3 Water Banking Can Help Great Salt Lake

Utah's Water Banking Act offers a mechanism to allocate water to a drying Great Salt Lake

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Utah's Great Salt Lake is a treasured resource, yet dedicated flows have not been established to preserve the economic, ecological, and cultural values that the lake provides. Utah's prior appropriation law allocates water rights based on time of first use, meaning agricultural water uses typically have senior rights. Utah's Water Banking Act, which was adopted in 2020, presents an opportunity to reallocate some water to the environment within existing appropriative rights water law.

Under the act, water users can create local water banks to temporarily lease water. Leased water can be used for various purposes, including environmental or agricultural uses. Water banking under the act allows right holders to lease some or all of their water and, crucially, protects banked water rights from forfeiture. Additionally, the water and money from leases remain in the local watershed. Water banking presents an opportunity to flexibly manage water and help preserve the dwindling Great Salt Lake. This analysis estimates the volume of water that could be delivered to Great Salt Lake and the lake's water level based on wet-year water banking in Utah's Cache Valley.

Highlights

- **Water banking allows water right holders to lease some or all of their water for environmental, agricultural, or other purposes. Banked water rights are protected from forfeiture, and the water and money from leases remain in the local watershed.**
- **Banking could help flexibly manage water and contribute water to Great Salt Lake, which is drying.**
- **Water banking could be a cost-effective strategy that would entail financing millions of dollars today to potentially save billions of dollars in future lake restoration, dust abatement, and human health costs.**

Great Salt Lake, Utah ©Sara Null

Environmental Water Management in Utah

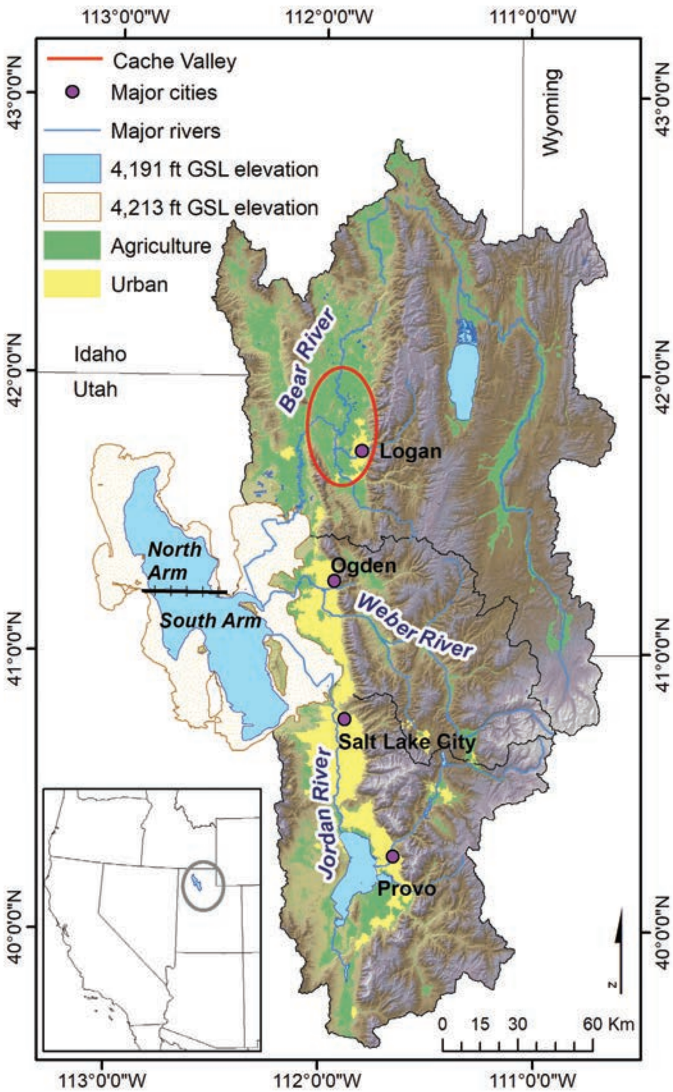
Legislation to codify environmental beneficial uses of water is relatively new to Utah. In 1986, instream flows were recognized as a legitimate water right in Utah, although only Utah's Division of Wildlife Resources could obtain instream flows for fish preservation.[1] A 1992 amendment expanded the law so that Utah's Division of Parks and Recreation could hold instream flow rights for public recreation or stream preservation.[2] In 2008, pilot legislation enabled private leasing of water for instream uses by fish conservation groups to restore habitat for native trout, and in 2019, that legislation was made permanent.[3] In 2020, the pilot Water Banking Act authorized voluntary water banking and split-season leasing,[4] and in 2022, Utah expanded the definition of beneficial use to broadly include instream flows and Great Salt Lake.[5]

