

# NATIONAL WATER SUMMARY ON WETLAND RESOURCES



United States Geological Survey  
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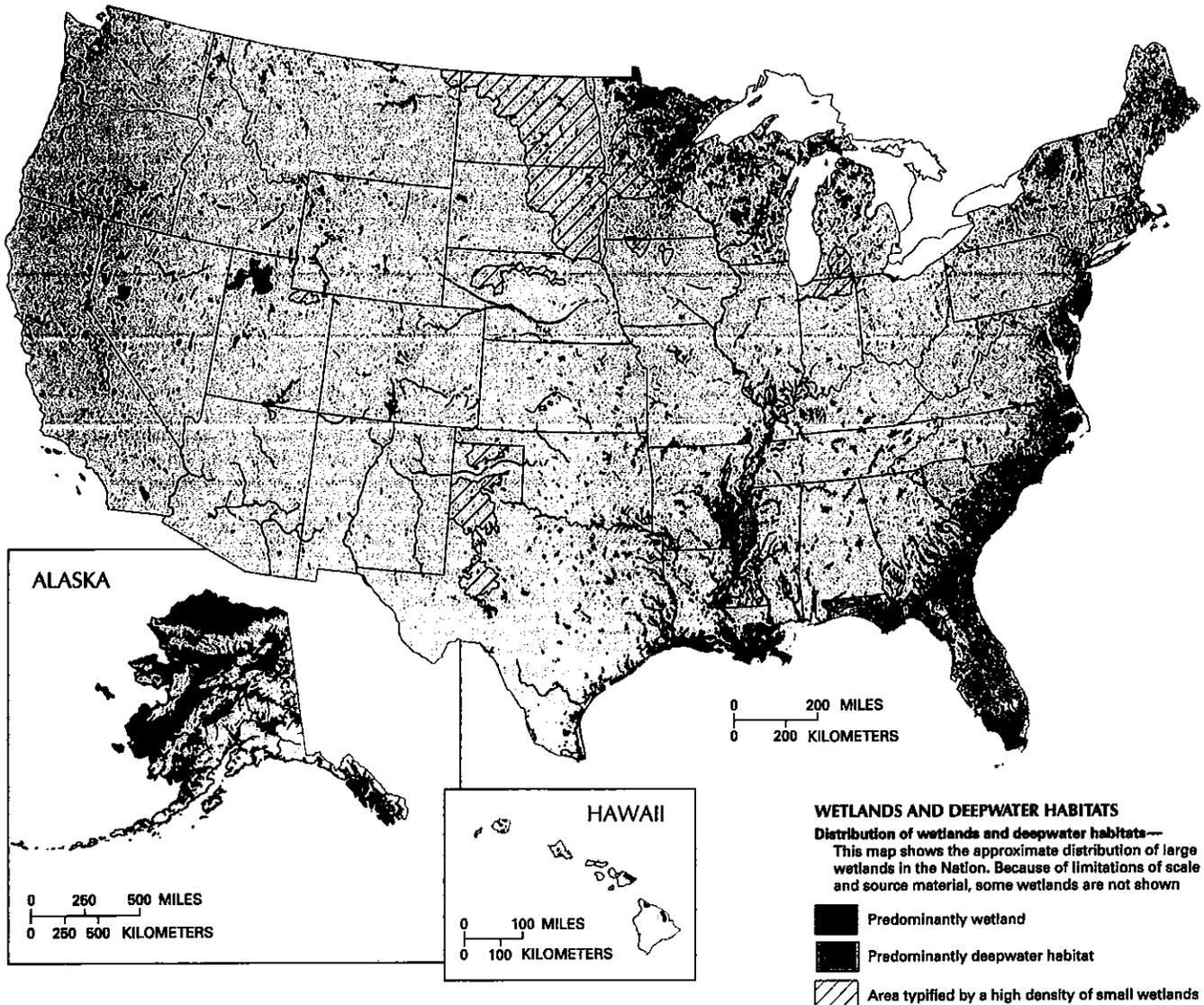
talities on highways and railroads; the floodwaters transported large amounts of contaminants and nutrients into and down streams; nuisance plants replaced native vegetation; and turbidity made it difficult for some fish to feed. Nevertheless, some fish spawn and feed on inundated flood plains when temperature rise accompanies flooding—which was the case in this flooding. Also, some fish habitat was improved by the creation of deep scour holes and massive underwater debris piles that provide cover. Effects of the flooding are discussed in "Effects of the Great Midwest Flood of 1993 on Wetlands."

## STATE SUMMARIES OF WETLAND RESOURCES

State Summaries of Wetland Resources in this National Water Summary provides an overview of the wetland resources of the 50 States, the District of Columbia (combined with Maryland), Puerto Rico, the U.S. Virgin Islands, and several Pacific islands over whose wetlands the United States has some form of jurisdiction. (The term "State" is used in the following discussion for all these geographic areas.) The State summaries contain the following sections:

### Types and Distribution

Wetlands in the United States are of many types. Some of the more familiar names for different kinds of wetlands are swamp, marsh, bog, playa, tideflat, prairie pothole, and pond. Examples of lesser known, local names for different wetland types are cienega, pocosin, muskeg, wet pine flatwoods, and willow carrs. The "Types and Distribution" section of each State summary contains a brief discussion of the wetland types in the State and relates the common, locally known wetland names to the classification system used by Federal agencies to identify and delineate wetlands (see the article "Wetland Definitions and Classifications in the United States" in this volume for an extensive discussion of wetland types and classification).



