NEVADA STATE WATER PLAN

PART 3 – WATER PLANNING AND MANAGEMENT ISSUES

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Nevada Division of Water Planning
Department of Conservation and Natural Resources

A. Water Conservation

Introduction

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 extend a given water supply. This issue discussion describes available conservation measures, current conservation activities in Nevada and in other states, and recommendations for addressing future needs. It is not the intent of this discussion 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.

Background

Numerous case studies have shown that a good conservation program can reduce demand significantly. 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. Following is a description of conservation measures available for municipal, agricultural and other water users.

Municipal Conservation

Conservation is becoming an important tool to help public water systems manage water demands and infrastructure needs, especially in fast growing areas. The main incentive for municipal systems to implement conservation measures is economics. For instance, conservation can defer the need for investment in expanded water supplies and costly infrastructure such as water treatment systems. Less water used within a municipal water system means less wastewater that must be treated at the wastewater treatment plant, potentially saving some additional treatment and infrastructure costs. On the other hand, conservation may impact treatment process due to higher waste concentrations in the wastewater, and result in less water available for reuse of reclaimed water, less return flows back into stream systems, and less recharge of shallow aquifers, thereby potentially affecting other water users. Consideration needs to be given to all of these factors when developing a conservation program.

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, implementation of a xeriscape program, and installation of meters to help establish a baseline to evaluate the water conservation program and to provide a basis for billing. Many of these features can also be part of a conservation program for a private home, or commercial or industrial water system, depending on the specifics of each system. In addition, commercial and industrial systems may take advantage of other measures aimed at improving water

use efficiency as related to heating, cooling, sanitary, kitchen and processing needs.

Agricultural Conservation

Agricultural support agencies such as the U.S. Natural Resources Conservation Service can frequently assist irrigators in analyzing their water management program and selecting the best management practices to implement. The Natural Resources Conservation Service offers financial, technical, and educational assistance to implement conservation practices. Using this help, farmers and ranchers can apply practices that reduce soil erosion, improve water quality, and enhance wetlands, grazing lands and wildlife habitat. Agricultural conservation measures typically include: laser leveling of fields, lining of ditches, use of soil moisture monitoring devices, conversion from flood to overhead or drip irrigation methods, selection of low water use crops, reusing water on-site and an analysis of water management practices on site.

Conservation can provide a number of financial benefits. With conservation, water users can stretch available supplies during drier periods; reduce groundwater pumping and power costs; and under a "credit for conservation" program, conservation can allow for the expansion of irrigated land, leasing or sale of saved water to another user or for instream flow purposes.

Conservation for Other Water Uses

Opportunities for water conservation in industrial and commercial facilities include capturing steam condensate in boilers and HVAC (heating, ventilating and air conditioning) systems for reuse, eliminating single-pass cooling in cooling tower operations, using closed-loop systems for water-cooled equipment, and installing low-flow plumbing fixtures.

Conservation in Nevada

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. Following is a discussion of existing conservation efforts within Nevada and some of the challenges being faced.

Water Law and Conservation

State water law is based on the principle of beneficial use. A water user must show that the permitted water is being beneficially used in order to perfect the right through the issuance of a water

right certificate. Water rights can be lost through forfeiture or abandonment[1]. Certificated groundwater rights come under Nevada's forfeiture statute. In most instances, the groundwater must be used at least once in every consecutive five year period in order to preserve the water right. If not, it may be lost through statutory forfeiture. Pre-statutory (pre-1913) rights to surface water are exempt from forfeiture, but may be subject to abandonment if clear and convincing evidence showing intent to abandon is presented. By statute any water right lost through forfeiture or abandonment returns to the public waters of the state and may be subject to re-appropriation by others. The water law regarding abandonment and forfeiture is subject to change due to evolving case law.

Cities, towns and municipalities are generally granted latitude in the speed with which they must show beneficial use. Municipalities and water companies are allowed to hold water rights in the permit stage for future growth, but eventually must put the water to beneficial use in order to perfect the right.

The beneficial use rule ("use it or lose it") as it applies to perfected (certificated) water rights does not encourage conservation. Water users do not have an incentive to reduce water use as they must show continuous beneficial use in order to preserve their right to use the water in the future. However, other aspects of the water law support conservation (See discussion on "Credit for Conservation"). Also, a number of sections in NRS 533 and 534 do prohibit the wasting of water.

Credit for Conservation

Water users have expressed a desire to obtain credit for water they save through conservation. With this credit, the water user could be allowed to use the saved water on additional lands or for additional homes, lease or sell the saved water, or dedicate the saved water to instream flows. The State Engineer has explained that this option is already available under existing water law. In fact, the State Engineer has approved applications allowing the use of existing water rights for expanded uses, as long as the expanded uses do not increase the total consumptive use, does not impact other water right holders, are not located in a fully-appropriated basin, and actual water savings can be demonstrated over time. Data shows that few water users have taken advantage of this option or even know it exists. It appears that either few are aware of the "credit for conservation" permitting process, the process is too cumbersome, water use data is not available to show actual savings, or the permitting process is not viewed as sufficiently beneficial to provide an incentive to conserve.

Conservation Plans

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. For publicly owned utilities, NRS 540.121

[1]In the case of *In re Waters of Manse Spring*, 60 Nev. 280 (1940), the Court clarified the meaning of abandonment and forfeiture by stating "While, upon the one hand, abandonment is the relinquishment of the right by the owner with the intent to forsake and desert it, forfeiture, upon the other hand, is the involuntary or forced loss of the right, caused by the failure of the appropriator or owner to do or perform some act required by the statute...The element of intent, therefore, so necessary in the case of an abandonment, is not a necessary element in the case of forfeiture."

through 540.151 was added to specify the contents of the plans and the process and timeframes to be followed. NRS 704.662 through 704.6624 was added to establish conservation plan requirements for those utilities regulated by the Public Service Commission (now the Public Utilities Commission). Water users located within Bureau of Reclamation projects (such as the Newlands Project, Southern Nevada Water Authority) are required to submit conservation plans to the Bureau. Issues relating to the conservation plan statutes include:

- Thus far, only about 100 out of 700 public water systems have approved conservation plans. However, those systems that do have approved plans serve about 95 percent of the total population served by public water systems. Under the Division of Water Planning's *Small Community Water System Grant Program*, approved conservation plans are required prior to the granting of any funds.

- There are no assurances that plans are actually being implemented or are effective as no ongoing reporting is required.

- There are no statutory requirements that plans be updated periodically to meet changing needs or new technological developments.

- The state has not funded the water conservation plan program. There are no specific staff to help water systems develop water conservation plans, to review the plans once they are submitted to the Division or to follow up with the water systems to ensure the plans are being implemented.

- Only municipal water systems are required to submit conservation plans to the State. These users account for only about 13 percent of the total water withdrawn in Nevada.

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.

In 1992, the U.S. Congress passed the National Energy and Policy Conservation Act which set nationwide minimum flow standards for plumbing fixtures. Legislation was introduced in 1997 to repeal the uniform national plumbing efficiency standards established in the Act. National standards, in addition to state standards, are appropriate and necessary because:

- otherwise plumbing manufacturers would be faced with the production of dozens of different product line to meet the varying standards for each state; and
- it supports Nevada's plumbing standards by controlling the flow of non-complying products into Nevada.

Water Measurement

Water use measurement is a key component to any conservation program. Meters and other measurement devices can be used as a tool to evaluate program effectiveness in terms of water use changes. In addition, meters can provide a basis for billing when used with a rate structure designed to promote conservation and discourage waste. Water use measurements are also needed for water users wishing to participate in a "credit for conservation" program.

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).

Water Reuse

The reuse of treated wastewater effluent is becoming more common in Nevada. The U.S. Geological Survey estimated that in 1995 about 26,000 acre-feet of treated effluent was reused statewide. Current uses for treated effluent include landscape irrigation; agricultural irrigation; industrial uses such as cooling water and process water; supplies for wetlands; and construction water. By using treated effluent as a replacement source, more potable water is available for other uses with more stringent water quality requirements.

U.S. Bureau of Reclamation Conservation Plans

The Reclamation Reform Act of 1982 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. Districts, such as the Truckee-Carson Irrigation District and Pershing County Water Conservation District, are impacted by this requirement.

Summary

Even though the State has no comprehensive program for promoting and encouraging conservation, many municipal water systems have taken the initiative to develop their own conservation programs and are reducing water use. For example, the rate of Municipal & Industrial (M&I) water use has declined in recent years primarily due to conservation efforts. Successful conservation programs during the 1990s lowered statewide M&I water use from 334 gallons per person per day (gpcd) in 1990 to 314 gpcd in 1995. Southern Nevada water purveyors have implemented a variety of conservation measures, such as: banning the creation of artificial lakes, adopting water waste ordinances, restricting lawn watering, establishing increasing block rates for billing purposes, establishing an active public education and outreach program, and pursuing the use of lower quality

water in lieu of potable supplies where feasible. As a result of these conservation efforts, Municipal & Industrial (M&I) water use in the Las Vegas Valley Water District has decreased from 358 gpcd (gallons per capita per day) in 1989 to 320 gpcd in 1997. Residential use in the District has decreased from 213 gpcd to 197 gpcd during the same period.

Nevada's agricultural community has also been implementing a variety of conservation measures throughout the State, particularly in the Walker River and Carson River basins, and the Lovelock area (Humboldt River basin). Through measures such as laser leveling of fields, sprinkler systems and reusing return flows, agricultural water users are improving their water use efficiency. As already discussed, irrigation conservation is motivated in part by economic incentives. However for some irrigation operations, conservation may not be economically justified if the irrigator's costs exceed the irrigator's expected benefits.

Conservation in Other States

Many other states recognize conservation as an important mechanism for extending water supplies, reducing and delaying infrastructure needs, controlling supply overdrafts, providing additional water for other uses, and reducing return flows affecting water quality. Throughout the United States a variety of approaches for promoting conservation have been undertaken. Following is a brief description of conservation activities in a few other western states.

Arizona

The Arizona Groundwater Management Code establishes the legal framework for conserving water in Arizona's most populous management areas. To help achieve its goals, selected active management areas are required to implement management plans which, among other things, establish conservation requirements for municipal, agricultural and industrial water users.

As required by the Groundwater Management Code, municipal water providers in certain management areas are assigned a water use rate target (in gallons per person per day). Water use audits are regularly performed and if a target is not met, the Arizona Department of Water Resources sends out a notice of non-compliance and attempts to negotiate a settlement for the overusage of water. In general, agricultural and industrial water users are also required to meet conservation requirements as set forth in the management plans.

California

California's Urban Water Management Planning Act of 1983 required all municipal water users with more than 3,000 connections to submit a water conservation plan, and update the plan every 5 years. Another key urban conservation effort has been the development of accepted measures for achieving conservation, otherwise known as "Best Management Practices (BMPs)" Urban water agencies, environmental groups and State agencies have identified 16 BMPs. Approximately two-thirds of California's urban water suppliers signed a 1991 memorandum of understanding (MOU) by which they agreed to implement the 16 BMPs, although implementation of the BMPs is spotty.

Legislation enacted in 1990 (AB 3616) resulted in development of another MOU by which signatory irrigation districts and water agencies commited to adopt a number of mandatory and voluntary "Efficient Water Management Practices" analogous to the BMPs designed for urban water suppliers. As with the urban suppliers' MOU, the agricultural MOU is not universally endorsed, and agricultural interests have questioned the practices aimed at enhancing planning and water measurement.

California has established a number of programs in support of agricultural conservation efforts. For example, they have established an Irrigation Management Information System to assist agricultural water users with irrigation scheduling. As part of this system, irrigators can access a number of computerized weather stations for climatological data and evapotranspiration. California has also established: 1) mobile labs to visit farmers and help them evaluate their water management efficiency; and 2) an irrigation training and research center, supported partially by training course fees.

Oregon

In 1990, the Oregon Water Resources Commission and Department adopted a statewide policy on Conservation and Efficient Water Use. The policy identifies a wide range of strategies for encouraging conservation, including public information, incentives and regulation to enforce the statutory prohibition against waste. The policy also calls for the preparation of water management and conservation plans by major agricultural and municipal water suppliers. Later, the Commission adopted rules by which municipal water suppliers are required by permit conditions to complete conservation plans. In addition, irrigation districts are required under the law to prepare conservation plans prior to using certain water right transfer processes.

In 1987, Oregon began a program which allows a water user who conserves water to use a portion of the conserved water on additional lands, lease or sell the water, or dedicate the water to instream use. Initially, the program was not utilized because of the complexity of the application review process and water users' concerns about the potential effects on their water rights. Since that time, the program has been restructured and is now being utilized by water users.

Issues

The primary issues relating to conservation in Nevada are as follows:

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:

    a. review water conservation plans and provide technical assistance;
    b. distribute grants;
    c. prepare conservation plans for state facilities;
    d. prepare and/or evaluate water audits for state facilities;
    e. assemble a repository of water conservation information for distribution;
    f. develop conservation education materials and provide educational seminars; and
    g. 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:

    a. require municipal water systems over a certain population threshold to periodically update their conservation plans, and establish ongoing reporting requirements;
    b. 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);
    c. 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
    d. 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:

    a. incorporating water conservation policy goals into all appropriate activities and programs of state government
    b. 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
    c. 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.

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B. Integrated Water Management

Introduction

Groundwater and surface water supplies in Nevada are finite resources. As the driest state in the nation, with an average precipitation of nine inches annually, Nevada's water supplies must be managed to maximize their effectiveness. As in many western states, Nevada's water supplies are typically not present at the locations where and when they are most needed. Further, variations between high water years and low water years can be dramatic. As an example, in northern Nevada along the Humboldt River, water supplies may vary from 25 percent of average (1994) to 250 percent of average (1995) from one water year to the next. The hydrologic systems throughout the state are complex and highly varied. The State's rapidly expanding population is putting increased pressures on available water supplies, thus increasing the need for integrated groundwater and surface water management.

Water Supply

Surface water provides approximately 60 percent of the total water used in the state. Snowmelt contributes to most of the stream flow, especially in the northern half of the state. Stream discharge is typically greatest during the months of May and June as a result of snow melt in the mountains. October low flow measurements range from 0.01 percent to 1 percent of June peak flow. Summer convective storms create much of the stream flow in southern Nevada. Flows are typically greatest near the headwaters, declining in low-altitude reaches due to irrigation, public use, infiltration and evapotranspiration. Surface waters in Nevada are virtually fully appropriated, thus, future development will rely heavily on groundwater resources.

Groundwater provides approximately 40 percent of the water used throughout the state. In many communities, groundwater provides 100 percent of the water used for municipal supply. In years of low surface water supply, groundwater may be pumped to supplement surface water sources. Groundwater usage typically increases in years with less rainfall, and declines when surface water supplies are adequate. Most groundwater supplies in the state have been developed from relatively shallow aquifers, less than 500 feet below ground surface.

Water Quality

Groundwater and surface water quality regulations are administered by the Nevada Division of Environmental Protection (NDEP) and adopted by the State Environmental Commission. In general, surface water quality varies over time and between reaches as one moves downstream, dependent on the amount of water in the stream. The water quality constituents of greatest concern in surface water are total dissolved solids (TDS), temperature, pH, nutrients and dissolved oxygen. Concentrations of chemical constituents are typically greatest during periods of low flow. In contrast, concentrations of suspended solids are generally greatest during high flows. Stormwater runoff can impact surface water quality, contributing pesticides, petroleum products, and organic chemicals to

surface water supplies.

Impacts from geothermal groundwater and surface water are found in areas throughout the state. Typically, the water quality constituents of thermal waters include temperature, TDS and metals such as arsenic and boron, and high concentrations of chloride, sulfate, and fluoride. Geothermal water is generally not suitable for most consumptive uses.

Groundwater quality typically varies throughout the State, dependant upon the composition of the aquifer material and sources and types 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.

Integrated Management

Conjunctive Use

The State of Nevada encourages conjunctive management of groundwater and surface water resources, to improve the reliability, economics and yield of available water supplies. The goal of conjunctive use of water systems in Nevada is to maximize the total yield of water. One approach is to maximize the use of surface water supplies when they are available and only rely on groundwater when surface water is not available. For example, the Carson City Utility Division has permits from the State Engineer authorizing them to increase groundwater withdrawals up to an imposed maximum (based on the conditions of the permit) during times of low surface water availability, with the understanding that surface water will be used to the maximum extent feasible. Another goal of integrated water management is to encourage the use of higher quality water sources for uses such as public drinking water supply. Lower quality sources can then be used for agricultural and landscape irrigation, mining, and other commercial and industrial uses which do not require potable water.

The availability of water from the three major rivers in northern Nevada (Truckee, Carson, and Walker) is dependent in large part on what flows across the state line from California. The amount of groundwater available to augment these supplies is small by comparison to the surface water flows. However, in times of drought, groundwater is an important component of an overall water management strategy to meet water demand.

Water Storage

One component of an integrated water management program is storage of surplus surface water in underground aquifers or in above ground reservoirs. The stored water enhances groundwater supplies, which can then be withdrawn when available surface water supplies are inadequate to meet demand. Surface reservoirs are relatively straightforward in their construction, but may not be financially, environmentally, or administratively feasible. Evaporation losses from surface reservoirs are also a factor. In northern Nevada, evaporation rates range from 3 to 5 feet per year, while in southern Nevada evaporative losses can exceed 8 feet per year. Underground storage is legally and

administratively complex, however, underground storage is typically less costly than above ground storage and evaporation losses are non-existent. The Nevada Division of Water Resources (NDWR) administers the statute governing development of aquifer recharge/recovery systems in the State. One component of the statute is a requirement to establish a "storage account", which defines the amount of water which can be recovered after recharge.

Water Reuse

The use of previously used water or treated waste water effluent for commercial, industrial, and irrigation uses is becoming more common in Nevada. Treated effluent is currently used for irrigation at many golf courses in both northern and southern Nevada. Treated effluent is also used for cooling tower make-up water at the Nevada Power Company power generating station at Sunrise Mountain in southern Nevada. Sierra Pacific Power Company's power generating station at Valmy uses water generated from mine dewatering at Lone Tree for cooling tower make-up water. This kind of water reuse helps to minimize withdrawals of potable water and thus maximize the amount of potable water available for the drinking water supply.

Groundwater / Surface Water Connection

The degree of connection between groundwater and surface water and the impacts due to water use can vary and so too, any impacts due to water withdrawals. Thus, water resources must be evaluated on a case-by-case basis to assess the best management practices for each specific use. In Nevada's basin and range province, the mountain ranges are typically fractured, allowing recharge to deep aquifers to occur. In contrast, in many locations, the valley floors are composed of fine lake sediments which inhibit groundwater recharge, as demonstrated by the presence of playa lakes. In most locations throughout the state, shallow groundwater aquifers have some connection with surface water systems.

If there is a connection between shallow groundwater and surface waters, water withdrawals may affect both water supplies and water quality. Monitoring and proper management of groundwater pumping can avoid or minimize any potential depletion of surface water resources which depend on groundwater inflows. Well drilling regulations which require a 100 foot deep sanitary seal in wells located within one-quarter mile of a stream, canal, or other water body are designed to prevent impacts due to pumping. How land is used may also affect groundwater and surface water quality. Fuel storage, land surface disturbance, urbanization and wastewater disposal all have the potential to impact both surface and groundwater supplies.

In some locations, applied irrigation using surface water is the primary component of shallow groundwater recharge. In these areas, water levels in shallow aquifer systems will vary depending on surface water supply and applied irrigation. Typically, the deeper aquifers are confined by fine-grained lake bed sediments and may be under artesian pressure, thus water levels will remain relatively constant over time, regardless of withdrawals from the shallow aquifer unless the shallow aquifer is significantly over-pumped.

State Agency Roles

Several state agencies have a role in integrated water management. The Nevada Division of Water Resources (NDWR) is responsible for issuing permits for groundwater and surface water use in the State. The Nevada Division of Environmental Protection (NDEP) is responsible for protecting surface and ground water quality. The Nevada Division of Water Planning is responsible for developing effective plans for water resource management in the state.

Nevada Division of Water Resources

The Nevada Division of Water Resources (NDWR) is responsible for allocating, adjudicating, and managing surface and groundwater rights in the State through the office of the State Engineer. Authorization for groundwater use is dependant upon the availability of unappropriated water and protection of existing water rights. Groundwater and surface water use requires a permit which identifies the point of use, timing, and manner of beneficial use. The State Engineer encourages the practice of conjunctive use for both public water supply systems and irrigation systems in the State. When the State Engineer issues permits for supplemental water rights, the total volume of water (duty) that can be used from any and all sources is established in the permit conditions. The State Engineer is responsible for ensuring that groundwater withdrawals do not exceed the perennial yield for each basin, in part to avoid impacts on surface water resources. NDWR also issues permits for aquifer recharge/recovery projects and conjunctive use projects.

Nevada Division of Environmental Protection

Groundwater and surface water quality are regulated by the NDEP and the State Environmental Commission. The NDEP updated the State of Nevada Comprehensive State Ground Water Protection Program (CSGWPP) in March 1998. This program addresses water quality impacts from sources such as agricultural chemicals, mining, underground storage tanks, underground injection wells, landfills and hazardous waste disposal. The NDEP's approach emphasizes pollution prevention. The Division's regulations require preventive measures, such as leak containment, discharge permitting, and storm water management.

Nevada Division of Water Planning

The Division of Water Planning (NDWP) is charged with development and implementation of a plan for use of groundwater and surface water resources within the state (the State Water Plan). NDWP provides the State, counties, and local communities with information, alternatives and recommendations for regional water planning and action for acquisition or conservation of existing resources. NDWP is responsible for investigation of new sources of water, including importation and conservation. The Nevada legislature has recognized the critical nature of the State's limited water resources and the demands placed on that resource by an increasing population, in the Divisions's statute (NRS 540). The legislature also recognizes the relationship between quality and quantity of water in NRS 540, including among the duties of the Division a stipulation that water quality and water quantity issues be considered simultaneously in planning efforts.

Nevada Division of Wildlife

The Nevada Division of Wildlife (NDOW) is responsible for protection and management of wildlife

and its habitat in the state. NDOW has specific water management concerns at the Wildlife Management Areas (WMAs) throughout the state. Water for fish and wildlife has been recognized as a beneficial use in Nevada since 1982, and NDOW is authorized to acquire land and water rights for preservation and restoration of wildlife and its habitat. However, water supplies vary, depending on the seniority of water rights owned by NDOW, and drought periods can severely impact wildlife habitat. Integrated groundwater and surface water management is a key component in maintaining water supplies for fish and wildlife habitat throughout the State and minimizing drought impacts.

Issues

1. If we are to increase our water supply development opportunities in Nevada, we must increase our understanding of the water resource as a whole. Effective management of the surface and groundwater supplies depends on a clear understanding of the nature and interaction of the water resources.

2. Surface water and groundwater are managed as two separate sources in Nevada. The appropriation and adjudication of surface water and groundwater are covered in NRS 533, and additional groundwater management tools are included in NRS 534. Each application for a water right permit can include only one source of water, even if the intended use requires water from more than one source, or a supplemental source (NRS 533.330). Water allocation and management decisions need to incorporate state-of-the-art knowledge regarding the relationship between groundwater and surface water.

3. Groundwater withdrawals in excess of perennial yield from near surface aquifers may impact the surface water base flow by drawing water down below the reach of a nearby stream. Over pumping groundwater can impact not only stream flows, but over time, may cause ground subsidence as well. Ground subsidence of up to five feet has occurred in Las Vegas Valley.

4. Underground storage is a viable alternative to the use of surface water reservoirs. Underground storage also virtually eliminates evaporative losses, which can range from 3 to 8 feet annually in Nevada. However, where the valley fill is fully saturated or where the alluvium consists of fine-grained silts and clays, surface water storage may be the only alternative to dampen variations between times of plentiful water and drought. Few communities are actively exploring the potential for underground storage of water, and fewer still are actively storing water underground.

Recommendations

To address the issues identified above, the following recommendations are made:

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.

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C. Interbasin and Intercounty Transfers

The Need for Water Transfers

Nevada is the driest state and one of the fastest growing, and is currently ranked as the most urbanized state in the nation. Overall, water demand in the state is expected to increase by about 9 percent by the year 2020, resulting in an increase in demand for new water appropriations of about 350,000 acre-feet. Most of Nevada's surface water systems are fully appropriated and nearly half of the groundwater basins have been *designated* as in need of additional administration by the State Engineer; in most cases this means that they are fully appropriated as well. There are few rivers flowing to the sea which might be tapped for future water needs.

Because of the limited options available, interbasin and intercounty transfers are likely to become more important in meeting future water needs than in the past. Growing urban areas are looking to appropriate new water rights or purchase existing water rights and transfer them to new places of use, frequently in a different basin or county. Water right transfers are also being viewed as an important way to augment instream flows and to meet environmental needs for water.

Water transfers involve withdrawing either groundwater or surface water from one basin or county for beneficial use in another. The term *water transfers* can apply to either an existing water right or a new appropriation. *Intercounty* transfers involve the movement of water from one county to another for use. *Interbasin* transfers involve the movement of water from a *basin-of-origin* to a *receiving basin* for use. The term *basin-of-origin* refers to the place from which the water is diverted; the term *receiving basin* refers to the place where the water is used. In the following discussion, the term *basin* can refer to either a groundwater basin or a surface water basin. A water transfer can be either an intercounty transfer or an interbasin transfer, or both.

Of all the topics in the *Nevda State Water Plan*, that of interbasin and intercounty transfers requires the greatest care in balancing the goals of the water plan, as set forth in Part 1. In summary these include:

- Water supply sufficiency
- Protection of existing water rights
- Preferential use of water for greatest economic gain to the state
- Greater conservation
- Protection of water quality
- Protection of water supplies for rural areas
- Environmental protection
- Sound processes for decision-making, including efficiency, cooperation, more information, sound science and public involvement

Water transfers provide an opportunity to resolve a variety of water management issues. A receiving

area (basin or county) can benefit from a water transfer if the new water supply allows the receiving area to meet current or projected water needs, or leads to economic development or expansion. An area of origin (county or basin) can benefit from a water transfer if the area has excess water resources not otherwise needed to meet future growth or resource conservation needs and some form of mitigation is offered to offset any impacts expected to the area (i.e., through the collection of a water transfer tax and/or implementation of a mitigation plan). Examples from California, Idaho, Colorado and even Nevada are discussed in the book *Water Transfers in the West.* Each of the case studies provides examples where water transfers are being used to solve a spectrum of problems, including water supply, power generation, wetlands restoration, instream flows or water quality improvements. Each case study also highlights potential impacts that have been or need to be addressed.

Historical Context

Water transfers have been around for a long time. Prior appropriation law has never limited the use of water to the watershed or ground water basin in which it originated. In Nevada, water transfers are an integral part of the water arena, and interwoven with the history of the settlement of the state. Without water transfers, Virginia City and Tonopah would not exist, many mining claims would never have been developed, farming in Fallon would be a fraction of what it is today, and Las Vegas would be a town not a destination city.

There are over 20 interbasin transfers occurring in Nevada today. Tables 1 and 2 show some examples of these interbasin transfers. The examples are divided by whether the source of the water is groundwater or surface water.

Water transfers in Nevada have contributed to economic development, growth and prosperity. But there are also costs associated with such transfers. In one case, the transfer of water for agricultural development has had an impact on lake levels downstream of the diversion point. Under the Truckee River Decree, mandated by Federal Court, water is transferred from the Truckee River Basin via the Truckee Canal to the Carson River Basin. Although this water transfer resulted in economic development in the Fernley and Fallon areas in Lyon and Churchill counties, it also resulted in declines of water levels in Pyramid Lake, the terminus of the Truckee River. Because of the potential for physical, social, fiscal and economic impacts, water transfers must be carefully evaluated prior to approval and closely monitored after implementation.

Table 1. Examples of Current Interbasin Diversions

Groundwater Source		
Basin-of-Origin	**Receiving Basin**	**Type of Use**
Washoe Valley	Eagle Valley	Carson City municipal supply
Goshute Valley	Great Salt Lake Desert	Wendover municipal supply
Pilot Creek Valley	Great Salt Lake Desert	Wendover municipal supply
Long Valley	Cold Springs Valley	municipal supply
Ralston Valley	Big Smokey Valley	Tonopah municipal Supply
Carson Valley	Eagle Valley	Carson City municipal supply
Dayton Valley	Eagle Valley	Carson City municipal supply
L. Meadow Valley Wash	Muddy River Springs Area	Reid Gardner Power Plant
Oreana Sub-area	Lovelock Valley	Lovelock Municipal Supply
Surface Water Source		
Source / Basin-of-Origin	**Receiving Basin**	**Type of Use**
Lake Tahoe Basin	Eagle Valley	Carson City municipal supply
Lake Tahoe Basin	Dayton Valley	Virginia City municipal supply
Truckee River (Tracy Segment)	Carson River (Churchill Valley via Truckee Canal)	Truckee-Carson Irrigation District irrigation
Newark Valley (spring)	Diamond Valley	Eureka municipal supply
Lake Tahoe Basin (treated effluent)	Carson Valley	irrigation
Truckee River (Truckee Meadows)	Lemmon Valley	SPPCo municipal supply
Carson River (Dayton Valley)	Eagle Valley	Carson City municipal supply
Colorado River (Black Mountain area)	Las Vegas Valley	Las Vegas area municipal supply
Truckee River (Truckee Meadows)	Spanish Springs Valley (via Orr Ditch)	irrigation
Truckee River (Truckee Meadows)	Sun Valley	SPPCo for municipal supply

Table 2. Examples of Interbasin Transfers of a Previously Existing Water Right

Original Point of Diversion	New Point of Diversion	Original Place of Use	New Place of Use	Type of Use
Carson River (Carson Valley)	Carson River (Dayton Valley)	Carson Valley	Eagle Valley	Carson City municipal supply
Humboldt River (Battle Mountain)	Rye Patch Reservoir (storage)	Battle Mountain	Lovelock area	irrigation

Laws and Legislative Actions Regarding Interbasin and Intercounty Transfers

Water Allocation. Nevada Revised Statutes 533 and 534 provide basic criteria for evaluating all water appropriations or changes of water rights, including interbasin and 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. The State Engineer has issued a number of orders and rulings which address the public interest issue.