The Water Banking Act promotes temporary, voluntary, and locally directed leasing arrangements for water rights. Water banking uses a market-based approach to protect water right ownership, generate local income, and provide flexible and expanded water access. Split-season leasing allows farmers to use their water for a portion of the season and lease it at other times. These changes to Utah's water code are the first formal mechanism to create a flexible source of water for environmental uses, such as preserving Great Salt Lake.[6]

Value and Vulnerability of Utah's Great Salt Lake

Great Salt Lake receives approximately 66 percent of its water from streamflow contributions, 31 percent from direct precipitation, and an estimated 3 percent from groundwater. Of the streamflow contributions, about 58 percent is from the Bear River, which flows through Wyoming, Idaho, and Utah and is predominantly fed by snowmelt from the Wasatch and Uinta Ranges. The average annual Bear River streamflow to Great Salt Lake is 1.2 million acre-feet (AF) per year, or 1,658 cubic feet per second.[7] Cache Valley is located along the Lower Bear River in northern Utah (see Figure 1), where agriculture is a dominant land use. The market value of Cache County agricultural products is $2.43 billion in inflation-adjusted dollars, with about 194,000 acres of irrigated farmland.[8]

Figure 1. **Great Salt Lake, Major Watersheds, and Cache Valley**



Great Salt Lake contributes an estimated $1.58 billion in inflation-adjusted dollars to Utah's economy through mineral extraction ($1.35 billion), recreation ($162.3 million), and brine shrimp harvest ($67.7 million).[9] However, due to an increase in consumptive water uses, the lake's water level has dropped at least 11 vertical feet since 19th-century pioneers arrived in northern Utah.[10] At record low lake levels in 2022, 53 percent of the lakebed was exposed. Exposed lakebed harms human health of nearby populations because fine dust (smaller than PM2.5) becomes airborne during high winds, increasing the prevalence of respiratory and cardiovascular diseases, inhibiting immune response, and increasing hospital visits and healthcare costs.[11] Dust-related human health costs are unknown.

Saline lakes have no outlet, so water leaves only through evaporation. As the level and volume of Great Salt Lake decline, salinity increases, threatening the lake's ecosystem. Brine shrimp are a keystone species in the lake. They control phytoplankton by grazing and are a predominant food source for many birds.[12] Maximum survival of brine shrimp declines when salinity exceeds 125 g/L,[13] and Great Salt Lake is bisected by a railroad causeway (as shown in Figure 1), creating non-uniform salinity and lake elevation in the north and south arms. The north arm is generally too saline to support brine shrimp.[14] The lake and its wetlands are a critical link in the Pacific Flyway, supporting approximately 4 to 6 million resident and migratory birds per year, comprising over 250 species.

