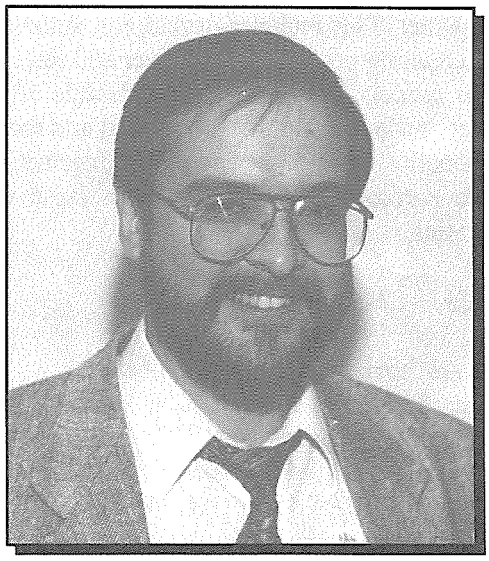

Karl Martin has been Chief of the Water Operations Branch for the Albuquerque Area Office of the Bureau of Reclamation since January 1994. Karl oversees river and reservoir operations, for the Rio Grande and Pecos River basins. He is responsible for Reclamation's San Juan-Chama Project water accounting. Other duties include oversight of the Area Office's Safety of Dams, and Review of Operation and Maintenance programs. Karl has worked for Reclamation for thirteen years and has held positions in several locations before coming to work in Albuquerque in 1987. While in Albuquerque, he worked in the Design and Construction and Water Operations branches. Karl is also involved in the development of a river simulation/optimization computer model and hydrologic database. He received a B.S. in Civil Engineering from UNM and will soon receive a M.S. in Hydraulic Engineering and Water Resources also from UNM. Karl is a registered professional engineer in the State of New Mexico.

SAN JUAN-CHAMA PROJECT WATER DELIVERIES

Garry M. Rowe
Karl A. Martin
U.S. Bureau of Reclamation
Albuquerque Area Office
505 Marquette NW, Suite 1313
Albuquerque, NM 87102

INTRODUCTION

The Bureau of Reclamation (Reclamation) was founded in 1902 and has been instrumental in developing water resources in the arid western United States, building such engineering marvels as Grand Coulee, Hoover, and Glen Canyon dams. Reclamation is the nation's largest wholesale supplier of water, sixth largest electric utility, and manages 45 percent of surface water in the West. Now, in the process to become a premier water resources management agency, Reclamation's focus and mission is changing to better suit the nation's water needs. The new mission of Reclamation is "**to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American Public.**" The San Juan-Chama Project is one of Reclamation's major efforts in accomplishing that mission.

Reclamation recognizes the benefits of effective resource management and conservation and the importance of using multiobjective water resource management that fully integrates environmental planning to understand the true, long-term costs and benefits of each alternative. In addition, the value of open, inclusive decision making to stimulate new ideas and avoid costly mistakes is important. In an effort to shift to a broader water resource management based approach, the Albuquerque Area Office is involved in developing the types of tools needed

to efficiently and effectively manage water and related resources in a fiscally and environmentally sound manner. This includes developing automated water accounting procedures and river and reservoir computer models. In addition, considerable efforts have been made to maximize ecological and recreational benefits through improved management of available surface water resources for these conjunctive uses.

SAN JUAN-CHAMA PROJECT

Project Authorization and Allocations

The San Juan-Chama (SJ-C) Project was authorized by Congress in 1962 through Public Law (P.L.) 87-483, which amended the Colorado River Storage Act of 1956 (P.L. 84-485) to allow diversion of Colorado River Basin water into the Rio Grande Basin of New Mexico. The original planning projections for the SJ-C Project contemplated an ultimate diversion of 235,000 acre-feet (ac-ft) per year, with an initial phase development of 110,000 ac-ft. The initial phase is all that was authorized (by P.L. 87-483) and subsequently constructed. The project takes water from the Navajo, Little Navajo, and Blanco rivers which are upper tributaries of the San Juan River, itself a tributary of the Colorado River, for use in the Rio Grande Basin, New Mexico. The New Mexico Interstate Stream Commission is responsible for prioritizing which entities can contract for the water and what their allocation will be.

