**CASE STUDY: Carson River Watershed, California & Nevada, USA**

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***Map and location of the Carson River watershed (from Wikipedia: Carson River)***

**General Overview**

The Carson River is about 4,000 square miles (10,400 square kilometers) in size and begins in the Sierra Nevada mountain range, continuing eastward into northwestern Nevada until its terminus in the Carson Sink (a lake without an outlet). In 1995, land use in the Carson River Basin was about 62% rangeland, 18% forest, 14% water and wetlands, and 5% irrigated agriculture.[[1]](#endnote-1)

Water supplies in the Carson River watershed vary considerably from year to year, affecting both irrigated agriculture and ecosystem health. The Lahontan Reservoir, located on the Carson River, was built in an effort to buffer annual water fluctuations to some extent. This reservoir receives supplementary water from the Truckee River via the Truckee Canal.**[[2]](#endnote-2)** Agriculture is the dominant water user in the basin.

Farmers in the Carson River watershed produce garlic, onions, corn, sunflowers, cantaloupes, melons, wheat, oats, and alfalfa, all of which require a large volume of water for irrigation.[[3]](#endnote-3) During times of water shortages, surface water allocations are given to water users based on the priority assigned to each water right.

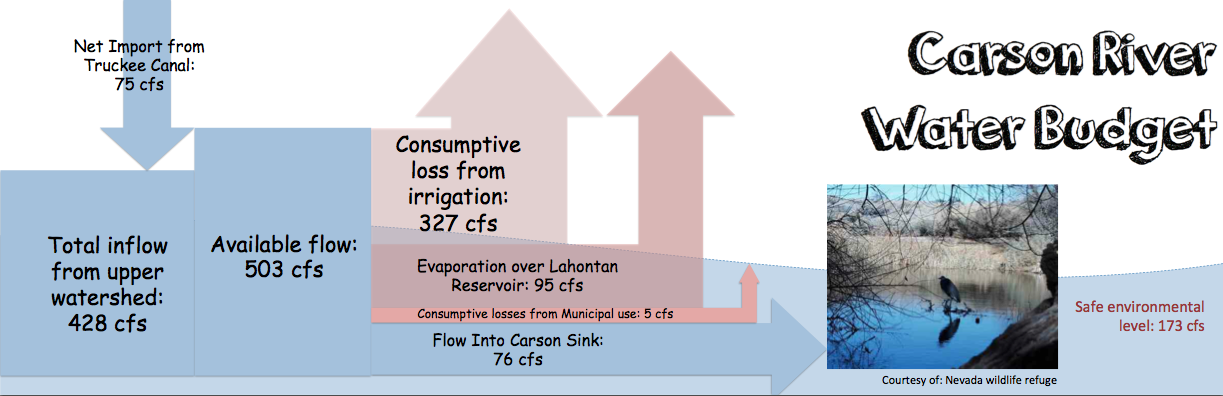
Most of the water available in the Carson River basin comes from snowmelt, which appears vulnerable to future climate change. As temperatures warm in coming decades, snowfall could decrease in these higher elevations, thereby reducing the volume or changing the seasonality of available water resources for the watershed.

Since the construction of the Lahontan Reservoir, water flows to the Carson Sink and Stillwater National Wildlife refuge have been reduced considerably because of irrigation consumption in the basin. These areas are important habitats for many species, including migratory birds. Actions taken under the Endangered Species Act have forced farmers to reduce their water withdrawals to some extent. But unfortunately, while these actions have reduced water withdrawals they have actually *increased* the net consumptive use of water in the basin,[[4]](#footnote-1) thereby reducing the volume of water draining into the Carson Sink wetlands.

In 1991, 77,500 acres of land in and around the Carson Sink were designated as the Stillwater National Wildlife Refuge. Recognizing that the wetlands were not receiving sufficient water flows to sustain ecological health, The Nature Conservancy began purchasing water rights for dedication to environmental purposes.[[5]](#endnote-4) The area is still highly susceptible to water scarcity, however, as allocations of water for human use take precedent over environmental flows in the Nevada portion of the Carson River basin.[[6]](#endnote-5)

**Water Budget**

The water budget compiled below is based on long-term averaged flow rates, in cubic feet per second (cfs). One cfs equates to a volume of 724 acre-feet per year, or 894,000 cubic meters per year.



Inputs (blue):

1. Inflow from upper watershed
2. Import from Truckee River

Consumptive Uses (red):

1. Evaporation from Lahontan Reservoir
2. Consumptive losses from Municipal Use
3. Consumptive losses from Irrigation (due to leakage, evaporation, transpiration by crops, etc.)

Leftover Flow: Flow into Carson Sink

Safe Environmental Flow: Describes amount of water needed to support ecosystem downstream

**Temporal Variability in Water Availability**

A graph of yearly water availability, calculated in the same way as the average computed for the water budget above, is shown below. While some years show an available flow in excess of 1000 cfs, many years dip below 400 cubic feet/sec (cfs) and some even as low as 200 cfs. In these years, virtually no flow remains to sustain the wetlands downstream. This dearth of water is likely to impact migratory bird species as well as native plants and other animals. In addition, many farmers receive less than the amount of water they need to produce their crops, potentially impacting overall crop production. Water shortages during drier years also cause heavy depletion of the Lahontan Reservoir, which can impact recreational use of the reservoir.

The Carson River water availability varies by month as well. Below is a chart of available water in the Carson River based on monthly averages for the years 1980-1984 and 1991-2012. The Carson River watershed, which receives snowmelt in the spring and summer, can receive more water than it can store in reservoirs during some times of the year, while other months do little to recharge the reservoir’s volume.