# Technical Aspects of Wetlands

## History of Wetlands in the Conterminous United States

By Thomas E. Dahl<sup>1</sup> and Gregory J. Allord<sup>2</sup>

At the time of European settlement in the early 1600's, the area that was to become the conterminous United States had approximately 221 million acres of wetlands. About 103 million acres remained as of the mid-1980's (Dahl and Johnson, 1991). Six States lost 85 percent or more of their original wetland acreage—twenty-two lost 50 percent or more (Dahl, 1990) (fig. 2). Even today, all of the effects of these losses might not be fully realized.

Historical events, technological innovations, and values of society sometimes had destructive effects on wetlands. By examining the historical backdrop of why things happened, when they happened, and the consequences of what happened, society can better appreciate the importance of wetlands in water-resource issues. Society's views about wetlands have changed considerably—especially in the last half century. Interest in the preservation of wetlands has increased as the value of wetlands to society has become more fully understood. From a cultural standpoint, it is interesting to understand how changes in opinions and values came about, and what effects these changes had on wetland resources. From an ecological perspective, it is important to understand how the loss of wetlands affects fish, wildlife, and the environment as a whole.

### EARLY 1600'S TO 1800—COLONIAL SETTLEMENT

Wetland drainage began with permanent settlement of Colonial America. Throughout the 1600's and 1700's, colonization was encouraged by European monarchs to establish footholds in North America. The effects of this colonization on the landscape became obvious in the early to mid-1700's.

Much of our knowledge of early wetlands comes from maps and other documents that survived over time. The origins of settlers influenced both where people settled and how they mapped and used natural resources. Few records exist because the original English, French, and Spanish settlements were established before the land was surveyed. Settlements in the North tended to be clustered, whereas communities in the South were more widely scattered because of the predominance of agriculture. Many different land surveying systems resulted in an incomplete patchwork of ownership that ultimately caused many legal problems due to boundary errors and overlapping claims (Garrett, 1988). It was not until 1785 that the Land Ordinance Act established the United States Public Land Survey, which required surveying and partitioning of land prior to settlement. Although not

*Interest in the preservation of wetlands has increased as the value of wetlands has become more fully understood.*



Figure 2. States with notable wetland loss, 1780's to mid-1980's. (Source: Modified from Dahl, 1990.)

<sup>1</sup> U.S. Fish and Wildlife Service.

<sup>2</sup> U.S. Geological Survey.

# Nevada

## Wetland Resources

**W**etlands cover less than 1 percent of Nevada but are some of the most economically and ecologically valuable lands in the State. Wetlands provide important habitat for the State's fish and wildlife. In Nevada, riparian (streamside) wetlands and large marshes provide stopover and breeding grounds for migratory waterfowl. Many of Nevada's threatened and endangered species inhabit wetlands. Other important functions of wetlands include flood attenuation, bank stabilization, and water-quality improvement (fig. 1). Economic benefits, such as recreational activities, are abundant in Nevada's wetland areas and include hunting, fishing, boating, bird watching, photography, and camping. Other economic benefits of wetlands and associated lands include grazing and mining. Wetland vegetation generally is more lush than that in surrounding uplands, so it is desirable for grazing of cattle or sheep. Mining of placer gold and silver deposits in riparian wetlands has been a profitable venture in parts of Nevada but not without negative effects on wetland resources. Economic-grade uranium deposits are present in alpine peat bogs and fens in the Sierra Nevada but have not been exploited.

### TYPES AND DISTRIBUTION

Wetlands are lands transitional between terrestrial and deepwater habitats where the water table usually is at or near the land surface or the land is covered by shallow water (Cowardin and others, 1979). The distribution of wetlands and deepwater habitats in Nevada is shown in figure 2A; only wetlands are discussed herein.

Wetlands can be vegetated or nonvegetated and are classified on the basis of their hydrology, vegetation, and substrate. In this summary, wetlands are classified according to the system proposed by Cowardin and others (1979), which is used by the U.S. Fish and Wildlife Service (FWS) to map and inventory the Nation's wetlands. At the most general level of the classification system, wetlands are grouped into five ecological systems: Palustrine, Lacustrine, Riverine, Estuarine, and Marine. The Palustrine System includes only wetlands, whereas the other systems comprise wetlands and deepwater habitats. Wetlands of the systems that occur in Nevada are described below.

System	Wetland description
Palustrine .....	Wetlands in which vegetation is predominantly trees (forested wetlands); shrubs (scrub-shrub wetlands); persistent or nonpersistent emergent, erect, rooted, herbaceous plants (persistent- and nonpersistent-emergent wetlands); or submersed and (or) floating plants (aquatic beds). Also, intermittently to permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep.
Lacustrine .....	Wetlands within an intermittently to permanently flooded lake or reservoir. Vegetation, when present, is predominantly nonpersistent emergent plants (nonpersistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both.
Riverine .....	Wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.

