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Section 9
WATER PLANNING AND DEVELOPMENT

This section describes potential development alternatives for the Bear River Basin, and discusses related considerations such as present water uses and supplies, future water needs, alternatives for meeting needs, potential storage sites, environmental effects, financial and economic analysis, water quality assessment, and cost estimates. A suggested "Water Development Plan" and recommendations for additional activities needed to finalize and implement the plan are included.

9.1 INTRODUCTION

The water supply available for development in the lower basin (Cache and Box Elder counties) is much larger than in the upper basin (Rich County). The Division of Water Resources has conducted many studies of potential water development projects in the Bear River Basin. The current effort in preparing a Bear River Basin Water Development Plan centers on the investigation of several damsites and some related facilities needed to develop and deliver water both in and out of the basin. Recent legislation has provided funding and direction to the division to accelerate the planning and development process.

9.1.1 Setting

Upper Basin - Prior to the 1958 Bear River Compact, only three storage reservoirs were in the Utah portion of the upper Bear River with storage capacities of 1,000 acre-feet or greater. They were the Neponset, a 6,900- acre-foot off-stream reservoir south of Woodruff; Birch Creek Reservoir, with a 2,000-acre-foot capacity on a tributary to Woodruff Creek west of Woodruff; and Little Creek Reservoir, with a capacity of about 1,000 acre-feet, located west of Randolph, Utah. The total capacity of all reservoirs in the Utah portion of the upper Bear River Basin was 11,850 acre-feet.

The 1958 Bear River Compact authorized an additional 17,750 acre-feet of water which could be stored annually in the upper basin in Utah. The reservoir capacity was not limited, only the amount of water which could be stored. The Woodruff Narrows Reservoir on the Bear River east of Woodruff near the Utah-Wyoming state line, with a 28,100-acre-foot capacity; and Woodruff Creek Reservoir west of Woodruff, with a capacity of 4,100 acre-feet, were built with this allocation.

The 1980 Amended Bear River Compact provided that an additional 35,000 acre-feet could be stored each year in the upper Bear River in Utah, with an annual depletion of 13,000 acre-feet. The depletion includes groundwater development. Also, in any year when Bear Lake is below elevation 5,911, none of the additional 35,000 acre-feet may be stored.

In 1981, the Woodruff Narrows Reservoir was enlarged to a total capacity of 57,300 acre-feet. New compact storage in the amount of 18,000 acre-feet per year, with an annual depletion limitation of approximately 6,700

acre-feet, was allocated for the enlargement project. Therefore, of the additional increment of development permitted by the amended compact, only 17,000 acre-feet can yet be stored each year, and about 6,300 acre-feet more can be depleted within Utah. More information is given in Section 7.

Lower Basin - The 1958 Bear River Compact reserved a portion of the storage capacity of Bear Lake for primary use by, and protection of, irrigation uses and rights downstream from Bear Lake; and provided that water delivery between Idaho and Utah would be based on priority of rights without regard to state boundary lines. The compact did not divide either the direct flow or storable water between the two states below Bear Lake, and it did not consider groundwater.

The 1980 Amended Bear River Compact provides for the protection of all prior rights applied to beneficial use as of January 1, 1976, and the protection of all rights granted under the 1958 compact. Also, the compact includes groundwater development and allocates the remaining water below Bear Lake between Idaho and Utah. More information is given in Section 7.

Prior to 1958, several dams and hydroelectric plants were built on the Bear River and tributaries. The Newton Reservoir on Clarkston Creek and Hyrum Reservoir on the Little Bear River were also built prior to 1958. The Porcupine Reservoir on the East Fork of the Little Bear River was built in 1962. No major reservoirs have been built since that time in the lower Bear River Basin in Utah.

9.1.2 Authority and Legislative History

Legislation in 1984 provided funds for the initial development and implementation of a State Water Plan with particular emphasis on the Bear River. In 1985, legislation was passed, providing funds for implementation of the State Water Plan, including, but not limited to, engineering studies of the Bear River water development projects. The 1988 General Session of the Utah State Legislature directed the Division of Water Resources to identify long-term water development opportunities upstream of the Great Salt Lake.

In the 1989 General Session, the Legislature created a Joint Gubernatorial/ Legislative Bear River Development Task Force to determine the state's role in the potential development of the Bear River. As recommended by the task force, the 1990 Legislature appropriated funds to the Division of Water Resources to prepare extensive pre-design reports to help identify development alternatives. The "Bear River Pre-Design Report"[3] was presented to the task force in October 1991.

9.1.3 Bear River Development Act - 1991[5]

The 1991 General Session of the Utah State Legislature passed the "Bear River Development Act" which directs the Division of Water Resources to develop the surface waters of the Bear River and its tributaries covered by filings of the board, filings acquired from the Bureau of Reclamation, or new filings, approved by the State Engineer. The division is to plan, construct, own, and operate reservoirs and associated facilities as authorized and funded by the Legislature, and to market the developed waters. Potential reservoir projects include Honeyville, Barrens, Hyrum Dam, Avon, Mill Creek, Oneida Narrows, and North Eden Creek, and they are described in Section 9.5.

Water developed by projects authorized by this act, except water reserved for wildlife or public recreation, shall be made available by contracts exclusively to the following entities: Bear River Water Conservancy District, 60,000 acre-feet; Salt Lake County Water Conservancy District, 50,000 acre-feet; Weber Basin Water Conservancy District, 50,000 acre-feet; and municipalities, water companies, and any water

conservancy district in Cache County, 60,000 acre-feet. The act also directs the division to allocate project costs according to the following purposes: municipal and industrial, agriculture, hydropower, recreation, fish and wildlife, and flood control.

Below Cutler Reservoir - Div. of Water Resources

9.1.4 1992 Legislation[6]

In response to recommendations from the Bear River Task Force, an act was passed in the 1992 General Session of the Utah State Legislature to appropriate money from the Bear River Development Account to the Division of Water Resources for studies and planning relating to development of the Bear River. If appropriate entities provide matching funds, authorized state funds may be used to study the feasibility of: 1) diverting water from the Bear River to Willard Bay Reservoir; 2) installing a lawn and garden water system in Salt Lake County; and 3) transmitting water from Hyrum Reservoir to Box Elder County or Cache County. The act also authorized the division to continue studies and preliminary design on Hyrum Dam.

9.2 PRESENT WATER USES AND SUPPLIES

Water in the Bear River Basin has been developed and used increasingly since the early 1850s. The evaluation of present supplies takes into consideration constraints such as pump capacity or pipe size, reliable stream flow or groundwater yield, and water rights and contracts. Present water use includes developed water which is actually diverted from surface water or withdrawn from groundwater. The currently developed water supplies in the basin are slightly greater than the uses. A summary of presently developed water supply and use data for the Bear River Basin is given in Table 9-1. More detailed information concerning water supplies for the Bear River Basin is given in Table 5-5.

TABLE 9-1
PRESENTLY DEVELOPED WATER SUPPLY AND USE DATA
(Acre-feet)

County	Supply	Use
Box Elder	785,900	781,900
Cache	478,100	466,700
Rich	227,800	227,200

9.2.1 Box Elder County

Box Elder County has significant agricultural activity and a growing industrial base. The non-agricultural industries and the public water systems rely totally on groundwater. The groundwater resources of the county are limited, primarily from a quality standpoint. The water resources originating in

the county are relatively limited when compared to the other counties in the study area. The Bear River, that flows through the eastern part of the county, and is the largest river entering the Great Salt Lake. The Bear River with Bear Lake storage water provides approximately 67 percent of the water for irrigated land in the Bear River Valley. Water used for open/wet areas includes the Bear River Migratory Bird Refuge and other private and state waterfowl areas at the mouth of the Bear River. Present use by category is depicted in Figure 9-1.