Water Rights. A water right owner has the right to use the water pursuant to the terms of the certificated water right, but any changes in the place of use, manner of use or point of withdrawal must be approved by the State Engineer prior to the change. The ability to buy and sell water rights is the basis for "water marketing" described below.

Public Noticing. The State Engineer's office publishes a notice of an application for a new appropriation or change of water rights in the newspaper of general circulation in the county where the water is to be appropriated and used, once a week for four consecutive weeks (NRS 533.360). In the case of intercounty transfers, NRS 533.363 requires the State Engineer to also notify county commissioners, in both the county of origin and the county of use, of a pending application for appropriation or change, with some minor exceptions. The applicant must send a copy of the application to each of the counties. Each county commission must then hold a public workshop on the proposed intercounty transfer, and send their non-binding recommendations on the proposal to the State Engineer.

Water Transfer Tax. In 1991, the Nevada Legislature amended NRS 534 to allow a $6 per acre-foot tax on water transfers where water is to be withdrawn in one county and used in another county or state (NRS 533.438). The monies collected are to be placed in a trust fund, the use of which is restricted to economic development, health care and education.

Mitigation Plans. If a county declines to impose the water use transfer tax, the applicant and the governing body of the county-of-origin may execute a plan to mitigate the adverse economic effects

caused by the transfer of the water (NRS 533.4385). The mitigation plan may include a reservation of designated water rights to the county-of-origin and compensation for the economic impacts of the transfer, among other things. The plan must be submitted to the State Engineer who then has the authority to amend the plan if it violates a specific statute or is deemed unworkable.

1994 Legislative Study. The 1994 Interim Legislative Committee heard testimony on the issue of interbasin transfers. In their report, *Study of the Use, Allocation and Management of Water*, the committee recommended that the state water plan include general criteria for the approval of water transfer applications and related determinations that pertain to the movement of water from one basin to another[1]. Further, they recommended that the general criteria should include evidence that:

1. the project is fair and equitable to the area-of-origin;
2. the project is environmentally sound; and
3. the project is an appropriate long-term solution which will not unduly limit future development and growth of the area-of-origin.

1995 Legislature. In 1995, the Legislature amended the water planning statute to require that "The [state] water plan ... include provisions designed to protect the identified needs for water for current and future development in rural areas of the state, giving consideration to relevant factors, including but not limited to, the economy ... and the quality of life in the affected areas" (NRS 540.101.3). In partial fulfillment of this statute, recommendations regarding interbasin transfers are listed at the end of this issue paper.

1997 Legislature. During the 1997 legislative session, the Legislature considered a bill (S.B. 454) to set specific criteria to ensure that interbasin transfers do not cause undue economic or environmental harm to rural counties. The bill was proposed jointly by three counties, Nye, Lincoln and White Pine. Rather than adopt the bill at that time, the Legislature referred the issue to the Legislative Committee on Public Lands for further fact finding during the interim period between legislative sessions. The committee held a number of work sessions to hear testimony on the issue and proposed a bill draft for consideration by the 1999 Legislature.

Issues

Water transfers can have both benefits and impacts. The degree to which a water transfer benefits or impacts a region, and the locations in which those benefits or impacts are experienced, varies widely. Some benefits and impacts are more commonly associated with interbasin transfers; others are more likely to be observed with an intercounty transfer. Some have a larger effect on an area of origin; others are felt more keenly in a receiving area. Impacts to the water resource itself or the environment are more likely with interbasin transfers than with intercounty transfers. Economic,

[1] *Study of the Use, Allocation and Management of Water* . Bulletin No - 95-4. Legislative Commission of the Legislative Counsel Bureau, State of Nevada. p. vii.

social or fiscal impacts are more commonly associated with intercounty transfers. Economic benefits are more likely to accrue to a receiving area than to a basin or county-of-origin, although areas of origin can certainly receive economic benefits, especially if a previously unused or unneeded water resource will now be put to beneficial use.

Potential Impacts

Basin-of-origin concerns center on whether a groundwater or surface 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. *County-of-origin* concerns center on potential losses of tax income, social stability or the ability to economically develop the region in the future. In a *receiving basin*, natural resource concerns include the possible introduction of poorer quality waters into the receiving basin, or the generation of air and water pollution associated with growth that is likely to occur if a new water source becomes available to a previously water short region. *Receiving county* concerns focus on managing the potential societal and quality of life impacts and new infrastructure demands associated with the new growth which may be induced by the availability of new water supplies.

Views of the Public

Concerns about the economic and environmental effects of interbasin and intercounty transfers increased in the late 1980's when large scale applications were filed for water transfers from rural areas to urban centers in both northern and southern Nevada.[2] In 1992, the Nevada Cooperative Extension, the Nevada Humanities Committee and a number of other organizations co-sponsored a series of water issue forums. More than 800 Nevadans participated in workshops held throughout the state. The workshops were designed both to educate residents about state water laws and policies and to elicit their thoughts and recommendations on current water issues.

The results of the water forums are summarized in a report entitled *Nevada's Water Future: Making Tough Choices*.[3] According to the report, some residents view water as they would any commodity - free to be bought and sold, moved and transferred — a resource to be put to work to meet the economic and social needs of the state. They believe that the market is the most desirable mechanism for ensuring that water is transferred to uses where its economic value is greatest. And clearly, the very existence of many of our communities and their prosperity can be traced directly to the movement of water across basin and county lines.

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[2] *Study of the Use, Allocation and Management of Water*, p. 24.

[3] Henderson, Ford, Cobourn. *Nevada's Water Future: Making Tough Choices - A Report on Nevada Water Forums, 1992-1993*, May 1993.

Others believe we should live within our means, that growth should be sustained only by locally available resources. These residents believe that transferring or "exporting" water out of basins is ecologically non-supportable. They express concerns that wetlands and springs in the basin-of-origin will dry up, playas will turn permanently to dust and the potential for growth in the basin-of-origin will be reduced.

The findings of 1992 water forums were mirrored in workshops held by the Division of Water Planning during development of the State Water Plan, both in the Winter of 1994/1995 and in 1998. Intercounty and interbasin transfers topped the list of all issues requested for discussion in the water plan, both in terms of amount of time spent in discussion and the fervor expressed.

People in rural counties were generally concerned about the potential impacts of both intercounty and interbasin transfers. In some cases, this concern went deep enough to cause individuals or their county commissions to call for an outright ban on such transfers even when the county itself was the beneficiary of an ongoing interbasin transfer. Some residents in urban counties viewed interbasin transfers as precursors to additional growth which they viewed negatively. In response to public concerns, urban community leaders and water managers have stated that they do not want their region to benefit at the expense of other areas, and have expressed a commitment to provide appropriate mitigation.

Water Marketing

Water marketing - or the change of water rights from existing uses to new uses at market value - has the potential to increase water use efficiency, certainly an important consideration in a state as dry as Nevada. According to the National Research Council [4]:

> "Markets respond to price signals to move resources from lower- to higher-valued uses. Markets respect existing property entitlements, and thus water right holders set the pace of transition and receive compensation when water is transferred. Reliance on water marketing, rather than government subsidy and regulation, reflects a general societal belief that markets are a more effective way to allocate scarce resources to meet the twin goals of efficiency and equity ... However, there is a need for caution....Transfers must be carefully evaluated because, as with any policy option, there are benefits and costs to their use. And significant costs - some concrete and others quite difficult to measure - can come at the expense of third parties."

Interest in water marketing, and associated interbasin and intercounty water transfers, is increasing due to a number of factors. First and foremost, the demand for water is growing, especially in the municipal and industrial sectors. Farmers and ranchers currently withdraw about 77 percent of the

[4] *Water Transfers in the West; Efficiency, Equity and the Environment*, prepared by the Committee on Western Water Management, Water Science and Technology Board and Commission on Engineering and Technical Systems, with the Assistance of the Board on Agriculture, National Research Council. 1992, p.3.

water in Nevada. Part 2 of the State Water Plan explains that municipal and industrial (M & I) water demand is expected to double over the next 20 years, while agricultural water use is expected to decline by about 7 percent over the same period.

Third Party Interests

The greatest concern over water marketing, especially interbasin and intercounty water marketing, is that potential third party impacts must be addressed if transfers are to be equitable and efficient. Third parties include everyone who is not a buyer or seller in a water transfer negotiation. Third party interests include those who hold other water rights that may be at risk due to a transfer, as well as those representing economic, wildlife, environmental and social interests that may be affected by the transfer.

Nevada has laws which are designed to ensure that pending water allocation actions are publicly noticed. Further, county commissions are specifically notified of proposed intercounty transfers. Third parties who are not water right holders have been recognized and allowed to participate in water right proceedings. In fact, the State Engineer has issued two rulings where the legitimacy of third parties to participate in administrative hearings was specifically acknowledged.

Rural Communities and Counties

Water transfers out of a county can have economic, fiscal, environmental and social impacts on rural communities. In the short term, per capita costs for system maintenance and operation in irrigation districts can increase. This possibility is addressed in NRS 533.370.1 (b), which requires the State Engineer to review any application within an irrigation district to ensure that it does not affect the costs of water for other irrigators or lessen the district's efficiency. In the long run, future development opportunities which might have brought increased tax revenues may be lost. This is partially addressed by NRS 533.438 which allows a county to assess a transfer tax or to require a mitigation plan.

If water rights are removed from the land it may result in the value of the land itself being removed from the tax rolls or taxed at a lower rate. County tax rates may then have to be increased placing a heavier load on existing tax payers, or alternatively, services cut. At the same time, the county's bonding capacity and legal debt limit, which are based on the county's net valuation may be decreased. Population is the basis for distribution of state sales tax revenues. If an area loses population because of decreased economic opportunities, sales tax revenues will decline as well, making it harder for the county to provide services for the remaining residents. Counties with only a small percentage of private land, i.e. most of the rural counties in Nevada, are particularly hard hit by the fiscal impacts of retiring irrigated lands.
Water transfers may affect a community's social structure and long term viability[5]. Production from remaining farms or ranches may be insufficient to support other local businesses. If a community

[5] *Water Transfers in the West*, p 45.

becomes less populous and prosperous, the social infrastructure such as churches, civic groups and political organizations may decline just when the community may need them most to deal with the new economic changes. A community's sense of independence, self- determination and "quality of life" may all be impacted. Increased air pollution may occur if lands are not adequately vegetated prior to a transfer. Surficial aquifers which may have been incidentally recharged from leaky irrigation canals may fall if the water that kept them full is transferred out of the basin, creating problems meeting domestic needs.

Despite these effects, water transfers that appear negative from a rural perspective may be viewed positively from an urban perspective. It is important to acknowledge that a dynamic, evolving economy is dependent on shifting resources as needs change. If Nevada's economy continues developing, and if the national and global demands for food produced in Nevada do not match production capability, then some dis-investment in irrigated agriculture is likely to occur.

Wildlife, Instream Flows, Recreation and Water Quality

Nevada's ecosystems include wetlands and riparian areas and associated fish, wildlife and vegetation. Transfers of surface or ground water, especially out of a basin, can have significant impacts on these water systems and their flora and fauna. Due to its basin and range nature, aridity, and active development, Nevada has many threatened and endangered species, especially fish species. In some cases, land and water development in Nevada has led to the reduction in size of wetland areas, stream flow and lakes at the end of closed river basins. On the other hand, agricultural return flows, flood irrigation of pastures, leakage along drainage ditches and canals, mine dewatering have actually created some new wetland areas.

Healthy ecosystems need dependable water supplies. In Nevada, recreational and environmental uses are considered *beneficial uses* in the state's water allocation law. Water rights may be appropriated or obtained by any legal water right owner to maintain instream flows or in-situ (in place) supplies. Since, for the most part, rivers and tributaries in Nevada are already fully appropriated, water for fish and wildlife enhancement must typically be acquired from existing water right holders.

Instream flows are not only critical to preserving fish and wildlife habitat in arid regions, but they are critical to water-dependent recreation. Tourism, which relies on both gaming and recreation, is an important segment in Nevada's economy. As the state seeks to promote itself, recreation is becoming increasingly important to the mix.

Instream flows for recreation generate dollars both directly and indirectly, and they provide water quality benefits as well. Both stream levels and flow rates influence dissolved oxygen levels, turbidity, nutrients and other water quality parameters. When evaluating a water transfer proposal it is sometimes difficult to adequately address the wide range of economic, environmental and intrinsic values that instream and in-situ (in place) uses of water provide, but it is important to do so if the public interest is to be effectively addressed and any potential impacts of water transfers appropriately mitigated.

Issues

While water transfers have the potential to bring large benefits to the state, the impacts and costs of such transfers must be identified, evaluated and mitigated. Following are the main issues which must be addressed:

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 wetlands and aquatic environments in a number of areas. 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 should precede any large scale water transfer.

5. Water markets are developing in a variety of 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:

    1. 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.

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D. Water Use Measurement and Estimation

Introduction

It has been estimated that 65 to 75 percent of the total water withdrawn annually from groundwater and surface water sources in Nevada is either measured with detailed diversion records, or estimated 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.

Water use information (whether measured or estimated) is critical for effective water planning and management at both the local and state levels. Managing and planning water resources without accurate water use information is comparable to managing a checking account without tracking the outgoing checks. In general, most of the groundwater basins in Nevada are managed as individual water sources. The State has tended to focus its water use measurement and estimation efforts as needed to implement the prior appropriation system. As a result, most of the data are compiled for those basins with declining water tables, increasing competition for the available resources, or usages with potential impacts to others. The lack of readily available and comprehensive water use information has complicated the *State Water Plan* development process.

Water use measurement is a key component to any conservation program. Meters and other measurement devices can be used as a tool in evaluating program effectiveness in terms of water usage changes. In addition, meters can provide a basis for billing with a rate structure such that customers pay for what is used and waste is discouraged.

Additional information on water use and measurement is presented in Part 2, Section 1, "Historic and Current Water Use", of the *State Water Plan*.

Water Metering in Nevada

Upon issuance of a permit, the State Engineer has always required some type of measuring device be placed near the point of diversion and that records of these measurements be kept; however the type of measuring device used was at the discretion of the permittee. These use records are the basis for establishing the beneficial use amount, except in the case of irrigation use. The beneficial use amount for irrigation is based on various items such as total irrigated acreage, crop type, geographic location, and length of growing season. In the early 1970s, requirements changed for permits issued for an underground source and totalizing meters were required on most wells. However, not all permittees were required to submit this information to the State Engineer. Beginning in the mid-1980s, all permits issued for an underground source required a totalizing meter except for some irrigation permits. In critical groundwater basins, totalizing meters were required for all irrigation permits. Today all new permits for major groundwater uses of all types have conditions requiring the

installation of totalizing meters on wells and the submittal of pumpage records to the State Engineer.

In the Truckee, Carson and Walker rivers, agricultural surface water diversions are measured with the data recorded and maintained by federal water masters and irrigation districts. On the Humboldt River system, flow measuring devices are installed and used to ensure compliance with the applicable decrees. Historically no detailed diversion records are kept for the Humboldt River system with surface water diversions monitored by the State Engineer's Office.

A majority of the public water system withdrawals (in terms of volume) are metered, however, service connections may or may not be metered (about 15 percent of the service connections in Nevada are unmetered). 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 the 1913 State Legislature. Since that time, gradual changes have occurred which require meters on all businesses (1977), require meters on all new homes built after 1988, allow meters on residences upon owner request, and allow retrofit of meters on residences under certain conditions tied to the Negotiated Settlement (1990).

Comprehensive Water Use Estimation in Nevada

Since 1950, the U.S. Geological Survey (USGS) has estimated statewide water use at 5-year intervals and published these estimates as part of a national program. USGS water use estimates for Nevada and other states are included in the national summary report, but a detailed Nevada water use report with individual county breakdowns is not published by USGS (although this information is compiled). In developing these estimates, the USGS obtains available water use data and related information from a variety of entities such as the Nevada Division of Water Resources, U.S. Bureau of Reclamation, U.S. Census Bureau, U.S. Department of Agriculture, irrigation districts, federal water masters, water purveyors and other USGS studies. Since much of the water use in Nevada is not measured, the USGS has to rely upon estimation techniques for filling in data gaps and developing comprehensive county and state total water use values.

The water use estimation program in 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. The Division of Water Planning has requested funds to resume this program on a small scale in the current budget cycle (FY 2000 and 2001). Since the entire *State Water Plan* is predicated on water use data, resumption of the program is viewed by many as vital to the integrity of the water planning program and development of future water plan updates.

Water Use Data Currently Compiled by the State

The Nevada Division of Water Resources (NDWR) compiles a majority of the detailed water use data and estimates available within the State. Groundwater use estimates are developed for selected basins and compiled in pumpage and crop inventories. NDWR also collects other pumpage data which are submitted to satisfy water right permit requirements. According to the State Engineer's Office, these data account for about 90 percent of all groundwater use in Nevada. While these sources account for most of the statewide groundwater usage, the data are generally not maintained in an electronic database for easier access and analysis for statewide planning purposes.

Pumpage and Crop Inventories

NDWR annually compiles pumpage and crop inventories for selected basins. NDWR estimates the total groundwater pumpage for about 16 of the 256 hydrographic areas. Generally these groundwater pumpage inventories are based upon a mixture of both actual measurements and estimates. The groundwater pumpage amounts estimated in these inventories accounts for over 95 percent of the total groundwater used by municipal water systems in Nevada. As part of the crop inventories, NDWR estimates irrigated crop acreage and associated water withdrawals for about 30 of the 256 hydrographic areas.

Miscellaneous Pumpage Data

In about 80 of the 256 hydrographic areas, some water right holders are required by permit conditions to submit surface water and groundwater pumpage data to NDWR. These data are specific to a particular users such as public supply systems, mining and other self-supplied users, and may not account for all water uses within a hydrographic area.

Public Water Supply Systems. About 20 percent of the approximately 300 systems in Nevada submit water withdrawal information to NDWR. These systems serve about 95 percent of the total population and account for about 95 percent of statewide public system withdrawals. However, data may not include all surface water withdrawals by these systems, and details such as population served, consumptive use estimates and breakdowns by domestic, commercial, industrial, and thermoelectric deliveries are not requested by the State.

Other Data. NDWR collects groundwater withdrawal information for approximately 50 mining operations in Nevada. The mining operations continuously measure water withdrawals, mining consumptive uses, irrigation uses of excess mine withdrawals, reinjection volumes, and water discharges to surface streams. It is estimated that these data account for over 95 percent of the statewide mining groundwater usage. Miscellaneous commercial and industrial operations also submit groundwater withdrawal information to NDWR.

Water Use Estimation in Other States

Utah

The Utah Water Use Program is a cooperative effort between the State of Utah and the U.S. Geological Survey. As required by Utah Administrative Code R309-102-8, all community water systems are required to complete annual water use forms furnished by the state. The state also collects data from self-supplied industrial users with questionnaires mailed to these users. In 1985, the State of Utah started delineating irrigated acreages on 7.5 minute topographic map sheets, in lieu of outdated U.S. Natural Resources Conservation Service estimates. Utah updates about one-tenth of these maps every year. Irrigated water usage is then estimated from these data.

California

The Department of Water Resources has surveyed retail water agencies and analyzed their water production data for more than 35 years. This information is used in updating the California State Water Plan. In addition, the Department has been performing land use surveys since the 1950s to quantify acreage of irrigated land and corresponding crop types, and currently maps irrigated acreage in six to seven counties per year. Water use estimates are derived from water use requirements and the irrigated acreage amounts.

Other States

Many other states have water use reporting and estimation programs. Wyoming has a cooperative water use program with the USGS and mails out survey forms similar to those used by Utah. In Indiana, all entities with water use greater than 100,000 gallons per day are required to report their water use annually to the state. This requirement came about in response to declining water tables and competition for available water.

Issues

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. The resulting lack of readily available water use data complicated development of the *State Water Plan* and has hindered other efforts. 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 recommendations are offered as a method for improving water use measurement and estimation, and ultimately future water planning and management efforts, in Nevada:

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

   A. Enter water use data and estimations currently being compiled by the State Engineer into electronic databases, and link this data with water right permits database;

   B. 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 for 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

   C. Expand existing program for estimating irrigated acreage and associated water use;

   D. Encourage public supply systems to meter all water deliveries; and

   E. 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.
   F. 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.

Index - Part 3, Section 1D - Water Use Measurement

E. Domestic Wells

Introduction

In Nevada, domestic wells serve approximately 6 percent of the population and withdraw about 18,000 acre-feet per year (less than 0.5 percent of total state water use). Though domestic wells account for a small portion of the State's total water use, some domestic well issues require consideration in the planning process. The purpose of this discussion is to present the main issues associated with domestic wells in Nevada and to provide recommendations addressing these concerns.

Domestic Wells and the Water Law

As in most states, domestic wells are exempt from water right permitting under state law. This exemption applies to domestic wells with uses less than 1,800 gallons per day, which includes most domestic wells (NRS 534.180 (1)). Although domestic wells owners do not need to file water right applications with the State Engineer, drillers are required to file drilling logs with the State Engineer within 30 days after the drilling of any well, including domestic wells (NRS 534.170 (2), added in 1981)). In 1981, the State Engineer was given the authority to the registration of all wells drilled for domestic purposes within any groundwater basin or portion of a basin (NRS 534.180 (2)). For domestic wells drilled in these declared areas, well drillers are required to submit information required by the State Engineer within 10 days after well completion, and a registry of these domestic wells is maintained by the State Engineer.

Domestic Well Owner Protection

Because no permits are required for domestic wells, well owners' legal rights as existing users have been subject to conflicting statutory interpretations. Domestic well owners have the right to protest any water right application. In fact, NRS 533.360 (3) requires that applicants for a proposed groundwater use for municipal, quasi-municipal or industrial purposes with an expected withdrawal rate of 0.5 cubic feet per second (cfs) or more, in all counties except Clark County, notify all domestic well owners within 2,500 feet of the proposed well. To circumvent this requirement, some water right applicants have filed numerous applications for withdrawals, each less than 0.5 cfs, but which total together more than 0.5 cfs. In addition to these protective measures, the State Engineer has recognized that domestic well owners have the right to file complaints if they believe they are being impacted by existing permitted water uses. However, state law does allow for a reasonable lowering of the static water level at the appropriator's point of diversion (NRS 534.110 (4)).

While domestic well owners may have some recourse through the State Engineer if impacted by other junior priority water users, all well owners may have little protection from natural declines in the groundwater level due to drought. The well owner's level of protection depends in part on the depth of his or her domestic well. State drilling regulations indirectly place depth requirements on any wells

through seal requirements, but do not explicitly require a minimum penetration into the aquifer. It becomes the responsibility of the well owner to be aware of potential problems with the private water supply and plan appropriately.

Parceling

For land which is to be developed as a "subdivision" with domestic wells, the State Engineer has the authority to require that water rights sufficient to meet the domestic needs be dedicated for the development. However, the State Engineer has no review authority for land divided under the "parceling map" statutes (NRS 278)[1]. Some developers have circumvented the subdivision approval requirements by parceling their property multiple times. In these instances, the State Engineer has not had an opportunity to ensure that adequate water supplies are available for the new development and that other water users are not impacted by the new development. This situation has complicated the State's ability to provide comprehensive water resource management, particularly in designated basins, and ensure that existing users are protected.

Many counties have addressed this problem by requiring water rights dedications for parcel developments under certain circumstances. 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. Also NRS 278.462 authorizes the county or other governing body to request the State Engineer's recommendation on water quantity needs for parcel developments.

Groundwater Management and Planning

Complete domestic well inventories do not exist for some areas of the state. As discussed in the "Water Resources Data Development, Collection and Management" issue in Part 3 of the *State Water Plan*, the State Engineer's Office maintains a database of well logs submitted since the 1940s. However at this time, the database does not account for those wells drilled in Northern Nevada prior to 1984. All wells drilled in Southern Nevada are included in the database.

Without adequate information for quantifying the number of domestic wells in some areas, it may become difficult to estimate total and domestic well water use and total committed groundwater resources in a basin. As a result, comprehensive groundwater management and planning becomes more difficult. The State Engineer needs to consider all water uses and commitments when reviewing an application for a water right or when considering the implementation of additional administrative measures for a basin. Thus, the lack of data regarding domestic well use impacts the State Engineer's

[1]According to NRS 278.320(1), a subdivision is generally defined as "...any land, vacant or improved, which is divided or proposed to be divided into five or more lots, parcels, sites, units or plots, for the purpose of any transfer, development or any proposed transfer or development..." The State Engineer has the authority to require water rights for subdivisions.. A developer can circumvent the State Engineer's review process by dividing the property into four or fewer lots (parceling).

decision process and may lead to an inadvertent over allocation of a basin's groundwater. Effective planning requires accurate knowledge of existing water use as well. Under the existing system, this information is frequently not available.

Domestic Wells and Water Quality

Most single family dwellings using domestic wells also use individual septic tanks for wastewater disposal. State regulations and policies provide spacing requirements between domestic wells and septic tanks, and septic tank concentrations. However, the quality of domestic water supplies have been impaired by septic tank discharges and other contaminants in some areas in Nevada. While the State has funding programs to assist public water systems in complying with state and federal drinking water quality standards, limited funding assistance is available for domestic well owners.

Issues

Following is a summary of the main issues related to domestic wells in Nevada:

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 well water supplies have been impaired by septic tank discharges and other contaminants in some areas. Limited funding assistance is available to mitigate these situations.

Recommendations

The following recommendations are offered to address the domestic wells issues in Nevada:

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.

Index - Part 3, Section 1E - Domestic Wells

A. Nonpoint Source Pollution

Background

Clean water is essential to all life. Yet every-day activities impair water quality and thus reduce the availability of good water supplies. Throughout the U.S. and Nevada water resource experts and agencies are finding that the leading cause of water quality impairment is nonpoint source (NPS) pollution. Pollution from nonpoint, or diffuse, sources is more difficult to control than pollution from point sources, which are discharges through pipes or channels from a distinct source. Almost any activity can increase runoff and add to NPS pollution. Commonly identified sources activities and facilities such as mining, construction, grading, roads and trails, septic systems, underground storage tanks, modified water courses, feed lots, grazing and timber harvesting are commonly identified sources. These widespread activities can stir up, produce and release pollutants which are then picked up by runoff from melting snow, rain fall, or irrigation and deposited downstream in pulses.

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 impacts such as 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 diffuse sources. For example, in the U.S. Fish and Wildlife Service (USFWS) recovery plans nonpoint sources are identified as an important cause of degraded fish habitat for endangered cui ui populations in the lower Truckee River system and for Lahontan cutthroat trout populations in the Truckee, Humboldt, Carson, and Walker River systems.[1] Accelerated eutrophication of lakes (e.g., Lake Tahoe) is also a concern.[2]

The presence of wetlands and water availability are important factors determining the degree of NPS impact to water quality. One of the reasons wetlands and riparian zones are valued and protected by regulation is their treatment capacity, which is the ability to detain, trap, convert and assimilate sediment, nutrients, and organic wastes. The actual relationship between stream flow and water quality is complex, but in general where river flows are lowered by drought and/or upstream diversions and nonpoint pollution is present, the negative water quality impacts can be amplified.

An innovative approach to improving water quality with increased stream flow is the Water Quality Settlement Agreement for the Truckee River. State, local, tribal and federal agencies cooperatively

[1] *Cui-ui Recovery Plan*. U.S. Fish and Wildlife Service. 1978. *Lahontan Cutthroat Trout Recovery Plan*. U.S. Fish and Wildlife Service. 1995.

[2] Eutrophication is the aging process of a lake. Over long time spans lakes receive sediment, nutrients, and organic material. As these materials accumulate the lake slowly undergoes ecosystem changes as it fills-in.

developed a plan in 1996 to increase flows and dilute point and nonpoint source pollutant concentrations, primarily in the Lower Truckee River. Federal and local governments have agreed to share the cost of acquiring water and reservoir storage rights in the upper Truckee River system. The acquired water is intended to increase stream flow during periods when low water levels are likely to contribute to poor water quality conditions.

The dry climate, infrequency of rainfall events, and diversions from streams often are significant factors influencing the degree of nonpoint pollution impacts on water resources. For example, Steamboat Creek, a tributary of the Truckee River, collects urban and agricultural drainage. Below the creek's confluence with the Truckee River, water quality conditions deteriorate in late summer because river flows are lower, so the nonpoint source pollutant load from Steamboat Creek has a larger influence on river water quality. In the case of a large storm water runoff event that occurs after a long dry spell, larger quantities of NPS pollutants from urban development and suburban ranches can be mobilized and thus cause not only a short term water quality impact but also contribute to longer term levels of lower water quality as more solids become deposited in the creek and river channels. Circumstances vary on each river, so intensive field investigations are helpful in explaining site specific cause and effect relationships between nonpoint sources and hydrologic conditions that contribute to NPS pollutant discharges and water quality impairment. [3]

Preventing and controlling NPS pollution is accomplished primarily by implementing Best Management Practices (BMPs).[4] BMPs work on the principles that materials belonging on the land should be kept there, and that decreasing the distance runoff travels from the source minimizes control costs. Some general categories of BMPs applicable to many source activities are soil conservation, revegetation of disturbed areas, erosion and storm water controls, fertilizer management planning, integrated pest management, wetland protection and enhancement, and storm water treatment cells. Land use planning practices such as open space master plan designations, zoning controls, and subdivision development ordinances also have been used to ameliorate nonpoint source pollution potential of land development.