Nevada had about 236,350 acres of wetlands in the mid-1980's, according to an inventory by the FWS (Dahl, 1990). However, wetland acreage available as bird and fish habitat varies considerably from wet years to dry years, as detailed by Hoffman and others

(1990) for wetlands in Lahontan Valley. Palustrine and lacustrine wetlands constitute most of the State's wetland acreage. Forested, scrub-shrub, and emergent wetlands are the most common types of palustrine wetlands. Riparian wetlands are mostly forested and scrub-shrub types.

The Bureau of Land Management (BLM) administers almost 48 million acres of land in Nevada, of which approximately 75,000 acres are riparian-wetland habitat (Bureau of Land Management, 1991). More than 2,100 miles of riparian-stream habitat are present on BLM land in Nevada. Some of the largest areas of riparian wetlands are along the Humboldt River and the upper part of the White River. Large marshes, such as Stillwater Marsh (33,400 acres) and Humboldt Marsh (58,000 acres) and those on Carson Lake (25,600 acres) and Ruby and Franklin Lakes (20,000 acres combined), are mostly scrub-shrub and emergent wetlands. Many of the basins in Nevada contain playa and wet-meadow wetlands; these are especially common in the northwestern part of the State. Some of the largest playas are in the Black Rock Desert in northwestern Nevada, Spring Valley in eastern Nevada, Railroad Valley in south-central Nevada, Smoke Creek Desert in northwestern Nevada, Carson Sink in west-central Nevada, Winnemucca Lake in northwestern Nevada, and Clayton Valley in southwestern Nevada. Pyramid Lake, Lake Tahoe, Walker Lake, Lake Mead (a reservoir), and many smaller reservoirs contain most of the nonplaya lacustrine wetlands. Riverine wetlands make up only a small percentage of the wetland acreage in the State.

### HYDROLOGIC SETTING

Wetlands in Nevada are limited to areas where there is a persistent water supply at or near land surface. The location and persistence of water supply is a function of several interrelated factors, including climate, physiography, and hydrology.

In Nevada, precipitation (fig. 2B) and runoff (fig. 2C) have wide ranges in values annually, seasonally, and areally (Moosburner, 1986). Nevada, the most arid State in the Nation, has average annual precipitation values ranging from more than 16 inches in the Sierra Nevada and other high mountain ranges to less than 4 inches



**Figure 1.** Wetland in Carson Valley, about 5 miles south of Carson City. This wetland was constructed to receive treated sewage effluent from Incline Village in the Lake Tahoe Basin and to function as a nutrient-removal system for the effluent before discharge into the Carson River. View looking southwest, with Sierra Nevada in background, 1993. (Photograph by Michael S. Lico, U.S. Geological Survey.)

near Fallon and in the Las Vegas area. Runoff in the spring and early summer is mostly a result of snowmelt and is greatest in the mountain areas. Occasional summer thunderstorms can create large amounts of runoff, although these storms generally are localized.

Evaporation, which removes water that could potentially form wetlands, is greatest in the lower altitudes and southern part of the State (fig. 2D). The lowest yearly evaporation is in the Sierra Nevada and other high mountain ranges. Large tracts of land in the basin areas have high evaporation rates, as much as 80 inches per year in the lowlands near the Colorado River (Moosburner, 1986).

Potential evaporation exceeds precipitation in most of Nevada, the exceptions being in the high mountain areas, creating a water deficit that inhibits wetland development. The existence of fens (emergent wetlands that have organic soil) in high mountain valleys and the paucity of them in lower altitude basins attests to their dependence on abundant water from precipitation. However, steep topography and shifting stream channels prevent the formation of fens in many areas where adequate water is present.

In most of the basins in Nevada, wetlands are associated

with discharge areas. Ground water commonly discharges from springs and seeps along the fault-bounded basins and creates wetlands. Water for the Ruby Lake wetlands (fig. 2A) is mostly from spring discharge. Playa lakes, where wetlands are maintained by water from the typically shallow water table, are another common setting for wetlands. Wetlands also are present at the discharge points of regional ground-water flow systems, where springs commonly

