



Colorado River Fundamentals

Understanding Utah's Transbasin Diversions

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Transbasin diversions transfer water from the Colorado River basin to the Great Basin, including the populations of the Wasatch Front.

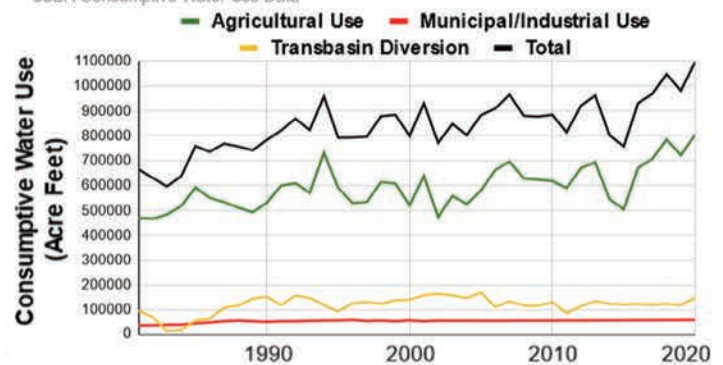
These transfers are considered to be vital to maintain the health of Utah's economy and to guarantee a secure water supply for Utah's growing population. The most significant transbasin diversion is the transfer of Duchesne River water from Strawberry Reservoir to the Spanish Fork River in Utah County. The Strawberry Water Users Association and the Central Utah Project (CUP) operate this major water transfer. Transbasin diversions comprise 15% of Utah's total consumptive use of the Colorado River.

Transbasin diversions are sometimes controversial. That is certainly the case in debates concerning the proposed Lake Powell Pipeline, which would transfer water from the Upper Colorado River Basin to the Lower Basin and provide water to Washington County. Transbasin diversions elsewhere have generated significant controversy such as the transfer of water from west-slope Colorado to the Colorado Front Range. Although the Strawberry Tunnel and CUP were less controversial, these diversions had significant ecological impacts on the Duchesne River and its tributaries in the Uinta basin. Because transbasin diversions provide a physical connection between Utah's largest cities and the Colorado River, **Utah municipalities, agriculture, and ecosystems will be increasingly shaped by the fate of the Colorado River.**

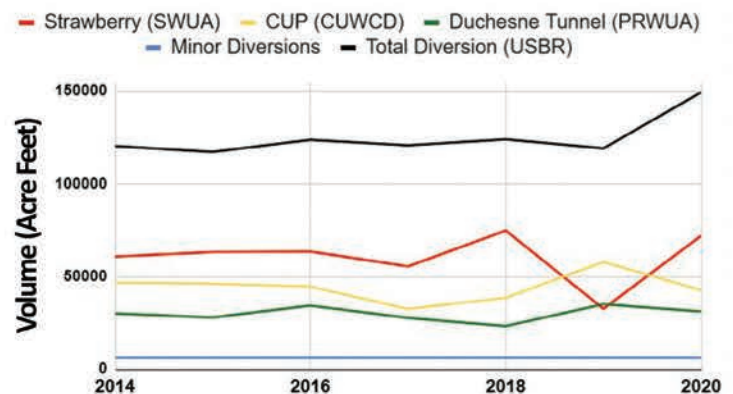


Colorado River Consumptive Water Use in Utah

USBR Consumptive Water Use Data



Utah Transbasin Diversion Volume Over Time





Utah Transbasin Diversion Timeline

1868 Ute Tribe Treaty is ratified and Ute Indian Tribe is moved to the Uintah and Ouray Indian Reservation

1879-1895 The first transbasin diversion in Utah is created in Daniels Canyon, diverting water from headwaters of the Strawberry River into the Heber Valley

1892 The Tropic Ditch is completed transferring water from the Sevier to the Paria River

1912 The Strawberry Tunnel is built, transferring Strawberry River water from Strawberry reservoir to Sixth Water Creek and the Spanish Fork River for use in Utah County

