Bear River Development Report

August 2005

Division of Water Resources
1594 W. North Temple, Ste. 310
Salt Lake City, UT 84114-6201

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Summary

The average annual flow of the Bear River into the Great Salt Lake (GSL) is about 1.2 million acre-feet. This water resource received a great deal of attention in the 1990s, and has been called by many "Utah's last untapped water source". Development of the Bear River has been studied for many years. In the 1950s the Bureau of Reclamation identified and studied a number of potential reservoir sites on the lower Bear River and its tributaries, and restated these studies in June 1970 in a report titled: *Bear River Investigations, Status Report*.

During the high precipitation and runoff period of the 1980s, the Utah State Legislature directed the Utah Division of Water Resources (Division) to investigate controlling the level of the GSL through storage and diversion of the Bear River. These investigations became the backbone of a renewed water development interest in the river, especially as the state entered a low precipitation period in the late 1980s and early 1990s.

In 1991 the legislature passed the Bear River Development Act (Act). The Act directs the Division to develop the waters of the Bear River and its tributaries. The Division is to plan, construct, own, and operate reservoirs and facilities on the river as authorized and funded by the legislature, and to market the developed water.

In the *Bear River Pre-Design Report to the Bear River Development Task Force* (October, 1991) and the *Utah State Water Plan, Bear River Basin* (January, 1992), the Division details a four-part development plan which includes: 1) enlarging Hyrum Reservoir, 2) connecting the Bear River with a canal and/or pipeline from a point somewhere below Cutler Dam to Willard Bay Reservoir, 3) providing conveyance and treatment facilities to deliver water to the Wasatch Front, and 4) building Honeyville Reservoir. The four parts were listed in the order they would be constructed.

Based on revised water need estimates, public response, and cost analysis, the Division's plan has been modified as follows[1]: 1) modify the existing operation of Willard Bay by agreement with the Weber Basin Water Conservancy District; 2) connect the Bear River with a pipeline and/or canal to Willard Bay from a point near the Interstate 15 crossing of the Bear River near Elwood in Box Elder County; 3) construct conveyance and treatment facilities to deliver water from Willard Bay to the Wasatch Front; and 4) build a dam in the Bear River Basin.

Items 1 through 3 would be timed to deliver water to the Wasatch Front by about the year 2025 (based on contracts with Jordan Valley Water Conservancy District (JVWCD) and Weber Basin Water Conservancy District (WBWCD) and legislative approval). Item 4 would be carried out when the water users need the additional water. Due to the extended period of time this plan covers it is possible it could be modified again.