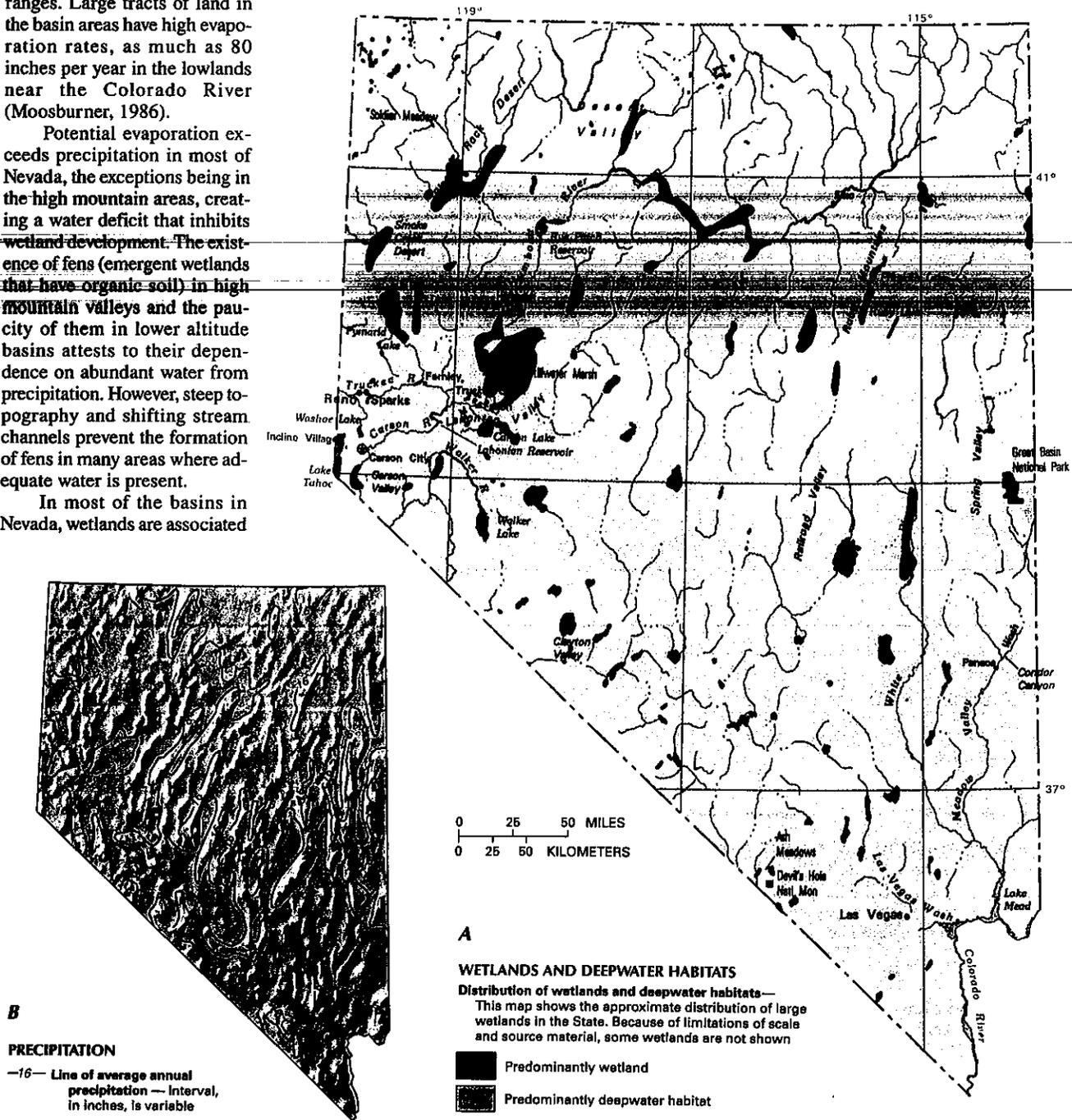


Figure 2. Wetland distribution in Nevada and physical and climatological features that control wetland distribution in the State. A, Distribution of wetlands and deepwater habitats. B, Annual precipitation. (Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991; B, Moosburner, 1986.)

discharge large volumes of ground water. An example of this hydrologic setting is the Ash Meadows wetlands (Winograd and Thordarson, 1975).

In the high mountain areas of the State, wetlands commonly form in glaciated valleys. Glacially scoured valleys commonly have large cirque basins where remnant glaciers or semipermanent snow fields supply water for wetlands. Many of these cirque basins have lakes (tarns) that provide wetland habitat. Below the cirque basins, the glaciated mountain valleys typically are steep sided, U-shaped, and have relatively flat floors with low-gradient streams. Wetlands form on the valley floors in cut-off meander channels (oxbows), behind glacial moraines, in small kettle holes, and behind beaver dams.

Riparian wetlands are present along most of the perennial streams in Nevada. These wetlands occur along natural streambanks and constructed channels. Annual flushing of stream channels and wetlands by spring floods has been attenuated largely by diversion for irrigation, stream channelization, and construction of dams. However, constructed water bodies such as reservoirs, canals, and agricultural drains are common settings for wetland formation. As an example of an artificially maintained wetland system, leakage from a canal near Fernley raised the water table until drainage ditches had to be dug to lower the water table for efficient crop growth. The water in these ditches flows to a State Wildlife Area where wetlands are present near the channels and impoundments.