While saline lakes are sensitive to climate, and lake levels vary naturally in response to wet and dry years, there has been no significant long-term change in precipitation that feeds rivers that flow to Great Salt Lake. However, agricultural and municipal water needs have increased dramatically over the past 150 years, causing the lake's decline.[15]

Cache Valley Water Banking

Water for Great Salt Lake could probably be leased by the state from water banks during wet years, when there is little competition for water, and water prices would be relatively inexpensive. This analysis focuses on physical water and ignores water right priorities and storage changes in upstream Bear Lake.[16] Water banking

Table 1. **Water Banking Alternatives with Estimated Cache Valley Irrigation Demands**

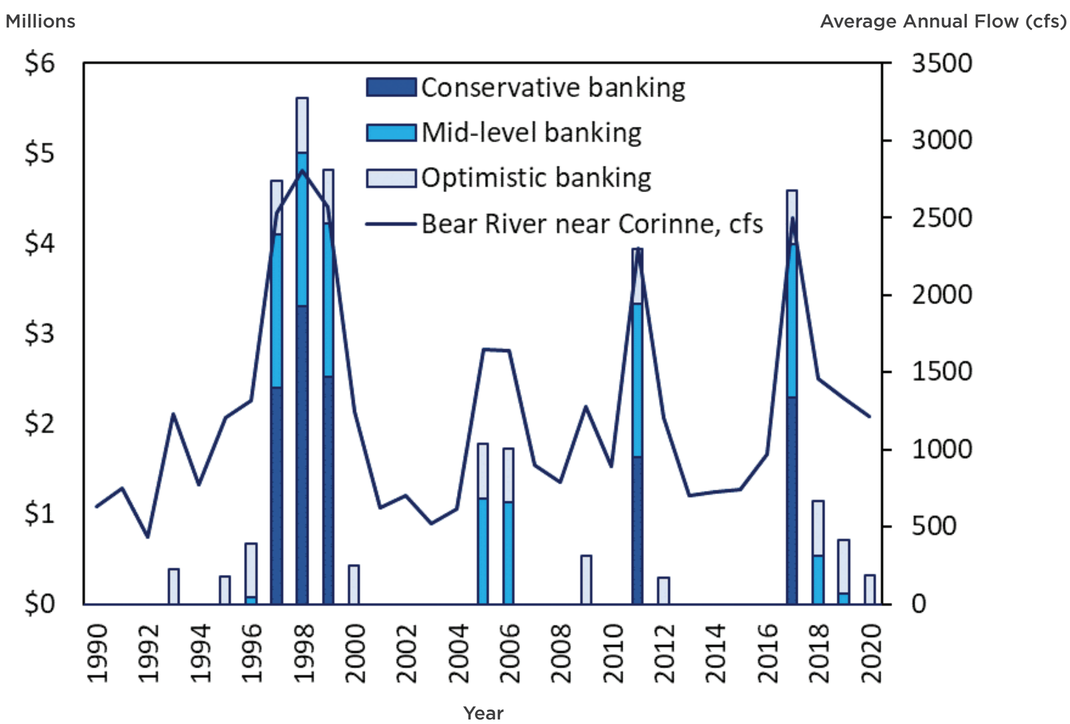
Water Banking Alternative	Irrigation Demand (AF per year)
Optimistic	185,000
Mid-level	215,000
Conservative	300,000

Source: J-U-B Engineers, "Cache County Water Master Plan," (2013).

could impair other water users or ecosystems, in which case water exchanges or other agreements would be needed. This analysis uses historical 1990-2020 data to estimate potential wet-year water leases to Great Salt Lake. A series of wet years occurred from 1987 through 1989, when water was pumped from Great Salt Lake to an adjoining basin to protect surrounding infrastructure. Water for Great Salt Lake would not have been leased during those years.

Three Cache Valley agricultural demand alternatives estimate wet-year water lease volumes to Great Salt Lake in excess of observed flows and represent the uncertainty to which irrigators would enter water banks. *Optimistic water banking* assumes that water in excess of 185,000 AF per year could have been leased for Great Salt Lake and added to observed streamflow to the lake, based off of average annual 2003-13 Cache County irrigation demand

Figure 2. **Annual Cost of Conservative, Mid-level, and Optimistic Water Banking**



Calculations are based on measured streamflow at USGS gage 10126000 (Bear River near Corinne).

Source: USGS and author's calculations.

