Bear River Development

Division of Water Resources
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BEAR RIVER DEVELOPMENT

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 has received a great deal of attention in the decade of the 90s, and has been called by many "Utah's last untapped water source". Development of the Bear River has been studied for 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 80s, 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 80s and early 90s.

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. The general direction of the Act was given by the Bear River Development Task Force, a gubernatorial/legislative task force created by statute in 1989.

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) 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.

Parts 1 through 3 would be timed to deliver water to the Wasatch Front by about the year 2015 (based on contracts with Jordan Valley and Weber Basin Water Conservancy districts and legislative approval). Part 4 would be carried out when the Bear River Water Conservancy District and/or Cache County water users need the water. Due to the extended period of time this plan covers it is possible it could be modified again.

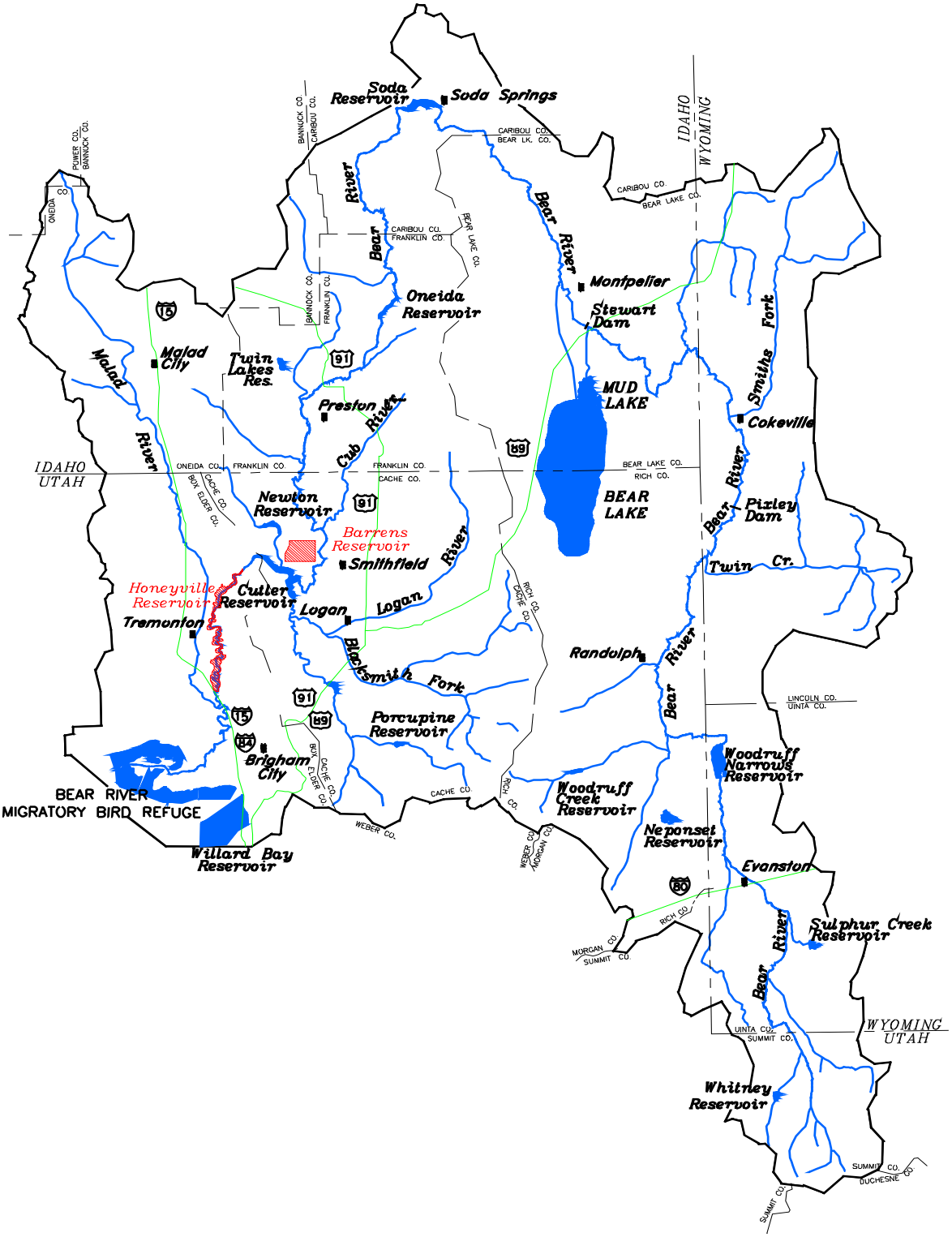


Figure 1. Bear River Basin Location Map and Two Potential Reservoir Sites

Introduction

The Bear River is the Western Hemisphere's largest stream that does not reach the ocean. The river rises in Utah (see Figure 1), but flows through parts of Wyoming and Idaho before returning 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 mouth 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. There is considerable variation in annual flow as can be seen from the hydrograph of the river at Corinne in Box Elder County in Figure 2.

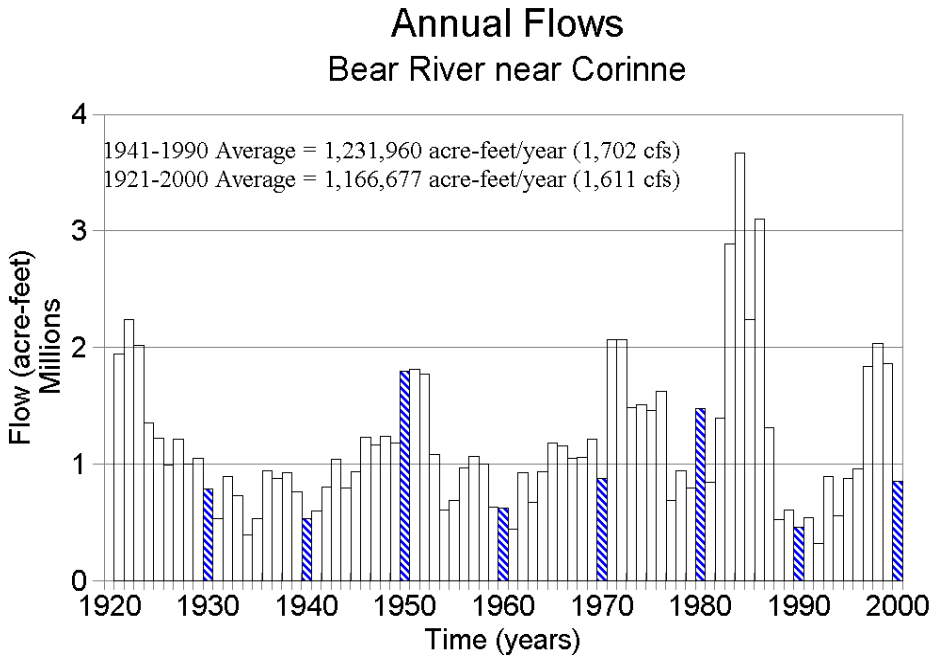


Figure 2. Hydrograph of Bear River At Corinne

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.

