STATE OF UTAH
NATURAL RESOURCES
Division of Water Resources


# Bear River Basin
## Planning for the Future
### Public Review Draft
### December, 2002

UTAH STATE WATER PLAN

**BEAR RIVER BASIN: PLANNING FOR THE FUTURE**
Public Review Draft
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# I. Introduction

The Bear River Basin has a plentiful water supply and is one of the few areas in the state with a significant amount of developable water. It is anticipated that Bear River water will eventually be developed to satisfy growing needs for areas within and outside the basin. Growth along the Wasatch Front has planners projecting a need to import Bear River water within the next couple of decades. Most communities within the basin have adequate water to meet their projected needs for at least the next twenty years. However, it is likely that industrial, commercial and even agricultural growth will necessitate the development of new sources of water within the basin. Additionally several communities will need to augment existing supplies within the next decade or two. Regardless of whether the pressure for new water development comes from within or outside of the basin, or whether it results from municipal, industrial, or some other use, a long-term planning effort is needed in the Bear River Basin. This planning effort will assure that the future development of this valuable resource reflects local and statewide concerns for the watershed, the environment, as well as meeting the water needs of a growing state.

This document is not a plan for the construction of any particular project or projects. Rather, it is a document that identifies the basin's current and projected water use and related issues. The purpose of this document is to provide planners with a snapshot of the current use of water throughout the basin, and a projection of how those uses may change over the next twenty to fifty years. It will discuss water quality, environmental and other issues associated with the current and projected water uses and will identify methods of dealing with increasing water demands, including potential development projects.

Ultimately local authorities and citizenry will have the final say on development and use of the Bear River's considerable resources. It is intended that this document will assist local planners with their efforts to effectively manage the Bear River.

## PURPOSE OF PLAN

In 1990 the Division of Water Resources published a State Water Plan. This plan provided a broad overview of the state's water resources and projected needs. The State Water Plan was followed by a series of river-basin plans which reflected the plan's format but provided much more detail. The Bear River Basin was the first of the state's eleven basins to be evaluated in detail and to have a basin plan published, in 1992. The plan has proved to be a valuable document to the Division, other state agencies, and to many of the local city and county planners in the Bear River Basin. Through the years it is anticipated that social, technologic and economic changes will all have an impact on the basin's water-related issues and concerns. Consequently, the state water-planning process and the basin-planning process have been dynamic in nature and, as such, will be re-written as necessary to ensure that the information contained in each plan is current and accurate. The *Utah State Water Plan* was rewritten in May 2001, with the publication of *Utah's Water Resources: Planning for the Future*. The *Bear River Basin: Planning for the Future* follows the format of that document in terms of chapter headings, sub-headings, figures, and tables.

The Bear River Basin Plan has been rewritten for a number of reasons. Although it has only been 10 years since the Bear River Basin Plan was published, considerable growth and change have occurred in the basin. Information from many studies and publications during that same period of time should be included in the basin plan to better define the current and projected water supply, uses, plans, and issues. Also the original *Bear River Basin Plan* did not address secondary water use as thoroughly as subsequent basin plans for other areas of the state.

This new document will address these topics as well as other changes in management of the Bear River. The past decade has seen a growing concern for water-quality, recreational, and environmental issues. These issues play an ever-increasing role in the management of the river, the reservoirs, and the basin's other natural resources. These changing attitudes are reflected in the Bear River Commission, in the FERC dam re-licensing process, and in PacifiCorp's (formerly Utah Power and Light) management of releases from its reservoirs.

Although this document replaces the 1992 document as the Bear River Basin Plan, there is a valuable collection of pertinent data and useful information that will not entirely be revisited here. While this report will update population projections, land use, water supply, and management practices, much of the detailed information included in the 1992 Bear River Basin Plan is unchanged and will not be reprinted in this document. Some of these items include:

- a detailed description of the state and federal regulatory agencies and their responsibilities;
- a description of the state and federal water-funding programs;
- an inventory of potentially irrigable lands in the basin; and
- a detailed description of the basin topography, geology, soils, and climate.

The 1992 Bear River Basin Plan, which is no longer in print, can be accessed on the Internet at the following address: http://www.water.utah.gov/planning/swp/bear/bearindex.htm

### Planning Process

By the conclusion of the review and approval process, four drafts of this document will have been prepared. These are: (1) In-House, (2) Committee, (3) Advisory, and (4) Public review drafts. After this process, the final report will be distributed to the public for its information and use. Public involvement is an important part of the planning process, and is necessary in assessing actual viewpoints and conditions in the basin. The opportunity for public discussion and input has been, and will continue to be, provided at the local, state, and federal levels as plan formulation moves through various phases.

## DESCRIPTION OF THE BASIN

The Bear River Basin is in northern Utah, southeastern Idaho, and western Wyoming. The basin covers approximately 7,500 square miles of mountain and valley land, including approximately 3,300 square miles in Utah, 2,700 square miles in Idaho, and 1,500 square miles in Wyoming.

The Bear River Basin is in the northeastern portion of the Great Basin. The Great Basin is unusual in that it is entirely enclosed by mountains, thus forming a huge bowl with no external drainage outlet. The Bear River empties into the Great Salt Lake, a remnant of ancient Lake Bonneville, which at one time occupied a large portion of the eastern Great Basin. It is the Western Hemisphere's largest stream that does not reach the ocean.

As shown in Figure 1, the headwaters of the Bear River is in Summit County, Utah on the north slope of the Uinta Mountains, approximately 60 miles due east of Salt Lake City. The Bear River follows a 500-mile circuitous route, crossing the Utah-Wyoming state line three times before flowing into Idaho, then turning south and returning to Utah and ultimately flowing into the Great Salt Lake, less than 100 miles from its headwaters.

For the first 20 miles of its course the Bear River flows down the north slope of the Uinta Mountains. As it crosses the Utah-Wyoming state line the river enters a series of five major valleys that extend along its course: Upper Bear River Valley, Bear Lake Valley, Gem Valley, Cache Valley, and Lower Bear River Valley. The arable lands throughout the basin are situated in the valleys along the main stem of the river and its tributaries. The elevations of these arable valleys range from 4,200 feet above sea level at Bear River Bay to 7,800 feet in the Upper Bear River Valley near Evanston, Wyoming. These valleys are separated by narrow canyons or gorges and bordered by jagged, sharply rising mountain ranges which reach elevations in excess of 10,000 feet above sea level. Among the 9,000 to 13,000 foot peaks in the upper reaches of the river, numerous small lakes in glacially carved cirque basins serve as catchment areas for precipitation, most of which falls as snow.

## HISTORIC DEVELOPMENT OF THE RIVER

The earliest water users in the Bear River Basin were irrigators in the Lower Bear River Valley and in Cache Valley. Consequently, they hold the earliest water rights. The management

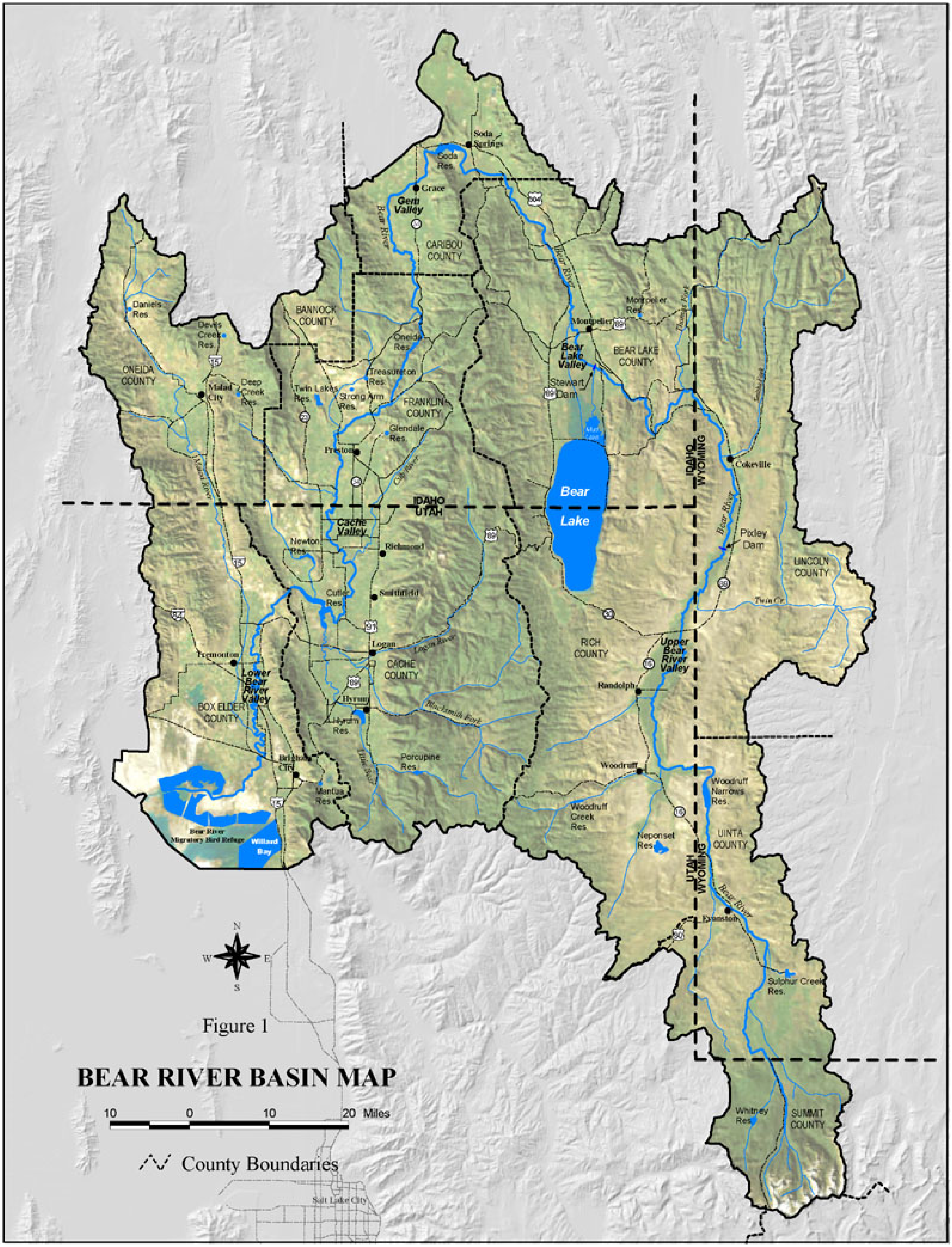



Figure 1

# BEAR RIVER BASIN MAP

10 0 10 20 Miles

County Boundaries

of the river is accomplished with delivery of irrigation water as the primary objective. One of the earliest efforts by irrigators to provide late-season irrigation water was to put Bear Lake to work as a storage reservoir.

Bear Lake is near the mid-point of the river's course from the Uinta Mountains to the Great Salt Lake. A few miles after entering Idaho, the Bear River flows westward into Bear Lake Valley. Bear Lake, at the south end of this valley, is about 20 miles long and seven miles wide. Historically, the river did not naturally flow into Bear Lake. In 1902 Telluride Power (predecessor to Utah Power and Light) began constructing inlet and outlet canals in an effort to divert Bear River water into the lake for later release during the agricultural growing season. In 1914 the Lifton pumping plant was constructed, at the north end of the lake, to pump water from Bear Lake into the outlet canal. These improvements and later modifications have created an active storage capacity of 1,452,000 acre-feet in Bear Lake and the ability to control the flow of the river.

Between 1904 and 1912, Telluride Power constructed five hydroelectric power plants below Bear Lake. These power plants at Soda, Grace, Cove, Oneida, and Cutler generate power from run-of-the-river flows. Between 1912 and 1916, Utah Power and Light entered into water-delivery contracts with the major irrigation companies along the Bear River. Releases from Bear Lake today are made to accommodate the irrigation demands in Cache and Box Elder counties in Utah and in Franklin and Caribou counties in Idaho, with power generation as a secondary benefit.

## II. Water Supply and Management

The Bear River's average annual inflow to the Great Salt Lake is nearly 1.2 million acre-feet (1941-1990). Some of this water can be developed to meet future needs within the basin, as well as some needs outside the basin in Salt Lake, Davis, and Weber counties.

### CLIMATE, PRECIPITATION AND EVAPORATION

The Bear River Basin is typical of mountainous areas in the West, with wide variations in temperature between summer and winter and between day and night. The high mountain valleys experience long, cold winters and short, cool summers. The lower valleys are warmer, but have more variance between maximum and minimum temperatures. As elevations in the basin vary from 4,200 to 13,000 feet, precipitation also varies from 10 to 65 inches. Figure 2 shows a detailed picture of the basin's average annual precipitation. Precipitation in the lower basin during the May-September growing season is only 5 to 6 inches, compared to a crop water requirement of 20 to 30 inches.

The National Weather Service has 18 climatological stations located throughout the Utah portion of the basin. These have varying lengths of record. Data from these stations are listed in Table 1. Mean annual temperatures vary from a high of $52.9^{o}$ F in Tremonton to a low of $37.0^{o}$ F at the Uintalands Weather Station. The record high temperature for the basin was $110^{o}$ F in Corinne, and the record low was $-47^{o}$ F in Woodruff. Precipitation results primarily from two major storm patterns: (1) frontal systems from the Pacific Northwest during winter and spring; and (2) thunderstorms from the south and southwest in the late summer and early fall. These storm patterns are influenced by the topography of the basin. As storm clouds rise over a mountains, the amount of precipitation increases significantly with elevation. The difference in elevation between valley and mountains also impacts the number of frost-free days. While the valley locations can experience as many as 189 frost-free days (Tremonton), the upper elevations receive as few as 33 days (Hardware Ranch).[1]

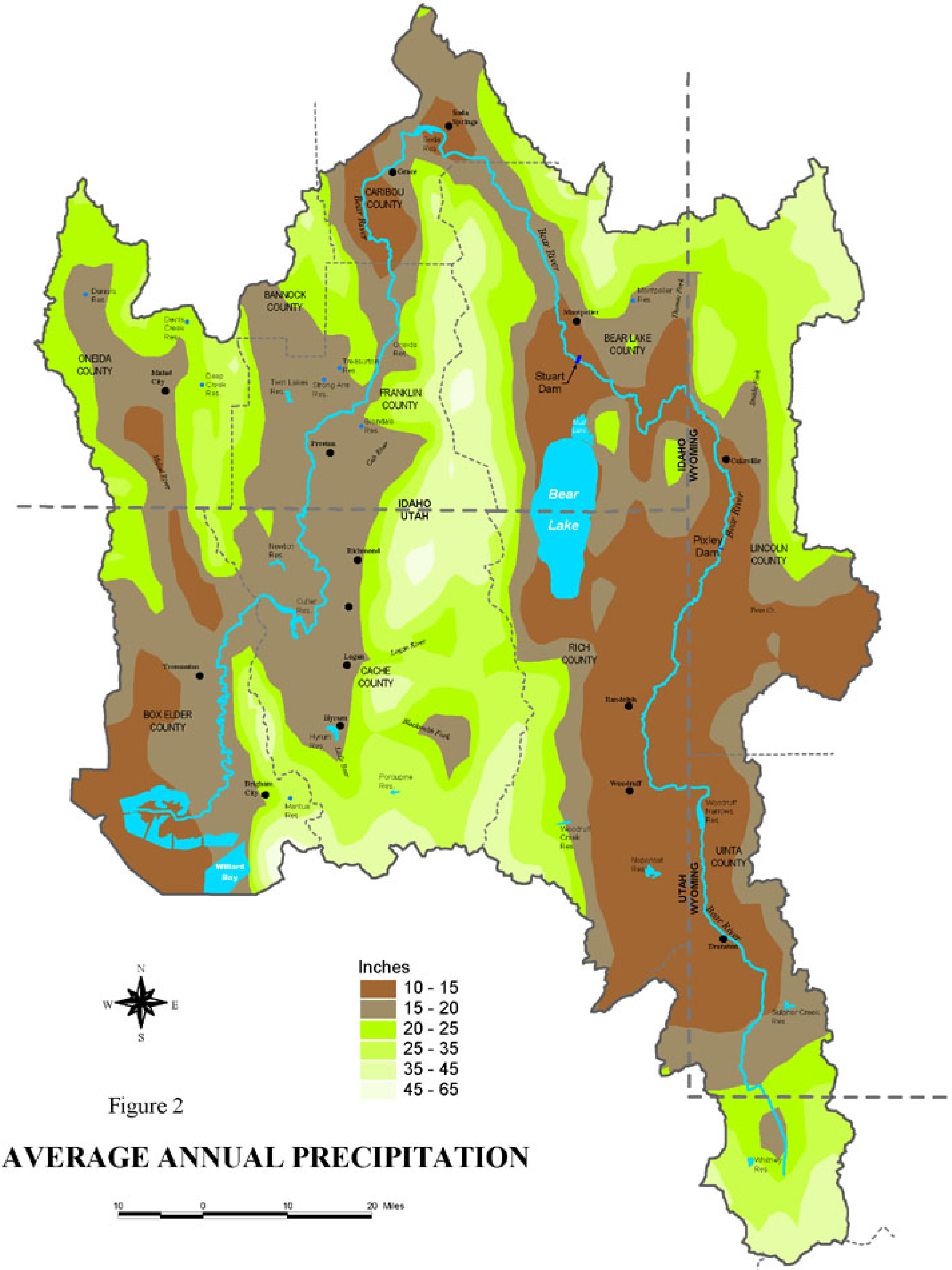



Figure 2

**AVERAGE ANNUAL PRECIPITATION**

| Table 1<br>**Climatological Data** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | Temperature (Average Max and Min.) | | | | | | | Precipitation | | Evap. | Frost Free Days |
| | January | | July | | Mean Ann. (°F) | Record | | Snow (in.) | Mean Ann. (in.) | Ave. Ann. (in.) | |
| | Max (°F) | Min. (°F) | Max. (°F) | Min. (°F) | | Max. (°F) | Min. (°F) | | | | |
| Summit Co. | | | | | | | | | | | |
| Uintalands | 32.7 | 6.6 | 73.9 | 41.8 | 37.0 | 85 | -33 | 224 | 22.9 | 34.7 | 53 |
| Rich Co. | | | | | | | | | | | |
| Laketown | 32.0 | 10.7 | 83.1 | 47.7 | 42.2 | 96 | -37 | 42.5 | 12.2 | 40.5 | 85 |
| Randolph | 25.9 | -0.2 | 80.6 | 43.2 | 38.4 | 92 | -43 | 34.2 | 11.2 | 40.2 | 50 |
| Woodruff | 28.5 | 2.4 | 81.7 | 44.0 | 39.0 | 94 | -47 | 42.3 | 9.0 | 40.0 | 56 |
| Bear Lake | 31.7 | 12.0 | 84.6 | 49.6 | 44.6 | 92 | -25 | 41.1 | 14.0 | 42.0 | 109 |
| Cache Co. | | | | | | | | | | | |
| Richmond | 31.4 | 13.1 | 90.0 | 52.9 | 46.6 | 104 | -28 | 69.4 | 19.5 | 45.3 | 121 |
| Logan (KVNU) | 30.8 | 11.3 | 89.3 | 54.4 | 46.4 | 104 | -30 | 25.4 | 16.6 | 44.4 | 132 |
| Logan (USU) | 31.7 | 15.5 | 86.7 | 59.2 | 47.8 | 102 | -25 | 68.7 | 19.5 | 40.9 | 158 |
| Logan (Exp. St.) | 33.5 | 14.7 | 88.7 | 54.4 | 47.4 | 99 | -27 | 17.3 | 16.6 | 44.3 | 133 |
| Logan (5 SW) | 31.3 | 8.7 | 87.6 | 51.7 | 45.2 | 102 | -44 | 50.9 | 18.2 | 43.7 | 118 |
| Hardware Ranch | 34.9 | 5.3 | 84.9 | 40.6 | 41.2 | 100 | -43 | 64.9 | 17.4 | 44.2 | 33 |
| Trenton | 30.8 | 10.2 | 87.4 | 50.1 | 44.8 | 105 | -44 | 52.0 | 17.7 | 44.8 | 112 |
| Box Elder Co. | | | | | | | | | | | |
| Cutler | 29.4 | 13.6 | 89.1 | 61.1 | 49.3 | 107 | -22 | 36.8 | 19.0 | 42.3 | 165 |
| Plymouth | NR | NR | NR | NR | NR | NR | NR | 26.2 | 9.8 | 48.8 | NR |
| Tremonton | 35.8 | 22.0 | 90.9 | 69.1 | 52.9 | 105 | -11 | 24.4 | 17.9 | 40.6 | 189 |
| Bothwell | NR | NR | NR | NR | NR | NR | NR | 33.9 | 12.97 | NR | NR |
| Corinne | 33.5 | 14.4 | 90.5 | 56.9 | 48.7 | 110 | -32 | 34.5 | 17.7 | 47.3 | 139 |
| Brigham City | 36.1 | 18.7 | 92.9 | 61.8 | 51.4 | 105 | -16 | 63.9 | 19.3 | 46.0 | 162 |
| NR – no record<br>Source: *Utah Climate*, Utah Climate Center, USU (period of record: 1948-92) | | | | | | | | | | | |

## AVERAGE ANNUAL WATER SUPPLY

### Surface Water

Figure 3 shows schematically the annual flow of the Bear River throughout its length, as well as tributary inflows, diversions, and groundwater inflows based on 1941-90 data.[2] The width of the bands representing the Bear River main stem and tributaries are proportional to the average annual flow in acre-feet. Main stem gaging stations are indicated by rectangles while diversions from the Bear River and from tributaries are represented by arrowheads. Bear Lake inflows and outflows are similarly shown. For most of the canals only the average annual


Figure 3

# BEAR RIVER FLOW CHART

depletion figure is shown. For these canals it is assumed that return flows occur reasonably close to the diversion. In some instances, however, such as the Twin Lakes Canal and the West Cache Canal, water is diverted upstream of the gage but the return flows are below the gage. In order to balance the figures from gage to gage it is necessary, at these locations, to show and use the actual diverted flows. Consequently, for some of the canals the average annual diversion figure is shown in parenthesis below the average annual depletion figure. Where both figures are shown the average annual diversion figure is the one that has been used to calculate streamflows.

The Logan River is the largest tributary to the Bear River. It is joined by Blacksmith Fork and the Little Bear River before entering Cutler Reservoir. The next largest tributary is Smiths Fork in Wyoming. Others are the Cub River in Utah, Mink Creek and Soda Creek in Idaho, and the Malad River in Idaho and Utah. Major diversions are Last Chance Canal in Idaho, West Cache Canal in Idaho, the Bear River Canal Company's West Side and East Side canals in Utah, and the Bear River Migratory Bird Refuge in Utah. A significant quantity of groundwater inflow to the river occurs in Cache and Box Elder counties.

The Bear River computer modeling done in 1992 with 1941-1990 data is still an accurate representation of average conditions in the Bear River Basin. A comparison of the 1941-1990 stream-flow data with the current period of record data is included in Table 2. Dry years between 1991 and 1995 have reduced average annual flows at several locations, particularly the diversions to Bear Lake at the Rainbow inlet and the releases from Bear Lake. The flow at the Idaho/Utah state line was also adversely affected by the dry years, whereas average flows near Collinston and Corinne were relatively unchanged.

A summary of streamflow records for the Bear River is also shown in Table 2. Except for the Rainbow Inlet Canal, the Bear Lake Outlet Canal and the Logan River gage, all streamflow records in Table 2 are from mainstem gaging stations. They are listed in downstream order, beginning with the Bear River crossing of the Utah-Wyoming state line, and ending with the last gaging station on the river, near Corinne, before the river enters the Bear River Migratory Bird Refuge.

| Table 2<br>**Stream Gaging Records** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Gaging Station On Bear River | Station Number | Drainage Area (square miles) | Period of Record | Instantaneous Extremes | | Average Annual Runoff (1,000 acre-feet) | |
| | | | | Min. (cfs) | Max. (cfs) | 1941-90 | Period of Record |
| Near Ut-Wy State line | 10011500 | 172 | 1942-2001 | 7 | 3,230 | 140 | 142 |
| Near Woodruff | 10020300 | 784 | 1961-2001 | 0 | 3,820 | 163 | 173 |
| Near Randolph | 10026500 | 1,616 | 1943-1992 | 2 | 3,630 | 150 | 150 |
| Smiths Fork, Wy[a] | 10032000 | 165 | 1942-2001 | 21 | 2,100 | 142 | 140 |
| At Wy-Id State Line | 10039500 | 2,486 | 1937-1995 | 24 | 4,880 | 325 | 315 |
| At Harer, Id. | 10044000 | 2,839 | 1913-1986 | 26 | 5,140 | 393 | 393 |
| Rainbow Inlet | 10046000 | - | 1922-2001 | 0 | 4,950 | 304 | 272 |
| Bear Lake Outlet | 10059500 | - | 1922-2001 | 1 | 3,080 | 332 | 301 |
| Pescadero | 10068500 | 3,705 | 1921-2001[b] | 23 | 4,280 | 466 | 444 |
| Alexander | 10079500 | 4,099 | 1911-2001 | 14 | 4,740 | 588 | 539 |
| Below Oneida Res. | 10086000 | 4,456 | 1921-2001 | 3 | 5,480 | 681 | 623 |
| Logan River[a] | 10109000 | 214 | 1896-2001[b] | 50 | 2,000 | 156 | 182 |
| At Id.-Ut. State line | 10092700 | 4,881 | 1970-2001 | 48 | 4,870 | 746 | 834 |
| Near Collinston | 10118000 | 6,267 | 1889-2001 | 10 | 12,700 | 1,095 | 1,165 |
| Near Corinne | 10126000 | 7,029 | 1949-2001[b] | 47 | 14,770 | 1,232 | 1,293 |
| Source: USGS Water Resource Data[2] [a] tributary stream [b] not a continuous record | | | | | | | |

**Available Water Supply**

By combining the climatological data with the streamflow data, an accurate snapshot of the water supply within the Bear River Basin can be produced. Table 3 presents a water budget for the Utah portion of the basin. The average annual precipitation for the basin is 22 inches per year. Within the Utah portion of the basin (3,381 square miles) this produces roughly 4 million acre-feet of water. It is estimated that about 60 percent of that is used by the native vegetation and natural systems. The remaining 1,572,000 acre-feet of basin yield manifests itself in surface and subsurface flow working its way toward the Great Salt Lake. In addition to the yield produced within the Utah portion of the basin, the Amended Bear River Compact allows Utah an additional 284,000 acre-feet of water. This means there is an available supply of about 1,856,000 acre-feet in the Utah portion of the Bear River Basin.

Agricultural water depletions (unrecoverable use) are estimated to be 295,000 acre-feet. Municipal and Industrial uses in the basin deplete roughly 21,000 acre-feet. It is estimated that the losses in the basin's wet and open water areas, including evaporative losses in the Bear River

Migratory Bird Refuge, are 340,000 acre-feet. The estimated total annual average outflow into the Great Salt Lake from the Bear River is 1,200,000 acre-feet.

Table 3
**Estimated Water Budget for the Utah Portion of the Bear River Basin**

| Category | Water Supply (acre-feet) |
|---|---|
| Total Precipitation | 4,000,000 |
| Used by vegetation and natural systems | 2,428,000 |
| Basin Yield | 1,572,000 |
| Amended Bear River Compact Increase | 284,000 |
| Available Supply | 1,856,000 |
| Agricultural Depletions | 295,000 |
| M&I Depletions | 21,000 |
| Wetland/Riparian Depletion & Reservoir Evaporation | 340,000 |
| Flow to Great Salt Lake | 1,200,000 |

Source: *Utah Water Data Book* (1961-1990 average annual supply and present depletions) [3c]

An average annual flow of 1,200,000 acre-feet from the Bear River into the Great Salt Lake can give the misleading impression that there actually are 1,200,000 acre-feet of water available for development. In reality, water rights held by the Bear River Migratory Bird Refuge account for a great deal of this water and necessitate that much of it continue to flow to the refuge. Additionally, the Amended Bear River Compact designates how the developable waters of the river are to be allocated among Idaho, Utah, and Wyoming. Assuming full development by Idaho and Wyoming and taking into consideration current uses and existing water rights, there remains an average annual developable flow of about 250,000 acre-feet for Utah. The water that is available for development is winter and spring flow. Because of the natural variability of the river's annual flow, the development of a firm yield of 250,000 acre-feet will require new storage. To provide a dependable water supply of this undeveloped flow will require new storage approximately equal to the amount of water to be developed. There may be options to develop some of this water through the use of existing reservoirs, but ultimately the development of 250,000 acre-feet will require the construction of a new reservoir and/or the development of aquifer storage and recovery.

**Groundwater**

In 1994 the U.S. Geologic Survey (USGS) published the *Hydrology of Cache Valley, Cache County, Utah and Adjacent part of Idaho, with Emphasis on Simulation of Ground-Water Flow*.[4] The study showed a close regional hydrologic connection between groundwater, springs and streams. The model simulates flow in part of the unconsolidated basin fill deposits only, and thus covers less than 1/3 of Cache County. Based on limited data, it generalizes a complex hydrologic system composed of stacked aquifers separated or partly separated by aquitards, the result of a long geologic history of deposition by the various streams and rivers and their interactions with the rise and fall of Lake Bonneville and its predecessor lakes. Calibration was difficult and required many assumptions and tweaking of parameters. Although useful for predicting hydrological response of the basin as a whole, it may be inaccurate at the local level. Since publication of the USGS document, Utah State University has been working on its own Cache Valley groundwater model, based on more recent geologic mapping of the basin.

Beyond the edges of the central alluvial basin, groundwater in the consolidated rock of the Bear River Range and Wellsville Mountains has received relatively little exploration, but the area appears to have a high potential for groundwater development. The synclinal structure of the Bear River Range with its core of fractured limestone is conducive to development of large groundwater reservoirs.

*Ground-water Resources of Cache Valley, Utah and Idaho: Utah Department of Natural Resources Technical Publication 36*[5] estimated that 25,000 acre-feet of storage could be released in Cache Valley for every foot of water table decline. The 1994 USGS model predicts that increasing groundwater pumping in the Cache valley alluvial basin by 30 cfs, would at the end of 30 years, if it were 100 percent consumed, decrease total streamflow by 30 cfs or about 10 percent, and would develop 100,000 acre-feet of storage. However, the amount of storage and effect on surface flow depends on the assumptions made in the model.

More work is needed to reach agreement on how best to model the Cache Valley groundwater system. Meanwhile, the State Engineer's Office has prepared an *Interim Cache Valley Ground-Water Management Plan* that emphasizes joint surface water and groundwater

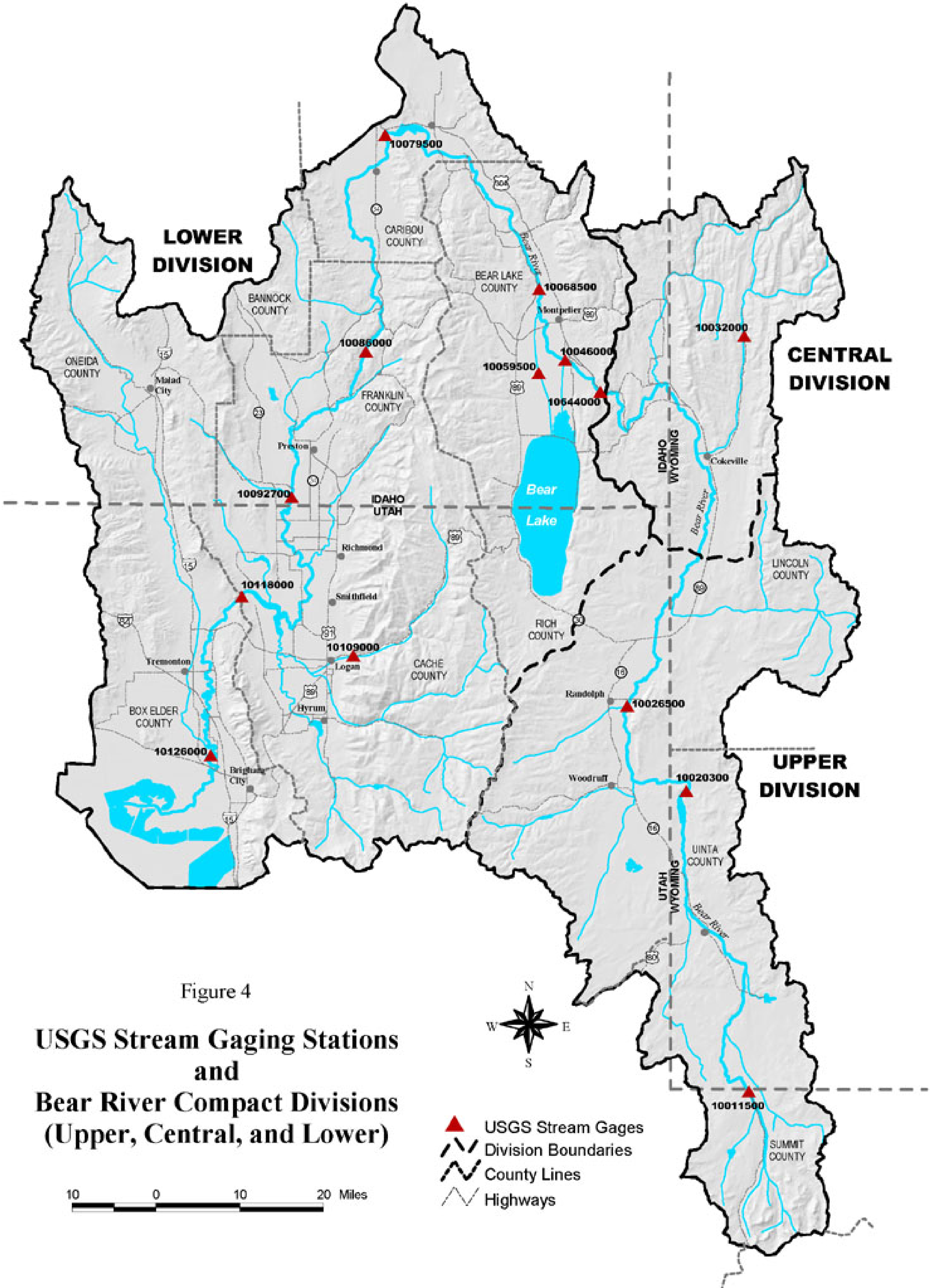



Figure 4

**USGS Stream Gaging Stations and Bear River Compact Divisions (Upper, Central, and Lower)**

management and limits groundwater withdrawals.[6]

The State Engineer's *Interim Cache Valley Ground-Water Management Plan* points out that much of the developable water in the basin is available only during winter and spring runoff. During peak demand periods of most years, principal water sources are fully appropriated and there is insufficient flow in surface sources to meet the demand of all existing surface water rights. Consequently, the plan limits the development of new groundwater rights in order to maintain the reliability of existing surface water rights. The plan states, "The limiting factor regarding groundwater development in Cache Valley is not the amount of water which is physically available within the aquifers, but rather the amount of groundwater which can be withdrawn without impairing prior rights."[7]

Estimates of groundwater recharge and discharge from the USGS groundwater study are given in Table 4. Based upon the USGS groundwater study and other available data the State Engineer's office, through its *Interim Cache Valley Ground-Water Management Plan* will allow an additional 25,000 acre-feet per year of groundwater withdrawals in the Cache Valley. As this water is developed, the effect of such development on the hydrologic system will be evaluated to determine if additional withdrawals can be allowed.

