Santa Fe River Studies

August 2009

Reservoir Storage

By Amy Lewis, Amy C. Lewis Consulting and
Claudia Borchert, City of Santa Fe

This is one of a series of scientifically-based studies designed to provide the technical background information for decision makers and the community in evaluating management options for the Santa Fe River. The series covers the following topics: stream flow, storm flow, reservoir storage, ecosystem watershed yield analysis, stream flow losses, stream-aquifer interaction, and fate of reservoir releases. For more information on the series, please contact Claudia Borchert at 505-955-4203 or ciborchert@santafenm.gov

Santa Fe River Studies:
Storage on the Santa Fe River

Flow in the Santa Fe River through town has historically been controlled by three reservoirs: Two-mile, Nichols and McClure. The historical volume of water in storage is shown in Figure 1. Two-mile Reservoir was built in 1880 with a capacity of 500 acre-feet (ac-ft), and was breeched in 1994 due to potential failure of the dam. McClure Reservoir was initially built in 1926, however the height of the dam was raised in 1935, 1947 and finally in 1995 when the 500 ac-ft of storage rights in Two-mile Reservoir was transferred to McClure Reservoir. The storage capacity of McClure Reservoir is 3,255.6 ac-ft (Gonzales, 2009). Nichols Reservoir was built in 1943 and has a storage capacity of 684.2 ac-ft. The combined capacity of the two reservoirs is 3,939.8 ac-ft (Gonzales, 2009). The City has a right to store up to 4,000 ac-ft in the McClure and Nichols Reservoirs under Office of the State Engineer License 1677.