1939 The Colorado River-Great Basin Project is proposed as a transfer of 1 million AF/yr from the Green River to the Wasatch Front and Central Utah. This proposal is eventually downsized and becomes the Bonneville Unit of the Central Utah Project (CUP)

1954 The 6-mile Duchesne tunnel is completed transferring the upper Duchesne River to the Provo River

1965 A 60,000 AF/yr foot Ute water right is sold to the CUP for \$295 million

1980s Strawberry Dam is replaced by the larger Soldier Creek Dam. The CUP builds 45 miles of tunnels and pipelines, called the Strawberry Collection System, to divert Duchesne River tributaries into Strawberry Reservoir

1992 The Central Utah Project Completion Act (CUPCA) transfers management of the CUP from the Bureau of Reclamation to the Central Utah Water Conservancy District

1996 The 5.7-mile Syar Tunnel is constructed as part of the CUP to replace the Strawberry Tunnel and provide increased capacity to transfer water to the Wasatch Front

2004 The Diamond Fork System is completed to keep CUP water from eroding Sixth Water and Diamond Fork Creeks. This new system transports water through underground pipes directly to Spanish Fork and Provo for municipal use

2008 Lake Powell Pipeline proposal formally initiated

2021 The Ute Tribe sues the federal government and State of Utah regarding tribal water rights and the CUP. The lawsuit is dismissed

2022 Proposed Lake Powell Pipeline environmental review and permitting status is currently paused

Key Numbers

Annual average total natural flow of the Colorado River at Lees Ferry between 2000 and 2022

12,200,000 AF/yr

Utah consumptive water use from the Upper Colorado River basin between 2001 and 2020

900,000 AF/yr

Annual average transbasin diversion from Colorado River basin to the Great Basin in Utah between 2001 and 2020
(Bureau of Reclamation data)

137,000 AF/yr

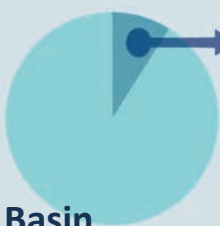
Utah consumptive water use from all watersheds between 1989 and 2018 (Utah DNR data)

2,960,000 AF/yr

Annual average consumptive water use in Utah, Salt Lake, and Wasatch counties.
(Utah DNR data, Jordan River Basin 1989-2018)

521,000 AF/yr

91% of Utahns live in the Great Basin



9% live in the Colorado River Basin: 3.5% in the Upper and 5.5% in the Lower, primarily Washington County.



The volume of Colorado River water conveyed by transbasin diversions to the Wasatch Front equals 26% total consumptive water use of Utah, Salt Lake, and Wasatch counties.



Active Utah Transbasin Diversions

Central Utah Project:

45,000 AF/yr average transbasin diversion

The Central Utah Project (CUP) is a large diversion of Duchesne River water from Strawberry Reservoir to the Spanish Fork River. Since the 1980s, the CUP has delivered water directly to southern Utah County farmers, Utah County municipalities and into Utah Lake. This Utah Lake water can be exchanged to allow for water diversion along most of the Wasatch Front through a network of intra-basin water transfers. This is how CUP water is accessed in Salt Lake County. The 1964 CUP water right is a relatively junior water right that would be one of the first to lose priority during a basin-wide Colorado River shortage. The CUP has a transbasin diversion water right of 101,900 AF/yr, but has averaged only 45,000 AF/yr since 2014 (CUWCD 2014-2021). This leaves room for the CUP to legally expand water deliveries to meet increasing demand along the Wasatch Front, but additional infrastructure would have to be built.