State agency water quality assessments, more fully described below, have found that urban areas, irrigation, grazing, and flow regulation practices are the largest nonpoint pollutant contributors.[5]

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[3] The Washoe/Storey Conservation District, Washoe County and NDEP, are working on watershed planning activities that address NPS pollution in Steamboat Creek. A related study by a University of Nevada graduate student investigates the role of land uses, pathways, and seasonality of nutrient loading into the creek.

[4] Best Management Practices for water quality improvements are defined as "those methods, measures or practices designed to prevent or reduce water pollution, including, but not limited to structural and nonstructural controls, and including both operation and maintenance procedures." BMPs should be "the most effective, practical means of preventing or reducing the amount of water pollution from nonpoint sources to a level compatible with water quality goals". *Nevada Water Quality Assessment 305(b) Report*. Nevada Division of Environmental Protection. 1998. *State of Nevada Non-Designated Area Water Quality Management Plan, Handbook of Best Management Practices*. State Conservation Commission, et. al. Not dated.

[5] Flow regulation practices includes hydromodification, which involves re-shaping a channel or drainage to carry higher volumes of water or constructing bank protective measures, and stream diversions or reservoir storage. Changes in flow patterns can cause undesirable channel adjustments that lead to impaired water quality.

Statewide, the most common NPS pollutants of concern include suspended solids, total dissolved solids (salinity and chlorides), total phosphates, nitrogen species, turbidity, and thermal energy. In some waters, arsenic, boron, selenium, lead, and iron levels are elevated. These elements are associated with geothermal sources, and become concentrated in closed basins by high evaporation rates. Runoff and subsurface flow from irrigated agricultural land may increase the amount of these contaminants. A special concern is mercury in the Carson River from historic mining and milling operations. Rapid population growth, changing land uses, urbanization, and changing public expectations regarding water quality add to the complexity of managing NPS pollution. Given the prevalence of these factors in Nevada, it is not surprising that all major rivers are impacted to some degree by NPS pollution.

Much is being done cooperatively by state, local and federal agencies and land owners to manage nonpoint source pollution through education, encouraging and funding implementation of pollution prevention and BMP retrofit projects, installation of control technologies, monitoring and assessment of nonpoint sources, improving our understanding of the cause and effect relationships between water quality impairment and pollutant sources, and researching and implementing new, more effective strategies is an ongoing effort of all agencies within the Department of Conservation and Natural Resources (Department).

State Agency Involvement with Nonpoint Sources

To address the role of nonpoint source pollution in water quality impairment, new and enhanced policies and measures were included in section 319 of the 1987 Clean Water Act Amendments (CWA). A key provision in section 319 is the requirement for states to develop, adopt and implement NPS management plans and undertake periodic water quality assessments. Nevada's policy, to identify, control, and abate NPS pollution through a combination of regulatory requirements and voluntary control and prevention measures, is consistent with section 319. In addition, NPS problem assessments and control plans in Nevada are developed through the CWA section 208 area wide Water Quality Improvement Planning process.

The NPS management activities of agencies within the Department are discussed next, followed by a general description of local and federal agency involvement in NPS pollution management.

Nevada Division of Environmental Protection

The Nevada Division of Environmental Protection (NDEP) developed Nevada's initial Nonpoint Source Pollution Management Program and Nonpoint Pollution Assessment Report in 1989. Since then the state has instituted regulatory and voluntary programs to control and abate the impacts of NPS pollution through public awareness, cooperation with other agencies and land owners, and application of Best Management Practices (BMPs). Pollution control regulations and permit programs have been implemented for discharges from septic systems, municipal storm water systems and construction or land clearing activities on projects covering five acres or more.

The NDEP emphasizes the use of Best Management Practices (BMPs), technology transfer through

demonstration projects, and supporting NPS management activities by local agencies and organizations with CWA section 319 pass-through grants and technical assistance. With the assistance of NDEP and other state agencies, many NPS projects have been completed or are on-going in all major river basins. Examples of projects funded by NDEP grants include wetland and riparian zone restoration, channel erosion controls, waste load assessments, urban BMPs, grazing management practices, and water education.

The Clean Water Action Plan (CWAP), a federal initiative launched in February 1998, provides incentives to states undertaking a multi-agency process of identifying and prioritizing watersheds in need of additional NPS management actions, referred to as a Unified Watershed Assessment. NDEP and the Natural Resource Conservation Service began the process in June 1998 with a statewide watershed assessment involving interested governmental agencies and non-governmental organizations. The assessment considered water quality and related natural resource goals, then set priorities on the area's ability to meet those goals. The 303(d) listed waters (see discussion below) were a major consideration in setting priorities for Nevada's Unified Water Assessment element of the CWAP. Restoration strategies are being developed for high priority watersheds which will then be implemented by watershed stakeholders.

Innovative water quality management practices include the use of Clean Water Act State Revolving Fund monies for the purchase of Truckee River water rights to maintain minimum stream flow and improve water quality. Additionally, the Division is considering implementing a program for NPS pollution credit trading. Conceptually, NPS pollutant loads would be quantified and then removed, generating a credit which then could be applied at a discounted rate to a point source discharge. Another innovative approach that is being evaluated is the use of biological indicators as a means to further assess water quality. NDEP is cooperating with EPA on the development of a rapid biological assessment protocol that could be modified to work on streams in Nevada.

NDEP, in cooperation with the U.S. Geological Survey (USGS), monitors various waters throughout the state. The data is used to produce the biennial *Nevada Water Quality Assessment 305(b) Report* and *Nevada's 303(d) List*. The *305(b) Report* provides an inventory of major river segments, lakes and wetlands where monitoring shows impairment of beneficial uses by both point sources and nonpoint sources. Source activities and causative agents of pollution are also identified. The *303(d) List* identifies water bodies that need additional controls to achieve or maintain water quality standards, including establishing total maximum daily loads (TMDLs), and is the basis for targeting water bodies for watershed-based solutions. The TMDL process provides an organized framework to develop these solutions. TMDLs have been set by the NDEP on segments of the Truckee, Carson, Walker, and Humboldt Rivers, and the Las Vegas Wash.

The Section 208 Water Quality Management Plan (WQMP) provides a framework within which state, regional and local agencies cooperatively prioritize the management of pollution sources, including NPS. Washoe, and Clark, and the Tahoe Regional Planning Agency (TRPA) have each developed Section 208 WQMP for their respective jurisdictions. NDEP has developed a Section 208 plan for the non-designated areas of the state (including the Walker and Humboldt river basins) plus another designated area, the Carson River Basin. Of this group, TRPA is unique in their use of a mandatory, tiered approach to implementing BMPs on private land in the Lake Tahoe Basin.

Nevada Division of Conservation Districts (NDCD)

In its overall approach to conservation planning, the NDCD works to prevent and control NPS pollution with programs that build community awareness and provide technical assistance to rural and urban landowners. Areas of focus include resource planning to prevent soil erosion, protection and restoration of riparian areas and wetlands, and implementation of BMPs. The Division networks with other state, federal and local agencies in providing technical and education assistance to the public, land owners, and resource managers. The division has 27 locally led conservation districts. The districts participate in resource planning for cooperative NPS control projects, obtain the voluntary services of natural resource professionals, seek grants from state and federal funding sources, and assist local governments with NPS water quality planning projects and programs. In 1994, the NDCD and NDEP together produced the state *Best Management Practices Handbook*.

Other State Agencies

The Nevada Division of Forestry consults with landowners on plant community management techniques that emphasize erosion control. The division also operates the Forest Stewardship program through which funding and technical expertise is supplied for projects that control NPS.

The Nevada Division of Wildlife (NDOW) manages extensive wetlands on Wildlife Management Areas, evaluates fish and wildlife habitat conditions, and supports actions to alleviate NPS pollution that impact the functioning of aquatic ecosystems. In cooperation with the Nevada Divisions of State Lands and Water Resources, NDOW also seeks to obtain additional wetland areas and water supplies for fish and wildlife habitat improvement.

The Nevada Division of Agriculture (NDOA) regulates the use of pesticides and monitors for contamination. With the U.S. Environmental Protection Agency (EPA), NDOA is finalizing a management plan to protect Nevada's ground water resources from pesticide contamination.

Bi-State Agency — Tahoe Regional Planning Agency

The Tahoe Regional Planning Agency (TRPA) administers and enforces land use ordinances in the Lake Tahoe Basin that are intended to reduce NPS pollution, among other things. BMPs are required by TRPA for all construction and other land use activity on private land in the Lake Tahoe Basin. The Nevada Division of State Lands (NDSL) administers the Tahoe Basin Act of 1996, a bond program which provides $20 million to implement storm water quality improvement, erosion control and stream and wetland restoration projects in the basin.

Local Agencies Involvement with Nonpoint Sources

Nevada's nonpoint source control program places an emphasis on local management and enforcement. Local governments have a variety of tools available to accomplish this, including: 1) identifying environmentally sensitive lands during the Master Land Use Planning process; 2) adopting development ordinances with design criteria intended to minimize soil disturbance and erosion, retain wetlands and riparian zones, and preserve natural drainages and stream channels; 3) acquiring open

space to achieve environmental objectives; and 4) adoption of ordinances requiring application of BMPs. Cities and counties also collaborate with conservation districts and the University of Nevada Cooperative Extension offices to enhance public education efforts on pollution prevention and to review development plans for NPS concerns.

The two largest metropolitan areas located in Washoe and Clark Counties hold permits from NDEP for discharges from their municipal stormwater systems. Under these permits, agencies within the metropolitan areas agree to monitor water quality, apply BMPs, correct illegal discharges to storm drains, and work to alleviate significant NPS discharges to storm drainage system segments within their jurisdiction.

Federal Agency Involvement with Nonpoint Sources

The U.S. Environmental Protection Agency (EPA) administers the Clean Water Act (CWA), including section 319, which encourages states to establish plans for assessing and reducing NPS pollution "to the maximum extent practicable." States meeting minimum requirements regarding assessment and management of NPS qualify for grant funding and technical assistance from the EPA.

NPS control is a key objective for federal land and water resource management agencies . The U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM) address NPS pollution through land use decisions, permits issued for grazing, timber harvest, mining and other resource extraction activities, and the application of Best Management Practices. The U.S. Army Corps of Engineers (COE) plays an important role in NPS management under CWA section 404 and other regulatory programs regarding dredging and filling of wetlands and certain waterways. Restoration of previously modified river channels and protection of wetlands are major objectives of the COE. The U.S. Fish and Wildlife Service (USFWS) coordinates with other agencies to protect wetlands on public lands and manages wetlands on national wildlife refuges. The USFS, BLM, COE and Natural Resource Conservation Service, have entered into Memorandums of Understanding with NDEP that lay out state, local and federal agency responsibilities in management and abatement of NPS pollution and wetland protection on public lands.

The Natural Resource Conservation Service (NRCS) administers programs that address NPS concerns in agricultural and suburban areas through partnerships with other agencies, such as the NDCD. The Emergency Watershed Protection, Environmental Quality Incentive Program (EQIP), and Wildlife Habitat Incentive Programs (WHIP) are examples of funding programs that help land owners pay for BMPs and NPS demonstration projects. Projects include fencing riparian areas, tailwater treatment in wetlands, and channel bank stabilization using bioengineering techniques.[6] Within a watershed framework, the NRCS periodically assesses natural resources to identify NPS problem areas and coordinates with NDEP to prioritize improvement projects.

Collection and analysis of water quality data is an essential part of the state NPS management

[6] Bioengineering techniques refers to the use of vegetation to stabilize eroding stream channels. For example, willow branches which are capable of producing new plants in moist soils, are bundled and secured in shallow trenches along sloughing embankments.

program. The USGS conducts water quality investigations and maintains permanent water quality sampling stations throughout Nevada. In addition to monitoring physical and chemical water quality constituents, sediment and biological sampling and analysis is performed.

Issues

1. The 1998 305(b) Nevada Water Quality Assessment Report indicates that ambient water quality is either partially not supporting or fully not supporting (i.e., does not meet some or all of the beneficial use standards) for 775 perennial river miles. Of the 14,988 miles of perennial rivers in Nevada, 1,639 were assessed in 1997. NPS pollution is a significant contributor to impairment of assessed waters. However, more comprehensive and watershed specific data may be necessary to track and correlate nonpoint source water quality consequences associated with hydrologic conditions (i.e., storm events, stream diversions, drought) and source areas. For example, more stream flow gauge data would be helpful in estimating nonpoint source loading during storm events and dry periods. This would result in greater cost, but these could be offset by performing field investigations in cooperation with other agencies and organizations. Furthermore, the possibility of producing more effective and lasting water quality solutions is greater.

2. Cost can be an obstacle to installing and maintaining BMPs. Federal grants are available through NDEP and NRCS (e.g., CWA section 319, EQIP, WHIP), money from which supports BMP projects on private land. The matching funds for these projects typically come from local agencies, organizations, and landowners. With the exception of the Tahoe Bond Act of 1996, currently there is no state source of funding for NPS projects.

3. Numerous studies have shown that wetlands act as relatively inexpensive NPS pollutant treatment systems, in addition to providing other natural resource benefits. The 1998 305(b) Report includes estimates that meadow wetlands historically may have covered about 246,000 acres in Nevada, and that 136,650 acres currently remain. Riparian wetland losses are uncertain. The NDEP, NDOW, community park planning departments, comprehensive planning departments, TRPA, COE and USFWS have stopped the decline of these sensitive areas. Projects encroaching upon wetlands are often required to mitigate losses in excess of the wetland acreage impaired. The cooperative approach to wetland protection between federal, state and local agencies needs to continue in order to prevent further losses and for wetland protection efforts to remain cost effective.
4. As the urban boundaries of communities in Nevada expand, development pressure on environmentally sensitive lands, such as hillslopes, wetlands, floodplains, and forested areas is likely to increase. Development of these areas can increase the potential for NPS pollution. Correcting NPS pollution problems after the fact is difficult and costly. Some local land use planning agencies in Nevada and elsewhere are addressing potential NPS impacts by incorporating water quality concerns into development policies and design standards. Examples include master planning to retain open space or protect environmentally sensitive areas, revising zoning ordinances to encourage cluster development, enlarging setbacks along drainage ways and flowing streams, limiting the amount of impervious surface, and incorporating a wide variety of BMPs into the design of roads and developments.

Recommendations

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

1. The 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.

Index for Part 3, Section 2A:

B. Comprehensive Groundwater Protection and Management

Background

Ground water is a vital and finite resource. In Nevada, aridity, complex hydrogeology, rapid population growth and diversifying public interests are factors substantiating the need for comprehensive ground water protection and management. The increasing importance of this water resource is indicated by statewide ground water supply data. Forty percent of the combined water use for domestic, commercial, industrial, mining and agricultural purposes is now withdrawn from ground water aquifers. All public supply water use in 11 of Nevada's 17 counties was met in 1995 with ground water withdrawals.[1] In 1997, a total of 1930 wells were drilled for domestic (1748), industrial/public-supply (145) and irrigation (37).

A number of factors suggest that dependence on ground water will increase. Surface waters in the state are essentially fully appropriated. Furthermore, ground water resources are considered to be more drought resistant than surface supplies, thus more reliable. At present, ground water supplies generally require less treatment for removal of pollutants than surface water, due in part to the pollutant filtering effect of soils and aquifer materials. (Pending changes to federal drinking water quality standards may result in new water treatment requirements.) Also, where ground water occurs near and at the surface in an integrated system of springs and seeps, it forms an important resource for upland and aquatic ecosystems, thereby contributing to the number and value of outdoor recreation opportunities, the protection of biological diversity, a higher quality of life statewide.

Most ground water basins in Nevada contain aquifers with water of adequate quality and quantity for one or more beneficial uses.[2] However, some aquifers are showing the effects of increased demand and water quality deterioration. People commonly associate ground water pollution with drinking water concerns, but agricultural, industrial and resource conservation uses may also be affected. Ground water pollution comes from many sources, both human induced and natural, potentially limiting the types of uses and further development of aquifers. Thus, the importance of taking a comprehensive approach to ground water pollution protection and management has been well established.

Allocation of ground water resources is managed by the state engineer in the Nevada Division of Water Resources (NDWR) in conformance with the Nevada Revised Statutes (NRS) Chapter 534. The statutes are intended to provide for the protection of existing water rights and to encourage

[1] *Draft State Water Plan,* Section 2. Public water supply refers to residential, commercial, and industrial water use by customers supplied by a public water supply system.

[2] The major exception may be basins where underground nuclear weapons testing has occurred. Matters related to accessibility and quality of ground water in these areas is beyond the scope of this paper.

efficient and non-wasteful use of the state's limited supplies. A fundamental principle is that additional allocation or appropriation of ground water will be restricted if the state engineer determines that additional wells would cause undue interference with existing wells or prove detrimental to the public interest. Where it appears that the average annual replenishment to the ground water supply may not be adequate for the needs of all permitted water right holders, the state engineer must investigate basins or portions thereof and may restrict withdrawals if recharge is found to be inadequate, or take other appropriate administrative measures (NRS 534.110).

Nevada's policy is to protect all ground water against deterioration in quality, in order to maintain supplies that are suitable for beneficial uses. In general, the approach to ground water quality has been centered on controlling specific sources of pollution. All ground water in Nevada is considered to be a potential source of drinking water. Therefore the federal Safe Drinking Water Quality Act standards (i.e., U.S. Environmental Protection Agency established Maximum Contaminant Levels) as adopted by the Nevada State Environmental Commission are applied when evaluating the potential impacts of different pollutant sources and setting remediation, or clean up, actions levels.

The Nevada Division of Environmental Protection (NDEP), in cooperation with other agencies, has developed and is now implementing a Comprehensive State Ground Water Protection Program (CSGWPP) to complement the existing water quality regulations. Program elements include assessment of ground water quality conditions, prioritization of pollution control and remediation needs, and implementation of pollution prevention and control strategies such as the Wellhead Protection Program. A primary objective of the program is to coordinate development of program elements between state, federal and local agencies, thereby taking advantage of complementary roles, responsibilities and resources to enhance the effectiveness and efficiency of ground water quality protection statewide.

Ground Water Quality

Contamination has occurred in many areas of the state, both in rural and urban settings. Sources found to cause ground water pollution include drainage from crop lands and urban lawns and golf courses treated with pesticides and fertilizers, livestock feed lots, clustered septic systems, underground chemical and fuel storage tanks, mining sites, federal facilities, oil wells and pipelines, and solid and hazardous waste disposal sites. Pollutant releases and ground water contamination from such sources are minimized through administration of regulations that require implementation of preventative measures and monitoring. Public education and awareness raising programs are elements of the cooperative strategy. Some pollution events are obvious, such as chemical or fuel spills, and can be cleaned up quickly enough to avoid aquifer contamination. However, there continues to be concern with less obvious pollutant releases which gradually become water quality problems. The presence of man-made contaminants such as pesticides, industrial solvents, and gasoline components in shallow monitoring and drinking water wells in urban areas are examples. Another example is the occurrence of high nitrate and/or pathogenic bacteria levels in some suburban and rural domestic wells. This problem often occurs in locations where the density of septic systems and residential livestock holdings are high and where the ability of soil and microorganisms to

assimilate and dilute the percolating effluent is relatively low.

Much deterioration of ground water occurs through natural processes, such as leaching of mineral from rock formations, soil and playas. Salts are the most pervasive naturally occurring pollutant. Salt concentrations generally are measured as total dissolved solids (TDS).[3] Geothermal systems and volcanic rocks impart iron, manganese, fluoride, arsenic, boron and sulfates. Radon is another contaminant of concern that is commonly associated with granitic rock types. In some basins with natural contaminants, decisions to increase pumpage rates or locate new wells must take into consideration potential for migration of contaminants. Some persistent forms of natural contaminants (e.g., TDS, metals) may become more of a problem as an aquifer is depleted. Several municipal and industrial water suppliers in Nevada have had to change supply resources or implement other measures to mitigate naturally occurring high levels of TDS, iron, manganese, arsenic or nitrates.

Ground Water Recharge

Aquifers may be recharged by natural, incidental or artificial mechanisms. Natural replenishment occurs slowly in Nevada, so protecting or enhancing aquifer recharge areas and processes should be an important element of land use planning in the state. On average, only 3 to 7% of the state's annual average precipitation (9 inches, the lowest of all states) is available for ground water recharge because of high evaporation and transpiration rates, periodic droughts, and land use factors. The quantity of ground water recharge is influenced by changes in hydrologic conditions of contributing source areas and by climate. Changes of land use in a watershed that interfere with infiltration and percolation of rainfall, snowmelt and streamflow (e.g., impervious areas, road cuts, and gully erosion) can diminish both the amount of percolating water and the water quality benefits from dilution of salts.

Ground water quality and quantity can be related to recharge rates and locations. Incidental recharge by different land uses (i.e., wastewater or stormwater impoundments, urban, agricultural and golf course irrigation, septic systems) is an important ground water protection consideration because saturated conditions are created that more readily conduct pollutants into an aquifer. Both urban and agricultural areas have experienced recharge benefits and pollution impacts due to incidental recharge. In contrast, artificial recharge is accomplished under controlled conditions through the use of injection wells and infiltration basins. Artificial recharge projects proceed under permits issued by the NDWR and NDEP that require careful study and monitoring to ensure that ground water quality and permeability of aquifer formations are not significantly affected. In fact, artificial recharge can be implemented to improve overall water quality by blending with higher quality water. The NDWR has issued permits for 5 artificial recharge projects. Project sites are in Eagle Valley (Carson City), Las Vegas Valley, the Truckee Meadows (Washoe County) and in Golden and Lemmon Valleys, north of Reno. The Las Vegas Valley aquifer storage and recovery program, started in 1988, has resulted in over 150,000 acre feet of Colorado River water being injected during the winter to help meet demand in the future. Subsidence control and ground water level stabilization may be additional

[3] Total Dissolved Solids is a measure of mostly inorganic salts (e.g., sodium and chloride) dissolved in water. High TDS is often associated with taste, water hardness, and salinity problems.

benefits.

The Ground Water/Surface Water Connection

Interconnections between shallow ground water and surface water systems (i.e., integrated water systems) may exist to varying degrees in some basins. The influence of ground water discharges on the amount of water available to streams, springs and wetlands is basin specific, dictated largely by the occurrence of subsurface flow paths through aquifer formations and climate conditions. Springs in the mountains and on valley floors provide important watering opportunities for many animals and habitat for diverse assemblages of fish, wildlife and plant species. A water table in decline due to pumping can diminish surface water resources that are dependent on ground water discharge, and in turn impact biological resources and water quality. For example, dewatering of mines in the Humboldt River Basin has the potential, both during and after mining, to interfere with ground water flow and quality, thereby altering the availability and suitability of surface water for natural resources. (These cause and effect relationships are being studied jointly by mining companies and federal and state agencies.)

Studies of the ecology of springs found throughout Nevada have identified many unique, long-lived species of fish, snails, and water insects which are threatened, endangered or have been extirpated. In some circumstances, ground water pumpage and water level decline has been linked to lost or impaired habitat. This suggests more research is needed to better understand the integrated relationships between ground water use, aquifer/surface water response, and natural resource resiliency.

State Agency Involvement with Ground Water Management

State agencies have the lead role in establishing a comprehensive approach to ground water protection and management. Authority lies in various federal and state statutes, regulations, and policies. More detailed information can be found in the *State of Nevada Comprehensive State Ground Water Protection Program Profile* (CSGWPP) report and the *State of Nevada Comprehensive State Ground Water Protection Program Self Assessment* report, both of which were updated by NDEP in March 1998. The NDWR has the primary authority to allocate, adjudicate, and manage underground water resources. Regulations for ground water quality protection are implemented by NDEP, the Bureau of Health Protection Services (BHPS) in the Nevada State Health Division, and the Nevada Division of Agriculture (NDOA). The Nevada Division of Water Planning (NDWP) cooperates with these agencies to forecast water supply needs and to recommend alternative management plans to meet them. Federal, local and regional agencies participate extensively in ground water protection also.

Nevada Division of Water Resources

Ground water use is managed by the State Engineer in NDWR according to Nevada water law (Chapters 533 and 534, NRS). Well construction and ground water use permits are issued by the State Engineer's office. Authorization for a new ground water use is contingent upon the availability of unappropriated water, the protection of existing water rights, and consideration of factors that may prove detrimental to the public interest. Ground water use is also subject to a permit that conditions the location, timing and manner of beneficial use. However, a water right permit is not required for a domestic well.[4] The State Engineer will only appropriate as much water in a basin as can safely be expected to recharge on average over the long run.

An important set of regulations administered by NDWR are those pertaining to well construction and abandonment measures that address concerns over direct aquifer contamination from the surface or aquifer to aquifer contamination. Construction codes require measures that prevent movement of pollutant through the wells, including surface seals and plugging of abandoned wells. Well drillers are licensed by NDWR, and they must adhere to the code or face license revocation. Drillers are also required to file well logs with NDWR.

Other ground water management duties include estimation of annual pumpage and collection of various types of data where required by the water right permit, including ground water use, withdrawal, and water level data.

Nevada Division of Environmental Protection

The state's integrated approach to ground water quality protection is described in the CSGWPP, mentioned above. This report lists and describes regulatory and cooperative programs aimed at preventing, mitigating and remediating ground water contamination. The NDEP is now in the process of implementing elements of the CSGWPP to complement the existing pollution control programs. The core elements of the comprehensive program are existing pollution control programs that address potential water quality impacts from pesticide use, mining, underground storage tanks, underground injection control, landfills, and hazardous waste disposal. Bureaus within NDEP involved in these programs include Water Pollution Control, Mining Regulation and Reclamation, Corrective Actions, Federal Facilities, Waste Management, and Water Quality Planning. The Nevada Division of Agriculture's (NDOA) pesticide regulation and monitoring responsibilities is also in the process of being integrated into the comprehensive state program.

An emphasis on prevention is an important aspect of NDEP's comprehensive approach to ground water protection. Water pollution control regulations mandate that preventative measures be designed into facilities that are potential pollution sources, such as impermeable leak containment structures for chemical and fuel storage tanks. Solutions to controlling diffuse source pollution from urban, industrial and agricultural areas include voluntary and mandatory use of Best Management Practices (BMPs), public education, and land use regulations (e.g., ground water protection district

[4] The exemption for domestic well owners applies if the use is for a single family dwelling and where the use does not exceed a daily maximum of 1800 gallons (about 2 acre feet per year) (NRS 534.180). Metering of domestic ground water use generally is not required.

overlay zoning).

The NDEP is committed to developing a comprehensive ground water assessment, under which a process will be established for identifying "critical basins". Criteria will include the impact of potential contaminant sources, inherent sensitivity of ground water, and the degree of local dependence on water. The assessments may be used to set priorities for basins needing additional attention in terms of coordination between programs and targeting pollution prevention efforts.

A major component of the CSGWPP is the Wellhead Protection Program (WHPP).[5] Wellhead protection involves integrated water resource planning and preventative actions intended to reduce the risk that the quality of current and future drinking ground water supplies will be contaminated from known or potential causes. Wellhead protection programs already have been started in twenty Nevada communities. Developing a WHPP requires coordinated effort by cooperating agencies and organizations to delineate wellhead protection areas, inventory potential and existing contamination sources, select and implement contaminant management strategies, develop plans for locating new wells, and develop a contingency plan. Public participation and education is an important part of wellhead protection.

Bureau of Health Protection Services, Nevada State Health Division

The Bureau of Health Protection Services (BHPS) supervises compliance of public drinking water supply systems with federal Safe Drinking Water Act (SDWA) requirements and permits domestic septic systems. SDWA Vulnerability Assessments of ground water sources supplying public water systems are done by BHPS to determine the risk of contamination and evaluate the need for periodic contaminant monitoring. A more comprehensive approach being implemented under provisions of the 1996 SDWA Amendments is the Source Water Assessment Program (SWAP). The SWAP will build upon Vulnerability Assessments with added provisions to evaluate surface water supply resources and conduct risk analysis. The source water assessment process is being integrated into wellhead protection programs in some municipalities. As SWAPs are completed, BHPS, NDEP and other cooperating agencies will encourage the development of Source Water Protection Plans. The BHPS also collects and monitors water quality data submitted by the public water supply systems.

[5] State of Nevada Wellhead Protection Area Delineation Recommendations. Nevada Division of Environmental Protection. August 1995.

Nevada Division of Agriculture

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Nevada Pesticides Act is administered by the NDOA. The division has authority to regulate pesticide use, and may impose a local or statewide ban on the use of specific pesticides. NDOA has drafted the Nevada State Ground Water Protection Pesticide Management Plan, and is coordinating with EPA and the USGS in the plan's implementation. Ground water monitoring in agricultural areas that have been targeted as vulnerable to pesticide contamination is done on a rotating basis around the state. Other agricultural areas are monitored randomly. Public education on safe pesticide and fertilizer use is provided by NDOA, as well as the University of Nevada Cooperative Extension and Conservation Districts.

Other State Agencies

The Nevada Division of Wildlife (NDOW) and the Nevada Division of State Parks (NDSP) hold ground water rights for various wildlife and recreation purposes, including drinking water, irrigation, wetlands, and fish rearing stations. If NDOW or NDSP has reason to believe an application to appropriate ground water will be detrimental to recreational or natural resources under their jurisdiction, the agency may object through the statutory protest process administered by the State Engineer. State water law protects springs and seeps on which wildlife customarily subsist (NRS 533.367). The Nevada Natural Heritage Program can play an important ground water management role by providing information on threatened, endangered and other sensitive aquatic species that inhabit unique shallow ground water-fed surface waters found throughout the state, and then help to develop recovery and habitat conservation plans.