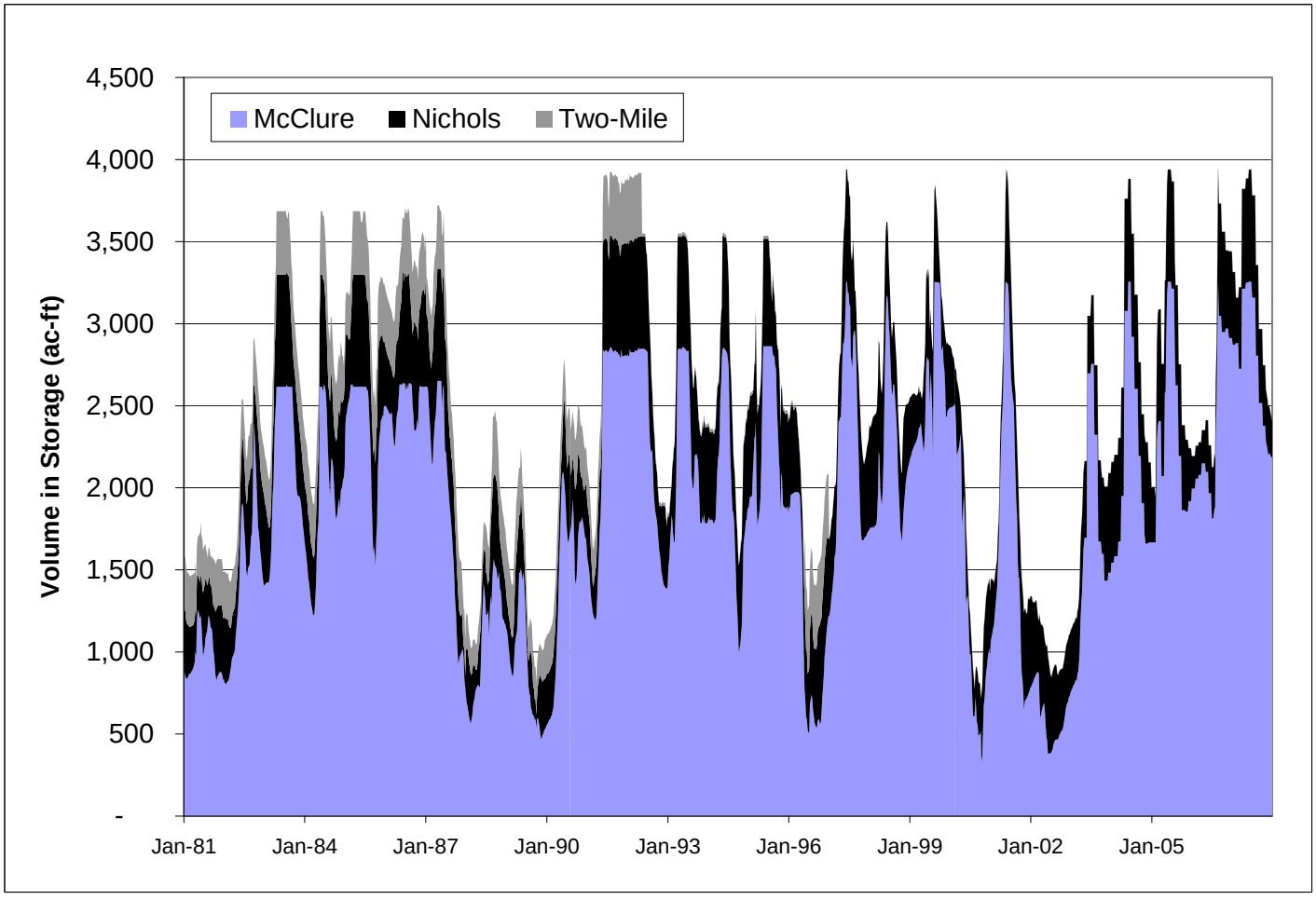

Figure 1. Historic volume of water in storage in McClure, Nichols and Two-Mile Reservoirs 1981-2007.

All but 1,061 ac-ft of the storage capacity of the Santa Fe River reservoirs fall under the regulations of the Rio Grande Compact (RGC). Under the rules of the RGC, operations at McClure and Nichols are affected in any year by the amount of water held in the Elephant Butte Project storage and whether New Mexico had an accrued debit or credit at the end of the previous year. Under Article VII of the RGC, no storage is allowed in reservoir capacity built after 1929. Article VII occurs when the usable project water in Elephant Butte and Cabello Reservoirs falls under 400,000 ac-ft, which has occurred 13 years from 1956 to 2008, or about 25 percent of the time. To date, the City has been able to manage its' water resources in a way that allows the City to store under Article VII by either releasing San Juan-Chama Project water in the amount equal to the amount stored under Article VII or by using its relinquishment credits to store water. Through the State of New Mexico, the City of Santa Fe has received 7,500 ac-ft (6,052 ac-ft in 2003/2004 and 1,448 ac-ft in 2008) of relinquishment credits. Relinquishment credits accrue when the State of Texas agrees to take delivery of the State of New Mexico credit water in addition to the annual deliveries required under the RGC.

As of December 2008, the City has 6,240 ac-ft of relinquishment credit available, which will allow the City to continue to store water above the pre-Compact amount of 1,061 ac-ft. The NM Interstate Stream Commission keeps track of the "pools" of water stored in each of the reservoirs that are involved in the RGC accounting procedures.

The amount of water in storage is monitored by USGS operated recorders. The station at McClure (08315500) has a period of record beginning in 1929, with end-of-the-month readings through September 1965. Beginning in October 1965, daily reservoir storage was recorded. The station at Nichols Reservoir (08316500) has monthly readings from 1943 through September 1965 and daily readings beginning October 1965. The Sangre de Cristo Water Company also recorded the amount of water in storage weekly from 1981 to 2003, and daily reservoir storage from 2003 to present.

The historical volume held in storage in the reservoirs for the period of record from 1981 through 2007 is shown in Figure 1. The total volume of storage in the reservoirs has been as low as about 20 percent, as occurred in October of 2000 and June 2002. Over the period of record 1981-2007, Nichols Reservoir has been full (and thus assumed to spill, releasing water to the river through town) 11 percent of the days. McClure Reservoir has been full about 8 percent of the period of record. When McClure Reservoir spills the water can be captured in Nichols Reservoir. The total storage capacity of 3,939.8 ac-ft has only been exceeded about 1 percent of the time.

Figure 2 shows the volume of water in storage over the more recent period of record 2001 through 2007, which corresponds with the period of record available for five stream gages on the Santa Fe River, discussed in the other reports in this series. Nichols Reservoir was full and spilled 8 percent of the time, whereas McClure was full and spilled only 4 percent of the time. This period of record represents a unique set of circumstances in that the water treatment plant was under construction for part of this period, and thus was not diverting as much water from storage.

The mean daily flow out of storage for McClure and Nichols Reservoirs is shown in Figure 3. A negative value indicates that water is going into storage, a positive value shows water released from storage. As shown on this graph, during spring runoff the reservoirs fill and thus the amount coming out of storage is negative. By June when the peak of snow melt has dissipated, the Canyon Road Water Treatment Plant pulls water out of storage to meet the supply needs for the City of Santa Fe. Some of the water that goes into storage is from inflow from side canyons that do not pass the above McClure gage and are not measured. Likewise, some of the water that comes out of storage may be lost to evaporation, which is also not measured. The gains from unmeasured inflow appear to be offset by the losses from open-water evaporation except in months or years with high precipitation (see Figure 12 of the Stream Flow report in this series). Figure 3 includes all gains and losses, regardless of the source of the change in storage.

