COMPETITION FOR WATER AMONG VARIOUS USES IN UTAH - PLANNING, LEGISLATION, ADMINISTRATION

Wayne Criddle*

Precipitation falling as rain, snow, and dew serves the consumptive water needs of all plant and animal life. But water also serves many other purposes. It carries away our wastes, and is used almost universally to help control our fires. It is used in our production of electricity through hydro turbines or for generation of steam in thermal plants. Heavy transportation is dependent upon this medium. It is used as a coolant, solvent, flotation medium, energy transfer agent, diluent, cleaning agent and in many other ways about the home and factory. Recreation also presents a growing need for water. Thousands of new swimming pools, boating and water skiing, and our desire for more fishing waters and more wildlife areas all require more and more water.

Available water

Of the 4.8 billion acre-feet falling on the continental United States, some 70 percent is returned directly to the atmosphere or is absorbed by the soil, and 30 percent becomes surface discharge or runoff. However, as we all know, precipitation and runoff vary widely from place to place throughout the country. A study of San Simon Creek, located in Arizona near the New Mexico line, shows that from a total fall of 1,560,000 acre-feet, only 9,000 acre-feet, or about one-half of one percent, normally reaches the mouth of the creek.

On all of Utah, more than 50 million acre-feet of precipitation falls each year. At least 45 million acre-feet of this is consumed through the natural processes of evaporation and transpiration where it falls and only 10 percent becomes surface runoff and available for controlled uses by man. The quantity of total water and the "manageable" water available to the state and its overall use has changed little since white man first settled the area over 100 years ago. We still have little control over 90 percent of our total precipitation. But we are now looking more carefully at the 20 percent of our state that furnishes some 80 percent of our usable runoff. We would like to manage these "water-supplying" areas in such a way that more of the precipitation would run off when we need it, particularly during the late spring and summer period. If we could capture the 50 million acre-feet falling on Utah we would be able to fill Lake Mead nearly twice every year. However, the total artificial reservoir storage capacity in the state is less than 5 percent of this fall and the amount of irrigation water actually consumed on our lands is less than 4 percent. Still, from that 4 percent of our water supply comes about 75 percent of our agricultural income. (Nearly 90 percent of the area of the state is used for some sort of agricultural production; some 87 percent for grazing of livestock).

*State Engineer, Salt Lake City, Utah.

Use of water

Although only 2 million acre-feet of the total precipitation is accumulated into irrigation systems and consumed on the irrigated land, upwards of another million acre-feet falls directly on the irrigated land and is practically all consumed where it falls. Thus, total water consumption on irrigated land is probably close to 3 million acre-feet.

To meet the consumptive irrigation water requirements, considerably more water is diverted from the streams and wells than the 2 million mentioned. Probably diversions and rediversion would total not less than 5 million acre-feet per year.

Present consumptive use of water by the people of Utah for culinary and domestic purposes is only a small part of the water that is needed for agricultural purposes. If we assume about 200 gallons per person per day as the delivery requirement, (1958 use in Salt Lake City was about 260 gpd/cap.) then one acre-foot of water would serve more than four people for an entire year.

With a population of about 750,000 people, Utah would then require less than 200,000 acre-feet per year for this purpose. If we assumed that all of this 200,000 acre-feet were consumed, which is far from correct since much of that delivered could be reclaimed and reused, this would represent only 10 percent of the 2 million consumptively used by agriculture, or about 4 percent of the water diverted for irrigation.

Industrial uses of water and uses by fish and wildlife are small in relation to the agricultural uses of water.

Present development

Although we Utahns have considerable money invested in irrigation works and water rights, only a small part of that investment is in ground water development. We have more than 450 storage dams, nearly 10,000 miles of canals and ditches, and 300 miles of pipe lines. We have spent large sums of money investigating and developing surface water supplies and storage. We are rapidly approaching the limit in surface water development. Still, in some areas, we have underground reservoirs that have been barely tapped. Our laws and lack of information are such that we allow water to "waste over the spillways" of these underground reservoirs year after year. This water, although perhaps not easily seen, is lost by phreatophytic vegetation whose roots, stems and leaves are syphoning the water from the ground to the atmosphere without serving any real useful purpose. In many such areas, springs and seeps occur too low in the basin to be easily captured. This water goes unused to the Great Salt Lake or to other low areas from which twice as much is evaporated each year as is consumed by all of our irrigated crops. Of the 1,200,000 acres of land irrigated in the state, only about 80,000 acres, or 6 percent, is irrigated from ground water. However, several of these ground water developments are already giving us some of our worst headaches in administration.