Non-Governmental Organizations

The Nevada Rural Water Association (NRWA) provides ground water protection assistance to rural public and private water systems. The organization helps with the design and implementation of wellhead protection programs, satisfying Safe Drinking Water Act requirements, technical assistance, and public education.

Local and Regional Agency Involvement with Ground Water Management

Local governmental agencies and organizations are active in ground water resource protection. Local governments have the authority to pass ordinances and make land use decisions to protect ground water. An important element of master land use planning should be the evaluation and consideration of the accessibility and suitability of ground water supplies to meet future development. Several counties have environmental health departments that review land use and development proposals for potential ground water impacts, monitor ground water conditions, and implement public education programs. Twenty communities are developing or implementing wellhead protection programs, although some are encountering difficulties in implementing the programs due to limited resources, data, and expertise. Many local agencies and utility districts are advancing ground water protection public awareness and education, with programs implemented individually or in partnerships

with different organizations such as the Ground Water Protection Task Force, University of Nevada Cooperative Extension, and local Conservation Districts.

In Clark County, the Advisory Committee for Groundwater Management and the Southern Nevada Water Authority (SNWA) will be seeking 1999 legislative approval to enhance and expand the Las Vegas Valley Groundwater Management Program.[6] Program elements include the construction of dedicated recharge facilities, the permanent storage of up to 5,000 acre-feet per year, public education and a comprehensive well inventory, among other activities. To meet increased water demands from 2007 until 2025, the SNWA intends to utilize Colorado River surpluses (if available), the Southern Nevada Groundwater Bank, the Arizona Banking Demonstration Project and the future Arizona ground water bank (if necessary). Under the Southern Nevada Groundwater Bank, the Las Vegas Valley Water District is recharging available Colorado River water into the regional ground water system for later use. Under the Arizona Banking Demonstration Project, the Authority paid the Central Arizona Water Conservation District to store a portion of Arizona's Colorado River apportionment in Arizona aquifers for use by Nevada. Under certain conditions, Nevada will be able to divert additional Colorado River water in exchange for the water stored in the Arizona aquifers.

Regional and local comprehensive ground water management plans are under development in other counties as well. Ground water management is a major component of the 1995-2015 Washoe County Comprehensive Regional Water Management Plan. Ground water quality and supply elements address, among other matters, industrial and nonpoint source pollution remediation and prevention, aquifer accessibility and suitability, maintenance of minimum ground water level and need for recharge, conjunctive use options, and other matters. The Carson Water Subconservancy District (Douglas, Carson City and Lyon Counties) is developing a water supply management plan which will include analysis of the benefits and costs of ground water banking (recharge) and conjunctive surface/ground water use alternatives. Nye County has undertaken a comprehensive ground water management planning effort, partly to address the potential reoccurrence of overdrafting of a ground water basin in the southern part of the county (Pahrump Valley). Other counties in developmental stages of ground water resource management planning include White Pine and Lincoln counties.

A good example of a collaborative local ground water protection organization is Nevada GOLD, or Guard Our Local Drinking water, sponsored by the University of Nevada, Reno Cooperative Extension with the Retired Senior Volunteer Program (RSVP) in Fallon and Churchill County. Volunteers use several channels to inform the public about potential pollution sources and the effect on ground water such as presentations at schools and information booths at community events. The group visits residences with private wells and septic systems to educate homeowners and to survey potential contaminant sources, such as fertilizer and pesticide use, keeping livestock, fuel storage tanks, abandoned wells, and maintenance of wells and septic systems**.**

Federal Agency Involvement with Ground Water Management

[6] *Las Vegas Valley Groundwater Management Program, Report to the Nevada Legislature*. Advisory Committee for Groundwater Management and the Southern Nevada Water Authority. December 31, 1998.

Recognizing the need for greater ground water protection, yet realizing that many state environmental statutes already addressed the matter, the U.S. Environmental Protection Agency (EPA) established the comprehensive state ground water protection program framework in 1992. Conformance with the EPA framework includes three steps: (1) developing a state profile of programs protecting ground water; (2) instituting a task force, or round table, of interested and affected organizations; and (3) performing a self-assessment of existing programs relative to protection goals. The Nevada Ground Water Protection Task Force serves the round table function through interagency coordination and public outreach. The EPA endorsed Nevada's CSGWPP in 1997.

The U.S. Geological Survey (USGS) performs many ground water basin investigations throughout Nevada, adding greatly to the understanding of the behavior of underground water systems and aquifer formations under different levels of use. Major areas of research include land subsidence, urban and agricultural drainage quality, pit mining impacts, and characterization of regional ground water systems. Monitoring of ground water levels and quality is another important activity; however, it is commonly associated with specific, localized projects or programs, and is not part of a statewide comprehensive ground water monitoring network capable of defining trends in quality or quantity.

The U.S. Bureau of Land Management (BLM), U.S. Forest Service (USFS), and U.S. Fish and Wildlife Service (USFWS) also have ground water protection interests and responsibilities. Recreational use of geothermal hot springs is popular, and these unique resources are managed to protect specially designated plant and animal species. Springs and wells are important watering supplies for wildlife and stock animals. Through land use planning and permitting, and watershed management activities, federal agencies work to avoid or mitigate potential impacts to ground water quality and recharge potential. Federal land management agencies also participate in USGS field studies involving ground water impacts on federal land.

Comprehensive Ground Water Protection Issues in Nevada

1. Substantial amounts of data on ground water quality and quantity are collected by local, state and federal agencies. Unfortunately, most data sources are scattered among the various agencies making data access for external agencies a cumbersome and time consuming process. Some agency-collected data exist in paper files and reports and are not entered into electronic database for more efficient access. State and federal agencies have recognized the need for improved data management and availability and are beginning to develop solutions. Additional funding is needed to make significant progress. The *Water Resource Data Management* issue paper (Part 3, *Nevada State Water Plan*) addresses this issue in greater detail.

2. The need for a statewide ground water level and quality monitoring network has been recognized for some time. In 1978, the USGS, with NDEP, produced a report titled *Ground-Water Quality in Nevada – A Proposed Monitoring Program* that outlined a program for systematically monitoring ground water conditions in Nevada and defined procedures for prioritizing basins for monitoring. A fundamental purpose for monitoring is to acquire data necessary for protection of existing rights and planning to accommodate increasing use of the state's limited supplies.

More information about ambient conditions and trends in water availability and suitability, and a better understanding of interactions between quality and quantity and between surface and ground water systems is needed. Extensive data are being collected in some areas, but these data collection efforts are typically driven by regulatory requirements or research projects; thus, insufficient data may exist for other areas, adding to the difficulty in current and future ground water supply planning and management efforts.

3. More reliance on ground water supplies to meet increasing demand creates a need for study of ground water supply management options. Obstacles to proposals for new dams and surface water reservoirs include high construction cost, potential environmental impacts, dwindling public funding and public opposition. There are few projects in Nevada which provide a basis for gauging the financial, socioeconomic and environmental benefits and costs of artificial aquifer recharge and recovery as a reasonable water supply alternative. In anticipation of increased ground water use, there is a need for more information about the technical, scientific, economic and legal feasibility of ground water recharge and recovery options. Additionally, research is needed to better identify important recharge zones and ascertain the potential impact of land disturbance and impermeable coverage over them.

4. Pollutants from such sources as irrigated agricultural land, golf courses, and lawns, from urban and industrial storm water impoundments and from septic systems, may cause significant ground water quality impairment. Nutrients, pesticides, salts and other pollutants can be transported through the subsurface not only to shallow wells and to deeper aquifers, but also to surface waters, contributing to nonpoint source pollution of streams. Consistent implementation of Best Management Practices (BMPs), public education programs are essential and wellhead protection programs are important ground water quality management strategies. Agencies and others recognize that higher mitigation and remediation costs can be controlled with ground water pollution prevention activities, however implementation costs may be an obstacle for some.

5. Relatively high densities of septic systems and stock animals in suburban areas have been associated with nitrate enrichment of ground water. This situation can occur where residential development proceeds incrementally over many years and the potential for cumulative water quality impacts are not recognized or studied. Domestic and municipal wells may be located in areas of impaired water quality. When larger developments are proposed, the NDEP and BHPS review project plans for potential water quality impacts and health risks. If necessary, agencies can require additional or enhanced protective measures. Remediation or mitigation measures required after water quality deterioration has occurred are often costly and controversial.

6. Relatively little is known about the cumulative effects of long term or seasonal lowering of water tables on stream or spring discharges, and whether upland and water dependent ecosystems are adversely impacted. More research is needed to gain a better understanding of seasonal and longer term ground water table changes and how fish and wildlife and their habitats, range and forest lands, and wetlands are affected by water level changes.

7. Municipal ground water supplies in California (e.g., South Lake Tahoe) have been contaminated

by methyl tert-*butyl* ether (MTBE), forcing the closure of many wells, and raising awareness and concern over MTBE use in Nevada. MTBE is mixed with gasoline to control pollutant emissions from vehicles. It was used in Clark and Washoe Counties in the past. Chemical and physical properties make MTBE a serious threat to drinking water supplies. A number of MTBE formulated gasoline fuel leaks have been discovered and are being remediated. In the absence of a federal safe drinking water standard, NDEP is developing an interim policy setting an MTBE clean-up level. Public water supply utilities with wells in the vicinity of gas stations are concerned over the present and future risk of contamination.

Recommendations

To further enhance comprehensive ground water protection and management, the following recommendations are offered.

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.

Index for Part 3, Section 2B.

A. Maintenance of Recreational Values

Background

Recreational use of public waters and lands is on the rise in the U.S. Federal and state visitor and expenditure data suggests that outdoor recreation in Nevada is growing as well. The U.S. National Park Service (NPS) reported 9,926,532 visits to National Parks in Nevada during 1995. The U.S. Forest Service (USFS) recorded 21,423,000 recreation visits to national forest lands during 1996. Nevada Division of State Parks (NDSP) reported about 3.2 million people visited its 24 state parks in 1997, compared to 2.5 million visitors at 22 state parks in 1987. In a 1996 nationwide study of freshwater sport fishing, the American Sportfishing Association estimated angler expenditures to be $211 million, overall economic impact of $335.7 million, and related salaries and wages to be $92 million. According to 1996 recreation expenditure data collected by the U.S. Fish and Wildlife Service (USFWS), fishing, hunting and wildlife watching activities generated about $211.1, $94.9, and $262.8 million, respectively. Boating registration has grown nearly 75% over the past ten years, according to the Nevada Division of Wildlife (NDOW). The forms of recreation are also changing. NDOW reports the number of registered personal water craft (e.g., jet skis) has grown in the past decade from 1,326 to 13,451. NDOW has also noted a groundswell in wildlife watching activities.

Water-based recreation is an integral part of meeting the recreation needs of Nevada's residents and visitors. About 70% (2,277,440) of the visits to Nevada State Parks in 1997 occurred at state parks with water resources available for recreation. Fishing, boating, skiing, swimming, camping and picnicking are popular activities at lakes and reservoirs. Nevada's larger streams offer many of the same activities plus white-water boating (i.e., rafting, kayaking, and canoeing). Of Nevada's 24 state parks, 14 incorporate water as a key component of the recreation resource. Nevada's State Wildlife Management Areas (WMA) contain natural and artificial wetlands that provide hunting, fishing, hiking, camping and bird and wildlife watching opportunities.

Some recreation resources in the state have international importance such as the Lahontan Valley Wetlands which support large populations of waterfowl migrating along the Pacific Flyway, and the Lake Tahoe Basin, with water clear enough to be the centerpiece of a multi-billion dollar tourism industry. Hydrologic, vegetative and open space conditions on some agricultural lands support recreational resources directly and indirectly with unique wildlife and aesthetic values. Providing adequate amounts of suitable water for Nevada's recreation resources is integral to the linkage between regional, state and local natural resource values and their economies. Thus, maintaining recreation values is an important consideration in water supply planning.

What are "Recreation Values"?

Water resources (i.e., streams, lakes, springs, riparian systems, wetlands, etc.) possess intrinsic characteristics that people value for passive and active recreation activities. The condition of fish and wildlife habitat and water quality, number of fish caught, upland game hunting prospects, biological diversity and aesthetics, wilderness, solitude and spiritual regeneration all play a part in

determining the public's recreation "values". The inherent values which users place on outdoor recreational experiences are difficult to measure. However, resource managers require "recreation values" information as inputs to develop plans that will provide the recreational opportunities for the state's growing population without sacrificing the quality and integrity of the natural resources and aquatic systems used and developed.

Recreation value can be measured in monetary terms in at least three ways: (1) the value users place on enjoyment of their recreation experiences measured by the amount people are willing to spend to get to and use various sites; (2) the net economic income a type of recreation generates - the revenues generated directly and indirectly by recreation activity, less the costs of providing and managing the recreation resources and facilities; and (3) an analysis of revenues (including taxes) generated by expenditures on recreational goods and services.

Additionally, the availability of water recreation resources is an amenity that can enhance a community's attractiveness to new businesses. In some communities, quality of life indicators have been adopted that recognize the linkage between economic development, community well being and outdoor recreation values.

State Agency Involvement with Recreation Values

The Nevada Divisions of Wildlife and State Parks have primary management responsibility for recreation resources and facilities at many water bodies in the state, but all divisions play an important role in maintaining recreation values. To varying degrees, the management of developed and natural features of state lands used for recreation is shared, according to each agency's area of expertise. For example, NDSP cooperates with NDOW to meet campground needs on wildlife management areas and NDOW cooperates with NDSP on fishery management matters at state parks. Key responsibilities and work efforts related to water-based recreation uses and values are summarized by state division below.

Nevada Division of State Parks

The Statewide Comprehensive Outdoor Recreation Plan (SCORP), prepared by NDSP, is intended "to carefully examine the collective influence of the many recreation providers, analyze the recreational issues important to both providers and recreationists, and provide a policy plan to improve and maintain Nevada's recreation base...[and] provide a tool for recreation leadership and action in Nevada for the next five years." Two of the foremost concerns identified by the participants in the 1992 SCORP planning process were: (1) "Water resources are vital components of Nevada's recreational base and should be protected to maintain sufficient quantity, quality and adequate accessibility, where appropriate; and (2) Existing levels of outdoor recreation funding are inadequate to meet the recreation needs of Nevada." [1] In recent years, steps have been taken to address both of these issues.

[1] *1992 State Comprehensive Outdoor Recreation Plan*. Nevada Division of State Parks. October 1992.

A comprehensive State Park System Plan was completed in 1997 which contains individual master development plans for each park unit. Almost $28 million has been spent since 1987 acquiring and improving state parks. Some of this funding came from the 1990 Parks and Wildlife Bond Initiative. A few of the many actions include acquisition of three major ranches along the Carson River between Fort Churchill and Lahontan Reservoir creating an innovative water trail, construction of the South Fork Reservoir boat launch facilities and campground, acquisition of Little Washoe Lake and development of basic day use facilities, and upgrading sewer and water systems in several parks.

Nevada Division of Wildlife

The protection, preservation, management, restoration and use of wildlife populations in Nevada is the primary responsibility of NDOW. Agency planning, operations and funding for wildlife population and habitat management are linked to the public's wants and needs for boating, hunting, fishing and wildlife watching opportunities. Protection and management of wildlife habitat and acquiring legal access to it for recreation purposes is a priority objective that is implemented cooperatively with other state and federal agencies, and private parties (e.g., owners of crop land with wildlife habitat). Acquiring access, conservation easements and water rights from willing parties to enhance fishery and other wildlife values of open water and wetland resources is one strategy being pursued. These actions will progressively meet the growing public demand for boating, fishing, and wildlife watching resources.

Another strategic action is the development of 150 water sources in areas where water is a limiting factor for wildlife. Over 1000 wildlife guzzlers have been installed, and NDOW has plans for more.[2] In addition, NDOW manages wildlife and habitat on approximately 120,000 acres at 11 State Wildlife Management Areas (WMAs). Wetlands are important features of most of the WMAs.

The Division's responsibilities for management and protection of fisheries, boating, and migratory and resident bird habitat are three major areas of statewide recreational resource management directly related to water resources. Approximately 150,000 people fish in Nevada each year, accounting for an estimated expenditure of over $211 Million, according to a Division study in 1996. Special protections for rare and jeopardized fishes, production of fishes at hatcheries and rearing stations, regulation of anglers, and access are elements of the fisheries program. Use of personal water craft is increasing also, presenting new challenges to maintenance of water recreation values. Boating activity is concentrated on lakes and reservoirs, although white-water boating on streams is growing. Six major areas of NDOW's boating safety program are administration and enforcement of regulations, education, registration and titling, navigational aids and public access.

Competition among multiple users of public lands and land use changes to private lands have resulted in impairment and loss of wetlands and riparian areas inhabited by waterfowl. The Division cooperates with several agencies and organizations in management of migratory game birds under provisions of the federal Migratory Bird Treaty Act. The Division's overall direction is to manage and protect all aquatic habitats for both game and non-game species.

[2] *Comprehensive Strategic Plan*. Nevada Division of Wildlife. 1997.

The Wetland Conservation Plan Applicable to Nine State of Nevada Wildlife Management Areas was completed in 1998. The preliminary assessment of wildlife resource values and functions at the WMAs (Volumes II and III of the above mentioned report) resulted in identification of several policy and management issues, of which the foremost was water management. Specific areas of concern mentioned are: (1) water has not always been managed efficiently in all areas of the State; (2) water availability depends on adequacy and seniority of water rights owned by NDOW; and (3) cyclical, prolonged drought periods exacerbate shortfalls in water needed to sustain wetlands at the WMAs. The Board of Wildlife Commissioners will review and may revise relevant policies as a result of this planning effort.[3]

Nevada Division of Water Resources

The State Engineer recognizes recreation and wildlife as legitimate beneficial uses for which water rights may be held (to establish and maintain wetlands, fisheries and watering sources at springs and seeps for wildlife use). Under statutory criteria the State Engineer must consider the public interest in his decision making process. The State Engineer has approved water rights for recreation purposes such as: (1) wetlands and open waters at many of the WMAs; (2) instream flows for Mahogany Creek and Condor Canyon (Meadow Valley Wash); (3) numerous spring developments for wildlife; and (4) minimum pool elevations at several reservoirs (Illipah, Lahontan, Knott Creek, Lake Tahoe, Lake Mead, and Topaz Lake). Ongoing actions to secure more water for recreation include applications received for many streams in the Jarbidge and Bruneau River drainages and negotiations involving Onion Reservoir.

Nevada Division of Environmental Protection

The Nevada Division of Environmental Protection (NDEP), with the State Environmental Commission, sets water quality standards protective of designated beneficial uses that include recreation, (i.e., contact and non-contact recreation activities, sustaining populations of aquatic organisms, and wildlife propagation). Water quality of major river systems, lakes and reservoirs is monitored to determine whether ambient conditions meet the site and use specific water quality standards. NDEP is also involved in water quality investigations to determine whether recreation activities, among others, may be impacting water quality. An example is study of the potential water quality impacts resulting from motorized recreational activities on Lake Tahoe. The division also cooperates with other agencies where changing water quality conditions may place the recreating public's health at risk.

Nevada Division of Forestry

The Division of Forestry (NDF) protects recreation values with watershed management activities, such as: (1) managing wildland fires; (2) operating a seed bank and nursery that provides native and adapted plants for rehabilitation projects; (3) managing conservation honor camp inmate crews to

[3] *Wildlife Resource Values of Wetlands. Task II. Wildlife Resource Values of Wetlands at the State of Nevada Wildlife Management Areas.* Prepared for Nevada Division of Wildlife by Huffman and Associates, Inc. July 1998.

rehabilitate recreation lands; and, (4) assisting public and private land owners to manage forest resources for watershed protection, wildlife habitat and recreation. Since 1990 NDF has written Forest Stewardship plans for over 121,377 acres of private land leading to projects such as bank stabilization on the Muddy River and timber stand improvement in the Lake Tahoe Basin.

Federal Agency Involvement with Recreation Values

More than 62 million acres are managed by federal agencies in Nevada. Recreation has become a major management emphasis for the federal agencies which include 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 the National Park Service. They manage developed recreational resources throughout Nevada. Most of the prominent natural and man-made lakes and reservoirs with developed recreation resources are located on public lands. State and federal agencies cooperatively manage fish and wildlife populations, water quality, lands leased by the state for recreation facilities, and other recreation resources.

The majority of public lands in Nevada are open for dispersed recreational activities such as day hiking, horseback riding, vehicle touring, camping, backpacking, canoeing and kayaking, fishing, and hunting. Dispersed activities on public lands may have cumulative water resource impacts where large numbers of recreationists visit popular streams, springs, wetlands and lakes, such as those near urban areas. Federal agencies generally recognize the potential water quality impacts from recreation as important watershed management considerations, especially in those watersheds that are sources for public water supplies.

Federal land managers have become more recreation-focused in their forest plans and land use plan revisions in response to public demand nationwide. The creation of wildlife management areas and refuges and national recreation areas, and efforts to acquire water rights for wildlife habitat are indicators of this changing focus, as is the National Recreation Lakes Study Commission. The commission was created in the Omnibus Parks and Public Land Management Act of 1996 (P.L. 104-333). The purpose of the commission's study is to "review the current and anticipated demand for recreational opportunities at federally-managed manmade lakes and reservoirs" and "to develop alternatives for enhanced recreational use of such facilities."

Issues

1. Maintenance of recreation values is an issue considered in the state water plan because recreation is an important beneficial use of the state's water resources. Recreationists today expect an diverse range of recreation choices in a variety of settings. Maintenance of recreation values depends upon a balance between developing facilities to accommodate a diversity of recreation types while protecting the quality and quantity of aquatic systems and natural resources from overuse for present and future generations.

2. With increased recreation, there is growing public interest in enhancing and maintaining stream

flows, reservoir and lake levels, good water quality conditions, high quality riparian zones and wetlands for fish and wildlife habitat, and public access to waters and adjacent land. However, major rivers in Nevada are fully allocated and during droughts recreation resources are negatively impacted. During the prolonged drought of the late 1980's through early 90's, many boating access points at lakes and reservoirs were unusable; fish and wildlife habitat deteriorated and populations declined; perennially flowing segments of major rivers went dry; water quality declined; and overall water-based recreational opportunities were fewer. It is likely that more innovative water allocation approaches will be needed to sustain water-based recreation values in the face of growing recreation demand, fully allocated rivers, and recurring droughts.

3. Nevada's urban areas are expanding. In some areas, development of private land abutting public land results in loss of access to recreational waters. Increased cooperation between federal, state, and local land use planning agencies could avoid or mitigate access issues.

4. While the public's demand for water-based recreation has grown, the cost of agency operations per user has increased and federal funding for recreation has dwindled (e.g., Federal Land and Water Conservation Fund awards to Nevada fell from $3.2 million in 1979 to zero in 1995). Funding is inadequate to maintain existing water based recreation sites and amenities. New funding strategies are warranted.

5. Conflicts occur between recreationists and other water resource users using the same water body for different purposes. For example, new diversion dams or weirs that extend the full width of river channels can impact navigability, limit fish passage and create safety hazards. Agencies reviewing project proposals to modify existing or construct new structures, as well as other land use activities in water bodies and shore zones, have become increasingly cognizant of the need to take changing recreation needs and values into consideration.

6. The type and intensity of recreation activities affects waters with unique or sensitive resource values, such as habitat of protected animal and plant species, archeological and historical features, and waters with unique or outstanding resource values. An example is the effect that increasing personal water craft use has on water quality. Recreation has been managed by state and federal agencies to avoid or minimize those effects, however increasing recreational activity could present the need for more monitoring to ensure unique or sensitive resources are adequately protected.

7. Most of Nevada's outdoor recreation occurs on and around waters managed by state and federal agencies. Finding opportunities to increase coordination between agencies could enhance recreation resource planning and management. Collection of recreation data (e.g., visitor days, forms of recreation, and recreation values) is one example where agency cooperation could be mutually beneficial in terms of sharing and reducing cost, improving data consistency and reliability, and assisting in making better informed recreation resource management decisions.

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.[4] 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 to manage watersheds for protection and enhancement of a full complement of recreation values, in addition to the other natural resource conservation considerations.

Index for Part 3, Section 3A

[4] The update of the State Comprehensive Outdoor Recreation Plan by the NDSP is ongoing. It should be completed late in 1999.

B. Water for Wildlife and Environmental Purposes

Background

As competition for the state's limited water intensifies, concern is growing that water supplies for wildlife and environmental purposes, or the minimum instream flow to conserve such resources, have not been fully considered in policy making and planning frameworks. Thus, maintaining minimum instream flows has become an important water use management issue in Nevada.

Instream flow is typically defined as water which is not diverted from a channel and used consumptively, but rather remains in a water course to maintain other non-consumptive beneficial uses. Herein, the term *instream flow* encompasses the broad range of non-consumptive uses also identified as water for wildlife and environmental purposes and resource conservation. A common water planning criteria is *minimum* instream flow. This is defined as the smallest amount of flow (measured in cubic feet per second) necessary to maintain one or more beneficial uses specified for a stream or segment. The term *instream flow* is further described in the broad context of water supply planning to conserve and enhance streams, riparian zones, wetlands, springs and lake and the biological resources they support.

Instream beneficial uses in Nevada include habitat for aquatic invertebrates, fishes, birds and other wildlife, maintenance of water quality, and recreation. Maintaining the productivity, diversity, and resiliency of Nevada's biological resources depends on adequate and reliable stream flow. Minimum streamflow for natural resource conservation is the focus of this issue paper. For more information about water supply planning for recreation, see the issue paper titled *Maintenance of Recreation Values* in Part 3 of the *Nevada State Water Plan*.

Surface water in Nevada is often fully appropriated. Yet, relatively few water rights are held for resource conservation, since most appropriated water is permitted for consumptive beneficial uses that require offstream diversions.[1] Since early in the state's development, people have had to divert streamflow for such essential purposes as agriculture, mining, domestic, municipal and industrial supply uses. While acknowledging the necessity of continuing to divert water for human use, society has begun to place increasing value on environmental protection and natural resource conservation.

[1] Agricultural, municipal and industrial consumptive uses generate return flows which vary in quantity and quality. Return flow is the portion of water diverted for use that is not consumed and is returned to the source. Unconsumed water which is returned to the original source is available for the next offstream or instream use. Streamflow which is reused many times without intervening treatment can increase pollutant concentrations, negatively affecting biological productivity of crop and pasture lands as well as aquatic and riparian ecosystems. Ameliorating impacts such as elevated salinity, biochemical oxygen demand, and temperature often requires the application of more water to flush or dilute pollutants concentrated in the soil or water column.

One hundred years ago, impacts on fish populations, riparian vegetation and lake ecosystems as a result of diversions were unanticipated or not viewed as a concern. In the last 25 years, expectations for the protection of rivers and streams have changed gradually. The Clean Water Act (CWA), Endangered Species Act (ESA), National Environmental Policy Act (NEPA) and Wild and Scenic Rivers Act (WSRA) were all passed in the last 30 years in growing recognition of the economic and social benefits to conserving natural resources. These laws are persuasive testimony to continuing public concern for the environment. Water resource allocation and management decisions now include consideration of vulnerable species, water quality, environmental values and recreation demand generated by the state's growing urban population and tourism-oriented industry. Nevada's laws permitting instream flow rights for wildlife and environmental (and recreation) purposes are responsive to this perspective.

Nevada's Unique Water Resources

Nevada's landscape encompasses unique water dependent ecosystems that provide economically and socially important benefits, including fishing, hunting, wildlife watching, scientific research and solitude. The state has terminal desert lakes and expansive wetlands which are crucial to waterfowl migrations. Rare, relict fish and mollusk species still subsist in ancient springs. Native fish populations have stood the test of the Great Basin's climatic and hydrologic extremes. Riparian plant communities host diverse assemblages of mammals, amphibians and birds, and also moderate stream temperatures, trap sediment, and impart resiliency and predictability to channel behavior in times of flood. Water available to these resources must be adequate in frequency, duration and amount in order to maintain their natural restorative and regenerative functions. Critical self regulating mechanisms include the ability to convert, dilute and flush accumulated pollutants; redistribute sediment to retain floodway capacity; rejuvenate coarse and fine grained patches of habitat essential for the diverse life cycle needs of aquatic organisms; disperse seeds from riparian and wetland plants and thereafter keep soil moist for their germination and survival.

The number of native fishes that have become extinct or listed as threatened, endangered or sensitive by federal and state agencies is an indicator of the adequacy of water supplies available for aquatic ecosystems. Of Nevada's 104 native fish species and subspecies, 11 are now extinct (i.e., no longer existing) or extirpated (i.e., no longer existing in portions of its native range) and 23 are listed as threatened or endangered under the Endangered Species Act (ESA). Approximately 56 percent are designated as sensitive.[2] Other water dependent species at risk include 7 amphibians, 3 mammals, 67 gastropods which inhabit springs and/or creeks, and a number of water insects. Twenty-eight (28) bird species that depend upon functioning aquatic or riparian ecosystems at some point in their life cycle are also at risk.[3] The statewide distribution of mapped occurrences of sensitive species is shown on Figure 3-1 on page 3B-5. The sensitive status of so many species is an indicator of the need for instream flow assessment and protection in some areas.

[2] *Sensitive* is a term used by the Nevada Natural Heritage Program that is applied to species that are tracked. Such species are either declining, exists in isolated populations, or requires special management to survive. Of the 70 native, extant fishes that are not listed, 39 are designated as sensitive.