9.2.2 Cache County

Cache County has significant agricultural activity which is dependent on surface water diversions from the Cub, Logan, Blacksmith Fork, and Little Bear rivers, other smaller mountain streams, and some diversions from the Bear River. Cache County also has a relatively large and growing commercial and industrial base. All public supply systems and the non-agricultural industries in Cache County obtain water supplies from wells and springs, except North Logan, which has surface water

FIGURE 9-1

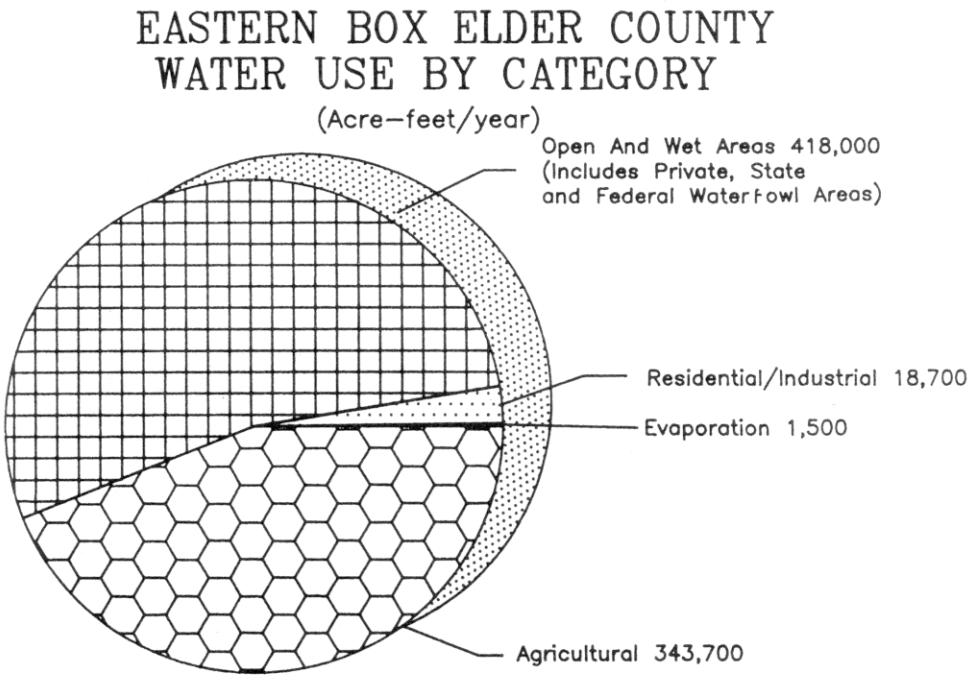
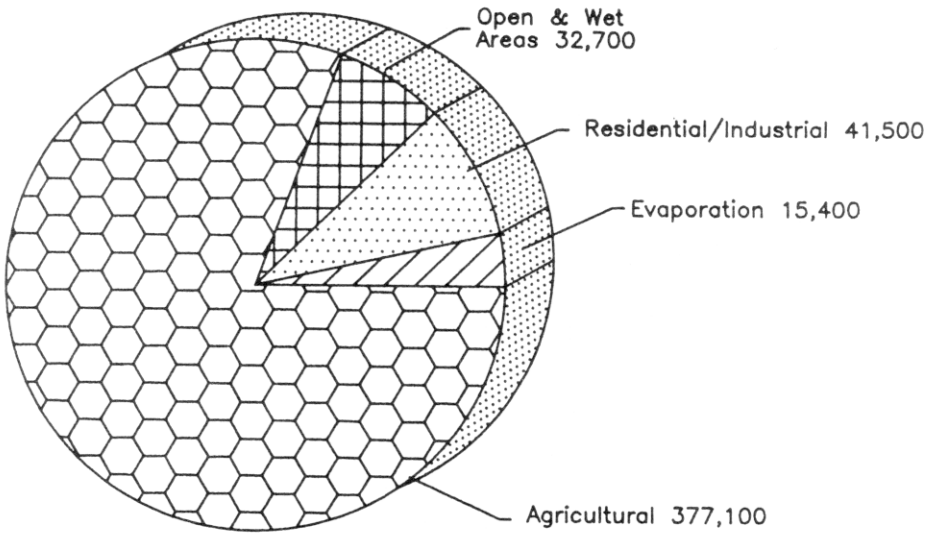


FIGURE 9-2

CACHE COUNTY WATER USE BY CATEGORY
(Acre–feet/year)



treatment capability as well as groundwater supplies. The water resources of the county, including groundwater, are relatively abundant. The majority of the groundwater resource is high quality and suitable for culinary use with little or no treatment. Present water use by category is depicted in Figure 9-2.

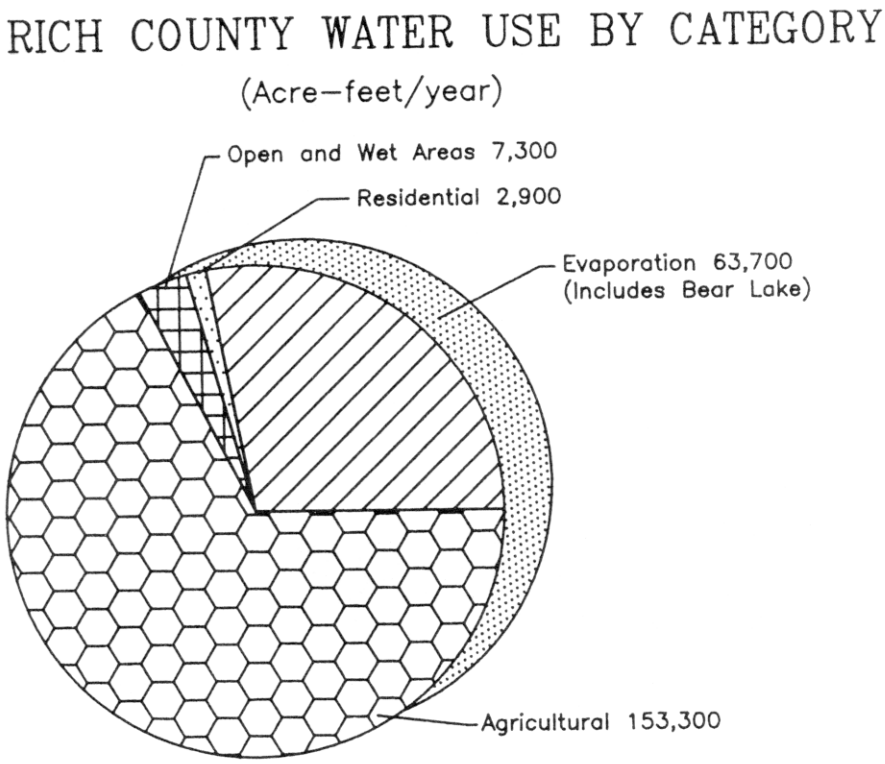
9.2.3 Rich County

Rich County's economic base has historically been dependent on agriculture. In recent years there has been a great increase in the growth of the recreation industry, particularly that associated with Bear Lake. Local surface and groundwater resources are generally high quality and adequate for present demands. Bear Lake, the most visible water resource in Rich County, is regulated by court decrees and the Amended Bear River Compact. Bear Lake is operated by Utah Power and Light Company for downstream irrigated agriculture and hydropower uses. Present water use by category is depicted in Figure 9-3.

9.3 FUTURE WATER NEEDS

Future municipal water needs were determined by the division based on projected population increases provided by the Office of Planning and Budget. Industrial needs are based in part on requests from local water users seeking to develop more water within the basin, as well as requests from outside the basin for Bear River water. Wherever possible, needs are identified by various use categories including M&I, agricultural, and

FIGURE 9-3



waterfowl. Table 9-2 compares projected municipal and industrial (M & I) water needs with current supplies for public community systems in the Bear River Basin. More detail is given in Sections 11 and 18.