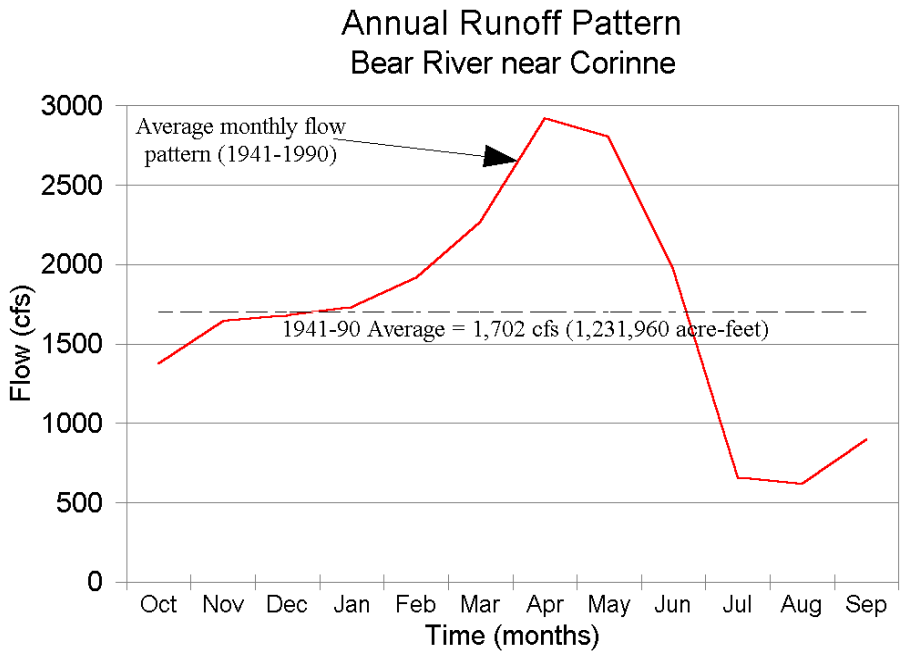


Figure 3. Average Annual Runoff Pattern

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 also 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.

Water Demand

Basin plan reports prepared by the Division show water demand in Box Elder, Cache, Davis, and Weber counties will not exceed current supply until about 2050. Salt Lake County's water demand will exceed its supply by about 2015. Municipal and industrial water needs and available supply for these counties are shown in Table 1. It should be noted that the numbers in Table 1 indicate water needs based on a reduction in per capita water use. The table assumes that through conservation measures there will be a reduction of 12.5% by 2020 and 25% by 2050. A greater increase in the reduction of per capita water use could further delay the need for water.

Table 1 Municipal and Industrial Water Needs/Supply Public Community Systems				
County	2000	2010	2020	2050
BOX ELDER				
Demand	12,500	16,800	18,300	23,300
Reliable Supply	19,000	19,000	19,000	19,000
Surplus(+)/Deficit(-)	6,500	2,200	700	(4,300)
CACHE COUNTY				
Demand	27,800	32,200	35,600	46,400
Reliable Supply	43,200	43,200	43,200	43,200
Surplus(+)/Deficit(-)	15,400	11,000	7,600	(3,200)
DAVIS AND WEBER COUNTIES*				
Demand	76,000	89,300	102,200	155,000
Reliable Supply	160,000	160,000	160,000	160,000
Surplus(+)/Deficit(-)	84,000	70,700	57,800	5,000
SALT LAKE COUNTY				
Demand	265,700	316,300	371,600	553,300
Reliable Supply	344,000	344,000	344,000	344,000
Surplus(+)/Deficit(-)	78,300	27,700	(27,600)	(209,300)

*Wasatch Front Communities

*Future Demand may be met by agricultural conversion

*Data based on Governor's Office of Planning & Budget Population Projections (12/99)

Bear River Development Act

In 1991 the Utah State Legislature passed the Bear River Development Act (Act). The Act directs the Utah Division of Water Resources (Division) to develop 220,000 acre-feet of water right applications held by the Board of Water Resources. The Act 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 Honeyville, Barrens, Hyrum Dam, and Avon reservoirs and associated works, including an interconnection from Honeyville Reservoir 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 Jordan Valley and Weber Basin (WBWCD) Water Conservancy districts, 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 by the state, and all other construction costs and all operation 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.

River Simulation

To determine the facilities required to develop the Bear River, the Division of Water Resources 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 reservoir, 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 the 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.

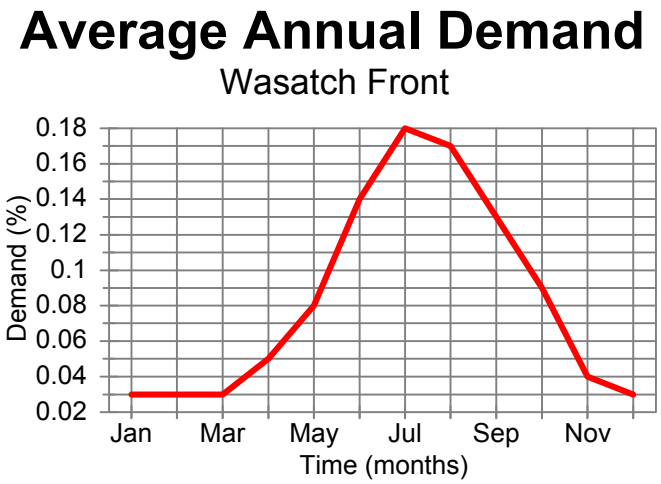


Figure 4. Average Annual Demand Pattern, Wasatch Front

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 and demand pattern the model uses were developed by the U.S. Fish & Wildlife Service. 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 and pipeline capacities were tested. 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		
	25%		0%
	AVERAGE SHORTAGE (%)	DELIVERED (ACRE-FEET)	DELIVERED (ACRE-FEET)
WILLARD - A*	4.80	60,000	43,000
WILLARD - B*	5.48	107,000	79,000
HONEYVILLE	4.3	170,000	119,000
HONEYVILLE/ WILLARD - B*	3.34	176,000	155,000
BARRENS (100)	3.0	125,000	89,000
BARRENS(100)/ WILLARD - B*	2.01	173,000	153,000
BEETON	3.84	75,000	52,000
BEETON/ WILLARD - B*	2.07	123,000	106,000

*Option A considers an 80,000 acre-foot conservation pool in Willard Bay and Option B considers a 50,000 acre-foot conservation pool in Willard Bay

Table 2 shows the annual amount of water delivered by the option shown with a 25% and a 0% 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 in operation.

There are several methods of mitigating reservoir shortages. 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 corn or grains and lease (sale) the water they would have used that year. Also projects to improve the irrigation efficiency could be built. Water saved by installing sprinkle systems, lining or piping canals or enhanced flood irrigation methods could be used to make up shortages in a municipal storage project. 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.

All development options include a connection from the Bear River to Willard Bay. The connection for all options except Honeyville Dam is by pipeline and a diversion dam located just downstream of the I-15 crossing of the river to Willard Bay. For Honeyville Dam options, the connection is a pipeline from Honeyville Dam to Willard Bay. A flow capacity of 400 cfs was used; for all options pump lift stations will be required. The cost to construct the pipeline is estimated to be $60 million.

Willard Bay

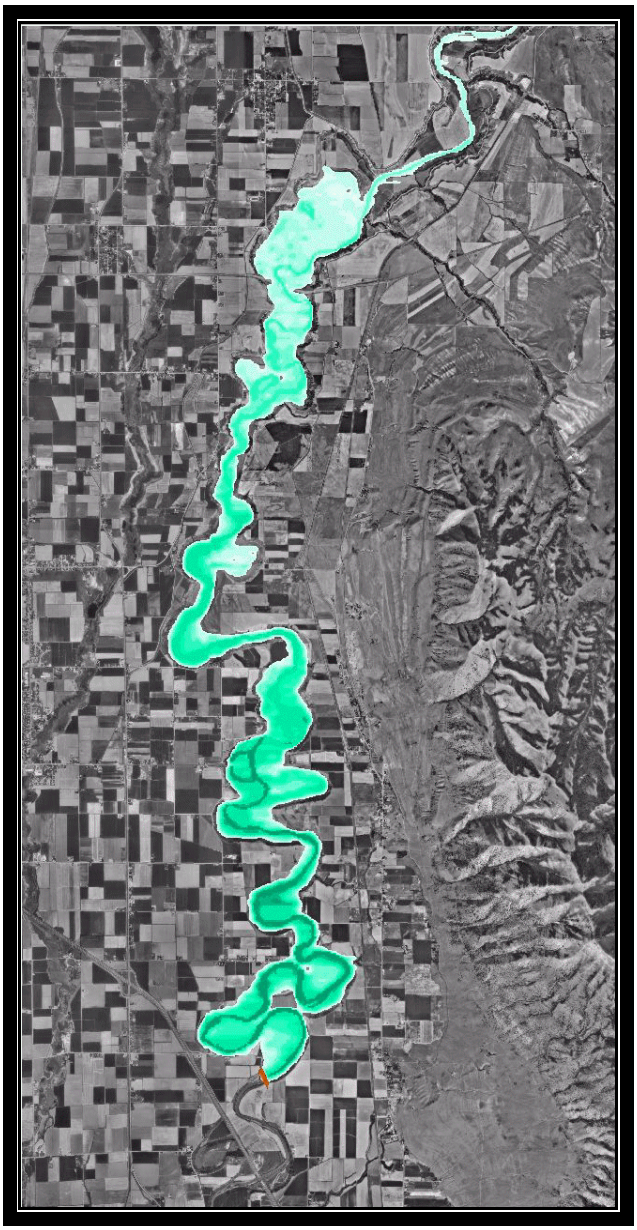
Willard Bay

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 the Bear River would

reduce the extended lows and it is likely a conservation pool would be added to further insure protection to fish and recreation values.



Proposed Honeyville Dam

Honeyville Dam

Honeyville Dam would be located on the river about one-half mile upstream of the I-15 crossing of the Bear River. The proposed dam is a zoned earthfill structure 90 feet high and would impound 117,000 acre-feet of water. The reservoir would extend 13 miles and at high water, be almost to the base of Cutler Dam. The dam would be over 1,900 feet in length. The crest elevation would be 4290 feet above mean sea level (msl) and the normal water surface elevation would be 4275 feet (msl). The reservoir surface area when full would be over 3,900 acres. A conservation pool of 20,000 acre-feet would be provided.

Honeyville Dam has considerable impact on the roads and public utilities in the reservoir area. Included in the cost of Honeyville Dam is the realigning of high voltage powerlines and telephone lines; relocating and constructing the Riverside to Logan and Deweyville bridges; drilling

wells to replace the Garland and Tremonton collection system (inundated by the reservoir); moving and replacing water lines for Tremonton, Garland, Fielding, and Elwood; replacing Petersen and Elwood City parks; and purchasing several homes in or near the reservoir rim. In addition, there will be considerable environmental, historical, and cultural mitigation. One visually significant cultural site is the Hampton Stage Stop, the site of the Oregon Trail ford on the river's edge at the upper end of the proposed reservoir.

The estimated cost of the Honeyville Dam is $60 million.

Proposed Beeton Dam

Beeton Dam

The Beeton Dam (small Honeyville) is five miles upstream of the Honeyville Dam and similar in concept to the Honeyville Dam. It would be 64 feet high and impound 49,000 acre-feet of water. The reservoir would extend 8 miles. The reservoir surface area when full would be almost 2,000 acres. The conservation pool would be 10,000 acre-feet.

The impacts of this reservoir are less than those at the Honeyville site but include relocating a power line, the Riverside Logan Bridge, Hampton Stage Stop, mitigation of other cultural sites, and environmental mitigation. This reservoir is located above the Garland and Tremonton water supply collection area and the Deweyville Bridge.

The cost of the Beeton Dam is $27 million.

Proposed Barrens Dam

Barrens Dam

The proposed off-stream Barrens Dam site is located about five miles west of Smithfield immediately to the west of the town of Amalga. The area is known as “The Barrens” because of the relatively barren ground encompassed by the area. Because groundwater is shallow in the dish-shaped drainage area and the soils are alkaline, limited agricultural activity has occurred in the region. The area drains into the Clay Slough, which is an arm of Cutler Reservoir.

Although a number of reservoir capacities (35,000 to 220,000 acre-feet) have been investigated, the cost for a 100,000 acre-foot reservoir is given here. The dam is a zoned earthfill structure with a maximum height of 40 feet and is over 58,000 feet in length. The “U”-shaped reservoir would have a crest elevation of 4453 feet (msl) and a normal water surface of 4439 feet (msl).

The reservoir surface, when full, is almost 4,500 acres. Constructing this dam would require moving a high voltage powerline and relocating a total containment sewage lagoon operated by a cheese production facility. Environmental mitigation would be required.

Water for the reservoir would be delivered from the West Cache Canal and/or a pump facility on the Bear River or in the Clay Slough. Use of the West Cache Canal would require an agreement with its owner and enlarging the canal's capacity. The canal diverts water from the Bear River in Idaho near Preston.

The cost estimate for Barrens (100,000 acre-feet) is $84 million.

Hyrum Reservoir

Hyrum Dam

Because raising Hyrum Dam was included in the original Bear River Development Plan a brief summary is included. It has been determined it is technically feasible that Hyrum Dam, an existing structure on the Little Bear River near the community of Hyrum, can be raised. Increasing the dam's height 50 feet would result in a capacity increase of 25,000 acre-feet. The cost estimate includes relocating the state park and mitigation of cultural and environmental impacts.

The cost is estimated to be $35 million.

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. This was further verified for the Honeyville Dam site in another BioWest report prepared in 1996 for the U.S. Fish and Wildlife Service and the Division of Water Resources.

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 Diversion south of Corinne, Utah.

The Bear River has primary tributaries in Cache Valley (the Cub River, Newton Creek, Logan River, Spring Creek and the 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 these 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. The five parameters are 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.

The 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 an accurate assumption.

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 show 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.

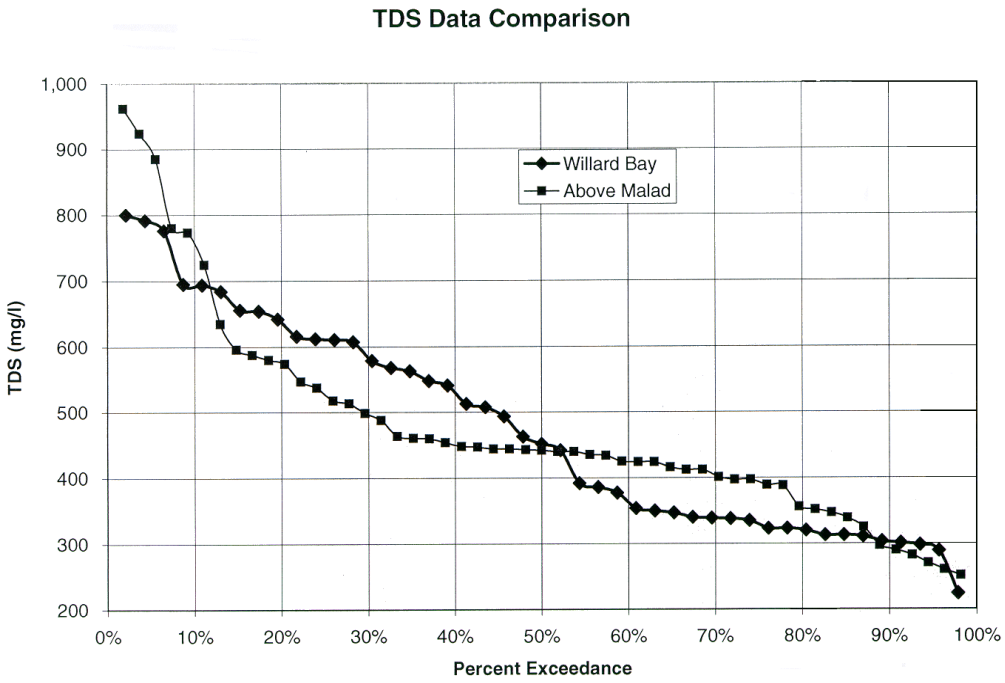


Figure 5. TDS of the Bear River and Willard Bay (April 1978-October 1998).

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 to1982) 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 the 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.