# MANAGING UTAH´S WATER THROUGH INTERBASIN TRANSFER

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## ABSTRACT

In order to utilize and manage the portion of Colorado River Water allotted to the State of Utah to the fullest extent, a significant problem has to be overcome. Approximately 80% of the population of Utah lives along the Wasatch Front between Ogden and Provo in the Bonneville Basin. The area in the eastern part of the state that is in the Colorado River Drainage Basin is very sparsely populated and has relatively little irrigable land. This means that in order to maximize the use of this water, it must be transferred between basins.

The Bureau of Reclamation planned, designed and is constructing the Central Utah Project to achieve this interbasin transfer. The purpose of this project is to divert water from streams that are tributary to the Colorado River and transport it to the Bonneville Basin where the major population centers and the prime irrigable lands are located.

The major features of the Project used for the interbasin transfer are the Strawberry Aqueduct, three storage reservoirs (one with a capacity of over one million acre-feet), and seven diversions structures of various capacities.

Additional storage reservoirs have also been built downstream of the aqueduct to capture and store excess runoff to minimize the impacts created by diverting the water.

Proper operation and management of this system will result in the interbasin transfer of 142,500 acre-feet of water annually, in addition to the 56,700 acre-feet diverted for the Strawberry Project, thus utilizing a portion of Utah´s Colorado River water.

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## HISTORY

The Colorado River and its tributaries flow through the States of Wyoming, Utah, Colorado, New Mexico, Arizona, Nevada, and California before it passes across the international border into Mexico. This mighty river is one of the major sources of water for these states as well as Mexico. Almost from the time that early pioneers began settling this part of the west, conflicts over the river have arisen. These early settlers realized that water from this river was a precious commodity that was necessary for any development of this arid land. As these western states continued to develop, the demand for water increased rapidly. Initially, the demand was for irrigation water but as the metropolitan areas continued to develop, the demand for municipal and industrial water was added. Soon it became apparent to those people with foresight and vision that the Colorado River could not meet all of the demands that would be placed on it. Competition among the various states and Mexico for this precious commodity became heated.

In an effort to resolve these conflicts, a compact was approved in 1922. This compact divided the Colorado River into three areas, the Upper Colorado Basin, the Lower Colorado Basin, and Mexico, and then allotted the water in the river system to the various divisions. The division between the upper and lower basins was at Lee's Ferry where the Colorado River crosses the Utah-Arizona border just downstream of Glen Canyon Dam. Under the terms of the compact, the upper Basin was to have the right to use 7,000,000 acre-feet of water from the river, the Lower Basin was to have the right to use 7,000,000 acre-feet, and Mexico was to have the right to 1,500,000 acre-feet. This compact, however, did not settle many of the issues between the various states, and as time went on, it was also determined that the allotted amount of 7,000,000 acre-feet to the upper basin was in excess of what was available in the river.

Therefore, in the 1940's, a new compact was reached that reduced the amount of water available for use in the Upper Basin to 5,800,000 acre-feet and divided that amount among the five states included in the basin. The upper Basin water was allotted as follows: Wyoming 14%, Utah 23%, Colorado 51.75%, New Mexico 11.25%, and Arizona 50,000 acre-feet. Arizona also received an allotment from the Lower Basin. Based on the long term average of the Colorado River flow at Lee's Ferry prior to 1949, Utah's

23% amounted to 1,322,000 acre-feet of water that could be diverted.

PROBLEM

Of this allowable diversion, it was realized that Utah was only using approximately 684,000 acre-feet. Another 397,000 acre-feet has been committed for use, leaving 241,000 acre-feet of water available for future development.

Studies were initiated to determine the best way to utilize the water allocated to Utah but not yet committed in meeting the demands of the state. Planners immediately became aware of a significant obstacle that would prevent the use of Utah's share of water from the Colorado River. Utah's portion of the Colorado River Basin lies in the sparsely populated eastern half of the State. This eastern section of the state contains less than 10% of the total state population. Agricultural land is very limited also with most of the terrain being either mountainous or rocky desert, not capable of being irrigated for agricultural production. Approximately 80% of the state's population resides along the "Wasatch Front" which is the western side of the Wasatch Range of Mountains. This area also encompasses the major portion of the irrigable acres of agricultural land in the state. This area of high population and extensive agricultural production is in the Bonneville Basin which drains to the Great Salt Lake. The water supply for this area is limited to the water originating on the west slope of the Wasatch Mountains.