9.3.1 Box Elder County

M&I - The data in Table 9-2 indicate Box Elder County has sufficient public water supplies to meet projected M & I water demands until sometime after the year 2010. However, about half of the current (1990) surplus water is in the Brigham City/Perry/ Willard area, and many of the other systems are rapidly approaching the limits of their systems and supply capacities. Some water suppliers will need to develop new sources of water by the year 2000 (See Table 11-8).

Agriculture - Development of new irrigation projects in Box Elder County, such as the Bonneville Bench project, (See Section 10.4.2) has been evaluated and determined to be economically infeasible under current conditions. However, an estimated 3,200 acres of non-irrigated cropland within the service area of existing canal systems could be irrigated if water was available in the existing canals. This would require nearly 13,000 acre-feet of additional water. Also, there may be as many as 8,000 acres of irrigated cropland with a late season water shortage which could use up to 2,000 acre-feet of supplemental water.

Waterfowl - According to the October 1991 U.S. Fish and Wildlife Service Environmental Assessment, the Bear River Migratory Bird Refuge has need for significant

TABLE 9-2				
MUNICIPAL AND INDUSTRIAL WATER NEEDS/SUPPLY PUBLIC COMMUNITY SYSTEMS[3] BEAR RIVER BASIN (Acre-feet)				
County	1990	2000	2010	2025
BOX ELDER				
Demand	15,000	16,400	18,500	22,000
Supply	18,900	18,900	18,900	18,900
Surplus(+)/Deficit(-)	+3,900	+2,500	+400	-3,100
CACHE				
Demand	32,200	35,600	41,900	52,200
Supply	43,600	43,600	43,600	43,600
Surplus(+)/Deficit(-)	+11,400	+8,100	+1,700	-8,600
RICH				
Demand	2,800	2,900	3,000	3,300
Supply	3,400	3,400	3,400	3,400
Surplus(+)/Deficit(-)	+600	+500	+400	+100

amounts of "new water" to meet existing and projected uses. Depending on the alternative implemented, this amount could range from 50,000 acre-feet to more than 300,000 acre-feet. The most likely way for the refuge to meet future water needs is to participate in constructing a multi-purpose reservoir on the Bear River.

9.3.2 Cache County

M & I - Data given in Table 9-2 indicate that Cache County has sufficient public community water supplies currently developed to meet anticipated M & I demands until approximately the year 2010. It is important to note that over half the current surplus is in the Logan/River Heights/Providence area. Many of the other community water systems are approaching the limit of their systems and supply capacities. Growth in some communities outside the Logan/River Heights/Providence area will require additional system or supply capacity by the year 2000 (See Table 11-9).

Agriculture - Development of the South Cache Irrigation Project (See Section 10.4.1) in Cache County which would bring new lands under irrigation, was found to be economically infeasible under current conditions. However, an estimated 1,500 acres of non-irrigated cropland within the service area areas of several large irrigation systems could be irrigated if 5,000 acre-feet of water were available in the existing canals. Approximately 25,000 acres of irrigated cropland with a late

season water shortage could use up to 6,000 acre-feet of supplemental water.

9.3.3 Rich County

M & I - While it appears that Rich County has sufficient public community water supplies to meet foreseeable future M & I demand, this is only true if all the systems were linked and able to share water supplies, or growth only occurs in the areas of the county that currently have additional developed but unused supplies. Due to the distance between current systems, linkage is not practical. It appears that some of the local water demands within Rich County will soon outstrip the currently developed supplies. While the amounts may be small, they are significant to those who are shorted.

Agriculture - Construction of new, large-scale irrigation projects in Rich County is not currently planned. However, an estimated 6,000 acres of irrigated cropland with a late season water shortage could use up to 1,500 acre-feet of supplemental water.

9.3.4 Export to Wasatch Front[3]

The Bear River Pre-Design Report detailed information on the existing and future water needs for Salt Lake, Davis, and Weber counties along the Wasatch Front. Future water needs are briefly described in this section.

Salt Lake County, as a whole, has or will have water supplies developed to meet projected M & I water demands until approximately the year 2018. As strong conservation programs are implemented, required in the Central Utah Project legislation, water supplies should be able to meet the overall demand until approximately the year 2021.

If supplies are not shared, then the two major water suppliers, Salt Lake County Water Conservancy District (SLCWCD) and Metropolitan Water District (MWD), will need additional water supplies in different time frames. The SLCWCD has or will have adequate supplies until about the year 2012, and MWD has or will have supplies to about the year 2025.

Davis and Weber counties have sufficient water supplies to meet anticipated M & I water demands beyond the year 2025.

9.4 ALTERNATIVES FOR MEETING NEEDS

Several possible alternatives to increase water supplies in the basin and along the Wasatch Front have been examined. The costs and impacts of these various alternative supplies vary and will have a major influence on which alternatives are selected for future investigation.

9.4.1 Building Reservoirs

Building storage reservoirs in the Bear River Basin is considered the most practical alternative to develop large quantities of new Bear River water. Several potential reservoir sites, discussed in Section 9.5, have been evaluated.

The Division of Water Resources developed a computer model of the Bear River system which includes existing reservoirs and various new reservoirs being investigated in the Bear River Basin. A computer model of the Weber River system was developed and used to integrate the operation of Willard Bay Reservoir with the Bear River system. These models were used to estimate water yields from various individual reservoirs or combinations of reservoirs on the Bear River system in conjunction with the Weber River system. Results from some of the selected computer runs of the models are shown in Table 9-3.

Unless otherwise noted, all computer simulations involving Willard Bay Reservoir

provide a conservation pool of 75,000 acre-feet. At the present time, there is no conservation pool in Willard Bay Reservoir, and the Weber Basin Water Conservancy District (WBWCD) can draw the reservoir down to the dead storage level of 20,000 acre-feet. The model runs assume Idaho will deplete an additional 50,000 acre-feet in the future, and the Bear River Migratory Bird Refuge will receive its historical supply from the Bear River.

9.4.2 Groundwater Use

Increased use of groundwater may be possible in some areas of the basin. The Bear River Water Conservancy District is pursuing the development of a well field in Cache valley to meet Box Elder County's future M & I water needs. Cache County's future M & I water needs will likely come from additional groundwater development. One question left unanswered is whether future groundwater depletions in Cache County will require these depletions to be replaced with water from new storage reservoirs to protect downstream water users in Box Elder County and groundwater users in Cache Valley. A three-year joint study led by the U.S. Geological Survey (USGS) with the financial and technical support of the Division of Water Resources and Division of Water Rights will be completed in the fall of 1993. The study will result in the development of a computer model of the valley that will help quantify what the effects of present and future groundwater development will have on existing water rights.

9.4.3 Conservation/Education

Water conservation and public education may be effective in delaying water needs. The exact number of years the need can be delayed will depend on the amount of water conserved and the time frame in which it takes place. Although an important ingredient in water use, conservation will only delay projected needs a few years. Most of the communities in the basin that need additional water in the near future have low per capita use rates and limited opportunity for additional conservation. Water conservation needs, issues, and alternatives are discussed in more detail in Section 17.

9.4.4 Water Rights Transfer

The transfer of water from agricultural uses to municipal and industrial (M & I) uses is occurring throughout the state. Utah has one of the most active intrastate water markets in the west, and the market system has been used to provide the water needed for thermal electric power plants in Millard and Emery counties. Even though the majority of the available water supply had been developed in these counties, the water was made available from agricultural users on a willing seller/willing buyer arrangement.

In contrast to Millard and Emery counties, over 300,000 acre-feet of undeveloped Bear River water is available to meet future water needs in and out of the basin if adequate new water storage facilities are built. Local officials and water users have expressed a desire to utilize this resource for expanding the basin industrial and agricultural base. Due to the large quantity of undeveloped water available, the option of purchasing existing agricultural water rights and retiring irrigated farmland is not necessary to meet future water needs in the Bear River Basin or the export of water to the Wasatch Front. It is recognized, however, that even though water right transfers are not currently required, some are likely to occur.