Table 4
**Cache Valley Groundwater Recharge and Discharge**

| Recharge | Acre-Feet |
|---|---|
| Infiltration of precipitation | 90,000 |
| Seepage from streams | 1,000 |
| Seepage from canals | 86,000 |
| Other forms of recharge (bedrock) | 46,000 |
| Total | 223,000 |
| Discharge | |
| Seepage to streams | 70,000 |
| Spring Discharge | 58,000 |
| Evapotranspiration | 36,000 |
| Seepage to Reservoirs | 31,000 |
| Withdrawals from wells | 28,000 |
| Total | 223,000 |

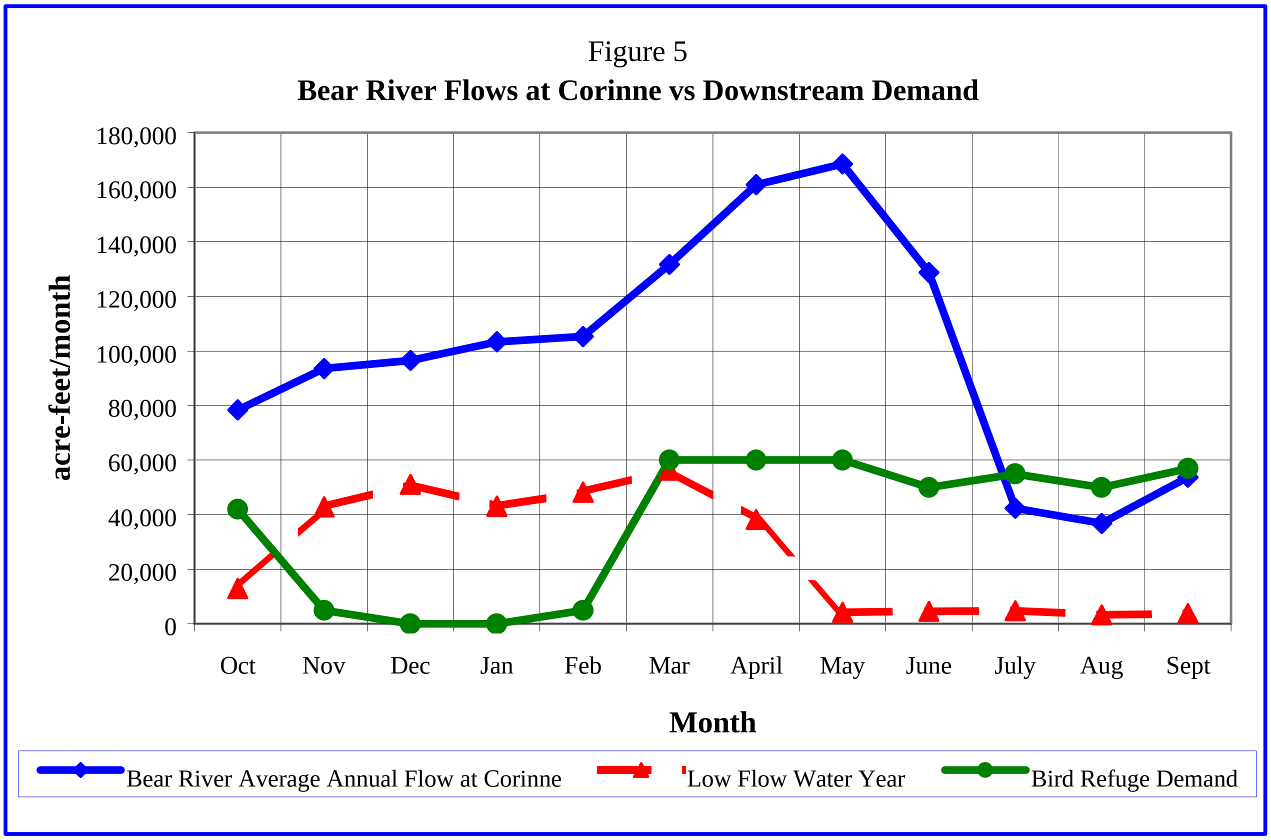
Source: *Interim Cache Valley Ground-Water Management Plan,* State Engineer's Office

## DEVELOPABLE SUPPLY

On an average annual basis, 1.2 million acre-feet of water flows past the Corinne gaging station and into the Bear River Migratory Bird Refuge. The 50-year interval of 1941-90 is a fairly representative base period for streamflow averages and other hydrologic computations. This period of record includes weather cycles with both extremely high and extremely low water years. Assuming full development by Idaho and Wyoming, and taking into consideration current uses, the Bear River was modeled for this period of record (1941-90). The modeling reveals, depending upon the amount of reservoir storage built, that between 50,000 and 250,000 acre-feet of water can be developed in the state of Utah. Unfortunately, in dry years, there is very little developable flow and it is primarily limited to the winter flows and spring runoff. In wet years the developable flow can be significantly higher than the average annual flow. Consequently, the development of a firm yield will require the construction of reservoir storage. The relationship between the developable yield and the needed reservoir storage will be discussed in more detail in Chapter VI, Water Development.

Figure 5 compares the average annual flow of the Bear River at the Corinne gaging station (blue line); with the record low flow water year of 1992 (red line) and the demand for water at the Bear River Migratory Bird Refuge (green line). The average monthly flow at the Corinne gage rises from 80,000 acre-feet per month in October to just over 100,000 acre-feet per month in February. With the spring runoff the flow at Corinne rises on average to 160,000 acre-feet per month in May. Through June the flow drops off dramatically to an average annual flow of about 40,000 acre-feet per month in July and August before increasing slightly in September. The lowest annual flow on record at the Corinne Gage was the 1992 water year. Flows that year started at 13,000 acre-feet/month in October and then ranged between 40,000 and 60,000 acre-feet/month during the winter months of November through March, before dropping off significantly in April and settling below 5,000 acre-feet/month throughout the entire summer.

Below the Corinne gage the only significant water use is at the Bear River Migratory Bird Refuge. The bird refuge's water demand is also shown in Figure 5 and reflects the refuge's water right and desired delivery pattern. The bird refuge's water needs are fairly insignificant during the winter months of November through February. From March through September the bird refuge's water needs hover around 60,000 acre-feet per month (1,000 cfs). As can be seen in Figure 5, the average annual flow of the river in July, August, and to some extent September, is inadequate to meet the needs of the refuge. During dry years, however, the flow of the river is inadequate to meet the bird refuge's need for more than half of the year.




Recognizing the need to supplement the river's flow during the summer months, the U.S. Fish and Wildlife Service is currently working with the Bureau of Reclamation to explore the possibility of enlarging Hyrum Reservoir to meet summer needs at the Bear River Bird Refuge. Surplus runoff in the spring months would be stored in Hyrum and released in the late summer months to insure the refuge has an adequate supply to mitigate against the possible outbreak of botulism and other ill effects the refuge suffers as a result of low flows. The possibility of enlarging Hyrum Reservoir will be discussed in more detail in Chapter VI, Water Development.

The developable flow of the Bear River is represented, in Figure 5, by the area between the blue line (flow at Corinne) and the green line (demand at the Migratory Bird Refuge). During dry years the developable flow is considerably less and is represented as the area between the red line (record low flow) and the green line. But even during the driest year on record the Bear River has a considerable volume of water available for development. However, the need for storage is attested to by the lack of late summer flows, and the significant reduction in the volume of flow in dry years.

In 1991 the Utah State Legislature passed the Bear River Development Act. The act directs the Utah Division of Water Resources to develop 220,000 acre-feet of Bear River water and allocates that water as shown in Table 5. The approach currently being considered is to: 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; and 3) construct conveyance and treatment facilities to deliver water from Willard Bay to the Wasatch Front.

Table 5
**Bear River Development Act Allocations**
(acre-feet)

| | |
|---|---|
| Bear River Water Conservancy District | 60,000 |
| Jordan Valley Water Conservancy District | 50,000 |
| Weber Basin Water Conservancy District | 50,000 |
| Cache County | 60,000 |
| Total | 220,000 |
| Bear River Development Act – 1991 | |

Ultimately the construction of a dam in the Bear River Basin will likely hinge on the needs of the basin's residents to develop their own allocated portion of the Bear River. The Bear River Water Conservancy District and the Cache County water users have allocations of 60,000 acre-feet. Possibly some of that water can be developed without additional storage. However, the development of a firm yield, particularly during periods of drought when new water sources will most likely be needed, will require some form of storage.

## MANAGEMENT

Under the Public Trust Doctrine, the Utah Division of Forestry, Fire and State Lands manages the bed of the Bear River between the surveyed meander lines, and the bed of Bear Lake. This doctrine establishes the right of the public to use and enjoy these trust waters, lands, and resources for a wide variety of recognized public uses.

The State Engineer (Utah Division of Water Rights) is presently adjudicating water rights in Box Elder County to define surface and groundwater rights that are held for various uses under decrees, claims, and applications. Proposed Determinations have been completed for Cache and Rich counties. Several applications to develop large additional amounts of water have been filed in the lower basin. Any water development on the Bear River or its tributaries must conform with established water rights as well as the Amended Bear River Compact. Table 6 lists each of the water rights areas and sub-areas within the basin along with a statement of the current status and general policy.

**Water Rights**

The Dietrich Decree was filed on July 14, 1920, in District Court of the United States for Idaho, eastern Division. The decree quantified and prioritized water rights for irrigation and power on the Bear River in Idaho. It also granted Utah Power and Light (now PacifiCorp) the right to divert 5,500 cfs of Bear River water into Bear Lake and 500 cfs from the Bear Lake and Mud-Lake tributaries. Non-consumptive rights were also granted for power purposes at the downstream hydropower projects.

On February 21, 1922, the Kimball Decree was filed in Utah District Court in Cache County. The Kimball Decree quantified and prioritized water rights on the Bear River in Utah. It also recognized Utah Power and Light's right to divert Bear River Water and store it in Bear Lake as well as non-consumptive rights for power purposes.

Table 6
**GENERAL STATUS OF WATER RIGHTS**
Bear River Basin

| AREA | SUBAREA | STATUS AND GENERAL POLICY |
|---|---|---|
| 21 | Summit County | Status: Revised Proposed Determination published in 1962.<br>Policy: Only domestic filings for in-house use are approved. |
| 23 | Laketown | Status: Proposed Determination published in 1965.<br>Policy: Canyon areas are fully appropriated. Springs and streams are closed to new appropriations of both groundwater and surface water. |
| | Southeast | Status: Proposed Determination published in 1966.<br>Policy: Canyon areas are fully appropriated. Springs and streams are closed to new appropriations of both groundwater and surface water. |
| | Woodruff Creek | Status: Proposed Determination published in 1966.<br>Policy: Canyon areas are fully appropriated. Springs and streams are closed to new appropriations of both groundwater and surface water. |
| | Northeast | Status: Proposed Determination published in 1965<br>Policy: Canyon areas are fully appropriated. Springs and streams are closed to new appropriations of both groundwater and surface water. |
| | Big Creek, Randolph Creek & Otter Creek | Status: Proposed Determination published in 1966.<br>Policy: Canyon areas are fully appropriated. Springs and streams are closed to new appropriations of both groundwater and surface water. |
| 25 | Logan River | Status: Proposed Determinations published in 1974 & 1976. (3 books)<br>Policy: Canyon areas closed. For most areas ground water is open to single family domestic applications. All applications are subject to the Cache Valley Groundwater Management Plan implemented Sept. 1, 1999. |
| | Richmond (High Creek) | Status: Proposed Determination published in 1977 .<br>Policy: Canyon areas closed. For most areas ground water is open to single family domestic applications. All applications are subject to the Cache Valley Groundwater Management Plan implemented Sept. 1, 1999. The Cove Area is closed to all but domestic application. |
| | Lewiston, Clarkston, & Newton | Status: Proposed Determination published in September 15, 1979.<br>Policy: Canyon areas closed. For most areas ground water is open to single family domestic applications. All applications are subject to the Cache Valley Groundwater Management Plan implemented Sept. 1, 1999. |
| | Blacksmith Fork | Status: Proposed Determination published in October 1, 1967.<br>Policy: Canyon areas closed. For most areas ground water is open to single family domestic applications. All applications are subject to the Cache Valley Groundwater Management Plan implemented Sept. 1, 1999. |
| | South Fork & East Fork | Status: Proposed Determination published in 1953<br>Policy: Canyon areas closed. For most areas ground water is open to single family domestic applications. All applications are subject to the Cache Valley Groundwater Management Plan implemented Sept. 1, 1999. |
| 29 | Brigham City & Deweyville | Status: Proposed Determination published in October 1, 1990.<br>Policy: Areas tributary to Black Slough are closed. All appropriations except .015's* are subject to the revised Bear River Compact. |
| | Willard | Status: Proposed Determination published on August 24, 1960<br>Policy: Area closed if springs lie down gradient. All appropriations except .015's* are subject to the Amended Bear River Compact. |
| | Portage Creek | Status: Proposed Determination published in September 5, 1991.<br>Policy: All appropriations except .015's* are subject to the revised Bear River Compact. |
| | Thatcher Penrose | Status: Proposed Determination published on August 24, 1960<br>Policy: All appropriations except .015's* are subject to the revised Bear River Compact. |
| | Plymouth | Status: Proposed Determination published on August 24, 1960<br>Policy: All appropriations except .015's* are subject to the revised Bear River Compact. |

* This is a single family residential water right of .015 cubic feet per second.

**Amended Bear River Compact**

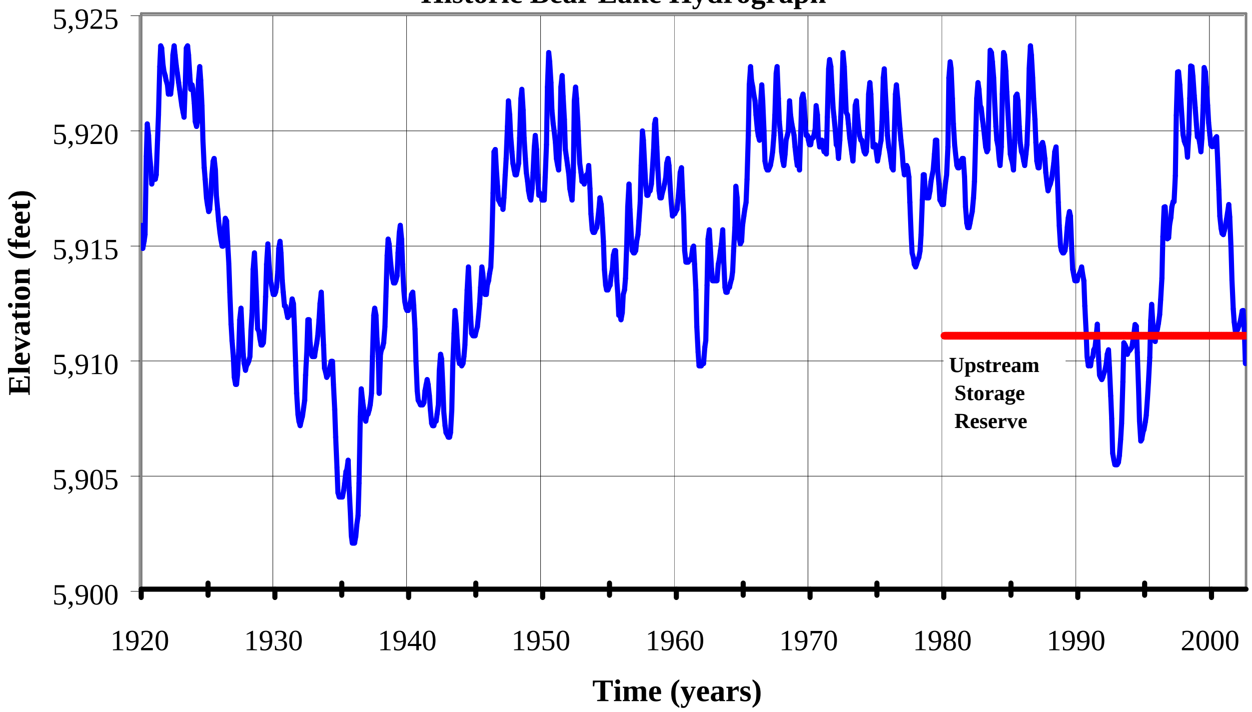
In 1958 the Bear River Compact was ratified by Congress and signed by the President of the United States.  The compact provided for: (1) apportionment of Bear River flows between the states of Utah, Wyoming and Idaho;  (2) allocation of upstream storage above Bear Lake; (3) establishment of an irrigation reserve in Bear Lake and; (4) a review of the compact provisions every 20 years.

In 1980 the Bear River Compact was amended[8] to allow additional storage above Bear Lake.  It also set restrictions on the additional upstream storage when the elevation of Bear Lake was below elevation 5911. The Amended Bear River Compact also established criteria for adjusting the irrigation reserve as upstream storage increased.  Prior to the Operational Agreement for Pacificorp's Bear River System, signed in 2000, the irrigation reserve elevation was the management tool use to regulate non-irrigation releases from the lake.  When the elevation of Bear Lake was below the irrigation reserve no water could be released from the lake solely for purpose of generating power.  Currently, the lake is managed using a Target Elevation.  A more detailed explanation of the current method of managing the lake will follow.

In 1994 Cutler Reservoir was re-licensed by FERC for continued use as a hydropower facility.  The re-licensing process for Soda, Cove, and Oneida hydropower plants is currently underway and scheduled for completion in 2003.

In 1995 the Bear Lake Group, a consortium of land owners, recreational, and environmental interest groups filed a lawsuit against the U.S. Army Corps of Engineers and the Environmental Protection Agency challenging the issuance of permits allowing PacifiCorp to dredge the channel to the Lifton pump station.  In April of 1995 a Bear Lake Settlement Agreement was signed by the interested parties, the Last Chance Canal Company, the West Cache Canal Company, the Bear River Canal Company, the Idaho Pumpers Association, Bear Lake Watch, Emerald Beach, Bear Lake East and PacifiCorp.   As part of the Settlement Agreement, PacifiCorp agreed not to dredge in 1995 and the Bear Lake land owners and special interest groups agreed to drop the pending law suit.  All parties agreed to form a new Bear Lake Preservation Advisory Committee that would meet annually in an attempt to negotiate resolutions to disagreements between the parties that would otherwise result in litigation.

Figure 6
Historic Bear Lake Hydrograph




In April 2000, PacifiCorp signed an operational agreement with the states of Utah, Idaho and Wyoming to continue operation of Bear Lake as it has been operated historically.  Water will be released from Bear Lake only for flood control and to meet downstream irrigation contractual requirements.  Once water is released for irrigation or flood control, power can be generated at the various downstream hydropower plants as a secondary benefit.  Bear Lake will now be managed by use of a target elevation rather than a irrigation reserve.  Pacificorp's Target Elevation (PTE) will be set on March 31 of each year.  The PTE may range from as low as 5916 feet during high runoff conditions to 5920 feet during projected low runoff conditions.  Under normal conditions the PTE will be set at 5918.  Generally, if Bear Lake's elevation is higher than the PTE at the end of the irrigation season, releases are scheduled to lower Bear Lake to the PTE by March 31 of the following year.  Conversely, if Bear Lake is below the PTE at the end of the irrigation season, releases are curtailed until such time as the lake is predicted to reach the PTE or until such time as high snowpack and runoff forecasts during the following winter months require PacifiCorp to make releases for flood control.

## NOTES

1. *Utah Climate*, Gaylen L. Ashcroft, Donald T. Jensen, Jeffrey L. Brown, (by Utah Climate Center, 1992).

2. *The Water Resources Data Utah*, Water Year 1990, U.S. Geological Survey Water Data Report UT-90-1

3. *The Utah Water Data Book*, Division of Water Resources, August 1997.

4. *Hydrology of Cache Valley, Cache County, Utah and Adjacent parts of Idaho, with Emphasis on Simulation of Ground-Water Flow,*

5. Bjorklund, L.J. and McGreevy, L.J., 1971, *Ground-water resources of Cache Valley, Utah and Idaho*: Utah Department of Natural Resources Technical Publication No. 36.

6. *Interim Cache Valley Ground-Water Management Plan*, Utah Division of Water Rights

7. *Interim Cache Valley Ground-Water Management Plan*, Utah Division of Water Rights, p2

8. Bear River Compact As Amended and By Laws of Bear River Commission, December 22, 1978.

# III. Population and Water Related Trends and Projections

## DEMOGRAPHICS AND ECONOMIC TRENDS AND PROJECTIONS

Approximately seven percent of Utah=s population resides in the three Bear River Basin counties of Rich, Cache and Box Elder. Although the basin includes a small portion of Summit County, at the headwaters of the Bear, there are only about 35 permanent residents there. The Utah portion of the Basin has a current population of 136,097 (2000 US Census), which is projected to increase to 191,530 by 2020 and 288,129 by 2050. This is a total increase of 41 percent or 1.7 percent per year over the next 20 years, and a total increase of 117 percent or 2.2 percent annually over the next 50 years.

During the past ten years, the population projections for Utah=s cities and counties have been modified several times to reflect the state=s ever changing growth trends. The Bear River Basin=s actual population increase during the past eight years has exceeded the Governor's Office of Planning and Budget (GOPB) projections used in the 1992 Bear River Basin Plan. At that time, Cache County=s 1990 population of 70,183 was projected to increase to 77,900 by 2000 and 107,200 by 2020. The 2000 U.S. Census put Cache County=s population at 91,391. At the present time the GOPB's projected population for Cache County for 2020 is 127,896 and 192,676 by 2050. Likewise, Box Elder County=s 1990 population was projected to increase from a population of 36,485 in 1990 to 40,500 in 2000 and 46,300 in 2020. The 2000 U.S. Census put Box Elder County=s population at 42,745. At the present time Box Elder County is projected to grow to a population of 63,209 by 2020 and to 93,639 by 2050. Population estimates for Rich County have the current population of 1,961 and a projected increase to 2,084 by 2020 and to 2,458 by 2050.

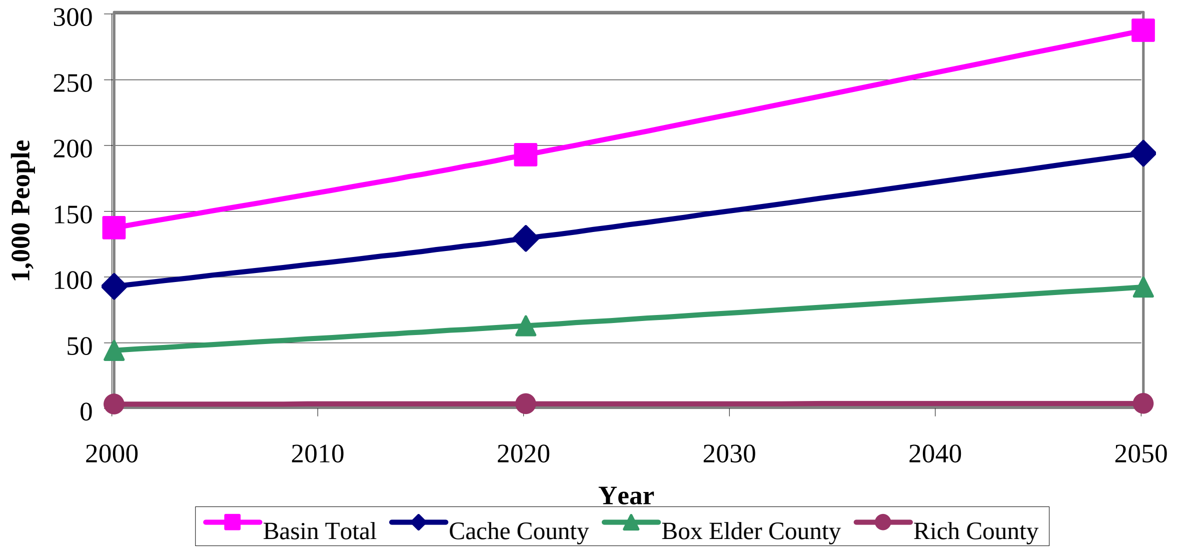
Current GOPB population estimates and projected population figures for the basin=s towns and cities are given in Table 7. The population projections for each of the basin=s three populated counties are graphically depicted in Figure 6. The principal cities in the basin and their 2000 population estimates include Logan, (42,670); Brigham City, (17,411); Smithfield, (7,261); North Logan, (6,163); Hyrum, (6,316); and Tremonton, (5,592). (See Table 7, )

Table 7
**POPULATION PROJECTIONS**
Bear River Basin

| Cities/Towns | 2000[1] | 2020[2] | 2050[2] |
|---|---|---|---|
| Box Elder County | | | |
| Bear River City | 750 | 1,068 | 1,686 |
| Brigham City* | 17,411 | 22,387 | 31,509 |
| Corinne* | 621 | 1,266 | 2,023 |
| Deweyville | 278 | 513 | 759 |
| Elwood | 678 | 768 | 976 |
| Fielding | 448 | 529 | 724 |
| Garland * | 1,943 | 3,798 | 6,577 |
| Honeyville* | 1,214 | 1,987 | 3,323 |
| Howell Town | 221 | 443 | 629 |
| Mantua | 791 | 1,150 | 2,250 |
| Perry * | 2,383 | 5,085 | 7,746 |
| Plymouth | 328 | 333 | 551 |
| Portage | 257 | 330 | 624 |
| Snowville | 177 | 407 | 677 |
| Tremonton* | 5,592 | 9,329 | 15,744 |
| Willard* | 1,630 | 2,321 | 3,726 |
| Total for Incorporated Cities and Towns | 34,722 | 51,714 | 79,524 |
| Balance of the County | 8,023 | 11,495 | 14,115 |
| **Box Elder County Total** | **42,745** | **63,209** | **93,639** |
| Cache County | | | |
| Amalga | 427 | 655 | 1,080 |
| Clarkston | 688 | 842 | 1,202 |
| Cornish | 259 | 432 | 1,160 |
| Hyde Park* | 2,955 | 4,601 | 7,866 |
| Hyrum* | 6,316 | 8,866 | 13,233 |
| Lewiston* | 1,877 | 2,034 | 2,906 |
| Logan* | 42,670 | 56,407 | 79,828 |
| Mendon* | 898 | 1,012 | 1,318 |
| Millville* | 1,507 | 2,028 | 4,285 |
| Newton | 699 | 781 | 3,186 |
| Nibley* | 2,045 | 4,858 | 8,340 |
| North Logan* | 6,163 | 8,727 | 10,902 |
| Paradise | 759 | 2,168 | 4,574 |
| Providence* | 4,377 | 6,549 | 9,609 |
| Richmond* | 2,051 | 4,227 | 7,062 |
| River Heights | 1,496 | 1,654 | 2,058 |
| Smithfield* | 7,261 | 10,573 | 15,394 |
| Trenton | 449 | 487 | 1,075 |
| Wellsville* | 2,728 | 4,828 | 8,401 |
| Total for Incorporated Cities and Towns | 85,625 | 121,729 | 183,479 |
| Balance of the County | 5,766 | 6,167 | 11,197 |
| **Cache County Total** | **91,391** | **127,896** | **192,676** |
| Rich County | | | |
| Garden City* | 357 | 348 | 502 |
| Laketown | 188 | 298 | 349 |
| Randolph* | 483 | 538 | 559 |
| Woodruff | 194 | 158 | 185 |
| Total for Incorporated Cities and Towns | 1,222 | 1,342 | 1,595 |
| Balance of the County | 739 | 742 | 858 |
| **Rich County Totals** | **1,961** | **2,084** | **2,453** |
| **Basin Totals** | **136,097** | **193,189** | **290,768** |

* Incorporated Cities
Source: 1) U.S. Census Bureau, National Census 2000
2) 2000 Baseline, UPED Model System, Governor's Office of Planning and Budget

Figure 6
**Population Trends and Projections**




Note: There are no permanent residents in the Summit County part of the basin.

Table 8 compares the results of the most recent economic survey (1997) of the basin with the 1987 economic survey used in the 1992 *Bear River Basin Plan*. No significant changes occured in the past decade, but some trends emerged. With a few exceptions, most industries have shown growth in the past decade. However, manufacturing accounted for nearly half the basin=s personal income in 1987, but has dropped to about 40 percent in ten years, while the Service, Retail Trade, and Transportation and Utilities sectors now constitute a larger part of the basin=s economy. Agriculture and agricultural-related services remain at about four percent of the basin=s total economy.

## LAND USE

Land-use data for the Utah portion of the basin, collected in 1996, is presented in Table 9. The table gives a county-by-county summary of the basin=s irrigated croplands by crop for the year 1996. Grain accounted for 26 percent of the county=s total irrigated lands, while alfalfa accounted for 23 percent. The land-use survey identified 306,900 acres of irrigated ground and 97,199 acres of dry-cropland. An additional 8,643 acres of idle/fallow ground were identified, and are included in the table. A total of 412,567 acres of agricultural ground was identified.

Table 8
**Personal Income and Earnings (Million $)**[a]

| | Box Elder | | Cache | | Rich | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1987 | 1997 | 1987 | 1997 | 1987 | 1997 | 1987 | % | 1997 | % |
| Manufacturing | 333 | 433 | 126 | 292 | [b] | 0.2 | 459 | 49% | 726 | 41% |
| Government | 32 | 58 | 123 | 226 | 2.5 | 4.5 | 158 | 17% | 289 | 16% |
| Services | 29 | 59 | 78 | 216 | 0.7 | 2.8 | 108 | 11% | 277 | 16% |
| Retail Trade | 24 | 62 | 38 | 97 | 0.4 | 1.2 | 62 | 7% | 159 | 9% |
| Construction | 19 | 33 | 36 | 73 | 0.3 | 0.7 | 55 | 6% | 106 | 6% |
| Agriculture and Ag Services | 18 | 32 | 18 | 30 | 4.2 | 3.4 | 40 | 4% | 65 | 4% |
| Transportation and Utilities | 7 | 22 | 16 | 41 | 0.5 | 0.3 | 24 | 2% | 63 | 4% |
| FIRE[c] | 5 | 11 | 13 | 27 | [b] | [b] | 18 | 2% | 37 | 2% |
| Wholesale Trade | 8 | 13 | 8 | 23 | [b] | [b] | 16 | 2% | 35 | 2% |
| Mining | 0 | 1 | 0 | 0 | 0.4 | 0.7 | 1 | 0% | 2 | 0% |
| Total | 475 | 724 | 456 | 1,025 | 9.0 | 13.8 | 940 | 100% | 1,762 | 100% |

[a] Source: *Utah Economic and Business Review* Volume 59 Numbers 3 and 4 March/April 1999
[b] Not shown to avoid disclosure of confidential information
[c] Financial, Insurance, and Real Estate

## WATER USE TRENDS AND PROJECTIONS

Agricultural use continues to be the major use of water in the Bear River Basin. During the past few decades, heavily populated portions of the state have experienced declining agricultural use corresponding to an increasing municipal and industrial (M&I) use. However, in the Bear River Basin the conversion of agricultural land to urban and the increasing use of water for M&I purposes has not resulted in reduced agricultural water use. The abundant supply of water in the basin has meant that it has not been necessary to convert agricultural water supplies to M&I uses. The conversion of agricultural land to urban has resulted in a net loss of dry-farm land but not in a loss of irrigated acreage. It is unlikely that this trend will be reversed any time soon.

