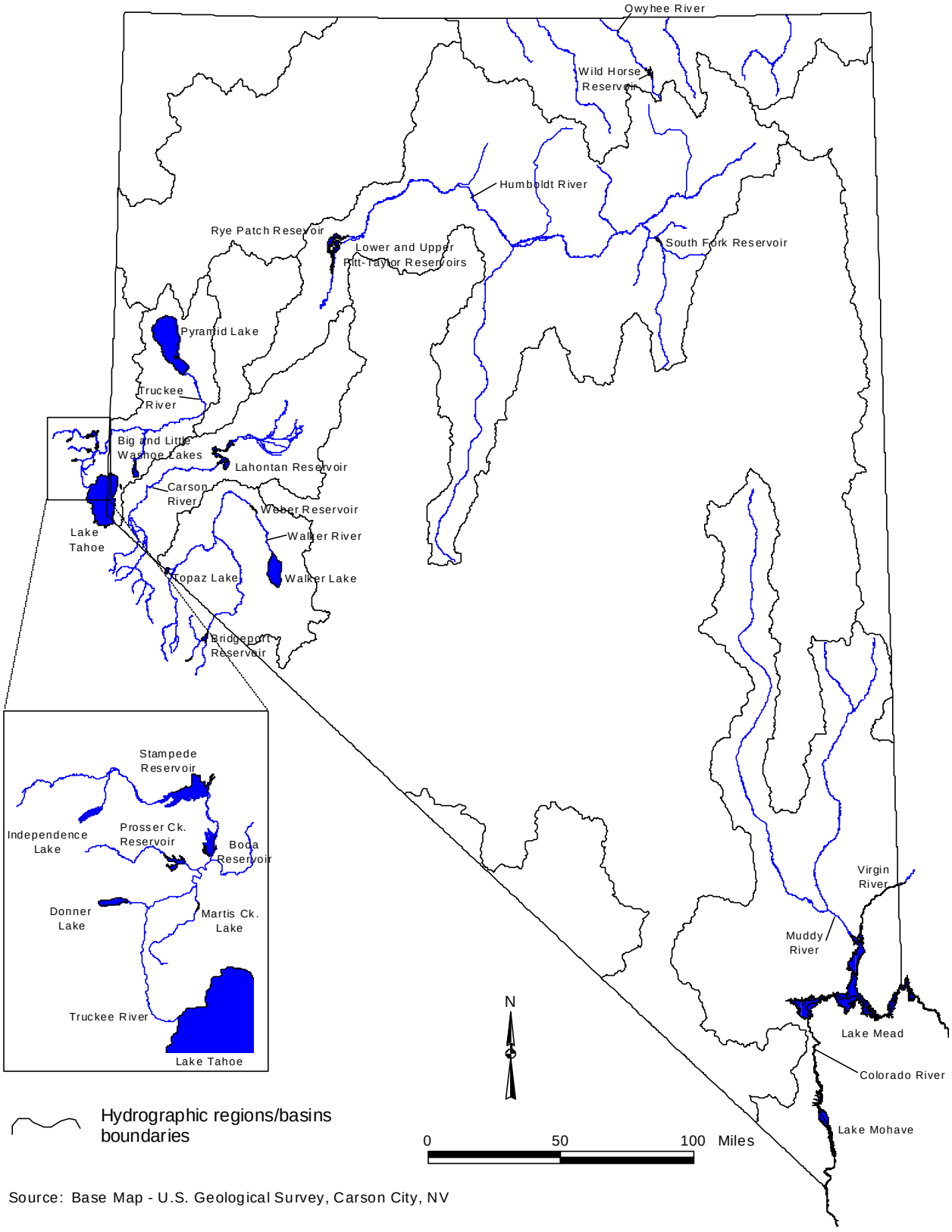
Surface water is a limited and precious resource in Nevada providing about 70 percent of the total water supply used in the state. Spring and summer snowmelt supplies most of the streamflow in Nevada. However, isolated summer convective storms probably cause a majority of the streamflow in southern Nevada's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



Source: Base Map - U.S. Geological Survey, Carson City, NV

Figure 3-2. Major Rivers, Lakes and Reservoirs

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

[1]Pyramid 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

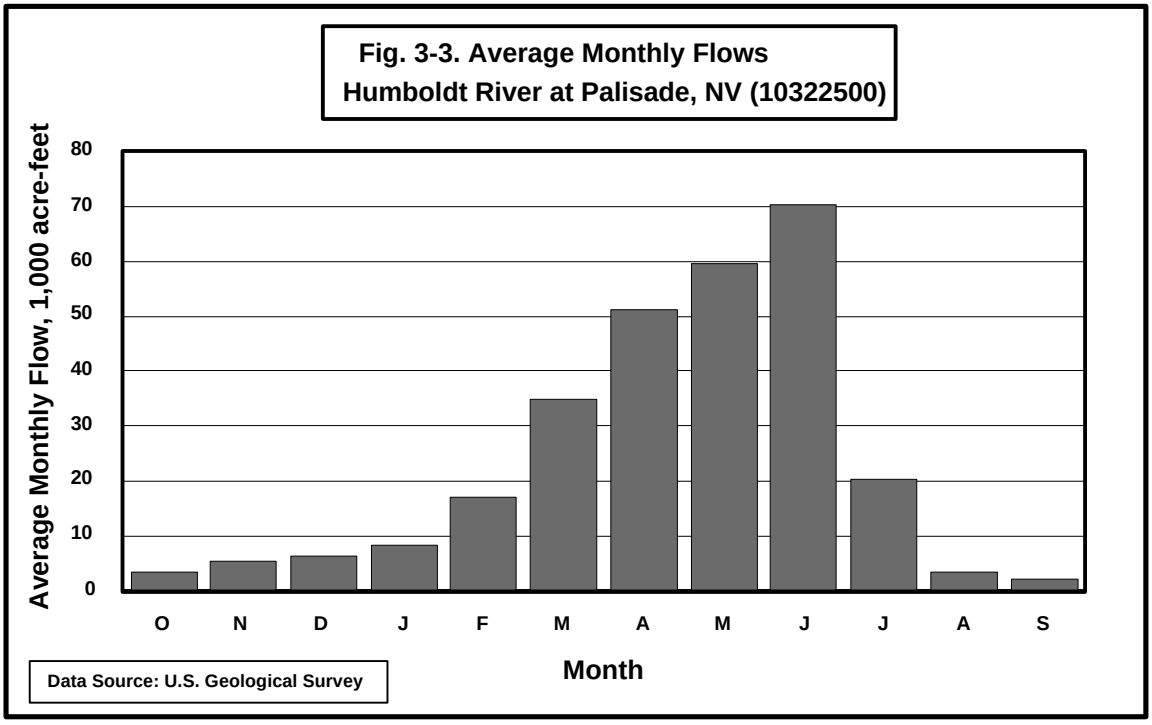


Fig. 3-3. Average Monthly Flows
Humboldt River at Palisade, NV (10322500)
Average Monthly Flow, 1,000 acre-feet
80
70
60
50
40
30
20
10
0
O
N
D
J
F
M
A
M
J
J
A
S
Month
Data Source: U.S. Geological Survey