The additional water introduced into the Rio Grande Basin is used for the following municipal, domestic, and industrial purposes: City of Albuquerque, 48,200 ac-ft; City and County of Santa Fe and Public Service Company of New Mexico, 5,605 ac-ft; Department of Energy, 1,200 ac-ft; Village of Los Lunas, 400 ac-ft; Twining Water and Sanitation District, 15 ac-ft; City of Española, 1,000 ac-ft; Village of Taos, 400 ac-ft; Town of Red River, 60 ac-ft; Town of Bernalillo, 400 ac-ft; Town of Belen, 500 ac-ft; and Jicarilla Apaches, 6,500 ac-ft. Supplemental water is provided for irrigation of 89,711 acres (20,900 ac-ft) within the Middle Rio Grande Conservancy District (MRGCD); and 2,768 acres (1,030 ac-ft) within the Pojoaque Valley Irrigation District. An additional annual allocation of up to 5,000 ac-ft is available for the Corps of Engineers' Cochiti Reservoir to assure a minimum pool of 1,200 surface acres for fish and wildlife, and recreation purposes. There is an allocated, but as yet uncontracted, availability of 4,990 ac-ft based on the current estimated SJ-C Project yield of 96,200 ac-ft per year.

Early History

Through prehistoric Indian activity at Sandia Cave northeast of Albuquerque, pueblo communities established before 600 A.D., Spanish settlement in 1598, and the homestead development in the late 1840s, the Rio Grande Valley has accommodated and nurtured man. The waters provided by the SJ-C Project flow to the descendants of these cultures and is helping to continue the varied lifestyles represented.

Along the upper San Juan River drainage, the project's water source, a similar settlement pattern developed. A desert culture base underlay the Anasazi development, but climatic conditions and the influx of the ancestors of the modern Navajo and Ute Indians limited pueblo development. Spanish exploration in the area is known to have occurred as early as the search for gold in 1765, with settlement later in the century. Reports by trappers in the 1820s brought prospectors and miners, and eventually permanent settlers.

Studies of the possibility of diverting San Juan River Basin waters into the Rio Chama, a tributary of the Rio Grande, began immediately after the First World War. In 1933, the Bunger Survey began surveys of the features involved. That survey was continued in 1936, as a part of the Rio Grande Joint Investigations, to determine the need for such a project. The investigations established the basis for recognizing, in the Rio Grande Compact, the possibility of a transmountain diversion to bring water from the San Juan River into the Rio Grande Basin. The Colorado River Basin report, issued by Reclamation in 1946, established the quantity of water that was considered for transmountain diversion during negotiation of the Upper Colorado River Basin Compact.

In 1950, in the interest of coordination, the Secretary of the Interior appointed a committee known as the San Juan River Technical Committee. Its summary report was prepared in May 1950, and the committee presented progress reports in 1951

and 1952. Field survey work was resumed at the beginning of 1951, and Reclamation prepared interim reports through 1955, followed by a feasibility study. That study was supplemented in 1957 and was followed by authorization of the Project, as previously mentioned. Volume I of the definite plan report, covering diversion and regulation elements of the Project, was approved on August 10, 1964.

Project Features

The northernmost facility is Blanco Diversion Dam on the Rio Blanco. It diverts water to Blanco Tunnel, a closed conduit of 520 cubic feet per second (ft^3/s) capacity, designed to carry water 8.6 miles from the Rio Blanco southward to the Little Navajo River. There, the Little Oso Diversion Dam diverts water from the Little Navajo River to the Oso Tunnel to join with flows from Blanco Tunnel. Oso Tunnel is a concrete-lined structure of 650 ft^3/s capacity and 5.1 mile length conducting water from the Little Navajo River to the Navajo River. The southernmost facility is Oso Diversion Dam, which diverts water from the Navajo River to Azotea Tunnel to join with flows from Oso Tunnel. The 12.8-mile, concrete-lined Azotea Tunnel, with a capacity of 950 ft^3/s, conveys water from the Navajo River, under the Continental Divide to Azotea Creek in the Rio Grande Basin.

These imported waters flow down Azotea and Willow creeks 11.8 river miles to Heron Reservoir. The regulating and storage reservoir is formed by Heron Dam, on Willow Creek just above the point where Willow Creek enters the Rio Chama. The dam is an earthfill structure, 269 feet high, which forms a reservoir with a conservation capacity of 401,320 ac-ft and surface area of 5,950 acres. Its spillway has a capacity of 660 ft^3/s, and the outlet works has a capacity of 4,160 ft^3/s.

Blanco Diversion Dam and Tunnel were completed during May 1969: Little Oso and Oso Diversion dams and Oso Tunnel were completed in November 1970; as was Azotea Tunnel, whose construction began six years earlier, in April 1964. Azotea Creek channelization was completed during December 1968; Willow Creek channelization was completed in August 1970; and construction of Heron Dam, which began in August 1967, was completed in June 1971.