[3] Personal communication, Nevada Natural Heritage Program staff, December 1998.

Other indicators that water supplies may be insufficient for wildlife and environmental purposes include extensive loss of riparian forest and wetland systems; long term declining water levels in Pyramid Lake and Walker Lake; periodic drying of river channel segments; and impaired water quality of some lakes and segments of the state's major rivers.[4] Managing stream flow to protect sensitive species alleviates stresses from other detrimental forces, forestalling more stringent regulations, and thereby reducing administrative burdens on private enterprise and public agencies. Thus, water resource managers are increasing their efforts to augment water supplies for instream beneficial uses and to enhance the integrity of water dependent ecosystems.

Factors other than stream flow depletion by offstream diversions may have an impact upon aquatic and riparian life and habitats. For example, some dams prevent fish passage or alter sedimentation processes in ways that impair the quality of aquatic habitat for fish and wildlife propagation. Nonnative fish species prey on a range of aquatic organisms and may be more aggressive, out-competing native fishes for spawning habitat and food supply. Overdrafting shallow aquifers may affect stream and spring flow, a growing concern as more ground water supplies are developed. Flow regimes may be impacted by land use activities and developments that do not adequately mitigate their effects on hydrologic processes, thereby diminishing a watershed's ability to capture and slowly release runoff and recharge aquifers. Encroaching development, nonpoint source pollution, invasion of exotic plants, degraded watershed and channel conditions, and natural variation are other possible causes for aquatic ecosystem impacts. These site specific factors should be evaluated when determining how best to achieve aquatic and riparian resource conservation objectives.

Assessing Water Needs for Wildlife and Environmental Purposes

Determining minimum instream flow requirements is an important consideration in protecting Nevada's comparatively rare aquatic and riparian ecosystems (and associated recreation opportunities). Minimum instream flow requirements fluctuate seasonally and vary by stream segment depending on characteristics such as channel dimensions and shape, amounts of shallow ground water flowing into or out of a channel reach, water or moisture requirements of present (and absent) aquatic and riparian animal and plant species, and the rate of pollutant inputs from both natural and human sources compared to the natural capacity of biogeochemical processes (e.g., nutrient and carbon cycles) to regulate pollution levels.

In Nevada, most upper basin stream segments are free-flowing. Proceeding downstream through the middle and lower valleys of Nevada's river basins, stream flow increasingly becomes regulated

[4] The estimated long term loss of wetland acreage statewide is 52 percent. In western Nevada, wetland losses are about 85%. An evaluation of threats to wetlands by the Nevada Divisions of Wildlife and State Parks in 1987 ranked diversions and lack of water rights as the most serious threat. (in *Wetland Conservation Plan Applicable to Nine State of Nevada Wildlife Management Areas*, Huffman and Associates, Inc., July 1998.) Lower Truckee River riparian shrub and forest communities historically covered about 7,700 acres, and is estimated today to be 1,020 acres according to recent US Army Corps of Engineers reports. US Fish and Wildlife Service vegetation mapping in 1993 indicated only about 85 acres of cottonwood forest coverage remains below Derby Dam (in *Truckee River Operating Agreement, Draft EIS/EIR, Biological Resources Appendix*. US Department of the Interior. February 1998.)

by the operation of reservoir and diversion dams. Flow fluctuations are important to help (re)establish riparian vegetation, maintain water quality, remove sediment from the floodway, and otherwise maintain the efficiency of a stream channel. Diversions may have a dampening effect on flows, moderating the natural highs and lows. The combination of natural losses and offstream diversions significantly reduces streamflow through the summer and autumn months. Typically, October low flow measurements are in the range of 1.0% to 0.1%, or less, of June peak flow measurements in the middle and lower stream reaches. Natural losses are due to higher evaporation and transpiration rates and seepage away from the channel. Evaporation and transpiration losses may be exacerbated along over-widened and unshaded stream segments, or where exotic phreatophytes (e.g., tamarisk) are dominant. By late autumn and early winter, stream discharge rates typically rebound to approximate base flow levels.

There are no standards for setting a baseline or formula for establishing minimum instream flows. However, various methods to assess minimum flow or minimum pool requirements for biota, recreation, aesthetics, and channel maintenance have been developed. Equivalent methods to estimate minimum water supply needs for other water bodies and wetlands have been developed and have been used occasionally in Nevada. Most often, instream flow assessments in Nevada have been conducted in response to applications for new water rights or changes in the point of diversion for existing water rights, and projects that require environmental assessments in accordance with provisions of the NEPA or the ESA.

Water Rights for Wildlife and Environmental Purposes

Protecting instream flow will depend on acquiring water rights, and converting them from existing uses to instream uses according to state water law. Nevada's legislature adopted a system of allocating water rights based on the principles of prior appropriation and beneficial use in 1905. Because surface water demand sometimes exceeded normal streamflow, the courts had to settle, or adjudicate, competing water claims on large and small stream systems. Court decrees were formulated for each major river, specifying the water right holder, the extent of the water right (i.e., quantity, location, and manner of use), allocation priorities, and river system-specific procedures for water transfers.

In recent years, more consideration has been given to obtaining water rights for instream purposes because of advancements in science and changes to the state water law. As scientists have refined their knowledge of aquatic and riparian ecology and as agencies have increased resource monitoring, awareness has grown regarding the impacts of diminished streamflow and lowered ground water levels. During this period, the Supreme Court of Nevada handed down decisions that have led to a broader legal interpretation of beneficial use, and have better defined public interest criteria that has been applied by the State Engineer when making decisions about appropriative water rights.

In 1988 the Court ruled that the State Engineer acted within the legislated authority of the office in granting a water right to the U.S. Bureau of Land Management (BLM) to maintain a minimum pool of water, an *in situ* use (i.e., in place, non-diversionary and nonconsumptive), for recreation, wildlife, fisheries and stockwater purposes in Upper Blue Lake, Humboldt County (Nevada v. Morros, 766 P.2d 263 (Nev. 1988)). Nevada water law allows the holding of water rights for instream uses for the benefit of biological resources and recreation. Additionally, where instream water rights for environmental uses have been permitted, applications for new water rights or the transfer of existing water rights may be denied if the proposed use "threatens to prove detrimental" to the instream water rights.

Examples of Instream Flow Management Actions

Over the past ten years a number of agencies and conservation organizations have assessed water supply needs and pursued water right purchases for wildlife and environmental purposes. Some of these activities are briefly described below.

1. To satisfy Truckee-Carson-Pyramid Lake Water Rights Settlement Act (Public Law 101-618) provisions, wetland water requirements were estimated by the US Fish and Wildlife Service (FWS) for the Stillwater National Wildlife Refuge, Stillwater Wildlife Management Area, Carson Lake and Pasture and Fallon Paiute-Shoshone Indian Reservation wetlands. The FWS, in cooperation with the U.S. Department of Interior (DOI) and Nevada Division of State Lands (NDSL), is responsible for purchasing from willing sellers sufficient water to sustain 25,000 acres of prime wetlands in Lahontan Valley.

2. To implement the Truckee River Water Quality Agreement, cooperating agencies have modeled water quality improvement as a function of stream flow and used the information to estimate water supply needs for flow augmentation during periods of lower water quality. Washoe County and the cities of Reno and Sparks, have begun to purchase water rights and apply for their transfer.

3. Also on the Truckee River, the FWS, using a plan developed by The Nature Conservancy, has obtained the Federal Water Master's agreement to modify reservoir releases when surplus water is available to meet requirements for riparian forest regeneration along the lower river.

4. The BLM has estimated Walker Lake inflow requirements for the restoration of lake level and water quality in support of the vulnerable cutthroat trout population and migratory waterfowl habitat.

5. The Nevada Division of Wildlife (NDOW) has assessed minimum instream flows to determine the potential impact to fish habitat from water development projects proposed for the Truckee River and Lamoille Creek. The agency also has taken advantage of opportunities to obtain water rights and formal and informal agreements for return flow water from irrigation systems, a power plant, and a municipal water treatment plant to maintain reservoir pool elevations and wetlands on state wildlife management areas (WMA).

Since a water right is recognized as property, any public policy measures to increase water supplies for resource conservation purposes may require compensation. In Nevada, both federal and state funds have been allocated to purchase water rights from willing sellers. Alternative approaches are being implemented in other western states. Colorado allows tax benefits for water right donations to the Colorado Water Conservation Board. In New Mexico, the Middle Rio Grande Conservancy District recently opened a water bank, which will lease surplus water to other users.[5]

Conservation organizations in several states have acquired water rights for instream flow protection. They have identified important considerations when evaluating the benefits of acquiring water rights for instream flow enhancement, which include: (1) whether transfer of the water rights to instream use can meet transfer requirements of state law; (2) the seniority of the water right relative to others; (3) the suitability of the source water for the instream purpose(s); (4) the availability of reservoir storage rights, if required; and (5) the price for a water right, which varies in a competitive market according to such factors as location, type of use and priority date.

State Agency Involvement in Instream Flow Management

Divisions within the Department of Conservation and Natural Resources have primary authority to administer laws and regulations pertaining to water use and allocation, water quality, and fish and wildlife populations in Nevada. Thus, these agencies have the largest role in water supply management for resource conservation. Federal agencies with land use management and federal law administration responsibilities make important contributions to instream flow protection as well. Local and tribal agencies have also become involved with instream flow management.

Nevada Division of Wildlife

The Nevada Board of Wildlife Commissioners has adopted explicit policies and regulations to achieve adequate instream flows, minimum reservoir pools, and water for wetlands, springs and seeps for the benefit of fish, aquatic ecosystems and wildlife. NDOW supports the acquisition of water rights from willing sellers as opportunities arise. Nine state wildlife management areas (WMAs) managed by NDOW contain wetland acreage and reservoirs for which surface and ground water rights have been obtained. Water rights at some WMAs depend on surplus flow or irrigation tail water, presenting management constraints and resource quality concerns, especially during dry periods.[6]

NDOW also has responsibilities and programs for protection and propagation of native fish populations and sensitive species. NDOW reviews water appropriation applications submitted to the State Engineer to evaluate potential for impacts to wildlife and habitat. If the proposed water use would threaten, drastically modify, or severely curtail protected or sensitive wildlife populations or their habitats, the Division Administrator may file a written protest against granting the

[5] *Saving Our Streams Through Water Markets. A Practical Guide*. Clay J. Landry. Political Economy Research Center. 1998.

[6] *Wildlife Resource Values of Wetlands. Task II. Wildlife Resource Values of Wetlands at the State of Nevada Wildlife Management Areas.* Huffman and Associates, Inc. July 1998.

application. Assessments of the adequacy of minimum instream flow have been performed to provide the grounds for protest. Instream flow and aquatic ecosystem values have been successfully protected through protest filings against water right transfers on the Truckee River west of Reno and Lamoille Creek near Elko.

NDOW has the ability to partially compensate for impacts of water supply deficiencies on fish and wildlife. For example, in coordination with federal agencies, NDOW has programs to rear game and sensitive fish species (e.g., Lahontan cutthroat trout, razorback sucker) at hatcheries and reservoirs for stocking programs associated with recreational fishing and sensitive species recovery plans. However, game fishes are not stocked in some areas to avoid potential impacts on populations of sensitive native aquatic species.

Periodically NDOW performs stream surveys on major rivers and tributaries to evaluate habitat conditions for wildlife and fishes, and fishery management plans are prepared for major rivers, reservoirs and lakes. This activity presents opportunities to assess instream flow requirements.

Nevada Natural Heritage Program

The Nevada Natural Heritage Program (NNHP) collects and disseminates information on the occurrence, distribution, and population status of all threatened, endangered and sensitive flora and fauna in order to identify trends that could result in their becoming either more or less vulnerable. Areas of the state which sustain critical concentrations of sensitive species are identified and ranked relative to protection urgency and management needs. This information is published periodically, most recently in the report titled *Scorecard - June 1998: Highest Priority Conservation Sites*. NNHP staff cooperate with other agencies, conservation organizations and developers to create habitat conservation plans and recovery plans for at-risk species. Each year the Program answers hundreds of requests for location, biology and conservation information and technical advice from planners, developers, agencies, scientists, conservationists and the general public.

Approximately 43 percent of Nevada's native fishes are designated sensitive. In addition, a number of sensitive amphibians, gastropods, insects, mammals, birds and plants have been identified. Ongoing research into the ecology of springs continues to unveil rare and unique aquatic species. Progress in mapping the past and current distribution of waterfowl, shorebirds and water resource-affiliated passerine birds (i.e., perching birds and songbirds) indicates that the loss of aquatic and wetland habitat is associated with a reduction in the abundance of bird species. Distributing information on the status of the vulnerability of species and cooperating in conservation planning is a crucial aspect of proactive management. By so doing, potential or actual impacts of land use activities on sensitive species may be moderated sufficiently to preclude the need for listing the species under the Endangered Species Act.

Nevada Division of Water Resources

Nevada water law (NRS Chapters 533, 534) and Court decisions authorize the State Engineer to approve water right applications for various instream beneficial uses, which may include wildlife, establishment of wetlands and fisheries, and recreation. Approval for a new water right or transfer of an existing water right is contingent upon the State Engineer's determination that certain criteria can be satisfied. The review criteria are: 1) the requested water is available, 2) the use will not conflict with existing water rights, and 3) the use does not threaten to prove detrimental to the public interest. Public interest is a discretionary matter for the State Engineer. Instream flow is not an explicit public interest criteria against which an application to appropriate water must be considered, however protection exists within the law. Where instream water rights for resource conservation purposes have been permitted, the State Engineer must evaluate whether a proposed new use or change in use threatens to prove detrimental to the instream water right. Further, spring flows which support wildlife populations must be protected (NRS 533.367).

New water rights and transfers of existing water rights have been granted for resource conservation and recreation purposes at a number of sites. In addition to those examples mentioned previously, other sites are Meadow Valley Wash (Condor Canyon), Upper Blue Lake (Pine Forest Range, Humboldt County), Mahogany Creek (Humboldt County), Bruneau River, Franklin Lake and South Fork of the Humboldt River.

Nevada Division of State Lands

The Nevada Division of State Lands (NDSL) acquires land and water rights on behalf of other state agencies, such as NDOW. The voters elected in 1990 to fund land and water rights acquisitions for parks and wildlife through a state bond. The Park and Wildlife Bond Act of 1990 (Question 5) authorized the expenditure of $47.2 million which has been used to purchase land with special resource values, including three ranches along the lower Carson River connecting Fort Churchill State Historic Park with Lahontan State Recreation Area. In addition, $5 million was designated for water rights, enabling NDSL so far to purchase about 8,000 acre feet of water for the Lahontan Valley Wetlands. Efforts to purchase additional land and water rights continue as a portion of the bond fund remains available.

As owner of the beds and banks of navigable water ways (i.e., Truckee, Carson, Colorado and Virgin rivers, Lake Tahoe and Washoe and Walker lakes), NDSL has authority to issue permits for activities and structures below the ordinary high water line, including construction of diversion dams. Through coordination with other agencies, permits may be conditioned to mitigate instream flow concerns, such as fish passage, habitat restoration and channel protection.

Nevada Division of Environmental Protection

The State Environmental Commission (SEC) is responsible for adopting surface water quality standards to protect beneficial uses. While abnormally high or low instream flow can adversely affect water quality and the attainment of a beneficial use, the Division of Environmental Protection (NDEP) and SEC have no authority under the Nevada Revised Statutes (NRS) to regulate water quantity (NRS 445A.725). Accordingly, water pollution control regulations do not consider water

quality standards violated during periods of abnormal flow (NAC 445A.121.8). However, a recent U.S. Supreme Court ruling has granted limited instream flow authority under section 401 of the Clean Water Act. Although NDEP has been delegated 401 certification authority, the agency clearly is bound by state statute. As stated previously, the Divisions of Water Resources, Wildlife and State Lands address instream flow with a variety of management techniques.

Federal Agency Involvement with Instream Flow Management

Since Nevada has primacy for administration of water laws, federal agencies must submit an application to the NDWR and receive the State Engineer's approval for the appropriation or transfer of a water right for instream wildlife and environmental use. Federal agencies may seek to acquire instream flow water rights in order to carry out provisions of the Endangered Species Act, Clean Water Act, Migratory Bird Treaty Act, or the Wild and Scenic Rivers Act. As mentioned before, the BLM, FWS, and DOI have been involved in purchases and transfers of water rights in several states under the auspices of these federal laws. Special designations under the Wild and Scenic Rivers Act have not been authorized by Congress in Nevada.[7]

The U.S. National Park Service (NPS) and U.S. Fish and Wildlife Service (FWS) have the ability, in limited circumstances, to protect instream flows through assertion of federal reserved water rights and implementation of federal environmental laws. Federal reserved water rights are implied rights, based on the primary purposes for which the federal land was reserved by Congress, and limited to the minimum quantity of water needed to accomplish the purposes for which the reservation was created. The priority date of reserved water rights coincides with the date Congress authorized creation of the reservation. Indian tribes and federal agencies have asserted reserved water rights for instream flows and minimum pools within Indian reservations, national parks and monuments, and wilderness areas. The U.S. Supreme Court decision requiring reduction in permitted agricultural ground water pumping to maintain the Devils Hole spring pool (an enclave of Death Valley National Monument) for the benefit of an endangered species of pupfish is one instance in Nevada where federal reserved water rights have been claimed successfully for minimum pool protection.

Federal courts in one case have decided that under some circumstances water should be reserved to meet resource protection requirements of federal laws. The U.S. Supreme Court ruled in favor of a proposal to release water from Stampede Reservoir for fish habitat flows for the threatened Lahontan cutthroat trout and endangered cui-ui inhabiting waters within the Pyramid Lake Paiute Indian Reservation and lower Truckee River.

The U.S. Bureau of Land Management (BLM) in Nevada is working on specific programs that may have the effect of preventing future riparian wildlife habitat loss and benefitting instream flow on rivers in western Nevada. One is the Rural Lands Initiative, in which a land owner can voluntarily

[7] In California, segments of the East Fork of the Carson River, and West Walker, each have been designated a "California Wild and Scenic River." The segments terminate at the state border. Similar to the federal counterpart, the California Wild and Scenic Rivers Act requires that certain rivers possessing extraordinary scenic, recreational, fishery, or wildlife values be preserved in their free-flowing state.

sell an agricultural conservation easement to the BLM. The conservation easement is legal assurance that use of productive agricultural land will continue to be cultivated, thereby avoiding the loss of wildlife, riparian, ground water or surface water resource values that often comes with subdivision and development. This program does not involve a water right acquisition. Another BLM program is "Water for Walker Lake". Its purpose is to acquire water rights from willing sellers and transfer the water use downstream to Walker Lake. Water is needed to raise lake levels sufficiently to improve the aquatic and riparian ecosystems for the diminished Lahontan cutthroat trout population and migratory bird habitat.

The BLM and U.S. Forest Service issue permits for grazing, timber harvest, mining and water development on federal lands. These permits may be conditioned to mitigate hydrologic impacts, such as diminished stream flow or reduced shallow ground water recharge. Riparian zone restoration is an important management objective in many areas. Watershed conditions are assessed periodically where permitted land use activities occur. If conditions warrant, measures to improve vegetative cover, soil and stream channel stability, and riparian and wetland plant community structure may be implemented by the permittee or the agency. Such rehabilitative efforts can augment instream flow by enhancing the ability of watersheds to detain snowmelt and storm runoff.

Local Agency and Tribal Involvement with Instream Flow Management

Local agencies have had some involvement with minimum instream flow protection and applying for water rights for resource conservation uses. Actions taken by Washoe County and the cities of Reno and Sparks and the Pyramid Lake Paiute Tribe provide examples of local governments directly assessing minimum instream flow requirements and obtaining water rights to meet water resource objectives. In accordance with the Truckee River Water Quality Agreement, the county, cities, and the DOI, will acquire reservoir storage and water rights for the purpose of improving water quality in the lower Truckee River. A total of $24 million will be spent jointly.

The Pyramid Lake Paiute Tribe obtained federal court consent to be granted water and storage rights on the Truckee River system for the protection of the Lahontan cutthroat trout and the cui-ui. Water stored in Stampede Reservoir is used solely for the benefit of the Pyramid Lake fishery.

Issues

1. A large share of Nevada's biological diversity is found in association with the state's comparatively rare aquatic and riparian ecosystems. An evaluation of threats to wetlands by the Nevada Divisions of Wildlife and State Parks in 1987 ranked diversions and lack of water rights as the most serious threat. A large number of fishes and other fauna dependent on aquatic and wetland ecosystems are designated sensitive, threatened, or endangered. A large percentage of the threatened, endangered and sensitive fish species and other aquatic organisms inhabit desert spring pools. Over 50 percent of the wetlands statewide, and over 80 percent of those in western Nevada, have been lost. Approximately 87 percent of the riparian area along the Truckee River and 50 percent of the wetlands along segments of the Humboldt River and Rock Creek also have

been lost.[8] The loss in riparian area along other large streams has not been quantified. Difficulty in stabilizing and reversing statewide trends in aquatic and riparian wetland resource losses signals a need for more conservation efforts.

2. The historic and potential future losses of the state's aquatic, riparian and wetland ecosystems, and the large number of water dependent species at risk indicates that additional emphasis on proactive planning and management of water supplies for natural resource conservation is a matter of urgency for the state. Although divisions in the Department have individual roles in protecting water supplies for natural resources, a more definitive, comprehensive and integrated state policy and appropriate authority may be needed to improve the effectiveness and efficiency of conservation actions. Current, key policy mechanisms include: a) the legal authority of the State Engineer to permit the appropriation of instream (non-diversionary) water rights for fish, wildlife and recreation in accordance with state statutes and Court decisions; b) the state funded water rights acquisition program for wetlands; and c) policies adopted by the Nevada Wildlife Commission that encourage NDOW to acquire water for wildlife and their habitats and to protest surface and ground water right applications that would threaten, drastically modify or severely curtail wildlife and its habitat.[9]

3. The Nevada Board of Wildlife Commissioners has adopted policies that directs the Division of Wildlife to secure water from willing sellers in order to maintain adequate instream flows, minimum reservoir pools, and existing wetlands, springs and seeps for the preservation, maintenance and enhancement of wildlife and their habitats. However, difficulties in acquiring water rights may be encountered because levels of funding or staffing are insufficient. In some instances, other participants in a water market can move more quickly to purchase water rights. Thus, the agency is hampered in its ability to purchase or lease more suitable or senior water rights. Increased cooperation with land and water conservancies is a strategy that could be implemented to overcome some of the mentioned obstacles to water rights procurement.

4. Obtaining instream flow rights may prove to be a cost effective and durable approach to achieve multiple aquatic and biological resource conservation objectives, including sensitive species protection, water quality requirements and increased recreation opportunities. There is a need for incentives to increase water supplies for resource conservation purposes may raise private and public support for this activity. Measures which could enhance instream flows include water conservation, noxious phreatophyte control, or watershed improvements. To encourage such actions, an administrative mechanism may be needed to officially permit, verify and establish a "credit" for the amount of "new" or "additional" water made available for instream flows. For example, an individual might may have an interest in paying for the implementation of conservation measures to augment streamflow for fish habitat if there was certainty that a valued, transferrable credit would be created. This approach could encourage natural resource improvements which may exceed the benefits of simply increasing water supplies. For more information about credit for conservation, see the *Conservation* issue paper (Part 3, Section 1A

[8] Wildlife and Wildlife Habitats Associated with the Humboldt River and Its Tributaries. Biological Bulletin No. 10. Nevada Department of Wildlife. 1989.

[9] Nevada Wildlife Commission Policies, Numbers 60 and 61, as amended December 2, 1995.

of the Nevada State Water Plan).

5. Most current surface water withdrawals are for agricultural purposes. Thus, acquiring additional water supplies for instream flow would likely involve the agricultural industry and rural communities. Agriculture is important to the economy and culture of many counties. Acquisition of water rights for instream flow protection could impact the viability of farming and ranching beyond the property lines of individual parcels. The continuity of the channel network and distribution of operation and maintenance costs within irrigation districts are some potential effects that may have to be addressed. Some irrigated crop fields and pastures support wildlife, which is another important consideration. A public program with market incentives and technical assistance may be needed to facilitate the willing agricultural water user to manage water more conservatively, lease water rights for instream uses, or undertake other measures to augment water supplies for water quality improvement, fisheries protection and other objectives.

6. Management of species that are threatened or endangered has proven to be complex, controversial, and costly for private enterprise and resource managers. Nevada is among the top 5 states in the nation for both the diversity and vulnerability of its biological resources. A large percentage of vulnerable species rely on functioning aquatic and riparian ecosystems for survival. Proactive planning and actions now could improve the distribution of species, and thus avoid the imposition of federal mandates and implementation of more difficult and more expensive recovery strategies later.

7. Use of the *minimum* criterion as a water supply planning objective may narrow the focus of conservation efforts to the water resource conditions needed for a particular resource or attribute (i.e., habitat for a fish species, or a recreation activity). Another criterion used in some instream flow management assessments is the *optimum* water supply, which expands the focus of study to the integrity of an ecosystem. Determining the optimum quantity of water needed entails conducting a more comprehensive and integrated assessment, but may increase the likelihood that the resource will become self-regulating, thereby reducing future management needs.

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.

Index for Part 3, Section B.

A. Flood Management in Nevada

Introduction

Flooding has been a concern for Nevada communities since the first settlers moved to the territory in the mid-1800's. Fourteen significant flood events have occurred on the Truckee River alone since the 1860's. Numerous flash floods take place throughout the state annually. The costs of recovery from flood events is rising. Prior to the January 1997 flood event in northern Nevada, damages due to flooding on the Truckee and Carson Rivers totaled more than $31.5 million.[1] The damage caused by flooding in northern Nevada during the January 1997 event topped out at over $600 million if indirect damages such as lost revenue, wages, and sales taxes are included.[2]

Flood hazards in Nevada are typically underestimated due to the arid climate, few perennial streams, and low precipitation. Lack of data and a sparse stream-gaging network also contribute to underestimation of flood hazards. Two types of flooding occur in Nevada: riverine flooding and alluvial fan flooding. Riverine flooding occurs when water levels in rivers and streams rise and discharge volumes increase over a period of hours or days. Flood waters overtop the stream banks and inundate nearby low lying areas. In Nevada, riverine flooding typically occurs during the winter or spring runoff periods.

Alluvial fans are found throughout Nevada. An alluvial fan is a fan-shaped deposit of material created where a stream flows out onto the valley floor. Alluvial fans are the cumulative result of successive flood events over hundreds to thousands of years. Alluvial fan flooding is potentially more dangerous than riverine flooding because it is less predictable and the threat is not apparent, therefore it is not often considered during land development. Additionally, the influence of minor grading, roads, and structures can greatly impact and exaggerate damage from alluvial fan flooding. This type of flooding can occur with little warning. Alluvial fan flooding occurs when flood waters emerge from canyon mouths and travel downstream at very high velocities carrying an enormous load of sediment and debris. The hazards associated with alluvial fan flooding are compounded by the potential for migration of flood waters across the width of the fan. Alluvial fan flooding impacts are especially severe on fans which are developed without mitigation measures installed.

Flash flooding on streams emerging from steep canyons in the mountains are another significant flood hazard in Nevada. Flash floods are very unpredictable, and can cause flooding at a distance from the precipitation source. Because flash floods are typically caused by high intensity-short duration convective storm events in the mountains, they occur with little warning, and can be very destructive in terms of erosion and sediment deposition.

Nevada's rapid population growth is contributing to flood impacts. As more land is developed in

[1] Flooding Issue Paper, prepared by U.S. Army Corps of Engineers, date unknown.

[2] The 1997 New Year's Floods in Western Nevada, Nevada Bureau of Mines and Geology, 1998.

river basins and on alluvial fans, the severity of flooding and cost of flood recovery is increasing. As development moves from flat prime real estate to the broad alluvial fans throughout the state, a greater percentage of the population is exposed to flood hazards. The impacts of flooding to the people, communities, and infrastructure throughout the state point to a need for floodplain management.

What is Floodplain Management?

Floodplain management consists of planning and implementing programs designed to alleviate the impact of flooding on people and communities. It includes activities such as instituting land use policies and regulations for development in flood prone areas, and restoring and preserving natural resources and functions of floodplains and contributing watersheds. A key component of floodplain management is implementation of the National Flood Insurance Program (NFIP) at the local level.

The U.S. Congress established the National Flood Insurance Program in 1968 with the passage of the National Flood Insurance Act. The purpose of the act is to encourage local communities to mitigate future flood damage by adopting and enforcing minimum floodplain management ordinances, thus making the community eligible for federally-subsidized flood insurance. In Nevada, 15 counties and 13 communities currently participate in this program. Participation in the program allows property owners in the communities to purchase federally subsidized flood insurance. The program provides Flood Insurance Studies (FIS) and Flood Insurance Rate Maps (FIRMs) prepared by the Federal Emergency Management Agency (FEMA) to participating communities. A FIRM designates Special Flood Hazard Areas (SFHAs) within a community which are subject to flooding that has a one-percent chance of being equaled or exceeded in any given year. This flood is also referred to as the '100-year' flood.

Floodplain management consists of both structural and nonstructural measures for mitigating flood impacts. Structural approaches include measures which reduce the amount of flood water in a stream or contain flood water in a channel so that it does not inundate nearby areas. Such measures may include detention facilities, levees or dikes. Structural measures built with public money have been used historically to manage flood impacts with varying degrees of success. Structural flood controls may require the use of valuable land and natural resources.

A structural approach to flood control in existing urban areas can provide a cost-effective benefit to the public. In southern Nevada, the Clark County Regional Flood Control District uses structural controls very effectively to manage flash flooding impacts in developing areas. Washoe County is currently implementing a Regional Flood Control Master Plan which also incorporates structural flood control, along with other measures.