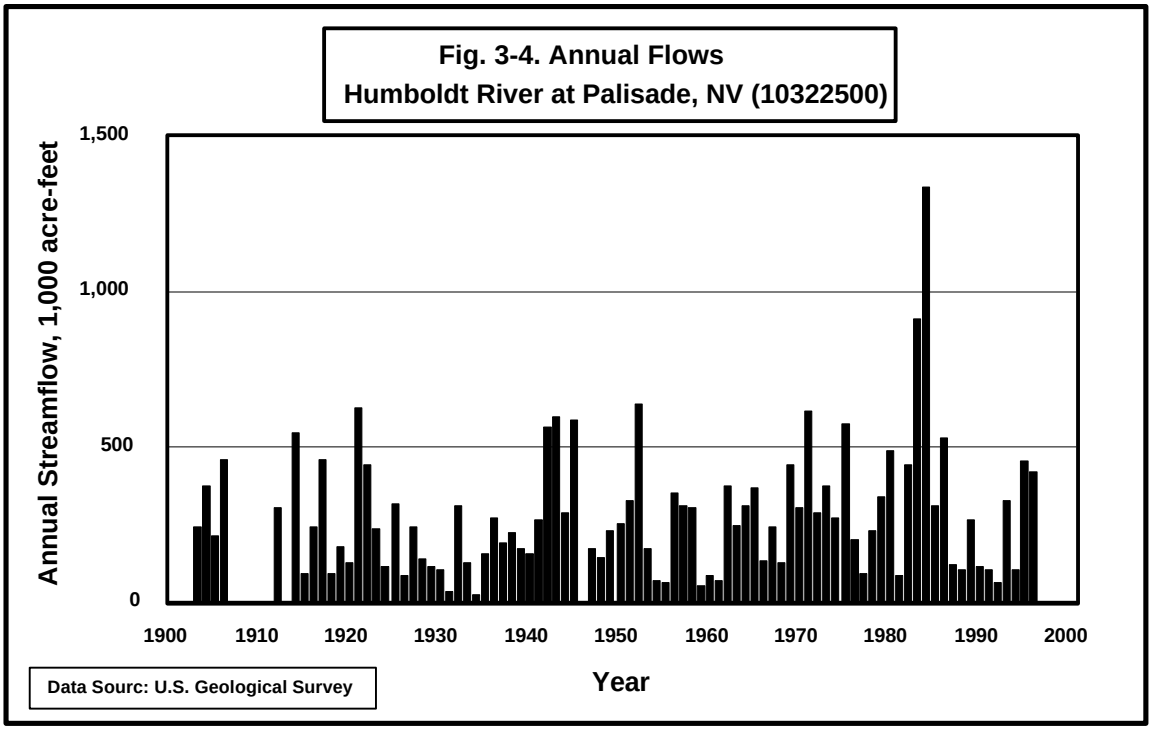


Fig. 3-4. Annual Flows
Humboldt River at Palisade, NV (10322500)
Annual Streamflow, 1,000 acre-feet
1,500
1,000
500
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Year
Data Sourc: U.S. Geological Survey

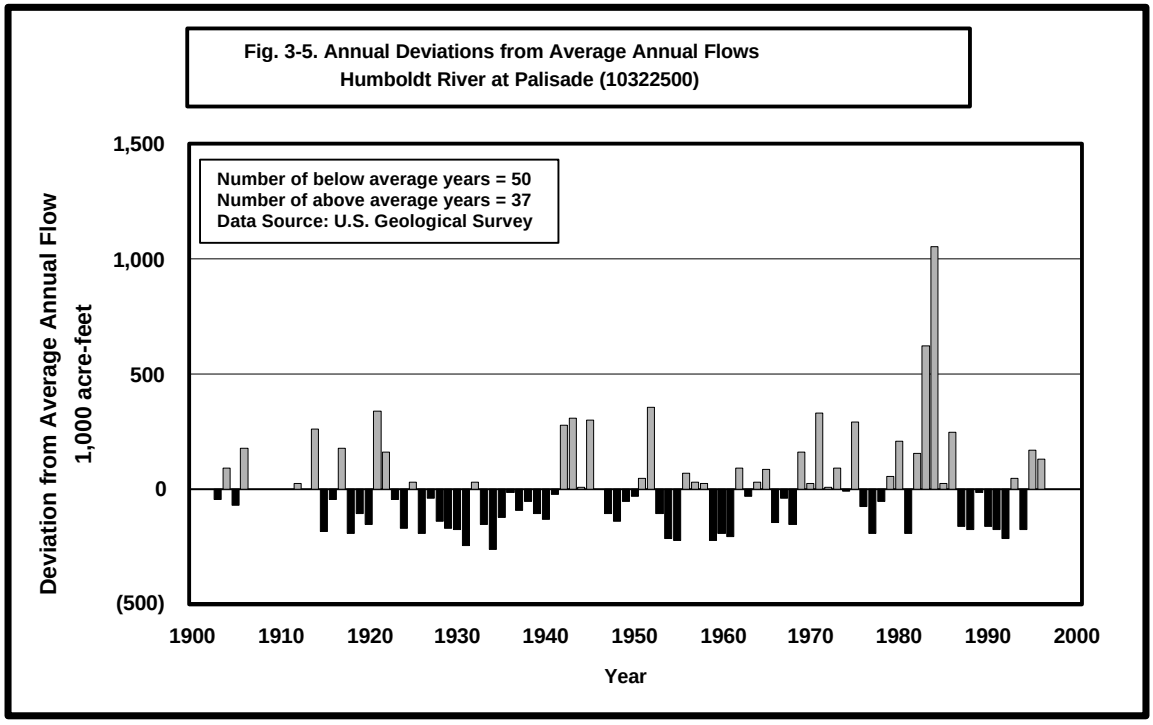
Table 3-4. Summary of Surface Water Runoff and Flows (excluding Colorado River)

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).