Most areas in Utah are underlain with ground water, some of which may be recovered. Frequently ground water development costs much less per acre-foot than does surface water development. However, fully developing ground

water basins often conflicts with early rights to the use of water from flowing or low lift wells. Most of the 32,000 registered wells in Utah are in counties where considerable acreages of wet lands are also found. A large proportion of these wells are small but flowing. Naturally as new wells are drilled and pumped in these areas, existing wells cease to flow. Although these small flowing wells produce little water, they are often the only sources of culinary and stock water that have ever been used by many of the old settlers. These people feel strongly about their rights to the continued use of such water and to having it delivered under pressure, even though many thousands of gallons may be wasted to evaporation and transpiration for every gallon used from the well. Our courts have been reluctant to allow interference with such established rights.

Future developments

This brings us to the point of deciding where we are going in the future in this water field if we are to grow and develop. Can we sit idly by and watch water go to waste without using our technical "know-how" for stopping this waste? Will our laws and courts prevent the necessary readjustments that are inevitable with the changing times? Shouldn't our educational system stress more and more the idea that this great resource, water, must be managed in such a way that it will return the greatest potential benefit to the public? These are but a few of the questions that must be answered in the near future. Such questions must be given mature study and investigation. Perhaps our present concepts of research in the water field may need some readjustments or expansions.

Conflicting demands

Since pioneer days, we in Utah have worked on the theory that irrigation is one of the highest uses to which water may be put. This was true, especially when home-grown foods were needed so badly, and when it could not easily be shipped in by truck or train. This is well illustrated by the fact that we once found it desirable to produce cotton in the southwest corner of our state, a practice which is no longer considered economic for this area. However, today any one state of our Nation is far from being wholly dependent upon its own agriculture for food and fiber. Fresh vegetables, fruits, rice, flour, meat, and all other foods are shipped to distant points, and agriculture, which is largely dependent upon irrigation, is expensive in terms of water usage. I believe that in the arid West, there may be a continual shift from uses of water by agriculture to uses for municipal and industrial purposes. Water needed to supply a living for one family on an irrigated farm may adequately serve industry that will furnish a living for 50 or more families. Some of us "old timers" in irrigated agriculture may shudder at such a statement. But we must face the fact that many water developments for agriculture at the present time may just be "banking" the water for a higher economic use later on. This is not a new idea or concept. In fact, we are well on our way towards such a shift in certain areas. Subdivisions and industrial plants are pushing agriculture out of many of our irrigated areas. The waters formerly used on the lands are not being released for agriculture in other areas. They are being used on these same lands and frequently considerable supplementary water is needed to serve the new uses that develop. And to develop minerals and other natural resources, we must have water; water for direct processing purposes, water for power production and water for drinking by

the people who will be employed in the new industries that will result from the development of these natural resources.

An example of the conversion of agricultural water to industrial purposes is a current project in one of the counties of central Utah. A new two-unit steam power plant recently constructed in the area soon will be in full operation. These two units will produce 166,000 kilowatts of electricity. This is sufficient to supply general needs of a city of some 300,000 people. To produce this much power will require 1690 tons of coal every day. When operating at full capacity approximately 180,000 gallons of water per hour, or about 7 cubic feet per second, will be needed to produce steam for this operation. It is estimated that between 50 and 60 full-time employees will be required at the plant. This is exclusive of those people needed to mine the coal and to distribute the power out over the system to all users.

In contrast, 7 cubic feet per second of water will adequately irrigate less than 500 acres of land during peak-use periods. To operate 500 acres of irrigated land in this area would require the full-time services of fewer than 10 people. Returns from irrigated agriculture on 500 acres would equal only a small part of the returns from the electric plant.

Furthermore, it has been estimated that the returns from industry in this same area represent something like $28,000,000 a year, and agricultural returns are in the neighborhood of $1,250,000 a year. However, in this area, about 3 acre-feet of water is used for irrigation for every acre-foot that is used for industrial and other purposes. It might be of further interest to know that of all property taxes in this county, agricultural interests paid less than 10 percent. Mining and utility companies paid over 60 percent.

With water resource development becoming more and more expensive, the ability of users to repay the costs decides whether or not the development can be made. Thus, the costs of our more difficult water development projects must probably be underwritten by industry or municipalities.

This principle is rather well illustrated by the Weber Basin Project whose lands lie between Ogden and Salt Lake City, and which is developing 285,000 acre-feet of water. Of this new water, 40,000 acre-feet has been allocated for municipal use and 245,000 acre-feet for irrigation, or at a ratio of about 1 to 6. However, the municipal users will repay about one-half of the total costs of the water development.

I do not wish to imply that this is unfair. Municipal users will benefit indirectly to a point where they should pay more per unit of water. If they were to develop the water they alone needed, the costs to them would probably be about the same as under the joint venture. Also, they have the ability to pay. Such an arrangement will be necessary for future developments. Our proposed Dixie Project in Southern Utah may be too costly if agriculture must pay all the costs under present economic conditions. However, under the theory that the water will temporarily be banked for future users who will be able to meet the repayment requirements, then I don't think we should hesitate to move ahead. Certainly this area is one with the kind of climate and recreational activities that are being sought after by many people today - but only if water is available.

These same changes are underway, but even more drastically, in other areas of the West. According to McGauchey and Erlich, 1/ there was 68 times as much water used for agricultural purposes in California as for industrial use in 1950. By 1955 the ratio had decreased down to 3.8 to 1 - not because irrigation use had decreased (In fact, it increased 12.6% in the 5-year period) but because industrial use increased over 2,000 percent. This same report shows that municipal and domestic uses, exclusive of self-supplied industrial users, amounts to only about 2 percent of the total use.

Administration problems

The above discussion has attempted to help you understand several of the problems of water administration that will not be discussed. Certainly many physical conditions in other states are different than we have in Utah. Also, water laws sometimes require that identical problems occurring in two or more states, may need to be handled much differently in each. This is somewhat unfortunate because we probably should have a more nearly common denominator for water laws regardless of where we are in the Western United States. However, there are some basic principles that cannot be ignored. And, regardless of the state, I think any water administrator has need for more and more information on sources, supplies, and uses of water in his state, and how the various problems are being handled in other states.

Canal seepage and linings - Over the years irrigation and drainage engineers have measured canal losses and have come up with the startling discovery that some 25 to 30 percent of all water diverted into the larger canals is lost through seepage and other losses. Probably a larger percentage is lost from smaller canals and ditches. This has led to a crusade for canal lining to "save" these heavy losses. Likewise, there has been a considerable study made on the efficiency with which irrigation water can be applied to the land.

We are now finding that canal lining, although good in theory, may sometimes be adverse to old rights developed as a result of these seepage losses. If the seepage returns to the water supply system, as is often the case, then lining and expanding the use of this "saved" water deprives other users who are dependent upon these return flows. Many times these rights have developed and have been in good standing for many years.

At the same time, to prevent further canal lining on the theory that downstream users may be hurt, even though some damage does occur, would be wrong. Water not under control is never good, and seepage waters are in this category for at least part of the time. But there must be a happy balance between any increase in use of the water saved and decrease in flow to downstream users. Perhaps a "change in use" should be filed so that other users have opportunity to see what such a project will do to their water rights. The facts of each case must be considered.

The term "saving water" has been used entirely too loosely in many

1/ "Economic Evaluation of Water" by P. A. McGauchey and Harry Erlich, Paper 2058 Vol. 85, No. IR-2, June 1959, Proceedings of Am. Soc. of Civil Engineers.

areas. When we start a water-saving project, we must take a look at whom we are saving the water from whether it be by canal lining, draining a swamp area, or by any other means. If it is saved from our neighbor downstream who has developed rights that have been in existence for some time and forms the basis for a going economy, then such a "saving" probably is not good from the community standpoint. If the saving is from phreatophytes that have little or no economic value, from evaporation, or from mixing with other water or waste that makes it non-usable, then we have a true salvage. In my own state, any water reaching Great Salt Lake is gone insofar as any appreciable economic return is concerned. Water which normally reaches the lake but which is prevented from doing so, is true salvage. Much of that water which now feeds the marshes and wet lands surrounding the lake can also be claimed as salvageable.

Well plugging - Along the Wasatch Mountain front and in certain other areas of Utah, we have artesian pressure areas. Many small flowing wells have been developed to take advantage of this natural condition but most have limited flow and pressure. Originally, these wells were developed for culinary and stockwatering purposes. However, as communities have grown and developed, municipal-type water systems have been constructed. These community systems are replacing wells that do not have adequate pressure for modern-day needs, and do not meet quality and health standards. As a result, wells are often abandoned, sometimes without plugging. More often they are plugged but the casings rust out below the ground surface and they continue to waste water from the pressure acquifer.

In order to salvage these waters - or prevent their waste - a well repair and sealing program has been underway since 1945. The state furnishes the equipment and personnel to operate it. A reasonable charge is made against the owner of the well for complete sealing with clay and cement. Incidentally, this service has been used by our state highway department when new highway locations cross flowing well areas. It has also been used some to help stabilize foundation areas for large structures. In general, this operation pays its own way and has resulted in the control of about 62 second-feet of water that was wasting from the 500 wells that have been repaired or sealed since 1945.

Changes in diversion points and places of use - In connection with surface water uses, oftentimes there is a desire on the part of a water user to change his point of diversion on a stream and perhaps use the water at some other location. Under the law, such changes are permissible in Utah providing other rights are not interfered with. However, if the move is downstream and if there are rights with points of diversion between the two places of use, there may be serious conflicts. If the applicant wishes to move water downstream past other diversion points, he may be limited to take only the stream depletion that occurred above these other rights - not the diversion right he has developed.

We find that this may reduce a man's diversion right when moved downstream to half that which he was allowed to divert upstream. In other words, his diversion downstream is limited to the diversion upstream minus the returns, (return flow from ditch and canal seepage and from excess application of water to the land). If this procedure were not used, there would be insufficient water to meet the intervening rights. We have somewhat similar problems in moving a diversion right upstream or from one

tributary of a stream to another tributary of the same stream. The magnitude of the factors that must be considered in these exchanges requires a great deal of judgment accompanied with all the basic data that we can assemble on the problem.

Water Commissioners - Under Utah law, water commissioners may be appointed either by the court or the State Engineer on streams or ground water basins "needing administration". Our interpretation of "need" has been when the water users cannot get along with each other and handle their own distribution problems.

When a commissioner is appointed, the burden of paying his costs must be assessed against the water users usually on a water-delivery basis. This often raises some real problems insofar as obtaining good administration is concerned and especially at the time when a commissioner is first appointed. The water users want to keep costs at a minimum and assessments down. And in some areas a few "near-sighted" men can often influence other water users to a point where raising an adequate budget is most difficult.

A much more workable plan, and one used by most of Utah's neighboring states, is to pay water commissioners from general state appropriations. Certainly this seems more workable than the direct assessment system and is probably justified since all people of the state are water users and benefit from good regulation.

Costs of administration on the "piece-meal" basis under which we have been operating have ranged from less than one cent per acre-foot to 20 cents per acre-foot for one small isolated creek. At the present time about 2,127,600 acre-feet are delivered under commissioners each year at an average cost of 3½ cents per acre-foot. It is estimated that if the entire water supply of the state is some day put under commissioners (some 5,000,000 acre-feet of diversion) the total cost will be about $250,000 or 5 cents per acre-foot average. This would allow for a much improved administration program, even under existing systems. It would justify the employment of full-time, qualified commissioners which is not possible under present conditions.

Changes in pumping costs and practices - Utah, like most other states, is facing the problem of trying to balance the available water supply with the rate at which it is being used. The Milford Valley in the southwestern part of our state represents one of the problem areas. Electric power costs for pumping in 1951 averaged $1.13 per acre-foot. Although the power rates have not changed, the average cost in 1957 had increased to $1.95 per acre-foot because of increased pumping lifts. This is still relatively inexpensive water when compared with costs in many areas of the West. However, it is startling to see the increase in pumping costs that has taken place in just 6 years. This increase is 73 percent or an average of 12 percent per year. Furthermore, it is estimated that the average annual cost of deepening the wells, lowering the pump bowls and increasing the motor size has averaged more than the increased cost of power. Therefore, it appears that the cost of pumping water in the Milford Valley in 1957 is about 2½ times what it was in 1951. Again I wish to emphasize that this increased cost is without any increase in power rates. It should be noted also that 80 percent of the water is pumped with lifts of less than 100 feet.

As a result of the lowering of the water table in this area, an adjudication of the water rights was made. The court has signed the adjudication order, limited the pumping to 4 acre-feet per acre on a trial basis, and ordered measuring and recording meters installed on each well. It is now the responsibility of the State Engineer to administer these waters in accordance with the restrictions imposed. This, of course, is an unpopular action to many of the people accustomed to unlimited pumping. Also, they must bear the expense of measuring and administering the water. Over past years, the amount of water pumped by various farms has varied from about 1.6 acre-feet per acre to about 8. The medium has been about 4.0. According to our best estimates, consumptive irrigation water requirements on all of the cropped valley land should average about 1.73 acre-feet per acre or could be met by the 4 acre-feet per acre allowance at about 43 percent irrigation efficiency. This is certainly liberal for those farms having an average cropping pattern. However, some farms may be planted wholly to alfalfa in any one year. Consumptive irrigation water for alfalfa in this area is nearly 3 acre-feet per acre or the water would need be applied at 75 percent efficiency which is rather high.

Utah water law rather broadly defines the duties of the administrative officer. In addition to being charged with seeing that the rights of all appropriators are respected, it is also his duty to prevent waste, loss or pollution of all surface or underground waters. Here is really where some of the fundamental controversies of administration develop. What is a man's right and where does waste, loss, or pollution begin? This is where we need help.

I do not wish to burden you with a recitation of all of Utah's administration problems. Certainly, I could not cite them all in the time allotted to me here today. However, I do feel that it is most important for people working in the fields of irrigation research, project planning, and associated work to better understand some of the administration problems. Only through mutual understanding are we able to most efficiently guide our work and obtain maximum utility of our information.