With the highest demand for water being in the Bonneville Basin and the largest water supply being in the upper Colorado River Basin, it was very obvious that if Utah was to utilize its allotted portion of Colorado River water then a transbasin diversion must occur to move the water from the east side of the state across the Wasatch Mountains to the Wasatch Front.

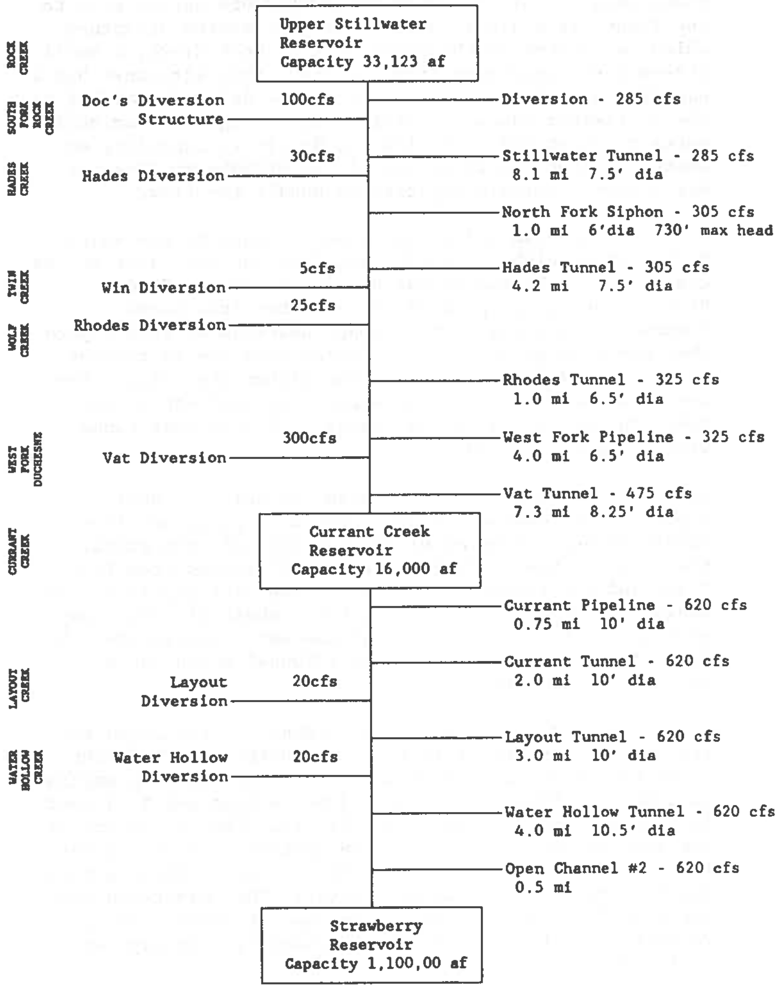
SOLUTION

The concept of such an interbasin transfer of water along with other aspects of developing the Colorado River water supply was studied by the Bureau of Reclamation starting in 1928 under the authority of the Boulder Canyon Project Act. Subsequent studies showed that it would be feasible to capture water from tributaries of the Colorado River in

Eastern Utah and transmit it to the Bonneville Basin. A plan was developed and on April 11, 1956, Congress authorized the Central Utah Project through Public Law 84-485. The project involved developing a water supply for three separate sub-basins, the Uinta Basin, the Bonneville Basin, and the Sevier River Basin. To do this, the project was divided into six separate units; (1) Jensen (2) Vernal (3) Uinta (4) Upalco (5) Bonneville (6) Ute Indian. The first four units were designed to develop a water supply for the Bonneville and Sevier River Basins from tributaries of the Colorado River through a transbasin diversion. The six units were to develop a total water supply of 486,900 AF during the initial phase and a total comprehensive development of 1,018,700 acre-feet, with the Bonneville Unit developing 281,850 acre-feet. Of this amount developed by the Bonneville Unit the Wasatch Front counties of Utah, Salt Lake and Juab would receive 71%. This would require a transmountain diversion of 151,000 acre-feet, allowing delivery of 142,500 acre-feet after transmission and storage losses. This diversion would be in addition to the 56,700 AF of transmountain water already delivered to the Strawberry Project constructed in the 1900's. This interbasin transfer of water would be accomplished by the construction and operation of the Strawberry Collector System. The concept of the collector system was to intercept and divert the flow of several streams on the south slope of the Uinta Mountain range. These streams are tributaries of the Duchesne River which flows into the Green River which flows into the Colorado River. The diversion points were to be connected with a series of tunnels and open channels, termed the Strawberry Aqueduct. The diverted water was to be carried through this aqueduct to a terminal reservoir for storage. Water would then be drawn from the reservoir via a tunnel through the Wasatch Mountains as needed to supply the demands of the Wasatch Front and the Sevier River Basin.