Table 9
**Irrigated Cropland by Crop**
Utah portion of the Bear River Basin

| Crop | (Acres, by County) | | | | |
| --- | --- | --- | --- | --- | --- |
| | Box Elder | Cache | Rich | Summit | Total |
| Surface Irrigated | | | | | |
| Orchard | 1,288 | 56 | 9 | 0 | 1,353 |
| Berries | 0 | 56 | 106 | 0 | 162 |
| Nurseries | 51 | 5 | 0 | 0 | 56 |
| Grain | 39,333 | 40,728 | 1,676 | 0 | 81,737 |
| Corn | 13,391 | 6,976 | 0 | 0 | 19,367 |
| Vegetables | 231 | 12 | 0 | 0 | 243 |
| Potatoes | 397 | 0 | 0 | 0 | 397 |
| Onions | 1,187 | 0 | 0 | 0 | 1,187 |
| Tomatoes | 18 | 0 | 0 | 0 | 18 |
| Alfalfa | 19,916 | 44,371 | 7,508 | 0 | 71,795 |
| Grass Hay | 5,109 | 5,356 | 33,510 | 128 | 44,103 |
| Grass/Turf | 493 | 125 | 0 | | 618 |
| Pasture | 20,956 | 19,163 | 28,992 | 2,792 | 71,903 |
| Other Forage Crops | 10 | 0 | 0 | 0 | 10 |
| Hay land | 0 | 0 | 249 | 0 | 249 |
| Subtotal | 101,380 | 116,848 | 72,050 | 2,920 | 293,198 |
| Subsurface Irrigation | | | | | |
| Pasture | 5,825 | 7,370 | 324 | 174 | 13,692 |
| Grass Hay | 10 | 0 | 0 | 0 | 10 |
| Subtotal | 5,835 | 7,370 | 324 | 174 | 13,702 |
| Total Irrigated Land | 107,215 | 124,218 | 72,374 | 3,094 | 306,900 |
| Fallow | 1,114 | 1,238 | 24 | 0 | 2,407 |
| Idle | 2,356 | 3,000 | 736 | 0 | 6,236 |
| Dry-Crop | 37,232 | 44,943 | 15,024 | 0 | 97,199 |
| Total Agricultural Land | 147,917 | 173,399 | 88,158 | 3,094 | 412,567 |

Source: Water Related Land-use Inventories, Bear River Basin (unpublished), Utah Water Resources, (1996 data)
Note: This table does not include irrigated lands in Idaho nor irrigated ground within the boundaries of the Bear River Migratory Bird Refuge.

## Drinking Water

Significant population growth is projected throughout the basin during the next 20 years. However, most of the basin=s municipalities have existing water supplies that are sufficient to meet the projected future demand. Although existing M&I water supplies appear adequate throughout much of the Bear River Basin, some systems currently have or will have problems in the near future. Some communities, such as Logan and Nibley in Cache County and Tremonton in Box Elder County, are already operating at or near the limits of their reliable system/source capacity. Other communities, such as Garland and Brigham City in Box Elder County and Lewiston in Cache County, will reach the limits of their reliable system/source capacity by the year 2020. Supply vs. demand graphs (Figures 7 through 12) have been included here to show the inter-relationships between each town's existing system's reliable system/source capacity and the projected demand for the next 50 years. Each figure includes a pair of future demand lines. One line shows the community's projected water needs based upon its current use rate, while the other line shows the reduction in demand if 25 percent conservation is achieved by the year 2050.

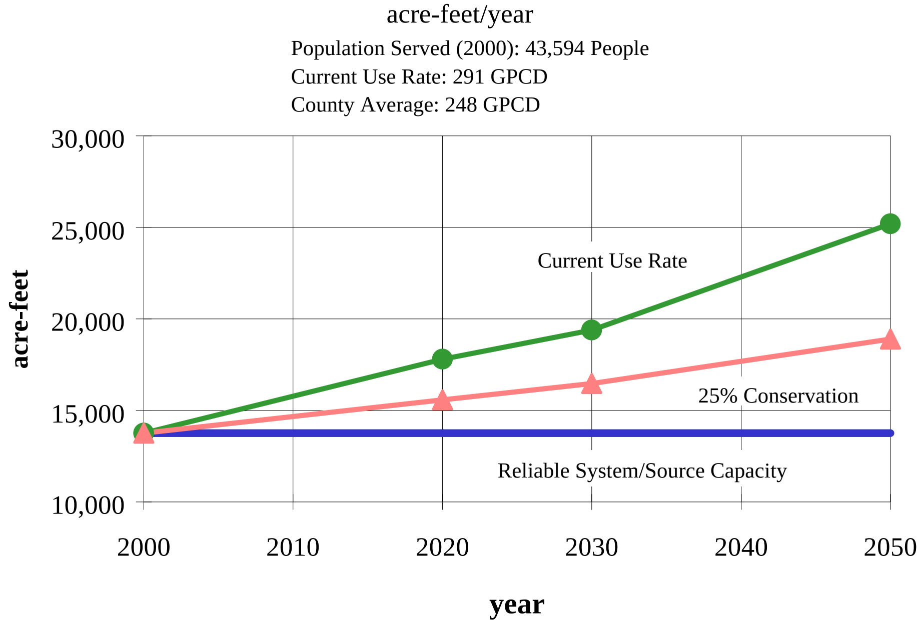
Similar figures have been prepared for each of the basin=s municipalities and are included in the appendix.

Figure 7

**Logan City**

Existing Supply vs Demand

acre-feet/year



reliable system/source capacity is a term used here to quantify how much water can be delivered by the existing community water system. As the term implies, delivery limits may be a result of inadequate infrastructure (system) or insufficient supply (source). For some communities, improving system capacity may simply mean replacing a pump, whereas for other communities it could entail locating and developing a new water source, building a larger storage tank, and enlarging mainline pipes. This report will not go into the detail of identifying the specifics of each system's limitations, nor identify possible remedies. The intent here is to compare each community water system's existing reliable system/source capacity to its projected future demand and thereby show when problems will likely arise. It is important to understand that the reliable system/source capacity is a theoretical number based upon supplying adequate flow during periods of peak demand. Consequently, it is possible for a system to deliver more total water than the calculated reliable system/source capacity. When this happens the system will function adequately much of the time. But during periods of peak demand, usually in the morning or early evening during the summer months, the system pressure will drop, resulting in delivery problems. Such reductions in system pressure have serious implications including potential water contamination and reduced in fire fighting capabilities.

Figure 8

**Nibley**

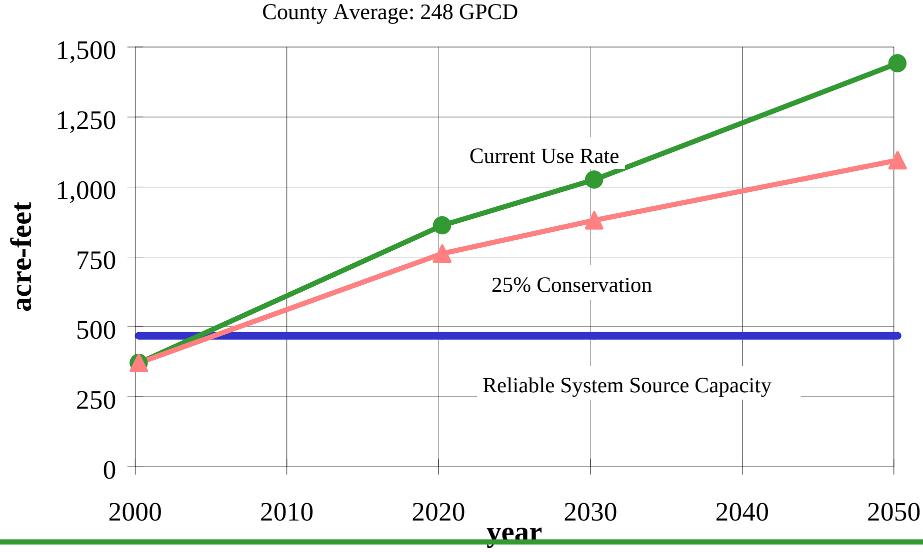
Existing Supply vs Demand

acre-feet/year

Population Served (2000): 1,900 People

Current Use Rate: 170 GPCD

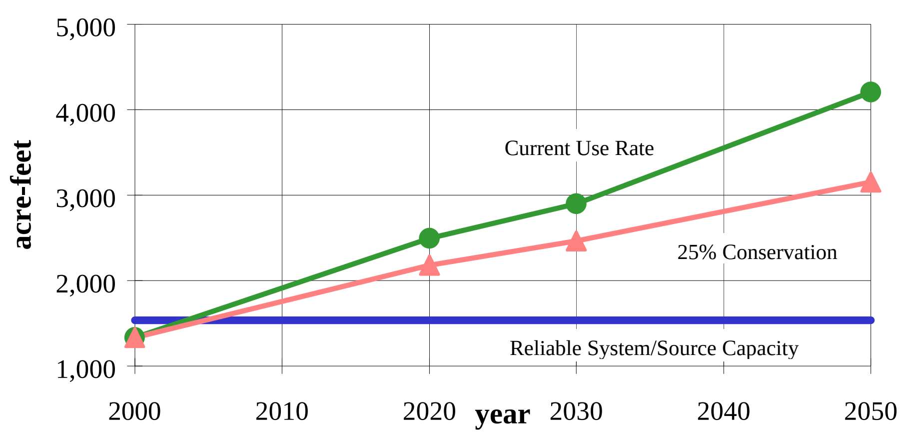
County Average: 248 GPCD



Many communities in the state have initiated water conservation plans in an effort to reduce the rate of consumption of M&I water supplies. The Division of Water Resources has encouraged communities to develop water conservation plans, and has required the existence of such a plan whenever state money has been used to assist in project development. Since water supplies are plentiful throughout most of the basin, often there seems to be little incentive for communities to develop and adhere to a water conservation program. However, there is considerable incentive when one considers the infrastructure needs and capital expense associated with increasing system capacity to meet future demands. It is hoped that communities in the basin will recognize the potential for water conservation efforts not only to stretch existing supplies but also to delay the need for expensive capital improvements.

As can be seen in Figure 7, Logan City's water system is currently operating at its reliable system/source capacity. This means there is already a need for some form of infrastructure improvement or additional water source. Logan's current total M&I use is 291 gallons per capita per day (GPCD), a rate which is about 17 percent higher than the county-wide average of 249 GPCD. The Current Use Rate line shows what Logan's future water needs will be if the residents continue to use water at the current rate of 291 GPCD. For comparison the 25 percent

Figure 9
**Tremonton**
Existing Supply vs Demand
acre-feet/year
Population Served (2000): 5,000 People
Current Use Rate: 259 GPCD
County Use Rate: 259 GPCD



conservation line shows how future demand will be impacted if Logan's residents can achieve 25 percent water use reduction by the year 2050.

The town of Nibley (current population 1,900) is presently operating near the reliable system/source capacity of the town=s water system (See Figure 8). At the present time, Nibley is only using 170 GPCD, approximately 68 percent of the countywide average. In addition to being near the limits of its reliable system/source capacity, Nibley is also faced with the probability of exceeding its existing water supply within the next 20 years. From Figure 8 it can be seen that 25 percent water conservation will do little to address either of these immediate problems for the town. At the present time Nibley is in need of additional water supplies and infra-structural improvements.

In Box Elder County, Tremonton's situation is almost identical to Logan's (See Figure 9). The city=s existing water system is operating near the limits of its reliable system/source capacity. Tremonton's total M&I use is currently 259 GPCD, within five percent of the countywide average of 249 GPCD.

Figure 10

**Garland City**

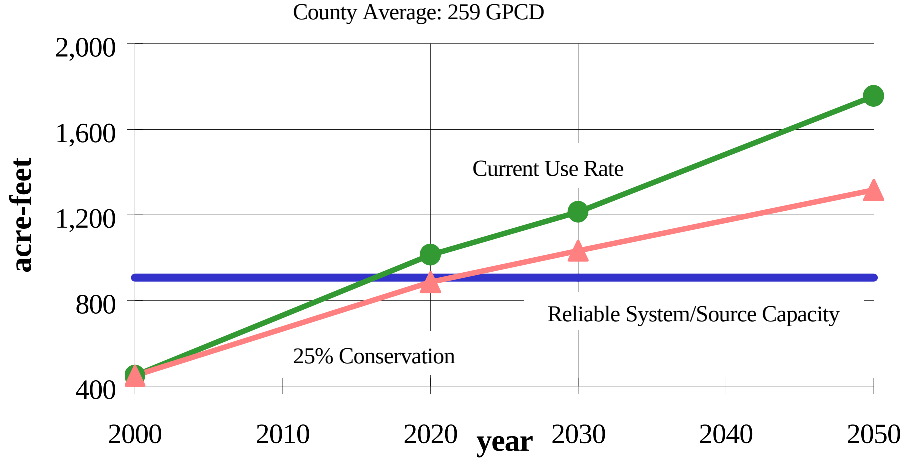
Existing Supply vs Demand

acre-feet/year

Population Served (2000): 1,680 People

Current Use Rate: 251 GPCD

County Average: 259 GPCD



Garland (Figure 10) is currently using 251 GPCD, which is virtually the same as the countywide average.  Future demand will approach the limits of Garland City system's reliable system/source capacity around the year 2018.

Despite having adequate water supplies, many towns in the basin will reach or exceed the limits of their reliable system/source capacity within the next 20 years.  For many of these towns, water conservation is a reasonable and economic means of postponing the inevitable cost of system improvements.  Figure 11 and Figure 12 show two towns, Brigham City in Box Elder County and Lewiston in Cache County, which will reach the limits of their system=s capacity by the year 2025 if water conservation efforts are not undertaken.  However, as shown by the graphs both of these towns could delay necessary infrastructure improvements to their systems, by 20 years or more, with effective water conservation efforts.

At its current total M&I per capita use rate of 285 gallons per minute, Brigham City will reach the limits of its reliable system/source capacity around 2018 (See Figure 11).  With 25 percent conservation, however, that date can be postponed until about 2038.  Conservation would

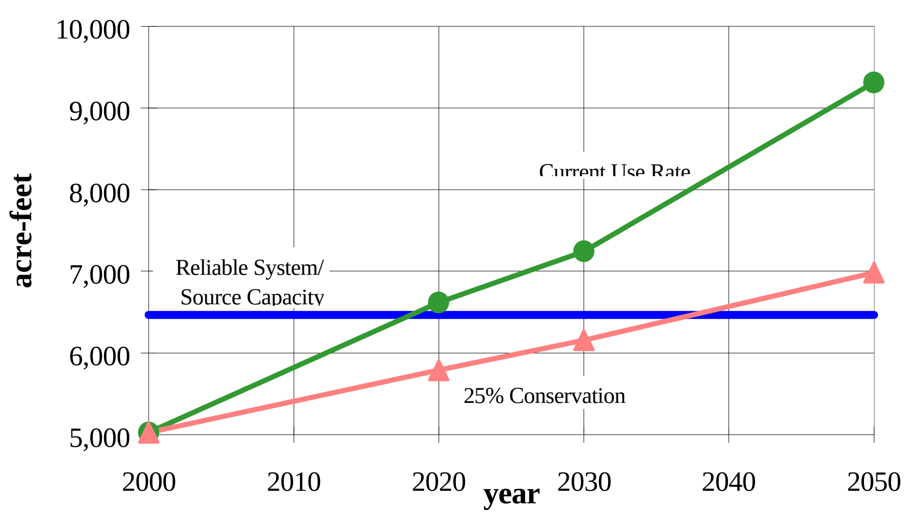
Figure 11

**Brigham City**

Existing Supply vs Demand

acre-feet/year

Population Served (2000): 17,000 People
Current Use Rate: 285 GPCD
County Average: 259 GPCD



in all likelihood delay expensive infrastructure improvements for twenty years.

For Lewiston, with a current total M&I use rate of 311 gallons per capita-day, the system's reliable system/source capacity will be exceeded about 2025. With water conservation that date can be moved back to about 2047. For Lewiston, as with Brigham City, the implication is that the life of the existing system could be prolonged by 20 years through conservation.

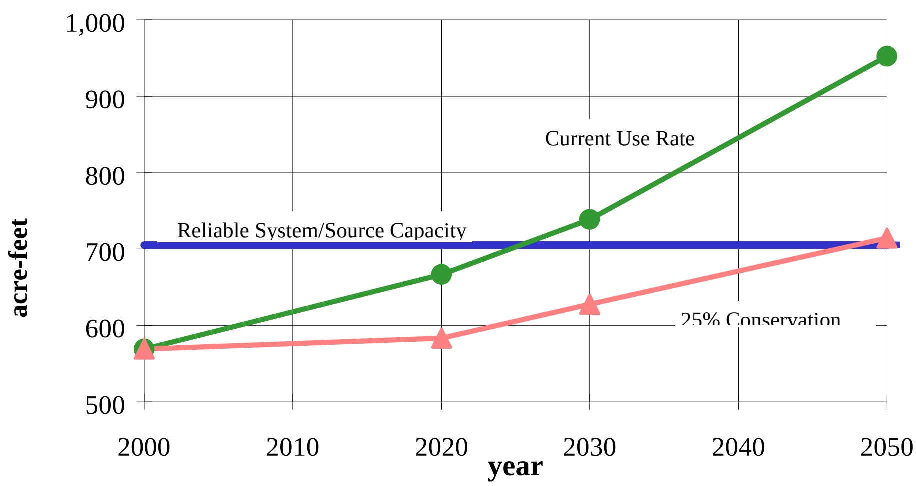
Figure 12

**Lewiston City**

Existing Supply vs Demand

acre-feet/year

Population Served (2000): 1,736 People
Current Ues Rate: 311 GPCD
County Use Rate: 259 GPCD




The impacts predicted by the supply vs. demand graphs are summarized for all communities in Table 10, which compares each water system's reliable system/source capacity to the community's predicted future water demand. Future water demands were calculated by multiplying the projected population, by the current use rate. The 25 percent conservation line assumes a water conservation reduction of 12.5 percent by 2020, and a 25 percent reduction by 2050. Through the use of color shaded cells Table 10 shows which communities are most likely to have problems with reliable system/source capacity over the next 50 years.

Table 10 shows that most communities in the basin have sufficient water supplies through the year 2020.  In Box Elder County six communities will need to address system deficiencies by 2020.  Through water conservation efforts alone three of these communities, Brigham City, Garland, and Mantua could reduce the impact of future demand enough to postpone the need for infrastructure improvement beyond the year 2020.  Three other communities, North Garland, Tremonton, and West Corrine will face significant system deficiencies and will need to implement some system improvements in addition to any water conservation measures.  These communities are all within the Bear River Water Conservancy Water District service area, and could obtain additional water through the district.  Several more communities in Box Elder County will face system deficiencies by the year 2050.  The communities of Perry, Honeyville, Corinne, and the Ukon Water Company could meet their needs through 2050 through water conservation alone.

In Cache County several communities (Amalga, Cornish, Logan, Millville, Nibley, and Paradise will face water system deficiencies by 2020.  By 2050 several more Cache County communities (Benson, Clarkston, Hyrum, Lewiston, Newton, Richmond, and Smithfield) will also face delivery problems.  Although all of these communities will benefit from water conservation, most will have to address their future water needs with more than just water conservation.

Most of these communities in Cache and Box Elder counties are small, however, and should not have a problem obtaining needed water supplies or addressing system deficiencies because their increased demand will be relatively small.

Table 10
**PROJECTED CULINARY M&I DEMAND AND SUPPLY**
**FOR PUBLIC COMMUNITY WATER SYSTEMS**
Bear River Basin (Cache County)
(acre-feet /year)

| Name | Reliable System/ Source Capacity | 2020 | | | 2050 | | |
|---|---|---|---|---|---|---|---|
| | | Population | Demand* | Surplus Deficit () | Population | Demand* | Surplus Deficit () |
| Amalga Municipal Water System | 559 | 655 | 725 | (166) | 1,080 | 1,024 | (465) |
| Benson Water Culinary District | 147 | 577 | 105 | 42 | 1,048 | 164 | (17) |
| Clarkston Municipal Water System | 471 | 842 | 395 | 76 | 1,202 | 483 | (12) |
| Cornish Municipal Water System | 99 | 432 | 143 | (44) | 1,160 | 325 | (226) |
| Goaslind Spring Water Works Co. | 401 | 60 | 11 | 390 | 60 | 9 | 392 |
| High Creek Culinary Water System | 64 | 85 | 19 | 45 | 85 | 16 | 48 |
| Hyde Park Culinary Water System | 1,244 | 4,601 | 568 | 676 | 7,866 | 832 | 412 |
| Hyrum City Water System | 4,771 | 8,866 | 2,833 | 1,938 | 13,233 | 3,624 | 1,147 |
| Lewiston Culinary Water System | 705 | 2,034 | 583 | 122 | 2,906 | 714 | (9) |
| Logan City Water System | 13,758 | 56,407 | 15,576 | (1,818) | 79,828 | 18,895 | (5,137) |
| Mendon Culinary Water System | 294 | 1,012 | 115 | 179 | 1,318 | 129 | 165 |
| Millville City Water | 454 | 2,028 | 401 | 53 | 4,285 | 727 | (273) |
| Newton Town Water | 158 | 781 | 128 | 30 | 1,186 | 167 | (9) |
| Nibley City | 406 | 4,858 | 707 | (301) | 8,340 | 1,040 | (634) |
| North Logan Culinary System | 2,986 | 8,727 | 1,230 | 1,756 | 10,902 | 1,317 | 1,669 |
| Paradise Town | 190 | 2,168 | 317 | (127) | 4,574 | 573 | (383) |
| Providence City Corp. Water | 3,748 | 6,549 | 1,441 | 2,307 | 9,609 | 1,812 | 1,936 |
| Richmond City | 919 | 4,227 | 731 | 188 | 7,062 | 1,047 | (128) |
| River Heights City Water System | 1,208 | 1,654 | 582 | 626 | 2,058 | 621 | 587 |
| Riverside Culinary Water Co. | 99 | 90 | 18 | 81 | 251 | 15 | 84 |
| Smithfield Municipal Water System | 2,311 | 10,573 | 1,722 | 589 | 15,394 | 2,149 | 162 |
| South Cove Water Supply | 182 | 73 | 19 | 163 | 202 | 16 | 166 |
| Trenton City | 577 | 487 | 79 | 498 | 1,075 | 149 | 428 |
| Wellsville City | 4,022 | 4,828 | 787 | 3,235 | 8,401 | 1,174 | 2,848 |
| **County Totals** | | 122,614 | 29,235 | 54,019 | 183,885 | 37,022 | 2,751 |

Yellow Surplus/Deficit Cell indicates that without conservation the existing Reliable System/Source capacity will be inadequate.

Red Surplus/Deficit Cell indicates that even with conservation the existing Reliable System/Source capacity will be inadequate

Table 10 (continued)
**PROJECTED CULINARY M&I DEMAND AND SUPPLY**
**FOR PUBLIC COMMUNITY WATER SYSTEMS**
Bear River Basin (Box Elder County)
(acre-feet /year)

| Name | Reliable System/ Source Capacity | 2020 | | | 2050 | | |
|---|---|---|---|---|---|---|---|
| | | Population | Demand* | Surplus Deficit () | Population | Demand* | Surplus Deficit () |
| Acme Water Co. (Bear River City) | 391 | 1,068 | 243 | 148 | 1,685 | 328 | 63 |
| Beaver Dam Water Co. | 163 | 61 | 17 | 146 | 61 | 14 | 149 |
| Bothwell Cemetery and Water Corp. | 174 | 529 | 169 | 5 | 562 | 177 | (3) |
| Brigham City Municipal Water | 6,473 | 22,387 | 5,790 | 683 | 31,509 | 6,985 | 512 |
| Cedar Ridge Subdivision | 150 | 100 | 19 | 131 | 100 | 16 | 134 |
| Coleman Mobile Home Court | 17 | 48 | 10 | 7 | 48 | 9 | 8 |
| Corinne City Corp. | 235 | 1,266 | 157 | 78 | 2,023 | 215 | 20 |
| Deweyville Municipal Water System | 202 | 513 | 111 | 91 | 759 | 141 | 61 |
| Elwood Town | 384 | 768 | 198 | 186 | 976 | 216 | 168 |
| Five C's Trailer Court | 17 | 50 | 7 | 10 | 50 | 6 | 11 |
| Garland City Corp. | 908 | 3,798 | 887 | 21 | 6,577 | 1,316 | (408) |
| Harper Ward* | 100 | 150 | 17 | 83 | 150 | 17 | 83 |
| Honeyville Municipal Water System | 1,186 | 1,987 | 694 | 492 | 3,323 | 994 | 192 |
| Hot Springs Trailer Court | 25 | 110 | 14 | 11 | 110 | 12 | 13 |
| Mantua Culinary Water System | 323 | 1,150 | 275 | 48 | 2,250 | 461 | (138) |
| Marble Hills Subdivision | 142 | 136 | 29 | 113 | 136 | 25 | 117 |
| Perry City Water System | 1,394 | 5,085 | 960 | 434 | 7,746 | 1,253 | 141 |
| Plymouth Town | 397 | 333 | 127 | 270 | 551 | 165 | 232 |
| Portage Municipal Water System | 94 | 330 | 58 | 36 | 624 | 94 | 0 |
| Riverside - North Garland Water Co.* | 212 | 1,933 | 313 | (101) | 3,262 | 452 | (240) |
| South Willard Culinary Water | 367 | 392 | 102 | 265 | 629 | 140 | 227 |
| Sunset Park Water Co. | 13 | 35 | 11 | 2 | 35 | 10 | 3 |
| Thatcher-Penrose Service District* | 553 | 926 | 184 | 369 | 1,137 | 194 | 359 |
| Tremonton Culinary Water* | 1,535 | 9,329 | 2,179 | (644) | 15,744 | 3,153 | (1,618) |
| Ukon Water Co.* | 200 | 1,031 | 127 | 73 | 1,070 | 149 | 51 |
| West Corinne Water Co | 967 | 1,852 | 1,165 | (198) | 2,274 | 1,256 | (259) |
| Willard Municipal Water System | 847 | 2,321 | 667 | 180 | 2,726 | 918 | (71) |
| County Totals | | 57,688 | 14,530 | 2,939 | 86,118 | 18,686 | (1,217) |

Yellow Surplus/Deficit Cell indicates that without conservation the existing Reliable System/Source Capacity will be inadequate.
Red Surplus/Deficit Cell indicates that even with conservation the existing Reliable System/Source Capacity will be inadequate.
* These communities also receive water from the Bear River Water Conservancy District

Table 10 (continued)
**PROJECTED CULINARY M&I DEMAND AND SUPPLY**
**FOR PUBLIC COMMUNITY WATER SYSTEMS**
Bear River Basin (Rich County)
(acre-feet /year)

| Name | Reliable System/ Source Capacity | 2020 | | | 2050 | | |
|---|---|---|---|---|---|---|---|
| | | Population | Demand* | Surplus Deficit () | Population | Demand* | Surplus Deficit () |
| Garden City Water System | 771 | 348 | 340 | 431 | 502 | 421 | 350 |
| Laketown City Water System | 235 | 298 | 181 | 54 | 349 | 182 | 53 |
| Mountain Meadow Park Imp. District | 325 | 120 | 14 | 311 | 139 | 14 | 311 |
| Randolph City | 276 | 538 | 260 | 16 | 559 | 232 | 44 |
| Woodruff Culinary Water System | 52 | 216 | 42 | 10 | 225 | 37 | 15 |
| County Totals | | 1,520 | 837 | 822 | 1,774 | 886 | 773 |

Yellow Surplus/Deficit Cell indicates that without conservation the existing Reliable System/Source Capacity will be inadequate.
Red Surplus/Deficit Cell indicates that even with conservation the existing Reliable System/Source Capacity will be inadequate.

*Calculated demand for 2020 and 2050 include 12½ percent and 25 percent conservation respectively.
I The system capacity represents the volume of water, which when divided by the average annual water per capita use, gives the population that can be reliably served by the existing system under peak day demand conditions.
Source: 2001 M&I Water Supply Bear River Report, Utah Division of Water Resources, April, 2001.

For many communities throughout the basin, the big problem is not actually water supply but some deficiency in their water delivery system. For Logan, Nibley, Paradise, Cornish, Tremonton, North Garland, and West Corinne the problems exist now. These systems are already operating at the limits of their reliable system/source capacity. For these communities, infrastructure improvements are already needed. For other communities like Lewiston, Millville, Clarkston, Amalga, Smithfield, and Newton, planning efforts now and water conservation strategies implemented over the next 20 years can postpone the need for expensive infra-structure improvements to the ›20s and ›30s.

In Rich County no communities appear to have a serious water system deficiency. Randolph is currently operating at the limits of its system’s reliable system/source capacity. However, the city’s current water-use rate is more than twice the county average. Water conservation efforts alone would resolve any delivery problems Randolph might face over the next 50 years.

**Secondary Water**

A secondary (or dual) water system supplies non-potable water for uses that do not require high quality water, principally for watering lawns and gardens. The major purpose of a secondary water system is to reduce the overall cost of water treatment by using cheaper untreated water where appropriate, and preserving higher quality water for domestic use. Secondary systems are most suitable for areas where it is economically feasible to construct a separate storage and distribution system in addition to the potable (drinking) water system. Installing secondary systems is generally more feasible in developing areas. This allows secondary lines to be placed at the same time as other infrastructure, greatly reducing costs and inconvenience to homeowners.

Although secondary systems free up higher quality water supplies for culinary uses, people tend to use more water with them than if they are watering lawns with the drinking water system. This is because secondary systems are not metered, so people pay a flat fee for as much water as they want rather than paying for what they actually use

An economical meter is not yet available that can withstand the severe conditions of a secondary system. Secondary water is often laden with suspended grit and organic material, which wears away and clogs moving parts. Also, secondary systems are drained in the fall and left idle through the winter months. This results in a buildup of organic material, which hardens and impedes the free movement of the meter parts when the system is then refilled.

Further research into the development of a meter, so that water users can be billed according to their use, is encouraged. Another solution that may work in some instances is the installation of filters to remove grit and organic material at the head of the systems. This would help reduce clogs and wear and tear on moving parts, but does not solve the problems associated with the draining of the system during the winter months.

In the Bear River Basin the total secondary use, including commercial and institutional uses, is about 5,200 acre-feet per year (See Table 11). This represents only about 13 percent of the basin's total residential water use. Percentage-wise the Bear River Basin has one of the lowest rates for secondary water in the state. Table 12 shows the current use rate of treated drinking water and untreated secondary water for each of the basin's communities.