1 Utah State Water Plan, Bear River Basin (January, 2004)

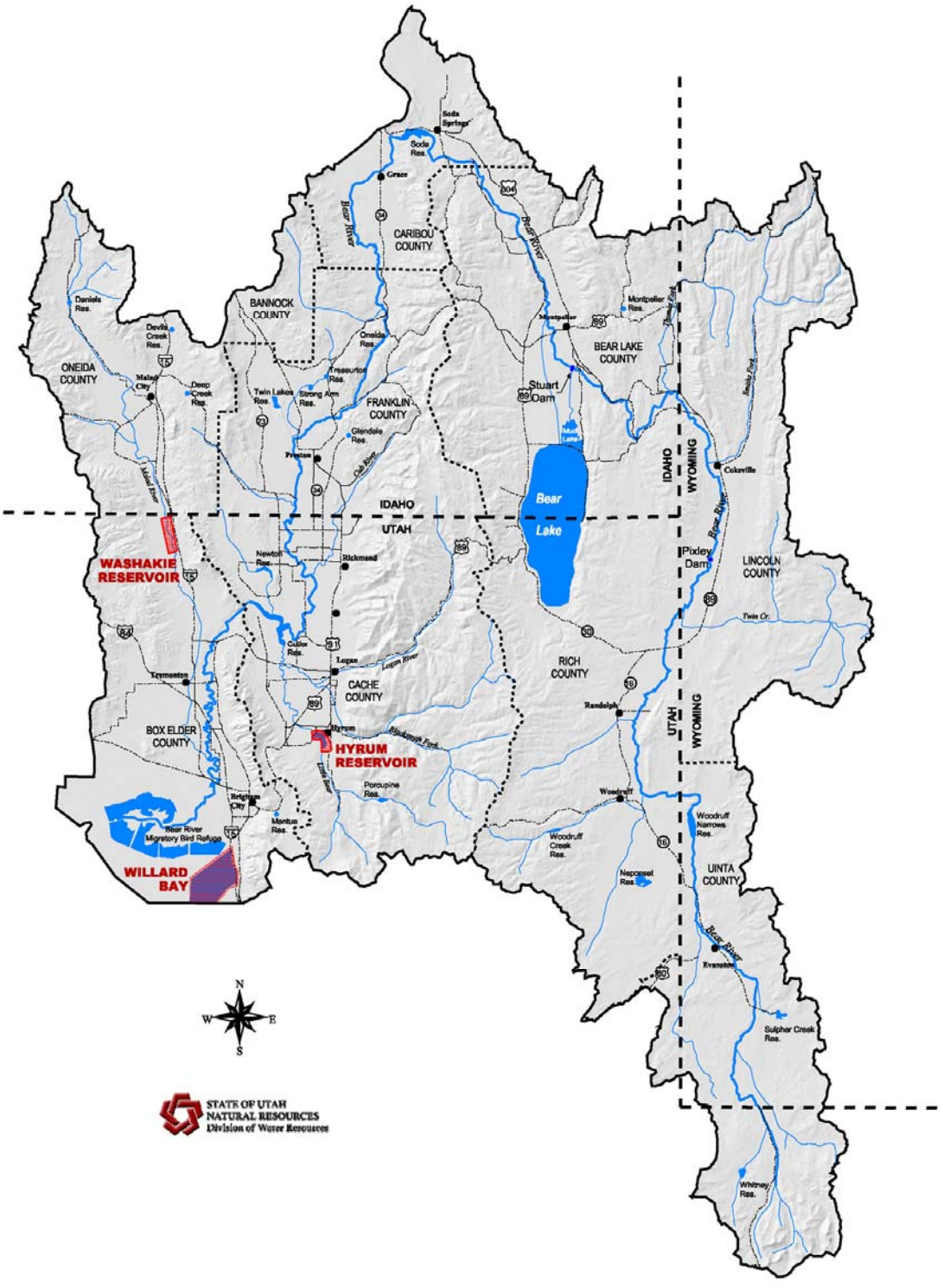


Figure 1. Bear River Basin

Introduction

The Bear River is the largest stream in the western hemisphere that does not reach the ocean. The river rises in Utah (see Figure 1), flows through parts of Wyoming and Idaho, and returns to Utah to empty into the Great Salt Lake. In its circuitous course the river flows about 500 miles, but the distance from its source to its terminus is only 90 miles.

Water Supply

The Bear River is one of the few rivers in the state where there is still a developable water supply. The river's average annual inflow to the Great Salt Lake is over one million acre-feet but average flow is reached through considerable variation in annual flow, as can be seen from the hydrograph of the river at Corinne in Box Elder County in Figure 2.