Nonstructural approaches to floodplain management have been gaining adherents as our recognition of the limitations of flood control has increased. The most cost-effective approach to flood hazard protection can be achieved using land use planning and sound floodplain management regulations in flood prone areas. Nonstructural approaches to floodplain management include:

1. Development of regional master plans for flood management;
2. Mapping and study of historic flood prone areas;
3. Implementation of floodplain regulations, including zoning ordinances, subdivision regulations, and building codes which guide development in floodplains and flood prone areas;
4. Implementation of a development review process at the local or regional level;
5. Acquisition and removal, or relocation of structures which experience repetitive losses;
6. Flood proofing existing structures by elevating a building's structure or the infrastructure;
7. Flood forecasting and warning systems;
8. Disaster preparedness plans;
9. Rehabilitation of disturbed watersheds, wetlands, and riparian zones;
10. Designation of green belts; and
11. Providing education and information to the local communities.

Flood Management in Nevada

Although floodplain management most effectively occurs at the local or regional level, the state plays an important role. The State's primary functions include coordination between federal and local agencies, education and information dissemination, and management of grant funds passed through from the federal government or the state to the local communities.

State Agency Involvement in Flood Management

Division of Water Planning

In 1997, as a direct result of the flooding in northern Nevada, the FEMA-sponsored Community Assistance Program (CAP) was transferred to the Division of Water Planning from the Division of Emergency Management at DEM's request. The objective of CAP is to provide technical assistance for flood mitigation activities and coordinate floodplain management in communities participating in the NFIP. The Division provides floodplain ordinance review, supports local agencies in development of building codes and enforcement capabilities, provides information and education on flooding issues, conducts floodplain management workshops for local officials, performs community visits to assess compliance with NFIP regulations, and prepares and distributes manuals, newsletters and flyers promoting flood hazard awareness.

In 1997, the Governor's Office named the Nevada Division of Water Planning as the point-of-contact for FEMA's new Flood Mitigation Assistance (FMA) program. The FMA provides grant funds for planning and project activities related to elevation or relocation of structures which experience repetitive losses. The Division is responsible for providing technical assistance to interested communities in preparing FMA grant applications and flood plans, and coordinating FMA funded projects.

Division of Emergency Management

The Nevada Division of Emergency Management (DEM) is responsible for implementing a comprehensive mitigation program which includes flooding mitigation. The State Hazard Mitigation Officer manages the FEMA-sponsored Hazard Mitigation Grant Program (HMGP), which can be used to purchase flood prone privately owned structures and flood easements subsequent to flood events. DEM and the Nevada Division of Water Planning are cosponsoring the state-wide All Hazard Mitigation Advisory Committee to evaluate hazard mitigation needs and funding sources for mitigation projects.

Division of Water Resources

The Division of Water Resources (DWR) manages a program for channel clearance, maintenance, restoration, surveying, and monumenting, established under NRS 532.220. Under the channel clearance program, local entities, including counties, cities, irrigation districts, and flood control districts can apply for matching grant funds to maintain channels of navigable rivers within their boundaries. In addition, the DWR is responsible for the state dam inspection and safety program, established under NRS 535.030. Communities throughout the state can take credit for the State's dam safety program through the NFIP's Community Rating System, resulting in lower flood insurance rates in the participating communities.

Disaster Relief Bill

During the 1997 legislative session, Senate Bill 218 was passed which established 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, and has been used to provide financial relief following river and flash flooding events in communities throughout the state.

Local Agency Involvement in Flood Management

Provisions for formation of 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. It is the only such district in the state. The District is comprised of the unincorporated county and the five incorporated cities within the county. The District was created to manage flooding hazards through land use controls, and to fund and coordinate construction and maintenance of flood control structures. Flood control projects are funded by a one-quarter of one percent sales tax. The District has also implemented a comprehensive floodplain management program that includes flood hazard mitigation and mapping.

Local communities and counties are responsible for developing and implementing ordinances for management of areas in their communities which are prone to flooding. Adoption of the minimum standards for floodplain management identified in the Code of Federal Regulations (CFR) Title 44, section 60.3, is the primary requirement for participation in the NFIP. The minimum NFIP

requirements are floodplain management standards which are generally applicable nationwide, but which do not take into account unique regional and local conditions. Washoe and Clark counties have adopted ordinances which go above the minimum NFIP standard. Counties and communities which do more than the minimum required by the NFIP are eligible for participation in the Community Rating System (CRS), which provides credits in the form of reduced insurance costs for property owners holding flood insurance.

Project Impact is FEMA's program for developing disaster resistant communities. This program was initiated in 1998, with the city of Sparks named as the first Project Impact Community in Nevada. Project Impact was developed to help communities take responsibility for mitigating the impact of disasters of all types.

Federal Involvement in Floodplain Management

Several federal agencies have programs which support floodplain management at the state level by providing funding and technical assistance, and facilitating coordination with local communities.

FEMA provides technical assistance on floodplain management issues and oversees the NFIP. In addition, FEMA offers flood mitigation programs and technical assistance in updating the State Hazard Mitigation Plan, and funds mitigation projects through grants such as the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program.

The U.S. Army Corps of Engineers (Corps) offers both emergency and long-term services for pre- and post-disaster mitigation and response. They perform general investigation studies for flood control, and provide floodplain management planning services, in addition to their role in design and construction of flood retention structures (see Part 1, Section 3 of the State Water Plan). The Corps has recently proposed a new Flood Hazard Mitigation and Riverine Restoration program, titled Challenge 21, intended to focus on nonstructural solutions to restore river channels that were modified for flood control.

The Natural Resources Conservation Service (NRCS) provides services related to measuring and reducing flood hazards and emergency response following a flood event. They conduct floodplain management studies in which ecological resources are cataloged and opportunities for restoring and preserving floodplains are identified. Under the Emergency Watershed Protection program, NRCS provides technical and financial assistance when a natural disaster causes damage in a watershed. Emergency response actions are related to assessing damages and identifying actions.

Regional Involvement in Flood Management

Western Governors' Association

The Western Governors' Association (WGA), adopted a policy resolution on Flood Mitigation and Recovery Issues in December 1997. The Task Force organized by WGA concluded that flood planning and floodplain management are essential elements in reducing flood risk. The task force developed *An Action Plan for Reducing Flood Risk in the West*. The action plan developed by the task force contains 21 recommendations for improving floodplain management and coordination and communication of flood issues. Several of WGA's recommendations are used as a basis for the recommendations presented at the end of this discussion.

Issues

1. Communities participating in the NFIP outside of the major urban centers have not had access to consistent state-level assistance in implementing and managing their floodplain management ordinances. In some cases, this lack of state assistance, combined with turnover in personnel at the community and county level, and resultant lack of training have made it difficult for local communities to comply with NFIP regulations.

2. Alluvial fan or flash flooding is a critical issue for two reasons: a) flash flooding is less predictable than riverine flooding and results in high velocity flows with great erosive capability, and there is a high potential for channel migration to previously unidentified areas; and b) the risk of alluvial fan flooding is either over- or under- predicted due to disagreement on effective models for predicting flows and mapping alluvial fan flood zones among engineering and planning professionals.

3. The Flood Insurance Rate Maps (FIRMs), used by the local administrators outside of major urban centers for planning and permitting development, are well over five years old, and areas which are currently being developed were never mapped in detail in the original studies. Use of regression equations that are based on generalized hydraulic geometry and that to not incorporate site specific geologic and soil type data have resulted in underestimating the extent and depth of flooding. Rapid growth in areas with outdated flood zone maps can result in the construction of homes and businesses in harm's way.

4. In the past, coordination between state agencies, and between state and local agencies, was often inadequate. This resulted in gaps in services and missed opportunities for grant funding. When the 1997 state legislature re-assigned the flood management program to Division of Water Planning and enhanced funding, it created the opportunity for improved coordination and will result in better implementation of flood mitigation efforts and reduced costs of flood recovery. Increased coordination is clearly an essential element in improving flood program effectiveness at all levels.

5. Floodplain management must be considered an essential on-going element in local and regional

planning, not something that takes place after a flooding event. 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. To avoid recurrence of losses experienced in the 1997 flood event in northern Nevada, the 1997 state legislature requested development of a Flood Management Plan for the state.

7. The State's Model Floodplain Ordinance contains the *minimum* national The minimum NFIP requirements are floodplain management standards which do not take Nevada's unique regional conditions into consideration. Conditions which make Nevada NFIP requirements that communities and counties must implement to obtain flood insurance. unique are rapid growth in areas with outdated flood maps, alluvial fan flooding and flash flooding. The State Model Ordinance was developed in 1994, prior to the 1997 flood event in northern Nevada, and needs to be updated to include lessons learned from that event. Further, to adequately prevent flood impacts and keep damages and costs of recovery to a minimum, the state also needs to develop a set of recommended standards over and above the minimum standards established in the model ordinance to reflect Nevada's unique flood management concerns.

8. In Northern Nevada, communities located along rivers are incurring increasing costs due to flooding. Growth and development in floodplains exacerbated flood losses. Further, it is clear that existing structural controls are not effective in preventing damages. Studies throughout the west show the benefits of incorporating non-structural measures such as preservation and restoration of floodplain areas, through zoning and conservation easements, and relocating structures out of floodplain areas.

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.

Index to Part 3, Section 4A:

A. Watershed Planning and Management

Background

What is a watershed? Generally, a watershed is described as an area within a hydrographic or river basin which consists of interconnected water sources and drainages, bounded by topographic highs or water divides. For watershed planning and management purposes, a watershed is an area with specified boundaries set by a group of stakeholders who have interests in the water resources within the watershed.[1]

Watershed planning and management is described as a process for integrating water resource, natural resource, and land use considerations into a collaborative problem solving network, supported by interested parties within a designated watershed. Resources of concern may include all or parts of riparian, wetland, spring and stream ecosystems, as well as specific watershed values, including fish and wildlife habitat, flood plain storage, water quality, water yield and recharge, soil stability, and productivity of agricultural lands. Typically, effective watershed planning and management efforts have certain basic characteristics. These are:

- *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, ground and surface water interaction, as well as interactions of other natural resources and environmental conditions.

Taking a comprehensive, inclusive, and integrated approach to water resource planning, allocation and management is intended to produce a strategic action plan to better protect water quantity, water quality and related resources for current and future needs. Greater cooperation leads to widespread support for agreed upon management objectives and action plans, and reduced reliance on new regulatory requirements and litigation.[2] Solutions are more practical and acceptable, and thus, more effective and lasting.

The basic steps in watershed planning include:

1. Identify stakeholders and facilitators to assist with problem definition and administration;
2. Listen to and develop an understanding of interests being expressed;
3. Develop a number of strategies to meet the concerns expressed by the interests;

[1] Stakeholders could include individuals, organizations, and agencies working, residing, recreating, or regulating in the watershed.

[2] Watershed planning is not an alternative to satisfying applicable regulatory requirements. It can be complementary, but it cannot be a substitute.

4. Evaluate the strategies as to scientific validity, cost, practicality, environmental impacts;
5. Develop an action plan to implement the strategies;
6. Define ways to monitor outcomes and evaluate success; and,
7. Periodically review the interests, goals and plan itself, and make adjustments.

Need for A Watershed Approach

The need for the state's support for the watershed approach stems from a recognition that water resource problems arise from a wide range of activities throughout a watershed, these activities are dispersed and cross political boundaries, and impacts on the environment are cumulative and are potentially long term and difficult to reverse.

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 because agencies collaborate more on problem resolution.
3. Data collection resources are pooled, so databases are more comprehensive and more types of related data are 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 understanding and support for management options 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 with good planning and plan implementation.

State Agency Involvement With Watershed Planning and Management

As the state's economy and population grows, so too does the intensity and diversity of land use activities, placing greater demand on the state's finite land and scarce water resources. To keep pace, over the past 20 years Nevada state agencies have administered regulatory and voluntary programs which have achieved significant reductions in both point and non-point sources of pollution; prevented contamination from hazardous waste sites; more efficiently allocated and managed water resources; and provided assistance, information and funding to local organizations for the management of watershed resources.

Watershed planning is well rooted in Nevada's water allocation process (Nevada Revised Statutes 533 and 534) and in the protection of water quality. 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 throughout Nevada. Such a system was needed to more effectively study, develop, allocate and manage the state's water resources, both groundwater and surface water, to meet current and future demand. The first hydrographic map was developed in 1968, and while it has undergone some minor revisions, it continues to provide the basis for water planning, management and administration today. Watershed-oriented planning and management programs and projects implemented by state and federal agencies are described below.

Department of Conservation and Natural Resources

The mission of the Department of Conservation and Natural Resources (Department) is to conserve, protect, manage, and enhance the State's natural resources in order to provide the highest quality of life for Nevada's citizens and visitors. Administrative, technical, budgetary and supervisory support is provided to coordinate management goals and activities involving all of the Divisions within the Department. The Department plays a leadership role in determining the extent to which watershed planning and management is instituted. Recent notable instances where the Department coordinated various Division's involvement in major water resource management issues set within a watershed context include the Tahoe Presidential Forum and the Truckee River Negotiated Settlement.

Division of Environmental Protection

In the mid 1970's, the Division of Environmental Protection (NDEP) developed water quality management plans for the hydrographic basins under section 303 of the Clean Water Act (CWA). In the late 1970's and early 1980's, the designated local agencies developed comprehensive wastewater management plans under section 208 of the CWA for Clark County, Truckee River Basin, Lake Tahoe Basin and the Carson River Basin. For the remainder of the state, the Division developed a CWA 208 plan utilizing as a minimum the basic steps for watershed planning.

Currently, under the Comprehensive State Groundwater Protection Program, mandatory and voluntary groundwater protection programs are administered by NDEP. The Nevada Ground Water Protection Task Force is a voluntary coordinating group composed of state, local and federal agencies which promote public awareness of ground water protection issues and of alternative protection options. This group is defining hydrographic basins which have critical ground water quality concerns.

The Bureau of Water Quality Planning administers the Nonpoint Source Management Program through which voluntary watershed management demonstration projects are funded under the Clean Water Act, Section 319. Active watershed planning and demonstration projects are underway at Steamboat Creek; Muddy River; Mason Valley; and the Upper, Middle, and Lower portions of the Carson River. A notable example of a comprehensive, inclusive and integrated plan is the Upper Carson River Watershed Management Plan. The Plan draft was completed in 1996 and contains strategic recommendations which are being implemented.

Other examples of watershed planning include the State and local Wellhead Protection Programs, the Truckee River Strategy Group, the Lake Mead Water Quality Forum and the Truckee River Water

Quality Agreement. The Division also supports water quality planning efforts regarding Emergency Response Planning on the Truckee River.

Divisions of State Lands and Conservation Districts

With the guidance and support of the Nevada Division of Conservation Districts, local Conservation Districts have adopted goals and facilitated projects to conserve, protect, and manage development of Nevada's natural resources on a watershed basis. These activities often occur jointly with federal agencies such as the Natural Resource Conservation Service and federal land management agencies. Administration of the Tahoe Bond Act funding program for water quality improvements by watershed is an example of these coordinated activities. Another is the Steamboat Creek Restoration Project, which is lead by the Washoe-Storey Conservation District.

Division of Water Planning

The State Water Plan is being developed on a hydrographic basin basis, with a consideration of many water resource issues, and with a great deal of public involvement. The goal is to analyze issues in a comprehensive, integrated fashion and to develop realistic recommendations which address the viewpoints of many stakeholders.

Walker River Basin Technical Network is an effort to bring together a wide variety of stakeholders in a hydrographic basin to share information, coordinate activities, leverage dollars, avoid duplication of effort, and ultimately, to develop a watershed plan for the basin addressing water supply, water quality, habitat, recreation, and economic issues.

Division of Water Resources

Under the Cooperative Program with the U.S. Geological Survey, the Division of Water Resources (NDWR) funds and supports data collection and report development on surface and ground water conditions. In addition, the NDWR has participated in site specific studies for watershed scale projects, such as the Humboldt River Basin Study, Fallon Basalt Aquifer Recharge Study, Las Vegas Valley Subsidence Study, Beaver Dam Wash Study, Spanish Springs Study and Honey Lake Valley Study.

Federal Agency Involvement in Watershed Planning and Management [3]

About 87 percent of the land in Nevada is managed by federal agencies. Most streams originate on and much of the ground water recharge occurs on upper and mid-level elevations of watersheds managed by the U.S. Forest Service and U.S. Bureau of Land Management. During the past 30 years, several laws have been enacted that direct federal agencies to make watershed protection a high priority in their management plans. These and other laws aim to protect riparian areas, wetlands, and stream ecosystems on federal lands, as well as protection of other watershed values, including fish and wildlife habitat, flood plains, water quality, water yield, soil stability, and productive agricultural lands. Since much of Nevada's water supply falls on portions of watersheds managed by federal agencies, their involvement in watershed planning and management is essential.

The Natural Resource Conservation Service (NRCS) is a federal agency involved in community level watershed planning and management activities. Their primary function is to provide natural resource planning and management assistance to farmers, ranchers and forest landowners. The NRCS also supports joint public/private watershed improvement projects with technical assistance and funding through a number of cost-share programs intended to improve water quality, soil stability, forest resources, flood plains, noxious weed management and wildlife habitat.

The U.S. Environmental Protection Agency (EPA) has championed the Watershed Protection Approach (WPA) for many years. The WPA strategy is based on the concept that many water quality and ecosystem problems are best solved at the watershed level, rather than the individual waterbody or discharger level. The WPA is grounded in the Clean Water Act and Safe Drinking Water Act, which contain provisions that promote aspects of watershed planning and management activities. Nevada's Wellhead Protection and Source Water Protection Programs, Area-wide Water Quality Management Plans, Comprehensive Ground Water Protection Program, and Nonpoint Source Pollution Program are examples of joint state, federal and local agency implementation of these programs.

The most recent federal initiative regarding the watershed approach is the President's *Clean Water Action Plan* (CWAP). Lead federal agencies are the EPA and NRCS; however, the CWAP provides incentives for state agency leadership in: (1) undertaking public/private cooperative efforts within a watershed framework; (2) conducting "unified watershed assessments" where impaired waters exist; (3) applying federal resources and technical expertise to state and local watershed restoration and protection; and, (4) making federal agencies' data and information about watershed conditions more available to the public. In response to the CWAP, NDEP and Natural Resources Conservation Service (NRCS) have developed a unified watershed assessment involving affected state, local and federal agencies, and interested organizations. Other key federal agencies could include the U.S. Forest, Service, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation and the Bureau of Indian Affairs.

[3] The involvement of federal agencies in watershed planning and management is discussed extensively in the Report of the Western Water Policy Review Advisory Commission, *Water in the West: Challenge for the Next Century*, June 1998.

Issues

1. The watershed planning approach is already being implemented by various groups in Nevada, and appears to be an effective approach to integrating water and land resource issue. The Department is striving to improve coordination across divisions in a more integrated framework. It is anticipated that all agencies in the Department could be involved in implementing certain recommendations listed below, as well as agencies within other departments, such as the Divisions of Health, Emergency Management, Agriculture and Minerals. To implement Recommendation 1, the Department will review state policies, laws and regulations, staff workloads and skills, current coordination among agencies, mechanisms for future coordination, and the availability of watershed planning funds.

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. To the extent practicable, Department staff should assist in meeting expressed needs of local watershed planning groups, whether the need is for data and information, or assistance in facilitating the planning process, mediating between local and federal concerns, developing watershed management plans, or implementing an action plan.

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.

   Recommendation 3 below, speaks to the next major step envisioned for State Water Plan development. It is a concept that has been informally discussed with the Advisory Board before. It is introduced here because instituting an integrated water basin planning approach: 1) is functionally similar to a watershed planning approach, and 2) should be complementary and consistent to watershed management plans in a basin where a plan has been developed and implemented.

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. Currently, a key program is the Clean Water Action Plan (CWAP). Under the CWAP, federal funding is being provided to support joint state, federal and local agencies implementation of an Unified Watershed Assessment and coordinated 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. Monitoring provides a vital feedback loop 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.

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watershed values (5A–1)

B. Water Resources Data Development, Collection and Management

Introduction

Accurate and comprehensive water resource data are critical to planners and decisionmakers 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. This issue discussion describes some of the current data development, collection and management efforts in Nevada, current and future challenges facing data managers and users, and recommendations for meeting these challenges.

Background

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 websites. 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, decisionmakers, 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 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.

For purposes of this discussion, data are divided into three types: temporal, textual and spatial data. Temporal data are those data related to a particular point in time or period of time. Examples include streamflows, groundwater levels, and precipitation data. Textual data consists of text-based information such as directories, library bibliographies and inventories. Spatial data are those data related to space which can be shown on a map, and are commonly maintained by Geographic Information Systems (GIS). GIS is a computer system for assembling, storing, manipulating, and displaying spatial data which includes information on the physical locations (geographic coordinates) of features and information about those features. GIS was once viewed as an expensive toy, but is now considered an indispensable planning and management tool.

Metadata, or information about the data in a dataset, is a critical component of information management. With metadata, the characteristics of a dataset are documented so that potential users can determine the appropriateness of the data for their particular purpose. Metadata can include a variety of information such as the agency responsible for the data; measurement, collection and laboratory methodologies; and data accuracy.

Major Water Resource Data Collection, Management and Distribution Programs

Brief descriptions of some of the major water resource data collection, management and distribution efforts currently underway follow. Separate discussions are provided for temporal, textual and spatial data.

Temporal Data

Temporal data are those data related to a particular point in time or period of time. Examples of temporal data include streamflows, groundwater levels and precipitation data. Following are examples of some major temporal datasets as maintained by various agencies.

Nevada Division of Water Resources. The Nevada Division of Water Resources (NDWR) collects, compiles and maintains and a variety of data including water rights information, well logs, groundwater levels, and water use information.

- **Water Rights Database.** NDWR maintains an electronic database of water rights within the State. Of the more than 73,000 records, over 60,000 have been entered into the database. The database includes information on place of beneficial use, point of diversion, allowable diversion rates and volumes, and other ancillary data. Direct access to the database is limited to internal users, however others can obtain database query reports upon request.

- **Well Logs Database.** Since the 1940s, well logs have been submitted to the NDWR. These well logs include a variety of information such as: well location, drilling method, proposed use, well depth, and depth to water. In 1994, NDWR and USGS cooperatively developed a computer database for managing the well log information. Direct access to the database is limited to internal users, however, others can obtain database query reports upon request. Currently, the database contains information on approximately 50,000 wells in Nevada. The computer database does not contain any detailed information on the subsurface geology. However, this information can be obtained from paper copies of the well logs. The database does not account for all existing wells logs. While all wells in southern Nevada are recorded in the database, only those well drilled since 1984 are accounted for in the database.

- **Groundwater Levels.** NDWR collects groundwater level data in about 73 basins. Much of this information is collected once a year, typically in the spring. Only a portion of the NDWR level data are stored in an electronic database maintained by USGS. The remaining data are stored in paper files.
- **Water Use Data.** NDWR compiles and develops a variety of water use data. According to the

State Engineer's Office, water use data submitted to the Office and calculated by staff in the pumpage and crop inventories accounts for about 90 percent of the total groundwater usage. These data are utilized by the U.S. Geological Survey in their development of statewide water use estimates.

NDWR estimates the total groundwater pumpage within about 16 of the 256 hydrographic areas. Generally these groundwater pumpage inventories are based upon a mixture of both actual measurements and estimates. These data are maintained in electronic spreadsheet files.

NDWR estimates irrigated crop acreages and associated water withdrawals within about 30 of the 256 hydrographic areas. These data are currently stored on paper.

Surface water and groundwater pumpage data are submitted to NDWR by some water right holders as a requirement of water right permit conditions within about 80 of the 256 hydrographic areas. These data are specific to particular users and may not account for all water uses within a hydrographic area. A majority of the uses reported are for public supply systems, mining operations and miscellaneous commercial and industrial operations. These data are maintained in electronic spreadsheet files. NDWR is researching the possibility of entry of these data into an electronic database with links to the water rights database.

Nevada Division of Environmental Protection. Nevada Division of Environmental Protection (NDEP) conducts surface water quality monitoring of major water bodies. Water quality parameters are monitored by NDEP at about 100 sites throughout Nevada. These data are stored in EPA's STORET database (see later discussion on STORET).

A variety of other data are compiled under NDEP programs. NDEP's Underground Injection Control (IUC) program requires groundwater quality characterization data in the permit application. The Solid Waste program, Resource Conservation and Recovery Act (RCRA) hazardous waste facilities oversight, mining-related permitting and state groundwater permitting programs all require some amount of groundwater monitoring in the absence of any contaminant release. Facilities such as wastewater treatment plants and industrial operations with permitted discharges to the surface water are required to monitor effluent quality and to submit discharge monitoring reports to NDEP. Currently, most of these data are stored on paper in files. NDEP's Bureau of Water Quality Planning has initiated efforts to encourage all NDEP programs to automate current data collection and management activities.

Nevada Division of Water Planning. The Division of Water Planning maintains a variety of socioeconomic databases and has taken steps to improve water resource data distribution.

- **Socioeconomic Databases.** The Nevada Division of Water Planning maintains over 20 socioeconomic databases containing information such as population, employment by sector, agricultural production and mining production. These data are obtained from a variety of sources and are available on diskette from the Division in spreadsheet format.
- **Data Access.** Recognizing the need for centralized access to water resources data and information, the Nevada Division of Water Planning has developed an Internet homepage which

provides links to websites for other agencies and data sources such as streamflow, precipitation and snowpack conditions.

Health Division and State Health Laboratory. As required by state and federal drinking water regulations, public supply systems routinely submit water samples to laboratories for analysis. The laboratory results are then sent as paper copies to the Nevada Health Division which has primary enforcement authority for drinking water regulations. Depending upon the public supply system, analyses are performed by either the State Health Laboratory or by private laboratories. The State Health Laboratory maintains analysis results in an electronic database, but these data are not readily available to other agencies. However, others can obtain database query reports upon request.

Currently, the Nevada Health Division is planning for the implementation of a comprehensive electronic data management system. Under this proposed system, data generated by the laboratories will be electronically transferred to the planned Health Division system. This program is being funded with federal monies and may take a number of years to implement.

U.S. Environmental Protection Agency. STORET (STOrage and RETrieval) is a computerized information system residing on U.S. Environmental Protection Agency's (EPA) computer at Research Triangle Park, North Carolina. STORET contains information for over 800,000 sampling sites throughout the United States, and consists of several software programs which allow users to store and retrieve water quality data, and analyze these data. Currently, STORET data are downloadable by selected users. EPA is in the process of making STORET data available via the Internet.

As discussed above, the Nevada Division of Environmental Protection (NDEP) operates a surface water quality monitoring network of about 100 sites throughout Nevada. NDEP utilizes STORET for the maintenance of these data.

U.S. Geological Survey. The USGS Water Resources Division routinely collects water discharge data for gaging stations on streams, canals and drains; peak-flow data at miscellaneous sites and springs; water elevation and contents for lakes and reservoirs; water levels in wells; and water quality for stream, canal and drain sites and wells. These data are maintained in a number of electronic databases and published in an annual data report. Only the streamflow data are available to the public via the Internet. Other data such as groundwater levels and water quality information can be obtained in electronic format only upon request. USGS is currently working on an application for Internet access to statewide groundwater level information. There are no current plans to provide Internet access to their groundwater and surface water quality data.

Other Agencies. A number of agencies provide climatological (precipitation, temperature, snowpack conditions) data via the Internet such as the U.S. Natural Resources Conservation Service, National Weather Service, National Climate Data Center and Western Regional Climate Center.

Textual Data

Textual data consists of text-based information such as directories, library bibliographies and inventories. Following are examples of some major textual datasets as maintained by various

agencies.

Nevada Division of Water Planning. The Division is in the process of developing a directory of professionals working in the water resources field and will provide information on occupation, areas of specialty and access. The directory will be produced in a database format and be available over the Internet.

The Division maintains a library of over 4,000 water resources related documents. The documents are indexed by major hydrographic region and subject area. The library includes water planning documents from many other states as well as many state, federal and local agency reports and publications. A detailed document listing is maintained within an electronic database. The Division is in the process of providing Internet access to the library document listing.

Biological Resources and Research Center (BRRC). BRRC's Effort Gap program is a database of biological research efforts in the Great Basin. The program's goal is to provide an easily accessible information center to agencies, organizations, and individuals involved in biological research. The database is accessible via the Internet and contains a variety of information such as contacts, project descriptions and directories of available data.

Spatial Data

Spatial data are those data related to space which can be shown on a map, and which are commonly maintained within a Geographic Information System (GIS). Following is a discussion of some past and ongoing GIS development and coordination efforts.

GIS data development. Many agencies and organizations in Nevada are developing GIS data files which are of use in water resource planning and management. Such agencies include:

- Department of Conservation and Natural Resources
- Division of Water Resources
- Division of Environmental Protection
- Division of Wildlife
- Division of State Lands
- Division of State Parks
- Natural Heritage Program
- Division of Water Planning
- Legislative Counsel Bureau
- Department of Transportation
- University of Nevada System
- Tahoe Regional Planning Agency
- Desert Research Institute
- U.S. Geological Survey
- U.S. Forest Service
- U.S. Bureau of Land Management
- U.S. Bureau of Reclamation
- U.S. Natural Resources Conservation Service
- Nevada Bureau of Mines and Geology

Few of these agencies provide Internet access to their GIS files or directories. No comprehensive list of all available GIS files held by these agencies exists at this time.

GIS Data Coordination and Distribution Efforts. Following is a discussion of some recent GIS data coordination and distribution efforts.