Table 11
**Secondary (Non-Potable) Water Use Within Public Community Systems**
Bear River Basin

| County | Residential Use (Ac-Ft/year) | Commercial Use (Ac-Ft/year) | Institutional Use (Ac-Ft/year) | Industrial/ Stockwater Use (Ac-Ft/year) | Total Secondary Use (Ac-Ft/year) |
|---|---|---|---|---|---|
| Box Elder | 754 | 186 | 594 | 0 | 1,535 |
| Cache | 2,392 | 173 | 907 | 0 | 3,472 |
| Rich | 21 | 138 | 28 | 0 | 186 |
| Total | 3,167 | 497 | 1,529 | 0 | 5,193 |

Source: *Bear River M&I Study,* Utah Water Resources, 2001

Table 12
**Municipal and Industrial Water Use**
Bear River Basin (Cache and Rich Counties)

| Community | Service[1] Population (2000) | Culinary Water Use | | Secondary Water Use (GPCD) | | Total M & I Use (GPCD) |
|---|---|---|---|---|---|---|
| | | (Ac-ft/yr) | (GPCD) | Residential | Other | |
| **Cache County** | | | | | | |
| Amalga Municipal Water System[2] | 410 | 518 | 1,128 | 16 | 0 | 1,144 |
| Benson Water Improvement District | 560 | 117 | 186 | 77 | 0 | 263 |
| Clarkston Municipal Water System | 670 | 359 | 478 | 0 | 0 | 478 |
| Cornish Municipal Water System | 250 | 94 | 336 | 11 | 21 | 368 |
| Goaslind Spring Water Works Co. | 60 | 6 | 92 | 89 | 0 | 181 |
| High Creek Water System | 85 | 26 | 277 | 11 | 0 | 288 |
| Hyde Park Water System | 3,000 | 423 | 126 | 56 | 8 | 190 |
| Hyrum City Water System | 6,185 | 2,259 | 326 | 110 | 14 | 450 |
| Lewiston City Water System | 1,736 | 569 | 293 | 14 | 4 | 311 |
| Logan City Water System | 43,594 | 13,758 | 282 | 0 | 10 | 292 |
| Mendon City Water System | 804 | 105 | 116 | 160 | 29 | 305 |
| Millville City Water System | 1,350 | 305 | 202 | 23 | 20 | 245 |
| Newton Town Water System | 690 | 129 | 167 | 111 | 34 | 312 |
| Nibley City | 1,900 | 316 | 149 | 22 | 0 | 171 |
| North Logan City Water System | 6,400 | 1,031 | 144 | 24 | 9 | 177 |
| Paradise Town Water System | 645 | 108 | 149 | 260 | 36 | 445 |
| Providence City Water System | 4,610 | 1,159 | 224 | 14 | 0 | 238 |
| Richmond City Water System | 1,938 | 383 | 176 | 67 | 18 | 261 |
| River Heights City Water System | 1,480 | 576 | 348 | 7 | 2 | 357 |
| Riverside Culinary Water Co. | 90 | 20 | 198 | 0 | 0 | 198 |
| Smithfield City Water System | 7,420 | 1,381 | 166 | 34 | 30 | 230 |
| South Cove Water Works | 73 | 12 | 146 | 73 | 49 | 268 |
| Trenton City Water System | 500 | 92 | 164 | 104 | 11 | 279 |
| Wellsville City Water System | 3,000 | 559 | 166 | 30 | 0 | 196 |
| **County Totals** | 87,450 | 24,305 | 248 | 24 | 11 | 283 |
| **Rich County** | | | | | | |
| Garden City Water System[3] | 225 | 251 | 997 | 6 | 546 | 1,549 |
| Laketown City Water System[3] | 340 | 237 | 622 | 36 | 14 | 672 |
| Mountain Meadow Imp. District | 80 | 16 | 179 | 0 | 0 | 179 |
| Randolph City | 500 | 276 | 493 | 0 | 32 | 525 |
| Woodruff Town Water System | 140 | 43 | 274 | 29 | 26 | 329 |
| **County Totals** | 1,285 | 823 | 572 | 17 | 111 | 700 |

Source: Bear River M&I Study, Utah Water Resources, 2001
GPCD - Gallons per Capita Day
1. Service population is reported by the water purveyor and may differ significantly from the 2000 Census numbers shown in Table 8.
2. High per capita use includes commercial water use at the cheese factory.
3. High per capita use is a result of high influx of seasonal tourism

Table 12 (continued)
**Municipal and Industrial Water Use**
Bear River Basin (Box Elder County)

| Community | Service[1] Population (2000) | Culinary Water Use (Ac-ft/yr) | Culinary Water Use (GPCD) | Secondary Water Use (GPCD) Residential | Secondary Water Use (GPCD) Other | Total M & I Use (GPCD) |
|---|---|---|---|---|---|---|
| **Box Elder County** | | | | | | |
| Acme Water Co. (Bear River City) | 820 | 213 | 232 | 34 | 49 | 315 |
| Beaver Dam Water System | 61 | 19 | 274 | 0 | 0 | 274 |
| Bothwell Cemetery and Water Corp. | 400 | 117 | 260 | 37 | 28 | 325 |
| Brigham City Water System | 17,000 | 5,025 | 264 | 5 | 16 | 285 |
| Cedar Ridge Subdivision | 100 | 21 | 191 | 0 | 0 | 191 |
| Coleman Mobile Home Court | 48 | 4 | 71 | 93 | 47 | 211 |
| Corinne City Water System | 646 | 92 | 127 | 76 | 50 | 253 |
| Deweyville City Water System | 350 | 87 | 221 | 34 | 64 | 319 |
| Elwood Town Water System | 625 | 185 | 264 | 28 | 0 | 292 |
| Five C's Mobile Home Park | 50 | 7 | 116 | 0 | 0 | 116 |
| Garland City Water System | 1,680 | 448 | 238 | 7 | 6 | 251 |
| Harper Ward Water System* | 150 | 20 | 182 | 182 | 0 | 364 |
| Honeyville City Water System | 1,250 | 499 | 356 | 0 | 24 | 380 |
| Hot Springs Trailer Court | 110 | 14 | 111 | 0 | 11 | 122 |
| Mantua Town Water System | 708 | 193 | 244 | 3 | 8 | 255 |
| Marble Hills Subdivision | 136 | 32 | 211 | 0 | 0 | 211 |
| Perry City Water System | 2,000 | 431 | 193 | 74 | 6 | 273 |
| Plymouth Town | 400 | 100 | 223 | 0 | 0 | 223 |
| Portage Town Water System | 250 | 50 | 180 | 107 | 0 | 287 |
| Riverside - North Garland Water System* | 1,100 | 203 | 165 | 35 | 83 | 283 |
| South Willard Water Company | 264 | 73 | 247 | 18 | 0 | 265 |
| Sunset Park Water Co. | 35 | 9 | 224 | 0 | 0 | 224 |
| Thatcher-Penrose Service District* | 700 | 159 | 203 | 50 | 0 | 253 |
| Tremonton City Water System* | 5,000 | 1,334 | 238 | 0 | 20 | 258 |
| Ukon Water Co.* | 920 | 130 | 126 | 149 | 51 | 326 |
| West Corinne Water Co. | 1,345 | 967 | 642 | 14 | 2 | 658 |
| Willard City Water System | 1,535 | 504 | 293 | 10 | 4 | 307 |
| **County Totals** | 37,683 | 10,936 | 259 | 18 | 18 | 295 |
| **Basin Totals/Average** | 126,450 | 36,063 | 255 | 22 | 15 | 292 |

Source: *Bear River M&I Study,* Utah Water Resources, 2001
GPCD - Gallons per Capita Day
* These communities also receive water from the Bear River Water Conservancy District
1. Service population is reported by the water purveyor and may differ significantly from the 2000 census numbers shown in Table 8.

Currently the statewide average residential water use is 293 gallons per capita-day (GPCD). Including the secondary water use the Bear River Basin's average is virtually the same at 292 GPCD. These numbers include indoor and outdoor residential, commercial, institutional and industrial uses. These per capita use numbers vary widely from town to town and can be used as an indicator of where water conservation might be beneficial. However, the numbers cannot be used as the sole indicator of where water supplies are being wasted. The town of Amalga, for instance, has a total residential use of 1,144 GPCD which includes 880 GPCD of industrial water use, primarily at the town=s cheese factory. Garden City and Laketown also have high per capita water use. For both of these communities though, these high numbers are a result of a seasonal influx of temporary residents and tourist.

**Agricultural**

The 1986 land-use data used in the 1992 *Bear River Basin Plan* identified the basin=s total cultivated ground as 420,000 acres. Of that total, 301,700 acres were irrigated and 118,300 acres were dry cropland. Land-use data collected in 1996 identified 306,900 acres of irrigated ground and 97,199 acres of dry-cropland for a total of 412,567 acres of cultivated ground. While there has been a slight increase in irrigated acres in the past ten years, there has been a decrease in total cultivated lands of about 7,400 acres.

The loss of 7,400 acres of cultivated land is consistent and attributable, at least in part, to a population increase of 25,000 individuals over the same relative period of time. The availability of water in the basin may have been a factor in the irrigation increases. New groundwater sources may have contributed to increased irrigation in Cache and Box Elder counties. The data indicate there has been an increase in irrigated acreage in the West Cache area around Newton. In Box Elder County, data show increased irrigation west of Corinne and in the Bothell Pocket. It is also possible that the data are inaccurate. Some discrepancy in the data is to be expected, since the same field viewed by different individuals and at different times of the year could at one time be classified as dry-cropland and then on another occasion classified as irrigated or sub-irrigated pasture. Likely the difference between the 1986 and 1996 numbers can be attributed to some combination of new development and data collection error.

The 1992 *Bear River Basin Plan* also showed Bear River water was used to irrigate 60,000 acres in Wyoming and 190,000 acres in Idaho. No effort has been made in this update to evaluate how much ground is now irrigated in these states.

Table 13
**Irrigated Cropland by County**
Bear River Basin

| County | 1986 | 1996 | Increase (%) |
|---|---|---|---|
| Summit | 2,700 | 3,094 | 14.6 |
| Rich | 73,400 | 72,374 | -1.4 |
| Cache | 119,800 | 124,218 | 3.7 |
| Box Elder | 105,800 | 107,215 | 1.3 |
| Basin Total | 301,700 | 306,900 | 1.7 |

Source: Bear River Basin Water Related Land Use Inventories, Division of Water Resources, January, 1991 & Unpublished 1996 land-use data

Table 13 compares the water-related land use data of 1986 which was used in the 1992 *Bear River Basin Plan* with the most recently collected land-use data for the basin collected in 1996. Percentage-wise the biggest change has been in Summit County were an additional 500 acres of irrigated land has raised the county totals by 15 percent. Rich County remains virtually unchanged while both Cache and Box Elder counties have experienced increases in irrigated acreage of seven to eight percent.

### Environmental

The Bear River Basin has no regulated instream flow requirements. The Hydro-power plant at Cutler Reservoir was relicensed by FERC in April of 1994, but the new license did not stipulate any instream flow requirement associated with the operation of Cutler Reservoir. The re-licensing process for the Soda, Grace-Cove, and Oneida projects is currently underway and scheduled for completion in the 2003.

Although the basin has no instream flow requirements, the larger streams have some flow present throughout the year. With the exception of small reaches of the Blacksmith Fork, which are seasonally dewatered by hydroelectric developments, the entire length of Blacksmith Fork River and Logan River are Class I and/or Class II fisheries from their respective headwaters to the canyon mouths. These rivers are unregulated, with no significant upstream storage or consumptive diversion. They are essentially subject to naturally occurring flows, and they include some of the highest quality trout fisheries in the state.

### Bear River Migratory Bird Refuge

The Bear River Migratory Bird Refuge is located 15 miles west of Brigham City, Utah, and covers 74,000 acres of marshes, uplands and open water. Established in 1928 on the delta of the Bear River in the Great Salt Lake, the refuge attracts thousands of migratory ducks, swans, geese, shorebirds, and other fowl. The site of the refuge has long been a popular stopping spot for migratory fowl. Botulism outbreaks at this location predate the existence of the bird refuge, which has suffered significant losses of birds to botulism in recent years. Botulism outbreaks typically occur in the late summer and early spring. The severity of the outbreaks appears to be influenced by the availability of water to flush the marsh system. The refuge's water right entitles it to a flow of 1,000 cfs up to a total use of 444,000 acre-feet per year. But late summer and early fall flows in the river are often significantly less than 1,000 cfs. To mitigate this problem, the refuge has expressed interest in enlarging Hyrum Reservoir. Additional storage at Hyrum Reservoir would provide the refuge with late season flows that could be used to flush the ponds and hopefully reduce botulism outbreaks.

### Recreation

The Bear River Basin has numerous large reservoirs and streams that offer many water-related recreation opportunities. All the lakes and reservoirs are used for fishing, and some of the larger ones, such as Bear Lake, Hyrum, Newton, and Mantua are popular with boaters. The upper end of Cutler Reservoir is a beautiful marshland inhabited by waterfowl and navigable by canoe or a small motorboat.

Recreational water use continues to grow in the state. From 1959 to 1998, the number of registered boats in the state multiplied just over nine times at a very steady rate[1]. While not at such a steady rate, the number of fishing licenses sold for the same period increased nearly three times[2]. Expectations are that both will continue to grow at these rates.

According to surveys done by the Division of Parks and Recreation, 95 percent of those boating at Bear Lake and Hyrum Reservoir were from Utah. The surveys also reveal that, although the number of boats grows steadily, the majority of boaters at Bear Lake and Hyrum reservoirs do not yet consider the lakes overly crowded. They did feel that limits on the number of boats out on the water should be established at Hyrum Reservoir, but not at Bear Lake. Most felt if they were not able to get their boat on the water at their first choice destination, there would still be nearby alternatives[3].

Conflicts have already surfaced between recreational use and traditional agricultural, M&I, and hydropower production. One of the natural results of reservoirs being used at their design limits is that average water levels will be lower, and at the end of summer could be quite low. Boaters at Hyrum Reservoir are noticing the fluctuations in water levels there and would like to see them remain higher[3]. Fully utilizing the reservoirs not only reduces useable surface areas but also increases the distance to the water. Similarly, when water use begins for water previously appropriated but not yet fully used, there will be reductions in stream flows which may affect fishing, kayaking, and other recreational uses.

Bear Lake's water levels are controlled by the stipulations of the Bear River Compact, which includes releases of water operations of Utah Power and Light (now Pacificorp) and their contracts with water users in Idaho and Utah. This has been a sore spot with property owners and recreational enthusiasts who desire a more stable shoreline and other recreational ideals for the lake. Although Pacificorp controls the operation of the lake and river, efforts have been made to include the homeowners and recreationists in discussions about operation of the lake.

Recreational water use has long been important in Utah and has been planned into many water projects. Recreational users are becoming more vocal in expressing their wishes. Where possible, it is important to include these users in discussions regarding new water projects or changes in the operation of existing ones. By so doing, and by everyone participating constructively, solutions to the increasingly complex situations now arising can be created.


1. Utah Division of Parks and Recreation, *State of Utah: Strategic Boating Plan*, April 2000

2. Utah Division of Wildlife Resources, license sales records

3. Utah State University Institute for Outdoor Recreation and Tourism and Utah Division of Parks and Recreation: *A Summary Report: 2001 Utah State Park Boater Intercept Survey*, March 2002

# IV. Water Conservation

The Bear River Basin's cities, towns, and industries generally enjoy an adequate water supply. Even looking as far ahead as the year 2050, most municipalities in the basin have enough water to meet their projected water needs or have an option available to acquire the needed water. For many of these communities the question has not been "When should we develop and implement a Water Conservation Plan?" but "Why?"

Drought conditions plaguing the northern portion of the state the past four years have served as a wake-up call for many Bear River Basin communities and agricultural water users. Water conservation by municipalities in the basin should be implemented as a way of life or an ethic, not merely as a drought mitigation tool. Communities should instill a conservation ethic among its consumers now, so there is a cushion of excess supply to fall back on when needed.

## BENEFITS OF WATER CONSERVATION

The primary objective and resultant benefit of water conservation is the reduction of water demand, thus allowing existing water supplies to last longer. In addition, water conservation has a number of important secondary benefits. Water conservation can:

- Delay capital investments to upgrade or expand existing water and wastewater facilities;
- Conserve energy as less water needs to be treated, pumped and distributed to the consumer;
- Lessen the leaching of chemicals and sediments into streams and aquifers through improved efficiencies; and
- Reduce stream diversions, enhancing water quality as well as environmental and recreational functions.

## UTAH'S WATER CONSERVATION EFFORT

A statewide goal has been established to reduce per capita water demand within public community systems by 12.5 percent by the year 2020 and a total of 25 percent before 2050. To guide the management of water development projects, the Board of Water Resources has issued a policy statement supporting conservation and the "wise use" of water. The Board's policy requires communities petitioning them for financial aid to: (1) develop a water conservation plan, (2) establish a time of day watering ordinance, and (3) develop a progressive water rate structure.

## Water Conservation Plans

The state's Water Conservation Plan Act requires all water conservancy districts and water retailers serving more than 500 connections to prepare Water Management and Conservation Plans. These were to be submitted to the Division of Water Resources by April 1999. These plans should present effective water conservation measures that can be employed to reduce municipal water use. Leak detection programs are recommended to find other unmetered water that is lost in the system. For most communities, unmetered losses will probably go unchecked as long as the existing supplies are adequate. Competent planning helps water system managers foresee the crises and reduce system losses through metering and system maintenance. Also, programs that improve the efficiency of large landscapes, such as parks, schools, and cemeteries, can realize significant water reductions through careful planning without sacrificing aesthetic appeal.

## Governor's Water Conservation Team

The Governor's Water Conservation Team's web site (www.conservewater.utah.gov) is hosted by the Utah Division of Water Resources. This informative web site contains many features that are designed to help Utahns use water inside and outside their homes wisely. Some of the web site's features include: a monthly lawn watering recommendation, a customizable landscape watering guide, a comprehensive list of tips, a water conservation events calendar, and copies of the team's radio and TV ads promoting conservation.

## Studies

The Utah Division of Water Resources has several studies underway to assess consumer water demand. The multi-family residential water demand analysis will determine how water is used indoors in apartments, condominiums, and other multi-family settings. These numbers will be beneficial because they can be used to generalize indoor water consumption rates.

A wide range of water conservation methods has been employed in various regions of the arid western United States. The practices used there are often useful to Utah. Studies are underway to test the adaptability of specific practices to Utah conditions. For example, the division has an irrigation controller study underway. The new controller has been installed in a few homes in the Salt Lake Valley to assess its water saving capabilities. The controller incorporates evapotranspiration (ET) rates into each irrigation zone's specific parameters, and recalculates an efficient irrigation schedule each time it receives the localized evapotranspiration rate from a satellite. This study will make it possible for the division to predict water savings from the installation of ET-based irrigation controllers.

A 1995 publication of the Utah Water Conservation Advisory Board offered a number of programs and suggestions for effectively conserving M&I water. These recommendations include: 1) development of water management and conservation plans by major water provider agencies, 2) reduction of secondary water use by replacing high water consuming landscaping with xeriscaping or landscaping with reduced water needs, 3) better overall management of water intensive businesses and large conveyance systems, and 4) implementation of incentive based water pricing policies.

## WATER CONSERVATION MEASURES

An effective water conservation program should contain a variety of water-saving measures, including incentive pricing, ongoing leak detection and repair programs, commercial and residential water use audits, and an effective water metering program. But the most effective residential water use program that can be implemented in the basin, and throughout the state, is to decrease the over-watering of residential, commercial, and institutional landscapes. Most Utah residents over-water their landscapes by 20-50 percent. Local water conservation programs should emphasize the reduced use of water on landscapes.

### Indoor Conservation

Because snow lies on the ground for several months out of the year, Utahns have an opportunity to focus more on indoor water conservation. Residents can install water-saving toilets and showerheads, check plumbing for leaks, and take shorter showers. Newer large appliances, such as washing machines and dishwashers are designed to use less water than older models. Even so, automatic dishwashers and washing machines should be run only for full loads. Residents can also avoid having faucets run unnecessarily for shaving, brushing teeth, or rinsing vegetables, dishes, and other items.

### Outdoor Conservation

Outdoor water use for landscape irrigation accounts for over 60 percent of all residential water use. This water can be supplied by either the primary culinary water system or a secondary water system.  Secondary supplies reduce the demand for the more expensive culinary water, thereby reducing overall water costs.  The use of secondary water does not, however, reduce overall water use.  In fact, the availability of un-metered, low cost, secondary water often results in over-watering of the landscape.  It is also recommended that, whenever feasible, secondary water systems should be metered.

Regardless of the cost, many people tend to over water lawns and gardens as much as 100 percent.  Studies have revealed that automated home sprinkler systems with timers result in the greatest over-watering of landscapes.  Homeowners that water by hand, dragging a hose and sprinkler, tend to water only the areas that need to be watered.  Homeowners that have an in-ground sprinkler system that is manually operated tend to water only when the lawn appears to need water.  However, many landscape owners with fully automated systems tend to set the timer to provide enough water for the hottest days of the summer and then leave the sprinkler at that setting.

Educating homeowners to periodically adjust their irrigation system's application rate to coincide with seasonal weather changes can achieve significant water savings.  Perhaps a more effective measure is to replace the system controller with a more sophisticated device capable of automatically adjusting the application rate to reflect seasonally-changing landscape water needs. Conservation measures that do not require the homeowner to adjust their habits are easier to implement and more effective.  Irrigation controllers linked with a local weather station that automatically adjust application rates to the water requirements of the landscape are a good way to implement water efficiency practices without changing personal water use habits.  These types of measures are called "hard fixes", and also include replacing or repairing broken sprinkler heads, improving system uniformity, or maintaining proper irrigation pressures.

Water conservation can also be achieved by changing residential landscaping paradigms. Grass areas should be designed so they are easy to care for, will actually be utilized, and can be irrigated efficiently.  The Utah State University Extension Service has information on low water consuming plants and vegetation that in many instances offer a suitable alternative to grass. Individuals interested in implementing any of these types of water conserving landscapes can get ideas from the Center for Water-Efficient Landscaping at Utah State University, the demonstration landscapes at the Greenville Farm Demonstration Garden (1800 North 800 East, Logan), the Utah State Botanical Gardens in Kaysville, or the Jordan Valley Water Conservancy District in the Salt Lake Valley.

The Division of Water Resources encourages water conservation through low water-use landscaping. Principles of low water-use landscaping include limiting lawn areas, grouping plants with similar water needs, using plants adapted to local climate conditions, irrigating only when needed, watering during morning or evening hours, mowing the lawn at a longer length, and improving soils in shrub and garden areas by using mulches.

**Metering**

Accurate measurement of water is an important part of any pricing structure and encourages conservation in several ways. Not only is each user assured a fair and equitable distribution of resources, it is also a more business-like way to operate a system and maintain records. When users pay according to the quantity of water they actually use, there is a built-in incentive to conserve.

Most community water systems are metered. However, properties such as city parks, golf courses, and cemeteries often are not. Metering all connections is an essential component in assessing the costs within a water system. Metering can also aid in water accounting, and can detect losses within the system. (See Section Five for a discussion of metering secondary water systems.)

**Incentive Pricing**

Pricing policies are a means of reducing per capita water use. Uniform rate structures (a constant price for each unit of water) provide little incentive for consumers to conserve unless the price is set at a high level. Decreasing block rate structures (lower unit prices for larger volumes used) provide an incentive to increase use. “Take or pay” contracts, which provide water purveyors with a guaranteed revenue stream, do not promote conservation below the contracted amount of water. Increasing block rate structures provide a greater conservation incentive for consumers. Under this pricing policy, consumers experience an increasing unit price for higher water consumption. To be effective, the increase in price between blocks must be substantial.

Table 14 shows water rates for selected communities in the Bear River Basin. Communities such as Millville City and North Logan City (Table 14) show strong economic pricing policies, completely separating any variable water use from the base rate. Doing this allows the water agency to cover fixed costs through fixed charges on the water bill, and charge for variable use from per-unit charges on the bill. This type of rate structure allows a more accurate cost-of-service accounting and stabilizes revenue.

Table 14
**Water Rates for Selected Communities**
All quantities measured in thousands of gallons (Gal)

| Agency | Base Rate | Limit | Block 1 | Limit | Block 2 | Limit | Block 3 | Limit | Block 4 | Limit |
|---|---|---|---|---|---|---|---|---|---|---|
| Garland City | $12.75 | 15 | $0.50 | Unlit | | | | | | |
| Hyde Park City | $26.00 | 10 | $0.50 | 50 | $1.00 | Unlim | | | | |
| Hyrum City | $8.00 | 10 | $0.45 | 50 | $0.65 | Unlim | | | | |
| Logan City | $8.95 | 3 | $0.55 | Unlim | | | | | | |
| Millville City | $17.00 | 0 | $0.60 | Unlim | | | | | | |
| Newton Town | $15.50 | 20 | $0.30 | Unlim | | | | | | |
| North Logan City | $7.11 | 0 | $1.57 | Unlim | | | | | | |
| Perry City | $15.50 | 15 | $0.95 | Unlim | | | | | | |
| Portage | $15.00 | Unlim | | | | | | | | |
| Providence City | $19.25 | 10 | $0.40 | 40 | $0.65 | 60 | $1.15 | Unlim | | |
| Richmond City | $19.60 | 10 | $0.72 | Unlim | | | | | | |
| River Heights | $22.20 | 8 | $0.40 | 108 | $0.45 | 208 | $0.50 | 308 | $0.55 | 408 |
| Smithfield City | $8.00 | 6 | $0.50 | Unlim | | | | | | |
| South Willard | $22.00 | 17 | $0.75 | Unlim | | | | | | |
| Tremonton City | $13.00 | 13 | $1.13 | Unlim | | | | | | |

Assuming an average family of four and using the respective per capita use rates (See Table 12), the price per 1000 gallons of water for the selected communities of Table 12 range between $0.54 per 1000 gallons to $1.98 per 1000 gallons, with the average rate price of $0.87 per 1000 gallons

Including more blocks within a rate structure is better economically and politically, as the consumer using large amounts of water will be paying the costs associated with that level of use. However, the increase between blocks must be substantial to encourage efficient water use. The increase from Block 3 to Block 4 in Providence City's pricing structure, from $0.65 per thousand gallons to $1.15 per thousand gallons, is a level of increase found effective in influencing water use. Inconsequential rate increases among blocks will have no significant effect on water consumption.

Setting water prices to encourage more efficient water use requires consideration of several principles. They are as follows:

- **Encourage lower water use without causing a shortfall in system revenues.** To avoid revenue shortfalls, the rate structure should provide a consistent base charge that is set to cover all fixed cost - those costs that do not vary with the amount of water delivered. It will cover all debt service, insurance, personnel, etc. which must be paid regardless of how much water is taken from the system. All customers pay this charge whether they use any water or not. Variable costs - those costs that vary with the amount of water delivered - should be covered by the volume charge, or what is often called the overage rate. Revenue from this part of the rate structure will vary with the amount of water delivered to customers and should cover the costs of all energy, treatment chemicals, etc. used in delivery of the water.

- **Identify water waste, reward efficient use and penalize excessive use**. In larger communities with more sophisticated billing and a customer relations staff, water use targets can become part of the conservation program with the combination of available weather station technologies and computer billing programs. With targets in place for each customer, water over-use is readily identified, as are exemplary water efficient behaviors.

- **Produce additional revenue from penalty rates that can be used to fund needed water conservation programs.** Water conservation comes at a cost. This cost can be added to the commodity portion of the rate, raising the price of each unit of water delivered to the customer's meter. Additional revenue generated by the penalty portions of the rate structure should be placed in a dedicated account and used to pay for water conservation programs.

- **Supported by a water bill that clearly communicates the cost of wasted water directly to the customer.** The ideal water bill would present the following information with each issuance: a target usage based on weather, landscaped area, and indoor water use; the amount of water delivered above (or below) the target use; and the rate (price) charged for the target usage and any excess. With this information, the customer is equipped with the information needed to make informed decisions about such things as landscape changes, spraying the driveway, washing the car, filling the pool, and long showers.

- **Supported by a person or staff who can respond to customer calls for help in reducing water usage.** Individual home owners who desire to stay within their targets and request assistance can be given a soil probe and taught to properly irrigate their lawns and gardens through home water use audits. Water audits for golf courses, school grounds, and other large areas can be provided by trained personnel or by private or extension service irrigation specialists.

Water rates can be structured in several ways, each of which upholds the above principles in whole or in part. A series of three tables is use to demonstrate two common rate structures and one that is relatively new to system managers and customers in Utah.

Table 15
**Seasonal Block Rate Structure**
All quantities are measured in thousands of gallons (Kgal)

| Month | Usage | Base Rate | Regular Rate $1.00 | Seasonal Rate $1.50 | Total |
|---|---|---|---|---|---|
| Jan | 5 | $10.00 | $5.00 | | $15.00 |
| Feb | 6 | $10.00 | $6.00 | | $16.00 |
| Mar | 9 | $10.00 | $9.00 | | $19.00 |
| Apr | 13 | $10.00 | $13.00 | | $23.00 |
| May | 38 | $10.00 | $38.00 | | $48.00 |
| Jun | 48 | $10.00 | | $72.00 | $82.00 |
| Jul | 53 | $10.00 | | $79.50 | $89.50 |
| Aug | 48 | $10.00 | | $72.00 | $82.00 |
| Sep | 29 | $10.00 | $29.00 | | $39.00 |
| Oct | 13 | $10.00 | $13.00 | | $23.00 |
| Nov | 9 | $10.00 | $9.00 | | $19.00 |
| Dec | 6 | $10.00 | $6.00 | | $16.00 |
| TOTALS | 277 | $120.00 | $128.00 | $223.50 | $471.50 |

The seasonal block rate structure increases the price of water during times of higher demand when most peaking problems and wear and tear on the infrastructure occur. Salt Lake City Public Utilities implemented a seasonal block rate in 1994 for the summer months of July and August, and continue this program with great success. Table 15 shows an example of seasonal rate structures.

Table 16
**Increasing Block Rate Structure**
All quantities are measured in thousands of gallons (Kgal)

| Month | Usage | Base | Overage | | | |
|---|---|---|---|---|---|---|
| | | | 0 - 10 | 10 - 20 | Over 20 | |
| | | | $0.90 | $1.00 | $1.25 | Total |
| Jan | 5 | $10.00 | $4.50 | | | $14.50 |
| Feb | 6 | $10.00 | $5.40 | | | $15.40 |
| Mar | 9 | $10.00 | $8.10 | | | $18.10 |
| Apr | 13 | $10.00 | $9.00 | $3.00 | | $23.00 |
| May | 38 | $10.00 | $9.00 | $10.00 | $22.50 | $51.50 |
| Jun | 48 | $10.00 | $9.00 | $10.00 | $35.00 | $64.00 |
| Jul | 53 | $10.00 | $9.00 | $10.00 | $41.25 | $70.25 |
| Aug | 48 | $10.00 | $9.00 | $10.00 | $35.00 | $64.00 |
| Sep | 29 | $10.00 | $9.00 | $10.00 | $11.25 | $40.25 |
| Oct | 13 | $10.00 | $9.00 | $3.00 | | $22.00 |
| Nov | 9 | $10.00 | $8.10 | | | $18.10 |
| Dec | 6 | $10.00 | $5.40 | | | $15.40 |
| TOTALS | 277 | $120.00 | $94.50 | $58.00 | $145.00 | $416.50 |

The increasing block rate structure is more complex but simple to administer if the water supplier has the proper computer billing software. Table 16 shows how this rate structure works in a hypothetical family for one year.

The seasonal block and increasing block rates can be constructed to encourage efficient water use without causing a shortfall in revenue. This can be done by setting the base charge to consistently cover fixed costs and setting the commodity charge to cover variable costs.

However, neither rate structure has the ability to identify wasteful or inefficient behaviors. In both situations it is possible to create a water bill to educate the customer regarding how much water is being used. A charge for each overage may encourage more efficient use. Both rate structures can be supported by staff that is able to respond to customer calls for help in reducing water use.

Table 17
**Ascending Block Rate Structure**
Usage and Target Usage measured in thousands of gallons (Kgal)

| Month | Usage | Base | Target Usage | Et.[1] | Rate 1[2] @ $.83 | Rate 2[3] @ $1.10 | Rate 3[4] @ $2.20 | Rate 4 $4.40 | Rate 5[5]@ $8.80 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Jan | 5 | $10.00 | 10 | 0 | $4.15 | | | | | $14.15 |
| Feb | 6 | $10.00 | 10 | 0 | $4.98 | | | | | $14.98 |
| Mar | 9 | $10.00 | 10 | 0 | $4.98 | $3.30 | | | | $18.28 |
| Apr | 13 | $10.00 | 28 | 2.0 | $10.79 | | | | | $20.79 |
| May | 38 | $10.00 | 39 | 3.3 | $19.47 | $16.06 | | | | $45.53 |
| Jun | 48 | $10.00 | 47 | 4.2 | $23.41 | $20.68 | $2.20 | | | $56.29 |
| Jul | 53 | $10.00 | 50 | 4.6 | $24.90 | $22.00 | $6.60 | | | $63.50 |
| Aug | 48 | $10.00 | 47 | 4.2 | $23.41 | $20.68 | $2.20 | | | $36.29 |
| Sep | 29 | $10.00 | 32 | 2.5 | $15.94 | $10.78 | | | | $36.72 |
| Oct | 13 | $10.00 | 28 | 2.0 | $10.79 | | | | | $20.79 |
| Nov | 9 | $10.00 | 10 | 0 | $4.98 | $3.30 | | | | $18.28 |
| Dec | 6 | $10.00 | 10 | 0 | $4.98 | | | | | $14.98 |
| Totals | 277 | $120.00 | 321 | 22.8 | $152.78 | $96.80 | $11.00 | | | $380.51 |

Days in Billing Period = 30    Appl. Effic. = .65    Indoor use = 70 gpcd
Irr. Area = .21 ac.    Family Size = 5
1) Estimated Evapotranspiration in inches
2) Conservation Use
3) Normal Use
4) Inefficient Use
5) Irresponsible Use

The ascending block rate provides a water use target for each customer based on size of landscaped area, number of people, and plant water needs measured by weather stations. Irrigation application efficiency is also accounted for in setting the targets. Table 17 shows how this rate structure works in a hypothetical family for one year.