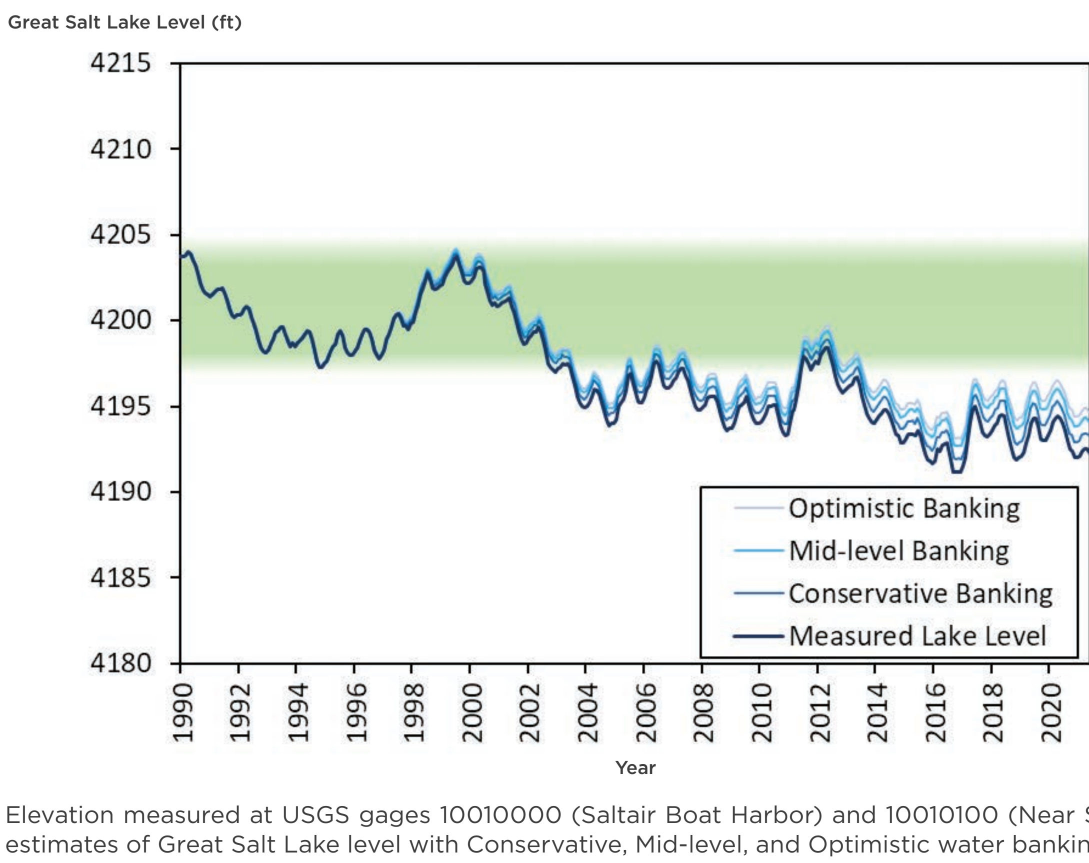
of 183,990 AF per year for 105,918 acres of irrigated cropland (see Table 1).[17] However, the Cache County Water Master Plan states that irrigators require an additional 30,000 AF per year of water for late season irrigation, so *Mid-level water banking* assumes water in excess of 215,000 AF per year could have been leased to Great Salt Lake.[18] The plan also states that ideally 300,000 AF per year of water would be supplied for Cache County agriculture, so flows in excess of that amount represent *Conservative water banking* leases to Great Salt Lake.[19]

In the 31-year time period used here, *Conservative water banking* would have occurred in five years, when Bear River streamflow through Cache Valley was 187 percent of normal or higher. *Mid-level water banking* would have occurred in 10 years, when streamflow was at least 107 percent of normal. *Optimistic water banking* would have occurred in 16 years, when streamflow was at least 97 percent of normal. Most wet-year water leases would have occurred in a handful of very wet years, including 1997-99, 2011, and 2017 (see Figure 2).