Strawberry Valley Project:

61,500 AF/yr average transbasin diversion

The Strawberry Valley Project (SVP) was the first large transbasin diversion in Utah. From 1912-1996, the now-decommissioned Strawberry Tunnel conveyed SVP water from the Duchesne River into the Spanish Fork River. Today, the SVP is functionally incorporated into the CUP infrastructure. Originally, all SVP water went to irrigation for farmers in southern Utah County, because local streams had been exhausted. Today, SVP water usage is trending towards municipal use as Utah County grows in population. Although 93% of SVP water is now applied to ~45,000 agricultural acres in Utah County, 7% is now used for landscaping irrigation by municipal customers

(SWUA 2022). The 61,500 AF/yr SVP water right has a priority date of 1922, before the Colorado River Compact was signed. This gives the water right significant protection from a declared shortage of Colorado River water supply. The SVP water right is fully utilized and cannot be increased.

Duchesne Tunnel:

28,200 AF/yr average transbasin diversion

The Duchesne Tunnel is a medium-sized diversion of water from the Duchesne River to the Provo River near Kamas. This diversion augments flows of the Provo River at Heber by 20% and depletes 23% of the natural flow of the Duchesne River at Tabiona (USGS data). The water is owned by the Provo River Water Users Association (PRWUA). Water delivery locations include municipalities in Salt Lake City, Provo, Orem, and farmers in the Kamas and Heber valleys. The Duchesne Tunnel is unlikely to increase diversion because of operational constraints.

Minor Diversions

Two small diversions transfer water to-and-from the Sevier River Basin. In the Sanpete Valley, 15 small canals and tunnels divert up to 11,000 AF/yr of water from the Price and San Rafael Rivers to the Sevier River basin between Fairview and Ephraim. The water is consumed by local agriculture.

The Tropic Ditch is an unusual diversion near Bryce Canyon National Park. Unlike other Utah diversions, it is the only diversion bringing Great Basin water into the Colorado River Basin. It brings 3,100-4,800 AF/yr of water from the Sevier River to the town of Tropic. Though small, this is a steady water supply. The yield of the local Paria River near Kanab has averaged 14,000 AF/yr since 2003 (USGS data).

Key Definitions

Acre Feet (AF): A measure of annual water supply; enough water to cover one acre, one foot deep

Great Basin Watershed: The western part of Utah where water flows towards the terminal Great Salt Lake or Sevier Lake

The Upper Basin of the Colorado River watershed comprises areas upstream of Lees Ferry. This includes parts of Utah, Colorado, New Mexico, Wyoming, and a small part of Arizona

The Lower Basin includes the drainages of the Virgin River and Kanab Creek in Utah, as well as parts of Nevada, Arizona, and California.

Consumptive Water Use: The Bureau of Reclamation defines consumptive water use as “use or depletion of water due to human-caused activity, including interbasin transfers (transbasin diversions)”

Approximately half of transbasin water goes to agricultural uses and half to municipal uses.

Municipal Water Use

Some transbasin water, primarily from the CUP and the Duchesne Tunnel, is used as municipal secondary water in Salt Lake and Utah counties. Transbasin water supports outdoor irrigation for an estimated 115,000 Utah households (Utah DNR data). A small amount of transbasin water goes to the culinary water supply.

Municipal use of transbasin-diverted water is increasing. CUP pipelines, including the Mapleton-Springville and Spanish Fork-Santaquin pipelines, are under construction to deliver new municipal water to their namesake areas. Both Utah and Salt Lake counties are expected to increase in population by 2060 (Kem Gardner Institute data).

Municipal Service Areas (and suburbs)

- Salt Lake City
- Sandy
- Provo
- Orem
- West Jordan
- South Jordan

Agricultural Water Use

Almost all transbasin agricultural water is used to grow alfalfa. Less common crops include grains and fruit. Transbasin diversions provide water supply to an estimated 35,000 acres in southern Utah County that produce approximately 200,000 tons of alfalfa, per year (estimated from University of Nevada Reno data). This represents 10% of Utah's annual alfalfa production (USDA 2020) with an estimated market price of \$40M. This is 0.02% of Utah's GDP.

Agricultural use of transbasin water is declining because farmland is being suburbanized, specifically in Utah County.