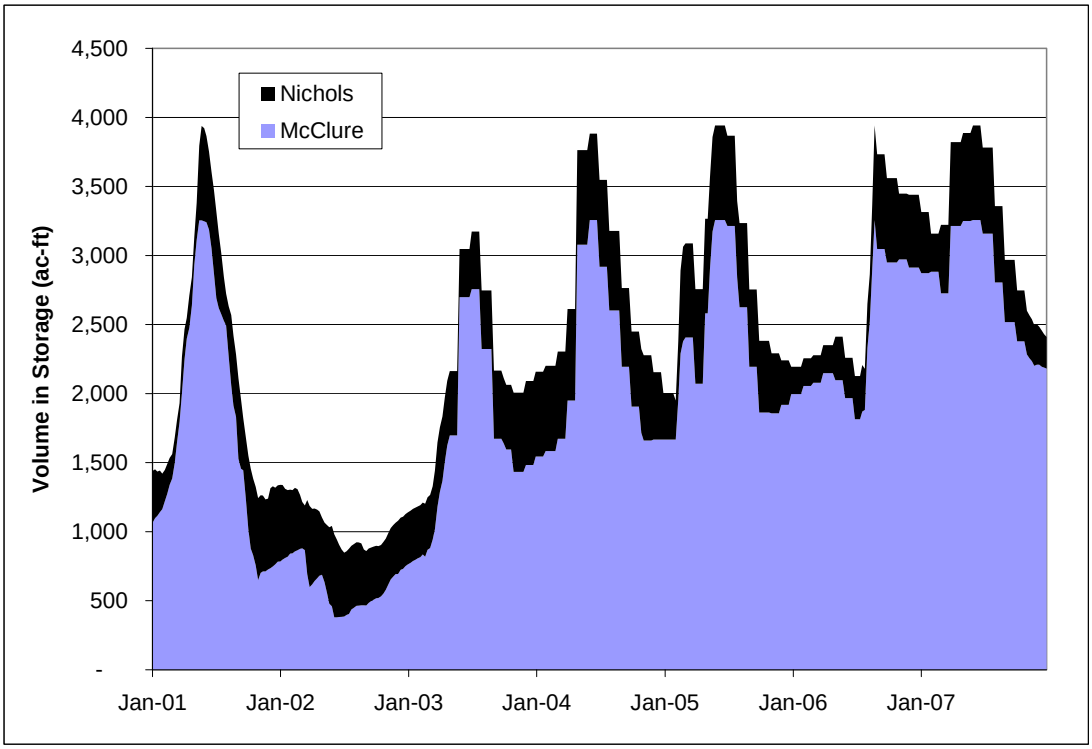

Figure 2. Historic volume of water in storage in McClure and Nichols Reservoirs 2001-2007