- **State GIS Task Force.** In 1995, the Department of Information Technology (DoIT), then the Department of Information Services, created a GIS task force in concurrence with the Department's strategic plan. The overall objectives of the task force were to:

  - document GIS hardware and software requirements;
  - develop standards for hardware and software;
  - set direction for future GIS users;
  - establish a standard data format for GIS data for the state;
  - provide recommendations to enable GIS information transfer among all agencies within the state who demonstrate a need;
  - establish a clearinghouse for GIS data; and
  - establish guidelines and recommendations for GIS training and education.

  The GIS Task Force consisted of about 50 representatives from state, local and federal agencies with meetings facilitated by DoIT staff. DoIT staff produced a draft report of conclusions and recommendations, but the report and its recommendations have not been finalized. One of the draft recommendations calls for the creation of a Geographic Information Board to take a leadership role in the coordination of state GIS functions.

- **Department of Conservation and Natural Resources GIS Committee.** The Department of Conservation and Natural Resources has formed a committee to coordinate departmental GIS issues.

- **Federal Geographic Data Committee.** The Federal Geographic Data Committee, established by Executive Order in 1994, was charged with three major activities:

  - establishment of a National Geospatial Data Clearinghouse;
  - development of standards for data documentation, collection, and exchange making data sharing easier; and
  - development of procedures and partnerships to decrease duplication of efforts in data development, and fill in areas where data gaps exist.

  The National Geospatial Data Clearinghouse is accessible via the Internet and provides access to a network of spatial data directories and libraries as maintained by a variety of participating agencies. The Clearinghouse does not maintain any data but merely provides the means to locate and obtain the data maintained by others. At this time, approximately 25 states are participating in the National Geospatial Data Clearinghouse program. The State of Nevada is in the process of developing a link to the Clearinghouse.

- **Nevada Bureau of Mines and Geology/State Mapping Advisory Committee.** The Nevada Bureau of Mines and Geology (NBMG), on behalf of the State Mapping Advisory Committee (SMAC), received a grant from the Federal Geographic Data Committee (FGDC) in 1997 to support a study of how we use and share our digital geographic data in Nevada. NBMG mailed out surveys to GIS users throughout Nevada. These surveys indicated that most GIS users are not satisfied with existing coordination activities and that more formal coordination and data accessibility efforts are necessary. As a start to addressing this issue, NBMG in cooperation with

SMAC established an Internet website as a rudimentary geographic information clearinghouse. The NBMG website does not directly provide any GIS file listings or file access capabilities, but rather provides links to the homepages of agencies which maintain GIS and related data. Although a number of these agencies maintain GIS systems, data listings and access information may or may not be available from their homepages.

SMAC/NBMG recently obtained additional funding from the Federal Geographic Data Committee to establish a link to the National Geospatial Data Clearinghouse. Funding will be used to purchase the necessary computer hardware and to develop the Internet links to geospatial data providers in Nevada. As described below, the National Geospatial Data Clearinghouse does not maintain any data but merely provides information on where and how users may access data, information about the data (metadata) and links to data source Internet sites. The Clearinghouse link will be online mid-1999 and ready to receive metadata from agencies. Geospatial data providers in Nevada will need to submit metadata to the clearinghouse administrator in order for this clearinghouse to be an effective distribution tool.

- **National Performance Review (NPR) Project.** The NPR project is a cooperative effort between the U.S. Forest Service, University of Nevada-Reno, and the Nevada Division of Water Planning. One goal of this project is to provide access to information relevant to watershed planning and risk assessment in the upper Carson, Truckee and Walker watersheds. The project participants are compiling GIS information (physical, biological and cultural) for these watersheds, and plan to provide others access to the information via the Internet to the extent possible including basic viewing and downloading capabilities.

- **Biological Resources Research Center (BRRC).** The BRRC homepage provides a listing of GIS files maintained by BRRC. None of the data are accessible via the Internet, however GIS files can be requested from BRRC.

Data Gaps and Research Needs

While the management and dissemination of existing data is critical for effective decisionmaking, there is also the need to collect additional data and perform further research. In the following discussion, key data and research needs are presented.

Groundwater Quality and Water Levels

The USGS and NDEP operate a network for monitoring surface water quality and flows. No such statewide network for monitoring groundwater quality and water levels exists in Nevada. Much of the available groundwater data are the result of special studies in specific areas, and monitoring required by State permitting programs and drinking water regulations. The USGS and NDWR are the primary agencies collecting groundwater level data on a statewide basis. Much of this information is collected once a year, typically in the spring.

A fundamental purpose for monitoring is to acquire data necessary for the protection of existing rights and planning to accommodate increased water usage. In some basins, the lack of continuous, long-term groundwater quality and level data makes it difficult to assess trends and manage the resource for current and future needs.

The need for a statewide groundwater level and quality monitoring network has been recognized for some time. In 1978, the USGS with NDEP produced a report titled "Ground-Water Quality in Nevada - A Proposed Monitoring Program" that outlined a program for systematically monitoring groundwater conditions in Nevada and defined procedures for prioritizing basins for monitoring.

Streamflow Gaging

The U.S. Geological Survey (USGS) is the principal Federal agency which collects surface water data in Nevada. The USGS began collecting streamflow data in 1889 with the establishment of a gaging station on the Truckee River near the Nevada-California State line. During the next six years, additional gaging stations were established in the Humboldt, Carson, Walker and Truckee basins. As of 1997, the USGS surface water quantity monitoring network consists of water discharge measurements for 173 gaging stations on streams, canals and drains, 170 peak flow stations and miscellaneous sites, and six springs; and water levels and contents for 21 lakes and reservoirs. The general objective of the stream-gaging program is to provide information on, or to develop estimates of, flow characteristics at any point on any stream. The USGS and various entities in Nevada have had cooperative agreements for implementation of the gaging program. Assistance from these other entities has come in the form of funding and/or services. This program would not be viable without these cooperative agreements.

Other entities collect streamflow data for regional purposes. For example, the Clark County Regional Flood Control District operates a network of meteorologic and water depth monitoring stations as part of the District's Flood Threat Recognition Program.

Streamflow records can be used for a number of purposes, such as:

- managing water supplies for various uses and minimum flow needs;
- administering compacts and decrees;
- operating and designing multipurpose storage facilities;
- characterizing water quality conditions, including sediment and chemical constituent loads;
- setting permit requirements for treated wastewater discharge;

- forecasting and managing floods;
- delineating and managing floodplains;
- designing highway bridges and culverts; and
- performing scientific studies for water quantity and quality planning and management purposes.

Most of the USGS gaging stations have one primary purpose and can have several secondary purposes. In some instances, gaging station data are used for day-to-day operations. However the resulting data can also be useful for long-term studies in the future. All existing and potential uses of the data need to be considered prior to discontinuing the operation of any gaging station. The maintenance of a viable stream gaging program is an integral part of managing our natural resources. Future efforts to discontinue existing gaging stations must be closely scrutinized. We must not lose sight of the long-term value of a comprehensive stream gaging network.

Water Use

Approximately 65 to 75 percent of the total water withdrawn annually from groundwater and surface water sources in Nevada is either measured with detailed diversion records maintained by various entities, or estimated by the State annually in detailed pumpage and crop inventories. Only a portion of these data are maintained in an electronic database and reported to any state planning agencies. 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. Water use information (whether measured or estimated) is critical for effective water planning and management both at the state and local levels**.** Additional information on water use and measurement is presented in Part 3, Section 1, "Water Use Measurement and Estimation."

Water Resources Research

Ongoing research concerning Nevada's water resources which utilizes new technologies and methodologies provides valuable information for improved water management and planning. Improved understanding of our water resources leads to enhancements in planning and management.

One particular research need is the updating of groundwater perennial yield estimates. A majority of the groundwater perennial yield estimates currently available were developed by the U.S. Geological Survey during the 1960's and 1970's as part of a reconnaissance investigation series. The resulting perennial yield estimates form the basis for the management of the groundwater quantity in Nevada. However, these reconnaissance investigations were never intended to provide definitive groundwater budgets for hydrographic areas in Nevada. Instead, these studies were intended to serve as guides for more comprehensive investigations when new data became available and more advanced methodologies were developed. Since the time of the original perennial yield estimates, developments in new methods and technology for estimating water resource availability and groundwater recharge and discharge have been significant. These new methodologies are considered to be more accurate and could result in higher perennial yield values than previously estimated. For instance, the U.S. Geological Survey has applied new procedures to 16 basins in east-central Nevada and now estimate perennial yield amounts at more than twice the previously recognized values for 14 of these basins.

Updated estimates of groundwater availability, recharge and discharge, will better facilitate economic development, protection of scarce water resources and optimal resource allocation.

Data Management in Other States

Many states have recognized the need for improved data management and distribution, and have taken steps towards meeting these demands. Responses to data management needs vary from state to state, but the Internet has become the primary instrument by which users can research available data in their state. Depending upon the state, users can view and/or search data directories, view associated metadata and in some cases can download both temporal and/or spatial datasets. About 25 states are participating in National Geospatial Data Clearinghouse efforts. Nevada is in the process of developing an Internet link to the Clearinghouse which will present GIS metadata.

Some states have coordinated statewide efforts for improving data distribution. For example, a number of states have created geographic information boards to develop their GIS management strategies and policies, and oversee data sharing activities. Board members typically represent a number of different state agencies. In other states, individual agencies have taken the lead on developing their own data distribution program. Some states have a state GIS coordinator who facilitates and coordinates the activities of an informal GIS task force. All states bordering Nevada have some form of GIS coordinating board whether formal or informal. Following are some examples of data management activities in other states.

Wyoming

In support of their state water plan development, the State of Wyoming recently completed a detailed inventory of temporal and spatial water data available in the state. The statewide data inventory is accessible via the Internet and allows water resource professionals and the general public to access primary data descriptions under specific themes in Wyoming river basins. Information on procedures for obtaining the data is also provided.

Idaho

In Idaho, the Department of Water Resources manages the Idaho Geographic Information Center in accordance with policies set by the Geographic Information Advisory Committee. Through the Center's Internet homepage, users can download spatial data generated by a variety of agencies, but maintained in a central location by the state.

Utah

The Utah Division of Water Rights is the office of record for water rights in the State of Utah, and all records are available for public review. Through the Division of Water Rights' Internet homepage, users can access a variety of information and data including water rights information.

Florida

In 1996, the Florida State Legislature created the Florida Geographic Information Board (FGIB) to facilitate the identification, coordination, collection, and sharing of geographic information throughout the state. The board develops solutions, policies, and standards to increase the value and usefulness of geographic information. In addition, FGIB maintains a data directory on the Internet from which interested parties can obtain metadata on available GIS files and information on obtaining electronic copies.

Issues

Good water resource management decisions require reliable and accessible water resource information and data. While agencies in Nevada have made important strides in gathering, compiling and sharing water resources information, more needs to be done to provide a common and accurate core of information to enable timely and wise decisions. Future State Water Plan releases would be significantly enhanced with improvements in data management and availability. Following are the main issues that need to be addressed:

1. The State lacks a comprehensive plan to coordinate development and dissemination of temporal, textual and spatial (GIS) information.

2. Data accessibility needs to increase. Some datasets are stored on paper or electronic spreadsheets which reduces their usefulness. Other datasets are managed using database systems, but access may be restricted.

3. Without a comprehensive data inventory, potential users have difficulties in 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. A viable stream gaging program is an integral part of managing our water resources, yet funding

and maintaining the stream gages remains problematic.

8. Ongoing research on 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.

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C. Water Planning Assistance to Local Governments

Introduction

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.

Comprehensive water planning can be time consuming and costly to local governments. The State currently has some programs to provide local water planning assistance but more could be done to facilitate local water planning efforts. This issue paper describes the need for local water planning, ways in which the State currently provides planning assistance, and recommendations for improving the State's assistance to local planning entities.

The Need for Local Water Planning

As with the state government, local entities also need water plans as tools to guide future decisions affecting their regions. 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. Water purveyors, sanitation districts, towns and cities, counties, irrigation districts, water conservancy districts, and general improvement districts can all benefit by implementing water planning programs. Depending upon an entity's authority, a variety of planning efforts may be desirable. For example, water plans can be developed to address drought response and emergency water supplies needs, future water and wastewater infrastructure needs, future water supply needs and options, conservation programs, flood control, land use and comprehensive watershed needs.

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. Local water plans may be useful for identifying areas of potential conflict with other groups within the jurisdiction of the planning agency and suggest appropriate actions.

A local or regional water plan can go far in helping to address water quantity and quality issues, coordinating individual actions and developing unique information to help assess potential impacts of proposed actions. Local water planning can also create an atmosphere of cooperation between the various participants. If the planning is done in a comprehensive manner, it brings the community and stakeholders together to plan for their future. Cooperatively developed water plans can address

the needs of all stakeholders and ensure that one program, for example water supply, does not succeed to the detriment of other community and state goals such as habitat protection or water quality protection. However, planning does require time and money to develop real solutions for the long term, not just quick fixes.

There are a number of local water and watershed planning efforts currently underway in Nevada. Southern Nevada Water Authority and Washoe County have successfully developed water resource plans which are frequently updated. Elko, Eureka, Lincoln, Nye and White Pine counties are developing water plans, but with limited staffing and funding support. In addition, the Carson River Subconservancy District is developing a regional water plan for the Carson Basin. A number of research and water planning efforts are underway in the Walker River basin (which encompasses parts of Mineral, Lyon and Douglas counties) aimed at developing technical information and tools to guide water resource decisions within the basin. Utilizing a one-time federal appropriation, the Nevada Division of Water Planning has recently hired a part-time watershed planner to facilitate the coordination of the various efforts in the Walker basin. During the mid-1990s, the Humboldt River Basin Water Authority was formed, with membership from Humboldt, Lander, Eureka, Elko and Pershing counties. The Authority has defined a number of roles and responsibilities for itself, including review and comment on activities which may impact the water resources within the Humboldt River Basin, and facilitation of the development and maintenance of data and information regarding the use and management of Humboldt River Basin water resources.

Water Planning Assistance

Many local governments have limited personnel and funding resources for water planning. As a result, local governments sometimes have difficulties with: effectively developing regional water plans and updating existing plans; planning for growth; adequately addressing environmental concerns; participating in planning efforts by others, such as Bureau of Land Management, U.S. Forest Service, that may affect local regions; and reviewing and commenting on federal environmental impact statements and environmental assessments for proposed projects in their area.

State water planning assistance to local governments can occur in many forms:

- Information and data sharing

  The State can assist local water planning by developing, providing or increasing access to water-related data, such as water use estimates, available and committed water resources, water quality characteristics, groundwater levels, and streamflow rates.

- Financial support of local water planning efforts

  The State can provide funding to support local water planning efforts. Funding could be used for the local water planning groups to hire staff and/or consultants to develop the necessary plans.

- Review of local water planning documents

  By reviewing planning documents and providing input, the State can be involved in improving local planning products and reports, and the local decisionmaking process.

- Technical assistance

  The State can provide technical assistance through a variety of activities such as: information and data sharing, data analysis, document review, document preparation, and map development.

- Participation in local water planning efforts

  The State can be an active participant in local water planning activities by having staff attend planning group meetings, facilitate planning meetings, and/or serve on local planning boards. Such involvement represents a high level of commitment to the local process and requires that the State obligate staff and associated funding as needed for the long term.

Current Water Planning Assistance Efforts

A number of state agencies provide local water planning assistance in some form, either directly or indirectly through the methods discussed above. Following are some examples of state assistance to local water planning efforts. This list is by no means intended to be a complete discussion of all water planning assistance currently occurring within Nevada.

Nevada Division of Water Planning

The Nevada State Legislature recognizes the need for local water planning assistance and the role of the Division of Water Planning (NDWP) in providing this assistance. As stated in the Nevada Revised Statutes pertinent to NDWP, "The legislature determines that the purpose of the state's water resource planning is to assist the state, its local government and its citizens in developing effective plans for the use of water" (NRS 540.011(4)). It is further stated that NDWP shall "Provide political subdivisions and private enterprises in arid regions with information, alternatives and recommendations bearing upon regional shortages of water including feasible selections or courses of planning and action for acquiring additional water or for conserving water now available, or both" (NRS 540.051).

NDWP has undertaken a number of activities in an attempt to satisfy these legislative directives. In fact, most of NDWP's activities provide some form of assistance to local interests:

- NDWP has generated numerous documents covering a variety of water-related topics and has compiled many socioeconomic databases, which are made available to local planning groups. In addition, the Division maintains an extensive library of 4,000 water-related

documents which serves as an aid to other planning and research entities. NDWP handles numerous requests for these publications and database. These documents and data have been a valuable resource for both the Division and other entities throughout Nevada and the United States. To improve data and information access and distribution, NDWP has developed an Internet homepage to help interested agencies and the public obtain desired information; and for providing links to other agency's Internet sites.

- As the lead agency for floodplain management at the state level, NDWP's duties include implementation of the Flood Mitigation Assistance Grants (FMA) program and the Community Assistance Program (CAP). FMA grants to local governments are for mitigation projects aimed at reducing repetitive insurance losses and future damage. Through this program, communities can also obtain technical and financial assistance for the development and updating of Flood Mitigation Plans. The Community Assistance Program focuses on assisting communities to plan for flooding events and prevent damages by locating buildings outside the floodplain or away from alluvial fans. Staff develop and update the state model flood ordinance and assist communities in developing and implementing their own ordinances and building codes. Staff also provide training to local officials on the latest FEMA regulations and flood management technologies.

- NDWP staff regularly provide assistance to local watershed planning groups, local governments and planning groups, and private citizens. This assistance has included activities such as providing technical reviews of documents; compiling and providing data, information and reports; cosponsoring conferences and technical training sessions; facilitating the development of additional data; and participating in local planning meetings. For example, NDWP is a non-voting member of the Washoe County Regional Water Planning Commission, and has participated in local planning efforts in the Walker, Carson, Truckee and Humboldt River basins. Further, at the request of White Pine County, the Division provided input on their draft water plan outline and has provided technical data in support of their plan. NDWP also handles many telephone, written and electronic mail requests for data, information, and technical advice.

- The Division administers the AB198 Grants to Small Water Systems program. Under this program, the Board for Financing Water Projects can award a total of $40 million dollars in grants to assist small water systems to provide better, higher quality water and become more self sufficient. Division staff review grant requests for capital improvements and work with communities to develop water system designs and financial approaches to best serve their customers. To date, 19 communities have received a total of over $19 million dollars to fund new wells and pumps, replace aging and leaking tanks and pipes, loop lines, rehabilitate springs, and install new treatment systems.

- The *State Water Plan* is intended to serve as a planning tool for local governments. The Plan provides information on existing laws and regulations, water resources, socioeconomic characteristics, and issue discussions and recommendations which will be useful to local planning groups.

While NDWP has provided local assistance in a variety of forms, the Division has been limited in its ability to provide a higher level of support. In some instances, the Division is not able to fully participate in local planning activities due to limited funding and staffing.

Nevada Division of Environmental Protection (NDEP)

208 Water Quality Management Plans. Section 208 of the federal Clean Water Act defines the need for the development and implementation of areawide wastewater treatment management plans. Following are the five areas for which 208 plans have been developed and the agencies responsible for plan development:

Planning Area	Responsible Agency
Carson River Basin	Nevada Division of Environmental Protection
Clark County	Clark County Board of County Commissioners
Lake Tahoe Basin	Tahoe Regional Planning Agency
Washoe County	Truckee Meadows Regional Planning Agency
Remainder of the State	Nevada Division of Environmental Protection

As indicated by this list, NDEP provides assistance to local entities through the development of 208 plans for a majority of the State's geographic area.

Wellhead Protection Program. Wellhead protection involves integrated resource planning and preventative actions intended to reduce the risk of contamination of the drinking groundwater supplies. In part, developing a Wellhead Protection Program (WHPP) has resulted in coordinated efforts by cooperating agencies and organizations to delineate wellhead protection areas, inventory potential and existing contamination sources, select and implement strategies for minimizing contamination potential, develop plans for locating new wells, and develop a contingency plan. NDEP provides technical and financial assistance when available to communities developing WHPPs.

Nonpoint Source Management Program. Section 319 of the federal Clean Water Act establishes the Nonpoint Source Management Program which is administered by NDEP. Under this program, NDEP provides technical and financial assistance for implementation of nonpoint source pollution control projects.

Nevada Division of State Lands. 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 water conservation, land use, population, public services and facilities, recreation and solid waste disposal. Upon request, Division of State Lands staff may provide technical assistance to the local entities during the plan development. Assistance has consisted of data sharing, document review and comment, and actual plan preparation and public meeting facilitation.

The Division of State Lands is working in cooperation with appropriate federal and state agencies and local governments to develop plans or statements of policy concerning the acquisition and use

of lands under federal management. The plans or statements of policy are developed to provide local input to federal land planning actions and require the approval of the governing board of the affected county.

Issues

Following is a summary of the main issues related to water planning assistance to local governments:

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 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 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.

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D. Water Education

Introduction

As the driest state in the nation and one of the fastest growing, 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. An educated populace is clearly a key to future management of water resources, and therefore, water education must become a priority.

Benefits of Water Education

The overall goal of water education is to develop more knowledgeable citizens who can participate in public discussion and debate about water issues. Information improves people's ability to examine and evaluate information presented — and the information that is not presented. With a basic understanding of water, residents can respond intelligently to issues such as the need to develop water supplies or wastewater treatment facilities, the benefits and costs of conservation, the dangers associated with leaking contaminants, the risks posed by poor water quality, the benefits and costs of river restoration or flood control. With education, people can form their own opinions based on data and information, and rely less on emotion or rhetoric.

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 as a topic has natural links to science, math, social studies, and language and is an excellent unifying curricular theme. Water attracts kids and learning about it can be interesting and fun, encouraging both a greater appreciation of the environment and a greater interest in selecting science and math oriented careers.

Background

The state of Nevada has had a water education program in the Nevada Division of Water Planning since 1991. The program has components focusing on both children and adults, and incorporates a variety of methods, tools and approaches to increase learning about water. The state water plan itself is an important educational tool.

Project WET

Project WET (Water Education for Teachers) is a science and math education enhancement program focused on grades K-12. It is an interdisciplinary program intended to supplement a school's existing curriculum. The mission of National Project WET is to increase awareness, appreciation, knowledge and stewardship of water resources. Project WET offers Nevada's teachers classroom-ready teaching

aids such as activity guides, lesson plans, groundwater and watershed models, computer simulations, publications and a network of specialists to call upon, so that incorporating water education into the classroom is easy for teachers and interesting for children.

National Project WET began in the 1980's at the University of North Dakota. The program's founder, Dennis Nelson, eventually moved to the University of Montana where the program is headquartered today. Forty states in the country have Project WET programs. In Nevada, the Division of Water Planning has sponsored the program with help from a variety of partners including the University of Nevada – Cooperative Extension and the U.S. Bureau of Reclamation. The Division of Water Planning operates the program under a cooperative agreement with National Project WET. National WET continues to establish guiding principles and standards for the program, develop new educational materials, sponsor national meetings for Project WET coordinators in all the participating states and assist with fund raising.

There are over 12,000 K-12 teachers in Nevada. Of these, approximately 700 have taken the 15-hour, 1-credit Project WET course. The course is accredited through the University of Nevada in both Reno and Las Vegas, Sierra Nevada College, Western Nevada Community College in Carson City and Fallon, and Brigham Young University in Salt Lake City. It is available for both graduate and undergraduate credit and for teacher in-service credit. Evaluations for the program have been outstanding. The only issues have concerned the large amount of information to be mastered, the desire to have more frequent classes in all areas of Nevada and the desire to obtain advanced training.

Nevada Project WET has no staff and has been dependent on grant funding. Over the last 7 years, the Division has raised close to $175,000 to support the program, with a state contribution during this period of approximately $15,000. In the last legislative session, the Legislature added $20,000 per year to the Division of Water Planning's budget to help support the program. The state dollars are being used to fund two water education contractors, one of whom is responsible for managing, tracking and applying for more grants (among other duties), while the other coordinates and instructs the Project WET classes throughout Nevada. Yet another contractor is supported by federal grant funds to coordinate and teach Project WET classes in southern Nevada.

Funding and staffing for Nevada Project WET has been provided by the Eisenhower Foundation, the U.S. Bureau of Reclamation, the U.S. Environmental Protection Agency, National Project WET, the Nevada Division of Environmental Protection's Section 319 Grant Program, the Southern Nevada Water Authority and the University of Nevada – Cooperative Extension.

Nevada Riverwatch

In 1996 and 1997, the Division of Water Planning was awarded several federal grants to start a student water quality monitoring program. The goals of *Nevada Riverwatch* are to help students develop skills in: (1) science (through sample collection, field and laboratory analysis, recordation, observation and comparison); (2) math, statistics, and time series using computers (through analysis of the data); (3) writing (by keeping records and writing an end of the year report); and (4) public speaking (by presenting data at conferences.) The funds were used to hire a contractor to design and implement the program, and to purchase extensive field and classroom equipment to test local waters

in northern Nevada. It is expected that the program will be expanded throughout Nevada if the pilot program is successful.

The Division developed Memorandums of Understanding (MOUs) with junior high and high schools in Washoe and Lyon Counties and Carson City. Each school had to agree to have the students take pre- and post- tests to evaluate the knowledge they gained during the project, help co-sponsor an end-of-the-year conference where students from all three schools would present their testing results, and make a three-year commitment to the program. Testing sites along the Truckee and Carson Rivers were selected and the Division arranged to have staff from cooperating agencies instruct the students and teachers in proper sampling and analysis techniques.

At this time the MOUs with the schools have been developed and all of the field and classroom equipment has been purchased. The first sampling period was to begin in winter of 1997, but was delayed a year because of flooding on the rivers, and then by restoration and clean-up work at the sample sites. The Division's contractor was laid off for a while due to fiscal issues arising from the grant funding. The Division is now about to rehire the contractor and continue the program. Funding sources for Nevada Riverwatch have included grants from the Nevada Division of Environmental Protection's Section 319 program and the U.S. Geological Survey (USGS) Educational Partnership program.

Nevada Water Education Calendar

For 7 years the Division of Water Planning has produced a Water Education Calendar for use in all 2nd through 6th grade classrooms in Nevada. Each year, the Division sponsors a poster contest using a different water theme. Children in grades 3 through 6 submit posters for judging. Thirteen of the posters are published in the water education calendar along with water facts and figures. To offset the costs of producing and printing the calendar, the Division solicits donations. The calendar includes a write-up on each major sponsor. A number of agencies in the Department of Conservation and Natural Resources help to co-sponsor the calendar including the Divisions of Water Resources and Environmental Protection. Other sponsors include the Bureau of Reclamation, Washoe and Clark Counties, mining companies, engineering companies, and private individuals.

Adult Education

The Division of Water Planning is also active in the adult water education arena. Throughout the year the Division co-sponsors seminars, conferences and events to help agency staff, professionals and the general public learn more about water. Examples from 1998 include two widely attended flood conferences about the Carson and Walker Rivers, the annual Nevada Water Resource Association Conference, a full day seminar on water banking, the Champions of the Truckee River Day, and Clean-up the Carson River Day. Frequent presentations on water topics and issues are made to service clubs, professional associations, and elected and advisory boards.

Staff from the Divisions of Water Resources (DWR) and Environmental Protection (DEP) provide similar educational support. In 1998, the DWR sponsored a number of full-day seminars on water rights and was actively involved in the NWRA conference, and the DEP gave many presentations to

groups, especially on the subject of groundwater protection.

Issues

1. **Grant Funding – Administrative and Fiscal Support.** Grants often require a large amount of administrative and fiscal support. Efforts must be devoted to researching grant opportunities and developing and writing grant proposals. Such proposals require a great deal of preliminary work to develop partnerships, prepare budgets, identify appropriate state match opportunities and generate letters of support. Once a grant is obtained, detailed administrative and fiscal data must be maintained and quarterly reports must be prepared. Tracking and accounting activities are usually significant. The time spent in grant administration could be more effectively spent in providing hands-on water education activities in the classroom or in the field.

   The addition of funds for Project WET contractors has allowed some of the administrative work to be assigned to contractors. However, many administrative activities are not appropriately assigned to contractors. State staff is necessary to coordinate and manage the water education programs, grants and contracts.

2. **Grant Funding – Match Requirements.** Many federal grants require a state match. The limited amount of state dollars available has limited the state's ability to qualify for a number of grants in terms of meeting the match requirements.

3. **Grant Funding - Start-Up.** Many federal grants are designed to provide startup funds, not long-term, continued funding. Oftentimes the Division has been able to tap a funding source only two to three times. The 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.** The American Water Works Association recently published a study on the importance of water education at all levels.[1] They found a broad range of programs across the country. According to the research, the cost of these programs is quite low, ranging from 5 to 57 cents per household per year, with an average of only 24 cents per household per year. There was widespread agreement about the long term value of such programs and the fact that youth education programs provide an excellent opportunity for outreach. There is also 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.

[1] Mirvis and Clark, *Assessing the value of youth education*, in Journal of the American Water Works Association, Volume 90, Issue 1, January 1998.

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.

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Nevada State Water Plan
PART 3 — WATER MANAGEMENT ISSUES

Section 6
Glossary of Terminology

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

Abandoned Well — A well which is no longer used or a well removed from service; a well whose use has been permanently discontinued or which is in a state of such disrepair that it cannot be used for its intended purpose. Generally, abandoned wells will be filled with concrete or cement grout to protect underground water from waste and contamination.

Acid Mine Drainage — Acidic water that flows into streams from abandoned mines or piles of mining waste or tailings. Iron sulfide oxidation products include sulfuric acid, the presence of which has reduced or eliminated aquatic life in many streams in mining regions. Also see *Open-Pit Mining* and *Yellowboy*. Also referred to as *Acid Mine Waste*.