### Commercial Water Conservation

Water conservation within commercial organizations is also essential and can provide the business with extra revenue formerly wasted on excess water use. Some commercial endeavors, such as laundries, have already implemented water conservation to reduce energy costs. Because of the common disconnect between the business owner and the landscape irrigation practices, commercial sites are often over watered by a significant amount. Water pricing incentives would likely further motivate commercial businesses to reevaluate their water conservation efforts.

### Industrial Water Conservation

Water pricing incentives will likely have a positive impact upon discretionary water use within industries that receive water from public water systems. Installing separate water meters for indoor and outdoor use is one way to analyze water use more accurately. Making production processes more water-efficient can also save large amounts of discretionary water.

### Education

An effective water conservation program requires an active water education component. Since everyone is a water user, water education is directed at changing individual attitudes and habits. Every public agency or private organization concerned with planning, developing or distributing water can make a difference through efforts in this regard. In Utah, water conservation materials are regularly mailed to schools, water-user organizations, and individuals upon request. These materials are part of a water education program sponsored by the Division of Water Resources. Other conservation objectives of the division's education program include water-efficient landscaping, proper gardening techniques, and the promotion of more efficient appliances such as low-flow toilets and low-flow showerheads. Assistance in implementing conservation-oriented water rate structures is also available. Water educational programs will continue to be directed at students in elementary and secondary schools through a consortium of public education and water agencies throughout the state.

# V. Water Transfers and Efficient Management of Developed Supplies

Using existing developed water supplies efficiently is an important element in successfully meeting Utah's future water needs. As competition for limited water supplies increases, the value of the existing water supplies also increases. This economic incentive leads to the transfer of water from one use to another. This chapter discusses the transfer of agricultural water to higher value uses as well as water management strategies, agricultural water-use efficiency, conjunctive use of surface and groundwater, aquifer storage and recovery, secondary water systems, cooperative water operating agreements, and water reuse.

## AGRICULTURAL WATER TRANSFERS

Agriculture uses about 94 percent of the presently developed water in the basin. Municipal and industrial (M&I) uses account for the other six percent. Over the next 50 years this ratio is expected to change to an 89 percent to 11 percent split as M&I uses grow.

To date, not a lot of agricultural water has been transferred to M&I use. While, there will be more in the future it is estimated that only 5 percent of the water now used for agriculture will be converted over the next 50 years. The change will not be nearly as large as it will on the Wasatch Front. Most existing M&I systems have sufficient supplies to take them well beyond the year 2020 and many beyond 2050. Where existing supplies are inadequate to address the growth of the next 20 years, there are developable groundwater and/or surface water sources. However, the development of surface water sources will likely require storage, making the new water expensive. In those cases, agricultural water transfers may prove to be a less expensive alternative compared to reservoir construction. In Box Elder County, the Bear River Water Conservancy District has acquired agricultural water in the Bothwell Pocket with the plans to convert this water to M&I use over time to meet the growth that is projected within the district.

### Temporary Water Leases

A non-permanent type of agricultural to M&I water transfer is a conditional or "dry year" transfer. Conditional transfers are temporary water leases that are contingent upon certain conditions. Such transfers often have arrangements that define an “interruptible supply” that may periodically be used, under certain conditions such as a drought or other emergency, by another user.[2] Leasing irrigators’ surface water rights was used extensively in California to stave off the effects of the 1987-1992 drought. Although there is only one surface treatment plant in the basin, it may be possible to exchange surface water rights for temporary groundwater rights in other parts of the basin.

## AGRICULTURAL WATER-USE EFFICIENCY

This section discusses the major benefits of agricultural water-use efficiency, investigates some of the complexities that must be carefully considered in order for an efficiency project to be successful, and explores some of the irrigation methods that can be employed to increase agricultural water-use efficiency.

### The Benefits of Water-Use Efficiency

The two major benefits of agricultural water-use efficiency are: (1) increased agricultural productivity and (2) improved water quality. In some instances, a third benefit of reduced stream diversion may also be realized. A short discussion of these benefits follows.

#### *Increased Agricultural Productivity*

Unless increasing the productivity of farms is a central focus of agricultural water-use efficiency, it will likely be difficult to gain the needed support of irrigators. Increasing agricultural productivity should be a high priority of any efficiency project. If a project fails to benefit the farmers who are expected to implement it, it will be difficult for the project to succeed.

Proper implementation of agricultural water-use efficiency typically increases crop yields 15 to 30 percent. Usually, irrigation system improvements first focus on the conveyance network, followed by on-farm improvements. A combination of both is necessary to achieve the higher yields. This process may lead to increased depletions and ultimately reduce the return flow or groundwater recharge.

*Improved Water Quality*

Improved irrigation efficiency can alleviate water quality problems. Reduced conveyance seepage losses will result in less salt pickup during subsurface transport. Reduced tailwater runoff (return flows) from irrigated fields will result in less soil erosion and fewer adsorbed phosphate fertilizer being transported to downstream water bodies. Reduced deep percolation losses below the crop roots will also result in less transport of nitrate fertilizer to the groundwater and less salt pickup.

*Reduced Water Diversions*

Reducing water diversions may be a benefit of agricultural water-use efficiency. Increased flows and improved quality in streams contribute to the health of riparian and wetland ecosystems, as well as fish and wildlife. It may also free up water for other uses. However, for many irrigation systems, the water savings from on-and off-farm improvements will likely be used to satisfy any water deficiencies within the system. As a consequence, the full benefits of reduced diversions often affect only nearby stream segments, and not the entire river system. This is especially true during the peak irrigation demand season (mid-June to mid-August), and also often late in the irrigation season when farms are more likely to suffer from a lack of a reliable supply.

**Irrigation Efficiency Methods**

Once the appropriateness of efficiency measures in an area is determined, actual implementation of these measures can proceed. A host of irrigation efficiency technologies exist for almost any imaginable situation. Typical irrigation systems include storage reservoirs, conveyance through open canals or distribution piping, and on-farm application facilities and equipment. These systems can "lose" between 20 and 65 percent of the water diverted into them to seepage and evaporation, although losses are typically between 35 and 55 percent. Clearly, technology or management improvements can result in an increase of total system efficiency and a reduction in water loss.

The effectiveness of canal operations can be improved by moving from a fixed rotation schedule, which supplies water to irrigators at pre-specified times, to an on-demand scheduling approach which supplies water when an irrigator requests. The amount of available storage dictates the degree to which on-demand scheduling can be implemented.

Automated canal operations, utilizing a network of water level and flow measurement devices as well as gate control mechanisms, provide the capability to monitor and manage entire irrigation systems through telemetry and computerized equipment. Remotely operated systems usually require considerable investments in technology and personnel, but can realize substantial improvements in water efficiency for large irrigation systems.

Many on-farm application technologies also exist which have the potential to improve irrigation application efficiency. For example, pressurized irrigation can be employed, such as sprinkle irrigation (designed for 80 percent irrigation application efficiency) or trickle (drip) irrigation (designed for 95 percent application efficiency). The appropriateness for these methods depends upon local soils and topography, along with the farm economics of the crops to be grown.[1,2,3]

Other technologies, such as laser land-leveling and advances in surface irrigation hydraulics, make it possible for traditional surface (flood) irrigation to be as efficient and in some cases even more efficient than sprinkler irritation. With proper management laser land-leveling can result in practically no tailwater runoff (return flows) and greatly reduce deep percolation.

## SECONDARY OR "DUAL" SYSTEMS

Secondary water systems, also known as "dual" water systems, provide untreated water for outdoor uses, primarily lawn-watering and gardening. The construction of these systems frees up existing treated water for drinking water purposes. Because these systems require the construction of an additional water conveyance infrastructure, they can be expensive. Since retrofitting can be expensive, it is doubtful that many new secondary water systems will be constructed in developed areas of existing communities. In areas of new construction where an adequate secondary water supply exists, secondary systems may prove economical. Secondary water systems may also prove economical as a retrofit if the construction costs are less than the cost of enlarging the M&I system to meet future needs and the costs associated with treating the water to drinking water standards.

While there may be an economic incentive for building secondary water systems based on the cost of high quality treated water conserved, studies have shown that "secondary" systems do not promote overall water conservation. Since secondary water is seldom metered, consumers tend to use more of it when watering their lawns. Secondary systems should be metered when water quality allows. The development of a new inexpensive secondary water meter is needed and would enable the metering of secondary water systems and the implementation of pricing structures that would help control use.

## MEASUREMENT

Measurement or metering of flows is important in both the agricultural setting and the urban setting. Accurate measurement of water use encourages conservation in several ways. Not only is each user assured a fair and equitable water distribution and a corresponding financial assessment, but it is also a more business-like way to operate a system and maintain records. When users pay according to the quantity of water they actually use, there is a built-in incentive to conserve, whether the use is irrigation, municipal, or industrial. Accurate metering can also help to identify and quantify system losses. Most community water systems are metered. However, there are properties, such as city parks, golf courses, and cemeteries, which lack meters.

## <u>WATER REUSE</u>

One effective method of conserving existing water supplies is to establish a system of reuse. To some extent, current water supplies are reused as return flows from irrigation fields and effluent from wastewater treatment plants flows back into the natural waterways and aquifers. Many communities in the United States have safely and successfully used reclaimed wastewater for numerous purposes, including:

<u>Landscape irrigation</u>: reclaimed sewage effluent can be used to irrigate parks, golf courses, highway medians, and residential landscapes.
<u>Industrial process water</u>: industrial facilities and power plants can use reclaimed water for cooling and other manufacturing processes.
<u>Wetlands:</u> reclaimed water can be used to create, restore, and enhance wetlands.
<u>Commercial toilet flushing</u>: reclaimed water can be used to flush toilets in industrial and commercial buildings including hotels and motels.

No direct reuse or recycling of wastewater for drinking water use has been attempted in the United States, except in emergency situations. However, reuse of wastewater for industrial, agricultural, and other uses such as golf course watering is becoming more common. In the future, water reuse may become a more valuable tool in conserving the existing water supply.

Water Reuse in Utah is regulated by the Division of Water Quality under Title R317-1-4 of the Utah Administrations Code. These rules state the conditions under which wastewater can be reused. Currently there are no reuse projects in the Bear River Basin.

The appropriateness of any individual reuse project will depend upon the effect that it will have on existing water rights. Often, downstream users depend upon the wastewater effluent to satisfy their rights. The effects on downstream water rights need to be addressed as part of the feasibility of any reuse project.

In some parts of the world rainwater is collected and used to water lawns and garden areas. In some instances even gray water (household water from tubs and sinks but not toilets) is collected for use outdoors. These rather extreme forms of water conservation may one day have an application in the basin, but at the present time water supplies are abundant enough and inexpensive enough to render these approaches economically unviable. At the present time and given the present cost of water, a collection system for either rainwater or gray water would, by far, exceed the cost of the water saved.

## CONJUNCTIVE USE OF SURFACE AND GROUNDWATER SUPPLIES

In areas where available water resources have been nearly fully developed, optimal beneficial use can be obtained by conjunctive use of surface water and groundwater supplies. This involves carefully coordinating the storage, timing, and delivery of both resources. Surface water is used to the fullest extent possible year round, while groundwater is retained to meet demands when streamflows are low[4]. Generally, the total benefit from a conjunctively managed basin will exceed that of a basin wherein the resources are managed separately. Additional benefits of conjunctive use may include:[5] better management capabilities with less waste; greater flood control capabilities; greater control over surface reservoir releases; and more efficient operation of pump plants and other facilities.

In evaluating alternatives for conjunctive use, water managers should view groundwater as more than a supplement to surface suppliers. In particular, managers should assess the value of groundwater in optimizing storage capacity, enhancing transmission capabilities, and improving water quality of the system.

## AQUIFER STORAGE AND RECOVERY

Another possible means of developing surface water and storing it for future M&I use, is Aquifer Storage and Recovery (ASR), also known as artificial groundwater recharge. The approach with ASR is to use a primary groundwater aquifer to store water supplies. Some utilities use ASR to store treated surface water during periods of low water demand, and provide the recovered water later to meet peak daily, short-term or emergency demands. Many communities have found ASR systems to have numerous advantages; these include: [6]

- Enhanced reliability of existing water supplies as aquifer storage provides a back-up supply during emergencies such as chemical spills or broken pipelines.
- Increased flows in streams to support fish, riparian habitat, and aesthetic purposes during periods of low summer flow.
- Decreased vulnerability to evaporation and contamination.

Aquifer storage and recovery requires minimal structural elements and has the ability to convey water from the point of recharge to any point of use near the aquifer without the extensive canals, piping and appurtenances. Aquifers also provide a water quality benefit since they have a natural ability to filter sediment and remove some biological contaminants. Unit costs for ASR facilities generally range from about $200,000 to $600,000 per million gallons per day (mgd) of recovery capacity, with an overall average of about $400,000 per mgd (or $360 per acre-foot per year).

To maintain groundwater quality, it is necessary to treat surface water to drinking water standards before injecting it into a primary drinking water aquifer. Any entity using ASR is required to comply with regulations established and administered by the Division of Water Quality. They also need to file a water right application with the Division of Water Rights.

Brigham City initiated a pilot study ASR program in 1998. The program proved very successful and has continued since that time. Brigham City's primary water source is six springs in Mantua. The water from these springs in collected and delivered by pipe to the town of Brigham City about three and a half miles down canyon. During the winter months the flow from the springs exceeds the towns current water needs. The excess flow during the winter season is chlorinated and injected into the local groundwater aquifer. At the present time Brigham City injects about 1.5 million gallons per day (4.6 acre-feet/day) for 180 days. During the summer months the city then withdraws 800 gallons per minute (3.5 acre-feet /day) from the aquifer. Because the collection and delivery system was already in place the project was started with a relatively low capital cost of about $165,000. There may be other opportunities in the basin for ASR to enhance M&I supplies, particularly in the Box Elder County area.

Jordan Valley Water Conservancy District, in Salt Lake County, recently completed an aquifer storage and recovery system that now produces an average of 5,800 acre-feet of water per year. The project treats spring runoff water from the canyons in the southeast portion of Salt Lake County and injects the treated water into the aquifer. The water is then pumped from wells later in the year as needed to meet demand.

## COOPERATIVE WATER OPERATING AGREEMENTS

Temporary localized water shortages may occur as the result of system failures or as a result of growth that approaches the limits of the water system or supply. A cooperative approach to water resource and system management at the local and regional level can help water managers prevent shortages better and cope with them if they do occur. This is often accomplished without committing the large sums of money to capital expenditures for new supplies that would otherwise be required. In its simplest form, connections are installed adjoining water systems and an agreement is made regarding the transfer of water between them.

Some of the many benefits to water suppliers who cooperatively operate their water systems in this way are:

- Greater flexibility in meeting peak and emergency water demands.
- Better scheduling options associated with regular maintenance and repair programs.
- Decreased capital costs as construction of new projects can be delayed.
- Increased opportunities for joint improvement projects as cooperative relationships are formed and resources more fully utilized.

At an institutional level, the manager of the cooperating systems must agree on such things as water transfer strategies, plans for interconnections, water conservation enforcement policies, and emergency management plans. Perhaps the most significant institutional challenge is to remove the psychological hurdle of taking water from one system and giving it to another.  To do this, education of the public on the concept and benefits of a regional, cooperative approach to system management will often be necessary. The Utah Division of Drinking Water is working towards this goal by helping small local water systems consolidate their water treatment operations.

## NOTES

[1]Israelsen, O. W., and V.E. Hansen, *Irrigation Principles and Practices,* (New York: John Wiley and Sons, Inc., 1962), 447.

[2]Jensen, M.E. (ed.), *Design and Operation of Farm Irrigation Systems.*  ASAE Monograph No. 3. (St. Joseph, MI: American Society of Agricultural Engineers, 1980), 829.

[3]Merriam, J.L. and J. Keller, *Farm Irrigation System Evaluation:  A Guide for Management,* (Logan: Utah State University, 1978), 271.

[4]Gorelick, S. M<. (ed.), "Conjunctive Water Use:  Understanding and Managing Surface Water-Groundwater Interactions," *Int. Assoc. Hydrol. Sci. Publ.*, (1986), 156&547.

[5]Hall, W., notes on Integrated River Basin Planning and Management prepared for the Central Water Commission, Government of India, the U.S. Agency for International Development, and Harza Engineering Company, in support of the Integrated Water Resources Planning Project, (New Delhi, India, 1990), 120.

[6]City of Salem, Oregon, "Salem Oregon's Aquifer Storage and Recovery System." Retrieved from the Internet web Page: www.open.org/~spubwork/water/asr.html.

## VI. Water Development

Generally speaking, existing water supplies are adequate throughout the basin for at least the next couple of decades. Throughout Cache County, the water supply should take them well into the 2040s, while Box Elder County=s present supply should meet the county needs through 2025. However, these projections are based upon a countywide condition for average water years and average yearly demand. On a micro scale and during drought conditions, some systems are hard pressed even now to provide adequate flows during periods of peak demand. Consequently, many local water providers are continually investigating additional water development options.

As growth takes place over the next couple of decades, local water suppliers will continue to develop available water sources. In Cache County, this will mean additional groundwater development by existing municipal water purveyors. In Box Elder County, where groundwater supplies are not so abundant, local water purveyors (primarily Bear River Water Conservancy District) will probably have to be a bit more creative in providing for future water needs. To hold costs down, the Bear River Water Conservancy District and other Box Elder County water providers will likely continue to acquire existing water rights through the willing buyer/willing seller process and develop whatever groundwater supplies might be available.

### BEAR RIVER DEVELOPMENT PROJECT

Development of the Bear River has been studied for many years. In the 1950s, the Bureau of Reclamation identified and studied several potential reservoir sites on the lower Bear River and its tributaries. During the high precipitation and runoff years of the early 1980s, the Utah State Legislature directed the Utah Division of Water Resources to investigate controlling the level of the Great Salt Lake through storage and diversion of water from the Bear River. These investigations spawned renewed interest in the development of Bear River water, especially as the state entered the drought period of the late 80s and early 90s.

In 1991 the Legislature passed the Bear River Development Act. The Act directs the Division of Water Resources to develop 220,000 acre-feet of the waters of the Bear River and its tributaries allocated as follows: 50,000 acre-feet each to Jordan Valley Water Conservancy District and Weber Basin Water Conservancy District; 60,000 acre-feet to Bear River Water Conservancy District, and 60,000 acre-feet to water users in Cache County. The division is to plan, construct, own, and operate reservoirs and facilities on the river as authorized and funded by the Legislature and to contract-out the developed water to these four entities as specified in the Act.

Based on revised estimates of water needs, public response, and cost analysis, the Utah Division of Water Resources' current plan for Bear River development is as follows: (1) modify the existing operation of Willard Bay by agreement with Weber Basin Water Conservancy District to store surplus Bear River Water, (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 as the demand for additional water continues to increase.

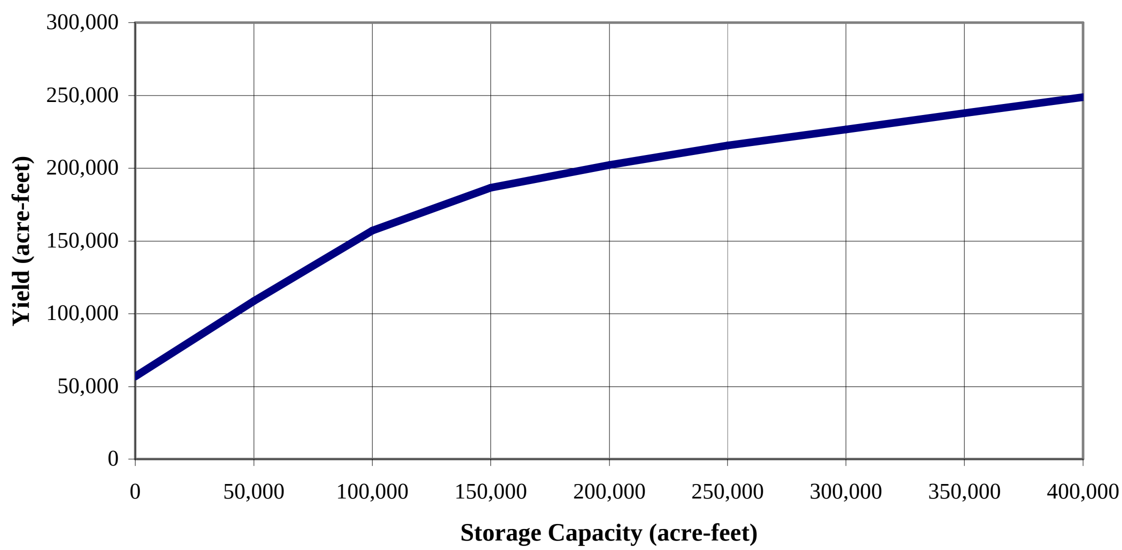
Parts 1 through 3 would be timed to deliver water to the Wasatch Front within the next two decades (based on contracts with Jordan Valley Water Conservancy District and Weber Basin Water Conservancy District and legislative approval). Part 4, the construction of a reservoir in the Bear River Basin, would be carried out when the Bear River Water Conservancy District and/or Cache County water users need additional water. Additional modifications to this development plan are likely, due largely to the long planning period.

The division estimates there are approximately 250,000 acre-feet of Bear River water that can be developed. Just how much will be a function of many factors. Without a doubt, the biggest deciding factor will be how much reservoir storage is built. Other factors include: where the storage is located, what the demand pattern is like, how much shortage is acceptable, and whether or not any water will be stored in Willard Bay. Figure 13 shows the relationship between the developable Bear River yield and the reservoir storage needed. The assumptions made in developing this figure are: Willard Bay is used to store flows from the Bear River, and a delivery reliability of 90 percent (a full supply in nine years out of ten) is acceptable. The graph shows about 60,000 acre-feet of water can be developed from the Bear River without any new reservoir storage. The next 100,000 acre-feet of developed water will require the construction of storage

capacity at a 1-to-1 ratio (or 100,000 acre-feet of storage yields 100,000 acre-feet of water). The next 50,000 acre-feet of storage will yield 25,000 acre-feet of water. After that, every 1,000 acre-feet of yield will require 4,000 acre-feet of storage. Consequently, to develop 250,000 acre-feet of water will require 400,000 acre-feet of storage (about the equivalent of Jordanelle Reservoir).

In the 1991 Bear River Development Act, the Utah Legislature specifically directed the Division of Water Resources to investigate the Honeyville and Barrens reservoir sites. With

**Figure 13**
**Developable Bear River Yield vs Storage Capacity**
(assuming use of Willard Bay and 90% reliable supply)



growing concern about the possible environmental impacts at those two sites, the 2002 Legislature rescinded the directive to consider the Honeyville and Barrens sites, and instead directed the division to investigate the Washakie Site.

### Washakie Reservoir

The Washakie Reservoir site is located just south of the Utah-Idaho state line between the I-15 freeway and the Union Pacific Railroad line. The reservoir is an off-stream site and would be contained on the north, west, and south sides by a long dike. Originally investigated by the division in 1983, the site was not as economically favorable as several other sites in the basin. Now however, with fewer impacts upon the environment, the site is considered by many to be the most favorable in the basin. The size of the reservoir would be determined by the height of the dike and could be as much as 185,000 acre-feet. Through exchanges upstream, water users in Cache Valley and the upper basin, could enjoy the storage benefits of Washakie. One example of this is that parties interested in reducing the fluctuations of Bear Lake could purchase storage space in Washakie and then exchange it for storage in Bear Lake. Of course any arrangements along these lines would require compliance with the amended Bear River Compact, water rights and the mutual consent of all interested parties, but there is potential for upstream benefactors to become involved in, and benefit from, the construction of storage in the lower portion of the basin.

## WEATHER MODIFICATION

Over the years, local sponsors and the Utah Division of Water Resources have been involved with numerous cloud seeding programs designed to increase the winter precipitation within different areas of the state. Nationally, studies indicate winter seeding projects generally increase the winter precipitation by 14 to 20 percent. Economic analysis of this sort of increase in precipitation shows the benefits from the extra water far outweigh the operational costs of seeding.

Cloud seeding in the East Box Elder/Cache County Project area is sponsored by the Bear River Water Conservancy District and Cache County. The East Box Elder/Cache County Project area has been in operation since 1989. Target and control regression analyses show a December-February precipitation average increase of 20 percent and an April 1 snow water content average increase of 18 percent. The net cost of the increased water is about $1 per acre-foot.

With the cost being so reasonable, it makes sense to consider weather modification as a viable source of water development in the Bear River Basin. Existing cloud seeded areas of Wellsville Mountains, Bear River Range, and eastern Uinta Mountains account for only about six percent of the basin's total area. While these areas do represent the most mountainous portions of the basin, and hence the most productive areas for cloud seeding, there is still potential for cloud seeding in other areas of the basin.

The existing cloud seeding coverage of the eastern Uinta Mountains could be expanded to include the entire Bear River Basin watershed within the Uinta Mountains. This effort could be coordinated with interested parties in the Uintah Basin to include expansion of coverage into the upper Duchesne drainage as well.

The Thomas Fork and Smith's Fork area of Wyoming was cloud-seeded as a test area in 1955 through 1970, 1980 through 1982, and 1989 through 1990. An evaluation of snow pack during those years indicated an increase in snow pack of 11 percent. Even though the topography of the test area is not as extreme as the Wellsville Mountains or the Bear River Range, the results were consistent with those realized elsewhere in the country. This is a strong indication that cloud-seeding in these other areas of the basin would be just as successful as it has been elsewhere.

The cloud seeding of the Bear River Range could be expanded into Rich County to include the eastern slopes of this range. This area is the rain shadow side of the mountain, however, and may not yield as great an increase in snow pack as experienced on the western slope.

## UPGRADING AND ENHANCING EXISTING INFRASTRUCTURE

M&I studies done by the division show that most drinking water systems in the basin have sufficient water to meet needs through at least 2020. Although they have sufficient water rights, many do not have the capacity or facilities to actually divert and deliver this water.

In a 1999 statewide survey of drinking water systems conducted by the Utah Division of Drinking Water, 91 percent of the respondents indicated the overall physical condition of their system would need to be upgraded within the next 15 years, and 31 percent of the respondents indicated their present system was deficient, particularly with respect to its ability to maintain minimum fire flows.[1] There is good reason to believe that within the Bear River Basin the percentage of systems in need of upgrades or system enhancements is similar to the statewide numbers. Indeed, data submitted by the basin's water purveyors, and published in the Municipal and Industrial Water Supply Studies for the Bear River Basin[2] indicate that many systems within the basin have an adequate water supply but suffer some limitation to the system's reliable capacity. Solutions to these problems include: developing additional water sources, enlarging a well or increasing a pump size, replacing existing piping with new and enlarged piping, or adding more reservoir storage.

### NOTES

[1]Utah Division of Drinking Water, *1999 Survey of Community Drinking Water Systems*, (Salt Lake City: Department of Environmental Quality, 2000), Appendix 11, 1 and 2. An annual survey prepared in cooperation with the Division of Water Rights and the Division of Water Resources. This survey, and the data it contains, is available on the Internet at the Division of Drinking Water's web site: www.deq.state.ut.us/eqdw.

2 Municipal and Industrial Water Supply Studies: Utah Bear River Basin, Utah Department of Natural Resources, Division of Water Resources, April, 2001

# VII. Water Quality, The Environment and Other Considerations

Water supply decisions can impact water quality, the environment, recreation, downstream water users and many other aspects of society. Water planners and managers need to be aware of these impacts and develop plans and strategies that fully consider them in order to make effective decisions.

## WATER QUALITY

The Utah Water Quality Board and Division of Water Quality, and the Utah Drinking Water Board and Division of Drinking Water are responsible for the protection, planning and management of water quality in the state of Utah.

### Water Quality Concerns in the Bear River Basin

Although there are exceptions, most groundwater in the Bear River Basin is of good quality, and is suitable for potable use with little or no treatment. One exception is portions of Box Elder County near the Great Salt Lake. Essentially all of the municipal, industrial, and domestic water in the basin comes from high-quality groundwater sources. Between 1997 and 1999 the Utah Division of Water Quality analyzed the general chemistry and nutrients for 163 wells in Cache Valley. The concentrations of total dissolved solids ranged from 178 to 1,758 mg/l, averaging 393 mg/l valley wide. Nitrate concentrations in Cache valley's principal aquifer ranged from less than .02 to 35.77 mg/l. Seven of the 163 wells yielded water samples that exceeded the groundwater quality standard of 10 mg/l for nitrate. High nitrate levels could be attributed to contamination from septic tank systems, feed lots and/or fertilizer.[1]

The quality of surface water varies through a wide range due to natural effects and human activity. In the upper basin, where the Bear River enters Utah from Wyoming, water quality is considered good. Water temperatures are low, as are TDS (total dissolved solids), alkalinity, hardness and sulfates. But the quality deteriorates as the river flows downstream. Return flow from irrigated land, sediment, animal wastes, municipal and industrial wastewater, natural saline springs, agricultural chemicals, and increasing water temperatures all combine to cause water quality problems in the lower basin. In general, each tributary stream shows a similar pattern of downstream deterioration, although some are much better than others.

In the lower Bear River Basin, water quality problems arise primarily from high phosphorus and total suspended sediment concentrations. In particular, dissolved phosphorous contributes to the eutrophication of existing reservoirs. Eutrophication causes diminished recreational and fishery benefits, and the algae produced in a eutrophic reservoir also greatly increase the cost of treatment for municipal use. Other impacts on fisheries arise when state water quality standards for dissolved oxygen and ammonia are not met. This is especially true in the Spring Creek portion of the Little Bear River drainage. High sediment loads in the Cub River and the mainstream of the Bear River also restrict fisheries. Violations of coliform criteria have occurred throughout the basin but were most severe in the Spring Creek subdrainage and indicate a potential public health problem.

*Total Maximum Daily Load Program*

The Federal Clean Water Act of 1972 directs each state to establish water quality standards to protect beneficial uses of surface and groundwater resources. The Act also requires states to monitor water quality to assess achievements of these standards. Where water quality is found to be impaired, each state must then establish a total maximum daily load (TMDL) for each pollutant that contributes to the impairment. A TMDL sets limits on pollution sources and outlines how these limits will be met through implementation of best available technologies for point sources and best management practices for non-point sources.

A TMDL is a calculation of the maximum amount of a pollutant that a water-body can receive and still meet water quality standards for its designated beneficial use. In other words, a

TMDL is the sum of the allowable loads of a single pollutant from all contributing point and non-point sources.  The calculation includes a margin of safety to ensure that the water-body can be used for the purposes the state has designated.  The calculation also accounts for seasonable variation in water quality.  The Clean Water Act, section 303, establishes the criteria for setting water quality standards and the TMDL programs.

The state is responsible to set water quality standards for each of its water-bodies (creek, river, pond, lake, reservoir, etc.) by identifying the uses associated with it.  Examples of designated uses are: drinking water supply, contact recreation (swimming) and aquatic life support (fishing).  The state then uses scientific criteria to establish water quality standards for that water-body based upon its designated use.  An impaired water-body is one which has had a measured pollutant exceeding the water quality standard associated with the designated use.  The current goal is to establish TMDLs for all of the state's impaired water-bodies by the year 2015.

The Division of Water Quality is responsible for implementing the TMDL programs in Utah.  In cooperation with other state, federal and local stake holders the Division of Water Quality has contracted with the Bear River RC&D and the Bear River Water Conservancy District to develop and implement the TMDL program for the Bear River Basin.

Acting under the direction of the Bear River Commission, a Bear River Tri-State Water Quality Task Force has been created.  This task force includes Division of Water Quality personnel from each of the three states through which the Bear River passes.  The primary function of this task force is to improve water quality in the Bear River and its tributaries.  From its creation, one of the task force's primary goals has been to build consistency in water quality standards across state lines.  The task force provides a valuable forum for coordinating Utah, Idaho and Wyoming's individual TMDL efforts to insure that the final product is consistent across state lines.