Great Salt Lake Water Banking Estimates

Prices are unavailable for Utah's nascent water banks. However, prices for Idaho's established agricultural water bank are $20/AF through 2022,[20] where 10 percent of fees support administrative costs and 90 percent compensate water right holders for the temporary use of water.[21] A uniform price of $20/AF was used here to estimate the cost of water leases to Great Salt Lake.[22] *Conservative water banking* would have cost $12.1 million

Figure 3. **Weighted Mean Elevation of Great Salt Lake**



Elevation measured at USGS gages 10010000 (Saltair Boat Harbor) and 10010100 (Near Saline, Utah), with estimates of Great Salt Lake level with Conservative, Mid-level, and Optimistic water banking in Cache Valley, Utah. The green band represents a healthy lake level range.

Source: Utah Department of Natural Resources Division of Forestry, Fire and State Lands, "Final Great Salt Lake Comprehensive Management Plan and Record of Decision," (2013).

Great Salt Lake, Utah ©Wayne Wurtsbaugh

and would have contributed 607,000 AF to Great Salt Lake. *Mid-level water banking* would have contributed 1,183,000 AF to Great Salt Lake at a cost of $23.7 million. *Optimistic water banking* would have contributed 1,597,000 AF to the lake and would have cost $31.9 million.

Great Salt Lake's water level was estimated using volume-stage relationships, with a weighted mean water level for the lake's north and south arms. The water volume from wet-year water leases was added to historical lake volume to estimate change in Great Salt Lake level from Cache Valley water banking. The ballpark estimates here do not account for increased evaporation, which is salinity dependent,[23] so results are upper-bound estimates of Great Salt Lake levels with water leases.

Had wet-year water leases for Great Salt Lake been practiced since 1990, *Conservative banking* would have raised Great Salt Lake water level by one foot and would have cost $12.1 million, *Mid-level banking* would have increased water level by 1.8 feet and would have cost $23.7 million, and *Optimistic banking* would have raised water level by 2.4 feet and would have cost $31.9 million.[24] Figure 3 shows the observed declining lake level (dark, bolded line) and estimated lake level with *Conservative*, *Mid-level*, and *Optimistic* water leases.

Healthy Great Salt Lake levels range from about 4,198 to 4,205 feet above sea level to best support economic, ecological, wildlife, and recreational benefits of the lake, and to prevent dust events.[25] Cache Valley water banking could have slowed lake level decline, but it would not have reversed it. A financing challenge for Great Salt Lake managers is that water leases would not occur uniformly in all years, rather, costs would be incurred in a handful of wet years (as shown in Figure 2).

Saline Lake Water Demands and Restoration Costs

Cache Valley water banking could have provided an average of 2.2 percent, 4.3 percent, or 5.8 percent more streamflow per year for *Conservative*, *Mid-level*, or *Optimistic* water banking, respectively. Previous research has recommended 20 percent,[26] 25 percent,[27] and 29 percent[28] more water to Great Salt Lake for a sustainable water level range most years. This implies that more widespread water banking would be required to sustain Great Salt Lake or that water banking could be one strategy among a portfolio of water management solutions for the lake.

Market-based environmental water allocation strategies have previously been shown to be cost-effective for Great Salt Lake. For instance, consistently providing Great Salt Lake with 20 percent more streamflow from cap-and-trade water cutbacks has been anticipated to cost $28 to $37 million based on more sophisticated cost curves than the uniform water banking costs estimated here.[29] Water conservation and cutback markets would not require water leasing costs but would likely involve more government oversight, monitoring, and enforcement.