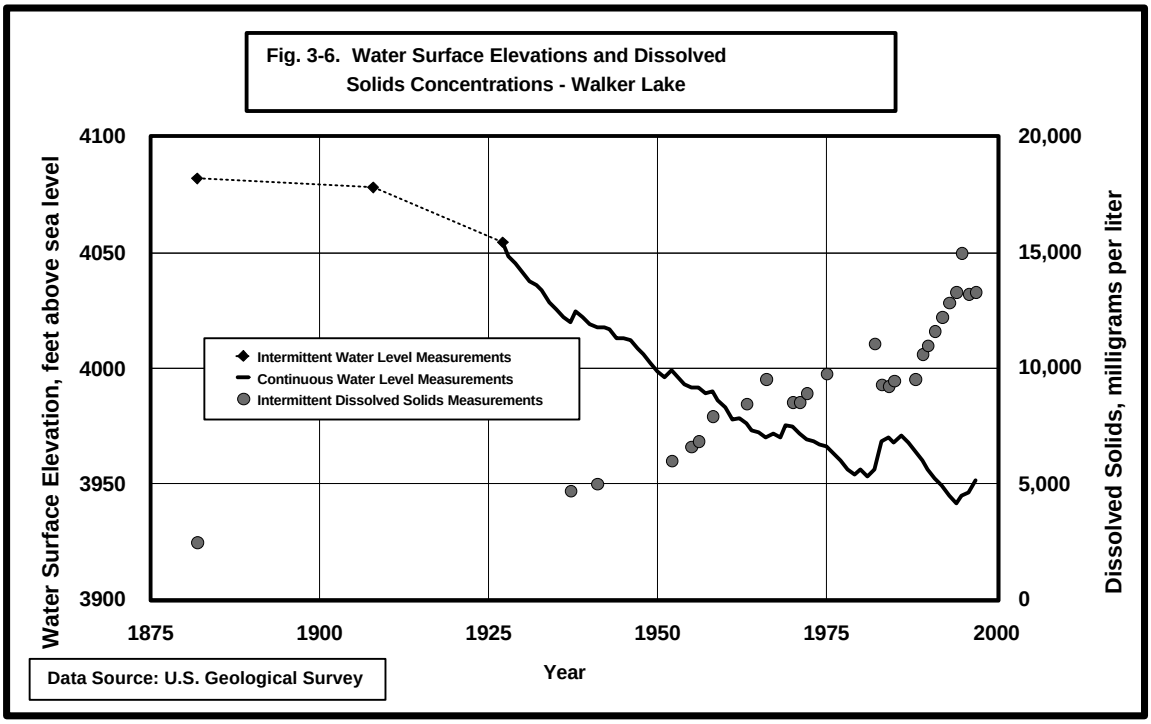


Even though Nevada is the driest state with an average annual precipitation of nine inches, floods are

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.

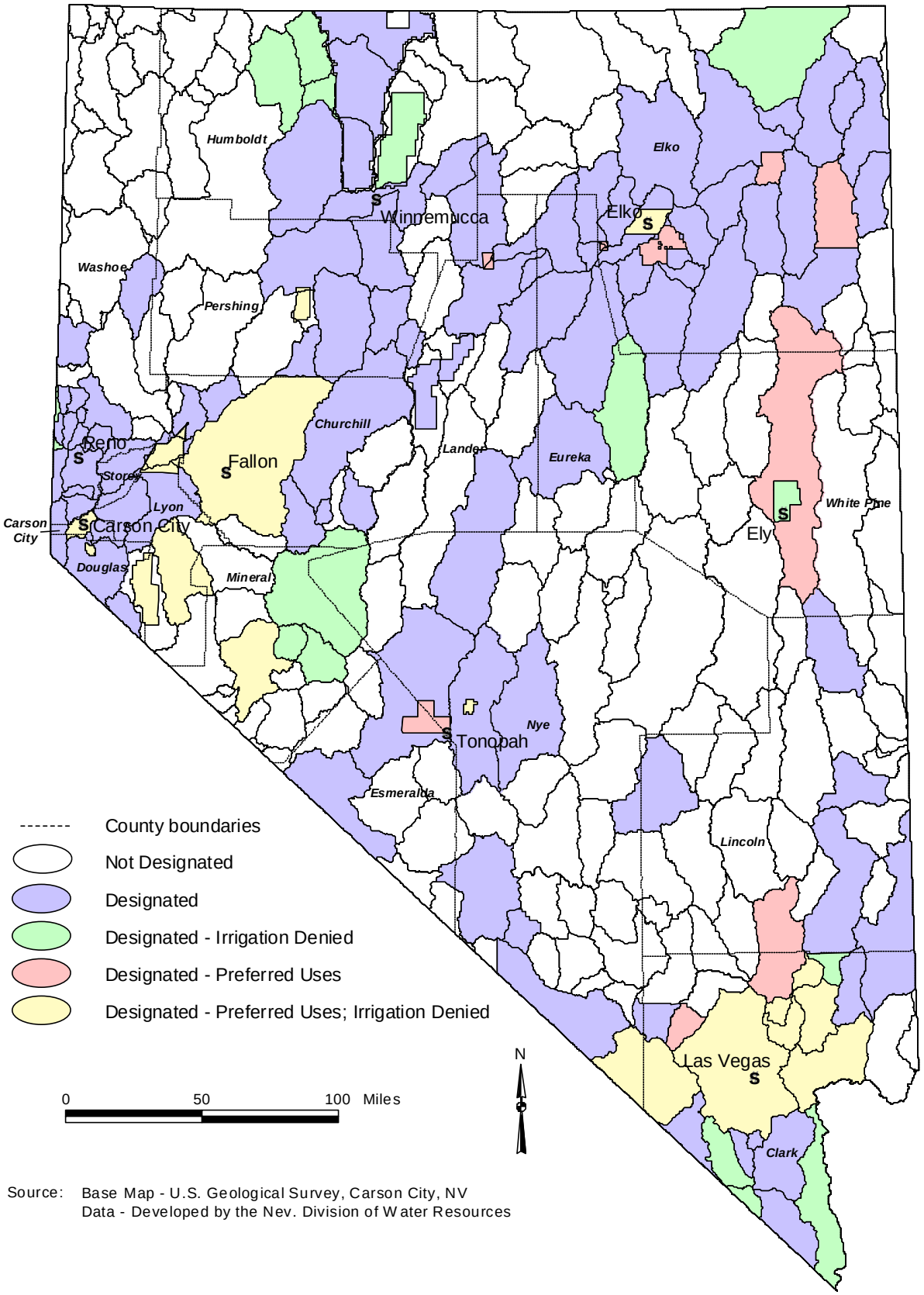


Figure 3-7. Designated Groundwater Basins of Nevada

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 not 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 not 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, 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.

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.

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.

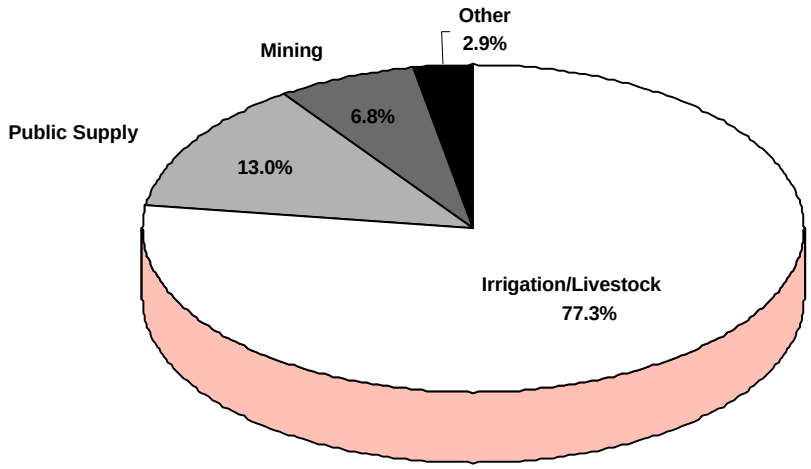
Livestock Water Use. *Livestock use* refers to water used for stock watering, feed lots, dairy operations, and other on-farm needs. Cattle are the major livestock raised in Nevada with most grazed on open range. Other livestock include sheep, horses and hogs. USGS estimates for 1970-95 shows wide fluctuations 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.

Fig. 3-8. 1995 Statewide Water Withdrawals by Public Supply and Self-Supplied Uses



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

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.