Agricultural Service Areas

- South Utah County/Payson Area (Strawberry Water Users, Central Utah Project)
- Heber Valley (Duchesne Tunnel, Central Utah Project)
- Kamas Valley (Duchesne Tunnel)





Exploring the Implications, Context and Controversy of Utah's Water Issues

Water consumption and climate-change induced drought have created a water supply crisis for the watersheds affected by transbasin diversions.

In the Colorado River watershed, river flow is decreasing from climate change. Lake Powell and Lake Mead are approaching levels that can no longer generate hydroelectricity. More than 40 million people deplete 100 percent of the Colorado River's flow, which rarely has reached the ocean in the last 50 years, thus the water in the river is overallocated.

In the Great Basin, human water usage has reduced the volume of the Great Salt Lake by 64%. The lake is now at an all-time low. Potential effects of the lake's decline include toxic dust pollution affecting millions of people, the drying of an ecosystem of "Hemispheric Importance" for North American wildlife, and a decrease in Utah's "lake effect" snowfall.

Transbasin diversions create significant physical and political connections between Colorado River and the Great Basin. The future of transbasin diversions will affect the future of Utah's water supply and the fate of its two major watersheds.

Proposed Lake Powell Pipeline (LPP)

Proposed 86,000 AF/yr average transbasin diversion

Context: This LPP is a proposed 140-mile pipeline to the Virgin River watershed in Washington County. The Environmental Review and Permitting Status of this controversial project is currently "paused." It would be a transfer from the Upper Colorado River basin to the Lower Colorado River basin.

It is important to note that Washington County population growth has been able to occur without significant increases in municipal water diversions or total consumptive water use. However, the Kem Gardner Institute forecasts 281,000 new residents in Washington County by 2060. The **Lake Powell Pipeline could more than meet that projected growth. Lake Powell Pipeline water could support an additional 345,000+ people.**