HERON RESERVOIR SAN JUAN-CHAMA PROJECT

Principles of Heron Reservoir Operation

Heron Reservoir is operated in compliance with the Rio Grande Compact. There are no provisions for storage of Rio Grande Basin water (i.e., natural water) in Heron; therefore, all natural inflow is bypassed. Two basic principles control the water release schedule from Heron Reservoir. The first is that groundwater pumping by contractors and those who lease their water results in an annual depletion of the Rio Grande. These depletions are offset by releases of SJ-C water from Heron Reservoir sufficient to assure that no residual effect occurs to natural waters of the Rio Grande due to project operations. The Interstate Stream Commission determines the amount released and recommends when the release is to be made. In addition, Project waters are conveyed past Otowi for use by downstream contractors. This includes the City of Albuquerque for its SJ-C pool (50,000 ac-ft) and the legislated permanent recreation pool (50,000 ac-ft) both in Elephant Butte Reservoir, the City's agreement with the Interstate Stream Commission to maintain the sediment pool at Jemez Canyon Reservoir, and MRGCD for supplemental irrigation water. San Juan-Chama water also is released past Otowi for the legislated permanent recreation pool at Cochiti Reservoir.

The second principle is that carryover storage into the next year is not permitted in Heron Reservoir. Contractually, if contractors have not called for their water to be released by December 31, the water normally remains in Heron as part of the Project supply and no longer belongs to the contractors. It is available, however, during following years to meet annual allocations.

Reclamation has, on occasion, given temporary waivers to contractors to allow carryover until April 30, in order to provide release rates on the Rio Chama that would enhance fisheries between El Vado Dam and Abiquiu Reservoir. The waivers also have provided an added benefit of increased flexibility for managing river flows. Such waivers are analyzed on their merits each year. The no-carryover stipulation often results in contractors seeking storage for their unused water in reservoirs downstream of Heron. El Vado, Abiquiu, Jemez

Canyon, and Elephant Butte reservoirs have all been used for storage of SJ-C waters. Another factor influencing Heron releases is ice cover on the reservoir, which may present a safety hazard to people who may be on the ice as Heron is drawn down. If hazardous conditions develop, releases are terminated until conditions are safe. During late March or April, any SJ-C Project water for which waivers were granted, but which was not released because of unsafe winter operation conditions, is released at a time when it will accomplish the same purposes as if it had been released during the winter months.

POJOAQUE TRIBUTARY UNIT SAN JUAN-CHAMA PROJECT

Project Features

The Pojoaque Tributary Unit provides supplemental water (1,030 ac-ft) for approximately 2,768 acres of irrigated land of which Indian lands comprise approximately 34 percent of the total. The storage feature of the SJ-C Pojoaque Tributary Unit is Nambe Falls Dam and Reservoir located on the Rio Nambe. It is a concrete and earth embankment structure 150 feet high, which forms a reservoir of 2,020 ac-ft capacity. Construction of Nambe Falls Dam began in June 1974, and was completed in June 1976. The operation and maintenance of Nambe Falls Dam and Reservoir is performed by the Pojoaque Valley Irrigation District.

Water which is physically stored in the reservoir is natural to the Rio Grande Basin but the reservoir is operated as if it were SJ-C water. San Juan-Chama water is released from Heron Reservoir to offset depletions of natural water as a result of reservoir operations at Nambe Falls Dam. The objective is to make the flows whole at the Otowi River gauge (i.e., as if Nambe Falls Reservoir did not exist).

EL VADO RESERVOIR MIDDLE RIO GRANDE PROJECT

Project Features

Although it was completed thirty years earlier, the outlet works for El Vado Dam (6,600 ft³/s capacity) were enlarged in 1965-66 so that SJ-C Project releases from Heron Reservoir could be passed unimpeded through the dam. El Vado Dam was originally constructed by MRGCD to provide conservation storage for irrigation use on lands along the Rio Grande from Cochiti Dam to below Socorro, New Mexico. Because El Vado Dam was constructed after 1929 (completed in 1935), reservoir operations for storage and release are subject to the terms and restrictions of the Rio Grande Compact, when it involves water natural to the Rio Grande Basin. Water imported into the Rio Grande Basin via the SJ-C Project and stored in El Vado Reservoir is not subject to storage and release restrictions of the Rio Grande Compact.

El Vado Operation for San Juan-Chama Water

El Vado operation is affected by the SJ-C Project in two ways. The first is that SJ-C Project water released from Heron Dam for use downstream of El Vado Reservoir is simply passed through. The second is that storage of large volumes of SJ-C Project water in El Vado Reservoir may take place for extended periods of time.

The Middle Rio Grande Conservancy District has contracted for 20,900 ac-ft per year of SJ-C Project water and maintains as much of this water in El Vado Reservoir as conditions permit. In addition, MRGCD has contracted with various contractors of SJ-C Project water for storage in El Vado Reservoir. Current MRGCD agreements with other water management bodies or agencies allow for MRGCD to borrow, for irrigation use, a portion of the agencies' SJ-C Project water held in El Vado Reservoir.

SAN JUAN-CHAMA PROJECT OPERATIONS FOR MIDDLE VALLEY CONSTITUENTS

The majority of SJ-C contractors are municipalities, of which the City of Albuquerque has the largest allocation, amounting to 48,200 ac-ft per year. The allocation for the remaining three middle valley contractors is 400 ac-ft for the Town of Bernalillo, 400 ac-ft for the Village of Los Lunas, and 500 ac-ft for the Town of Belen. The main agricultural entity using SJ-C water is the MRGCD, with 20,900 ac-ft. The Middle Rio Grande Conservancy District stores its allocation in El Vado Reservoir for release during the mid-summer to early fall

months to supplement natural flows for irrigation purposes.

In recent years, the City of Albuquerque has used between 50 and 65 percent of its annual SJ-C Project allotment for a variety of purposes. These uses include: delivery of 5,000 to 10,000 ac-ft to replace evaporative losses from the sediment pool in Jemez Canyon Reservoir and recreational pool in Elephant Butte Reservoir; transfer of 20,000 ac-ft to MRGCD to assure a minimum flow of 250 ft^3/s in the Rio Grande through the Albuquerque Reach south of Central Avenue; and release of 500 to 1,500 ac-ft to offset depletions to natural flows from pumping by City subcontractors. These uses are based on short-term agreements that will eventually expire. To date, the City's only requirement to release SJ-C water to offset depletions from its own groundwater pumping activities in the middle valley occurred in 1992 (960 ac-ft). City projections in 1990 for using its SJ-C water allocation to offset depletions from the City's groundwater pumping activities indicate steadily increasing use until the maximum is reached by the year 2,030. Estimates in 1994 now indicate that the City's SJ-C allotment will be fully utilized by the year 2,005. During the period of increasing use, the City may elect to retain more of its SJ-C water as agreements expire.

Since 1984, the City has been able to take full delivery of its annual allotment with the exception of the spill years of 1987 and 1988 when deliveries were reduced to 23,870 ac-ft and 1,420 ac-ft respectively because of a lack of storage space in reservoirs downstream of Heron. Through implementation of various public laws, contracts, and agreements, the remaining unused portion of the City's allotment has been stored in El Vado Reservoir or, more recently, in Abiquiu Reservoir, where the City has obtained a storage easement to elevation 6,220 feet (est. 185,980 ac-ft in 1994).

Until the City fully utilizes its SJ-C water, it will likely continue to keep Abiquiu Reservoir filled to elevation 6,220 feet. As City demand for SJ-C increases in the years to come, storage requirements in Abiquiu may decrease. It is possible that storage of City water would not be needed in Abiquiu as Project water is released from Heron each year to either offset depletions or for direct use by the City. The City's relatively large allotment of SJ-C water, and their large storage space in Abiquiu Reservoir (170,900 ac-ft in 1994), significantly increases operational flexibility. In addition, the MRGCD plays a key role with El Vado, which provides alternative ways of moving water through the system to accomplish the main task of meeting the irrigation needs of the MRGCD.

Reclamation currently is conducting studies as part of an interagency effort to evaluate groundwater recharge in the Albuquerque Basin. Reclamation has specifically been looking at the surface water to shallow groundwater recharge interaction and the potential to preserve or enhance it. This includes natural surface water features as well as MRGCD facilities. Recharge enhancement alternatives may allow the City and other basin contractors to continue using their SJ-C allocations via groundwater withdrawals by reducing the rate at which the groundwater aquifer is depleted. If such alternatives are viable, then the need to develop a surface water diversion, treatment and distribution infrastructure may be reduced or eliminated.

Water banking may provide another method of utilizing unused portions of annual SJ-C allocations on a short-term basis. It would allow different contractors to relinquish a portion of their unused allotment for temporary use by others, on an as needed basis and possibly for a price. The customers (SJ-C contractors or other interested water users), would either borrow the water or pay for it. If borrowed, it would be paid back with the borrower's own allocation at a later date. Such procedures may provide a means for contractors to take delivery of their water for storage in the "bank," which would likely be Abiquiu Reservoir. This in turn, would provide a supply for other contractors or water users interested in short-term use. It may also provide a source of water for endangered species or ecosystem enhancement. In either case, any such use would be strictly monitored and must be consistent with the original authorization, established federal and state laws, and Compact regulations.

Another possible short-term use of SJ-C Project water would be the unallotted portion in Heron Reservoir. Nearly every year since 1982, Heron has been filled to its maximum conservation storage of 401,320 ac-ft. Of that amount, about 75,000 ac-ft is released for project use downstream, and 12,000

ac-ft is lost to evaporation. A portion of what remains could be provided to interested water users via year-to-year, short-term contracts.

Of the remaining three middle valley SJ-C municipal contractors, the Town of Bernalillo and the Village of Los Lunas have used about 35 percent of their 400 ac-ft allotments of Project water for the purpose of offsetting depletions to the Rio Grande. The depletions are created by groundwater pumping by contractors or other entities which lease their water. It is reasonable to assume that all of the middle valley contractors (including the third, the Town of Belen) will increase their use of Project water as populations increase and pumping increases. Typically, the unused balance of each year's allotments for the three contractors is either given to the City of Albuquerque, or MRGCD, or is temporarily stored in El Vado Reservoir through agreements with the MRGCD, or in Abiquiu Reservoir through agreements with the City.

PROJECT BENEFITS

In addition to providing about 90,000 ac-ft of supplemental water for a variety of municipal, domestic, industrial, and agricultural constituents, SJ-C Project water has significantly enhanced surface water resources in the State of New Mexico. The project has resulted in the establishment of three major reservoir pools on the Rio Chama: Heron, El Vado, and Abiquiu. Before the project's construction, it would not have been possible, as it is now, to establish significant pools for Cochiti and Jemez Canyon reservoirs. In addition, the project has made possible a permanent recreational pool of 50,000 ac-ft at Elephant Butte Reservoir (Daves 1990).

The importation of SJ-C water has provided instream benefits for the Rio Chama and Rio Grande. Effective and efficient management of deliveries of project water provides conjunctive benefits for fisheries and recreation. During the non-irrigation season, deliveries downstream of El Vado Dam enhance winter brown trout spawning, and the fishery in general. In addition, movements of large flows on weekends and lower flows during the week from El Vado Dam to Abiquiu Reservoir, for an eight-week period each summer, provide exceptional boating and rafting experiences through the designated "Wild and Scenic" Rio Chama. Management of a portion of the City's SJ-C water assures adequate flow for the City's annual "Great Raft Race." It is quite clear that the San Juan-Chama Project has greatly enhanced available surface water resources. Operational flexibility will likely be stretched to the limit as constituents continue to find ways to use the water for its original intent of offsetting depletions.

REFERENCES

Beard, D.P., Commissioner, Bureau of Reclamation. 1994. "Remarks—Application of Ecosystem Based Science to Natural Resource Management," May 31, 1994.

Beard, D.P., Commissioner, Bureau of Reclamation. 1994. "Remarks—American Consulting Engineers Council," October 12, 1994.

Bureau of Reclamation, Albuquerque Projects Office. 1993. *Annual Operating Plan—1992 Operations Overview/1993 Operations Outlook.* April 1993.

Bureau of Reclamation, Albuquerque Projects Office. 1990. *Rio Chama Water Management Addendum.*

Bureau of Reclamation, Southwest Region. 1982. *San Juan-Chama Project, Colorado: Urceolate and Mineral Counties, New Mexico: Rio Arriba and Santa Fe Counties.* Project Data Book, Region Revision, December 1982.

Daves, G. 1988. *Document on Acreage and Ownership Limitations to the City of Albuquerque's Delivery of Water to Elephant Butte Reservoir.* City of Albuquerque.

Daves, G. 1990. *San Juan-Chama Water Marketing Study.* City of Albuquerque, July 1990. p. 17.

Federal Reclamation and Related Laws Annotated. 1963. *Public Law 87-483, Navajo Indian Irrigation Project and San Juan-Chama Project, Initial Stage.* Volume III, 1959-1966, pp. 1658-1667.