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.

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.

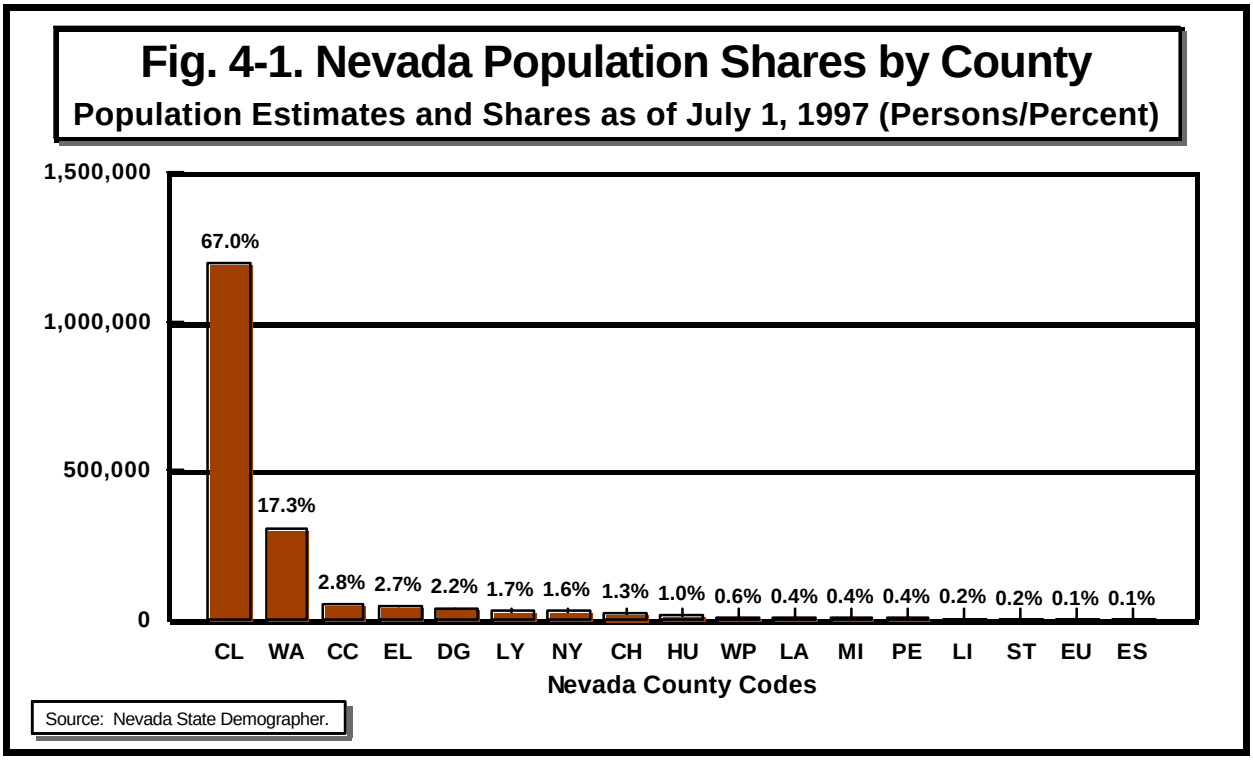
Table 4–1. Nevada Population Analysis — 1950–1997

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.

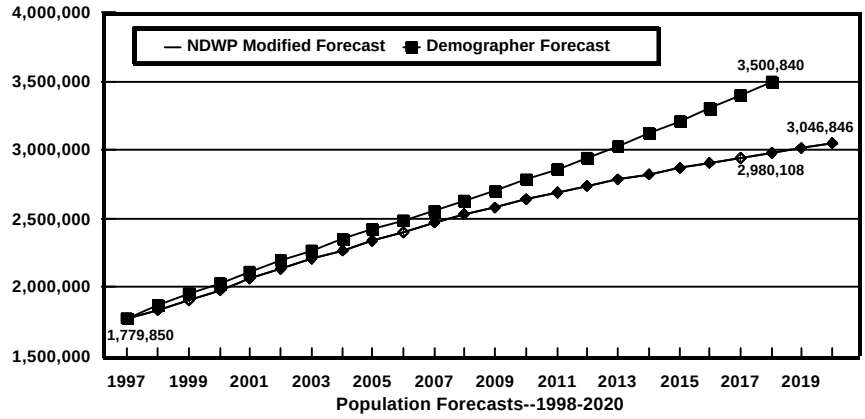
Clark County's total resident population was estimated at 1,192,200 persons in 1997 and accounted for 67.0 percent of the state's total population. This represented an increase of 36.7 percentage points in Clark County's share of the state's total population since 1950. Washoe County's population was 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.

Fig. 2-6. Nevada Population Forecast Comparisons
State Demographer and NDWP Modified--July 1 (Persons)

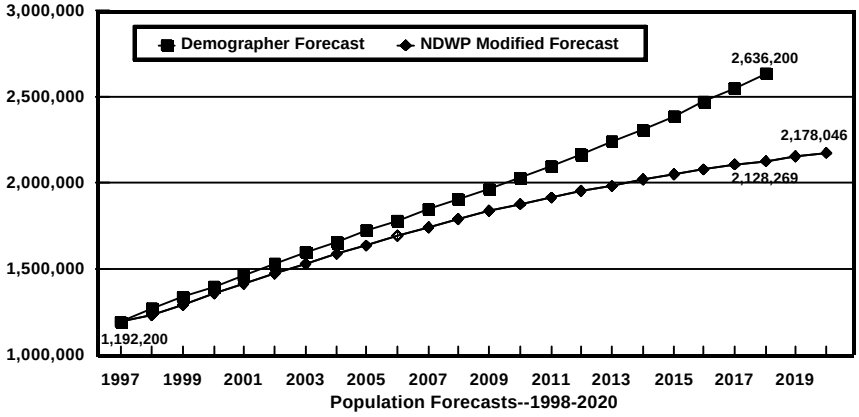


Sources: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

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

Fig. 2-7. Clark County Population Forecasts
State Demographer and NDWP Modified--July 1 (Persons)



Source Data: Nevada State Demographer; Nevada Division of Water Planning modified forecast.

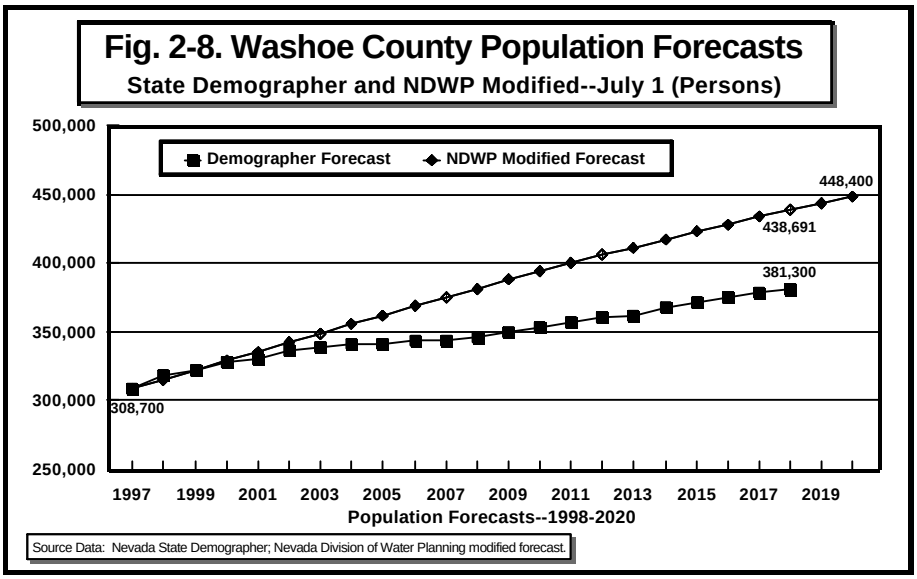
resource limitations, local planners in Clark County expect slower growth over the plan's forecast horizon than does the State Demographer. The State Water Plan incorporates both sets of population forecasts, as shown in Table 4–2. Nevada Population Forecast Comparisons to present an anticipated "range 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.