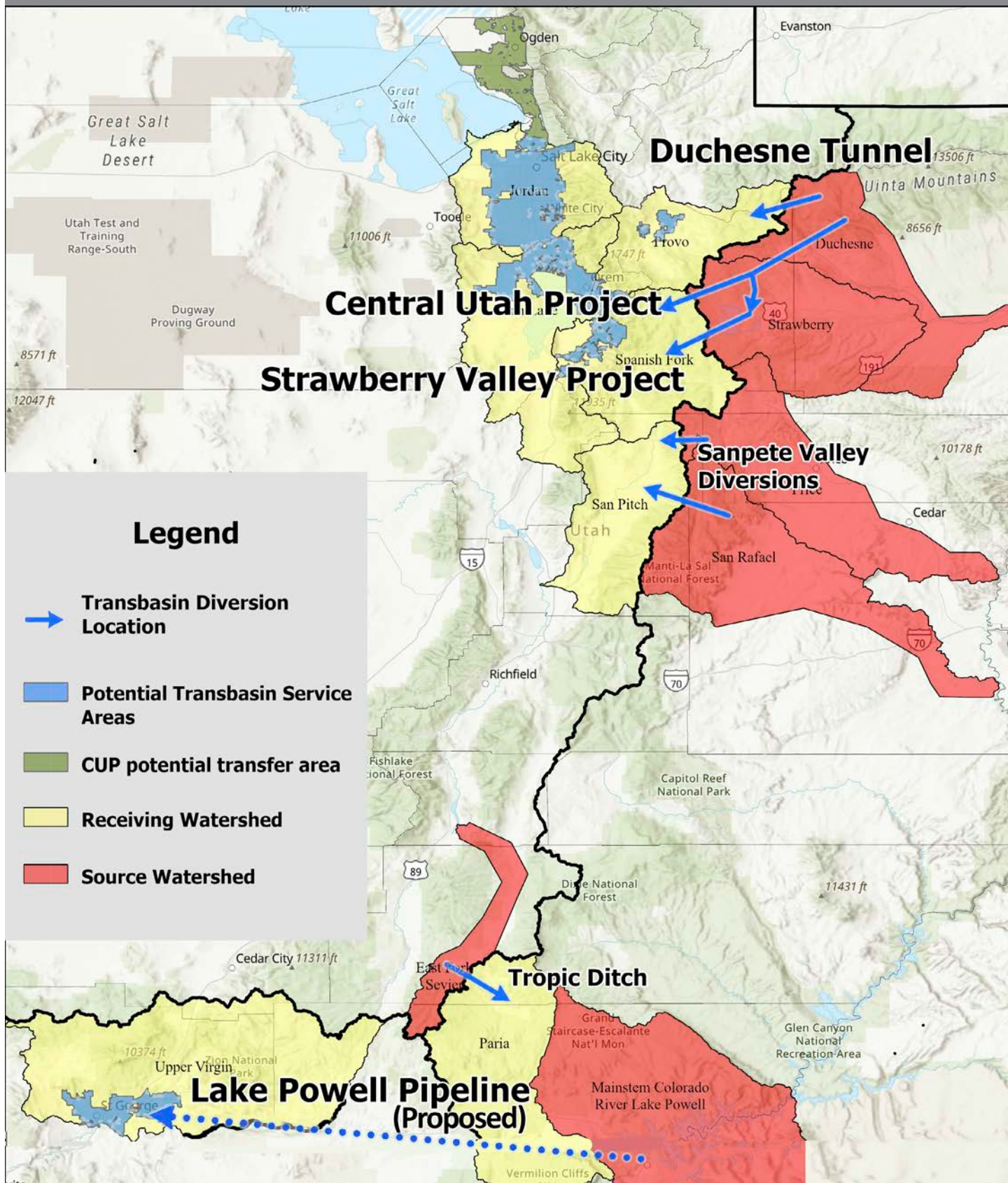
LPP project planners estimate the LPP to cost **\$1.3-2.2 billion, but have outlined the ability to raise \$6.12 billion** from Washington County residents. Funding would be raised by property tax and utility increases, and a one-time LPP hookup tax per home. Dividing this cost by each projected new adult resident is \$6,100-\$10,400 per capita in additional costs, or \$29,000 per capita at the maximum number outlined by the EIS. The EIS acknowledges "ability to pay is dependent on continued growth in the region and...the cost of service assumptions" (Bureau of Reclamation 2020 pg. 243). Under lower population growth sce-

narios studied, "ability to pay would not be sufficient to cover all costs" associated with the LPP.

Legal Implication: Utah plans to exert 86,000 AF/yr of "Water Right No. 41-3479" (Bureau of Reclamation 2020). This water right has a priority date of 1958, but the Utah State Engineer has declared the LPP right will be subordinate to the 1964 CUP right (Whalen 2019). Utah owns this water right on paper, however, **developable physical water supply in the Colorado River basin does not currently exist, because the Colorado River is already "overallocated". This has created interstate conflict.** In 2020, the other 6 states in the Colorado River Basin sent a letter to the Interior Secretary asking to block the LPP until states achieve a "consensus regarding outstanding legal and operational concerns" the LPP raises. In order to avoid interstate conflict but still pursue the LPP, Utah could potentially repurpose in-state Colorado River water rights for the LPP. This could include buying and repurposing water rights in the Castle Valley or Uinta Basin.

Controversy: Proponents of the LPP, including many Utah officials, hold the view the LPP is necessary to support economic and population growth in Washington County. Detractors of the pipeline believe the pipeline is unaffordable, and that it will increase wasteful outdoor water usage in a county with some of the highest per-capita water usage in the nation. Other concerns are that the construction of the pipeline itself could jeopardize sacred lands around the Kaibab Paiute Indian Reservation and harm the desert environment.