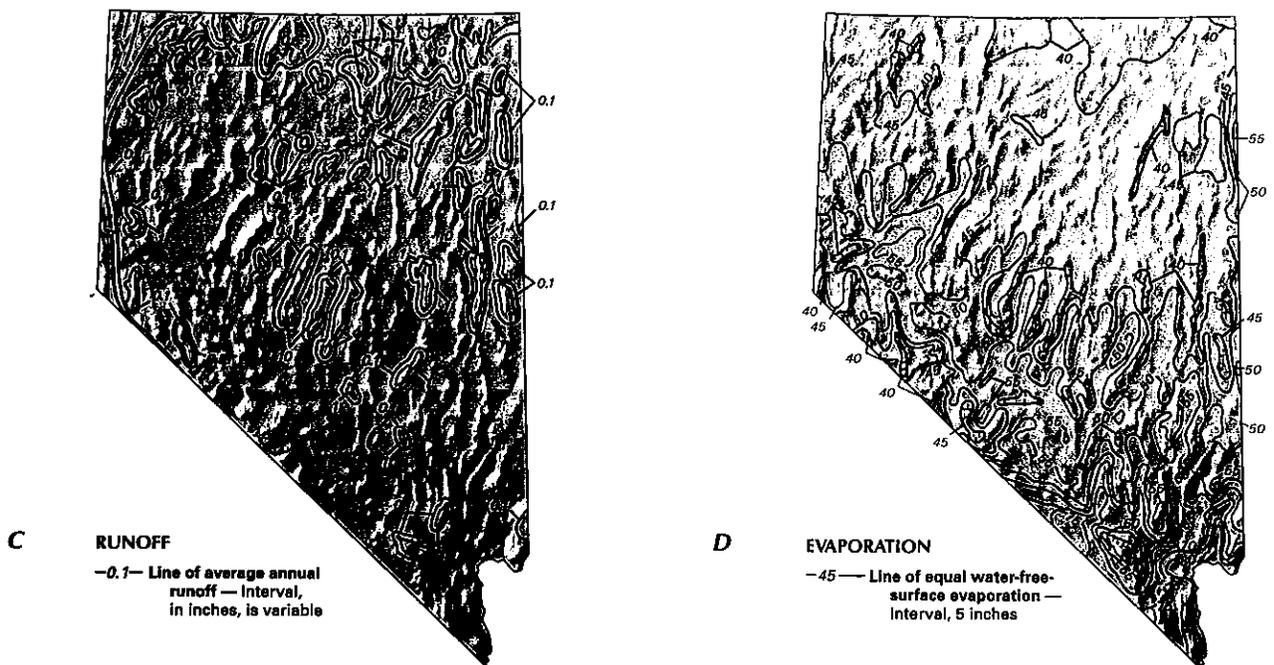
Most wetlands are maintained by a shallow water table. The water-table altitude depends on several factors, among which are geology, topography, soil characteristics, water supply, pumpage, and local hydrology. Irrigation of land for agriculture commonly results in a rise of the water table, which can create wetlands. The Newlands (irrigation) Project near Fallon in western Nevada has caused the water table in parts of Lahontan Valley to rise by as much as 30 to 60 feet (Rush, 1972; R.L. Seiler, U.S. Geological Survey,

written commun., 1993); this water-table rise has resulted in the formation of small wetlands throughout the valley.

Wetlands can be formed by other human activities. Dewatering—more than 23,000 acre-feet in 1991—of a large open-pit mine in Desert Valley in northern Nevada has created a lush wetland of 3,500 acres that is being used by increasing numbers of waterfowl. In Carson Valley, about 900 acres of wetlands have been created by constructing cells (diked impoundments) and filling them with treated sewage effluent from the Lake Tahoe Basin (fig. 1). The area has become a popular duck-hunting site.

Stillwater Marsh is an important wetland complex in the Pacific Flyway. Archeological evidence indicates that as much as 5,000 years ago humans used the marsh for food resources (Hoffman and others, 1990). Because of the importance of Stillwater Marsh and other Lahontan Valley wetlands to migratory birds, the area has been classified as a Hemispheric Reserve within the Western Hemispheric Shorebird Reserve Network (WHSRN) by the WHSRN Council. Lahontan Valley supports about 75 percent of the ducks, 50 percent of the Canada geese, and 65 percent of the tundra swans in the State. Between 30 and 50 percent of the Pacific Flyway canvasback ducks stop in Lahontan Valley in the fall.

Stillwater Marsh is located at the terminus of the Carson River, which flowed freely to the wetlands until the Newlands Project was constructed in the early 1900's. Annual springtime floods flushed the wetlands and removed accumulated mineral salts, leaving a prime freshwater marsh. Currently, most of the water flowing to Stillwater Marsh is irrigation drainage that has high concentrations of arsenic, boron, selenium, and other toxic constituents (Lico, 1992). Owing to the highly regulated nature of the irrigation system, springtime floods are uncommon, and no mechanism exists to remove salts from the marsh. Presently, Stillwater Marsh would require large volumes of freshwater to reduce the salinity and concentrations of several toxic constituents that have been implicated



**Figure 2. Continued.** Wetland distribution in Nevada and physical and climatological features that control wetland distribution in the State. *C*, Annual runoff. *D*, Annual free-water-surface (lake) evaporation. (Sources: *C*, Moosburner, 1986; *D*, Farnsworth and others, 1982.)

in the deaths and low reproduction rates of waterfowl (Hoffman and others, 1990; Lico, 1992). Volumes of irrigation return flow will be further reduced when the Newlands Project implements operating criteria adopted by the Bureau of Reclamation [(BOR)1987]. Recent drought has severely affected Stillwater Marsh, leaving only a few hundred acres of water surface for waterfowl use. In 1990, Public Law 101-618 was passed by Congress, authorizing the FWS to purchase water rights from willing sellers within the Newlands Project area and use the water for maintenance of wildlife habitat. The Nevada Department of Wildlife and The Nature Conservancy are assisting FWS in this "water-buyout program."