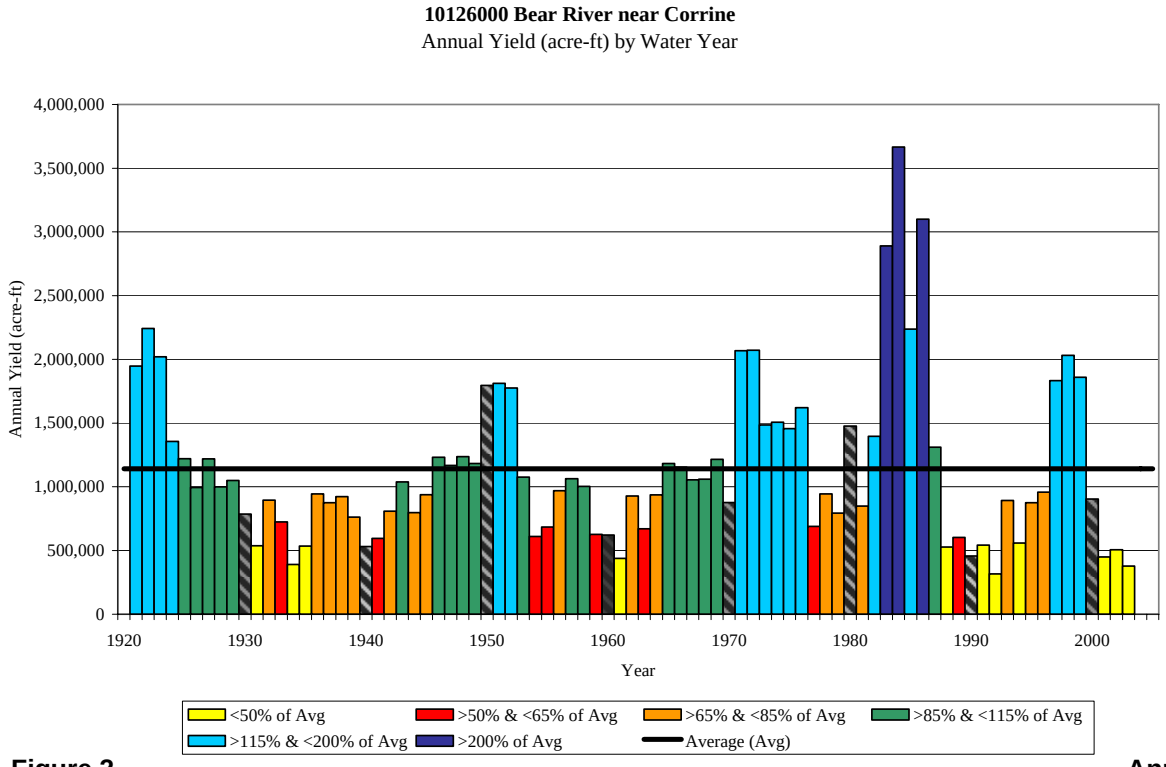


Figure 2. Annual Flows Bear River near Corinne

Development Potential

The Amended Bear River Compact of 1980 allocates all the waters of the river to the states of Idaho, Utah, and Wyoming. Assuming full development by Idaho and Wyoming and taking into consideration current uses, there remains an average annual developable flow at Corinne of about 275,000 acre-feet.

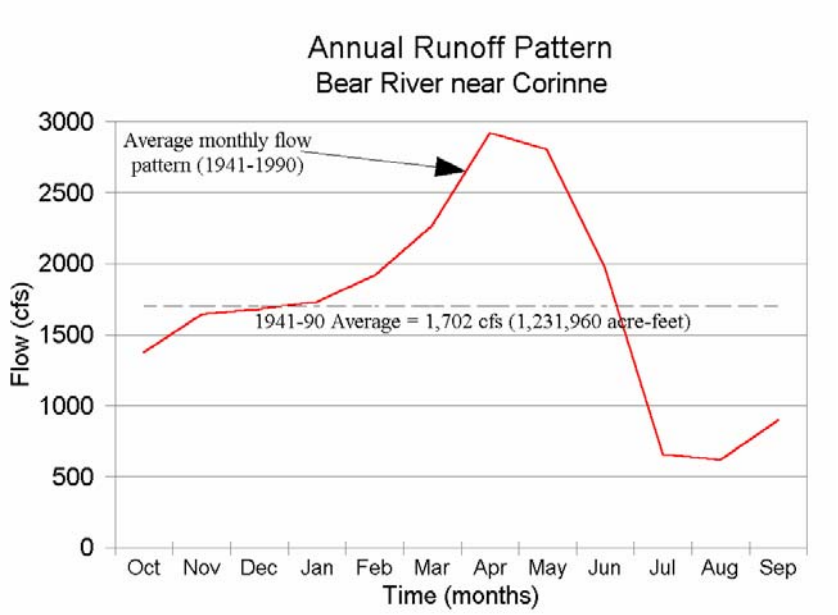


Figure 3. Annual Runoff Pattern - Bear River near Corinne

Figure 3 shows the average annual runoff pattern. Approximately 60 percent of the annual flow occurs during the snowmelt season of April, May, and June. The heavy demand period of July, August, and September reduces the river level to its lowest point and it is during this period that peak municipal demands occur. Municipal needs require a water supply that is consistent and dependable from year to year. The need for storage is emphasized when it is understood the river will probably be developed to meet municipal needs.