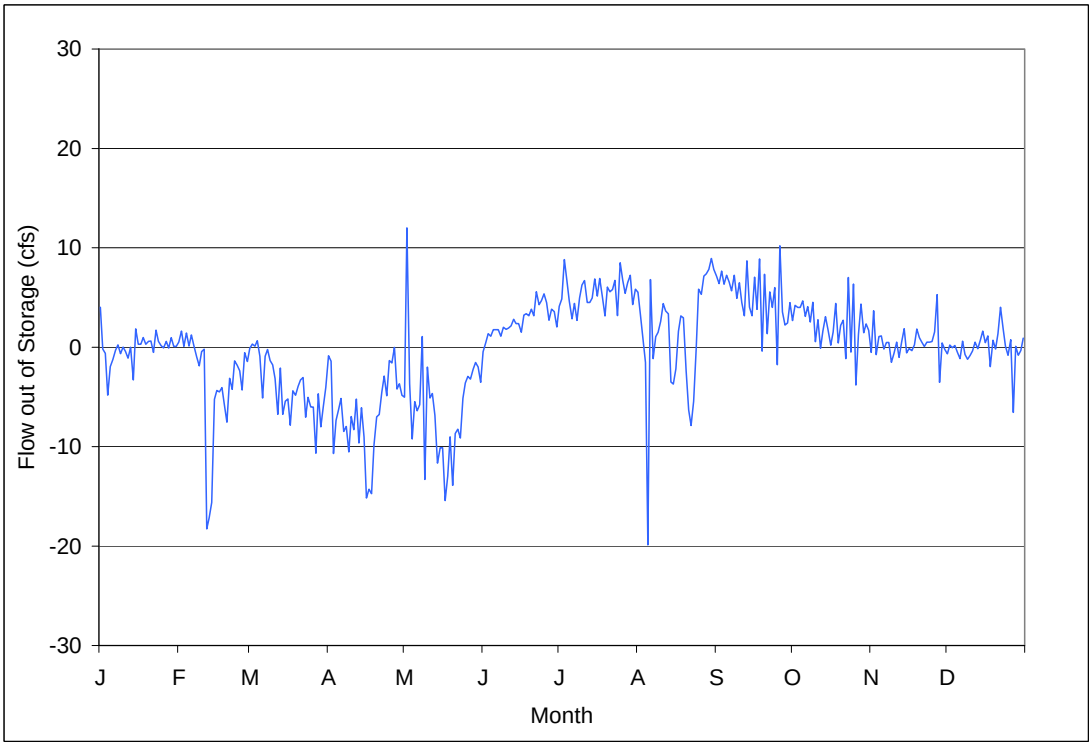

Figure 3. Mean Daily Flow out of storage in McClure and Nichols Reservoirs (2001-2007).

Bathymetry studies of McClure and Nichols Reservoirs determined the volumetric capacity of the reservoirs at different water level elevations. The results of the surveys conducted in 1994 for Nichols Reservoir and 1995 for the revised height of the McClure Dam are presented Table 1 (Gardey, 1994 and Kantz, 1995). At the time, the survey also concluded that the reservoir had not filled substantially enough with sediment to merit sediment dredging.

References

Eric Armstrong, 2008, City of Santa Fe Water Treatment Plant provided daily data for water in storage. May 14, 2008.

Gardey, Gary D. 1995. Survey of McClure Reservoir. Prepared for Sangre de Cristo Water Company by Koogle and Pouls Engineering, Inc. July 7, 1995

Gonzales, Michael. 2009. Source of Supply Manager, City of Santa Fe, Personal Communication from with Amy Lewis May 19, 2009.

Kuntz, William E. 1994. Survey of Nichols Reservoir. Prepared for Sangre de Cristo Water Company by Koogle and Pouls Engineering, Inc. Revised January 11, 1994.

Table 1. Stage-Capacity relationship for McClure and Nichols Reservoirs (Kantz, 1995 and Gardey, 1994).

McClure Reservoir		
Elevation	Area	Capacity
ft amsl	Acres	Acre-ft
7782	0.02	0.05
7786	0.2	0.61
7790	0.57	2.46
7794	1.28	6.78
7800	3.55	23.21
7804	5.14	42.14
7806	6.02	54.18
7810	8.33	85.18
7814	10.03	123.66
7816	11.14	145.94
7820	13.54	197.71
7824	16.13	259.62
7826	18.11	295.84
7830	21.73	379.39
7834	24.84	475.57
7836	26.52	528.62
7840	30.45	646.27
7842	32.45	711.18
7844	34.64	780.46
7846	37.06	854.57
7848	39.24	933.05
7850	41.4	1015.85
7852	43.77	1103.39
7854	46.24	1192.86
7856	48.66	1293.18
7858	51.25	1395.69
7860	54.24	1504.17
7862	57.59	1619.36
7864	59.78	1738.92
7866	61.18	1861.28
7868	62.63	1986.54
7870	64.29	2115.13
7872	66.24	2247.61
7874	68.06	2383.72
7876	69.83	2523.37
7878	71.58	266.53
7880.16 (Previous Spillway)	73.49	2825.26
7882	74.28	2963.65
7884	76.8	3117.25
7885.79 (Current Spillway)	87.63	3257.45
7886	78.34	3273.93
7888	79.91	3433.75
7890	81.5	3596.76
7892	83.15	3763.01

Nichols Reservoir		
Elevation	Area	Capacity
ft	Acres	Acre-ft
7416	0	0
7424	0	0
7426	0.1	0
7428	0.3	0.4
7430	0.6	1.3
7432	0.93	2.8
7434	1.34	5
7436	1.84	8.1
7438	2.5	12.3
7440	3.29	18.1
7442	4.13	25.5
7444	5.02	34.7
7446	5.93	45.6
7448	6.85	58.4
7450	7.9	73.0
7452	9.01	90.0
7454	9.98	109.0
7456	10.94	129.9
7458	12.01	152.8
7460	13.21	177.9
7462	14.56	205.6
7464	15.8	236.2
7466	16.95	268.9
7468	18.23	304.0
7470	19.69	341.8
7472	21.34	382.7
7474	22.99	427.1
7476	24.65	474.7
7478	26.44	525.7
7480	28.14	580.5
7482	29.63	638.3
7483 (Spillway)	30.36	668.3
7484	30.92	699.0
7486	32.04	761.9
7488	33.15	827.1
7490	34.22	894.5
7492	35.26	964.0
7494	36.25	1035.6