9.4.5 Bear River Water Conservancy District

The Bear River Water Conservancy District was created in 1988 to plan and implement a regional municipal and industrial (M&I) water system for Box Elder County. The district has invested considerable time and money to investigate an interconnected regional water system, making use of all present county water

TABLE 9-3

BEAR RIVER WATER YIELD FROM SELECTED RESERVOIR COMBINATIONS[a] AND GROUNDWATER PUMPING[3]

Selected Reservoir Combinations	Deliveries (acre-feet)				
	Wasatch Front M&I	Cache County M&I	Box Elder County M&I	Other Uses[b]	Total
Willard Bay Res 20,000 AF Conservation Pool[c]	84,000				84,000
Willard Bay Res 75,000 AF Conservation Pool	44,000				44,000
Honeyville Res	100,000			54,000	154,000
Millcreek Res		14,000	14,000		28,000
Avon Reservoir		6,000	6,000		12,000
Hyrum Reservoir		10,500	10,500		21,000
Barrens[d]	83,000				83,000
Oneida Reservoir	88,000				88,000
Willard Bay, Hyrum + Groundwater (GW)	60,000	26,000	35,000		121,000
Willard Bay, Honeyville + GW	100,000	26,000	35,000	52,000	213,000
Willard Bay, Barrens[d] GW	84,000	26,000	35,000	10,000	155,000
Willard Bay, Avon + GW	45,000	26,000	35,000		106,000
Willard Bay, Millcreek + GW	67,000	26,000	35,000		128,000
Willard Bay, Oneida + GW	100,000	26,000	35,000	13,000	174,000
Willard Bay, Hyrum, Barrens[d] + GW	100,000	26,000	35,000	7,000	168,000
Willard Bay, Honeyville, Barrens[d] + GW	100,000	26,000	35,000	74,000	235,000
Willard Bay, Honeyville, Hyrum + GW	100,000	26,000	35,000	63,000	224,000
Willard Bay, Honeyville, Millcreek, + GW	100,000	26,000	35,000	64,000	225,000
Willard Bay, Oneida, Millcreek, + GW	100,000	26,000	35,000	23,000	184,000
Willard Bay, Honeyville, Oneida + GW	100,000	26,000	35,000	73,000	234,000

[a] All estimates include Idaho depletions of 50,000 acre-feet and providing the Bear River Migratory Bird Refuge with the historical water supply.
[b] Other refers to water that could be used for other purposes such as irrigation, recreation, and wildlife.
[c] Current dead pool storage level.
[d] Barrens Reservoir with a 75,000 acre-feet capacity and pump station for delivery.

sources. To meet the interim need and provide a strong basis for meeting the long-term need, the district is proposing to construct an M&I water system to deliver culinary-quality water to interested municipalities and industries in eastern Box Elder County. Basic elements of the system include groundwater wells in Cache Valley, a transmission pipeline to Box Elder County, and a series of culinary water storage reservoirs and distribution pipelines. The initial phase will provide approximately 7,000 acre-feet of M&I water from Cache Valley groundwater to meet the projected needs. Development of this groundwater may require replacement of surface water, depending upon the ruling of the State Engineer.

9.5 POTENTIAL STORAGE SITES

Potential reservoir projects being considered in the upper Bear River include a 5,000-acre-foot reservoir on Big Creek near Randolph, a 4,000-acre-foot enlargement of Woodruff Creek Reservoir, and a 2,000-acre-foot reservoir on Otter Creek near Randolph. If these were constructed, only 6,000 acre-feet of annual storage would be left for Utah in the upper Bear River Basin. Under current economic conditions and projected water needs, it is unlikely any of these reservoirs will be built in the near future.

In the lower Bear River, the Division of Water Resources has located and evaluated almost 40 potential reservoir sites. After consideration of the problems and merits associated with each, some were found to be more feasible than others. Variables such as reservoir capacity, stream hydrology, water quality, project purposes, and environmental impacts influenced the selection of reservoir sites. The sites described in the following paragraphs and summarized in Table 9-4 are the most favorable at the present time, and they are included as potential projects in the Bear River Development Act. Construction can not begin on any of these projects until additional investigations are completed, water sales contracts are signed, and the Legislature authorizes the funding.

9.5.1 Avon

The Avon reservoir site is located south of the small community of Avon, about six miles south of Hyrum, Utah, in a narrow steep canyon at the confluence of Davenport Creek and the South Fork of the Little Bear River. The dam is proposed as an earth embankment with an uncontrolled spillway and concrete-lined channel on the left abutment. The outlet works would consist of a gated conduit with a multi-level inlet tower located near the right abutment. At normal water elevation, the reservoir would extend about 1.8 miles south and cover portions of existing South Canyon Road, one home, and several farm structures. The proposed reservoir area is mostly farmland and pastureland.

9.5.2 Barrens

The Barrens Reservoir site is located approximately five miles west of Smithfield, Utah, 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 the groundwater is shallow in the dish-shaped drainage 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. Several springs and flowing wells are located within the proposed reservoir area. The reservoir would be an off-stream storage facility with a limited drainage area contributing runoff water to the reservoir. Water to fill the reservoir must be brought to the site through either the West Cache Canal or a pump station on the nearby Bear River. A major power transmission line crosses the reservoir basin, and an industrial sewage lagoon facility is situated inside the proposed reservoir basin. The balance of the

TABLE 9-4

POTENTIAL RESERVOIR DATA SUMMARY[3]

	Honeyville	Barrens	Avon	Mill Creek	Oneida Narrows		Hyrum
RESERVOIR							
Conservation Pool - AF	10,000	0	8,300	8,300	26,000		4,245[b]
Active Storage - AF	107,000	75,000	24,765	18,750	77,000		40,055
Total Storage - AF	117,000	75,000	33,065	27,050	103,000		44,300
Surface Area - acres	3,903	4,410	483	450	1,600		725
Reservoir Length - miles	13	-	1.86	1.86	9.9		2.9
Surface Elev. - msl	4275	4433	5272	5747	4887		4715
DAM							
Type	Earthfill	Earthfill	Earthfill	Earthfill	Earthfill or RDCC		Earthfill
Crest Elevation - msl	4290	4447	5287	5760	4910	4910	4730
Height - feet	90	34	207	207	240	240	145
Crest Length							
Dam - feet	1,000	58,150	1,800	1,000	715	615	600
Dike - feet	1,800	-	-	-	-	-	3,400
Volume of Fill - cu.yd.	1,400,000	4,950,000	6,345,000	2,380,000	3,200,000	442,000	2,500,000
COSTS							
Dam Construction - $M	43.0	48.7	36.0	19.0	66.5a	57.5a	26.0
Power Plant (optional) - $M	7.9	-	2.7	3.0	-		-

a Includes $20.7 million for power plant replacement
b Existing dead and inactive storage

basin is farmland and marshland. A mobile home, three barns, and a log home would need to be relocated.

9.5.3 Honeyville

The proposed Honeyville damsite is located in Box Elder County at a point just upstream from the I-15 crossing of the Bear River, 10 miles north of Brigham City. The dam is proposed to be an earthfill embankment located on the main river channel with an extended dike on the right abutment. A concrete spillway is proposed for the right abutment with an auxiliary spillway located west of it. A multi-level outlet works would be located on the left abutment.

As proposed, the reservoir basin would extend upstream approximately 13 miles to a point just downstream from Cutler Dam. The reservoir would inundate and require replacement of portions of two state highways. The springs that serve as sources of culinary water for Garland and Tremonton would be inundated, and replacement of culinary water would be required. Two small local parks would need to be replaced. The historic Hampton's Ford area and several homes would be inundated. Several utility lines would need to be relocated.

9.5.4 Hyrum Dam Enlargement

The existing Hyrum Dam and Reservoir is located on the Little Bear River south of the town of Hyrum in southern Cache County. It was constructed by the Bureau of Reclamation in the mid 1930s.