## CONSTRUCTION OF COLLECTOR SYSTEM

Construction of the Strawberry Collector System commenced in 1966 and was completed in 1988. A schematic of the collector system is shown in Figure 1. The upper end of the collector system consists of the Upper Stillwater Dam on Rock Creek. The dam is a roller compacted concrete (RCC) structure 275 feet high and 2,665 feet long. The dam captures the spring flows of Rock Creek and stores them in the 33,123 acre-foot reservoir. Water from the reservoir can be diverted into the head of the 7.5 foot




<u>Strawberry Aqueduct</u>

Figure 1

diameter 8.1 mile long Stillwater Tunnel at a maximum rate of 285 cubic feet per second (cfs). Connected to the downstream end of the Upper Stillwater Dam outlet pipe to the tunnel is a pipeline from Doc's Diversion Structure which is located on the South Fork of Rock Creek, a small stream just downstream from the dam. This structure has a capacity of 100 cfs. The water can be delivered either to the Stillwater tunnel or backflowed through the dam outlet works to be stored in Stillwater Reservoir depending on whether or not the lower end of the Strawberry Aqueduct has enough available capacity to handle the flow.

At the downstream end of Stillwater Tunnel is the North Fork Siphon which drops 730 feet down the east side of the canyon to the bottom at which point the Hades Feeder Pipeline bringing up to 30 cfs of water from Hades Diversion Structure is far enough upstream of this siphon that the head created in the feeder pipeline is greater than the head in the siphon. The siphon then climbs the west side of the canyon and enters the head end of the Hades Tunnel, a 7.5 foot diameter, 4.2 mile long tunnel with a capacity of 305 cfs.

At the downstream end of the Hades Tunnel is a short siphon across another canyon. Two more pipelines from diversion structures enter the aqueduct at this point. The first is the 5 cfs capacity win Diversion from Twin Creek and the second is the 25 cfs capacity pipeline from Rhodes Diversion Structure located a short distance away on Wolf Creek. From this point the water enters the 6.5 foot diameter, 1 mile long Rhodes Tunnel which has a capacity of 325 cfs.

The downstream end of the Rhodes Tunnel is connected to the 4 mile long West Fork Pipeline which has a 6.5 foot diameter and a capacity of 325 cfs. This pipeline empties into the Vat Tunnel which is 7.3 miles long and 8.25 feet in diameter and a capacity of 475 cfs. The Vat Diversion Dam also introduces water at the upstream end of the Vat Tunnel. The Vat Diversion Dam diverts up to 300 cfs from the West Fork of the Duchesne River. This diversion dam has a small reservoir that is designed to handle daily variations in the runoff volume caused by warm days and cool nights.

The Vat Tunnel empties into the 16,000 acre foot capacity Currant Creek Reservoir. This reservoir is formed by Currant Creek Dam a 130 foot high, 1,600 foot long earth fill dam on Currant Creek. This reservoir is designed to provide recreation as well as divert water. The dam was designed so that the water surface of the reservoir would only fluctuate a maximum of 4 feet while handling the variable flow of Currant Creek. Water is released from Currant Creek Reservoir into the .75 mile long, 10 foot diameter Currant Pipeline which has a capacity of 620 cfs.

The Currant Pipeline discharges into the 2 mile long, 10 foot diameter Currant Tunnel which also has a capacity of 620 cfs. This tunnel ends at a small siphon that crosses Layout Creek. A small diversion structure, Layout Diversion, diverts a maximum of 20 cfs from this creek and empties it into the aqueduct. The 10 foot diameter Layout Tunnel extends another 3 miles from this point and has a capacity of 620 cfs. This tunnel also ends in a siphon. This siphon crosses Water Hollow Creek which also has a 20 cfs capacity diversion structure on it. The Water Hollow Diversion Structure diverts water into the aqueduct at the upstream end of Water Hollow Tunnel. This 620 cfs capacity, 4 mile long tunnel has a diameter of 10.5 feet and empties into a 1/2 mile long section of open channel which carries the water from the Water Hollow Tunnel to the enlarged Strawberry Reservoir which is the terminal storage reservoir for the collector system. This reservoir has a capacity of 1.1 million acre-feet and is formed by Soldier Creek Dam on the Strawberry River.