Table 19
Impaired Waterbodies in the Bear River Basin
(Impaired use class in Bold)

| Waterbody | Pollutant | Use Class |
|---|---|---|
| Bear River & tributaries<br>From Cutler Reservoir to the Great Salt Lake | Total Phosphorus | 2B, **3B, 3D, 4** |
| Bear River from Utah/Wyoming border to Utah/Wyoming border | Dissolved oxygen | 2B, **3A, 4** |
| Saleratus Creek &tributaries from confluence with Woodruff Creek to headwaters | TDS, Temperature, Dissolved oxygen | 2B, **3A, 4** |
| Spring Creek from confluence with Little Bear River to headwaters | Fecal coliform,<br>Ammonia,<br>Temperature,<br>Total Phosphorus<br>Dissolved oxygen | **2B, 3A**, 3D, 4 |
| Hyrum Reservoir | Total Phosphorus<br>Dissolved oxygen | **2A, 2B**, 3A, 4 |
| Newton Reservoir | Total Phosphorus<br>Dissolved oxygen | 2B, **3A**, 4 |
| Porcupine Reservoir | Temperature | 2B, **3A**, 4 |
| Tony Grove Lake | Dissolved oxygen | 2B, **3A**, 4 |

*Beneficial Use Classifications for Water In The State of Utah*

| | |
|---|---|
| Class 1 | Protected for use as a raw water source for domestic water |
| Class 2 | Protected for Recreational use and aesthetics<br>Class 2A – Protected for primary contact recreation such as swimming.<br>Class 2B – Protected for secondary contact recreation such as boating, wading, or similar uses. |
| Class 3 | Protected for use by aquatic wildlife<br>Class 3A – Protected for cold water species of game fish and other aquatic life.<br>Class 3B – Protected for warm water species of game fish and other aquatic life<br>Class 3C – Protected for non-game fish and other aquatic life<br>Class 3D - Protected for waterfowl, shorebirds, and other water-oriented wildlife. |
| Class 4 | Protected for agricultural uses including irrigation of crops and stockwatering. |
| Class 5 | The Great Salt Lake. Protected for primary and secondary contact recreation, aquatic wildlife and mineral extraction |

Table 19 provides a list of the water bodies in the Bear River Basin that have been identified as impaired in the State's assessment report issued by the Utah Division of Water Quality. Throughout the drainage, including the Malad River sub-drainage, manure management is a critical issue. Runoff from fields spread with manure during the winter and direct runoff from feedlots are serious problems. Point sources also contribute substantially to nutrient loadings. Sediment problems arise from exposed banks, irrigation return flows and severely degraded riparian areas. The resulting high phosphorus loads and reduced dissolved oxygen counts are the most common pollutant problems in the Bear River Basin. It is predicted that with a medium to high level of remediation effort, phosphorus loads can be reduced substantially, and the TMDL targets could be met in the Bear River.[2]

*Preservation and Restoration of Riparian and Flood Plain Corridors*

Some of the basin's riparian zones adjacent to streams and rivers have been impacted by construction, stream bank modification or channelization as a result of urban growth and agricultural practices. Riparian zones and flood plains need to be preserved and protected because they represent important habitat for wildlife, help improve water quality and buffer the population from flooding.

Historically, impacts to the main stem of the Bear River from urban growth have been relatively insignificant. This is because, with the exception of Evanston, Wyoming in the upper portion of the basin, there are no urban settings directly on the Bear River. A few of the Bear River's tributaries, however, have experienced impacts associated with urban growth and will undoubtedly experience more impacts in the future. Most notable of these is the Logan River which flows through Logan city. To a lesser extent the Little Bear River, near Hyrum and Smithfield and Summit Creek near Smithfield also represent a potential for urban growth to impact riparian and flood plain corridors. In Box Elder County growth around Bear River City and Corinne are also areas of concern. In these areas it will be important for county and city planners to insure that urban growth does not negatively impact the riparian and flood plain corridors.

Within the Bear River Basin some cattle management practices have had a significant impact upon riparian lands. In some areas inadequate fencing has allowed cattle direct access to the stream. This practice has resulted in trampled and degraded stream banks and adjacent riparian zones. An increased awareness of this problem has resulted in several fencing and re-vegetation projects with very favorable results. There is still room, however, for further water quality improvements through fencing and other cattle management practices.

### *Storm Water Runoff*

In urban areas, storm water runoff is primarily a water quality problem. As the storm water and snow-melt runs off streets, parking lots, driveways and industrial areas, the water picks up salt, gasoline, oil, and residue of numerous other harmful chemicals and pollutants. This water then flows into receiving waters without treatment. In some cases, these flows are detained for a brief period in a retention basin whose primary function is to attenuate the flood effects. Recent EPA regulations require many communities to detain and address pollutants in this water.

In more rural settings, as growth occurs, agriculture canals are often used to convey storm water runoff. This can be a financial boon for some communities faced with the burden of developing infrastructure to accommodate storm water runoff. However, serious potential flooding problems can result from this situation. Canals are managed to deliver agricultural water. Consequently, it is easy for an unexpected storm to occur while the canal is full of water. This can result in flooding and even a possible breach of the canal creating even more significant flooding and a potential liability situation for the canal owner.

### *Discharge Permitting*

Discharge of storm water runoff from industrial and urban landscapes into streams and rivers is a significant point source of pollution. Runoff and erosion from construction sites is also a contributor to this problem. To address this concern the U.S. Environmental Protection

Agency (EPA) has initiated a two-phase process for implementation of storm water management regulations. During the first phase of the process, most industries, as well as cities with more than 100,000 people, were required to obtain storm water discharge permits. The second phase of the storm water regulations will go into effect in the year 2003 and will require many smaller communities to seek a storm water discharge permit. Under the second phase of storm water regulations, requirement for a storm water discharge permits will not be based solely on community size, but instead on a complex matrix of parameters which will include the sensitivity of the receiving waters and the potential downstream water uses.

The Utah Division of Water Quality is working closely with affected communities to help them comply with these new regulations. The communities in the Bear River Basin that will be required to obtain storm water discharge permits are Brigham City, Hyde Park, Logan, Millville, Nibley, North Logan, River Heights, Smithfield, Cache County and Providence.

*Nutrient-Loading*

Nutrient over-enrichment continues to be one of the leading causes of water quality problems in the Bear River Basin. Although these nutrients (nitrogen and phosphorus) are essential to the health of aquatic ecosystems, excessive nutrients can result in the growth of aquatic plants and algae, leading to oxygen depletion, increased fish and macro-invertebrate mortality, and other water quality and habitat impairments.

The Bear River=s water quality suffers primarily from high phosphorus and high sediment loads. The sediment load is mentioned here because one of the potential sources of phosphorus in the basin is the erosion of soils with high phosphorus content. It is believed that stabilizing stream banks and reducing erosion in the basin can have a positive impact in reducing the overall phosphorus load. The primary causes of high phosphorus loads, however, are believed to be wastewater treatment plant effluent, return flows from agriculture (particularly cattle waste runoff from feedlots and pasturelands) and runoff from heavily fertilized lawns and landscapes.

Much of the efforts resulting from the TMDL process will be directed at reducing the phosphorus loads from these sources.

*Concentrated Animal Feedlot Operations*

Another concern receiving national and local attention is the impact which animal feedlot operations have on water quality. These operations, where large numbers of animals are grown for meat, milk or egg production can increase the biological waste loads introduced into rivers, lakes, and surface or groundwater reservoirs. Animal manure contains nutrients, pathogens and salts. Because of the water quality problems created by animal feedlot operations and the relative lack of stringent regulations to control the majority of these operations, the EPA and the U.S. Department of Agriculture and Food recently developed a joint national regulation strategy.

The Utah Division of Water Quality, working together with the Utah Farm Bureau Federation, Utah Association of Conservation Districts, Dairy Association, Cattleman's Association, wool growers, and representatives from the turkey, poultry and hog industries, prepared a Utah Animal Feeding Operation and Concentrated Animal Feeding Operation strategy that will satisfy the EPA's requirements. The Utah strategy has three primary goals: (1) to restore and protect the quality of our water for beneficial uses, (2) to maintain a viable and sustainable agricultural industry, and (3) to keep the decision making process on these issues at the state and local level.

Utah's strategy calls for a commodity-group assessment of all livestock operations. Following this assessment, a general permit will be issued covering all CAFOs with 1,000 animal units or more or smaller facilities with significant water pollution problems. The strategy provides a five-year window for facilities to make voluntary improvements. After this "grace" period, the initial focus of more stringent regulatory action will be directed toward those facilities located within priority watersheds with identified water quality problems.[6]

*Septic Tank Densities*

In the rural areas of the basin, where advanced wastewater treatment systems have not been constructed, individual septic tank systems are used to dispose of domestic wastes. As the population in these areas grows, the density of septic tanks typically increases. This threatens water quality by placing increasing demands on the environment's natural ability to dissipate the pollutants created.

Septic Tank densities in Cache Valley currently range from 26 to 145 acres per septic system for the designated communities. The countywide average is 72 acres per septic system.[3] Septic tank densities are a significant concern in Cache Valley and could soon become a problem elsewhere in the basin. Septic tanks for summer home developments are also a concern, as they are commonly located in sensitive watershed areas. Unless alternative wastewater treatment systems are built, there may be restrictions placed on future development in these areas in the form of septic tank density regulations.

*Water Quality Protection and Improvement Programs in Utah*

Many state and federal programs are in place to improve the nation's and Utah's water quality. The Utah Pollutant Discharge Elimination System (UPDES) closely regulates point sources of pollution. This system has brought about significant improvement to water quality over the past 30 years and continues to play a valuable role. The Division of Water Quality is currently preparing a Non-point Source Pollution Plan to better handle non-point sources of pollution, which are believed to be responsible for 95 percent of the state's remaining water quality impairments. The division will integrate this plan with the TMDL requirements using a watershed-based approach. This approach seeks the participation and involvement of local stakeholders.

The Utah Division of Drinking Water is responsible for protecting Utah's drinking water sources. To accomplish this task, the division has implemented a drinking water source protection program that provides valuable guidelines and rules to help communities protect their water sources.

Under the direction of the Bear River Commission and with management of the Bear River RC&D and the Bear Lake Commission a Tri-State Water Quality Task Force has been established to plan and implement water quality improvement projects. This task force consists of representatives from the Department of Environmental Quality for each of the three states along with representatives from Idaho Fish and Game, Utah Division of Wildlife Resources, Wyoming Fish and Game, U.S. Fish and Wildlife Service, Utah Division of Water Resources, Utah Division of Water Rights, U.S. Natural Resources Conservation Service, Pacificorp Power Company, Bear River Water User=s Association, U.S. Forest Service, U.S. Environmental Protection Agency, U.S. Department of Agriculture, and other local interest groups. This task force meets quarterly and is currently working to insure that the TMDL process and water quality standards are consistent throughout the Bear River Basin and particularly across state boundaries. The task force has sponsored and continues to sponsore water quality projects within the basin.

## THE ENVIRONMENT

### *Endangered Species*

The U.S. Fish and Wildlife Service (FWS) has jurisdictional responsibility over wildlife issues with national implication, such as migratory birds or threatened and endangered species. The FWS administers and operates the Bear River Migratory Bird Refuge at the mouth of the Bear River in Box Elder County.

Table 19 lists the species considered threatened or endangered which reside in the Bear River Basin. The list changes over time as various species are added when they become threatened or removed from the list as they recover. When any activity is planned which may impact a threatened or endangered species, it is the responsibility of the project sponsor to take actions to protect them.

The FWS compiles lists of native animal and plant species for review and possible addition to the list of threatened and endangered species. Such species are generally referred to as candidates. While these species presently have no legal protection under the Endangered Species Act, it is prudent to consider impacts to these species as well. From a planning perspective, it is prudent to consider the possibility that a candidate species could, in the near future be added to the list of threatened and endangered species. The candidate species listed for the Bear River Basin are the Fat-Whorled Pondsnail and the Yellow-Billed Cuckoo.

Table 19
**Threatened and Endangered Species**
Bear River Basin

| | |
|---|---|
| Gray Wolf - Possible | *endangered |
| Whooping Crane | endangered |
| Black-footed Ferret - Unconfirmed | *endangered |
| Lahontan Cutthroat Trout | threatened |
| Bald Eagle | threatened |
| Maguire Primrose | threatened |
| Brown Grizzly Bear | *threatened |
| Canada Lynx - Possible | threatened |
| Fat-Whorled Pondsnail | candidate |
| Yellow-Billed Cuckoo | candidate |

*Considered by U.S. Fish and Wildlife Service to no longer occur in Utah

*Wetlands*

Wetlands are among the most biologically productive natural ecosystems in the world. Wetlands provide many benefits to the people of Utah; they provide natural flood protection, improve water quality, assist in storm water management, and afford unique opportunities for recreation, education and research. In addition, they provide many benefits to wildlife species. The Wetlands definition currently accepted by the Corp of Engineers and the EPA is found in the 1987 Corp of Engineers Wetlands Delineation Manual. Under these guidelines, three criteria must be met to define an area as a wetland: (1) Hydrophytic vegetation; (2) hydric soils; and (3) wetland hydrology. Wetlands are defined as:

> "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegitation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." [4]

*Instream Flow Maintenance*

Over the past several decades, instream flow maintenance has had more and more of an effect on water resources development and management. Previously undervalued instream uses of water for recreation, groundwater recharge, and fish and wildlife habitat are now recognized alongside agricultural irrigation, domestic consumption, and industrial and energy production as beneficial uses of water resources in most states.

The advantages of maintaining year-round minimum flows in natural streams in the Bear River Basin are: (1) protection of existing fish populations; (2) maintenance of riparian vegetation, for stream bank stability and resistance to erosion; (3) maintenance of favorable conditions of flow in stream channels; (4) esthetic enjoyment and recreational use by people; and (5) normal daily use by birds, and animals and aquatic organisms and plants.

Releases from Bear Lake for irrigators in Box Elder County have helped to insure instream flows for much of the main stem of the Bear River through the late summer season and early fall. Many of the Bear River's tributary streams, however, are dewatered through this period as flows are diverted for irrigation supplies.

The ability to obtain instream water rights in Utah lies exclusively with the Division of Wildlife Resources and the Division of Parks and Recreation. The *Utah Code* allows these two state agencies to file changes on perfected water rights in order to provide instream flows in designated reaches of streams. These flows may be acquired for preservation and enhancement of fisheries, the natural stream environment, or public recreation. Acquisition of such water rights is dependent upon legislative appropriations and a willing seller, unless the water right is previously owned by the agency or is gifted or deeded to it.

The *Utah Code* also authorizes the State Engineer to reject an application to appropriate water or to change use of a water right if, in the State Engineer's judgment, approval would unreasonably affect public recreation or the environment by decreasing instream flows. In this sense, an instream water right is not the only way that instream flows can be protected. In addition to actual instream water rights, numerous instream flow requirements exist around the state. These minimum flows are typically part of an agreed project operation or permit requirement.

*Wilderness Designation*

Wilderness designation of Utah lands has been the subject of heated debate since the early 1980s. Wilderness proponents have concluded that a significant portion of federal lands in the state qualify for designation as wilderness. State and local leaders are deeply concerned by the potential impacts that such broad-sweeping designations will have on state and local resources.

Wilderness is believed by many to be the most restrictive federal land management designation. As such, development within these areas becomes very difficult, if not impossible.

Use of existing water supplies and facilities would also be restricted to prior uses, thus prohibiting some changes or upgrades needed to meet future needs. Access for maintenance would also be restricted. Careful consideration of all impacts should be made before designating areas as wilderness or wilderness study areas. Current and potential uses of water needs must be considered when evaluating the impact of wilderness designation.

*Wild and Scenic River Designation*

The Wild and Scenic Rivers Act (WSRA) of 1968 states that, "certain selected rivers of the nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations." Designation of a stream or river segment as "wild and scenic" would prevent construction of flow modifying structures or other facilities on such river segments. The area for which development is limited along a wild and scenic river varies from river to river, but includes at least the area within one-quarter mile of the ordinary high water mark on either side of the river.

Currently there are no rivers in Utah with the Wild and Scenic River designation. In recent years, however, national forests and other federal agencies have made inventories of Utah streams for consideration as wild and scenic rivers. Environmental groups have compiled similar lists with thousands of miles of rivers for consideration. These include portions of the Logan River.

Before designating streams and rivers as "wild and scenic", state, federal, and local agencies should assure that all the potential water management and other resource impacts such designation would have far into the future are assessed. They must also ensure that designation is done in the spirit of the WSRA and not simply used as a tool to impede water and other important resource development.

*Land Management and Water Yield*

The federal government, primarily the U.S. Forest Service and the Bureau of Land Management, administers about two-thirds of the land area in the state of Utah. More significantly, these federal agencies own and manage the headwaters of almost all the watersheds from which the state's surface water supply is derived and the state's population is dependent. Utah is concerned about the ability of these lands to yield a high quality, non-declining supply of water to its communities for agricultural, M&I, and other uses.

Since the 1920s, federal agencies have been very successful in suppressing natural fire. Consequently, there has been a buildup in standing vegetation (biomass) on these lands. Federal agencies should practice responsible watershed management that will help ensure a continued high quality, non-declining supply of water to meet the state's increasing needs.

## NOTES

[1] Geology of Northern Utah: Utah Geological Association Publication 27, Utah Geological Survey, US Geological Survey, Rocky Mountain Foundation, American Association of Petroleum Geologists, (September 11, 1999).

[2] Utah State Department of Environmental Quality Web Page, waterquality.utah.gov/watersheds/bear/water_quality.htm

[3] Ground-Water Quality Classification and Recommended Septic Tank Soil-Absorption-System Density Maps, Cache Valley Utah, by Mike Lowe, Janae Wallace, and Charles E. Bishop, Environmental Sciences Program, Utah Geologic Survey (June, 2002)

[4] U.S. Army Corps of Engineers, 1987. Wetlands Delineation Manual, Environmental Laboratory, Department of Army, Waterways Experiment Station, Corps of Engineers, Vicksburg, Mississippi, p. 13.

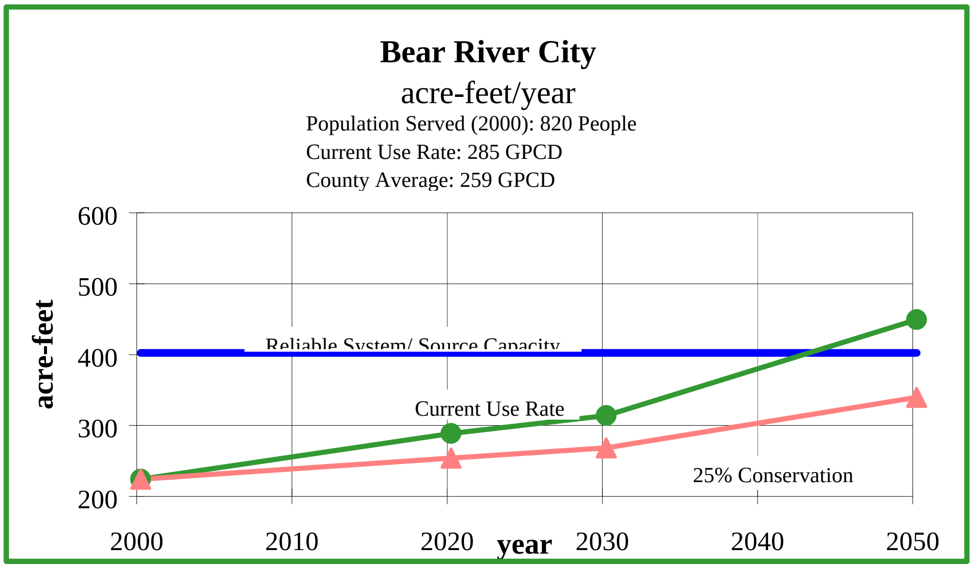
# Appendix

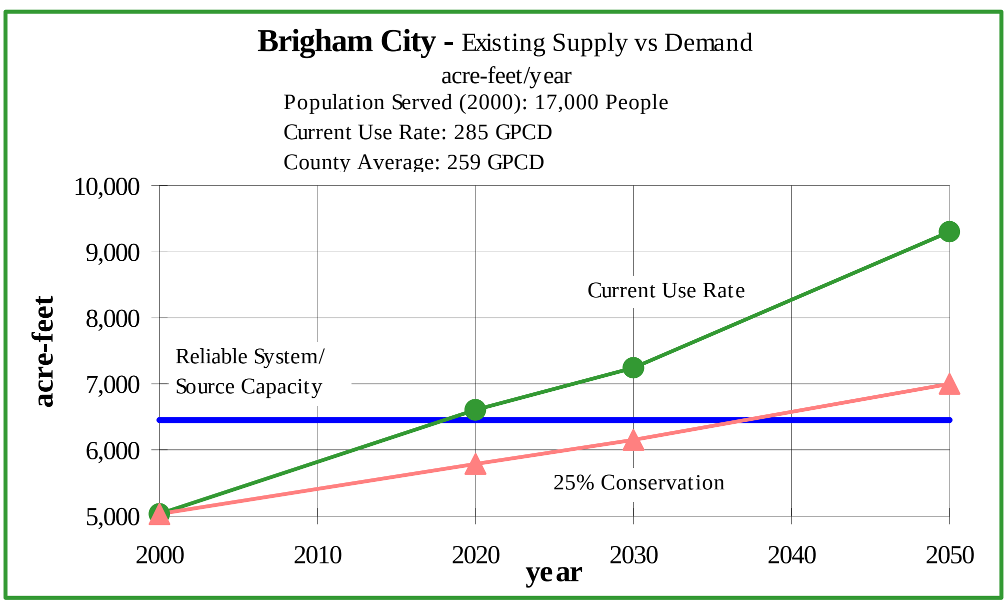
<u>Water Supply vs. Demand Graphs</u>

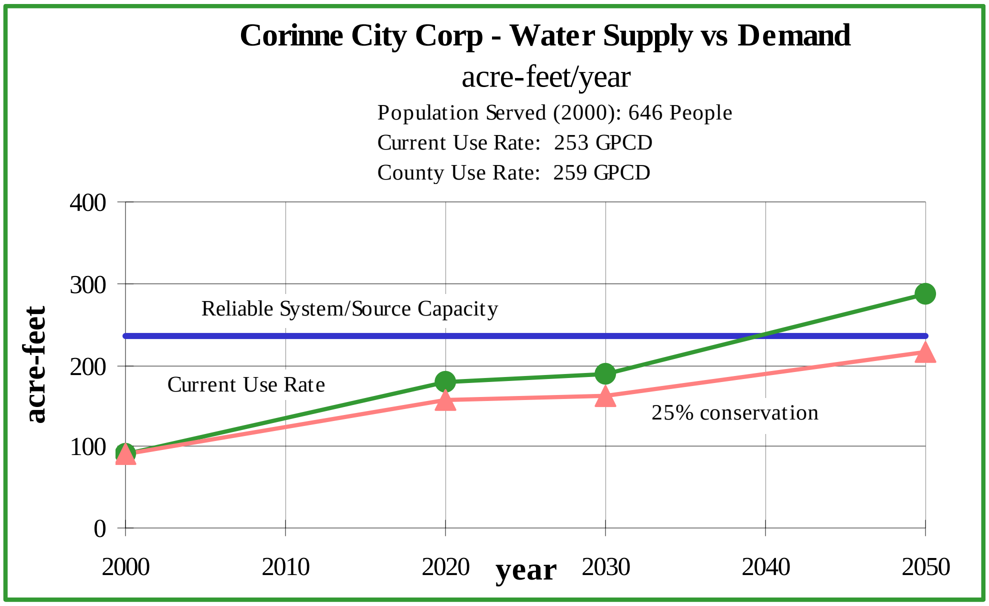
The following Water Supply vs Demand Graphs are presented alphabetically by county.

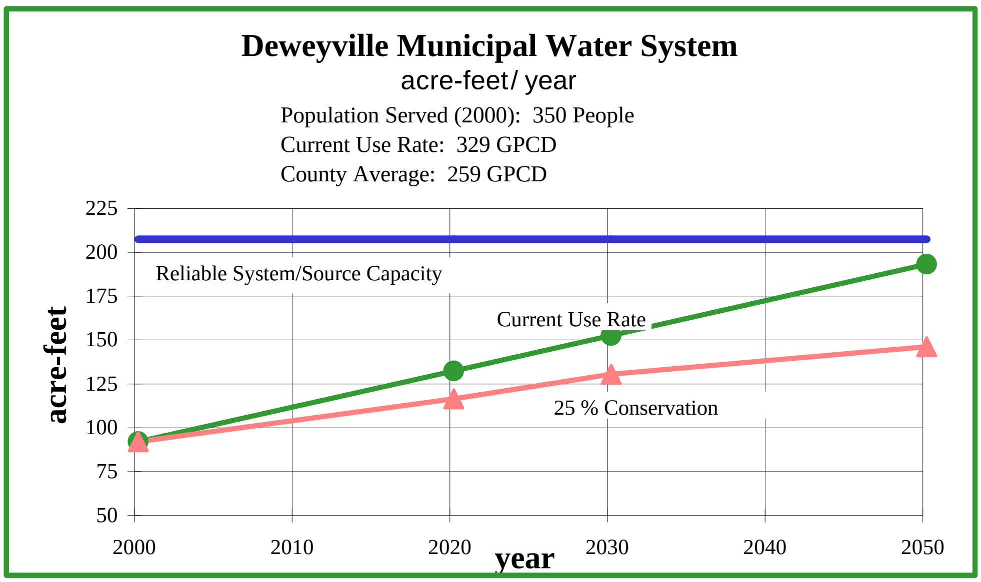
These graphs show the inter-relationships between each town's existing system's reliable system/source capacity and its projected demand for the next fifty years. Each figure includes a pair of future demand lines. The green line shows the community's projected water needs based upon its current use rate, while the Tan line shows the reduction in demand if twenty-five percent conservation is achieved by the year 2050. The system's existing reliable system/source capacity is shown in blue. Also shown on each figure is the population served in 2000, the current use rate in gallons per capita day, and for comparison the county average per capita use rate

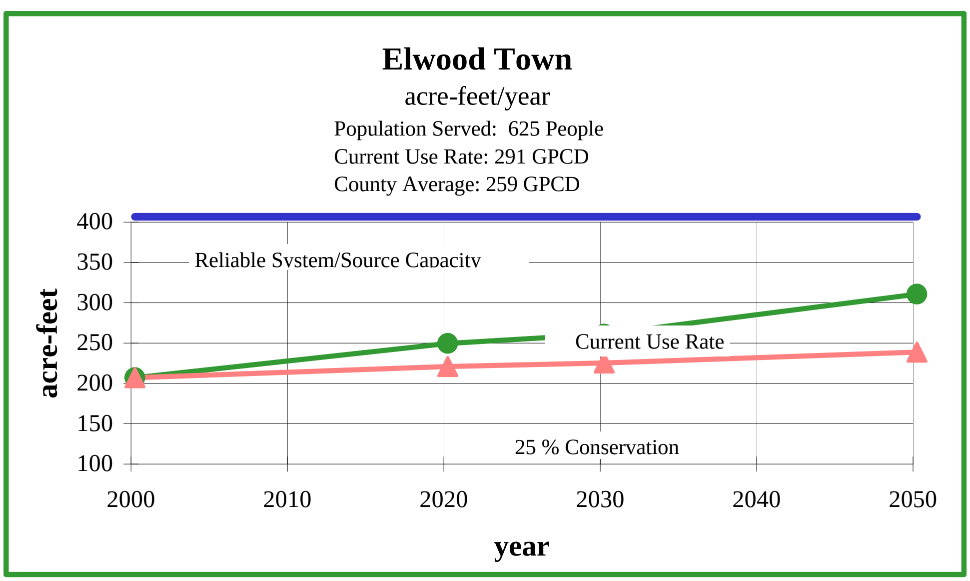
**Box Elder County Communities**:

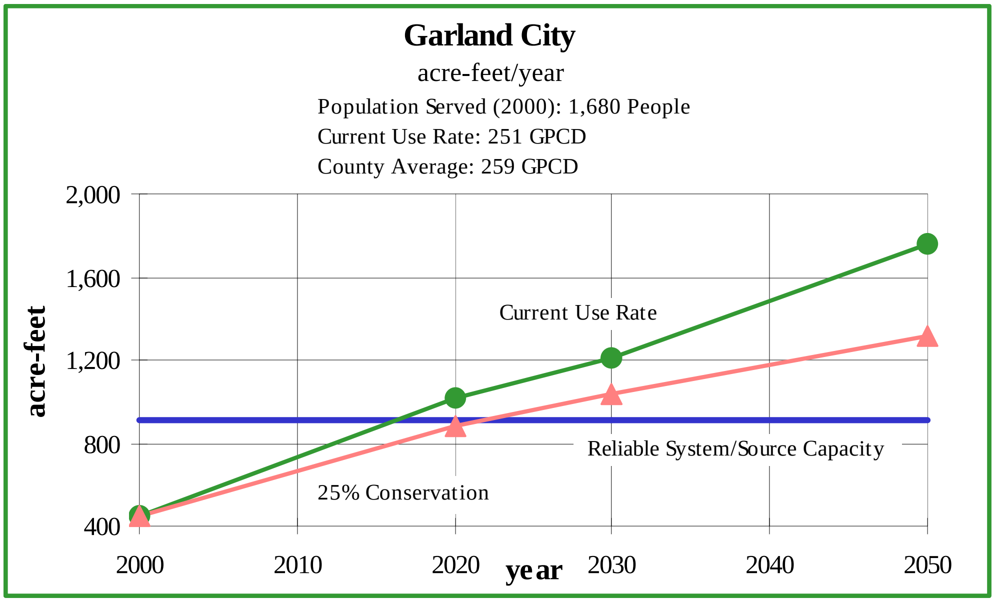


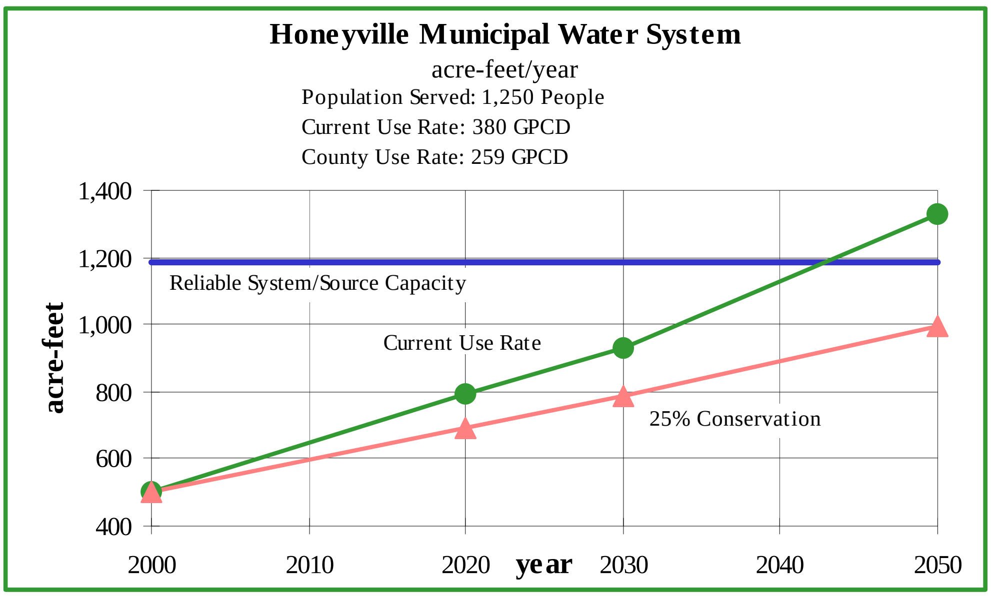



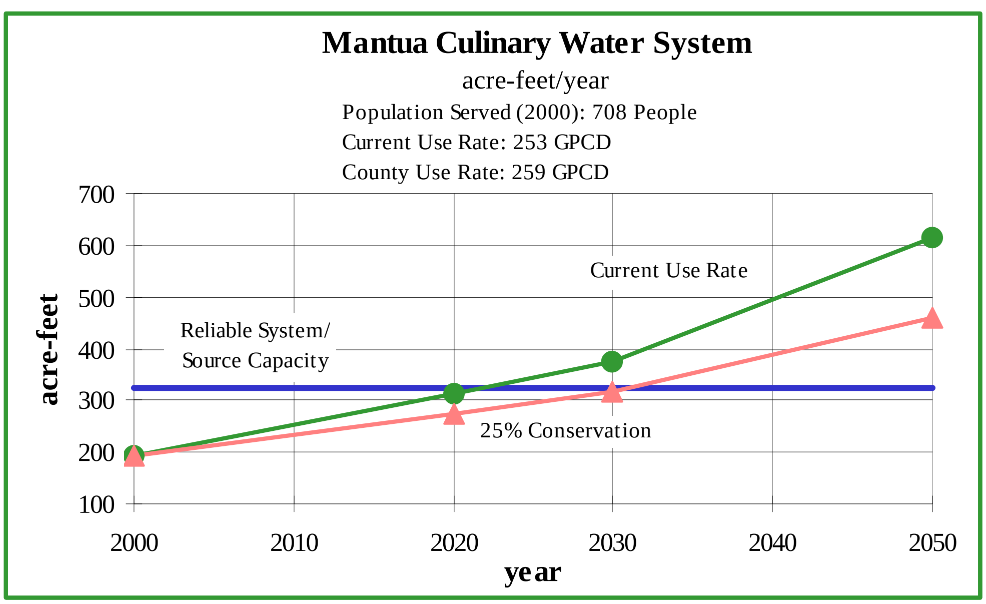

Corinne City Corp - Water Supply vs Demand
acre-feet/year
Population Served (2000): 646 People
Current Use Rate: 253 GPCD
County Use Rate: 259 GPCD
400
300
200
100
0
acre-feet
Reliable System/Source Capacity
Current Use Rate
25% conservation
2000
2010
2020
year
2030
2040
2050