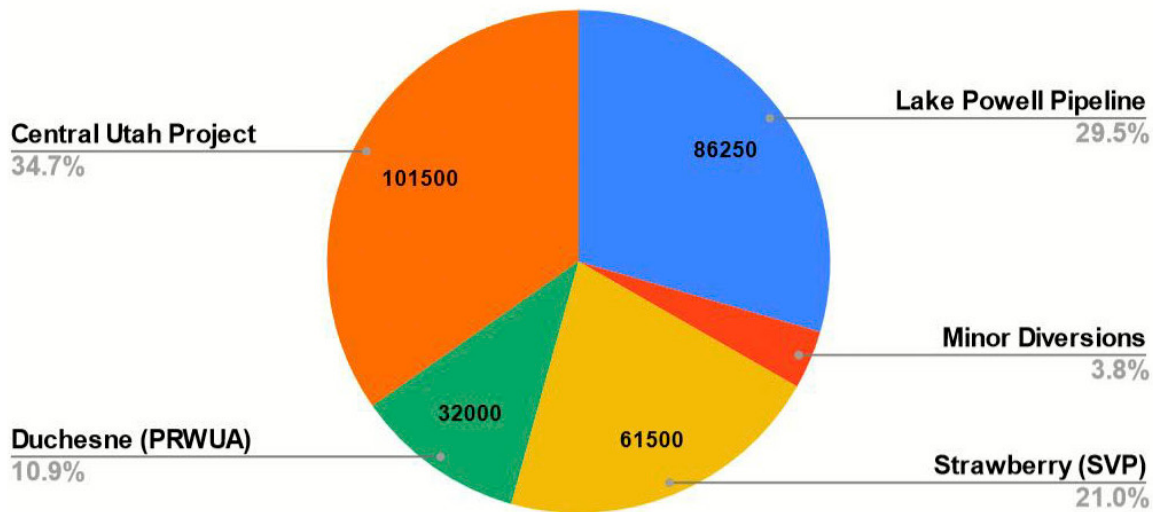
Utah Transbasin Diversions



Credits: USCB, NHD, USU, CUP, Esri, HERE, Garmin, FAO, NOAA, USGS, BLM, EPA, NPS



Utah Potential Transbasin Diversion (292,000 AF/yr)



Increased Transbasin Diversion Capacity

Context: The CUP water right has room for increased diversion. Other diversions like the SVP, Duchesne Tunnel, and minor diversions cannot significantly increase water diversion. Only two thirds of Utah's current transbasin water rights are being utilized (137,000/206,000).

If the CUP and Lake Powell Pipeline water rights were fully utilized, transbasin diversion volume could increase 114% to **292,000 AF/year**.

Implication: Utah transbasin diversion volume could significantly increase.

Future Water Consumption in Utah

Context: Utah's population is projected to increase by 2.2 million (66%) by 2060 (Kem Gardner Institute). Utah's per capita domestic water use currently is 217% of the national average. Agriculture consumes more than 80% of Utah's water. Transitioning Utah's agricultural water to municipal use theoretically could support an additional 16.7 million people (500% increase) even at Utah's current high per-capita water usage levels (Lozada 2021). Transbasin diversions have allowed for significant increases in municipal and agricultural water use on the Wasatch Front.

Implications: If agricultural to municipal water conversion occurs in the Colorado River basin, new transbasin diversions may need to be built to redirect formerly agricultural water to cities. If transbasin diversions had not been not built, water supply to the Wasatch Front would be less or other Great Basin water such as the Bear River might have been developed.

Controversy: There are different perspectives about how to address Utah's water problems. Utah agriculture is often criticized for consuming the majority of Utah's water. Utah cities are criticized for high municipal water usage. Commonly proposed solutions to Utah's water problems include agricultural water conservation, municipal outdoor water conservation (grass/lawns), water transfers from agriculture to municipalities, and transbasin water development from the Colorado River.