Great Salt Lake's desiccation mirrors that of other saline lakes worldwide.[30] Saline lake restoration has used varied approaches including dust mitigation, litigation, environmental water purchases, water transfers, and diking.[31] In the United States, restoring saline lakes has been costly. Three examples from California are informative. To mitigate airborne dust for the dry bed of Owens Lake, Los Angeles Department of Water and Power anticipates spending $3.6 billion over 25 years.[32] The cost of replacement water for protecting Mono Lake public trust resources was estimated at $496 million in inflation-adjusted dollars over 20 years, until the lake reaches a target level. Increasing Mono Lake's water level has taken longer than 20 years, increasing costs. After the target level has been reached, replacement water costs might fall to about $6.4 million annually.[33] Salton Sea restoration is being legislated, and capital costs of restoration to increase streamflow, decrease salinity, and reduce airborne dust range from $631 million to $1.4 billion.[34]

To partially restore Walker Lake in Nevada, $76.7 million has been spent since 2009 to purchase water rights from willing sellers.[35] Restoration costs at these other saline lakes suggest that a proactive approach for increasing water deliveries to Great Salt Lake would be less costly than mitigation following environmental degradation.

Conclusion

More water is needed to sustain Great Salt Lake. The lake and most of Utah's freshwater ecosystems do not have dedicated water rights—although as of 2022, streams and lake beds are considered beneficial uses of water.[36] During droughts or periods of water scarcity, Great Salt Lake receives little water and bears substantial drought risk. Since Utah has been slow to dedicate and manage environmental water, water banking allows environmental interests to partner with water right holders for flexible water management within prior appropriation law.

Leasing water for Great Salt Lake through water banks is a cost-effective strategy to sustain the lake. Water banking could entail the state or another entity financing millions of dollars today to potentially save billions of dollars in future lake restoration, dust abatement, and human health costs. Water leases from Cache Valley water banking could be relatively cheap, costing approximately $12.1 to $31.9 million for 607,000 to 1,597,000 AF of water.[37] Restoration costs from other saline lakes illustrate the cost-effectiveness of water leasing to Great Salt Lake. Expanding water banks to regions outside of Cache Valley, and using a portfolio of environmental water management alternatives such as conservation, cutback markets, dedicating recycled water, or securing environmental water rights, could provide water to Great Salt Lake and play a role in sustainable management of an iconic lake.