Bear River Development Act

The Act was passed in 1991, has been amended twice, and currently directs the Division to develop 220,000 acre-feet of water right applications held by the Board of Water Resources. It states:

> "The Division shall develop the surface waters of the Bear River and its tributaries through the planning and construction of reservoirs and associated facilities as authorized and funded by the Legislature; own and operate the facilities constructed; and market the developed waters. The Division is authorized to develop the Washakie, Hyrum Dam, and Avon reservoirs and associated works, including an interconnection from the Corinne area to Willard Reservoir, and shall proceed with design work, environmental assessments, acquisition of land and rights-of-way, and construction subject to: the appropriation of funds for those purposes by the Legislature. The Division may not begin construction of any project until contracts have been made for sale or lease of 70% or more of the developed water and all required permits have been obtained."

The Act allocates the water developed as follows: 50,000 acre-feet each to JVWCD and WBWCD, 60,000 acre-feet to Bear River Water Conservancy District, and 60,000 acre-feet to water users in Cache County.

The Act defines public purpose uses of the facilities constructed to be recreation, fish and wildlife (required mitigation is <u>not</u> a public purpose), and flood control. These public purpose uses are to be paid for by the state, and all other construction costs, operation, maintenance, and replacement costs are to be paid by the water users.

Construction costs must be repaid with interest in no more than 50 years and the Act directs the Board of Water Resources to set an interest rate. The Act allows a ten year development period for initial water purchasers. If a purchase contract is made before completion of the Division's project, the contracting entity shall repay all allocated costs as follows: 1) water taken during the first ten years after the project is completed shall be repaid within 50 years from its delivery date, and 2) water taken after ten years from the completion of the project shall be repaid within 50 years from the date the project was completed. Contracts for water purchased after the completion of the project shall be repaid within 50 years from the date of the contract.

Water Demand

The Utah Water Demand Supply Model (model) prepared by the Division shows water demand in the Bear River Basin will exceed its existing culinary water supplies by about 2025. The Weber Basin will exceed its existing culinary water supplies by 2029. Salt Lake County will exceed its existing culinary water supplies by about 2049, JVWCD by about 2025, and Metropolitan Water District of Salt Lake and Sandy (MWDSLS) will exceed its existing culinary water supplies well after 2050. Even though there is a physical connection between JVWCD and MWDSLS, there is no mechanism currently in place to share the water. It should be noted that these figures do not include agricultural water conversion, which could delay the need for Bear River water.

PUBLIC COMMUNITY WATER SYSTEMS

Municipal and Industrial Water Demand/Supply

Acre-Feet/Year

COUNTY	2000	2020	2050
BOX ELDER			
Demand	12,900	16,834	23,557
Reliable Supply	21,062	21,062	21,062
Surplus(+)/Deficit(-)	**8,162**	**4,228**	**(2,495)**
CACHE COUNTY			
Demand	29,228	41,916	65,743
Reliable Supply	43,447	53,447	68,447
Surplus(+)/Deficit(-)	**14,219**	**11,531**	**2,704**
DAVIS COUNTY			
Demand	87,633	112,595	109,203
Reliable Supply	105,026	114,026	114,026
Surplus(+)/Deficit(-)	**17,393**	**1,431**	**4,823**
WEBER COUNTY			
Demand	81,887	101,259	114,171
Reliable Supply	92,845	107,845	107,845
Surplus(+)/Deficit(-)	**10,958**	**6,586**	**(6,326)**
MORGAN COUNTY			
Demand	1,607	3,999	11,205
Reliable Supply	1,540	1,540	1,540
Surplus(+)/Deficit(-)	**(67)**	**(2,459)**	**(9,665)**
SUMMIT COUNTY (Weber Basin)			
Demand	11,172	21,920	35,500
Reliable Supply	17,470	25,796	36,196
Surplus(+)/Deficit(-)	**6,298**	**3,876**	**696**
TOTAL FOR WEBER RIVER			
Demand	182,299	239,773	270,079
Reliable Supply	216,881	249,207	259,607
Surplus(+)/Deficit(-)	**34,582**	**9,434**	**(10,472)**