It is proposed to raise the height of the existing dam and increase the capacity of the reservoir to 44,300 acre-feet from the present capacity of 18,700 acre feet. The enlarged dam would be a homogenous earthfill embankment located on the main river channel at the present dam location. A dike would be required along the right abutment.

The enlargement would displace and/or inundate portions of Hyrum State Park. Replacement facilities would be constructed on the shoreline of the enlarged reservoir. The existing roadway across the dam would have to be replaced. A few homes and the road by the park will also be affected. Hyrum Reservoir is on federal land.

9.5.5 Mill Creek

The Mill Creek Reservoir site is located approximately 3/4 mile south of Hardware Ranch on the right fork of the Blacksmith Fork River, approximately 20 miles east of Hyrum, Utah, in a steep narrow canyon. Ant Flat Road passes through the site and provides access to the area. The dam is proposed as an earth embankment. A spillway would be located at the left abutment in a saddle area. A small dike would be required at the saddle area to match the dam elevation. The reservoir would extend south approximately two miles. The reservoir basin would be mostly private recreation and grazing lands. Two homes and other buildings located within the reservoir basin would have to be purchased and removed. The area is currently fenced and access is restricted. The springs located in and around the Anderson Ranch area would be inundated.

9.5.6 Oneida Narrows

The Oneida Narrows Reservoir site is located in Idaho approximately 12 miles northeast of Preston, and about 3.3 miles downstream of the existing Oneida Dam, which is owned and operated by Utah Power & Light Company (UP&L). The dam is located on the Bear River at a point where the canyon narrows; hence the name Oneida Narrows. The reservoir area extends upstream about 9.9 miles and inundates the existing Oneida Reservoir. A county gravel road passes through the site and provides access to the area as well as the Oneida Dam and Power Station.

Earthfill and roller-compacted concrete (RCC) dam concepts were investigated for the site. Either type would impound the same reservoir capacity and be constructed to the same water surface elevation. A 30-MW power plant would be included as part of the project to replace the existing UP&L plant. A saddle area located on the left abutment of the earthfill dam would provide a location for the primary and emergency spillways. A spillway would be constructed over the crest of the RCC dam and be sized to handle projected flood flows. A multi-level intake tower would be located on the upstream face of either dam, permitting releases from various levels of the reservoir.

The area where the reservoir would be located is mostly grazing land and farmland. A gravel county road through the reservoir basin can be relocated by routing it from the existing Oneida Dam eastward to the Mink Creek road. Private land will need to be acquired for the project. Permits to use BLM land for the project will need to be secured.

The UP&L facilities located at Oneida Station would have to be removed. Some facilities would also have to be replaced at the proposed dam. The power plant and substation would need to be relocated. The costs of replacing all of the UP&L facilities and removing existing facilities and breaching the old dam are included in the costs for the power plant replacement.

9.5.7 North Eden

This reservoir is located on North Eden Creek on the east side of Bear Lake in Rich County. This is a small privately-owned reservoir which, prior to being destroyed by floods in 1979, was used to store water to irrigate land at the mouth of North Eden Creek. It is proposed the state acquire this reservoir along with several parcels of adjacent privately-owned land, and upgrade it for use as a fishery and water supply for recreational developments.

9.6 ENVIRONMENTAL ANALYSIS

The environmental analysis identifies and documents environmental conditions at the various potential reservoir sites and contrasts the sites in terms of impacts and costs of mitigation. The impacts to particular resources of concern among the various sites are summarized in Table 9-5. The Oneida Narrows and North Eden sites were not evaluated.

9.6.1 Impacts

All of the sites would impact wetlands, although there is a wide range in the acreage among the sites. Wildlife impacts at all sites would result from the loss of wetland habitat. Reservoir construction at the Barrens site would result in the loss of a wetland habitat type unique in Cache Valley. The Avon and Mill Creek sites would result in the loss of some acreage of big game (elk and deer) winter habitat.

Fishery impacts resulting from reservoir construction would be greatest at the Mill Creek site. Impacts include the inundation of Class 1 stream on the Blacksmith Fork River, and additional downstream impacts on Class 1 and Class 2 sections. Fishery impacts would also be significant at Avon, but the impacted streams are Class 2 and Class 3. Fishery impacts at the Hyrum site would be moderate, affecting approximately a mile of Class 2 stream. Fishery values at Honeyville are relatively low because the Bear River at this location is a Class 3 warm-water stream.

Recreation impacts would also be greatest at the Mill Creek site, due to impacts to portions of the Blacksmith Fork River, one of Utah's few "blue ribbon" trout streams. Enlargement of Hyrum Reservoir would

TABLE 9-5
SUMMARY OF ENVIRONMENTAL IMPACTS AND MITIGATION COSTS[3]

Resource	Avon	Barrens	Honeyville	Mill Creek	Hyrum Enlargement
Fisheries					
Impacts	Loss of 3.4 miles Class 3 stream; degradation of 5.4 miles of Class 2 & 3 stream	None	Loss of 13 miles of Class 3 stream	Loss of 2.6 miles Class 1 stream, and 0.6 miles Class 2; up to 9.7 miles Class 1 stream and 5.4 miles Class 3 stream degraded	Loss of 1.24 miles of Class 2 stream
Mitigation Cost	$0.5 to $2 million	None	Undetermined	$1 to $3 million	Undetermined
Wetlands					
Impacts	13 acres palustrine scrub-shrub; 6 acres palustrine emergent	1032 acres palustrine emergent; 77 acres mudflat; 163 acres open water	259 acres palustrine emergent; 64 acres palustrine scrub-shrub; 65 acres open water	29 acres palustrine scrub-shrub; 20 acres palustrine emergent	16 acres palustrine emergent; 40 acres palustrine scrub-shrub;
Mitigation Costs	$0.5 to $1 million	$3 to $5 million	$1.5 to $3 million	$0.5 to $1 million	$0.1 to $0.5 million
General Vegetation					
Impacts	275 acres sagebrush-grassland; 64 acres agriculture; 27 acres riparian forest; 20 acres mountain brush	1157 acres pasture; 1522 acres cropland	34 acres sagebrush-grassland; 736 acres pasture; 1344 acres cropland; 314 acres riparian forest	280 acres sagebrush-grassland; 53 acres pasture; 30 acres riparian forest	91 acres pasture; 53 acres riparian forest
Farmlands					
Impacts	10 acres prime farmland; 75 acres statewide important farmland	72 acres prime farmland; 28 acres statewide important farmland	1748 acres prime farmland; 549 acres statewide important farmland	None	23 acres of statewide important farmland
Wildlife					
Impacts	430 acres deer & elk critical winter range; raptor nesting areas; 430 acres habitat for common non-game species; 19 acres wetland habitat	1400 acres wetland habitat	388 acres of wetland habitat	435 acres of deer & elk critical winter range; 49 acres wetland habitat	71 acres wetland habitat
Mitigation Costs	$0.75 to $2 million	Included in wetland costs	Included in wetland costs	$0.75 to $2 million	Included in wetland costs
Visuals					
Impacts	Loss of moderately high quality views	Obtrusive dike system	Insignificant visual impacts	Loss of unique high quality visual setting	Insignificant visual impacts
Recreation					
Impacts	Pleasure driving; Class 2 & 3 fishing	Wildlife observation; waterfowl hunting	Warm water fishing; canoeing	Pleasure driving; class 1 fishing	Class 2 stream fishing; Hyrum State Park to be relocated
Cultural Resources					
Impacts	Undetermined - likely	Unlikely	2 structures on National Historic Register	Undetermined - likely	Unlikely
Unavoidable Adverse impacts	Loss of statewide important farmland	Loss of statewide important farmland, mudflat wetland	Loss of statewide important farmland	Class 1 stream	Loss of 23 acres of statewide important farmland
Total Mitigation Cost	$1.75 to $5 million	$3 to $5 million	$1.5 to $3 million	$2.25 to $6 million	Undetermined

require replacement of the existing state park. With the exception of the Hampton's Ford historical site in the Honeyville Reservoir area, the areas are not known to have cultural resources of significant value. The potential exists for historic or prehistoric properties at any project area in a floodplain location.

9.6.2 Mitigation

Mitigation costs for the various sites vary considerably, and will be substantial in some cases. For each project, combining fishery, wetland, and wildlife mitigation efforts into one site would reduce costs by minimizing the amount of property that would have to be acquired for mitigation.

Two of the sites, Mill Creek and Barrens, would incur impacts very difficult to mitigate. The loss and degradation of the Class 1 stream on Blacksmith Fork River may be extremely difficult to fully mitigate because of unique attributes of the Mill Creek site.

The loss of the mudflat wetland at the Barrens site would also be difficult to mitigate. Mudflat habitat is not necessarily rare or uncommon in northern Utah, but it is uncommon in Cache Valley. The use of the area by snowy plover, a candidate for federal listing as a threatened or endangered species, adds to the concern about potential habitat replacement for this species. While it is possible to replace the values of this habitat, it may not be possible to replace it "in-kind" within Cache Valley.

In summary, all of the sites investigated to date have environmental problems that would require mitigation. The Mill Creek and the Barrens sites are currently evaluated as being the most difficult to mitigate. The Avon site is classified as moderately difficult to mitigate. The Honeyville and Hyrum enlargement sites have the least impacts and will be the least difficult to mitigate.

9.7 WATER QUALITY ASSESSMENT

Constructing reservoirs and diverting water from streams would affect water quality. While reservoirs would generally improve water quality, there may be times when water quality in reservoirs would deteriorate. Water quality is discussed in Section 12.

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9.7.1 Reservoir Modeling

Based on computer modeling, Avon Reservoir is predicted to have the best water quality. Mill Creek would have moderate water quality. Hyrum Reservoir would have fair water quality. Barrens would have high nutrients and algal blooms. All predictions indicate Honeyville would have the most impaired water quality, including probable dominance by bluegreen algae. Bluegreen algae is undesirable because it can cause odor and taste problems in water, and it would require special treatment. The Oneida Narrows Reservoir was not evaluated. Table 9-6 gives a

summary of predicted water quality in the proposed reservoirs.

Water quality at Honeyville can be improved to fair or moderate if upstream nutrient input problems are addressed. Decreasing the upstream nutrient loadings is estimated to cost $1.9 to $8.9 million depending on the level of improvement desired.

9.7.2 Treatment Requirements

If water from any of the reservoirs is used for M & I purposes, conventional treatment will be required. All water supplies experience high turbidity and algae levels, and most likely have taste and odor problems. Ozone, potassium permanganate, and powdered activated carbon should be provided in the design of water treatment facilities for any of these sources for the control of tastes and odors.

The maximum levels shown for iron and manganese are very high for the water sources below Cutler Dam. Selection of conventional treatment as the basic water treatment process, along with ozone as a primary disinfectant and preoxidant, will allow adequate control of iron and manganese.

Based upon available data, it appears that all the reservoir water supplies occasionally exceed the federal secondary drinking water regulation and the Utah drinking water secondary regulations for total dissolved solids (TDS) of 500 mg/l. On occasion, Honeyville could exceed the primary Maximum Contaminant Level (MCL) (assumed as 1,000 mg/l) established by the state of Utah.

9.8 ECONOMIC ANALYSIS

An economic analysis was performed to determine, from a state perspective, if the projects being proposed for construction will create benefits in excess of cost. Benefits flowing from the investment were analyzed, without regard to whom they accrue. Costs of developing the water, and delivering it to people who will put it to use, were calculated without regard to who pays the costs. Several projects were examined ranging from a single purpose reservoir to combinations of two or more. Table 9-7 summarizes benefits, costs, and net benefits of the most feasible project alternatives. All costs and benefits shown are adjusted to present worth.

9.8.1 Benefits and Costs

The benefit calculation relies on values assigned to water in its various uses and to other project outputs such as recreation and flood damage reduction. The cost part of the benefit/cost calculation consists of construction, interest during construction, and mitigation costs of the project. All dam and conveyance construction costs are included. Operation, maintenance, and replacement (OM&R) costs are treated as disbenefits and subtracted from benefits.

9.8.2 Wasatch Front M&I

Benefits from this purpose are tied to population projections for the Wasatch Front and assume that the present per capita water use will continue. Use of 100 years as the relevant time period means that, for purposes of this analysis, project construction will begin three years before Bear River water is needed in Salt Lake County. Given present growth projections, this will occur in 2018. The construction period will end in 2020 and water deliveries will begin in 2021. The 100-year period for counting benefits begins in 2021 and continues until 2121. The 1991 prices are used in all calculations.

The value of M&I water is defined as the cost of the next best alternative. In this case, the best alternative is considered to be that of installing a lawn and garden irrgation system in

TABLE 9-6

PREDICTED WATER QUALITY SUMMARY FOR PROPOSED RESERVOIRS[3]

	CE-Qual- Model							Steady State Model	Bluegreen Model[b]
Water Quality[a] Parameters	Min DO (mg/l)	OP (mg/l)	N:P	Max Algae (g C/L)	Period of Peak Algae	Avg. TDS (mg/l)	Avg. TSS (mg/l)	Avg. Annual TP (mg/l)	
Avon	>4.5	1-6	>16	0.06	fall	<200	0-18	0.026	BG
Mill Creek	>2.5[c]	5-10	>16	0.18	summer	300-350	0-18	0.036	BG
Willard	0.0[d]	2-10	≥16	0.16	fall	480	15-20	0.084	BG
Barrens	>6.5	<5	>16	0.52	spring	450-550	40	0.091	*
Hyrum	>6.0[e]	20-40	>16	0.60	fall	<250	10-40	0.102	*
Honeyville	>2.0	5-25	<16[f]	1.50	summer-fall	400-500 >750 in fall	50-100	0.183	BG

[a]DO is dissolved oxygen, OP is ortho-phosphate, N:P is the nitrogen to phosphorous ratio, TDS is total dissolved solids, TSS is total suspended solids, TP is total phosphorous
[b]BG indicates bluegreen dominance; * indicates non-bluegreen dominance
[c]Low dissolve oxygen (DO) only in late fall.
[d]Periodic Mixing
[e]DO ≤ 2.0 when reservoir stratifies.
[f]Indicates reservoir in N-limited and may be dominated by bluegreen algae.

TABLE 9-7

SUMMARY OF ECONOMIC ANALYSIS ($ IN MILLIONS)[4]

Project Description	Costs	Benefits	Net Benefits	Benefit Cost Ratio
Willard Bay[a], Honeyville, Mill Creek, and Groundwater	260.3	284.7	24.4	1.09
Willard Bay[a], Honeyville, and Groundwater	239.5	265.8	26.3	1.11
Willard Bay[a], Honeyville, Hyrum, and Groundwater	253.6	269.3	15.7	1.06
Mill Creek Reservoir	35.0	44.3	9.3	1.26

[a]A conservation pool of 75,000 acre-feet was assumed.

Salt Lake County using Utah Lake water. The cost of this alternative, calculated by a consultant, is $230/af. Therefore, all water delivered from the Bear River to the Wasatch Front is assigned a value of $230/af in the economic analysis.

The Bear River Development Act stipulates 70 percent of project water be purchased before construction can begin. For purposes of the analysis it was assumed Wasatch Front purchasers of project water will begin paying for 70 percent of their share of project water from the first year water is available for delivery. That is, there must be a demonstrated willingness to pay for 70 percent. Therefore, annual benefits from this purpose, beginning in the year 2021, are equal to 70 percent of the amount of water allocated to the Wasatch Front multiplied by $230/af. Annual benefits will continue at this level until Wasatch Front demand exceeds 70 percent of its allocation, then benefits will rise until the full allocation is being used. Wasatch Front annual M&I benefits will then be equal to the full amount allocated to the Wasatch Front multiplied by $230/af.

The cost of delivering water to the Wasatch Front consists of a transmission system capable of delivering 100,000 acre-feet per year to treatment plants along the Wasatch Front, accounting for operation, maintenance, replacement, and water treatment costs.

9.8.3 Recreation

Recreation benefits are calculated as the net increase in recreation visits expected to be generated by project facilities times the value assigned to each visit. The expected net increase in boating recreation was estimated by a consultant using the contingent valuation approach. This study found that people with boats registered in the Bear River Basin would visit a new site 5.38 times each year (increased trips due to the new site). Wasatch Front boaters could be expected to have a net increase in boating trips of 2.1 as a result of visiting new project sites. The value of each new trip is estimated within a range of $3.10 to $14.75. This analysis used the approximate midpoint of $9.00. The cost of providing boat ramps and other recreation facilities at each site and OM&R costs are included.

9.8.4 Hydropower

The value used to calculate hydropower benefits was taken from Pacific Corp.'s schedule of avoided costs. Since the current avoided cost of 14.06 mills/kwh is quite small compared to 99.3 mills/kwh in 2015, the 2015 estimate was converted to present worth using the 5.64 percent discount rate. This provided a value of 39.79 mills/kwh. Cost associated with this purpose include generation facilities and OM&R expenses.

9.8.5 Box Elder County M&I

Box Elder M&I benefits are based on the amount of water estimated to be needed for replacement of groundwater. For Box Elder County to withdraw 35,000 acre-feet of groundwater, an estimated 16,000 acre-feet may have to be replaced. The value of replacement water from the project is calculated as the cost of acquiring it from the next best alternative source. Three alternative sources were considered, and renting irrigation water was identified as the least-cost alternative.

The cost of renting irrigation water for in-basin M&I use on a year-to-year basis at an amount sufficient to cover the farmer's fixed costs and foregone profit is estimated to be $100/af. This is based on crop budget data and assumes the consumptive use of 3.6 acre-feet per acre can be transferred to M&I use.

Project costs for delivering replacement water to Box Elder County are small. It is assumed that the Bear River Water Conservancy District will proceed with its

groundwater pumping project (See Section 9.4.5) with or without the Bear River development project.

9.8.6 Cache County M&I

As in Box Elder County, the future water supply for this area will be from groundwater. Replacement water may also be needed but only in the amount of 3,500 acre-feet. The value of this water is also estimated as the cost of renting irrigation water at $100/af. Delivery costs are also low.

9.8.7 Flood Damage Reduction

Benefits from this purpose are based on damage reduction estimates provided by the U.S. Army Corps of Engineers in studies completed in 1989. No separable costs are associated with this purpose.

9.8.8 Irrigation

Approximately 3,200 acres of existing non-irrigated cropland to be served with project water is located primarily within the Bear River Canal Company service area. This is expected to return $139 per acre of increased net income, based on studies carried out on the Bonneville Bench Project (See Section 10.4). Cost of on-farm sprinkler equipment is accounted for. Cost of water delivery will consist only of a short pump lift or releases from an upstream reservoir.

9.8.9 Bird Refuge

Potential capacity exists in the larger proposed reservoirs to store water for release to the Bear River Migratory Bird Refuge during periods of low water levels. No attempt is made to convert the benefits derived from this purpose into dollar values. It was assumed that benefits equal costs and that costs of project construction would be paid up-front by the federal government. Should the U.S. Fish and Wildlife Service decline to participate, reservoirs could be downsized, or this water could be used for other purposes.

9.9 WATER DEVELOPMENT PLAN AND IMPLEMENTATION SCHEDULE

Consistent with Bear River Task Force recommendations and legislative direction, the division suggests the following plan and implementation schedule to develop the surface waters of the Bear River and its tributaries covered by water right filings held by the Board of Water Resources. This development plan is flexible and may be modified. It will be influenced by many factors such as water demands, costs, available funding, appropriate sponsorship arrangements, new legislation, physical and legal constraints, and environmental concerns. However, on the basis of investigations, evaluations and assumptions discussed in previous sections, this appears to be the most practical plan to meet future water needs in and out of the basin for the next 30-35 years. Construction on authorized projects may begin only after legislative requirements are fulfilled.

9.9.1 Water Development Plan

The plan includes: 1) enlarging Hyrum Reservoir, 2) connecting the Bear River with a pipeline and/or canal 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.

These facilities used in conjunction with groundwater pumping in Cache County, would yield 224,000 acre-feet of water (including 163,000 acre-feet of surface water) for various M&I, irrigation, recreational, wildlife, and hydropower uses. The total cost of the project is estimated at about $270 million.

The enlargement of Hyrum Reservoir would provide M&I surface water storage or, if

needed, water to replace M&I groundwater pumped by the Bear River Water Conservancy District and communities in Cache County. It would also provide storage water for supplemental irrigation within the basin. Connecting the Bear River to the Weber River system would not only develop water, but provide the cooperative use of water resources between the Bear River Basin and the Wasatch Front. Constructing a pipeline to move water from Willard Reservoir to the Wasatch Front would provide for delivery of water to Salt Lake County and help alleviate an infrastructure problem in Davis County. Building Honeyville Reservoir would provide a large, dependable supply of water for the Wasatch Front and/or the Bear River Migratory Bird Refuge.

9.9.2 Implementation Schedule

The initial phase should center around completing the technical investigations required to enlarge Hyrum Reservoir to meet future needs in Box Elder and Cache counties. The next phase would be connecting the Bear River to Willard Reservoir, followed by providing the infrastructure necessary to deliver water from Willard Reservoir to the Wasatch Front. The last phase would be building Honeyville Reservoir.

Evaluation of current information indicates that full implementation of the plan will require 30-35 years. This includes environmental assessments (EA) and environmental impact statements (EIS), final design and permitting, preparation of plans and specifications, construction, and meeting filling requirements of reservoirs. Figure 9-4 shows the suggested implementation schedule.

The Division of Water Resources will proceed with various work items subject to legislative appropriation of funds. The division will not begin construction of any project until: a) all technical investigations have been completed, b) contracts have been made for the sale or lease of 70 percent or more of the developed water, c) all required permits have been obtained, d) an environmental mitigation plan has been prepared by an environmental mitigation team, and e) funds have been appropriated by the Legislature.

Based on current information, the plan outlines how the water resources can be developed. The timetable for development is a complex issue. It is influenced by regional needs, money, and the balancing of when to construct a project so there is a supply of water available to meet a future demand. If future needs do not develop as anticipated, then the plan will be modified by eliminating or postponing some features.

9.10 FINANCIAL ANALYSIS

A financial analysis was performed on the suggested water development plan described in Section 9.9. The purpose of this analysis is to separate costs of the project into categories and decide who should pay them. The Bear River Water Development Act stipulates that the state will own and finance construction of the dams. Purveyors will finance and build distribution systems to bring project water to their customers.