**Water Tools**

**Desalination** is likely a prohibitively expensive option, given that the high Sierra Nevada mountain range lies between the ocean and the watershed and no sizeable (brackish) groundwater aquifers exist in the area.

**Water reuse** takes place in the watershed to irrigate golf courses, city parks, and agricultural fields.[[7]](#endnote-6) Reusing water from municipal wastewater systems can reduce the volume of water that must be withdrawn from the Carson River. However, it may not result in a net reduction of consumptive use overall, because much of the municipal wastewater was likely discharged back into the river in the first place. However, reusing water from municipal systems on landscaped areas and agriculture could reduce the energy required to treat municipal water supplies.

**Water storage** is used capture snowmelt runoff, for use in later months or years. While this is quite beneficial in providing water for irrigated agriculture, the Lahontan Reservoir loses a great deal of water to evaporation (see Water Budget diagram above).

**Water importation** is used to supplement the water flow in the Carson River. Water is diverted from the Truckee River into Lahontan Reservoir on the Carson River. While beneficial to agricultural water use in the Carson River watershed, the diversion causes a reduction in Truckee River flows, which have caused problems for the ecological health of the lower Truckee River and Pyramid Lake into which the Truckee River flows.

**Water conservation** is not yet fully utilized in the basin. A lot of water leaks or is evaporated in the agricultural irrigation system. Water conservation projects undertaken to date include installing evapotranspiration controllers, offering irrigation audits to citizens with large turf areas, installing water-conserving sprinkler heads, and educating the public. Residential landscape irrigation surveys were conducted from 2009 to 2011, and over 70% of the participants rated the water program useful. However, only 40% of the audited home and business owners were able to reduce water use in their yards and other landscaped areas due to the difficulty and cost of re-planting with plants requiring less water. Financial incentives could be used to subsidize replacement of water-intensive landscape vegetation.

There appears to be considerable potential in agricultural areas to reduce consumptive water losses due to evaporation from open canals and ditches, as well as on farm fields that are presently being flood-irrigated.

In addition, **watershed management** would include a reexamination of the crops grown in the watershed. 27% of irrigated land in the watershed supports alfalfa.[[8]](#endnote-7) Alfalfa consumes a great deal of water compared to other crop types, and may not be the most prudent crop to grow in a desert with high evaporation rates and low water supply.

**Water Stakeholders**

**Environmental Groups:** The US Fish and Wildlife Service has determined that an annual average of 125,000 acre-feet per year (173 cfs) is needed to sustain the wetlands downstream of Lahontan Reservoir.[[9]](#endnote-8) According to our water budget, only about 55,640 acre-feet presently enter the Carson Sink each year on average. The US Fish and Wildlife Service is continuing to purchase additional water rights to ensure that the Stillwater Wildlife Refuge receives enough water to support migratory bird species and other important wildlife.

**Recreationalists and sportsmen** promote water conservation for environmental benefits, but these efforts are generally directed at keeping more water in Lahontan Reservoir to support lake fishing and other forms of recreation. They have also advocated in favor of providing enough water in the wetlands for tourism to persist. The Nevada Division of State Parks maintains parks and recreation areas. Find out more at: <http://parks.nv.gov>.

**Farmers and Ranchers:** Because farmers and ranchers rely on continued water supply for their productivity, this interest group would likely lobby to continue extraction of water resources – especially exploring new water import projects that would expand water supply for irrigation. It is likely that they would be in conflict with the environmental groups above. The Newlands Protective Association defends the rights of water users in the Newlands Reclamation Project, primarily representing farmers.[[10]](#endnote-9)

**Appendix 1 – General References**

1. USGS. “Water Quality in the Las Vegas Valley Area and Carson and Truckee River Basins, Nevada and California, 1992-96.” Retrieved from <http://pubs.usgs.gov/circ/circ1170/agric.htm> [↑](#endnote-ref-1)
2. Wilds, Leah J. *Water Politics in Northern Nevada: A Century of Struggle*. Reno: University of Nevada, 2010. [↑](#endnote-ref-2)
3. **“**The Carson River: Our Lifeline in the Desert.” *Carson River Subconservancy District.* Retrieved from <http://www.unce.unr.edu/publications/files/ag/2003/sp0302.pdf> [↑](#endnote-ref-3)
4. This is a counter-intuitive but unfortunately common result of actions taken to improve water-use efficiency in farming areas. For example, a shift from flood irrigation to drip irrigation will often require less water to be withdrawn from a river or aquifer, but it may at the same time lead to much higher crop production, which consumes more water! [↑](#footnote-ref-1)
5. Morrison, Jim. “Water and Time.” Southwest Airlines Spirit Magazine. September 1997. [↑](#endnote-ref-4)
6. Carson River Watershed Stewardship Plan. May 2007. Section 5.0. Retrieved from cwsd.org. [↑](#endnote-ref-5)
7. Walker and Associates. Reclaimed Water Use Analysis – Carson River Watershed. Appendix A. Retrieved from: <http://www.cwsd.org/newcms/Admin/Uploads/2013-8-6AppendixAWaterSystemPlan.pdf> [↑](#endnote-ref-6)
8. North Lahontan Region Water Plan. Table NL-7. Evapotranspiration of Applied Water by Crop. Retrieved from <http://www.waterplan.water.ca.gov/previous/b160-93/b160-93v2/NLR.cfm>. [↑](#endnote-ref-7)
9. U.S. Department of the Interior and Fish and Wildlife Service. September 1996. “Water rights acquisition for Lahontan Valley Wetlands: Final Environmental Impact Statement.” Portland, Oregon. [↑](#endnote-ref-8)
10. Entities with Carson River Watershed Interests. Appendix A. <http://cwsd.org/Books/AppendixA.pdf> [↑](#endnote-ref-9)