JVWCD Systems			
Demand	125,782	175,721	210,416
Reliable Supply	132,255	194,705	186,505
Surplus(+)/Deficit(-)	**6,473**	**18,984**	**(23,911)**
MWDSLS Systems			
Demand	118,833	141,753	160,681
Reliable Supply	165,775	202,225	202,225
Surplus(+)/Deficit(-)	**46,942**	**60,472**	**41,544**
TOTAL FOR SALT LAKE COUNTY			
Demand	261,584	339,730	397,370
Reliable Supply	322,637	421,537	413,337
Surplus(+)/Deficit(-)	**61,053**	**81,807**	**15,967**

*Utah Water Demand Supply Model – Division of Water Resources

*Reliable supplies are a 9 out of 10 year scenario that includes spring supplies at 50% of maximum, wells at 50% of maximum and surface supplies equal to the maximum

*Does not include any agricultural water conversions

*Population data – GOPB (July 2005)

*All demands have 25% reduction in per capita water use by 2050

River Simulation

To determine the facilities required to develop the Bear River, the Division created the "Bear River Simulation Computer Model" (model). The model has the capability of simulating the effect of development scenarios and was used to determine the amount of water that could be developed using variations of direct diversion, dams and reservoirs, and combinations of both. The model assumes existing water rights would be honored and uses historical water flow records. It includes the option of using Willard Bay with its existing Weber River water supply and WBWCD's forecasted future demand schedule.

The amount of water developed in the different scenarios is also a function of the demand (use of water) of the user or customer. Although any number of uses can be assumed, the principal and controlling demand is water for domestic use. The model uses a typical Wasatch Front domestic demand pattern as shown in Figure 4.

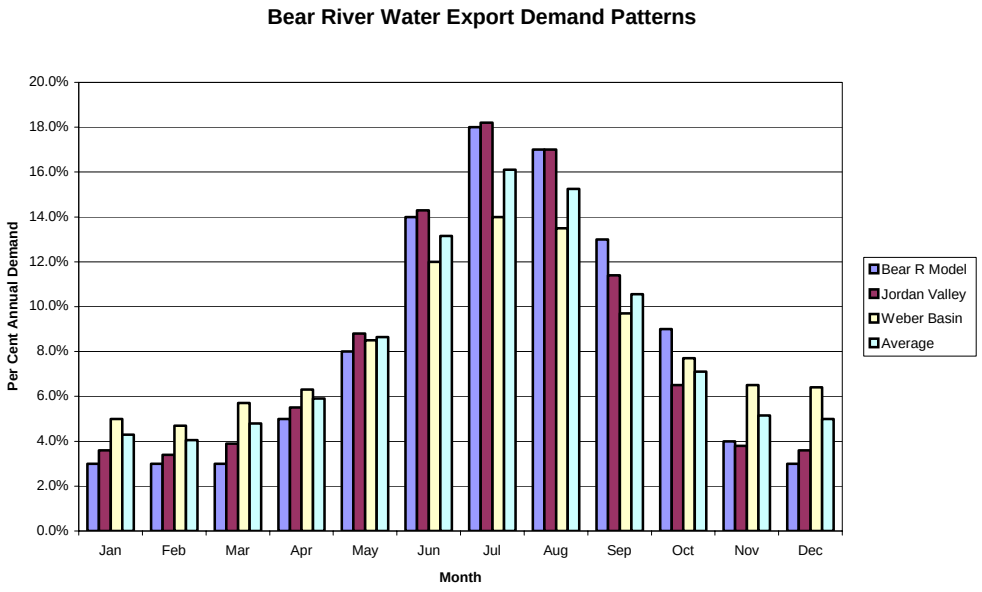


Figure 4. Bear River Water Export Demand Patterns

The model takes into consideration water rights and use patterns of downstream users and the Bear River Bay. The Bear River Migratory Bird Refuge has the major downstream water right and the delivery demand pattern the model uses was developed by the U.S. Fish and Wildlife Service. This model reflects the interpretation of the water right as defined by the State Engineer in December 2000. The model meets the refuge demand before water is stored in a simulated reservoir or diverted from the river.

