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An Analysis of the Drought of 1996 in the Middle Rio Grande Valley of New Mexico

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The Concept of Drought

Drought in a binational setting has been the theme of current environmental debates. Drought is an important topic because it is under conditions of stress that natural-resource allocation systems are challenged. Unfortunately, there is no clear, uniformly accepted set of criteria for "drought conditions." It would be an inaccurate oversimplification to conclude that droughts occur when demand exceeds supply. That might be 100 percent of the time in the arid borderlands that we share with Mexico. A prolonged period without precipitation could be an economic disaster for a roofing contractor, but a delight for tennis players. It would also be wrong to conclude that drought is "just in the eye of the beholder."

In a 1997 report to the Western Water Policy Review Advisory Commission,[1] Donald Wilhite discusses the concept of drought and suggests four types of drought for consideration: meteorological, agricultural, hydrological, and socioeconomic. This article offers a "test" of the spring 1996 flows in the Río Grande as they passed through the Middle Valley in New Mexico, with respect to each of these types of drought.

Hydrologic Drought and Characteristics of the Middle Río Grande Basin

Hydrologic drought in the region is related to the physical characteristics of the system. The Middle Río Grande Basin runs from the U.S. Geological Survey's gauging station at Otowi Bridge (just upstream from Cochiti Dam) to the head waters of Elephant Butte Reservoir, about 120 miles downstream. These two points have significance under the Río Grande Compact between Colorado, Texas, and New Mexico. Flows past the Otowi gauge determine the Compact delivery requirements at Elephant Butte Dam. It should be also noted that New Mexico obtained a credit in 1996 for an over delivery of almost 70,000 acre-feet at Elephant Butte Dam.[2]

The drainage basin above Otowi Bridge encompasses about 15,000 square miles, one-third of which are in Colorado. There are about 700,000

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1. DONALD WILHITE, IMPROVING DROUGHT MANAGEMENT IN THE WEST - THE ROLE OF MITIGATION AND PREPAREDNESS, REPORT TO THE WESTERN WATER POLICY REVIEW ADVISORY COMMISSION 2-4 (1997).

2. *See* REPORT OF THE RÍO GRANDE COMPACT COMMISSION ANN. REP. 25 (1996).

acres of irrigated land in the Río Grande drainage basin above the Otowi gauge; 90 percent of these lands are in Colorado. The only significant tributaries below Cochiti Dam enter the Río Grande from the west: the Jemez River just above Albuquerque (about 900 square miles of drainage area) and the Río Puerco (7,300 square miles of watershed) that enters the Río Grande half-way between Socorro and Belen. The bulk of the flows in the Middle Río Grande during the spring and early summer are derived from snowmelt on the mountains in southern Colorado and in northern New Mexico.

The Middle Río Grande is a long, relatively narrow basin, with the groundwater table very close to the ground surface in the valley areas. The valley is constricted in places to less than a mile (near Cochiti, near Isleta just south of Albuquerque, and at San Acacia just above Socorro) and below these points the valley widens appreciably. These changes in the valley width are thought to be related to the geologic structure of the Basin.

This description of the physical characteristics of the Middle Río Grande Valley identifies some of the features that contribute to periods of very low, or no flow in the river at various points. For example, in the period 1937 to 1960, the Río Grande at Bernardo, New Mexico, (between Albuquerque and Socorro) was essentially dry for 30 consecutive days in 1951 and for 90 days in 1956.[3] High rates of loss of the surface flows have been observed to occur during the irrigation season in reaches below these valley constrictions, particularly when the river channel has been allowed to become dry for a period of a week or more.

This characteristic of the Middle Río Grande was manifested prior to the existence of the Conservancy District. A 1937 report on the Upper Río Grande[4] showed that for the period 1890 to 1935, losses from the river between Otowi Bridge and San Marcial (below Socorro) were on the same order of magnitude as the stream flow at Otowi when the discharge at that gauge was less than 1,000 cubic feet per second. Some of the river losses are to the shallow groundwater system and may be regained as stream flow, but much of the lost water is used by non-beneficial vegetation and is not recovered.

The reliance of the Middle Río Grande water supply on snowpack runoff from mountains in southern Colorado and in northern New Mexico, and the length of the Río Grande Basin, make this section of the river

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3. LOUIS J. REILAND & G. L. HAYNES, FLOW CHARACTERISTICS OF NEW MEXICO STREAMS, FLOW-DURATION, HIGH-FLOW AND LOW-FLOW TABLES FOR SELECTED STATIONS THROUGH WATER YEAR 1959, at 172-73 (1963).