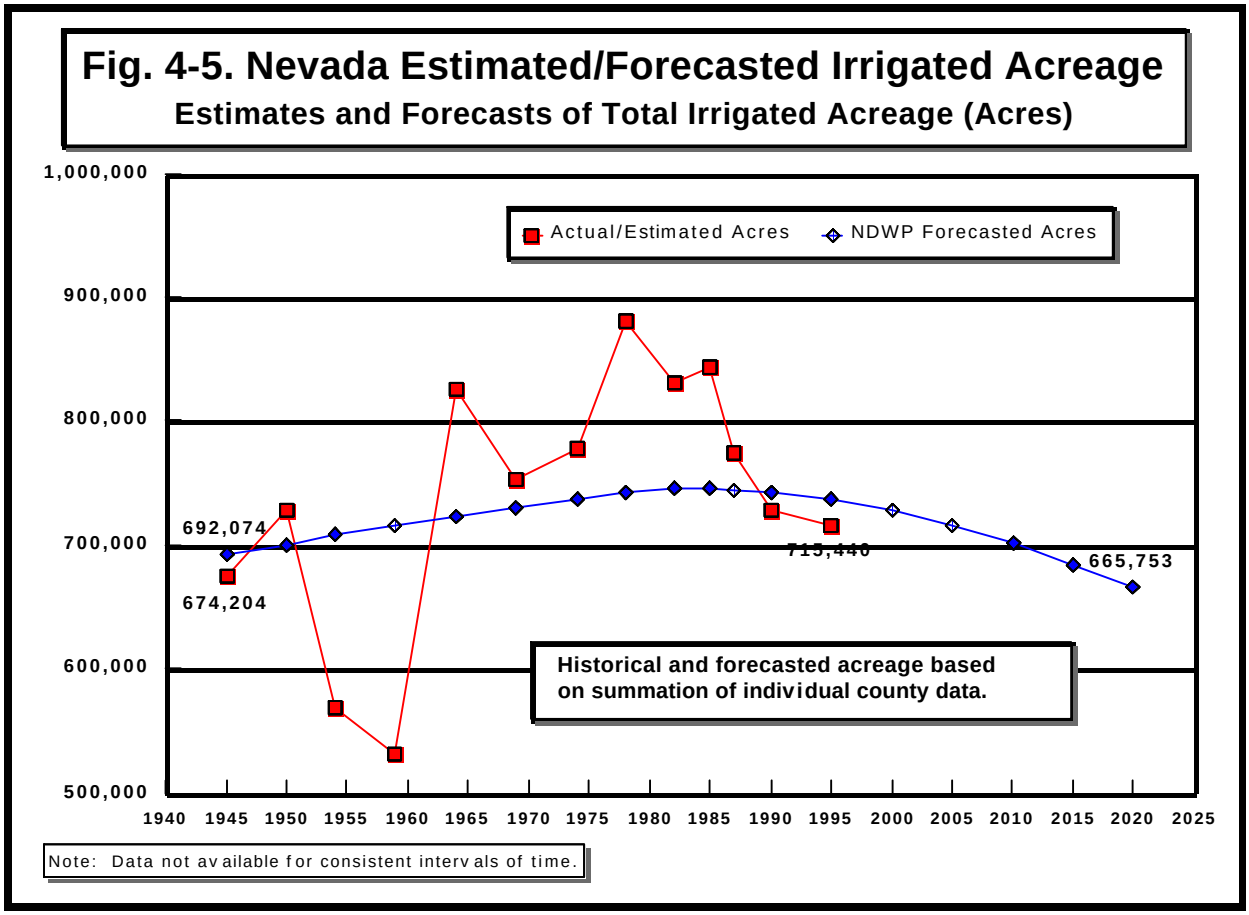
Agriculture. Agriculture represents one of Nevada's oldest and most lasting economic activities. Since the first settlements were established in the 1850's, agriculture in Nevada has continued to survive and even prosper. Today, agriculture remains a fundamental socioeconomic underpinning for a number 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)

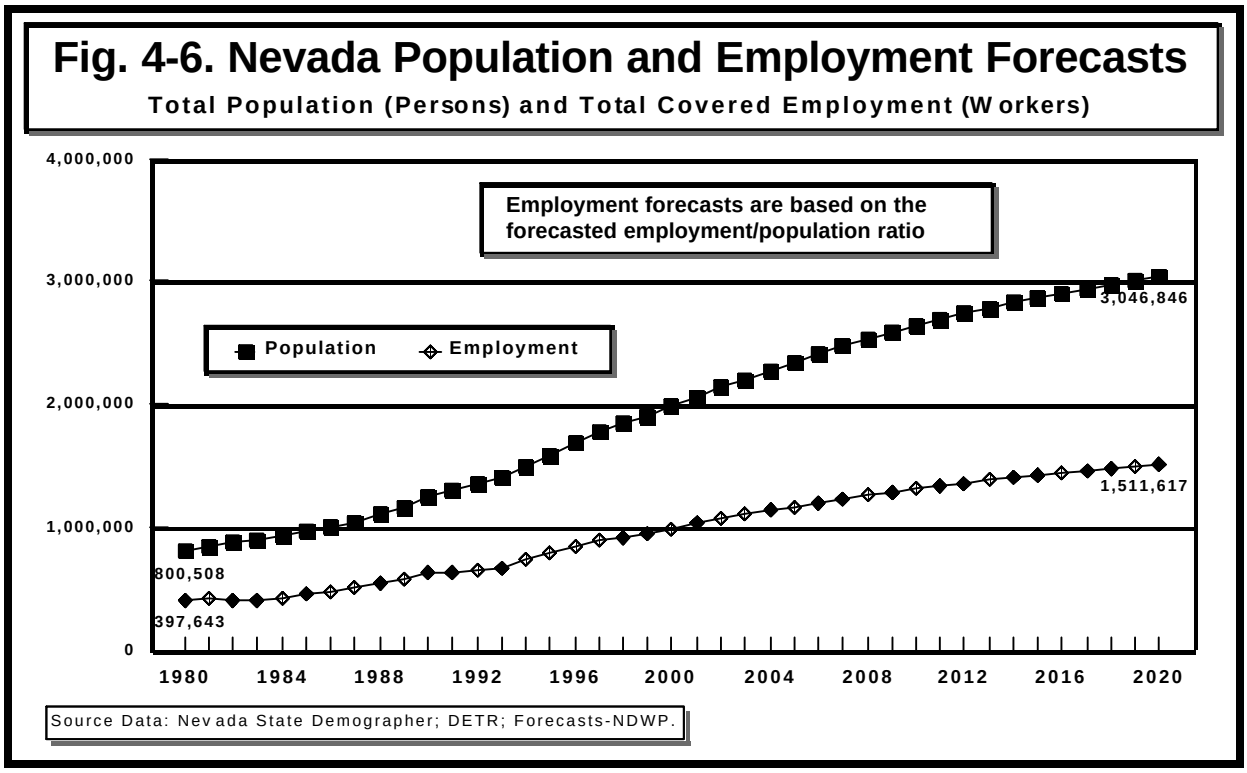
NEVADA	1997	2000	2005	2010	2015	2020	1997-2020 Change	1997-2020 Percent Change*
Population	1,779,850	1,986,257	2,341,374	2,640,306	2,868,979	3,046,846	1,266,996	71.2%
Employment	888,574	987,950	1,162,764	1,310,176	1,423,256	1,511,617	623,043	70.1%
Employment-to-Population Ratio	49.9%	49.9%	49.8%	49.7%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