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Endnotes

1 Utah H.B. 58 (1986). Utah Code §73-3-30.
2 J. Mortensen, "The Upstream Battle in the Protection of Utah's Instream Flows," *Journal of Energy, Natural Resources, and Environmental Law* 14, no. 2 (1994): 113.
3 Utah H.B. 117 (2008).
4 Utah S.B. 26 (2020). Utah Code §73-21. Utah H.B. 130 (2020).
5 Utah H.B. 33 (2022).
6 C.P. Carney et al., "The Accumulating Interest in Water Banks: Assessing Their Role in Mitigating Water Insecurities," *Journal of the American Water Resources Association* 57, no. 4 (2021): 552-71.
7 Utah Division of Water Resources, "Bear River Basin Planning for the Future," (2004) https://water.utah.gov/wp-content/uploads/2020/06/Bear-River-2004.pdf.
8 U.S. Department of Agriculture, "2017 Census of Agriculture: Utah State and County Data," Volume 1 (2019) https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Census_by_State/Utah/index.php.
9 Bioeconomics, "Economic Significance of the Great Salt Lake to the State of Utah," Great Salt Lake Advisory Council (2012) https://documents.deq.utah.gov/water-quality/standards-technical-services/great-salt-lake-advisory-council/Activities/DWQ-2012-006864.pdf.
10 W.A. Wurtsbaugh et al., "Decline of the World's Saline Lakes," *Nature Geoscience* 10, no. 11 (2017): 816-21.
11 W. Wurtsbaugh et al., "Impacts of Water Development on Great Salt Lake and the Wasatch Front," White paper prepared by Utah State University, Utah Division of Water Resources, Salt Lake Community College, and Utah Division of Wildlife Resources (2016).
12 D.W. Stephens, "Changes in Lake Levels, Salinity and the Biological Community of Great Salt Lake (Utah, USA), 1847-1987," *Hydrobiologia* 197, no. 1 (1990): 139-46.
13 B.D. Barnes and W.A. Wurtsbaugh, "The Effects of Salinity on Plankton and Benthic Communities in the Great Salt Lake, Utah, USA: A Microcosm Experiment," *Canadian Journal of Fisheries and Aquatic Sciences* 72, no. 6 (2015): 807-17.
14 J.S. White, S. E. Null, and D.G. Tarboton, "How Do Changes to the Railroad Causeway in Utah's Great Salt Lake Affect Water and Salt Flow?" *PloS ONE* 10, no. 12 (2015): e0144111.
15 Wurtsbaugh et al., *Decline of the World's Saline Lakes*.
16 Alternatively, some water right holders with priority storage in Bear Lake may consider leasing water.
17 J-U-B Engineers, "Cache County Water Master Plan," (2013) https://www.cachecounty.org/assets/department/water/water-master-plan/Cache_County_Water_Master_Plan_Report_Aug_2013.pdf.
18 *Ibid*.
19 Total annual agricultural water depletions for Utah's portion of the Bear River Basin are 536,000 AF, so estimates of 185,000 to 300,000 AF for Cache Valley water diversions and depletions are reasonable. Utah Division of Water Resources, *Bear River Basin Planning*.
20 Water right rental price in Idaho's Water Supply Bank will increase to $23 beginning in 2023.
21 Idaho Department of Water Resources, "Water Supply Bank," (2021) https://idwr.idaho.gov/iwrb/programs/water-supply-bank/.
22 Higher prices would incentivize participation in water banks, especially as banks initially develop.
23 I.N. Mohammed and D.G. Tarboton, "An Examination of the Sensitivity of the Great Salt Lake to Changes in Inputs," *Water Resources Research* 48, no. 11 (2012).
24 More water is needed to increase Great Salt Lake by a foot at high lake levels than at low lake levels. Water lease price does not change.
25 Utah Department of Natural Resources Division of Forestry, Fire and State Lands, "Final Great Salt Lake Comprehensive Management Plan and Record of Decision," (2013) https://ffsl.utah.gov/wp-content/uploads/OnlineGSL-CMPandROD-March2013.pdf.
26 E.C. Edwards and S.E. Null, "The Cost of Addressing Saline Lake Level Decline and the Potential for Water Conservation Markets," *Science of The Total Environment* 651 (2019): 435-42.
27 Mohammed and Tarboton, *An Examination of the Sensitivity of the Great Salt Lake to Changes in Inputs*.
28 Wurtsbaugh et al., *Decline of the World's Saline Lakes*.
29 Estimates consider an annual average of about 300,000 AF, or 10 million AF since 1990. Edwards and Null, *The Cost of Addressing Saline Lake Level Decline*.
30 Wurtsbaugh et al., *Decline of the World's Saline Lakes*.
31 S.E. Null and W.A. Wurtsbaugh, "Water Development, Consumptive Water Uses, and Great Salt Lake," in *Great Salt Lake Biology: A Terminal Lake in a Time of Change*, eds. B.K. Baxter and J.K. Butler (Springer, 2020), 1-21.

32 Ramboll Environ, "Great Basin Unified Air Pollution Control District: 2016 Owens Valley Planning Area PM10 State Implementation Plan," Great Basin Unified Air Pollution Control District, Bishop, California (2016).

33 California State Water Resources Control Board, "Decision and Order Amending Water Right Licenses to Establish Fishery Protection Flows in Streams Tributary to Mono Lake and the Protect Public Trust Resources at Mono Lake and in the Mono Lake Basin," Sacramento, California (1994) https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649/wrd1631.pdf.

34 L.R. Levers, T.H. Skaggs, and K.A. Schwabe, "Buying Water for the Environment: A Hydro-Economic Analysis of Salton Sea Inflows," *Agricultural Water Management* 213 (2019): 554-67.

35 L.R. Elmore, S.E. Null, and N.R. Mouzon, "Effects of Environmental Water Transfers on Stream Temperatures," *River Research and Applications* 32, no. 7 (2016): 1415-27.

36 Utah H.B. 33 (2022).

37 Developing water banks also requires time and professional services.