4. NATURAL RESOURCES COMM., REGIONAL PLANNING, PART VI - THE RÍO GRANDE JOINT INVESTIGATION IN THE UPPER RÍO GRANDE BASIN IN COLORADO, NEW MEXICO AND TEXAS, 1936-1937 (1938).

subject to periodic low flows. The U.S. Natural Resources Conservation Service (NRCS) provides estimates (one month apart) of the expected spring runoff in this section of the river. In the NRCS forecast for April 1, 1996,[5] the total spring runoff from January first to July first was predicted to be about 230,000 acre-feet at Otowi Bridge, compared to a thirty-year average discharge of 686,000 acre-feet. Over the fifty years of runoff forecasting, there have been five years when the April forecast for spring flows past the Otowi gauge were equal to or less than 230,000 acre-feet. A log-normal distribution of these NRCS half-year yield predictions suggests that the average return frequency is about eight years for flows on the order of 230,000 acre-feet at Otowi for the first six months of the year.

From an engineer's perspective, a hydrologic drought could be defined as the conditions that exist when the water supply available fails to meet demands five percent of the time, on average. This engineer's definition translates into a return frequency for hydrologic droughts of about once every twenty years or so, on average. Niemi and McGuckin, in a 1997 report to the Western Water Policy Advisory Commission, note that a major drought occurs in the Middle Río Grande every 20 to 25 years.[6] While there is no firm definition, it must be assumed that a hydrologic drought is an unusual event, one that has a relatively long, average return-frequency. Both the Niemi and McGuckin estimates for a major drought on the Río Grande and the engineer's definition suggest a 20 to 25-year return period for hydrologic droughts. It is concluded that a hydrologic drought did not occur in the Middle Río Grande Valley in New Mexico in spring of 1996, as the shortfall in the stream flow experienced in the Middle Río Grande had a return period of about eight years.

Drought: A Meteorological Phenomenon or an Act of God

> *And I called for a drought upon the land, and upon the mountains, and upon the corn, and upon the new wine, and upon the oil, and upon that which the ground bringeth forth, and upon men, and upon cattle, and upon all the labour of the hands.*[7]

There was a time when long droughts and extreme floods could be ascribed to an act of God as a punishment of a people for their failure to obey some commandment, for declining to build a temple, or for failing to

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5. NATURAL RESOURCES CONSERVATION SERV., U.S. DEP'T OF AGRIC., NEW MEXICO BASIN OUTLOOK REPORT (Apr. 1, 1996).

6. ERNIE NIEMI & TOM MCGUCKIN, WATER MANAGEMENT STUDY: UPPER RÍO GRANDE BASIN: FINAL REPORT: REPORT TO THE WESTERN WATER POLICY REVIEW ADVISORY COMMISSION 73 (1997).

7. *Haggai* 1:11 (King James) (1920).

heed an admonition that they "consider their ways."[8] With respect to great floods and drought, modern hydrologists have left little room for acts of God. The magnitude of the most unusual future flood is now predictable: the U.S. Weather Bureau has made meteorological estimates of the maximum possible amount of precipitable water for locations across America[9] and estimates can be made of the magnitude of floods that have an average return frequency for periods as long as five hundred years.[10] The low flows in the Río Grande in the spring of 1996 did not constitute a meteorological drought as the stream discharge fell well within the expected realm of meteorological events.

The Drought of 1996 and Negative Impacts on a Socioeconomic Good

There may or may not have been a definable hydrologic drought in the Middle Río Grande Basin in New Mexico in 1996, but there was a water shortage in some reaches of the river. The supply was not sufficient to meet the requirements for all of the intended water uses listed in New Mexico's water quality standards for the Middle Río Grande.[11] The quotes below have been excerpted from a mid-April 1996 Associated Press story printed in the *Las Cruces Sun-News* which tells of the loss of a socio-economic good as a result of the relatively low spring runoff experienced in the Middle Río Grande in New Mexico in 1996.

> SOCORRO – More that 1,000 rare minnows, many of them females on the verge of spawning, died when water from the Río Grande was diverted into irrigation ditches this month to help farmers north of Socorro, wildlife officials said. The female fish that died—each with 500 to 1000 eggs— were getting ready to spawn, when the Middle Río Grande Conservancy District, on April 13 began diverting virtually the entire flow of the Río Grande at the San Acacia dam, 12 miles north of Socorro, to irrigators....The Río Grande Silvery Minnow [was added to] the federal endangered species list in July 1994...the short, stout 3 1/2-inch minnow has disappeared from the Pecos and survives in the Río Grande from Cochiti Dam...south to Elephant Butte. The 45-mile stretch of river is home to 70 percent of the known population....The

8. *See* Haggai 1:7 (King James) (1920).

9. *See* WARREN VIESSMAN, JR. & GARY L. LEWIS, INTRODUCTION TO HYDROLOGY 370 (T. Michael Slaughter & Lisa A. De Mol eds., 4th ed. 1996).