Ash Meadows wetlands, in southern Nevada, are administered by the FWS and are the sole habitat for 33 plant and animal species (U.S. Fish and Wildlife Service, 1990). The wetlands are home for three species of endangered pupfish and one species of speckled dace. These unique wetlands are a result of ground water from a regional carbonate-rock aquifer discharging through lake-bed deposits to a series of springs along a fault contact. More than 17,000 acre-feet of water discharges from these springs annually (Winograd and Thordarson, 1975). Devils Hole National Monument, administered by the National Park Service (NPS), is included in this group of wetlands but is unique in that it occupies a solution cavern in the carbonate-rock aquifer. The Devils Hole pupfish, an endangered species, is found only within this small pool (U.S. Fish and Wildlife Service, 1990).

Carson Valley, in western Nevada, is the setting for wetlands of a different nature. Incline Village, in the Lake Tahoe Basin, exports all of its treated sewage effluent to Carson Valley by way of a pipeline. Before 1984, the effluent was discharged into the Carson River at the northern end of the valley. In 1975, the U.S. Environmental Protection Agency (EPA) issued a more stringent discharge permit; as a result, several diked impoundments were constructed to hold the sewage effluent, creating a 900-acre site with 140 acres of permanent wetlands. The area now provides nesting habitat for waterfowl and recreational opportunities for residents of the area.

Ruby Lake wetlands are east of the Ruby Mountains in northeastern Nevada (fig. 2A). The FWS operates and maintains a 37,600-acre National Wildlife Refuge there, which includes the marsh and surrounding area. During a year of average precipitation, more than 13,000 acres of bird and fish habitat are present in the spring, declining to about 11,000 acres in the fall. Water for the wetlands is provided mostly by the discharge of many springs at the base of the Ruby Mountains. This discharge is proportional to the amount of snowpack in the mountains (Jeff Mackay, U.S. Fish and Wildlife Service, written commun., 1992). More than 200 species of birds regularly use the wetlands for nesting, feeding, or stopover during migration periods. In some years, more than 6,000 ducks, mostly redheads and canvasbacks, have hatched at the marsh.

## TRENDS

The FWS has estimated that, from the 1780's to the 1980's, 52 percent of Nevada's wetlands were lost (Dahl, 1990). In terms of area, that represents a loss of about 251,000 acres of wetlands during settlement of the State. Conversion of wetlands to cropland and diversion of water for agricultural and urban purposes are the primary reasons for this loss of wetlands. A large part of the flow in major rivers within the State (Carson, Humboldt, Truckee, and Walker) has been diverted for irrigation, leaving insufficient quantities of water for wetland maintenance. Riparian wetlands have been drastically affected by a variety of human activities. The BLM, which administers approximately 2,100 miles of riparian stream habitat in the State, has reported that more than 80 percent of that habitat is in poor condition (Nevada Department of Conservation and Natural Resources, 1988). In the same report, the U.S. Forest Service (FS) estimated that 53 percent of the riparian wetlands under its jurisdiction are in fair to poor condition. The primary reason for

the poor quality of the riparian wetland habitat is overgrazing of cattle on Federal land (Bureau of Land Management, 1992). The BLM has formal plans for improving the condition of wetlands under its jurisdiction (Bureau of Land Management, 1991). Urban development, particularly near Reno, has adversely affected wetlands; detrimental activities include building directly on filled wetlands, draining of wetlands, channelization of creeks and rivers, and contamination of wetlands by inadequately treated sewage and industrial waste. Las Vegas Wash contains wetlands that are threatened by treated municipal sewage effluent, industrial chemicals, and erosion.

According to Thompson and Merritt (1988), 82 percent of wetlands have been lost in western Nevada. They document the loss of two National Wildlife Refuges and the decreasing quality of the remaining wetlands. Historical accounts by Captain J.H. Simpson in 1859 of conditions before irrigation read as follows: "Carson Lake beautifully blue; lake margined with rushes; the shores are covered with muscle-shells [sic]; pelicans and other aquatic fowl a characteristic." According to Simpson, "\*\*\*\*the lake is filled with fish\*\*\*\*"; he also observed that the local Indians had "\*\*\*\*piles of fish lying about drying" (Simpson, 1876). Carson Lake no longer supports fish populations of any consequence. The loss of wetlands was mostly due to diversion of streamflow to irrigate crops in western Nevada and for urban uses in the Reno-Sparks area. The drought of the late 1980's to early 1990's further reduced the acreage of wetlands in western Nevada.

Some human activities have resulted in an increase in wetland acreage. Constructed wetlands in Carson Valley (fig. 1) utilize sewage effluent to provide habitat for waterfowl. In Desert Valley, a mine-dewatering operation has supplied water for constructed wetlands that have become important habitat for waterfowl and other wildlife. Wetlands were constructed by the Nevada Department of Transportation in Washoe Valley near Washoe Lake to offset losses from highway construction (John Nelson, Nevada Division of Environmental Protection, oral commun., 1993). Leakage from the Truckee Canal near Fernley has been used to create an extensive wetland operated and maintained by the Department of Wildlife. Agriculture-related activities, including construction of ponds, reservoirs (such as Lahontan and Rye Patch), drainage ditches, and canals, undoubtedly have added to wetland acreage throughout the State.