Development Alternatives

Using the computer model, a number of development options were analyzed and several combinations of dams were tested. The capacity of the pipeline from the Bear River to Willard Bay was calculated at 400 cfs. Table 2 is a tabular summary of some delivery options that were most cost-effective. Several other reservoir sites were investigated and although more costly, have not been eliminated as development options. Development of a reservoir(s) may be several years in the future and any

number of things could happen to cause the current status to change. It is also expected that public opinion and acceptance at the time of construction will be a major determining factor.

Table 2
Bear River Development Options

DAM	M&I DELIVERIES FOR WORST YEAR SHORTAGE		
	0% Delivered (Acre-Feet)	5% Average Delivered (Acre-Feet)	10% Average Delivered (Acre-Feet)
WILLARD	89,500	94,900	109,300
WASHAKIE	127,300	131,200	144,000
WASHAKIE/WILLARD	203,600	209,300	227,700

*Willard has a conservation pool of 50,000 acre-feet .

Table 2 shows the annual amount of water delivered by the option shown with a 0%, 5%, and 10% shortage. The allowed shortage is the maximum shortage in the 50-year simulation period. As stated previously, municipal water supplies need to be dependable. If a shortage is allowed in developing the project scenario, it must be mitigated when a project is actually put into operation.

There are several methods of mitigating reservoir shortage. Users may have groundwater options that allow additional pumping to meet shortages. Groundwater options may be enhanced by groundwater recharge; groundwater recharge takes advantage of water in above-average years by diverting it into existing groundwater

aquifers for future use. Another method that has been used is to have an agreement or agreements with irrigation water users to use some of their water. During times of shortage, irrigators would fallow (not plant) land that is used for annual crops like grains and lease (sell) the water they would have used that year. There always exists the option of purchasing existing water rights when a willing seller can be found. It is

noteworthy that these mitigating options also exist independently as options to meet current and future water needs.

Division of Water Resources' Plan to Develop the Bear River

Modify Existing Operation of Willard Bay

Figure 5. Willard Bay

The first step in the Division's plan is to modify the existing operation of Willard Bay by establishing an agreement with WBWCD. The agreement would consist of bringing water from the Bear River to Willard Bay. When Willard Bay is included, the option assumes a storage use in the bay. Although there is no construction cost included for the use of Willard Bay, changing the current use will require costs for permits and an agreement with WBWCD for operation and maintenance.

Willard Bay is an option for developing the Bear River because it was constructed to allow the storage of water during high flow years in the Weber River for use during low flow years. Willard Bay has a capacity of over 200,000 acre-feet and a projected water yield of less than 100,000 acre-feet. When the demand on the Weber River is less than its flow, water is diverted into Willard Bay. Because of the variability of the

river's flow, the dry cycles control how much water WBWCD can rely on from Willard Bay.

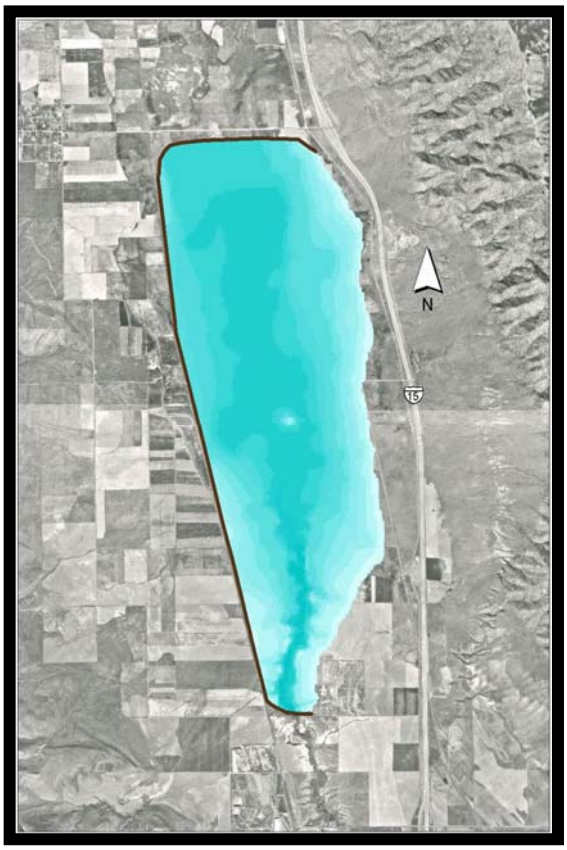
Adding another water source from the Bear River firms up the water supply and increases the yield of Willard Bay. All of the current and projected uses of Willard Bay would have to be met before new (other) uses. Even with that restriction, Willard Bay represents a unique opportunity to develop the Bear River without constructing a new reservoir. There is no question that Willard Bay would be impacted. The water elevation will fluctuate more than it currently does, but it should be remembered that Willard Bay is not currently being used to its development potential. When full development occurs, Willard Bay will certainly fluctuate more than it does now and during dry periods could be low for several years. The addition of Bear River water would reduce the extended lows and it is likely a conservation pool would be added to further insure protection to fish and recreation values.