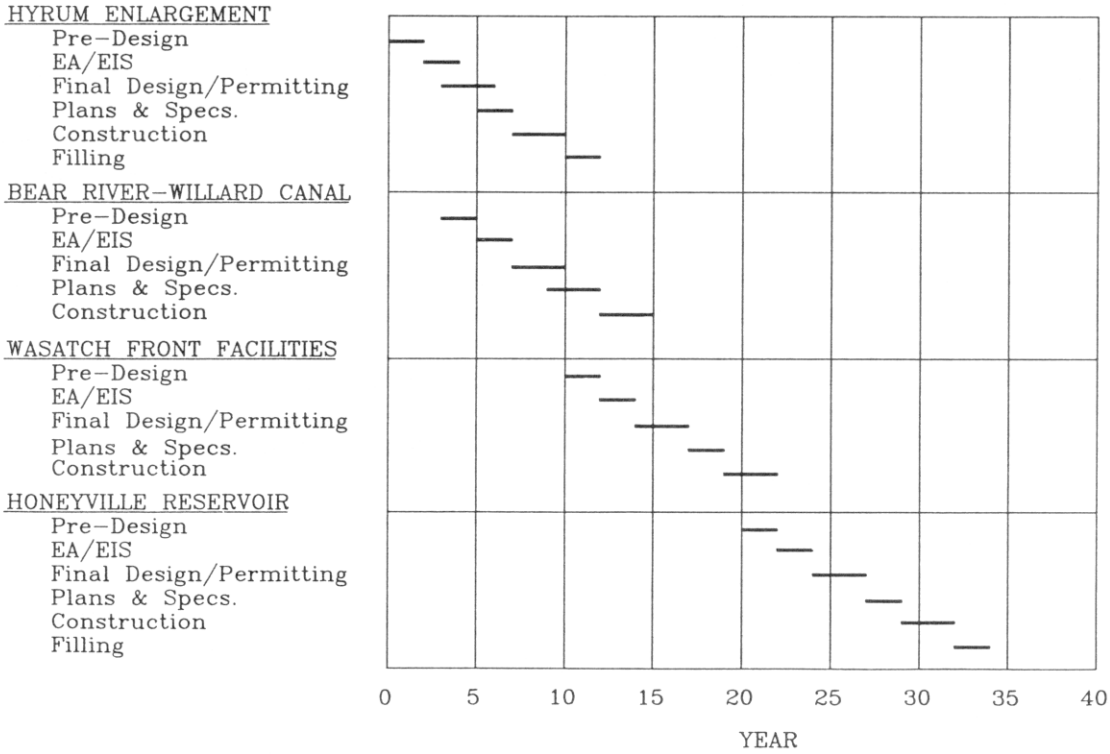
The analysis focused on allocating joint costs or, in other words, project costs that contribute to more than one purpose. In addition, the amount of the payment required to return all state funds invested in project facilities other than flood and recreation was calculated. Table 9-8 shows how project costs are allocated to each project and approximate revenues (payments) to the state.

9.10.1 Cost Allocation

Separable costs are those that are incurred for specific features that serve only one purpose. An example is the cost of the hydropower generation plant which contributes only to the hydropower purpose.

FIGURE 9-4

BEAR RIVER WATER DEVELOPMENT PLAN
IMPLEMENTATION SCHEDULE



Joint costs are for dam and reservoir construction, interest during construction, and wildlife and wetland mitigation. These costs and the facilities purchased are shared by two or more purposes. Joint costs were allocated according to the percentage of benefits arising from each purpose. For example, if 75 percent of the total project benefits is received by Wasatch Front water users, then they will pay 75 percent of the joint costs.

9.10.2 Cost Recovery

Costs for state-funded facilities are to be repaid to the state for all purposes that the legislature designated. These include Wasatch Front M&I, Box Elder County M&I, Cache County M&I, and hydropower. Twenty-five percent of irrigation's share of joint costs is to be returned.

Payments for reimbursable costs were calculated at six percent over 50 years. Official policy on contract terms (i.e., interest charges and repayment period) are the prerogative of the Board of Water Resources and have not been set at this time. Non-reimbursable costs for irrigation, recreation, and flood reduction are about $9 million.

9.11 RECOMMENDATIONS

Recommendations relate to the development of the surface waters of the Bear River and its tributaries in order to meet current and long-range needs within the

TABLE 9-8

FINANCIAL ANLYSIS OF HONEYVILLE, HYRUM, WILLARD BAY RESERVOIR AND GROUNDWATER[4]

Purpose	Separable Cost ($)	Share of Joint Cost ($)	Total Cost ($)	Annual AF Delivered	Annual Total Cost per AF ($)	Annual Revenue to State ($)	Present Worth of Non-reimbursable Cost ($)
Wasatch Front M&I	173,000,000	52,808,000	225,808,000	100,000	239	7,198,000	0
Box Elder M & I	156,000	5,073,000	5,229,000	16,000	22	298,000	0
Cache M & I	34,000	1,234,000	1,268,000	3,500	25	73,000	0
Irrigation	614,000	1,218,000	1,832,000	13,000	23	18,000a	913,000
Bird Refuge	0	15,637,000	15,637,000	30,500			0
Recreation	4,000,000	2,925,000	6,925,000				6,925,000
Hydropower	7,900,000	3,661,000	11,561,000			215,000	0
Flood Reduction	0	998,000	998,000				998,000
Total	185,704,000	83,554,000	269,258,000	163,000		7,802,000	8,836,000

[a]Revenues to the state reflect agriculture's 25 percent of the actual cost of water development as outlined in S.B. 98 of the 1991 State Legislature.

basin along the Wasatch Front. They address initial steps in implementing the suggested Bear River Development Plan.

9.11.1 Water Sales Agreements

The Division of Water Resources should continue with activities necessary to assess the local needs and interests in pursuing development of the suggested Bear River water development plan including obtaining water sales agreements.

9.11.2 Oneida Narrows Joint Reservoir Project

Even though potential project combinations with the Oneida Narrows Reservoir have a benefit/cost ratio slightly less than one, they may have a benefit/cost ratio greater than one if Idaho participated in a joint project. The Division of Water Resources should continue dialogue with Idaho concerning a consensus on how to develop a joint project.

9.11.3 Hyrum Reservoir Investigation

The Division of Water Resources should complete a detailed engineering investigation of enlarging the existing Hyrum Reservoir to better understand the site and reservoir basin bank stability conditions. The division should also conduct additional environmental assessment work in order to quantify the impacts.

9.11.4 Blacksmith Fork Water Diversion

The Division of Water Resources should investigate the option of diverting water from Blacksmith Fork via a canal/pipeline to the Hyrum Reservoir as a method of enhancing feasibility of the suggested plan.

9.11.5 Bird Refuge Joint Project

The U.S. Fish and Wildlife Service (USFWS) has indicated a need for additional water for the Bear River Migratory Bird Refuge, but to date it has not clarified its interest in participating with the state in developing a jointly funded project to make additional water available. The Division of Water Resources should determine the extent of current and future interest by USFWS in a joint water development project on the Bear River.

9.11.6 Bear River to Willard Reservoir Conveyance System

The Division of Water Resources, in conjunction with Weber Basin and Salt Lake County water conservancy districts, should investigate an identify the most cost-effective conveyance system alternatives for delivering Bear River water to Willard Reservoir with and without the Honeyville Reservoir.

9.11.7 Hyrum Reservoir to Box Elder County Conveyance System

The Division of Water Resources, in conjunction with the Bear River Water Conservancy District, should study alternatives for delivering water from Hyrum Reservoir to selected points in Box Elder County for M&I use. Water treatment costs should be included.

9.11.8 Protection of Potential Reservoir Sites

While recognizing the rights of existing land owners, all appropriate agencies of the state of Utah should discourage improvements and new developments within the Honeyville and Hyrum Reservoir sites which could significantly increase reservoir costs. The state of Utah should consider taking options to acquire these sites to protect them for future reservoir development.

9.12 REFERENCES

In addition to the references listed below, attention is directed to Section 9 of the Utah State Water Plan, January 1990, where the activities and programs of the Board of Water Resources and its staff (the Division of Water Resources) are discussed.

1. "Bear River Pre-Design Study Status Report," Utah Division of Water Resources, October 1990.

2. "Overview of the Proposed Lower Bear River Water Development Plan," Utah Division of Water Resources, December 1988, Revised September 1989.

3. "Bear River Pre-Design Report," Utah Department of Natural Resources, Division of Water Resources, October 1991.

4. "Economics of the State Water Plan, Background Paper," Utah Division of Water Resources, February 1992.

5. Bear River Development Act, Title 73, Chapter 26, *UCA* 1953 Amended.

6. Appropriation for Bear River Development, Senate Bill No. 19, Utah State Legislature, General Session, 1992.