Frank Titus *became a New Mexico water user in 1956, when, just out of graduate school, he joined the U.S. Geological Survey as a hydrogeologist in Albuquerque. Nine years later he moved to Socorro to teach geology and groundwater at New Mexico Tech (1965-1973). During this 17-year period, his major reports were on geology and water resources in the Sandia and northern Manzano Mountains, in Valencia County, and in the Estancia Valley. From 1973-1987, Frank managed Environmental Impact Statements and waste-management studies coast to coast, including Canada and Alaska. In 1987 he returned to Albuquerque to manage DOE's Uranium Mill Tailings Remedial Action Project. In 1995 Frank became state engineer Tom Turney's Science Advisor and also chairman of the Technical Advisory Committee for Middle Rio Grande water resources. He is now active in the Middle Rio Grande Water Assembly and its Action Committee. His Ph.D. in geology is from the University of New Mexico.*

Current Water Budget of the Middle Rio Grande Basin

Note: Frank Titus distributed copies of the "Current Water Budget of the Middle Rio Grande Basin," which was prepared by the Middle Rio Grande Water Assembly, Inc. The following is the summary from that report. Those interested in obtaining a copy of the Budget should contact the Assembly at (505) 247-1750.

Current Water Budget of the Middle Rio Grande Basin

Middle Rio Grande Water Budget Summary Text

This simple water budget and the material accompanying it are designed for a broad audience of people who have an interest in the region's water resources. This summary provides context for understanding the information in the tables and graphs on the following pages. An audience with good understanding will, we hope, improve public input and also multiply the public's influence over water stewardship.

The water budget addresses wet water in both the surface water and the groundwater parts of the regional hydrologic system. Many water budgets have been created over the past three decades by knowledgeable professionals. The numbers we use here differ little from those earlier presentations. Most of those water budgets however were embedded in lengthy technical documents not at all designed for non-hydrologist audiences.

Both tabular and graphic formats are used in this pamphlet to present the hydrologic picture, and the numbers in the two formats are the same. Some people like numbers, some like pictures. In addition to the annual averages, an *actual* one-year water budget, for 1993, a near-typical year, is also provided.

1. The **Middle Rio Grande Valley** addressed in this water budget extends from the Otowi gage on the north (where the Los Alamos highway crosses the Rio Grande) to Elephant Butte Dam on the south, a distance of about 200 miles. These are the two index" points, or water-accounting points, in New Mexico that are specified by the Rio Grande Compact.

2. Groundwater and surface water are but parts of a single hydrologic system. Throughout the river's floodplain (the inner valley" of the Rio Grande) the water table in most places (though not at Albuquerque) is only 10 feet or so below land surface. The uppermost groundwater in the shallow aquifer, which underlies the floodplain, is in direct contact in most places with the surface water in the river and with water in the many drainage ditches throughout the valley. It is here that all exchanges between groundwater and surface water occur.

3. All municipal water systems pump groundwater to supply their customers, and the larger systems—principally Albuquerque and Rio Rancho—pump at rates we now know significantly exceed the ability of the Rio Grande to replenish (ie., recharge) the aquifer. This is called **"mining" groundwater.**

* Groundwater currently is being mined at a rate of about 70,000 acre-feet per year (af/y). An effect of the overdraft is that the water table beneath Albuquerque has been seriously lowered—locally beneath the northeast heights by amounts approaching 200 feet.
* Both specialists and non-specialists are aware that this rate of exploitation is unsustainable, and alternative plans are under serious discussion by many parties and concerned specialists.

4. This is an **annual water budget.** It gives annual averages for nearly all inflows, outflows and changes in storage in the system, and it identifies the pathways on which these occur. Information presented herein conforms generally with definitions and parameters used in the Rio Grande Compact.

* Natural variability is high for nearly all the numbers in the budget. The variability range is shown for some, but not all, parameters. (The high variability in flow of the Rio Grande is shown graphically in the histogram on page 3.)
* The data for river flows at Otowi gage and Elephant Butte Dam, the data for major-tributary inflows, and the data for most of the aquifer pumping and municipal wastewater are direct measurements of surface-water flows or pumping. Most other numbers are from complex analyses, and/or from analytical or computer modeling.
* Rio Grande flow gaging data have officially reported uncertainties of the order of 10%. Groundwater and other calculated data have uncertainties at least this large. Hence, the accuracy of data in this water budget is affected by this reality.

5. The water budget is for the **26-year period of 1972-1997**, inclusive.

* Flow records at the Otowi gage go back more than 100 years, but in 1971 the San Juan-Chama diversion project began importing water from the Colorado River system into the Rio Grande.

6. The **Otowi gage**, located as it is downstream from the confluence of the Rio Chama and the Rio Grande at Española, measures the combined flow of native water in the Rio Grande system and the imported water from the San Juan-Chama diversion system.

* The 1972-1997 average flow of *native* water at Otowi is approximately 1,100,000 acre-feet/year.
* The 1910-1993 average of all flows past the gage is also about 1,100,000 acre-feet (af).

7. **The San Juan-Chama diversion project** delivers an average of 96,000 af/y to Heron Reservoir. Evaporation and water used to increase reservoir storage reduces the amount reaching the Rio Grande. That reaching the Rio Grande has augmented the flow at Otowi gage by about 55,000 af/y since 1971.

* This is part of New Mexico's Colorado River share; it is picked up from tributaries of the San Juan River, conveyed through a tunnel under the continental divide to Heron Lake, then to the Rio Chama.
* The San Juan-Chama water is not subject to Rio Grande Compact control.

8. The **Rio Grande Compact** specifies the annual amount of surface water to be provided to downstream users from Elephant Butte Reservoir based on "native" Rio Grande inflow at Otowi. Four values that relate to Elephant Butte outflow are given in the accompanying table and flow diagram. These are, (a) the delivery that would be required it the averages in the table were the actual flow fro a single year; (b) The average of **actual wet-water flows** past the dam; (c) the average of the **Elephant Butte Effective Supply** (which combines actual deliveries and change in lake storage). Note: given 10% or larger error for data, the Elephant Butte Effective Supply and the deliveries mandated by compact are statistically the same.

9. "Depletion" is calculated by subtracting the outflow at Elephant Butte Dam from the native-water inflow at Otowi. (Note that this calculation ignores all other inflows and outflows that originate *within* the Middle Rio Grande.)

* Under the compact, the *maximum* that the Middle Rio Grande is allowed to deplete from any and all Otowi *native inflows exceeding 1,500,000 af/y* is a fixed 405,000 af/y. At lesser inflows, the depletable amount decreases progressively (down to 47,000 at inflows of 100,000 af/y).
* *Evaporation from Elephant Butte Reservoir* must be included as part of the Middle Rio Grande's permissible depletion.

10. Direct **evaporation from Elephant Butte Reservoir** is commonly the largest single depletion loss from the system. The amount varies widely from year to year, being controlled by both weather and size of the lake surface through the year.

* Note: The outflow called "Recharge to shallow aquifer" above San Acacia, while a larger number, is mostly offset by nearby shallow-aquifer returns to the surface-water part of the system.