10. *See id.* at 363.

11. *See* NEW MEXICO WATER QUALITY CONTROL COMMISSION, STATE OF NEW MEXICO STANDARDS FOR INTERSTATE AND INTRASTATE STREAMS (1994) (effective Jan. 23, 1995).

Fish and Wildlife Service has notified the district that the water diversion might violate the Endangered Species Act.

Flows in the Middle Río Grande and Agriculture

Pueblo Indian tribes have a little over eight thousand acres of land under cultivation in the basin. The Middle Río Grande Conservancy District furnishes water to these lands, as well as to about 80,000 other irrigated acres in the valley. The Pueblos have a primordial right to irrigate their lands; the bulk of the Conservancy District's water rights are based on pre-1907 water appropriations made when New Mexico was still a territory.

The irrigation season in the Middle Río Grande Valley usually starts about the first of March when water is diverted from the river at four points over the one-hundred mile reach between Cochiti Dam and Socorro, New Mexico. Diversions are made at Cochiti Dam, at Angostura (for the Albuquerque area), at Isleta (for the Belen area), and at San Acacia (for the Socorro Division). Withdrawals from the river continue into October. Diversions in March and October are less than in the remainder of the irrigation season (9 to 12 percent of the total annual water use). Diversions from the river in the months of April, May, June, August, and September are typically each 12 to 14 percent of the total. July diversions are lower in years when good regional summer rains occur. Over the years, the management strategy in the Middle Río Grande Conservancy District has been to use as much of the spring runoff as possible to keep canals, drains, and the riverbed wet so that flow losses will be as low as possible when releases from storage in El Vado Reservoir are made early in the summer to meet irrigation demands.

The start of the 1996 irrigation season, during the second week in March, was not atypical. The Natural Resources Conservation Service had made stream-flow forecasts in January, February and March for expected flow during the first six months of the year. Based on NRCS information, regional water-managers for all agencies should have, or did know that the surface supply available for irrigation in the spring months would be somewhat below normal. Other information available from the NRCS offered regional water managers both encouraging and discouraging news. Storage in reservoirs on the Río Grande system was reported to be high (some at 200 percent above normal levels), but precipitation and the snowpack were reported to be far below average. The water content of the

snowpack was only about one-third of normal conditions.[12] Overall, when the 1996 irrigation season started, it looked like business as usual in a water-short year.

Lean agricultural water-years, like 1996, have occurred over the century on the river. Water use on the Río Grande in Colorado, and dry years in the late 1890s and early 1900s, demonstrated that shortfalls in the supply of the Río Grande could occur, and were sure to occur again. As a consequence of the turn of the century water shortages and other experiences, when New Mexico's water laws were adopted in 1907 they provided for droughts (agriculture was the principal water user at the time). New Mexico, like many Western states, follows the doctrine of prior appropriation where the priority to use water during periods of shortages is based on the concept of the "first in time, is the first in right." This concept was embodied in the State water code by the Territorial Legislature in 1907. While priority calls have been made on New Mexico's stream systems in the past, sharing of shortages is not an uncommon practice. Water managers found 1996 to be a water-short year, but not an "agricultural drought." The irrigated lands in the District received a somewhat diminished supply—a supply that would be expected once every eight years or so, on average.

Summary

The 1996 spring runoff did not constitute a drought, except from the perspective of the socio-economic loss of one public good, the Río Grande silvery minnow. It should be noted that the 1996 low-flow situation below the diversion dam at San Acacia was quickly mitigated by the release of federal and municipal water held in storage above Cochiti Reservoir. Water that was routed down the river for the silvery minnow helped the state of New Mexico build a credit in its Río Grande Compact deliveries in 1996.

The Río Grande silvery minnow is a relative newcomer in the hierarchy of Middle Río Grande water priorities, having been designated as an endangered species only in 1994. Firm plans to ensure a sustaining supply for this small fish during low-flow years should be put into effect as quickly as possible. The U.S. Bureau of Reclamation has a set of options under active review that may result in the formulation of a method of

12. *See* NATURAL RESOURCES CONSERVATION SERV., U.S. DEP'T OF AGRIC., NEW MEXICO BASIN OUTLOOK REPORT (May 1, 1996).

providing a supplemental water supply for the silvery minnow in the Middle Río Grande Basin.[13]

13. *See* Dr. John W. Hernández, A REPORT ON THE EFFICACY OF FORBEARANCE AS A MEANS OF PROVIDING SUPPLEMENTAL STREAM-FLOW IN THE MIDDLE RÍO GRANDE BASIN IN NEW MEXICO 6 (1997) (prepared for the Albuquerque Area Office, U.S. Bureau of Reclamation).