Connect the Bear River with a Pipeline and/or Canal to Willard Bay

All development options include a connection from the Bear River to a point at or near Willard Bay. The connection for all options is by pipeline and a diversion dam located just downstream of the I-15 crossing of the river near Elwood. A 96-inch concrete-lined steel pipeline will extend about 90,000 feet and have a capacity of 400 cfs; for all options pump lift stations will be required. The cost to construct the pipeline is estimated to be about $70 million and is included in the project cost estimates that follow.

Conveyance and Treatment Facilities

The Division will provide water to Willard Bay. Necessary treatment facilities and additional conveyance will be the responsibility of each individual water district. The point of diversion begins near Elwood to keep the quality of the water as high as possible in order to reduce treatment costs and to comply with secondary drinking water standards.



Washakie Dam

The location for the proposed Washakie Dam site is just east of Washakie Town, about ten miles north of Tremonton. The proposed reservoir would be an off-stream facility surrounded by 38,000 linear feet of dike on three sides. Water would be diverted from the Bear River through Cutler Reservoir and then piped to the proposed dam site. Getting the water into the reservoir will require a maximum pump lift of 60 feet. The Malad River runs through the proposed site, but because of salinity in the water the river would be routed around the dam. The dam would impound 160,000 acre-feet when full and cover 4,906 acres. Crest elevation would be 4415 feet (msl) with water surface elevation at 4407 feet (msl).

A Utah Power & Light Company power line would have to be moved out of the basin of the potential reservoir. In addition, some homes would have to relocated, purchased, or removed.

Further investigation is needed to determine environmental impacts and costs of mitigation.

The total cost to construct Washakie is approximately $278 million.

Hyrum Dam

Hyrum Dam was included in the original Bear River Development Plan and has been considered as a potential water source for the Bear River Migratory Refuge (Refuge). If U.S. Fish and Wildlife is able to enlarge Hyrum, it will increase the capacity by 50,000 acre-feet. This will provide the Refuge with an additional 25,000 acre-feet/year average. If this option is not built, the Division plans to help the refuge with water needs through any future water storage on the Bear River.

The cost is estimated to be $107 million, which includes relocating the state park and mitigation of cultural and environmental impacts.

Environmental

In 1991, an overview of the environmental impacts of the most cost-efficient dams and reservoirs was conducted by BioWest of Logan. BioWest concluded that unless there are unexpected findings of listed endangered species, all anticipated environmental impacts could be mitigated.

The estimated cost of mitigating environmental impacts is included in all cost estimates.

Water Quality

Since 1995, the Division has conducted a water quality monitoring program on the Bear River. The Bear River watershed presents significant challenges to potential municipal and industrial development water users. From pristine headwaters to the silt-

laden mouth at the Great Salt Lake, the Bear River water undergoes many changes. Of primary interest to potential Utah water users is the reach of the Bear River from the West Cache Canal Diversion north of Preston, Idaho, to the Reeder Canal Division south of Corinne, Utah.

The Bear River has primary tributaries in Cache Valley (Cub River, Newton Creek, Logan River, Spring Creek, and Little Bear). These tributaries generally have water quality that equals or exceeds the quality of the Bear River at the point of confluence. The Bear River in Box Elder County has two tributaries of note: the Malad River and Salt Creek (from Crystal Springs). Both of the tributaries have inferior water quality and tend to degrade the quality of water in the Bear River at the point of confluence.