## CONSERVATION

Many government agencies and private organizations participate in wetland conservation in Nevada. The most active agencies and organizations and some of their activities are listed in table 1.

*Federal wetland activities.*—Development activities in Nevada wetlands are regulated by several Federal statutory prohibitions and incentives that are intended to slow wetland losses. Some of the more important of these are contained in the 1899 Rivers and Harbors Act; the 1972 Clean Water Act and amendments; the 1985 Food Security Act; the 1990 Food, Agriculture, Conservation, and Trade Act; and the 1986 Emergency Wetlands Resources Act.

Section 10 of the Rivers and Harbors Act gives the U.S. Army Corps of Engineers (Corps) authority to regulate certain activities in navigable waters. Regulated activities include diking, deepening, filling, excavating, and placing of structures. The related section 404 of the Clean Water Act is the most often-used Federal legislation protecting wetlands. Under section 404 provisions, the Corps issues permits regulating the discharge of dredged or fill material into wetlands. Permits are subject to review and possible veto by the EPA, and the FWS has review and advisory roles. Section 401 of the Clean Water Act grants to States and eligible Indian Tribes the authority to approve, apply conditions to, or deny section 404 permit applications on the basis of a proposed activity's probable effects on the water quality of a wetland.

**Table 1.** Selected wetland-related activities of government agencies and private organizations in Nevada, 1993

[Source: Classification of activities is generalized from information provided by agencies and organizations. •, agency or organization participates in wetland-related activity; ..., agency or organization does not participate in wetland-related activity. MAN, management; REG, regulation; R&C, restoration and creation; LAN, land acquisition; R&D, research and data collection; D&I, delineation and inventory]

Agency or organization	MAN	REG	R&C	LAN	R&D	D&I
<b>FEDERAL</b>						
<b>Department of Agriculture</b>						
Consolidated Farm Service Agency .....	•	•	•	•	•	•
Forest Service .....	•	•	•	•	•	•
Natural Resources Conservation Service .....	•	•	•	•	•	•
<b>Department of Defense</b>						
Army Corps of Engineers .....	•	•	•	•	•	•
Military reservations .....	•	•	•	•	•	•
<b>Department of the Interior</b>						
Bureau of Land Management .....	•	•	•	•	•	•
Bureau of Reclamation .....	•	•	•	•	•	•
Fish and Wildlife Service .....	•	•	•	•	•	•
Geological Survey .....	•	•	•	•	•	•
National Biological Service .....	•	•	•	•	•	•
National Park Service .....	•	•	•	•	•	•
Environmental Protection Agency .....	•	•	•	•	•	•
<b>STATE</b>						
<b>Department of Conservation and Natural Resources:</b>						
Division of Environmental Protection .....	•	•	•	•	•	•
Division of State Lands .....	•	•	•	•	•	•
Division of State Parks .....	•	•	•	•	•	•
Division of Water Planning .....	•	•	•	•	•	•
Department of Transportation .....	•	•	•	•	•	•
Department of Wildlife .....	•	•	•	•	•	•
<b>PRIVATE</b>						
Ducks Unlimited .....	•	•	•	•	•	•
Environmental Defense Fund .....	•	•	•	•	•	•
The Nature Conservancy .....	•	•	•	•	•	•

Most farming, ranching, and silviculture activities are not subject to section 404 regulation. However, the "Swampbuster" provision of the 1985 Food Security Act and amendments in the 1990 Food, Agriculture, Conservation, and Trade Act discourage (through financial disincentives) the draining, filling, or other alteration of wetlands for agricultural use. The law allows exemptions from penalties in some cases, especially if the farmer agrees to restore the altered wetland or other wetlands that have been converted to agricultural use. The Wetlands Reserve Program of the 1990 Food, Agriculture, Conservation, and Trade Act authorizes the Federal Government to purchase conservation easements from landowners who agree to protect or restore wetlands. The Consolidated Farm Service Agency (formerly the Agricultural Stabilization and Conservation Service) administers the Swampbuster provisions and Wetlands Reserve Program. The Natural Resources Conservation Service (formerly the Soil Conservation Service) determines compliance with Swampbuster provisions and assists farmers in the identification of wetlands and in the development of wetland protection, restoration, or creation plans.

The 1986 Emergency Wetlands Resources Act encourages wetland protection through funding incentives. The act requires States to address wetland protection in their Statewide Comprehensive Outdoor Recreation Plans to qualify for Federal funding for State recreational land; the NPS provides guidance to States in developing the wetland component of their plans.