Environmental Concerns

Context: Transbasin diversions dewater the source stream and cause excessive inflows to the receiving stream. **The Duchesne River, the main river affected by transbasin diversions, now flows at only 26% of historic water levels.** Due to flow reductions, the river channel has shrunk (Gaeuman 2005). Water depletions including transbasin diversions have decreased the value of the Duchesne River for endangered species in the Upper Colorado River. (Modde & Keleher 2003). Transbasin diversions also decrease the dilution of salt and pollutants along the Colorado River.

Historic transbasin diversion led to *daily* flows on Sixth Water Creek equal to a 500-year flood, a flood with a 0.2% chance of naturally occurring in a given year. This caused up to 33 ft (10m) of vertical erosion to the stream channel (Jones 2018). Major erosion and flooding stopped in 2004 with the Diamond Fork System diverting the water into underground pipelines.

Implication: Transbasin diversions cause environmental damage to river ecosystems



The Cost of Transbasin Diversions

Context: Construction of Utah's transbasin diversions has cost approximately \$2.5 billion (Kem Gardner Institute 2020). \$2.3 billion of this came from the Federal Government, the rest from property tax and customer fees in Utah. Compare this to spending on other Utah water projects—\$40 million dollars to save the declining Great Salt Lake and \$210 million to build drinking water infrastructure for the Navajo Nation, of which Utah contributed \$8 million. **Transbasin water development is expensive compared to conservation: \$200+ per acre foot** of water paid by the customer (CUWCD 2021) despite significant federal subsidy. Federal and District Water Conservation Credit Program projects in Utah have conserved water at the cost of **\$80** an acre foot (CUWCD 2020).

Controversy: Some people believe Utah's emphasis on developing Colorado River water has been at the expense of other Utah water projects or water conservation.

Utah/Tribal Conflict

Context: Because the CUP harmed water and riparian resources on the Uintah and Ouray Reservation, the Ute Tribe received a \$295 million settlement as reparation/mitigation. **In 2021, the Ute Tribe led a now dismissed lawsuit against the Interior Department and the State of Utah** concerning whether tribal sovereignty was violated during this water transaction. In addition, the CUP promised the Tribe several large infrastructure projects. These multi-billion dollar projects, which would have benefited the Ute Tribe, were never built. Previously, relations between incoming

settlers and the Tribe were harmed by water transfers with the historic Daniels Canyon transbasin diversion that has since been incorporated into the CUP.

Controversy: Transbasin diversions have caused conflict between the Ute Tribe and State of Utah.

Pacific Desalination Pipeline

Context: A \$10 million federally funded study is currently awaiting full congressional approval that would explore a theoretical desalinated water pipeline from the Pacific Ocean. According to sponsor Senator Mitt Romney, the study focus is "addressing drought conditions in the Great Salt Lake, which may include... pipelines, coastal desalination plants...capable of redirecting water...across state borders."

Implication: A Utah-Pacific desalination transbasin project would be among the largest infrastructure projects ever attempted on Earth. If a Utah desalination pipeline was intended to offset Utah's consumptive water use in the Great Salt Lake watershed, the pipeline would have a capacity of 1.3 million AF/yr and be ~750 miles in length. This would be an estimated 20x the capacity and 6x the length of the world's only existing desalination transbasin system, the \$1B+ Jordan Red Sea-Dead Sea project (Coren 2019). This would be an estimated 10x the capacity of all existing Utah transbasin diversions.

Controversy: Implausible schemes to pipe water across the nation into Utah pop up now and again in the public discourse. Extreme cost, lack of political will, and infeasibility of construction make any mega-pipelines into Utah unlikely to ever be built.

Data Sources and Useful References

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The Colorado River Fundamentals Series offers basic information about water supply and the Colorado River system. Christian Stewart (christianjstewart02@gmail.com) is an undergraduate student of Watershed Sciences at Utah State University. This project was supervised by Jack Schmidt and supported by a QCNR Undergraduate Research Grant. Figures and photos not otherwise credited were created by the author from data sources. Layout by Lael Gilbert.