The Bear River is currently classified for recreational and wildlife uses and under this classification the river meets standards most of the time. If the criteria for a drinking water supply are applied to the Bear River, the water quality fails many of the standards. Five parameters for finished water are particularly important in estimating the anticipated cost of treating the water to meet drinking water standards: total dissolved solids (TDS), turbidity, hardness, iron, and manganese. The quality of the Bear River in Utah frequently exceeds drinking water supply standards for these parameters.

WBWCD is reluctant to allow Bear River water to be stored in Willard Bay. District officials believe the water in Willard Bay is of much higher quality than the water quality of the Bear River. This opinion, however, is only accurate when comparing the quality of Willard Bay's water with the Bear River's quality below Corinne. Because of the consistent muddy green color of the Bear River in Utah, many assume the water quality is poor, but that is not accurate.

Current water quality analysis of the Bear River reveals some interesting insight into the quality of the river. Water quality is highest in the spring (during runoff) and in

the winter. During this period the river's quality at Preston, Idaho is about the same as its quality just above the confluence of the Bear and Malad rivers. After the Malad River and Salt Creek enter the Bear River, the TDS shows a marked increase, especially during periods of low flow in the winter and summer.

The water quality of Willard Bay has been monitored since 1956 by WBWCD. The long-term TDS average of the reservoir is 595 mg/l. The relationship of TDS between Willard Bay and the Bear River above the confluence of the Malad River is shown in Figure 5. The figure shows that the quality of the Bear River and Willard Bay are similar.

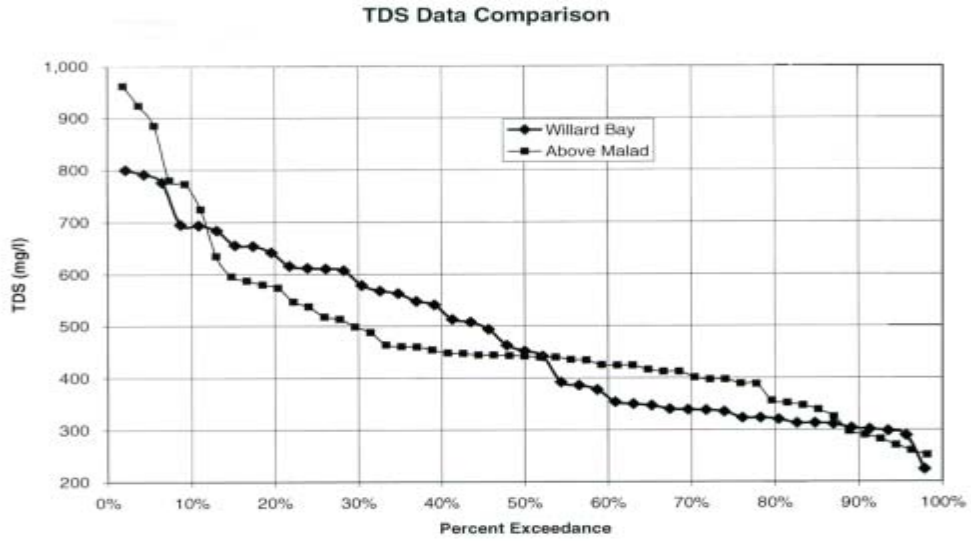


Figure 5. TDS of the Bear River and Willard Bay (April 1978-October 1998).

The initial use of Willard Bay as a water supply was minimal. When constructed, it was considered by many to be in an unacceptable location for recreation. For several years water was diverted into Willard Bay only to replace evaporative losses. During this period (1969 to 1982) the average TDS of Willard Bay was 650 mg/l. Willard Bay was discovered as a fishery and recreation facility in the 1980's, and facilities were constructed on its west dike to allow water to be delivered to a mineral industry. A new way of operating Willard Bay evolved. The developing uses prompted WBWCD to flush Willard by spilling water over the outlet/spillway on the north dike whenever good quality water could be diverted from the Weber River. This improved the water quality of Willard Bay. The average TDS is now about 470 mg/l.

When water is diverted from the Bear River above the confluence of the Malad River during winter and spring runoff, its quality is near that of the water in Willard Bay. If a reservoir were constructed above the Willard Bay diversion point, the quality would be lessened somewhat due to the effects of reservoir evaporation and the storing of summer flow; however, this effect would be small.