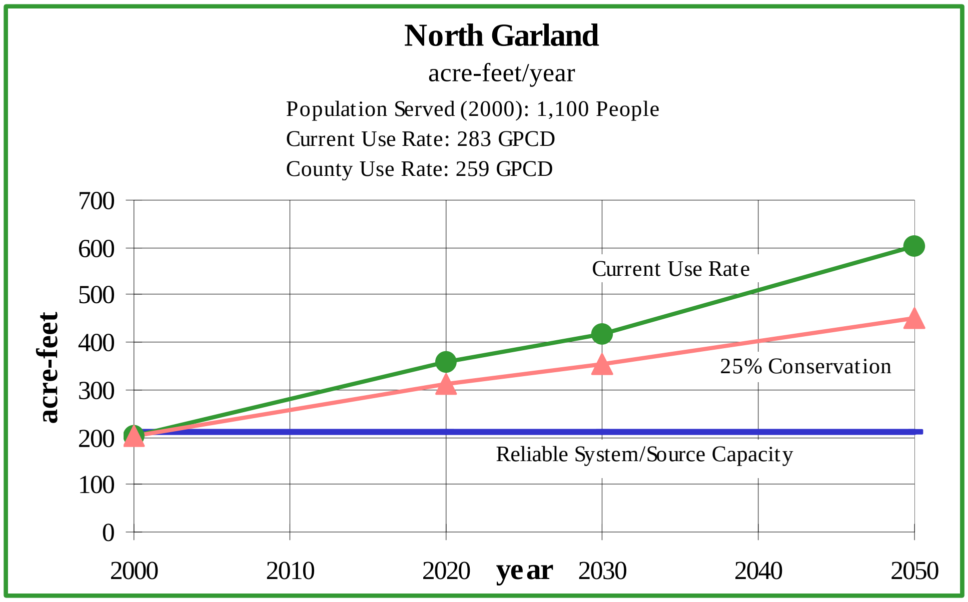

Deweyville Municipal Water System
acre-feet/ year
Population Served (2000): 350 People
Current Use Rate: 329 GPCD
County Average: 259 GPCD
225
200
175
150
125
100
75
50
acre-feet
Reliable System/Source Capacity
Current Use Rate
25 % Conservation
2000
2010
2020
year
2030
2040
2050

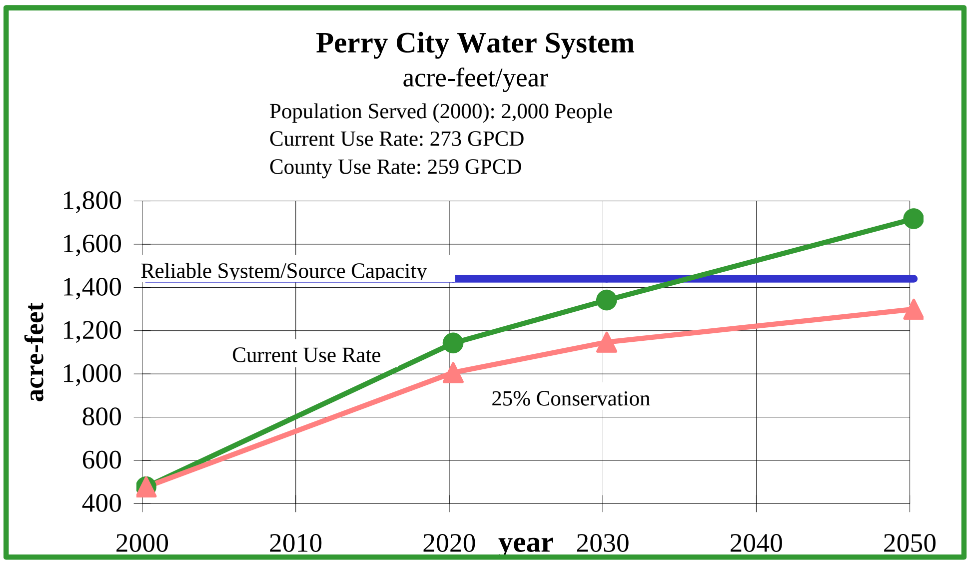

Elwood Town
acre-feet/year
Population Served: 625 People
Current Use Rate: 291 GPCD
County Average: 259 GPCD
400
350
300
250
200
150
100
acre-feet
Reliable System/Source Capacity
Current Use Rate
25 % Conservation
2000
2010
2020
2030
2040
2050
year

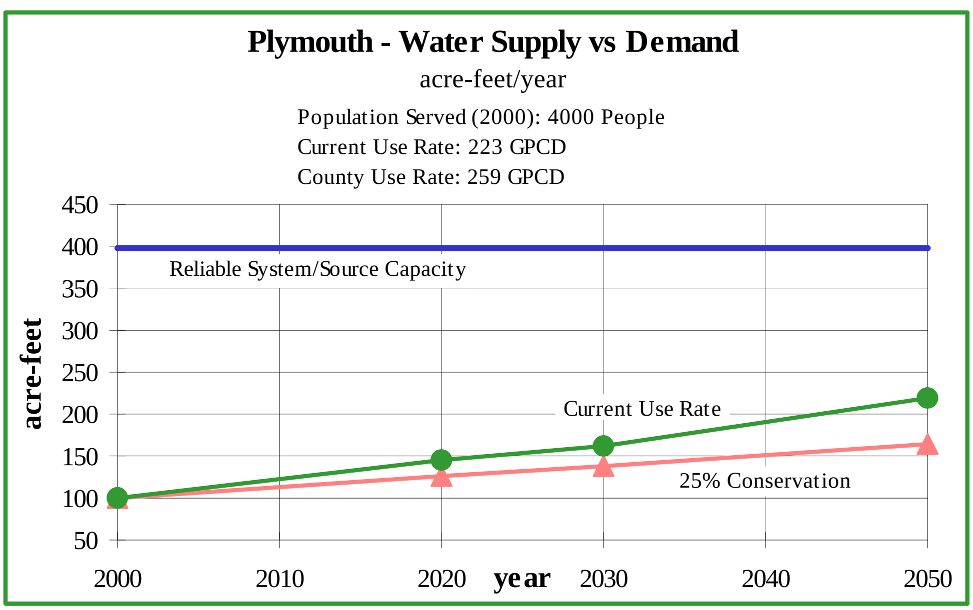

Garland City
acre-feet/year
Population Served (2000): 1,680 People
Current Use Rate: 251 GPCD
County Average: 259 GPCD
2,000
1,600
1,200
800
400
acre-feet
Current Use Rate
Reliable System/Source Capacity
25% Conservation
2000
2010
2020
year
2030
2040
2050

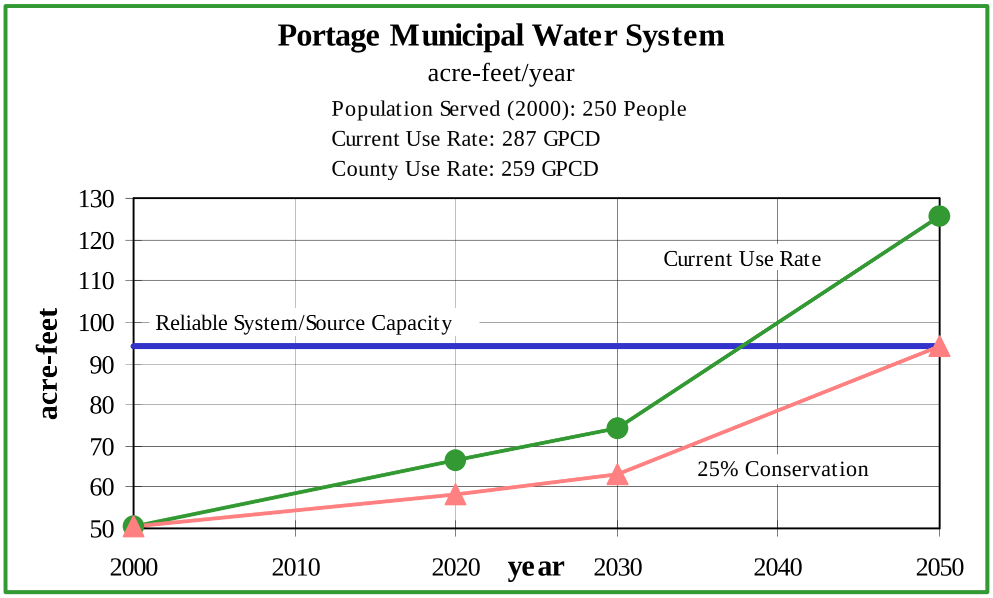

Honeyville Municipal Water System
acre-feet/year
Population Served: 1,250 People
Current Use Rate: 380 GPCD
County Use Rate: 259 GPCD
1,400
1,200
1,000
800
600
400
acre-feet
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050

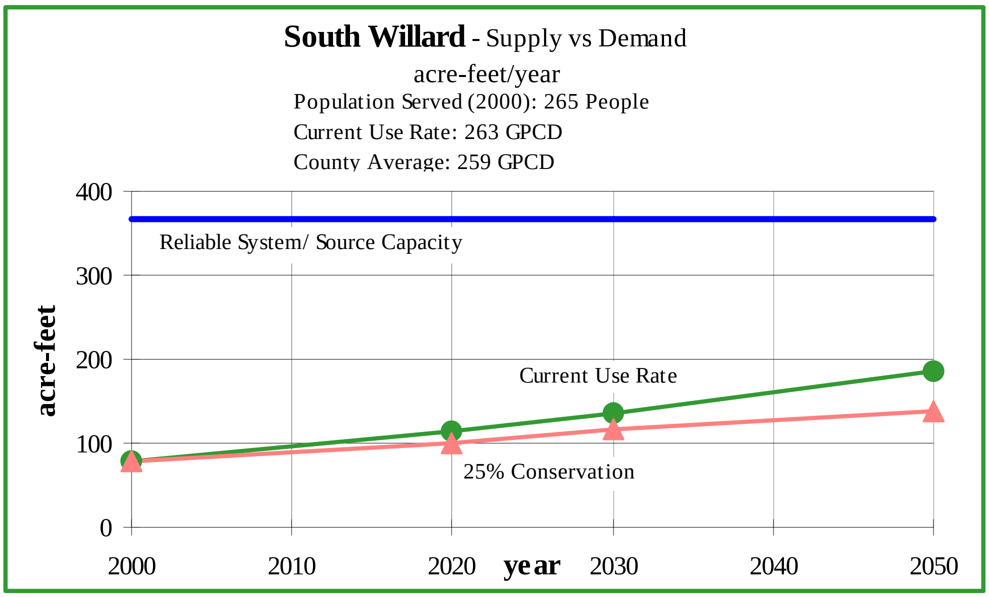

Mantua Culinary Water System
acre-feet/year
Population Served (2000): 708 People
Current Use Rate: 253 GPCD
County Use Rate: 259 GPCD
700
600
500
400
300
200
100
acre-feet
Current Use Rate
Reliable System/
Source Capacity
25% Conservation
2000
2010
2020
2030
2040
2050
year

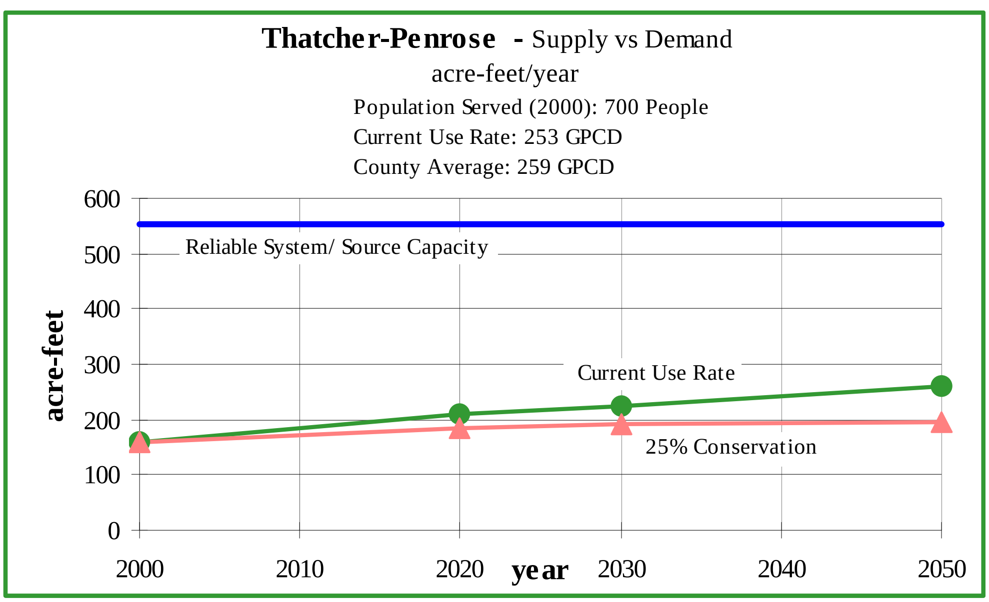

North Garland
acre-feet/year
Population Served (2000): 1,100 People
Current Use Rate: 283 GPCD
County Use Rate: 259 GPCD
acre-feet
700
600
500
400
300
200
100
0
Current Use Rate
25% Conservation
Reliable System/Source Capacity
2000
2010
2020
year
2030
2040
2050

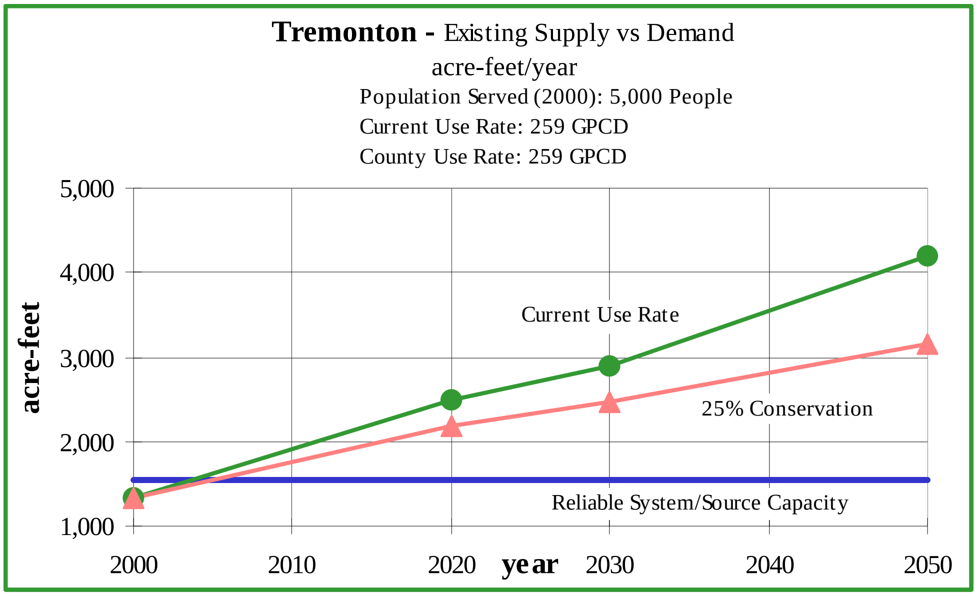

Perry City Water System
acre-feet/year
Population Served (2000): 2,000 People
Current Use Rate: 273 GPCD
County Use Rate: 259 GPCD
acre-feet
1,800
1,600
1,400
1,200
1,000
800
600
400
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050

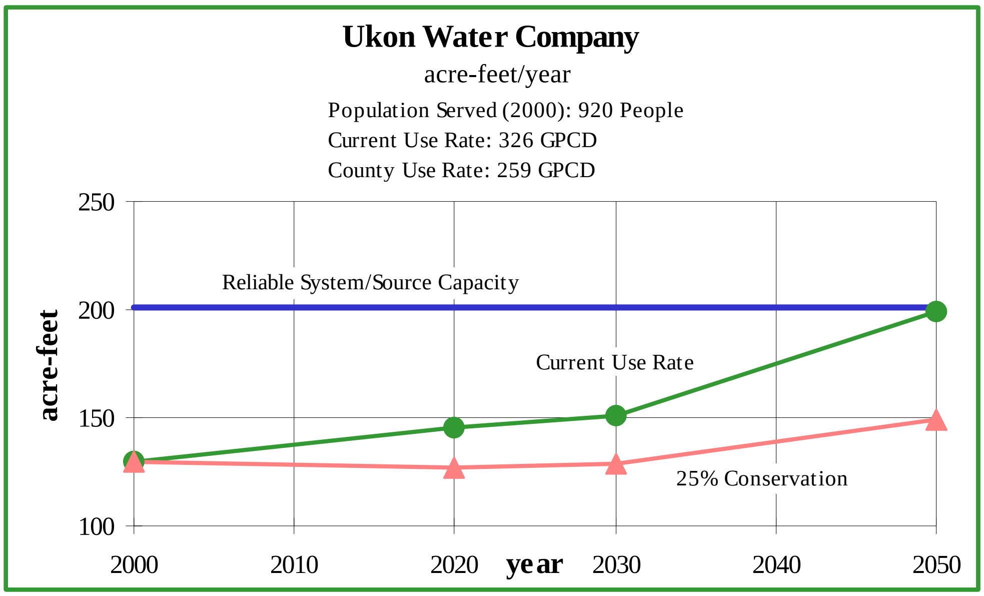

Plymouth - Water Supply vs Demand
acre-feet/year
Population Served (2000): 4000 People
Current Use Rate: 223 GPCD
County Use Rate: 259 GPCD
acre-feet
450
400
350
300
250
200
150
100
50
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050

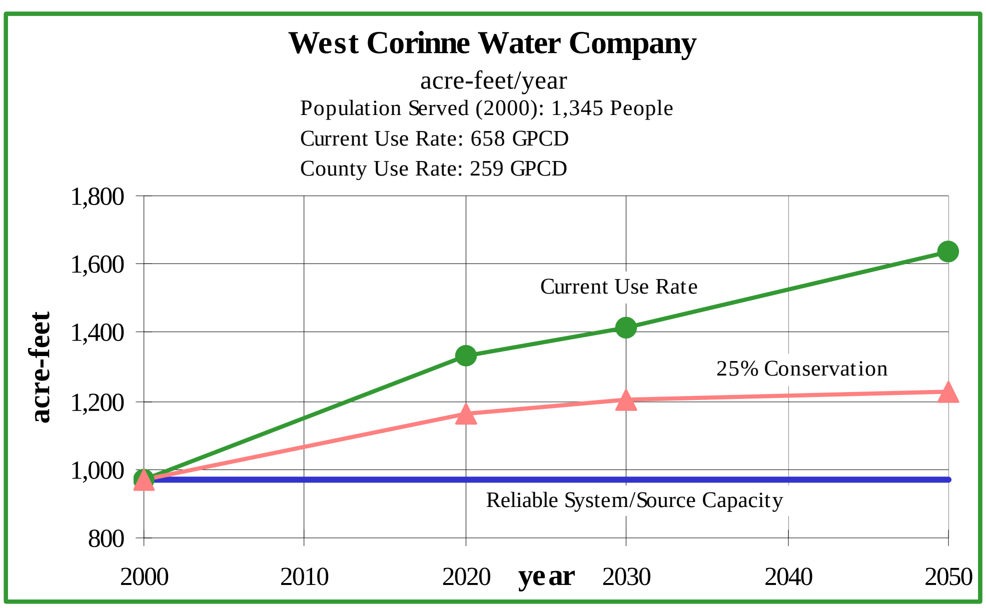

Portage Municipal Water System
acre-feet/year
Population Served (2000): 250 People
Current Use Rate: 287 GPCD
County Use Rate: 259 GPCD
acre-feet
130
120
110
100
90
80
70
60
50
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050

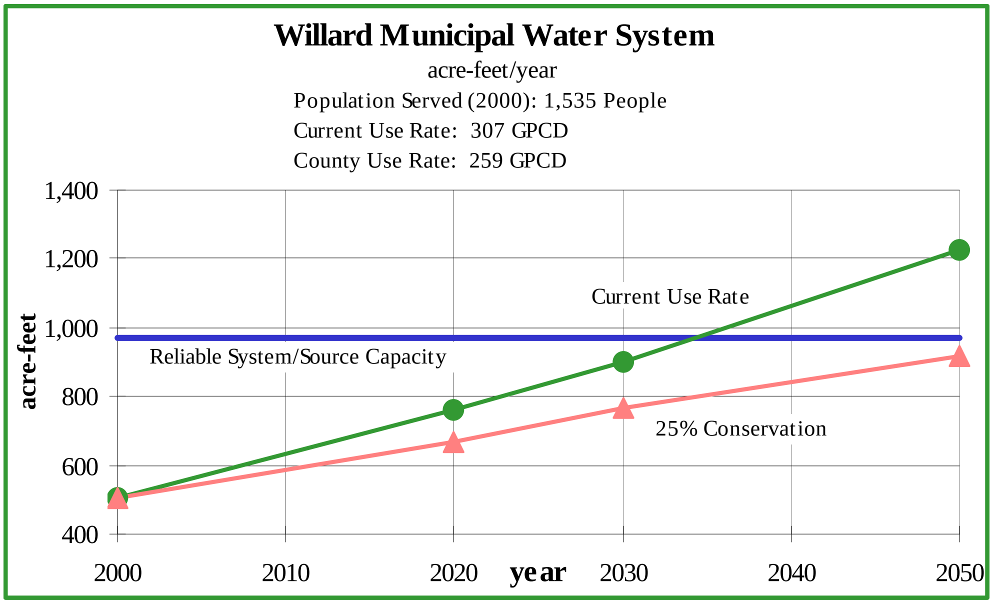

South Willard - Supply vs Demand
acre-feet/year
Population Served (2000): 265 People
Current Use Rate: 263 GPCD
County Average: 259 GPCD
acre-feet
400
300
200
100
0
Reliable System/ Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050


Thatcher-Penrose - Supply vs Demand
acre-feet/year
Population Served (2000): 700 People
Current Use Rate: 253 GPCD
County Average: 259 GPCD
acre-feet
600
500
400
300
200
100
0
Reliable System/ Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050

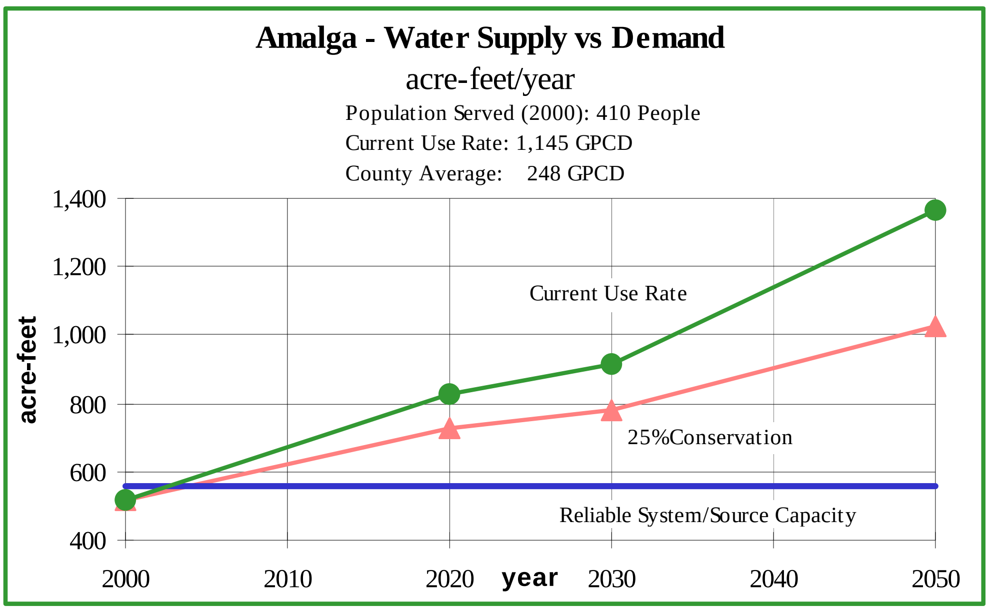

Tremonton - Existing Supply vs Demand
acre-feet/year
Population Served (2000): 5,000 People
Current Use Rate: 259 GPCD
County Use Rate: 259 GPCD
acre-feet
5,000
4,000
3,000
2,000
1,000
Current Use Rate
25% Conservation
Reliable System/Source Capacity
2000
2010
2020
year
2030
2040
2050

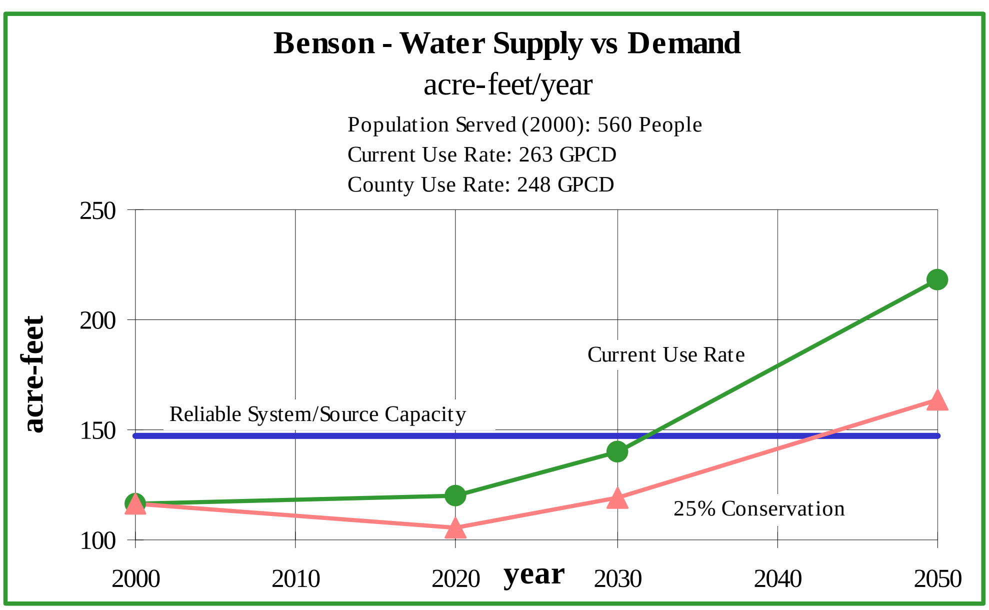

Ukon Water Company
acre-feet/year
Population Served (2000): 920 People
Current Use Rate: 326 GPCD
County Use Rate: 259 GPCD
acre-feet
250
200
150
100
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050

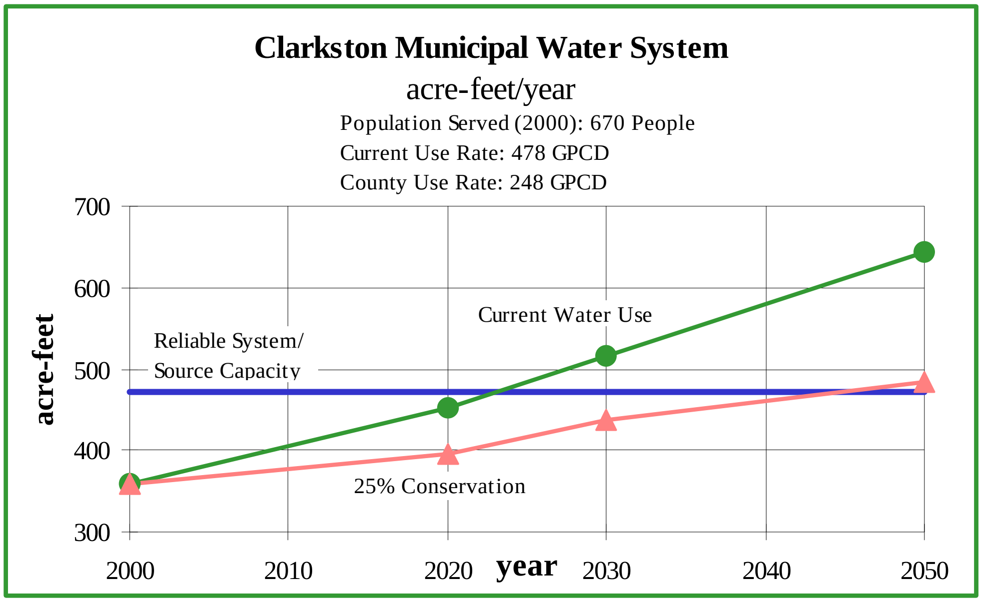

West Corinne Water Company
acre-feet/year
Population Served (2000): 1,345 People
Current Use Rate: 658 GPCD
County Use Rate: 259 GPCD
acre-feet
1,800
1,600
1,400
1,200
1,000
800
Current Use Rate
25% Conservation
Reliable System/Source Capacity
2000
2010
2020
year
2030
2040
2050