Index to Summary, Section 4:



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 and 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

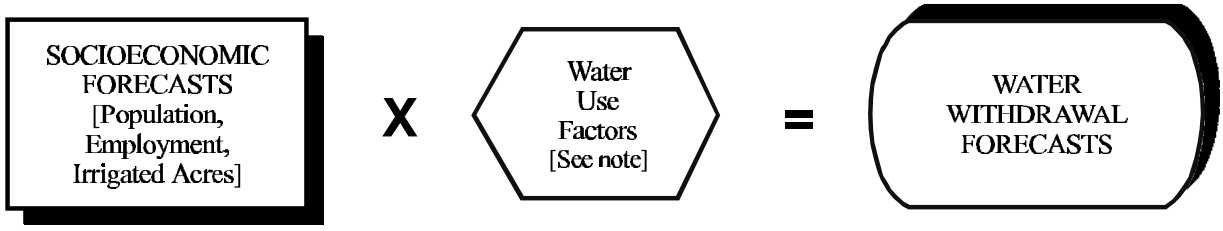
The Forecast Methodology

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

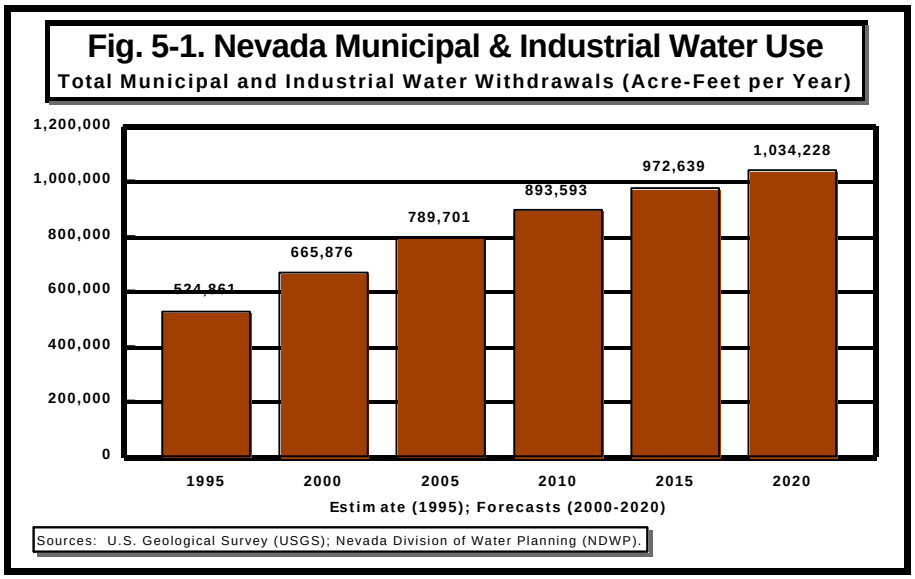


Note: Water Use Factors Measured in Gallons per Capita per Day, Gallons per Employee per Day, or Acre-Feet per Acre per Year

Nevada Division of Water Planning/Socioeconomic Analysis and Planning

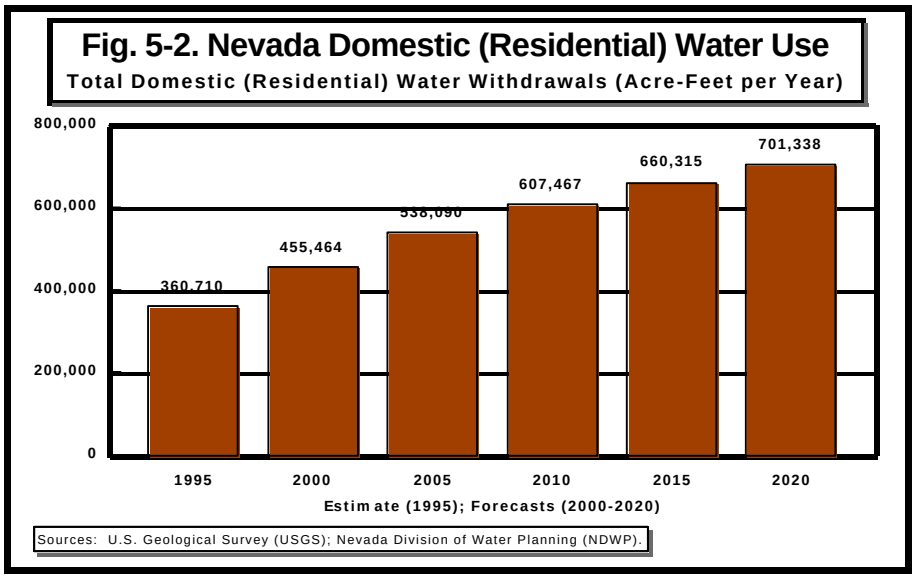
of the population being supplied water by public supply water systems. These forecasts were based on forecasts of total resident population. The estimates of the population on public supply water systems were made at the county level and were derived from 1995 water use characteristics and forecasts 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]	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%	7.8%
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 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.

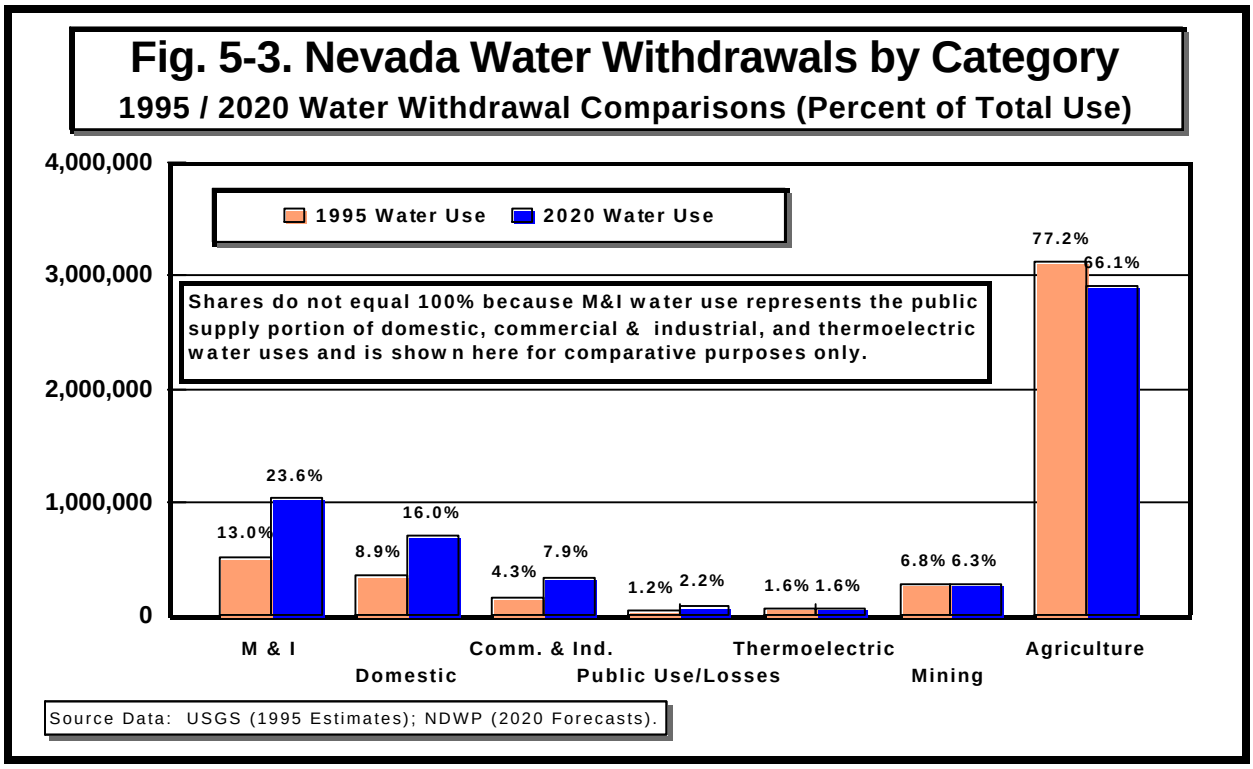
[5] Total mining withdrawals include both consumptive and non-consumptive uses (i.e., processing and mining dewatering).

[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.

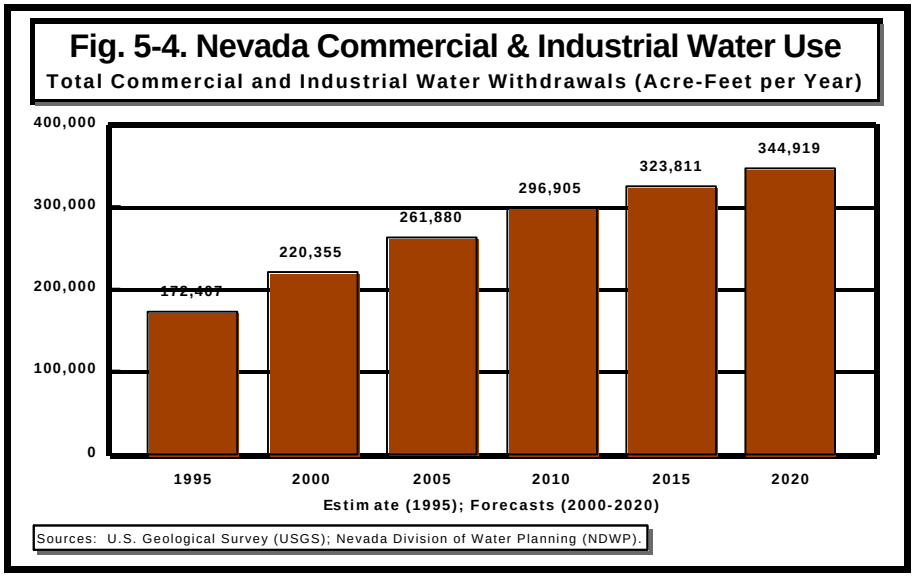
Total domestic (residential) water withdrawals are expected to increase by over 340,000 acre-feet, or 94 percent over the forecast horizon, from an estimated 360,710 acre-feet of water withdrawals

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



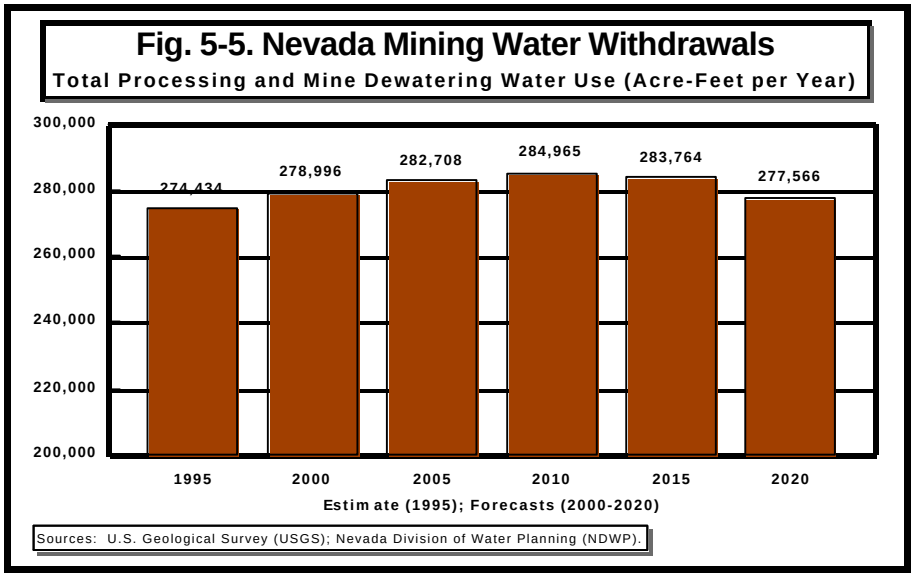
acre-feet in 1995 to 94,600 acre-feet by the year 2020. This will increase this category's share of total water use from 1.2 percent in 1995 to 2.2 percent by 2020. Thermoelectric water withdrawals are predicted to increase modestly throughout the forecast period based on rising population, continued 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 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. 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.

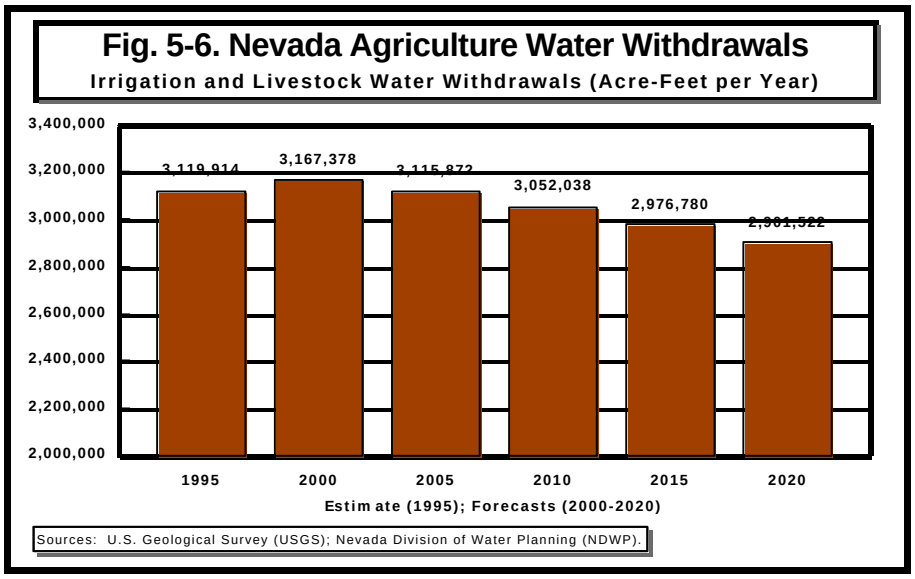


Table 5–2. Municipal & Industrial (M&I) Water Withdrawals, presents estimated (1995) and forecasted (2000 to 2020) municipal and industrial (M&I) water withdrawals for Nevada. M&I water use consists of withdrawals from public supply water systems for domestic, commercial and industrial and thermoelectric 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.

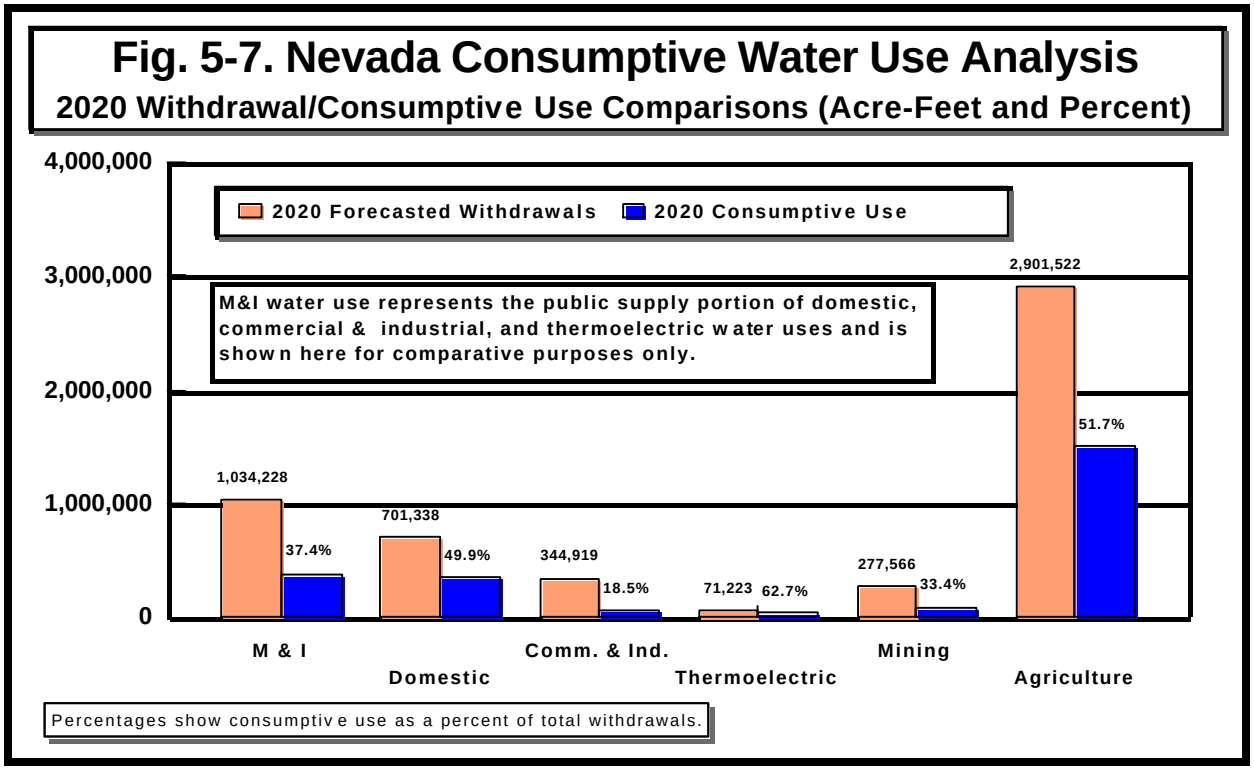
[7] Forecasts for public use and losses were based on a fixed percent of total M&I water withdrawals for each county. The Nevada figure was based on the aggregation of the county totals and while shown here as a fixed 9.2 percent of M&I withdrawals, this figure actually varies slightly over the forecast 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.



Index to Summary, Section 5:

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.

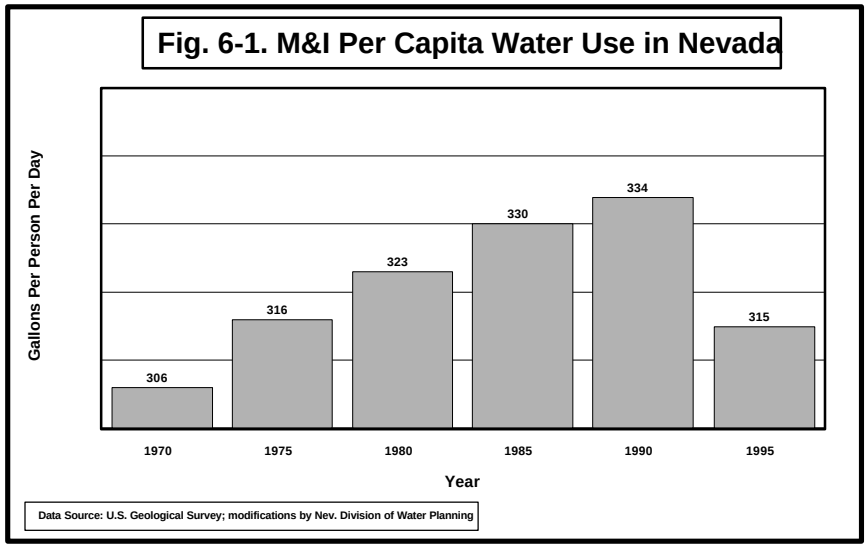
Increasing demands and competition for our limited resources oblige water managers and suppliers to implement both demand management and supply development strategies. However, each option needs to be evaluated on a case-by-case basis for suitability, cost effectiveness and public acceptance.

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 contaminates 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 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.

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

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.

Index to Summary, Part 7:

Nevada State Water Plan
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 grand 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 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. 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

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 steams, 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 of 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 Unites 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.]

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)

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

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

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)

Section 10
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Nevada State Water Plan
SUMMARY

Section 11
Indexes to Summary

[Note: Index entries are presented separately for each section.]

Executive Summary:

Section 1 – Introduction, Guidelines and Organization:

Section 2 – Institutional Framework for Water Planning and Management:

Section 3 – Water Resources and Use Assessment:

Section 4 – Socioeconomic Assessment and Forecasts:

Section 5 – Water Use Assessment and Forecasts:

Section 6 – Meeting Our Future Water Supply Needs:

Section 7 – Issues and Recommendations: