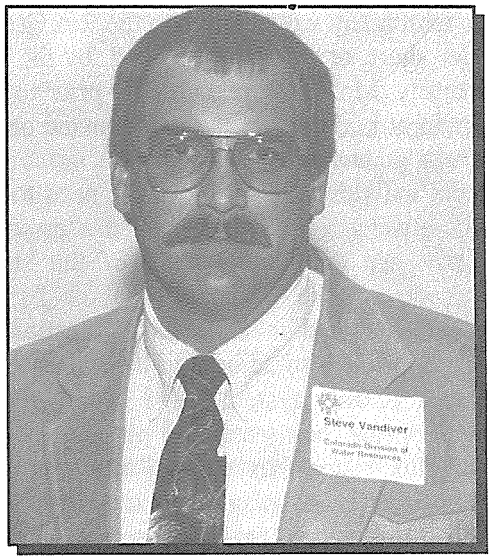
Steve Vandiver is Division Engineer for the Colorado Division of Water Resources, which is supervised by the State Engineer. The Division is responsible for all water-rights administration in Colorado, both surface and groundwater, dam safety, and well permitting. There is one division engineer and staff for each of the seven major river drainages in Colorado. Steve's responsibility is to administer the Rio Grande Basin in Colorado. He has held various engineering positions in the Division including hydrography, dam safety and water-rights administration. He received a B.S. in Civil Engineering from the University of Colorado. Steve lives with his family in Alamosa, Colorado and enjoys hunting, fishing, and river boating.



MANAGING SURFACE FLOWS IN COLORADO: AN UPSTREAM VIEWPOINT

Steven E. Vandiver
Division of Water Resources
Office of the State Engineer
PO Box 269
Alamosa, CO 81101-0269

How many of us consider ourselves to be Water Managers? How many of us were trained or educated as Water Managers? The title indicates we know who and what we are, and what we are supposed to do in order to handle this most valuable resource. You can work for just about anyone in the west and be called a Water Manager, whether you work for the City of Albuquerque, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, Bureau of Land Management, National Weather Service, states of Colorado, New Mexico or Texas, a ditch company or district, and the list goes on and on.

The interesting thing is that none of us use or control the river independently, which is probably a very good thing, or outside of many controls, restrictions and influences by other water managers who have their own rules and agendas. But there are a few basic things all water managers must consider if we are to be even fairly successful in managing the resource.

Water managers first must consider what resources are available. How much water is available, where is it located, and the timing of its flows must be determined. Second, we must determine what tools are available to monitor and control the resource. Third, we must consider the laws, constraints, and restrictions which govern the use, obligation and ultimately the management of the resource. And last, we must consider what can be done with the consent of those involved to address

a problem outside the normal channel of doing business.

As with many western rivers, the Rio Grande was water short, or over appropriated, by the turn of the century. More than two decades prior to that in Colorado, it became obvious that demand on the system was greater than the supply. A number of far-sighted individuals determined the need to put into place a water rights system which allowed for the orderly use and management of the state's water resources. The Doctrine of Prior Appropriation as contained in Colorado's Constitution, allows appropriators to adjudicate their claims and enter into a priority system based upon the date they first diverted their water and put it to beneficial use. This system has evolved into what it is today by using special water courts created in 1969 to make determinations regarding new or changes in water rights. Colorado, therefore, for over a century has had a systematic approach to the management of its water supplies, allowing new rights on underappropriated streams, and more importantly, allowing exchanges, transfers and changes in existing water rights when the need has arisen.

The first adjudication on the Rio Grande in Colorado came in 1889. It allowed the state to administer the water rights on the river in a clear and orderly fashion from that point forward. This adjudication covered approximately the first 3000 cubic feet per second (cfs) of flow in the river. The second adjudication came in 1903 for another 2400 cfs; the third in 1916 for 200 cfs; a fourth in 1934 for 125 cfs; and a fifth in 1959 for 110 cfs. Currently, there are approximately 6000 cfs of surface water rights decreed on the Rio Grande along with several large storage rights. In addition, approximately 3500 cfs direct flow water rights exist on the Conejos, along with the Platoro Reservoir storage right.

Therein lies the problem for Colorado water administrators, users, and indirectly, downstream states. The long-term average April-September flows are 590 cfs for the Conejos and 1530 cfs for the Rio Grande. The instantaneous demand on the system can be four to six times the amount of water available during that period. Of course, the snowmelt runoff does provide many more users the opportunity to divert water, but then only for a short time period. But even then, perhaps as seldom as once every decade can all water rights be served simultaneously and then for only a very short time period.

Coupled with this, Rio Grande system users do not have the luxury of having transmountain diversions or reservoirs that can be used to supplement or smooth out river flows during the season. The three largest reservoirs in our system are owned by three canals and the water stored in them is unavailable to all other canal systems on the river. Platoro is the only facility offering most users on the Conejos River system a chance to supplement their direct flow supplies. A federal moratorium on reservoir construction on the Rio Grande in Colorado was in effect during the years of investigation and negotiation of the Compact and prevented any reservoir project from being completed on federal lands.

Therefore, sound management of water supplies of the upper basin is due to the fact that historically we have had water rights adjudicated into a priority system. Also, we have had staff available to ensure that our water is administered effectively and orderly regardless of the use or amount of their relative priority. In my opinion, a comprehensive water rights system of administration is pivotal to the effective management of water. Again, this is driven by the fact we have a limited resource with an ever increasing demand on it. Many in Colorado are calling for a statewide water plan to better define our water situation and uses. I submit that our present system already allows water to flow between owners, users and areas and gives any interested or effected party the opportunity to participate in that process, including the State Engineer Office and the Colorado Water Conservation Board, which hold many of our state's instream flow water rights. It is important to understand that the system allows and accommodates new interests as long as an existing water right can be changed without injury to other water rights' holders in the system. So, in having to manage a widely varying stream flow with virtually no control or storage, what could go wrong?

In 1938, the Rio Grande Compact was signed, obligating Colorado and New Mexico to deliver water downstream according to their respective delivery schedules in order to allocate equitably the water of the Rio Grande among Col-

orado, New Mexico, and Texas. The Rio Grande Compact is in place today and continues to serve its purpose.

Colorado, in order to meet her obligations under the Compact, must sometimes curtail water right owners of water to which they would otherwise be entitled and send that water downstream to New Mexico. At times this has amounted to approximately 50 percent of the flow on both the Rio Grande and the Conejos River during the irrigation season. Over the last 25 years or so, Colorado water administrators and water users have spent considerable time and effort in dissecting the water system and identifying operational and administrative scenarios which would allow Colorado to meet its Compact obligations while maximizing the use of its entitlements. To name just a few initiatives, we have sought to maximize Compact deliveries during the winter and early spring to reduce curtailment during the irrigation season; to cooperate with users to deliver extra water during rainy periods in the spring and summer; to develop a better understanding and monitoring of return flows, channel losses and diversions; to incorporate the Closed Basin Project production into deliveries; and to install a satellite monitoring system on all river gages and many reservoirs. Water conservancy and water conservation districts and water user groups have been instrumental in helping to identify and initiate many of these efforts to facilitate more efficient and effective deliveries.

Crucial to the overall management of the basin is the need for good snowmelt runoff forecasts. These forecasts are critical to our overall management since the majority of the upper basin supply, which is generated by snowmelt, occurs over a 60 to 75 day period. The Soil Conservation Service and the National Weather Service coordinated forecasts have steadily improved over the past decade partly due to their understanding that a large envelope of possible flows does not contribute to good Compact administration. Forecasters from these agencies have a better understanding of the Rio Grande Compact, the operational needs and concerns of river managers and how important accurate forecasts are to those of us responsible for meeting our obligations without excessive overdelivery. If it weren't for improved forecasting methods, state and federal agencies such as the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation would find it much more difficult to manage river flows, reservoir operations, and deliveries under the Compact.

Perhaps the most significant water management concern on the upper Rio Grande Basin involves the complex relationship between surface and groundwater. As most of you are probably aware, the San Luis Valley relies to a large extent on groundwater, particularly in the area north of the Rio Grande. Originally surface water was used as the primary source for irrigation in this area of the basin. Later, wells were developed as a supplemental source. With advances in irrigation technology starting in the late 1960s and continuing today, it was obvious that using wells as the primary source of water was more efficient and effective, especially when used in conjunction with a center pivot sprinkler system. The San Luis Valley is blessed with approximately 2000 of these systems which have replaced many of the flood irrigation systems.

Our next concern was how to conjunctively use surface diversions and wells to ensure a sustainable and dependable long-term water supply for these areas. Most of these areas are located in the Closed Basin area of the San Luis Valley, which is underlain by a shallow and very porous unconfined aquifer. The aquifer readily accepts surface water through percolation from ditches and both formal and informal recharge areas. The aquifer is then effectively used as a reservoir allowing the withdrawal and use of only the water necessary to properly and efficiently serve the needs of the center pivot systems.

The aquifer is recharged in the fall by runoff when the area's two largest canals make substantial diversions into the area. Natural recharge from the streams surrounding the Closed Basin also occurs, much of which is lost into the aquifer before reaching the valley floor. This "reservoir" of underground water also is used as a hedge against drought years and allows continued diversions as were made prior to the use of wells and pivots. The conjunctive use of surface and groundwater has provided at least some irrigators in the river's upper basin a mechanism to manage their water supplies very effectively.

This program did not come easily and there is a continuing need for more education on how this very dynamic system works. Problems such as over filling the "reservoir" or the inability to recharge the aquifer uniformly sometimes cause water tables to be too high or too low in some areas. However, overall it is a very interesting and challenging groundwater hydrology endeavor.

Surface water rights owners also had to obtain state water court approval to use their ditch diversions in this manner. As more data become available, comparing the relationship of diversions to the resulting groundwater recharge will allow us to adjust the program to address problems still being encountered. Additional data also will give us a better understanding of aquifer dynamics and recharge.

Although various recharge facilities are used, the primary vessels are ditches and laterals. Recharge is accomplished without expanding the use of water rights. Since these diversions have and continue to be diverted primarily into the Closed Basin area, there is no overall depletion to the river different than what has occurred since the ditches were dug in the 1870s and 80s.

Another factor stands out in our attempt to improve river management. Colorado began installing satellite monitoring sites in the early 1980s. These sites enable us to get a much better view of the river and its vagaries. Tracking flood peaks, reservoir runs, diurnal effects of snowmelt, and daily and weekly trends, all in real time, provides us with better data to help us accomplish our mission of effective administration of water rights and the Compact. Gone are the old days when we had to physically observe gages. The satellite system allows us to obtain current data at any time involving nearly every significant stream gage and reservoir in the upper basin. This has given us the ability to advise other agencies and users on various courses of action to best manage the available water.

But, when all is said and done, what we discovered over the last several years is that good management boils down to good people who have a sincere desire to manage the river to serve the many interests and demands on it. Understanding each other's needs as users, administrators, and managers, along with environmental needs, can go a long way in developing innovative and ingenious ideas for improving the system. Whether it is the National Weather Service and Soil Conservation Service taking the time to learn about the Compact, something for which they have no direct responsibility, or the Bureau of Land Management learning about the hydrology of the river and its influences, or water managers learning about the needs of an endangered fish and its protection, these efforts are all a part of good water management.

My experience has been that when a problem is defined properly and articulated to those having some influence on it, oftentimes the problem can be addressed with little or no cost to anyone. It is only when a group wants to ignore the real physical and/or institutional constraints of a situation that things get bogged down. A genuine understanding of the different sides of a management issue by all concerned is the first step in solving many problems. There are people in every circle who can offer sound ideas to help address most problems if people are willing to be educated, understand the problem at hand, and work toward a win-win situation.