This 251 foot high 1,290 foot long dam replaced the old Strawberry Dam and increased the capacity of the reservoir approximately fourfold. The Strawberry Dam was built in the early 1900's to provide carryover storage for the Strawberry Project on the Wasatch Front near Spanish Fork, Utah. A tunnel was drilled through the Wasatch Mountains from the Spanish Fork River to the Strawberry Reservoir to carry the water to the project use area. A similar tunnel will be used to carry Bonneville Unit water diverted by the Strawberry Collector system to the Bonneville Unit service area as well as Strawberry Project water.

Because the collector systems diverts so much water from the Duchesne River, consideration had to be given for assuring prior water rights on this river would be met. Consequently, Starvation Dam was built on the Duchesne River near the town of Duchesne, Utah. This 163 foot high and 2,720 foot long earthfill dam has a reservoir capacity of 167,310 acre-feet. Flood waters of the Duchesne River originating downstream of the collector system diversions and those flows that exceed the capacity of the diversion structures are captured in Starvation and later released to meet prior rights on the Duchesne River. To supplement the water captured by Starvation Dam, Knight Diversion Dam was constructed on the North Fork of the Duchesne River about 5 miles North of the town of Duchesne. A 0.6 mile long pipeline and 1 mile long tunnel carry the diverted water to Starvation Reservoir. Again, the waters diverted are excess flows in the river not needed to meet downstream water rights.

## OPERATION OF SYSTEM

The unusual operating conditions created by this large collection system are significant. The elevation differences in the various watersheds as well as the daily fluctuations in flow caused by the warm daytime temperatures and cool nighttime temperatures cause many operational problems. To complicate the situation even more, the tunnels all have the operational restriction that they must never become pressurized but must have a free water surface at all times. These factors require frequent changes of regulating gates on the diversion structures and dams. To optimize the operation of the collection system, a Programmable Master Supervisory Control System is being developed. This system will allow complete automation and remote control of the system from a central control point scheduled to be located in Duchesne, Utah.

Water gathered by the Strawberry Collector System and stored in Strawberry Reservoir is carried through the Wasatch Mountains and used in the Bonneville and Sevier River Basins. The water will be released as needed to the 5.7 mile long Syar Tunnel. This 8.5 foot diameter tunnel has a total capacity of 600 cfs and terminates at the 6th Water Aqueduct. Water scheduled for delivery to the Sevier River Basin will be carried through a system of canals, tunnels, and pipelines to the project area for use as supplemental irrigation. Water used to meet the Municipal and Industrial demands of the Wasatch Front area of Provo and Salt Lake City, Utah as well as many surroundings smaller towns takes a very different path.

The quality of the water that is collected from the tributaries of the Colorado River and stored in Strawberry Reservoir is adequate for irrigation purposes but is poor enough quality that it would require extensive treatment to supply municipal needs. However, water that flows down the western slope of the Wasatch Mountains in the Provo River is of a high quality and very well suited for municipal use. Some of the Provo River water flows to Utah Lake to satisfy irrigation rights as well as maintain the lake. In order to best utilize these two sources of water an exchange was effected wherein Provo River water that normally flows to Utah Lake is used for the Municipal and Industrial demands and Colorado River water will flow through the Syar Tunnel and down the Spanish Fork River into Utah Lake to replace the diverted Provo River water. In order to divert and fully utilize the Provo River water the Jordanelle Dam is presently being built on the Provo River about 8 miles north of Heber City, Utah. The earthfill dam will be 300 feet high and 3,700 feet long with a reservoir capacity of 320,000 acre-feet. This reservoir stores the excess flows of the Provo River as well as those flows that go to satisfy rights in Utah Lake and release the water as needed for diversions into aqueducts for treatment and delivery along the Wasatch Front.

## CONCLUSION

Through the use of this complicated and extensive system of collection, storage, and distribution facilities, the Bureau of Reclamation has been able to help the residents of the State of Utah utilize approximately 181,000 acre-feet of their allotted share of Colorado River water, including the 56,700 acre-feet of Strawberry project water. The Bonneville Unit of the Central Utah Project will meet the water demands of the Wasatch Front area for many years to come.