Federal agencies are responsible for the proper management of wetlands on public land under their jurisdiction. The BLM, FS, and the Department of Defense administer most of the Federal land in Nevada; BLM land (almost 48 million acres) alone contains about 75,000 acres of riparian wetlands (Bureau of Land Management,

1991). The BLM and FS have riparian-wetland management plans that include educating the public on the benefits and importance of healthy riparian areas; assessing acreage and condition of riparian wetlands; and restoring, maintaining, and protecting riparian wetlands. The BLM has acquired about 5,000 acres of wetlands in Soldier Meadow, Black Rock Desert, through land exchange. Military installations are responsible for preparing resource-management plans for fish and wildlife, recreation, and other natural and cultural resources. The plans provide policy and a framework for addressing wetland and other natural and cultural resource issues. The FWS manages seven National Wildlife Refuges, two National Wildlife Ranges, and two fish hatcheries in Nevada. National Wildlife Refuges total more than 220,000 acres and National Wildlife Ranges total more than 2 million acres. The NPS manages more than 77,000 acres of land (National Park Service, 1991) at two locations—Great Basin National Park and Devils Hole National Monument. An estimate of wetland acreages within National Parks in Nevada does not exist. The BOR is involved in the restoration and creation of wetlands in conjunction with some of their projects and has been instrumental in the construction of irrigation projects in Nevada. Inherently associated with these projects is the alteration of natural riparian and wet-meadow wetlands. The BOR has attempted either to minimize or to mitigate adverse effects on these wetlands.

*State wetland activities.*—Several State agencies are involved in wetland activities in Nevada (table 1). Nevada does not currently (1993) have a comprehensive wetlands-protection program but follows Federal policy and cooperates in many Federal programs.

Four agencies within the Nevada Department of Conservation and Natural Resources engage in wetland-related activities. The Division of Environmental Protection is the key regulatory agency and enforces provisions of the Clean Water Act within the State. Pursuant to section 305(b) of the act, the Division of Environmental Protection submits to the EPA and the U.S. Congress a biennial assessment of the State's surface-water quality (Nevada Department of Conservation and Natural Resources, 1992), including that of wetlands. The Division issues discharge permits, monitors water quality, and sets water-quality standards for Nevada. Reviews for subdivision permits also are under the jurisdiction of the Division of Environmental Protection. The Division of Water Planning is responsible for review of section 404 permit applications, and Division approval is necessary for the Corps to issue a permit. The Division of State Lands has legislative authority for wetlands protection on lands owned or managed by the State of Nevada; the Division issues permits for all activities associated with State lands. The Division of State Parks is responsible for management of State park land and reviews activities that may affect wetlands in parks. The Division of State Parks has been involved in the construction of wetlands on State park land and is responsible for Nevada's Statewide Comprehensive Outdoor Recreation Plans, which contain a summary of wetland-related activities within the State.

The Nevada Department of Transportation is responsible for assessing and mitigating impacts on wetlands that are a result of highway construction and maintenance. In cooperation with Department of State Parks, the Department of Transportation has constructed wetlands near Washoe Lake to mitigate losses of wetlands from construction of nearby highways.

The Department of Wildlife is responsible for day-to-day management of the State's 10 Wildlife Management Areas (comprising about 256,000 acres). These areas contain important wetlands and include areas such as Carson Lake in Lahontan Valley and Franklin Lake on the eastern side of the Ruby Mountains. The Department of Wildlife can require a Habitat Modification Permit before dredging in any river, stream, or lake if the Department determines that the activity will be harmful to fish. The Department of Wildlife has been monitoring the condition of wetlands by taking yearly population counts of waterfowl (Norman Saake, Nevada Department of Wildlife, oral commun., 1992). The Department of Wildlife has the

authority to implement and manage a program for conserving, protecting, restoring, and propagating selected species of native fishes and other wildlife that are threatened with extinction. Wetlands have been constructed under the auspices of the Department of Wildlife; these wetlands, which are mostly for waterfowl, include most of the State Wildlife Management Areas and those constructed with the cooperation of private entities.

*County and local wetland activities.*—Most regulation of development activities in Nevada's wetlands is accomplished through Federal and State laws. However, some local activities, such as pond construction at local parks or river-enhancement projects, also can be beneficial to wetlands.

*Private wetland activities.*—Activities by private entities include purchasing wetlands and water rights, public education on wetland issues, and lobbying for wetland-enhancement legislation. The Nature Conservancy is perhaps the most active private organization involved in wetland protection in Nevada. The Nature Conservancy has one wetland holding in Condor Canyon, a part of Meadow Valley Wash near Panaca. Purchasing sensitive wetland areas has been a critical function of The Nature Conservancy in Nevada. The Nature Conservancy has purchased land containing wetlands at Franklin Lake and Ash Meadows and sold the properties to State or Federal agencies for management (Livermore, 1988). In Lahontan Valley, The Nature Conservancy has purchased water rights from farmers within the Newlands Project area, taking land out of agricultural production, and is reselling the water rights to the fws for use at Stillwater Marsh. This action is providing freshwater to the marsh, which has received irrigation drainage as its only source of water in recent years. This effort by The Nature Conservancy will result in an improvement of the habitat in this important wetland on the Pacific Flyway. The Environmental Defense Fund has been actively assisting The Nature Conservancy in acquisition of water rights in Lahontan Valley. Ducks Unlimited also acquires wetlands for purposes of conservation. Private local and national organizations that participate in educational or lobbying activities in the State include gun and hunting clubs, the Sierra Club, the Lahontan Valley Wetlands Coalition, the National Audubon Society, and the Nevada Waterfowl Association.

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