Alluvial Fan Flooding — Flooding occurring on the surface of an *Alluvial Fan* or similar landform which originates at the apex and is characterized by high-velocity flows: active processes of erosion, sediment transport, deposition, and unpredictable flow paths.

Annual Flood — The highest peak discharge of a stream in a *Water Year*.

Annual Low-Flow — The lowest flow occurring each year, usually the lowest average flow for periods of perhaps 3, 7, 15, 30, 60, 120, or 180 consecutive days.

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.

Base Flood (100-Year Flood) — The flood having a 1 percent average probability of being equaled or exceeded in a given year at a designated location. It may occur in any year or even in successive years if the hydrologic conditions are conducive for flooding. Also see *Hundred-Year Flood, X-Year Flood,* and *X-Year Flood, Y-Duration Rain*.

Base Flood Elevation — The height in relation to mean sea level (MSL) expected to be reached by the waters of the base flood at specific points in the floodplain of *Riverine* areas.

Basin Management (of Water) — Also referred to as *Water or Watershed Management,* it is 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 man. Basin management for water production is concerned with the quality, quantity, and timing of the water which is produced.

Beneficial Use (of Water) — (1) The amount of water necessary when reasonable intelligence and diligence are used for a stated purpose. (2) A use of water resulting in appreciable gain or benefit to the user, consistent with state law, which varies from one state to another. Most states recognize the following uses as beneficial:

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

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

(3) 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-consumptive 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) — Accepted methods for controlling *Non-Point Source (NPS) Pollution* as defined by the 1977 *Clean Water Act (CWA)*; may include one or more conservation practices. Also refers to water conservation techniques of proven value. See, for example, *Best Management Practices (BMP) — Urban Water Use*.

Best Management Practices (BMP)–Urban Water Use — Water conservation measures that generally meet one of two criteria: (1) Constitutes an established and generally accepted practice among water purveyors 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. Thus, the term encompasses different ecosystems, species, and genes. It is generally accepted that human survival is dependent upon the conservation and preservation of a diversity of life forms. Typically five levels of biodiversity are recognized:

[1] ***Genes*** — Genetic diversity encompasses the variety of genetically coded characteristics of plant and animal populations;
[2] ***Populations*** — Groups of individuals of a species that interbreed or interact socially in an area;
[3] ***Species*** — The level at which most organisms are recognizable as distinct from all others;
[4] ***Natural Communities*** — Groups of species that typically occur in recognizable units, such as redwood forests, coastal sage scrub, or oak woodlands. A natural community includes all the vegetation and animal life, and their interactions within that community; and
[5] ***Ecosystems*** — A collection of natural communities. 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.

Biological Oxygen Demand (BOD) — A measure of the amount of oxygen removed from aquatic environments by aerobic micro-organisms for their metabolic requirements. Measurement of BOD is used to determine the level of organic pollution of a stream or lake. The greater the BOD, the greater the degree of water pollution. Also referred to as *Biochemical Oxygen Demand (BOD)*.

Blackwater — Water that contains animal, human, or food wastes; wastewater from toilet, latrine, and agua privy flushing and sinks used for food preparation or disposal of chemical or chemical-biological ingredients. Compare to *Greywater*.

Candidate Species — Plant or animal species designated by the Department of the Interior, *U.S. Fish and Wildlife Service (USFWS)* as candidates for potential future listing as an *Endangered Species* or *Threatened Species* pursuant to the *Endangered Species Act (ESA)* of 1973; plant or animal species that are candidates for designation as endangered (in danger of becoming extinct) or threatened (likely to become endangered).

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).

Community Assistance Program (CAP) — A grant program for state programs funded by the *Federal Emergency Management Agency (FEMA)* with the objective of providing technical assistance for flood mitigation activities and coordinating floodplain management activities in counties and communities participating in the *National Flood Insurance Program (NFIP)*.

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.

Conservation District — A public organization crated under state-enabling law as a special purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries. In the United States, such districts are usually a subdivision of state government with a local governing body and are frequently called a soil conservation district or a soil and water conservation district.

Conservation Easement — An agreement negotiated on privately owned lands to preserve open space or protect certain natural resources.

Coordinated Resource Management and Planning — A planning process used by the U.S. Department of the Interior, *Bureau of Land Management (BLM)* that includes public users, interest groups, agencies and affected individuals in the decision-making process before on-the-ground implementation of an activity plan.

Data — In its strictest sense, data may be defined only as the raw numbers (or descriptions, in the case of qualitative data), either in *Time-Series* format (data covering observations over specific periods of time), *Cross-Sectional* format (spatial numeric data consisting of a number of observations taken at a specific point in time or about a specific event or phenomenon), or a combination of these two. Information, on the other hand, deals more specifically with the manipulation, re-organization, analysis, graphing, charting, and presentation of data for specific management and decision-making purposes. Also see *Information Management*.

Data Base — A well-defined collection of data, usually of the same general type, which can be accessed by a computer and may readily be used for further analysis, presentation, and forecasting.

Data Management — The act, process, or means by which data is managed. This may include the compilation, storage, safe-guarding, listing, organization, extraction, retrieval, manipulation, and dissemination of data.

Designated Groundwater Basin — A basin where permitted ground water rights approach or exceed the estimated average annual recharge and the water resources are being depleted or require additional administration. Under such conditions, a state's water officials will designate a groundwater basin and, in the interest of public welfare, declare *Preferred Uses* (e.g., municipal and industrial, domestic, agriculture, etc.). Also referred to as *Administered Groundwater Basin*.

Designated Groundwater Basin [Nevada] — In the interest of public welfare, the Nevada State Engineer, *Division of Water Resources, Department of Conservation and Natural Resources*, is authorized by statute (Nevada Revised Statute 534.120) and directed to designate a ground water basin and declare *Preferred Uses* within such designated basin. The State Engineer has additional authority in the administration of the water resources within a designated ground water basin. [A listing of Nevada's Hydrographic Regions, and designated 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).]

Dewater, and Dewatering — (1) To remove water from an aquifer or streambed. (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.

Disaster Relief Bill (SB 218) [Nevada] — A State of Nevada fund established to help communities recover from damages sustained in a disaster.

Dissolved Oxygen (DO) — (1) Concentration of oxygen dissolved in water. (2) The amount of free (not chemically combined) oxygen dissolved in water, wastewater, or other liquid, usually expressed in milligrams per liter, parts per million, or percent of saturation. Adequate concentrations of dissolved oxygen are necessary for the life of fish and other aquatic organisms and the prevention of offensive odors. Dissolved oxygen levels are considered the most important and commonly employed measurement of water quality and an indicator of a water body's ability to support desirable aquatic life. The ideal dissolved oxygen level for fish is between 7 and 9 milligrams per liter (mg/l); most fish cannot survive at levels below 3 mg/l of dissolved oxygen. Secondary and advanced wastewater treatment techniques are generally designed to ensure adequate dissolved oxygen in waste-receiving waters.

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.

Drinking Water Standards [Nevada] — The primary objective of Nevada's drinking water standards is to assure safe water for human consumption. To this end, the *Nevada Department of Human Resources, Health Division — Consumer Health Protection* has established statewide primary and secondary drinking water standards at least as rigorous as those required by the *U.S. Environmental Protection Agency (EPA)*. *Primary Drinking Water Standards* limit contaminants (constituents) which may affect consumer health. *Secondary Drinking Water Standards* were developed to deal with the aesthetic qualities of drinking water. [Appendix B–3, Nevada Drinking Water Standards, presents a listing of Nevada's current primary and secondary drinking water quality standards.]

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.

Ecology — The study of the inter-relationships of living things to one another and to the environment.

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

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

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

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 Control Districts — A district organized to manage flooding hazards through land use controls and construction and maintenance of flood control structures.

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*.

Flood Hazard Zones (Defined) — Zones on the *Flood Insurance Rate Map (FIRM)* in which the risk premium insurance rates have been established by a *Flood Insurance Study (FIS)*.

Flood Insurance — A means of spreading the cost of flood losses. It enables property owners in communities participating in the *National Flood Insurance Program (NFIP)* to purchase insurance against loss resulting from floods.

Flood Insurance Rate Map (FIRM) — Official map on which the *Federal Emergency Management Agency (FEMA)* has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

Flood Insurance Study (FIS) — A document containing the results of an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations, mudslides and erosion hazards.

Flood Mitigation Assistance Program (FMA) — A grant program funded by the *Federal Emergency Management Agency (FEMA)* with the objective of providing funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes and other structures insurable under the *National Flood Insurance Program (NFIP)*.

Floodplain, also Flood Plain — (1) A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current. It is called a *Living Flood Plain* if it is overflowed in times of high water but a *Fossil Flood Plain* if it is beyond the reach of the highest flood. (2) The lowland that borders a stream or river, usually dry but subject to flooding. (3) That land outside of a stream channel described by the perimeter of the *Maximum Probable Flood*. Also referred to as a *Flood-Prone Area*.

Floodplain Management — Comprehensive flood damage prevention programs which require the integration of all alternative measures (structural and nonstructural) in investigation of flood problems and planning for wise use of the floodplain. Includes corrective and preventive measures for reducing flood damage and preserving and enhancing, where possible, natural resources in the floodplain, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations and ordinances.

Floodplain Management Regulations — Any federal, state, or local government regulations and zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as a grading permit and erosion control requirement) and other applications of regulatory power which control development in flood-prone areas specifically for the purpose of preventing and reducing flood loss and damage.

Floodplain Management Measures — Refers to an overall community program of corrective and preventive measures for reducing future flood damage. The measures take a variety of forms and generally include zoning, subdivision, or building requirements and special-purpose floodplain ordinances. Also see *National Flood Insurance Program (NFIP)* and *Federal Emergency Management Agency (FEMA)*.

Gap Analysis — A method for determining spatial relationships between areas of high biological diversity and the boundaries of *National Parks*, *National Wildlife Refuges (NWR)*, and other preserves. The primary goal of Gap Analysis is to prevent additional species from being listed as threatened or endangered. Analyses are made and displayed using a *Geographic Information System (GIS)*. Estimates of diversity are often derived from known or hypothesized relationships between mapped plant communities and animal populations. In addition to the *National Biological Survey*, which serves as the primary coordinating agency, there are over 200 collaborating organizations involved in performing Gap Analysis on a state-by-state basis, including businesses, universities, and state, local, and federal government entities. [The term *Gap* originated from an initial *Biodiversity* study in Hawaii which showed that for certain sensitive animal species there existed a physical (geographic) gap between the species and its habitat and wildlife preserves (national parks, forests, wildlife protection areas, etc.), indicating potential

limitations of species and habitat protection.]

Geothermal — Terrestrial heat, usually associated with water as around hot springs.

Greywater (Graywater) — Waste water from a household or small commercial establishment which specifically excludes water from a toilet, kitchen sink, dishwasher, or water used for washing diapers.

Groundwater, also Ground Water — (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*.

Import (Water) — Water piped or channeled into an area.

Injection — Generally refers to a system of artificially introducing surface water into the ground water system as a means of storage or recharge. Most typically, this includes the use of *Recharge Wells* which work directly opposite of pumping wells to inject surface water into underlying formations. Depending on the water-bearing formation, these methods may have limited usefulness and are generally better used for pumping water into deep, confined aquifers. (Water Quality) Refers to a system of subsurface disposal of brine effluent into an acceptable formation. Also see *Induced Recharge*.

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.

Instream Flow Requirement — The flow required in a stream to maintain desired instream benefits such as navigation, water quality, fish propagation, and recreation.

Integrated (Water) Resource Planning (IRP) — A comprehensive, interdisciplinary approach to water resource planning that encompasses water resource assessment, demand considerations, analysis of alternatives, risk management, resource diversity, environmental considerations, least-cost analysis, multidimensional modeling, and participatory decision making and public input, among other factors. Integrated Resource Planning begins with specific policy objectives that are applied to extensive lists of options for water supply sources, distribution systems, or other operational requirements. The options are then narrowed after evaluating demand requirements, environmental impacts, conservation options, costs, risks, and other aspects of a project. IRP involves a dynamic process of assessing demand and supply conditions and creatively integrating alternatives and new technologies. While the concepts of IRP are relatively new to the process of water planning, it has been used extensively in the energy industry. As a planning process it helps decision makers select the best mix of water resources, facilities, and conservation measures to meet water demands.

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*.

Intermittent Stream — A stream that carries water only part of the time, generally in response to periods of heavy runoff either from snowmelt or storms; a stream or part of a stream that flows only in direct response to precipitation. It receives little or no water from springs or other sources. It is dry for a large part of the year, generally more than three months. Flow generally occurs for several weeks or months in response to seasonal precipitation, due to groundwater discharge, in contrast to the *Ephemeral Stream* that flows but a few hours or days following a single storm. Also referred to as *Seasonal Streams*. Also see *Stream*.

Interstate Waters — According to federal and state laws, interstate waters are defined as: (1) rivers, lakes and other waters that flow across or form a part of state or international boundaries; (2) waters of the Great Lakes; and (3)

coastal waters whose scope has been defined to include ocean waters seaward to the territorial limits and waters along the coastline (including inland steams) influenced by the tide.

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*.

Land Use Planning — The process of inventorying and assessing the status, potentials, and limitations of a particular geographic area and its resources, interacting with the populations associated and/or concerned with the area to determine their needs, wants, and aspirations for the future.

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.

Minimum Instream Flow — The specific amount of water required to support aquatic life, to minimize pollution, or for recreation. It is subject to the priority system and does not affect water rights established prior to its institution.

Mitigation — (1) (Environmental, General) Actions designed to lessen or reduce adverse impacts; frequently used in the context of environmental assessment. (2) (NEPA) Action taken to avoid, reduce the severity of, or eliminate an adverse impact. Mitigation can include one or more of the following:

[1] avoiding impacts;
[2] minimizing impacts by limiting the degree or magnitude of an action;
[3] rectifying impacts by restoring, rehabilitating, or repairing the affected environment;
[4] reducing or eliminating impacts over time; and
[5] compensating for the impact by replacing or providing substitute resources or environments to offset the loss.

Monitoring Well — (1) A well used to obtain water quality samples or measure groundwater levels. (2) (Water Quality) A well drilled in close proximity to a waste storage or disposal facility, or hazardous waste management facility or *Superfund Site* to check the integrity of the facility or to keep track of leakage of materials into the adjacent groundwater.

Native Species — A species that is a part of an area's original fauna or flora.

Natural Resource — A material source of wealth, such as timber, fresh water, or a mineral deposit, that occurs in a natural state and has economic and/or value. Natural resources are considered *Nonrenewable* when they do not naturally replenish themselves within the limits of human time or *Renewable* when they are more or less continuously replenished in the course of natural events within the limits of human time.

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.

Nonstructural Measures — Measures for managing, utilizing, or controlling water and related lands without structural development to achieve the desired objective. Such measures include best management practices, flood plain zoning, flood warning systems, education and legal restraints, and preservation, as well as the more common land management measures.

One Hundred-Year Flood — Having the same meaning as *Base Flood, 1 percent Flood,* or *Hundred-Year Flood*. Also see *X–Year Flood,* and *X–Year Flood, Y–Duration Rain*.

Overdraft — (1) A condition that occurs in a ground water basin when pumping exceeds recharge over an extended period of time. (2) That quantity of water pumped in excess of the safe yield; the act of overdrawing a water supply or aquifer in amounts greater than replenishment. Also, the sustained extraction of ground water from an aquifer at a rate greater than the recharge rate of the aquifer, resulting in a drop in the level of the water table. Also see *Ground Water Overdraft* and *Ground Water Mining*.

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*.

pH (Hydrogen Ion Concentration) — (1) A convenient method of expressing the acidity or basicity of a solution in terms of the logarithm of the reciprocal (or negative logarithm) of the hydrogen ion concentration. The pH scale runs from 0 to 14; a pH value of 7.0 indicates a neutral solution. Values above 7.0 pH indicate basicity (basic solutions); those below 7.0 pH indicate acidity (acidic solutions). Natural waters usually have a pH between 6.5 and 8.5.

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*.

Pollution — (1) Any alteration in the character or quality of the environment which renders it unfit or less suited for certain uses. With respect to water, the alteration of the physical, chemical, or biological properties by the introduction of any substance that adversely affects any beneficial use. (2) Adverse and unreasonable impairment of the beneficial uses of water even though no actual health hazard is involved. Under the Clean Water Act (CWA), for example, the term is defined as the manmade or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

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

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. National Project WET at Montana State University coordinates the individual state WET programs. The *Nevada Division of Water Planning* (*Department of Conservation and Natural Resources*), is the official sponsor of the Project WET program in the State of Nevada. Other water education programs include the International Office for Water Education (IOWE), established at Utah State University in 1983 to promote water/science education, the *U.S. Geological Survey (USGS)* National Water Information Clearinghouse (NWIC), which was established to serve as a focus for the dissemination of water resource information to all levels of government, academia, the private sector, the cooperative extension, and the general public.

Recharge (Hydrologic) — (1) The process by which water is added to the *Zone of Saturation*. (2) The introduction of surface or ground water to groundwater storage such as an aquifer. Recharge or replenishment of groundwater

supplies consists of three (3) types:

[1] ***Natural Recharge*** which consists of precipitation or other natural surface flows making their way into groundwater supplies;

[2] ***Artificial or Induced Recharge*** which includes actions by man specifically designed to increase supplies in a groundwater reservoirs through various methods such as water spreading (flooding), ditches, and pumping techniques; and

[3] ***Incidental Recharge*** which consists of actions, such as irrigation and water diversion, which add to groundwater supplies but are intended for other purposes.

Recharge may also refer to the amount of water so added.

Recharge Area (Groundwater) — The area in which water reaches the *Zone of Saturation* by surface infiltration. Infiltration moves downward into the deeper parts of an aquifer in a recharge area. Also referred to as a *Recharge Zone*.

Recharge, Artificial — The designed (as opposed to the natural or incidental) replenishment of ground water storage from surface water supplies. There exist five (5) common techniques to effect artificial recharge of a groundwater basin:

[1] ***Water Spreading*** consisting of the basin method, stream-channel method, ditch method, and flooding method, all of which tend to divert surface water supplies to effect underground infiltration;

[2] ***Recharge Pits*** designed to take advantage of permeable soil or rock formations;

[3] ***Recharge Wells*** which work directly opposite of pumping wells although have limited scope and are better used for deep, confined aquifers;

[4] ***Induced Recharge*** which results from pumping wells near surface supplies thereby inducing higher discharge towards the well; and

[5] ***Wastewater Disposal*** which includes the use of secondary treatment wastewater in combination with spreading techniques, recharge pits, and recharge wells to reintroduce the water to deep aquifers thereby both increasing the available groundwater supply and also further improving the quality of the wastewater.

Also referred to as *Induced Recharge*. Also see *Natural Recharge*, *Incidental Recharge*, *Injection*, and *Perennial Yield*.

Recharge Basin — A surface facility, often a large pond, used to increase the infiltration of surface water into a ground water basin.

Recharge Well — Used in conjunction with artificial or induced ground water recharge techniques, the recharge well works directly opposite of pumping wells to induce surface water into the ground water system. Based on the nature of the soil and rock being recharged, the use of recharge wells typically have limited scope and are better employed for recharging deep, confined aquifers. Also see *Injection*.

Reclaimed Waste Water — Waste water that becomes suitable for a specific beneficial use as a result of treatment or brackish water demineralized for use. General types of reclaimed waste water include:

[1] ***Primary Effluent*** — reclaimed water that only has had sewage solids removed and is typically used only for surface irrigation of tree, fodder, and fiber crops;

[2] ***Secondary Effluent*** — reclaimed water that has had sewage solids removed and has been oxidized and disinfected and is used to irrigate golf courses and cemeteries and provide water for pasture and food crops; and

[3] ***Tertiary Recycled Water*** — water produced by conventional sewage treatment followed by more advanced procedures including filtration and disinfection, providing it with the broadest range of uses.

Also see *Waste Water Reclamation* and *"Repurified Water."*

Reclaimed Water — Refers to water that has received at least *Secondary Wastewater Treatment* and is reused after flowing out of a wastewater treatment facility.

Recreation Resource — Land and water areas and their natural attributes, with or without man-made facilities, that provide opportunities for outdoor recreation.

Restoration — The act or process of bringing something back to a previous condition or position. For example, the establishment of natural land contours and vegetative cover following extensive degradation of the environment caused by activities such as *Surface Mining*. Under this condition, the term is used interchangeably with *Reclamation*.

Reuse (of Water) — (1) Water that is discharged by one user and is used by other users. (2) Repeated use of the same

water by subsequent users in sequential systems. Sometimes, it also means water discharged by one unit and used by other units in the same plant. Also referred to as *Recycled Water*.

Reverse Osmosis — (1) (Desalination) Refers to the process of removing salts from water using a membrane. With reverse osmosis, the product water passes through a fine membrane that the salts are unable to pass through, while the salt waste (brine) is removed and disposed. This process differs from electrodialysis, where the salts are extracted from the feedwater by using a membrane with an electrical current to separate the ions. The positive ions go through one membrane, while the negative ions flow through a different membrane, leaving the end product of freshwater. (2) (Water Quality) An advanced method of water or wastewater treatment that relies on a *Semi-permeable Membrane* to separate waters from pollutants. An external force is used to reverse the normal osmotic process resulting in the solvent moving from a solution of higher concentration to one of lower concentration.

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 Yield — (1) The rate at which water can be withdrawn from supply, source, or an aquifer over a period of years without causing eventual depletion or contamination of the supply. (2) A rate of extraction that does not deplete the basin over time. (3) (Groundwater) The amount of water that can be withdrawn from an aquifer without producing an undesired effect. (4) (Surface Water) The amount of water than can be withdrawn or released from a reservoir on an ongoing basis with an acceptably small risk of supply interruption (i.e., reducing the reservoir storage to zero.) More commonly referred to a *Perennial Yield* and *Sustained Yield*. Generally consists of the rate of *Natural Recharge*, *Artificial* (or *Induced*) *Recharge*, and *Incidental Recharge*.

Salinity — (1) The concentration of dissolved salts in water or soil water. (2) The relative concentration of salts, usually sodium chloride, in a given water sample. It is usually expressed in terms of the number of parts per thousand (‰) or parts per million (ppm) of chloride (Cl). Although the measurement takes into account all of the dissolved salts, sodium chloride (NaCl) normally constitutes the primary salt being measured. As a reference, the salinity of seawater is approximately 35‰. See *Salts* for comparative salt concentrations in water. Also see *Total Dissolved Solids*.

Sanitary Seal (Water Well) — The neat cement seal at the top of a water well intended to prevent well contamination from surface water or shallow ground water flows containing potential contaminants.

Sensitive Species — Those plant or animal species susceptible or vulnerable to activity impacts or habitat alterations. Species not yet officially listed but undergoing status review for listing on the *U.S. Fish and Wildlife Service's (USFWS)* official threatened and endangered list; species whose populations are small and widely dispersed or restricted to a few localities; and species whose numbers are declining so rapidly that official listing may be necessary. Also see *Endangered Species Act (ESA)*, *Endangered Species* and *Threatened Species*.

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*.

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. Also see *Hard Water* and *Salinity*.

Treated (Wastewater) Effluent — Water that has received primary, secondary, or advanced treatment to reduce its pollution or health hazards and is subsequently released from a wastewater facility after treatment.

Trihalomethanes (THMs) — (1) Any of several synthetic organic compounds formed when chlorine combines with organic materials in water during the disinfection process. The most common THM is chloroform.

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. Turbidity in water has public health implications due to the possibilities of pathogenic bacteria encased in the particles and thus escaping disinfection processes. Turbidity interferes with water treatment (filtration), and affects aquatic life. Excessive amounts of turbidity also make water aesthetically objectionable. The degree of the turbidity of water is measured by a *Turbidimeter*.

Water Bank — A mechanism for holding water for eventual use. A water bank may include the use of surface water reservoirs, underground storage facilities (e.g., groundwater recharge), or a combination of these mechanisms.

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. In its broadest sense, all water rights would be covered under such water banking arrangements to include surface water, groundwater, treated wastewater effluent, and irrigation tailwater. 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-Based Recreation — Those activities which require water for participation such as boating, swimming, sailing and canoeing.

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 Marketing — A concept of water transfer and use borne out of increased demand by urban populations for water whereby a holder of water rights is allowed to sell or lease those rights in an open market to the highest bidder. As an example, in the United States one acre-foot of water typically yields only about $400 on a farm versus $400,000 in manufacturing (National Geographic Special Edition, *WATER: The Power, Promise, and Turmoil of North America's Fresh Water*, November 1993). Such water marketing arrangements, however, can only succeed

where necessary water transport and delivery systems exist between supply points and demand points. There are a variety of transactions that are considered marketing transactions, including intrastate transfers, interstate transfers, interbasin transfers, conserved water, and short-term and long-term leasing arrangements, etc. Also see *Water Banking*.

Water Pollution — Generally, the presence in water of enough harmful or objectionable material to damage the water's quality. More specifically, pollution shall be construed to mean contamination of any waters such as will create or is likely to create a nuisance or to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, municipal, commercial, industrial, agricultural, recreational, or other legitimate uses, or to livestock, wild animals, birds, fish or other aquatic life, including but not limited to such contamination by alteration of the physical, chemical or biological properties of such waters, or change in temperature, taste, color or order thereof, or the discharge of any liquid, gaseous, radioactive, solid or other substances into such waters. More simply, it refers to quality levels resulting from man's activities that interfere with or prevent water use or uses.

Water Quality Management — Planning for the protection of a water's quality for various *Beneficial Uses*, for the provision of adequate wastewater collection, treatment, and disposal for municipalities and industries, and for activities that might create water quality problems, and regulating and enforcing programs to accomplish the planning goals and laws and regulations dealing with water pollution control.

Water Quality Standards — (1) A plan for water quality management containing four major elements: water use; criteria to protect uses; implementation plans, and enforcement plans. An anti-degradation statement is sometimes prepared to protect existing high quality water sources. (2) State-adopted and *U.S. Environmental Protection Agency (EPA)* approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

Watershed Protection Approach (WPA) — A type of pollution management program supported by the *U.S. Environmental Protection Agency (EPA)* as being the most effective mechanism for achieving clean water and healthy, sustainable ecosystems throughout the United States. The WPA is a "placed-based" strategy that integrates water quality management activities within hydrologically defined drainage basins or watersheds as opposed to using conventional, politically-defined boundaries. The WPA allows stakeholders to tailor corrective actions to local concerns within the coordinated framework of a state, Tribal, and national water program. In addition, an emphasis on public participation provides the opportunity to incorporate environmental justice issues into watershed management. Six basic objectives form the general foundations of EPA's watershed protection process:

[1] identifying critical watersheds with EPA and state participation;
[2] clearly defining the problems, general causes, and specific sources of risks and impairments to the watershed;
[3] developing potential pollution prevention and control strategies;
[4] implementing point and nonpoint source controls;
[5] developing scientifically valid and practical indicators for gauging and reducing the risks in the watershed; and
[6] developing ecological criteria that states may use in formulating future watershed protection standards.

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

Water Use Practices — Direct, indirect, consumptive, and nonconsumptive uses of water. These include domestic practices (e.g., washing, bathing, cooking, drinking), navigation, wildlife habitat management, irrigation practices, recreation activities, industrial uses, and hydroelectric power generation.

Water Use, Types — The use of water may be classified by specific types according to distinctive uses, such as the following:

[1] Commercial Water Use
[2] Domestic Water Use
[3] Hydroelectric Power Water Use
[4] Irrigation Water Use

[5] Livestock Water Use
[6] Mining Water Use
[7] Navigational Water Use
[8] Other Water Use
[9] Public Water Use (same as *Utility Water Use*)
[10] Residential Water Use (same as *Domestic Water Use*)
[11] Rural Water Use
[12] Thermoelectric Power Water Use

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, also Wetland — Wetlands are those areas where water saturation is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the surrounding environment. The identification of wetlands and associated habitats is regulated by complex federal legislation. The *U.S. Environmental Protection Agency (EPA)*, the *U.S. Army Corps of Engineers (COE)*, the (U.S. Department of Agriculture) *Natural Resources Conservation Service (NRCS)* (formerly the *Soil Conservation Service — SCS*), and the (Department of the Interior) *U.S. Fish and Wildlife Service (USFWS)*, have developed definitions of wetlands in response to their regulatory responsibilities. The single feature that all wetlands have in common is a soil or substrate that is saturated with water during at least a part of the growing season. These saturated conditions control the types of plants and animals that live in these areas. Other common names for wetlands are *Sloughs*, *Ponds*, *Swamps*, *Bogs*, and *Marshes*. Basically, all definitions of wetlands require that one or more attributes be met:

[1] ***Wetland Hydrology*** — At some point of time in the growing season the substrate is periodically or permanently saturated with or covered by water;
[2] ***Hydrophytic Vegetation*** — At least periodically, the land supports predominantly water-loving plants such as cattails, rushes, or sedges;
[3] ***Hydric Soils*** — The area contains undrained, wet soil which is anaerobic, or lacks oxygen in the upper levels.

Wildlife Management Areas (WMAs) [Nevada] — Nevada's Wildlife Management Areas (WMAs) are lands and waters which have been acquired to effectuate a coordinated and balanced program resulting in the maximum revival of fish and wildlife and in the maximum recreational advantages to the people of the State of Nevada. Lands in Nevada set aside as WMAs currently total almost 275,000 acres (429 square miles). State WMAs are subject to supervision by the Nevada Board of Wildlife Commissioners.

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

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Section 7
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