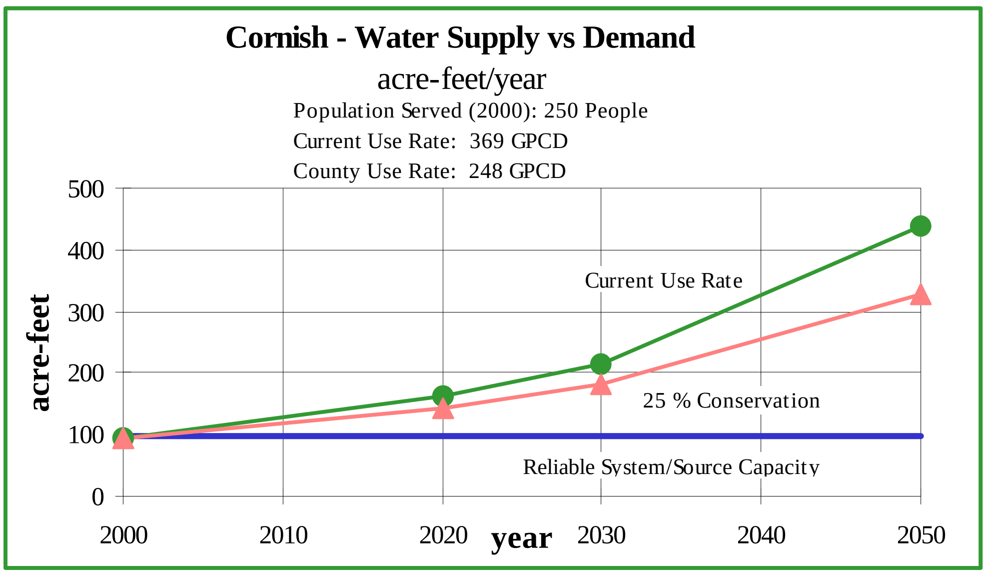


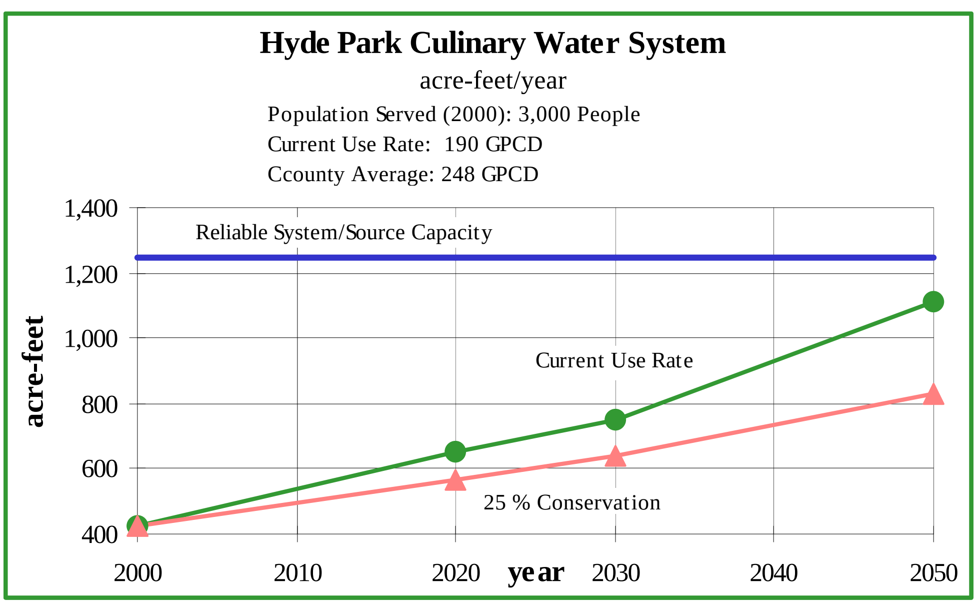

**Cache Valley Communities**:

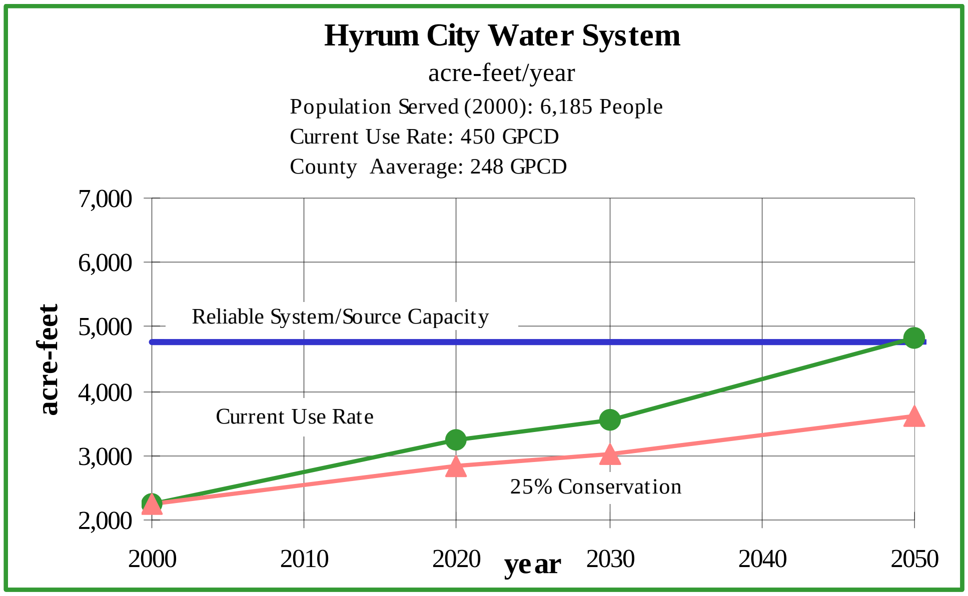


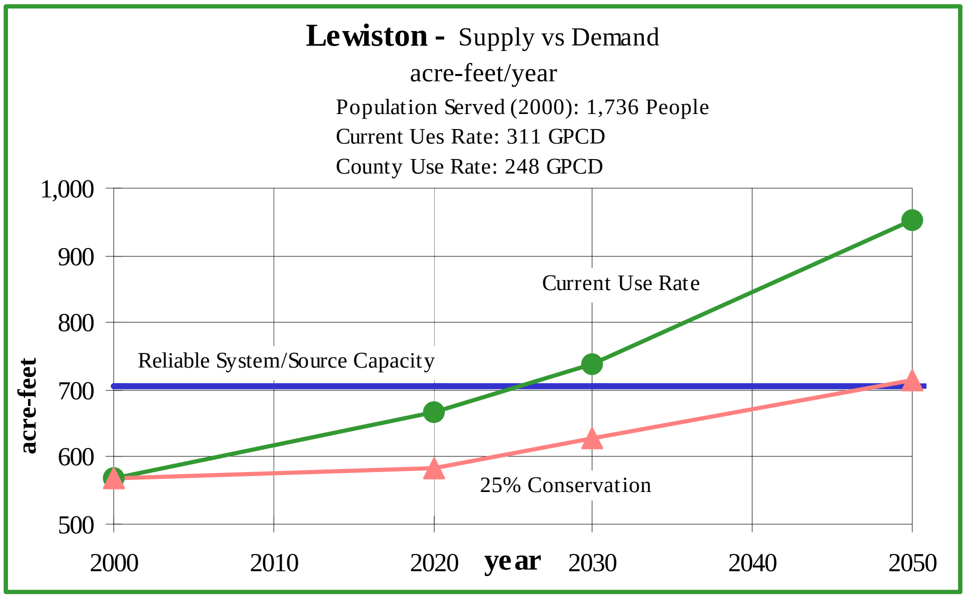



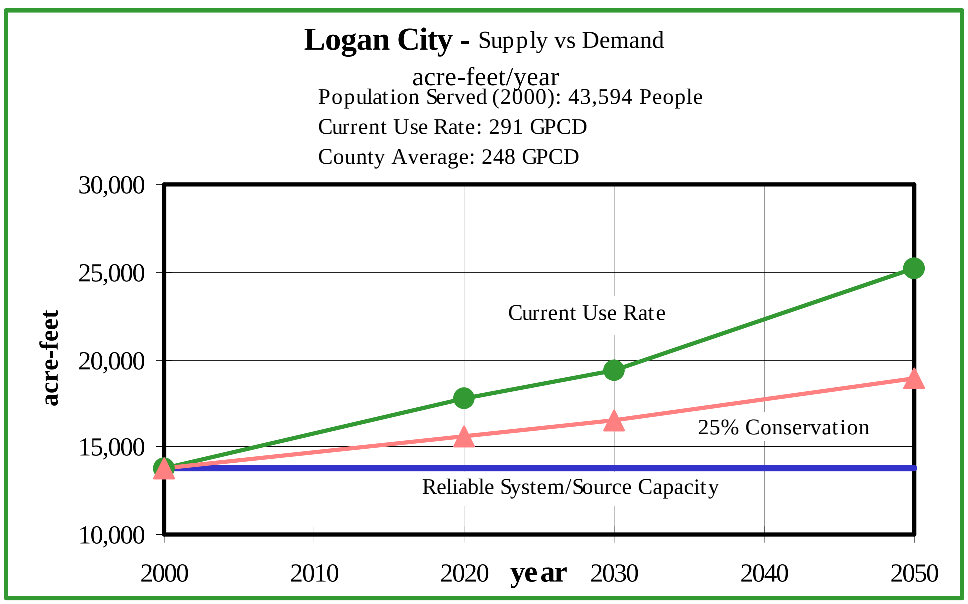

Clarkston Municipal Water System
acre-feet/year
Population Served (2000): 670 People
Current Use Rate: 478 GPCD
County Use Rate: 248 GPCD
700
600
500
400
300
acre-feet
Reliable System/
Source Capacity
Current Water Use
25% Conservation
2000
2010
2020
year
2030
2040
2050

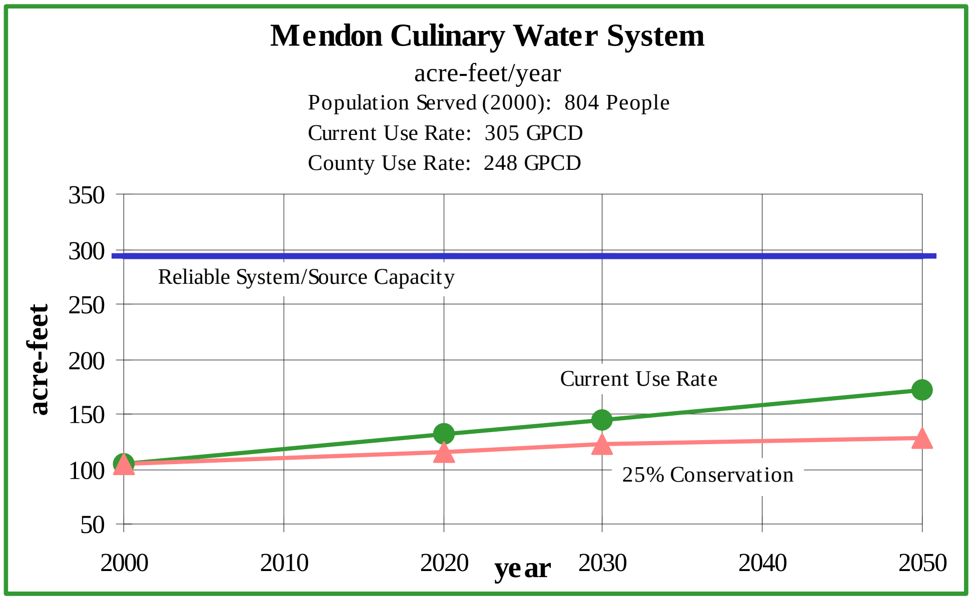

Cornish - Water Supply vs Demand
acre-feet/year
Population Served (2000): 250 People
Current Use Rate: 369 GPCD
County Use Rate: 248 GPCD
500
400
300
200
100
0
acre-feet
Current Use Rate
25 % Conservation
Reliable System/Source Capacity
2000
2010
2020
year
2030
2040
2050

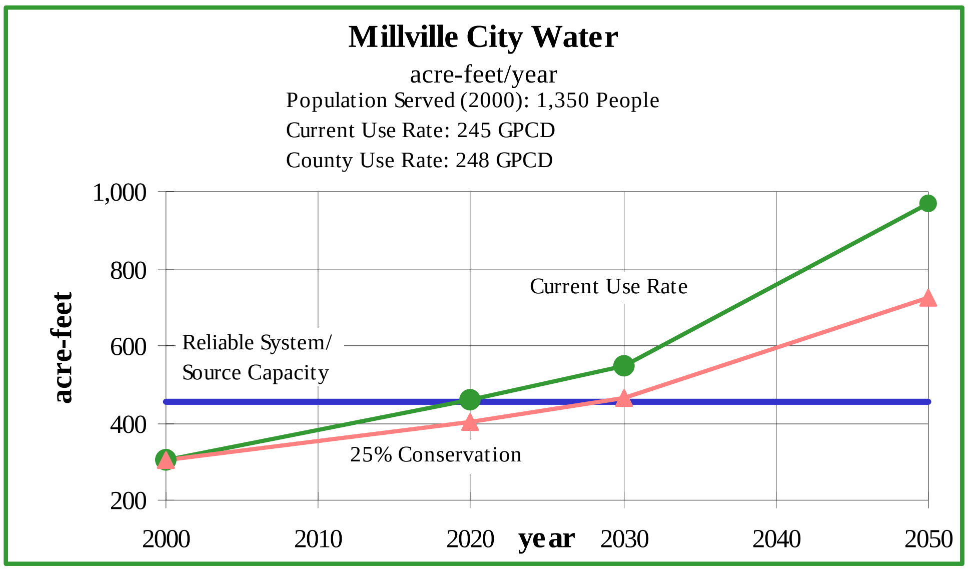

Hyde Park Culinary Water System
acre-feet/year
Population Served (2000): 3,000 People
Current Use Rate: 190 GPCD
Ccounty Average: 248 GPCD
1,400
1,200
1,000
800
600
400
acre-feet
Reliable System/Source Capacity
Current Use Rate
25 % Conservation
2000
2010
2020
year
2030
2040
2050

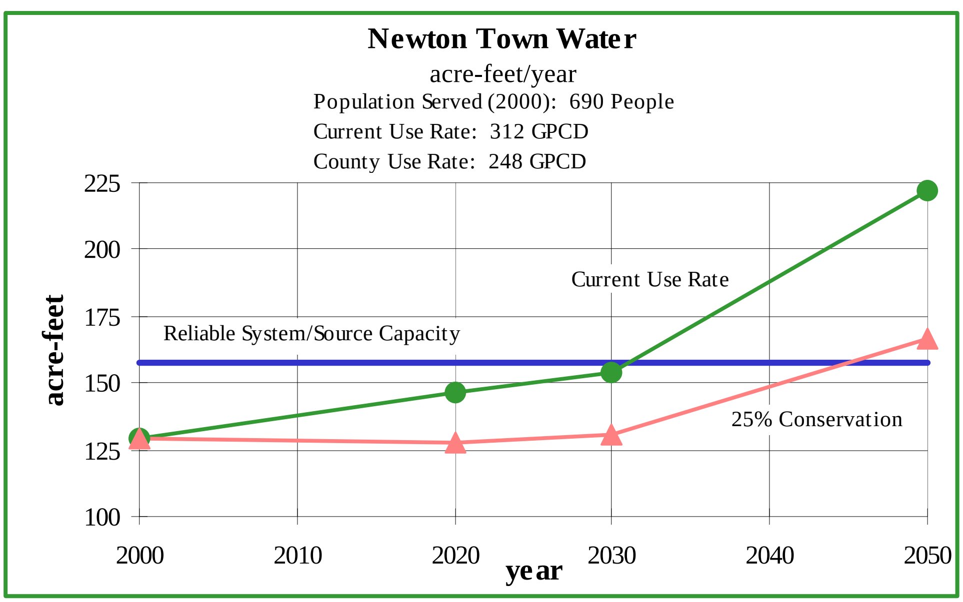

Hyrum City Water System
acre-feet/year
Population Served (2000): 6,185 People
Current Use Rate: 450 GPCD
County  Aaverage: 248 GPCD
acre-feet
7,000
6,000
5,000
4,000
3,000
2,000
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
2030
2040
2050
year

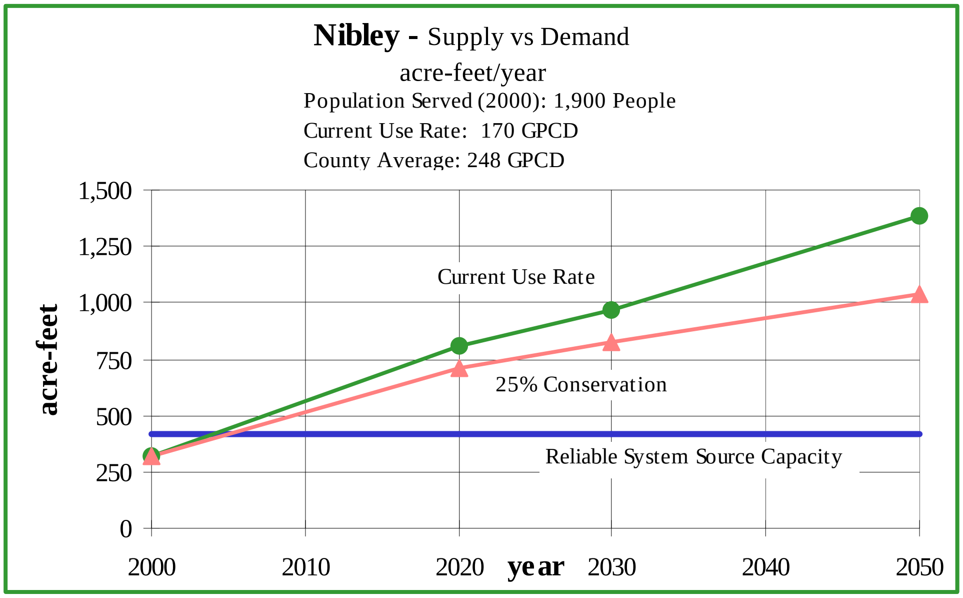

Lewiston - Supply vs Demand
acre-feet/year
Population Served (2000): 1,736 People
Current Ues Rate: 311 GPCD
County Use Rate: 248 GPCD
acre-feet
1,000
900
800
700
600
500
Current Use Rate
Reliable System/Source Capacity
25% Conservation
2000
2010
2020
2030
2040
2050
year

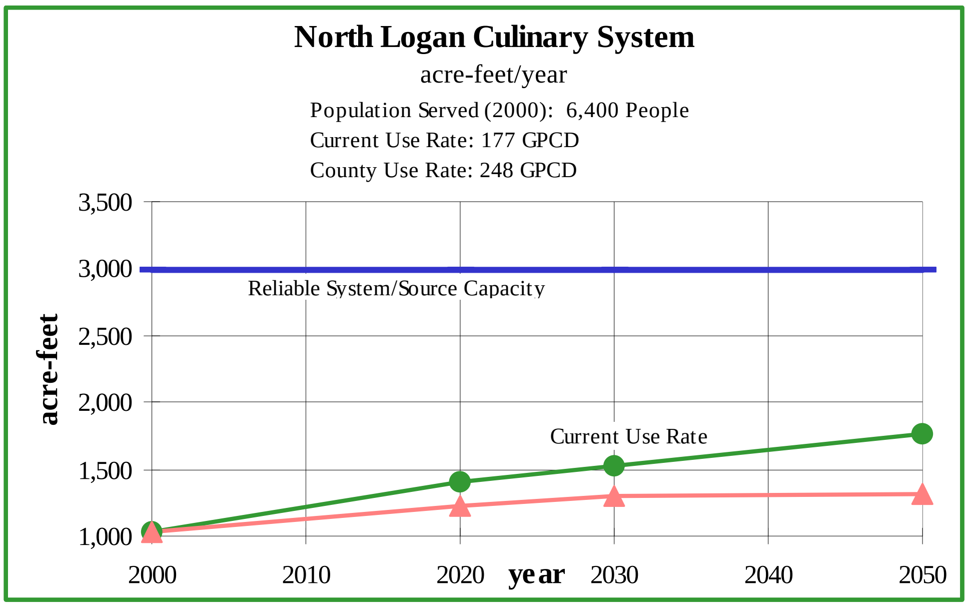

Logan City - Supply vs Demand
acre-feet/year
Population Served (2000): 43,594 People
Current Use Rate: 291 GPCD
County Average: 248 GPCD
acre-feet
30,000
25,000
20,000
15,000
10,000
Current Use Rate
25% Conservation
Reliable System/Source Capacity
2000
2010
2020
2030
2040
2050
year

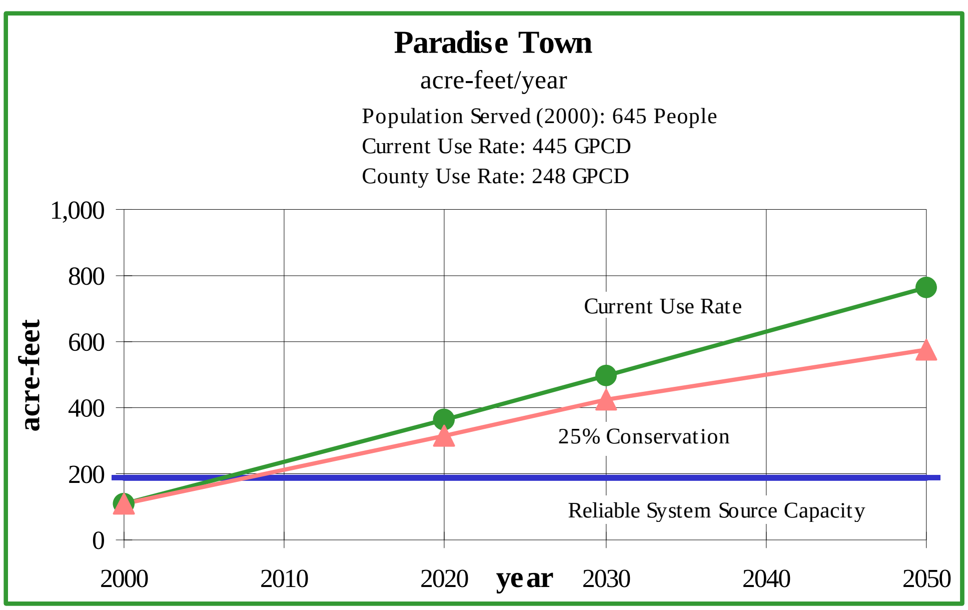

Mendon Culinary Water System
acre-feet/year
Population Served (2000): 804 People
Current Use Rate: 305 GPCD
County Use Rate: 248 GPCD
350
300
250
200
150
100
50
acre-feet
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
2030
2040
2050
year

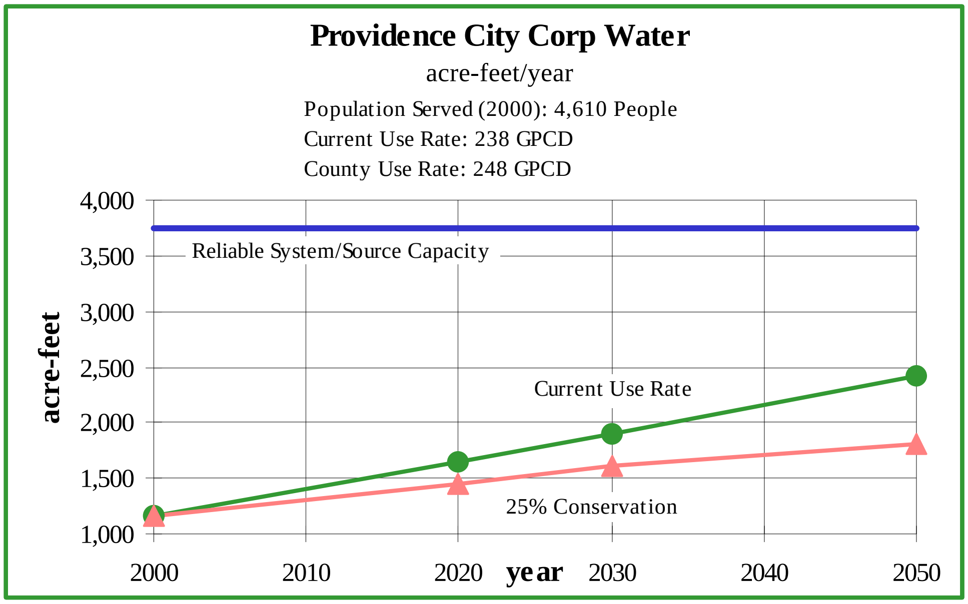

Millville City Water
acre-feet/year
Population Served (2000): 1,350 People
Current Use Rate: 245 GPCD
County Use Rate: 248 GPCD
1,000
800
600
400
200
acre-feet
Current Use Rate
Reliable System/
Source Capacity
25% Conservation
2000
2010
2020
2030
2040
2050
year

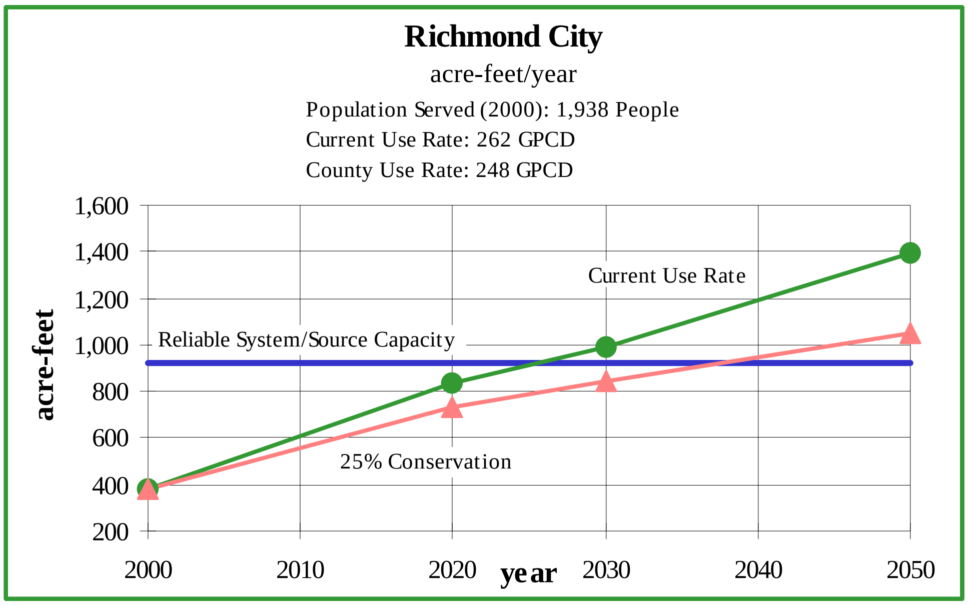

Newton Town Water
acre-feet/year
Population Served (2000): 690 People
Current Use Rate: 312 GPCD
County Use Rate: 248 GPCD
225
200
175
150
125
100
acre-feet
Current Use Rate
Reliable System/Source Capacity
25% Conservation
2000
2010
2020
2030
2040
2050
year

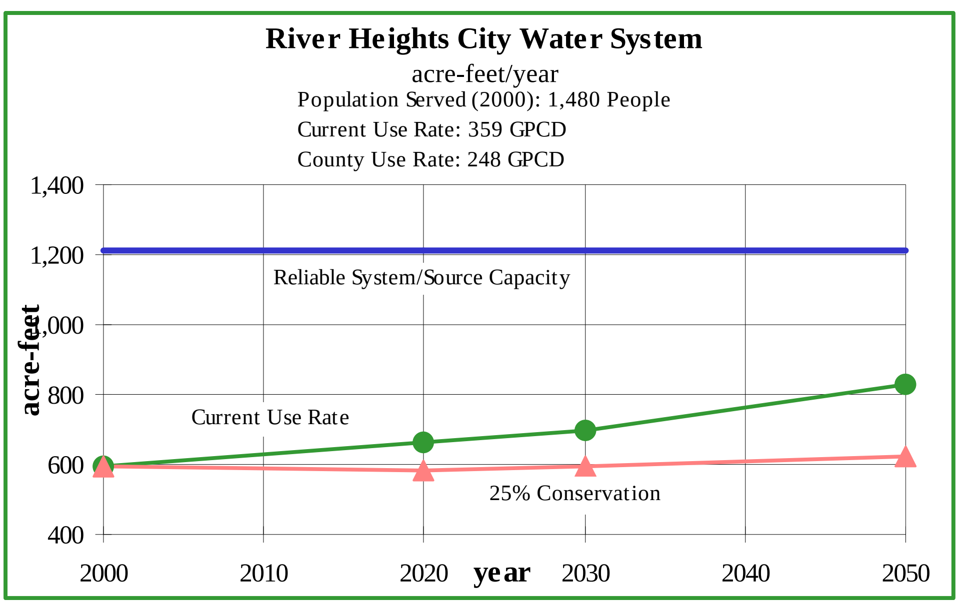

Nibley - Supply vs Demand
acre-feet/year
Population Served (2000): 1,900 People
Current Use Rate: 170 GPCD
County Average: 248 GPCD
acre-feet
1,500
1,250
1,000
750
500
250
0
Current Use Rate
25% Conservation
Reliable System Source Capacity
2000
2010
2020
year
2030
2040
2050

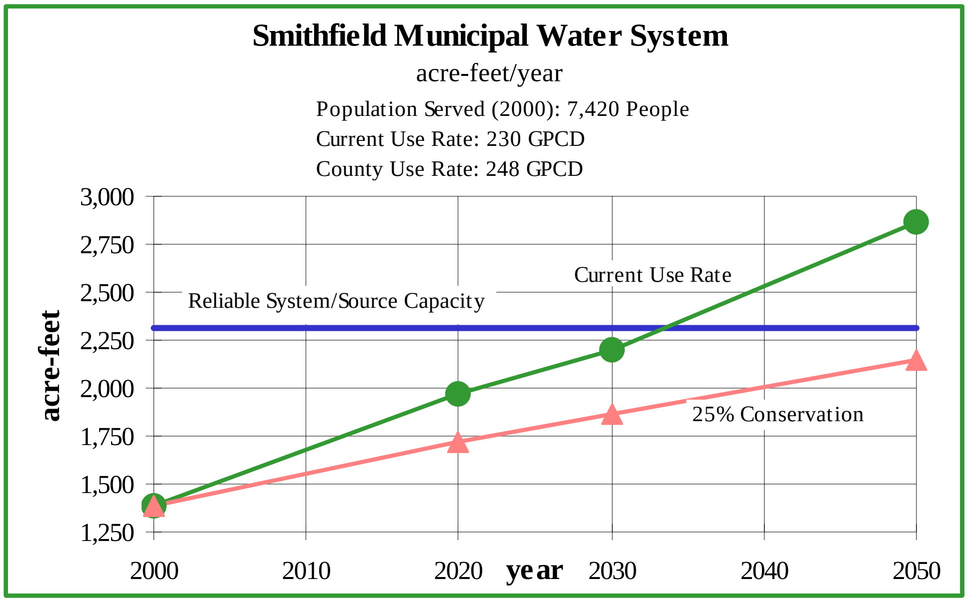

North Logan Culinary System
acre-feet/year
Population Served (2000): 6,400 People
Current Use Rate: 177 GPCD
County Use Rate: 248 GPCD
acre-feet
3,500
3,000
2,500
2,000
1,500
1,000
Reliable System/Source Capacity
Current Use Rate
2000
2010
2020
year
2030
2040
2050


Paradise Town
acre-feet/year
Population Served (2000): 645 People
Current Use Rate: 445 GPCD
County Use Rate: 248 GPCD
acre-feet
1,000
800
600
400
200
0
Current Use Rate
25% Conservation
Reliable System Source Capacity
2000
2010
2020
year
2030
2040
2050

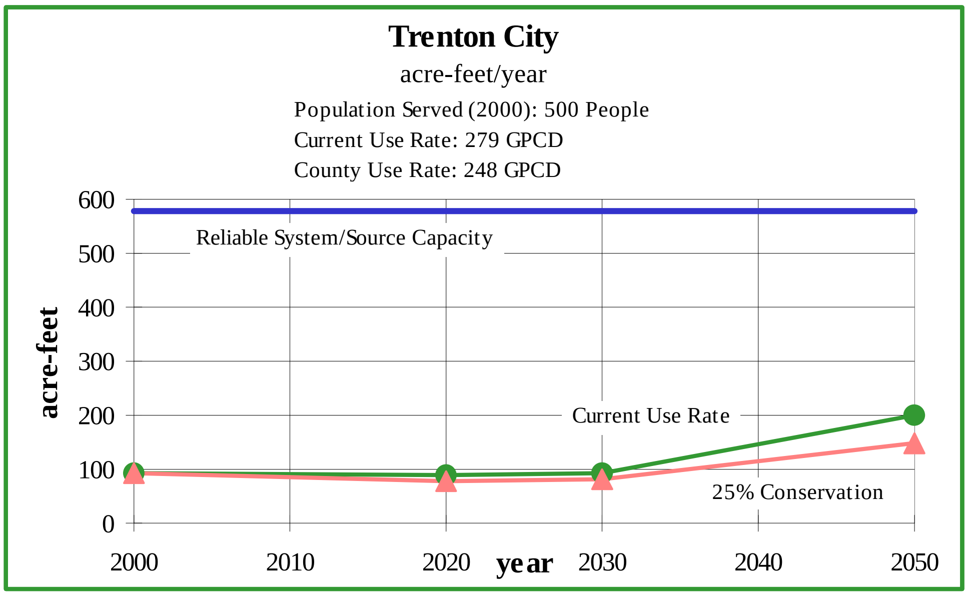

Providence City Corp Water
acre-feet/year
Population Served (2000): 4,610 People
Current Use Rate: 238 GPCD
County Use Rate: 248 GPCD
4,000
3,500
3,000
2,500
2,000
1,500
1,000
acre-feet
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050


Richmond City
acre-feet/year
Population Served (2000): 1,938 People
Current Use Rate: 262 GPCD
County Use Rate: 248 GPCD
1,600
1,400
1,200
1,000
800
600
400
200
acre-feet
Current Use Rate
Reliable System/Source Capacity
25% Conservation
2000
2010
2020
year
2030
2040
2050

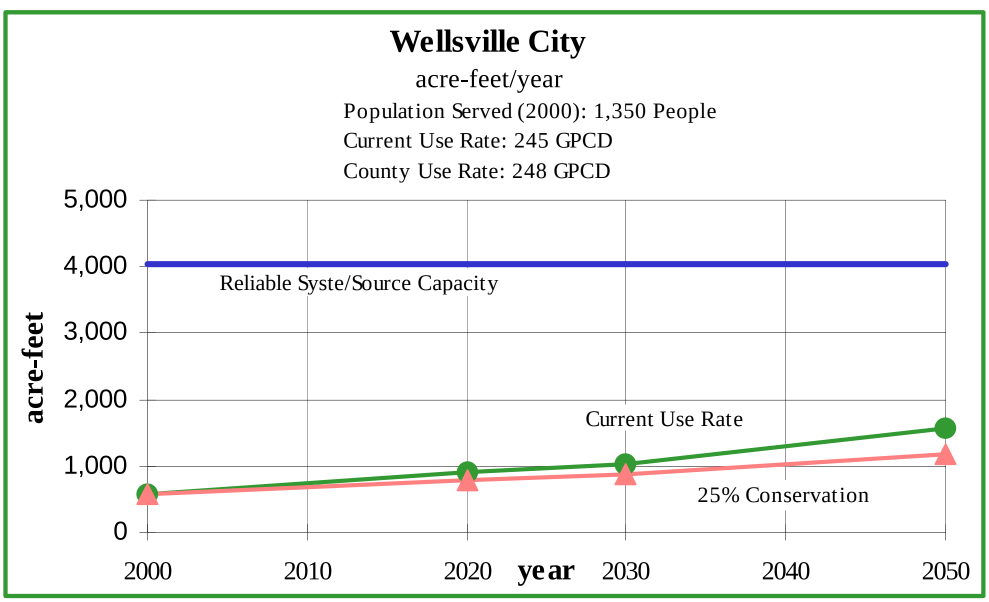

River Heights City Water System
acre-feet/year
Population Served (2000): 1,480 People
Current Use Rate: 359 GPCD
County Use Rate: 248 GPCD
1,400
1,200
1,000
800
600
400
acre-feet
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050



Smithfield Municipal Water System
acre-feet/year
Population Served (2000): 7,420 People
Current Use Rate: 230 GPCD
County Use Rate: 248 GPCD
acre-feet
3,000
2,750
2,500
2,250
2,000
1,750
1,500
1,250
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050

Trenton City
acre-feet/year
Population Served (2000): 500 People
Current Use Rate: 279 GPCD
County Use Rate: 248 GPCD
acre-feet
600
500
400
300
200
100
0
Reliable System/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050

Wellsville City
acre-feet/year
Population Served (2000): 1,350 People
Current Use Rate: 245 GPCD
County Use Rate: 248 GPCD
acre-feet
5,000
4,000
3,000
2,000
1,000
0
Reliable Syste/Source Capacity
Current Use Rate
25% Conservation
2000
2010
2020
year
2030
2040
2050

**Rich County Communities**: